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Seasonal Occurrence of Aphids (*Aulacorthum solani* K., *Aphis glycines* M.) and Effects of Some Insecticides on Aphids with Infurrow Treatment in Soybean

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Abstract

This study was conducted to investigate the seasonal occurrence of aphids and to evaluate efficacy of Carbofuran, Disulfoton and Ortran applied infurrow at the planting time in the field for the control of some aphids on soybean in 1976.

Foxglove aphids (*Aulacorthum solani*) and soybean aphids (*Aphis glycines*) were dominant species in the soybean field and there were two peaks in the year. The occurrence patterns of aphids were different between visual counting on leaves and in yellow-pans. Carbofuran and Disulfoton showed a good effect for the control of aphids but Ortran was less effective.

Introduction

The aphid causes damage to its host plants directly or indirectly by sucking and transmitting viruses. The foxglove aphid (*Aulacorthum solani*) and the soybean aphid (*Aphis glycines*) are the most important pests in beans. About 20 species of aphids are known to transmit viruses in beans [1,3]. Soil treatment of systemic insecticides to control sucking pests has some merits: labor-reductive treatment, long effective time and a little effect on natural enemies [2,6,9].

It has been reported that soil treatment of insecticides suppressed occurrence of aphids and mites in soybean fields for 1-3 months [4,9,11,15]. Similar results were reported with potatoes, red beans and radishes [5,6,7,14]. Control of aphids on soybeans and azuki beans could reduce virus damage in early stage by delaying the aphid occurrence [4,6,7,9]. Lee *et al*. reported that chemical control for aphids in radish lowered the virus-infected plant rate [13]. Insecticides applied in soil could provide good conditions for plant growth by controlling pests and increasing nitrate-form nitrogen in soil [8,9].

We report here, the seasonal occurrence of aphids and the effects of infurrow treatment on aphids control in soybean field in 1976.

Materials and Methods

1. Aphids occurrence

Kwang-gyo, a soybean variety, was used in this experiment. Three seeds were planted per seed furrow, each furrow 60x15cm^2 apart, in 30m^2 plot in the field of *Institute of Agricultural Sciences, Suwon on May 18. Aphids counts were taken once a week or in two weeks. Nine leaves (from the upper third, middle third, and lower third of the plant) per plant were selected randomly and the aphids, both alate and apterous, on them were counted. The total number of each aphid species on 270 leaves of 30 plants was counted. Two yellow pans (49x34x9 cm) were installed 70cm above the ground at the border of the plot. The number of 5 aphid species (*A. solani*, *A. glynices*, *Myzus persicae*, *Aphis gossypee*, *Aphis craccivora*) caught in the yellow pans was counted every morning at 10 o'clock.

2. Effectiveness of infurrow treatment

We used split-plot design; with the main plot effect assigned to the insecticides, and the sub

plot effect to the dosage of each insecticide. The plot area was $9m^2$, with 3 replicates. The granulated Carbofuran 3%, granulated Disulfoton 5% and Ortran 2% dust were applied directly to the furrow after planting and the dosages of each insecticide were 2kg, 4kg and 8kg per 10a. Twenty days after seeding, the number of stands and damage rating low (3), middle (2), high (1) of 10 plants (30 seeds) in the center of the plot was investigated. 40 days after seeding virus-infected plants were investigated in the whole plot. The number of aphids on 10 plants (9 leaves per plant) per treatment was evaluated 23, 37, 51 and 64 days after the insecticide treatments. Soybeans were harvested in 3.3 m^2 of the center of the plot, and the yield per 10a was calculated.

Results and Discussion

1. Aphids occurrence

Fig. 1 presents the number of the aphids on the leaves of 30 plants in the untreated plot.

<Fig 1. Seasonal occurrence of aphids in soybean field >

Foxglove aphids appeared in early June and there were two peaks of them, one in middle June and the other in late August to early September. Soybean aphids occurred in late June and showed high density in July and late August.

<Fig 2. Seasonal occurrence of aphids with yellow pan investigation>

Among the aphids were captured in the yellow pans, the portion of foxglove aphids, soybean aphids and green peach aphids were 21.4%, 2.3% and 9.3%, respectively. But foxglove aphids and soybean aphids were dominant in the soybean field. Similar results that the abundance of aphids differed between yellow pan trap and visual counting have been reported in potatoes [1,4]. Visual counting of aphids on plant leaves may give more accurate information on the composition and abundance of the aphid population in a crop field. However, yellow pan traps should be considered as easy and effective monitoring tools.

2. Effectiveness of in-furrow treatment

A. Stands soybean plants and phytotoxicity

Phytotoxicity of the insecticides to soybeans at 20days after seeding was as follows.

(Table 1) The standing soybean plants at 20days after seeding following the in-furrow treatment of insecticides.

Insecticides	Standing soybean plants (%)*		
	2kg	4kg	8kg
Carbofuran 3% G	129.4	110.6	118.8
Disulfoton 5% G	97.6	107.8	97.6
Ortran 2% D	90.6	94.4	70.6

*** : Index to the untreatment**

The rate of standing soybean plants was higher in Carbofuran 4kg and Disulfoton 4kg treated plots than in untreated plot. However, due to the damage from disease and drought during germination time, the rate of standing plants in untreated plot was only 56.3%. It was notable that the rates of standing plants in Carbofuran treated plots were high. Choi et al. [12] reported same results, however, the cause or mechanism of this phenomenon was unknown. Soil treatment of insecticides promoted rice growth and heading so that rice yield was increased [12]. Soil treatment of systemic insecticides affected stands plant rate and plant growth [4,5,7,8,9,15]. Carbofuran treatment might increase the rate of stand plants in this study.

