IDENTIFICATION OF SELECTED *JASMINUM* SPECIES IN THAILAND BASED ON MICROSCOPIC CHARACTERISTICS AND RAPD FINGERPRINTING

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การจัดจำแนกพืชสกุลมะลิบางชนิดในประเทศไทยด้วยลักษณะทางจุลทรรศน์และลายพิมพ์อาร์เอพีดี

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จินดาพร พิทักษ์ศิลป์ : การจัดจำแนกพืชสกุลมะลิบางชนิดในประเทศไทยด้วยลักษณะทางจุลทรรศน์ และลายพิมพ์อาร์เอพีดี (IDENTIFICATION OF SELECTED *JASMINUM* SPECIES IN THAILAND BASED ON MICROSCOPIC CHARACTERISTICS AND RAPD FINGERPRINTING) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ผศ. ดร.กาญจนา รังษีหิรัญรัตน์, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: รศ. ดร.นิจศิริ เรืองรังษี, 364 หน้า.

มะลิเป็นพืชที่มีวงศ์สกุลขนาดใหญ่ มีจำนวนมากกว่า 200 ชนิด พืชสกุลมะลิหลายชนิดได้ถูกนำมาใช้ในยาพื้นบ้าน ผลิตภัณฑ์น้ำหอม และผลิตภัณฑ์แต่งกลิ่นชา พืชสกุลมะลิมีฤทธิ์ในการคลายเครียด ลดปวด ต้านการอักเสบ ต้านการติดเชื้อ และขับปัสสาวะ เนื่องจากพืชสกุลมะลิมีลักษณะทางพฤษศาสตร์และชื่อพื้นถิ่นที่คล้ายคลึงกัน ทำให้เกิดการใช้แทนที่โดยไม่ได้ตั้งใจ การจำแนกพืชจึงมีความสำคัญสำหรับการนำพืชสมุนไพรมาใช้ พืชสกุลมะลิจำนวน 30 ชนิดในประเทศไทย ถูกนำมาศึกษาลักษณะทางจุลทรรศน์ และค่าคงที่ของใบ (จำนวนเซลล์ผิวใบ พื้นที่ของเซลล์ผิวใบ จำนวนปากใบ ดัชนีปากใบ อัตราส่วนพาลิเสด จำนวนขน จำนวนเส้นปลายของใบ และจำนวนแก่งของใบ) รวมทั้งลายพิมพ์ดีเอ็นเอชนิดอาร์เอพีดี ผลการศึกษาทางจุลทรรศน์ พบปากใบชนิด anisocytic พืชสกุลมะลิ 2 ชนิด (*J. funale* Decne. subsp. *sootepense* (Craib) P. S. Green และ *J. fluminense* Vahl subsp. *gratissimum*) พบปากใบทั้งด้านบนและด้านล่างของใบซึ่งสามารถใช้ในการจำแนกพืชทั้ง 2 ชนิดนี้ ขณะที่มะลิที่เหลืออีก 28 ชนิดพบปากใบบริเวณด้านล่างของใบเท่านั้น นอกจากนี้พืชสกุลมะลิ 3 ชนิด (*J. funale* Decne subsp. *sootepense, J. humile* and *J. cordatum*) มีลักษณะรูปร่างของเซลล์ผิวใบแบบขอบไม่สม่ำเสมอ ส่วนที่เหลืออีก 27 ชนิด มีเซลล์ผิวใบรูปสี่เหลี่ยม การมีหรือไม่มีขนที่ใบของมะลิทั้ง 30 ชนิดสามารถจัดจำแนกได้เป็น 3 กลุ่ม ได้แก่ กลุ่มที่ 1 ไม่พบขนที่ใบ (4 ชนิด) กลุ่มที่2 พบขนทั้งด้านบนและล่างของใบ (5 ชนิด) และกลุ่มที่ 3 พบขนเพียงด้านล่างของใบ (21 ชนิด) การใช้ลักษณะหลายอย่างทางจุลทรรศน์ร่วมกับลักษณะทางสัณฐานวิทยาสามารถใช้ในการจำแนกชนิดของพืชสกุลมะลิได้ ลายพิมพ์ดีเอ็นเอชนิดอาร์เอพีดีถูกนำมาใช้เพื่อหาความสัมพันธ์ทางพันธุกรรมของพืชสกุลมะลิ 30 ชนิด พบว่า มีค่าความคล้ายคลึงกันอยู่ระหว่าง 0.022 – 0.477 สามารถจัดจำแนกออกเป็น 3 กลุ่ม โดยสรุป ลักษณะทางจุลทรรศน์และค่าคงที่ของใบรวมทั้งลายพิมพ์ดีเอ็นเอชนิดอาร์เอพีดีสามารถใช้ในการจำแนกพืชสกุลมะลิ 30 ชนิดได้ นอกจากนี้ข้อมูลที่ได้จากการศึกษานี้สามารถใช้เพื่อการจำแนกและพิสูจน์เอกลักษณ์ของพืชสมุนไพรในอนาคต

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Jasminum, one of the largest genus in family Oleaceae, comprised of more than 200 species. Several species of *Jasminum* have a long history of usage in traditional medicine, perfumery and flavoring tea. They play an important role in antidepressant, analgesic, anti-inflammatory, antiseptic, and diuretics. Many *Jasminum* species possess the similar morphology and vernacular name resulting in unintentional substitution. Plant identification plays an important role for herbal usage. Thirty *Jasminum* accessions in Thailand were investigated for their leaf microscopic characteristics and leaf constant numbers (epidermal cell number, epidermal cell area, stomatal number, stomatal index, palisade ratio, trichome number, vein islet number, and vein termination numbers) as well as RAPD fingerprinting. The microscopic results showed anisocytic type of stomata. Two *Jasminum* accessions (*J. funale* Decne. subsp. *sotepense* (Craib) P. S. Green and *J. fluminense* Vahl subsp. *gratissimum*) had stomata on both adaxial and abaxial surface of the leaves which can be used for identification of these two species whereas the 28 remaining accessions had stomata on abaxial surface. Moreover, *J. funale* Decne subsp. *satepense, J. humile* and *J. cordatum* had the irregular shape of epidermal cell whereas the lease 27 *Jasminum* accessions had square shape. The present or absent of trichome among 30 *Jasminum* accessions could be divide into three clusters; cluster 1 had no trichome (4 accessions), cluster 2 had trichome on both adaxial and abaxial surface (5 accessions), and cluster 3 had trichome on abaxial side of the leaf (21 accessions). Combination of several microscopic characteristics and morphology are able to identify *Jasminum* accessions. Random amplified polymorphic DNA (RAPD) marker was used to generate the phylogenetic relationships among 30 *Jasminum* accessions. The similarity index ranged from 0.022 – 0.477. The results from cluster analysis could be divided into 3 groups. In conclusion, leaf microscopic characteristics and leaf constant numbers as well as RAPD fingerprinting can be used to identify 30 *Jasminum* accessions. Moreover, the data obtained from this study are providing additional information for further identification of medicinal plant species.

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Student's Signature .....
Advisor's Signature .....
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CONTENTS

Page

THAI ABSTRACT iv

ENGLISH ABSTRACT v

ACKNOWLEDGEMENTS vi

CONTENTS vii

LIST OF TABLES i

LIST OF FIGURES i

LIST OF ABBREVIATIONS i

CHAPTER I INTRODUCTION 1

Research hypothesis 3

Research Questions 3

Research objectives 3

Conceptual framework 4

CHAPTER II LITERATURE REVIEW 5

1. Genus *Jasminum* 5

2. Morphological characteristics 13

3. Phytochemical study in *Jasminum* species 13

4. Pharmacological activities in *Jasminum* species 15

5. Methods in plant authentication 18

5.2 Microscopic evaluation 19

6. Molecular evaluation 27

7. Phylogenetic analysis 43

7.1 Phenolic based method 43

Page

7.2 Cladistic based method 44
8. Molecular marker in *Jasminum* spp. 45
CHAPTER III MATERIALS AND METHODS 47
3.1 Plants materials 47
3.2 Microscopic evaluation 47
3.3 RAPD analysis 57
CHAPTER IV RESULTS 65
Part I. Microscopic Characteristics 65
Part II. Molecular evaluation 90
CHAPTER V DISCUSSION AND CONCLUSION 102
REFERENCES 107
APPENDICES 114
APPENDIX I Botanical Characteristics 115
APPENDIX II Microscopic evaluation 183
VITA 364

LIST OF TABLES

Table 1 List of 40 *Jasminum* species existing in Thailand 6

Table 2 Addition list of 26 *Jasminum* species in Thailand 11

Table 3 List of 30 authentic samples and their different localities in Thailand 52

Table 4 List of 60 oligonucleotide primers used for RAPD screening 61

Table 5 The average measurement of trichome number values of thirty investigated *Jasminum* accessions from three locations. 67

Table 6 The epidermal number and epidermal cell area of thirty investigated *Jasminum* accessions from three locations. 72

Table 7 The average measurement of palisade ratio values of thirty investigated *Jasminum* accessions from three locations. 76

Table 8 The average measurement of vein termination number and vein islet number of thirty investigated *Jasminum* accessions from three locations. 80

Table 9 The average measurement of stomatal number and stomatal index values of thirty investigated *Jasminum* accessions from three locations 86

Table 10 The sequence of the oligonucleotide primers used for the RAPD analysis and the number of PCR products obtained from *Jasminum* accessions and outgroup plant 94

Table 11 The similarity index of 30 *Jasminum* accessions and *P. jasminoides* 100

Table 12 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Malila' (Location Bangkok) 184

Table 13 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Malila' (Location Bangkok) 185

Table 14 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Malila' (Location Chonburi) 186

Table 15 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Malila’ (Location Chonburi) 187

Table 16 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Malila’ (Location Sisaket) 188

Table 17 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Malila’ (Location Sisaket) 189

Table 18 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Malison’ (Location Bangkok) 190

Table 19 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Malison’ (Location Bangkok) 191

Table 20 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Malison’ (Location Chonburi) 192

Table 21 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Malison’ (Location Chonburi) 193

Table 22 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Malison’ (Location Sisaket) 194

Table 23 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Malison’ (Location Sisaket) 195

Table 24 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Chat Phikun’ (Location Bangkok) 196

Table 25 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Mali Chat Phikun’ (Location Bangkok) 197

Table 26 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Chat Phikun’ (Location Nonthaburi) 198

Table 27 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Mali Chat Phikun’ (Location Nonthaburi) 199

Table 28 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Chat Phikun’ (Location Sisaket).....200

Table 29 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Mali Chat Phikun’ (Location Sisaket).....201

Table 30 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Thod’ (Location Bangkok).....202

Table 31 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Mali Thod’ (Location Bangkok).....203

Table 32 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Thod’ (Location Chonburi).....204

Table 33 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘‘Mali Thod’ (Location Chonburi).....205

Table 34 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Thod’ (Location Sisaket).....206

Table 35 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Mali Thod’ (Location Sisaket).....207

Table 36 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Chat Dokbua’ (Location Bangkok).....208

Table 37 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Mali Chat Dokbua’ (Location Bangkok).....209

Table 38 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Chat Dokbua’ (Location Chonburi).....210

Table 39 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Mali Chat Dokbua’ (Location Chonburi).....211

Table 40 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Chat Dokbua’ (Location Nonthaburi).....212

Table 41 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Mali Chat Dokbua’ (Location Nonthaburi).....213

Table 42 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Chantaboon’ (Location Pathumthani).....214

Table 43 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Mali Chantaboon’ (Location Pathumthani).....215

Table 44 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Chantaboon’ (Location Khon Kaen).....216

Table 45 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Mali Chantaboon’ (Location Khon Kaen).....217

Table 46 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* ‘Mali Chantaboon’ (Location Sisaket).....218

Table 47 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘Mali Chantaboon’ (Location Sisaket).....219

Table 48 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* ‘Maluli’ (Location Nonthaburi).....220

Table 49 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* ‘Maluli’ (Location Nonthaburi).....221

Table 50 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* ‘Maluli’ (Location Bangkok).....222

Table 51 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* ‘Maluli’ (Location Bangkok).....223

Table 52 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* ‘Maluli’ (Location Nakornratchasima).....224

Table 53 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* ‘Maluli’ (Location Nakornratchasima).....225

Table 54 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* ‘Maluli Sichomphu’ (Location Nonthaburi) 226

Table 55 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* ‘Maluli Sichomphu’ (Location Nonthaburi)..... 227

Table 56 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* ‘Maluli Sichomphu’’ (Location Nakornratchasima) 228

Table 57 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* ‘Maluli Sichomphu’’ (Location Nakornratchasima)..... 229

Table 58 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* ‘Maluli Sichomphu’ (Location Bangkok)..... 230

Table 59 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* ‘Maluli Sichomphu’ (Location Bangkok) 231

Table 60 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* ‘Maluli Phum’ (Location Bangkok)..... 232

Table 61 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* ‘Maluli Phum’ (Location Bangkok) 233

Table 62 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* ‘Maluli Phum’ (Location Nonthaburi) 234

Table 63 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* ‘Maluli Phum’ (Location Nonthaburi)..... 235

Table 64 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* ‘Maluli Phum’ (Location Nonthaburi) 236

Table 65 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* ‘Maluli Phum’ (Location Nonthaburi)..... 237

Table 66 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* ‘Mali Ngachang’ (Location Chiangmai)..... 238

Table 67 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Mali Ngachang' (Location Chiangmai) 239

Table 68 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Mali Ngachang' (Location Chiangmai) 240

Table 69 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Mali Ngachang' (Location Chiangmai) 241

Table 70 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Mali Ngachang' (Location Chiangmai) 242

Table 71 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Mali Ngachang' (Location Chiangmai) 243

Table 72 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. scandens* (Retz.) Vahl (Location Bangkok) 244

Table 73 Palisade ratio, trichome number, vein termination number, vein islets number of *J. scandens* (Retz.) Vahl (Location Bangkok) 245

Table 74 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. scandens* (Retz.) Vahl (Location Nonthaburi) 246

Table 75 Palisade ratio, trichome number, vein termination number, vein islets number of *J. scandens* (Retz.) Vahl (Location Nonthaburi) 247

Table 76 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. scandens* (Retz.) Vahl (Location Sisaket) 248

Table 77 Palisade ratio, trichome number, vein termination number, vein islets number of *J. scandens* (Retz.) Vahl (Location Sisaket) 249

Table 78 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. auriculatum* (Location Bangkok) 250

Table 79 Palisade ratio, trichome number, vein termination number, vein islets number of *J. auriculatum* (Location Bangkok) 251

Table 80 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. auriculatum* (Location Nonthaburi) 252

Table 81 Palisade ratio, trichome number, vein termination number, vein islets number of *J. auriculatum* (Location Nonthaburi)..... 253

Table 82 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. auriculatum* (Location Chonburi)..... 254

Table 83 Palisade ratio, trichome number, vein termination number, vein islets number of *J. auriculatum* (Location Chonburi)..... 255

Table 84 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Bangkok)..... 256

Table 85 Palisade ratio, trichome number, vein termination number, vein islets number of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Bangkok).... 257

Table 86 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Chonburi)..... 258

Table 87 Palisade ratio, trichome number, vein termination number, vein islets number of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Chonburi) .. 259

Table 88 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Saraburi)..... 260

Table 89 Palisade ratio, trichome number, vein termination number, vein islets number of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Saraburi) 261

Table 90 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. cordatum* (Location Chiangmai) 262

Table 91 Palisade ratio, trichome number, vein termination number, vein islets number of *J. cordatum* (Location Chiangmai)..... 263

Table 92 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. cordatum* (Location Chiangmai) 264

Table 93 Palisade ratio, trichome number, vein termination number, vein islets number of *J. cordatum* (Location Chiangmai).....265

Table 94 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. cordatum* (Location Chiangmai).....266

Table 95 Palisade ratio, trichome number, vein termination number, vein islets number of *J. cordatum* (Location Chiangmai).....267

Table 96 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Nonthaburi).....268

Table 97 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Nonthaburi).....269

Table 98 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Chiangmai).....270

Table 99 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Chiangmai).....271

Table 100 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Sisaket).....272

Table 101 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Sisaket).....273

Table 102 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Patumthani).....274

Table 103 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Patumthani).....275

Table 104 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Lampoon).....276

Table 105 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Lampoon)277

Table 106 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Sisaket).....278

Table 107 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Sisaket).....279

Table 108 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. siamense* Craib (Location Nakornratchasima).....280

Table 109 Palisade ratio, trichome number, vein termination number, vein islets number of *J. siamense* Craib (Location Nakornratchasima).....281

Table 110 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. siamense* Craib (Location Nakornratchasima).....282

Table 111 Palisade ratio, trichome number, vein termination number, vein islets number of *J. siamense* Craib (Location Nakornratchasima).....283

Table 112 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. siamense* Craib (Location Chiangmai).....284

Table 113 Palisade ratio, trichome number, vein termination number, vein islets number of *J. siamense* Craib (Location Chiangmai).....285

Table 114 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. elongatum* (Bergius) Willd (Location Nakornratchasima).....286

Table 115 Palisade ratio, trichome number, vein termination number, vein islets number of *J. elongatum* (Bergius) Willd (Location Nakornratchasima).....287

Table 116 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. elongatum* (Bergius) Willd (Location Nakornratchasima).....288

Table 117 Palisade ratio, trichome number, vein termination number, vein islets number of *J. elongatum* (Bergius) Willd (Location Nakornratchasima).....289

Table 118 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. elongatum* (Bergius) Willd (Location Chiangmai).....290

Table 119 Palisade ratio, trichome number, vein termination number, vein islets number of *J. elongatum* (Bergius) Willd (Location Chiangmai).....291

Table 120 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. grandiflorum* (L.) Kobuski (Location Nonthaburi).....292

Table 121 Palisade ratio, trichome number, vein termination number, vein islets number of *J. grandiflorum* (L.) Kobuski (Location Nonthaburi).....293

Table 122 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. grandiflorum* (L.) Kobuski (Location Bangkok).....294

Table 123 Palisade ratio, trichome number, vein termination number, vein islets number of *J. grandiflorum* (L.) Kobuski (Location Bangkok).....295

Table 124 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. grandiflorum* (L.) Kobuski (Location Saraburi).....296

Table 125 Palisade ratio, trichome number, vein termination number, vein islets number of *J. grandiflorum* (L.) Kobuski (Location Saraburi).....297

Table 126 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nervosum* Lour (Location Nakornratchasima).....298

Table 127 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nervosum* Lour (Location Nakornratchasima).....299

Table 128 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nervosum* Lour (Location Nakornratchasima).....300

Table 129 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nervosum* Lour (Location Nakornratchasima).....301

Table 130 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nervosum* Lour (Location Nakornnayok).....302

Table 131 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nervosum* Lour (Location Nakornnayok) 303

Table 132 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lanceolaria* Roxb. (Location Nakornratchasima) 304

Table 133 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lanceolaria* Roxb. (Location Nakornratchasima) 305

Table 134 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lanceolaria* Roxb. (Location Nakornratchasima) 306

Table 135 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lanceolaria* Roxb. (Location Nakornratchasima) 307

Table 136 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lanceolaria* Roxb. (Location Nakornnayok) 308

Table 137 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lanceolaria* Roxb. (Location Nakornnayok) 309

Table 138 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. coarctatum* Roxb. (Location Pathumtani) 310

Table 139 Palisade ratio, trichome number, vein termination number, vein islets number of *J. coarctatum* Roxb. (Location Pathumtani) 311

Table 140 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. coarctatum* Roxb. (Location Nonthaburi) 312

Table 141 Palisade ratio, trichome number, vein termination number, vein islets number of *J. coarctatum* Roxb. (Location Nonthaburi) 313

Table 142 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. coarctatum* Roxb. (Location Saraburi) 314

Table 143 Palisade ratio, trichome number, vein termination number, vein islets number of *J. coarctatum* Roxb. (Location Saraburi) 315

Table 144 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Nakornratchasima)....316

Table 145 Palisade ratio, trichome number, vein termination number, vein islets number of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Nakornratchasima)....317

Table 146 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Nakornratchasima)....318

Table 147 Palisade ratio, trichome number, vein termination number, vein islets number of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Nakornratchasima)....319

Table 148 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Kanchanaburi)....320

Table 149 Palisade ratio, trichome number, vein termination number, vein islets number of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Kanchanaburi)....321

Table 150 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. humile* L. (Location Nakornratchasima)....322

Table 151 Palisade ratio, trichome number, vein termination number, vein islets number of *J. humile* L. (Location Nakornratchasima)....323

Table 152 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. humile* L. (Location Sisaket)....324

Table 153 Palisade ratio, trichome number, vein termination number, vein islets number of *J. humile* L. (Location Sisaket)....325

Table 154 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. humile* L. (Location Sisaket)....326

Table 155 Palisade ratio, trichome number, vein termination number, vein islets number of *J. humile* L. (Location Sisaket) 327

Table 156 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. mesnyi* Hance (Location Nakornratchasima) 328

Table 157 Palisade ratio, trichome number, vein termination number, vein islets number of *J. mesnyi* Hance (Location Nakornratchasima) 329

Table 158 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. mesnyi* Hance (Location Sisaket) 330

Table 159 Palisade ratio, trichome number, vein termination number, vein islets number *J. mesnyi* Hance (Location Sisaket) 331

Table 160 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. mesnyi* Hance (Location Sisaket) 332

Table 161 Palisade ratio, trichome number, vein termination number, vein islets number of *J. mesnyi* Hance (Location Sisaket) 333

Table 162 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Nakornratchasima) 334

Table 163 Palisade ratio, trichome number, vein termination number, vein islets number of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Nakornratchasima) 335

Table 164 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Sisaket) 336

Table 165 Palisade ratio, trichome number, vein termination number, vein islets number of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Sisaket) 337

Table 166 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Sisaket).....338

Table 167 Palisade ratio, trichome number, vein termination number, vein islets number of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Sisaket).....339

Table 168 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 1 (Location Sisaket).....340

Table 169 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 1 (Location Sisaket).....341

Table 170 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 1 (Location Sisaket).....342

Table 171 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 1 (Location Sisaket).....343

Table 172 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 1 (Location Sisaket).....344

Table 173 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 1 (Location Sisaket).....345

Table 174 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 2 (Location Sisaket).....346

Table 175 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 2 (Location Sisaket).....347

Table 176 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 2 (Location Sisaket).....348

Table 177 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 2 (Location Sisaket).....349

Table 178 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 2 (Location Sisaket).....350

Table 179 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 2 (Location Sisaket).....351

Table 180 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 3 (Location Nakornratchasima).....352

Table 181 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 3 (Location Nakornratchasima).....353

Table 182 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 3 (Location Nakornratchasima).....354

Table 183 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 3 (Location Nakornratchasima).....355

Table 184 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 3 (Location Nakornratchasima).....356

Table 185 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 3 (Location Nakornratchasima).....357

Table 186 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 4 (Location Nakornratchasima).....358

Table 187 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 4 (Location Nakornratchasima).....359

Table 188 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 4 (Location Nakornratchasima).....360

Table 189 Palisade ratio, trichome number, vein termination number, vein islets number of *J. Jasminum* spp. 4 (Location Nakornratchasima).....361

Table 190 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 4 (Location Nakornratchasima).....362

Table 191 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 4 (Location Nakornratchasima).....363

LIST OF FIGURES

Figure 1 Anatomy of Leaf 20

Figure 2 Surface view of epidermis illustrates four patterns of stomata type 22

Figure 3 Four upper contiguous epidermal cells with underlying palisade cells in surface view 24

Figure 4 PCR amplification process 32

Figure 5 RAPD process 34

Figure 6 AFLP technique 36

Figure 7 Sequence Characterized Amplified Region (SCAR) procedure 37

Figure 8 Restriction enzymes 38

Figure 9 Hybridization-based method 39

Figure 10 The Maxam-Gilbert (chemical cleavage) method 42

Figure 11 Sanger method DNA sequencing 42

Figure 12 The compound microscope attached with a digital camera 50

Figure 13 The trichome characteristic of *J. multiflorum* 'Maluli sichomphu' leaf 66

Figure 14 The trichome characteristic of *J. sp* 4 leaf 66

Figure 15 The constant of trichome number of thirty investigated *Jasminum* accessions from three locations 69

Figure 16 The irregular epidermal cell type of *J. funale* Decne. subsp. *sootepense* (Craib) P. S. Green 70

Figure 17 The irregular epidermal cell type of *J. humile* 70

Figure 18 The irregular epidermal cell type and trichomes of *J. cordatum* 71

Figure 19 The square epidermal cell type of *J. sambac* 'Malila' 71

Figure 20 The epidermal cell number of thirty investigated *Jasminum* accessions ... 74

Figure 21 The epidermal cell area of thirty investigated *Jasminum* accessions 74

Figure 22 The round, closely packed palisade cells in the boundary of four clear continuous epidermal cells of *J. siamense* leaf 75

Figure 23 The constant of palisade ratio values of thirty investigated *Jasminum* accessions..... 77

Figure 24 The vein termination number of *J. fluminense* Vahl subsp. *gratissimum* ... 78

Figure 25 The vein termination number of *J. humile* L. leaf 79

Figure 26 The vein islets number of *J. grandiflorum* Linn leaf..... 79

Figure 27 The constant vein termination number of thirty investigated *Jasminum* accessions..... 81

Figure 28 The constant of vein islets number of thirty investigated *Jasminum* accessions..... 82

Figure 29 The anisocytic stomata type of *J. scandens* leaf 83

Figure 30 Stomata of the leaf of *J. funale* Decne. subsp. *sootepense* (Craib) P. S. Green 84

Figure 31 Stomata of the leaf of *J. fluminense* Vahl subsp. *gratissimum*..... 85

Figure 32 The constant of stomatal number values of thirty investigated *Jasminum* accessions 88

Figure 33 The constant of stomatal index values of thirty investigated *Jasminum* accessions..... 88

Figure 34 The microscopic characteristics diagram 89

Figure 35 Agarose gel electrophoresis of genomic DNA..... 90

Figure 36 Variation of genomic DNA concentration using primer A25..... 91

Figure 37 Variation of $MgCL^{2+}$ concentration 92

Figure 38 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPA-20 primer..... 95

Figure 39 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPB-05 primer 95

Figure 40 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPC-02 primer 96

Figure 41 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPC-15 primer 96

Figure 42 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPD-07 primer 97

Figure 43 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPF-04 primer 97

Figure 44 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPL-07 primer 98

Figure 45 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPL-08 primer 98

Figure 46 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the RAPD A-29 primer 99

Figure 47 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the RAPD F-25 primer 99

Figure 48 Dendrogram produced by UPGMA cluster analysis 101

LIST OF ABBREVIATIONS

° C	=	degree Celsius
µl	=	microliter
µg	=	microgram
µM	=	micromolarity
A	=	Adenosine
AFLP	=	Amplified Fragment Length Polymorphism
bp	=	base pair
BKF	=	Forest Herbarium Thailand
C	=	Cytosine
cm	=	centimeter
CTAB	=	cetyltrimethylammonium (cetrimonium) bromide
dATP	=	deoxyadenosine triphosphate
dCTP	=	deoxycytosine triphosphate
dGTP	=	deoxyguanosine triphosphate
DNA	=	Deoxyribonucleic Acid
dNTPs	=	dioxyribonucleotide triphosphate
dTTP	=	deoxythymidine triphosphate
EDTA	=	ethylenediaminetetraacetic acid
etc	=	et cetera (and other things)
G	=	Guanine
kb	=	kilobase
m	=	meter

M	=	molarity
mg	=	milligram
mM	=	millimolar
mm	=	millimeter
mm^2	=	square millimeter
NaCl	=	Sodium chloride
nm	=	nanometer
PCR	=	Polymerase Chain Reaction
pH	=	the negative logarithm of the concentration of hydrogen ions
RAPD	=	Random Amplified Polymorphic DNA
RFLP	=	Restriction Fragment Length Polymorphism
RNA	=	Ribonucleic Acid
rpm	=	round per minute
SCARs	=	Sequence Characterized Amplified regions
SD	=	standard diviation
sec	=	second
sp. /spp.	=	species
T	=	Thymine
TBE buffer	=	tris-boric and EDTA buffer
Tm	=	Temperature of annealing
TMC	=	traditional Chinese medicine
Tris	=	(hydroxymethyl)-aminomethane hydrochloride
UV	=	Ultraviolet

UPGMA	=	Unweighted pair-Group Method with Arithmeic Mean
V	=	Volt

CHAPTER I

INTRODUCTION

Jasminum, one of the largest genus in family Oleaceae, comprised of more than 200 species of deciduous and evergreen shrubs, climbers, and ramblers in the tropical and subtropical regions especially, in South Asia and Southeast Asia. Flowers are commonly white in color, around 2.5 cm in diameter and usually fragrant. Sixty six species of *Jasminum*, both native plants and imported from abroad, were found in Thailand [1]. Several species of *Jasminum* have a long history of usage in medicine, perfumery and flavoring tea. Plants in the genus *Jasminum* are important sources of medicines, exhibiting a wide array of pharmacological activities including antidepressant, analgesic, anti-inflammatory, antiseptic, and diuretics. They are used as folk medicines in many countries such as India, China and Thailand for treatment of many conditions such as amenorrhea, infections with high fever, sunstroke, conjunctivitis, dermatitis, as well as cancer of the bones, lymphatic nodes and breast cancer [2-6]. *Jasminum grandiflorum* has been attracted attention because of its effectiveness in hepatoprotective activity to anti-hepatitis B virus, preventing breast cancer and stop uterine bleeding [7, 8]. In Thailand, *J. sambac* has been traditional used as a principle ingredient for many remedies in the Thai traditional medical text book called “Phathayasastra Sangkhraha” for treatment of many diseases [5] and a good source of jasmine essential oil. Six cultivars in *J. sambac* and 4 cultivars in *J. multiflorum* have been found in Thailand. Furthermore, there are *J. adenophyllum*, *J. gracilimum* and *J. lanceolarium* which had been used for anti-pyretic and anti-inflammatory especially for the skin diseases [4]. Medicinal plants are the source of chemical compounds used as drugs in modern medicine and used as the primary treatment for alternative medicine. The botanical sources of herbal supplements and medicines are identified at the species level by their scientific names. Moreover, herbal preparation for health care purposes always start their description by naming the botanical species used for its preparation. Furthermore, the elementary and critical

step at the beginning of the quality assurance process is identification and authentication of the plants.

The oldest and most widely used for species identification are morphological, physiological or horticultural which are largely subject to environment conditions and human determinations. Morphological description of 66 jasmine species as well as the keys for their identifications, flowering period and flower color has been previously described [1]. However, the actual identity of some species is still in question due to their similar morphology and various local names or vernacular names [9, 10]. Furthermore, morphological identification is not possible when the original plant material has been processed. Visual identification provides the simplest and quickest means by which to establish plant identity. Leaf constants such as epidermal cell number, epidermal cell area, stomata type, stomatal number, stomatal index, palisade ratio, trichome, vein-islets, and vein termination number have been used for plant identification [11-13]. However, examination by microscopic alone cannot always provide complete identification since these characteristics are judged subjectively and environmental influence. It is often necessary to use in association with other analytical methods such as physicochemical and molecular fingerprint for supporting evidence. Identification based on molecular techniques has been applied to authenticate important medicinal plants and crude drugs [14]. DNA extracted from leaves, stems, or roots of plant carry the same genetic information which is not effected by physiological conditions, environmental factors and/ or developmental factors during plant growth. Polymerase chain reaction (PCR)-based technique has become an effective method for herbal medicine identification [15]. Random amplified polymorphic DNA (RAPD) is a robust and simply assay for determination of DNA variation using single arbitrary primer to amplify template DNA without prior knowledge of target sequence and only small amount of sample is sufficient for analysis. Moreover, high polymorphism can be generated within a short time and able to screen many genes simultaneously.

Although *Jasminum* has been widely used in Thai traditional medicine, discrimination of Thai *Jasminum* species is still limited. Considering of many potential marker for plant identification, the present study aimed to distinguish *Jasminum* species

distributed in Thailand on the basis of their microscopic and molecular characteristics. The information generated from this work will be useful for preparing the monograph for species identification, and future pharmacological activities study.

Research hypothesis

Jasminum species distributed from different locality in Thailand can be distinguished on the basis of their microscopic and molecular characteristics.

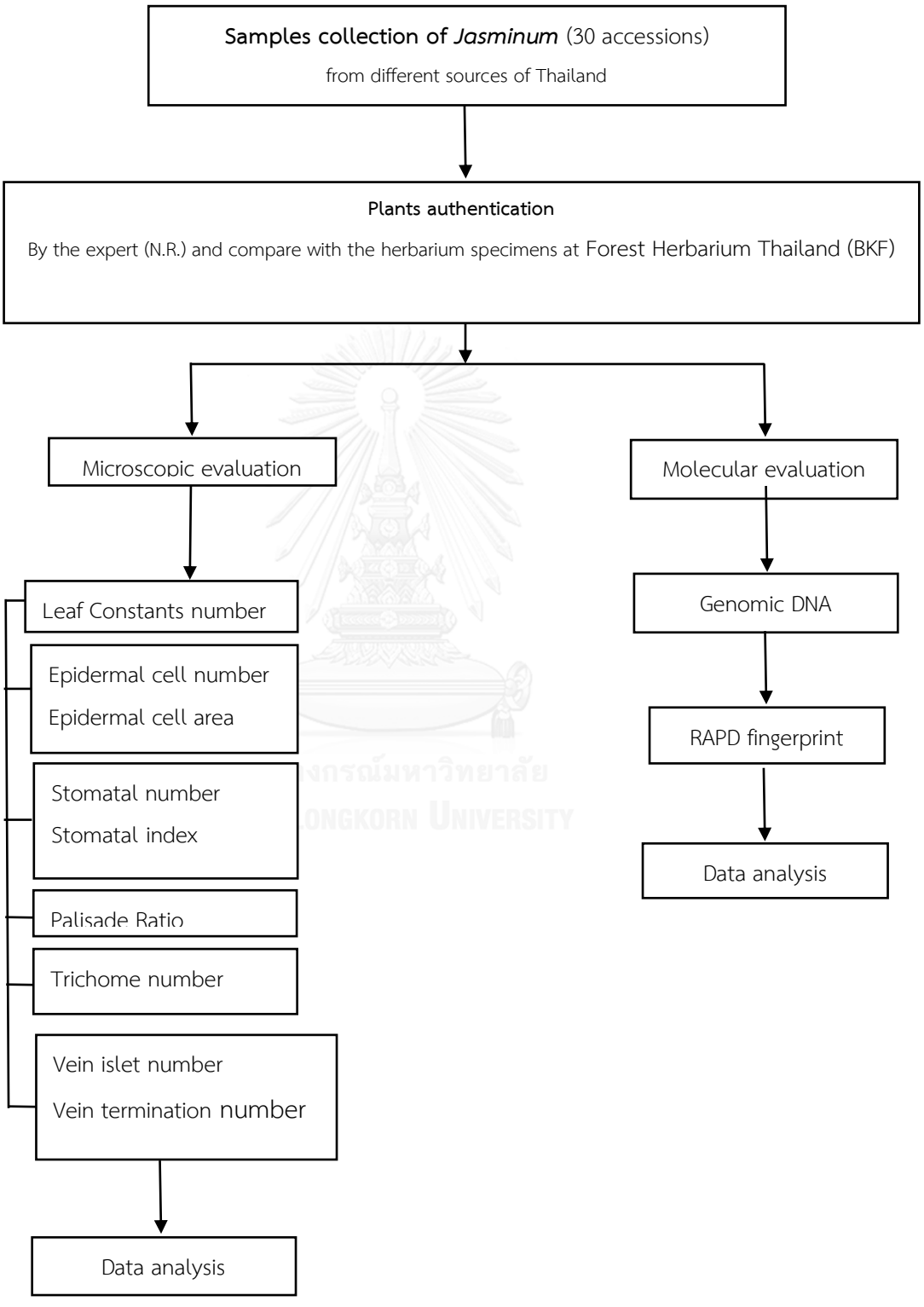
Research Questions

1. Do the differences of leaf constant numbers (epidermal cell number, epidermal cell area, stomatal number, stomatal index, palisade ratio, trichome, vein islet, and vein termination numbers**)** can be discriminate *Jasminum* species in Thailand?
2. Do the random amplified polymorphic DNA (RAPD) fingerprinting can be discriminate *Jasminum* species in Thailand?
3. Do the phylogenetic relationship can be discriminate *Jasminum* species in Thailand?

Research objectives

1. To investigate the leaf constant numbers (epidermal cell number, epidermal cell area, stomatal number, stomatal index, palisade ratio, trichome, vein islet and vein termination numbers**)** of *Jasminum* species in Thailand
2. To investigate random amplified polymorphic DNA (RAPD) fingerprinting of *Jasminum* species in Thailand
3. To study the phylogenetic relationship of *Jasminum* species in Thailand

Conceptual framework



CHAPTER II

LITERATURE REVIEW

1. **Genus *Jasminum***

The genus *Jasminum* belongs to the family Oleaceae that comprises more than 200 species distributed in the tropic and sub-tropical regions of the world. *Jasminum* species are used as a traditional medicine from many countries such as India, China and Thailand. Plants of the genus *Jasminum* are also extremely important as a source of drugs in medicine, exhibiting a wide array of pharmacological activities including antidepressant, analgesic, anti-inflammatory, antiseptic, and diuretics [7].

The generic name of *Jasminum* was first described by Linnaeus in 1753 [16]. The taxonomic hierarchy of genus *Jasminum* can be classified as the following:

Kingdom Plantae

Phylum Magnoliophyta

Class Angiospermae

Order Lamiales

Family Oleaceae

Tribe Jasmineae

Genus *Jasminum*

Forty species of *Jasminum* existing in Thailand has been reported by Smitinand [9] **(Table 1)**. Moreover, 26 additionally of *Jasminum* species found in Thailand, both native plants and imported from abroad have been reported by Chalermklin [1] (**Table 2**). Among these, 3 native *Jasminum* species (*J. flexile* Vahl, *J. latipetalum* C. B. Clarke and *J. perissanthum* P. S. Green) were no longer exist in the wild of Thailand [1].

Table 1 List of 40 Jasminum species existing in Thailand [9]

No.	Scientific name	Vernacular name
1	*Jasminum adenophyllum* Wall. ex C. B. Clarke	Mali Wan (มะลิวัลย์); Phak Saeo (ผักแส้ว)
2	*J. annamense* Wernham subsp. *annamense*	Mali Krai krun (มะลิไกรกรัน)
3	*J. annamense* Wernham subsp. *kerrii* (Bhatnagar) P. S. Green	Mali mo kha (มะลิหมอคาร์)
4	*J. anodontum* Gagnep.	Mali Sai Kai Kan Daeng (มะลิไส้ไก่ก้านแดง)
5	*J. attenuatum* Roxb. ex G. Don	Mali thao (มะลิเถา)
6	*J. auriculatum* Vahl	Mali Phutthachat (มะลิพุทธชาด) Kai noi (ไก่น้อย) (central, Loei)
7	*J. calcicola* Kerr	Mali Siao Ton (มะลิเสี้ยวตัน)
8	*J. coarctatum* Roxb. var. *coarctatum*	Mali Khruea Nam Kho (มะลิเครือหนามข้อ) (Phetchabun), TongWi (ตองวี) (Central), Kafae Pa(กาแฟป่า) (Chuntburi), Siao Khruea (เสี้ยวเครือ) (Chiang Mai, Sukhothai)
9	*J. coarctatum* Roxb. var *vanprukii* (Craib) P. S. Green	Mali pa (มะลิป่า)
10	*J. cordatum* Ridl.	Mali chang (มะลิช้าง)

Table 1 List of 40 *Jasminum* species existing in Thailand (continue)

No.	Scientific name	Vernacular name
11	*J. craibianum* Kerr	Mali craib (มะลิเครบ)
12	*J. decipiens* P. S. Green	Mali phu luang (มะลิภูหลวง)
13	*J. decussatum* Wall. ex G. Don	Krong chan (กรงจัน) (North), Mali khiao-ngu (มะลิเขี้ยวงู) (central), Mali pa (มะลิป่า) (central, Narathiwas)
14	*J. dispermum* Wall. subsp. *forrestianum* (Kobuski) P. S. Green	Mali Doi (มะลิดอย) Khruea Katawa (เครือเกตถวา)
15	*J. elongatum* (Bergius) Willd.	Sai Kai (ไส้ไก่), Mali yan (มะลิย่าน), Mali thuean (มะลิเถื่อน), Li (ลิ), Siao ton (เสี้ยวตัน), Dok bai (ดอกใบ), Lai kai (ไลไก่), Dok siao (ดอกเสี้ยว), Khiao ngu (เขี้ยวงู)
16	*J. extensum* Wall. ex G. Don	Mali E-Ka (มะลิเอกา), Mali pa (มะลิป่า)
17	*J. flexile* Vahl	Mali mae taeng (มะลิแม่แตง)
18	*J. funale* Decne. subsp. *funale*	Khun Sai Kai (คุณไส้ไก่), Mali Sai Kai Bai Man (มะลิไส้ไก่ใบมัน)

Table 1 List of 40 *Jasminum* species existing in Thailand (continue)

No.	Scientific name	Vernacular name
19	*J. funale* Decne. subsp. *sootepense* (Craib) P. S. Green	Khiao ngu (เขี้ยวงู) (central, Surat thani), Mali Nok (มะลินก) (Lampoon), Mali Fa (มะลิฟ้า) (Lampoon), Saeo Noi (แส้วน้อย) (Nakhornsawan, North), Sai Kai (ไส้ไก่) (Loei), Saeo pa (แส้วป่า) (Chaingmai)
20	*J. grandiflorum* (L.) Kobuski	Sathan (สถาน) (Chaingmai), Chakhan (จะขาน) (Mahongsorn), Mali Kan Daeng (มะลิก้านแดง)
21	*J. harmandianum* Gagnep.	Sai Kai (ไส้ไก่) (Central, Ubonratthani), Mali Sai Kai Bai Na (มะลิไส้ไก่ใบหนา)
22	*J. kedahense* (King & Gamble) Ridl.	Mali Bai Riao (มะลิใบเรียว)
23	*J. lanceolaria* Roxb. subsp. *lanceolaria*	Mali Wan Lek (มะลิวัลย์เล็ก)
24	*J. lanceolaria* Roxb. subsp. *scortechinii* (King & Gamble) P. S. Green	Mali Wan Noi (มะลิวัลย์น้อย)
25	*J. latipetalum* C. B. Clarke	Mali Liam (มะลิเหลี่ยม)
26	*J. laurifolium* Roxb. var. *brachylobum* Kurz	Mali Rabam (มะลิระบำ)
27	*J. laurifolium* Roxb. var. *laurifolium*	Mali Lo (มะลิลอ)
28	*J. maingayi* C. B. Clarke	Mali Pun (มะลิปูน)

Table 1 List of 40 *Jasminum* species existing in Thailand (continue)

No.	Scientific name	Vernacular name
29	*J. multiflorum* (Burm.f.) Andr.	Mali som (มะลิซ่อม) (Bangkok), Maluli (มะลุลี), Mali Louay (มะลิเลื้อย) (Central, Trad)
30	*J. nervosum* Lour.	Khiao ngu (เขี้ยวงู) (Central, Suratthani), Sai Kai (ไส้ไก่) (Central, North), Mali Khiao Ngu Lek (มะลิเขี้ยวงูเล็ก) (Chumphon), Mali din (มะลิดิน) (Central, Trad), Li yan (ลิ ย่าน) (Suratthani), Saeo dong (แส้วดง) (Lampang, North)
31	*J. nobile* C. B. Clarke	Panyi (ปันหยี) (Chantburi), Mali pa (มะลิป่า) (Central, Naratiwas), Maliwan dong (มะลิวัลย์ดง) (Chantburi)
32	*J. perissanthum* P. S. Green	Mali Phu Kha (มะลิภูคา) (Nan)
33	*J. pierreanum* Gagnep.	Mali Pi (มะลิปี) (Central)
34	*J. rambayense* Kuntze	Mali Ram (มะลิรำ) (Central)
35	*J. sambac* (L.) Aiton	Kho take (ข้าวแตก) (Maehongson), Teamoon (เตียมูน) (Chiangmai), Malikikai (มะลิขี้ไก่) (Chiangmai), Malison (มะลิซ้อน) (Central), Malila (มะลิลา) (Bangkok, Central)

Table 1 List of 40 *Jasminum* species existing in Thailand (continue)

No.	Scientific name	Vernacular name
36	*J. scandens* (Retz.) Vahl	Siao Phi (เสี้ยวผี) (Chiangmai), Kai Noi (ไก่น้อย) (Central, Laoi), Sai Kai (ไส้ไก่) (Central, Ubonrathani)
37	*J. siamense* Craib	Sai Kai (ไส้ไก่) (Central, Ubonrathani), Dok siao (ดอกเสี้ยว) (Central), Mali mao (มะลิเมา) (Central), Siao din (เสี้ยวดิน) (North), Khai kai (ไข่ไก่) (Laoi), Mali Siam (มะลิสยาม), Mali Thao (มะลิเถา) (Prajuabkerekun, Surattani)
38	*J. stellipilum* Kerr	Mali Lang Suan (มะลิหลังสวน) (Southern)
39	*J. syringifolium* Wall. ex G. Don	Mali Khiao Ngu Bai Laem (มะลิเขี้ยวงูใบแหลม) (Central, Surattani)
40	*J. undulatum* Ker Gawl.	Maliliam (มะลิเหลี่ยม) (Northern)

Table 2 Addition list of 26 *Jasminum* species in Thailand [1]

No.	Scientific name	Vernacular name
1	*J. aemulum* R. Br.	Mali Aemulum (มะลิแอมูลัม)
2	*J. angular* Vahl	Mali Angul (มะลิอังกูล)
3	*J.* sp. 1 'Mali Khao Ngoen'	Mali Khao Ngoen (มะลิเขาเงิน)
4	*J.* sp. 2 'Phu Mu'	Mali Phu Mu (มะลิภูหมู)
5	*J. azoricum* L.	Azores Jasmine, Mali Prakai Dao (มะลิประกายดาว)
6	*J. didymium* G. Forst subsp. *didymum*	Mali Khayeng (มะลิเขย่ง)
7	*J. elongatum* (Burgis) Willd. 'Mali Guangzhou'	Mali Guangzhou (มะลิกวางโจว)
8	*J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green	Mali Phutthachat Luang (มะลิพุทธชาดหลวง)
9	*J. fruticans* L.	Mali Chai Chana (มะลิชัยชนะ)
10	*J. humile* L.	Mali Lueang, Yellow Jasmine (มะลิเหลือง)
11	*J. laurifolium* Roxb. var. *nitidum* (Skan) P. S. Green	Mali Luang (มะลิหลวง), Windmill Jasmine
12	*J. mesnyi* Hance	Japanese Jasmine, Primrose Jasmine (มะลิพริมโรส)
13	*J. odoratissimum* L.	Mali Hom Lamai (มะลิหอมละไม)
14	*J. polyanthum* Franch.	Mali Nepal (มะลิเนปาล), Pink Jasmine

Table 2 Addition list of 26 *Jasminum* species in Thailand [1]

No.	**Scientific name**	**Vernacular name**
15	*J. bhumibolianum* Chalermglin	Mali Chaloem Narin (มะลิเฉลิมนรินทร์)
16	*J. cordatum* Ridl. 'Dwarf'	Mali Chang Khrae (มะลิช้างแคระ)
17	*J. rufohirtum* Gagnep.	Mali Khon Fu (มะลิขนฟู)
18	*J. multiflorum* (Burm. F.) Andr. 'Maluli Phum'	Maluli Phum (มะลุลีพุ่ม)
19	*J. multiflorum* (Burm. F.) Andr. 'Maluli Sichomphu'	Maluli Sichomphu (มะลุลีสีชมพู)
20	*J. humile 'Variegated'*	Mali Lueang Bai Dang
21	*J. multiflorum 'Variegated'*	Mali Li Bai Dang
22	*J. nervosum 'Variegated'*	Mali Khiao Ngu Lek Bai Dang
23	*J. sambac 'Variegated'*	Mali La Bai Dang
24	*J. sambac* (L.) Aiton 'Mali Chanthabun'	Mali Chanthabun (มะลิจันทบูร)
25	*J. sambac* (L.) Aiton 'Mali Chat Dok Bua'	Mali Chat Dok Bua (มะลิฉัตรดอกบัว)
26	*J. sambac* (L.) Aiton 'Mali Chat Phikun'	Mali Chat Phikun (มะลิฉัตรพิกุล)

2. Morphological characteristics

The important morphological characteristics for classification of *Jasminum* existing in Thailand has been reported by Chalermglin [1] which has shown in the appendix 1. In addition, morphological characteristics at floral development stage including the processes of sporogenesis, gametosis and pollen germinability have been done in *J. sambac* Aiton [17]. Furthermore, comparative study of Inflorescence development in Oleaceae have been reported [18].

3. Phytochemical study in *Jasminum* species

Many species of *Jasminum* have long been used in the traditional medicine. Phytochemical research of genus *Jasminum* for determination the active constituents and their pharmacological activities has been studied due to their rich source of phytochemical compounds. Various groups of medicinally interesting compounds was found in the flower, leaf, stem and root of the plants.

Jasminum sambac

Phytochemical studies of *J. sambac* revealed that the ethanolic flower extract contained the mixtures of coumarins, cardiac glycosides, essential oils, flavonoids, phenolics, saponins and steroids [19]. Moreover, the volatile constituents of flowers consist of benzyl acetate, indole, E-E-α-farnesene, Z-3-hexenyl benzoate, benzyl alcohol, linalool, and methyl anthranilate. The roots contains dotriacontanol, dotriacontanoic acid, oleanolic acid, daucosterol and hesperidin and leaves contain sambacosides A, E and F, Flower contains molihuaside A-E, sambacoside A [20] [21]. The plant contains sambacin, jasminin, sambacoside A, quercetin, isoquercitin, rutin, kaempferol, luteolin, phenyl methanol, linalool, alpha-terpineol, friedelin, ursolic acid, and seco-irridoid glucoside [22].

Jasminum grandiflorum

Phytochemical studies of *J. grandiflorum* revealed that leaves contains 2'-epifraxamoside, demethyl-2'- epifraxamoside, jasminanhydride, 3, 4- dihydroxy benzoic acid, 2-hydroxy-30, 40-dihydroxyacetophenone, oleanolic acid, oleacein, 2-(3, 4-dihydroxy phenyl)-ethanol, isoquercitrin, ursolic acid, jasminine, salicylic acid, resin, indol oxygenase. In addition, flower contains Cis-3-hexenol, 2-vinyl pyridine, indole, myrcene, linalool, geranyl linalool, α-terpineol, geraniol, linalyl acetate, nerolidol, phytol, farnesol, eugenol, benzyl alcohol, p-cresol, methyl benzoate, benzyl cyanide, benzyl acetate, methyl dihydrojasmonate, methyl anthranilate, jasmine, methyl- N-methyl anthranilate, vanillin, cis-3-hexenyl benzoate, benzyl benzoate, methyl benzoate, methyl palmitate, methyl linoleate, jasgranoside, jaspolyoside, 8-epi-kingiside, 10-hydroxy-oleuropein, 10-hydroxyligstroside, oleoside-7, 11-dimethylester, 3-O-α-L-rhamnopyranosyl(1→ 2) - β-D-xylopyranosyl-hederagenin-28-O-β-D-galactopyranosyl (1→6)-β-D-galactopyranosylester, hederaheragenin-3-O-β-D-glucopyranosyl(1→3)-α-L- arabinopyranoside, 2-α,3β,23-trihydroxyolean-12-en-28-oic-O-β-D-glucopyranosyl ester, hederaheragenin-3-O-β-Dxylopyranosyl(1→3)-α-L-rhamnopyranosyl(1→2)-α-L- arabinopyranoside, 2α,3β,23-trihydroxyolean-12-en-28-pic-O-α-L-rhamnopyranosyl(1→2)- α-Larabinopyranoside [23], kaempferol-3-O-rutinoside, 7-ketoganin, oleoside-11-methyl ester, kaempferol-3-O-α-L-rhamnopyranosyl(1→3)-[α-L-rhamnopyranosyl(1→6)-β-D- galactopyranoside, 7-glycosyl-11-methyloleoside, ligstroside and oleuropein. Moreover, jasmine oil consist of methyl jasmonate, benzyl benzoate, linalyl acetate, benzyl alcohol, indole, jasmine, methyl anthranilate, P-cresol, geraniol, racemic (5-pent-2enyl)-5, 1-pentanolide, benzyl benzoate, nerol, 1-α-terpeol, d and dl-linalool, γ-jasmolactone, fernesol, nerolidol and eugenol [16, 20, 24].

Jasminum lanceolarium

Phytochemical studies of *J. lanceolarium* revealed that leaves and stems contains 5, 7, 3', 5'-tetrahydroxyflavanone, (2S)-5, 7, 3', 4'-tetrahydroxyflavan-5-O-beta-D- glucopyranosie, manitol, nonacosane, trans-p-coumaric acid, cis-p- coumaric acid, ferulic acid and trans-cinnamic acid, trans-p-coumaroyl and trans-feruloyl esters of 10-hydroxyoleoside, jaslanceosides A-E and (2S)-5, 7, 3', 5'- tetrahydroxy-flavanone 7-O-Beta-D-allopyranoside, Betulinaldehyde, betulinic acid, betulin, syringing, liriodendrin and compound and (2S)-5, 7, 3', 5'- tetrahydroxy-flavanone 7-O-Beta-D-allopyranoside [16, 20].

Jasminum multiflorum

Phytochemical studies of *J. multiforum* revealed that flowers contain cis-jasmone, eugenol, alpha-farnesene and hexyl benzoate [21,25,26].

4. Pharmacological activities in *Jasminum* species

Jasminum sambac

The essential oil and methanol extract of flowers were evaluated for its antimicrobial activity against E. faecalis CIP1037, E. coli CIP 105182, S. enterica CIP105150 and S. pyogenes., B. Cereus LMG 13569 by using disc diffusion and micro dilution techniques and also subjected for their antioxidant activity by DPPH free radical scavenging and β-carotene-linoleic acid assays. In the DPPH test system, the IC50 value of essential oil and methanol extract were respectively 7.43 and 2.30 µg/ml. In the β-carotene-linoleic acid system, and the relative antioxidant activity (RAA) value of essential oil and methanol extract were respectively 96.6% and 93.9% [20]. In addition, the leaves extract caused an increase in type I collagen production in NB1RGB cells by promotin TG F-β1 expression, suggesting its potential in a variety of skin therapeutic and cosmetic applications [25]. Ethyl acetate and water extract of leaves showed reduction in plasma glucose level, lipid profile and serum urea in diabetic rats. The efficacy of jasmine flowers applied to the breasts to suppress

puerperal lactation was compared that of Bromocriptine by reduction in serum prolactin level [20, 27].

Jasminum grandiflorum

Hydro alcoholic extract of leaves of *J. grandiflorum* showed antiulcer activity in aspirin and pylorus ligation (APL) included acute gastric ulcer models with reduction in gastric fluid volume, free acid, total acid and an increase in the pH of gastric fluid. In addition, petroleum ether, acetone, chloroform, methanol and aqueous extracts of leaves were screened for their *in vitro* antibacterial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas aeruginosa* by using agar diffusion method. Chloroform extract was effective against *Bacillus subtilis* and *Pseudomonas aeruginosa*, acetone extract was effective against *Escherichia coli* and *Pseudomonas aeruginosa* whereas aqueous extract, methanol and petroleum ether were effective against all four micro organisms. The antioxidant activity of ethanolic extract of leaves has been assayed by using in vitro methods like 2, 2-diphenyl-l-picrylhydrazylhydrate (DPPH) assay, reductive ability, superoxide anion scavenging activity, nitric oxide scavenging activity and it showed antioxidant activity in a dose dependent manner [16, 20].

Ethanolic extract from flower have been tested in the wound models which shown the healing activity by reduction in wound area, increased wet and dry granulation tissue weight. As a result, oleuropein extracted from the flowers demonstrated indubitable anti hepatitis B virus activity in HepG2 2.2.15 cells test in vitro and duck hepatitis B virus (DHBV) infected duckings test *in vivo*. Moreover, the *J. grandiflorum* flowers tea are useful to preventing breast cancer and stopping uterine bleeding in women. Furthermore, ethanolic and aqueous extract from flowers and leaves in DMBA treated rats showed reduction of micronucleated polychromatic erythrocytes in bone marrow [20].

Jasminum auriculatum

The roots of *J. auriculatum* are useful in skin diseases especially for ringworm. The flowers are useful in burning sensation, hyperdesia, ulcers, odotalgia, stomatopathy, opthalmopathy, cadiopathy, urolithiasis, nephrolithaisis, atrangury and dermatopathy. Phytochemical studies of *J. auriculatum* revealed that leaves contains lupeol and jasminol. Alcoholic and aqueous extract of flowers showed diuretic activity by increasing the total volume of urine and concentration of potassium and sodium salts in urine and antiurolithiatic activity by reducing the elevated urinary oxalate synthesis [20].

Jasminum lanceolarium

The constituent in *J. lanceolarium* can exhibited significant radical scavenging activity through DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging assay [20].

Jasminum multiflorum

In vitro, antibacterial activities of crude hexane *J. multiflorum* extract indicated that *Staphylococcus aureus*, *Bacillus cereus*, *Escherichia coli*, *Enterobacter aerogenes* and *Pseudomonas aeruginosa* were inhibited with the minimum inhibition concentration (MIC) ranging from 250-1,000 µg/ml by using agar diffusion method [25].

***Jasminum scandens* Vahl**

Ethanolic extract from aerial parts of *J. scandens* Vahl have shown the produced significant antinociceptive effect in mice. A sub effective dose of *J. scandens* also potentiated the analgesic activity of sub-effective doses of both morphine and aspirin. These finding indicated that, it can lower the requirement of morphine and aspirin. Regular dosages of morphine sulfate can cause drop in blood pressure and other common side effects of the drug includes sedation, mental clouding, lethargy, constipation, nausea, vomiting, respiratory distress and blurred vision and the plant parts may avoid dose related untoward effects of these drugs if used as an adjuvant therapy reducing the dose of morphine. Aspirin also produce some side effects at regular dosage as well. The analgesic doses are associated with nausea, vomiting, epigastric distress, increased occult blood loss in stool, gastric mucosal damage and

peptic ulcer. The plant can be used to reduce the side effects of aspirin as an adjuvant [27].

5. Methods in plant authentication

The methods employed for authentication of medicinal plants are necessary. Pharmacognostic study is consisting of various methods used to characterize and identify the medicinal plants such as macroscopic and microscopic characterization. These methods are rapid and inexpensive. Herbal materials are categorized according to sensory, macroscopic and microscopic characteristics [28]. The macroscopic examination was based on plant morphological features such as shape, size, color, and texture. Visual investigation provides the simplest and quickest means by which to establish plant identity. Microscopic examination was based on the plant material observing under the microscope which can be investigated by anatomical and histological characteristics. Microscopic observation of leaf stoma, stomatal number, stomatal index, vein-islets, palisade ratio and trichome number have been used for plant identification [13]. However, there has been only one microscopic reported in this genus. Sabharwal S. et al. had studied on microscopic evaluation of the leaves of J. sambac [29]. Trichome number has been used for identification some plant that contained trichomes covering their leaves due to their simple, rapid and inexpensive. This technique can be used to resolve the taxonomic problems of critical species together with other analytical methods [13].

5.1 Macroscopic evaluation

Macroscopic evaluation method is an assessment of plant material, either with the naked eye or with a hand lens or stereo-microscope [30]. It typically includes gross morphological characteristic or organoleptic sensation is used to determine the color, odor, taste, from, size, shape, etc. of plant material, so the similar species of plants can share similar morphological characteristics and appropriate training is needed to acquire the macroscopic identification skills [31].

5.2 Microscopic evaluation

Microscopic evaluation method of medicinal plant is based on the observation of the cellular structure and their content of plant material by use of a microscope. It reveals plant histological characteristics [13]. It was used as primary screening test for identification and authentication of plant materials [31]. A number of leaf constants are used to distinguish between some closely related species not easily characterized by Lucida microscopy [23].

Microscopic evaluation use a digital camera attached above the microscope. It is more convenient than camera Lucida. The photomicrography is uniquely qualified to be used for routine and advanced microscopic investigations of medicinal plant materials [32]. Final leaf area in a plant is an integrated variable depending on many different elementary processes, such as cell production and cell expansion, duration and rate of expansion of each individual leaf [33].

The usefulness of epidermal characteristics in comparative anatomy and taxonomy in some members of *Leguminosae* has been highlighted. These reports utilized information from the structure, development and types of stomata, trichome and trichome types and various other quantitative leaf epidermal characters to achieve taxa elucidation [34]. Moreover, the usefulness of these characters are also effectively used in the identification of fossil leaf impression in paleobotany and authentication of foliar drugs in pharmacognosy [35].

The plant epidermis is a multifunctional tissue playing important rules in water relation, defense and pollinator attraction. This range of functions is performed by a number of difference types of specialized cells, which differentiate in adaptively significant patterns and frequencies (**Figure 1**). These various cells show different degrees of morphological specialization. Moreover, stomatal development has focused on the cell lineage mechanism and trichome differentiation has focused on the cell interaction model [36]. For instance, stomata, trichomes and epidermal cells were used to differentiate features in six species of genus *Ocigum* L. (Lamiaceae) [37] and leaves

of *Clerodendrum polycephalum* Baker [38]. Furthermore, quantitative measure of leaf epidermal cells were used for identification of *Stanhopea* species (Orchidaceae) [39].

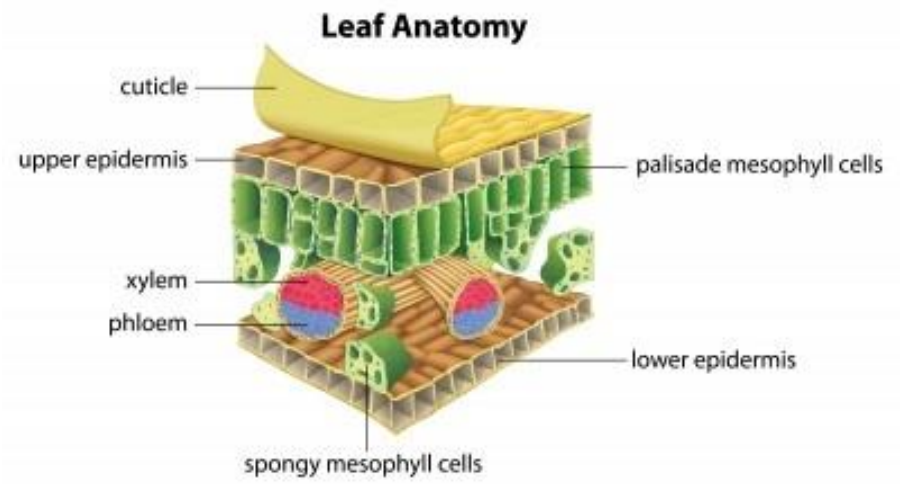


Figure 1 Anatomy of Leaf [40]

Determination of epidermal cell number and epidermal cell area

Epidermal cells are usually shaped like the interlocking pieces of a jigsaw puzzle [36]. This from gives the leaf a measure of mechanical strength which important in the light of the large air spaces necessary in the underlying mesophyll layers to ensure rapid diffusion of carbon dioxide for photosynthesis [41]. The jigsaw puzzle shape of leaf cells also reflects the growth of a leaf which requires cell expansion in all directions within the plane of the lamina. However, these differences in based shape and direction of expansion are only distinctive morphological characteristics of a largely unspecialized cell types [36].

Epidermal cell number is the number of epidermal cells / unit area of leaves (mm^2).

$$\text{Epidermal cell area} = \frac{500 \times 500}{\text{Number of epidermal cells in 500 } (\mu m^2)}$$

Determination of stomatal number and stomatal index

Stomata are pores on leaf surfaces through which plants exchange CO_2, water vapor, and other constituents with the atmosphere. They form early in leaf development, and typically mature by the time the leaf reaches 10-60% of its final leaf size [42]. It is convenient to apply the term stomata to the entire unit, the pore and the two guard cells. The structure of the epidermis and stomata are the first importance in the microscopical identification of leaves. Stomata may be surrounded by cells resembling the other epidermal cells. These distinct cells are called subsidiary cell of the stomata. The subsidiary cells may or may not be closely relate on to genetically to the guard cells [29].

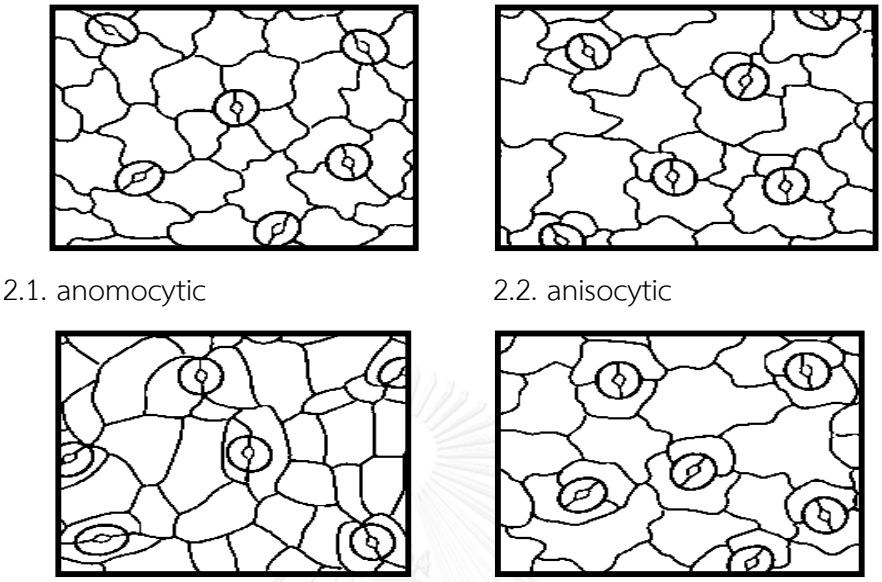
The stomatal number and the stomatal index are the very specific criteria for identification and characterization of leafy crude drugs. In the mature leaves, four significant types of stomata are distinguished by their form and the arrangement of the surrounding cells, especially the subsidiary cells (**Figure 2**) [28].

a) The anomocytic or ranunculaceous (irregular-celled) type; the stomata is surrounded by a varying number of cells, generally not different from those of the epidermis (**Figure 2.1**).

b) The anisocytic or cruciferous (unequal-celled) type; the stomata is usually surrounded by three or four subsidiary cells, one of which markedly smaller than the other (**Figure 2.2**).

c) The paracytic or rubiaceous (parallel-celled) type; the stomata has two subsidiary cells, of which the long axis of the stomata (**Figure 2.3**).

d) The diacytic or caryophyllaceous (cross-celled) type; the stomata is accompanied by two subsidiary cells, the common wall of which is at right angle to the stomata (**Figure 2.4**).



2.1. anomocytic 2.2. anisocytic

2.3. paracytic 2.4.diacytic

Figure 2 Surface view of epidermis illustrates four patterns of stomata type 2.1: anomocytic; 2.2: anisocytic; 2.3: paracytic; 2.4: diacytic [28]

Stomatal number

Stoma is another type of epidermal structure processing great diagnostic value. A stoma consists of two similar cells, the guard cells, placed with their long axis parallel and having a small cellular space, the porous between them. The average number of stomata per square millimeter of epidermis is termed the stomata number. In recording results the range as well as the average value should be recorded or each surface of the leaf and the ratio of values for the two surfaces. The actual number of stomata per square millimeter is variable for the same plant, this being especially noticeable if records are made for different years. In certain cases this ratio may be of diagnostic importance [13, 29, 43].

Stomatal number is the number of stomata per unit area of leaves. It was designed by Timnerman [23].

$$\text{Stomatal number} = \frac{\text{Number of stomata}}{\text{Area of epidermal cell (mm}^2\text{)}}$$

Stomatal index

The significance of the number of stomata per unit area of leaf was investigated by Timmerman in 1927. Salisbury showed that a high correlation coefficient exists between the number of stomata and the number of epidermal cell per unit area of leaf surface of a given species. Stomatal index is the percentage proportion of the ultimate divisions of the epidermis of a leaf which have been converted into stomata [23].

In other words, stomatal index is defined as the percentage of stomata from the total number of epidermal cells, which can be explained as:

$$\text{Stomatal index} = \frac{S}{E+S} \times 100$$

Where; S = the number of stomata per unit area.

E = the number of ordinary epidermal cells in the same unit area.

Stomatal number varies considerably with the age of the leaf, stomatal index is highly constant for a given species and many be determined either on powered samples [13].

Palisade ratio

Palisade cells are a type of photosynthetic cells of the mesophyll of leaf occurring mostly just beneath the upper epidermal surface layer (Figure 3) [43]. The cells are elongated and more cylindrical and arranged in one or more rather regular, relatively compact layer near the ventral, or upper side of the leaf with the long axis of the cells perpendicular to the leaf surface [29]. The term “palisade ratio” was introduced by two British pharmacognosists, Wallis and Dewar, in 1933. It represents a figure obtained by counting the total number of palisade cells beneath four upper epidermal cells and dividing the number by four [23]. The value remains constant within a range for a given plant species and is of diagnostic value in differentiating the species to species [32] and that is why it is a very useful diagnostic feature for characterization of different plant species [44].

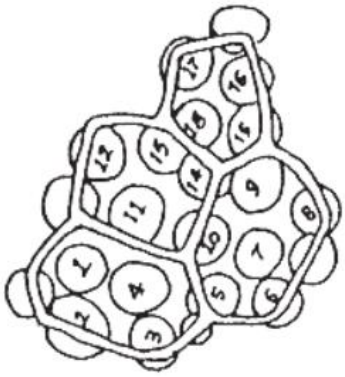


Figure 3 Four upper contiguous epidermal cells with underlying palisade cells in surface view [31]

Trichome number

Trichomes (shoot epidermal hairs) are present on the aerial surfaces of most plants, ranging from ferns to angiosperms. The term trichome is derived from trichos, the Greek root meaning hair. Trichomes exist in a wide variety of morphologies, from single celled to multicellular, and include glandular secretory hairs and nonglandular hairs. The leaf hairs derived from epidermal cells that are formed in a regular spacing pattern in a rapidly growing cell layer at the leaf base. A wide variety of functions have been ascribed to trichomes in various plants, including resisting insect herbivores, reducing transpiration, increasing freezing tolerance, and protecting plants from UV light [44]. Several genes are involved in restricting trichome expression to appropriate tissues. The trichome number has been used as one of the constant numbers for identification of the plant leaves covering trichomes [45].

Vein islet number

The term ‘vein islet’ is used to denote the minute area of photosynthetic tissue encircled by the ultimate divisions of the conducting strands. The number of vein-islets per mm^2 calculated from four contiguous square millimeter in the central part of the lamina, midway between the midrib and the margin, is termed the vein-islet number. When determined on whole leaves, the area examined should be form the central part of lamina, midway between the margin and midrib. Each numbered area must be completely enclosed by veins, and those which are incomplete are excluded from the count if cut by the other two sides [13].

Veinlet termination number

Hall and Melville in 1951 determined veinlet termination number, which they define as 'the number of veinlet terminations per mm^2 of leaf surface. A vein termination is the ultimate free termination of a veinlet or branch of a veinlet'. It can be used as distinguishing character for the leaf of the same species or different species [46]. One practical difficulty in the measurement of vein-islet and veinlet-termination numbers is deciding exactly where, and if, a veinlet terminates. This may appear to vary according to the preliminary treatment a leaf has received [13].

