Source: Natural Enemies of Insects [Kunchong Tiandi, ISSN: 1001-6155; CN44-1190/Q] (1997) v.19(4) p.145-151
Translated by Liu Qizhi, China Agricultural University; Edited by Donna Schenck-Hamlin, Kansas State University, 2003

Toxicity of G-P compound Bioinsecticide to Different Developmental Stages of four Dominant Species of Natural Enemies of Aphids

Dai Mei Xue [1], Zu Ai Min [2]
[1] Department of Biology, Shandong Normal University, Ji Nan, 250014
[2] Department of Biology, Ji Nan Education College, 250001

Abstract The results of laboratory investigations on the toxicity of the bioinsecticide G-P (germ metabolite and plant extract compound) to different developmental stages of four natural enemies of aphids are reported in this paper. G-P insecticide had weak toxicity to adults and pupae of the four species of natural enemies. The toxicity of G-P insecticide to larvae and eggs of different species of natural enemies was different, and that to the great gray syrphid fly, *Syrophus corollae* (Fabricius) was higher than to other species.
Key Words G-P compound bioinsecticide, toxicity, aphid, natural enemy

G-P bioinsecticide, a combination of germ metabolite and plant extract, is a compound bioinsecticide developed in our laboratory. G-P was developed in techniques by authors with extraction of two plants and condensed ferment liquid of *Paecilomyces griseoviride* strain U-2, isolated from dead aphid, *Aphid gossypii* Glover. It was used for controlling aphids on beans [soybean?] (Dai Mei Xue, 1997), wheat, and vegetables in 1995 and 1996 (reported in another paper). The effect was satisfactory in showing that G-P insecticide had a great prospect for aphid control.

Aphids have many natural enemies, among which the ladybug, syrphid fly and aphid cocoon wasp are four dominant groups having an important role in aphid control. (Ma Zhenquan *et al.*, 1986). In order to appraise the safety of G-P bioinsecticide to natural enemies, the current study was conducted in a laboratory with the turtle vein ladybug (*Propylea japonica),* the great lacewing (*Chrysopa septempunctata),* the great gray syrphid fly (*Syrphus corollae)* and wheat aphid cocoon wasp (*Ephedrus plagiator).*

1. MATERIALS AND METHODS

1.1 G-P bioinsecticide

G-P bioinsecticide was a trial product developed by Shandong Dingtao Bio-Chemical Factory and Biology Department of Shandong Normal University. The spore suspension

of gray-green mould *Paecilomyces griseoviride* strain U-2 was inoculated in liquid medium (main ingredients: potato, sugar, inorganic salt, etc) and leavened at 27±2℃ for 6 days. The fermented liquid was centrifuged at 3000rpm for 20min. The upper clear part of the ferment liquid was condensed 5 fold under low pressure and was mixed with plant extract of white Mantuo and Chinese prickly ash in the ratio of 5: 1: 0.2.

1.2 Natural enemies of aphids for the experiment

Turtle vein ladybug: The adults of turtle vein ladybug, *Propylea japonica* were captured in wheat fields in late April and raised in an insect cage of 60, 80, 90cm in length, width and height respectively, in an air-conditioned room. Garden pots with growing young plants of wheat and vegetable and aphids were put in the cage. The aphids were inoculated on the plants in time to assure that the ladybird had enough to consume.

The great lacewing: The adults of the great lacewing, *Chrysopa septempunctata* were caught from the field. Identical amounts of males and females (about 20 for each) were put in a nylon cage of the size 80, 80,120cm in length, width and height, respectively. The young plants of cabbage in pots were put in the cage. The eggs, after one day laying out were moved into 10mm x 60mm finger tubes (plugged with absorbent cotton) for egg hatching, one egg per tube. Fresh cabbage leaves with aphids were put into tubes. The conditions for rearing was regulated at 26±2℃ and 65 - 75% RH.

