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STUDY ON BIOLOGY AND CONTROL OF *APHIS GLYCINES**

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Abstract Results of laboratory and field experiments showed that *Aphis glycines* could reproduce 18-22 generations per year in Jinan, and that generation period, reproductive period and reproduction rate were dependent on temperature. The aphids migrated with two peaks -- in the first ten days of June and between the last ten days of July and first ten days of August. The insect population on soybean plants was low during seedling stage and peaked in the first ten days of August. The aphid was controlled effectively by furrow application of carbofuran (Furaden) and aldicarb (Temik) and by spray application of omethoate (Dimethoate - met) and fenvalerate (Sumicidin).

Key words *Aphis glycines*; Biology; Control

Among the aphids that were confirmed as pests of *Glycine max* in soybean fields, there are three kinds that have been reported in China: *Aphis glycines, A. craccivora*, and *Acyrthosiphon solani*[2,3]. Only *A. glycines* and *A. craccivora* were found to infest soybeans in Shandong province, where *A. glycines* was injurious in the seedling period but had little influence on the soybean growth and yield. But *A. glycines* is one of the most serious pests in Shandong province; and it is also the important vector of soybean mosaic virus [2,3]. There were few research reports on *A. glycines* biology, outbreak dynamics and management techniques in the past, so the authors conducted this research in 1984-1990.

1. Material and methods

1.1 Reproductive generation per year

After aphids appeared on soybeans in the fields, the aphid nymphs were collected and transferred to pot-cultured soybean seedlings having two leaves and a terminal bud (1-2 plants per pot). The variety was Lu-Bean No. 4 (Lu means Shandong); each plant was inoculated using 5 aphids. When they grew to adult aphids and produced 5 nymphs, the five nymphs were retained and the fully-grown aphids and the redundant young aphids were removed. We went on observing the development status of the next generation until the temperature was unsuitable; then we stopped the development and calculated the reproductive generation numbers and determined the relationships between the numbers

and the period of each generation and temperature.

1.2 Reproductive capacity of per aphid

The experiment was carried out in five periods from the middle ten days of July to the last ten days of July, the first ten days of August to the last ten days of August, the last ten days of August to the first ten days of September, the middle ten days of September to the last ten days of September, and the first ten days of October to the first ten days of November respectively. The 10-18 individual alate aphids and 10-18 individual apterous aphids were bred on the soybean seedlings during each period and on each plant. We recorded the reproductive capacity and temperature on each day and calculated the reproductive capacity per aphid and determined the relationship between the reproductive capacity and the reproductive periods and temperature.

1.3 Investigation of dynamic increase and decrease of aphid number in the fields

Yellow-pan trapped aphids: One yellow pan (50cm from the ground) with a 33cm diameter filled with water was placed in the soybean field in summer. We checked the number of the alate aphids in the pan at 8am every morning.

Aphid field population: The investigation was conducted once every 5 days after the soybean seedling emerged. We randomly sampled at 5 points, with 10 plants at each point; then we recorded the aphid numbers, natural enemy species, and soybean developmental periods for the spear leaf and three pieces of compound leaves from the top of the plant.

1.4 Control using insecticides

4% aldicarb (Temik) granules (produced in USA) and 3% carbofuran (Furadan) granules (produced in USA) were used in furrows while planting. The dosages were all 30kg/hm^2 (soybean seeds were not treated). 750ml/hm^2 40% omethoate oil based and 150ml/hm^2, 225ml/hm^2 and 300ml/hm^2 20% fenvalerate (Sumicidin) diluted with 750kg/hm^2 water were uniformly sprayed at the early flowering stage of the plants before the aphid outbreak peak. Blank experiments were set up respectively for comparisons. For each treatment, the sub-zone area was 9m^2, row space was 0.5m; and row length was 3m. Each treatment was repeated three times. The treated varieties were Lu Bean No. 4 and Wenfeng No. 5. We investigated the aphid number on the top three compound leaves of 10 soybean plants respectively, compared with the blank experiments and calculated the control effects.

2. Results and analysis

2.1 Reproductive generations per year

A. glycines could produce 18-22 generations per year in Jinan under condition of abundant nutrition from the middle ten days of July to the end of October until the migration of alate aphids appeared on the soybean seedlings. The average number of generations was 20; the shortest generation period was 2 days, the longest was 16 days. The generation periods had close relationships with temperature: the generation periods gradually prolonged with the decrease of temperature. They were 2-6 days at 22-24.9°C with an average of 4.2 days, 3-6 days at 25-26.9°C with an average of 4.7 days, 4-11 days at 22-24.9°C with an average of 6 days and 6-17 days at below 22°C with an average of 10.7 days.

2.2 Reproductive capacity *A. glycines* individual females

The results of the five-period experiments on the alate aphids and apterous aphids indicated that the apterous aphids' reproductive capacity was the greatest with the average reproductive capacity per aphid of 58.1 at 26.6°C; the alate aphids' reproductive capacity was the greatest with 38 at 26.1°C; the reproductive capacities of alate aphids and apterous aphids decreased markedly when the temperature was higher than 27°C and lower than 26°C; the alate aphids could hardly reproduce when the temperature was lower than 20°C. The generation periods prolonged with the decrease of the temperature. They were 5-11 days at 27.2°C with the average of 7.7 days, 3-13 days at 26.6°C with the average of 10.5 days, 5-21 days at 21.6°C with the average of 12.6 days and 7-34 days at 16.7°C with the average of 20.1 days. The reproductive capacity per aphid decreased with the temperature. The capacities were 5.5, 3.1 and 1.6 respectively when the apterous aphids were at 26.6°C, 21.6°C and 16.7°C (See Table 1).