At present, of the above leaf measurement, only stomatal index is employed officially. With the increasing number of whole herbs and leaves now being introduced into the *European and British Pharmacopeias* and the need for standardization of the many herbal products of interest world-wide, a further investigation of the possible usefulness of these leaf measurements might prove rewarding. For acceptance, the results from any future measurements would necessitate a more sophisticated statistical analysis than was probably afforded the examples quoted above [13].

The presence of various contents within the cell such as starch grain, plastids, fat and oils, etc., may give non-translucent section and obscure certain characteristics. There are some reagents that can dissolve of these contents and have been used to make a penetrating effect. Those sections may be more transparent and reveals details of the structures. Some of the reagents that most frequently used such as Chloral hydrate and Haiter Bleach solution are described below [13].

Haiter Bleach solution

This solution is an useful bleaching agent to remove deeply colored sections such as many barks as well as for removing chlorophyll from the leaves [13]. The sections are immersed in the solution and leaved for a few minutes or until bleaching. The section should be removed from the solution and then washed with water when bleaching is completed.

Chloral hydrate

Chloral hydrate is colorless hygroscopic crystal with melting point at 55°C. It is valuable and widely used as the best for clearing reagent. This solution dissolves starch, proteins, chlorophyll, resins, and volatile oils with the help of gently warming. It does not dissolve calcium oxalate and causes the shrunken cells to expand without damage of cell wall or other tissue. This solution is not only used for cross section, but also for whole leaves, flowers etc. [31].

According to the leaf measurements, the constant number used to distinguish between some closely related species. The comparison can be applied to the positive identification of the botanical, geographical and other sources of plant [47]. Thus, these parameters which when taken together are demonstrated a useful method to support authenticated evidence. In addition, a complementary with other analytical methods such as molecular technology will provide important supporting evidence [13].

6. Molecular evaluation

The molecular analysis has now become popular for species identification and their genetic relationship. The three genomes of a plant cell i.e., nuclear DNA, mitochondrial DNA, and chloroplast DNA have been explored in great detail. The first two plant species, for which all three genomes have been sequenced, are the model organisms *Arabidopsis thaliana* and rice [48]. DNA technology provides a useful and independent tool for the authentication and quality assurance of plant materials. DNA-base markers are less effect by age, physiological conditions and environmental factors. They are not tissue-specific and thus can be detected at any phase of organism development. Only a small amount of sample is sufficient for analysis and the physical form of the sample does not restrict detection [15].

Prior to investigate the plants by molecular method, the genomic DNA is needed to isolate from the plants' cells. Accordingly, an enormous number of plant DNA isolation protocols (and modifications of existing procedures) have been published. The majority of methods aim at isolating total cellular DNA, which is a suitable substrate for almost all PCR-based marker methods. Plant DNA isolation

methods differ in many respects, including the disruption of tissues and cells, the composition of extraction and lysis buffers, and the way that DNA is purified from other cell ingredients (such as protein, RNA, membranes, Polysaccharides, and polyphenols). Besides the commercial instant DNA extraction kit, isolation DNA by standard Cetyltrimethyl ammonium bromide (CTAB) procedure is considered to be a widely isolation method for DNA preparation, that is sufficiently pure for PCR analyses in many plants species. There are several regions in the DNA from various origins, which were used for studying the divergence or identity of plants [48].

Nucleic Acids

Nucleic acids that are routinely used for experimentation and analysis in molecular biology are primarily isolated from tissue. The preparation of crude lysates from plant tissue, usually snap frozen in liquid nitrogen and crushed prior to lysate which allows the tissues to be broken into digestible sized pieces, and the individual cells can be disrupted to release their cellular contents. Moreover, by using a variety of ionic detergents and/or protease to break open the cells. Common lysis methods have been modified for specific procedures. After that, the nucleic acids can then be isolated and purified from the nuclear and cellular proteins, lipids, and other biological molecules especially polysaccharide and carbohydrate from plants. Phenol is act as a protein solvent which disassociate nucleic acids from protein and in conjunction with salt solutions, isolate nucleic acids from nuclear proteins bound to nucleic acids. In addition, phenol itself is hydrophobic and ability to denature lipids and proteins but not nucleic acids. Furthermore, the reason for which the DNA is not soluble in phenol and partition to the aqueous phase due to the sugar-phosphate backbone of DNA which very hydrophilic. Chloroform is a protein denaturant which useful features, it remains the uncertain boundary between pure phenol phase and an aqueous phase. The mixed of phenol/ chloroform solution reduces the amount of aqueous solution remained in the organic phase to improve productivity. Furthermore, added Isoamyl alcohol to prevent bubble while mixture upon vortex and helping in the separation between organic and aqueous phase. Ethanol precipitation is useful for concentrating DNA solution; remove residual chloroform and phenol solution of protein. In addition,

ethanol and isopropanol are both commonly used for the precipitation of nucleic acids which isopropanol give less volatile than ethanol and take long time to remove by evaporation. Some salts are not soluble in isopropanol than ethanol and will be precipitated along with nucleic acids. Extra washings may therefore be helpful to get rid of those salts contamination.

Quantitation of DNA

There are two methods are widely used for estimating DNA concentration. One method is based on the spectrophotometric measurement of UV absorbance at 260 nm. A major disadvantage of this method is that RNA, oligonucleotides, proteins, residual CTAB, and other contaminants interfere with the measurement. The DNA purity can be estimated with the OD260/OD280. The second method is based on the UV-induced fluorescence emitted by ethidium bromide-DNA complexes. The quality of extracted DNA was estimated by comparing the band intensity of the extracted DNA with DNA ladder marker (Progema, USA) in agarose gel stained with ethidium bromide. Five microliter of extract DNA solution was mixed with 1X loading dye and loaded onto the gel, which is placed in an electrophoresis chamber filled with 1X TBE buffer. Electrophoresis was carried out at 100 V for 30 min or until the dye migrated to a sufficient distance. The gel was photographed under UV light using UV transilluminator gel documentation machine.

PCR (Polymerase Chain Reaction)

The polymerase chain reaction is an *in vitro* amplification technique, which was invented by Mullis in 1983. The process has revolutionary the whole DNA study which reproduces the biological procedures of DNA replication but limited to specific DNA sequences of interest. PCR technique is the amplification of the interested region in the genome by using thermostable DNA polymerase and a random or specific primers.

The melting temperature can be calculated using formula [49]:

$$Tm = 2(A+T) + 4(G+C)$$

Million copies of the target DNA sequence can be synthesized from a low amount of starting template within a few hours. The PCR reaction component consist of genomic DNA template for copies, a pair of primers for amplified in target sequences that are complementary to the 3' ends of each of the sense and anti-sense strand of the DNA target, deoxynucleoside triphosphate (dNTPs; dATP, dCTP, dGTP and dTTP) which acts like the building blocks from which the DNA synthesizes a new DNA strand, buffer solution, providing a suitable chemical environment for optimum activity and stability of the DNA polymerase, divalent cations, magnesium or manganese ions; generally Mg^{2+} is used, but Mg^{2+} can be utilized for PCR-mediated DNA mutagenesis, as higher Mg^{2+} concentration increases the error rate during DNA synthesis [50], monovalent cation potassium ions and *Taq* DNA polymerase with an optimum temperature at around 70 °C. *Taq* DNA polymerase is a highly thermostable DNA polymerase of thermophilic bacterium *Thermus aquaticus*. The enzyme catalyzes 5' to 3' synthesis of DNA. *Taq* DNA polymerase has no proofreading activity which is no detectable 3' to 5' exonuclease and possesses low 5' to 3' exonuclease activity. Recombinant *Taq* DNA polymerase is ideal for standard PCR of templates 5 Kilo base (kb) or shorter. The error rate of *Taq* DNA polymerase in PCR is 2.2×10^{5} errors per nucleotide (nt) per cycle, as determined by a modified method that was described [51]. Accordingly, the accuracy of PCR is 4.5×10^{4}. Accuracy is an inverse of the error rate and shows an average number of correct nucleotides incorporated before an error occurs. The PCR is commonly carries out in a reaction volume of 10-100 µl in small reaction tubes to achieve the temperatures required at each step of reaction [52].

The amplification reaction consists of three steps. First, the sample DNA is denatured into the individual lines. Two DNA primers are used to be hybridization in two corresponding nearby sites on opposite DNA strands in such a fashion that the normal enzymatic extension of the active terminal of each primer leading to toward the other primers. In this fashion, two new sets of the sequence of interest are created (**Figure 4**) [53]. Moreover, repeated in this fashion would produce a growing number of copies of DNA [49]. Furthermore, PCR technique used very small DNA samples and greatly expanded the volume of the DNA specific region by the oligonucleotide primers and DNA polymerase thermostable enzyme.

Then, evaluate the PCR product in 1.5% agarose gel electrophoresis which can separated nucleic acid molecules by sizes. Agarose gel that contains buffer is formed by a meshwork of molecules, and nucleic acids are separated through a matrix of agarose gel by applying an electric field to move the negative charged to the positive charged molecules. Then visualize by staining the gel in ethidium bromide and observed under UV light [54].

The thermal denaturation is performed in general and in this case the replication enzymes that are tolerant of high temperatures (*Taq* DNA polymerase). PCR-based method including AFLP (Amplify fragment length polymorphism), RAPD (Random Amplify Polymorphism DNA), SCAR (sequence characterize amplified region), and Polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) are widely used as molecular markers. Various types of DNA-based molecular techniques are utilized to evaluate DNA polymorphism. The DNA-based molecular methods can be divided into three major techniques namely hybridization-based method, PCR-based method, and DNA sequencing-based method.

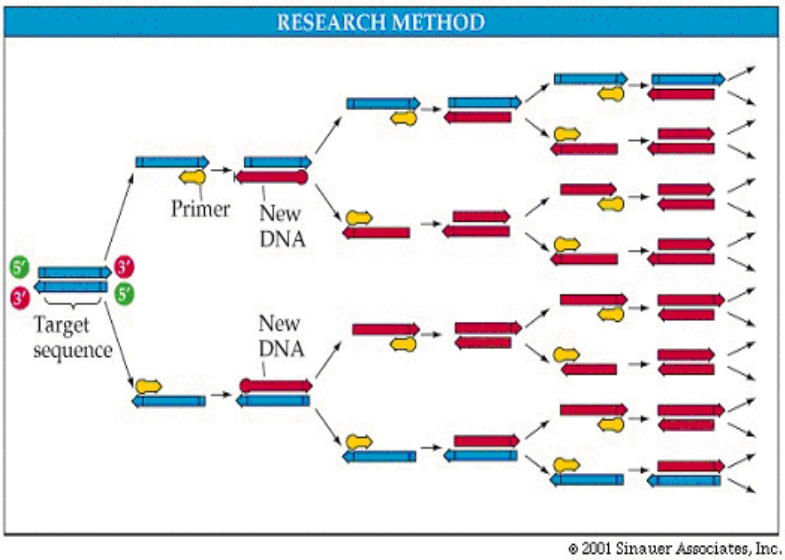


Figure 4 PCR amplification process [55]

PCR-based method

PCR-based method are the amplification of DNA fragments or loci *in vitro* with the oligonucleotide primers and the thermostable DNA polymerase enzymes [49]. For examples, random amplified polymorphic DNA (RAPD), arbitrary primed PCR (AP-PCR), DNA amplification fingerprinting (DAF), amplified fragment length polymorphism (AFLP), Polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP), single strand conformation polymorphism (SSCP), sequence characterized amplified polymorphic (SCAR), amplification refractory mutation system (ARMS), single sequence repeat (SSR) analysis, direct amplification of length polymorphism (DALP), inter-simple sequence repeat (ISSR) and direct amplification of minisatellite-region DNA (DAMD) [55]. Mace and colleague used AFLP technique to evaluate and assess species relationships within the tribe *Datureae* [56]. Furthermore, amplified fragment length polymorphism analysis have been used for studying genetic relationships among *Mangifera* species in Thailand [57].

Random Amplified Polymorphic DNA (RAPD)

RAPD is a PCR-based technique using random sequence primers for amplification. It offers fast approach to genome profiling. RAPD were first developed in 1990 using PCR to randomly anonymous segments of nuclear DNA. RAPD marker has frequently been used for the detection of the genetic variability in plants. The advantage of the approach is rapid, simplicity, and the absence of any need for prior genetic information of the plant. In the reaction, a single species of primer anneals to the genome DNA at two different sites on complementary strands of DNA template (**Figure 5**). The primers used are normally decamer (10 nucleotide length). This is short enough for annealing to occur at a number of positions in the genome. When annealing of the single primer in the reaction occurs on opposite strands of DNA which is short enough to form a template for PCR, a product will be formed. It is probable that this situation will occur at several points in the genome, giving rise to several PCR products which can be resolved by gel electrophoresis to give a characteristic pattern. Additionally, insertions or deletions between primer annealing positions will lead to a change in the length of the PCR product. RAPD marker was applied to differentiate various kinds of medicinal plants. For instance, it was used to discriminate *Phyllantus* species in Thailand [58], and used to characterize four important species of Bamboo, found in Maharashtra State, India [59]. Furthermore, it was used to discriminate four *Jasminum* species comprised of *J. pubescens*, *J. sambac* (Mali la, Mali Thod, Mali Chat and Mali Son), *J. adenophyllum* and *J. auriculatum* existing in Thailand [60].

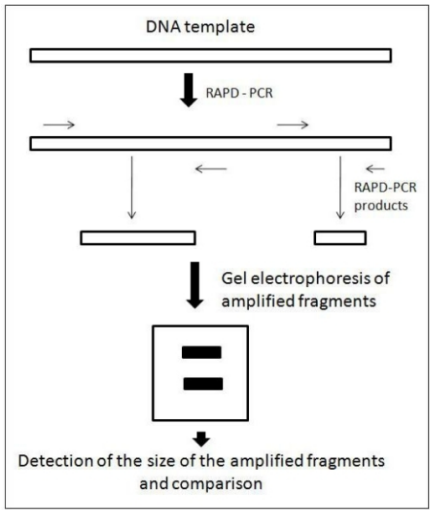


Figure 5 RAPD process [49]

The PCR consisting of three step, starting with double-stranded DNA is denatured at high temperature (94-96°C, 30-60 sec) to single strands (templates), followed by short simple strands of DNA (primers) bind at a lower annealing temperature to the single stranded complementary templates at the end flanking the sequences (30-36 °C, 30-60sec), after that the temperature is raised to 72°C (30-120 sec) for the DNA polymerase enzyme to catalyze the template-directed syntheses of new double-stranded DNA molecules (primer extension) that are identical in sequence to the starting material. Furthermore, the newly synthesized double-stranded DNA target sequences are denatured at high temperature, and the cycle is repeated [55].

For illustrated the amplification products, PCR fragments will run in 1.5% agarose gel electrophoresis with 80-120 V. which appropriated for range of separation at 200- 3,000 bp and comparing to the standard bands from DNA Marker under gel documentation system.

Amplified fragment length polymorphism (AFLP)

The AFLP reaction comprises two principle steps (**Figure 6**). In the first step, genomic DNA is digested with two different restriction enzymes producing sticky ends, and double-stranded synthetic adapters of a defined sequence are ligated into both ends of all restriction fragments. Adapter and restriction site sequences then provide universal primer binding sites for subsequent PCR reactions that comprise the second step. Typically, two successive PCRs are performed on the restricted template, using specifically designed primers that allow only a subset of the restriction fragments to be amplified. The amplified fragments are separated and visualized on denaturing polyacrylamide gels [30]. The AFLP technology has the capability to detect various polymorphisms in different genomic regions simultaneously. It is also highly sensitive and reproducible. As a result, AFLP has become widely used for the identification of genetic variation in strains or closely related species of plants, fungi, animals, and bacteria. The AFLP technology has been used in criminal and paternity tests, also to determine slight differences within populations.

AFLP not only has higher reproducibility, resolution, and sensitivity at the whole genome level compared to other techniques, but it also has the capability to amplify between 50 and 100 fragments at one time. In addition, no prior sequence information is needed for amplification [30]. As a result, AFLP has become extremely beneficial in the study of taxa including bacteria, fungi, and plants, where much is still unknown about the genomic makeup of various organisms.

There are many advantages to AFLP when compared to other marker technologies including randomly amplified polymorphic DNA (RAPD), restriction fragment length polymorphism (RFLP), and microsatellites.

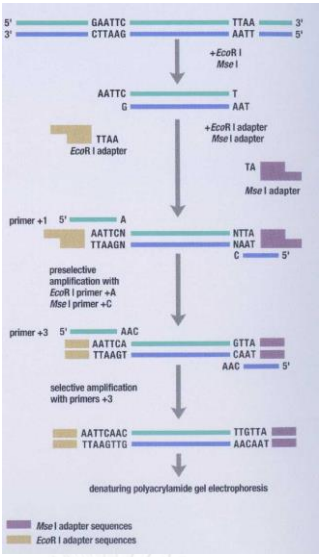


Figure 6 AFLP technique [30]

Sequence Characterized Amplified Region (SCAR markers)

A SCAR marker can be used for detection or differentiation of samples by using specific primers designed from polymorphic RAPD. Sequence characterized amplified regions (SCARs) which are derived from RAPD markers, have the advantages of RAPD markers and the additional benefits of increased specificity and reproducibility. The main steps of this method are first identification of a polymorphic band using RAPD, ISSR, PCR-RFLP or AFLP, then nucleotide sequencing of the polymorphic band, and finally PCR reproduction of the polymorphic band as template DNA using a pair of long primer (25-30 bp) that are specific to the band (**Figure 7**) [49]. The conversion of a RAPD to a SCARs improves reproducibility of PCR product and enhances the discriminatory power and reliability of the identification methods. In recent years, the informative dominant SCAR markers have been widely and successfully used in the identification and authentication of *Rosa* species [61], medicinal herbs species [62]. The most significant drawback of SCAR markers is development time and expense. Once established, however, the cost of individual SCAR PCR reactions are similar to those of RAPD markers, and a reduction in the number of required reactions can decrease overall expense.

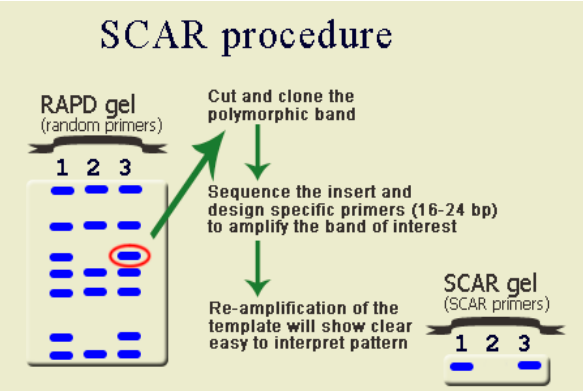


Figure 7 Sequence Characterized Amplified Region (SCAR) procedure [49]

PCR-RFLP

PCR-restriction fragment length polymorphism (RFLP)-based analysis, also known as cleaved amplified polymorphic sequence (CAPS), is a popular technique for genetic analysis. It was used to detect the intra-species as well as interspecies variation [63]. There are different types of genetic variations includes single nucleotide polymorphisms (SNPs). The first step in PCR-RFLP analysis is amplification of a fragment containing the variation. This is will follow by treatment of the amplified fragment with an appropriate restriction enzyme. A restriction enzyme (or restriction endonuclease) is an enzyme that cuts DNA at or near specific recognition nucleotide sequences known as restriction sites. Over 3000 restriction enzymes have been studied in detail, and more than 600 of these are available commercially (**Figure 8**).

These enzymes are routinely used for DNA modification and manipulation in laboratories, and are a vital tool in molecular cloning. Restriction enzymes recognize a specific sequence of nucleotides and produce a double-stranded cut in the DNA. The recognition sequences usually vary between 4 and 8 nucleotides, and many of them are palindromic, meaning the base sequence reads the same backwards and forwards. Since the presence or absence of the restriction enzyme recognition site results in the formation of restriction fragments of different sizes, allele identification can be done by electrophoretic resolving of the fragments.

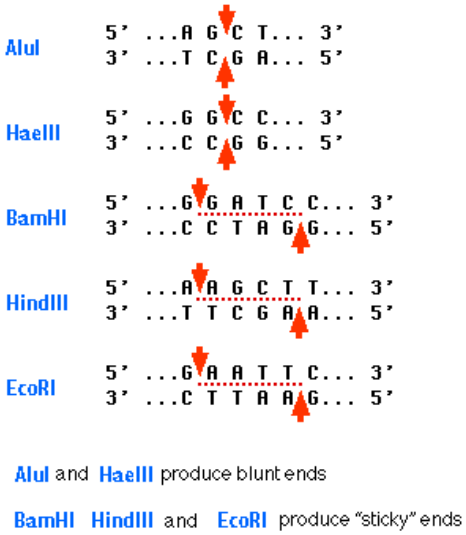


Figure 8 Restriction enzymes [30]

The advantages of the PCR-RFLP technique include inexpensiveness and lack of requirement for sophisticated tools. In addition, the design of PCR-RFLP analyses generally is easy and successful use of the available public programs. Disadvantages include the requirement for specific endonucleases and difficulties in identifying the exact variation in the event that several SNPs (single nucleotide polymorphisms) affect the same restriction enzyme recognition site. The PCR-RFLP technique has been applied for the authentication of the *Panax* species which used in a traditional Chinese medicine [49]. Furthermore, this technique has been widely used and also applied to many plants such as, *Mentha cordifolia* [64] including other groups, such as fungi [65].

Hybridization-based method

Hybridization-based method or non PCR-based method including Restriction Fragment Length Polymorphism (RFLP), DNA is digested and hybridized by restriction enzymes that reveal a pattern difference between DNA fragment sizes from gel electrophoresis and labeled probes in individual organisms, respectively. RFLP can be visualized using radiolabeled complementary DNA sequence. Polymorphism is analysis after hybridization by observing present or absent bands (**Figure 9**) [65]. In present, the popularity of using RFLP fingerprint technique was diminished due to the complicated procedures, and the safety in work with radioactive materials. In addition, there are other ways to access and easier, including PCR based method.

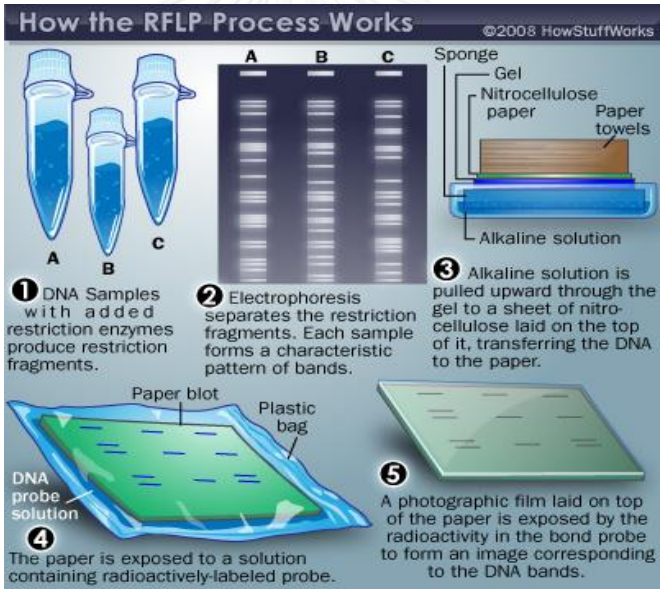


Figure 9 Hybridization-based method [30]

DNA sequencing-based method

Polymorphism at the DNA level can be studied by several methods but the direct strategy is determination of nucleotide sequences of a defined region. For this technique, the primer is specifically designed based on a defined region of gene sequences. Variation due to transitions, insertion or deletion can be accessed directly and information on a defined locus can be obtained [14]. The nucleotide sequencing is one of the most techniques to utilize the phylogenetic history. DNA sequences data are the power of informative tool for molecular systematic and comparative analysis of plant systematic and evolution [65]. From previous studied of DNA sequencing-based method [66], Carles has designed a silicon-based DNA microarray for the authentication of toxic traditional Chinese medicine (TMC). Genomic DNA was extracted from fresh leaves of *Datura metal* L. The spacer region of the 5S-RNA gene was amplified by PCR and subsequently sequenced. Oligonucleotide probes were spotted on to silicon-based chip. DNA corresponding to the 5S-rRNA gene of the toxic TCM plants was amplified by asymmetric PCR and hybridized to the microarrays. *D. metal* L was discriminated based on the difference on the hybridization bases [66].

The nuclear (nDNA) and chloroplast genome (cpDNA) are commonly able to investigate in the molecular systematic and taxonomy of plants. The nDNA is more complexity and repetitive properties. On the other hand, the cpDNA is well suitable for evolutionary and phylogenetics studies above the species level because cpDNA; 1) is relative abundant component of total DNA, 2) contains primarily single copy gene, 3) has a conservative rate of nucleotide substation. The most common genes in nuclear ribosomal gene consists of a transcribed region that comprises an external transcribed spacer (ETS), followed by 18s rDNA, an internal transcribed spacer (ITS-1), the 5.8s rDNA, a second internal transcribed spacer (ITS-2), and finally the 26s rDNA. Each repeat is separated from the next repeat by an intergenic spacer (IGS) [67].

Maxam & Gilbert method and Sanger's method

In 1970's, two DNA sequencing techniques for longer DNA molecules were invented. These were the Sanger (chain termination) method and the Maxam-Gilbert (chemical cleavage) method. The Maxam-Gilbert method is based on nucleotide specific cleavage by chemicals and is best used to sequence oligonucleotides (short nucleotide polymers, usually smaller than 50 base-pairs in length) (**Figure 10**) [68]. In this requires radioactive labeling at one 5' end of the DNA by a kinase reaction using gamma-32P ATP and purification of the DNA fragment. Chemical treatment generates breaks at a small proportion of one or two of the four nucleotide bases in each of four reactions. To visualize the fragment, the gel is exposed to x-ray film for autoradiography, yielding a series of dark bands each corresponding to a radiolabeled DNA fragment, from which the sequence may be inferred [69].

In the Sanger method, the DNA strand to be analyzed is used as template and DNA polymerase is used in a PCR reaction to generate complementary strands using primers. Four different PCR reaction mixtures are prepared, each containing a certain percentage of dideoxy nucleoside triphosphate (ddNTPs) analogs to one of the four nucleotides (dATP, dCTP, dGTP and dTTP). Synthesis of the new DNA strand continues until one of these analogs is incorporated, at which time the strand is prematurely truncated. Each PCR reaction will end up containing a mixture of different lengths of DNA strands, all ending with the nucleotide that was dideoxy labeled for that reaction. Gel electrophoresis is then used to separate the strands of the four reactions, in four separate lanes, and determine the sequence of the original template based on what lengths of strands end with what nucleotide (**Figure 11**).

In the automate Sanger reaction, primers are used that are labeled with four different colored fluorescent tags, PCR reactions, in the presence of the different dideoxy nucleotides, are performed as described above. However, next, the four reaction mixtures are then combined and applied to a single lane of a gel. The color of each fragment is detected using a laser beam and the information is collected by a computer which generates chromatograms showing peaks for each color from which the template DNA can be determined [69].

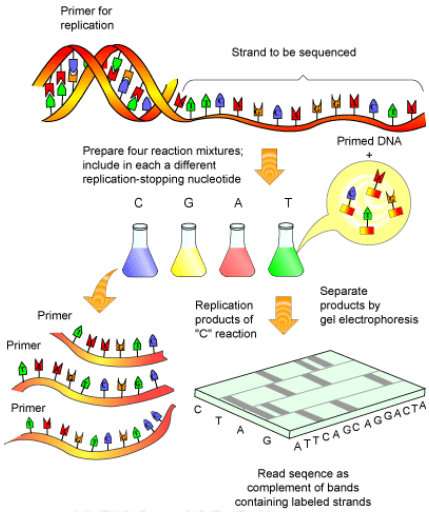


Figure 10 The Maxam-Gilbert (chemical cleavage) method [69]

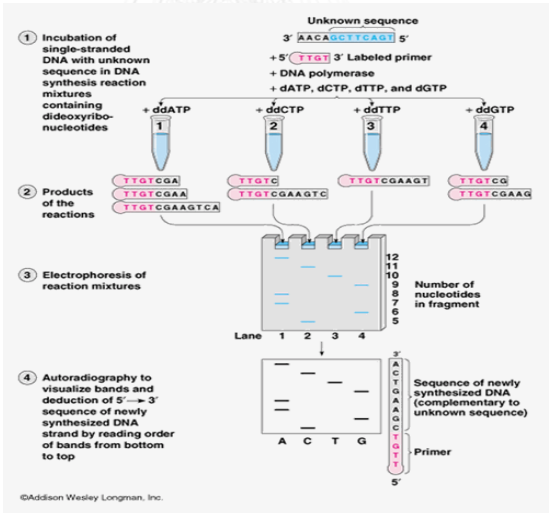


Figure 11 Sanger method DNA sequencing [69]

7. **Phylogenetic analysis**

Phylogenetic analysis of DNA or protein sequences has become an important tool for studying the evolutionary history of organisms. Since the rate of sequence evaluation varies extensively with gene or DNA segment, one can study the evolutionary relationships of virtually all levels of classification of organisms such as families, genera, species, and intra-specific populations by using different genes or DNA segments [55].

Traditionally, phylogenies have been constructed from morphological data but following the growth of genetic information it has become common practice to construct phylogenies based on molecular data. The data is most commonly in the form of DNA or protein sequences but can also be in the form of molecular marker such as RAPD, AFLP or microsatellite. The most important method for inferring phylogenetic relationships of life is that of acquiring DNA sequences. Comparisons of homologous regions of DNA among the taxa under study yield the characters and character states that are used to infer relationships in phylogenetic analyses [70]. There are two categories, distance based method and character based method for molecular marker.

7.1 Phenolic based method

Unweighted Pair-Group Method with Arithmetic Mean (UPGMA)

UPGMA is a clustering method. The program first finds the pair of taxa with the smallest distance between them and defines the branching between them as half of that distance in effect placing a node at the midpoint of the branch. It then combines the two taxa into a “cluster” and rewrites the matrix with the distance from the cluster to each of the remaining taxa. Since the “cluster” serves as a substitute for two taxa, the number of entries in the matrix is now reduce by one. That process is repeated on the new matrix and repeated until the matrix consists of a single entry. That set of matrices is then used to build up the tree by starting at the root and moving out to the first two nodes represented by the last two clusters [71]. UPGMA is intended to reconstruct a species tree, although topological errors often occur when the rate of

gene substitution is not constant or when the number of genes or nucleotides used is small [55].

Neighbor Joining (NJ)

NJ is similar to UPGMA in that it manipulates a distance matrix, reducing it in size at each step, then reconstructs the tree from that series of matrices. It differs from UPGMA in that it does not construct clusters but directly calculates distances to internal nodes [71]. One of the important concepts in the NJ method is neighbors, which are defined as two taxa that are connected by a single node in an unrooted tree [55]. NJ is, like parsimony, a minimum-change method, but it does not guarantee finding the tree with the smallest overall distance [71].

7.2 Cladistic based method

Maximum Parsimony (MP)

MP is the one of the most commonly used for phylogenetic analysis. Parsimony is based on the assumption that the most likely tree is the one that requires the fewest number of changes to explain the data in the alignment. The algorithm is used to evaluate a possible tree at each informative site. MP is a computationally hard problem so heuristics are used to find good solutions. Since there can be equally good solutions, the majority consensus tree of the set of optimal solution is returned [71].

Maximum Likelihood (ML)

ML is currently considered to be one of the most reliable criteria for phylogenetic interference from nucleotide or amino acid sequence data. In the ML method of the phylogenetic inferences the likelihood of observing a given set of sequence data for a specific substitution model is maximized for each topology. [55]. Construction of ML trees is extremely time-consuming, especially when large data and complex substitution models are used.

Bootstrap values

A popular way of evaluating the reliability of an inferred phylogenetic tree is bootstrap analysis. The concept of bootstrap analysis is to re-example the alignment columns with replacement. A high bootstrap score is a sign of greater reliability.

8. Molecular marker in *Jasminum* spp.

Classification of the genus *Jasminum* has long been controversial as this genus shares floral characters and very few morphological characters can be designated as representative indicators for identification purposes.

In Thailand, there are several *Jasminum* species have been used in traditional medicine and some species are subjected for phytochemical analysis. However, there have been reported in genus *Jasminum*. By using RAPD markers, Thananun N. *et al*. have studied on the genetic relationships among seven *Jasminum* cultivars comprised *J. pubescens*, *J. sambac* (Mali la, Mali Thod, Mali Chat and Mali Son), *J. adenophyllum* and *J. auriculatum* existing in Thailand. The result showed significant differences among 7 cultivars. A dendrogram, showed genetic similarities among *Jasminum* species and separated to 4 clusters with similarity coefficients ranging 0.25-0.75 [60]. Moreover, Mahmood M. *et al*. have studied on the detection of genetic diversity in *Jasminum* species through RAPD Techniques and identification of *J. sambac* and *J. grandiflorum* from different areas in Pakistan. The result used to work out the genetic relationship among the 21 accessions. The resulting dendrogram divides the accessions into two distinct main clusters (A and B) at 0.40 similarity value. Cluster A has the most diverse jasmine accessions, while cluster B divided into 2 groups (*J. sambac* and *J. grandiflorum*) [72]. Shekhar S. *et al*. have studied on the detection of genetic diversity in *Jasmine* species by DNA Fingerprinting using RAPD Molecular markers [73]. The comparative analysis and phylogenetic relationships between populations of commercially important *J. grandiflorum*, *J. sambac*, *J. multiflorum* and *J. auriculatum* have been done using RAPD markers [74]. The ISSR Markers had been used to analyze molecular relationships in Iranian Jasmine (*Jasminum* sp.) [75]. Moreover, there are

many species of jasmines. The correct number of species belonging to the genus *Jasminum* has not been established. Many of *Jasminum* species are actually the same (synonyms), in Thailand the common names and vernacular names are duplicate to the others such as, 'Sai kai' consisted of 3 species, 'Maliwan' has 2 species and 'Khiao Ngu' also has 2 species. There are still a lot of confusion in identifying plants because of the existence of a large number of species, varieties and cultivars and which some synonyms. Due to the medicinal usage of *Jasminum* sp. and questionable classification based on morphological characters, a preliminary molecular marker will be analyze using RAPD analysis. Furthermore, a phylogenetic study will be conduct using a simple technique, RAPD will be apply for DNA fingerprinting for the important medicinal *Jasminum* species, and future pharmacological activities study.

CHAPTER III

MATERIALS AND METHODS

3.1 **Plants materials**

Thirty *Jasminum* accessions, including 16 known species, 6 *J. sambac* cultivars, 4 *J. multiflorum* cultivars and 4 unidentified species were used in this study. Fresh leaves of the plant samples were collected between January 2012 and to October 2013 from 3 different locations of each sample. Plant samples were authenticated by expert (Associate Professor Dr. Nijsiri Ruangrangsi, College of Public Health Sciences, Chulalongkorn University), and compared with the herbarium specimens at Forest Herbarium Thailand (BKF). The voucher specimens of plant samples were deposited at College of Public Health Sciences, Chulalongkorn University. The detail of the plant samples used in the study are shown in **Table 3**.

3.2 Microscopic evaluation

Leaf constant numbers of 30 investigated *Jasminum* accessions with three different locations according to Table 3 were determined from thirty fields of photographs for each sample. Trichome number, epidermal cell number, palisade ratio, vein termination number vein islet number and stomatal type, stomatal number were counted and expressed as mean and standard deviation (SD). Then, mean and SD of each sample were averaged as the constant number of each accessions.

Chemicals and Reagents

- 70 Degree ethyl alcohol
- Chloral hydrate (Ajax Finechem Pty Ltd., Australia)
- Distilled water
- Glycerol
- Haiter Bleach Solution (Kao industrial, Thailand)

Apparatus

- Beaker 250 ml. (Pyrex, Germany)
- Compound microscope (Carl Zeiss model Axioskop, Germany) with AxioVision 40 V4.6.3.0 software
- Digital camera (Cannon Power shot A640, Canon Inc., Japan)
- Forceps
- Microscope slide (Sail Brand, China)
- Cover slips (Menzel. Glazer)
- Hot plate Model HP-A191 (Thermolyne, USA)

Procedure for leaf constant numbers

Preparation of leaf sample for trichome number investigation

The fresh mature leaves were cleaned and cut in the central part of lamina into a small pieces (1x1 cm) and soaked in the Haiter Bleach Solution mixture (Haiter Bleach Solution: water, 1:1) to remove the chlorophyll at least 2 days in room temperature. The transparent leaf samples were washed in distilled water then mounted to very clean microscope slide, cover with cover glass, and label the slide as appropriate for the specimen being examined. A 10X magnification of objective lens of compound microscope with an attached digital camera (**Figure 12**) was used and recorded the image. The leaf samples were used for trichome number investigation.

Determination of trichome number

A 10X magnification of objective lens of compound microscope with an attached digital camera were used in this study. The number of trichome were count in the area of 1 mm^2 on both adaxial and abaxial. The area of sample was to be changed and recorded at least 30 images from several fractions of leaves from one location.

Preparation of leaf sample for palisade cell, epidermal cell number, vein termination number, vein islet number and stomatal number investigation

The fresh mature leaves were cleaned and cut in the central part of lamina into a small pieces (1x1 cm) and soaked in the Haiter Bleach Solution mixture (Haiter Bleach Solution: water, 1:1) to remove the chlorophyll at least 2 days in room temperature. Let the fractions of leaf to warmed 55°C in chloral hydrate solution (chloral hydrate: water, 4:1) until the samples were transparent. Then, the samples were rinsed with distilled water until the samples were clean and mounted the samples on slide and cover with cover glass. This leaf samples were used for palisade cell, epidermal cell number, vein termination number and vein islets number investigation. According to the stomatal number, the fractions of leaf were peel at abaxial leaf after warmed 55°C in chloral hydrate solution before investigation.

Determination of epidermal cell number and epidermal cell area

A 20X magnification of objective lens of compound microscope with an attached digital camera were used in this study. The number of epidermal cell were count in the area of 0.5 mm^2. The number of epidermal cell was multiplied by 4 in order to give total number of epidermal cell in the area of 1 mm^2 and epidermal cell area was calculated. The area of sample was to be changed and recorded at least 30 images from several fractions of leaves from one location.

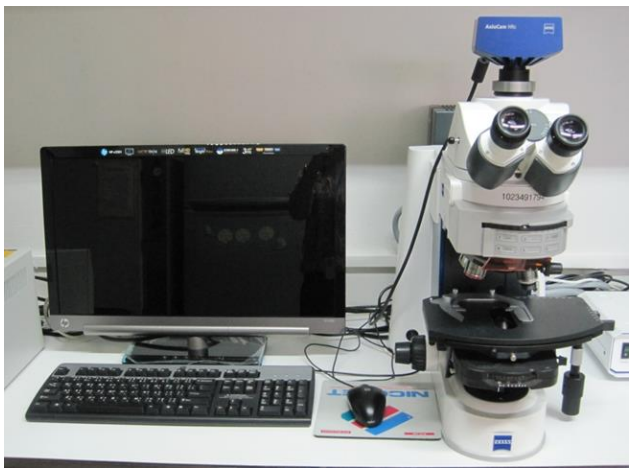


Figure 12 The compound microscope attached with a digital camera

Determination of palisade number and palisade ratio

A 40X magnification of objective lens of compound microscope with an attached digital camera was used and recorded the image. The image of four clear contiguous epidermal cells consist of the round, closely packed palisade cells was observed and recorded. The number of total palisade cells was divided by 4, which gave the average number of palisade cell under each epidermal cell.

Determination of vein termination number

A 10X magnification of objective lens of compound microscope with an attached digital camera was used and recorded the image. The number of vein termination which they define as 'the number of veinlet terminations per mm^2 of leaf surface. A vein termination is the ultimate free termination of a veinlet or branch of a veinlet'. The area of sample was to be changed and recorded at least 30 images from several fractions of leaves from one location.

Determination of vein islet number

A 10X magnification of objective lens of compound microscope with an attached digital camera was used and recorded the image. The number of vein-islets per mm^2 calculated from four contiguous square millimeters in the central part of the lamina, midway between the midrib and the margin, is termed the vein-islet number. The area of sample was to be changed and recorded at least 30 images from several fractions of leaves from one location.

Determination of stomatal type, stomatal number and stomatal index

A 20X magnification of objective lens of compound microscope with an attached digital camera were used in this study. The number of stomata were count in the area of 0.5 mm^2 both adaxial and abaxial. The number of stomata and epidermal cells was multiplied by 4 in order to give total number of stomata and epidermal cells in the area of 1 mm^2. The area of sample was to be changed and recorded at least 30 images from several fractions of leaves from one location.

Table 3 List of 30 authentic samples and their different localities in Thailand

Species	Sample Codes	Provinces	Date of Collection	Voucher ID
J. sambac (L.) Aiton 'Mali La'	S1B	Bangkok	07.2012	JP-0712101
	S1C	Chonburi	07.2012	JP-0712102
	S1S	Sisaket	02.2013	JP-0213103
J. sambac (L.) Aiton 'Mali Son'	S2B	Bangkok	07.2012	JP-0712104
	S2C	Chonburi	07.2012	JP-0712105
	S2S	Sisaket	02.2013	JP-0213106
J. sambac (L.) Aiton 'Mali Chat Phikun'	S3B	Bangkok	08.2012	JP-0812107
	S3N	Nonthaburi	10.2012	JP-1012108
	S3S	Sisaket	02.2013	JP-0213109
J. sambac (L.) Aiton 'Mali Thod'	S4B	Bangkok	07.2012	JP-0712110
	S4C	Chonburi	07.2012	JP-0712111
	S4S	Sisaket	02.2013	JP-0213112
J. sambac (L.) Aiton 'Mali Chat Dokbua'	S5B	Bangkok	07.2012	JP-0712113
	S5C	Chonburi	07.2012	JP-0712114
	S5N	Nonthaburi	10.2012	JP-1012115
J. sambac (L.) Aiton 'Mali Chantaboon'	S6P	Pathumthani	07.2012	JP-0712116
	S6K	Khon Kaen	07.2012	JP-0712117
	S6S	Sisaket	02.2013	JP-0213118

Table 3 List of 30 authentic samples and their different localities in Thailand (continue)

Species	Sample Codes	Provinces	Date of Collection	Voucher ID
J. scandens (Retz.) Vahl	SCB	Bangkok	07.2012	JP-0712119
	SCN	Nonthaburi	07.2012	JP-0712120
	SCS	Sisaket	02.2013	JP-0213121
J. auriculatum	AUB	Bangkok	07.2012	JP-0712122
	AUN	Nonthaburi	07.2012	JP-0712123
	AUC	Chonburi	09.2012	JP-0912124
J. adenophyllum Wall. ex C. B. Clarke	ADB	Bangkok	07.2012	JP-0712125
	ADC	Chonburi	07.2012	JP-0712126
	ADSR	Saraburi	09.2012	JP-0912127
J. multiflorum (Burm. f.) Andr. 'Maluli'	M1N	Nonthaburi	07.2012	JP-0712128
	M1B	Bangkok	07.2012	JP-0712129
	M1NR	Nakornratchasima	09.2012	JP-0912130
J. multiflorum (Burm. f.) Andr. 'Maluli Sichomphu'	M2N	Nonthaburi	07.2012	JP-0712131
	M2NR	Nakornratchasima	08.2012	JP-0812132
	M2B	Bangkok	08.2012	JP-0812133
J. multiflorum (Burm. f.) Andr. 'Maluli Phum'	M3B	Bangkok	10.2013	JP-1013188
	M3N1	Nonthaburi	10.2013	JP-1013189
	M3N2	Nonthaburi	10.2013	JP-1013190

Table 3 List of 30 authentic samples and their different localities in Thailand (continue)

Species	Sample Codes	Provinces	Date of Collection	Voucher ID
J. multiflorum (Burm. f.) Andr. 'Ngachang'	M4CM1	Chiangmai	10.2013	JP-1013191
	M4CM2	Chiangmai	10.2013	JP-1013192
	M4CM3	Chiangmai	10.2013	JP-1013193
J. cordatum Ridl	COCM1	Chiangmai	09.2012	JP-0912134
	COCM2	Chiangmai	09.2012	JP-0912135
	COCM3	Chiangmai	09.2012	JP-0912136
J. nobile C. B. Clarke	NON	Nonthaburi	07.2012	JP-0912137
subsp. *rex* (Dunn)	NOCM	Chiangmai	02.2013	JP-0912138
	NOS	Sisaket	02.2013	JP-0912139
J. laurifolium Roxb. var.	NIPT	Patumthani	07.2012	JP-0712140
nitidum (Skan) P. S. Green	NILP	Lampoon	02.2013	JP-0213141
	NIS	Sisaket	02.2013	JP-0213142
J. siamense Craib	SINR1	Nakornratchasima	09.2012	JP-0912143
	SINR2	Nakornratchasima	09.2012	JP-0912144
	SICM	Chiangmai	04.2013	JP-0413145
J. elongatum (Bergius) Willd	ELNR1	Nakornratchasima	04.2013	JP-0413146
	ELNR2	Nakornratchasima	04.2013	JP-0413147
	ELCM	Chiangmai	06.2013	JP-0613148

Table 3 List of 30 authentic samples and their different localities in Thailand (continue)

Species	Sample Codes	Provinces	Date of Collection	Voucher ID
J. grandiflorum (L.) Kobuski	GRN	Nonthaburi	09.2012	JP-0912149
	GRB	Bangkok	04.2013	JP-0413150
	GRSR	Saraburi	06.2013	JP-0613151
J. nervosum Lour	NENR1	Nakornratchasima	04.2013	JP-0413152
	NENR2	Nakornratchasima	04.2013	JP-0413153
	NENY	Nakhonnayok	04.2013	JP-0413154
J. lanceolaria Roxb.	LANR1	Nakornratchasima	04.2013	JP-0413155
	LANR2	Nakornratchasima	04.2013	JP-0413156
	LANY	Nakhonnayok	04.2013	JP-0413157
J. coarctatum Roxb.	COAPT	Prathumtani	04.2013	JP-0413158
	COAN	Nontaburi	04.2013	JP-0413159
	COASR	Saraburi	07.2013	JP-0713160
J. funale Decne. subsp. *sootepense* (Craib) P. S. Green	FSNR1	Nakornratchasima	04.2013	JP-0413161
	FSNR2	Nakornratchasima	04.2013	JP-0413162
	FSK	Kanchanaburi	07.2013	JP-0713163
J. humile L.	HUNR	Nakornratchasima	08.2013	JP-0813164
	HUS1	Sisaket	08.2013	JP-0813165
	HUS2	Sisaket	08.2013	JP-0813166

Table 3 List of 30 authentic samples and their different localities in Thailand (cont)

Species	Sample Codes	Provinces	Date of Collection	Voucher ID
J. mesnyi Hance	MENR	Nakornratchasima	08.2013	JP-0813167
	MES1	Sisaket	08.2013	JP-0813168
	MES2	Sisaket	08.2013	JP-0813169
J. fluminense Vahl subsp. *gratissimum* (Deflers) P. S. Green	FGNR	Nakornratchasima	08.2013	JP-0813170
	FGS1	Sisaket	08.2013	JP-0813171
	FGS2	Sisaket	08.2013	JP-0813172
Mali Pa1	SP1S1	Sisaket	08.2013	JP-0813173
(*Jasminum* sp 1)	SP1S2	Sisaket	08.2013	JP-0813174
	SP1S3	Sisaket	08.2013	JP-0813175
Mali Pa 2	SP2S1	Sisaket	08.2013	JP-0813176
(*Jasminum* sp 2)	SP2S2	Sisaket	08.2013	JP-0813177
	SP2S3	Sisaket	08.2013	JP-0813178
Mali Pa 3	SP3NM1	Nakornratchasima	04.2013	JP-0413179
(*Jasminum* sp 3)	SP3NM2	Nakornratchasima	04.2013	JP-0413180
	SP3NM3	Nakornratchasima	04.2013	JP-0413181
Mali Pa 4	SP4NM1	Nakornratchasima	04.2013	JP-0413182
(*Jasminum* sp 4)	SP4NM2	Nakornratchasima	04.2013	JP-0413183
	SP4NM3	Nakornratchasima	04.2013	JP-0413184
Pandora jasminoides Lindl. (outgroup)	OGB	Bangkok	08.2012	JP-0812185
	OGN	Nonthaburi	10.2012	JP-1012186
	OGC	Chonburi	01.2013	JP-0113187

3.3 RAPD analysis

Isolation of genomic DNA

Chemicals and Reagents

- 2-Mercaptoethanol (AR grade, BDH Chemical, England)
- 3 M Sodium acetate (pH 5)
- 70 degree ethyl ethanol
- Absolute ethanol (Merck, Darmstadt, Germany)
- CTAB: cetyltrimethylammonium (cetrimonium) bromide (Sigma-Aldrich Company Co., St. Louis, MO, U.S.A.)
- Chloroform (Merck, Darmstadt, Germany)
- EDTA: Ethylene diamene tetra-acetic acid (Merck, Darmstadt, Germany)
- Isoamyl alcohol (Sigma-Aldrich Company Co., St. Louis, MO, U.S.A.)
- Liquid nitrogen
- NaCl: Sodium Cloride (BDH Laboratory supplies, Poole, England)
- Tris (hydroxymethyl)-aminomethane hydrochloride (Fluka, Biochemika, Germany)

Apparatus

- 1.5 Micro-centrifuge tubes (Axygen, U.S.A.)
- -20 °C Freezer
- Centrifuge machine
- Micropipette (Eppendorf, Germany)
- Mortar and pestle
- Shaking water bath
- Spatula

- Vortex mixer

Plant genomic DNA was extracted individually from the fresh young leaves using a modified CTAB method [76].

Method for DNA extraction

1. The fresh young leaves were cleaned, rapidly freeze in liquid nitrogen and grinded into a powder with mortar and pestle. Transfer the powder into 1.5 micro-centrifuge tubes.
2. Add 500 µl of CTAB buffer (2% w/v CTAB, 100 mM Tris-HCl pH 8.0, 20 mM EDTA, 1.4 M, $NaCl_2$ 4ul/ml and 2-Mercaptoethanol) into micro-centrifuge tubes then incubate at 65°C for 1 hour in constant shaking water bath.
3. Centrifuge at 10,000 round per minute (rpm) for 10 min to spin down cell debris and transfer supernatant into a new clean 1.5 micro-centrifuge tube.
4. Add 500 µl of chloroform to get rid of proteins. The solution was mix by vortex and centrifuge at 10,000 rpm for 10 min.
5. Transfer the aqueous phase to a new clean 1.5 ml micro-centrifuge tube then add 500 µl Chloroform: Isoamyl (24:1) and mix well by vortex mixer. Centrifuge at 10,000 rpm for 10 min then, transfer the aqueous phase to a new clean micro-centrifuge tube.
6. Add 1:10 volume of 3 M sodium acetate (pH 5). Add 2 volume of cold absolute ethanol to precipitate DNA, invert the tube 2-3 and keep at -20°C for 1 hour.
7. Centrifuge at 10,000 rpm for 10 min then remove all supernatant and wash with cold 70% ethanol and centrifuge at 10,000 rpm for 10 min. Discarded the supernatant and allow the DNA pallet dried at room temperature.
8. Finally, add 100 µl of TE buffer (10mM Tris pH8, 0.1 mM EDTA pH8) to the DNA pellet in order to dissolve homogeneously, and store at 4°C refrigerator.
9. The extracted DNA was store at -20°C for further use.

Quantification of genomic DNA and DNA amplification by Polymerase Chain Reaction (PCR)

Chemical and Reagent

- 1kb DNA ladder marker (Fermentas, USA)
- 100 bp DNA ladder marker (Fermentas, USA)
- 1X Loading dye (bromophenol blue, Fermentas, USA)
- 1X TBE buffer
- 10 mM dNTPs (Fermentas, USA)
- 10X PCR buffer (Fermentas, USA)
- 5 Unit/ µl *Taq* DNA polymerase (Fermentas, USA)
- 25 mM $MgCl^{2+}$ (Fermentas, USA)
- Agarose gel (Merck, Darmstadt, Germany)
- Distilled deionized water
- DNA template (Extracted DNA solution)
- Ethidium bromide (Sigma-Aldrich Company Co., St. Louis, MO, U.S.A.)
- Oliconucleotide primer (Fermentas, USA)
- *Taq* DNA polymerase (Fermentas, USA)

Apparatus

- 1.5 Microcentrifuge tube
- microcentrifuge machine
- Electrophoresis chamber and power supply
- Micropipette
- PCR tubes

- Thermal cycler (Applied Biosystems Vertiri ^{TM} Thermal Cycler 0.2 ml)
- UV visualize gel documentation
- Vortex mixer

The quantity of extracted DNA was estimated by comparing the band intensity of the extracted DNA with 1 kb DNA ladder marker (Fermentas, USA) in agarose gel. To prepare 1.5% agarose gel, 1.5g of agarose was weighted into a clean 500 ml bottle and add 100 ml of 1XTBE buffer (0.89 M Tris base, 0.02 M EDTA, 0.89 M boric acid, pH 8.0). Agarose was melted completely by boiling and then cool down to 50^{O}C. Gel casting tray was set up and agarose was poured. After solidification, the gel was immersed in the buffer tank containing 1XTBE buffer. 5 µl of DNA samples along with 6Xloading dye (6X loading/ tracking dye-40% sucrose, 0.025 % bromophenol blue, 0.25 % xylene cyanol) was added, mixed and loaded into the well. Electrophoresis was carried out at 100 Volt/cm for 30 min or until the loading dye migrate to two third of the gel. Remove the gel tray and stain with ethidium bromide for 15 min and then destain with water for 10 min. The gel was photographed under UV light using UV transilluminator gel documentation system.

Random Amplification Polymorphic DNA (RAPD) procedure

Primer screening

Sixty arbitrary oligonucleotide primers (**Table 4**) (Operon Technologies Alameda, USA) were used for PCR amplification screening. The primers that give high enough polymorphism and constant pattern were chosen for further study.

Table 4 List of 60 oligonucleotide primers used for RAPD screening

No	Primer code	Sequence (5'-3')	No	Primer code	Sequence (5'-3')
1	RAPD-01	AGGGGTCTTG	23	OPC-03	GGGGGTCTTT
2	RAPD-02	TTCCGAACCC	24	OPC-04	CCGCATCTAC
3	RAPD-03	TTTGCCCGGA	25	OPC-05	GATGACCGCC
4	RAPD-04	TCTGGTGAGG	26	OPC-11	AAAGCTGCGG
5	RAPD-05	TTCCGGGTGC	27	OPC-12	TGTCATCCCC
6	RAPD-06	GTCGCCGTCA	28	OPC-13	AAGCCTCGTC
7	RAPD-07	GAGGTCCAGA	29	OPC-14	TGCGTGCTTG
8	RAPD-08	GACCGCTTGT	30	OPC-15	GACGGATCAG
9	RAPD-09	CCTGGGCTTT	31	OPD-04	TCTGGTGAGG
10	RAPD-10	CAGCACCGCA	32	OPD-07	TTGGCACGGG
11	OPA-02	TGCCGAGCTG	33	OPE-04	GTGACATGCC
12	OPA-03	AGTCAGCCAC	34	OPE-07	AGATGCAGCC
13	OPA-04	AATCGGGCTG	35	OPF-01	ACGGATCCTG
14	OPA-13	CAGCACCCAC	36	OPF-02	GAGGATCCCT
15	OPA-20	GTTGCGATCC	37	OPF-03	CCTGATCACC
16	OPB-01	GTTTCGCTCC	38	OPF-04	GGTGATCAGG
17	OPB-02	TGATCCCTGG	39	OPF-05	CCGAATTCCC
18	OPB-03	CATCCCCCTG	40	OPL-06	GAGGGAAGAG
19	OPB-04	GGACTGGAGT	41	OPL-07	CCGTGACTCA
20	OPB-05	TGCGCCCTTC	42	OPL-08	CTCGTTCCCC
21	OPC-01	TTCGAGCCAG	43	OPL-09	TGCGAGAGTC
22	OPC-02	GTGAGGCGTC	44	OPL-10	TGGGAGATGG

Table 4 List of 60 oligonucleotide primers used for RAPD screening (continue)

No	Primer code	Sequence (5'-3')	No	Primer code	Sequence (5'-3')
45	OPM-06	CTGGGCAACT	53	OPS-03	CAGAGGTCCC
46	OPM-07	CCGTGACTCA	54	OPS-08	TTCAGGGTGG
47	OPM-08	CTCGTTCCCC	55	OPS-12	CTGGGTGAGT
48	OPM-09	GTCTTGCGGA	56	OPS-19	GAGTCAGCAG
49	OPM-10	TCTGGCGCAC	57	OPY-05	GGCTGCGACA
50	OPN-16	AAGCGACCTG	58	A-29	GGTTCGGGAATG
51	OPN-18	GGTGAGGTCA	59	F-25	CCAGATCCGAAT
52	OPS-01	CTACTGCGCT	60	F-29	GCCGCTAATATG

Reaction mixture for RAPD

The investigated and optimized PCR reaction was the first step of RAPD because it could affected the pattern of PCR products and held constant throughout the experiment. The concentration of magnesium chloride varied from 2 to 5 mM. The optimum magnesium concentration was 4 mM since it could produce clear and reproducible RAPD band (**Figure 37**). A 20 µl reaction was set up in sterile 0.2 ml microfuge tubes. The volume of reaction mixture per one reaction is as follows:

Stock Reagent	Final concentration	Volume(µl)
10X *Taq* Polymerase buffer	1X	2.0
25 mM $MgCl_2$	4 mM	2.0
10 mM dNTPs	0.2 mM	0.2
10uM Random primer	0.4µM	0.4
5 U *Taq* Polymerase	1 Unit	0.1
Sterile water	-	14.3
Template DNA	-	1
Total		20 µl

The DNA template was added to individual tube at the end after dispensing 19 µl of the reaction mixture.

RAPD amplification condition

The reaction mixture PCR tubes were spun down briefly and placed in the thermo cycler (Applied Biosystems Vertiri ^{TM} Thermal Cycler 0.2 ml). RAPD amplification was carried out with following amplification conditions:

1. Initial denaturation at 95 ^{O}C for 5 min.

2. Denaturation at 95 ^{O}C for 1 min

3. Annealing at 36 ^{O}C for 1 min

4. Extension at 72 ^{O}C for 1 min (repeat steps 2-4 for 45 cycles)

5. Final extension at 72 ^{O}C for 5 min

The amplification products were resolved on 1.5% agarose gel electrophoresis in TBE buffer and stained with ethidium bromide. The RAPD fragments were photographed using a UV transilluminator and analyzed with a gel documentation system. The amplification products size were compared to the 1 kb standard Gene Ruler DNA Ladder Marker.

Data analysis

The molecular weight of bands could be estimated based on the standard bands from DNA ladder marker. By counting the total number of bands for each primer, the present (score=1) and absence (score=0) of DNA band at particular position or distance of migration on the gel would be recorded. Only clear and reproducible bands would be considered. The data matrix of 1 and 0 were entered into the Syngene program data analysis. Percentage of polymorphic band could be calculated.

Phylogenetic tree construction

The similarity index could be calculated across all pair wise comparison of individual following the method of Nei and Li [77] and the similarity index could be used to calculate the genetic distance values and to construct the dendrogram. The dendrogram could be constructed using the unweighted Pair-Group Method of Arithmetic (UPGMA) method. The relationship of each sample could be analyzed from polymorphic banding pattern.

CHAPTER IV
RESULTS

Part I. Microscopic Characteristics

The leaf constants of 30 investigated accessions which consist of trichome number, epidermal cell number, epidermal cell area, stomatal number, stomatal index, palisade ratio, vein termination number and vein islet number were analyzed by microscopic assessment as described in chapter III and expressed as mean and standard deviation.

Determination of trichome number

Microscopic characters of 30 *Jasminum* accessions were examined on both adaxial and abaxial surface. The characteristic of trichome in all *jasminum* accessions were unicellular and multicellular non-glandular trichome (**Figure 13, 14**). In addition, a number of trichome of abaxial (lower) epidermis were more presented than adaxial (upper) epidermis. The mean and standard deviation of trichome were shown in **Table 5** and **Figure 15**.

The present and absence of trichome could be divide 30 *jasminum* accessions into three groups. Cluster one consisting of 4 accessions of *J. humile*, *J. fluminense* Vahl subsp. *gratissimum, J. nervosum* and *J. mesnyi* had no trichome on both side of the leaves. Cluster two consisting of 5 accessions of *J. multiflorum* 'Maluli Phum', *J. multiflorum* 'Maluli Sichomphu', *J. cordatum, J. nobile* subsp. *rex* and *J. funale* subsp. *sootepense* had trichome presented on both adaxial and abaxial leaves. Cluster three consisting of the 21 remaining accessions of *J. sambac* 'Malison', *J. sambac* 'Malila'', *J. sambac* 'Mali Chantaboon', *J. sambac* 'Malithod', *J. sambac* 'Mali Chatphikun', *J. sambac* 'Mali Chatdokbua', *J. multiflorum* 'Maluli', *J. multiflorum* 'Mali Ngachang', *J. scandens*, *J. siamense*, *J. nitidum*, *J. grandiflorum*, *J. lanceolaria*, *J. auriculatum*, *J. adenophyllum* l, *J. elongatum*, *J. sp.* 1, *J. sp.* 2, *J. sp.* 3 and *J. sp.* 4 had presented on abaxial (lower) leave.

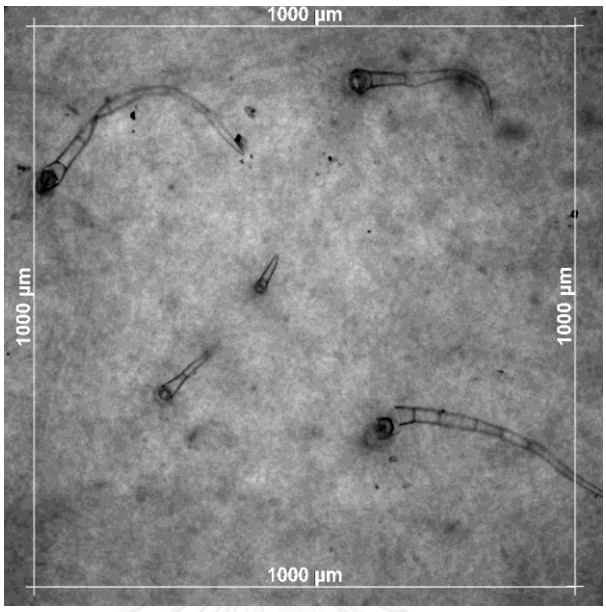


Figure 13 The trichome characteristic of *J. multiflorum* 'Maluli sichomphu' leaf with 10X magnification

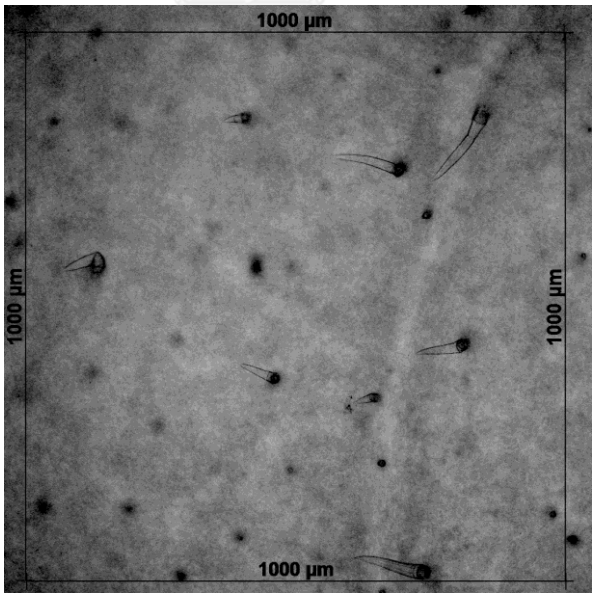


Figure 14 The trichome characteristic of *J. sp* 4 leaf with 10X magnification

Table 5 The average measurement of trichome number values of thirty investigated *Jasminum* accessions from three locations. (Mean ± SD, n = 90)

No	*Jasminum* accessions	Vernacular name	Code	Trichome number/ mm^2	
				Adaxial	Abaxial
1	*J. sambac* Aiton L.	Malila	S1	NF	8.10 ± 2.30
2	*J. sambac* Aiton L.	Malison	S2	NF	7.02 ± 2.24
3	*J. sambac* Aiton L.	Mali Chatphikun	S3	NF	7.25 ± 1.93
4	*J. sambac* Aiton L.	MaliThod	S4	NF	4.84 ± 1.39
5	*J. sambac* Aiton L.	Mali ChatDokbua	S5	NF	3.14 ± 1.31
6	*J. sambac* Aiton L.	Mali Chantaboon	S6	NF	6.24 ± 7.34
7	*J. multiflorum* (Burm. f.) Andr.	Maluli	M1	NF	5.71 ± 1.51
8	*J. multiflorum* (Burm. f.) Andr.	Maluli Sichomphu	M2	RF	6.55 ± 2.15
9	*J. multiflorum* (Burm. f.) Andr.	Maluli Phum	M3	12.31 ± 2.93	33.05 ± 2.73
10	*J. multiflorum* (Burm. f.) Andr.	Mali Ngachang	M4	NF	17.49 ± 3.66
11	*J. scandens* (Retz.) Vahl	Seao Phi	SC	NF	22.51 ± 6.70
12	*J. auriculatum* Vahl	Putthachat	AU	NF	14.83 ± 2.68
13	*J. adenophyllum* Wall	Maliwan	AD	NF	6.71 ± 1.57
14	*J cordatum* Ridl	Mali Chang	CO	19.55 ± 3.62	23.18 ± 3.57
15	*J. nobile* C. B. Clarke subsp. *rex* (Dunn)	Mali Punyi	NO	7.37 ± 1.01	17.21 ± 1.87
16	*J. nitidum* Skan	Mali Loung	NI	NF	15.26 ± 2.89
17	*J. siamense*	Mali Siam	SI	NF	15.92 ± 2.19
18	*J. elongatum* (Bergius) Willd	Mali Sai Kai	EL	NF	4.67 ± 1.30
19	*J. grandiflorum*	Mali Sathan	GR	NF	13.35 ± 1.35

Table 5 The average measurement of trichome number values of thirty investigated *Jasminum* accessions from three locations. (Mean ± SD, n = 90) (Continue)

No	*Jasminum* accessions	Vernacular name	Code	Trichome number/ mm^2	
				Adaxial	Abaxial
20	*J. nervosum* Lour	Mali Khiao Ngu Lek	NE	NF	NF
21	*J. lanceolaria* Roxb	Mali Wan Lek	LA	NF	11.52 ± 2.20
22	*J. coarctatum* Roxb.	Mali Burapha	COA	NF	RF
23	*J. funale* Decne. subsp. *sootepense* (Craib) P. S. Green	Mali Nok	FS	5.02 ± 1.18	7.09 ± 1.52
24	*J. humile* L.	Malilueang	HU	NF	NF
25	*J. mesnyi*	Mali Moung Nhaw	ME	NF	NF
26	*J. fluminense* Vahl subsp. *gratissimum*	Putthachatloung	FG	NF	NF
27	*J. sp.* 1	Malipa 1	SP1	NF	8.60 ± 1.55
28	*J. sp.* 2	Malipa 2	SP2	NF	15.55 ± 2.18
29	*J. sp.* 3	Malipa 3	SP3	NF	15.40 ± 2.67
30	*J. sp.* 4	Malipa 4	SP4	NF	31.91 ± 3.02

Remark: RF= Rarely Found (1-2 per mm^2) and NF= Not Found

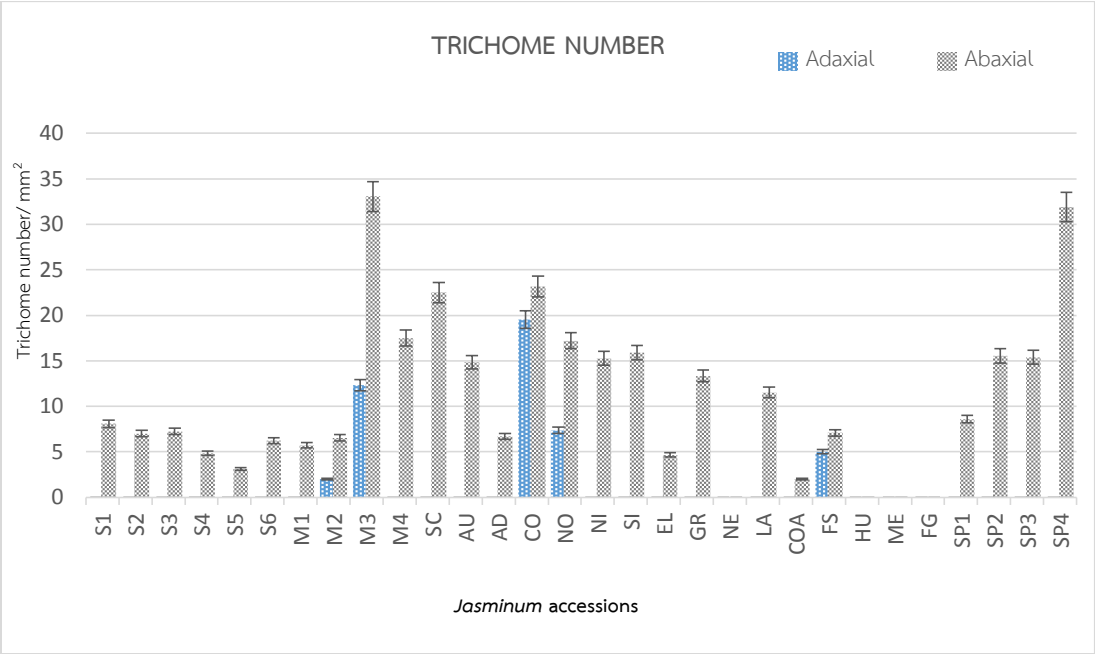


Figure 15 The constant of trichome number of thirty investigated *Jasminum* accessions from three locations

Abbreviations of the plant samples are according to the codes used in Table 5

Determination of Epidermal cell number and epidermal cell area

There are 2 types of epidermal cell. The irregular shape of epidermal cell were found in *J. funale* Decne subsp. *saotepense* (**Figure 16**), *J. humile* (**Figure 17**) and *J. cordatum* (**Figure 18**) whereas the remaining 27 *Jasminum* accessions were in square shape (**Figure 19**).

