REFERENCES

1. Molisch, H. *Der Einfluss einer Pflanze auf die audere-Allelopathie*, Fischer: Jena, **1937**.
2. Rice, E.L. *Allelopathy*, Acdemic Press: New York, **1974**, 353.
3. Rice, E.L. "Some roles of allelopathic compounds in plant communities", *Biochem. System. Ecol.*, **1977**, *5*, 201.
4. Lee, I.K., Monsi, M. "Ecological studies on *Pinus densiflora* I. Effects of plant substances on the composition of the undergrowth", *Bot. Mag. Tokyo*, **1963**, *76*, 400.
5. Bonner, J. Galston, A.W. "Toxic substances from the culture media of guayule which may inhibit growth", *Bot. Gaz.*, **1944**, *106*,185.
6. Bonner, J. "Further investigation of toxic substances which arise from guayule plant. Relation of toxic substances to the growth of guayule in soil", *Bot. Gaz.*, **1946**, *107*, 343.
7. Bode, H.R. "Leaf excretions of wormwood (*Artemisia absinthium* L.) and their effect upon other plants", *Planta*, **1940**, *30*, 567.
8. Guenzi, W.D., McCalla, T.M. "Phenolic acids in oats, wheat, sorghum and corn residues and their phytotoxicity", *Agron. J.*, **1966**, *58*, 303.
9. Patterson, D.T. "Effects of allelopathic chemicals on growth and physiology responses of soybean", *Weed Science*, **1981**, *29*, 53.
10. Robinson, T. *The Organic Constituents of Higher Plants*, Burgess. Minneapolis, Minnesota, **1963**, 8.
11. Whittaker, R.H.; Feeny, P.P. "Allelochemics: Chemical interactions between species", *Science*, **1971**, *171*, 757.
12. Sajise, P.E.; Lalse, J.S. "Allelopathy in mixture of Cogon (*Imperata* cylindrica) and *Stylosanthes guyanenis*", *Weed Abstract*, **1976**, *25*, 326.
13. Chou, C.H. *Allelopathy*, American Chemical Society, Washington, DC, **1985**, 211.
14. Koul, O. In *Allelopathy: Basic and Applied Aspects*, Rizvi, S.J.H.; Rizvi, V.; Eds.; Chapman and Hall: London, **1992**, 389.

15. Chou, C.H.; Kuo, Y.L. "Allelopathic research of subtropical vegetation in Taiwan. III. Allelopathic exclusion of understory by *Leucaena leucocephala* (Lam.)", *J. Chem. Ecol.*, **1986**, *12*, 1431.

16. Chou, C.H. *Allelochemicals: Role in Agriculture and Forestry*, American Chemical Society, Washington, DC, **1987**,102.

17. Li, H.H.; Inoue, M.; Nishimura, H.; Mizutani, J.; Tsuzuki, E. "Interaction of *trans*- cinnamic acid, its related phenolic allelochemicals, and abscisic-acid in seedling growth and seed germination of lettuce", *J. Chem. Ecol.*, **1993**, *19*, 1775.

18. Frankenthal, P.P.; Wachenheim, K.E.; Speyer, L.R.; Ludwigshafen, B.S.; Speyer, K.W.; Otterstandt, B.W. "5-(N-3,4,5,6-Tetrahydrophthalimido)-cinnamic acid derivatives": U.S. Pat. 5,009,701 Apr. 23,1991.

19. Speyer, .R.; Wachenheim, K.E.; Speyer, K.W.; Otterstandt, B.W. "Cinnamic esters": U.S. Pat.5,296,451 Mar. 22, 1994.

20. Speyer, L.R.; Wachenheim, K.E.; Speyer, K.W.; Otterstandt, B.W. "3-(3,4,5,6-Tetrahydrophthalimido)-cinnamic esters": U.S. Pat. 5,296,452 Mar. 22,1994.

21. Bachmann, W.E.; Fieser, L.F.; Johnson, J.R.; Synder, H.R. *Organic Reaction*, John Wiley & Sons, Inc., New York, **1954**, 210-265.

22. Kittipong, P. *Giant Mimosa and Control*, Funny Publishing, Bangkok, **2530**, 1.

23. Chinawong, S. *Principle of Control and Practical Weeds*, Department of Paddy-field, Faculty of Agricultural, Kasetsart Universiry, **2539**, 1.

24. Smith, R.J. Jr.; Shaw, W.C. *Weeds and Their Control in Rice Production*, Agriculture Handbook No. 292, USDA, Washington, **1968**, 68.

25. Holm, L.G.; Herberger, J. *Weeds of Tropical Crops*, Proceedings. 10th British Weed Control Conference, **1970**, 1132.

26. Whitson, T.D. *Weeds of the West*, Pioneer of Jackson Hole, Jackson, Wyoming, **1996**, 408.

27. Chisaka, C. *Weed Damage to Crop, Yield Loss Due Weed Competition*, Integrated Control of Weeds. University of Tokyo Press, Tokyo, **1970**, 1.

28. Robert, L.G. *Economic Returns to Investment in Control of Mimosa pigra in Thailand*, Internation Plant Protection Center, Oregon State University, Corvallis, Oregon U.S.A.

29. Wongsaroj, P. *Document of Weed Management in Rice Field*, Media Press Publishing, Bangkok, **2540**, 1.

30. Tietze, L.; Eicher, T. *Reaction and syntheses in the organic chemistry laboratory*, University Science Books Mill Valley, California, **1989**, 110.

31. *Dictionary of organic compounds*, 4th ed., Completely Revised, Enlarge and Re-set Edition in Five Volumes: Eyre & Spottiswoode, Publisher Ltd. E. & F. N. SPON Ltd.

32. Bergmann, E.D.; Berkovic, S.; Ikan, R. "A new method for the preparation of aromatic fluorine compounds", *J. Am. Chem. Soc.*, **1956**, *78*, 6037.

33. Pouchert C.J. *The Aldrich Library of Infrared Sprctra*, 2nd ed.

34. Pouchert C.J.; Campbell J.R. *The Aldrich Library of NMR Spectra*, Volume VI.

35. Weast, R.C. *CRC Handbook of chemistry and physics*, 1st Student ed., CRC Press, Inc., Boca Raton, Floria.

36. Pierce, J.S.; Gano, R.D.; Lukeman J.M. "Local anesthetics III. Aroyl derivatives of β-methyl-β-monoalkylamino propanols", *J. Am. Chem. Soc.*, **1948**, *70*, 255.

37. Bennet, G.M.; Jones, B. "Mesomorpism and polymorphism of some *p*-alkoxybenzoic and *p*-alkoxycinnamic acids", *J. Chem. Soc.*, **1929**, 420.

38. Joshi, B.S.; Viswanathan, N.; Balakrishan, V.; Gawad, D.H.; Ravindranath, K.R. "Attenoul-structure, stereochemistry and synthesis", *Tetrahedron*, **1979**, *35*, 1665.

39. Orr, G.F.; Musso, D.L.; Kelley, L.J.; Joyney, S.S.; Davis, S.T.; Baccanar, D.P. "Inhibition of uridine phosphorylase. synthesis and structure-activity relationships of aryl-substitute 1-((2-hydroxyethoxy)methyl)-5-(3-phenoxybenzyl)uracil", *J. Med. Chem.*, **1997**, *40*(8), 1179.

40. Moore, M.B.; Wright, H.B.; Vernsten, M.; Freifelder, M; Richards, R.K. "Local anesthetics. IV. The synthesis of local anesthetic 3,4-dihydroisoquinolines", *J. Am. Chem. Soc.*, **1954**, *76*, 3656.

41. Pearl, I.A.; Beyer, D.L. "Reactions of vanillin and its compounds. XI. Cinnamic acids derivatived from vanillin and its related compounds", *J. Org. Chem.*, **1951**, *16*, 216.

42. Koelsch, C.F.; Stephens, C.R. "The internal michael reaction. II. Formation of arylated coumarans, of an indoline, a dihydrothionaphlene and a hydrocarbostyril", *J. Am. Chem. Soc.*, **1950**, *72*, 2209.

43. Wittstruck, T.A.; Trachtenberg, E.N. "A nuclear magnetic resonance study of transmission of electronic effects. Ethylbenzenes, dihydrocinnamic acids, and *cis*- and *trans*-cinnamic acids", *J. Am. Chem. Soc.*, **1967**, *89*, 3803.

44. Robinson, C.N.; Li, P.K.; Addison, J.F. "Reduction and hydrolysis of triethyl α-phosphonicinnamate and its derivatives", *J. Org. Chem.*, **1972**, *37*(19), 2039.

45. Davis, C.H.; Carmark, M. "The Willgerodt reaction V. Substituted acetamides from β-substituted acrylic acids", *J. Org. Chem.*, **1947**, *12*, 76.

46. Johnston, K. "Friedel-Crafts cyclizations-I the influence of nuclear substituents on the polyphosphoric acid-catalysed isomerization of cinnamanilide to 4-phenyl-3,4-dihydrocarbostyril", *Tetrahedron*, **1968**, *24*, 5595.

47. Ahluwalia, G.S.; Haq, M.A.; Ray, J.N. "The condensation of aromatic aldehydes with malonanilic acid and its derivatives", *J. Chem. Soc.*, **1931**, 2059.

48. Shizuoko, T.Y.; Takematsu, T.; Konnai, M. " Phenoxyacetic acid derivatives and plant growth regulating agents containing them as active ingredients": U.S. Pat. 5,235,092 Aug. 10,1993.

49. Harada, J.; Yano, M. *Proceedings of The Ninth Asian-Pacific Weed Science Society Conference*, The nation Science and Technology Authority and Philippine Tobacco Research and Training Center, **1983**, 71.

50. Camper, N.D. *Research Methods in Weed Science*, 3rd ed., Southern Weed Science Society, **1986**, 48.

51. Tadashi, M. *Weeds in The Tropics*, Association for International Cooperation of Agriculture & Forestry, Japan, **1997**, 21.

APPENDICES

Appendices A

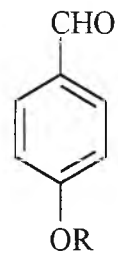
A.1 Synthesis of Starting Materials

A.1.1 Synthesis of 4-Alkoxybenzaldehyde

General Procedure[30]

A mixture of 4-hydroxybenzaldehyde (0.05 mol), interested alkyl chloride (0.05 mol), potassium carbonate (0.025 mol) and 40 mL of ethanol was stirred and refluxed for 4-5 hours. The mixture was cooled to RT, KCl was removed by filtration and washed with ethanol, and the filtrate was evaporated in vacuum. The residual yellow solid was triturated with 30 mL of 0.5 M sodium hydroxide for 30 min, collected by filtration, washed with H_2O until neutral, and recrystallized from ethanol to give the desired compound.

Five 4-alkoxybenzaldehydes were synthesized and their structure are displayed as shown below:



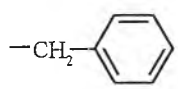
Cpds	Substance	R
R1	4-Butyloxybenzaldehyde	$-(CH_2)_3CH_3$
R2	4-Hexyloxybenzaldehyde	$-(CH_2)_5CH_3$
R3	4-Octyloxybenzaldehyde	$-(CH_2)_7CH_3$
R4	4-Dodecyloxybenzaldehyde	$-(CH_2)_{11}CH_3$
R5	4-Benzyloxybenzaldehyde	

Fig A.1 Structures of synthesized 4-alkoxybenzaldehydes

4-Alkoxybenzaldehyde

4-Butyloxybenzaldehyde (**R1**): yellow liquid (64%), R_f 0.53 (dichloromethane); ^{1}H-NMR ($CDCl_3$) δ (ppm): 9.72 (*s*, -C**H**O), 7.66 (*d*, *J* = 8.92 Hz, 2H), 6.83 (*d*, *J* = 8.76 Hz, 2H), 3.87 (*t*, *J* = 6.45 Hz, 2H), 1.26-1.71 (*m*, br, 4H) and 0.84 (*t*, *J* = 7.23 Hz, 3H); ^{13}C-NMR ($CDCl_3$) δ (ppm): 190.5 (-**C**HO), 164.1, 131.8 (2x1C), 129.7 and 114.6 (2x1C) (aromatic carbons), 68.0, 31.0, 19.1 and 13.7.

4-Hexyloxybenzaldehyde (**R2**): yellow liquid (72%), R_f 0.85 (dichloromethane); ^{1}H-NMR ($CDCl_3$) δ (ppm): 9.82 (*s*, -C**H**O), 7.77 (*d*, *J* = 8.93 Hz, 2H), 6.94 (*d*, *J* = 8.77 Hz, 2H), 3.98 (*t*, *J* = 6.51 Hz, 2H), 1.25-1.83 (*m*, br, 8H) and 0.86 (*t*, *J* = 6.87 Hz, 3H); ^{13}C-NMR ($CDCl_3$) δ (ppm): 190.7 (-**C**HO), 164.3, 131.9 (2x1C), 129.7 and 114.7 (2x1C) (aromatic carbons), 68.4, 31.5, 29.0, 25.6, 22.5 and 14.0.

4-Otyloxybenzaldehyde (**R3**): yellow liquid (68%), R_f 0.54 (dichloromethane); ^{1}H-NMR ($CDCl_3$) δ (ppm): 9.77 (*s*, -C**H**O), 7.72 (*d*, *J* = 8.83 Hz, 2H), 6.89 (*d*, *J* = 8.64 Hz, 2H), 3.93 (*t*, *J* = 6.44 Hz, 2H), 1.11-1.79 (*m*, br, 12H) and 0.77-0.84 (br, 3H); ^{13}C-NMR ($CDCl_3$) δ (ppm): 190.5 (-**C**HO), 164.2, 131.8 (2x1C), 129.7 and 114.7 (2x1C) (aromatic carbons), 68.3, 31.7, 29.4, 29.2, 28.1, 25.9, 22.6 and 14.0.

4-Dodecyloxybenzaldehyde (**R4**): yellow liquid (54%), R_f 0.69 (dichloromethane); ^{1}H-NMR ($CDCl_3$) δ (ppm): 9.80 (*s*, -C**H**O), 7.75 (*d*, *J* = 8.88 Hz, 2H), 6.90 (*d*, *J* = 8.73 Hz, 2H), 3.97 (*t*, *J* = 6.47 Hz, 2H), 1.14-3.37 (*m*, br, 20H) and 0.80-0.86 (br, 3H); ^{13}C-NMR ($CDCl_3$) δ (ppm): 190.5 (-**C**HO), 164.2, 131.9 (2x1C), 129.7 and 114.7 (2x1C) (aromatic carbons), 68.3, 31.9, 29.6, 29.6, 29.5, 29.4, 29.3, 29.0, 28.2, 25.9, 22.7 and 14.1.

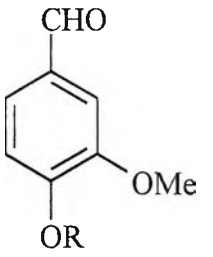
4-Benzyloxybenzaldehyde (**R5**): pale yellow crystal (58%), m.p. 70-72°C (ethanol), R_f 0.63 (dichloromethane); ^{1}H-NMR ($CDCl_3$) δ (ppm): 9.80 (*s*, -C**H**O), 7.66 (*d*, *J* = 8.90 Hz, 2H), 7.33-7.62 (Ar-H, 5H), 7.04 (*d*, *J* = 8.77 Hz, 2H) and 5.15 (s, -OC**H**$_2$-, 2H); ^{13}C-NMR ($CDCl_3$) δ (ppm): 190.0 (-**C**HO), 167.8, 140.9, 130.7 (2x1C), 129.0, 128.7 (2x1C), 127.4, 127.3 (2x1C) and 114.6 (2x1C) (aromatic carbons) and 77.8 (-O**C**H$_2$-).

A.1.2 Synthesis of 4-Alkoxy-3-methoxybenzaldehyde

General Procedure[30]

A mixture of 4-hydroxy-3-methoxybenzaldehyde (0.05 mol), interested alkyl chloride (0.05 mol), potassium carbonate (0.025 mol) and 40 mL of ethanol was stirred and refluxed for 4-5 hours. The mixture was cooled to RT, KCl was removed by filtration and washed with ethanol, and the filtrate was evaporated in vacuum. The residual yellow solid was triturated with 30 ml of 0.5 M sodium hydroxide for 30 min, collected by filtration, washed with H_2O until neutral, and recrystallized from ethanol to give the desired compound.

Five 4-alkoxy-3-methoxybenzaldehydes were synthesized and their structures are displayed as shown below:



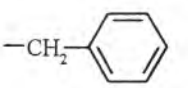
Cpds	Substance	R
R6	4-Butyloxy-3-methoxybenzaldehyde	$-(CH_2)_3CH_3$
R7	4-Hexyloxy-3-methoxybenzaldehyde	$-(CH_2)_5CH_3$
R8	4-Octyloxy-3-methoxybenzaldehyde	$-(CH_2)_7CH_3$
R9	4-Dodecyloxy-3-methoxybenzaldehyde	$-(CH_2)_{11}CH_3$
R10	4-Benzyloxy-3-methoxybenzaldehyde	

Fig A.2 Structures of synthesized 4-alkoxy-3-methoybenzaldehydes

4-Alkoxy-3-methoxybenzaldehyde

4-Butyloxy-3-methoxxybenzaldehyde (**R6**): yellow liquid (67%), R_f 0.56 (hexane-ethyl acetate); ^{1}H-NMR ($CDCl_3$) δ (ppm): 9.72 (*s*, -C**H**O), 7.28-7.34 (Ar-H, 2H), 6.85 (*d*, *J* = 7.93 Hz, 1H), 3.98 (*t*, *J* = 6.68 Hz, 2H), 3.80 (*s*, -OC**H**$_3$, 3H), 1.34-1.79 (*m*, br, 4H) and 0.88 (*t*, *J* = 7.28 Hz, 3H); ^{13}C-NMR ($CDCl_3$) δ (ppm): 190.9 (-**C**HO), 154.2, 149.8, 129.9, 126.8, 111.4, 109.3 (aromatic carbons), 68.8, 56.0 (-O**C**H$_3$), 31.0, 19.2 and 13.8.

4-Hexyloxy-3-methoxxybenzaldehyde (**R7**): yellow liquid (61%), R_f 0.51 (dichloromethane); ^{1}H-NMR ($CDCl_3$) δ (ppm): 9.77 (*s*, -C**H**O), 7.34-7.39 (Ar-H, 2H), 6.90 (*d*, *J* = 7.91 Hz, 1H), 4.02 (*t*, *J* = 6.01 Hz, 2H), 3.85 (*s*, -OC**H**$_3$, 3H), 1.25-1.88 (*m*, br, 8H) and 0.80-0.87 (br, 3H); ^{13}C-NMR ($CDCl_3$) δ (ppm): 190.8 (-**C**HO), 154.2, 149.8, 129.8, 126.7, 111.3, 109.2 (aromatic carbons), 69.1, 56.0 (-O**C**H$_3$), 31.5, 28.9, 25.5, 22.5 and 14.0.

4-Octyloxy-3-methoxxybenzaldehyde (**R8**): yellow liquid (92%), R_f 0.60 (hexane-ethyl acetate); ^{1}H-NMR ($CDCl_3$) δ (ppm): 9.75 (*s*, -C**H**O), 7.31-7.37 (Ar-H, 2H), 6.88 (*d*, *J* = 7.89 Hz, 1H), 4.00 (*t*, *J* = 6.80 Hz, 2H), 3.83 (*s*, -OC**H**$_3$, 3H), 1.11-1.83 (*m*, br, 12H) and 0.77-0.83 (br, 3H); ^{13}C-NMR ($CDCl_3$) δ (ppm): 190.7 (-**C**HO), 154.1, 149.8, 129.8, 126.7, 111.3, 109.2 (aromatic carbons), 69.1, 55.9 (-O**C**H$_3$), 31.7, 29.3, 29.1, 12.9, 25.9, 22.6 and 14.1.

4-Dodecyloxy-3-methoxxybenzaldehyde (**R9**): yellow liquid (92%), R_f 0.51 (dichloromethane); ^{1}H-NMR ($CDCl_3$) δ (ppm): 9.81 (*s*, -C**H**O), 7.37-7.43 (Ar-H, 2H), 6.93 (*d*, *J* = 7.90 Hz, 1H), 4.06 (*t*, *J* = 6.80 Hz, 2H), 3.89 (*s*, -OC**H**$_3$, 3H), 1.17-1.89 (*m*, br, 20H) and 0.81-0.88 (br, 3H); ^{13}C-NMR ($CDCl_3$) δ (ppm): 190.9 (-**C**HO), 154.2, 149.8, 129.8, 126.8, 111.3, 109.2 (aromatic carbons), 69.2, 56.0 (-O**C**H$_3$), 34.0, 32.8, 31.9, 29.6, 29.3, 28.9, 28.8, 28.2, 25.9, 22.7 and 14.1.

4-Benzyloxy-3-methoxybenzaldehyde (**R10**): white needle crystal (69%), m.p. 60-62°C (ethanol), R_f 0.60 (dichloromethane); ^{1}H-NMR ($CDCl_3$) δ (ppm): 9.80 (*s*, -C**H**O), 7.24-7.44 (Ar-H, 7H), 6.96 (*d*, *J* = 8.12 Hz, 2H), 5.21 (s, -OC**H**$_2$-, 2H) and 3.91 (*s*, -OC**H**$_3$, 3H); ^{13}C-NMR ($CDCl_3$) δ (ppm): 190.9 (-**C**HO), 153.6, 150.1, 136.0, 130.3, 128.7 (2x1C), 128.2, 127.3 (2x1C), 126.6, 112.4 and 109.4 (aromatic carbons), 70.8 (-O**C**H$_2$-) and 56.0 (-O**C**H$_3$)

Appendices B

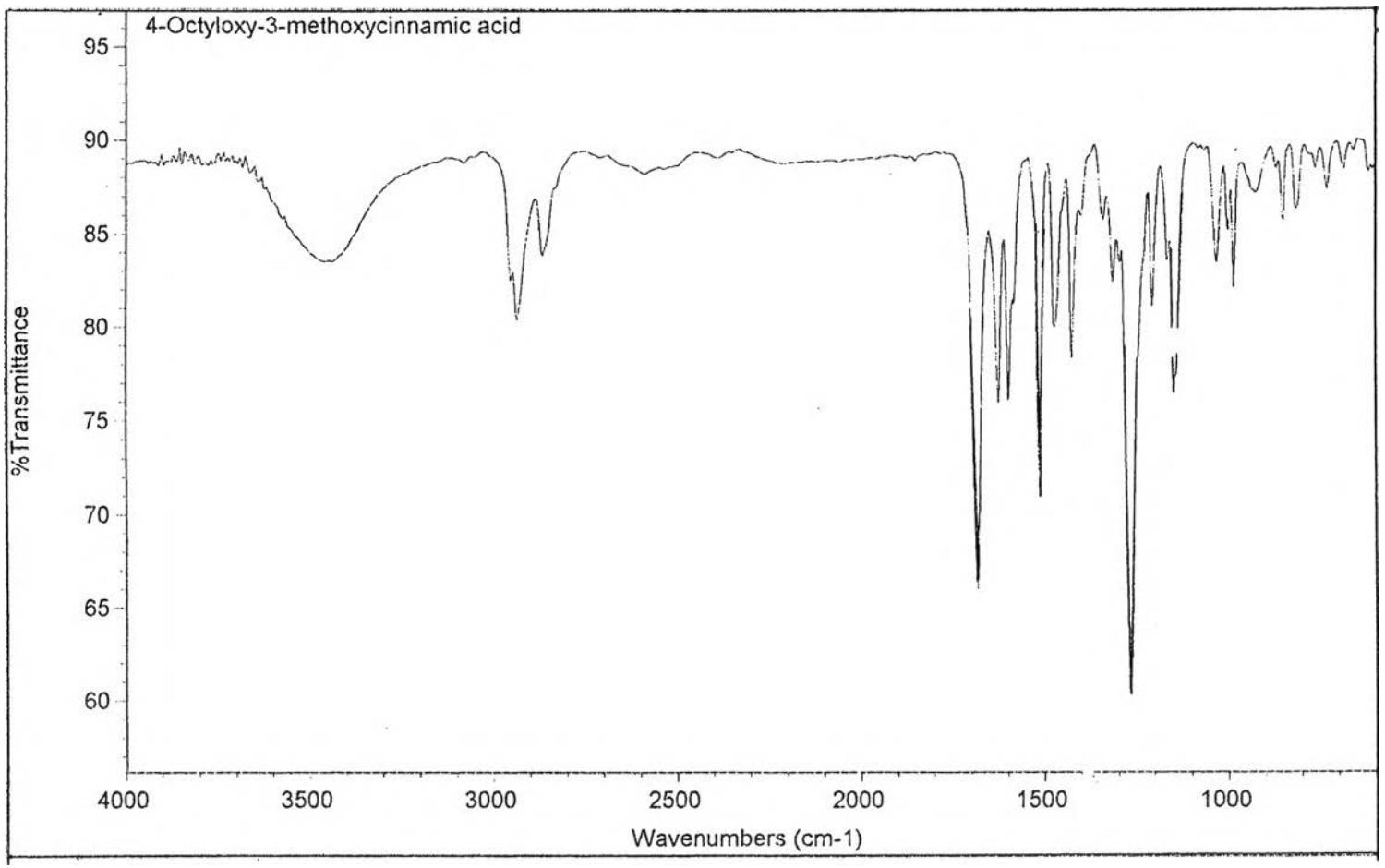


Fig B.1 The FT-IR spectrum of **C24**

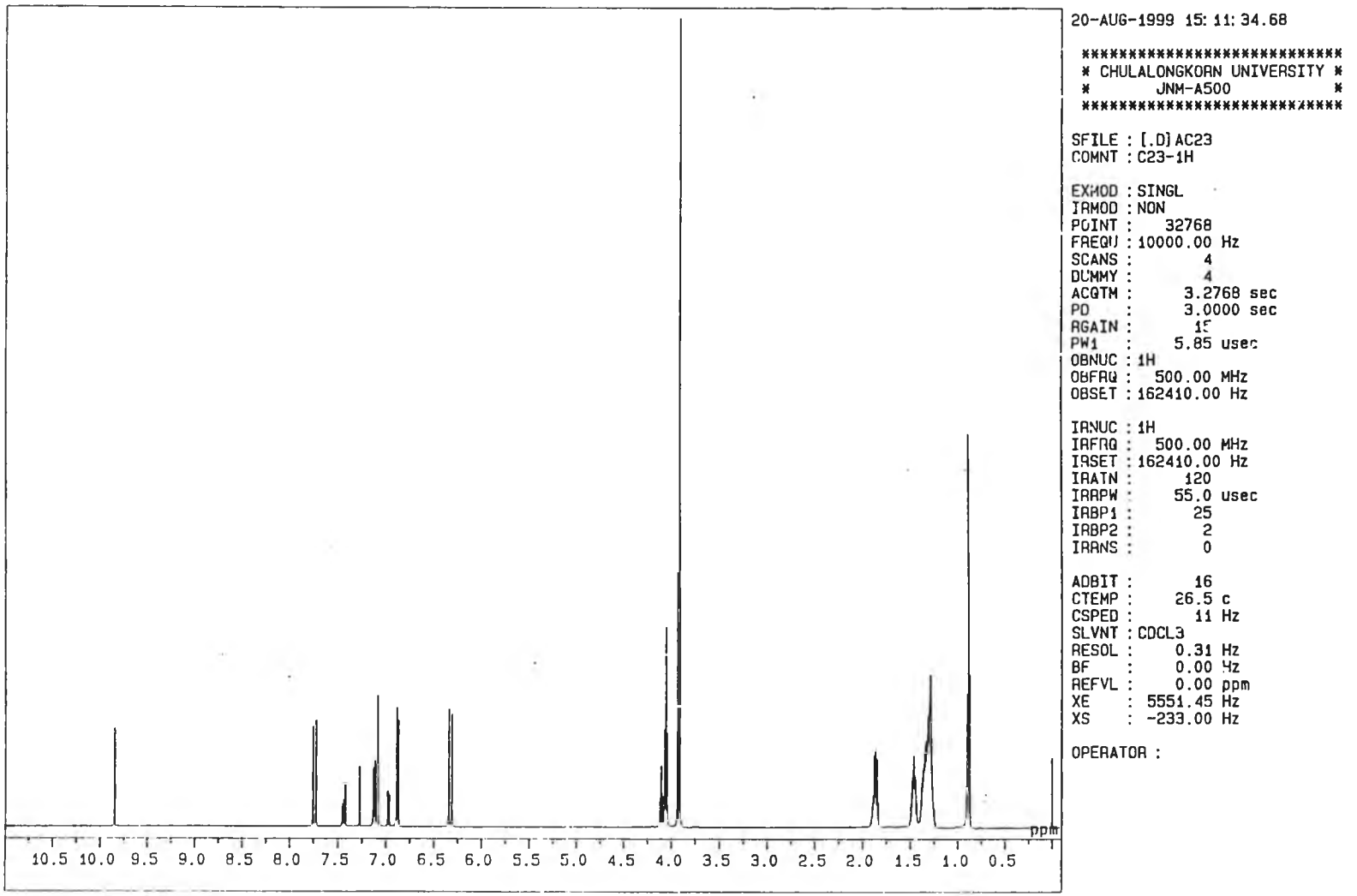


Fig B.2 The ^{1}H-NMR spectrum of **C24**

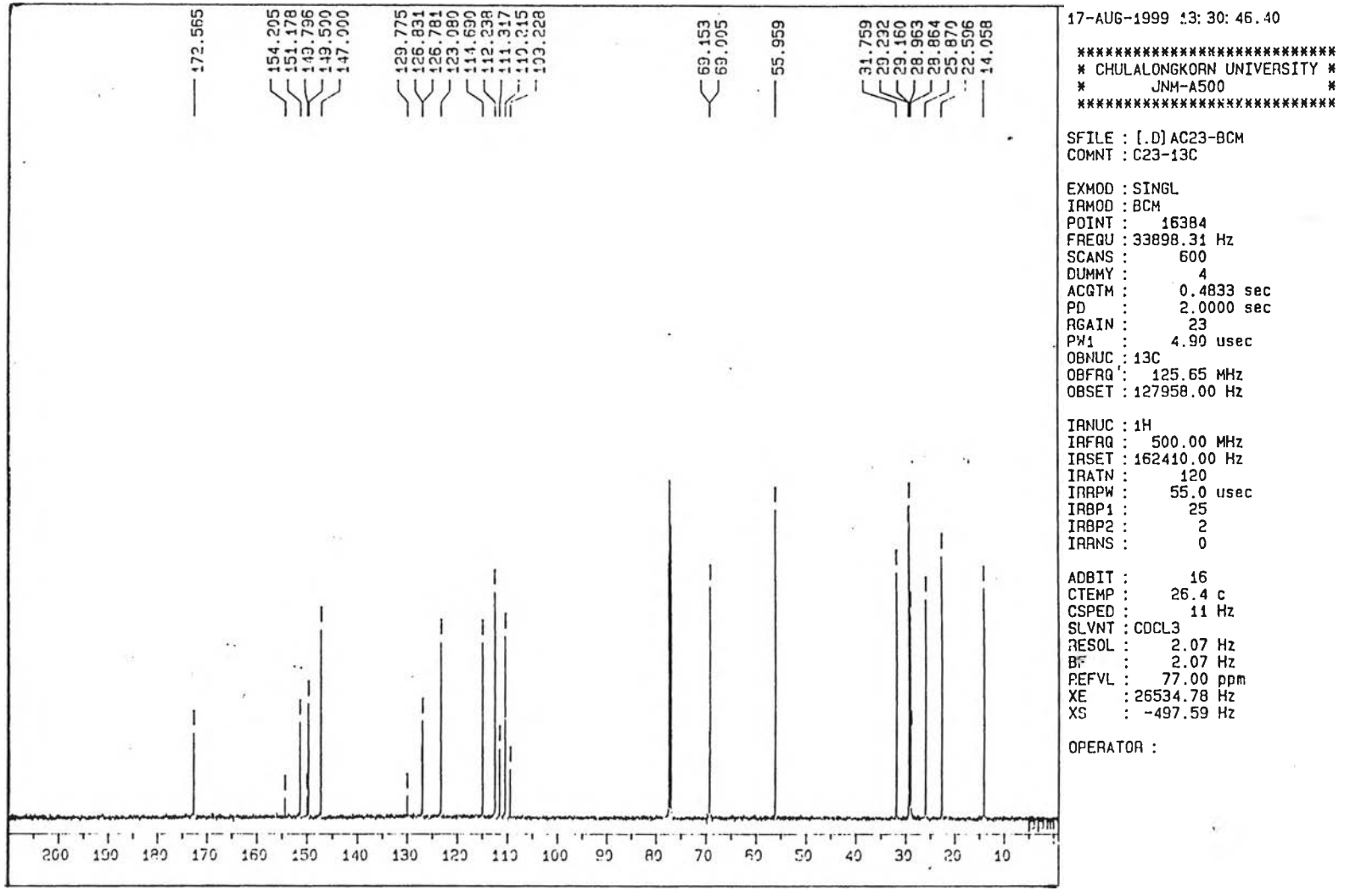


Fig B.3 The ^{13}C-NMR spectrum of **C24**