The great gray syrphid fly: Adults of the great gray syrphid fly, *Syrphus corollae* were caught in the field. Identical amounts of identified males and females were moved into the nylon cage of 80, 80,120cm in length, width and height, respectively. Young vegetable plants inoculated with aphids were put into the cage according to the needs of the fly. The conditions for rearing were regulated at 27±2℃ and 65 -75% RH.

Wheat aphid cocoon wasp: Dark brown stiff aphids were captured in a wheat field in mid-May and put in a greenhouse (26±3℃, 70 % RH). After wasps had emerged from the mummy of aphids, they were identified to be wheat aphid cocoon wasp, *Ephedrus plagiator*. Identical amount of males and females were fed in 60 mesh nylon cage in 60cm long, 60cm wide and 80cm high. Absorbent cotton drenched with 15% honey solution was hung in the cage. Plants (young plants of vegetable and beans) with sufficient aphids were supplied in the cage.

The four natural enemies described above reared in the greenhouse would be used for experiment with the successive stages of adult, larva, pupa and egg.

1.3 Experimental Method

1.3.1 Testing of adults

Three treatments were performed: water as control, 100 times and 400 times dilution of G-P bioinsect-cide suspensions. Experimental adults were put in hand-tailored nylon net bags and sprayed from one open side of the bag with a small sprayer. The sprayed adults were put in the cage with aphid plants. The absorbent cotton drenched with 15% honey solution was hung in the cage for aphid cocoon wasps. Dead adults would be recorded in

a timely manner. The mortality would be calculated. Three replications were given for each treatment.

1.3.2 Testing of larvae

The 3rd to the last instar larvae of turtle vein ladybug, the great lacewing and the great gray syrphid fly were put on vegetable leaves in a petri dish. The experimental pesticides were sprayed uniformly on the larvae and then we moved the larvae onto the plants inoculated with aphids, then covered with 60 mesh nylon net. The last instar larvae of wheat aphid wasp cocoons were divided into two treatments: one cocoon was sprayed directly onto the stiff aphids (larvae in it); another last instar larvae of wasps (with cocoon) was picked out carefully using a microscope from the stiff aphids. It was placed on a sterile filter paper and then sprayed with the insecticide. The treated larvae of the cocoon wasps were put in small finger-shaped tubes with some body plasma of aphids (adding a little Nepal aurum) for food of the larvae. Each treatment had two replications. Water was the control.

1.3.3 Testing to pupa and egg

The leaves with experimental natural enemies were infused in experimental pesticides for 20 seconds and put in beakers (covered with two-layers of gauze) under conditions of 26 ±2℃ and 60 - 70%RH. The emergence of pupae and hatch of eggs were observed and recorded. The treatment to the eggs was conducted in the way of directly immersing the aphids which had been parasited for 36 h by the cocoon wasps.

2 RESULTS

2.1 Toxicity of G-P to the adults of four species of natural enemies

The results (in table 1) show that the rectified mortality of the adults of turtle vein ladybugs, the great lacewings, the great gray syrphid flies and wheat aphid cocoon wasps was 9.4%, 9.6%, 11.4% and 8.5%, respectively in 400 times G-P compound bioinsecticide dilution and 10.9%, 11.7%, 14.6% and 9.1%, respectively in 100 times G-P dilution. It was revealed that G-P compound bioinsecticide had a weak toxicity to the adults of the four tested natural enemy species.