2.3 Population dynamics of aphids in the fields

The results of the 7-year experiment of the yellow-pan trapped aphid and the investigation in the fields during 1984-1990 indicated that *A. glycines* had two migratory flying peaks in the entire soybean reproducing period. The first one was in the first ten days of June; the second one between the last ten days of July and the first ten days of August. *A. glycines* appeared relatively late in summer in the soybean fields in Shandong province. Only sporadic populations were found in the seedling periods, but the population increased rapidly in the soybean flowering and pod-forming period in the last ten days of July. The population reached a peak in the soybean pod-forming and seed-filling period at the first ten days of August, and the population declined after the last ten days of August

It has been known for many years from our investigation that the natural enemies of *A. glycines* are *Coccinella septempunctata* L., *Propylaea japonica* T. and *Lysiphlebus japonicus* A. etc.

2.4 Insecticidal control

4% aldicarb (Temik) granules and the 3% carbofuran (Furadan) granules were used in the furrows while planting to control *A. glycines*. For the soybeans in spring, the effects of the insecticide could last for 35 days; but for the soybeans in summer, the effects of the insecticide could last for 55 days. The control effects of aldicarb (Temik) were 95.4% and 97.6% respectively and that of carbofuran (Furadan) were 92.2% and 90.2% respectively after the insecticide was used for 15 days and 40 days for the soybeans in spring and summer respectively. The 750ml/hm^2 40% omethoate was diluted 1000 times; its effects could last for 10 days. The control effects of omethoate were 91.8% and 72.9% respectively after it was sprayed for 5 days for the soybeans in spring and summer. The control effects of 150, 225 and 300ml/hm^2 fenvalerate (Sumicidin) on the *A. glycines* were 80.9%-91.7%, 91.9%-95.9% and 94.2%-96.9% respectively after they were sprayed for 24 days for the soybeans in summer.

Table 1. Reproductive capacity of *Aphis glycines* in different phases

Type of aphid	Date of beginning reproduce	Number of aphids	Mean temperature in reproductive period (C)	Reproductive period (day)		Reproductive capacity of one aphid per day		Reproductive capacity per aphid	
				range	average	range	average	range	average
Wingless aphid	7.18	12	27.4	2-13	8	1-12	5.1	10-77	40.8
	8.1	14	27.2	5-11	7.7	1-11	4.8	17-66	37.3
	8.21	15	26.6	7-13	10.5	0-13	5.5	22-82	58.1
	9.11	12	21.6	5-21	12.6	0-7	3.1	15-59	39.0
	10.6	14	16.7	7-34	20.1	0-6	1.6	11-44	30.6
Winged aphid	7.20	10	27.6	1-9	4.3	0-9	4.3	1-49	18.8
	8.2	10	27.0	1-15	10.6	1-8	3.5	3-64	38.0
	8.21	16	26.1	8-20	13.2	0-9	2.9	22-57	38.0
	9.11	11	21.4	2-25	13.1	0-7	2.2	4-47	27.2
	10.7	18	18.3	0-1	18.3	0-1	0.06	0-1	0.06

3. Discussion

It has been shown through this study that *A. glycines* in the Jinan area could reproduce 18-22 generations; that generation periods, reproduction periods and reproductive capacities change with the temperature. *A. glycines* could reproduce on the potted cultured soybean seedlings in the first ten days of October. But it is difficult to see *A. glycines* in the first ten days of September in the fields. This is because the host tissue becomes decrepit and the nutritional condition of the plant changes. The relationship between the nutritive composition of soybean tissue and the growth development of the *A. glycines* deserves further research and discussion.

It was reported that *A. glycines* lived through winters on *Rhamnus davurica*[1]. But there is little *R. davurica* that appears in the Shandong area. The authors investigated some

plants such as the *R. davurica*, *R. parvifolia*, and *R. globosa* etc. in Taian (Tai Mountain), Jinan and Xixia etc. in spring and autumn during recent s years and also found another aphid similar to *A. glycines*. But the experiments were not successful when we bred it on soybeans repeatedly. In addition, field investigations from 7 years (1984-1990) show that the period when *A. glycines* appears is after the last ten days of July, which is obviously later than Jiaodong (Xixia) area and northeast area where the plant climate is even later. In 1990, the aphid number on every 100 plants reached 120-690 in the Xixia area; and the aphid population on every 100 plants had reached above 600 until the end of May in Sipin area, Jilin province where the control had started. Therefore, the outbreak cycle of the *A. glycines* in Shandong province needs further research.

As for the control of *A. glycines*, if 750ml/hm^2 omethoate or 225-300ml/hm^2 fenvalerate (Sumicidin) is sprayed before the aphid population reaches its peak, aphids could be effectively controlled. Because *A. glycines* is not serious in the seedling period, although aldicarb (Temik) and carbofuran (Furadan) are effective against seedling aphids, their effects in the conducive outbreak periods are relatively low; it is not suitable to use aldicarb (Temik) and carbofuran (Furadan) on the west plains of Shandong province where the outbreak of the *A. glycines* is relatively late.

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