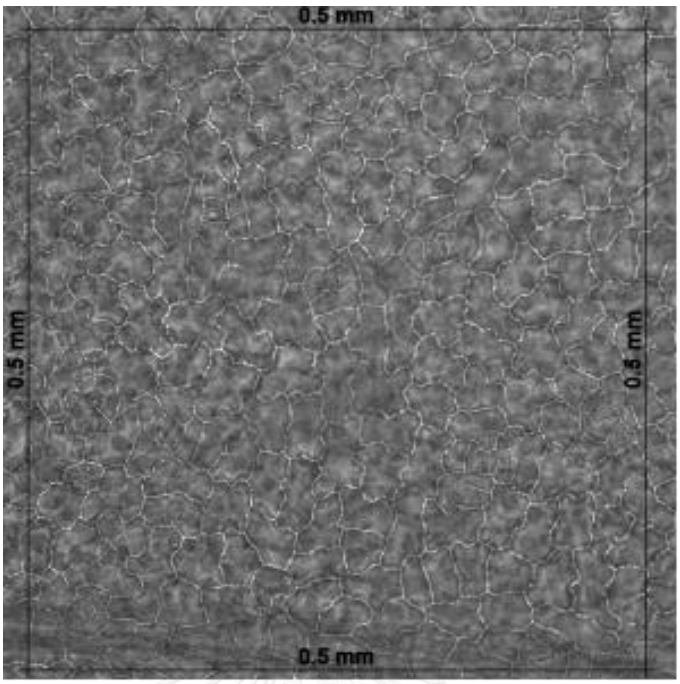


Figure 16 The irregular epidermal cell type of *J. funale* Decne. subsp. *sootepense* (Craib) P. S. Green with 20X magnification

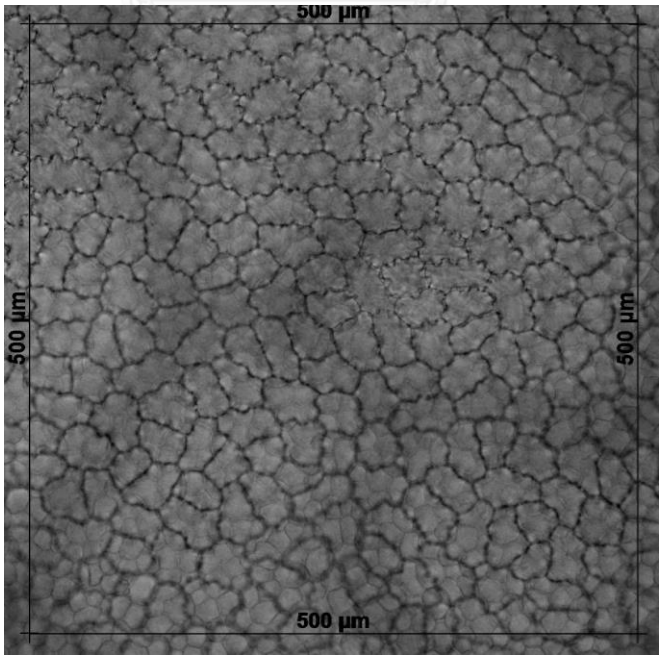


Figure 17 The irregular epidermal cell type of *J. humile* with 20X magnification

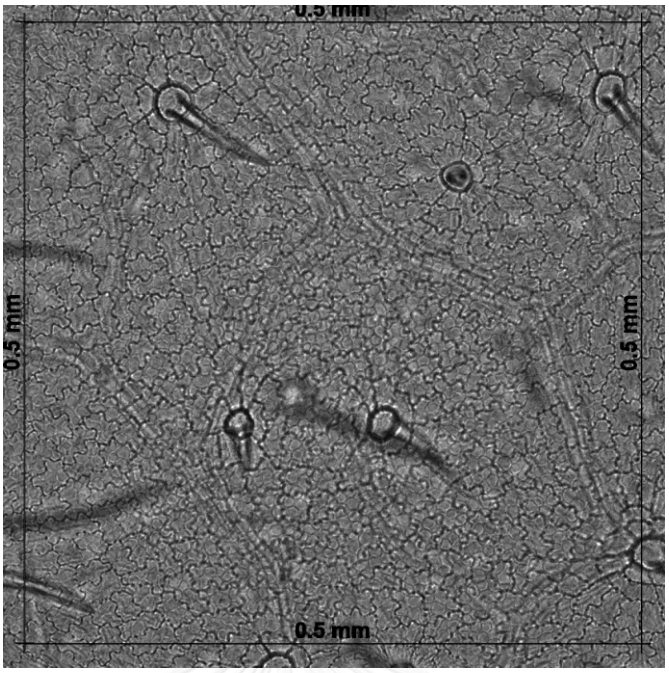


Figure 18 The irregular epidermal cell type and trichomes of *J. cordatum* with 20X magnification

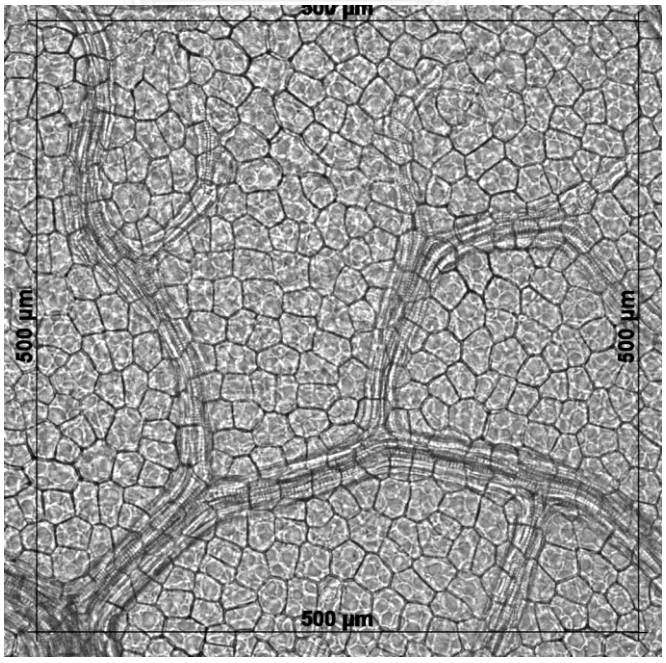


Figure 19 The square epidermal cell type of *J. sambac* 'Malila'

Table 6 The epidermal number and epidermal cell area of thirty investigated *Jasminum* accessions from three locations. (Mean ± SD, n = 90)

No	*Jasminum* accessions	Vernacular name	Epidermal Cell number/mm^2	Epidermal Cell area (μm^2)
1	*J. sambac* Aiton L.	Malila	1663.25 ± 195.84	595.59 ± 26.87
2	*J. sambac* Aiton L.	Malison	2607.73 ± 60.79	383.43 ± 15.19
3	*J. sambac* Aiton L.	Mali Chatphikun	1986.04 ± 136.70	503.51 ± 34.17
4	*J. sambac* Aiton L.	MaliThod	1384.80 ± 18.98	722.12 ± 4.74
5	*J. sambac* Aiton L.	Mali ChatDokbua	1816.24 ± 70.69	550.58 ± 17.67
6	*J. sambac* Aiton L.	Mali Chantaboon	1671.15 ± 63.76	597.06 ± 15.94
7	*J. multiflorum* (Burm. f.) Andr.	Maluli	1733.24 ± 34.19	577.30 ± 8.17
8	*J. multiflorum* (Burm. f.) Andr.	Maluli Sichomphu	2837.91 ± 61.67	352.33 ± 15.46
9	*J. multiflorum* (Burm. f.) Andr.	Maluli Phum	3321.69 ± 66.43	301.07 ± 16.47
10	*J. multiflorum* (Burm. f.) Andr.	Mali Ngachang	2236.44 ± 51.47	447.09 ± 13.04
11	*J. scandens* (Retz.) Vahl	Seao Phi	2493.86 ± 89.05	400.98 ± 22.26
12	*J. auriculatum* Vahl	Putthachat	1580.17 ± 40.44	632.27 ± 10.11
13	*J. adenophyllum* Wall	Maliwan	1522.35 ± 53.54	656.96 ± 13.83
14	*J cordatum* Ridl	Mali Chang	1767.02 ± 75.00	565.93 ± 18.75
15	*J. nobile* C. B. Clarke subsp. *rex* (Dunn)	Mali Punyi	1432.49 ± 40.02	689.09 ± 10.00
16	*J. nitidum* Skan	Mali Loung	1514.31 ± 109.54	660.36 ± 27.38
17	*J. siamense*	Mali Siam	1367.86 ± 58.51	731.06 ± 14.63
18	*J. elongatum* (Bergius) Willd	Mali Sai Kai	2185.11 ± 41.51	457.64 ± 10.37
19	*J. grandiflorum*	Mali Sathan	1927.82 ± 112.32	518.72 ± 28.08
20	*J. nervosum* Lour	Mali Khiao Ngu Lek	2232.57 ± 68.71	447.91 ± 17.18
21	*J. lanceolaria* Roxb.	Mali Wan Lek	1245.15 ± 74.47	803.11 ± 18.62
22	*J. coarctatum* Roxb.	Mali Burapha	2545.42 ± 118.18	392.86 ± 29.54
23	*J. funale* Decne. subsp. *sootepense* (Craib) P. S. Green	Mali Nok	1008.09 ± 37.75	979.01 ± 9.44
24	*J. humile* L.	Malilueang	901.11 ± 43.99	1109.73± 11.00

Table 6 The epidermal number and epidermal cell area of thirty investigated *Jasminum* accessions from three locations. (Mean ± SD, n = 90) (continue)

No	*Jasminum* accessions	Vernacular name	Epidermal Cell number/mm^2	Epidermal Cell area (μm^2)
25	*J. mesnyi*	Mali Moung Nhaw	2425.55 ± 75.46	412.28 ± 18.87
26	*J. fluminense* Vahl subsp. *gratissimum*	Putthachatloung	958.17 ± 54.40	1043.67± 13.60
27	*J. spp* 1	Malipa 1	1585.60 ± 54.50	630.68 ± 13.63
28	*J. spp* 2	Malipa 2	1884.97 ± 51.02	530.52 ± 12.76
29	*J. spp* 3	Malipa 3	1679.11 ± 108.21	595.55 ± 27.06
30	*J. spp* 4	Malipa 4	1356.66 ± 28.58	737.11 ± 7.14

The epidermal number and epidermal cell area of thirty investigated *Jasminum* accessions from three locations were shown **Table 6**. The range of epidermal cell number ranging between 901.11 ± 43.99 to 3321.69 ± 66.43 and *J. multiflorum* 'Mali Ngachang' showed the highest epidermal cell number (**Figure 20**). Among 6 *J. sambac* cultivars, Malithod had the highest value of epidermal number.

The epidermal cell area ranging from 301.07 ± 16.47 to 1109.73±11.00. *J. multiflorum* 'Mali Ngachang' had the lowest epidermal cell area (**Figure 21**) but had the highest epidermal cell number (**Figure 20**). The highest epidermal cell area was found in *J. humile*.

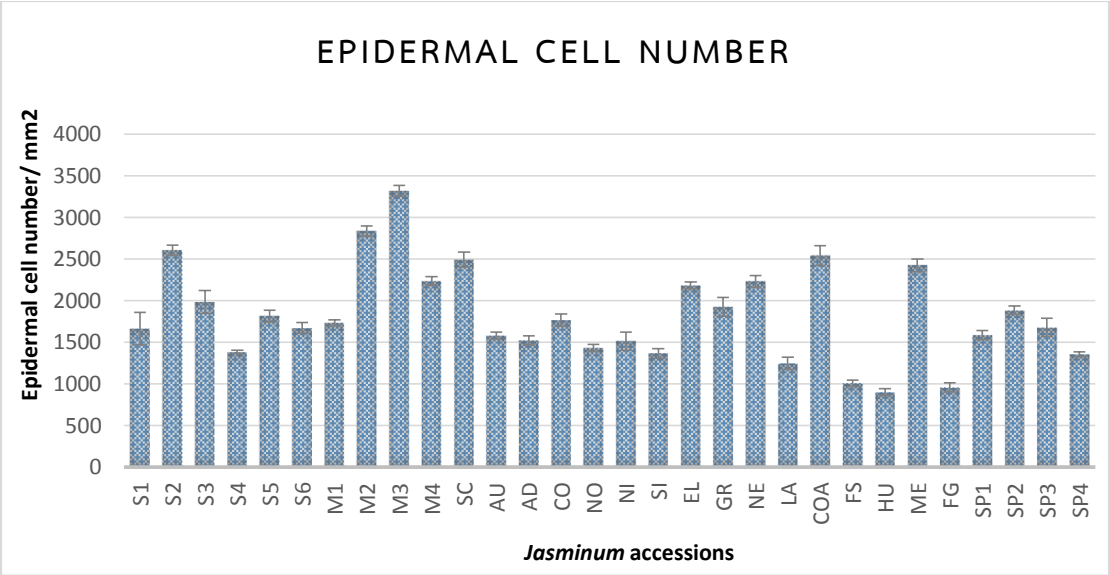


Figure 20 The epidermal cell number of thirty investigated *Jasminum* accessions from three locations

Abbreviations of the plant samples are according to the codes used in Table 5

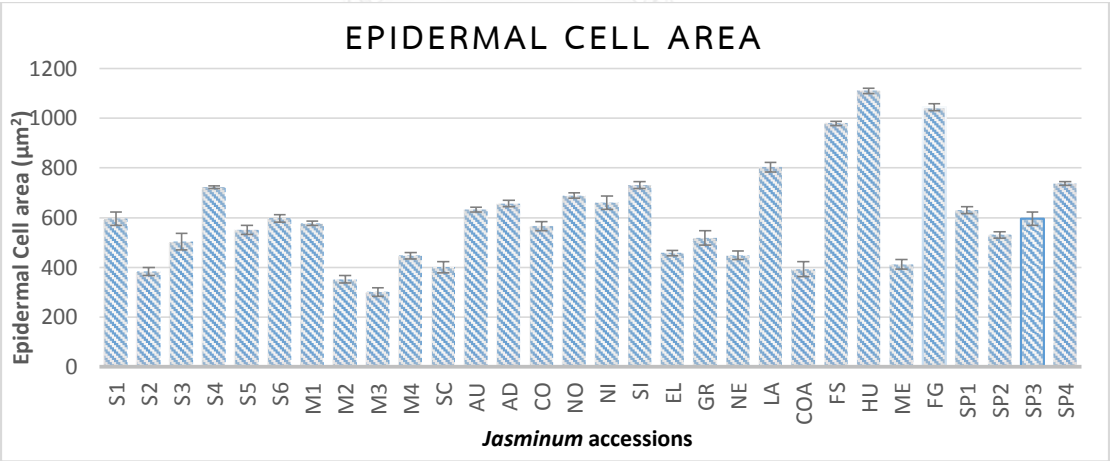


Figure 21 The epidermal cell area of thirty investigated *Jasminum* accessions from three locations

Abbreviations of the plant samples are according to the codes used in Table 5

Determination of palisade and palisade ratio

The image of four clear continuous epidermal cells consist of the round, closely packed palisade cells was observed (**Figure 22**) and recorded. The average measurement of palisade ratio values of thirty investigated *Jasminum* accessions from three locations were shown in **Table 7** and **Figure 23**.

The distribution of palisade ratio ranging from 1.62 ± 0.21 to 5.04 ± 0.38. *J. sambac* and *J. cordatum* Ridl had the high value of palisade ratio whereas *J. multiflorum* 'Maluli sichomphu' had the lowest palisade palisade ratio. Among 6 *J. sambac* cultivars, Malithod had the highest value of palisade ratio.

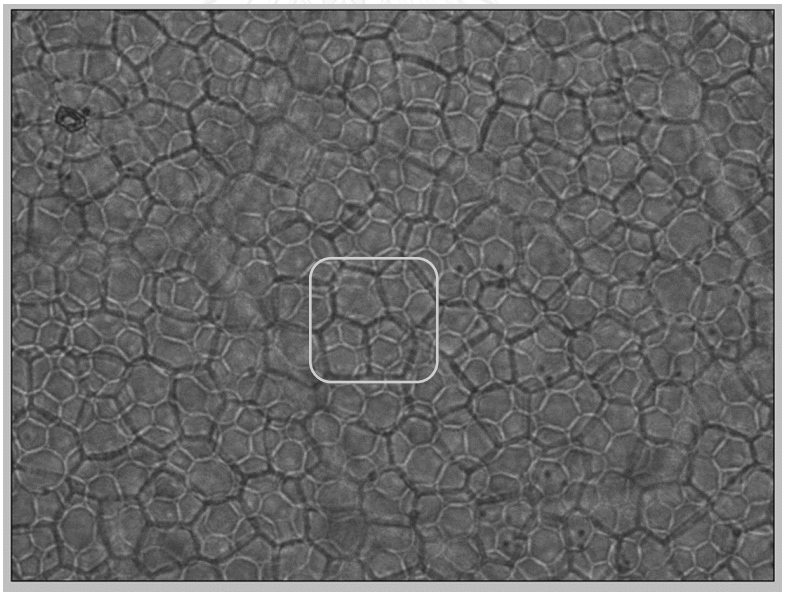


Figure 22 The round, closely packed palisade cells in the boundary of four clear continuous epidermal cells of *J. siamense* leaf with 40X magnification

Table 7 The average measurement of palisade ratio values of thirty investigated *Jasminum* accessions from three locations. (Mean ± SD, n = 90)

No	*Jasminum* accessions	Vernacular name	Palisade Ratio
1	*J. sambac* Aiton L.	Malila	3.41 ± 0.43
2	*J. sambac* Aiton L.	Malison	3.59 ± 0.29
3	*J. sambac* Aiton L.	Mali Chatphikun	3.44 ± 0.35
4	*J. sambac* Aiton L.	MaliThod	5.04 ± 0.38
5	*J. sambac* Aiton L.	Mali ChatDokbua	3.15 ± 0.33
6	*J. sambac* Aiton L.	Mali Chantaboon	3.43 ± 0.42
7	*J. multiflorum* (Burm. f.) Andr.	Maluli	1.69 ± 0.22
8	*J. multiflorum* (Burm. f.) Andr.	Maluli Sichomphu	1.62 ± 0.21
9	*J. multiflorum* (Burm. f.) Andr.	Maluli Phum	1.92 ± 0.22
10	*J. multiflorum* (Burm. f.) Andr.	Mali Ngachang	2.01 ± 0.14
11	*J. scandens* (Retz.) Vahl	Seao Phi	2.57 ± 0.24
12	*J. auriculatum* Vahl	Putthachat	2.60 ± 0.28
13	*J. adenophyllum* Wall	Maliwan	1.84 ± 0.18
14	*J cordatum* Ridl	Mali Chang	5.19 ± 0.59
15	*J. nobile* C. B. Clarke subsp. *rex* (Dunn)	Mali Punyi	1.93 ± 0.20
16	*J. nitidum* Skan	Mali Loung	3.00 ± 0.31
17	*J. siamense*	Mali Siam	3.57 ± 0.28
18	*J. elongatum* (Bergius) Willd	Mali Sai Kai	2.06 ± 0.16
19	*J. grandiflorum*	Mali Sathan	3.54 ± 0.84
20	*J. nervosum* Lour	Mali Khiao Ngu Lek	2.26 ± 0.27
21	*J. lanceolaria* Roxb	Mali Wan Lek	2.46 ± 0.29
22	*J. coarctatum* Roxb.	Mali Burapha	2.46 ± 0.37

Table 7 The average measurement of palisade ratio values of thirty investigated *Jasminum* accessions from three locations. (Mean ± SD, n = 90) (continue)

No	*Jasminum* accessions	Vernacular name	Palisade Ratio
23	*J. funale* Decne. subsp. s*ootepense* (Craib) P. S. Green	Mali Nok	4.18 ± 0.40
24	*J. humile* L.	Malilueang	2.78 ± 0.31
25	*J. mesnyi*	Mali Moung Nhaw	2.13 ± 0.24
26	*J. fluminense* Vahl subsp. *gratissimum*	Putthachatloung	2.16 ± 0.21
27	*J. sp.* 1	Malipa 1	3.35 ± 0.23
28	*J. sp.* 2	Malipa 2	2.02 ± 0.25
29	*J. sp.* 3	Malipa 3	3.07 ± 0.82
30	*J. sp.* 4	Malipa 4	3.51 ± 0.43

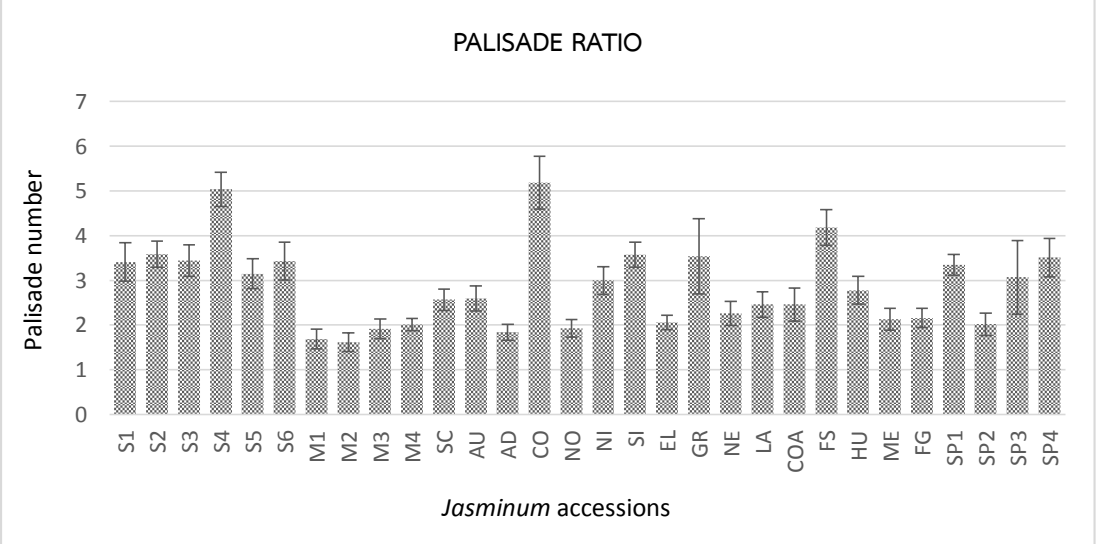


Figure 23 The constant of palisade ratio values of thirty investigated *Jasminum* accessions from three locations

Abbreviations of the plant samples are according to the codes used in Table 5

Determination of vein termination number and vein islet number

The average measurement of vein termination number and vein islet number of thirty investigated *Jasminum* accessions from three locations were shown in **Table 8**. The vein termination number (**Figure 24**) ranging from 3.33 ± 1.63 to 14.11 ± 2.26. *J. multiflorum* 'Mali Ngachang' had the highest vein termination number whereas *J. humile* (**Figure 25**) had the lowest value.

The average vein islet number (**Figure 26**) was shown in **Table 8**. The distribution of vein termination number and vein islet number of thirty investigated *Jasminum* accessions were shown in **Figure 27** and **28** respectively. The vein islets number ranging from 2.30 ± 1.00 to 11.40 ± 2.33. *J. auriculatum* had the highest vein-islet number whereas *J. nervosum* had the lowest value.

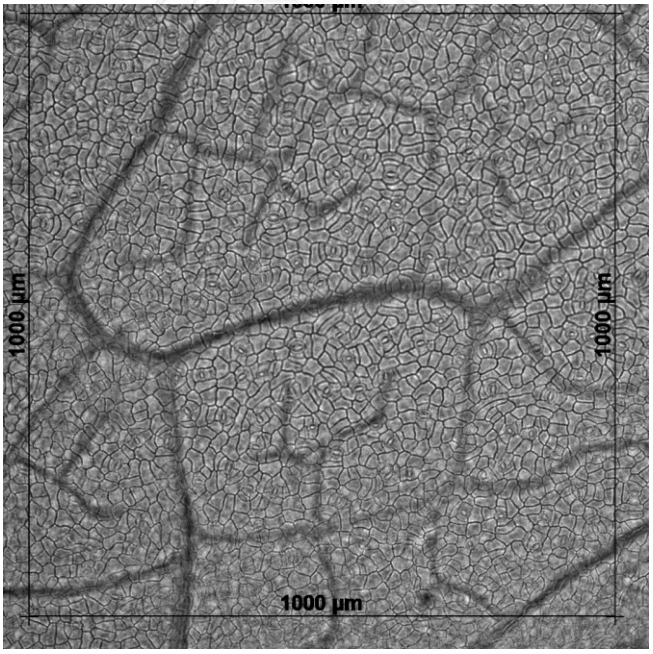


Figure 24 The vein termination number of *J. fluminense* Vahl subsp. *gratissimum* leaf with 10X magnification

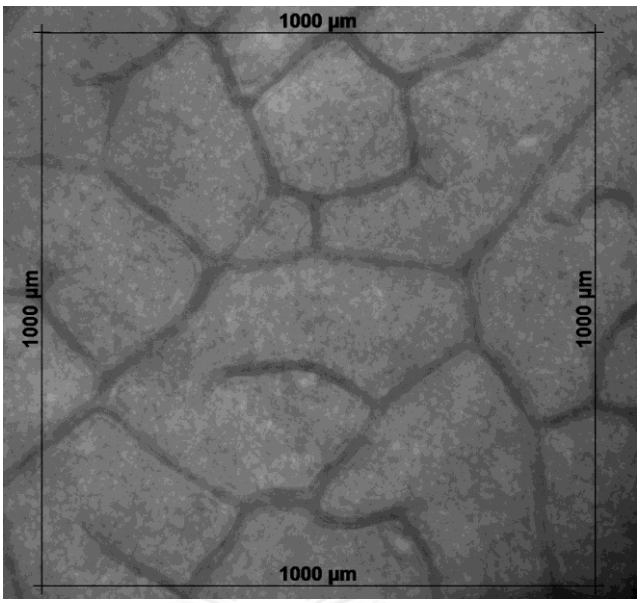


Figure 25 The vein termination number of *J. humile* L. leaf with 10X magnification

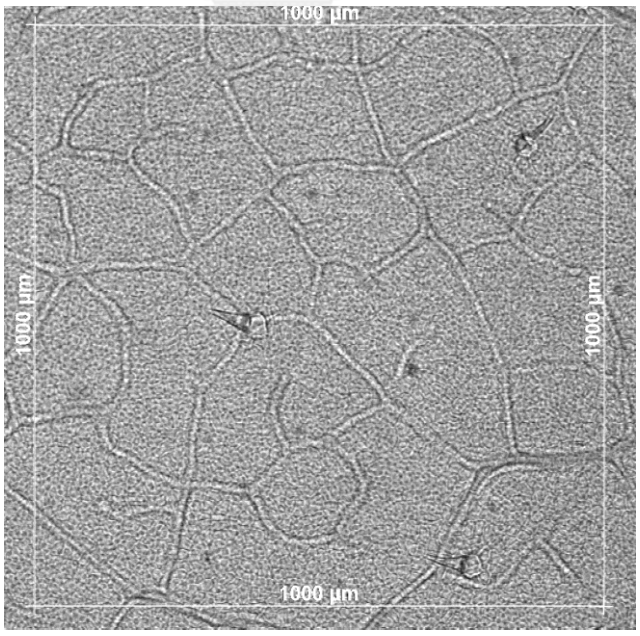


Figure 26 The vein islets number of *J. grandiflorum* Linn leaf with 10X magnification

Table 8 The average measurement of vein termination number and vein islet number of thirty investigated *Jasminum* accessions from three locations. (Mean ± SD, n = 90)

No	*Jasminum* accessions	Vernacular name	Vein termination number/ mm^2	Vein islets number/ mm^2
1	*J. sambac* Aiton L.	Malila	8.43 ± 2.33	4.73 ± 1.29
2	*J. sambac* Aiton L.	Malison	12.82 ± 1.36	5.73 ± 1.02
3	*J. sambac* Aiton L.	Mali Chatphikun	8.10 ± 1.84	3.01 ± 1.19
4	*J. sambac* Aiton L.	MaliThod	6.03 ± 1.28	4.36 ± 1.04
5	*J. sambac* Aiton L.	Mali ChatDokbua	7.97 ± 1.74	4.68 ± 1.16
6	*J. sambac* Aiton L.	Mali Chantaboon	9.49 ± 2.32	3.28 ± 1.71
7	*J. multiflorum* (Burm. f.) Andr.	Maluli	4.76 ± 1.24	4.36 ± 1.06
8	*J. multiflorum* (Burm. f.) Andr.	Maluli Sichomphu	11.90 ± 1.87	6.70 ± 0.94
9	*J. multiflorum* (Burm. f.) Andr.	Maluli Phum	7.55 ± 2.01	3.42 ± 1.12
10	*J. multiflorum* (Burm. f.) Andr.	Mali Ngachang	14.11 ± 2.26	6.82 ± 1.41
11	*J. scandens* (Retz.) Vahl	Seao Phi	11.96 ± 3.32	7.46 ± 2.50
12	*J. auriculatum* Vahl	Putthachat	11.20 ± 1.52	11.40 ± 2.33
13	*J. adenophyllum* Wall	Maliwan	4.30 ± 1.00	3.65 ± 1.06
14	*J cordatum* Ridl	Mali Chang	3.97 ± 1.29	3.26 ± 1.29
15	*J. nobile* C. B. Clarke subsp. *rex* (Dunn)	Mali Punyi	6.52 ± 3.72	5.79 ± 4.24
16	*J. nitidum* Skan	Mali Loung	9.71 ± 1.60	5.79 ± 0.98
17	*J. siamense*	Mali Siam	3.59 ± 1.14	2.84 ± 0.71
18	*J. elongatum* (Bergius) Willd	Mali Sai Kai	8.35 ± 0.97	4.82 ± 0.73
19	*J. grandiflorum*	Mali Sathan	7.90 ± 1.35	10.17 ± 3.44
20	*J. nervosum* Lour	Mali Khiao Ngu Lek	7.20 ± 1.44	2.30 ± 1.00
21	*J. lanceolaria* Roxb	Mali Wan Lek	8.15 ± 1.80	4.38 ± 1.27
22	*J. coarctatum* Roxb.	Mali Burapha	4.33 ± 1.17	3.25 ± 1.00
23	*J. funale* Decne. subsp. *sootepense* (Craib) P. S. Green	Mali Nok	6.38 ± 1.76	2.38 ± 0.91
24	*J. humile* L.	Malilueang	3.33 ± 1.63	5.21 ± 1.39

Table 8 The average measurement of vein termination number and vein islet number of thirty investigated *Jasminum* accessions from three locations. (Mean ± SD, n = 90) (Continue)

No	*Jasminum* accessions	Vernacular name	Vein termination number/ mm^2	Vein islets number/ mm^2
25	*J. mesnyi*	Mali Moung Nhaw	5.33 ± 1.35	5.10 ± 1.77
26	*J. fluminense* Vahl subsp. *gratissimum*	Putthachatloung	8.44 ± 1.42	4.62 ± 1.19
27	*J. sp.* 1	Malipa 1	9.84 ± 1.88	4.83 ± 1.58
28	*J. sp.* 2	Malipa 2	8.56 ± 1.79	5.45 ± 1.72
29	*J. sp.* 3	Malipa 3	7.03 ± 1.60	5.03 ± 1.24
30	*J. sp.* 4	Malipa 4	4.97 ± 1.52	2.69 ± 0.97

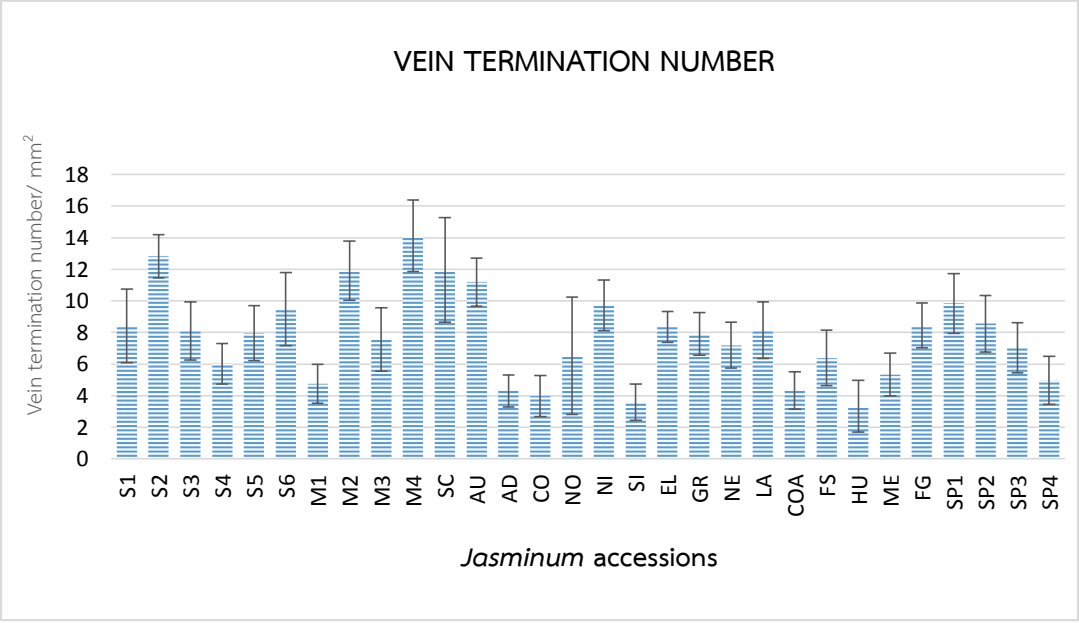


Figure 27 The constant vein termination number of thirty investigated *Jasminum* accessions from three locations

Abbreviations of the plant samples are according to the codes used in Table 5

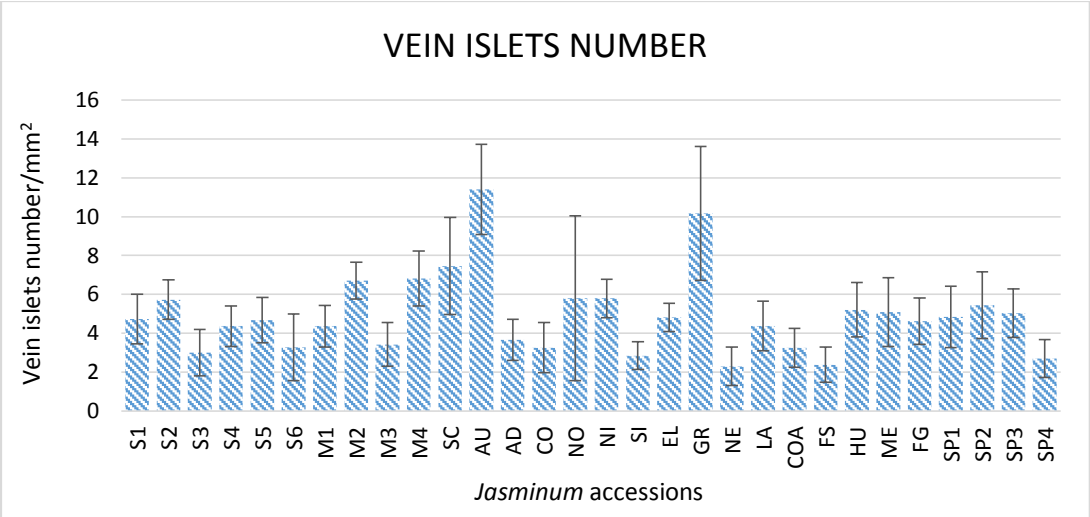


Figure 28 The constant of vein islets number of thirty investigated *Jasminum* accessions from three locations

Abbreviations of the plant samples are according to the codes used in Table 5

Determination of stomatal type, stomatal number and stomatal index

The stomata in all *Jasminum* species was classified as the anisocytic stomata type which markedly small than the other (**Figure 29**).

The average measurement of stomatal number and stomatal index values of thirty investigated *Jasminum* accessions from three locations were shown in **Table 9**.

J. funale Decne. subsp. *sootepense* (Craib) P. S. Green (**Figure 30**) and *J. fluminense* Vahl subsp. *gratissimum* (**Figure 31**) shown the stomata on adaxial and abaxial leaves whereas the 28 remaining *Jasminum* accessions shown the stomata only on abaxial leaves. The distribution of stomatal number and stomatal index of 30 investigated *Jasminum* accessions had shown in **Figure 32** and **33**. The highest stomatal number (575.27 ± 25.61) was found in *J. coartatum* whereas the lowest stomatal number (21.26 ± 9.75) was found in *J. fluminense* Vahl subsp. *gratissimum*. The highest stomatal index (17.71 ± 2.25) was found in *J. funale* Decne. subsp. *sootepense* (Craib) P. S. Green whereas the lowest stomatal number (8.01 ± 1.17) was found in *J. sp* 3.

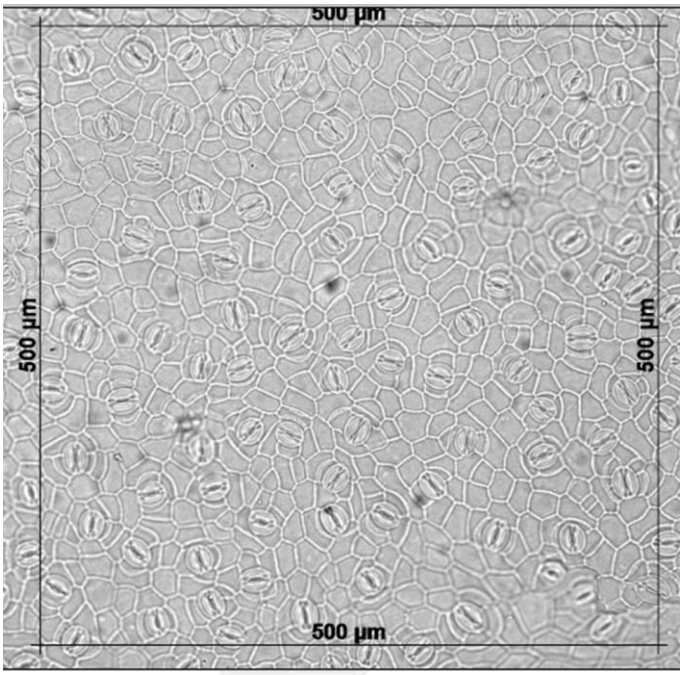
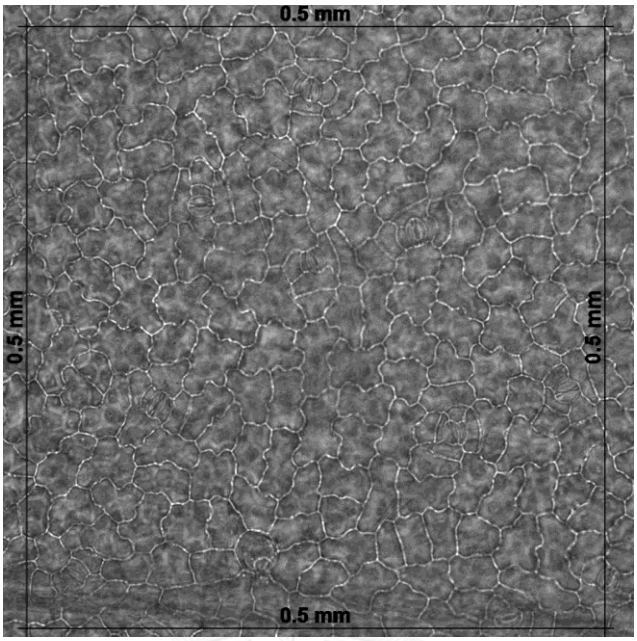
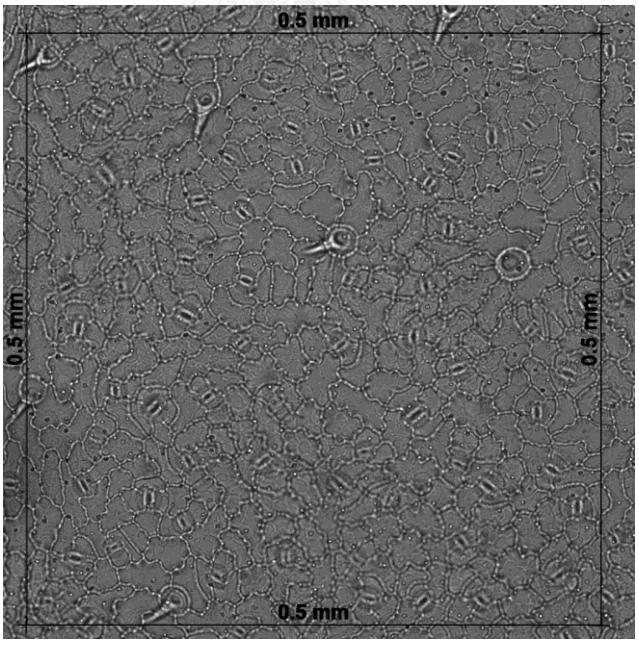


Figure 29 The anisocytic stomata type of *J. scandens* leaf with 20X magnification

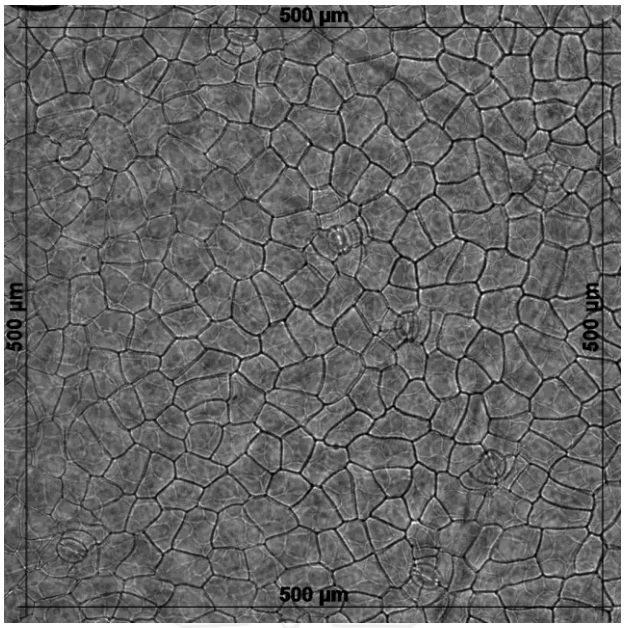


a

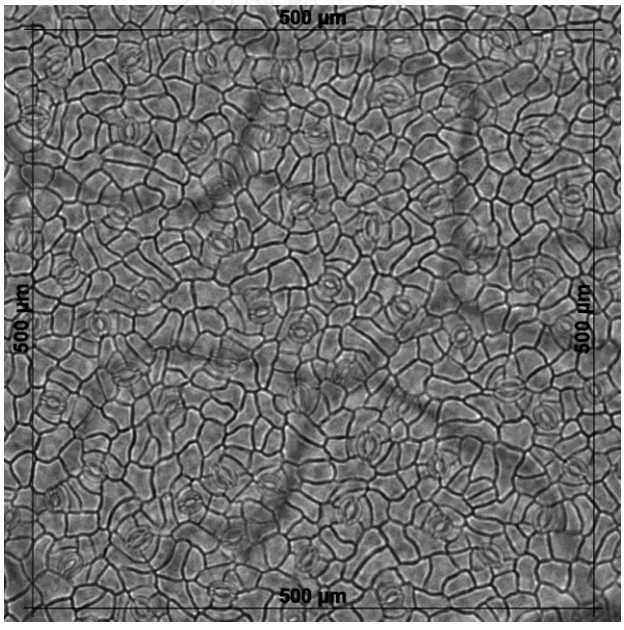


b

Figure 30 Stomata of the leaf of *J. funale* Decne. subsp. *sootepense* (Craib) P. S. Green with 20X magnification (a. adaxial and b. abaxial)



a



b

Figure 31 Stomata of the leaf of *J. fluminense* Vahl subsp. *gratissimum* with 20X magnification (a. adaxial and b. abaxial)

Table 9 The average measurement of stomatal number and stomatal index values of thirty investigated *Jasminum* accessions from three locations. (Mean ± SD, n = 90)

No	*Jasminum* accessions	Vernacular name	Stomatal Number /mm^2		Stomatal Index (%)	
			Adaxial	Abaxial	Adaxial	Abaxial
1	*J. sambac* Aiton L.	Malila	NF	345.47 ± 25.89	NF	11.79 ± 0.88
2	*J. sambac* Aiton L.	Malison	NF	434.53 ± 13.31	NF	10.99 ± 0.31
3	*J. sambac* Aiton L.	Mali Chatphikun	NF	320.58 ± 30.64	NF	9.72 ± 0.82
4	*J. sambac* Aiton L.	MaliThod	NF	247.86 ± 16.98	NF	9.54 ± 0.64
5	*J. sambac* Aiton L.	Mali ChatDokbua	NF	407.07 ± 39.29	NF	12.70 ± 1.01
6	*J. sambac* Aiton L.	Mali Chantaboon	NF	358.04 ± 37.97	NF	11.07 ± 1.30
7	*J. multiflorum* (Burm. f.) Andr.	Maluli	NF	382.57 ± 22.53	NF	11.07 ± 0.79
8	*J. multiflorum* (Burm. f.) Andr.	Maluli Sichomphu	NF	459.15 ± 51.74	NF	11.94 ± 1.32
9	*J. multiflorum* (Burm. f.) Andr.	Maluli Phum	NF	404.66 ± 36.83	NF	10.18 ± 0.65
10	*J. multiflorum* (Burm .f.) Andr.	Mali Ngachang	NF	350.53 ± 21.70	NF	11.37 ± 0.75
11	*J. scandens* (Retz.) Vahl	Seao Phi	NF	400.57 ± 41.17	NF	9.43 ± 0.61
12	*J. auriculatum* Vahl	Putthachat	NF	364.17 ± 44.73	NF	12.69 ± 1.48
13	*J. adenophyllum* Wall	Maliwan	NF	242.17 ± 26.06	NF	8.67 ± 0.78
14	*J cordatum* Ridl	Mali Chang	NF	210.27 ± 23.75	NF	9.54 ± 0.95
15	*J. nobile* C. B. Clarke subsp. *rex* (Dunn)	Mali Punyi	NF	258.89 ± 19.23	NF	11.58 ± 0.80
16	*J. nitidum* Skan	Mali Loung	NF	375.02 ± 19.55	NF	10.42 ± 0.72
17	*J. siamense*	Mali Siam	NF	202.35 ± 13.56	NF	12.20 ± 0.97
18	*J. elongatum* (Bergius) Willd	Mali Sai Kai	NF	501.15 ± 42.67	NF	15.22 ± 3.91
19	*J. grandiflorum*	Mali Sathan	NF	345.91 ± 25.04	NF	12.91 ± 0.69
20	*J. nervosum* Lour	Mali Khiao Ngu Lek	NF	364.00 ± 21.33	NF	11.40 ± 0.48

Table 9 The average measurement of stomatal number and stomatal index values of thirty investigated *Jasminum* accessions from three locations. (Mean ± SD, n = 90) (continue)

No	*Jasminum* accessions	Vernacular name	Stomatal Number /mm^2		Stomatal Index (%)	
			Adaxial	Abaxial	Adaxial	Abaxial
21	*J. lanceolaria* Roxb	Mali Wan Lek	NF	336.00 ± 29.63	NF	11.97 ± 1.47
22	*J. coarctatum* Roxb.	Mali Burapha	NF	575.27 ± 25.61	NF	14.16 ± 0.77
23	*J. funale* Decne. subsp. *sootepense* (Craib) P. S. Green	Mali Nok	64.40 ± 4.07	193.2 ± 64.40	5.94 ± 0.36	17.71 ± 2.25
24	*J. humile* L.	Malilueang	NF	219.24 ± 15.39	NF	17.03 ± 1.86
25	*J. mesnyi*	Mali Moung Nhaw	NF	268.89 ± 18.71	NF	11.39 ± 0.74
26	*J. fluminense* Vahl subsp. *gratissimum*	Putthachatloung	5.27 ± 2.44	21.26 ± 9.75	2.13 ± 0.94	10.90 ± 0.94
27	*J. sp.* 1	Malipa 1	NF	286.71 ± 34.53	NF	9.84 ± 1.08
28	*J. sp.* 2	Malipa 2	NF	309.86 ± 16.00	NF	12.76 ± 0.61
29	*J. sp.* 3	Malipa 3	NF	194.53 ± 34.70	NF	8.01 ± 1.17
30	*J. sp.* 4	Malipa 4	NF	214.57 ± 24.30	NF	11.15 ± 1.31

Remark: NF= Not Found

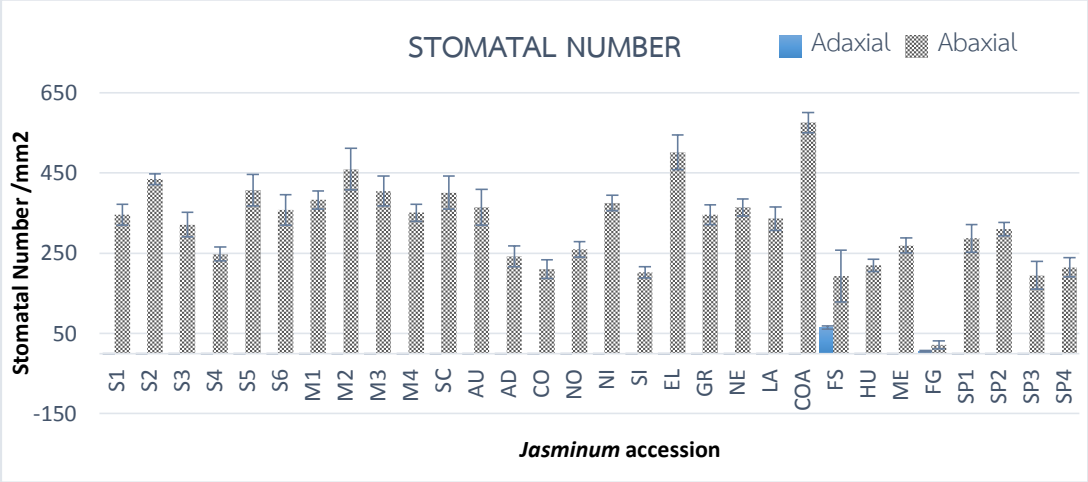


Figure 32 The constant of stomatal number values of thirty investigated *Jasminum* accessions from three locations

Abbreviations of the plant samples are according to the codes used in Table 5

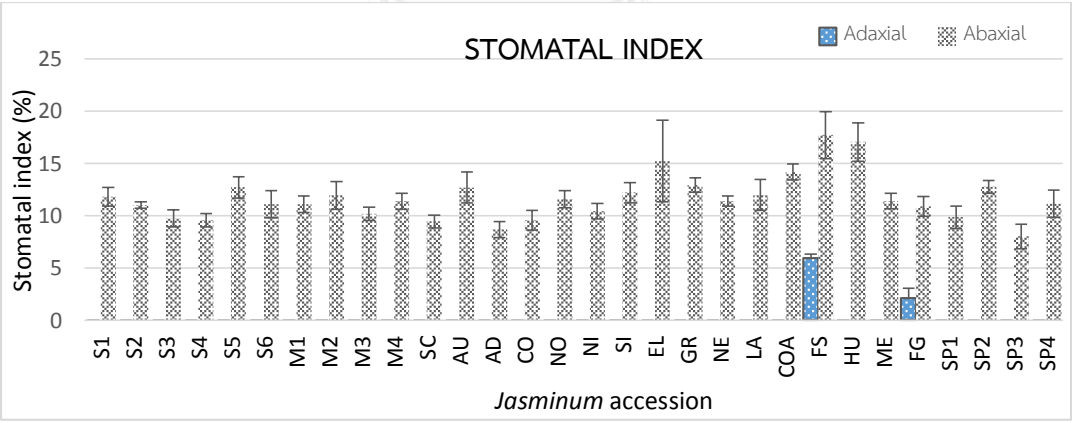


Figure 33 The constant of stomatal index values of thirty investigated *Jasminum* accessions from three locations.

Abbreviations of the plant samples are according to the codes used in Table 5

The summarized of the microscopic characteristics diagram was shown in **Figure 34**.

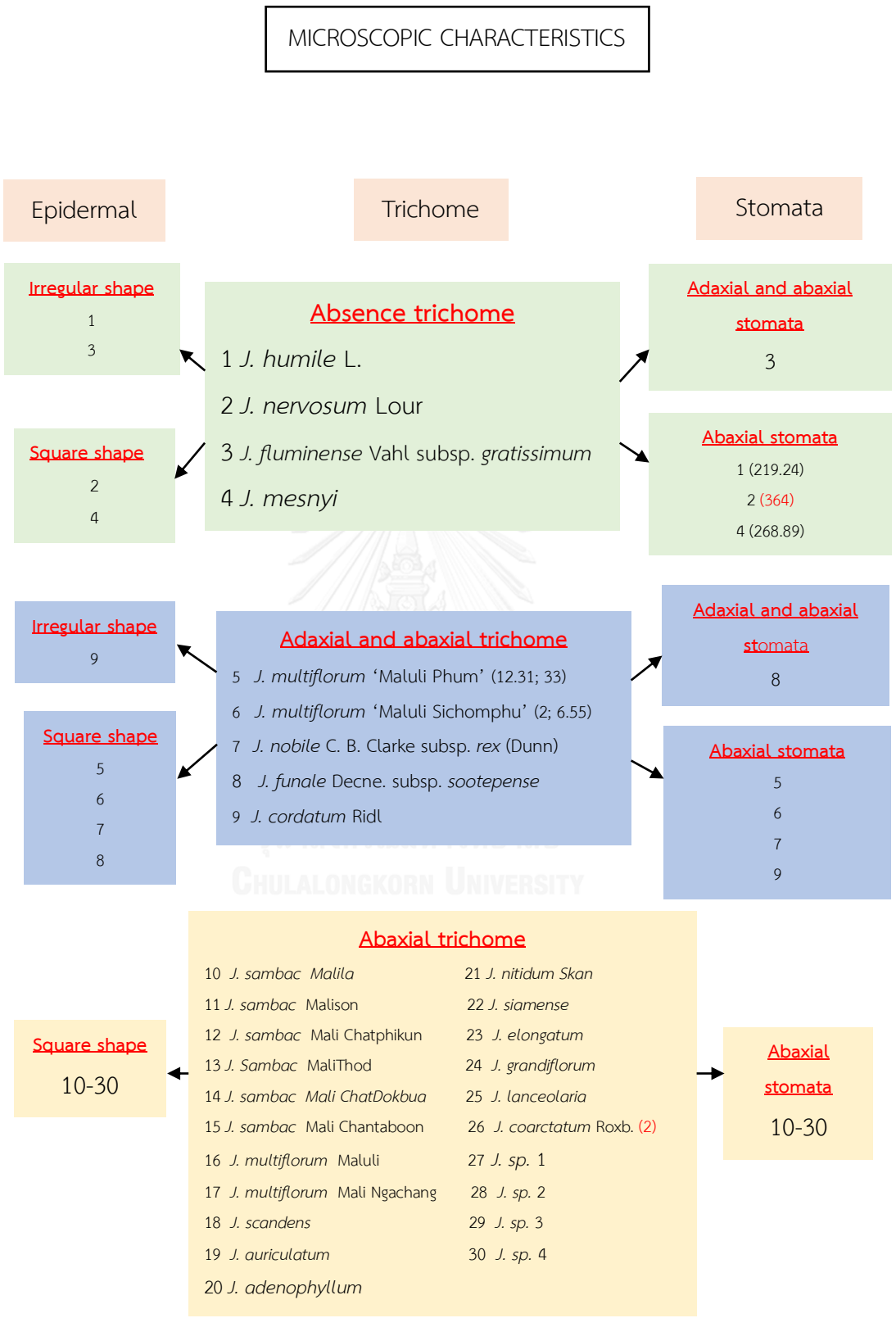


Figure 34 The microscopic characteristics diagram

Part II. Molecular evaluation

3.1 DNA extraction

The quantity of extracted DNA was estimated by comparing the band intensity of the extracted DNA with 1 kb DNA ladder marker (Fermentas, USA) in 1.5% agarose gel. Electrophoresis was carried out at 100 V for 30 min or until the loading dye migrate to two third of the gel. Stained with ethidium bromide for 15 min and then destained in water for 10 min. The gel was photographed under UV light using UV transilluminator gel documentation system (**Figure 35**).

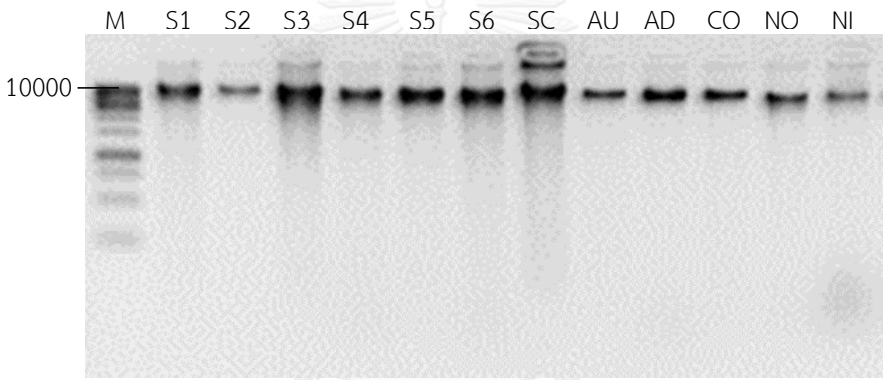


Figure 35 Agarose gel electrophoresis of genomic DNA from selected *Jasminum* accesions

Lane M: 1 kb GeneRuler, Fermentas, USA (size shown in bp)

Abbreviations of the plant samples are according to the codes used in Table 3

3.2 Random Amplification Polymorphic DNA (RAPD) analysis

The PCR reaction step of RAPD was first investigated and optimized because it could affect the pattern and the consistency of PCR products. The volume of genomic DNA was varied from 1 to 3 µl (**Figure 36**). The concentration of magnesium chloride varied from 2 to 5 mM and the optimum magnesium concentration was 4 mM (**Figure 37**).

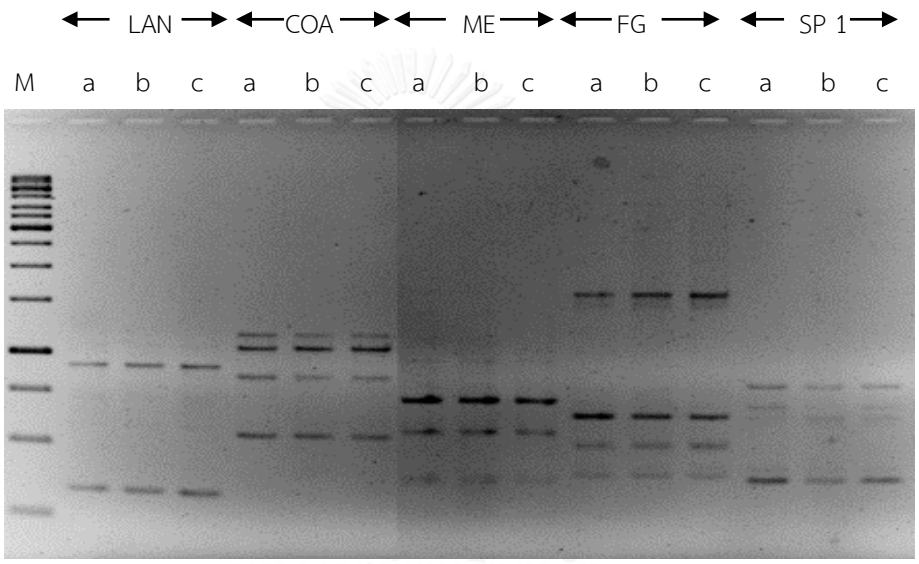


Figure 36 Variation of genomic DNA concentration using primer A25

Abbreviations of the plant samples, LAN: *J. lanceolaria*,

COA: *J. coartatum*, ME: *J. mesnyi*,

FG: *J. fluminense* Vahl subsp. *gratissimum* and SP1: *J. spp* 1

Lane M: 1 kb GeneRuler, Fermentas, USA

Lane a = 1 µl, b = 2 µl and c = 3 µl of genomic DNA

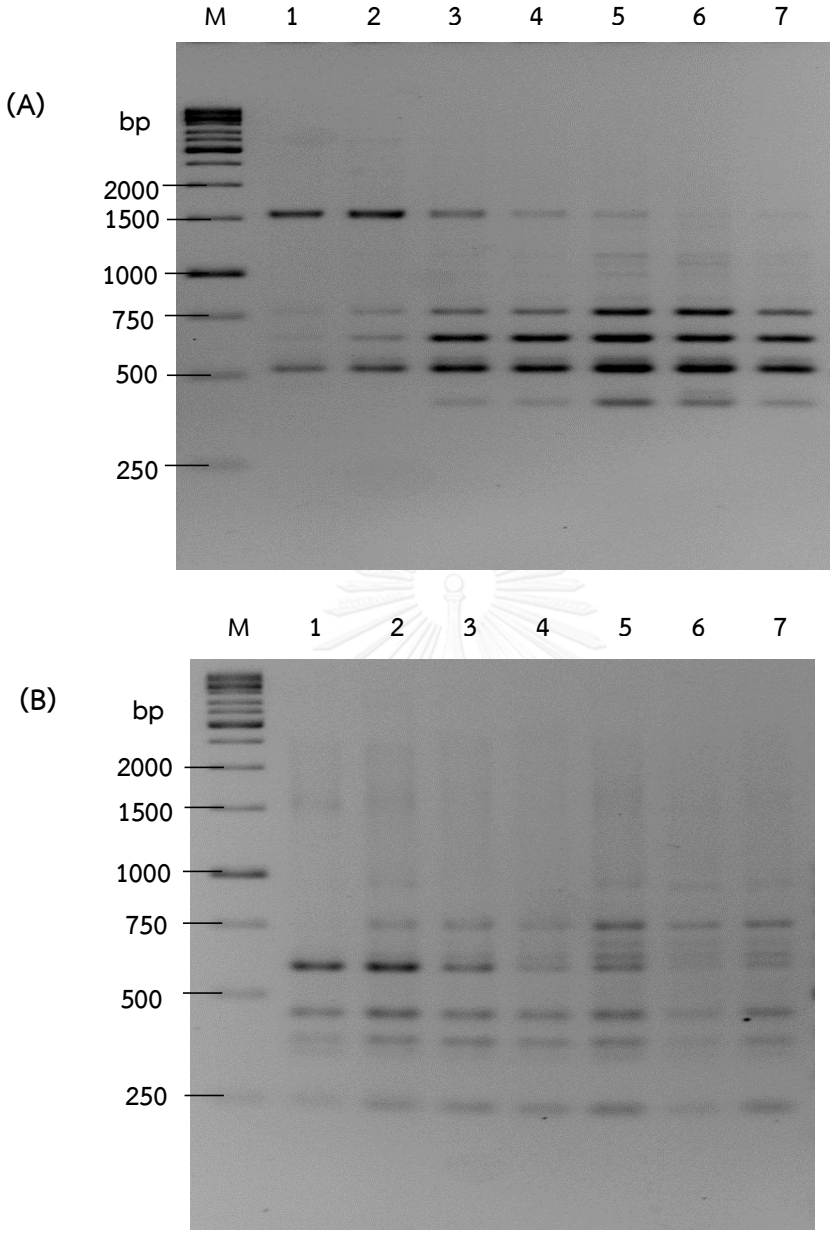


Figure 37 Variation of $MgCL^{2+}$ concentration (A) RAPD patterns of *J. adenophyllum* using primer F29 (B) RAPD patterns of *J. sambac* 'Malila' using primer A29

Lane M: 1 kb GeneRuler, Fermentas, USA

Lane 1-7: 2.0 mM, 2.5 mM, 3 mM, 3,5 mM, 4 mM, 4.5 mM, and 5 mM $MgCl^{2+}$

Random Amplification Polymorphic DNA (RAPD)

RAPD analysis

Sixty random primers were used for PCR amplification screened. Only ten primer (OPA-20, OPB-05, OPC-02, OPC-15, OPD-07, OPF-04, OPL-07 OPL-08, RAPD A-29, and RAPD F-25,) produced clear and reproducible polymorphic bands in all plants samples. Fourteen to thirty-two PCR products were amplified, with an average 21.7 bands by each primer. The highest number of RAPD bands (32 bands) was generated from OPL-08 while the lowest (14 bands) was from OPB-05. A total of 217 amplified bands were amplified ranging from 170 to 2020 bp 155 polymorphic bands were observed. Primer OPB-05 produced the highest percentage of polymorphism (78.57%) while OPC-15 produced the lowest (61.90%) (**Table 10**).

The RAPD fingerprint of 30 *Jasminum* accessions were shown in **Figure 38-47**. The pair-wise comparisons of the RAPD profiles based on both the shared and unique amplification bands were used to generate a similarity index. Among 30 *Jasminum* accessions including outgroup plants, Dice similarity index ranged from 0.022 to 0.477 (**Table 11**). The hightest genetic similarity index (0.477) was found between *J. sambac* 'Malila' and 'Malison' whereas, the lowest similarity index (0.022) was found between *J. fluminense* subsp. *gratissimum* and *P. jasminoides.*

A dendrogram was constructed according to the UPGMA cluster analysis using Dice similarity coefficient. The UPGMA dendrogram of the 30 *Jasminum* accessions can be divided into three clusters (**Figure 48**). Cluster I, consists of 6 *J. sambac* Aiton L. (Mali Son, Malila, MaliThod, Mali Chat Dokbua, Mali Chat Phikun and Mali Chantaboon), *J. coarctatum* and *J. grandiflorum* with 0.057-0.477 similarity index. Cluster II includes eleven accessions of 4 *J. multiflorum* (Maluli, Maluli Sichomphu, Mali Ngachang and Maluli Phum), *J. auriculatum*, *J. elongatum*, *J. nitidum J. nobile* subsp. *rex*, *J. adenophyllum*, *Jasminum* sp 3 and *Jasminum* sp 4 with 0.026-0.307 similarity index. Cluster III includes eleven accessions of *J. scandens*, *J. siamense, Jasminum* sp 1, *J. fluminense* subsp. *gratissimum, J. funale* subsp. *sootepense, J. mesnyi*, *J. cordatum*,

J. humile, *Jasminum* sp 2, *J. lanceolaria* and *J. nervosum* with 0.022-0.354 similarity index. Outgroup plant was completely separated from the *Jasminum* species (**Figure 48**).

