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Influence of Insecticides on Population of Major Insect Pests and Natural Enemies in Seedling Stage of Soybeans

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Soybean aphid (*Aphis glycines* Matsumura) and soybean stem borer [*Melanagromyza sojae* (Zehntner)] are the major pest insects in the seedling stage of soybean, which cause 30% loss of soybean production in average year. The purpose of this experiment was to identify insecticides that have striking effects on aphids and with no clear injury on natural enemies. The overall target of the experiment was to protect natural enemies and apply them on keeping ecological balance in soybean field as well as to avoid eco-disastrous caused by chemical controlling happened in cotton field in North China and paddy rice field in the South.

I Materials and Methods

In 1988, a series of comparative plot experiment on the efficacy of 50% Pirimicarb vettable powder (England) and 35% Phosalone emulsible concentrate (Jiyang, Shandong Province) were conducted in Boxin County, Shandong Province. The plot area was 1 mu (about 1/15 hectare) for each and arranged randomly with duplications. Spraying water was applied as crosscheck. Specimens were sampled from 10 fixed plants in 5 fixed sites in each plot. And aphid numbers on 2nd leaf from top of the plant were counted. Base and efficiency were investigated before spraying and at the 1st, 2nd, 3rd, 4th, 5th, 7th and 10th days after spraying. At the same time, the insects of 50 nets were netted for each treatment to calculate the types and numbers of natural enemies under microscope.

In 1989, 35% Phosalone, 50% Pirimicarb, 40% Omethoate (Zhangdian Pesticide Factory, Shandong Province) and 205 Fenvalerate (Japan) were compared. The plot area was 0.5 mu for each, and arranged randomly with triplication. The sampling method for the experiment was the same as in 1988. The aphid numbers were counted from 3 leaves on top of every plant. The total aphid number from 10 plants was counted before spraying and efficiency of insecticides was checked at the 2nd, 5th, 7th and 11th days after spraying. Insects of 20 nets were netted for counting the number of natural enemies.

In 1988 and 1989, soybean stem borer was inspected by cutting stem in after 12-13 days of spraying. Anyway, there's no clear results obtained because of the mild occurrence.

II Results and Analysis

Data of the experiment were analyzed statistically. The decreasing rate of soybean aphid and surviving rate of natural enemies were counted and transformed as logarithms separately. Among which, two means were taken from the values of investigations at the 2nd and 5th days, the 5th and 11th days after spraying. The efficacy of the 4 applied insecticides was checked by LSR (least significant range) test (for results, see table 1 and 2).

From table 1, the 4 insecticides showed an obvious inhibition on soybean aphid. Statistically, significant correlation existed in both 2-5 days' and 7-11 days' datum. Controlling efficiency is not the only criteria on choosing insecticide; more attention should be paid to effects on the ecological system in soybean field. The conclusion was deduced from datum in table 2.

Although the dispersion of natural enemies could not be eliminated among the plots, no striking negative influence on natural enemies from 35% Phosalone (AI 25g / mu) showed through investigations after 2-5 days of spraying, so it was a satisfying insecticide. And, Fenvalerate (AI 3g / mu) should be applied alternately in order to avoid increasing resistance of aphids. This is profitable for keeping ecological balance in soybean field and decreasing resistance of aphids.

It was found that Phosalone exerted an influence on population of natural enemies. Trend of the influence was showed as follows:

lacewings > spiders > ladybirds > beneficial pentatomid bugs > parasitic wasps.

Beneficial pentatomid bugs and parasitic wasps are the dominating species in local area. The application of Phosalone is also consistent with utilizing the dominating species of natural enemies.

III Summary

1. Spraying 35% Phosalone (AI 25g / mu) on soybean seedlings could control the major pest (soybean aphid) efficiently and had no obvious negative influence on the 2 dominating species of natural enemies: beneficial pentatomid bugs and parasitic wasps. At present, Phosalone is the better insecticide for regulating contradiction between chemical and biological controlling and, it also has distinct economic and ecological benefits on keeping ecological balance and giving positive effects on natural enemies in soybean field.
2. Applying Phosalone and Fenvalerate alternately could reduce the resistance of soybean aphid to single insecticide. The inspection of resistance to insecticide from soybean aphid population should be developed for changing pesticide promptly. If not, big financial loss will occur like it happened in controlling of cotton aphid.
3. Harm of soybean aphid had risen and soybean stem borer had decreased obviously because of changing of farming system and the effect of natural enemies. It is correct to control aphid first and take into consideration of other pest insects in the seedling stage of soybean.

Table 1: Comparison on Efficiency of Insecticides to Soybean Aphid

2-5 days after spraying						7-11 days after spraying				
Insecticide	Base number	Decrease (%) x	x t [log (x+10)]	Significance of difference		insecticide	Decrease (%) x	x t [log (x+10)]	Significance of difference	
				5%	1%				5%	1%
Omethoate AI 10g / mu	105.3	70.29	1.0295	a	A	Fenvalerate	18.59	1.0080	a	A
Fenvalerate AI 3g / mu	172	63.65	1.0268	a	A	Omethoate	- 8.26	0.9964	a	A
Phosalone AI 25g / mu	142	31.81	1.0136	a	AB	Pirimicarb	- 66.96	0.9699	a	A
Pirimicarb AI 15g / mu	185.7	- 13.27	0.9942	b	B	Phosalone	- 77.43	0.9650	a	A
CK	173.3	- 129.24	0.9399	c	C	CK	- 343.25	0.8174	b	B

Note: 1. Base number is the mean of aphid population on 10 plants from 3 replicates;
2. g / mu is active ingredient of insecticide.

Table 2: Comparison on Effect of Insecticide to Natural Enemies in Soybean Field

2-5 days after spraying						7-11 days after spraying				
Insecticide	Living number	Survival (%) x	x t [log (x+1)]	Significance of difference		Insecticide	Survival (%) x	x t [log (x+1)]	Significance of difference	
				5%	1%				5%	1%
CK	53	175.80	0.4406	a	A	Fenralerate	260.74	0.5572	a	A
Phosalone AI 25g / mu	43.3	95.75	0.2917	ab	AB	CK	163.15	0.4202	a	A
Fenralerate AI 3g / mu	31.7	58.74	0.2007	b	AB	Phosalone	136.86	0.3745	a	A
Pirimicarb AI 15g / mu	73	50.63	0.1779	b	AB	Omethoate	83.95	0.2647	a	A
Omethoate AI 10g / mu	77	23.94	0.0932	b	B	Pirimicarb	77.42	0.2490	b	B

Note: Living number is the mean of total natural enemy population of 20 nets from 3 replicates.