Brown lesions were shown on cotyledons to the second leaves in the Carbofuran treated plots and the damage from Carbofuran increased with the dosage. Disulfoton and Ortran also had light phytotoxicity in seedlings. Several researchers reported similar results [2,4,15].

(Table 2) Degree of the phytotoxic symptoms on 20th day seeding following the infurrow treatment of insecticides.

Insecticides	Phytotoxicity */10 plants		
	2kg	4kg	8kg
Carbofuran 3% G	11.0	17.0	13.0
Disulfoton 5% G	3.0	5.3	6.0
Ortran 2% D	0.3	2.3	0.7

*** : Degree of phytotoxic symptoms were divided into three levels (1,2,3) for each plant.**

B. Virus infected plants

The result of surveying virus-infected plants on 40th day after seeding is presented in table3.

(Table 3) Percentages of infected plants (SMV) * on 40th day after seeding following the infurrow treatment of Insecticides.

Insecticides	Percentages of infected plants/254 plants			
	Untreated	2kg	4kg	8kg
Carbofuran 3% G	1.2	2.8	2.6	2.1
Disulfoton 5%G	1.6	2.2	2.1	1.5
Ortran 2%D	2.4	2.0	2.2	3.4

***SMV-Nec.: Soybean Mosaic Virus Necrotic strain.**

Owing to the low disease incidence, difference was not apparent between treated and untreated plots. Kobayashi [9] reported similar results. However, the effect of soil treatment of insecticides on virus disease could be proved by the fact that control of aphids on azuki beans with Disulfoton reduced virus infection by delaying the aphid occurrence in early growth stage of plant [6].

C. Control efficacy

Table 4 presents population density of aphids investigated for 64 days after the in-furrow treatment.

Table 4 Population density of aphid on soybean plants following the infurrow treatment of insecticides

	Amounts	Numbers of aphids / 9 leaves / 10 plants

Insecticides	(kg/10a)	June		July	
		10(23)*	24(37)	8(51)	21(64)
Carbofuran %G	0	27.3	16.7	251.3	12.7
	2	0.0	0.0	0.7	0.7
	4	0.0	0.3	0.3	0.0
	8	0.0	0.0	0.0	0.0
Disulfoton 5%G	0	17.0	24.7	223.7	22.7
	2	0.0	0.0	0.7	0.7
	4	0.0	1.0	0.0	2.3
	8	0.0	0.0	0.0	0.0
Ortran 2% D	0	16.0	19.0	9.3	15.7
	2	4.3	1.3	12.0	56.0
	4	0.0	9.0	6.0	11.3
	8	0.0	3.7	11.0	7.7

( )*: Days after treatment.

Ortran became less effective from the 51st day after treatment while Carbofuran and Disulfoton were effective to control aphids for 64 days. It is possible to control aphids for long period in soybean when insecticides are applied as in-furrow treatment at seeding. It is supported by many reports that some insecticides were effective for 3 months after treatment [2,4,5,6,7,9,11].

D. Soybean yield

Soybeans were harvested in 3.3.m^2 in the center of the plot. The results are shown in table 5.

Table 5. Yield of soybean following the infurrow treatment of insecticides

Insecticides	Yield (kg/10a)			
	0kg	2kg	4kg	8kg
Carbofuran 3% G	219.7	213.8	202.0	191.4
Disulfoton 5%G	206.3	201.1	187.9	227.0

Ortran	**2%D**	**197.4**	**211.7**	**210.6**	**211.0**

Choi and Lee [2] reported that population density of aphids and mites had no direct effect on soybean yield. However it has been reported that some insecticides increased plant yield by promoting plant growth, acting insecticides as well as acting fungicides in soil. As shown in Table 5, there was not any trend in the yield of soybean and it is possibly due to lodging of plants late in the growing season.

Summary

Seasonal occurrence of aphids in soybean field was investigated and the efficacy of in-furrow treatment of granulated Carbofuran 3%, granulated Disulfoton 5% and Ortran 2% dust with different dosage was evaluated. The results are as follow.

1. Foxglove aphids and soybean aphids were dominant species in the soybean field. Foxglove aphids showed high density in early and late in the season and soybean aphids in July. With yellow pan investigation, density of soybean aphids was low in late season.
2. Stands were high in Carbofuran treated plot and low in Disulfoton and Ortran treated plots. Phytotoxicity of Carbofuran was severe while that of Disulfoton and Ortran were slight.
3. The rate of virus-infected plants was 2 to 3%, and there was no difference among the insecticides and dosage.
4. Carbofuran and Disulfoton were effective for control of aphids for 64 days after treatment, but Disulfoton became less effective from the 51st day.
5. There was no significant difference in the yield among the insecticides and dosage. This is possibly due to lodging of the plants late in the growing season.

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* Its current name is NIAST (National Institute of Agricultural Science and Technology).