6-1-1976

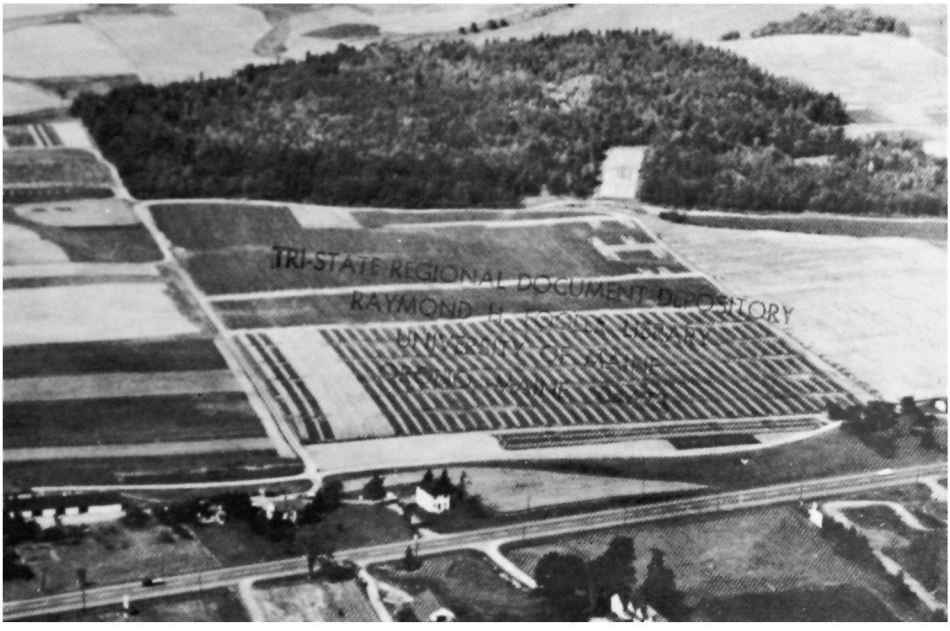
TB83: Insecticidal Control of Potato Infesting Aphids in Northeastern Maine

Geddes W. Simpson

R. H. Storch

INSECTICIDAL CONTROL OF POTATO INFESTING APHIDS IN NORTHEASTERN MAINE

Geddes W. Simpson and R. H. