EFFECTS OF AMITROLE, ZYTRON AND OTHER HERBICIDES
OR PLANT GROWTH REGULATORS ON THE PEA APHID,
ACYRTHOSIPHON PISUM (HARRIS), CAGED ON
BROAD BEAN, *VICIA FABA* L.

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ABSTRACT

Thirty herbicides or plant growth regulators were tested against the pea aphid, *Acyrtosiphon pisum* (Harris), on broad bean, *Vicia faba* L. When amitrole at 300, 200 and 100 p.p.m. of active ingredient in water was absorbed by the roots, fecundity of the adults was reduced and mortality of their progeny was 100, 100 and 93.9 per cent respectively. No significant effects on fecundity occurred when amitrole was applied to the leaves or as a contact spray on adult aphids. When Zytron at 3,000, 2,000 and 1,000 p.p.m. of active ingredient in water was absorbed by the roots, mortality of adults was 100, 100 and 95 per cent and of their progeny 100, 100 and 98.6 per cent respectively. When Zytron was applied to the leaves at 8,000, 4,000 and 2,000 p.p.m. of active ingredient in water there was a mortality of adults of 85, 70 and 50 per cent and of nymphs 75.1, 45.4 and 29.9 per cent. The lower mortality of nymphs occurred over a 5-day period, indicating that the initial toxic effects from application to the leaves were soon lost. Mortality of nymphs refers to young aphids born alive and killed by the toxic effects of amitrole or Zytron. Twenty-seven of the chemicals showed no effects on aphids caged on treated plants.

INTRODUCTION

A study was begun in 1958 at the University of Manitoba to determine possible effects, either deleterious or beneficial, of herbicides or plant growth regulators on the pea aphid, *Acyrtosiphon pisum* (Harris), caged on treated broad bean, *Vicia faba* L. Continuation of the project was encouraged by the discovery that maleic hydrazide applied by absorption through the roots caused a significant decrease in fecundity of wingless female pea aphids (apterous alienicolae). Preliminary results were reported by Robinson (4,5). Recently Adams (1) reported some mortality to the larvae of three species of coccinellid beetles predacious on aphids on barley when sprayed with 2,4-D and an increase in mean time to pupation in all groups except the 1-day-old larvae. Effects of gibberellic acid on growth and food consumption of *Periplaneta americana* L. were reported by Siakotos and Dewey (6) and on rate of reproduction of *Tetranychus telarius* (L.) by Eichmeier and Guyer (2).

MATERIALS AND METHODS

During this study 30 herbicides or plant growth regulators were applied to broad bean plants by absorption through the roots and by dipping leaves. A wide range of chemicals was tested which included all those at present commonly used or under test in Western Canada. Twenty-seven of the chemicals are shown in Table 1. The other three were amitrole, Zytron and maleic hydrazide. All dosages used are reported as p.p.m. of active ingredient. The plants were grown in soil in the greenhouse until 2-4 inches high and then transplanted to vermiculite in 3½-inch clay pots. The

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TABLE 1.—NAMES OF 27 HERBICIDES OR PLANT GROWTH REGULATORS THAT HAD NO EFFECTS ON PEA APHIDS CAGED FOR 5 DAYS ON TREATED BROAD BEAN PLANTS

Common ¹ or trade name	Chemical name ¹	Formulation ²	Highest rate p.p.m. of active ingredient	
			Root treatment	Leaf treatment
atrazine	2-chloro-4-ethylamino-6-isopropylamino-s-triazine	50% WP	0.01	100
Avadex	2,3-dichloroallyl-diisopropylthiol-carbamate	50% EC	4,000	4,000
barban	4-chloro-2-butyryl-N-(3-chlorophenyl) carbamate	12.5% EC	3,000	8,000
CDA A	2-chloro-N, N-diallyl-acetamide	47% EC	100	1,000
CDEC	2-chloroallyl diethyldithio-carbamate	46.4% EC	100	1,000
chlorazine	2-chloro-4,6-bis (diethyl-amino)-s-triazine	49.5% EC	1,000	1,000
CIPC	isopropyl N-(3-chlorophenyl) carbamate	48% EC	3,000	10,000
2,4-D	2,4-dichlorophenoxyacetic acid	50% EC (amine)	2	1,000
dalapon	2,2-dichloropropionic acid	74% S	1,000	10,000
4-(2,4-DB)	4-(2,4-dichlorophenoxy) butyric acid	40% EC (amine)	100	100
DMTT	3,5-dimethyltetrahydro-1,3,5,2H-thiadiazine-2-thione	85% WP	100	1,000
DNBP	4,6-dinitro ortho secondary butylphenol	53% EC (amine)	300	1,000
eptam	ethyl N,N-di-n-propylthiol-carbamate	78% EC	100	1,000
erbon	2-(2,4,5-trichlorophenoxy) ethyl 2,2-dichloropropionate	41.3% EC	1,000	10,000
gibberellic acid	potassium gibberellate	94% S	1,000	1,000
IPC	isopropyl N-phenylcarbamate	25% EC	1,000	1,000
MCPA	2-methyl-4-chlorophenoxy-acetic acid	50% EC (amine)	8	10
4-(MCPB)	4-(2-methyl-4-chloro-phenoxy) butyric acid	40% EC (amine)	100	1,000
monuron	3-(p-chlorophenyl)-1,1-dimethylurea	80% WP	1	1,000
NPA	N-1-naphthylphthalamic acid	Alanap-3	1,000	1,000
sesone	sodium 2,4-dichloro-phenoxyethyl sulfate	90% S	1,000	8,000
silvex	2-(2,4,5-trichlorophenoxy) propionic acid	42.5% EC (ester)	100	100
simazine	2-chloro-4,6-bis (ethylamino) -s-triazine	50% WP	1	100
2,4,5-T	2,4,5-trichlorophenoxyacetic acid	42.5% EC (ester)	0.1	0.1
2,3,5,6-TBA	2,3,5,6-tetrachlorobenzoic acid	47.7% EC	100	1,000
2,3,6-TBA	2,3,6-trichlorobenzoic acid	24.8% EC	100	1,000
TCA	trichloroacetic acid	79% S	4,000	10,000

¹ Common and chemical names from *Weeds*, Vol. 8, No. 3, July 1960, p. 490² EC = Emulsifiable concentrate; WP = Wettable powder; S = Soluble powder

treatment by absorption through the roots consisted of standing the pots in a dilute solution for 48 hours. The treatment of the leaves was applied by dipping one of the lower leaves in a dilute solution of the chemical for about 5 seconds to simulate field spraying. In all cases the highest concentrations used gave some visible plant injury such as epinasty, chlorosis or leaf blotching, but not plant death.

Forty-eight hours after application young adult wingless female pea aphids of approximately the same age were caged singly in replicates of 20 on treated plants. They remained on the plants for 5 days in a Coldstream Plant Growth Cabinet at a temperature set to hold at 69°F., average relative humidity of about 70 per cent, with continuous lighting, and a nutrient solution of Plant Prod 20-20-20*. At the end of 5 days counts were made on mortality and fecundity.

Amitrole was applied by absorption through the roots in two separate tests, at rates of 300, 200 and 100 p.p.m., and at 100, 10 and 1 p.p.m., and by dipping leaves in solutions of 300, 200 and 100 p.p.m. Amitrole was also applied as a contact spray on adult aphids at a treatment of 100 p.p.m. Zytron was applied by absorption through the roots at rates of 3,000, 2,000 and 1,000 p.p.m. and by dipping leaves at rates of 8,000, 4,000 and 2,000 p.p.m.

The data on fecundity of aphids in the tests with amitrole were analysed statistically by a transformation using $\sqrt{x + 0.5}$ suggested by Goulden (3).

RESULTS AND DISCUSSION

Of the 30 herbicides or plant growth regulators tested only amitrole, Zytron and maleic hydrazide [see Robinson (4,5)] had any effects on mortality or fecundity of the aphids. The remaining 27 which had no effects are listed in Table 1 with the highest rates of concentrations used.

Table 2 shows that amitrole at rates of 300, 200 and 100 p.p.m. by absorption through the roots caused a reduction in fecundity (total nymphs born) compared with the check, and a mortality of nymphs (total nymphs dead) of 100, 100 and 93.9 per cent respectively. Average number of live progeny of surviving adults differed significantly at the 1 per cent level from the check. Mortality of adults was low. At rates of 10 and 1 p.p.m. no effects on the aphids were noted. When amitrole was applied by dipping leaves in solutions of 300, 200 and 100 p.p.m. there were no effects on the aphids. When this material was applied to aphids as a contact spray at 100 p.p.m., 13 adults died out of 20, but there was no significant difference in fecundity of surviving aphids. These results indicate that amitrole is taken up through the roots of the broad bean plant and acts systemically to reduce fecundity of adults and to cause mortality of nymphs of the pea aphid.

When amitrole was applied to broad beans at 300 and 200 p.p.m., either through the roots or the leaves, plants were severely damaged by the end of one week. At the above rates and at 100 p.p.m. terminal leaves were highly chlorotic. Dosages above 300 p.p.m. killed the plants.

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TABLE 2.—MORTALITY OF ADULTS AND NYMPHS, AND PROGENY PER ADULT, AFTER 20 ADULT PEA APHIDS WERE CAGED FOR 5 DAYS ON BROAD BEAN PLANTS TREATED BY ABSORPTION THROUGH THE ROOTS OR BY LEAF TREATMENT WITH AMITROLE OR ZYTRON, OR SPRAYED WITH A CONTACT SPRAY OF AMITROLE

Treatment	Active ingredient p.p.m.	No. of dead adults	Total nymphs born	Total nymphs dead	Live progeny per surviving adult	
					Average	Transformed average ¹
Amitrole ² (root absorption)	300	3	320	320	0	0.71**
	200	1	473	473	0	0.71**
	100	1	497	459	2.0	1.39**
	Check (Water)	0	662	0	33.1	5.74
Amitrole (root absorption)	100	1	296	267	1.5	1.21**
	10	0	603	0	30.1	5.52
	1	1	635	0	28.2	5.33
	Check (Water)	1	652	0	34.3	5.87
Amitrole (leaf dipping)	300	0	636	0	31.8	5.65
	200	0	635	0	31.7	5.57
	100	0	617	0	30.8	5.56
	Check (Water)	1	565	0	29.7	5.47
Amitrole (contact spray)	100	13	220	0	25.7	5.08
	Check (Water)	4	445	0	27.6	5.14
Zytron ³ (root absorption)	3,000	20	15	15	—	—
	2,000	20	29	29	—	—
	1,000	19	70	69	—	—
	Check (Water)	0	503	32	23.5	—
Zytron (leaf dipping)	8,000	17	205	154	—	—
	4,000	14	271	123	21.5	—
	2,000	10	331	111	21.7	—
	Check (Water)	3	402	18	21.2	—

¹ Transformed by the formula $\sqrt{x+0.5}$

² 3-amino-1, 2,4-triazole (25% emulsifiable concentrate)

³ 0-2,4-dichlorophenyl 0-methyl isopropylphosphorothioate (25% emulsifiable concentrate)

**Significant at the 1% level

When Zytron was applied by absorption through the roots at rates of 3,000, 2,000 and 1,000 p.p.m., mortality of adults was 100, 100 and 95 per cent and of nymphs 100, 100 and 98.6 per cent respectively (Table 2). When Zytron was applied to the leaves at 8,000, 4,000 and 2,000 p.p.m., mortality of adults was 85, 70 and 50 per cent and of nymphs 75.1, 45.4 and 29.9 per cent respectively. The lower mortality of nymphs occurred over a 5-day period, indicating that the initial toxic effects through dipping the leaves were soon lost. Surviving adults reproduced normally and the averages of their live progeny were nearly identical. There was only slight plant injury at the rates used. These results show that Zytron acts on aphids as an insecticide, probably systemic, although there may have been some fumigant action. The insecticidal action of Zytron on ants in lawns has been reported by Watson and Leasure (7).

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