Source: Journal of the Korean Society of Crop Science [Han'guk Changmul Hakhoe chi] (1980) v. 25(3) p.35-40
Translated by Taeyu Yun, National Institute of Agricultural Science and Technology; edited by Donna Schenck-Hamlin, Kansas State University, 2003

# Studies on the Density of Soybean Aphids in Different Cultivars, Planting Dates and Spacing

Chung, K.H., S.H. Kwon and Y.I. Lee

## Abstract

In order to evaluate the fluctuation of the soybean aphid (*Aphis glycines* Matsumura) population, six leading soybean cultivars were planted on five different planting dates with different plant densities. The survey of aphid population and climate condition was made from June through September in 1978. According to the differences of planting dates and plant density the soybean aphid populations were varied, and varietal response to the aphid was significantly different. Counting of aphid infestation on the top third trifoliate leaf seemed to be efficient for the estimation of soybean aphid population.

## Introduction

Aphids have a great number of species and occur continuously during a growing season. They mainly attack newly emerged leaves, so the damage to plant growth is serious. In the case of Moapa alfalfa, it was almost killed off by infestation of two spotted alfalfa aphids [7,8]. The soybean aphid has become a very important pest of soybean in soybean growing areas, since it causes retarded plant growth in early stages and transmits plant pathogenic viruses. One of the limitations to chemical control of aphids is resistance against insecticides. As alternatives to chemical control, biological and cultural control has recently been considered.

Painter [9,10] has reported different responses of insects with plants. Havey and Hackerott [3] noted varietal responses to aphids in alfalfa. The fact that several varieties of alfalfa had fewer aphids than others was reported by Dobson and Watts [2]. Howe and Smith [4] reported that only a few instars of aphids survived on leaves of resistant plants. Also Nielson and Curie [6] reported that the reproduction and viability of aphids were lowered on highly resistant alfalfa variety. This resistance can be explained with tolerance and antibiosis. Many studies have been conducted to reveal the mechanism of resistance, but breeding of resistant varieties has not been successful.

The seasonal occurrence and occurrence patterns of soybean aphids according to cultural conditions and soybean varieties were examined as a basic study for ecological control of soybean aphids.

## Materials and Methods

### 1) Seasonal occurrence of soybean aphids

To investigate the seasonal occurrence of soybean aphids, six varieties of soybean were planted on 9 May. Each variety plot was 60 cm apart and each soybean seed was 10cm apart. The aphid count was made weekly after seeding to 15 September. The number of aphids on the top 3rd trifoliate leaves of 30 plants was counted, with 3 replicates [6]. The highest and lowest temperature of a day, the temperature at 10 a.m. and rainfall were recorded during the season to reveal the relation between climate condition and fluctuation of aphids population. Also the number of aphids on a whole plant and on the top third trifoliate leaf was compared.

### 2) Occurrence patterns of soybean aphids according to cultural condition and soybean varieties

The aphid population was observed by planting date, plant density and variety. Six varieties of soybean were planted on May 9, 20, June 5, 20, and July 5. The distances between seeds were 10cm, 20cm and 30cm, each row 60cm apart. Aphid counts were made as above. Influences of planting date, plant density and varieties on the fluctuation of the aphid population were compared.

## Results and Discussion

### 1) Seasonal occurrence of soybean aphids

Aphid counts were made once a week from May 26 to September 15. Aphids emerged on June 2 and reached the first peak on June 23, but their density was not significantly high. The aphid population decreased sharply - on July 14 there were only a few aphids - then increased on July 26 and made the highest peak in the season on August 18 (Fig. 1).

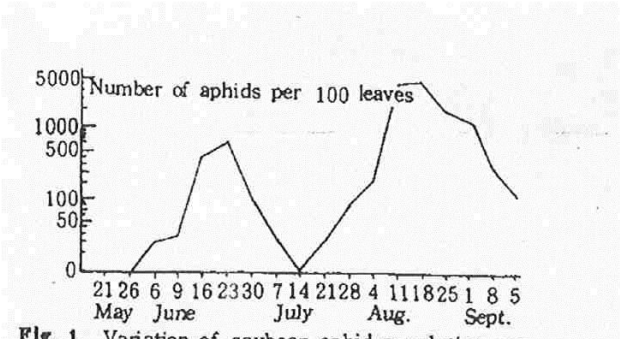


Fig. 1. Variation of soybean aphid population per 100 top third leaves from May 21 to September 15 in 1978.

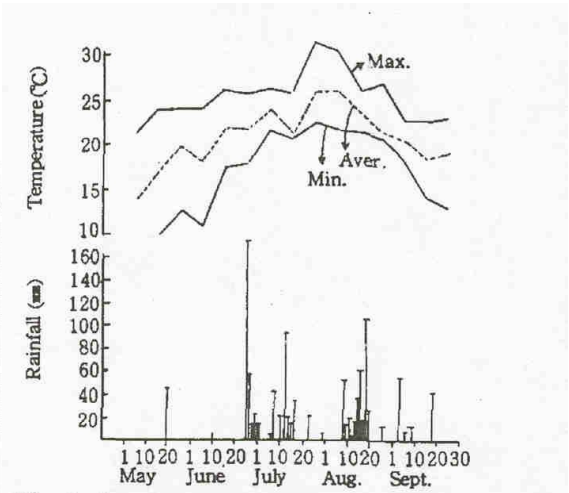


Fig. 2. Temperature and rainfalls at Keumgok Experimental Farm May to September in 1978.

The population density at the second peak was 8 times higher than at the first peak. Fig. 2 presents the

temperature and rainfall at the soybean field during May to September.

The temperature began to rise in early May. The average temperature per month rose from 13.5 °C in early May to 21.9 °C in June. The temperature in mid-June was favorable for aphid growth and reproduction, so the population increased. The heavy rainfalls from late June to middle July were thought to cause a decrease in the aphid population. The low rainfall from late July to early August and the comparatively low temperature in early August in this year might have caused the highest peak on August 18. An unusual heavy rain and weakened leaves in late August might have decreased the aphid population. Since the experimental field is located in the northern part of middle Korea, the temperature is lower in Fall. The low temperature possibly affected soybean growth rather than the aphid population directly. Consequently, the decrease in aphid population during Fall was due to withered leaves. Choi et al. [1] reported that 3 peaks in aphid population were shown in a season in Suwon, the first one in July, the others in August and mid-September.

**Table 1.** Percent of soybean aphid counts on the top third leaf vs whole plant

| Varieties | Percent of aphid on top 3rd leaf/whole plant | | | | | | |
|---|---|---|---|---|---|---|---|
| | June 30 | July 14 | July 28 | Aug. 11 | Aug. 25 | Sept. 8 | Average |
| Chungbuk-baik | 25.2 | — | 35.1 | 13.1 | 9.8 | 28.3 | 22.3 |
| Kadamishiro | 24.6 | 15.6 | — | 14.2 | 8.4 | 22.0 | 17.0 |
| Clark | 6.7 | 24.5 | 67.3 | 14.7 | 10.0 | 17.9 | 23.5 |
| Bong-eui | 9.3 | — | 57.7 | 10.0 | 8.2 | 23.4 | 21.7 |
| Kumkang-daerip | 8.3 | 13.9 | 28.1 | 14.5 | 9.4 | 35.9 | 18.4 |
| KEX-2 | 11.5 | 30.8 | 54.6 | 12.8 | 9.0 | 24.9 | 23.9 |
| Average | 14.3 | 21.2 | 48.6 | 13.2 | 9.1 | 25.4 | 21.5 |

**Table 2.** Percent of soybean aphid counts top third leaf vs whole plant count in different ecological types of soybean

| Plant types | Aphid count in percent | | |
|---|---|---|---|
| | June23-July28 | Aug.11-Sept.8 | Average |
| Determinate | 23.1 | 18.6 | 20.9 |
| Indeterminate | 29.4 | 14.6 | 20.9 |