Table 10 The sequence of the oligonucleotide primers used for the RAPD analysis and the number of PCR products obtained from *Jasminum* accessions and outgroup plant

Primer	Nucleotide sequence (5' to 3')	No. of bands	Size of bands	No. of Polymorphic bands	Polymorphism (%)
OPA-20	GTTGCGATCC	20	288-2020	14	70.00
OPB-05	TGCGCCCTTC	14	529-1634	11	78.57
OPC-02	GTGAGGCGTC	18	333-1811	14	77.77
OPC-15	GACGGATCAG	21	223-1691	13	61.90
OPD-07	TTGGCACGGG	21	226-1828	14	66.66
OPF-04	GGTGATCAGG	28	170-1851	20	71.43
OPL-07	AGGCGGGAAC	25	390-1424	17	68.00
OPL-08	AGCAGGTGGA	32	275-2020	24	75.00
RAPD A-29	GGTTCGGGAATG	17	314-1555	13	76.47
RAPD F-25	CCAGATCCGAAT	21	216-1640	15	71.43
Total		217		155	

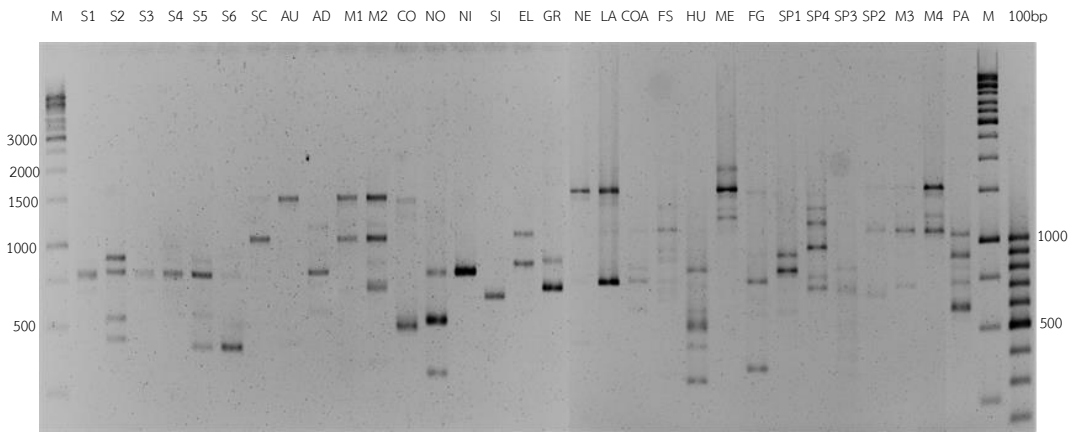


Figure 38 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPA-20 primer

Abbreviations of the plant samples are according to the codes used in Table 3

Lane M: 1 kb GeneRuler, Fermentas, USA

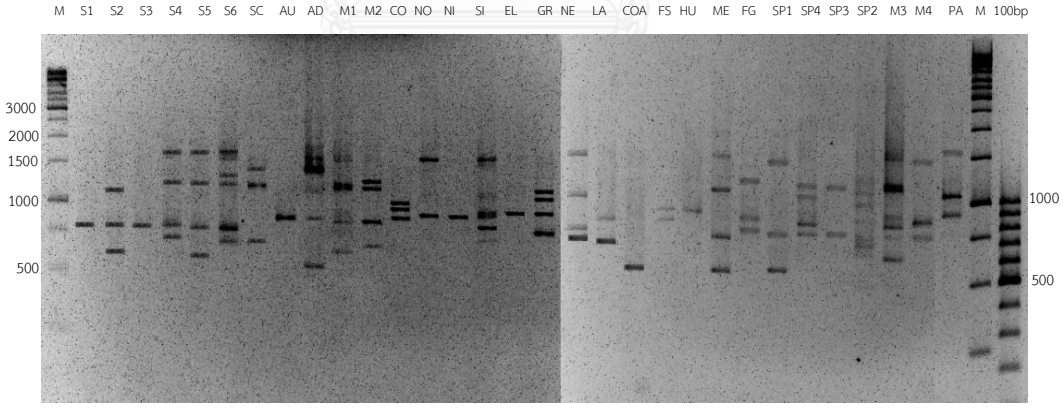


Figure 39 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPB-05 primer

Abbreviations of the plant samples are according to the codes used in Table 3

Lane M: 1 kb GeneRuler, Fermentas, USA

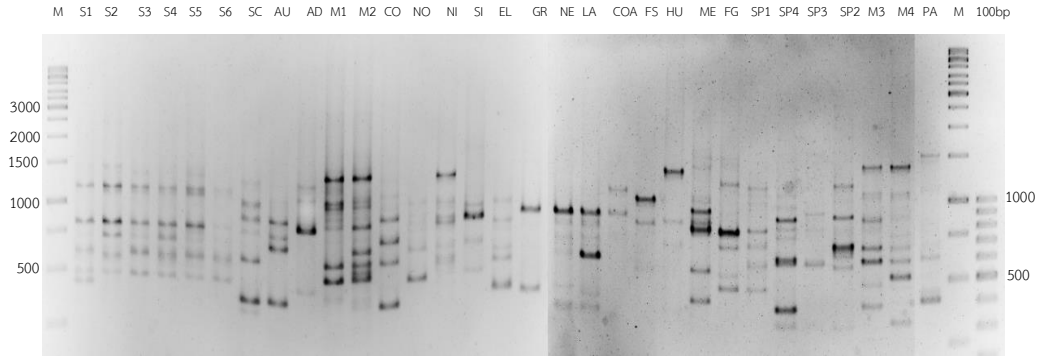


Figure 40 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPC-02 primer

Abbreviations of the plant samples are according to the codes used in Table 3

Lane M: 1 kb GeneRuler, Fermentas, USA

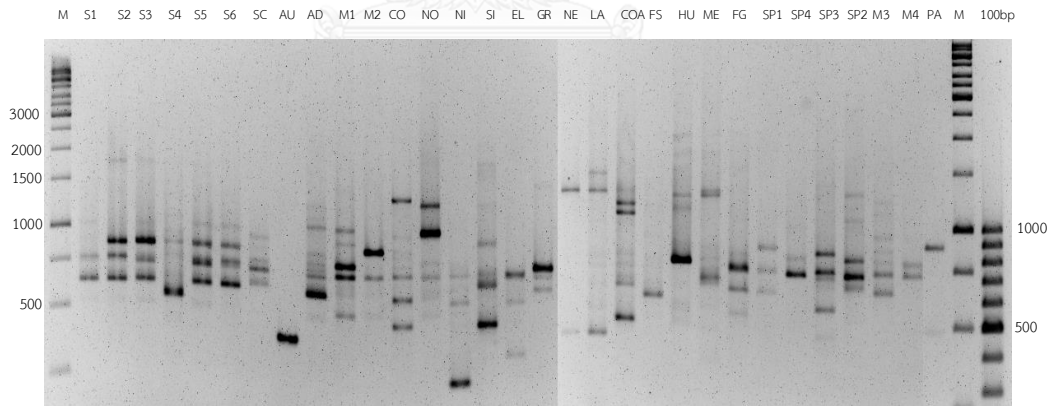


Figure 41 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPC-15 primer

Abbreviations of the plant samples are according to the codes used in Table 3

Lane M: 1 kb GeneRuler, Fermentas, USA

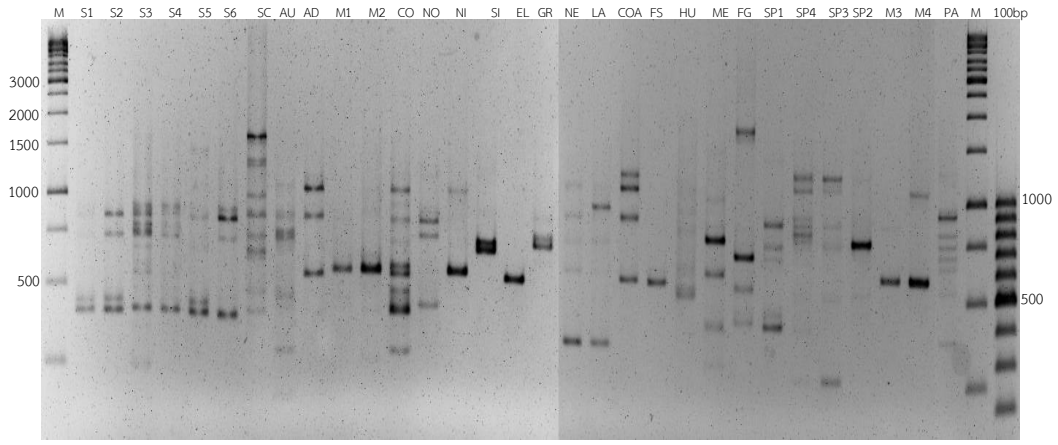


Figure 42 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPD-07 primer

Abbreviations of the plant samples are according to the codes used in Table 3Lane M: 1 kb GeneRuler, Fermentas, USA

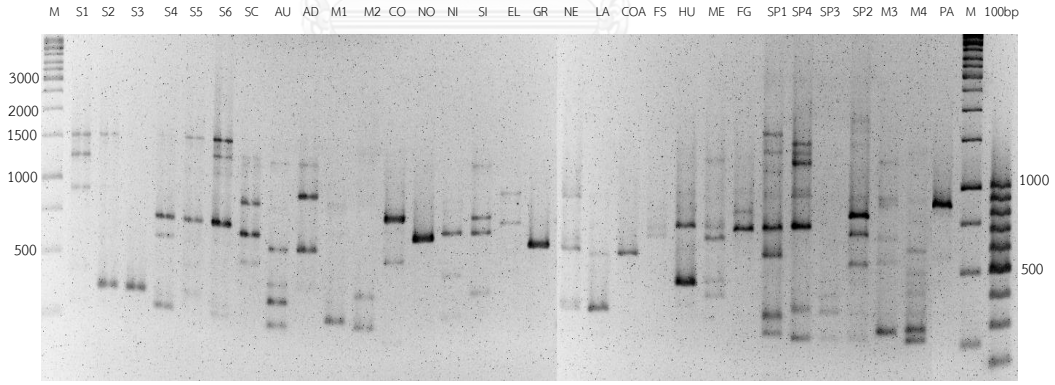


Figure 43 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPF-04 primer

Abbreviations of the plant samples are according to the codes used in Table 3

Lane M: 1 kb GeneRuler, Fermentas, USA

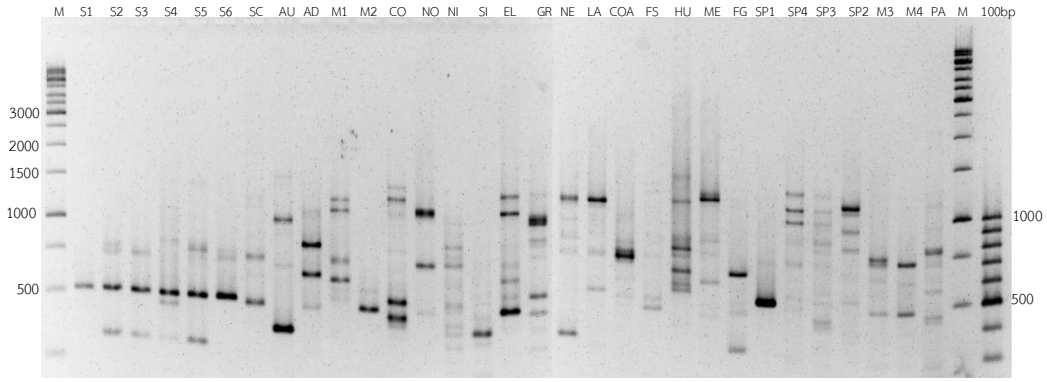


Figure 44 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPL-07 primer

Abbreviations of the plant samples are according to the codes used in Table 3

Lane M: 1 kb GeneRuler, Fermentas, USA

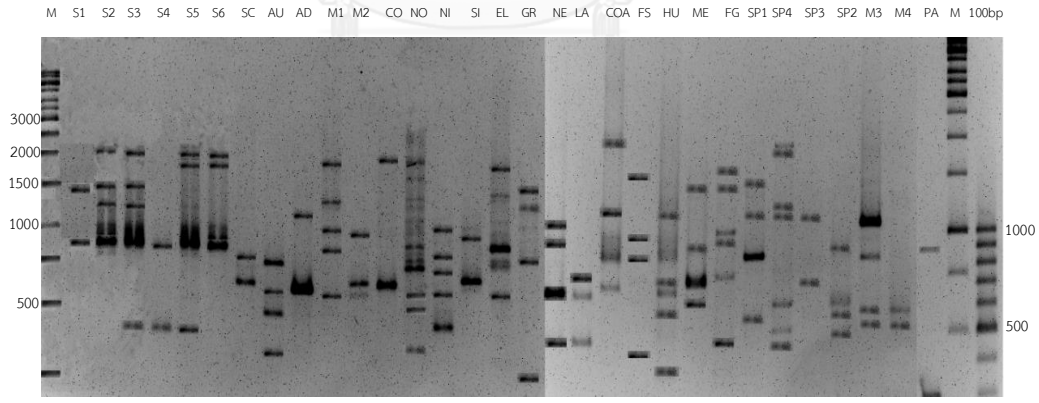


Figure 45 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the OPL-08 primer

Abbreviations of the plant samples are according to the codes used in Table 3

Lane M: 1 kb GeneRuler, Fermentas, USA

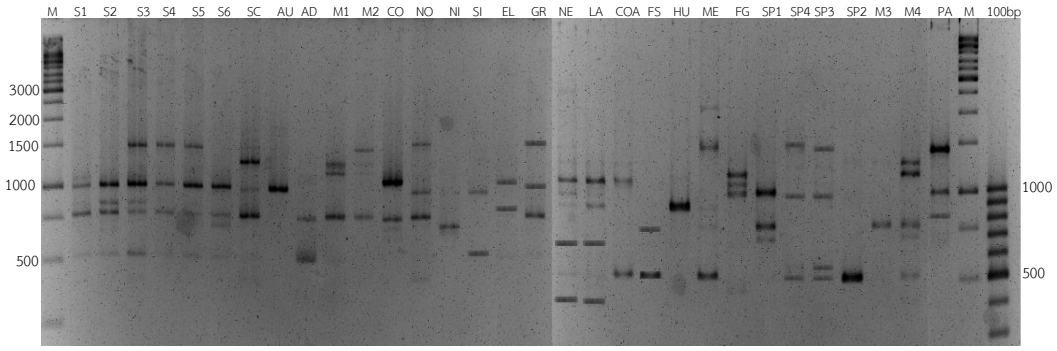


Figure 46 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the RAPD A-29 primer

Abbreviations of the plant samples are according to the codes used in Table 3

Lane M: 1 kb GeneRuler, Fermentas, USA

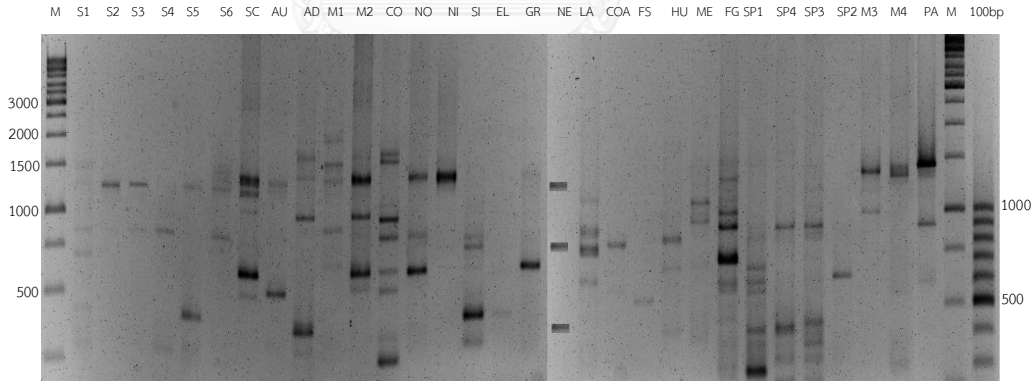


Figure 47 RAPD fingerprint of 30 *Jasminum* accessions and out group plant obtained from the RAPD F-25 primer

Abbreviations of the plant samples are according to the codes used in Table 3

Lane M: 1 kb GeneRuler, Fermentas, USA

Table 11 The similarity index of 30 *Jasminum* accessions and *P. jasminoides*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24	26	27	28	29	30	31
1 *J. sambac* 'Mali Son'	1.000																														
2 *J. sambac* 'Mali La'	0.477	1.000																													
3 *J. sambac* 'Mali Thod'	0.139	0.139	1.000																												
4 *J. sambac* 'Mali Chat Phikun'	0.323	0.303	0.362	1.000																											
5 *J. sambac* 'Mali Chantaboon'	0.075	0.137	0.135	0.148	1.000																										
6 *J. sambac* 'Mali Chat Dokbua'	0.172	0.085	0.306	0.274	0.447	1.000																									
7 *J. coarctatum*	0.115	0.083	0.105	0.105	0.089	0.105	1.000																								
8 *J. grandiflorum*	0.128	0.151	0.057	0.085	0.218	0.086	0.214	1.000																							
9 *J. multiflorum* 'Maluli Sichomphu'	0.064	0.056	0.118	0.037	0.131	0.131	0.037	0.059	1.000																						
10 *J. multiflorum* 'Maluli'	0.053	0.120	0.102	0.030	0.030	0.095	0.000	0.093	0.307	1.000																					
11 *J. multiflorum* 'Mali Ngachang'	0.151	0.240	0.184	0.073	0.028	0.056	0.030	0.101	0.186	0.089	1.000																				
12 *J. multiflorum* 'Maluli Phum'	0.096	0.061	0.178	0.069	0.114	0.061	0.104	0.153	0.183	0.166	0.256	1.000																			
13 *J. auriculatum*	0.033	0.037	0.037	0.074	0.062	0.059	0.042	0.064	0.056	0.083	0.125	0.099	1.000																		
14 *J. elongatum*	0.087	0.101	0.101	0.092	0.067	0.061	0.139	0.172	0.163	0.186	0.056	0.221	0.175	1.000																	
15 *J. nitidum*	0.128	0.074	0.067	0.094	0.070	0.128	0.030	0.100	0.037	0.183	0.130	0.125	0.269	0.266	1.000																
16 *J. nobile* subsp. *rex*	0.076	0.107	0.117	0.021	0.064	0.067	0.161	0.101	0.067	0.039	0.143	0.200	0.121	0.214	0.304	1.000															
17 *J. adenophylum*	0.117	0.122	0.098	0.098	0.097	0.108	0.206	0.067	0.071	0.079	0.144	0.198	0.118	0.205	0.097	0.209	1.000														
18 *Jasminum* spp 3	0.083	0.095	0.112	0.065	0.109	0.079	0.073	0.024	0.165	0.056	0.105	0.093	0.123	0.165	0.058	0.141	0.185	1.000													
19 *Jasminum* spp 4	0.118	0.109	0.302	0.072	0.079	0.148	0.069	0.093	0.151	0.026	0.171	0.195	0.083	0.121	0.083	0.145	0.187	0.205	1.000												
20 *J. scandens*	0.042	0.095	0.078	0.037	0.251	0.042	0.048	0.162	0.137	0.048	0.082	0.104	0.024	0.139	0.104	0.026	0.180	0.204	0.093	1.000											
21 *J. siamense*	0.075	0.104	0.093	0.175	0.083	0.117	0.089	0.127	0.083	0.079	0.097	0.111	0.089	0.120	0.198	0.161	0.139	0.078	0.033	0.354	1.000										
22 *Jasminum* spp 1	0.048	0.073	0.189	0.137	0.056	0.094	0.067	0.033	0.113	0.103	0.063	0.056	0.044	0.083	0.094	0.097	0.102	0.123	0.183	0.056	0.083	1.000									
23 *J. fluminense* subsp. *gratissimum*	0.065	0.106	0.097	0.081	0.144	0.125	0.097	0.065	0.064	0.137	0.059	0.186	0.030	0.198	0.028	0.145	0.091	0.094	0.164	0.067	0.061	0.431	1.000								
24 *J. funale* subsp. *scotepense*	0.048	0.056	0.048	0.125	0.089	0.085	0.137	0.103	0.057	0.141	0.067	0.075	0.144	0.067	0.118	0.024	0.078	0.017	0.026	0.230	0.104	0.218	0.165	1.000							
25 *J. mesnyi*	0.030	0.023	0.130	0.109	0.052	0.109	0.067	0.089	0.065	0.075	0.152	0.208	0.037	0.196	0.079	0.074	0.088	0.110	0.217	0.121	0.131	0.215	0.134	0.139	1.000						
26 *J. cordatum*	0.037	0.038	0.075	0.104	0.100	0.081	0.172	0.125	0.130	0.139	0.026	0.065	0.083	0.167	0.061	0.054	0.097	0.044	0.098	0.131	0.184	0.110	0.125	0.272	0.257	1.000					
27 *J. humile*	0.095	0.177	0.136	0.170	0.033	0.116	0.061	0.123	0.091	0.114	0.139	0.056	0.075	0.098	0.053	0.094	0.118	0.030	0.135	0.115	0.152	0.109	0.119	0.221	0.260	0.292	1.000				
28 *Jasminum* spp 2	0.108	0.117	0.172	0.075	0.061	0.125	0.108	0.022	0.156	0.125	0.187	0.086	0.042	0.042	0.085	0.053	0.120	0.130	0.186	0.091	0.179	0.175	0.094	0.111	0.241	0.178	0.114	1.000			
29 *J. lanceolaria*	0.028	0.030	0.037	0.199	0.070	0.074	0.067	0.037	0.033	0.168	0.107	0.033	0.067	0.088	0.070	0.025	0.037	0.105	0.083	0.075	0.033	0.137	0.093	0.123	0.208	0.139	0.172	0.211	1.000		
30 *J. nervosum*	0.134	0.081	0.104	0.141	0.131	0.133	0.079	0.211	0.073	0.061	0.042	0.154	0.133	0.081	0.059	0.112	0.033	0.159	0.145	0.030	0.134	0.093	0.126	0.028	0.250	0.056	0.185	0.164	0.354	1.000	
31 *P. jasminoides*	0.028	0.164	0.067	0.123	0.089	0.033	0.056	0.118	0.065	0.086	0.030	0.091	0.030	0.214	0.090	0.089	0.117	0.063	0.085	0.056	0.067	0.064	0.026	0.022	0.083	0.051	0.083	0.033	0.037	0.125	1.000

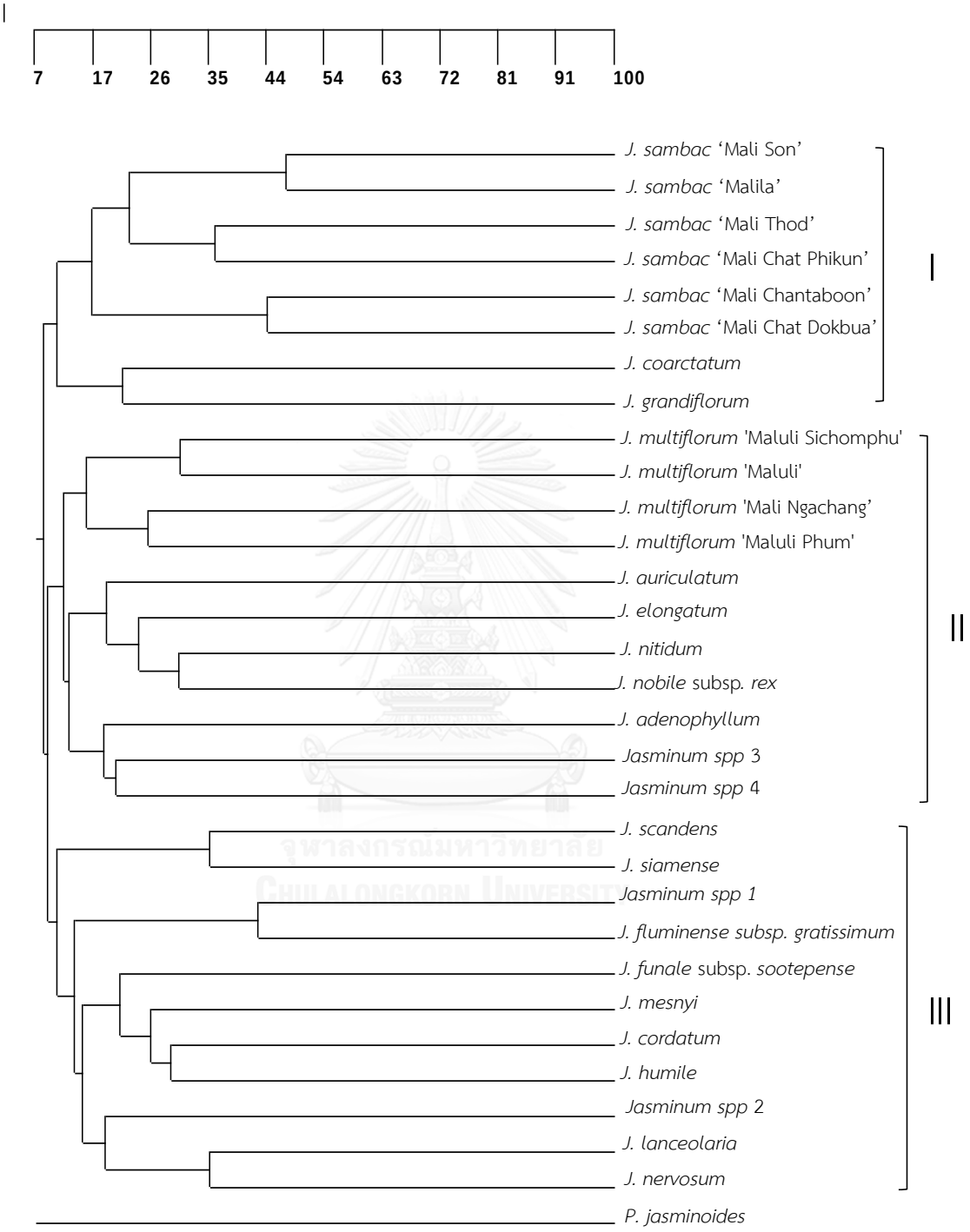


Figure 48 Dendrogram produced by UPGMA cluster analysis of RAPD data showing the genetic relationship among 30 *Jasminum* accessions and out group plant

CHAPTER V

DISCUSSION AND CONCLUSION

Herbal medicines are being widely used throughout the world. The identification of plant or plant materials is a great important issue dealing with their safety and effectiveness [78]. According to WHO guideline for research and evaluation of herbal medicine, the first step is the correct identification. In order to characterize an herbal medicine, various method were available, ranging from morphological to physiochemical examination and DNA molecular technique [13]. Each method had their drawbacks and advantages. Sometimes two or several methods are applied for authentication. However, microscopic evaluation is still the most practical method for primary authentication by determination the cell structure of herbal samples. Apart from light microscope, other fluorescence microscope also has been used to enhance the accuracy of authentication. There is species confusion of different herbal medicine sharing one name or using different names and misused or confusion of poisoning incidents has raised the concern of herbal identification. This study aimed to identify 30 *Jasminum* accessions using microscopic characteristic including leaf constant numbers and molecular analysis. Microscopic method offers several advantages over conventional authentication including the effectiveness, simplicity and low cost. This method widely adopted as an official method in many international herbal pharmacopoeias (WHO) [31]. According to the results, 30 *Jasminum* accessions showed different microscopic characteristics and constant numbers of leaves and several microscopic characteristics could be used to identify these plants as summarized in the microscopic characteristics diagram (**Figure 34**). Trichome is one of the most important identifying characteristics. The trichome characteristic, the cell number, shape, length, color or their arrangement is usually observed under the microscope. When using trichome characteristic, 30 *Jasminum* accessions can be divided into 3 groups; 4 accessions had no trichome, 5 accessions had trichome on both adaxial and abaxial surface and the 21 remaining had trichome only on abaxial surface. However, when consider trichome with the stomata characteristic, 30 *Jasminum* accessions can

be divided into 5 subgroups; the first group had no trichome but had stomata on both side which is the *J. fluminense* Vahl subsp. *gratissimum.* The second group had no trichome but had stomata only on abaxial side was found in 3 accessions. Among these 3 accessions, *J. nervosum* Lour had the highest stomata number when compared to *J. humile* L and *J. mesnyi.* When consider the 5 accessions that had both adaxial and abaxial trichome, *J. funale* Decne. subsp. *sootepense* also had both upper and lower stomata and the 4 remaining had only abaxial stomata. However, the 21 remaining accessions could not be discriminated from each other. When using both trichome and epidermal characteristics, *J. cordatum* can be identified. Among 6 *J. sambac* cultivars, Malithod can be identify by using the highest epidermal cell area value and/or palisade ratio. Moreover, the upper epidermis irregular cell shape in *J. funale* Decne subsp*. saotepense, J. humile* and *J. cordatum* could be used for identification of these 3 accessions from another [22, 79, 80]. The stomata index is also useful parameter in order to distinguish plant as well as palisade ratio in species level [48]. When compare to the previous studied, quantitative microscopic indicated that *J. sambac* Aiton L (Malila) had the stomatal index (11.26) coincide with the stomata index (11.79 ± 0.88) in this recent this study [78]. When considering other microscopic characteristics, determination of vein termination number revealed that *J. multiflorum* 'Mali Ngachang' had the highest vein termination number (14.11 ± 2.26) whereas *J. humile* had the lowest value (3.33 ± 1.63). The vein termination number of *J. mesnyi* (5.33 ± 1.35) was also coincided with the previous reported in *J. mesnyi* (5) [79]. Furthermore, determination of vein-islet number revealed that *J. grandiflorum* had the highest vein-islet number (7.90 ± 1.35) whereas, *J. nervosum* had the lowest value (2.30 ± 1.00) [24, 79, 80]. The quantitative microscopic characteristics have been commonly used in the identification of herbal medicines in many countries such as Chinese herbal medicines, European pharmacopoeia, and Japanese pharmacopoeia including Thai herbal medicines. The quantitative microscopic characteristics have been reported in *J. sambac* Aiton L [80], *J. mesnyi* Hance [79] and *J. grandiflorum* [24] for identification. This study provided the first report on the leaf constant numbers of 30 *Jasminum* accessions existing in Thailand. The result obtained might be used as the

information for identification the *Jasminum* accessions and other herbal medicines in Thailand.

Although morphological and microscopic characteristics of herbal medicine are commonly used for identification, some herbal medicine within a genus is sometime or always similar therefore, DNA molecular markers for identification have come out with the rapid development of molecular biology technique. DNA molecular marker is a method to identify species by comparing their genetic diversities. Genetic material presented in the cell is unique for each individual organism. DNA extracted from leaves, stem or roots of plants all carry the same genetic information without being affected by physiological conditions and environmental factors [81]. Different region in the DNA molecule display various degree of genetic diversity. As a result, DNA markers could be used to identify exact herbal medicine in grouping species. For accuracy results in this study, the high quality of genomic DNA free from secondary metabolites was isolated from plant samples by modified CTAB method and the RAPD marker technique has been employed. Their benefits include rapid analysis, highly informative results, and independent from the environment factors. Due to the reproducibility, it was necessary to optimize the PCR components for successful amplification and constant result. $MgCl^{2+}$ of 3 mM concentration was proved to be the best in 20 ul reaction volume and the annealing temperature at $36^{O}C$ has been used. As indicated in many previous studies, the RAPD give the useful information to assist in the taxonomic classification and identification of the botanical origin of herbal drug. In this recent study, the RAPD profiles of *Jasminum* accessions showed that the Dice similarity index ranged from 0.022 to 0.477 indicated the wide genetic variability among these *Jasminum* accessions. The highest genetic similarity index (0.477) was found between *J. sambac* 'Malila' and 'Malison' whereas the lowest similarity index (0.022) was found between *J. fluminense* subsp. *gratissimum* and *P. jasminoides.* A dendrogram was constructed according to the UPGMA cluster analysis using Dice similarity coefficient. The UPGMA dendrogram could be divided 30 *Jasminum* accessions into three clusters. Cluster I, consists of 6 *J. sambac* Aiton L. (Mali Son, Malila, MaliThod, Mali Chat Dokbua, Mali Chat Phikun and Mali Chantaboon), *J. coarctatum* and *J. grandiflorum* with 0.057-

0.477 similarity index. Cluster II includes eleven accessions which are *J. multiflorum* (Maluli, Maluli Sichomphu, Mali Ngachang and Maluli Phum), *J. auriculatum*, *J. elongatum*, *J. nitidum J. nobile* subsp. *rex*, *J. adenophyllum*, *Jasminum* sp 3 and *Jasminum* sp 4 with 0.026-0.307 similarity index. Cluster III includes eleven accessions which are *J. scandens*, *J. siamense, Jasminum* sp 1, *J. fluminense* subsp*. gratissimum, J. funale* subsp. *sootepense, J. mesnyi*, *J. cordatum*, *J. humile*, *Jasminum* sp 2, *J. lanceolaria* and *J. nervosum* with 0.022-0.354 similarity index. Outgroup plant was completely separated from the *Jasminum* accessions. Genetic identification has been applied to the evaluation of medicinal authentication in many aspects such as authentication of closely related species, contamination and adulterant species. Recently, several molecular markers have been developed and increasingly used as modern techniques to distinguish genotypes of organisms. The DNA fragment markers, such as Inter Simple Sequence Repeat (ISSR) [82, 83], PCR-restriction fragment length polymorphism (PCR-RFLP) [63], Amplified Fragment Length Polymorphism (AFLP) [56, 57], and Random Amplified Polymorphic DNA (RAPD) [58-60, 62, 72], have been successfully used in polymorphism analysis and phylogenetic evaluation in many medicinal plants [58,62,64] including *Jasminum* species [60,72].

Although there are several identification methods are available, no single method is sufficient to identify herbal drugs. Applying various methods in concert is necessary to conclusively confirm an identification or authentication [84]. The microscopic examination can be used as rapid and inexpensive identification method combine with molecular analysis which offers an assortment of techniques that can be very useful for medicinal plants authentication. Each of these methodologies has limitations and more analytical methods are needed to assist in the authentication process. The use of both microscopic and molecular analyses is successful for the identification of 30 *Jasminum* accessions in Thailand.

In conclusion, microscopic examination based on leaf constant numbers and molecular analysis based on RAPD fingerprinting of thirty *Jasminum* accessions are might be used as information for identification the *Jasminum* species in Thailand. Furthermore, sequence charactersized amplified regions (SCARs) could be further developed to differentiate plants that have similar morphological characteristics.

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APPENDICES

APPENDIX I

Botanical Characteristics

The botanical characteristics of *Jasminum* species can be described as the following [1, 10].

1. *Jasminum adenophyllum* Wall ex C. B.

Description: Woody climber, young shoots glabrous or scattered puberulent. *Leaves* elliptic to oblong-elliptic, 6-15 cm long, 2.5-7 cm broad, base attenuate onto the grooved petiole; apex slightly acuminate; glabrous; 4 or 5 primary veins on each side of the midrib, raised below, but not reticulate, slightly sunk above, joining to form a distinct submarginal vein; 3-4 tufted domatia in the axils of the primary nerves with the midrib below; petioles 5-20 mm long, glabrous or pilose above. *Inflorescence* axillary or terminal on short shoots, 1 to 3(-5) flowered, glabrous; bracts linear, 2 mm long glabrous; pedicels 1-4 cm long. *Calyx* tube 2 mm long; lobes 5-14 mm long, somewhat filiform, glabrous. *Corolla* white, fragrant; tube (9-) 15-20 mm long; lobes 8 or 9, 15-20mm long, 2-3.5 mm broad. *Fruit* spheroidal, 7 x 5 mm.

Vernacular names: Mali wan (มะลิวัลย์), Phak Saeo (ผักแส้ว)

2. *Jasminum annumense* Wernham, J. Nat. Hist.

2a. subsp. *annumense.- J. plumosum* Kerr.

Description: Woody climber, young shoots velutinous. *Leaves* ovate, 4-12cm long, 2-6 cm broad; base rounded to almost truncate, apex long acute to slightly acuminate; velutinous, especially below, becoming ± glabrous above; venation raised below, sunk above, 3-4 primary veins on each side of the midrib, without domatia; petioles about 5-15 mm long, velutinous. *Inflorescence* terminal on side shoots, cymose-corymbose, crowded, about 10 to many flowered; 4-10 cm long, 5-15 cm broad, velutinous; bracts lanceolate linear to lanceolate, 5-20 mm long; pedicels 2-15 mm long. *Calyx* villous; tube 1.5-2 mm long; lobes linear-filiform, 10-17 mm long, often wavy. *Corolla* white; tube 15-22 mm long; lobes 7-8, 8-12 mm long, 1.5-3 mm broad. *Anthers* 4 mm long±sessile, connective appendage about, 0.5 mm long, acute *Overy* barrel-shaped, 0.5 mm long; stigma 2.5 mm long, acute. *Fruit* ellipsoid, 10 x 6 mm.

Vernacular names: Mali Krai krun (มะลิไกรกรัน)

Notes. This subspecies is related to the Indo-Chinese subsp. *Glabrescens* P. S. Green. It differs from this latter in its velutinous leaves and often slightly longer corolla tube and lobes.

2b. subsp. *kerrii (Bhatnagar)* - P. S. Green

Description: Suffrutex or woody climber, young shoots pilose to shortly, coarsely pilose. *Leaves* lanceolate to narrowly lanceolate, 3-6 cm long, 0.7-3 cm broad; base rounded to narrowed onto the petiole; apex acute with a fine point; velutinous to slightly scattered villous below, becoming glabrous above except for the midrib and primary veins, veins raised below, somewhat sunk above, 2-3 primary veins on each side of the midrib, without domatia; petioles 3-5 mm long, articulate. *Inflorescence* terminal on side shoots, cymose-corymbose, dense, 3- to about 10 flowered, pilose; bracts linear; pedicels 1-5 mm long. *Calyx* tube 2 mm long; lobes 12-17 mm long, linear-filiform, densely pilose. *Corolla* tube 20-24 mm long; lobes 10-12 mm long, 2-4 mm broad. *Fruit* ellipsoid, 7 x 4 mm.

Vernacular names: Mali mo kha (มะลิหมอคาร์)

Notes. Differing from subsp. *annamense* in its lanceolate to narrowly lanceolate leaves. Many of the hairs are branched.

3. *Jasminum anodonum* Gagnep.

Description: Woody climber, or straggling shrub, young shoots glabrous. *Leaves* chartaceous, broadly ovate to lanceolate, to oblong-elliptic, 4-8(-10) cm long, 2-3.5(-4) cm broad; base narrowed to rarely almost rounded; apex acuminate; 3-4 primary veins on each side of the midrib; the lowest arising at an acute angle to the midrib and curving round to meet the next primary vein about half way up the lamina, venation raised above and often finely reticulate, slightly raised below; 2-3 shortly tufted domatia on each side below; petioles 4-8 mm long, *Inflorescence* axillary or terminal on side shoots, cymose, glabrous, (3-)7- to about 21 flowered; bracts linear, 1-2 mm long; pedicels 1-10 mm long, that of the central flower the shortest *Calyx* glabrous, tube 1.5 mm long; lobes 0 or scarcely perceptible. *Corolla* tube red, 13-15 mm long, lobes white or red externally, white inside, 6-7, 5-6 mm long, 1 mm broad. *Fruit* spheroid, 5-6 diameter.

Vernacular names: Mali Sai Kai Kan Daeng (มะลิไส้ไก่ก้านแดง)

Notes. This species is very close to *J. extensum* Wall.

4. ***Jasminum attenuatum* Roxb. Ex G. Don, Gen.**

Description: Woody climber, young shoots glabrous. *Leaves* lanceolate to broadly ovate or oblong, (7-)10-22cm long, (3.5-)4-10.5 cm broad; base obtuse to rounded; very shortly attenuate onto the petiole; apex shortly acuminate; glabrous; 6-8(-9) primary veins on each side of the midrib; raised below and above, the lowest one short and making an obtuse angle with the midrib; without domatia; petioles glabrous, 10-15 mm long. *Inflorescence* axillary rarely apparently terminal, decussate racemose, 5-15 cm long, 3-to ca. 23- flowered, glabrous; bracts linear, 1-2 mm long; pedicels 5-25 mm long. *Calyx* (1.5-)2-2.5 mm long, obconic; lobes 0.25-0.5 mm or scarcely perceptible, glabrous. *Corolla* white; tube 15-24 mm long; lobes 5-7,10-15 mm long, 2.5-6 mm broad. *Fruit* ellipsoid, (8-)15 mm long, (5-)10 mm broad.

Vernacular names: Mali thao (มะลิเถา)

5. ***Jasminum calcicola* Kerr**


Description: Woody climber. *Leaves* trifoliolate, chartaceous, broadly lanceolate to lanceolate, terminal leaflet 4-8 cm long, 1.8-3.8 cm broad, lateral 3.5-6 cm long, 1.3-2.5 cm broad; base rounded to obtuse; apex long acute, often slightly acuminate; glabrous below and above; venation raised below, midrib slightly sunk above, 1-2 pairs of basal veins forming submarginal lamina veins, 1-3 slightly obscure primary veins on each side of the midrib;without domatia; petiole 1-3 cm long, glabrous, terminal petiolule 5-10 mm long, lateral 3-8 mm long. *Inflorescence* axillary and terminal on side shoots, cymose-paniculate, 2-10 cm long, terminal groups of flowers corymbose-clustered, slightly puberulent, especially towards the flowers; pedicels 0-1 mm long. *Calyx* very finely puberulent to glabrate; tube 1-1.25 mm long; lobes 0.3-0.5 mm long. *Corolla* white, fragrant; tube 8-12 mm long; lobes 5-6, 6-10 mm long, 2.5-3.5 mm broad. *Anthers* 3 mm long, connective acute. *Fruit* ellipsoid, 9x6 mm.

Vernacular names: Mali Siao Ton (มะลิเสี้ยวตัน).

6. *Jasminum coarectatum* Roxb.

6a var. *coarectatum*


Description: Woody climber, or straggling shrub, young shoots finely to coarsely pilose. *Leaves* chartaceous, oblong-elliptic to sometimes broadly ovate or slightly obovate, 6-15 cm long, 3.5-5 cm long, 3-7 cm broad; base narrowed to obtuse or rounded; apex acute shortly and finely acuminate; glabrous below and above or midrib sometimes scattered pilose towards the base; venation raised reticulate below and slightly so above with midrib sunk, 4-7 primary veins on each side of the midrib; with or without up to 4 hairy domatia in the axils of the primary veins with the midrib below; petioles 5-10 mm long, puberulent to pilose, ± articulate. *Inflorescence* terminal on side shoots, a dense head, sometimes branched with up to many subsidiary heads, (3-) 5- to many flowered, finely pubescent; bracts white or cream-coloured, leaf-like, 5-25 cm long; pedicels 0-4 mm long. *Calyx* tube 2 mm long; lobes filiform, 5-10(-14) mm long, finely pubescent to pilose to pilose. *Corolla* tube glabrous, 20-22 mm long; lobes 6-7(-8), 8-10 mm long, 2-5 mm broad. *Fruit* ellipsoid, 9 x 7 mm.

Vernacular names: Mali Khruea Nam Kho (มะลิเครือหนามข้อ) (Phetchabun), TongWi (ตองวี) (Central), Kafae Pa(กาแฟป่า) (Chuntburi), Siao Khruea (เสี้ยวเครือ) (Chiang Mai, Sukhothai)

Notes. A number of a species complex which includes *Jasmininum curtisit* King & Gamble, *J. griffithii* C. B. Clarke and *J. rufohirtum* Gagnep.

6b. var. *vanprukii* (Craib) P. S. Green

Description: Differs from var. *coarctatum* in the generally more hairly young shoots, petioles and leaf midrib below, a lack of domatia, a finely velutinous inflorescence rachis, pedicels and calyx, and especially in the more or less velutinous outside of the corolla, especially the tube.

Vernacular name- Mali pa (มะลิป่า)

Notes. Close to *J. grifithii* C. B. Clarke, but, amongst other things, the pilose exterior to the corolla of that species is not velutinous as in var. *vanprukii*.

6. ***Jasminum cordatum* Ridl**


Description: Woody climber or scrambling shrub, young shoots puberulent. *Leaves* somewhat coriaceous, ovate, ovate-deltoid with rounded angles to lanceolate or narrowly lanceolate, 1.3-5.5 cm long, 0.6-2 cm broad; base truncate to very slightly cordate; apex rounded to long acute, with a very small apiculum or mucronulate; glabrous; 3- to 5- veins at the base, raised above and below, otherwise venation obscure; without domatia; petioles 1.5-5 mm long, puberlent, especially on the upper surface *Inflorescence* terminal on side shoots, 1 flowered; bracts acicular, paired, 1 mm long, glabrous; pedicels 1-2 mm long. *Calyx* tube 1.5-2 mm long, glabrous externally, scattered puberulent within; lobes 2-5 mm long, subulate, scattered puberulent on the upper surface. *Corolla* white; tube 17-30 mm long; lobes 6-8, 9-17 mm long, 2.5-6 mm broad. *Fruit* ellipsoid-globose.

Vernacular name: Mali chang (มะลิช้าง).

7. ***Jasminum craibianum*** **Kerr**

Description: Woody climber, young shoots villous. *Leaves* narrowly ovate to elliptic, lanceolate or slightly oblanceolate, (4-)6-14 cm long, (1.5-)2.5-4.5 cm broad base rounded truncate; apex acute to acuminate; villous, especially on the midrib and veins below, sometimes becoming glabrous above; venation slightly raised below, 5-6 primary veins on each side of the midrib, without domatia; petioles 5-10 mm long, villous. *Inflorescence* axillary or terminal on side shoots, 1 to 3 flowered, villous; pedicels 5-10 mm long. *Calyx* tube 2.5 mm long; lobes linear-filiform, 5-8 mm long, villous. *Corolla* white, tube 18-20 mm long; lobes 6-7, narrow, 12-13 mm long, 2 mm broad. *Anthers* 4 mm long, filament 0.5 mm long, connective appendage narrowly acute, 0.2 mm long. Overy barrel-shaped, 0.5 mm long. *Fruit* not known.

Vernacular name: Mali craib (มะลิเครบ)

8. ***Jasminum decipines*** **P. S. Green**

Description: Woody climber or low shrub, young shoots glabrous or rarely finely puberulous. *Leaves* to lanceolate or elliptic, (4-)7-10(-12) cm long, (2-)3.5-5(-6.5) cm broad; base obtuse to sometimes acute, attenuate onto the petiole; apex acuminate, often shortly so; glabrous; 1(-2) prominent primary veins at the base, forming a submarginal vein, 1-2 primary veins above, primary veins only visible, raised below, slightly sunk above; without domatia; pedicels 10-20 mm long, glabrous. *Inflorescence* terminal on side shoots, cymose-corymbose, somewhat open to fairly dense, 4-10 cm diameter, 15- to many flowered, puberulous; basal bracts leaf-like, the upper linear; pedicels 1-5 mm long. *Calyx* tube 2 mm long, lobes (5-) -6, narrowly acuminate-triangular, (1.5-)2(-3) mm long, exterior puberulous, pubescent within. *Corolla* white, fragrant; tube 7-8 mm long; lobes 7, 5-6 mm long, 3-5 mm broad. *Fruit* ellipsoid, 15 x 10 mm.

Vernacular name: Mali phu luang (มะลิภูหลวง)

9. ***Jasminum decusstum*** **Wall ex G. Don**

Description: Woody climber, young shoots villous, to rarely almost glabrous. *Leaves* thickish chartaceous, ovate to lanceolate, 5-11 cm long, 2-6 cm broad; base rounded sometimes slightly caudate; apex acute to acuminate; villous to velutinous above and especially below, rarely glabrate, persistently villous on the veins and midrib below; margins ciliolate; 3-4 primary veins on each side of the midrib; without domatia; petioles 6-16 mm long, articulate, villous, usually densely so. *Inflorescence* terminal on side shoots, cymose-corymbose, many flowered, villous; bracts linear, 1-10 mm long; pedicels 0-3 mm long. *Calyx* tube 1-1.5 mm long; lobes (5 or) 6, linear, 1-2 mm long, often reflexed, villous to pilose. *Corolla* white; tube 4-6(-10) mm long; lobes 7-8, (-9) mm long, 1-2 mm broad, acute to acuminate. *Fruit* ellipsoid, 10 x 6 mm.

Vernacular name: Khiao ngu (เขี้ยวงู), krong jan (กรงจัน)

***11. Jasminum dispermum* Wall. Roxb.**

Description: Woody climber. *Leaves* simple or trifoliolate (to 5 foliolate pinnate outside Thailand), chartaceous; leaflets lanceolate, terminal 7-13 cm long, 4-7 cm broad, lateral 3.5-6.5 cm long, 2-3 broad; base rounded to truncate, sometimes subcordate; apex long acuminate, glabrous below and above; venation raised below, sunk above, 2 basal veins on each side of the midrib on terminal leaflets, 1 in lateral, 3-4 primary veins on each side of the midrib; hairy domatia at the base below and sometimes in the axils of the primary veins; petiole 1-2 cm long, terminal petiolule 1-2 cm long, lateral 2-5 mm long. *Inflorescence* axillary and terminal on side shoots, cymose-corymbose, shorter than the subtending leaves, glabrous; pedicels 3-7 mm long. *Calyx* glabrous, tube 2mm long: lobes triangular, 0.6-0.8 mm long. *Corolla* white, fragrant; tube 7-10 mm long; lobes 5, ovate, 5-6 mm long, 5 mm broad. *Anthers* ± sessile, 4 mm long, connective appendage pointed, 0.5 mm long. *Fruit* ellipsoid, 8x6 mm.

Vernacular name: Mali Doi (มะลิดอย) Khruea Katawa (เครือเกตถวา)

12. *Jasminum elongatum* (Bergius) Wild.


Description: Shrub or woody climber, young shoots finely to strongly pilose. *Leaves* ovate to narrowly lanceolate, (2-)4-9(-11) cm long, (1.5-)2-4(-6) cm broad; base rounded or sometimes obtuse or almost subcordate; apex long acute to slightly acuminate; appressed pilose to glabrous below, scattered pilose to glabrous above, midrib and main veins pilose; primary veins 2-4 on each side of the midrib, curving round below the margin, raised below, sunk above, otherwise venation obscure; without domatia; petioles 3-7(-10) mm long, finely to strongly pilose. *Inflorescence* terminal on side shoots, cymose-corymbose, dense, 3-to about 10- flowered, pilose to finely pilose; bracts leaf-like, 0.5-1 cm long; pedicels 0.5-3 mm long. *Calyx* tube 1.5-2 mm long; lobes filiform, (2-) 4-11 mm long, densely to finely pilose. *Corolla* tube 15-25 mm long; lobes 7-9, 6-12 mm long, 2-4 mm broad. *Fruit* ellipsoid, 8 x 6 mm.

Vernacular name: Mali yan (มะลิย่าน), Mali thuean (มะลิเถื่อน), li (ลิ), siao ton (เสี้ยวต้น), dok bai (ดอกใบ), lai kai (ไลไก่), dok siao (ดอกเสี้ยว), sai kai (ไส้ไก่), khiao ngu (เขี้ยวงู)

Notes. This is a very widespread and variable SE Asian tropical species, and probably the commonest in Thailand. It has been described under a number of names. The degree of pubescence, the length of the calyx lobes and the corolla size have at times been used in attempts to distinguish separate taxa within this complex, but they appear to provide no clear discontinuities.

13. *Jasminum extensum* Wall ex G. Don

Description: Woody climber, young shoots glabrous. *Leaves* somewhat coriaceous, elliptic or elliptic-oblong to lanceolate, 5-12 cm long, 2.5-6 cm broad; base obtuse to rounded; apex acuminate; glabrous 5-6 primary veins on each side of the midrib; the lowest at a broad angle to the midrib, veins raised below and above, finely reticulate to ± obscure; 3-4 small, slightly hairy domatia; petioles glabrous, 5-8 mm long. *Inflorescence* terminal on side shoots, open cymose, (5-to) many-flowered, glabrous; bracts linear, 1-6 mm long; pedicels 1-10 mm long. *Calyx* glabrous; tube 1-1.5 mm long; lobes 0.25-0.5 mm long, triangular, broadly acute. *Corolla* white; tube 16-20 mm long; lobes 7,6-12 mm long, 1-1.5 mm broad, *Fruit* spheroid, 5- 6 mm diameter.

Vernacular name: Mali E-Ka (มะลิเอกา), Mali pa (มะลิป่า), “Bla kha de”

14. *Jasminum flexile* Vahl

Description: Woody climber, glabrous. *Leaves* trifoliolate, ±chartaceous, narrowly ovate to lanceolate, terminal leaflet 7-10 cm long, 3.5-5 cm broad, lateral 6-8.5 cm long, 3-4 cm broad; base obtuse to rounded; apex acute to slightly acuminate; glabrous below and above; venation raised, midrib sunk above, 2 almost basal veins on each side of the midrib joining with 3-5 primary veins on each side to form a submarginal vein; domatia 3-6, small, tufted; petiole 3-4 cm long, terminal petiolule 2-3 cm long, lateral 0.3-1 cm long, with a bent "pulvinus" just below the base of the petiolule. *Inflorescence* usually axillary or terminal on side shoots, open cymose-decussate 7-10 cm long, 7- 13 flowers, glabrous or very sparingly short puberulous; pedicels 3-7 mm long. *Calyx* tube 2 mm long; lobes insignificant, 0.1-0.2 mm long. Glabrous except for a few, small scattered hair, especially on the rim. *Corolla* white, tube 25-30 mm long; lobes 4-5 mm broad. *Anthers* 4-4.5 mm long, not including an acute, connective appendage 0.5-1 mm long. Overy barrel-shaped, 0.5 mm long; style 2 mm long (in short styled specimen), stigma 3 mm long. *Fruit* (Indien specimens) broadly ellipsoid, 8x6 mm.

Vernacular name: Mali mae taeng (มะลิแม่แตง)

15. *Jasminum funale* Decne

15a. subsp. funale.- *J. sootepense* var. *tremulifolium* Gagnep.

Description: Woody climber, often shrubby young shoots usually finely puberulent or glabrous. *Leaves* chartaceous, ovate to sometimes broadly ovate or broadly lanceolate, (2.5-)4-7.5(-8) cm long, (1.5-)2.5-4(-5.5) cm broad; base obtuse, rounded truncate or subcaudate; apex acute, acuminate; glabrous but sometimes with 1-4, small, tufted domatia beneath; 3-4 primary veins on each side of the midrib; raised below, slightly so above or sometimes obscure; petioles 6-14(-20) mm long, glabrous or usually finely perberulent, especially the upper surface. *Inflorescence* terminal on side shoots, or sometimes axillary and reduced, open cymose, (1-)3-14-or sometimes more-flowered, finely perberulent to glabrous; bracts linear-subulate, 1-5 mm long; pedicels 2-14 mm long. *Calyx* glabrous to finely perberulent; tube 1-2 mm long; lobes triangular, acute, rarely almost subulate at the apex, 0.25-1(-1.5) mm long. *Corolla* white; tube 10-20 mm long; lobes 6-8, 8-12 mm long, 1.5-3 mm broad, apex acuminate. *Fruit* spheroid to slightly ellipsoid, 8-12 x 8-10 mm, black when ripe.

Vernacular name: Khun Sai Kai (คุณไส้ไก่), Mali Sai Kai Bai Man (มะลิไส้ไก่ใบมัน)

15b. subsp. *sootepense* (Craib) P. S. Green

Description: This species differs from subsp. *funale* in young shoots, petioles and inflorescence axes being pubescent, leaves slightly smaller, (2.5-)3-6(-7) cm long, (1.5-) 2-4(-4.5) cm broad, velutinous below, sometimes slightly so, usually fewer flowered inflorescence, the calyx pubescent or glabrous, and the corolla tube often slightly smaller, 8-16 mm long.

Vernacular name: Khiao ngu (เขี้ยวงู) (central, Suratthhani), Mali Nok (มะลินก) (Lampoon), Mali Fa (มะลิฟ้า) (Lampoon), Saeo Noi (แส้วน้อย) (Nakhornsawan, North), Sai Kai (ไส้ไก่) (Loei), Saeo pa (แส้วป่า) (Chaingmai)

16. *Jasminum harmandianum* Gagnep.

Description: Woody climber, young shoots glabrous. *Leaves* slightly coriaceous, oblong-elliptic to somewhat narrowly ovate, 5-12 cm long, 2-4 cm broad, base acute to obtuse; apex slightly acuminate; glabrous below and above; venation raised, finely and more or less reticulate below and above, with 5-6 primary veins on each side of the midrib, domatia absent or about 2 on each side in the axils of the primary veins on each side of the midrib; petioles 4-6 mm long, glabrous. *Inflorescence* terminal on side shoots, cymose-paniculate, open, extended, 5 to about 15 flowered; bracts linear to linear-lanceolate, 5-15 mm long; pedicels 2-10 mm long. *Calyx* tube 1.5-2 mm long; lobes subulate, 5-10 mm long, glabrous. *Corolla* tube 18-22 mm long; lobes 7-8, 10-15mm long narrow, 1.5-2 mm broad, long pointed. *Fruit* spheroidal, about 5 mm diameter.

Vernacular name: Sai Kai (ไส้ไก่) (Central, Ubonratthani), Mali Sai Kai Bai Na (มะลิไส้ไก่ใบหนา)

Notes. The length of the calyx lobes is usually diagnostic in *Jasminum*, but in this species there is a range from very short, 1 mm, to fairly long, 10 mm and subulate; the extremes apparently not associated with any other characters. However in most characters, other than those of the calyx, it is very close to *J. extensum*, which has calyx lobes only 0.25 to 0.5 mm long.

17. *Jasminum kedahense* (King& Gamble) Ridl.

Description: Woody climber, young shoots glabrous or shortly puberulent. *Leaves* coriaceous, ovate to lanceolate or elliptic, (5-)7-15 cm long, (2.5-)4-7 cm broad; base obtuse or rounded; apex acuminate; glabrous; venation 1 or usually 2 strong primary veins on each side of the midrib in lower usually forming a submarginal vein, and 1-2 smaller ones above, raised below, sunk above, and on each side of the midrib, sometimes slightly reticulate below, usually obscure above; reticulation ± obscure below; without domatia; pedicels 6-20 mm long, angled- articulate, glabrous or very finely puberulent. *Inflorescence* axillary or terminal on side shoots, densely cymose-corymbose, (3-)5-to many flowered, finely puberulous; bracts diminutive leaf-like to linear, 3-6 mm long; pedicels 2-5 mm long. *Calyx* finely puberulent become glabrous; lobes± ciliolate; tube 2-3 mm long, lobes subulate, 5-7 mm long. *Corolla* white; tube 22-25 mm long; lobes 7-8, 15-20 mm long, 5-6 mm broad. *Fruit* ellipsoid, 15 x 10 mm.

Vernacular name: Mali Bai Riao (มะลิใบเรียว)

18. *Jasminum lanceolaria* Roxb.

18a. subsp. *lanceolaria*

Description: Woody climber, glabrous. *Leaves* coriaceous, elliptic-oblong to lanceolate, terminal leaflet 7-13 cm long, 3.5-6 cm broad, the lateral 5-8 cm long, 3-4 cm broad; base obtuse to rounded; apex acute to rounded and shortly acuminate; glabrous; venation slightly raised below and above, 4-6 primary veins on each side of the midrib, without basal lateral veins or domatia; petioles 1-3 cm long, terminal petiolule 1-3 cm long, lateral 1-2 cm long, usually a distinct pulvinus at the base of the lamina, often bent. *Inflorescence* 1-2 axillary or terminal on major side shoots, cymose-paniculate to corymbose, croweded, 6-15 cm long, glabrous, 8 to many-flowered, pedicels 0-3 mm long. *Calyx* tube 2 mm long; lobes triangular, 0.1-0.5 mm long, glabrous. *Corolla* white, fragrant; tube 18-25 mm long; lobes 12-14 mm long, 3-4 mm broad. *Anthers* 5.5 mm long, with an acute connective appendage 0.5 mm long. Overy barrel-shaped, 0.5 mm long; style 4 mm long (in short styled specimen), stigma 3 mm long. *Fruit* spheroidal, 11x9 mm.

Vernacular name: Mali Wan Lek (มะลิวัลย์เล็ก)

18b. subsp. *scortechinii* (King& Gamble)

Description: *Leaves* less thickly coriaceous. *Corolla* tube 10-15 mm long; lobes 7-12 mm long, *Anthers* 3 mm long, plus a very acute connective appendage 0.5 mm long. *Overy* barrel-shaped, 0.5 mm long; style 14 mm long (in long styled specimen), stigma 2 mm long. *Fruit* ellipsoid, 18x20 x 12-14 mm.

Vernacular name: Mali Wan Noi (มะลิวัลย์น้อย)

19. *Jasminum latipetalum* C. B. Clarke.

Description: Woody climber, young shoots glabrous, slightly quadrangular. *Leaves* lanceolate to narrowly lanceolate, 4.5-12 cm long, 1.5-3.5 cm broad; base obtuse to rounded; apex long acute; glabrous below and above; 6-9 primary veins on each side of the midrib; obscure below and above, without domatia; petioles 5-12 mm long glabrous. *Inflorescence* axillary or terminal on side shoots, cymose, 1-to 3- flowered, glabrous; bracts linear acute, 1-3 mm long; pedicels 5-12 mm long. *Calyx* glabrous; tube 2-2.5 mm long; lobes± setose, 1-1.5 mm long. *Corolla* white; tube 20-28 mm long; lobes 5,15-18 mm long, 10-15 mm broad, *Fruit* not known.

Vernacular name: Mali Liam (มะลิเหลี่ยม).

20. *Jasminum laurifolium* Roxb.

20a. var. *laurifolium*

Description: Woody climber, young shoots glabrous. *Leaves* somewhat coriaceous, very narrowly lanceolate, (6-)8-14 cm long, 1-2.5 cm broad; base narrowed and rounded onto the petiole; apex long acute and slightly acuminate; glabrous 2 lateral veins at the base forming a submarginal vein, pinnate primary veins more or less obscure, 5 to about 12 per side, obscurely or slightly raised reticulate above and below; without domatia; petioles glabrous, 5-10 mm long, articulated. *Inflorescence* cymose, axillary or terminal on small side shoots, (1-)3 -to 5- flowered, glabrous; bracts linear, 1 mm long; pedicels 3-30 mm long. *Calyx* tube 2-mm long; lobes filiform, 5-10 mm long glabrous. *Corolla* tube 13-19 mm long; lobes 9-8, 13-19 mm long, 1.5-2 mm broad. *Fruit* not known.

Vernacular name: Mali Lo (มะลิลอ)

20b. var. *brachylobum* Kurz

Description: Differs from var. *laurifolium* in its smaller calyx and sometimes broader leaves. Leaves very narrowly lanceolate to oblong-elliptic, 5-10 cm long, 1-3 cm broad; apex long acuminate and slightly acuminate to acuminate. *Calyx* tube 1-2 mm long and the lobes (1-) 2-3 mm long, usually somewhat reflexed in flower.

Vernacular name: Mali Rabam (มะลิระบำ)

21. *Jasminum maingayi* C. B.

Description: Woody climber, young shoots puberulent or glabrous. *Leaves* somewhat coriaceous, narrowly ovate to oblong-ovate, 9-11.5(-17)cm long, 2.5-4.5(-8) cm broad; base obtuse (to rounded), attenuate onto the petiole; apex acuminate; glabrous; 5 primary nerves on each side of the midrib, slightly raised below, not reticulate, obscure to slightly sunk above, without domatia; petioles 10-15 mm long, glabrous or puberulent. *Inflorescence* terminal on side shoots, cymose, dense, 7 to many flowered, finely pubscent, rarely remotely so, often subtened by a pair of reduced leaves; bracts linear, 3-5 mm long; pedicels 2-4 mm long. *Calyx* tube 2 mm long; lobes 5-10 mm long, subulate, finely puberulent. *Corolla* white; tube (15-) -25-30 mm long; lobes (8-)12-15 mm long, (3-)5-6 mm broad. *Fruit* (7 x 4 mm. ellipsoid) not known in Thai specimens.

Vernacular name: Mali Pun (มะลิปูน)

Notes. The specimens from Thailand appear to have somewhat smaller, less coriaceous leaves, up to 11.5 cm long and 4 cm broad.

22. *Jasminum multiflorum* (Burm. f.) Andr.

Description: Climber or straggler young shoots densely pilose. *Leaves* lanceolate-oblong to broadly ovate, (3-)4.5-6(-8) cm long, (1.8-)2-3(-6) cm broad; base-subcordate to truncate; apex acute, usually slightly acuminate; velutinous to densely pilose beneath, pirose above; 4 primary veins on each side of the midrib, raised pilose below, slightly raised or sunk above, pilose, venation otherwise±obscure; without domatia; petiole 4-15 mm long, densely pilose. *Inflorescence* terminal on axillary side shoots, cymose-corymbose, dense, 3 to many flowered, densely pilose; bracts resembling reduced leaves; pedicels 0.5-2 mm long. *Calyx* tube 1-1.5 mm long; lobes filiform, 4-10 mm long, densely pilose. *Corolla* tube 12-17 mm long; lobes 7-8, 12-17 mm long, 4-5 mm broad, *Fruit* ellipsoid, -8 mm long, 5 mm diameter.

Vernacular name: Mali som (มะลิซ่อม) (Bangkok), Maluli (มะลุลี), Mali Louay (มะลิเลื้อย) (Central, Trad)

23. *Jasminum nervasum* Lour.

Description: Woody climber young shoots glabrous to sometimes very finely puberulent at first. *Leaves* ovate to narrowly ovate or broadly lanceolate to lanceolate, (2.5-) 3.5-7(-12) cm long, (1-)1.5-3.5(-4.5) cm broad; glabrous base obtuse to rounded; apex acute to acuminate, often slenderly so; 2 main basal veins, 1 on each side of the midrib, becoming submarginal and linking up with about 3 lateral veins, raised reticulate below± obscure, slightly sunk above; without domatia. *Inflorescence* axillary, almost sessile, 1- to rarely 3-flowered, glabrous; pedicels 2-5 mm long. *Calyx* tube 2-3 mm long; lobes subulate, 5-12 mm long, glabrous. *Corolla* white; tube 12-20 mm long; lobes 7-8, 12-20 mm broad. *Fruit* ellipsoid-spheroid, 10-12 x 8-9 mm.

Vernacular name: Li yan (ลิย่าน), khiaongu (เขี้ยวงู), Mali din (มะลิดิน)

24. *Jasminum nobile* C. B. Clarke.


Description: Woody climber, young shoots glabrous. *Leaves* ± coriaceous, oblong-elliptic or ovate to broadly lanceolate, rarely elliptic or narrowly elliptic, 5-14 cm long, (1.5-) 2.5-5 cm broad; base acute to obtuse or rounded; apex somewhat acuminate; venation of 2 main veins arising from near midrib base and forming a submarginal vein, sometimes with a smaller outer pair as well, 2-3 obscure laterals nerves, 5 to about 12 per side, obscurely or slightly raised reticulate above and on each side of the midrib, sometimes slightly reticulate below, usually obscure above; without domatia; *Inflorescence* terminal on side shoots, (1-)3- flowered, glabrous; bracts linear, 2 mm long; pedicels 20-40 mm long. *Calyx* tube 2-mm long; lobes 6-10 mm long, subulate, glabrous. *Corolla* white, not fragrant; tube 25-35 mm long; lobes 7-9, oblong-elliptic, 8-18 mm broad. *Fruit* ellipsoid, 12 x 8 mm.

Vernacular name: Panyi (ปันหยี) (Chantburi), Mali pa (มะลิป่า) (Central, Naratiwas), Maliwan dong (มะลิวัลย์ดง) (Chantburi)

25. *Jasminum perissanthum* P. S. Green.

Description: Woody climber, young shoots glabrous. *Leaves* lanceolate, 4-5 cm long, 2.5-4 cm broad; base obtuse, slightly attenuate onto the petiole; apex long acute, slightly acuminate; glabrous; 5 primary veins on each side of the midrib, slightly raised below, not above, otherwise obscure; without domatia; petioles 8-10mm long. *Inflorescence* axillary, dense, on side shoots, cymose, dense, cymose-corymbose, about 10- to 20 flowered, glabrous; bracts ovate, leaf-like, 1.5-2 cm long, 1-1.5 cm broad; pedicels 1-2 mm long. *Calyx* tube 2 mm long; lobes linear, 5-7 mm long, glabrous. *Corolla* white, fragrant; tube 25-30 mm long; lobes 8-9, 12-15 mm long, 5-6 mm broad. *Fruit* not known.

Vernacular name: Mali Phu Kha (มะลิภูคา) (Nan)

26. *Jasminum pierreanum* Gagnep.


Description: Woody climber, young shoots glabrous. *Leaves* chartaceous, elliptic-oblong to usually narrowly obovate or broadly oblanceolate, (4.5-)6-12(-18) cm long, (1.7-)2.5-5(-7.5) cm broad; base rounded or broadly rounded, somewhat attenuate; apex acuminate; glabrous but base of midrib above usually pilose; venation raised, ± reticulate below, somewhat obscure above, about 4 primary veins on each side of the midrib; small domatia in the axils of 1-3 primary veins with the midrib; petioles 3-5 mm long, pilose on the upper surface. *Inflorescence* axillary or terminal on side shoots, 1-to 9 or more flowered, the cyme sometimes reduced to a single flower; subtended by a pair of small narrow bracts at the base of the pedicels, glabrous, bracts linear, 1-4 mm long, pedicels 2-5 mm long. *Calyx* tube slightly obconic or barrel-shaped, 1.5-2 mm long; lobes subulate to usually somewhat triangular, acute, 0.25-1 mm long, lobes usually arising from thickened ribs. *Corolla* white; tube 15-22 mm long; lobes usually 6, 9-12 mm long, 1-2 mm broad. *Fruit* spheroidal, 6 diameter.

Vernacular name: Mali Pi (มะลิปี) (Central)

Notes. Very close to *J. nepalense* Spreng. (*J. glandulosum* Wall. ex G. Don) of the Himalayas, and to the following species, *J. extensum*, from which latter it may be separated by its petioles being pilose above and lacking any distinct articulation.

27. *Jasminum rambayense* Kuntz

Description: Woody climber, young shoots densely tomentose. *Leaves* broadly ovate or broadly lanceolate, to oblong (4.5-)5.5-8.5(-12) cm long, 2.5-4(-5) cm broad; base rounded; apex acute, ± acuminate; pilose on the veins and midrib below, sometimes velutinous below and almost so above, margins ciliate-pilose; primary veins 4-5 on each side of the midrib; slightly raised above and below; with 2-6 tufted domatia in their axes on each side; petioles densely tomentose, 5-8 mm long, *Inflorescence* terminal on side shoots or less commonly axillary, crowded, cymose-corymbose 7- to many flowered; bracts 1-5 mm long; pedicels 0.5-1mm long. *Calyx* slightly obconic, ± tomentose, rarely almost glabrous; tube 2(-3) mm long; lobes broadly ovate-triangular, 1 mm long, acute or blunt, plicate, ± glabrous in the folds, apices somewhat divergent, rarely 2 mm long and very acute. *Corolla* white, tube 18-22 mm long; lobes 6-7, 10-12 mm long, 2-4 mm broad. *Fruit* spheroid, 7 diameter.

Vernacular name: Mali Ram (มะลิรำ) (Central)

28. *Jasminum scandens* (Retz.) Vahl

Description: Shrub or woody climber, young shoots finely puberous. *Leaves* lanceolate, 3.5-8(-12) cm long, 1.5-4(-6) cm broad; base rounded; apex acute; glabrous except for puberulous midrib below; 4-5 primary veins on each side of the midrib, raised below, level or slightly sunk above, without domatia; petioles 5-6(-20) mm long, finely puberulous. *Inflorescence* terminal on axillary shoots, dense cymose-corymbose, about 5- to 15 flowered, finely puberulous; bracts leaf-like, 10-30 mm long; 6-10 mm broad; pedicels 1-3 mm long. *Calyx* tube 1-2 mm long; lobes subulate-triangular, (0.5-)-1(-3) mm long, scattered puberulous to glabrous. *Corolla* white, scented; tube 10-12 mm long; lobes 5-6(-8) mm long, 1.5-2 mm broad. *Fruit* ellipsoid, 10-11 x 7-8 mm.

Vernacular name: Siao Phi (เสี้ยวผี) (Chiangmai), Kai Noi (ไก่น้อย) (Central, Laoi), Sai Kai (ไส้ไก่) (Central, Ubonrathani)

Notes. Near to *J. elongatum* but with a smaller corolla and a generally more western distribution.

29. *Jasminum siamense* Craib

Description: Suffrutex or straggling climber, 0.25 m tall or more, often with a woody base, young shoots finely pubelent. *Leaves* simple, elliptic or broadly elliptic to sometimes lanceolates, (1-)3-5 (-10) cm long, (0.8-)1.5-1(-5) cm broad, base attenuate onto the petiole; apex acute with a very small mucro; glabrous below and above; or minutely puberulent on the basal part of the midrib when young; venation slightly raised below and above, 3(-4) primary veins on each side of the midrib; without domatia; petiole 2-5 mm long, finely puberulent. *Inflorescence* terminal on side shoots, 1-to rarely 3 flowered, glabrous; pedicels 3-15 mm long. *Calyx* "leafy", tube 2 mm long; lobes (4-) 5-15 mm long, 1-4 mm broad, elliptic, with a midrib and sometimes 2 lateral veins, very finely puberulent to glabrous. *Corolla* white, tube 10-18 mm long; lobes 12-20 mm long, 2-4 mm broad, narrowly elliptic, acute. *Anthers* 4 mm long, ±sessile, connective appendage very small, acute. *Overy* barrel-shaped, 1 mm long. *Fruit* spheroid 6-8 mm diameter, red, orange.

Vernacular name: Dok siao (ดอกเสี้ยว), Khai kai (ไข่ไก่), mali mao (มะลิเมา)

30. *Jasminum stellipilum* Kerr

Description: Woody climber, young shoots densely stellate pilose, somewhat chartaceous. *Leaves* oblong elliptic, sometimes somewhat narrowly ovate or slightly oblanceolate, (3.5-)6-10 cm long, (1.5-)3-4.5 cm broad; base narrowed attenuate onto the petiole; apex acuminate; scattered stellate-pilose on both surfaces, especially below, becoming glabrate above except for the midrib and the margins; venation raised below, slightly sunk above, 2(-3) primary veins on each side of the midrib; without domatia; petioles 5-10 mm long, densely stellate-pilose. *Inflorescence* axillary or terminal on side shoots, compact, cymose, 3 flowered, densely stellate-pilose; bracts resembling reduced leaves or linear-lanceolate; pedicels 1-2 mm long. *Calyx* tube 1.5-2 mm long; lobes linear-filiform, (1.5-) 2-3 mm long, densely stellate-pilose. *Corolla* white; tube 18-20 mm long; lobes 7, 7-10 mm, long, 2-3 mm broad. *Fruit* beaked ovoid, 6-14 mm.

Vernacular name: Mali Lang Suan (มะลิหลังสวน) (Southern)

31. *Jasminum syringifolium* Wall ex G. Don

Description: Spreading shrub or woody climber, young shoots finely puberulous. *Leaves* ovate to lanceolate, 4-11 cm long, 2-5 cm broad; base rounded rarely narrowed; apex acute to acuminate; glabrous on both surfaces but midrib often puberulous towards the base; 3-4 primary veins on each side of the midrib, raised below, sunk above, otherwise venation obscure; without domatia; petioles 3-10 mm long, tomentose. *Inflorescence* terminal on side shoots, cymose to cymose-corymbose, 1-10 cm diameter, 5- to many flowered, puberulous; bracts linear, 1-7 mm long; pedicels 1-6 mm long. *Calyx* puberulous; especially the lobes, to subglabrous; tube 1.5-2 mm long; lobes narrowly triangular-subulate, 0.5-1.5 mm long. *Corolla* white; tube 11-13 mm long; lobes 7-8, 7-11 mm long, 2.5-3 mm broad. *Fruit* [ellipsoid, 14 x 8 mm].

Vernacular name: Mali Khiaongu Bai Laem (มะลิเขี้ยวงูใบแหลม) (Central, Surattani)

Notes. Very close to *J. elongatum* but differing by a combination of shorter calyx lobes and corolla tube, and a more open inflorescence not loosely subtended by leaf-like bracts.

32. *Jasminum bhumibolianum* Chalermglin

Description: Woody climber, 1-2 m with some short hair on young shoot. Leaf simple, rather thick, elliptic, 3-3.5 cm wide, 6-8 cm long: apex acuminate; base round; blade smooth and glossy; lateral nerve obscured, 3-4 pairs, no gland underneath; petiole 4-5 mm long. Inflorescence cyme, borne on the terminal of lateral branch, 7-13 florests; bract slender, 5-6 mm long; peduncle 2-3 mm long; calyx lobe short with 4-5 spiny sharp lobes, 3-4 mm wide. Open flower is 2-2.4 cm in diameter. Strongly scented. Fruit elliptic, 9-11 mm in size.

Vernacular name: Mali Chaloem Narin (มะลิเฉลิมนรินทร์)

32. *Jasminum cordatum* Ridl.

Description: Climber, 1-3 m. Leaf elliptic, cordate to lanceolate, 0.6-2 cm wide, 1.3-5.5 cm long: apex obtuse, cuspidate; base round; blade thick; veinlet 3-5 pairs, slightly ridged. The first pair prominent, approaching the second pair at the middle of the leaf; petiole 4-5 mm long. Inflorescence cyme, borne on the terminal of lateral branch, 7-13 florests; bract slender, 5-6 mm long; peduncle 2-3 mm long; calyx lobe short with 4-5 spiny sharp lobes, 1.5-5 mm long. Open flower is 2-3.5 cm in diameter; corolla tube 17-30 mm long. Strongly scented. Fruit ellipsoid, 7-9 mm in size.