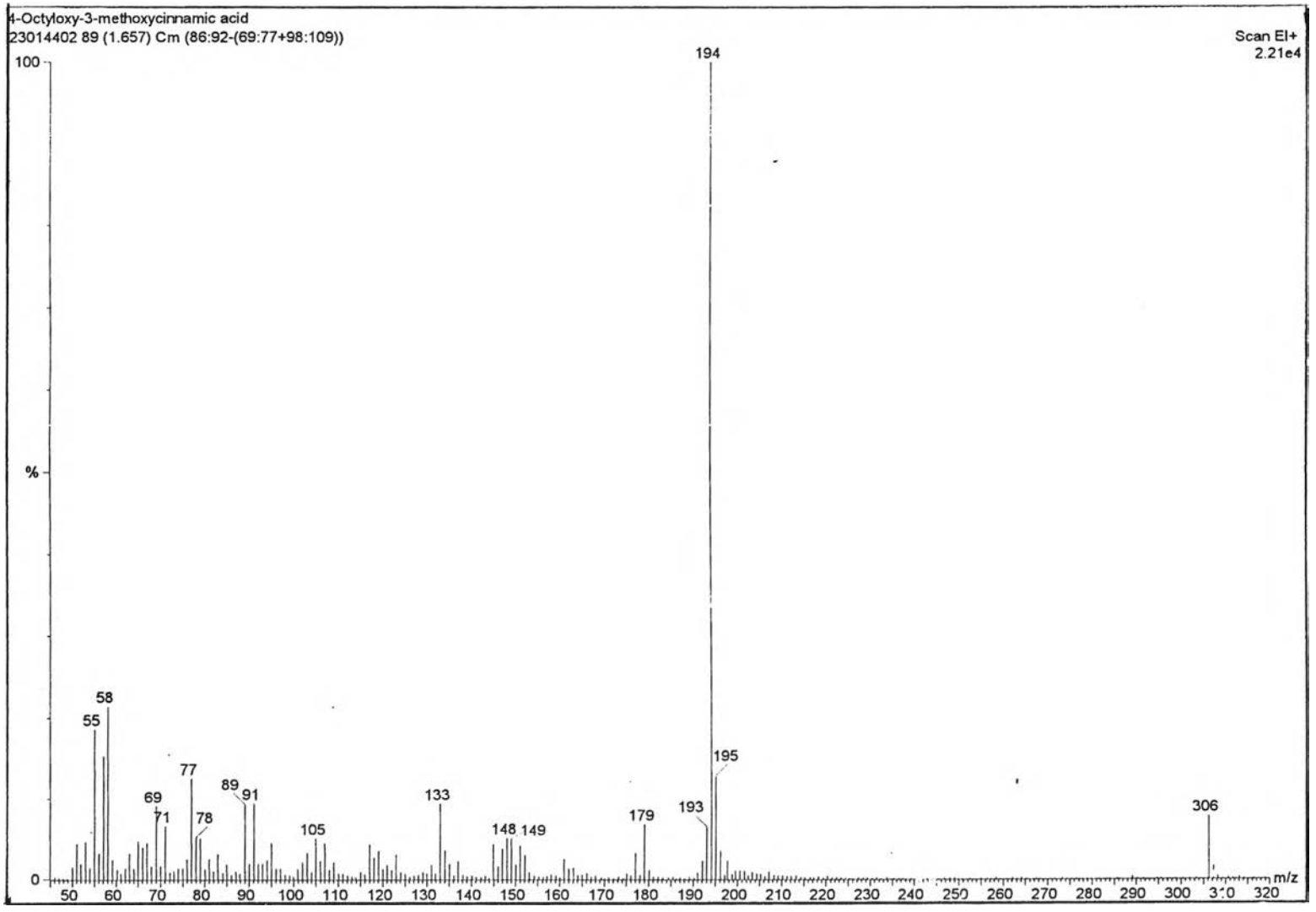


Fig B.4 The mass spectrum of **C24**

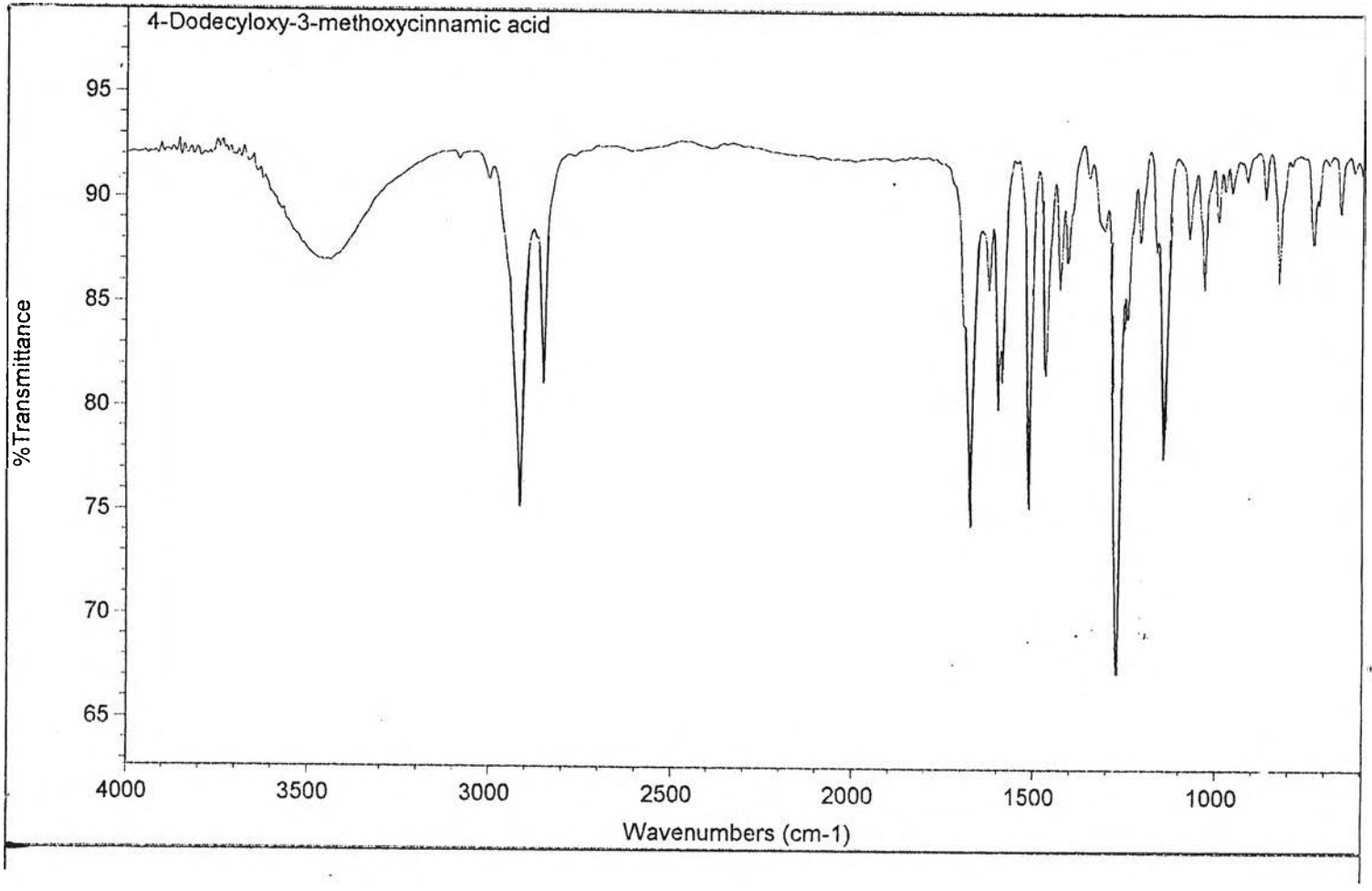


Fig B.5 The FT-IR spectrum of **C25**

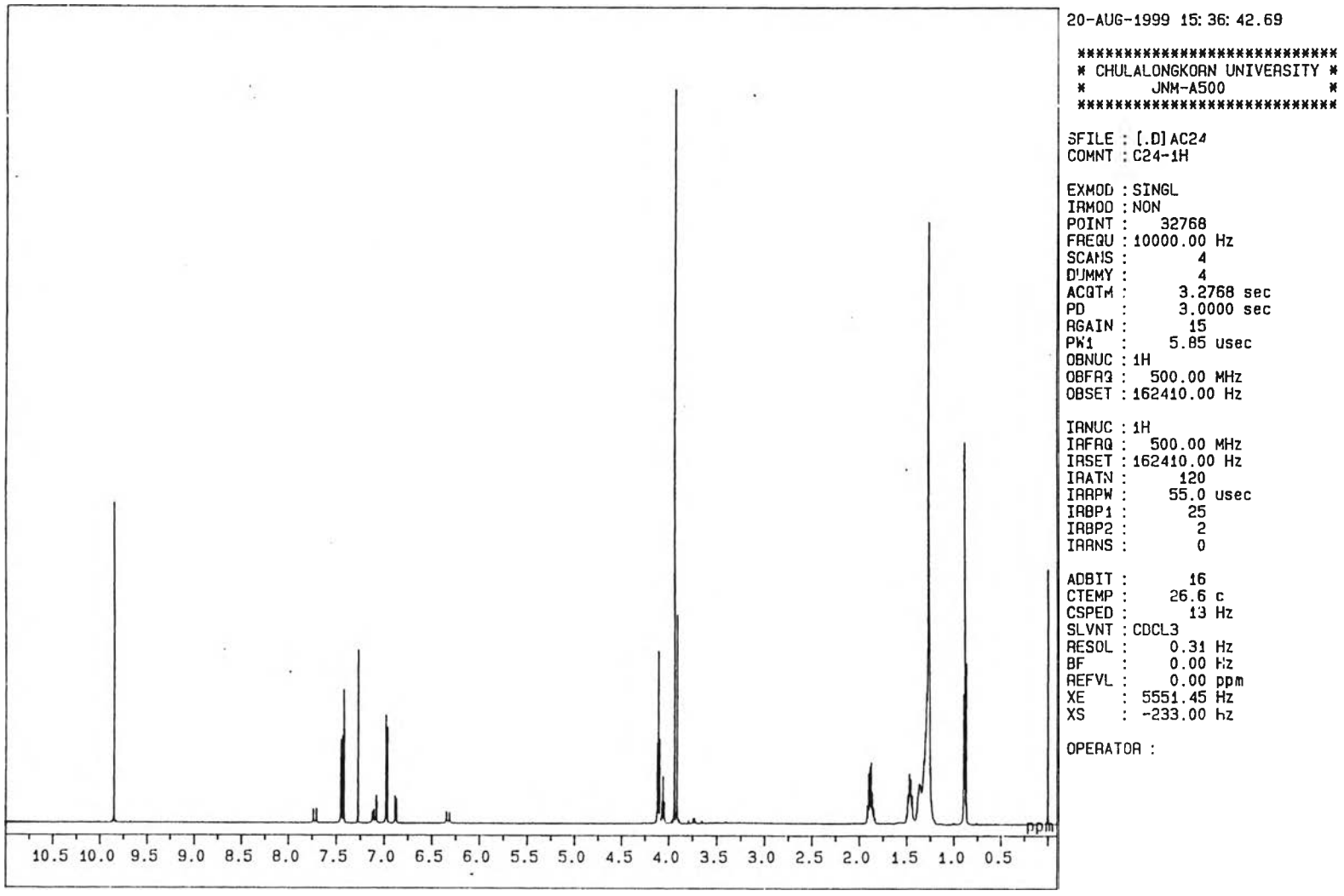


Fig B.6 The ^{1}H-NMR spectrum of **C25**

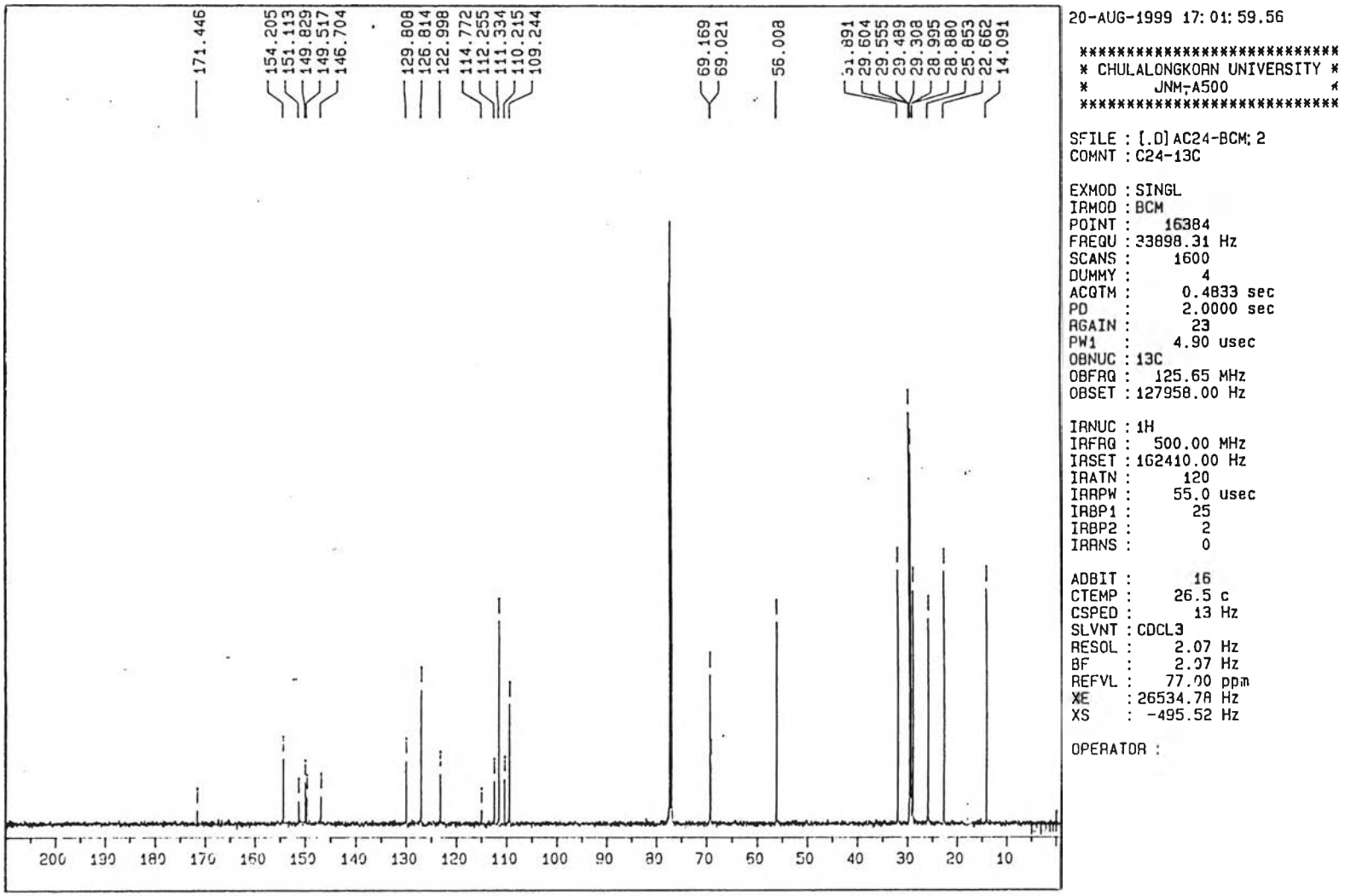


Fig B.7 The ^{13}C-NMR spectrum of **C25**

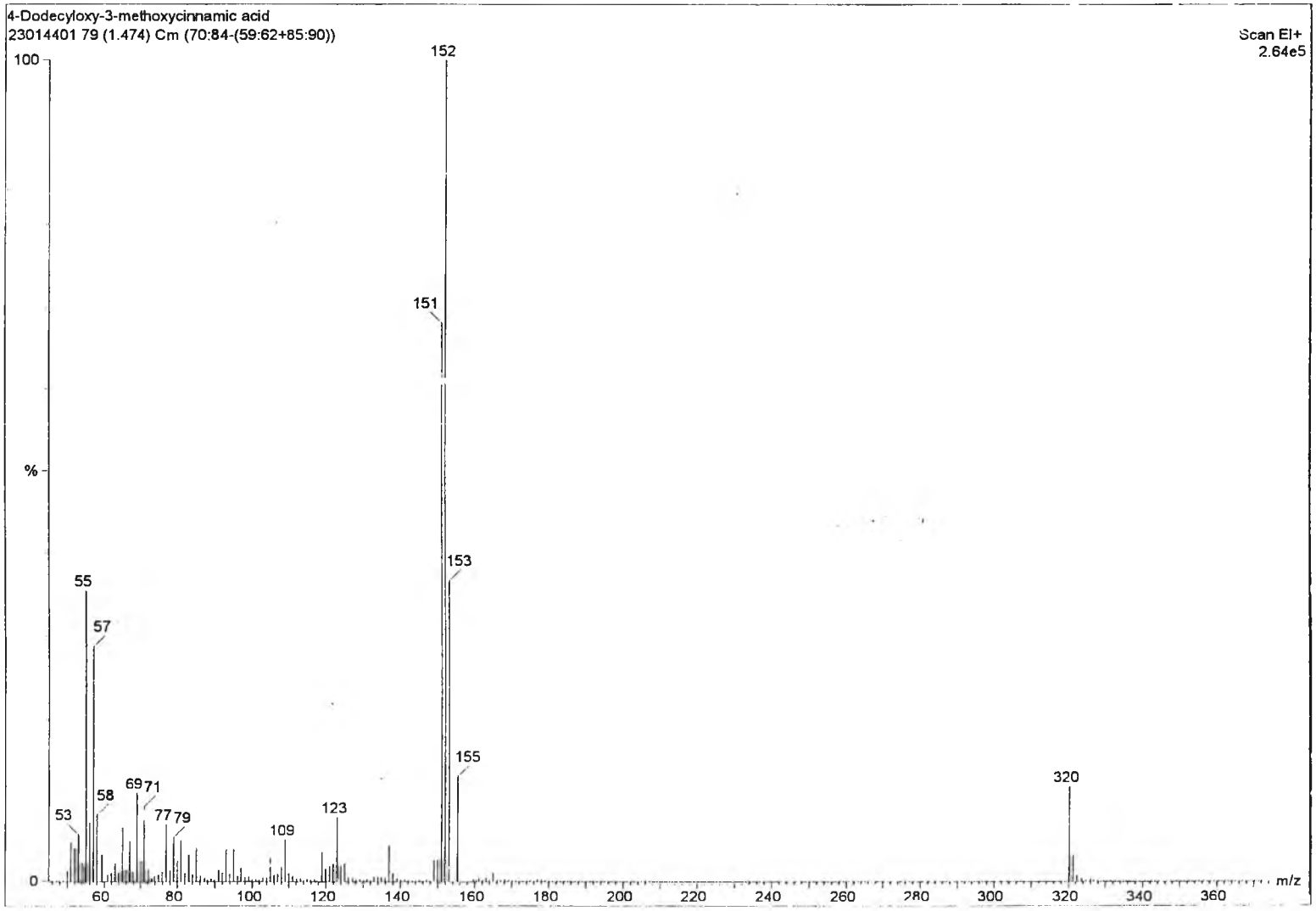


Fig B.8 The mass spectrum of **C25**

Appendices C

C.1 Herbicidal Activity of Substituted *trans*-Cinnamic Acids

Table C.1 The results of weed growth inhibition of substituted *trans*-cinnamic acids against *M. pigra*

Cpds	% Growing Inhibition at (ppm)							
	Root				Shoot			
	3	30	300	3000	3	30	300	3000
C	13.36	21.31	32.13	86.28	14.80	7.84	32.19	84.35
C1	5.25	36.73	81.79	100.00	-18.31	-8.55	25.60	100.00
C2	-	31.54	73.85	93.08	-	20.27	27.03	75.68
C3	-	78.08	64.62	47.69	-	43.24	31.08	0.00
C4	18.83	53.40	99.38	100.00	-0.01	3.65	93.90	100.00
C5	-	64.23	65.00	66.15	-	5.41	31.08	28.38
C6	-	23.85	56.92	61.54	-	31.08	29.73	16.22
C7	-	25.77	73.46	75.77	-	8.11	59.46	40.54
C8	-	57.31	35.77	52.69	-	1.35	21.62	28.38
C9	-	52.69	47.69	53.85	-	9.46	24.32	22.97
C10	-	50.00	86.54	91.15	-	21.62	8.11	28.38
C11	-	39.62	58.85	61.54	-	8.11	25.68	29.73
C12	21.60	35.80	94.14	100.00	-4.89	8.53	51.21	100.00
C13	-20.05	54.30	66.73	76.55	-25.16	-31.75	-35.05	-36.14
C14	9.57	47.53	84.26	100.00	-30.50	-1.23	40.24	100.00
C15	19.83	37.07	83.37	85.77	-76.77	-5.40	8.87	5.58
C16	-22.01	-15.52	14.09	16.25	11.32	25.23	37.40	47.84
C17	-6.13	13.36	7.59	10.48	16.54	39.14	25.23	28.71
C18	-18.40	2.53	-10.46	-26.34	16.54	33.92	2.63	-7.81
C19	-11.18	11.20	-11.91	-27.07	7.84	9.58	11.32	-19.98

Note - : no test

Table C.1 (cont.)

Cpds	% Growing Inhibition at (ppm)							
	Root				Shoot			
	3	30	300	3000	3	30	300	3000
C20	-24.90	-9.74	30.69	31.41	21.75	2.63	18.28	39.14
C21	-8.33	-11.11	30.25	92.59	7.31	6.09	29.26	69.51
C22	-37.12	-34.13	-11.97	-23.95	9.22	10.64	14.89	31.92
C23	18.57	13.78	40.12	25.75	0.71	-3.55	-61.70	20.57
C24	-4.79	-25.75	8.98	-44.31	23.40	29.08	2.13	0.71
C25	-23.35	-2.99	13.18	44.91	-3.55	9.22	3.55	21.99
C26	9.58	34.13	35.33	35.93	-19.15	-3.55	27.66	-54.61
C27	-24.46	-18.45	26.65	48.27	-54.81	-11.29	39.52	31.45
C28	40.44	51.63	75.45	80.51	6.73	-12.19	16.19	29.71
C29	29.97	58.85	73.29	96.75	-0.03	-1.38	12.14	55.39
C30	1.95	42.87	76.10	82.49	-0.81	-0.81	26.61	43.55
C31	38.63	11.20	42.96	79.06	-4.08	4.03	13.49	27.01
C32	-8.33	-1.54	47.53	100.00	-14.65	-4.89	3.65	100.00
C33	62.65	83.13	86.75	98.19	4.51	-19.09	68.54	91.01
C34	-2.35	13.08	56.71	75.84	-3.24	-19.63	-4.88	11.50
C35	50.60	85.24	98.19	100.00	10.12	10.12	35.96	88.77
C36	13.42	33.22	46.31	63.76	3.31	3.31	0.03	-13.08
C37	21.31	44.41	56.68	71.84	21.75	13.06	26.97	28.71
C38	23.47	39.35	62.46	90.61	28.71	23.49	23.49	58.27
C39	-10.46	24.19	24.92	92.78	-18.24	16.54	-6.07	79.13
C40	5.54	26.46	64.31	72.92	46.85	63.30	41.79	51.91
C41	8.00	23.38	61.84	87.08	54.44	62.03	49.38	44.32
C42	10.46	25.54	31.69	46.77	69.63	58.24	65.83	51.91
C43	27.07	35.38	69.54	70.77	25.34	36.72	53.18	50.65
C44	23.20	13.86	67.16	89.76	-5.61	4.51	15.74	66.30
C45	17.77	15.67	60.24	81.02	3.38	-19.09	30.34	51.69
C46	-36.52	2.40	53.89	74.85	3.55	0.71	23.40	36.17
C47	-26.94	-5.39	11.98	70.66	7.80	-0.71	-3.54	17.73

Table C.2 The results of weed growth inhibition of substituted *trans*-cinnamic acids against *E. crus-galli*

Cpds	% Growing Inhibition at (ppm)							
	Root				Shoot			
	3	30	300	3000	3	30	300	3000
C	-9.07	-1.68	-3.98	81.82	-12.56	16.34	17.10	53.61
C1	0.15	58.53	100.00	100.00	-12.92	-0.01	100.00	100.00
C2	-	79.17	97.15	97.93	-	24.87	51.30	48.70
C3	-	36.61	87.06	93.53	-	-5.18	41.97	54.92
C4	51.79	96.26	100.00	100.00	39.35	31.60	100.00	100.00
C5	-	91.98	92.76	94.18	-	30.05	56.48	54.40
C6	-	83.70	89.50	91.70	-	36.27	45.08	53.89
C7	-	89.90	97.20	97.80	-	46.11	60.10	57.51
C8	-	92.00	92.37	95.60	-	32.12	44.56	53.89
C9	-	93.40	94.70	97.41	-	37.82	52.33	51.30
C10	-	72.57	94.83	97.80	-	39.90	49.74	63.21
C11	-	93.40	94.44	96.51	-	34.20	45.60	59.59
C12	5.24	51.20	100.00	100.00	13.54	10.96	94.84	92.26
C13	23.64	87.66	95.06	-0.52	-1.25	33.75	85.63	0.63
C14	3.89	66.17	100.00	100.00	4.50	19.99	83.22	100.00
C15	0.65	62.21	93.77	97.79	8.75	4.38	50.00	69.38
C16	-7.93	-52.81	-9.07	-28.38	19.39	20.15	40.68	23.19
C17	4.00	-14.18	-14.75	-34.63	-9.51	9.50	3.41	21.67
C18	-15.31	-1.68	-5.09	-29.52	9.50	-2.67	4.18	-19.40
C19	-7.36	-44.29	14.79	10.25	8.74	10.26	4.94	-27.77
C20	-25.54	-8.50	30.13	40.35	21.67	19.39	44.48	21.67
C21	-9.88	26.94	100.00	100.00	-1.95	13.54	96.77	100.00
C22	13.50	-1.45	-30.00	-13.00	100.00	-124.00	41.18	-147.00
C23	-97.00	-73.00	-97.00	-60.00	41.18	29.41	-29.40	17.65
C24	3.55	-77.00	-16.00	-154.00	64.71	-29.40	52.94	-52.90

Note - : no test

Table C.2 (cont.)