It is difficult to observe aphid populations accurately, due to their small size and distribution on a whole plant. For more convenient monitoring, counts of aphid infestation on the top third trifoliate leaf were used and its portion of total aphids on a plant was examined, as shown in table 1. The percent ranged 9.1% to 48.6% and the average was 21.5%. This indicated that soybean aphids tend to aggregate on the top part of a plant. There was a tendency for the aphid population to increase or decrease with the number of aphids on the top third trifoliate leaf. Also, differences in the distribution pattern of aphids with the ecological types of soybean, determinate and indeterminate were investigated, but there was no significant difference (Table 2). Nielson [5] suggested that the best sampling method of spotted alfalfa aphids was counting the number of aphids on trifoliate leaves selected from the top, middle and bottom portion of alfalfa. However, in soybean it is recommended to count the number of aphids on the top part of the plants because of the morphological character of soybean.

**2) Occurrence patterns of soybean aphids according to cultural condition and soybean varieties**

The number of soybean aphids on six varieties with different planting date are shown in Table 3.

**Table 3.** Number of soybean aphids on the top third the growth period in several soybean varieties

| Varieties | Planting date | | | | | |
|---|---|---|---|---|---|---|
| | May 9 | May 20 | June 5 | June 20 | July 5 | Average |
| Chungbuk-baik | 12.7 | 7.0 | 6.8 | 3.5 | 7.3 | 7.5 |
| Kadamishiro | 11.2 | 9.7 | 9.1 | 9.5 | 12.2 | 10.3 |
| Clark | 10.8 | 9.4 | 8.7 | 9.5 | 17.3 | 11.1 |
| Bong-eui | 12.1 | 8.1 | 7.3 | 6.8 | 9.9 | 8.8 |
| Kumkang-daerip | 14.0 | 10.4 | 13.7 | 9.6 | 15.9 | 12.7 |
| KEX-2 | 9.6 | 10.0 | 8.9 | 6.6 | 11.7 | 9.4 |
| Average | 11.7 | 9.1 | 9.1 | 7.6 | 12.4 | 10.0 |

The highest density of aphid population was shown in the plot planted on July 5 and the lowest in the plot planted on June 20. This could be explained with the soybean growth and the weather condition for aphid occurrence. The counting date of the plot planted on July 5 was mid-August, and it was also the highest peak of the aphid population shown in Fig. 1. Soybeans in the plot planted on June 20, having the lowest aphids population density, were grown in the monsoon season. Therefore, the aphid population could not increase in this plot. As a result of an ANOVA of the aphid population, the plots of May 9 and July 5 were significantly different from other plots, as shown in table 4. Therefore, the damage from aphids was great in soybeans planted in early May or late July. Temperature, rainfall, and growth stage of plants influenced the population of aphids, so the damage of soybean from aphids might vary greatly.

**Table 4.** Analysis of variance for soybean aphid count in different planting dates

| Source of variation | Degrees of freedom | Sum of squares | Mean of squares | F |
|---|---|---|---|---|
| Total | 29 | 2212.06 | | |
| Between varieties | 5 | 768.51 | 153.70 | 5.37** |
| Between planting dates | 4 | 871.36 | 217.84 | 7.61** |
| Error | 20 | 572.19 | 28.61 | |

** significant at 1%

The abundance of soybean aphids with different plant densities and the result of ANOVA are presented in tables 5 and 6. Plant density increased with a decrease in the aphid population density per plant. The aphid population of the plot of 60x10 cm was significantly lower than that of the plot of 60x30cm.