Vernacular name: Mali chang (มะลิช้าง)

33. *Jasminum cordatum* Ridl. 'Dwaef'

Description: It is similar to *J. cordatum*. Its vine can climb, 1 m. Leaf orbicular to broad cordate, 1-1.5 cm wide, 1-1.8 cm long: apex obtuse, base round; blade thick; veinlet 2 pairs. The first pair shallowly grooved but prominent, approaching the second pair at the leaf apex; petiole 1.5-5 mm long. Inflorescence solitary, borne on the terminal of lateral branch, calyx lobe 2-5 mm long. Open flower is 2-3 cm in diameter; corolla tube white 15-20 mm long, 6-7 lobes, each is 2.5-5 mm wide. Strongly scented. Fruit ellipsoid, 7-9 mm in size.

Vernacular name: Mali chang Khrae (มะลิช้างแคระ)

34. *Jasminum rufohirtum* Gagnep.

Description: Climber, 1-3 m. The young shoots are quadrangular. There are dense long hair on young shoots, inflorescence and leaf. Leaf lanceolate or elliptic, 5-8 cm wide, 10-15 cm long: apex acute, base round; veinlet 6-8 pairs grooved on upper side, florescence cyme, borne on terminal with 5-many flowers; calyx lobe 3-8 mm long. Open flower is 2 cm in diameter; corolla tube 2.5-3 cm long with 5-8 petals, each is 3 mm wide. Strongly scented all day. Fruit ellipsoid, 6-10 mm in size.

Vernacular name: Mali Khon Fu (มะลิขนฟู)

35. *Jasminum* sp.1 'Mali Khao Ngoen'

Description: Woody climber, 1-3 m. Young shoot smooth. Leaf simple, rather thin, narrowly lanceolate 0.8-1.2 cm wide, 2.5-5.5 cm long: base round; apex acuminate; blade smooth and glossy; the first pairs of lateral vein prominent with grooved on upper side and ridge underneath, petiole 4-5 mm long. Inflorescence borne on the terminal with 1 flower; bract linear, 3-4 mm long; calyx lobe 10-12 mm long: corolla tube white, 22-25 mm long, tip split into 6-7 lobes, 4-6 mm wide. Strongly scented all day. Fruit ellipsoid, 6-10 mm in size; peduncle 3-4 mm long. Open flower is 2 cm in diameter. Strongly fragrant. Fruit ellipsoid, 8-12 mm in size.

Vernacular name: Mali Khao Ngoen (มะลิเขาเงิน)

36. *Jasminum* sp.2 'Phu Mu'

Description: Woody climber, 2-4 m. Young terminal shoot covered with short hair. Leaf simple, rather thick, narrowly lanceolate 2-2.5 cm wide, 6-7 cm long: base round; apex acuminate; blade smooth and glossy; the first 2 pairs of lateral nerve prominent with deep groove on upper side and high ridge underneath, no reticulated vein and no gland underneath; petiole 6-8 mm long. Inflorescence cyme, borne on the terminal; bract linear, 15-18 mm long; floret 1-3; peduncle 3-4 mm long; calyx lobe 15-18 mm long. Open flower is 5-6 cm in diameter: corolla tube pale pink, 15-18 mm long, tip split into 7-9 lobes, 3-5 mm wide. Strongly scented. Fruit ellipsoid, 7-9 cm in size.

Vernacular name: Mali Phu Mu (มะลิภูหมู)

37. *Jasminum aemulum* R. Br.

Description: A scandent, if grown far from other plants, it will grow as a bush, 2m high. It can climb as far as 10 m. Terminal shoot small, young branch hairy, old branch smooth. Leaf simple, ovate or lanceolate, 2.5 cm wide, 4-8 cm long: apex acute; base attenuate; lateral vein grooved on the upper side. Inflorescence cyme, 3.5 cm long, borne at terminal of lateral branch with 5-15 florets; calyx lobe curved, 3-5 mm long, covered with thick hair. Open flower is 1.5-2 cm in diameter: corolla tube 12-15 mm long, tip split into 6-8 lobes, 4-6 mm wide, cuspidate. Strongly scented. Fruit ellipsoid, 6-10 mm in size.

Vernacular name: Mali Aemulum (มะลิแอมูลัม)

38. *Jasminum angular* Vahl.

Description: Small climber, 1-2 m; terminal shoot 4 angled; compound leaf has 3 leaflets, lanceolate; the first pairs 2-2.5 cm wide, 4-5 cm long, the last leaflet is the largest, 2.5-3 cm wide, 5-6 cm long; apex obtuse; petiole 1 cm long; deep grooved on the upper side; blade smooth, glossy; lateral vein obscure. Inflorescence cyme, 7-13 florets, borne on the terminal of lateral branch, 4-6 cm long; calyx lobe 1 mm long. Open flower is 2.5-3 cm in diameter: corolla tube 14-18 mm long, tip split into 4-5 lobes. Soft and sweet fragrance. Fruit unrecorded.

Vernacular name: Mali Angul (มะลิอังกูล)

39. *Jasminum auriculatum* Vahl.

Description: A scandent shrub. Young shoot has short hair. Leaf elliptic, 2.5-3 cm wide, 4-5 cm long; apex acute; base round. Inflorescence panicle, borne on the tip of lateral branch, producing more than 50 flowers; calyx lobe 0.5 mm long. Open flower is 2 cm in diameter: corolla tube 12-15 mm long, tip split into 6 lobes, 4-5 mm wide. Strongly scented. Fruit unrecorded.

Vernacular name: Mali Phutthachat (มะลิพุทธชาด), Kai noi (ไก่น้อย) (central, Laoi)

40. *Jasminum azoricum* L.

Description: Small climber, 1-2 m; compound leaf has 3 leaflets, the first pairs lanceolate, small and short; the last leaflet lanceolate or ovate, large; petiole 1 cm. Inflorescence cyme, 5-11 florets, borne on the terminal of lateral branch, 4-6 cm long; calyx lobe 1 mm long. Open flower is 2.5-3 cm in diameter: corolla tube 10 mm long, petal 4-5 lobes, 5-7 mm wide, tip of lobe acuminate. No fruit reported.

Vernacular name: Azores Jasmine, Mali Prakai Dao (มะลิประกายดาว)

41. *Jasminum didymum* G. Forst subsp. *didymium*

Description: A scandent developes as a shrub, 2-4 m high, some can climb as far as 15 m. Leaf compound with 3 leaflets, the last is the largest, thick and hard. Sometimes a simple leaf is formed, 2.5-5 cm wide, 5-10 cm long; apex acute; base attenuate, terminal branch and leaf stiff, covered with short hair; lateral vein on the upper side consist of 4-5 pairs of shallow groove. Inflorescence panicle, 5-10 cm long with 15-50 florests; calyx lobe 1-2 mm long. Open flower is 1-1.2 cm in diameter: petal 4-5 lobes, 3-4 mm wide, tip of the petal drooped and twisted. Strongly scented. Fruit solitary or twin, spheroid, 8-12 mm in size.

Vernacular name: Mali Khayeng (มะลิเขย่ง)

42. *Jasminum elongatum* (Bergius) Willd. 'Mali Guangzhou'

Description: This species can climb as far as 2-3 m; produce many branchs. If grown far from other plants, it will grow as a shrub. Leaf ovate, 2.5-3.5 cm wide, 3-4 cm long; apex obtuse; base emarginate, margin undulate; lateral vein on the upper side prominently grooved. Inflorescence cyme, borne at the terminal of lateral branch with 7-13 florests; calyx lobe long and slender, 10-15 mm long. Open flower is 2.5-3 cm in diameter: corolla tube greenish white, 20-25 mm long, tip split into 7-9 lobes, apex mucronulate. Pistil extended over the flower. No fruit reported.

Vernacular name: Mali Guangzhou (มะลิกวางโจว)

43. *Jasminum fluminense* Vahl supsp. *gratissimum* (Deflers) P. S. Green

Description: A softwood climber can climb as far as 2-5 m. The shoot is quadrangular. Leaf compound, trifoliate. Leaflets lanceolate, 2-3 cm wide, 4-6 cm long, apex acute, base obtuse. Inflorescence cyme, borne at the terminal of lateral branch with 12-60 florests; calyx lobe 1 mm long. Open flower is 2.5-3 cm in diameter: corolla tube 16-20 mm long, tip split into 7-8 lobes. Mild scented. Fruit spheroid, 7-9 mm in size.

Vernacular name: Mali Phutthachat Luang (มะลิพุทธชาดหลวง)

44. *Jasminum fruticans* L.

Description: A scandent shrub, 1-2 m high. Shoot quadrangular, smooth. Leaf compound, trifoliate, sometimes single; terminal leaflet elliptic, the last is the largest and long, 1-1.5 cm wide, 2-3 cm long; apex round; base attenuate, lateral vein obscure. Inflorescence cyme, borne on terminal with 1-8 flowers; peduncle slender, 10 mm long; calyx lobe 3-5 mm long. Dark yellow flower is 1.5 cm in diameter: corolla tube 8-15 mm long with 5 round petals, each is 3-6 mm wide. Strongly scented all day. Fruit ellipsoid, 7-8 mm in size.

Vernacular name: Mali Chai Chana (มะลิชัยชนะ)

45. *Jasminum grandiflorum* (L.) Kobuski


Description: A softwood climber can climb as far as 2-5 m. Young shoot smooth and slender. Leaf compound, 5-7; leaflet lanceolate. Inflorescence cyme, borne at terminal branch with 9-15 florests; calyx lobe 3-6 mm long; unopen flower reddish purple. Open flower is 3-4 cm in diameter: corolla tube red-purplish white, 20-25 mm long, tip split into 5 lobes, 8- 12 mm wide. Scented all day. Fruit ellipsoid, 8-12 mm in size.

Vernacular name: Sathan (สถาน) (Chaingmai), Chakhan (จะขาน) (Mahongsorn), Mali Kan Daeng (มะลิก้านแดง)

46. *Jasminum humil* (L.)

Description: A climber can climb as far as 1-3 m. Young shoot smooth. Leaf compound, 5-9; leaflet oblanceolate, the last leaflet is the largest and the longest, 5 cm long; apex acute; base attenuate. Inflorescence cyme, terminal, 15-30 florests; calyx lobe 1 mm long. Open flower is 2.5-3 cm in diameter: corolla tube yellow, 20-25 mm long, tip split into 4-5 lobes, dark yellow, 4-8mm wide, extended or slightly curved. Mildly scented all day. No fruit reported.

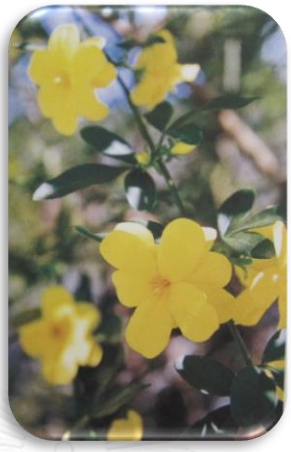
Vernacular name: Mali Lueang, Yellow Jasmine (มะลิเหลือง)

47. *Jasminum laurifolium* Roxb. var. *nitidum* (Skan) P. S. Green

Description: A small shrub, 1-2 m; sprout numerous branches near soil surface to form compact shrub. Branch stiff and tough. Young shoot smooth. Leaf lanceolate, 4-6 cm wide, 8-12 cm long; apex acuminate; base attenuate; blade thick, smooth and glossy. Inflorescence cyme, borne on the terminal; calyx lobe spreading upright: corolla tube purplish white, 9-11 lobes. No fruit reported.

Vernacular name: Mali Loung (มะลิหลวง)

48. *Jasminum mesnyi* Hance



Description: A climbling shrub with long hardwood branch, 2-5 m tall. Leaf compound, trifoliate, oblong-lanceolate; the first pairs 2-2.5 cm wide, 4-5 cm long, the last pairs 2.5-3 cm wide, 5-6 cm long; apex round; base attenuate, blade smooth, rather thick; lateral vein not prominent. Inflorescence cyme, borne on the lateral branch, 1-3 flowers; calyx lobe 4-5 mm long. Open flower is 4 cm in diameter: corolla tube yellow, 8-10 mm long, tip split into 8-10 lobes; petals 10-15 mm wide, overlapping in 2 layers. No scent and no record of fruit set.

Vernacular name: Japanese Jasmine, Primrose Jasmine (มะลิพริมโรส)

49. *Jasminum multiflorum* (Burm. f.) Andr. 'Mali Ngachang'

Description: A shrub, 0.50-1.50 m tall. Young shoot thick, soft short hair. Leaf elliptic to lanceolate, 2.5- 3 cm wide, 5-7 cm long; apex acuminate; base attenuate; midrib and lateral vein prominently deep grooved on the upper side; margin undulate; each lateral vein equally prominent with 4 pairs; petiole 6-8 mm long. Inflorescence borne on the terminal of lateral branch with 12-18 florets; bract acicular, 6-8 mm long; calyx lobe 10-15 mm long. Open flower is 7-8 mm in diameter; corolla tube white, 23-25 mm long, tip split into 6-8 lobes, lanceolate, 5-6 mm wide, 30-35 mm long; apex accumulate, spreading downward. No fragrance and fruit set. When withered, the flower changes to brown color and still attached to the inflorescence.

Vernacular name: 'Mali Ngachang'

50. *Jasminum multiflorum* (Burm. f.) Andr. 'Maluli Phum'

Description: A shrub, 20-50 cm tall, producing short branch. Leaf overlapping concisely, ovate, 1.5-2.5 cm wide, 3-4 cm long; apex acute; base obtuse. Inflorescence short cyme with 3-7 florets; calyx lobe 6-10 mm long. Open flower is 2-2.5 cm in diameter: corolla tube 10-15 mm long, tip split into 7-8 lobes; 2-4 mm wide. Scent but no fruit set.

Vernacular name: 'Maluli Phum'

51. *Jasminum multiflorum* (Burm. f.) Andr. 'Maluli Si Chomphu'

Description: A shrub, 1-2 m tall. Produce many branches to become compact shrub. Leaf elliptic, 2.5-4 cm wide, 5-7 cm long; apex acute; base obtuse; blade smooth and tough; petiole 6-10 mm long. Inflorescence cyme, borne on the lateral with 6-15 florets; calyx lobe 8-9 mm long, curved inward; flower bud pink. Open flower is 3-3.5 cm in diameter: corolla tube 10-12 mm, tip split into 8 lobes; petals 4-8 mm long, pink on the lower side and white on the upper side. Fruit ellipsoid, 8-12 mm in size.

Vernacular name: Maluli Si Chomphu

52. *Jasminum odoratissimum* L.

Description: A dwarf, 0.5-1 m tall with numerous short lateral branches. Leaf compound, 3-5 foliate, ovate; apex obtuse; base attenuate. Inflorescence corymb, borne at terminal of lateral branch with 5-11 florets; calyx lobe 1 mm long. Open flower is 1.5 cm in diameter: corolla tube yellow, 12-18 mm long, tip split into 5 lobes; thin, 5-8 mm wide, cuspidate, obtuse or retuse. Fruit has never been recorded.

Vernacular name: Mali Hom Lamai (มะลิหอมละไม)

53. *Jasminum polyanthum* Franch.

Description: A climber with 2-4 m vine. Young shoot covered with soft short dense hair. Leaf compound, 5-9 foliate; the last leaflet is the largest, lanceolate, 1.5-2 cm wide, 4-6 cm long; apex acute; base attenuate, petiole 12-15 mm long. Inflorescence large, borne at terminal; florets more than 50; calyx lobe 1 mm long. Open flower is 2.5-3 cm in diameter. Flower bud purplish red; corolla tube purplish red; 12-15 mm long, tip split into 5 lobes, 4-7 mm wide, white on the upper side and purplish red underneath. Strongly scented. No record of fruit set in Thailand.

Vernacular name: Mali Nepal (มะลิเนปาล), Pink Jasmine

54. *Jasminum sambac* (L.) Aiton 'Mali Chanthabun'

Description: A small shrub, 0.50-1 m tall, but sometimes it produces slender terminal shoots. Leaves elliptic or obtuse; lateral vein on the upper side deep grooved; leaf surface rough; margin undulate; calyx lobe curved, 8-12 mm long. Open flower is 3.5-4.5 cm in diameter; corolla tube greenish white, 13-17 mm long, tip split into 8-12 lobes, some of which overlap for 2 layer; petal 6-12 mm wide, there is a ridge lengthwise at the middle of the petal. Strongly scented. No record of fruit set.

55. *Jasminum sambac* (L.) Aiton 'Mali Chat Dok Bua'

Description: A small shrub, 0.50-1 m tall, with short upright shoot. Leaf ovate or elliptic, 4-6 cm wide, 6-10 cm long, 2-3 leaves attached in whorl around the branch; apex obtuse; base cordate; surface rough; lateral vein on the upper side deep grooved. Inflorescence cyme, borne on terminal; solitary or with 3 florets; petal arranged tightly with more than 5 layers. At the middle of the flower, petal attached tightly with each other. Open flower is 3-5.5 cm in diameter. Strongly scented. No record of fruit set.

56. *Jasminum sambac* (L.) Aiton 'Mali Chat Phikun'

Description: A small shrub, 0.50-1 m tall. It produces a short upright branch. Leaf simple, opposite, some arranged in 3 whorls; leaf elliptic, 3.5-6 cm wide, 6-10 cm long; apex obtuse; base cuneate. Flower solitary or cyme with 3 florets; borne at terminal of a branch, calyx lobe straight, 6-10 mm long. Open flower is 1.5-2 cm in diameter; corolla lobe arranged in 3-5 whorls, white or purple-reddish white. Strongly scented. No record of fruit set.

57. *Jasminum sambac* (L.) Aiton 'Mali La'

Description: A small shrub, 0.50-1 m tall. Upright branch rather long and slender. Leaf elliptic, 4-6 cm wide, 6-9 cm long, apex obtuse; base obtuse. Inflorescence cyme, borne at terminal of lateral branch with 3-7 florets; calyx lobe curved, 6-15 mm long. Open flower is 3-4 cm in diameter; corolla tube 10-13 mm long, tip split into 7-12 lobes, base overlapping each other to form 1-2 whorls, each lobe 8-12mm wide. Strongly scented. No record of fruit set in Thailand.

58. *Jasminum sambac* (L.) Aiton 'Mali Son'

Description: A scandent shrub with upright slender branch. Shoot quadrangular. Leaf simple, forming 3 whorls around the stem, thick and hard, ovate and elliptic, 3-5 cm wide, 6-10 cm long, apex obtuse; base cordate; surface rough with deep grooved of midrib and lateral nerve on the upper side. Flower solitary or cyme with 3-5 florets. Open flower is 3-4 cm in diameter; corolla lobe densely overlapping with more than 5 whorls. When fully open, the central of corolla lobe does not adhere to each other. Strongly scented. No record of fruit set.

59. *Jasminum sambac* (L.) Aiton 'Mali Thod'

Description: A small shrub, 0.50-1 m tall; producing short upright branch. Leaf simple, opposite, elliptic, 3.5-6 cm wide, 6-10 cm long, apex acute; base cuneate. Flower solitary or cyme with 3 florets, borne at terminal; calyx lobe straight, 6-10 mm long. Open flower is 1.5-2 cm in diameter; petal arranged in 3-4 white whorls, central of corolla lobe adhered to form a funnel. Strongly scented. No record of fruit set.

60. *Jasminum humile* 'Variegated'

Description: It is similar to the normal *J. humile* but in such similarity that differs, the flower does not receive the interest of the growers as much as the leaf, having white stripe, white patch or white mottle. It is recommended that compost should be used rather than chemical fertilizer. Do not use urea fertilizer as it will make the leaf greener with less variegation.

Vernacular name: Mali Lueang Bai Dang

61. *Jasminum multiflorum* 'Variegated'

Description: It is similar to the normal *J. multiflorum* but in such similarity that differs, the flower does not receive the interest of the growers as much as the leaf, having white stripe, white patch or white mottle.

Vernacular name: Maluli Bai Dang

62. *Jasminum nervosum* 'Variegated'

Description: It is similar to the normal *J. nervosum* but in such similarity that differs, the flower does not receive the interest of the growers as much as the leaf, having sweet delight pink stripe, less green color.

Vernacular name: Mali Khiao Ngu Lek Bai Dang

63. *Jasminum sambac* 'Variegated'

Description: It is similar to the normal *J. sambac* but in such similarity that differs, the flower does not receive the interest of the growers as much as the leaf, having white stripe**,** white patch or white mottle.

Vernacular name: Mali La Bai Dang

APPENDIX II

Microscopic evaluation

(Constant values of leaves)

Table 12 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Malila' (Location Bangkok)

Position	upper epidermal cell no. per mm2	epidermal cell area (μm2)	Number of epidermal cell per mm2	Number of stomata mm2	Stomata index mm2
1	1456	686.81	2396	300	11.13
2	1476	677.51	2352	272	10.37
3	1380	724.63	2272	328	12.62
4	1464	683.06	2224	344	13.40
5	1564	639.38	2340	300	11.36
6	1500	666.66	2400	308	11.37
7	1516	659.63	2336	316	11.92
8	1492	670.24	2368	312	11.64
9	1436	696.37	2392	360	13.08
10	1440	694.44	2400	300	11.11
11	1392	718.39	2412	352	12.74
12	1360	735.29	2240	348	13.45
13	1380	724.63	2300	364	13.66
14	1312	762.19	2060	348	14.45
15	1272	786.16	2196	308	12.30
16	1320	757.57	2200	280	11.29
17	1396	716.33	2296	320	12.23
18	1400	714.28	2256	320	12.42
19	1408	710.22	2244	300	11.79
20	1436	696.38	2152	248	10.33
21	1260	793.65	2000	288	12.59
22	1496	668.45	2160	260	10.74
23	1464	683.06	2236	348	13.47
24	1480	675.67	2400	304	11.24
25	1516	659.63	2344	264	10.12
26	1556	642.67	2268	320	12.36
27	1472	679.35	2348	292	11.06
28	1372	728.86	2080	336	13.91
29	1376	726.74	2380	360	13.14
30	1400	714.28	2400	308	11.37
Mean	**1426.40**	**703.08**	**2281.73**	**313.60**	**12.09**
SD	**76.97**	**38.84**	**111.38**	**31.17**	**1.14**

Table 13 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Malila' (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome number (mm2)	Vein terminal number (mm2)	Vein islets number (mm2)
1	13	3.25	8	10	4
2	13	3.25	7	10	5
3	12	3	8	11	4
4	13	3.25	6	9	4
5	14	3.5	7	9	5
6	13	3.25	6	8	4
7	11	2.75	5	7	3
8	13	3.25	7	7	6
9	14	3.5	7	12	3
10	12	3	6	6	5
11	13	3.25	9	4	6
12	13	3.25	8	5	6
13	17	4.25	10	4	5
14	12	3	0	5	3
15	11	2.75	8	6	4
16	14	3.5	8	5	6
17	13	3.25	6	6	4
18	11	2.75	5	8	6
19	16	4	5	9	2
20	14	3.5	7	6	5
21	13	3.25	7	4	5
22	13	3.25	8	5	4
23	12	3	8	7	4
24	13	3.25	6	4	4
25	13	3.25	9	9	6
26	11	2.75	9	6	6
27	11	2.75	7	6	4
28	12	3	7	6	4
29	15	3.75	6	7	5
30	14	3.5	7	5	5
Mean	12.97	3.24	6.90	6.87	4.57
SD	1.43	0.36	1.78	2.19	1.07

Table 14 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Malila' (Location Chonburi)

Position	upper epidermal cell no. per mm2	epidermal cell area (μm2)	Number of epidermal cell per mm2	Number of stomata mm2	Stomata index mm2
1	1900	526.31	2452	344	12.30
2	1848	541.12	2168	352	13.97
3	1940	515.46	2404	380	13.65
4	2024	494.07	2800	372	11.73
5	2000	500	2716	384	12.39
6	2100	476.19	2724	344	11.21
7	1804	554.32	2696	320	10.61
8	1788	559.28	2640	388	12.81
9	1784	560.54	2856	384	11.85
10	1744	573.39	3152	400	11.26
11	1848	541.12	3176	404	11.28
12	1804	554.32	3200	424	11.70
13	1788	559.28	3200	412	11.41
14	1760	568.18	3160	400	11.24
15	1800	555.55	3208	416	11.48
16	1920	520.83	2560	360	12.33
17	1780	561.79	2460	396	13.87
18	2052	487.33	2800	416	12.94
19	2072	482.62	3048	412	11.91
20	1568	637.75	2840	388	12.02
21	1684	593.82	2936	424	12.62
22	1740	574.71	2860	416	12.70
23	1684	593.82	2744	376	12.05
24	1640	609.76	2880	424	12.83
25	1720	581.39	2856	384	11.85
26	1816	550.66	2800	376	11.84
27	1792	558.03	2720	380	12.26
28	1840	543.47	2696	356	11.66
29	1816	550.66	2600	376	12.63
30	1840	543.48	2800	368	11.62
Mean	1829.87	548.98	2805.07	385.87	12.13
SD	126.67	37.37	258.55	26.73	0.80

Table 15 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Malila' (Location Chonburi)

Position	Palisade	Palisade Ratio	Trichome number (mm2)	Vein terminal number (mm2)	Vein islets number (mm2)
1	12	3	10	9	3
2	14	3.5	5	11	5
3	15	3.75	12	10	4
4	14	3.5	9	9	4
5	12	3	10	14	3
6	13	3.25	15	12	3
7	15	3.75	11	9	6
8	16	4	8	8	4
9	12	3	13	7	5
10	13	3.25	14	9	5
11	14	3.5	11	14	3
12	12	3	18	9	6
13	17	4.25	12	14	4
14	16	4	8	18	3
15	17	4.25	11	8	4
16	15	3.75	17	8	6
17	15	3.75	12	12	6
18	14	3.5	11	8	8
19	14	3.5	9	9	5
20	14	3.5	8	10	4
21	17	4.25	10	8	5
22	14	3.5	12	6	6
23	12	3	7	11	3
24	14	3.5	6	9	4
25	13	3.25	7	7	6
26	16	4	7	8	6
27	15	3.75	14	12	3
28	11	2.75	11	12	4
29	13	3.25	11	10	6
30	16	4	10	10	4
Mean	14.17	3.54	10.63	10.03	4.60
SD	1.66	0.42	3.06	2.59	1.30

Table 16 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Malila' (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	umber of epiderma cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2160	462.96	2544	304	10.67
2	2084	479.84	2704	324	10.70
3	1960	510.2	2720	332	10.88
4	2160	462.96	2760	340	10.97
5	2280	438.59	2712	324	10.67
6	2240	446.43	2736	344	11.17
7	2200	454.54	2840	360	11.25
8	2316	431.77	2800	348	11.05
9	2160	462.96	2816	352	11.11
10	2220	450.45	2704	332	10.94
11	2256	443.26	2600	304	10.47
12	2192	456.2	2720	348	11.34
13	1340	746.26	2720	328	10.76
14	1368	730.99	2840	352	11.03
15	1456	686.81	2816	348	11.00
16	1388	720.46	2520	356	12.38
17	1404	712.25	2440	320	11.59
18	1488	672.04	2800	356	11.28
19	1380	724.63	2720	316	10.41
20	1528	654.45	2600	344	11.68
21	1292	773.99	2816	292	9.40
22	1368	730.99	2720	332	10.88
23	1436	696.37	2736	304	10.00
24	1380	724.63	2560	352	12.09
25	1500	666.66	2840	364	11.36
26	1468	681.19	2584	336	11.51
27	1476	677.50	2560	368	12.57
28	1520	657.89	2600	344	11.68
29	1440	694.44	2568	360	12.30
30	1544	647.66	2720	324	10.64
Mean	1733.47	1733.47	2693.87	336.93	11.13
SD	383.89	383.89	110.05	19.78	0.68

Table 17 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Malila' (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome number (mm^2)	Vein terminal number (mm^2)	Vein islets number (mm^2)
1	14	3.50	11	7	8
2	12	3.00	8	6	6
3	14	3.50	6	8	6
4	14	3.50	5	9	3
5	14	3.50	6	14	6
6	13	3.25	4	4	3
7	15	3.75	5	8	3
8	13	3.25	2	6	8
9	12	3.00	6	8	4
10	15	3.75	7	10	4
11	12	3.00	8	7	3
12	14	3.50	7	7	7
13	15	3.75	8	9	5
14	12	3.00	6	7	4
15	17	4.25	5	10	4
16	14	3.50	6	7	4
17	18	4.50	6	13	8
18	15	3.75	5	9	4
19	15	3.75	6	12	4
20	13	3.25	5	8	4
21	12	3.00	7	9	5
22	14	3.50	6	11	7
23	13	3.25	10	8	6
24	10	2.50	7	6	5
25	12	3.00	11	6	6
26	12	3.00	6	7	5
27	10	2.50	7	9	4
28	17	4.25	10	10	5
29	16	4.00	8	10	6
30	17	4.25	9	7	4
Mean	13.80	3.45	6.77	8.40	5.03
SD	1.99	0.50	2.03	2.21	1.52

Table 18 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Malison' (Location Bangkok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2656	376.50	3676	468	11.29
2	2648	377.64	3476	428	10.96
3	2644	378.21	3600	400	10.00
4	2520	396.82	3520	432	10.93
5	2556	391.23	3504	424	10.79
6	2516	397.45	3488	416	10.66
7	2608	383.43	3520	440	11.11
8	2608	383.43	3560	440	11.00
9	2616	382.26	3568	432	10.80
10	2640	378.78	3576	448	11.13
11	2632	379.93	3520	440	11.11
12	2612	382.85	3544	448	11.22
13	2580	387.59	3520	444	11.20
14	2600	384.61	3500	440	11.17
15	2640	378.78	3520	448	11.29
16	2592	385.80	3544	460	11.49
17	2600	384.61	3560	456	11.35
18	2648	377.64	3600	448	11.07
19	2588	386.39	3640	440	10.78
20	2600	384.61	3636	448	10.97
21	2616	382.26	3556	448	11.19
22	2400	416.66	3600	444	10.98
23	2632	379.93	3640	440	10.78
24	2520	396.82	3560	432	10.82
25	2544	393.08	3556	424	10.65
26	2392	418.06	3512	428	10.86
27	2544	393.08	3520	440	11.11
28	2640	378.78	3560	448	11.18
29	2608	383.43	3564	440	10.99
30	2604	384.02	3580	432	10.77
Mean	2586.80	386.82	**3557.33**	**439.20**	**10.99**
SD	65.42	10.22	**48.70**	**13.30**	**0.28**

Table 19 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Malison' (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome number (mm^2)	Vein terminal number (mm^2)	Vein islets number (mm^2)
1	14	3.50	6	13	5
2	16	4.00	6	13	3
3	15	3.75	5	11	5
4	16	4.00	5	11	6
5	15	3.75	4	9	7
6	14	3.50	4	14	8
7	13	3.25	5	11	5
8	15	3.75	4	12	5
9	14	3.50	4	14	6
10	15	3.75	6	14	8
11	16	4.00	3	13	7
12	16	4.00	4	12	6
13	14	3.50	8	13	5
14	15	3.75	5	13	5
15	15	3.75	6	12	6
16	14	3.50	6	12	5
17	13	3.25	5	11	7
18	14	3.50	4	11	7
19	13	3.25	4	11	6
20	16	4.00	6	12	6
21	15	3.75	5	12	5
22	14	3.50	6	13	5
23	13	3.25	6	14	4
24	13	3.25	5	14	5
25	14	3.50	5	13	5
26	15	3.75	4	13	6
27	15	3.75	4	12	6
28	16	4.00	3	12	4
29	13	3.25	5	10	7
30	15	3.75	5	11	7
Mean	14.53	3.63	4.93	12.20	5.73
SD	1.04	0.26	1.08	1.27	1.17

Table 20 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Malison' (Location Chonburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2780	359.71	3400	408	10.71
2	2672	374.25	3440	416	10.79
3	2600	384.61	3448	412	10.67
4	2668	374.81	3416	440	11.41
5	2640	378.78	3440	460	11.79
6	2600	384.61	3464	432	11.09
7	2592	385.8	3460	412	10.64
8	2432	411.18	3480	408	10.49
9	2600	384.61	3504	408	10.43
10	2616	382.26	3460	412	10.64
11	2632	379.93	3480	408	10.49
12	2520	396.82	3488	412	10.56
13	2544	393.08	3472	416	10.70
14	2608	383.43	3520	432	10.93
15	2616	382.26	3528	440	11.09
16	2640	378.78	3496	448	11.36
17	2672	374.25	3464	448	11.45
18	2660	375.93	3480	456	11.59
19	2616	382.26	3520	440	11.11
20	2632	379.93	3496	432	11.00
21	2520	396.82	3480	416	10.68
22	2544	393.08	3472	408	10.52
23	2640	378.78	3480	408	10.49
24	2608	383.43	3488	416	10.66
25	2636	379.36	3360	432	11.39
26	2608	383.43	3400	440	11.46
27	2632	379.93	3440	440	11.34
28	2616	382.26	3472	432	11.07
29	2640	378.78	3480	424	10.86
30	2648	377.64	3520	460	11.56
Mean	**2614.40**	**382.69**	**3468.27**	**427.20**	**10.97**
SD	**60.58**	**9.00**	**38.42**	**17.05**	**0.40**

Table 21 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Malison' (Location Chonburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	15	3.75	7	15	6
2	15	3.75	8	14	4
3	14	3.50	9	11	5
4	16	4.00	11	15	5
5	16	4.00	10	13	5
6	15	3.75	8	14	5
7	12	3.00	10	14	8
8	13	3.25	2	15	7
9	15	3.75	3	11	6
10	12	3.00	4	14	7
11	13	3.25	3	14	6
12	13	3.25	5	15	5
13	14	3.50	4	14	5
14	14	3.50	3	13	6
15	15	3.75	9	15	5
16	16	4.00	5	14	7
17	16	4.00	5	11	5
18	15	3.75	4	11	5
19	14	3.50	4	16	8
20	13	3.25	5	14	7
21	14	3.50	8	13	4
22	15	3.75	6	13	5
23	12	3.00	5	11	5
24	13	3.25	4	11	5
25	15	3.75	5	12	5
26	14	3.50	6	14	6
27	15	3.75	5	14	7
28	15	3.75	5	12	5
29	16	4.00	5	11	5
30	15	3.75	5	14	6
Mean	**14.33**	**3.58**	**5.77**	**13.27**	**5.67**
SD	**1.24**	**0.31**	**2.34**	**1.53**	**1.06**

Table 22 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Malison' (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2640	378.78	3440	440	11.34
2	2600	384.61	3500	432	10.99
3	2608	383.43	3560	436	10.91
4	2640	378.78	3472	448	11.43
5	2544	393.08	3480	440	11.22
6	2636	379.36	3496	420	10.73
7	2640	378.78	3520	432	10.93
8	2544	393.08	3600	436	10.80
9	2616	382.26	3640	440	10.78
10	2632	379.93	3560	448	11.18
11	2640	378.78	3520	448	11.29
12	2672	374.25	3548	440	11.03
13	2600	384.61	3540	432	10.88
14	2660	375.93	3560	448	11.18
15	2672	374.25	3552	440	11.02
16	2640	378.78	3600	432	10.71
17	2636	379.36	3512	436	11.04
18	2648	377.64	3480	440	11.22
19	2720	367.64	3504	440	11.16
20	2632	379.93	3520	432	10.93
21	2616	382.26	3560	448	11.18
22	2544	393.08	3472	440	11.25
23	2400	416.66	3520	440	11.11
24	2624	381.09	3504	400	10.25
25	2640	378.78	3520	448	11.29
26	2672	374.25	3600	432	10.71
27	2656	376.50	3600	436	10.80
28	2632	379.93	3560	440	11.00
29	2616	382.26	3576	440	10.96
30	2640	378.78	3584	432	10.76
Mean	**2622.00**	381.56	**3536.67**	**437.20**	**11.00**
SD	**56.37**	**8.62**	**47.29**	**9.58**	**0.25**

Table 23 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Malison' (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	14	3.50	3	14	6
2	12	3.00	3	14	6
3	15	3.75	3	13	5
4	11	2.75	10	12	5
5	11	2.75	10	14	6
6	14	3.50	15	15	5
7	15	3.75	6	14	5
8	15	3.75	8	15	6
9	14	3.50	10	15	6
10	14	3.50	11	11	7
11	15	3.75	13	11	7
12	16	4.00	13	12	6
13	16	4.00	14	13	6
14	15	3.75	10	13	7
15	14	3.50	13	14	6
16	13	3.25	15	12	5
17	14	3.50	10	12	5
18	14	3.50	12	12	6
19	14	3.50	10	11	5
20	15	3.75	16	12	7
21	13	3.25	10	11	5
22	13	3.25	13	12	4
23	15	3.75	12	12	5
24	14	3.50	10	13	5
25	16	4.00	10	14	7
26	15	3.75	12	14	7
27	15	3.75	10	14	7
28	16	4.00	10	15	6
29	14	3.50	9	13	5
30	14	3.50	10	13	6
Mean	**14.20**	**3.55**	**10.37**	**13.00**	**5.80**
SD	**1.30**	**0.32**	**3.30**	**1.29**	**0.85**

Table 24 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Chat Phikun' (Location Bangkok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2312	432.52	2580	280	9.79
2	2280	438.59	2668	240	8.25
3	2224	449.64	2748	216	7.29
4	2520	396.82	2760	228	7.63
5	2880	347.22	2804	240	7.88
6	2800	357.14	2756	216	7.27
7	2812	355.61	2532	204	7.46
8	2680	373.13	2632	224	7.84
9	2560	390.62	2684	248	8.46
10	2480	403.22	2760	276	9.09
11	2240	446.42	2820	284	9.15
12	2432	411.18	2720	260	8.72
13	2608	383.43	2600	276	9.60
14	2600	384.61	2712	264	8.87
15	2592	385.80	2588	304	10.51
16	2680	373.13	2600	236	8.32
17	2816	355.11	2616	240	8.40
18	2720	367.64	2720	192	6.59
19	2640	378.78	2800	300	9.68
20	2536	394.32	2816	308	9.86
21	2336	428.08	2752	208	7.03
22	2268	440.91	2792	204	6.81
23	2200	454.54	2800	304	9.79
24	2228	448.83	2740	260	8.67
25	2232	448.02	2752	248	8.27
26	2256	443.26	2760	268	8.85
27	2280	438.59	2600	264	9.22
28	2300	434.78	2680	236	8.09
29	2312	432.52	2628	228	7.98
30	2320	431.03	2712	204	7.00
Mean	**2471.47**	**407.52**	**2704.40**	**248.67**	**8.41**
SD	**214.97**	**34.60**	**81.92**	**33.27**	**1.02**

Table 25 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Mali Chat Phikun' (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	11	2.75	10	11	3
2	12	3.00	12	10	3
3	13	3.25	10	7	3
4	11	2.75	13	9	4
5	14	3.50	11	8	4
6	12	3.00	10	7	5
7	13	3.25	8	9	6
8	14	3.50	12	13	5
9	12	3.00	9	7	4
10	15	3.75	7	5	4
11	13	3.25	8	6	2
12	11	2.75	11	7	4
13	11	2.75	8	6	3
14	12	3.00	11	6	2
15	13	3.25	11	6	3
16	14	3.50	9	11	2
17	13	3.25	8	9	3
18	13	3.25	9	10	4
19	14	3.50	12	11	2
20	12	3.00	14	8	4
21	15	3.75	11	8	3
22	15	3.75	13	16	2
23	14	3.50	9	8	5
24	15	3.75	13	10	4
25	13	3.25	11	11	4
26	13	3.25	10	9	3
27	14	3.50	12	10	4
28	13	3.25	8	9	3
29	12	3.00	7	10	2
30	12	3.00	11	9	2
Mean	**12.97**	**3.24**	**10.27**	**8.87**	**3.40**
SD	**1.25**	**0.31**	**1.91**	**2.33**	**1.07**

Table 26 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Chat Phikun' (Location Nonthaburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1736	576.03	3056	288	8.61
2	1812	551.87	3024	336	10.00
3	1724	580.04	3076	360	10.48
4	2000	500.00	2792	316	10.17
5	1884	530.78	2916	336	10.33
6	1960	510.2	2880	300	9.43
7	1764	566.89	2808	280	9.07
8	2072	482.62	2808	324	10.34
9	1828	547.04	3048	376	10.98
10	2060	485.43	3000	332	9.96
11	1812	551.87	2760	328	10.62
12	1904	525.21	2800	304	9.79
13	1668	599.52	2792	276	9.00
14	1920	520.83	3016	324	9.70
15	1908	524.10	2960	348	10.52
16	1944	514.40	2900	344	10.60
17	1740	574.71	3000	320	9.64
18	1916	521.92	3040	332	9.85
19	1904	525.21	2984	316	9.58
20	2000	500.00	3032	332	9.87
21	2076	481.69	2880	320	10.00
22	2040	490.19	2960	320	9.76
23	1988	503.01	2984	360	10.77
24	1992	502.00	3060	340	10.00
25	2000	500.00	2952	336	10.22
26	2040	490.19	2972	360	10.80
27	1984	504.03	3040	356	10.48
28	1912	523.01	3056	368	10.75
29	2072	482.62	2984	360	10.77
30	1956	511.24	2852	284	9.06
Mean	**1920.53**	**522.56**	**2947.73**	**329.20**	**10.04**
SD	**114.75**	**32.45**	**97.15**	**26.39**	**0.61**

Table 27 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Mali Chat Phikun' (Location Nonthaburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	13	3.25	3	8	3
2	12	3.00	5	8	3
3	16	4.00	3	6	5
4	14	3.50	4	6	5
5	15	3.75	5	6	6
6	13	3.25	4	5	3
7	13	3.25	6	9	2
8	12	3.00	3	6	4
9	14	3.50	6	6	3
10	14	3.50	7	7	5
11	16	4.00	4	6	3
12	15	3.75	5	5	3
13	12	3.00	7	8	6
14	13	3.25	8	6	4
15	14	3.50	5	5	3
16	12	3.00	6	7	5
17	15	3.75	3	6	3
18	13	3.25	6	8	5
19	15	3.75	7	5	3
20	14	3.50	3	7	4
21	15	3.75	8	7	2
22	13	3.25	3	8	2
23	13	3.25	5	7	4
24	13	3.25	5	6	3
25	14	3.50	6	8	2
26	14	3.50	4	8	3
27	12	3.00	6	8	4
28	14	3.50	6	6	2
29	13	3.25	6	4	3
30	13	3.25	3	7	4
Mean	**13.63**	**3.41**	**5.07**	**6.63**	**3.57**
SD	**1.16**	**0.29**	**1.55**	**1.22**	**1.17**

Table 28 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Chat Phikun' (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1560	641.02	3092	400	11.45
2	1520	657.89	3180	360	10.17
3	1412	708.21	2672	352	11.64
4	1600	625.00	3000	368	10.93
5	1564	639.38	3200	436	11.99
6	1640	609.75	3240	412	11.28
7	1628	614.25	3072	408	11.72
8	1592	628.14	3120	392	11.16
9	1652	605.32	3240	384	10.60
10	1620	617.28	3260	436	11.80
11	1504	664.89	3360	400	10.64
12	1520	657.89	3340	360	9.73
13	1468	681.19	3432	376	9.87
14	1460	684.93	3392	352	9.40
15	1704	586.85	3072	324	9.54
16	1640	609.75	3156	360	10.24
17	1648	606.79	3240	320	8.99
18	1672	598.08	3292	400	10.83
19	1584	631.31	3256	416	11.33
20	1540	649.35	3200	304	8.68
21	1472	679.34	3332	392	10.53
22	1640	609.75	3292	384	10.45
23	1672	598.08	3260	400	10.93
24	1632	612.74	3200	392	10.91
25	1436	696.37	3160	416	11.63
26	1480	675.67	3184	420	11.65
27	1500	666.66	3200	400	11.11
28	1468	681.19	3260	396	10.83
29	1604	623.44	3220	368	10.26
30	1552	644.32	3200	388	10.81
Mean	**1566.13**	**640.16**	**3204.13**	**383.87**	**10.70**
SD	**80.39**	**33.30**	**139.29**	**32.27**	**0.85**

Table 29 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Mali Chat Phikun' (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	11	2.75	8	10	1
2	16	4.00	7	12	3
3	18	4.50	9	8	1
4	14	3.50	8	13	1
5	17	4.25	7	12	1
6	15	3.75	7	9	1
7	14	3.50	5	9	4
8	18	4.50	3	8	2
9	16	4.00	4	9	3
10	15	3.75	2	9	2
11	14	3.50	8	10	4
12	13	3.25	8	8	5
13	14	3.50	11	10	3
14	13	3.25	9	8	3
15	14	3.50	8	7	1
16	12	3.00	3	6	2
17	15	3.75	9	12	3
18	13	3.25	6	8	2
19	16	4.00	6	6	1
20	15	3.75	7	7	1
21	15	3.75	6	10	0
22	14	3.50	5	9	3
23	15	3.75	7	6	5
24	13	3.25	2	10	0
25	15	3.75	5	7	3
26	14	3.50	11	5	1
27	12	3.00	6	9	2
28	16	4.00	7	7	1
29	16	4.00	5	10	2
30	18	4.50	4	10	1
Mean	**14.70**	**3.68**	**6.43**	**8.80**	**2.07**
SD	**1.76**	**0.44**	**2.34**	**1.97**	**1.34**

Table 30 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Thod' (Location Bangkok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1372	728.86	2344	264	10.12
2	1324	755.28	2280	256	10.09
3	1376	726.74	2368	252	9.62
4	1408	710.22	2268	232	9.28
5	1400	714.28	2232	212	8.67
6	1364	733.13	2280	236	9.38
7	1380	724.63	2296	236	9.32
8	1400	714.28	2320	232	9.09
9	1380	724.63	2424	260	9.69
10	1392	718.39	2272	240	9.55
11	1400	714.28	2264	208	8.41
12	1352	739.64	2336	232	9.03
13	1392	718.39	2360	260	9.92
14	1352	739.64	2348	240	9.27
15	1400	714.28	2432	228	8.57
16	1340	746.26	2400	228	8.68
17	1344	744.04	2152	228	9.58
18	1360	735.29	2232	232	9.42
19	1380	724.63	2272	272	10.69
20	1348	741.83	2360	256	9.79
21	1356	737.46	2424	268	9.96
22	1400	714.28	2392	252	9.53
23	1380	724.63	2280	272	10.66
24	1392	718.39	2356	228	8.82
25	1408	710.22	2400	272	10.18
26	1400	714.28	2320	252	9.80
27	1372	728.86	2400	260	9.77
28	1384	722.54	2384	240	9.15
29	1372	728.86	2412	264	9.87
30	1380	724.63	2400	248	9.37
Mean	**1376.93**	**726.43**	**2333.60**	**245.33**	**9.51**
SD	**22.13**	**11.78**	**69.46**	**17.65**	**0.57**

Table 31 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Mali Thod' (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	23	5.75	6	7	3
2	19	4.75	5	5	3
3	22	5.50	5	5	3
4	19	4.75	6	6	5
5	21	5.25	6	5	6
6	15	3.75	3	7	4
7	21	5.25	5	10	3
8	18	4.50	3	6	4
9	22	5.50	2	4	3
10	22	5.50	4	7	3
11	22	5.50	4	7	5
12	20	5.00	5	5	5
13	20	5.00	6	6	5
14	21	5.25	4	5	3
15	19	4.75	6	5	4
16	19	4.75	5	5	4
17	19	4.75	5	9	6
18	19	4.75	5	7	4
19	22	5.50	5	7	3
20	20	5.00	4	5	4
21	20	5.00	8	7	4
22	21	5.25	3	5	6
23	20	5.00	2	7	5
24	19	4.75	7	5	2
25	21	5.25	7	7	5
26	22	5.50	7	5	6
27	19	4.75	5	8	4
28	20	5.00	3	7	4
29	20	5.00	7	5	4
30	19	4.75	6	7	4
Mean	**20.13**	**5.03**	**4.97**	**6.20**	**4.13**
SD	**1.61**	**0.40**	**1.54**	**1.37**	**1.07**

Table 32 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Thod' (Location Chonburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1360	735.29	2560	248	8.83
2	1352	739.64	2312	236	9.26
3	1400	714.28	2800	256	8.38
4	1400	714.28	2388	252	9.55
5	1392	718.39	2880	232	7.46
6	1360	735.29	2600	240	8.45
7	1408	710.22	2800	252	8.26
8	1416	706.21	2320	232	9.09
9	1360	735.29	2240	260	10.40
10	1388	720.46	2312	240	9.40
11	1400	714.28	2224	216	8.85
12	1360	735.29	2184	244	10.05
13	1352	739.64	2120	252	10.62
14	1348	741.83	2240	240	9.68
15	1400	714.28	2192	232	9.57
16	1356	737.46	2184	224	9.30
17	1384	722.54	2200	228	9.39
18	1408	710.22	2280	236	9.38
19	1420	704.22	2280	256	10.09
20	1400	714.28	2312	248	9.69
21	1392	718.39	2400	256	9.64
22	1392	718.39	2376	240	9.17
23	1384	722.54	2416	268	9.99
24	1396	716.33	2400	248	9.37
25	1376	726.74	2512	280	10.03
26	1400	714.28	2400	260	9.77
27	1392	718.39	2440	256	9.50
28	1392	718.39	2360	256	9.79
29	1400	714.28	2424	264	9.82
30	1400	714.28	2344	240	9.29
Mean	**1386.27**	**721.51**	**2383.33**	**246.40**	**9.40**
SD	**20.63**	**10.82**	**187.88**	**13.96**	**0.66**

Table 33 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* ‘‘Mali Thod’ (Location Chonburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	19	4.75	5	5	4
2	19	4.75	5	7	3
3	22	5.50	3	5	4
4	21	5.25	6	5	3
5	18	4.50	4	6	3
6	22	5.50	5	7	5
7	20	5.00	3	6	3
8	18	4.50	5	8	4
9	20	5.00	4	9	3
10	20	5.00	6	5	3
11	21	5.25	2	6	4
12	22	5.50	4	10	5
13	19	4.75	5	6	5
14	20	5.00	6	7	4
15	18	4.50	4	6	4
16	19	4.75	4	5	5
17	19	4.75	5	5	3
18	20	5.00	5	8	3
19	21	5.25	5	5	4
20	23	5.75	3	6	4
21	19	4.75	5	6	5
22	20	5.00	6	5	4
23	22	5.50	7	7	4
24	18	4.50	8	6	5
25	19	4.75	7	6	6
26	19	4.75	7	5	5
27	19	4.75	7	6	4
28	19	4.75	5	4	5
29	20	5.00	5	5	5
30	20	5.00	6	5	3
Mean	**19.87**	**4.97**	**5.07**	**6.07**	**4.07**
SD	**1.36**	**0.34**	**1.39**	**1.34**	**0.87**

Table 34 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Thod' (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1388	720.46	2584	296	10.28
2	1400	714.28	2400	276	10.31
3	1360	735.29	2320	284	10.91
4	1400	714.28	2360	272	10.33
5	1352	739.64	2160	280	11.48
6	1392	718.39	2400	280	10.45
7	1388	720.46	2336	276	10.57
8	1400	714.28	2320	244	9.52
9	1380	724.63	2344	280	10.67
10	1408	710.22	2400	248	9.37
11	1392	718.39	2304	252	9.86
12	1392	718.39	2336	232	9.03
13	1396	716.33	2240	256	10.26
14	1400	714.28	2280	248	9.81
15	1384	722.54	2348	236	9.13
16	1420	980.39	2264	232	9.29
17	1356	737.46	2336	240	9.32
18	1392	718.39	2360	248	9.51
19	1384	722.54	2360	224	8.67
20	1400	714.28	2424	232	8.73
21	1396	716.33	2392	248	9.39
22	1396	716.33	2280	256	10.09
23	1392	718.39	2400	236	8.95
24	1392	718.39	2320	232	9.09
25	1400	714.28	2392	240	9.12
26	1400	714.28	2400	244	9.23
27	1400	714.28	2344	252	9.71
28	1392	718.39	2336	240	9.32
29	1388	720.46	2312	232	9.12
30	1396	716.33	2368	248	9.48
Mean	**1391.20**	**728.08**	**2347.33**	**252.13**	**9.70**
SD	**14.19**	**48.15**	**71.72**	**19.33**	**0.69**

Table 35 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Mali Thod' (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	20	5.00	5	6	3
2	21	5.25	6	6	4
3	19	4.75	6	5	4
4	18	4.50	7	7	5
5	18	4.50	5	5	6
6	19	4.75	4	5	5
7	20	5.00	3	4	5
8	21	5.25	4	7	5
9	21	5.25	5	5	4
10	19	4.75	4	5	3
11	19	4.75	5	6	4
12	22	5.50	3	7	4
13	23	5.75	4	5	5
14	21	5.25	4	5	4
15	23	5.75	5	6	6
16	22	5.50	6	8	7
17	21	5.25	6	7	8
18	23	5.75	7	3	6
19	22	5.50	3	5	5
20	21	5.25	2	6	5
21	21	5.25	4	6	7
22	23	5.75	5	8	4
23	18	4.50	5	7	4
24	19	4.75	4	7	4
25	21	5.25	3	6	5
26	20	5.00	4	5	5
27	21	5.25	4	5	6
28	20	5.00	5	6	4
29	19	4.75	3	6	4
30	18	4.50	3	6	5
Mean	**20.43**	**5.11**	**4.47**	**5.83**	**4.87**
SD	**1.59**	**0.40**	**1.25**	**1.12**	**1.17**

Table 36 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Chat Dokbua' (Location Bangkok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1920	520.83	2412	360	12.99
2	1836	544.66	2480	264	9.62
3	1720	581.39	2600	344	11.68
4	1760	568.18	2472	404	14.05
5	1772	564.33	2408	352	12.75
6	1920	520.83	2760	360	11.54
7	1840	543.47	2364	320	11.92
8	1820	549.45	2632	480	15.42
9	1912	523.01	2720	420	13.38
10	1800	555.55	2736	384	12.31
11	1744	573.39	2768	452	14.04
12	1752	570.77	2760	400	12.66
13	1952	512.29	2712	460	14.50
14	1960	510.20	2744	440	13.82
15	1928	518.67	2760	488	15.02
16	1920	520.83	2716	472	14.81
17	1912	523.01	2392	480	16.71
18	1860	537.63	2560	420	14.09
19	1952	512.29	2580	384	12.96
20	1952	512.29	2720	424	13.49
21	1904	525.21	2700	400	12.90
22	1920	520.83	2760	392	12.44
23	1972	507.09	2712	372	12.06
24	1900	526.31	2736	440	13.85
25	1960	510.20	2744	432	13.60
26	1920	520.83	2700	392	12.68
27	1912	523.01	2712	356	11.60
28	1860	537.63	2392	400	14.33
29	1832	545.85	2756	408	12.90
30	1848	541.12	2712	468	14.72
Mean	**1875.33**	**534.04**	**2640.67**	**405.60**	**13.29**
SD	**73.04**	**21.36**	**137.02**	**51.96**	**1.41**

Table 37 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Mali Chat Dokbua' (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	14	3.50	1	6	6
2	11	2.75	0	6	6
3	12	3.00	3	6	4
4	15	3.75	2	5	5
5	12	3.00	1	6	4
6	13	3.25	1	8	5
7	12	3.00	1	6	4
8	14	3.50	5	6	3
9	13	3.25	0	5	3
10	12	3.00	2	7	7
11	12	3.00	4	8	3
12	13	3.25	4	8	5
13	14	3.50	3	6	3
14	10	2.50	0	5	3
15	12	3.00	1	7	4
16	10	2.50	4	7	4
17	12	3.00	1	7	5
18	16	4.00	1	6	5
19	12	3.00	0	7	6
20	12	3.00	2	5	4
21	15	3.75	0	6	4
22	13	3.25	2	5	4
23	13	3.25	1	9	5
24	12	3.00	1	7	6
25	12	3.00	2	8	5
26	14	3.50	0	7	5
27	13	3.25	2	7	4
28	12	3.00	2	6	5
29	12	3.00	1	8	5
30	13	3.25	2	8	4
Mean	**12.67**	**3.17**	**1.63**	**6.60**	**4.53**
SD	**1.35**	**0.34**	**1.35**	**1.10**	**1.04**

Table 38 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Chat Dokbua' (Location Chonburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1908	524.10	3000	320	9.64
2	1872	534.18	2940	356	10.80
3	1800	555.55	2916	400	12.06
4	1820	549.45	2940	368	11.12
5	1728	578.70	2936	364	11.03
6	1792	558.03	3000	380	11.24
7	1832	545.85	2884	440	13.24
8	1848	541.12	2892	392	11.94
9	1840	543.47	2960	428	12.63
10	1840	543.47	2948	384	11.52
11	1736	576.03	2912	420	12.61
12	1800	555.55	3000	348	10.39
13	1752	570.77	2948	392	11.74
14	1792	558.03	2912	356	10.89
15	1760	568.18	2936	404	12.10
16	1888	529.66	2912	392	11.86
17	1848	541.12	2980	400	11.83
18	1880	531.91	3000	408	11.97
19	1840	543.47	2984	448	13.05
20	1860	537.63	2968	440	12.91
21	1828	547.04	2948	448	13.19
22	1836	544.66	2972	388	11.55
23	1832	545,85	2980	360	10.78
24	1860	537.63	2940	396	11.87
25	1800	555.55	2972	440	12.90
26	1880	531.91	3000	392	11.56
27	1848	541.12	2992	400	11.79
28	1860	537.63	2944	420	12.49
29	1880	531.91	3000	448	12.99
30	1860	537.63	2952	380	11.40
Mean	**1830.67**	**546.60**	**2955.60**	**397.07**	**11.84**
SD	**45.31**	**14.01**	**34.30**	**32.95**	**0.88**

Table 39 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Mali Chat Dokbua' (Location Chonburi)

Position	Palisade	Palisade Ratio	Trichome number (mm^2)	Vein terminal number (mm^2)	Vein islets number (mm^2)
1	11	2.75	2	5	6
2	12	3.00	3	8	4
3	11	2.75	3	8	5
4	14	3.50	4	9	4
5	14	3.50	3	5	5
6	12	3.00	5	8	5
7	11	2.75	4	5	5
8	11	2.75	5	6	3
9	12	3.00	6	7	3
10	11	2.75	5	7	5
11	11	2.75	3	10	4
12	12	3.00	4	12	5
13	12	3.00	5	10	4
14	12	3.00	4	9	4
15	10	2.50	5	5	5
16	11	2.75	4	9	5
17	12	3.00	4	10	6
18	14	3.50	6	8	6
19	12	3.00	7	6	4
20	14	3.50	5	8	6
21	15	3.75	6	5	3
22	12	3.00	5	9	3
23	11	2.75	5	7	3
24	12	3.00	5	9	6
25	10	2.50	6	14	5
26	12	3.00	6	10	6
27	14	3.50	3	15	5
28	12	3.00	5	11	6
29	11	2.75	4	14	6
30	12	3.00	5	13	5
Mean	**12.00**	**3.00**	**4.57**	**8.73**	**4.73**
SD	**1.26**	**0.31**	**1.17**	**2.83**	**1.05**

Table 40 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Chat Dokbua' (Location Nonthaburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1660	602.40	2636	432	14.08
2	1712	584.11	2756	400	12.67
3	1800	555.55	2704	380	12.32
4	1880	531.91	2720	412	13.15
5	1788	559.28	2736	460	14.39
6	1920	520.83	2800	420	13.04
7	2020	495.04	2812	412	12.78
8	1940	515.46	2840	440	13.41
9	1920	520.83	2760	392	12.44
10	1920	520.83	2800	400	12.50
11	1872	534.18	2880	436	13.15
12	1880	531.91	2792	448	13.83
13	2000	500.00	2740	388	12.40
14	1960	510.20	2896	416	12.56
15	1840	543.47	2880	448	13.46
16	2000	500.00	2760	432	13.53
17	2012	497.01	2780	396	12.47
18	2000	500.00	2840	440	13.41
19	1880	531.91	2848	392	12.10
20	1940	515.46	2880	400	12.20
21	2000	500.00	2740	420	13.29
22	1960	510.20	2792	400	12.53
23	1804	554.32	2800	456	14.00
24	1816	550.66	2860	436	13.23
25	1960	510.20	2900	444	13.28
26	2000	500.00	2880	432	13.04
27	1784	560.53	2912	372	11.33
28	2008	498.00	2860	440	13.33
29	1920	520.83	2840	452	13.73
30	1904	525.21	2872	360	11.14
Mean	**1903.33**	**526.68**	**2810.53**	**418.53**	**12.96**
SD	**93.71**	**27.10**	**67.76**	**26.63**	**0.75**

Table 41 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Mali Chat Dokbua' (Location Nonthaburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	14	3.50	2	9	6
2	12	3.00	5	8	5
3	12	3.00	3	8	6
4	12	3.00	4	7	3
5	11	2.75	3	10	3
6	13	3.25	5	9	5
7	14	3.50	5	7	5
8	12	3.00	5	7	5
9	11	2.75	2	9	7
10	13	3.25	5	6	4
11	13	3.25	6	11	5
12	13	3.25	3	10	4
13	14	3.50	4	9	3
14	14	3.50	5	9	3
15	15	3.75	3	8	7
16	15	3.75	3	10	5
17	14	3.50	4	8	4
18	15	3.75	4	9	5
19	15	3.75	5	10	4
20	12	3.00	4	10	3
21	11	2.75	5	9	3
22	10	2.50	4	9	6
23	12	3.00	4	9	6
24	15	3.75	2	6	7
25	14	3.50	2	8	5
26	14	3.50	2	10	2
27	13	3.25	1	10	5
28	15	3.75	0	8	7
29	13	3.25	3	7	6
30	14	3.50	3	8	5
Mean	**13.17**	**3.29**	**3.53**	**8.60**	**4.80**
SD	**1.42**	**0.35**	**1.41**	**1.28**	**1.40**

Table 42 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Chantaboon' (Location Pathumthani)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1592	628.14	2288	312	12.00
2	1724	580.04	2152	300	12.23
3	1756	569.47	2304	276	10.70
4	1752	570.77	2352	292	11.04
5	1564	639.38	2672	340	11.29
6	1496	668.44	2688	312	10.40
7	1684	593.82	2720	344	11.23
8	1636	611.24	2752	328	10.65
9	1652	605.32	2840	320	10.13
10	1696	589.62	2760	320	10.39
11	1684	593.82	2600	328	11.20
12	1660	602.40	2584	344	11.75
13	1668	599.52	2280	252	9.95
14	1576	634.51	2328	324	12.22
15	1588	629.72	2312	332	12.56
16	1732	577.36	2480	344	12.18
17	1712	584.11	2328	352	13.13
18	1640	609.75	2540	320	11.19
19	1592	628.14	2544	340	11.79
20	1680	595.23	2560	332	11.48
21	1640	609.75	2624	368	12.30
22	1692	591,01	2800	380	11.95
23	1656	603.86	2360	368	13.49
24	1620	617.28	2320	296	11.31
25	1648	606.79	2400	368	13.29
26	1680	595.23	2460	356	12.64
27	1800	555.55	2472	396	13.81
28	1744	573.39	2400	380	13.67
29	1784	560.53	2440	348	12.48
30	1684	593.82	2460	400	13.99
Mean	**1667.73**	**600.93**	**2494.00**	**335.73**	**11.88**
SD	**68.38**	**25.38**	**179.83**	**33.92**	**1.12**

Table 43 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Mali Chantaboon' (Location Pathumthani)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	14	3.50	3	13	1
2	12	3.00	5	7	2
3	12	3.00	6	7	2
4	12	3.00	5	0	2
5	15	3.75	5	10	1
6	15	3.75	4	7	2
7	15	3.75	5	10	0
8	16	4.00	4	7	2
9	15	3.75	5	9	2
10	16	4.00	3	9	2
11	13	3.25	3	7	2
12	14	3.50	2	14	2
13	12	3.00	5	8	1
14	15	3.75	4	8	2
15	13	3.25	4	7	1
16	10	2.50	5	12	1
17	12	3.00	4	9	2
18	12	3.00	5	7	2
19	11	2.75	4	5	1
20	11	2.75	6	11	3
21	12	3.00	10	10	4
22	11	2.75	10	11	3
23	14	3.50	8	12	3
24	12	3.00	15	12	4
25	15	3.75	9	9	4
26	13	3.25	15	10	7
27	10	2.50	14	9	5
28	12	3.00	10	9	5
29	15	3.75	12	10	4
30	14	3.50	10	14	4
Mean	**13.10**	**3.28**	**6.67**	**9.10**	**2.53**
SD	**1.75**	**0.44**	**3.72**	**2.83**	**1.53**

Table 44 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Chantaboon' (Location Khon Kaen)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1520	657.89	2684	320	10.65
2	1572	636.12	2800	332	10.60
3	1496	668.44	3196	368	10.33
4	1508	663.12	3120	388	11.06
5	1644	608.27	3184	424	11.75
6	1612	620.34	3076	416	11.91
7	1604	623.44	3200	400	11.11
8	1664	600.96	3160	364	10.33
9	1692	591.01	3136	368	10.50
10	1620	617.28	3040	336	9.95
11	1660	602.40	3120	348	10.03
12	1604	623.44	3220	428	11.73
13	1600	625.00	2600	392	13.10
14	1532	652.74	3144	332	9.55
15	1724	580.04	3120	416	11.76
16	1804	554.32	3140	364	10.39
17	1772	564.33	3200	392	10.91
18	1768	565.61	3240	392	10.79
19	1680	595.23	2984	360	10.77
20	1596	626.56	3160	412	11.53
21	1592	628.14	3104	360	10.39
22	1552	644.32	2800	388	12.17
23	1496	668.44	3200	424	11.70
24	1612	620.34	2864	296	9.37
25	1572	636.13	3160	392	11.04
26	1560	641.02	3168	392	11.01
27	1572	636.13	2984	368	10.98
28	1572	636.13	3008	384	11.32
29	1552	644.32	3200	432	11.89
30	1564	639.38	3000	368	10.93
Mean	**1610.53**	**622.36**	**3067.07**	**378.53**	**10.99**
SD	**80.63**	**30.13**	**164.79**	**34.14**	**0.81**

Table 45 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Mali Chantaboon' (Location Khon Kaen)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	12	3.00	7	11	3
2	11	2.75	7	12	3
3	12	3.00	10	10	3
4	14	3.50	8	13	3
5	14	3.50	6	8	7
6	15	3.75	6	8	5
7	13	3.25	6	12	3
8	12	3.00	5	13	5
9	16	4.00	6	11	3
10	16	4.00	7	12	5
11	15	3.75	7	12	5
12	16	4.00	5	8	7
13	15	3.75	4	9	3
14	12	3.00	3	9	5
15	14	3.50	7	10	4
16	13	3.25	7	13	5
17	15	3.75	8	15	2
18	15	3.75	9	13	2
19	15	3.75	6	15	2
20	11	2.75	9	12	2
21	16	4.00	5	10	6
22	15	3.75	5	9	6
23	15	3.75	3	11	2
24	15	3.75	4	6	3
25	13	3.25	6	8	1
26	13	3.25	4	13	3
27	15	3.75	4	8	4
28	13	3.25	5	9	2
29	14	3.50	3	7	3
30	12	3.00	3	14	2
Mean	**13.90**	**3.48**	**5.83**	**10.70**	**3.63**
SD	**1.54**	**0.38**	**1.90**	**2.41**	**1.61**

Table 46 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. sambac* 'Mali Chantaboon' (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1760	568.18	2896	388	11.81
2	1768	565.61	2800	388	12.17
3	1776	563.06	3376	456	11.90
4	1772	564.33	3200	428	11.80
5	1808	553.09	3352	420	11.13
6	1748	572.08	3000	368	10.93
7	1720	581.39	3324	428	11.41
8	1664	600.96	3360	424	11.21
9	1692	591.01	3192	404	11.23
10	1720	581.39	3200	424	11.70
11	1764	566.89	3092	360	10.43
12	1660	602.40	3016	352	10.45
13	1744	573.39	2976	360	10.79
14	1760	568.18	2840	308	9.78
15	1792	558.03	3032	344	10.19
16	1680	595.23	2960	340	10.30
17	1740	574.71	2720	288	9.57
18	1760	568.18	2800	308	9.91
19	1712	584.11	2632	336	11.32
20	1756	569.47	2640	344	11.53
21	1784	560.53	2968	288	8.85
22	1672	598.08	3000	296	8.98
23	1712	584.11	3060	316	9.36
24	1704	586.85	2840	324	10.24
25	1652	605.32	2920	352	10.76
26	1712	584.11	3000	360	10.71
27	1732	577.36	2876	376	11.56
28	1760	568.18	2920	336	10.32
29	1792	558.03	2980	320	9.70
30	1740	574.71	2800	360	11.39
Mean	**1735.20**	**576.63**	**2992.40**	**359.87**	**10.71**
SD	**42.29**	**14.19**	**202.19**	**45.85**	**0.90**

Table 47 Palisade ratio, trichome number, vein termination number, vein islets number of *J. sambac* 'Mali Chantaboon' (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	13	3.25	8	7	4
2	14	3.50	8	10	7
3	8	2.00	6	8	9
4	11	2.75	7	12	4
5	15	3.75	6	9	5
6	13	3.25	5	11	4
7	15	3.75	4	11	4
8	16	4.00	9	7	4
9	16	4.00	10	5	4
10	15	3.75	7	8	5
11	14	3.50	5	8	4
12	16	4.00	4	7	7
13	15	3.75	5	7	4
14	13	3.25	6	14	2
15	14	3.50	5	14	2
16	15	3.75	4	7	1
17	14	3.50	7	11	4
18	15	3.75	6	10	2
19	13	3.25	7	7	3
20	16	4.00	5	9	7
21	14	3.50	10	8	3
22	15	3.75	8	8	4
23	13	3.25	6	5	1
24	13	3.25	7	8	4
25	15	3.75	7	7	2
26	15	3.75	3	7	1
27	16	4.00	6	9	3
28	17	4.25	5	9	1
29	14	3.50	6	7	4
30	12	3.00	5	10	1
Mean	**14.17**	**3.54**	**6.23**	**8.67**	**3.67**
SD	**1.78**	**0.45**	**1.72**	**2.23**	**1.99**

Table 48 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Maluli' (Location Nonthaburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1740	574.71	3064	360	10.51
2	1700	588.23	2824	340	10.75
3	1688	592.41	3080	380	10.98
4	1792	558.03	2968	404	11.98
5	1764	566.89	2648	412	13.46
6	1736	576.03	3160	376	10.63
7	1700	588.23	3240	400	10.99
8	1708	585.48	3420	392	10.28
9	1700	588.23	3260	368	10.14
10	1712	584.11	3232	400	11.01
11	1748	572.08	3160	368	10.43
12	1756	569.47	3200	396	11.01
13	1744	466.41	3040	432	12.44
14	1720	581.39	3200	440	12.09
15	1784	560.53	3180	432	11.96
16	1712	584.11	3296	420	11.30
17	1700	588.23	3240	368	10.20
18	1760	568.18	3304	400	10.80
19	1712	584.11	2800	384	12.06
20	1748	572.08	2960	400	11.90
21	1772	564.33	2952	432	12.77
22	1716	582.75	2900	404	12.23
23	1732	577.36	2960	384	11.48
24	1700	588.23	3040	376	11.01
25	1716	582.75	2880	392	11.98
26	1720	581.39	3280	380	10.38
27	1732	577.36	3128	384	10.93
28	1712	584.11	3480	400	10.31
29	1760	568.18	3420	380	10.00
30	1780	561.79	3200	372	10.41
Mean	**1732.13**	**573.91**	**3117.20**	**392.53**	**11.22**
SD	**28.85**	**22.42**	**197.02**	**23.41**	**0.88**

Table 49 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Maluli' (Location Nonthaburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	4.50	1.13	11	4	4
2	4.50	1.13	11	4	4
3	5.50	1.38	9	2	5
4	6.00	1.50	6	4	4
5	6.50	1.63	9	4	4
6	6.00	1.50	8	3	3
7	6.50	1.63	3	4	6
8	7.00	1.75	8	3	2
9	7.50	1.88	6	4	4
10	5.50	1.38	3	4	3
11	6.00	1.50	5	5	4
12	6.50	1.63	6	8	5
13	7.00	1.75	5	5	4
14	4.50	1.13	5	6	6
15	6.00	1.50	3	7	5
16	6.00	1.50	6	6	3
17	6.50	1.63	6	3	5
18	7.00	1.75	5	5	3
19	7.50	1.88	7	6	5
20	5.50	1.38	6	7	4
21	7.50	1.88	7	4	5
22	8.00	2.00	8	5	5
23	8.00	2.00	7	7	4
24	7.00	1.75	7	3	6
25	7.50	1.88	5	5	3
26	7.00	1.75	6	6	4
27	8.00	2.00	6	6	4
28	7.50	1.88	4	5	4
29	7.00	1.75	6	6	5
30	6.50	1.63	6	4	6
Mean	7.00	1.75	4	4	4
SD	6.62	1.65	6.10	4.83	4.30

Table 50 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Maluli' (Location Bangkok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1756	569.47	2700	380	12.34
2	1744	573.39	2760	376	11.99
3	1720	581.39	3056	384	11.16
4	1784	560.53	3040	372	10.90
5	1712	584.11	3120	380	10.86
6	1700	588.23	3100	376	10.82
7	1712	584.11	2960	320	9.76
8	1760	568.18	3032	384	11.24
9	1708	585.48	2820	408	12.64
10	1720	581.39	2896	344	10.62
11	1712	584.11	3280	392	10.68
12	1712	584.11	3000	372	11.03
13	1748	572.08	3052	396	11.48
14	1772	564.33	3160	400	11.24
15	1716	582.75	3000	400	11.76
16	1688	592.41	3140	356	10.18
17	1720	581.39	3200	376	10.51
18	1712	584.11	2620	384	12.78
19	1820	549.45	3180	388	10.87
20	1800	555.55	3160	380	10.73
21	1692	591.01	3200	416	11.50
22	1752	584.11	2828	424	13.04
23	1712	584.11	3160	368	10.43
24	1764	566.89	3120	392	11.16
25	1708	585.48	3240	380	10.50
26	1748	572.08	3260	372	10.24
27	1712	584.11	3200	380	10.61
28	1720	581.39	3040	360	10.59
29	1740	574.71	3016	352	10.45
30	1756	569.47	3160	360	10.23
Mean	**1734.00**	**577.33**	**3050.00**	**379.07**	**11.08**
SD	**32.15**	**10.55**	**168.00**	**21.08**	**0.81**

Table 51 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Maluli' (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	6.00	1.50	7	5	6
2	8.00	2.00	6	3	5
3	7.00	1.75	6	5	4
4	7.00	1.75	6	6	3
5	6.00	1.50	7	7	5
6	6.00	1.50	4	7	3
7	6.00	1.50	5	6	6
8	5.50	1.38	5	4	2
9	8.00	2.00	3	7	4
10	6.50	1.63	5	5	3
11	5.50	1.38	4	3	4
12	5.00	1.25	2	5	5
13	5.00	1.25	4	4	4
14	7.00	1.75	3	6	6
15	6.00	1.50	5	5	5
16	6.50	1.63	6	6	3
17	7.50	1.88	6	5	5
18	8.00	2.00	7	4	3
19	6.50	1.63	6	6	5
20	7.00	1.75	6	6	3
21	7.50	1.88	8	7	5
22	5.50	1.38	7	4	4
23	6.00	1.50	8	4	3
24	6.00	1.50	5	3	4
25	8.00	2.00	7	4	5
26	7.50	1.88	6	5	5
27	8.00	2.00	5	5	3
28	7.50	1.88	6	3	4
29	7.00	1.75	7	4	4
30	8.00	2.00	3	5	5
Mean	6.70	1.68	5.5	4.97	4.2
SD	0.96	0.24	1.53	1.25	1.06

Table 52 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Maluli' (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1700	588.23	3040	384	11.21
2	1712	584.11	2780	364	11.58
3	1748	572.08	2820	356	11.21
4	1712	584.11	3120	364	10.45
5	1688	592.41	3160	360	10.23
6	1632	612.74	2692	364	11.91
7	1708	585.48	2800	308	9.91
8	1712	584.11	3100	380	10.92
9	1708	585.48	3140	412	11.60
10	1748	572.08	3152	360	10.25
11	1712	584.11	3420	384	10.09
12	1720	581.39	3360	376	10.06
13	1740	574.71	3200	380	10.61
14	1820	549.45	3280	388	10.58
15	1800	555.55	3240	400	10.99
16	1692	591.01	3120	340	9.83
17	1712	584.11	3160	372	10.53
18	1764	566.89	3000	352	10.50
19	1708	585.48	3140	392	11.10
20	1720	581.39	3176	356	10.08
21	1740	574.71	3160	428	11.93
22	1756	569.47	2840	412	12.67
23	1784	560.53	3200	376	10.51
24	1832	545.85	3180	388	10.87
25	1720	581.39	3200	384	10.71
26	1712	584.11	3100	380	10.92
27	1720	581.39	3040	388	11.32
28	1760	568.18	3032	392	11.45
29	1744	573.39	2920	364	11.08
30	1784	560.53	2840	380	11.80
Mean	**1733.60**	**577.15**	**3080.40**	**376.13**	**10.90**
SD	**41.58**	**13.74**	**175.86**	**23.10**	**0.69**

Table 53 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Maluli' (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	6.00	1.50	8	4	6
2	6.50	1.63	5	3	5
3	7.00	1.75	7	5	3
4	7.00	1.75	5	3	6
5	6.00	1.50	6	5	2
6	6.00	1.50	6	4	4
7	7.00	1.75	6	6	3
8	7.00	1.75	8	5	4
9	7.50	1.88	7	6	6
10	8.00	2.00	6	3	5
11	7.00	1.75	6	5	5
12	6.00	1.50	5	6	5
13	6.00	1.50	7	6	4
14	8.00	2.00	6	5	5
15	7.50	1.88	6	4	4
16	7.00	1.75	4	6	6
17	7.00	1.75	5	5	5
18	7.00	1.75	4	3	3
19	6.00	1.50	5	5	5
20	8.00	2.00	5	3	3
21	7.50	1.88	5	5	6
22	7.00	1.75	4	4	5
23	6.50	1.63	4	3	5
24	7.00	1.75	4	5	6
25	7.50	1.88	5	3	5
26	5.50	1.38	5	5	4
27	8.00	2.00	4	4	5
28	8.00	2.00	6	5	3
29	7.50	1.88	6	4	5
30	7.50	1.88	6	4	4
Mean	**6.98**	**1.75**	**5.53**	**4.47**	**4.57**
SD	**0.72**	**0.18**	**1.14**	**1.04**	**1.10**

Table 54 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Maluli Sichomphu' (Location Nonthaburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2820	354.6	3720	484	11.51
2	2704	369.82	3920	500	11.31
3	2884	346.74	3940	520	11.66
4	2916	342.93	3880	560	12.61
5	2840	352.11	3996	636	13.73
6	2872	348.18	3960	600	13.16
7	2948	339.21	3980	540	11.95
8	2892	345.78	3840	568	12.89
9	2772	360.75	3680	560	13.21
10	2752	363.37	4000	520	11.50
11	2800	357.14	3920	572	12.73
12	2776	360.23	3940	512	11.50
13	2800	357.14	3996	516	11.44
14	2788	358.68	3880	592	13.24
15	2848	351.12	4000	456	10.23
16	2880	347.22	3940	600	13.22
17	2944	339.67	4040	608	13.08
18	2876	347.7	3952	600	13.18
19	2880	347.22	3960	468	10.57
20	2760	362.31	3956	560	12.40
21	2752	363.37	3940	440	10.05
22	2800	357.14	3960	540	12.00
23	2848	351.12	3948	600	13.19
24	2868	348.67	3960	568	12.54
25	2792	358.16	3980	516	11.48
26	2756	362.84	4080	600	12.82
27	2844	351.61	3992	592	12.91
28	2880	347.22	4000	600	13.04
29	2940	340.13	3956	592	13.02
30	2912	343.4	3952	512	11.47
Mean	**2838.13**	**352.52**	**3942.27**	**551.07**	**12.25**
SD	**64.96**	**8.09**	**80.71**	**50.57**	**0.98**

Table 55 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Maluli Sichomphu' (Location Nonthaburi)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	6.00	1.5	1	0	15	6
2	5.00	1.25	0	0	14	6
3	5.00	1.25	0	0	10	7
4	5.00	1.25	0	0	10	7
5	5.00	1.25	2	0	11	6
6	4.00	1.00	1	1	15	7
7	7.00	1.75	0	1	11	6
8	5.00	1.25	0	1	8	7
9	6.00	1.50	1	0	11	7
10	8.00	2.00	0	0	12	7
11	5.00	1.25	0	0	11	8
12	6.00	1.50	1	0	14	6
13	5.00	1.25	1	0	7	7
14	6.00	1.50	0	2	14	7
15	6.00	1.50	0	0	12	7
16	6.00	1.50	1	0	13	8
17	7.00	1.75	1	1	13	7
18	7.00	1.75	0	0	13	6
19	5.00	1.25	0	0	11	6
20	5.00	1.25	2	0	14	8
21	6.00	1.50	0	0	15	6
22	5.00	1.25	0	0	15	7
23	6.00	1.50	1	0	14	6
24	5.00	1.25	0	0	14	7
25	6.00	1.50	0	0	12	8
26	6.00	1.50	0	0	13	6
27	5.00	1.25	0	0	14	8
28	5.00	1.25	0	0	14	6
29	6.00	1.50	0	0	14	6
30	6.00	1.50	0	2	15	6
Mean	5.67	1.42	0.4	0.27	12.63	6.73
SD	0.84	0.21	0.62	0.58	2.09	0.74

Table 56 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Maluli Sichomphu'' (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2892	345.78	3320	420	11.23
2	2840	352.11	3840	440	10.28
3	2916	342.93	3520	488	12.18
4	2772	360.75	3620	456	11.19
5	2752	363.37	3888	436	10.08
6	2800	357.14	3312	428	11.44
7	2800	357.14	3760	364	8.83
8	2772	360.75	3296	368	10.04
9	2940	340.13	2900	432	12.97
10	2864	439.16	2960	320	9.76
11	2880	347.22	3200	340	9.60
12	2760	362.31	3060	376	10.94
13	2848	351.12	3620	400	9.95
14	2880	347.22	3232	456	12.36
15	2880	347.22	3080	360	10.47
16	2848	351.12	3416	396	10.39
17	2868	348.67	3172	324	9.27
18	2788	358.68	3080	352	10.26
19	2752	363.37	3060	376	10.94
20	2800	357.14	2780	320	10.32
21	2848	351.12	2880	396	12.09
22	2900	344.82	2680	340	11.26
23	2876	347.70	2480	464	15.76
24	2880	347.22	2760	392	12.44
25	2752	363.37	2800	460	14.11
26	2760	362.31	2940	456	13.43
27	2880	347.22	2900	376	11.48
28	2932	341.06	3000	440	12.79
29	2852	350.63	3560	448	11.18
30	2860	349.65	2812	428	13.21
Mean	**2839.73**	**355.28**	**3164.27**	**401.73**	**11.34**
SD	**57.15**	**17.36**	**362.59**	**48.56**	**1.55**

Table 57 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Maluli Sichomphu'' (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	6.00	1.5	1	5	14	8
2	6.00	1.50	1	5	10	7
3	7.00	1.75	0	6	11	6
4	8.00	2.00	0	6	9	6
5	7.00	1.75	0	3	10	6
6	8.00	2.00	0	5	12	7
7	6.00	1.50	2	4	12	8
8	6.00	1.50	0	5	14	8
9	7.00	1.75	0	5	10	5
10	8.00	2.00	1	5	11	7
11	6.00	1.50	0	5	12	6
12	7.00	1.75	0	4	9	6
13	6.00	1.50	0	5	11	7
14	6.00	1.50	0	8	10	7
15	5.00	1.25	0	8	9	6
16	6.00	1.50	0	6	9	5
17	7.00	1.75	0	9	11	8
18	7.00	1.75	1	6	12	5
19	7.00	1.75	0	7	13	6
20	6.00	1.50	0	9	12	5
21	7.00	1.75	0	5	14	7
22	7.00	1.75	0	9	15	7
23	6.00	1.50	0	11	10	6
24	7.00	1.75	1	8	11	8
25	7.00	1.75	0	6	10	7
26	7.00	1.75	0	11	9	7
27	6.00	1.50	0	13	12	7
28	7.00	1.75	0	13	13	6
29	6.00	1.50	0	9	10	6
30	6.00	1.50	0	14	9	6
Mean	6.60	1.65	0.23	7.17	11.13	6.53
SD	0.72	0.18	0.50	2.91	1.74	0.94

Table 58 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Maluli Sichomphu' (Location Bangkok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2844	351.61	2960	412	12.22
2	2872	348.18	3200	428	11.80
3	2948	339.21	2940	484	14.14
4	2892	345.78	2840	412	12.67
5	2916	342.93	2640	396	13.04
6	2840	352.11	2660	320	10.74
7	2772	360.75	3200	380	10.61
8	2740	364.96	3680	392	9.63
9	2800	357.14	2840	448	13.63
10	2776	360.23	2900	300	9.38
11	2860	349.65	2772	308	10.00
12	2772	360.75	2940	360	10.91
13	2948	339.21	3100	420	11.93
14	2864	349.16	3212	464	12.62
15	2868	348.67	3040	388	11.32
16	2788	350.68	3380	404	10.68
17	2852	350.63	3080	504	14.06
18	2752	363.37	3180	436	12.06
19	2848	351.12	3080	448	12.70
20	2876	347.70	2440	432	15.04
21	2880	347.22	3100	520	14.36
22	2752	363.37	3376	492	12.72
23	2760	362.31	3040	508	14.32
24	2752	363.37	3120	408	11.56
25	2880	347.22	3200	424	11.70
26	2920	342.46	3340	488	12.75
27	2756	362.84	3180	432	11.96
28	2800	357.14	3072	440	12.53
29	2848	351.12	3112	480	13.36
30	2900	344.82	2888	412	12.48
Mean	**2835.87**	**352.52**	**3050.40**	**424.67**	**12.23**
SD	**62.92**	**7.76**	**247.66**	**56.11**	**1.44**

Table 59 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Maluli Sichomphu' (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	5.00	1.25	1	6	14	6
2	6.00	1.50	1	7	13	6
3	9.00	2.25	0	5	14	7
4	6.00	1.50	0	4	12	7
5	8.00	2.00	0	7	10	7
6	9.00	2.25	0	6	14	6
7	8.00	2.00	2	4	14	5
8	7.00	1.75	0	4	9	5
9	6.00	1.50	0	7	11	4
10	7.00	1.75	1	11	10	5
11	8.00	2.00	0	11	12	7
12	8.00	2.00	0	12	13	7
13	7.00	1.75	0	7	13	6
14	8.00	2.00	0	8	14	8
15	6.00	1.50	0	8	14	7
16	8.00	2.00	0	6	12	8
17	8.00	2.00	0	8	13	8
18	7.00	1.75	1	6	14	7
19	7.00	1.75	0	5	8	7
20	8.00	2.00	0	4	9	6
21	7.00	1.75	0	6	10	6
22	6.00	1.50	0	6	10	7
23	7.00	1.75	0	8	12	7
24	6.00	1.50	1	6	11	8
25	8.00	2.00	0	4	13	8
26	6.00	1.50	0	6	13	7
27	6.00	1.50	0	6	12	8
28	8.00	2.00	0	5	10	9
29	6.00	1.50	0	5	11	8
30	8.00	2.00	0	3	13	8
Mean	**7.13**	**1.78**	**0.23**	**6.37**	**11.93**	**6.83**
SD	**1.04**	**0.26**	**0.50**	**2.16**	**1.78**	**1.15**

Table 60 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Maluli Phum' (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	7.00	1.75	19	31	6	5
2	7.00	1.75	20	27	7	5
3	6.50	1.63	18	25	5	4
4	7.00	1.75	17	29	4	4
5	7.00	1.75	18	32	4	3
6	7.00	1.75	13	28	6	3
7	7.50	1.88	12	33	5	5
8	6.50	1.63	13	27	6	4
9	8.00	2.00	12	29	9	4
10	6.50	1.63	21	29	8	4
11	7.00	1.75	10	28	7	5
12	9.00	2.25	15	29	8	4
13	6.00	1.50	11	31	8	2
14	8.00	2.00	11	28	6	4
15	7.50	1.88	14	29	9	4
16	7.50	1.88	12	30	11	2
17	8.50	2.13	9	29	8	3
18	9.00	2.25	11	29	9	2
19	8.00	2.00	10	29	9	3
20	8.00	2.00	12	29	9	5
21	7.50	1.88	9	30	7	4
22	8.00	2.00	10	30	6	3
23	8.00	2.00	12	26	7	5
24	7.00	1.75	13	34	9	2
25	7.50	1.88	12	31	7	3
26	7.50	1.88	17	30	9	3
27	9.00	2.25	16	26	5	4
28	7.00	1.75	20	29	5	2
29	6.50	1.63	16	29	6	4
30	7.00	1.75	11	27	5	2
Mean	7.45	1.86	13.8	29.1	7	3.57
SD	0.78	0.20	3.55	1.99	1.78	1.04

Table 61 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Maluli Phum' (Location Bangkok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	3480	287.35	3680	424	10.33
2	3432	291.37	3360	392	10.45
3	3444	290.36	3560	416	10.46
4	3456	289.35	3360	388	10.35
5	3280	304.87	3400	396	10.43
6	3224	310.17	3544	352	9.03
7	3296	303.39	3452	436	11.21
8	3264	306.37	3400	408	10.71
9	3256	307.12	3420	332	8.85
10	3228	309.78	3520	416	10.57
11	3252	307.5	3200	388	10.81
12	3260	306.74	3320	372	10.08
13	3324	300.84	3380	368	9.82
14	3292	303.76	3632	452	11.07
15	3324	300.84	3680	440	10.68
16	3400	294.11	3600	400	10.00
17	3372	296.55	3400	380	10.05
18	3260	306.74	3600	416	10.36
19	3332	300.12	3640	352	8.82
20	3308	302.29	3560	432	10.82
21	3412	293.08	3600	404	10.09
22	3296	303.39	3640	400	9.90
23	3340	299.4	3600	464	11.42
24	3280	304.87	3760	472	11.15
25	3232	309.4	3660	400	9.85
26	3244	308.26	3560	352	9.00
27	3300	303.03	3520	408	10.39
28	3336	299.76	3560	400	10.10
29	3368	296.91	3600	456	11.24
30	3384	295.5	3720	480	11.43
Mean	**3322.53**	**301.11**	**3530.93**	**406.53**	**10.32**
SD	**72.53**	**6.49**	**133.41**	**37.03**	**0.72**

Table 62 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Maluli Phum' (Location Nonthaburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	3424	292.05	3160	344	9.82
2	3324	300.84	3440	400	10.42
3	3400	294.11	3320	392	10.56
4	3372	296.55	3200	324	9.19
5	3260	306.74	3720	392	9.53
6	3400	294.11	3360	376	10.06
7	3372	296.55	3312	364	9.90
8	3260	306.76	3224	376	10.44
9	3332	300.12	3280	352	9.69
10	3308	302.29	3200	380	10.61
11	3244	308.26	3568	428	10.71
12	3296	303.39	3352	380	10.18
13	3336	299.76	3200	360	10.11
14	3368	296.91	3560	412	10.37
15	3388	295.15	3380	372	9.91
16	3260	306.74	3480	364	9.47
17	3320	301.2	3472	360	9.39
18	3292	303.76	3640	400	9.90
19	3400	294.11	3200	380	10.61
20	3296	303.39	3240	372	10.30
21	3352	298.32	3680	452	10.94
22	3280	304.87	3560	372	9.46
23	3236	309.02	3580	424	10.59
24	3260	306.74	3600	444	10.98
25	3276	305.25	3600	432	10.71
26	3240	308.64	3680	408	9.98
27	3324	300.84	3400	392	10.34
28	3360	297.61	3520	380	9.74
29	3316	301.56	3560	440	11.00
30	3320	301.2	3560	424	10.64
Mean	**3320.53**	**301.23**	**3434.93**	**389.87**	**10.19**
SD	**54.03**	**4.89**	**171.99**	**31.42**	**0.51**

Table 63 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Maluli Phum' (Location Nonthaburi)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	9.00	2.25	10	31	9	4
2	8.00	2.00	9	29	10	1
3	7.00	1.75	11	27	9	2
4	6.50	1.63	13	28	10	3
5	6.50	1.63	11	30	7	5
6	7.00	1.75	10	26	9	4
7	6.50	1.63	12	26	9	4
8	8.50	2.13	14	30	8	3
9	8.00	2.00	11	27	12	3
10	7.00	1.75	17	31	8	3
11	7.50	1.88	8	29	7	2
12	8.00	2.00	10	28	6	3
13	7.50	1.88	11	28	5	4
14	7.00	1.75	10	30	9	3
15	7.00	1.75	13	28	5	5
16	7.50	1.88	12	33	10	5
17	9.00	2.25	10	31	11	3
18	9.50	2.38	7	32	6	4
19	7.50	1.88	9	30	7	3
20	8.50	2.13	12	35	8	5
21	8.00	2.00	11	30	5	2
22	10.50	2.63	7	29	7	5
23	10.00	2.50	13	32	5	4
24	6.50	1.63	12	26	7	2
25	7.00	1.75	9	26	6	5
26	8.00	2.00	14	28	6	2
27	7.50	1.88	21	30	5	4
28	8.00	2.00	10	32	4	1
29	7.50	1.88	14	31	5	3
30	8.00	2.00	12	31	5	1
Mean	7.80	1.95	11.43	29.47	7.33	3.27
SD	1.02	0.26	2.84	2.26	2.11	1.26

Table 64 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Maluli Phum' (Location Nonthaburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	3412	293.08	3200	320	9.09
2	3296	303.39	3904	444	10.21
3	3348	298.68	3560	440	11.00
4	3280	304.87	3320	368	9.98
5	3324	300.84	3716	400	9.72
6	3380	295.85	3784	392	9.39
7	3316	301.56	3720	372	9.09
8	3320	301.20	3792	412	9.80
9	3352	298.32	3864	396	9.30
10	3284	304.50	3800	420	9.95
11	3236	309.02	3832	408	9.62
12	3264	306.37	3952	388	8.94
13	3296	303.39	3496	348	9.05
14	3352	298.32	3856	420	9.82
15	3280	304.87	3872	460	10.62
16	3200	312.50	3568	420	10.53
17	3260	306.74	3252	372	10.26
18	3280	304.87	3832	380	9.02
19	3252	307.5	3920	388	9.01
20	3260	306.74	3800	444	10.46
21	3324	300.84	3840	436	10.20
22	3292	303.76	3480	392	10.12
23	3456	289.35	3840	480	11.11
24	3352	298.32	3964	472	10.64
25	3264	306.37	3960	508	11.37
26	3296	303.39	3888	464	10.66
27	3276	305.25	3992	432	9.76
28	3472	288.01	3880	440	10.19
29	3436	291.03	3552	452	11.29
30	3500	285.71	3880	460	10.60
Mean	**3322.00**	**301.15**	**3743.87**	**417.60**	**10.03**
SD	**72.73**	**6.48**	**216.04**	**42.05**	**0.72**

Table 65 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Maluli Phum' (Location Nonthaburi)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	8.50	2.125	13	41	7	3
2	8.00	2.00	11	38	9	3
3	7.00	1.75	11	40	5	2
4	6.00	1.50	14	43	9	3
5	7.00	1.75	11	40	8	4
6	7.00	1.75	13	41	8	4
7	7.00	1.75	12	43	10	4
8	7.50	1.88	10	45	12	3
9	7.50	1.88	13	47	16	2
10	8.00	2.00	16	40	9	4
11	9.50	2.38	10	39	8	3
12	7.50	1.88	11	41	7	3
13	8.00	2.00	10	45	8	4
14	7.00	1.75	11	34	8	4
15	7.50	1.88	16	40	6	6
16	9.00	2.25	13	39	11	5
17	7.50	1.88	11	41	11	3
18	7.50	1.88	6	39	9	3
19	9.00	2.25	8	37	7	4
20	9.00	2.25	11	40	7	5
21	8.00	2.00	10	38	7	3
22	8.50	2.13	8	43	6	3
23	6.50	1.63	12	46	8	4
24	9.00	2.25	12	41	10	2
25	8.00	2.00	11	47	7	5
26	8.50	2.13	13	38	8	3
27	8.00	2.00	17	39	7	4
28	7.50	1.88	12	43	8	1
29	7.50	1.88	15	42	7	4
30	7.50	1.88	10	27	7	2
Mean	**7.80**	**1.95**	**11.7**	**40.57**	**8.33**	**3.43**
SD	**0.82**	**0.20**	**2.41**	**3.94**	**2.14**	**1.07**

Table 66 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Mali Ngachang' (Location Chiangmai)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2316	431.77	2552	360	12.36
2	2340	427.35	2300	336	12.75
3	2224	449.64	2240	356	13.71
4	2224	449.64	2220	304	12.04
5	2172	460.4	2280	324	12.44
6	2212	452.07	2748	404	12.82
7	2184	457.87	2232	340	13.22
8	2180	458.71	2700	360	11.76
9	2188	457.03	2400	300	11.11
10	2252	444.04	2340	332	12.43
11	2328	429.55	2300	364	13.66
12	2176	459.55	2360	360	13.24
13	2184	457.87	2640	352	11.76
14	2276	439.36	3040	360	10.59
15	2288	437.06	2632	336	11.32
16	2340	427.35	2700	344	11.30
17	2192	456.20	2640	332	11.17
18	2280	438.59	2384	320	11.83
19	2200	454.54	2520	376	12.98
20	2188	457.03	2876	360	11.12
21	2296	435.54	2820	348	10.98
22	2192	456.20	2800	356	11.28
23	2268	440.91	2760	352	11.31
24	2196	455.37	2768	336	10.82
25	2216	451.26	2800	340	10.83
26	2196	455.37	2760	352	11.31
27	2204	453.72	2800	360	11.39
28	2240	446.42	2820	368	11.54
29	2220	450.45	2760	356	11.42
30	2308	433.27	2320	392	14.45
Mean	**2236.00**	**447.47**	**2583.73**	**349.33**	**11.97**
SD	**54.00**	**10.65**	**236.39**	**22.17**	**1.00**

Table 67 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Mali Ngachang' (Location Chiangmai)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	9.00	2.25	12	13	6
2	8.00	2.00	15	15	5
3	9.00	2.25	10	17	6
4	9.00	2.25	13	18	6
5	8.50	2.13	10	17	6
6	7.00	1.75	15	15	5
7	7.50	1.88	17	18	10
8	8.00	2.00	16	15	7
9	7.50	1.88	17	21	5
10	8.00	2.00	15	15	7
11	7.00	1.75	13	10	9
12	8.00	2.00	12	12	9
13	8.00	2.00	9	14	6
14	8.00	2.00	13	12	7
15	9.00	2.25	15	14	5
16	9.00	2.25	13	13	9
17	8.50	2.13	18	13	9
18	8.00	2.00	18	14	8
19	8.00	2.00	19	18	7
20	8.00	2.00	17	14	9
21	8.50	2.13	20	15	6
22	9.00	2.25	19	18	5
23	9.00	2.25	19	15	5
24	8.00	2.00	19	16	6
25	7.50	1.88	19	14	7
26	8.00	2.00	19	13	4
27	7.50	1.88	19	13	8
28	8.00	2.00	19.00	14	7
29	8.50	2.13	19.00	15	6
30	9.00	2.25	19.00	15	5
Mean	**8.20**	**2.05**	**15.93**	**14.87**	**6.67**
SD	**0.61**	**0.15**	**3.27**	**2.27**	**1.58**

Table 68 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Mali Ngachang' (Location Chiangmai)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2288	437.06	2860	368	11.40
2	2212	452.07	2880	376	11.55
3	2184	457.87	2988	384	11.39
4	2180	458.71	2680	368	12.07
5	2252	444.04	2560	380	12.93
6	2328	429.55	2640	352	11.76
7	2176	459.55	2700	368	11.99
8	2320	431.03	3040	356	10.48
9	2192	456.20	2800	316	10.14
10	2280	438.59	2320	304	11.59
11	2260	442.47	2600	360	12.16
12	2224	449.64	2972	360	10.80
13	2180	458.71	2920	372	11.30
14	2212	452.07	3000	376	11.14
15	2192	456.2	2652	344	11.48
16	2224	449.64	3056	352	10.33
17	2320	431.03	2860	360	11.18
18	2192	456.2	3040	376	11.01
19	2240	446.42	3020	372	10.97
20	2236	447.22	3160	388	10.94
21	2192	456.2	2720	344	11.23
22	2280	438.59	3100	372	10.71
23	2196	455.37	3040	368	10.80
24	2204	453.72	2900	360	11.04
25	2224	449.64	3000	356	10.61
26	2208	452.89	2700	320	10.60
27	2192	456.20	2620	336	11.37
28	2324	430.29	2840	380	11.80
29	2256	443.26	2960	368	11.06
30	2320	431.03	3040	360	10.59
Mean	**2236.27**	**447.38**	**2855.60**	**359.87**	**11.21**
SD	**49.98**	**9.87**	**197.40**	**20.00**	**0.61**

Table 69 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Mali Ngachang' (Location Chiangmai)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	7.00	1.75	18	13	6
2	7.00	1.75	16	15	6
3	7.00	1.75	8	18	6
4	8.00	2.00	14	17	5
5	8.00	2.00	17	18	7
6	8.00	2.00	16	17	7
7	7.50	1.88	19	13	7
8	7.50	1.88	15	15	5
9	7.50	1.88	14	11	7
10	8.00	2.00	22	12	9
11	8.00	2.00	18	16	8
12	8.50	2.13	15	13	8
13	7.00	1.75	13	13	7
14	7.00	1.75	18	15	6
15	8.50	2.13	20	11	7
16	7.50	1.88	24	12	9
17	8.00	2.00	20	12	6
18	7.50	1.88	18	13	7
19	8.00	2.00	16	13	8
20	8.00	2.00	23	14	8
21	8.00	2.00	19	11	8
22	7.50	1.88	19	10	8
23	8.00	2.00	19	18	6
24	8.00	2.00	20	13	6
25	8.00	2.00	20	14	7
26	7.50	1.88	22	13	5
27	7.50	1.88	18	13	5
28	9.00	2.25	24.00	12.00	4
29	8.50	2.13	25.00	13.00	6
30	8.00	2.00	26.00	14.00	8
Mean	**7.78**	**1.95**	**18.53**	**13.73**	**6.73**
SD	**0.50**	**0.13**	**3.90**	**2.20**	**1.26**

Table 70 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. multiflorum* 'Mali Ngachang' (Location Chiangmai)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2252	444.04	2840	356	11.14
2	2320	431.03	2800	340	10.83
3	2176	459.55	2940	364	11.02
4	2340	427.35	2760	344	11.08
5	2192	456.20	2720	340	11.11
6	2280	438.59	2700	320	10.60
7	2196	455.37	2720	332	10.88
8	2204	453.72	2560	320	11.11
9	2240	446.42	2480	288	10.40
10	2220	450.45	2640	272	9.34
11	2308	433.27	2688	364	11.93
12	2188	457.03	2720	348	11.34
13	2296	435.54	2936	360	10.92
14	2192	456.20	2960	360	10.84
15	2268	440.91	2800	348	11.05
16	2196	455.37	2980	344	10.35
17	2216	451.26	2780	328	10.55
18	2236	447.22	2800	324	10.37
19	2224	449.64	2860	380	11.73
20	2172	460.40	2800	352	11.17
21	2212	452.07	3080	340	9.94
22	2224	449.64	2960	340	10.30
23	2208	452.89	3020	372	10.97
24	2192	456.20	2600	328	11.20
25	2320	431.03	2972	360	10.80
26	2172	460.40	2560	340	11.72
27	2220	450.45	2632	340	11.44
28	2292	436.30	2908	348	10.69
29	2320	431.03	2940	348	10.58
30	2236	447.22	2520	372	12.86
Mean	**2237.07**	**447.23**	**2789.20**	**342.40**	**10.94**
SD	**50.44**	**9.95**	**160.24**	**22.93**	**0.64**

Table 71 Palisade ratio, trichome number, vein termination number, vein islets number of *J. multiflorum* 'Mali Ngachang' (Location Chiangmai)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	7.00	1.75	16	14	5
2	8.50	2.13	15	12	5
3	7.50	1.88	12	15	7
4	8.00	2.00	16	15	6
5	8.50	2.13	16	16	7
6	7.00	1.75	18	18	6
7	7.50	1.88	20	16	7
8	8.00	2.00	15	17	9
9	8.50	2.13	15	16	6
10	8.00	2.00	11	16	8
11	7.50	1.88	16	17	8
12	9.00	2.25	14	18	7
13	9.00	2.25	10	14	5
14	9.00	2.25	20	11	7
15	7.50	1.88	18	10	9
16	8.00	2.00	21	12	9
17	8.50	2.13	19	13	6
18	8.00	2.00	22	15	6
19	8.00	2.00	20	11	8
20	9.00	2.25	23	14	10
21	8.50	2.13	20	11	6
22	9.00	2.25	19	10	7
23	8.00	2.00	19	12	6
24	8.00	2.00	16	12	5
25	7.50	1.88	17	12	6
26	8.00	2.00	22	13	8
27	7.50	1.88	20	13	8
28	8.00	2.00	20	14	9
29	8.50	2.13	25	12	8
30	9.00	2.25	26	13	8
Mean	**8.13**	**2.03**	**18.03**	**13.73**	**7.07**
SD	**0.60**	**0.15**	**3.80**	**2.30**	**1.39**

Table 72 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. scandens* (Retz.) Vahl (Location Bangkok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2292	436.3	3440	344	9.09
2	2300	434.78	3880	396	9.26
3	2296	435.54	3920	416	9.59
4	2328	429.55	3948	436	9.95
5	2412	414.59	3980	428	9.71
6	2464	405.84	3940	424	9.72
7	2512	398.08	2992	324	9.77
8	2480	403.22	3040	336	9.95
9	2624	381.09	3788	436	10.32
10	2612	382.84	4380	416	8.67
11	2628	380.51	3360	392	10.45
12	2572	388.80	3920	408	9.43
13	2540	393.70	3600	320	8.16
14	2440	409.83	3320	304	8.39
15	2480	403.22	3536	412	10.44
16	2472	404.53	3776	468	11.03
17	2536	394.32	3940	372	8.63
18	2624	381.09	4400	460	9.47
19	2380	420.16	4480	480	9.68
20	2452	407.83	3600	336	8.54
21	2504	399.36	3960	392	9.01
22	2600	384.61	3920	416	9.59
23	2572	388.8	3956	412	9.43
24	2600	384.61	3816	392	9.32
25	2432	411.18	4320	440	9.24
26	2620	381.67	3960	384	8.84
27	2536	394.32	3920	352	8.24
28	2428	411.86	3840	380	9.00
29	2480	403.22	4000	400	9.09
30	2460	406.5	3600	388	9.73
Mean	**2489.20**	**402.40**	**3817.73**	**395.47**	**9.39**
SD	**102.13**	**16.84**	**355.70**	**44.53**	**0.68**

Table 73 Palisade ratio, trichome number, vein termination number, vein islets number of *J. scandens* (Retz.) Vahl (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	8.50	2.13	6	19	5
2	8.00	2.00	8	18	9
3	9.00	2.25	10	16	12
4	9.50	2.38	5	20	7
5	9.50	2.38	12	17	11
6	10.00	2.50	6	14	11
7	10.00	2.50	5	19	11
8	10.50	2.63	15	17	10
9	11.00	2.75	15	22	8
10	10.00	2.50	15	13	12
11	11.50	2.88	8	8	7
12	10.50	2.63	22	8	9
13	9.50	2.38	20	11	5
14	9.50	2.38	4	13	6
15	8.00	2.00	18	11	5
16	9.00	2.25	5	11	10
17	9.00	2.25	14	15	9
18	10.00	2.50	18	12	10
19	9.00	2.25	8	11	12
20	11.00	2.75	10	9	5
21	9.50	2.38	10	8	5
22	9.00	2.25	8	10	4
23	11.50	2.88	15	13	7
24	12.00	3.00	15	8	8
25	10.50	2.63	8	8	6
26	8.50	2.13	18	11	4
27	9.00	2.25	24	11	7
28	11.00	2.75	7.00	10.00	8
29	9.50	2.38	27.00	12.00	9
30	9.00	2.25	8.00	9.00	12
Mean	**9.75**	**2.44**	**12.13**	**12.80**	**8.13**
SD	**1.04**	**0.26**	**6.17**	**4.04**	**2.60**

Table 74 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. scandens* (Retz.) Vahl (Location Nonthaburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2420	413.22	3680	436	10.59
2	2480	403.22	3960	372	8.59
3	2440	409.83	4080	440	9.73
4	2400	416.66	3600	384	9.64
5	2360	423.72	4400	496	10.13
6	2540	393.70	3500	340	8.85
7	2492	401.28	3600	336	8.54
8	2612	382.84	3640	360	9.00
9	2580	387.59	3600	348	8.81
10	2620	381.67	4000	396	9.01
11	2540	393.70	4360	440	9.17
12	2400	416.66	3920	360	8.41
13	2448	408.49	3640	348	8.73
14	2572	388.80	4800	504	9.50
15	2376	420.87	3712	352	8.66
16	2572	388.80	4120	432	9.49
17	2600	384.61	4000	376	8.59
18	2492	401.28	3720	356	8.73
19	2460	406.50	3960	392	9.01
20	2536	394.32	4136	468	10.17
21	2592	385.80	3012	328	9.82
22	2480	403.22	3600	384	9.64
23	2496	400.64	3992	516	11.45
24	2580	387.59	3872	428	9.95
25	2552	391.84	3960	400	9.17
26	2572	388.80	4800	448	8.54
27	2620	381.67	3600	392	9.82
28	2448	408.49	3520	348	9.00
29	2400	416.66	4052	376	8.49
30	2432	411.18	3656	392	9.68
Mean	**2503.73**	**399.79**	**3883.07**	**398.27**	**9.30**
SD	**79.33**	**12.74**	**377.23**	**51.77**	**0.71**

Table 75 Palisade ratio, trichome number, vein termination number, vein islets number of *J. scandens* (Retz.) Vahl (Location Nonthaburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	10.00	2.5	27	17	8
2	11.50	2.88	26	20	9
3	10.50	2.63	42	10	8
4	11.50	2.88	29	11	11
5	12.00	3.00	30	11	10
6	10.00	2.50	40	12	12
7	11.50	2.88	30	9	8
8	12.00	3.00	30	13	9
9	11.50	2.88	41	18	7
10	11.00	2.75	24	15	11
11	9.00	2.25	28	13	5
12	10.00	2.50	25	10	5
13	9.50	2.38	25	13	4
14	11.50	2.88	27	8	7
15	10.50	2.63	39	8	0
16	9.00	2.25	26	11	6
17	11.00	2.75	25	11	6
18	10.00	2.50	23	10	5
19	9.50	2.38	34	12	5
20	9.50	2.38	30	9	6
21	10.50	2.63	30	12	10
22	11.00	2.75	36	9	8
23	9.00	2.25	30	11	12
24	10.00	2.50	30	11	11
25	9.00	2.25	31	10	10
26	9.00	2.25	24	12	9
27	11.00	2.75	24	9	12
28	9.50	2.38	29.00	13.00	8
29	10.00	2.50	24.00	13.00	7
30	11.00	2.75	28.00	12.00	9
Mean	**10.37**	**2.59**	**29.57**	**11.77**	**7.93**
SD	**0.96**	**0.24**	**5.32**	**2.80**	**2.77**

Table 76 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. scandens* (Retz.) Vahl (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2400	416.66	3936	428	9.81
2	2320	431.03	3956	460	10.42
3	2440	409.83	3500	404	10.35
4	2376	420.87	3700	372	9.14
5	2500	400.00	3600	384	9.64
6	2600	384.61	3948	408	9.37
7	2540	393.70	4000	420	9.50
8	2552	393.70	3960	416	9.51
9	2628	380.51	3760	388	9.35
10	2640	378.78	3360	364	9.77
11	2512	398.08	3912	424	9.78
12	2488	401.92	4000	416	9.42
13	2600	384.61	4080	424	9.41
14	2492	401.28	4136	440	9.62
15	2540	393.70	4000	432	9.75
16	2388	418.76	3880	416	9.68
17	2500	400.00	3560	400	10.10
18	2520	396.82	3912	392	9.11
19	2584	386.99	4032	416	9.35
20	2496	400.64	3560	312	8.06
21	2452	407.83	3868	428	9.96
22	2480	403.22	3920	428	9.84
23	2576	388.19	3940	420	9.63
24	2560	390.62	3952	396	9.11
25	2508	398.72	3984	424	9.62
26	2440	409.83	3600	400	10.00
27	2400	416.66	3872	416	9.70
28	2380	420.16	3900	396	9.22
29	2348	425.89	3896	424	9.81
30	2400	416.66	3600	392	9.82
Mean	**2488.67**	**402.34**	**3844.13**	**408.00**	**9.59**
SD	**85.71**	**13.90**	**192.88**	**27.23**	**0.44**

Table 77 Palisade ratio, trichome number, vein termination number, vein islets number of *J. scandens* (Retz.) Vahl (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	11.00	2.75	25	15	5
2	11.50	2.88	28	17	4
3	11.00	2.75	40	14	5
4	11.00	2.75	30	12	5
5	11.00	2.75	41	10	4
6	9.50	2.38	34	18	7
7	11.50	2.88	30	11	8
8	10.50	2.63	6	15	6
9	11.00	2.75	5	10	12
10	12.50	3.13	18	13	7
11	11.00	2.75	13	8	9
12	9.50	2.38	23	8	10
13	10.00	2.50	25	11	8
14	11.00	2.75	9	11	10
15	8.50	2.13	30	10	6
16	10.00	2.50	24	12	5
17	10.50	2.63	24	9	5
18	11.00	2.75	29	10	4
19	9.50	2.38	35	9	6
20	9.50	2.38	24	8	5
21	11.50	2.88	24	8	7
22	12.00	3.00	32	8	9
23	10.00	2.50	30	20	5
24	10.50	2.63	30	10	5
25	9.50	2.38	26	11	4
26	11.00	2.75	30	11	4
27	10.50	2.63	30	12	4
28	10.50	2.63	22.00	9.00	8
29	11.50	2.88	28.00	8.00	7
30	12.00	3.00	30.00	11.00	6
Mean	**10.67**	**2.67**	**25.83**	**11.30**	**6.33**
SD	**0.90**	**0.23**	**8.61**	**3.12**	**2.12**

Table 78 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. auriculatum* (Location Bangkok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1556	642.67	2800	356	11.28
2	1628	614.25	2776	276	9.04
3	1580	632.91	2032	320	13.61
4	1672	598.08	2880	328	10.22
5	1612	620.34	2680	292	9.83
6	1628	614.25	2012	396	16.45
7	1620	617.28	1980	280	12.39
8	1536	651.04	2460	480	16.33
9	1524	656.16	2400	428	15.13
10	1600	625.00	2332	436	15.75
11	1608	621.89	2580	364	12.36
12	1624	615.76	2188	380	14.80
13	1592	628.14	2420	276	10.24
14	1456	686.81	2320	392	14.45
15	1500	666.66	2380	380	13.77
16	1588	629.72	2504	328	11.58
17	1552	644.32	2460	372	13.14
18	1616	618.81	2440	420	14.69
19	1520	657.89	2240	376	14.37
20	1552	644.32	2300	372	13.92
21	1600	625.00	2640	400	13.16
22	1556	642.67	2488	372	13.01
23	1472	679.34	2600	356	12.04
24	1596	626.56	2540	368	12.65
25	1620	617.28	2424	404	14.29
26	1548	645.99	2480	372	13.04
27	1572	636.13	2520	364	12.62
28	1608	621.89	2480	332	11.81
29	1588	629.72	2384	280	10.51
30	1604	623.44	2440	352	12.61
Mean	**1577.60**	**634.48**	**2439.33**	**361.73**	**12.97**
SD	**49.04**	**20.21**	**213.76**	**49.81**	**1.90**

Table 79 Palisade ratio, trichome number, vein termination number, vein islets number of *J. auriculatum* (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	9.00	2.25	3	11	14
2	12.00	3.00	8	13	10
3	13.00	3.25	6	12	12
4	9.00	2.25	10	11	10
5	11.00	2.75	12	12	10
6	9.00	2.25	10	11	11
7	9.00	2.25	10	10	12
8	9.00	2.25	9	10	9
9	10.00	2.50	7	11	9
10	10.00	2.50	10	11	7
11	9.00	2.25	11	10	11
12	11.00	2.75	8	11	10
13	10.00	2.50	11	11	11
14	10.00	2.50	11	9	15
15	9.00	2.25	12	9	12
16	9.00	2.25	12	12	14
17	8.00	2.00	20	14	8
18	9.50	2.38	15	14	18
19	10.00	2.50	15	12	14
20	8.50	2.13	12	11	9
21	8.00	2.00	15	11	9
22	10.50	2.63	14	11	14
23	10.00	2.50	13	8	13
24	11.00	2.75	14	15	7
25	11.50	2.88	15	12	8
26	10.50	2.63	10	9	11
27	10.50	2.63	12	8	10
28	8.50	2.13	11.00	10.00	9
29	10.50	2.63	13.00	12.00	7
30	9.50	2.38	10.00	9.00	8
Mean	**9.85**	**2.46**	**11.30**	**11.00**	**10.73**
SD	**1.17**	**0.29**	**3.25**	**1.68**	**2.66**

Table 80 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. auriculatum* (Location Nonthaburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1620	617.28	2540	348	12.05
2	1536	651.04	2660	380	12.50
3	1624	615.76	2380	348	12.76
4	1592	628.14	2600	388	12.99
5	1556	642.67	2360	304	11.41
6	1628	614.25	2400	336	12.28
7	1580	632.91	2300	340	12.88
8	1500	666.66	2460	360	12.77
9	1588	629.72	2720	388	12.48
10	1552	644.32	2560	416	13.98
11	1616	618.81	2592	380	12.79
12	1520	657.89	2780	404	12.69
13	1548	645.99	2940	420	12.50
14	1572	636.13	2664	368	12.14
15	1608	621.89	2600	388	12.99
16	1588	629.72	2720	380	12.26
17	1604	623.44	2440	372	13.23
18	1620	617.28	2592	368	12.43
19	1600	625.00	2624	336	11.35
20	1556	642.67	2400	328	12.02
21	1472	679.34	2520	360	12.50
22	1612	620.34	2552	364	12.48
23	1600	625.00	2580	392	13.19
24	1580	632.91	2680	396	12.87
25	1604	623.44	2828	396	12.28
26	1592	628.14	2700	404	13.02
27	1588	629.72	2552	360	12.36
28	1600	625.00	2360	292	11.01
29	1580	632.91	2440	380	13.48
30	1592	628.14	2580	312	10.79
Mean	**1580.93**	**632.88**	**2570.80**	**366.93**	**12.48**
SD	**37.19**	**15.34**	**149.64**	**32.14**	**0.69**

Table 81 Palisade ratio, trichome number, vein termination number, vein islets number of *J. auriculatum* (Location Nonthaburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	9.00	2.25	22	14	10
2	10.00	2.50	24	12	11
3	9.00	2.25	20	14	6
4	10.50	2.63	21	13	10
5	8.50	2.13	18	12	9
6	9.00	2.25	21	14	13
7	11.50	2.88	26	13	15
8	11.00	2.75	22	14	14
9	10.50	2.63	18	11	8
10	10.00	2.50	22	12	10
11	11.00	2.75	20	11	12
12	11.00	2.75	26	10	12
13	10.00	2.50	22	12	14
14	10.00	2.50	20	11	12
15	12.00	3.00	22	14	11
16	11.00	2.75	21	10	9
17	12.00	3.00	22	11	9
18	10.00	2.50	20	11	10
19	9.50	2.38	27	10	13
20	8.50	2.13	22	9	15
21	10.00	2.50	21	9	14
22	12.00	3.00	23	11	14
23	11.00	2.75	22	10	15
24	11.00	2.75	21	14	16
25	11.50	2.88	20	12	15
26	12.00	3.00	26	11	11
27	10.50	2.63	21	9	14
28	10.00	2.50	20.00	9.00	13
29	12.00	3.00	22.00	10.00	13
30	11.00	2.75	23.00	10.00	9
Mean	**10.50**	**2.63**	**21.83**	**11.43**	**11.90**
SD	**1.06**	**0.26**	**2.20**	**1.70**	**2.51**

Table 82 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. auriculatum* (Location Chonburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1612	620.34	2700	300	10.00
2	1600	625.00	2640	344	11.53
3	1580	632.91	2040	336	14.14
4	1628	614.25	2160	280	11.48
5	1580	632.91	2432	364	13.02
6	1500	666.66	1920	368	16.08
7	1608	621.89	2720	304	10.05
8	1588	629.72	2160	528	19.64
9	1604	623.44	2592	432	14.29
10	1500	666.66	2800	464	14.22
11	1588	629.72	2680	368	12.07
12	1552	644.32	2664	344	11.44
13	1616	618.81	2360	272	10.33
14	1580	632.91	2720	352	11.46
15	1604	623.44	2704	376	12.21
16	1592	628.14	2596	348	11.82
17	1552	644.32	2840	352	11.03
18	1600	625.00	2720	416	13.27
19	1556	642.67	2340	360	13.33
20	1596	626.56	2360	368	13.49
21	1620	617.28	2740	408	12.96
22	1548	645.99	2560	376	12.81
23	1608	621.89	2680	396	12.87
24	1588	629.72	2600	368	12.40
25	1604	623.44	2748	376	12.04
26	1500	666.66	2664	356	11.79
27	1588	629.72	2560	368	12.57
28	1552	644.32	2400	348	12.66
29	1616	618.81	2300	288	11.13
30	1600	625.00	2512	356	12.41
Mean	**1582.00**	**632.42**	**2530.40**	**363.87**	**12.62**
SD	**35.09**	**14.41**	**234.57**	**52.26**	**1.87**

Table 83 Palisade ratio, trichome number, vein termination number, vein islets number of *J. auriculatum* (Location Chonburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	11.00	2.75	10	12	14
2	11.00	2.75	10	13	10
3	12.00	3.00	15	13	9
4	12.50	3.13	12	11	9
5	8.50	2.13	20	11	10
6	11.00	2.75	12	12	14
7	14.00	3.50	10	11	13
8	11.00	2.75	10	10	11
9	11.00	2.75	12	14	11
10	10.50	2.63	10	12	14
11	11.00	2.75	11	11	12
12	11.00	2.75	12	12	11
13	10.00	2.50	12	11	11
14	12.00	3.00	5	11	10
15	11.00	2.75	12	12	10
16	10.50	2.63	12	11	14
17	9.00	2.25	11	10	11
18	9.00	2.25	13	12	11
19	11.00	2.75	10	11	10
20	12.00	3.00	6	10	11
21	10.00	2.50	11	10	9
22	10.50	2.63	12	14	10
23	10.00	2.50	12	10	13
24	9.00	2.25	12	11	11
25	11.00	2.75	12	11	10
26	10.50	2.63	11	10	11
27	10.00	2.50	10	10	15
28	11.00	2.75	12.00	10.00	14
29	11.50	2.88	10.00	10.00	14
30	10.00	2.50	15.00	10.00	14
Mean	**10.75**	**2.69**	**11.40**	**11.20**	**11.57**
SD	**1.13**	**0.28**	**2.58**	**1.19**	**1.83**

Table 84 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Bangkok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1596	626.56	2800	224	7.41
2	1624	615.76	2280	232	9.24
3	1640	609.75	2668	244	8.38
4	1604	623.44	2620	264	9.15
5	1564	639.38	2580	244	8.64
6	1548	645.99	2480	240	8.82
7	1500	666.66	2284	248	9.79
8	1516	659.63	2680	236	8.09
9	1504	664.89	2820	244	7.96
10	1412	708.21	2856	236	7.63
11	1480	675.67	2720	228	7.73
12	1460	684.93	2800	260	8.50
13	1460	684.93	2680	252	8.59
14	1428	700.28	3112	228	6.83
15	1516	659.63	2800	236	7.77
16	1640	609.75	2780	252	8.31
17	1580	632.91	2380	236	9.02
18	1504	664.89	2600	256	8.96
19	1460	684.93	2620	240	8.39
20	1548	645.99	2520	228	8.30
21	1476	677.50	2624	220	7.74
22	1460	684.93	2592	212	7.56
23	1472	679.34	2200	216	8.94
24	1520	657.89	2720	272	9.09
25	1504	664.89	2340	220	8.59
26	1548	645.99	2320	228	8.95
27	1600	625.00	2316	248	9.67
28	1480	675.67	2720	240	8.11
29	1460	684.93	2744	244	8.17
30	1520	657.89	2680	232	7.97
Mean	**1520.80**	**658.61**	**2611.20**	**238.67**	**8.41**
SD	**62.56**	**26.73**	**209.47**	**14.22**	**0.68**

Table 85 Palisade ratio, trichome number, vein termination number, vein islets number of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	6.00	1.5	6	3	3
2	7.50	1.88	4	4	3
3	6.00	1.50	4	4	3
4	6.50	1.63	5	3	3
5	7.00	1.75	5	5	4
6	7.00	1.75	3	3	3
7	7.50	1.88	4	4	5
8	7.00	1.75	6	4	4
9	7.00	1.75	6	5	4
10	6.50	1.63	4	4	3
11	6.00	1.50	5	5	2
12	7.00	1.75	4	5	5
13	6.50	1.63	9	5	4
14	7.50	1.88	6	6	4
15	7.50	1.88	6	4	5
16	7.50	1.88	5	5	4
17	8.00	2.00	7	4	3
18	8.00	2.00	6	6	3
19	8.00	2.00	5	6	4
20	7.00	1.75	6	4	4
21	7.00	1.75	7	4	6
22	7.00	1.75	7	6	4
23	6.50	1.63	9	5	5
24	6.50	1.63	8	5	5
25	6.50	1.63	8	4	4
26	8.00	2.00	6	4	5
27	8.00	2.00	7	3	4
28	7.50	1.88	7.00	3.00	5
29	7.50	1.88	8.00	3.00	3
30	8.00	2.00	6.00	5.00	4
Mean	**7.12**	**1.78**	**5.97**	**4.37**	**3.93**
SD	**0.64**	**0.16**	**1.54**	**0.96**	**0.91**

Table 86 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Chonburi)

Position	Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1	1520	657.89	2784	392	12.34
2	2	1504	664.89	3048	400	11.60
3	3	1548	645.99	2780	316	10.21
4	4	1600	625.00	2800	268	8.74
5	5	1460	684.93	2880	272	8.63
6	6	1428	700.28	2788	256	8.41
7	7	1480	675.67	2800	260	8.50
8	8	1460	684.93	2380	248	9.44
9	9	1520	657.89	2456	224	8.36
10	10	1548	645.99	2400	252	9.50
11	11	1516	659.63	2520	260	9.35
12	12	1504	664.89	2400	236	8.95
13	13	1432	698.32	2480	228	8.42
14	14	1552	644.32	2512	220	8.05
15	15	1600	625.00	2144	216	9.15
16	16	1608	621.89	2240	236	9.53
17	17	1592	628.14	2344	244	9.43
18	18	1520	657.89	2440	248	9.23
19	19	1504	664.89	2540	256	9.16
20	20	1484	673.85	2640	268	9.22
21	21	1440	694.44	2500	236	8.63
22	22	1516	659.63	2652	256	8.80
23	23	1524	656.16	2580	204	7.33
24	24	1540	649.35	2320	172	6.90
25	25	1600	625.00	2152	212	8.97
26	26	1528	654.45	2400	248	9.37
27	27	1564	639.38	2560	244	8.70
28	28	1500	666.66	2460	200	7.52
29	29	1520	657.89	2536	248	8.91
30	30	1564	639.38	2552	240	8.60
Mean	**Mean**	**1522.53**	**657.49**	**2536.27**	**252.00**	**9.00**
SD	**SD**	**50.10**	**21.73**	**212.55**	**47.15**	**1.07**

Table 87 Palisade ratio, trichome number, vein termination number, vein islets number of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Chonburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	6.00	1.5	5	3	3
2	7.00	1.75	7	5	2
3	6.50	1.63	8	3	3
4	7.50	1.88	6	3	4
5	7.00	1.75	9	4	4
6	6.00	1.50	7	5	3
7	8.00	2.00	5	4	4
8	7.00	1.75	5	5	3
9	7.00	1.75	6	5	3
10	6.50	1.63	5	5	3
11	8.00	2.00	7	4	2
12	7.00	1.75	9	3	4
13	7.00	1.75	6	4	2
14	7.00	1.75	9	4	5
15	7.00	1.75	8	5	4
16	8.00	2.00	6	4	4
17	8.00	2.00	4	3	5
18	9.00	2.25	6	3	4
19	7.50	1.88	7	4	4
20	7.50	1.88	10	4	5
21	7.50	1.88	8	6	4
22	6.50	1.63	10	6	3
23	8.00	2.00	8	5	4
24	8.00	2.00	13	4	4
25	9.00	2.25	10	4	4
26	9.00	2.25	9	3	4
27	8.00	2.00	9	4	3
28	7.00	1.75	6.00	3.00	3
29	8.00	2.00	8.00	5.00	3
30	8.00	2.00	7.00	6.00	2
Mean	**7.45**	**1.86**	**7.43**	**4.20**	**3.50**
SD	**0.80**	**0.20**	**1.98**	**0.96**	**0.86**

Table 88 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Saraburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1516	659.63	2600	240	8.45
2	1640	609.75	2400	260	9.77
3	1580	632.91	2640	212	7.43
4	1552	644.32	2760	236	7.88
5	1480	675.67	2400	220	8.40
6	1600	625.00	2540	232	8.37
7	1516	659.63	2668	232	8.00
8	1420	704.22	2720	256	8.60
9	1504	664.89	2240	216	8.79
10	1520	657.89	2480	208	7.74
11	1416	706.21	2580	240	8.51
12	1520	657.89	2520	236	8.56
13	1504	664.89	2500	260	9.42
14	1548	645.99	2620	232	8.13
15	1600	625.00	2720	276	9.21
16	1480	675.67	2400	240	9.09
17	1524	656.16	2400	248	9.37
18	1540	649.35	2500	232	8.49
19	1560	641.02	2400	252	9.50
20	1528	654.45	2580	248	8.77
21	1500	666.66	2600	244	8.58
22	1520	657.89	2480	248	9.09
23	1564	639.38	2600	232	8.19
24	1520	657.89	2460	228	8.48
25	1504	664.89	2480	232	8.55
26	1548	645.99	2520	212	7.76
27	1504	664.89	2240	200	8.20
28	1504	664.89	2400	224	8.54
29	1460	684.93	2280	244	9.67
30	1540	649.35	2360	236	9.09
Mean	**1523.73**	**656.91**	**2502.93**	**235.87**	**8.62**
SD	**47.96**	**20.76**	**136.15**	**16.82**	**0.59**

Table 89 Palisade ratio, trichome number, vein termination number, vein islets number of *J. adenophyllum* Wall. ex C. B. Clarke 'Maliwan' (Location Saraburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	7.00	1.75	7	3	3
2	7.50	1.88	6	4	3
3	7.50	1.88	6	3	4
4	8.00	2.00	6	2	4
5	6.50	1.63	8	4	4
6	7.00	1.75	5	3	4
7	7.00	1.75	8	4	4
8	7.50	1.88	6	4	5
9	7.00	1.75	5	5	3
10	6.50	1.63	6	6	2
11	7.00	1.75	5	3	4
12	7.00	1.75	6	4	2
13	8.00	2.00	6	4	4
14	6.50	1.63	6	6	4
15	7.50	1.88	8	5	3
16	9.00	2.25	7	4	3
17	7.50	1.88	7	5	5
18	8.00	2.00	8	4	3
19	8.00	2.00	10	5	4
20	7.00	1.75	9	5	4
21	7.00	1.75	7	6	4
22	6.50	1.63	7	5	4
23	7.00	1.75	7	4	5
24	7.00	1.75	5	4	3
25	8.00	2.00	8	6	4
26	9.00	2.25	7	5	3
27	9.00	2.25	6	3	2
28	8.00	2.00	6.00	3.00	4
29	9.00	2.25	7.00	6.00	2
30	9.00	2.25	7.00	5.00	3
Mean	**7.55**	**1.89**	**6.73**	**4.33**	**3.53**
SD	**0.81**	**0.20**	**1.20**	**1.09**	**0.86**

Table 90 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. cordatum* (Location Chiangmai)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1788	559.28	1880	164	8.02
2	1796	556.79	1892	196	9.39
3	1824	548.24	2060	204	9.01
4	1852	539.95	1900	224	10.55
5	1860	537.63	2072	188	8.32
6	1888	529.66	1920	240	11.11
7	1780	561.79	2060	200	8.85
8	1752	570.77	2080	216	9.41
9	1684	593.82	2240	188	7.74
10	1724	580.04	2172	176	7.50
11	1872	534.18	2120	232	9.86
12	1664	600.96	2148	224	9.44
13	1688	592.41	2040	232	10.21
14	1752	570.77	2000	192	8.76
15	1640	609.75	2100	204	8.85
16	1800	555.55	2000	184	8.42
17	1820	549.45	2060	240	10.43
18	1720	581.39	2160	272	11.18
19	1848	541.12	2072	220	9.60
20	1788	559.28	2136	212	9.03
21	1860	537.63	2100	216	9.33
22	1700	588.23	1788	176	8.96
23	1804	554.32	2008	240	10.68
24	1748	572.08	2020	208	9.34
25	1760	568.18	2080	192	8.45
26	1712	584.11	2056	220	9.67
27	1788	559.28	2024	212	9.48
28	1768	565.61	1912	200	9.47
29	1708	585.48	1700	160	8.60
30	1740	574.71	2080	192	8.45
Mean	**1770.93**	**565.42**	**2029.33**	**207.47**	**9.27**
SD	**65.30**	**20.93**	**116.42**	**24.92**	**0.93**

Table 91 Palisade ratio, trichome number, vein termination number, vein islets number of *J. cordatum* (Location Chiangmai)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	17.00	4.25	18	29	3	4
2	17.50	4.38	17	28	4	3
3	23.00	5.75	20	27	2	2
4	19.00	4.75	18	25	3	2
5	17.00	4.25	16	28	3	4
6	18.50	4.63	19	22	2	4
7	19.00	4.75	22	27	4	5
8	20.50	5.13	19	26	3	5
9	22.00	5.50	18	21	2	1
10	21.00	5.25	16	25	5	3
11	19.00	4.75	15	24	3	4
12	18.00	4.50	15	28	7	4
13	22.00	5.50	17	21	3	5
14	25.00	6.25	20	27	4	2
15	24.50	6.13	18	23	3	4
16	21.00	5.25	21	18	3	1
17	20.00	5.00	19	16	3	3
18	15.00	3.75	22	20	5	4
19	21.00	5.25	22	15	3	1
20	18.50	4.63	19	14	4	6
21	19.00	4.75	23	16	3	1
22	21.00	5.25	20	18	3	3
23	16.50	4.13	24	11	7	3
24	22.00	5.50	22	15	3	3
25	23.00	5.75	12	30	3	3
26	21.50	5.38	14	25	3	0
27	18.50	4.63	19	23	5	5
28	19.00	4.75	20	21	5	4
29	21.00	5.25	16	20	3	4
30	19.50	4.88	15	25	3	6
Mean	**19.98**	**5.00**	**18.53**	**22.27**	**3.57**	**3.30**
SD	**2.35**	**0.59**	**2.87**	**5.09**	**1.25**	**1.53**

Table 92 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. cordatum* (Location Chiangmai)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1820	549.45	1928	160	7.66
2	1848	541.12	1852	192	9.39
3	1860	537.63	2000	236	10.55
4	2280	438.59	2020	216	9.66
5	1692	591.01	1940	200	9.35
6	1740	574.71	1928	232	10.74
7	1800	555.55	1936	188	8.85
8	1828	547.04	1980	220	10.00
9	1716	582.75	2200	184	7.72
10	1736	576.03	2160	200	8.47
11	1680	595.23	1960	220	10.09
12	1732	577.36	2080	224	9.72
13	1772	564.33	1916	240	11.13
14	1804	554.32	1740	200	10.31
15	1728	578.70	1880	192	9.27
16	1708	585.48	1760	200	10.20
17	1740	574.71	1740	236	11.94
18	1760	568.18	2020	260	11.40
19	1772	564.33	1956	212	9.78
20	1788	559.28	2100	200	8.70
21	1768	565.61	2160	208	8.78
22	1724	580.04	1800	192	9.64
23	1700	588.23	2040	240	10.53
24	1720	581.39	1920	192	9.09
25	1584	631.31	1948	204	9.48
26	1728	578.70	2040	236	10.37
27	1760	568.18	1980	228	10.33
28	1712	584.11	1880	208	9.96
29	1784	560.53	1720	156	8.32
30	1772	564.33	2240	200	8.20
Mean	**1768.53**	**567.27**	**1960.80**	**209.20**	**9.65**
SD	**111.30**	**30.48**	**134.37**	**23.54**	**1.04**

Table 93 Palisade ratio, trichome number, vein termination number, vein islets number of *J. cordatum* (Location Chiangmai)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	18.00	4.5	19	29	4	5
2	18.50	4.63	22	25	6	5
3	20.00	5.00	18	28	4	2
4	21.00	5.25	19	20	4	5
5	19.00	4.75	22	17	6	4
6	18.50	4.63	20	17	4	3
7	26.00	6.50	20	26	6	4
8	24.00	6.00	21	31	5	3
9	22.50	5.63	15	23	4	2
10	19.00	4.75	13	25	3	3
11	22.00	5.50	12	22	5	4
12	23.50	5.88	18	22	6	2
13	19.00	4.75	15	17	5	5
14	16.50	4.13	24	29	4	4
15	22.00	5.50	16	26	5	4
16	22.00	5.50	19	26	2	1
17	23.00	5.75	21	30	3	3
18	22.00	5.50	17	26	3	3
19	21.50	5.38	19	27	2	2
20	19.50	4.88	13	23	4	3
21	18.00	4.50	18	27	3	2
22	21.00	5.25	16	28	3	3
23	17.00	4.25	18	29	5	5
24	21.00	5.25	14	21	2	3
25	25.00	6.25	18	22	3	4
26	23.00	5.75	21	26	2	1
27	18.50	4.63	18	26	5	5
28	20.00	5.00	18	27	4	4
29	19.50	4.88	15	27	5	2
30	20.00	5.00	17	24	3	3
Mean	**20.68**	**5.17**	**17.87**	**24.87**	**4.00**	**3.30**
SD	**2.35**	**0.59**	**2.91**	**3.79**	**1.26**	**1.21**

Table 94 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. cordatum* (Location Chiangmai)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1804	554.32	1780	156	8.06
2	1728	578.7	1960	200	9.26
3	1708	585.48	2012	224	10.02
4	1848	541.12	2000	220	9.91
5	1788	559.28	2060	196	8.69
6	1860	537.63	2060	236	10.28
7	1700	588.23	2020	200	9.01
8	1688	592.41	1940	216	10.02
9	1752	570.77	2100	208	9.01
10	1704	586.85	2176	204	8.57
11	1800	555.55	1880	232	10.98
12	1720	581.39	2000	236	10.55
13	1708	585.48	2000	240	10.71
14	1728	460.92	1860	208	10.06
15	1760	568.18	1840	220	10.68
16	1712	584.11	1852	192	9.39
17	1804	554.32	1824	240	11.63
18	1748	572.08	2180	268	10.95
19	1760	568.18	2060	228	9.97
20	1712	584.11	2032	200	8.96
21	1788	559.28	2192	220	9.12
22	1736	576.03	1868	200	9.67
23	1800	555.55	2060	244	10.59
24	1792	558.03	1960	188	8.75
25	1772	564.33	2060	208	9.17
26	1700	588.23	2000	228	10.23
27	1804	554.32	1920	220	10.28
28	1840	543.47	2000	216	9.75
29	1784	560.53	1920	168	8.05
30	1800	555.55	2120	208	8.93
Mean	**1761.60**	**564.15**	**1991.20**	**214.13**	**9.71**
SD	**48.41**	**24.84**	**108.24**	**22.82**	**0.90**

Table 95 Palisade ratio, trichome number, vein termination number, vein islets number of *J. cordatum* (Location Chiangmai)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	18.50	4.625	18	30	7	4
2	20.00	5.00	21	27	5	2
3	22.00	5.50	17	28	4	1
4	25.50	6.38	15	23	3	4
5	20.00	5.00	17	20	4	6
6	20.00	5.00	13	25	5	4
7	25.50	6.38	21	27	5	3
8	23.00	5.75	22	30	4	3
9	23.00	5.75	15	25	4	2
10	21.00	5.25	10	24	3	4
11	20.00	5.00	13	22	4	4
12	28.00	7.00	13	29	8	3
13	26.50	6.63	15	21	6	5
14	22.00	5.50	17	38	5	4
15	20.00	5.00	19	35	5	2
16	19.00	4.75	21	29	5	2
17	21.00	5.25	25	32	3	2
18	20.00	5.00	20	28	3	3
19	25.00	6.25	18	27	3	2
20	21.00	5.25	17	26	6	4
21	19.00	4.75	19	29	3	5
22	19.50	4.88	13	29	4	3
23	20.00	5.00	18	29	6	4
24	22.00	5.50	16	27	3	3
25	24.00	6.00	18	28	3	3
26	22.00	5.50	21	26	2	2
27	20.00	5.00	16	27	5	4
28	21.00	5.25	18	28	5	3
29	20.00	5.00	16	28	4	2
30	20.00	5.00	16	25	3	3
Mean	**21.62**	**5.40**	**17.27**	**27.40**	**4.33**	**3.20**
SD	**2.43**	**0.61**	**3.23**	**3.70**	**1.37**	**1.13**

Table 96 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Nonthaburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1472	679.34	1808	292	13.90
2	1488	672.04	1860	276	12.92
3	1412	708.21	1920	280	12.73
4	1444	692.52	2000	272	11.97
5	1476	677.50	1940	276	12.45
6	1392	718.39	2040	260	11.30
7	1384	722.54	2048	284	12.18
8	1412	708.21	1920	292	13.20
9	1420	704.22	2000	260	11.50
10	1416	706.21	1992	280	12.32
11	1436	696.37	1960	272	12.19
12	1420	704.22	2000	288	12.59
13	1448	690.60	2060	280	11.97
14	1416	706.21	1900	288	13.16
15	1464	683.06	2040	268	11.61
16	1480	675.67	1976	264	11.79
17	1392	718.39	1860	288	13.41
18	1460	684.93	1816	280	13.36
19	1432	698.32	1872	260	12.20
20	1476	677.50	2040	292	12.52
21	1560	641.02	1920	276	12.57
22	1432	698.32	1860	288	13.41
23	1468	681.19	1800	280	13.46
24	1416	706.21	1872	292	13.49
25	1388	720.46	1920	272	12.41
26	1444	692.52	2060	284	12.12
27	1420	704.22	1960	280	12.50
28	1488	672.04	1980	288	12.70
29	1420	704.22	2048	284	12.18
30	1392	718.39	2000	292	12.74
Mean	**1438.93**	**695.43**	**1949.07**	**279.60**	**12.56**
SD	**38.88**	**18.38**	**79.76**	**10.04**	**0.65**