Table 1: Result of G-P bioinsecticide toxicity to the adults of the four kinds of natural enemies

Natural enemy	Dose of G-P insectcide	Sum of tested adults	24 hours		48 hours		96 hours	
			Morality (%)	rectified morality (%)	Morality (%)	rectified morality (%)	Morality (%)	rectified morality (%)
Ladybug	400×	60	8.9	5.8	11.2	7.9	12.4	9.4
	100×	59	11.0	8.0	13.1	10.1	13.8	10.9

	CK	60	3.3		3.3		3.3	
Lacewing	400×	42	9.6	5.3	14.9	9.2	15.3	9.6
	100×	45	11.4	7.5	16.1	10.5	17.3	11.7
	CK	48	4.2		6.3		6.3	
Syrphid fly	400×	35	7.7	4.6	13.4	10.1	14.3	11.4
	100×	35	9.4	6.3	14.2	10.9	17.4	14.6
	CK	35	3.3		3.3		3.3	
Cocoon wasp	400×	29	6.9	3.5	10.4	7.2	14.8	8.5
	100×	28	7.4	4.0	11.7	8.5	15.4	9.1
	CK	29	3.5		3.5		6.9	

2.2 Toxicity of G-P to the larvae of the four species of natural enemies

Table 2: Result of G-P bioinsecticide toxicity to the larvae of the four kinds of natural enemies

natural enemy		Dose of G-P	Sum of tested insects	Mortality (%)*		
				24 hours	48 hours	96 hours
Turtle vein ladybug, *(Propylea japonica)*		400×	78	11.6	15.6	17.2
		100×	76	12.9	16.1	19.8
		CK	79	8.2	10.8	11.3
The great lacewing *(Chrysopa septempunctata)*		400×	65	8.2	10.3	11.9
		100×	64	8.7	11.7	13.9
		CK	65	7.9	7.9	10.4
The great gray syrphid fly *Syrphus corollae*		400×	80	31.1	38.5	43.9
		100×	80	34.3	46.7	51.3
		CK	79	8.9	11.2	11.8
Wheat aphid cocoon wasp (*Ephedrus plagiator)*	Inside aphid	400×	36	6.1	7.1	7.9
		100×	35	5.8	7.3	7.7
		CK	35	5.4	5.4	6.7
	Shelled out of aphid	400×	30	34.9	54.7	56.3
		100×	30	42.4	59.6	63.5
		CK	30	10.3	23.5	28.7

*The larvae which became pupae during the experiment were counted as live ones.

The results are presented in table2. The larvae of turtle vein ladybugs and the great lacewings were treated with G-P compound bioinsecticide for 96 hours. The mortality in 400 times dilution of G-P was 17.2% and 11.9%, exceeding the control by 5.9% and 1.5%, respectively. The mortality of the two kinds of larvae treated with 100-fold G-P was 19.8% and 13.9%, respectively, higher than that of the control by 8.5% and 3.5%, respectively. The mortality in both treatments had no significant difference compared statistically with that of the control. The fly larva mortality with 400 and 100-fold G-P for 96h (43.9%, 51.3%) was higher than that of the control (11.8%) by 32.1% and 39.5%, respectively. There was a statistically significant difference between the treatments and control, which indicated that G-P compound bioinsecticide had toxicity to the great gray syrphid fly. The larva mortality of wheat aphid cocoon wasp had a significant difference

in different treatment methods. In the group of treating stiff aphids with G-P insecticide, the larva mortality was similar to that of thecontrol. However, in another treatment group, the larvae of the cocoon wasp were shelled out from aphid bodies and then treated with 400 and 100 fold G-P for 48h and 96h, for which the mortality was 54.7%, 59.6% and 56.3%, 63.4%, respectively. It was significantly different than that of the control. This experiment showed that G-P insecticide had toxicity to the wasp pupae when they were exposed directly to G-P insecticide. However, G-P insecticide was not toxic to the last instar larva if it was sprayed on the stiff aphids.

2.3 Toxicity of G-P to the pupae of the four kinds of natural enemies

Table3: Result of G-P bioinsecticide toxicity
to the pupae of the four kinds of natural enemies

Natural enemy	Does of G-P	Sum of tested pupa	Sum of Dead pupa	Rate of dead pupa (%)	Sum of normal emergence	Rate of abnormal emergence (%)
Turtle vein ladybug (*Propylea japonica)*	400×	47	7	14.9	40	85.1
	100×	48	8	16.7	39	81.3
	CK	50	7	14.0	42	84.0
The great lacewing (*Chrysopa septem-punctata)*	400×	40	7	17.5	31	77.5
	100×	38	8	21.1	28	73.7
	CK	39	6	15.4	31	79.5
The great gray syrphid fly (*Syrphus corollae)*	400×	68	7	10.3	60	88.2
	100×	68	7	10.3	59	86.8
	CK	70	6	8.6	63	90.0
Wheat aphid cocoon wasp (*Ephedrus plagiator)*	400×	29	3	10.3	25	86.2
	100×	29	4	13.3	24	80.0
	CK	30	3	10.0	26	86.7

As shown in table 3, after infusing in G-P compound bioinsecticide with 400 and 100-fold dilutions respectively, the pupae of the four kinds of natural enemies appeared similar with control in mortality and rate of normal emergence. There was no significant difference, which indicated that G-P bioinsecticide had no or only had weak toxicity to the pupae of the four tested kinds of natural enemies, and no obvious impact on their normal emergence.

2.4 Toxicity of G-P to the eggs of the four kinds of natural enemies

The experimenal results (table 4) indicated that the egg hatching rate of turtle vein ladybug and the great lacewing treated with 400-fold G-P compound bioinsecticide was 76.7% and 77.9%, respectively. It was lower than that of the control by 6.9% and 1.9%, respectively. The egg hatching rate of the above two natural enemies treated with 100-fold G-P was lower than that of the control by 11.9% and 6.6%, respectively. It was concluded that G-P compound bioinsecticide had to some extent toxicity to eggs of the turtle vein ladybug (*Propylea japonica)* and the great lacewing *(Chrysopa septempunctata).* The egg hatching rate of the great gray syrphid fly (*Syrphus corollae)* treated with G-P compound bioinsecticide in 400 and 100-fold, respectively was

obviously lower than that of the control (34.7% and 45.7%, respectively). It was shown that G-P compound bioinsecticide had distinct toxicity to the eggs of the great gray syrphid fly, *Syrphus corollae*. After the host aphids were inoculated to the cocoon wasps (laying eggs) for 36 hours, the hosts were infused in 400 and 100- fold G-P. The final hatching rate of wheat aphid cocoon wasps was 8.5% and 1.7%, respectively, lower than that of the control (infused in water) by 73% and 79.8%, respectively, an extremely significant difference. However, the result did not necessarily indicate that G-P insecticide had high toxicity to the egg of the cocoon wasp, since most nympha of aphid died after 48h with G-P treatment, which made the wasp lose normal developmental conditions. Only the eggs in the bodies of surviving nymphae could hatch into larvae successfully. However, results of this study might at least reveal that the population of wheat aphid cocoon wasp in the next generation would be reduced by the application of G-P compound bioinsecticide for aphid control during the cocoon wasp egg period.

Table 4: Result of G-P bioinsecticide toxicity to the eggs of the four kinds of natural enemies

Natural enemy	Dose of G-P	Sum of tested egg	Sum of dead egg	Rate of dead egg (%)	Sum of hatched egg	Hatch rate (%)
Turtle vein ladybug (*Propylea japonica)*	400×	116	27	23.3	89	76.7
	100×	120	34	28.3	86	71.7
	CK	128	21	16.4	107	83.6
The great lacewing *(Chrysopa septem-punctata)*	400×	86	19	22.1	67	77.9
	100×	82	22	26.8	60	73.2
	CK	89	18	20.2	71	79.8
The great gray syrphid fly (*Syrphus corollae)*	400×	60	29	48.3	31	51.7
	100×	59	35	59.3	24	40.7
	CK	59	8	13.6	51	86.4
Wheat aphid cocoon wasp *(Ephedrus plagiator)*	400×	117	107	91.5	10	8.5
	100×	116	114	98.3	2	1.7
	CK	119	22	18.4	97	81.5