Table 5. Number of soybean aphids on the top third leaf planted in different plant spacing

| Varieties | Plant spacing(cm) | | | | |
|---|---|---|---|---|---|
| | 60 × 10 | 60 × 20 | 60 × 30 | Total | Average |
| Chungbuk-baik | 7.6 | 8.7 | 9.5 | 25.8 | 8.6 |
| Kadamishiro | 10.2 | 13.2 | 13.7 | 37.1 | 12.4 |
| Clark | 10.6 | 12.0 | 12.5 | 35.1 | 11.7 |
| Bong-eui | 8.8 | 9.9 | 10.4 | 29.1 | 9.7 |
| Kumkang-daerip | 12.5 | 13.6 | 14.7 | 40.8 | 13.6 |
| KEX-2 | 9.2 | 11.1 | 12.2 | 32.5 | 10.8 |
| Total | 58.9 | 68.5 | 73.0 | | |
| Average | 9.8 | 11.4 | 12.1 | | 11.1 |

Table 6. Analysis of variance for soybean aphid count in different plant spacings

| Source of variation | Degrees of freedom | Sum of squares | Mean squares | F |
|---|---|---|---|---|
| Total | 17 | 68.76 | | |
| Between varieties | 5 | 49.47 | 9.89 | 49.45** |
| Between plant spacings | 2 | 17.29 | 8.65 | 43.25** |
| Error | 10 | 9.00 | 0.20 | |

** significant at 1%

Six varieties including Chungbuk-baik were tested. There was a significant difference in aphids present on the soybean varieties (Table 3,4,5,6). Among the tested varieties Chungbuk-baik was the most resistant variety and Kumkang-daerip showed high susceptibility to the soybean aphid. The same result was obtained in our laboratory experiment (unpublished). Since varietal response to aphids was proven to be significantly different, resistant varieties to the soybean aphid can be selected, although the effectiveness may be low.

## Summary

As a basic study for ecological control of the soybean aphid (*Aphis glycines* Matsumura), six leading cultivars were planted on different planting dates from May to July with 3 levels of plant spacing, and aphid counts at 7-day intervals were made from May to September 1978. For the estimation of aphid population the aphids infested on the top third leaf or whole plant were counted. The results obtained are summarized as follows:

1. Soybean aphid population showed two peaks, one on June 23 and the other on August 18. The population of the second peak was about 8 times higher than that of the first one.
2. About 20% of the aphids appeared on the top third leaf and the percentages varied from 9 to 49% with the season.
3. Aphid population was significantly increased in the early or later planting plots.
4. Varietal response of aphid infestation was significantly different at 1% level.
5. Plant spacing seemed to affect the aphid population and sparse plant spacing increased the population density.

## References

1. Choi, K.M., Y.J. Ahn and B.I. Lee. 1972. Report of ecology and control of soybean pests. RDA Report (Vol.2):188-214.

2. Dobson, R.C. and J.G. Watts. 1957. Spotted alfalfa aphid occurrence on seedling alfalfa as influence by systemic insecticides and varieties. Jour. Econ. Ent. 50:132-135.

3. Harvey, T.L. and H.L. Hackerott. 1956. Apparent resistance to the spotted alfalfa aphid selected from seedlings of susceptible alfalfa varieties. Jour. Econ. Ent. 49:289-291.

4. Howe, W.I. and O.F. Smith. 1959. Resistance to the spotted alfalfa aphid in Lahontan alfalfa. Jour. Econ. Ent. 50: 320-324.

5. Nielson, M.W. 1957. Sampling technique studies on the spotted alfalfa aphid. Jour. Econ. Ent. 50:385-389.

6. _____ and W.E. Curie. 1959. Effect of alfalfa variety on the biology of the spotted alfalfa aphid in Arizona. Jour. Econ. Ent. 52(5):1023-1024.

7. _____, M.H. Schonhorst and H. Don. 1969. Arizona alfalfa resist new strain of the spotted alfalfa aphid. Prog. Agr. Ariz. 21:18-19.

8. _____ , W.F. Lehman and V.L. Marble. 1970. A new severe strain of the spotted alfalfa aphid in California. Jour. Econ. Ent. 63:1489-1491.

9. Painter, R.H. 1951. Insect resistance in crop plants. Macmillan, New York. p. 520.

10. _____. 1958. Resistance of plants to insects. Ann. Rev. Ent. 4: 267-290.