Cpds	% Growing Inhibition at (ppm)							
	Root				Shoot			
	3	30	300	3000	3	30	300	3000
C25	40.40	-18.00	-74.00	67.40	-5.88	64.71	-100.00	-5.88
C26	-77.00	-160.00	36.20	70.20	52.94	-312.00	-112.00	64.71
C27	1130	-0.52	21.69	91.17	10.00	12.50	11.25	65.63
C28	17.97	-55.55	53.39	94.18	-21.30	-6.55	-8.19	26.22
C29	10.73	-78.35	20.12	100.08	-27.86	-36.87	-7.37	27.04
C30	2.34	-15.58	39.87	86.10	0.63	5.00	32.50	100.00
C31	-50.31	-59.84	71.91	98.47	-53.26	-46.70	-5.73	48.35
C32	0.30	4.04	37.57	100.00	58.70	56.77	54.19	71.61
C33	35.18	83.38	100.00	100.00	-0.01	38.06	64.51	84.51
C34	-84.00	-50.00	-174.00	43.30	-52.90	5.88	-100.00	52.94
C35	2.13	56.00	71.60	100.00	-159.00	-29.40	-5.88	-52.90
C36	-18.00	77.30	60.30	77.30	-276.00	52.94	-147.00	-112.00
C37	37.51	-20.43	-2.25	55.69	-4.95	30.03	-4.95	46.76
C38	8.54	33.54	44.33	68.76	-11.04	-16.36	30.79	49.05
C39	-14.75	-14.75	2.86	86.93	9.50	13.30	34.60	48.29
C40	-46.41	82.33	100.00	100.00	5.51	14.83	80.00	73.54
C41	-7.19	22.75	100.00	100.00	4.50	8.38	79.35	100.00
C42	-4.34	21.26	88.77	100.00	0.63	12.89	52.90	92.26
C43	29.79	77.10	100.00	98.65	14.18	17.41	77.42	92.90
C44	11.53	-27.64	41.32	90.15	-13.11	-25.40	2.46	15.57
C45	-28.45	-50.98	70.30	99.81	-46.70	-51.62	-12.29	7.38
C46	26.20	-35.00	-22.00	57.40	100.00	-124.00	76.47	-5.88
C47	-167.00	-49.00	-160.00	47.50	-52.90	5.88	100.00	-5.88

C.2 Herbicidal Activity of *trans*-Cinnamic Acid Derivatives

C.2.1 Cinnamamides (D1-D12)

Table C.3 The results of weed growth inhibition of cinnamamides against *M. pigra*

Cpds	% Growing Inhibition at (ppm)							
	Root				Shoot			
	3	30	300	3000	3	30	300	3000
D1	3.14	10.23	66.14	70.08	7.73	-19.18	-1.88	3.88
D2	24.40	21.25	11.41	9.84	-3.81	-32.64	-42.25	-26.87
D3	36.22	18.50	35.82	35.82	-11.50	-19.18	-11.50	-21.11
D4	-4.34	2.35	27.16	-13.00	-17.26	-11.50	-11.50	-15.34
D5	3.14	17.32	11.02	29.52	-23.03	-24.95	-30.72	-42.25
D6	0.30	3.01	20.18	8.14	-4.48	0.01	5.63	-8.98
D7	52.71	3.62	21.39	6.03	14.62	-4.48	-4.48	-10.10
D8	21.09	60.84	54.82	58.74	9.00	-2.24	10.12	17.99
D9	14.98	45.41	66.18	83.09	-4.84	-4.84	-13.28	15.64
D10	20.48	75.90	81.93	84.64	-7.85	17.99	7.88	25.85
D11	21.06	8.07	34.78	85.08	-7.19	-1.96	17.65	-17.65
D12	22.51	29.73	44.65	79.78	-7.19	11.11	20.26	35.95

C.2.2 Cinnamate Esters (E1-E15)

Table C.4 The results of weed growth inhibition of cinnamate esters against *M. pigra*

Cpds	% Growing Inhibition at (ppm)							
	Root				Shoot			
	3	30	300	3000	3	30	300	3000
E1	31.88	5.50	26.77	50.00	3.88	1.96	25.03	32.72
E2	20.47	29.52	-3.16	17.71	11.57	11.57	15.42	26.95
E3	31.10	23.22	59.05	88.19	0.04	-1.88	-11.50	17.34
E4	21.26	29.95	79.23	85.51	1.18	-27.74	-24.13	31.31
E5	29.47	52.17	74.88	92.75	13.23	-6.05	40.95	60.23
E6	-10.64	-4.73	16.14	22.04	-7.65	-5.73	-11.50	-5.73
E7	5.90	-7.88	25.58	31.88	-7.65	-21.11	3.88	7.73
E8	5.31	-0.48	22.22	91.30	-27.74	-16.90	10.82	40.95
E9	-9.18	6.28	-20.29	52.17	-15.69	-14.49	-9.66	4.80
E10	21.26	10.63	1.93	10.14	-20.51	-10.87	2.39	-6.05
E11	44.44	25.12	43.00	100.00	-92.82	-4.84	10.82	100.00
E12	19.81	3.86	82.61	91.30	-4.84	-31.36	12.03	37.94
E13	20.29	19.81	84.54	90.34	-24.13	-8.46	12.03	2.39
E14	8.07	50.42	90.37	100.00	-26.80	-11.11	41.18	100.00
E15	48.98	52.59	74.97	93.98	9.80	-9.80	-1.96	69.93

C.2.3 Sodium Cinnamate Derivatives (S1-S6)

Table C.5 The results of weed growth inhibition of sodium cinnamate derivatives against *M. pigra*

Cpds	% Growing Inhibition at (ppm)							
	Root				Shoot			
	3	30	300	3000	3	30	300	3000
S1	67.16	70.41	96.42	100.00	20.00	-5.19	83.70	100.00
S2	33.34	67.16	96.75	100.00	-5.19	-2.22	92.59	100.00
S3	72.36	77.89	100.00	100.00	0.74	-11.11	100.00	100.00
S4	55.78	81.79	96.42	100.00	-2.22	3.70	77.78	100.00
S5	9.08	82.29	94.26	100.00	-10.71	0.00	46.45	100.00
S6	52.15	80.86	86.60	95.21	0.00	8.94	25.01	76.82

C.2.4 Calcium Cinnamate Derivatives (CS1-CS3)

Table C.6 The results of weed growth inhibition of calcium cinnamate derivatives against *M. pigra*

Cpds	% Growing Inhibition at (ppm)							
	Root				Shoot			
	3	30	300	3000	3	30	300	3000
CS1	16.14	42.40	69.62	97.47	10.87	-4.35	13.04	71.75
CS2	51.58	81.64	90.51	96.84	-15.22	2.17	23.92	58.71
CS3	41.77	76.27	90.19	97.78	-4.35	-10.87	28.27	56.53

C.3 Germination and Root Growth Inhibition

Table C.7 The results of germination and root growth inhibition of 3,4-methylene-dioxycinnamic acid (**C33**) against various weeds

Weeds	% Germination Inhibition at (ppm)				% Root Growth Inhibition at (ppm)			
	3	30	300	3000	3	30	300	3000
M. pigra	-1.55	0.01	-3.12	3.91	29.02	55.10	71.18	92.75
E. crus-galli	0.68	0.01	0.68	33.56	28.90	60.73	93.14	100.00
E. geniculata	0.67	4.00	1.33	6.67	-11.86	24.81	76.22	98.83
A. americana	-6.10	-10.44	-6.10	9.56	14.30	51.56	70.19	91.00

Table C.8 The results of germination and root growth inhibition of 3-nitrocinnamic acid (**C35**) against various weeds

Weeds	% Germination Inhibition at (ppm)				% Root Growth Inhibition at (ppm)			
	3	30	300	3000	3	30	300	3000
M. pigra	-1.55	-5.46	3.13	94.53	17.65	67.65	91.76	98.63
E. crus-galli	-0.66	0.01	0.68	2.69	24.59	42.61	86.88	99.41
E. geniculata	2.00	3.33	1.33	4.67	-15.44	60.58	78.50	98.97
A. americana	1.73	-0.88	-6.97	19.99	21.75	61.81	86.03	94.72

Note: The results of germination and root growth inhibition derived from *T. portulacastrum*, *C. argentea*, *D. aegyptium*, *T. porcumbens*, *C. echinatus* and *P. pedicellatum* should be excluded from this examination because the control of them did not germinate or show good germination

C.4 Herbicidal Activity of Commercial Available Herbicides

Table C.9 The results of weed growth inhibition of commercially available herbicides against *M. pigra*

Herbicide	% Growing Inhibition at (ppm)							
	Root				Shoot			
	3	30	300	3000	3	30	300	3000
H1	70.01	73.35	85.01	100.00	42.64	49.31	62.65	100.00
H2	23.37	35.03	80.01	83.34	18.63	35.97	63.99	71.99
H3	21.71	31.70	33.37	30.03	-0.04	44.96	25.30	26.64

H1 = 2,4-D, active ingredient: 2,4-Dichlorophenoxyacetic acid

H2 = alachlor, active ingredient: 2-chloro 2,6-diethyl-*N*-(methyloxymethyl) acetanilide

H3 = atrazine, active ingredient: 6-chloro-*N*-ethyl-*N'*-(*iso*-propyl)-1,3,5-triazine-2,4-diamine

VITA

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