Table 97 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Nonthaburi)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	7.00	1.75	6	16	9	4
2	6.00	1.50	6	15	5	5
3	7.00	1.75	7	17	5	5
4	7.00	1.75	6	18	5	3
5	7.00	1.75	8	20	5	4
6	8.00	2.00	7	18	6	3
7	8.00	2.00	9	20	5	5
8	6.00	1.50	6	17	5	5
9	6.00	1.50	7	18	6	5
10	7.00	1.75	8	16	7	4
11	9.00	2.25	9	15	6	8
12	8.00	2.00	7	14	5	8
13	7.00	1.75	6	19	5	5
14	7.00	1.75	8	19	8	8
15	8.00	2.00	7	16	6	4
16	8.00	2.00	9	20	6	7
17	8.00	2.00	7	20	9	6
18	9.00	2.25	7	14	4	4
19	9.00	2.25	9	19	6	7
20	7.50	1.88	9	20	5	4
21	8.00	2.00	8	20	6	4
22	7.00	1.75	9	17	9	7
23	7.00	1.75	9	19	7	8
24	6.50	1.63	8	18	6	7
25	8.00	2.00	7	20	6	7
26	6.00	1.50	7	15	8	8
27	6.00	1.50	6	20	6	8
28	8.00	2.00	9	16	5	3
29	9.00	2.25	9	20	8	4
30	6.00	1.50	8	18	9	5
Mean	**7.37**	**1.84**	**7.60**	**17.80**	**6.27**	**5.50**
SD	**0.97**	**0.24**	**1.13**	**2.01**	**1.46**	**1.74**

Table 98 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Chiangmai)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1436	696.37	2080	288	12.16
2	1440	694.44	2288	260	10.20
3	1472	679.34	1968	220	10.05
4	1504	664.89	2320	264	10.22
5	1380	724.63	1992	260	11.55
6	1360	735.29	1900	228	10.71
7	1420	704.22	2000	212	9.58
8	1392	718.39	1980	276	12.23
9	1440	694.44	1960	276	12.34
10	1396	716.33	2040	248	10.84
11	1428	700.28	1956	236	10.77
12	1440	694.44	1960	280	12.50
13	1388	720.46	2000	260	11.50
14	1400	714.28	1948	248	11.29
15	1436	696.37	1992	240	10.75
16	1460	684.93	1920	232	10.78
17	1488	672.04	1944	280	12.59
18	1392	718.39	2280	256	10.09
19	1416	706.21	1980	232	10.49
20	1432	698.32	2032	288	12.41
21	1476	677.50	1920	280	12.73
22	1444	692.52	1940	268	12.14
23	1480	675.67	1880	292	13.44
24	1464	683.06	1916	300	13.54
25	1392	718.39	1960	264	11.87
26	1436	696.37	2000	292	12.74
27	1388	720.46	2000	276	12.13
28	1504	664.89	1860	260	12.26
29	1360	735.29	2000	280	12.28
30	1400	714.28	1988	272	12.04
Mean	**1428.80**	**700.42**	**2000.13**	**262.27**	**11.61**
SD	**40.14**	**19.61**	**110.62**	**23.08**	**1.06**

Table 99 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Chiangmai)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	7.00	1.75	7	18	7	5
2	6.50	1.63	6	20	7	4
3	8.00	2.00	6	17	6	4
4	8.00	2.00	6	18	9	5
5	8.50	2.13	6	16	8	3
6	9.00	2.25	8	19	7	3
7	7.00	1.75	7	16	7	5
8	7.00	1.75	8	20	6	4
9	6.00	1.50	7	16	5	7
10	7.00	1.75	6	15	7	6
11	8.00	2.00	7	15	7	5
12	8.50	2.13	6	15	6	4
13	7.00	1.75	6	15	6	4
14	9.00	2.25	6	15	5	5
15	8.00	2.00	6	19	8	5
16	7.00	1.75	6	18	8	5
17	7.50	1.88	8	20	7	7
18	8.00	2.00	9	15	8	6
19	9.00	2.25	7	18	8	6
20	8.00	2.00	9	20	9	6
21	7.00	1.75	7	17	6	5
22	7.50	1.88	7	18	8	5
23	9.00	2.25	7	16	7	7
24	8.00	2.00	7	15	6	7
25	7.00	1.75	9	18	6	8
26	6.50	1.63	8	16	7	7
27	7.00	1.75	7	15	9	6
28	7.00	1.75	7	15	8	7
29	7.00	1.75	6	18	8	7
30	7.00	1.75	6	16	8	6
Mean	**7.57**	**1.89**	**6.93**	**16.97**	**7.13**	**5.47**
SD	**0.83**	**0.21**	**0.98**	**1.79**	**1.11**	**1.31**

Table 100 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1508	663.12	2112	264	11.11
2	1528	654.45	2160	256	10.60
3	1468	681.19	1920	216	10.11
4	1380	724.63	2000	240	10.71
5	1424	702.24	1960	232	10.58
6	1400	714.28	2000	244	10.87
7	1384	722.54	1872	192	9.30
8	1440	694.44	1880	228	10.82
9	1416	706.21	1752	204	10.43
10	1380	724.63	2000	232	10.39
11	1420	704.22	2000	224	10.07
12	1392	718.39	1960	248	11.23
13	1420	704.22	1968	232	10.55
14	1440	694.44	1800	188	9.46
15	1392	718.39	1760	184	9.47
16	1400	714.28	2000	248	11.03
17	1432	698.32	1920	196	9.26
18	1420	704.22	2000	208	9.42
19	1448	690.60	2040	248	10.84
20	1468	681.19	2000	232	10.39
21	1488	672.04	2032	224	9.93
22	1400	714.28	2060	252	10.90
23	1444	692.52	2096	264	11.19
24	1400	714.28	1980	236	10.65
25	1496	668.44	2060	256	11.05
26	1420	704.22	2080	272	11.56
27	1440	694.44	1980	248	11.13
28	1480	675.67	1960	272	12.19
29	1368	730.99	2000	248	11.03
30	1396	716.33	2052	256	11.09
Mean	**1429.73**	**699.97**	**1980.13**	**234.80**	**10.58**
SD	**41.04**	**19.75**	**95.37**	**24.59**	**0.70**

Table 101 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nobile* C. B. Clarke subsp. *rex* (Dunn) (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	8.50	2.125	8	18	5	5
2	7.00	1.75	9	20	5	7
3	9.00	2.25	8	17	6	7
4	8.50	2.13	8	18	5	6
5	7.00	1.75	8	16	5	6
6	7.00	1.75	7	15	7	7
7	7.50	1.88	9	15	7	7
8	7.00	1.75	9	15	6	8
9	8.00	2.00	6	18	6	5
10	9.00	2.25	7	20	5	5
11	8.50	2.13	7	17	5	6
12	8.00	2.00	7	18	6	7
13	8.00	2.00	7	16	7	6
14	8.00	2.00	7	16	7	4
15	9.00	2.25	8	16	6	7
16	9.00	2.25	9	15	7	4
17	8.00	2.00	9	15	8	4
18	8.00	2.00	8	19	6	7
19	8.00	2.00	7	16	6	8
20	9.00	2.25	7	20	9	8
21	7.50	1.88	6	15	4	6
22	8.00	2.00	7	15	6	7
23	9.00	2.25	9	16	7	7
24	8.50	2.13	7	19	7	8
25	8.00	2.00	7	18	8	7
26	8.00	2.00	7	20	6	6
27	9.00	2.25	9	15	6	6
28	8.00	2.00	7	18	7	6
29	9.00	2.25	7	15	4	7
30	9.00	2.25	7	15	6	8
Mean	**8.20**	**2.05**	**7.60**	**16.87**	**6.17**	**6.40**
SD	**0.68**	**0.17**	**0.93**	**1.81**	**1.15**	**1.19**

Table 102 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Patumthani)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1656	603.86	3280	380	10.38
2	1636	611.24	3344	372	10.01
3	1624	615.76	3200	364	10.21
4	1644	608.27	3352	344	9.31
5	1680	595.23	3280	348	9.59
6	1688	592.41	3300	352	9.64
7	1520	657.89	3360	344	9.29
8	1320	757.57	3248	364	10.08
9	1540	649.35	3304	380	10.31
10	1596	626.56	3424	360	9.51
11	1408	710.22	2880	376	11.55
12	1260	793.65	3056	360	10.54
13	1388	720.46	3200	384	10.71
14	1264	791.13	3192	372	10.44
15	1508	663.12	3240	400	10.99
16	1600	625.00	3160	392	11.04
17	1540	649.35	2920	372	11.30
18	1468	681.19	3176	380	10.69
19	1480	675.67	3184	388	10.86
20	1460	684.93	3228	392	10.83
21	1560	641.02	3120	328	9.51
22	1420	704.22	3360	376	10.06
23	1504	664.89	3376	364	9.73
24	1560	641.02	3176	328	9.36
25	1388	720.46	3120	320	9.30
26	1548	645.99	3200	352	9.91
27	1592	628.14	3140	340	9.77
28	1508	663.12	3040	332	9.85
29	1604	623.44	3200	352	9.91
30	1464	683.06	3120	320	9.30
Mean	**1514.27**	**664.27**	**3206.00**	**361.20**	**10.13**
SD	**114.82**	**53.33**	**126.82**	**22.31**	**0.65**

Table 103 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Patumthani)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	12.50	3.125	10	8	8
2	11.00	2.75	16	9	7
3	11.50	2.88	17	9	6
4	11.50	2.88	18	8	6
5	12.00	3.00	10	9	4
6	13.00	3.25	11	10	4
7	11.00	2.75	12	9	6
8	12.50	3.13	13	10	8
9	13.00	3.25	15	14	4
10	10.00	2.50	17	9	5
11	13.50	3.38	20	8	5
12	10.50	2.63	22	9	5
13	12.50	3.13	24	9	6
14	10.50	2.63	15	7	6
15	12.00	3.00	13	9	7
16	12.00	3.00	20	12	4
17	13.00	3.25	16	11	4
18	11.50	2.88	15	10	6
19	12.50	3.13	9	9	6
20	13.00	3.25	13	9	4
21	10.00	2.50	15	8	5
22	13.50	3.38	18	7	5
23	10.50	2.63	20	9	4
24	11.00	2.75	20	12	7
25	11.00	2.75	17	10	5
26	10.00	2.50	12	8	6
27	10.50	2.63	17	7	7
28	11.00	2.75	13	9	6
29	10.50	2.63	15	9	6
30	10.50	2.63	20	10	6
Mean	**11.58**	**2.90**	**15.77**	**9.23**	**5.60**
SD	**1.11**	**0.28**	**3.76**	**1.52**	**1.19**

Table 104 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Lampoon)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1592	628.14	3504	348	9.03
2	1508	663.12	3456	384	10.00
3	1604	623.44	3480	352	9.19
4	1540	649.35	2944	364	11.00
5	1596	626.56	2980	380	11.31
6	1408	710.22	3472	400	10.33
7	1540	649.35	2776	388	12.26
8	1468	681.19	3172	376	10.60
9	1600	625.00	2832	356	11.17
10	1640	609.75	2576	368	12.50
11	1668	599.52	3200	384	10.71
12	1468	681.19	3024	368	10.85
13	1720	581.39	3680	364	9.00
14	1520	657.89	3320	356	9.68
15	1460	684.93	3360	340	9.19
16	1420	704.22	3536	376	9.61
17	1504	664.89	3040	380	11.11
18	1548	645.99	3520	396	10.11
19	1592	628.14	3200	408	11.31
20	1420	704.22	3408	428	11.16
21	1380	724.63	3312	408	10.97
22	1280	781.25	2960	384	11.48
23	1500	666.66	3200	360	10.11
24	1472	679.34	2996	376	11.15
25	1428	700.28	3148	384	10.87
26	1360	735.29	3260	360	9.94
27	1600	625.00	3240	352	9.80
28	1512	661.37	3320	380	10.27
29	1568	637.75	3300	360	9.84
30	1396	716.33	3120	368	10.55
Mean	**1510.40**	**664.88**	**3211.20**	**374.93**	**10.50**
SD	**99.10**	**44.43**	**253.38**	**19.85**	**0.89**

Table 105 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Lampoon)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	10.00	2.5	12	9	6
2	10.50	2.63	14	9	7
3	13.00	3.25	15	8	7
4	11.00	2.75	15	8	6
5	12.50	3.13	12	8	5
6	13.00	3.25	18	9	5
7	10.50	2.63	20	10	5
8	12.50	3.13	22	13	6
9	10.50	2.63	18	12	6
10	12.00	3.00	17	10	7
11	11.00	2.75	16	9	6
12	11.00	2.75	16	10	5
13	10.50	2.63	20	9	5
14	12.00	3.00	19	10	5
15	12.00	3.00	16	14	6
16	11.50	2.88	18	12	5
17	10.00	2.50	13	11	5
18	12.00	3.00	16	13	5
19	13.50	3.38	15	8	6
20	10.50	2.63	14	7	6
21	11.00	2.75	12	11	4
22	10.00	2.50	18	7	5
23	10.50	2.63	16	12	5
24	14.00	3.50	20	10	5
25	13.50	3.38	19	11	6
26	12.50	3.13	20	12	4
27	13.00	3.25	17	11	5
28	14.00	3.50	16	14	6
29	14.00	3.50	17	10	5
30	13.00	3.25	15	11	5
Mean	**11.83**	**2.96**	**13.40**	**10.27**	**5.47**
SD	**1.32**	**0.33**	**2.61**	**1.93**	**0.78**

Table 106 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1680	595.23	3200	356	10.01
2	1432	698.32	3120	376	10.76
3	1540	649.35	3272	396	10.80
4	1596	626.56	3280	420	11.35
5	1408	710.22	3648	384	9.52
6	1720	581.39	3344	416	11.06
7	1520	657.89	3104	396	11.31
8	1460	684.93	3856	384	9.06
9	1592	628.14	3320	368	9.98
10	1420	704.22	3200	376	10.51
11	1380	724.63	3328	380	10.25
12	1720	581.39	3400	392	10.34
13	1520	657.89	3200	376	10.51
14	1540	649.35	3380	368	9.82
15	1596	626.56	3536	372	9.52
16	1408	710.22	3312	380	10.29
17	1260	793.65	2976	380	11.32
18	1668	599.52	3060	408	11.76
19	1468	681.19	3120	400	11.36
20	1720	581.39	3312	416	11.16
21	1520	657.89	3340	416	11.08
22	1320	757.57	3080	400	11.49
23	1540	649.35	3160	384	10.84
24	1548	645.99	3240	400	10.99
25	1592	628.14	3260	408	11.12
26	1508	663.12	3384	392	10.38
27	1424	702.24	3200	376	10.51
28	1468	681.19	3248	388	10.67
29	1480	675.67	3160	372	10.53
30	1500	666.66	3200	388	10.81
Mean	**1518.27**	**662.33**	**3274.67**	**388.93**	**10.64**
SD	**114.73**	**50.74**	**176.91**	**16.50**	**0.64**

Table 107 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lauriforium* Roxb. var. *nitidum* (Skan) P. S. Green (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	11.00	2.75	15	10	8
2	12.00	3.00	14	10	5
3	11.00	2.75	18	9	5
4	13.00	3.25	19	8	5
5	12.50	3.13	22	9	6
6	11.50	2.88	15	9	6
7	12.00	3.00	16	7	7
8	12.00	3.00	19	9	8
9	13.00	3.25	20	10	8
10	11.00	2.75	16	11	7
11	12.50	3.13	18	8	6
12	13.00	3.25	13	9	6
13	14.00	3.50	16	12	7
14	13.00	3.25	17	10	7
15	13.00	3.25	18	9	6
16	15.50	3.88	20	9	6
17	13.00	3.25	18	12	5
18	12.00	3.00	17	11	6
19	11.50	2.88	18	10	7
20	14.00	3.50	19	10	7
21	10.00	2.50	20	12	6
22	12.50	3.13	22	12	6
23	10.50	2.63	20	11	7
24	13.00	3.25	18	10	5
25	14.00	3.50	17	9	6
26	15.00	3.75	14	9	7
27	14.00	3.50	14	7	8
28	13.00	3.25	17.00	9.00	6
29	12.50	3.13	16.00	9.00	5
30	12.00	3.00	16.00	9.00	5
Mean	**12.57**	**3.14**	**17.40**	**9.63**	**6.30**
SD	**1.26**	**0.32**	**2.31**	**1.35**	**0.99**

Table 108 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. siamense* Craib (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1436	696.37	1380	196	12.44
2	1388	720.46	1400	192	12.06
3	1480	675.67	1420	184	11.47
4	1492	670.24	1408	188	11.78
5	1464	683.06	1300	192	12.87
6	1484	673.85	1344	200	12.95
7	1240	806.45	1360	200	12.82
8	1228	814.33	1400	204	12.72
9	1384	722.54	1376	192	12.24
10	1360	735.29	1384	200	12.63
11	1460	684.93	1464	208	12.44
12	1228	814.33	1360	208	13.27
13	1364	733.13	1400	200	12.50
14	1308	764.52	1432	204	12.47
15	1380	724.63	1476	212	12.56
16	1304	766.87	1464	220	13.06
17	1480	675.67	1460	196	11.84
18	1360	735.29	1392	208	13.00
19	1384	722.54	1408	192	12.00
20	1460	684.93	1440	204	12.41
21	1384	722.54	1416	196	12.16
22	1360	735.29	1432	216	13.11
23	1236	809.06	1440	220	13.25
24	1420	704.22	1448	212	12.77
25	1440	694.44	1460	200	12.05
26	1348	741.83	1424	192	11.88
27	1384	722.54	1440	200	12.20
28	1408	710.22	1456	204	12.29
29	1360	735.29	1416	204	12.59
30	1368	730.99	1440	208	12.62
Mean	**1379.73**	**727.05**	**1414.67**	**201.73**	**12.48**
SD	**77.23**	**42.16**	**40.62**	**9.02**	**0.46**

Table 109 Palisade ratio, trichome number, vein termination number, vein islets number of *J. siamense* Craib (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	16.00	4	16	7	2
2	14.00	3.50	13	5	2
3	15.00	3.75	13	4	2
4	11.00	2.75	15	3	2
5	15.00	3.75	14	5	2
6	15.00	3.75	16	5	3
7	14.00	3.50	13	2	3
8	13.00	3.25	15	4	2
9	16.00	4.00	16	3	2
10	15.00	3.75	18	5	2
11	14.00	3.50	16	6	2
12	14.00	3.50	18	4	3
13	13.00	3.25	17	4	2
14	13.00	3.25	18	3	2
15	14.00	3.50	20	5	4
16	15.00	3.75	19	5	2
17	14.00	3.50	14	4	3
18	15.00	3.75	15	7	3
19	14.00	3.50	12	5	3
20	13.00	3.25	16	7	3
21	14.00	3.50	13	5	4
22	13.00	3.25	17	4	2
23	14.00	3.50	16	5	3
24	12.00	3.00	16	4	3
25	15.00	3.75	13	4	2
26	15.00	3.75	15	4	2
27	14.00	3.50	13	5	2
28	14.00	3.50	16.00	3.00	4
29	13.00	3.25	16.00	4.00	3
30	12.00	3.00	16.00	5.00	2
Mean	**13.97**	**3.49**	**15.50**	**3.53**	**9.02**
SD	**1.16**	**0.29**	**1.98**	**1.20**	**0.68**

Table 110 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. siamense* Craib (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1360	735.29	1328	240	15.31
2	1384	722.54	1312	248	15.90
3	1460	684.93	1232	200	13.97
4	1384	722.54	1328	208	13.54
5	1480	675.67	1316	212	13.87
6	1384	722.54	1320	204	13.39
7	1360	735.29	1600	240	13.04
8	1460	684.93	1368	188	12.08
9	1424	702.24	1460	220	13.10
10	1360	735.29	1720	276	13.83
11	1420	704.22	1480	188	11.27
12	1460	684.93	1400	176	11.17
13	1432	698.32	1504	192	11.32
14	1360	735.29	1456	208	12.50
15	1352	739.64	1400	200	12.50
16	1308	764.52	1296	192	12.90
17	1360	735.29	1720	196	10.23
18	1312	762.19	1232	184	12.99
19	1420	704.22	1368	212	13.42
20	1468	681.19	1296	208	13.83
21	1312	762.19	1456	192	11.65
22	1384	722.54	1424	196	12.10
23	1348	741.83	1472	192	11.54
24	1360	735.29	1360	204	13.04
25	1392	718.39	1568	200	11.31
26	1308	764.52	1536	188	10.90
27	1376	726.74	1344	192	12.50
28	1300	769.23	1664	208	11.11
29	1352	739.64	1780	192	9.74
30	1376	726.74	1712	196	10.27
Mean	**1381.87**	**724.61**	**1448.40**	**205.07**	**12.48**
SD	**51.17**	**26.60**	**153.35**	**21.32**	**1.45**

Table 111 Palisade ratio, trichome number, vein termination number, vein islets number of *J. siamense* Craib (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	15.00	3.75	18	6	3
2	15.00	3.75	16	7	2
3	14.00	3.50	21	7	2
4	13.00	3.25	19	5	3
5	16.00	4.00	17	6	3
6	15.00	3.75	18	5	3
7	14.00	3.50	17	5	2
8	14.00	3.50	15	4	3
9	13.00	3.25	19	6	4
10	14.50	3.63	16	7	3
11	15.00	3.75	15	7	3
12	16.00	4.00	13	5	2
13	14.50	3.63	14	4	2
14	13.00	3.25	16	4	2
15	15.00	3.75	11	3	4
16	16.00	4.00	11	5	4
17	14.50	3.63	14	6	3
18	15.50	3.88	20	6	2
19	16.00	4.00	17	6	2
20	13.00	3.25	19	5	3
21	14.00	3.50	19	7	3
22	12.50	3.13	16	4	3
23	14.00	3.50	15	4	2
24	14.00	3.50	16	6	2
25	15.50	3.88	16	3	3
26	16.00	4.00	15	5	3
27	16.00	4.00	18	5	4
28	15.50	3.88	16	4	2
29	13.00	3.25	15	5	3
30	14.00	3.50	16	4	3
Mean	**14.55**	**3.64**	**16.27**	**3.98**	**9.13**
SD	**1.09**	**0.27**	**2.36**	**1.19**	**0.68**

Table 112 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. siamense* Craib (Location Chiangmai)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1304	766.87	1504	200	11.74
2	1360	735.29	1568	192	10.91
3	1236	809.06	1472	188	11.33
4	1420	704.22	1648	196	10.63
5	1352	739.64	1360	176	11.46
6	1308	764.52	1616	200	11.01
7	1360	735.29	1712	204	10.65
8	1312	762.19	1408	212	13.09
9	1420	704.22	1636	176	9.71
10	1348	741.83	1520	192	11.21
11	1364	733.13	1720	204	10.60
12	1308	764.52	1728	196	10.19
13	1380	724.63	1360	192	12.37
14	1304	766.87	1744	196	10.10
15	1236	809.06	1792	200	10.04
16	1420	704.22	1320	196	12.93
17	1376	726.74	1456	208	12.50
18	1300	769.23	1480	212	12.53
19	1308	764.52	1536	208	11.93
20	1384	722.54	1600	216	11.89
21	1348	741.83	1504	196	11.53
22	1384	722.54	1456	212	12.71
23	1308	764.52	1584	196	11.01
24	1360	735.29	1440	208	12.62
25	1304	766.87	1472	216	12.80
26	1348	741.83	1548	200	11.44
27	1300	769.23	1360	208	13.27
28	1360	735.29	1392	196	12.34
29	1384	722.54	1400	196	12.28
30	1364	733.13	1452	216	12.95
Mean	**1342.00**	**746.06**	**1526.27**	**200.27**	**11.66**
SD	**47.15**	**26.63**	**128.93**	**10.34**	**1.02**

Table 113 Palisade ratio, trichome number, vein termination number, vein islets number of *J. siamense* Craib (Location Chiangmai)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	16.00	4	17	5	2
2	15.00	3.75	18	4	3
3	14.00	3.50	18	6	4
4	15.50	3.88	18	4	3
5	16.00	4.00	16	3	3
6	13.00	3.25	19	5	2
7	14.00	3.50	14	6	2
8	12.00	3.00	14	4	2
9	13.50	3.38	14	4	4
10	15.00	3.75	18	4	4
11	14.50	3.63	18	7	3
12	15.50	3.88	13	5	2
13	14.00	3.50	13	7	3
14	13.00	3.25	13	5	4
15	13.00	3.25	13	4	3
16	12.50	3.13	13	5	3
17	13.00	3.25	17	4	2
18	14.00	3.50	15	5	2
19	14.50	3.63	17	5	2
20	15.00	3.75	18	5	4
21	15.00	3.75	17	5	3
22	14.00	3.50	16	6	3
23	16.00	4.00	17	4	4
24	15.50	3.88	15	3	3
25	14.00	3.50	13	5	2
26	14.00	3.50	14	5	2
27	15.50	3.88	15	4	3
28	13.00	3.25	21	3	4
29	15.00	3.75	19	4	4
30	16.00	4.00	17	4	3
Mean	**14.37**	**3.59**	**16.00**	**3.80**	**9.22**
SD	**1.14**	**0.29**	**2.24**	**1.03**	**0.78**

Table 114 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. elongatum* (Bergius) Willd (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2156	463.82	2464	528	17.65
2	2152	464.68	2640	504	16.03
3	2200	454.54	2608	520	16.62
4	2192	456.2	2320	512	18.08
5	2224	449.64	2920	528	15.31
6	2216	451.26	2600	544	17.30
7	2208	452.89	2720	560	17.07
8	2200	454.54	2624	568	17.79
9	2268	440.91	2592	584	18.39
10	2264	441.69	3080	568	15.57
11	2176	459.55	2912	548	15.84
12	2120	471.69	2624	524	16.65
13	2164	462.1	2592	516	16.60
14	2116	472.58	2360	520	18.06
15	2140	467.28	2240	508	18.49
16	2188	457.03	2800	548	16.37
17	2164	462.1	2720	480	15.00
18	2148	465.54	2624	496	15.90
19	2192	456.2	2920	480	14.12
20	2140	467.28	2680	512	16.04
21	2164	462.1	2696	520	16.17
22	2188	457.03	2640	508	16.14
23	2152	464.68	2400	560	18.92
24	2188	457.03	2620	492	15.81
25	2256	443.26	2608	528	16.84
26	2240	446.42	2640	560	17.50
27	2196	455.37	2680	560	17.28
28	2212	452.07	2800	536	16.07
29	2240	446.42	2560	560	17.95
30	2188	457.03	2340	520	18.18
Mean	**2188.40**	**457.10**	**2634.13**	**529.73**	**16.79**
SD	**40.32**	**8.39**	**188.36**	**27.37**	**1.16**

Table 115 Palisade ratio, trichome number, vein termination number, vein islets number of *J. elongatum* (Bergius) Willd (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	8.00	2	4	10	4
2	8.50	2.13	5	8	5
3	6.50	1.63	5	10	3
4	7.00	1.75	3	9	6
5	8.00	2.00	3	8	4
6	8.50	2.13	4	7	4
7	7.00	1.75	3	8	4
8	9.00	2.25	4	9	4
9	8.00	2.00	4	9	5
10	8.50	2.13	4	8	5
11	9.00	2.25	5	7	4
12	8.50	2.13	5	7	6
13	9.00	2.25	4	8	5
14	8.00	2.00	4	7	5
15	7.00	1.75	3	7	5
16	9.00	2.25	4	6	4
17	9.00	2.25	5	8	4
18	8.50	2.13	5	8	4
19	8.00	2.00	4	7	5
20	7.50	1.88	3	7	5
21	8.00	2.00	6	7	5
22	8.00	2.00	6	8	5
23	8.50	2.13	5	7	4
24	8.50	2.13	4	8	6
25	9.00	2.25	5	8	5
26	8.00	2.00	4	7	5
27	8.00	2.00	4	7	5
28	9.00	2.25	3	6	4
29	7.50	1.88	4	9	4
30	7.50	1.88	2	7	4
Mean	**8.15**	**2.04**	**4.13**	**7.73**	**4.60**
SD	**0.70**	**0.17**	**0.94**	**1.01**	**0.72**

Table 116 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. elongatum* (Bergius) Willd (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2200	454.54	2504	520	17.20
2	2176	459.55	2880	548	15.99
3	2120	471.69	2840	544	16.08
4	2164	462.10	2880	552	16.08
5	2116	472.58	2800	520	15.66
6	2140	467.28	2900	548	15.89
7	2160	462.96	3000	564	15.82
8	2216	451.26	2820	544	16.17
9	2152	464.68	2852	552	16.22
10	2240	446.42	2920	540	15.61
11	2236	447.22	2860	448	13.54
12	2256	443.26	2840	456	13.83
13	2188	457.03	2880	460	13.77
14	2152	464.68	2856	540	15.90
15	2188	457.03	2800	536	16.07
16	2152	464.68	2920	440	13.10
17	2220	450.45	2600	448	14.70
18	2192	456.20	2400	460	16.08
19	2196	455.37	2480	468	15.88
20	2148	465.54	3000	436	12.69
21	2240	446.42	3200	424	11.70
22	2188	457.03	3040	452	12.94
23	2256	443.26	3120	424	11.96
24	2140	467.28	2880	416	12.62
25	2192	456.20	3120	436	12.26
26	2188	457.03	2560	460	15.23
27	2152	464.68	2760	436	13.64
28	2116	472.58	2600	428	14.13
29	2192	456.20	2520	500	16.56
30	2248	444.83	2480	516	17.22
Mean	**2184.13**	**458.00**	**2810.40**	**487.20**	**14.82**
SD	**41.55**	**8.69**	**207.33**	**50.44**	**1.64**

Table 117 Palisade ratio, trichome number, vein termination number, vein islets number of *J. elongatum* (Bergius) Willd (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	9.00	2.25	5	9	5
2	8.00	2.00	6	8	5
3	8.00	2.00	4	9	6
4	9.00	2.25	5	10	5
5	8.50	2.13	4	8	4
6	8.50	2.13	8	8	4
7	9.00	2.25	4	9	5
8	8.00	2.00	4	9	6
9	8.00	2.00	5	8	5
10	9.00	2.25	5	7	4
11	8.50	2.13	5	10	5
12	7.50	1.88	5	9	5
13	8.00	2.00	4	9	5
14	8.00	2.00	3	8	6
15	9.00	2.25	3	9	5
16	7.50	1.88	6	10	4
17	7.50	1.88	8	11	4
18	7.50	1.88	5	9	5
19	8.00	2.00	5	10	5
20	8.00	2.00	6	8	6
21	8.50	2.13	4	7	5
22	8.50	2.13	6	10	4
23	9.00	2.25	5	10	5
24	9.00	2.25	6	9	5
25	9.00	2.25	5	10	5
26	9.00	2.25	5	9	5
27	7.00	1.75	4	9	4
28	7.50	1.88	5	9	4
29	8.00	2.00	4	10	5
30	8.00	2.00	2	9	5
Mean	**8.27**	**2.07**	**4.87**	**9.00**	**4.87**
SD	**0.60**	**0.15**	**1.28**	**0.95**	**0.63**

Table 118 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. elongatum* (Bergius) Willd (Location Chiangmai)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2188	457.03	3040	452	12.94
2	2152	464.68	2960	444	13.04
3	2220	450.45	2920	560	16.09
4	2216	451.26	2904	528	15.38
5	2152	464.68	3160	516	14.04
6	2240	446.42	3120	536	14.66
7	2236	447.22	3160	532	14.41
8	2192	456.2	2940	504	14.63
9	2188	457.03	2880	496	14.69
10	2152	464.68	2860	512	15.18
11	2116	472.58	2820	504	15.16
12	2216	451.26	2800	500	15.15
13	2208	452.89	3120	544	14.85
14	2200	454.54	3080	552	15.20
15	2268	440.91	3160	512	13.94
16	2264	441.69	3120	532	14.57
17	2140	467.28	2976	512	14.68
18	2188	457.03	3000	520	14.77
19	2152	464.68	3016	520	14.71
20	2164	462.10	2800	440	13.58
21	2148	465.54	2872	432	13.08
22	2176	459.55	2840	428	13.10
23	2120	471.69	2872	368	11.36
24	2164	462.10	2840	408	12.56
25	2116	472.58	3000	420	12.28
26	2140	467.28	3032	444	12.77
27	2160	462.96	2960	440	12.94
28	2216	451.26	2800	420	13.04
29	2152	464.68	3100	520	14.36
30	2240	446.42	3000	500	14.29
Mean	**2182.80**	**458.29**	**2971.73**	**486.53**	**14.05**
SD	**42.66**	**8.91**	**118.71**	**50.22**	**1.11**

Table 119 Palisade ratio, trichome number, vein termination number, vein islets number of *J. elongatum* (Bergius) Willd (Location Chiangmai)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	8.00	2	4	10	5
2	9.00	2.25	8	8	4
3	9.00	2.25	4	8	5
4	8.50	2.13	7	9	5
5	7.50	1.88	5	10	5
6	8.00	2.00	8	9	6
7	8.00	2.00	5	9	6
8	8.50	2.13	4	7	6
9	8.00	2.00	4	8	5
10	8.00	2.00	4	8	3
11	9.00	2.25	5	9	4
12	9.00	2.25	5	9	4
13	8.50	2.13	4	8	4
14	7.50	1.88	6	8	6
15	8.00	2.00	3	8	6
16	9.00	2.25	6	7	5
17	9.00	2.25	8	9	5
18	7.50	1.88	6	10	4
19	8.50	2.13	3	10	6
20	8.50	2.13	5	9	5
21	8.00	2.00	7	8	5
22	8.00	2.00	4	8	6
23	9.00	2.25	7	8	5
24	9.00	2.25	5	7	4
25	8.50	2.13	7	9	5
26	7.00	1.75	2	8	5
27	7.00	1.75	4	8	6
28	8.00	2.00	4	7	6
29	9.00	2.25	4	7	4
30	9.00	2.25	2	7	5
Mean	**8.32**	**2.08**	**5.00**	**8.33**	**5.00**
SD	**0.62**	**0.16**	**1.68**	**0.96**	**0.83**

Table 120 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. grandiflorum* (L.) Kobuski (Location Nonthaburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2104	475.28	2288	324	12.40
2	2128	469.92	2320	344	12.91
3	1924	519.75	2220	360	13.95
4	1920	520.83	2364	352	12.96
5	1820	549.45	2208	332	13.07
6	1756	569.47	2400	360	13.04
7	1916	521.92	2272	348	13.28
8	1772	564.33	2320	356	13.30
9	2300	434.78	2392	380	13.71
10	2204	453.72	2312	376	13.99
11	2020	495.04	2392	372	13.46
12	1888	529.66	2400	380	13.67
13	1680	595.23	2400	340	12.41
14	1736	576.03	2208	360	14.02
15	1840	543.47	2320	384	14.20
16	1768	565.61	2312	392	14.50
17	1928	518.67	2272	392	14.71
18	2000	500.00	2400	360	13.04
19	2068	483.55	2304	388	14.41
20	1832	545.85	2348	360	13.29
21	1888	529.66	2332	372	13.76
22	1948	513.34	2224	360	13.93
23	2024	494.07	2236	324	12.66
24	1956	526.31	2348	332	12.39
25	1900	526.31	2320	368	13.69
26	1892	528.54	2260	384	14.52
27	1820	549.45	2316	384	14.22
28	1872	534.18	2312	348	13.08
29	1944	514.4	2356	376	13.76
30	2040	490.19	2320	392	14.45
Mean	**1929.60**	**521.30**	**2315.87**	**363.33**	**13.56**
SD	**140.04**	**36.62**	**59.15**	**20.43**	**0.67**

Table 121 Palisade ratio, trichome number, vein termination number, vein islets number of *J. grandiflorum* (L.) Kobuski (Location Nonthaburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	15.00	3.75	16	5	13
2	15.00	3.75	12	8	12
3	14.00	3.50	10	10	11
4	15.00	3.75	9	9	9
5	15.00	3.75	13	10	11
6	13.00	3.25	12	9	12
7	16.00	4.00	16	8	10
8	14.00	3.50	12	9	11
9	15.00	3.75	12	10	12
10	15.00	3.75	12	9	11
11	15.00	3.75	16	9	10
12	15.00	3.75	12	8	11
13	16.00	4.00	12	1	11
14	13.00	3.25	11	9	11
15	15.50	3.88	12	9	12
16	14.00	3.50	13	8	11
17	14.00	3.50	12	10	12
18	14.00	3.50	12	10	11
19	15.00	3.75	12	9	9
20	15.00	3.75	12	8	11
21	16.00	4.00	15	8	12
22	14.00	3.50	12	10	11
23	13.00	3.25	12	8	11
24	15.00	3.75	12	9	12
25	15.00	3.75	15	10	10
26	13.00	3.25	15	9	12
27	15.00	3.75	12	8	11
28	14.00	3.50	15	8	11
29	13.00	3.25	15	10	11
30	15.00	3.75	16	9	12
Mean	**14.55**	**3.64**	**12.90**	**8.57**	**11.13**
SD	**0.91**	**0.23**	**1.86**	**1.77**	**0.90**

Table 122 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. grandiflorum* (L.) Kobuski (Location Bangkok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1920	520.83	1800	312	14.77
2	1820	549.45	1980	300	13.16
3	2000	500.00	1840	336	15.44
4	1916	521.92	2032	300	12.86
5	1772	564.33	2192	320	12.74
6	2000	500.00	2368	308	11.51
7	2040	490.19	2240	344	13.31
8	1956	511.24	2176	304	12.26
9	1872	534.18	2200	324	12.84
10	1908	524.1	2348	312	11.73
11	1872	534.18	2320	320	12.12
12	1880	531.91	2160	312	12.62
13	1712	584.11	2528	332	11.61
14	1820	549.45	2240	336	13.04
15	2000	500.00	2560	328	11.36
16	1940	515.46	2480	356	12.55
17	1960	515.46	2400	340	12.41
18	1940	515.46	2360	384	13.99
19	1680	595.23	2400	372	13.42
20	1736	576.03	2560	364	12.45
21	1992	502.00	2580	372	12.60
22	1920	520.83	2672	372	12.22
23	1904	525.21	2288	320	12.27
24	1960	515.46	2340	340	12.69
25	1920	520.83	2224	300	11.89
26	1944	514.4	2320	340	12.78
27	2000	500.00	2180	312	12.52
28	1968	508.13	2352	340	12.63
29	1960	515.46	2448	360	12.82
30	2120	471.69	2520	380	13.10
Mean	**1914.40**	**524.25**	**2303.60**	**334.67**	**12.72**
SD	**97.78**	**27.64**	**208.60**	**25.57**	**0.87**

Table 123 Palisade ratio, trichome number, vein termination number, vein islets number of *J. grandiflorum* (L.) Kobuski (Location Bangkok)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	14.00	3.5	13	8	12
2	13.00	3.25	16	7	11
3	16.00	4.00	13	8	10
4	17.00	4.25	12	6	11
5	16.00	4.00	12	7	9
6	14.50	3.63	12	9	9
7	13.50	3.38	13	7	8
8	13.00	3.25	13	8	10
9	13.50	3.38	13	8	9
10	15.00	3.75	12	9	10
11	12.00	3.00	13	7	8
12	16.50	4.13	15	7	8
13	15.00	3.75	15	6	11
14	13.00	3.25	14	7	11
15	12.50	3.13	15	6	12
16	13.00	3.25	15	5	10
17	14.00	3.50	14	6	11
18	14.50	3.63	13	7	11
19	15.00	3.75	14	6	12
20	13.00	3.25	14	8	10
21	13.00	3.25	13	8	11
22	12.50	3.13	13	8	11
23	14.00	3.50	12	7	11
24	14.00	3.50	15	7	12
25	13.00	3.25	13	8	11
26	13.00	3.25	15	6	10
27	13.50	3.38	13	9	9
28	12.00	3.00	13	8	8
29	13.00	3.25	13	8	10
30	13.00	3.25	14	7	9
Mean	**13.83**	**3.46**	**13.50**	**7.27**	**10.17**
SD	**1.30**	**0.33**	**1.11**	**1.01**	**1.26**

Table 124 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. grandiflorum* (L.) Kobuski (Location Saraburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1756	569.47	2400	328	12.02
2	1916	521.92	2400	320	11.76
3	2020	495.04	2480	332	11.81
4	1888	529.66	2056	288	12.29
5	2040	490.19	2328	324	12.22
6	1956	511.24	2100	304	12.65
7	1872	534.18	2480	332	11.81
8	2000	500.00	2160	296	12.05
9	2052	487.32	2152	312	12.66
10	1860	537.63	2352	304	11.45
11	1928	518.67	2400	336	12.28
12	1940	515.46	2348	344	12.78
13	1748	572.08	2400	344	12.54
14	1800	555.55	2680	376	12.30
15	1960	510.20	2400	340	12.41
16	1920	520.83	2480	348	12.31
17	1944	514.40	2632	376	12.50
18	1968	508.13	2700	376	12.22
19	1960	510.20	2512	392	13.50
20	2120	471.69	2600	368	12.40
21	1912	523.01	2400	364	13.17
22	1960	510.20	2272	368	13.94
23	1872	534.18	2360	344	12.72
24	1948	513.34	2172	312	12.56
25	1888	529.66	2200	308	12.28
26	1824	548.24	2260	336	12.94
27	1868	535.33	2280	304	11.76
28	1992	502.00	2400	352	12.79
29	2080	480.76	2600	380	12.75
30	2192	456.20	2580	384	12.96
Mean	**1939.47**	**516.89**	**2386.13**	**339.73**	**12.46**
SD	**99.13**	**26.22**	**170.42**	**29.13**	**0.53**

Table 125 Palisade ratio, trichome number, vein termination number, vein islets number of *J. grandiflorum* (L.) Kobuski (Location Saraburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	14.50	3.625	15	9	8
2	13.00	3.25	14	6	9
3	15.00	3.75	13	7	8
4	16.00	4.00	13	7	9
5	15.50	3.88	13	10	10
6	14.00	3.50	13	9	11
7	14.00	3.50	13	7	10
8	13.00	3.25	12	7	8
9	12.50	3.13	13	8	9
10	13.00	3.25	13	8	10
11	15.00	3.75	12	9	11
12	14.00	3.50	15	9	8
13	14.50	3.63	13	8	8
14	14.00	3.50	15	10	10
15	13.00	3.25	13	9	11
16	13.00	3.25	12	10	7
17	15.00	3.75	15	8	8
18	14.50	3.63	13	8	8
19	16.00	4.00	15	7	7
20	14.00	3.50	13	6	10
21	13.00	3.25	12	6	9
22	15.00	3.75	15	7	9
23	14.50	3.63	13	5	11
24	12.00	3.00	15	8	10
25	13.00	3.25	15	8	8
26	13.00	3.25	15	9	8
27	14.00	3.50	14	7	10
28	16.00	4.00	14.00	8.00	11
29	15.00	3.75	14.00	9.00	10
30	13.00	3.25	15.00	7.00	11
Mean	**14.07**	**3.52**	**13.67**	**7.87**	**9.23**
SD	**1.10**	**0.28**	**1.09**	**1.28**	**1.28**

Table 126 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nervosum* Lour (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2060	485.43	2840	360	11.25
2	2388	418.76	2720	356	11.57
3	2364	423.01	2800	360	11.39
4	2376	420.87	2736	352	11.40
5	2340	427.35	2860	376	11.62
6	2304	434.02	2880	372	11.44
7	2324	430.29	2852	360	11.21
8	2276	439.36	2840	368	11.47
9	2260	442.47	2788	348	11.10
10	2176	459.55	2688	364	11.93
11	2212	452.07	2720	352	11.46
12	2144	466.41	2820	360	11.32
13	2168	461.25	2800	352	11.17
14	2080	480.76	2880	376	11.55
15	2116	472.58	3120	360	10.34
16	2200	454.54	3000	380	11.24
17	2284	437.82	2700	340	11.18
18	2180	458.71	2760	352	11.31
19	2236	447.22	2800	360	11.39
20	2188	457.03	2800	384	12.06
21	2208	452.89	2880	364	11.22
22	2156	463.82	2840	360	11.25
23	2180	458.71	2900	360	11.04
24	2192	456.2	2720	312	10.29
25	2220	450.45	2748	348	11.24
26	2236	447.22	2720	352	11.46
27	2324	430.29	2820	384	11.99
28	2356	424.44	2920	392	11.84
29	2236	447.22	2760	340	10.97
30	2284	437.82	3000	428	12.49
Mean	**2235.60**	**447.95**	**2823.73**	**362.40**	**11.37**
SD	**86.59**	**17.40**	**98.14**	**19.92**	**0.44**

Table 127 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nervosum* Lour (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)
1	9.50	2.38	5	1
2	9.00	2.25	8	2
3	9.00	2.25	7	2
4	7.00	1.75	7	2
5	10.00	2.50	8	0
6	8.00	2.00	9	1
7	8.50	2.13	6	2
8	10.50	2.63	4	4
9	8.50	2.13	7	2
10	6.00	1.50	9	2
11	10.00	2.50	7	3
12	8.50	2.13	8	2
13	7.00	1.75	6	2
14	10.50	2.63	7	3
15	8.50	2.13	9	4
16	8.00	2.00	6	3
17	9.00	2.25	5	3
18	9.00	2.25	6	2
19	10.00	2.50	8	2
20	11.00	2.75	7	4
21	9.00	2.25	9	3
22	9.50	2.38	7	2
23	8.00	2.00	9	1
24	7.00	1.75	9	3
25	9.00	2.25	6	2
26	10.00	2.50	6	5
27	10.50	2.63	4	2
28	11.00	2.75	8	3
29	10.00	2.50	9	4
30	10.00	2.50	9	2
Mean	**9.05**	**2.26**	**7.17**	**2.43**
SD	**1.26**	**0.32**	**1.53**	**1.07**

Table 128 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nervosum* Lour (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2200	454.54	2900	372	11.37
2	2284	437.82	2720	352	11.46
3	2180	458.71	2860	380	11.73
4	2236	457.03	2880	408	12.41
5	2188	457.03	2936	392	11.78
6	2208	452.89	2800	360	11.39
7	2156	463.82	2872	380	11.69
8	2180	458.71	2880	356	11.00
9	2212	452.07	2760	348	11.20
10	2240	446.42	2860	376	11.62
11	2220	450.45	2880	368	11.33
12	2236	447.22	2776	376	11.93
13	2324	430.29	2860	372	11.51
14	2356	424.44	2800	380	11.95
15	2276	439.36	2840	356	11.14
16	2260	442.47	2856	372	11.52
17	2176	459.55	2760	352	11.31
18	2212	452.07	2720	360	11.69
19	2120	471.69	2692	364	11.91
20	2156	463.82	2880	388	11.87
21	2112	473.48	2852	372	11.54
22	2324	430.29	2760	352	11.31
23	2224	449.64	2800	384	12.06
24	2172	460.40	2880	300	9.43
25	2280	438.59	2720	340	11.11
26	2240	446.42	3000	380	11.24
27	2236	447.22	2860	360	11.18
28	2360	423.72	2876	368	11.34
29	2292	436.3	2912	372	11.33
30	2232	448.02	2760	320	10.39
Mean	**2229.73**	**449.15**	**2831.73**	**365.33**	**11.42**
SD	**63.03**	**12.69**	**72.75**	**20.99**	**0.54**

Table 129 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nervosum* Lour (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)
1	10.00	2.50	8	3
2	8.50	2.13	9	2
3	7.00	1.75	6	2
4	10.50	2.63	4	1
5	8.50	2.13	7	1
6	8.00	2.00	9	4
7	9.00	2.25	6	2
8	10.00	2.50	7	3
9	10.00	2.50	7	3
10	10.00	2.50	8	2
11	10.50	2.63	6	3
12	9.00	2.25	10	2
13	10.00	2.50	9	1
14	8.50	2.13	7	3
15	7.00	1.75	5	2
16	10.50	2.63	7	5
17	8.50	2.13	8	2
18	9.50	2.38	6	3
19	10.00	2.50	7	4
20	8.50	2.13	9	1
21	9.00	2.25	8	3
22	10.00	2.50	8	4
23	9.00	2.25	7	3
24	7.50	1.88	8	3
25	9.00	2.25	9	2
26	11.00	2.75	7	2
27	10.00	2.50	8	4
28	10.50	2.63	8	3
29	9.00	2.25	9	2
30	9.00	2.25	9	2
Mean	**9.25**	**2.31**	**7.53**	**2.57**
SD	**1.05**	**0.26**	**1.36**	**1.01**

Table 130 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. nervosum* Lour (Location Nakornnayok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2176	459.55	2880	368	11.33
2	2212	452.07	2800	348	11.05
3	2200	454.54	2780	368	11.69
4	2284	437.82	2720	336	10.99
5	2180	458.71	2800	356	11.28
6	2236	447.22	2960	408	12.11
7	2116	472.58	2880	388	11.87
8	2200	454.54	2928	396	11.91
9	2284	437.82	2720	320	10.53
10	2240	446.42	2424	304	11.14
11	2236	447.22	2908	392	11.88
12	2360	423.72	2836	372	11.60
13	2292	436.3	2880	380	11.66
14	2232	448.02	2904	400	12.11
15	2284	437.82	2880	360	11.11
16	2180	458.71	2760	340	10.97
17	2236	447.22	2880	368	11.33
18	2188	457.03	2740	340	11.04
19	2208	452.89	2800	356	11.28
20	2224	449.64	2860	372	11.51
21	2172	460.4	2900	368	11.26
22	2280	438.59	2860	368	11.40
23	2208	452.89	2920	380	11.52
24	2224	449.64	2632	364	12.15
25	2172	460.4	2580	356	12.13
26	2356	424.44	2800	376	11.84
27	2276	439.36	3080	364	10.57
28	2312	432.52	3000	376	11.14
29	2232	448.02	2880	376	11.55
30	2172	460.40	2800	328	10.49
Mean	**2232.40**	**448.22**	**2826.40**	**364.27**	**11.41**
SD	**56.53**	**11.24**	**127.26**	**23.49**	**0.47**

Table 131 Palisade ratio, trichome number, vein termination number, vein islets number of *J. nervosum* Lour (Location Nakornnayok)

Position	Palisade	Palisade Ratio	Vein terminal number (mm^2)	Vein islets number (mm^2)
1	9.00	2.25	6	2
2	10.00	2.50	7	1
3	9.00	2.25	8	1
4	8.00	2.00	6	2
5	9.00	2.25	5	4
6	10.00	2.50	7	2
7	10.00	2.50	8	2
8	9.50	2.38	6	0
9	9.00	2.25	7	2
10	8.00	2.00	9	3
11	9.50	2.38	8	2
12	8.00	2.00	9	2
13	8.00	2.00	6	1
14	9.00	2.25	4	2
15	9.00	2.25	7	1
16	9.00	2.25	9	3
17	8.00	2.00	7	2
18	10.00	2.50	7	1
19	9.00	2.25	6	3
20	9.00	2.25	6	2
21	11.50	2.88	7	2
22	8.50	2.13	9	1
23	7.00	1.75	5	2
24	8.00	2.00	6	1
25	7.00	1.75	9	1
26	9.50	2.38	7	4
27	8.50	2.13	9	1
28	8.00	2.00	5	2
29	8.00	2.00	6	2
30	9.00	2.25	5	3
Mean	**8.83**	**2.21**	**6.87**	**1.90**
SD	**0.96**	**0.24**	**1.43**	**0.92**

Table 132 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lanceolaria* Roxb. (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1288	776.39	1976	272	12.10
2	1304	766.87	1920	276	12.57
3	1320	757.57	2000	260	11.50
4	1372	728.86	1900	272	12.52
5	1388	720.46	2040	256	11.15
6	1356	737.46	1860	248	11.76
7	1280	781.25	1700	272	13.79
8	1220	819.67	1744	276	13.66
9	1244	803.85	1740	284	14.03
10	1220	819.67	2000	260	11.50
11	1184	844.59	1960	244	11.07
12	1140	877.19	2100	236	10.10
13	1120	892.85	2072	224	9.76
14	1120	892.85	1800	232	11.42
15	1156	865.05	1720	184	9.66
16	1132	883.39	2000	248	11.03
17	1196	836.12	2048	228	10.02
18	1208	827.81	1740	220	11.22
19	1244	803.85	2000	264	11.66
20	1188	841.75	1868	220	10.54
21	1368	730.99	1800	248	12.11
22	1260	793.65	1808	240	11.72
23	1220	819.67	1748	224	11.36
24	1160	862.06	1860	244	11.60
25	1244	803.85	1664	216	11.49
26	1228	814.33	1740	232	11.76
27	1264	791.13	1860	224	10.75
28	1308	764.52	1700	232	12.01
29	1344	744.04	1660	224	11.89
30	1296	771.60	1720	224	11.52
Mean	**1245.73**	**805.78**	**1858.27**	**242.80**	**11.58**
SD	**77.96**	**50.39**	**134.58**	**23.02**	**1.06**

Table 133 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lanceolaria* Roxb. (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	7.50	1.88	10	11	3
2	7.50	1.88	12	12	4
3	8.00	2.00	12	7	5
4	10.50	2.63	10	13	2
5	8.50	2.13	10	14	3
6	12.00	3.00	11	12	4
7	11.50	2.88	16	9	6
8	9.50	2.38	14	10	4
9	9.00	2.25	13	9	3
10	9.00	2.25	12	9	4
11	8.50	2.13	10	10	4
12	11.00	2.75	10	8	7
13	10.50	2.63	11	6	6
14	10.50	2.63	16	9	6
15	9.50	2.38	14	8	4
16	8.50	2.13	12	9	3
17	10.50	2.63	10	8	2
18	12.00	3.00	15	8	3
19	10.00	2.50	11	8	4
20	9.50	2.38	13	7	5
21	12.00	3.00	12	7	5
22	8.50	2.13	16	9	6
23	10.50	2.63	15	5	5
24	11.00	2.75	13	7	5
25	14.00	3.50	13	9	3
26	10.50	2.63	11	10	3
27	9.00	2.25	14	9	3
28	9.00	2.25	10	8	5
29	8.50	2.13	10	9	4
30	9.00	2.25	12	9	4
Mean	**9.85**	**2.46**	**12.27**	**8.97**	**4.17**
SD	**1.52**	**0.38**	**2.00**	**1.97**	**1.26**

Table 134 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lanceolaria* Roxb. (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1356	737.46	2080	464	18.24
2	1280	781.25	2360	424	15.23
3	1220	819.67	2520	416	14.17
4	1140	877.19	2160	428	16.54
5	1120	892.85	2240	440	16.42
6	1120	892.85	2400	432	15.25
7	1156	865.05	2320	388	14.33
8	1188	841.75	2880	400	12.20
9	1368	730.99	2768	412	12.96
10	1260	793.65	2600	384	12.87
11	1220	819.67	2640	372	12.35
12	1244	803.85	2792	424	13.18
13	1188	841.75	2872	360	11.14
14	1368	730.99	3200	352	9.91
15	1260	793.65	2680	324	10.79
16	1220	819.67	2824	360	11.31
17	1280	781.25	2920	364	11.08
18	1336	748.5	2800	392	12.28
19	1360	735.29	2600	372	12.52
20	1160	862.06	2680	360	11.84
21	1208	827.81	3000	356	10.61
22	1280	781.25	2700	360	11.76
23	1196	836.12	3000	400	11.76
24	1320	757.57	3240	364	10.10
25	1280	781.25	2760	352	11.31
26	1156	865.05	2680	408	13.21
27	1240	806.45	2720	324	10.64
28	1276	783.69	2800	400	12.50
29	1296	771.60	2744	320	10.44
30	1260	793.65	3460	348	9.14
Mean	**1245.20**	**805.79**	**2714.67**	**383.33**	**12.54**
SD	**73.43**	**47.69**	**308.07**	**36.68**	**2.14**

Table 135 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lanceolaria* Roxb. (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	8.50	2.125	12	8	5
2	8.00	2.00	10	8	6
3	8.50	2.13	13	7	4
4	11.00	2.75	7	7	4
5	10.50	2.63	10	9	3
6	10.50	2.63	10	5	2
7	9.50	2.38	10	7	3
8	9.50	2.38	11	8	4
9	9.00	2.25	16	6	5
10	8.50	2.13	10	9	5
11	10.00	2.50	11	5	6
12	8.50	2.13	11	7	5
13	8.00	2.00	16	9	5
14	10.50	2.63	14	8	3
15	10.00	2.50	13	6	3
16	10.00	2.50	12	6	3
17	9.50	2.38	9	13	4
18	10.00	2.50	12	14	4
19	10.50	2.63	10	12	5
20	10.00	2.50	10	9	7
21	10.50	2.63	11	10	5
22	12.00	3.00	16	9	6
23	10.00	2.50	14	9	4
24	9.00	2.25	13	10	4
25	8.50	2.13	12	8	6
26	11.00	2.75	15	9	7
27	10.00	2.50	12	10	3
28	9.50	2.38	10	9	4
29	10.00	2.50	9	7	4
30	10.00	2.50	15	8	5
Mean	**9.70**	**2.43**	**11.80**	**8.40**	**4.47**
SD	**0.96**	**0.24**	**2.31**	**2.09**	**1.25**

Table 136 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. lanceolaria* Roxb. (Location Nakornnayok)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1340	746.26	2400	388	13.92
2	1244	803.85	2440	376	13.35
3	1188	841.75	3040	352	10.38
4	1368	730.99	2680	392	12.76
5	1260	793.65	2600	420	13.91
6	1220	819.67	2660	384	12.61
7	1140	877.19	2700	376	12.22
8	1120	892.85	2912	420	12.61
9	1120	892.85	2680	396	12.87
10	1156	865.05	2680	428	13.77
11	1132	883.39	3032	400	11.66
12	1352	739.64	3160	376	10.63
13	1356	737.46	3120	396	11.26
14	1280	781.25	3072	416	11.93
15	1220	819.67	3000	392	11.56
16	1160	862.06	3080	352	10.26
17	1208	827.81	2880	360	11.11
18	1280	781.25	3000	348	10.39
19	1196	836.12	3200	336	9.50
20	1244	803.85	2640	332	11.17
21	1228	814.33	3016	376	11.08
22	1264	791.13	2680	360	11.84
23	1308	764.52	2976	448	13.08
24	1240	806.45	2780	396	12.47
25	1260	793.65	2840	384	11.91
26	1280	781.25	2860	400	12.27
27	1264	791.13	3000	344	10.29
28	1360	735.29	2880	408	12.41
29	1272	786.16	2800	340	10.83
30	1276	783.69	3200	360	10.11
Mean	**1244.53**	**806.14**	**2866.93**	**381.87**	**11.81**
SD	**72.02**	**47.12**	**215.95**	**29.39**	**1.21**

Table 137 Palisade ratio, trichome number, vein termination number, vein islets number of *J. lanceolaria* Roxb. (Location Nakornnayok)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	10.50	2.63	8	8	4
2	10.50	2.63	12	6	5
3	9.50	2.38	13	9	4
4	9.50	2.38	12	6	3
5	8.50	2.13	10	6	3
6	8.00	2.00	10	5	2
7	10.50	2.63	8	7	5
8	10.00	2.50	9	9	6
9	10.00	2.50	8	8	7
10	9.50	2.38	9	7	5
11	8.50	2.13	12	6	6
12	9.00	2.25	10	6	6
13	10.50	2.63	10	5	7
14	10.00	2.50	11	8	4
15	10.50	2.63	16	6	3
16	12.00	3.00	14	6	4
17	10.00	2.50	13	5	5
18	10.50	2.63	12	7	5
19	10.50	2.63	15	9	6
20	11.00	2.75	12	8	5
21	8.50	2.13	10	7	5
22	11.00	2.75	6	7	3
23	10.50	2.63	9	10	3
24	10.50	2.63	11	8	3
25	9.50	2.38	8	8	4
26	12.00	3.00	8	7	4
27	8.50	2.13	11	7	5
28	10.50	2.63	10	9	3
29	12.00	3.00	10	5	6
30	10.00	2.50	8	7	4
Mean	**10.07**	**2.52**	**10.50**	**7.07**	**4.50**
SD	**1.04**	**0.26**	**2.30**	**1.36**	**1.31**

Table 138 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. coarctatum* Roxb. (Location Pathumtani)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2480	403.22	3140	580	15.59
2	2812	355.61	3200	600	15.79
3	2788	358.68	3160	636	16.75
4	2584	386.99	3216	588	15.46
5	2604	384.02	3240	592	15.45
6	2672	374.25	3480	600	14.71
7	2616	382.26	3672	616	14.37
8	2416	413.90	3280	604	15.55
9	2312	432.52	3424	608	15.08
10	2340	427.35	3192	616	16.18
11	2504	399.36	3180	552	14.79
12	2532	394.94	3200	600	15.79
13	2560	390.62	3600	592	14.12
14	2600	384.61	3516	580	14.16
15	2500	400.00	3596	600	14.30
16	2648	377.64	3520	612	14.81
17	2592	385.80	3588	540	13.08
18	2444	409.16	3600	560	13.46
19	2600	384.61	3744	500	11.78
20	2512	398.08	3672	580	13.64
21	2360	423.72	3640	552	13.17
22	2472	404.53	3640	600	14.15
23	2560	390.62	3648	552	13.14
24	2632	379.93	3680	568	13.37
25	2688	372.02	3596	632	14.95
26	2420	413.22	3640	600	14.15
27	2456	407.16	3660	540	12.86
28	2520	396.82	3632	608	14.34
29	2620	381.67	3700	560	13.15
30	2680	373.13	3600	600	14.29
Mean	**2550.80**	**392.88**	**3488.53**	**585.60**	**14.41**
SD	**120.74**	**18.66**	**202.83**	**30.35**	**1.13**

Table 139 Palisade ratio, trichome number, vein termination number, vein islets number of *J. coarctatum* Roxb. (Location Pathumtani)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	7.00	1.75	0	6	3
2	8.00	2.00	0	4	3
3	8.00	2.00	0	6	3
4	11.00	2.75	0	5	5
5	10.00	2.50	0	4	2
6	8.00	2.00	0	5	2
7	9.00	2.25	0	5	5
8	9.00	2.25	0	4	3
9	8.00	2.00	0	4	5
10	10.00	2.50	0	4	3
11	11.00	2.75	1	5	4
12	11.00	2.75	0	6	4
13	10.00	2.50	0	6	3
14	9.00	2.25	1	5	5
15	11.00	2.75	0	6	4
16	10.00	2.50	1	6	5
17	8.00	2.00	0	4	4
18	10.00	2.50	0	5	5
19	11.00	2.75	0	4	4
20	11.00	2.75	0	6	4
21	12.00	3.00	0	5	4
22	11.00	2.75	0	6	5
23	12.00	3.00	0	5	4
24	11.00	2.75	1	5	4
25	12.00	3.00	3	3	5
26	14.00	3.50	0	6	3
27	9.00	2.25	0	6	3
28	12.00	3.00	0	6	3
29	11.00	2.75	1	5	4
30	12.00	3.00	0	6	5
Mean	**10.20**	**2.55**	**0.27**	**5.10**	**3.87**
SD	**1.63**	**0.41**	**0.64**	**0.88**	**0.94**

Table 140 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. coarctatum* Roxb. (Location Nonthaburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2420	413.22	3600	552	13.29
2	2580	387.59	3432	560	14.03
3	2720	367.64	3440	580	14.43
4	2620	381.67	3460	552	13.76
5	2560	390.62	3456	540	13.51
6	2440	409.83	3480	512	12.83
7	2400	416.66	3520	560	13.73
8	2320	431.03	3540	544	13.32
9	2460	406.50	3560	520	12.75
10	2528	395.56	3516	552	13.57
11	2520	396.82	3556	560	13.61
12	2580	387.59	3520	532	13.13
13	2592	385.80	3504	552	13.61
14	2380	420.16	3420	544	13.72
15	2680	373.13	3400	560	14.14
16	2620	381.67	3460	540	13.50
17	2492	401.28	3500	592	14.47
18	2580	387.59	3516	544	13.40
19	2632	379.93	3496	592	14.48
20	2476	403.87	3560	584	14.09
21	2392	418.06	3428	600	14.90
22	2580	387.59	3600	572	13.71
23	2476	403.87	3504	584	14.29
24	2480	403.22	3472	580	14.31
25	2600	384.61	3488	588	14.43
26	2480	403.22	3536	576	14.01
27	2504	399.36	3436	584	14.53
28	2456	407.16	3508	580	14.19
29	2800	357.14	3516	584	14.24
30	2712	368.73	3560	596	14.34
Mean	**2536.00**	**395.04**	**3499.47**	**563.87**	**13.88**
SD	**110.79**	**17.10**	**52.15**	**23.26**	**0.53**

Table 141 Palisade ratio, trichome number, vein termination number, vein islets number of *J. coarctatum* Roxb. (Location Nonthaburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	10.00	2.5	0	4	4
2	7.00	1.75	0	4	2
3	8.50	2.13	0	6	1
4	11.00	2.75	0	3	3
5	9.50	2.38	0	3	3
6	7.50	1.88	1	4	3
7	7.50	1.88	0	2	2
8	9.00	2.25	1	5	1
9	11.00	2.75	1	3	2
10	7.00	1.75	0	5	2
11	9.00	2.25	0	2	3
12	8.50	2.13	0	3	2
13	11.00	2.75	1	2	2
14	9.50	2.38	0	3	2
15	9.00	2.25	1	3	3
16	11.00	2.75	1	4	3
17	8.50	2.13	2	4	3
18	9.50	2.38	0	3	3
19	10.00	2.50	1	2	2
20	9.50	2.38	1	4	2
21	11.00	2.75	0	5	4
22	10.50	2.63	0	2	5
23	11.00	2.75	0	5	4
24	9.50	2.38	0	5	3
25	7.50	1.88	0	5	2
26	8.00	2.00	0	2	5
27	11.00	2.75	2	5	4
28	9.50	2.38	0	3	4
29	11.50	2.88	1	5	4
30	10.00	2.50	0	5	6
Mean	**9.43**	**2.36**	**0.43**	**3.70**	**2.97**
SD	**1.34**	**0.33**	**0.63**	**1.21**	**1.19**

Table 142 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. coarctatum* Roxb. (Location Saraburi)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2400	416.66	3520	560	13.73
2	2360	423.72	3544	552	13.48
3	2452	407.83	3540	568	13.83
4	2800	357.14	3516	556	13.65
5	2496	400.64	3496	548	13.55
6	2560	390.62	3420	512	13.02
7	2528	395.56	3520	520	12.87
8	2612	382.84	3372	548	13.98
9	2512	398.08	3424	568	14.23
10	2620	381.67	3272	584	15.15
11	2592	385.80	3184	600	15.86
12	2684	372.57	3372	576	14.59
13	2444	409.16	3480	596	14.62
14	2512	398.08	3428	604	14.98
15	2456	407.16	3472	584	14.40
16	2580	387.59	3560	592	14.26
17	2472	404.53	3596	600	14.30
18	2504	399.36	3504	592	14.45
19	2348	425.89	3576	556	13.46
20	2408	415.28	3600	580	13.88
21	2520	396.82	3496	592	14.48
22	2808	356.12	3560	588	14.18
23	2540	393.7	3580	600	14.35
24	2472	404.53	3192	584	15.47
25	2736	365.49	3504	592	14.45
26	2460	406.50	3436	592	14.70
27	2528	395.56	3500	588	14.38
28	2748	363.90	3584	580	13.93
29	2656	376.50	3600	588	14.04
30	2676	373.69	3576	592	14.20
Mean	**2549.47**	**393.10**	**3480.80**	**576.40**	**14.22**
SD	**123.01**	**18.59**	**110.97**	**23.24**	**0.65**

Table 143 Palisade ratio, trichome number, vein termination number, vein islets number of *J. coarctatum* Roxb. (Location Saraburi)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	8.00	2.00	0	4	1
2	8.50	2.13	0	5	3
3	11.00	2.75	0	4	2
4	11.50	2.88	0	4	2
5	12.00	3.00	0	2	1
6	8.00	2.00	0	4	3
7	9.00	2.25	0	3	3
8	10.50	2.63	0	6	3
9	9.00	2.25	0	6	4
10	10.00	2.50	0	8	3
11	11.00	2.75	0	4	3
12	9.50	2.38	4	6	2
13	8.50	2.13	2	5	3
14	10.00	2.50	1	3	5
15	10.50	2.63	0	3	2
16	8.00	2.00	0	4	3
17	7.00	1.75	0	3	3
18	9.00	2.25	0	3	3
19	11.00	2.75	0	4	3
20	8.50	2.13	0	5	3
21	7.50	1.88	0	6	4
22	10.00	2.50	0	7	4
23	11.00	2.75	1	3	3
24	9.50	2.38	0	2	4
25	11.50	2.88	3	3	4
26	12.00	3.00	2	4	3
27	11.00	2.75	2	3	3
28	11.50	2.88	1	4	2
29	12.00	3.00	0	4	3
30	11.00	2.75	0	4	2
Mean	**9.92**	**2.48**	**0.53**	**4.20**	**2.90**
SD	**1.47**	**0.37**	**1.04**	**1.42**	**0.88**

Table 144 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	Number of stomata mm^2	Stomata index Adaxial (mm^2)	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index Abaxial (mm2)
1	888	56	5.93	1126.12	1600	248	13.42
2	968	68	6.56	1033.05	1200	264	18.03
3	900	64	6.64	1111.11	1036	256	19.81
4	960	68	6.56	1041.66	1280	232	15.34
5	980	64	6.64	1020.40	1080	252	18.92
6	1008	56	5.51	992.06	1360	224	14.14
7	1080	68	6.49	925.92	1200	212	15.01
8	992	56	5.26	1008.06	1280	264	17.10
9	1000	72	6.25	1000.00	1144	252	18.05
10	1040	68	6.42	961.53	960	232	19.46
11	1008	60	5.66	992.06	1036	244	19.06
12	992	64	5.80	1008.06	1200	228	15.97
13	996	60	5.62	1004.01	1280	256	16.67
14	1028	64	6.06	972.76	1352	264	16.34
15	1016	64	6.04	984.25	1200	232	16.20
16	1032	68	6.20	968.99	1240	256	17.11
17	988	64	5.93	1012.14	1192	196	14.12
18	1080	68	6.18	925.92	1240	216	14.84
19	1040	68	6.44	961.53	1024	240	18.99
20	952	68	5.92	1050.42	1100	232	17.42
21	1016	72	6.47	984.25	1056	248	19.02
22	980	60	5.93	1020.40	1280	256	16.67
23	1016	68	6.27	984.25	1304	264	16.84
24	1024	72	6.84	976.56	1200	280	18.92
25	1080	60	5.58	925.92	1360	260	16.05
26	1100	72	6.57	909.09	1296	288	18.18
27	1032	72	6.25	968.99	1344	268	16.63
28	1040	68	5.82	961.53	1300	276	17.51
29	960	64	5.84	1041.66	1392	280	16.75
30	1112	68	6.14	899.28	1408	272	16.19
Mean	**1010.27**	**68.00**	**6.61**	**992.40**	**1231.47**	**249.73**	**16.96**
SD	**51.81**	**60.00**	**5.12**	**51.91**	**138.34**	**21.88**	**1.69**

Table 145 Palisade ratio, trichome number, vein termination number, vein islets number of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	19.00	4.75	3	5	9	1
2	15.00	3.75	4	8	9	2
3	15.00	3.75	3	7	8	2
4	18.00	4.50	5	8	8	3
5	12.00	3.00	3	6	3	4
6	20.00	5.00	4	8	5	4
7	18.00	4.50	3	5	6	4
8	16.00	4.00	2	8	9	4
9	18.00	4.50	3	8	8	3
10	16.00	4.00	4	6	9	3
11	16.00	4.00	5	10	5	3
12	16.00	4.00	6	9	5	4
13	16.00	4.00	5	6	9	3
14	18.00	4.50	5	10	4	3
15	18.00	4.50	3	8	9	4
16	16.00	4.00	6	6	5	4
17	14.00	3.50	5	8	8	4
18	18.00	4.50	6	6	5	1
19	18.00	4.50	5	6	8	1
20	20.00	5.00	2	8	9	1
21	20.00	5.00	6	9	6	2
22	20.00	5.00	4	9	9	3
23	15.00	3.75	5	7	9	1
24	21.00	5.25	3	10	9	4
25	18.00	4.50	4	10	9	1
26	20.00	5.00	2	6	9	1
27	20.00	5.00	2	7	9	2
28	18.00	4.50	4	6	9	2
29	18.00	4.50	2	7	8	2
30	21.00	5.25	3	8	9	2
Mean	**17.60**	**4.40**	**3.9**	**7.50**	**7.57**	**2.60**
SD	**2.21**	**0.55**	**1.32**	**1.50**	**1.89**	**1.16**

Table 146 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	Number of stomata mm^2	Stomata index Adaxial (mm^2)	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index Abaxial (mm2)
1	960	60	5.88	1041.16	1344	204	13.18
2	1008	64	5.97	992.06	1632	220	11.88
3	1032	72	6.52	968.99	1552	260	14.35
4	1036	68	6.16	965.25	1424	256	15.24
5	980	60	5.77	1020.40	992	264	21.02
6	1000	60	5.66	1000.00	1000	236	19.09
7	1048	64	5.76	954.19	1000	224	18.30
8	1060	64	5.69	943.39	1184	260	18.01
9	1040	64	5.80	961.53	1200	212	15.01
10	1036	68	6.16	965.25	976	240	19.74
11	1016	68	6.27	984.25	960	172	15.19
12	1024	60	5.54	976.56	1000	208	17.22
13	1056	64	5.71	946.96	1440	212	12.83
14	1088	60	5.23	919.11	1264	220	14.82
15	1016	60	5.58	984.25	1200	164	12.02
16	992	64	6.06	1008.06	1200	172	12.54
17	1040	64	5.80	961.53	1032	216	17.31
18	1048	68	6.09	954.19	1008	260	20.50
19	1056	60	5.38	946.96	1232	248	16.76
20	1032	60	5.49	968.99	1060	232	17.96
21	980	64	6.13	1020.40	1200	240	16.67
22	1080	64	5.59	925.92	960	256	21.05
23	1072	68	5.96	932.83	1000	276	21.63
24	1060	60	5.36	943.39	1200	252	17.36
25	1040	56	5.11	961.53	1152	256	18.18
26	1056	60	5.38	946.96	1160	252	17.85
27	1032	60	5.49	968.99	1144	304	20.99
28	960	64	6.25	1041.16	1024	280	21.47
29	1008	64	5.97	992.06	1200	284	19.14
30	1024	68	6.23	976.56	1240	292	19.06
Mean	**1029.33**	**63.33**	**5.80**	**972.43**	**1166.00**	**239.07**	**17.21**
SD	**32.72**	**3.65**	**0.35**	**31.37**	**176.43**	**34.80**	**2.95**

Table 147 Palisade ratio, trichome number, vein termination number, vein islets number of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	16.00	4	6	6	8	2
2	15.00	3.75	6	5	8	2
3	17.00	4.25	7	5	7	2
4	15.00	3.75	7	8	8	2
5	15.00	3.75	5	6	5	2
6	20.00	5.00	6	7	4	2
7	19.00	4.75	4	6	4	3
8	18.00	4.50	5	6	3	2
9	18.00	4.50	3	7	8	2
10	18.00	4.50	6	7	3	3
11	19.00	4.75	6	5	3	2
12	17.00	4.25	6	9	3	2
13	16.00	4.00	6	8	5	3
14	16.00	4.00	4	8	6	2
15	17.00	4.25	6	7	6	2
16	17.00	4.25	6	10	5	2
17	17.00	4.25	4	9	8	4
18	16.00	4.00	6	7	4	2
19	16.00	4.00	5	7	8	1
20	17.00	4.25	5	10	8	1
21	16.00	4.00	7	6	9	2
22	15.00	3.75	5	9	8	2
23	16.00	4.00	4	8	7	2
24	16.00	4.00	5	7	7	3
25	17.00	4.25	5	9	4	2
26	16.00	4.00	7	9	4	3
27	16.00	4.00	6	9	5	4
28	17.00	4.25	7	7	3	4
29	17.00	4.25	6	8	3	2
30	18.00	4.50	7	9	8	3
Mean	**16.77**	**4.19**	**5.60**	**7.47**	**5.73**	**2.33**
SD	**1.25**	**0.31**	**1.07**	**1.46**	**2.07**	**0.76**

Table 148 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Kanchanaburi)

Position	upper epidermal cell no. per mm^2	Number of stomata mm^2	Stomata index Adaxial (mm^2)	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index Abaxial (mm2)
1	1000	64	6.02	1000.00	996	228	18.63
2	1008	64	5.97	992.06	1020	240	19.05
3	972	60	5.81	1028.80	1000	284	22.12
4	980	60	5.77	1020.40	992	260	20.77
5	992	60	5.70	1008.06	984	244	19.87
6	1016	64	5.93	984.25	1024	236	18.73
7	1032	68	6.18	968.99	1020	240	19.05
8	1040	68	6.14	961.53	1040	248	19.25
9	1020	64	5.90	980.39	992	220	18.15
10	992	60	5.70	1008.06	1040	224	17.72
11	1040	60	5.45	961.53	1016	160	13.61
12	1048	64	5.76	954.19	1020	200	16.39
13	1060	64	5.69	943.39	1032	228	18.10
14	1080	64	5.59	925.92	1040	208	16.67
15	992	68	6.42	1008.06	1024	172	14.38
16	1008	68	6.32	992.06	992	180	15.36
17	1040	60	5.45	961.53	1040	224	17.72
18	1032	64	5.84	968.99	1000	240	19.35
19	1016	68	6.27	984.25	1016	240	19.11
20	1000	60	5.66	1000.00	980	224	18.60
21	1008	60	5.62	992.06	1000	256	20.38
22	1040	64	5.80	961.53	1016	272	21.12
23	1056	72	6.38	946.96	992	256	20.51
24	1016	68	6.27	984.25	1012	264	20.69
25	992	72	6.77	1008.06	1000	260	20.63
26	1072	64	5.63	932.83	1024	256	20.00
27	1036	68	6.16	965.25	992	280	22.01
28	1080	64	5.59	925.92	960	268	21.82
29	1032	68	6.18	968.99	920	244	20.96
30	1040	64	5.80	961.53	1040	228	17.98
Mean	**1024.67**	**64.53**	**5.93**	**976.66**	**1007.47**	**236.13**	**18.96**
SD	**28.73**	**3.60**	**0.32**	**27.28**	**26.38**	**29.94**	**2.13**

Table 149 Palisade ratio, trichome number, vein termination number, vein islets number of *J. funile* Decne. subsp. *sootepense* (Craib) P. S. Green (Location Kanchanaburi)

Position	Palisade	Palisade Ratio	Trichome number (mm2)		Vein terminal	Vein islets
			Adaxial	Abaxial	number (mm^2)	number (mm^2)
1	18.00	4.5	6	7	8	2
2	17.00	4.25	6	7	6	2
3	18.00	4.50	7	6	6	2
4	18.00	4.50	7	6	6	2
5	16.00	4.00	5	7	5	2
6	16.00	4.00	4	8	6	2
7	17.00	4.25	5	8	5	3
8	14.00	3.50	5	9	6	2
9	14.00	3.50	6	7	5	1
10	16.00	4.00	5	8	6	3
11	17.00	4.25	5	9	7	1
12	14.00	3.50	6	9	6	3
13	14.00	3.50	7	8	5	4
14	17.00	4.25	7	7	5	3
15	16.00	4.00	7	7	5	2
16	14.00	3.50	6	6	4	1
17	14.00	3.50	4	5	3	3
18	16.00	4.00	5	5	5	2
19	16.00	4.00	4	6	7	1
20	17.00	4.25	4	7	7	2
21	17.00	4.25	7	6	6	2
22	16.00	4.00	4	5	6	2
23	14.00	3.50	4	5	8	1
24	16.00	4.00	4	4	5	3
25	16.00	4.00	5	4	5	2
26	17.00	4.25	7	5	4	2
27	14.00	3.50	7	3	8	4
28	14.00	3.50	7	4	9	3
29	14.00	3.50	5	5	6	2
30	17.00	4.25	6	6	5	2
Mean	**15.80**	**3.95**	**5.57**	**6.30**	**5.83**	**2.20**
SD	**1.42**	**0.36**	**1.17**	**1.60**	**1.32**	**0.81**

Table 150 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. humile* L. (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	980	1020.40	1144	252	18.05
2	988	1012.14	1180	248	17.37
3	924	1082.25	1116	240	17.70
4	932	1072.96	1200	252	17.36
5	896	1116.07	1008	232	18.71
6	856	1168.22	1200	240	16.67
7	880	1136.36	1192	208	14.86
8	904	1106.19	1240	252	16.89
9	824	1213.59	1060	240	18.46
10	900	980.39	1260	248	16.45
11	888	1126.12	1200	224	15.73
12	896	1116.07	1232	232	15.85
13	892	1072.96	1240	240	16.22
14	880	1136.36	1240	232	15.76
15	872	1136.78	1232	248	16.76
16	980	1020.40	1120	224	16.67
17	852	1173.70	1156	204	15.00
18	864	1157.40	1200	240	16.67
19	936	1068.37	1192	240	16.76
20	808	1237.62	1104	232	17.37
21	960	1041.66	1072	180	14.38
22	888	1126.12	1120	196	14.89
23	908	1101.32	1116	248	18.18
24	940	1063.82	1140	220	16.18
25	972	1028.80	1200	232	16.20
26	948	1054.85	1032	264	20.37
27	860	1162.79	1200	248	17.13
28	900	1111.11	1036	260	20.06
29	904	1106.19	1200	204	14.53
30	868	1152.07	1232	204	14.21
Mean	**903.33**	**1103.44**	**1162.13**	**232.80**	**16.71**
SD	**45.58**	**60.71**	**69.91**	**20.22**	**1.53**

Table 151 Palisade ratio, trichome number, vein termination number, vein islets number of *J. humile* L. (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Vein terminal number (mm^2)	Vein islets number (mm^2)
1	11.00	2.75	3	6
2	11.00	2.75	2	4
3	12.00	3.00	2	6
4	11.00	2.75	3	4
5	8.00	2.00	5	4
6	11.00	2.75	3	6
7	12.00	3.00	2	7
8	13.00	3.25	3	4
9	11.00	2.75	2	6
10	11.00	2.75	3	6
11	11.00	2.75	2	4
12	13.00	3.25	3	7
13	12.00	3.00	0	8
14	11.00	2.75	4	6
15	13.00	3.25	2	6
16	13.00	3.25	3	5
17	12.00	3.00	4	6
18	11.00	2.75	3	6
19	12.00	3.00	3	5
20	13.00	3.25	4	6
21	13.00	3.25	3	4
22	12.00	3.00	3	7
23	11.00	2.75	3	5
24	11.00	2.75	4	6
25	12.00	3.00	3	5
26	13.00	3.25	1	6
27	12.00	3.00	1	5
28	13.00	3.25	2	6
29	13.00	3.25	2	6
30	13.00	3.25	5	5
Mean	**11.83**	**2.96**	**2.77**	**5.57**
SD	**1.12**	**0.28**	**1.10**	**1.04**

Table 152 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. humile* L. (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	880	1136.36	1060	204	16.14
2	872	1146.78	1168	212	15.36
3	980	1020.40	1020	204	16.67
4	852	1173.70	1000	200	16.67
5	864	1157.40	960	184	16.08
6	888	1126.12	1080	220	16.92
7	908	1101.32	800	204	20.32
8	940	1063.82	920	216	19.01
9	972	1028.80	980	228	18.87
10	892	1121.07	840	204	19.54
11	880	1136.36	1080	200	15.63
12	872	1146.78	960	212	18.09
13	980	1020.40	1160	208	15.20
14	844	1184.83	1080	212	16.41
15	868	1152.07	880	208	19.12
16	852	1173.70	840	196	18.92
17	892	1121.07	948	204	17.71
18	880	1136.36	1152	224	16.28
19	872	1146.78	1080	196	15.36
20	980	1020.40	1160	216	15.70
21	860	1162.79	1200	204	14.53
22	872	1146.78	1160	220	15.94
23	856	1168.22	1200	212	15.01
24	904	1106.19	1232	216	14.92
25	916	1091.70	1000	220	18.03
26	972	1028.80	840	224	21.05
27	888	1126.12	960	196	16.96
28	916	1091.70	1200	220	15.49
29	904	1106.19	1160	252	17.85
30	948	1054.85	1160	224	16.18
Mean	**900.13**	**1113.26**	**1042.67**	**211.33**	**17.00**
SD	**42.52**	**50.88**	**127.80**	**12.91**	**1.73**

Table 153 Palisade ratio, trichome number, vein termination number, vein islets number of *J. humile* L. (Location Sisaket)

Position	Palisade	Palisade Ratio	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)
1	12.00	3.00	5	6
2	10.00	2.50	6	5
3	10.00	2.50	4	8
4	10.50	2.63	5	4
5	9.00	2.25	6	3
6	10.50	2.63	4	8
7	11.50	2.88	4	3
8	11.00	2.75	4	6
9	9.00	2.25	4	7
10	11.00	2.75	1	5
11	12.00	3.00	3	4
12	11.50	2.88	2	5
13	10.00	2.50	2	8
14	11.00	2.75	2	7
15	12.00	3.00	5	5
16	11.50	2.88	4	3
17	8.50	2.13	2	5
18	8.00	2.00	3	5
19	9.00	2.25	3	2
20	10.00	2.50	4	4
21	10.50	2.63	4	3
22	11.00	2.75	6	3
23	12.00	3.00	3	4
24	13.50	3.38	7	4
25	13.50	3.38	5	6
26	12.00	3.00	5	8
27	10.50	2.63	1	5
28	11.00	2.75	0	6
29	11.00	2.75	0	5
30	11.50	2.88	6	5
Mean	**10.82**	**2.70**	**3.67**	**5.07**
SD	**1.31**	**0.33**	**1.83**	**1.68**

Table 154 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. humile* L. (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	888	1126.12	1040	200	16.13
2	908	1101.32	1200	208	14.77
3	940	1063.82	1184	208	14.94
4	972	1028.80	1120	204	15.41
5	880	1136.26	1440	200	12.20
6	872	1146.78	1424	208	12.75
7	980	1020.40	920	228	19.86
8	844	1184.83	1080	224	17.18
9	868	1152.07	1100	220	16.67
10	916	1091.70	980	208	17.51
11	904	1106.19	968	216	18.24
12	948	1054.85	920	212	18.73
13	836	1196.17	832	212	20.31
14	860	1027.72	1200	208	14.77
15	828	1027.72	1120	212	15.92
16	880	1136.26	900	200	18.18
17	860	1027.72	952	200	17.36
18	920	1086.95	840	232	21.64
19	904	1106.19	880	200	18.52
20	872	1146.78	1040	212	16.93
21	900	1111.11	960	200	17.24
22	920	1086.95	864	224	20.59
23	960	1041.66	1200	208	14.77
24	892	1121.07	960	220	18.64
25	880	1136.26	876	228	20.65
26	872	1146.78	920	212	18.73
27	980	1020.40	960	200	17.24
28	872	1146.78	880	224	20.29
29	980	1020.40	1120	260	18.84
30	860	1027.72	1140	220	16.18
Mean	**899.87**	**1094.26**	**1034.00**	**213.60**	**17.37**
SD	**43.87**	**53.93**	**158.57**	**13.06**	**2.33**

Table 155 Palisade ratio, trichome number, vein termination number, vein islets number of *J. humile* L. (Location Sisaket)

Position	Palisade	Palisade Ratio	Vein terminal number (mm^2)	Vein islets number (mm^2)
1	10.50	2.63	4	6
2	12.00	3.00	6	5
3	12.00	3.00	4	7
4	10.50	2.63	5	5
5	11.50	2.88	6	3
6	10.00	2.50	4	7
7	10.50	2.63	4	4
8	11.00	2.75	3	5
9	8.50	2.13	4	7
10	10.50	2.63	0	5
11	12.00	3.00	3	4
12	11.50	2.88	2	4
13	11.00	2.75	1	8
14	11.50	2.88	2	6
15	10.50	2.63	6	5
16	8.00	2.00	4	3
17	10.00	2.50	2	5
18	12.00	3.00	3	4
19	11.00	2.75	2	3
20	8.00	2.00	4	4
21	10.00	2.50	4	4
22	11.50	2.88	7	3
23	9.00	2.25	3	4
24	9.50	2.38	7	4
25	12.00	3.00	5	6
26	11.50	2.88	4	8
27	13.00	3.25	2	4
28	11.50	2.88	0	7
29	12.00	3.00	0	5
30	12.00	3.00	6	5
Mean	**10.82**	**2.70**	**3.57**	**5.00**
SD	**1.26**	**0.32**	**1.96**	**1.46**

Table 156 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. mesnyi* Hance (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2508	398.72	2204	288	11.56
2	2492	401.28	2040	248	10.84
3	2468	405.18	1940	224	10.35
4	2460	406.50	2060	240	10.43
5	2448	408.49	2024	248	10.92
6	2456	407.16	1960	240	10.91
7	2488	401.92	2140	264	10.98
8	2476	403.87	1880	252	11.82
9	2484	402.57	1968	264	11.83
10	2508	398.72	1980	256	11.45
11	2448	408.49	1960	260	11.71
12	2320	431.03	1940	232	10.68
13	2420	413.22	2000	260	11.50
14	2216	451.26	1920	252	11.60
15	2224	449.64	2200	296	11.86
16	2400	416.66	2000	280	12.28
17	2440	409.83	2040	288	12.37
18	2472	404.53	2020	276	12.02
19	2352	425.17	2040	284	12.22
20	2440	409.83	2020	312	13.38
21	2376	420.87	2180	280	11.38
22	2352	425.17	2148	268	11.09
23	2360	423.72	2120	264	11.07
24	2428	411.86	2160	272	11.18
25	2456	407.16	2120	284	11.81
26	2480	403.22	2152	280	11.51
27	2484	402.57	2012	260	11.44
28	2508	398.72	2080	228	9.88
29	2440	409.83	2120	220	9.40
30	2472	404.53	2040	288	12.37
Mean	**2429.20**	**412.06**	**2048.93**	**263.60**	**11.40**
SD	**75.52**	**13.45**	**88.30**	**22.56**	**0.80**

Table 157 Palisade ratio, trichome number, vein termination number, vein islets number of *J. mesnyi* Hance (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)
1	7.50	1.88	5	4
2	9.00	2.25	4	6
3	8.50	2.13	5	8
4	7.50	1.88	5	3
5	8.50	2.13	5	7
6	9.00	2.25	7	2
7	8.50	2.13	7	5
8	7.00	1.75	5	6
9	8.00	2.00	5	9
10	7.00	1.75	5	5
11	7.50	1.88	6	7
12	9.00	2.25	6	8
13	7.00	1.75	9	4
14	8.50	2.13	7	6
15	9.00	2.25	7	7
16	8.00	2.00	7	4
17	9.50	2.38	7	5
18	10.00	2.50	8	4
19	8.50	2.13	3	8
20	9.00	2.25	4	6
21	9.50	2.38	7	4
22	7.50	1.88	6	6
23	8.00	2.00	7	3
24	8.00	2.00	5	6
25	9.00	2.25	5	2
26	9.50	2.38	3	6
27	10.00	2.50	4	6
28	8.50	2.13	5	8
29	10.00	2.50	7	8
30	10.00	2.50	4	5
Mean	**8.55**	**2.14**	**5.67**	**5.60**
SD	**0.93**	**0.23**	**1.47**	**1.87**

Table 158 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. mesnyi* Hance (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2456	407.16	2140	312	12.72
2	2488	401.92	2212	256	10.37
3	2476	403.87	2100	268	11.32
4	2440	409.83	2320	272	10.49
5	2472	404.53	1980	272	12.08
6	2352	425.17	1980	232	10.49
7	2420	413.22	1900	276	12.68
8	2216	451.26	2100	256	10.87
9	2224	449.64	2240	256	10.26
10	2400	416.66	2120	264	11.07
11	2472	404.53	2160	280	11.48
12	2352	425.17	2140	276	11.42
13	2440	409.83	2220	280	11.20
14	2376	420.87	2248	280	11.08
15	2352	425.17	2140	272	11.28
16	2376	420.87	2188	280	11.35
17	2352	425.17	2240	272	10.83
18	2360	423.72	2040	272	11.76
19	2428	411.86	2020	244	10.78
20	2480	403.22	2136	280	11.59
21	2484	402.57	2224	252	10.18
22	2508	398.72	2160	276	11.33
23	2440	409.83	2000	272	11.97
24	2472	404.53	2060	272	11.66
25	2488	401.92	2172	280	11.42
26	2476	403.87	2140	288	11.86
27	2484	402.57	2032	268	11.65
28	2508	398.72	2056	232	10.14
29	2448	408.49	2080	236	10.19
30	2500	400.00	2080	280	11.86
Mean	**2424.67**	**412.83**	**2120.93**	**268.53**	**11.25**
SD	**75.75**	**13.46**	**95.53**	**17.16**	**0.70**

Table 159 Palisade ratio, trichome number, vein termination number, vein islets number *J. mesnyi* Hance (Location Sisaket)

Position	Palisade	Palisade Ratio	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)
1	7.00	1.75	5	3
2	8.50	2.13	4	3
3	8.00	2.00	5	6
4	7.50	1.88	6	7
5	8.00	2.00	5	5
6	8.50	2.13	5	4
7	9.00	2.25	5	2
8	6.50	1.63	5	8
9	7.50	1.88	5	6
10	9.00	2.25	5	5
11	6.50	1.63	3	5
12	9.00	2.25	6	6
13	8.50	2.13	6	6
14	8.50	2.13	7	5
15	9.00	2.25	7	5
16	8.00	2.00	4	7
17	10.00	2.50	7	6
18	8.00	2.00	5	7
19	8.00	2.00	3	3
20	9.00	2.25	4	4
21	10.00	2.50	4	8
22	8.00	2.00	6	7
23	9.00	2.25	5	6
24	7.50	1.88	5	6
25	8.50	2.13	5	6
26	10.50	2.63	3	4
27	9.00	2.25	4	5
28	7.50	1.88	5	6
29	8.50	2.13	7	5
30	9.50	2.38	4	6
Mean	**8.40**	**2.10**	**5.00**	**5.40**
SD	**0.96**	**0.24**	**1.14**	**1.48**

Table 160 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. mesnyi* Hance (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	2440	409.83	2240	284	11.25
2	2472	404.53	2000	268	11.82
3	2352	425.17	2080	280	11.86
4	2472	404.53	2080	284	12.01
5	2352	425.17	1968	300	13.23
6	2440	409.83	2000	248	11.03
7	2376	420.87	2020	288	12.48
8	2352	425.17	2120	264	11.07
9	2508	398.72	2200	272	11.00
10	2440	409.83	2180	268	10.95
11	2472	404.53	2100	288	12.06
12	2488	401.92	2180	284	11.53
13	2476	403.87	2080	284	12.01
14	2484	402.57	2120	276	11.52
15	2508	398.72	2180	280	11.38
16	2448	408.49	2200	288	11.58
17	2500	400.00	2120	264	11.07
18	2320	431.03	2080	284	12.01
19	2420	413.22	2080	276	11.71
20	2216	451.26	2120	284	11.81
21	2224	449.64	2240	272	10.83
22	2400	416.66	2200	272	11.00
23	2440	409.83	2104	260	11.00
24	2468	405.18	2200	268	10.86
25	2460	406.50	2080	292	12.31
26	2448	408.49	2060	292	12.41
27	2456	407.16	2020	272	11.87
28	2472	404.53	2120	236	10.02
29	2352	425.17	2060	224	9.81
30	2428	411.86	2000	284	12.43
Mean	**2422.80**	**413.14**	**2107.73**	**274.53**	**11.53**
SD	**75.11**	**13.39**	**75.30**	**16.42**	**0.73**

Table 161 Palisade ratio, trichome number, vein termination number, vein islets number of *J. mesnyi* Hance (Location Sisaket)

Position	Palisade	Palisade Ratio	Vein terminal number (mm^2)	Vein islets number (mm^2)
1	8.50	2.13	4	5
2	9.00	2.25	3	6
3	10.00	2.50	4	6
4	8.00	2.00	6	4
5	7.50	1.88	4	2
6	9.00	2.25	4	5
7	7.00	1.75	3	3
8	8.00	2.00	6	3
9	9.00	2.25	6	5
10	7.00	1.75	6	5
11	7.50	1.88	5	3
12	10.00	2.50	5	5
13	8.00	2.00	6	6
14	8.00	2.00	4	5
15	8.50	2.13	4	5
16	7.50	1.88	6	4
17	8.00	2.00	6	5
18	7.00	1.75	6	3
19	9.00	2.25	4	8
20	10.00	2.50	4	6
21	10.00	2.50	5	3
22	7.50	1.88	6	6
23	8.00	2.00	7	3
24	8.00	2.00	4	7
25	8.00	2.00	5	3
26	10.50	2.63	3	6
27	10.00	2.50	5	5
28	9.00	2.25	4	8
29	9.00	2.25	5	3
30	10.00	2.50	6	6
Mean	**8.55**	**2.14**	**4.87**	**4.80**
SD	**1.05**	**0.26**	**1.11**	**1.56**

Table 162 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	Number of stomata mm^2	Stomata index Adaxial (mm^2)	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index Abaxial (mm^2)
1	412	54	11.59	1157.4	1648	216	11.59
2	420	46	9.87	976.56	1680	184	9.87
3	410	56	12.02	1000.00	1640	224	12.02
4	428	58	11.93	984.25	1712	232	11.93
5	430	58	11.89	961.53	1720	232	11.89
6	460	56	10.85	1111.11	1840	224	10.85
7	420	60	12.50	1033.05	1680	240	12.50
8	480	58	10.78	1000.00	1920	232	10.78
9	475	61	11.38	1168.22	1900	244	11.38
10	500	59	10.55	984.25	2000	236	10.55
11	485	54	10.02	1116.07	1940	216	10.02
12	495	52	9.51	1111.11	1980	208	9.51
13	470	56	10.65	1068.37	1880	224	10.65
14	445	57	11.35	1136.36	1780	228	11.35
15	500	53	9.58	1219.51	2000	212	9.58
16	490	52	9.59	1059.32	1960	208	9.59
17	405	55	11.96	1136.36	1620	220	11.96
18	420	59	12.32	1086.95	1680	236	12.32
19	465	53	10.23	1050.42	1860	212	10.23
20	408	54	11.69	1086.95	1632	216	11.69
21	450	51	10.18	1059.32	1800	204	10.18
22	440	48	9.84	1000.00	1760	192	9.84
23	470	56	10.65	1024.59	1880	224	10.65
24	398	54	11.95	1000.00	1592	216	11.95
25	405	60	12.90	1050.42	1620	240	12.90
26	448	50	10.04	1020.40	1792	200	10.04
27	430	53	10.97	988.14	1720	212	10.97
28	425	48	10.15	961.53	1700	192	10.15
29	428	51	10.65	1111.11	1712	204	10.65
30	438	48	9.88	1000.00	1752	192	9.88
Mean	**445.00**	**54.33**	**10.92**	**1055.44**	**1780.00**	**217.33**	**10.92**
SD	**31.45**	**3.98**	**0.98**	**68.21**	**125.79**	**15.91**	**0.98**

Table 163 Palisade ratio, trichome number, vein termination number, vein islets number of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)
1	8.50	2.13	9	4
2	8.50	2.13	10	4
3	10.00	2.50	9	2
4	11.00	2.75	10	4
5	8.00	2.00	9	3
6	8.00	2.00	8	6
7	9.00	2.25	6	5
8	8.50	2.13	8	4
9	8.00	2.00	8	3
10	8.50	2.13	6	5
11	10.00	2.50	7	6
12	9.50	2.38	9	5
13	8.00	2.00	9	5
14	9.50	2.38	6	5
15	10.00	2.50	5	3
16	8.00	2.00	11	6
17	8.00	2.00	10	4
18	8.50	2.13	7	4
19	9.00	2.25	10	5
20	8.50	2.13	8	6
21	8.00	2.00	8	6
22	8.50	2.13	11	7
23	10.00	2.50	8	5
24	9.50	2.38	11	6
25	10.00	2.50	9	5
26	9.00	2.25	9	5
27	9.00	2.25	8	5
28	9.50	2.38	10	3
29	8.00	2.00	9	4
30	10.00	2.50	9	3
Mean	**8.95**	**2.24**	**8.57**	**4.60**
SD	**0.84**	**0.21**	**1.55**	**1.19**

Table 164 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Sisaket)

Position	upper epidermal cell no. per mm^2	Number of stomata mm^2	Stomata index Adaxial (mm2)	epidermal cell area (µm2)	Number of epidermal cell per mm2	Number of stomata mm2	Stomata index Abaxial (mm2)
1	1032	20	1.90	968.99	1704	204	10.69
2	1052	28	2.59	950.57	1800	172	8.72
3	1024	20	1.92	976.56	1860	124	6.25
4	920	32	3.36	1086.95	1704	196	10.32
5	960	20	2.04	1041.66	1712	240	12.30
6	912	4	0.44	868.05	1828	252	12.12
7	936	16	1.68	1068.37	1752	220	11.16
8	1000	24	2.34	1000.00	1860	236	11.26
9	980	24	2.39	1020.40	1880	240	11.32
10	960	12	1.23	1041.66	1820	252	12.16
11	1032	28	2.64	968.99	1760	248	12.35
12	960	20	2.04	1041.66	1780	252	12.40
13	900	16	1.75	1111.11	1920	236	10.95
14	944	12	1.26	1059.32	1780	220	11.00
15	980	28	2.78	1020.40	1824	208	10.24
16	912	16	1.72	1096.49	1820	200	9.90
17	1000	28	2.72	1000.00	1640	212	11.45
18	1016	24	2.31	984.25	1860	228	10.92
19	992	40	3.88	1008.06	1720	200	10.42
20	960	28	2.83	1041.66	1792	216	10.76
21	1008	32	3.08	992.06	1960	200	9.26
22	880	12	1.35	1136.36	1700	216	11.27
23	860	16	1.83	1162.79	1752	208	10.61
24	896	24	2.61	1116.07	2000	200	9.09
25	920	24	2.54	1086.95	1820	204	10.08
26	984	36	3.53	1016.26	1788	216	10.78
27	1008	20	1.95	992.06	1800	220	10.89
28	944	28	2.88	1059.32	1820	212	10.43
29	1000	8	0.79	1000.00	2080	232	10.03
30	892	16	1.76	1121.07	1820	204	10.08
Mean	**962.13**	**21.87**	**2.20**	**1034.60**	**1811.87**	**215.60**	**10.64**
SD	**50.97**	**8.25**	**0.78**	**63.41**	**92.87**	**26.08**	**1.25**

Table 165 Palisade ratio, trichome number, vein termination number, vein islets number of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Sisaket)

Position	Palisade	Palisade Ratio	Vein terminal number (mm^2)	Vein islets number (mm^2)
1	9.00	2.25	10	5
2	8.50	2.13	9	4
3	8.00	2.00	8	4
4	8.50	2.13	6	4
5	10.00	2.50	8	3
6	9.50	2.38	8	5
7	8.50	2.13	8	6
8	9.00	2.25	9	5
9	9.00	2.25	9	7
10	10.00	2.50	8	4
11	8.50	2.13	10	4
12	9.00	2.25	9	5
13	9.50	2.38	8	6
14	8.00	2.00	6	5
15	7.50	1.88	7	5
16	9.50	2.38	10	5
17	7.50	1.88	8	3
18	8.00	2.00	8	4
19	8.00	2.00	11	3
20	9.00	2.25	8	5
21	10.00	2.50	10	4
22	9.50	2.38	9	3
23	8.00	2.00	9	6
24	9.50	2.38	8	5
25	10.00	2.50	8	4
26	8.00	2.00	7	3
27	8.00	2.00	9	6
28	8.50	2.13	6	6
29	10.00	2.50	10	8
30	9.00	2.25	9	4
Mean	**8.83**	**2.21**	**8.43**	**4.70**
SD	**0.79**	**0.20**	**1.25**	**1.24**

Table 166 Epidermal number, epidermal cell area, stomatal number and stomatal index of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Sisaket)

Position	upper epidermal cell no. per mm^2	Number of stomata mm^2	Stomata index Adaxial (mm2)	epidermal cell area (µm2)	Number of epidermal cell per mm2	Number of stomata mm2	Stomata index Abaxial (mm2)
1	428	56	11.57	915.75	1712	224	11.57
2	410	54	11.64	984.25	1640	216	11.64
3	418	49	10.49	980.39	1672	196	10.49
4	425	53	11.09	1000.00	1700	212	11.09
5	434	57	11.61	968.99	1736	228	11.61
6	455	62	11.99	1050.42	1820	248	11.99
7	450	56	11.07	1086.95	1800	224	11.07
8	440	57	11.47	1162.79	1760	228	11.47
9	435	56	11.41	1086.95	1740	224	11.41
10	448	60	11.81	1050.42	1792	240	11.81
11	484	63	11.52	1063.82	1936	252	11.52
12	500	62	11.03	1028.80	2000	248	11.03
13	475	62	11.55	1050.42	1900	248	11.55
14	488	61	11.11	1000.00	1952	244	11.11
15	438	62	12.40	1050.42	1752	248	12.40
16	468	58	11.03	1000.00	1872	232	11.03
17	400	54	11.89	1054.85	1600	216	11.89
18	480	58	10.78	1111.11	1920	232	10.78
19	437	55	11.18	1086.95	1748	220	11.18
20	447	58	11.49	1054.85	1788	232	11.49
21	440	56	11.29	1190.47	1760	224	11.29
22	490	55	10.09	1000.00	1960	220	10.09
23	460	54	10.51	1020.4	1840	216	10.51
24	463	54	10.44	1050.42	1852	216	10.44
25	450	50	10.00	1068.37	1800	200	10.00
26	445	56	11.18	1008.06	1780	224	11.18
27	453	52	10.30	1041.66	1812	208	10.30
28	464	56	10.77	1000.00	1856	224	10.77
29	455	60	11.65	1008.06	1820	240	11.65
30	460	53	10.33	1126.12	1840	212	10.33
Mean	**451.33**	**56.63**	**11.16**	**1043.39**	**1805.33**	**226.53**	**11.16**
SD	**23.77**	**3.66**	**0.59**	**57.69**	**95.08**	**14.65**	**0.59**

Table 167 Palisade ratio, trichome number, vein termination number, vein islets number of *J. fluminense* Vahl subsp. *gratissimum* (Deflers) P. S. Green (Location Sisaket)

Position	Palisade	Palisade Ratio	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)
1	7.50	1.88	10	5
2	9.50	2.38	9	6
3	7.50	1.88	8	5
4	8.00	2.00	6	5
5	8.50	2.13	7	5
6	9.00	2.25	10	3
7	9.50	2.38	8	4
8	8.00	2.00	8	6
9	9.00	2.25	11	5
10	8.50	2.13	8	5
11	8.00	2.00	8	5
12	8.50	2.13	7	3
13	10.00	2.50	9	5
14	9.50	2.38	7	5
15	10.00	2.50	7	4
16	8.00	2.00	8	7
17	8.00	2.00	9	4
18	9.50	2.38	9	3
19	7.00	1.75	10	6
20	8.00	2.00	9	5
21	6.50	1.63	7	4
22	7.50	1.88	9	3
23	10.00	2.50	9	3
24	9.50	2.38	6	6
25	8.00	2.00	5	4
26	9.50	2.38	11	5
27	10.00	2.50	8	4
28	8.00	2.00	10	3
29	8.00	2.00	9	3
30	8.50	2.13	8	6
Mean	**8.57**	**2.14**	**8.33**	**4.57**
SD	**0.96**	**0.24**	**1.45**	**1.14**

Table 168 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 1 (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1596	626.56	2720	224	7.61
2	1584	631.31	2480	288	10.40
3	1604	623.44	2800	224	7.41
4	1640	609.75	2500	232	8.49
5	1672	598.08	2720	280	9.33
6	1528	654.45	2740	304	9.99
7	1564	639.38	2800	232	7.65
8	1568	637.75	2760	296	9.69
9	1576	634.51	2760	288	9.45
10	1556	642.67	2480	280	10.14
11	1632	612.74	2840	296	9.44
12	1580	632.91	2860	236	7.62
13	1640	609.75	2736	312	10.24
14	1560	641.02	2800	248	8.14
15	1504	664.89	2872	288	9.11
16	1520	657.89	2860	272	8.68
17	1592	624.14	2920	304	9.43
18	1612	620.34	2848	280	8.95
19	1592	628.14	2804	232	7.64
20	1664	600.96	2912	288	9.00
21	1396	716.33	3020	296	8.93
22	1648	606.79	3040	304	9.09
23	1580	632.91	3060	296	8.82
24	1592	624.14	3080	304	8.98
25	1504	664.89	2980	312	9.48
26	1652	605.32	3020	232	7.13
27	1668	599.52	3060	312	9.25
28	1592	624.14	2840	280	8.97
29	1600	625.00	2880	260	8.28
30	1664	600.96	3000	280	8.54
Mean	**1589.33**	**629.69**	**2839.73**	**276.00**	**8.86**
SD	**59.70**	**24.85**	**162.18**	**29.41**	**0.87**

Table 169 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 1 (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	13.00	3.25	8	11	3
2	12.00	3.00	9	10	4
3	14.00	3.50	10	9	3
4	13.00	3.25	11	11	5
5	14.00	3.50	10	10	5
6	14.00	3.50	11	10	5
7	13.00	3.25	11	11	4
8	13.00	3.25	10	10	4
9	12.00	3.00	11	10	5
10	12.00	3.00	10	9	5
11	12.00	3.00	6	10	4
12	13.00	3.25	8	9	5
13	14.00	3.50	11	9	3
14	14.00	3.50	8	8	6
15	14.00	3.50	6	11	7
16	12.00	3.00	8	10	4
17	14.00	3.50	7	9	5
18	13.00	3.25	8	10	8
19	12.00	3.00	9	10	8
20	14.00	3.50	8	9	7
21	14.00	3.50	7	8	8
22	12.00	3.00	8	9	5
23	13.00	3.25	9	9	6
24	13.00	3.25	7	9	5
25	13.00	3.25	8	10	9
26	14.00	3.50	8	8	10
27	14.00	3.50	8	10	5
28	12.00	3.00	9	9	5
29	13.00	3.25	9	10	5
30	12.00	3.00	11	12	3
Mean	**13.07**	**3.27**	**8.80**	**9.67**	**5.37**
SD	**0.83**	**0.21**	**1.52**	**0.96**	**1.81**

Table 170 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 1 (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1632	612.74	2000	240	10.71
2	1580	632.91	2240	232	9.39
3	1612	620.34	2480	204	7.60
4	1592	628.14	2780	320	10.32
5	1664	600.96	2704	260	8.77
6	1668	599.52	2440	280	10.29
7	1592	628.14	2592	228	8.09
8	1600	625.00	2392	332	12.19
9	1512	661.37	2928	308	9.52
10	1640	609.75	2880	288	9.09
11	1560	641.02	2656	348	11.58
12	1600	625.00	2208	312	12.38
13	1580	632.91	2272	320	12.35
14	1592	628.14	2600	348	11.80
15	1504	664.89	2464	340	12.13
16	1520	657.89	2320	228	8.95
17	1508	663.12	2344	224	8.72
18	1548	645.99	2520	240	8.70
19	1560	641.02	2448	304	11.05
20	1512	661.37	2544	352	12.15
21	1600	625.00	2400	320	11.76
22	1516	659.63	2600	292	10.10
23	1592	628.14	2500	332	11.72
24	1548	645.99	2800	260	8.50
25	1528	654.45	3040	300	8.98
26	1596	626.56	2760	332	10.74
27	1668	599.52	2540	280	9.93
28	1640	609.75	2840	272	8.74
29	1596	626.56	2600	280	9.72
30	1672	598.08	2560	260	9.22
Mean	**1584.40**	**631.80**	**2548.40**	**287.87**	**10.17**
SD	**51.56**	**20.56**	**231.47**	**42.82**	**1.45**

Table 171 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 1 (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	14.00	3.50	11	10	4
2	14.50	3.63	10	10	5
3	13.00	3.25	11	11	5
4	14.50	3.63	10	10	4
5	12.00	3.00	11	12	2
6	12.00	3.00	8	7	4
7	14.00	3.50	6	11	5
8	14.00	3.50	8	9	5
9	15.00	3.75	11	7	4
10	15.50	3.88	10	12	3
11	12.00	3.00	11	14	5
12	14.00	3.50	10	16	1
13	13.50	3.38	9	16	5
14	12.50	3.13	7	8	5
15	14.00	3.50	8	11	6
16	14.00	3.50	8	12	5
17	15.00	3.75	9	11	5
18	13.00	3.25	7	9	3
19	14.50	3.63	8	9	5
20	14.50	3.63	8	8	6
21	15.00	3.75	6	8	7
22	14.00	3.50	7	8	4
23	13.50	3.38	8	7	6
24	14.00	3.50	8	8	6
25	15.00	3.75	6	11	4
26	13.00	3.25	8	9	9
27	14.00	3.50	8	10	3
28	13.50	3.38	8	10	4
29	14.00	3.50	8	10	4
30	15.00	3.75	8	13	4
Mean	**13.88**	**3.47**	**8.53**	**10.23**	**4.60**
SD	**0.94**	**0.24**	**1.55**	**2.37**	**1.50**

Table 172 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 1 (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1668	599.52	2416	332	12.08
2	1592	628.14	2380	320	11.85
3	1600	625.00	2400	284	10.58
4	1672	598.08	2460	272	9.96
5	1632	612.74	2600	256	8.96
6	1580	632.91	2400	284	10.58
7	1592	628.14	2880	308	9.66
8	1552	644.32	2440	336	12.10
9	1612	620.34	2472	304	10.95
10	1592	628.14	2840	292	9.32
11	1664	600.96	2396	308	11.39
12	1648	606.79	2580	360	12.24
13	1580	632.91	2800	316	10.14
14	1592	628.14	2992	360	10.74
15	1504	664.89	2520	344	12.01
16	1560	641.02	2576	320	11.05
17	1512	661.37	2368	272	10.30
18	1580	632.91	2400	260	9.77
19	1592	628.14	2480	280	10.14
20	1504	664.89	2392	264	9.94
21	1548	645.99	2240	232	9.39
22	1528	654.45	2464	280	10.20
23	1596	626.56	2320	260	10.08
24	1516	659.63	2880	320	10.00
25	1592	628.14	2800	312	10.03
26	1520	657.89	2760	272	8.97
27	1508	663.12	2304	288	11.11
28	1548	645.99	2500	280	10.07
29	1640	609.75	2360	288	10.88
30	1668	599.52	2400	284	10.58
Mean	**1583.07**	**632.35**	**2527.33**	**296.27**	**10.50**
SD	**52.26**	**20.83**	**200.11**	**31.35**	**0.92**

Table 173 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 1 (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	13.00	3.25	11	11	3
2	12.50	3.13	8	10	5
3	14.00	3.50	6	9	5
4	14.00	3.50	8	12	2
5	15.00	3.75	8	6	5
6	14.50	3.63	8	6	5
7	13.00	3.25	8	11	6
8	12.00	3.00	11	12	5
9	12.00	3.00	10	8	5
10	12.50	3.13	11	8	5
11	12.00	3.00	10	12	4
12	13.00	3.25	10	15	1
13	14.00	3.50	11	15	7
14	12.50	3.13	10	8	4
15	15.00	3.75	11	11	6
16	12.00	3.00	10	11	4
17	14.00	3.50	9	7	5
18	13.00	3.25	7	8	3
19	13.00	3.25	8	9	4
20	12.50	3.13	8	7	4
21	15.00	3.75	7	8	7
22	14.00	3.50	8	9	4
23	14.00	3.50	8	6	6
24	14.50	3.63	7	10	6
25	13.00	3.25	6	10	4
26	12.50	3.13	7	10	7
27	12.00	3.00	8	8	3
28	13.00	3.25	8	10	4
29	13.00	3.25	6	11	3
30	13.00	3.25	8	11	4
Mean	**13.25**	**3.31**	**8.53**	**9.63**	**4.53**
SD	**0.96**	**0.24**	**1.59**	**2.33**	**1.43**

Table 174 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 2 (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1920	520.83	2184	332	13.20
2	1888	529.66	2180	312	12.52
3	1836	544.66	2200	292	11.72
4	1828	547.04	2220	304	12.04
5	1832	545.85	2152	280	11.51
6	1868	535.33	2272	300	11.66
7	1932	517.59	2064	324	13.57
8	1936	516.52	2200	328	12.97
9	1972	507.09	2172	336	13.40
10	1980	505.05	2200	320	12.70
11	1936	516.52	2232	344	13.35
12	1896	527.42	2080	328	13.62
13	1796	556.79	2160	324	13.04
14	1844	542.29	2180	316	12.66
15	1888	529.66	2140	328	13.29
16	1824	548.24	2040	324	13.71
17	1796	556.79	2120	332	13.54
18	1812	551.87	2028	308	13.18
19	1880	531.91	2180	296	11.95
20	1912	523.01	2172	324	12.98
21	1864	536.48	2188	284	11.49
22	1884	530.78	2168	296	12.01
23	1836	544.66	2104	292	12.19
24	1872	534.18	2072	304	12.79
25	1872	534.18	2092	300	12.54
26	1920	520.83	2152	296	12.09
27	1892	528.54	2140	312	12.72
28	1908	524.10	2160	320	12.90
29	1928	518.67	2200	304	12.14
30	1980	505.05	2080	308	12.90
Mean	**1884.40**	**531.05**	**2151.07**	**312.27**	**12.68**
SD	**51.63**	**14.53**	**58.76**	**16.37**	**0.66**

Table 175 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 2 (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	8.00	2.00	20	8	4
2	9.00	2.25	18	5	5
3	7.00	1.75	18	9	7
4	8.00	2.00	15	7	6
5	7.50	1.88	14	10	3
6	6.50	1.63	15	11	5
7	7.00	1.75	13	7	5
8	8.00	2.00	15	9	7
9	8.50	2.13	14	8	6
10	9.00	2.25	19	8	8
11	7.00	1.75	17	10	4
12	8.50	2.13	20	7	5
13	6.00	1.50	19	8	6
14	6.50	1.63	17	7	5
15	7.50	1.88	13	7	7
16	8.50	2.13	14	6	3
17	6.50	1.63	15	8	2
18	7.00	1.75	21	6	5
19	8.00	2.00	15	10	4
20	8.00	2.00	16	11	3
21	7.00	1.75	17	11	3
22	9.50	2.38	16	8	6
23	8.00	2.00	15	7	4
24	9.00	2.25	13	9	6
25	9.50	2.38	16	8	5
26	7.00	1.75	17	6	6
27	9.00	2.25	15	10	7
28	9.50	2.38	20	12	5
29	9.50	2.38	18	8	6
30	10.00	2.50	21	9	4
Mean	**8.00**	**2.00**	**16.53**	**8.33**	**5.07**
SD	**1.10**	**0.27**	**2.42**	**1.73**	**1.46**

Table 176 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 2 (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1892	528.54	2048	308	13.07
2	1908	524.10	2140	312	12.72
3	1928	518.67	2040	320	13.56
4	1980	505.05	2080	304	12.75
5	1936	516.52	2100	292	12.21
6	1896	527.42	2120	312	12.83
7	1796	556.79	2040	304	12.97
8	1812	551.87	2172	320	12.84
9	1880	531.91	2120	296	12.25
10	1912	523.01	1972	336	14.56
11	1864	536.48	1980	304	13.31
12	1884	530.78	2040	292	12.52
13	1836	544.66	2192	328	13.02
14	1920	520.83	2200	340	13.39
15	1892	528.54	2040	308	13.12
16	1908	524.10	2180	332	13.22
17	1820	549.45	2124	328	13.38
18	1800	555.55	2060	312	13.15
19	1852	539.95	2096	308	12.81
20	1928	518.67	2200	320	12.70
21	1820	549.45	2056	296	12.59
22	1880	531.91	2080	300	12.61
23	1840	543.47	2040	284	12.22
24	1848	541.12	2100	300	12.50
25	1920	520.83	1916	292	13.22
26	1904	525.21	2052	304	12.90
27	1916	521.92	2080	316	13.19
28	1920	520.83	2104	308	12.77
29	1932	517.59	1900	296	13.48
30	1912	523.01	1960	304	13.43
Mean	**1884.53**	**530.94**	**2074.40**	**309.20**	**12.98**
SD	**46.07**	**13.11**	**77.77**	**13.98**	**0.48**

Table 177 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 2 (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	7.00	1.75	18	7	7
2	8.50	2.13	17	9	11
3	8.00	2.00	20	8	6
4	8.00	2.00	19	8	7
5	9.50	2.38	17	10	9
6	8.50	2.13	14	7	8
7	8.00	2.00	12	8	7
8	7.00	1.75	15	7	5
9	7.50	1.88	11	7	5
10	9.00	2.25	14	6	7
11	8.50	2.13	12	9	7
12	7.00	1.75	12	10	3
13	7.50	1.88	14	14	2
14	7.00	1.75	15	12	4
15	6.00	1.50	13	8	6
16	6.50	1.63	16	7	5
17	9.00	2.25	15	9	6
18	9.50	2.38	19	8	7
19	7.50	1.88	13	5	7
20	7.00	1.75	15	10	4
21	6.50	1.63	15	12	4
22	9.00	2.25	16	8	5
23	8.00	2.00	16	6	7
24	9.50	2.38	14	10	6
25	8.50	2.13	12	11	3
26	7.50	1.88	13	9	5
27	7.00	1.75	15	8	5
28	8.50	2.13	16	8	6
29	10.50	2.63	12	10	3
30	8.00	2.00	14	9	3
Mean	**7.98**	**2.00**	**14.80**	**8.67**	**5.67**
SD	**1.06**	**0.27**	**2.31**	**1.95**	**1.97**

Table 178 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 2 (Location Sisaket)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1912	523.01	2200	316	12.56
2	1864	536.48	2232	320	12.54
3	1884	530.78	2100	308	12.79
4	1836	544.66	2112	288	12.00
5	1920	520.83	2120	300	12.40
6	1892	528.54	2040	304	12.97
7	1908	524.10	2200	312	12.42
8	1824	548.24	2080	304	12.75
9	1796	556.79	2112	288	12.00
10	1812	551.87	2020	340	14.41
11	1868	535.33	2120	300	12.40
12	1932	517.59	2104	296	12.33
13	1936	516.52	2080	320	13.33
14	1972	507.09	2220	352	13.69
15	1920	520.83	2160	356	14.15
16	1904	525.21	2000	324	13.94
17	1916	521.92	2324	320	12.10
18	1920	520.83	2120	308	12.69
19	1932	517.59	2232	300	11.85
20	1912	523.01	2240	288	11.39
21	1888	529.66	2080	304	12.75
22	1824	548.24	2040	288	12.37
23	1796	556.79	2160	296	12.05
24	1812	551.87	2240	300	11.81
25	1972	507.09	2060	296	12.56
26	1976	506.07	2140	288	11.86
27	1936	516.52	2180	320	12.80
28	1896	527.42	2080	300	12.61
29	1824	548.24	2220	308	12.18
30	1796	556.79	2040	300	12.82
Mean	**1886.00**	**530.66**	**2135.20**	**308.13**	**12.62**
SD	**55.36**	**15.71**	**79.43**	**17.66**	**0.70**

Table 179 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 2 (Location Sisaket)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	8.50	2.13	15	9	4
2	8.00	2.00	14	10	6
3	7.00	1.75	15	11	5
4	7.50	1.88	13	7	6
5	9.00	2.25	12	9	7
6	8.50	2.13	13	8	5
7	7.00	1.75	14	8	7
8	8.00	2.00	17	10	3
9	8.50	2.13	14	7	2
10	8.00	2.00	16	8	6
11	9.00	2.25	15	13	4
12	9.00	2.25	13	10	5
13	7.50	1.88	15	9	7
14	8.00	2.00	18	9	6
15	8.00	2.00	16	10	3
16	8.00	2.00	15	11	5
17	9.50	2.38	15	9	3
18	7.50	1.88	18	8	5
19	7.50	1.88	14	8	5
20	7.50	1.88	18	6	7
21	9.00	2.25	17	10	5
22	9.50	2.38	18	7	6
23	9.50	2.38	19	8	7
24	8.50	2.13	15	7	5
25	9.00	2.25	14	7	7
26	6.50	1.63	15	6	11
27	7.50	1.88	17	8	6
28	8.00	2.00	17	6	7
29	9.00	2.25	14	10	7
30	9.50	2.38	14	11	6
Mean	**8.25**	**2.06**	**15.33**	**8.67**	**5.60**
SD	**0.83**	**0.21**	**1.81**	**1.71**	**1.73**

Table 180 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 3 (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1780	561.79	2000	168	7.75
2	1800	555.55	2160	188	8.01
3	1756	569.47	1808	164	8.32
4	1784	560.53	1880	144	7.11
5	1772	564.33	2080	164	7.31
6	1776	563.06	2152	172	7.40
7	1808	552.09	1960	140	6.67
8	1700	588.23	1992	192	8.79
9	1540	649.35	2040	164	7.44
10	1500	666.66	2008	176	8.06
11	1524	656.16	2216	192	7.97
12	1532	652.74	1860	184	9.00
13	1772	564.33	2216	216	8.88
14	1564	639.38	2260	152	6.30
15	1736	576.03	2248	212	8.62
16	1540	649.35	2452	228	8.51
17	1500	666.66	2068	196	8.66
18	1784	560.53	1836	156	7.83
19	1772	564.33	2560	280	9.86
20	1800	555.55	1860	168	8.28
21	1756	569.47	2560	264	9.35
22	1780	561.79	2464	208	7.78
23	1800	555.55	2140	156	6.79
24	1756	569.47	2240	224	9.09
25	1564	639.38	2360	184	7.23
26	1540	649.35	2348	188	7.41
27	1524	656.16	2300	168	6.81
28	1736	576.03	2412	196	7.52
29	1756	569.47	2408	180	6.96
30	1740	574.71	2700	192	6.64
Mean	**1689.73**	**594.58**	**2186.27**	**187.20**	**7.88**
SD	**115.59**	**42.59**	**238.74**	**32.20**	**0.90**

Table 181 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 3 (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	12.00	3.00	7	8	6
2	12.50	3.13	9	8	6
3	10.00	2.50	14	6	6
4	14.00	3.50	12	5	6
5	11.00	2.75	14	8	4
6	12.00	3.00	16	8	6
7	11.50	2.88	12	8	4
8	13.00	3.25	14	6	6
9	11.50	2.88	18	7	6
10	10.00	2.50	15	8	3
11	11.50	2.88	16	5	6
12	10.50	2.63	17	6	4
13	11.00	2.75	15	7	6
14	10.50	2.63	14	7	7
15	10.00	2.50	14	5	6
16	11.50	2.88	15	7	3
17	15.00	3.75	12	8	3
18	11.00	2.75	13	6	4
19	11.50	2.88	13	5	4
20	12.50	3.13	10	8	5
21	14.00	3.50	11	9	5
22	13.50	3.38	13	3	4
23	11.00	2.75	10	8	4
24	12.00	3.00	11	8	3
25	13.00	3.25	11	9	5
26	13.50	3.38	12	9	6
27	14.00	3.50	10	5	5
28	13.00	3.25	15	9	7
29	11.50	2.88	10	7	5
30	10.50	12.50	10	9	6
Mean	**11.95**	**3.32**	**12.77**	**7.07**	**5.03**
SD	**1.35**	**1.77**	**2.57**	**1.55**	**1.22**

Table 182 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 3 (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1700	588.23	2456	184	6.97
2	1540	649.35	2440	176	6.73
3	1612	620.34	2320	208	8.23
4	1772	564.33	2240	136	5.72
5	1776	563.06	2256	224	9.03
6	1700	588.23	2180	216	9.02
7	1540	649.35	2420	160	6.20
8	1772	564.33	2280	168	6.86
9	1564	639.38	2420	160	6.20
10	1736	576.03	2288	188	7.59
11	1520	657.89	2448	184	6.99
12	1600	625.00	2080	204	8.93
13	1560	641.02	2200	224	9.24
14	1680	595.23	2300	112	4.64
15	1704	586.85	2320	232	9.09
16	1552	644.32	2400	200	7.69
17	1736	576.03	2000	196	8.93
18	1652	605.32	1960	120	5.77
19	1396	716.33	2460	288	10.48
20	1644	608.27	2040	156	7.10
21	1612	620.34	2400	232	8.81
22	1688	592.41	2320	200	7.94
23	1708	585.48	2096	192	8.39
24	1664	600.96	2180	220	9.17
25	1720	581.39	2320	192	7.64
26	1780	561.79	2380	216	8.32
27	1800	555.55	2400	224	8.54
28	1688	592.41	2340	180	7.14
29	1792	558.03	2360	196	7.67
30	1800	555.55	2400	220	8.40
Mean	**1666.93**	**602.09**	**2290.13**	**193.60**	**7.78**
SD	**100.04**	**37.94**	**141.25**	**36.14**	**1.30**

Table 183 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 3 (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	11.50	2.88	15	5	6
2	10.50	2.63	19	6	6
3	11.00	2.75	17	7	6
4	10.50	2.63	20	7	4
5	10.00	2.50	19	5	6
6	14.00	3.50	20	8	6
7	13.00	3.25	18	9	4
8	12.50	3.13	19	5	6
9	13.00	3.25	15	9	7
10	14.00	3.50	14	8	5
11	13.50	3.38	14	9	3
12	13.00	3.25	12	5	3
13	10.50	2.63	17	9	4
14	11.00	2.75	18	7	4
15	11.00	2.75	18	5	5
16	16.00	4.00	18	6	6
17	11.50	2.88	16	7	4
18	12.50	3.13	18	7	6
19	15.00	3.75	15	5	7
20	13.00	3.25	18	7	6
21	11.50	2.88	15	8	4
22	10.50	2.63	19	6	3
23	11.00	2.75	12	5	3
24	10.50	2.63	14	8	4
25	10.00	2.50	10	8	4
26	11.50	2.88	13	8	5
27	14.00	3.50	13	9	6
28	13.00	3.25	15	9	7
29	11.50	2.88	18	6	6
30	10.50	2.63	18	7	7
Mean	**11.00**	**3.01**	**16.23**	**7.00**	**5.10**
SD	**1.57**	**0.39**	**2.65**	**1.46**	**1.32**

Table 184 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 3 (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1772	564.33	2520	204	7.49
2	1564	639.38	2248	160	6.64
3	1736	576.03	2288	168	6.84
4	1564	639.38	2228	160	6.70
5	1540	649.35	2172	200	8.43
6	1524	656.16	2216	168	7.05
7	1600	625.00	2380	180	7.03
8	1688	592.41	2236	196	8.06
9	1708	585.48	2400	200	7.69
10	1664	600.96	2260	208	8.43
11	1720	581.39	2400	172	6.69
12	1780	561.79	1912	188	8.95
13	1800	555.55	2184	236	9.75
14	1736	576.03	2272	140	5.80
15	1756	569.47	2040	220	9.73
16	1740	574.71	2152	236	9.88
17	1756	569.47	2080	208	9.09
18	1780	561.79	1700	188	9.96
19	1800	555.55	2480	288	10.40
20	1564	639.38	2000	144	6.72
21	1540	649.35	2200	280	11.29
22	1524	656.16	2200	196	8.18
23	1652	605.32	2080	180	7.96
24	1396	716.33	2520	228	8.30
25	1644	608.27	2300	212	8.44
26	1756	569.47	2392	232	8.84
27	1780	561.79	2280	232	9.24
28	1800	555.55	2380	244	9.30
29	1756	569.47	1912	184	8.78
30	1780	561.79	2200	232	9.54
Mean	**1680.67**	**597.57**	**2221.07**	**202.80**	**8.37**
SD	**109.02**	**41.14**	**185.95**	**35.78**	**1.32**

Table 185 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 3 (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	11.50	2.88	19	5	6
2	13.00	3.25	22	6	4
3	11.50	2.88	19	7	6
4	10.00	2.50	21	7	7
5	12.50	3.13	21	5	6
6	13.00	3.25	22	7	5
7	13.00	3.25	13	8	4
8	11.50	2.88	15	6	4
9	10.50	2.63	19	5	3
10	11.00	2.75	18	8	3
11	10.50	2.63	14	8	4
12	10.00	2.50	16	8	4
13	11.50	2.88	18	8	5
14	10.50	2.63	19	9	6
15	11.00	2.75	17	5	6
16	10.50	2.63	19	9	6
17	10.00	2.50	16	7	4
18	11.50	2.88	20	5	6
19	14.00	3.50	18	6	7
20	13.00	3.25	17	7	4
21	11.50	2.88	16	7	6
22	10.50	2.63	19	5	6
23	11.00	2.75	15	6	5
24	10.50	2.63	13	8	6
25	10.00	2.50	11	9	4
26	11.50	2.88	14	12	4
27	15.00	3.75	14	3	3
28	11.00	2.75	15	8	6
29	11.50	2.88	18	8	5
30	12.50	3.13	18	9	4
Mean	**11.50**	**2.88**	**17.20**	**7.03**	**4.97**
SD	**1.25**	**0.31**	**2.81**	**1.79**	**1.19**

Table 186 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 4 (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1376	726.74	1680	228	11.95
2	1384	722.54	1616	220	11.98
3	1312	762.19	1700	164	8.80
4	1308	764.52	1576	172	9.84
5	1372	728.86	1684	236	12.29
6	1412	708.21	1640	244	12.95
7	1360	735.29	1660	192	10.37
8	1372	728.86	1560	188	10.76
9	1332	750.75	1640	200	10.87
10	1312	762.19	1620	244	13.09
11	1336	748.50	1752	236	11.87
12	1392	718.39	1740	220	11.22
13	1400	714.28	1552	228	12.81
14	1376	726.74	1740	224	11.41
15	1300	769.23	1640	236	12.58
16	1380	724.63	1740	240	12.12
17	1400	714.28	1720	212	10.97
18	1332	750.75	1680	220	11.58
19	1316	759.87	1676	228	11.97
20	1364	733.13	1780	188	9.55
21	1380	724.63	1840	160	8.00
22	1356	737.46	1832	172	8.58
23	1400	714.28	1760	200	10.20
24	1344	744.04	1788	228	11.31
25	1380	724.63	1640	224	12.02
26	1364	733.13	1688	216	11.34
27	1348	741.83	1560	208	11.76
28	1336	748.50	1920	228	10.61
29	1312	762.19	1720	212	10.97
30	1324	755.28	1784	208	10.44
Mean	**1356.00**	**737.86**	**1697.60**	**212.53**	**11.14**
SD	**32.29**	**17.63**	**88.29**	**23.79**	**1.27**

Table 187 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 4 (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	10.50	2.63	32	8	3
2	12.50	3.13	36	5	2
3	11.50	2.88	26	3	4
4	12.50	3.13	28	4	2
5	11.00	2.75	34	4	3
6	10.50	2.63	33	5	2
7	15.50	3.88	35	4	2
8	16.00	4.00	28	4	4
9	15.50	3.88	31	7	3
10	17.00	4.25	32	4	4
11	14.00	3.50	25	7	1
12	11.00	2.75	32	4	4
13	17.00	4.25	34	3	5
14	18.00	4.50	31	4	5
15	14.50	3.63	29	8	5
16	18.50	4.63	32	3	2
17	15.50	3.88	30	3	3
18	11.00	2.75	34	3	3
19	10.50	2.63	34	4	4
20	12.00	3.00	31	4	2
21	11.50	2.88	28	5	2
22	13.00	3.25	32	6	4
23	13.50	3.38	32	5	3
24	14.00	3.50	30	6	2
25	13.00	3.25	32	6	2
26	13.50	3.38	27	5	3
27	16.50	4.13	26	4	3
28	16.00	4.00	32	4	1
29	13.50	3.38	34	7	2
30	13.00	3.25	28	6	2
Mean	**13.73**	**3.43**	**30.93**	**4.83**	**2.90**
SD	**2.36**	**0.59**	**2.89**	**1.49**	**1.12**

Table 188 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 4 (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1372	728.86	1732	216	11.09
2	1412	708.21	1600	240	13.04
3	1360	735.29	1660	224	11.89
4	1348	741.83	1640	232	12.39
5	1336	748.5	1692	256	13.14
6	1312	762.19	1600	236	12.85
7	1324	755.28	1752	228	11.52
8	1380	724.63	1640	224	12.02
9	1356	737.46	1660	220	11.70
10	1400	714.28	1720	212	10.97
11	1332	750.75	1740	196	10.12
12	1344	744.04	1800	220	10.89
13	1380	724.63	1580	204	11.43
14	1364	733.13	1560	188	10.76
15	1348	741.83	1680	172	9.29
16	1316	759.87	1760	232	11.65
17	1364	733.13	1740	208	10.68
18	1380	724.63	1652	200	10.80
19	1356	737.46	1840	232	11.20
20	1400	714.28	1760	204	10.39
21	1400	714.28	1828	244	11.78
22	1352	739.64	1900	200	9.52
23	1380	724.63	1620	216	11.76
24	1356	737.46	1640	220	11.83
25	1368	730.99	1660	228	12.08
26	1280	781.25	1900	176	8.48
27	1316	759.87	1860	216	10.40
28	1360	735.29	1952	208	9.63
29	1344	744.04	1900	232	10.88
30	1356	737.46	1912	268	12.29
Mean	**1356.53**	**737.51**	**1732.67**	**218.40**	**11.22**
SD	**29.45**	**16.15**	**111.62**	**21.21**	**1.11**

Table 189 Palisade ratio, trichome number, vein termination number, vein islets number of *J. Jasminum* spp. 4 (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	16.00	4.00	31	7	3
2	13.00	3.25	40	5	4
3	13.50	3.38	33	4	3
4	13.50	3.38	36	4	2
5	14.50	3.63	32	5	2
6	15.00	3.75	34	4	2
7	13.00	3.25	30	5	2
8	14.50	3.63	31	4	3
9	12.00	3.00	30	4	1
10	15.00	3.75	37	4	1
11	17.00	4.25	30	6	2
12	16.00	4.00	35	4	3
13	15.00	3.75	33	7	3
14	19.00	4.75	37	6	2
15	15.50	3.88	32	6	2
16	16.50	4.13	35	3	4
17	15.00	3.75	33	9	1
18	14.00	3.50	36	7	5
19	13.50	3.38	35	5	3
20	11.50	2.88	32	5	2
21	12.00	3.00	29	4	3
22	14.00	3.50	28	5	3
23	15.00	3.75	30	3	3
24	13.50	3.38	32	5	3
25	16.00	4.00	40	7	2
26	13.50	3.38	34	3	2
27	14.50	3.63	36	3	3
28	13.50	3.38	40	7	3
29	14.00	3.50	35	3	2
30	14.00	3.50	29	6	3
Mean	**14.43**	**3.61**	**33.50**	**5.00**	**2.57**
SD	**1.58**	**0.39**	**3.33**	**1.53**	**0.90**

Table 190 Epidermal number, epidermal cell area, stomatal number and stomatal index of *Jasminum* spp. 4 (Location Nakornratchasima)

Position	upper epidermal cell no. per mm^2	epidermal cell area (μm^2)	Number of epidermal cell per mm^2	Number of stomata mm^2	Stomata index mm^2
1	1316	759.87	1708	240	12.32
2	1360	735.29	1840	204	9.98
3	1344	744.04	1680	216	11.39
4	1356	737.46	1748	228	11.54
5	1316	759.87	1880	160	7.84
6	1364	733.13	1920	120	5.88
7	1380	724.63	1720	180	9.47
8	1356	737.46	1668	216	11.46
9	1400	714.28	1700	236	12.19
10	1344	744.04	1920	216	10.11
11	1380	724.63	1760	200	10.20
12	1364	733.13	1760	228	11.47
13	1348	741.83	1780	220	11.00
14	1336	748.50	1576	192	10.86
15	1312	762.19	1720	204	10.60
16	1324	755.28	1692	160	8.64
17	1400	714.28	1700	220	11.46
18	1352	739.64	1600	236	12.85
19	1380	724.63	1648	240	12.71
20	1356	737.46	1692	240	12.42
21	1368	730.99	1660	248	13.00
22	1380	724.63	1788	224	11.13
23	1356	737.46	1700	228	11.83
24	1400	714.28	1720	224	11.52
25	1332	750.75	1540	232	13.09
26	1344	744.04	1680	220	11.58
27	1352	739.64	1460	200	12.05
28	1380	724.63	1732	232	11.81
29	1356	737.46	1680	208	11.02
30	1368	730.99	1620	212	11.57
Mean	**1357.47**	**736.88**	**1709.73**	**212.80**	**11.10**
SD	**24.01**	**13.05**	**100.61**	**27.92**	**1.56**

Table 191 Palisade ratio, trichome number, vein termination number, vein islets number of *Jasminum* spp. 4 (Location Nakornratchasima)

Position	Palisade	Palisade Ratio	Trichome	Vein terminal	Vein islets
			number (mm^2)	number (mm^2)	number (mm^2)
1	14.50	3.63	28	4	2
2	15.00	3.75	32	4	2
3	13.50	3.38	30	7	4
4	12.00	3.00	30	4	1
5	13.00	3.25	33	5	3
6	12.50	3.13	31	4	3
7	14.50	3.63	28	5	2
8	15.00	3.75	29	3	2
9	11.50	2.88	32	6	2
10	13.50	3.38	35	6	3
11	15.00	3.75	33	5	3
12	14.50	3.63	33	4	5
13	12.50	3.13	35	6	1
14	14.00	3.50	27	6	2
15	13.50	3.38	35	5	2
16	15.00	3.75	38	7	2
17	15.00	3.75	34	3	2
18	14.50	3.63	33	8	4
19	15.00	3.75	30	7	3
20	12.00	3.00	28	3	2
21	12.50	3.13	29	5	2
22	14.50	3.63	33	4	3
23	13.50	3.38	28	4	3
24	14.00	3.50	34	7	3
25	15.00	3.75	30	9	2
26	14.00	3.50	28	4	2
27	14.50	3.63	27	5	4
28	17.00	4.25	34	4	3
29	12.50	3.13	32	3	3
30	15.00	3.75	30	5	3
Mean	**13.95**	**3.49**	**31.30**	**5.07**	**2.60**
SD	**1.23**	**0.31**	**2.84**	**1.55**	**0.89**

VITA

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Publication

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Poster presentation

Phithaksilp, J., Ruangrungsri, N., and Rungsihirunrat, K.2014. Random Amplified Polymorphic DNA analysis of Jasminum sambac (L.) Aiton in Thailand. The 39th Congress on Science and Technology of Thailand (STT 39), October, 21-23, 2013, Bangkok, Thailand.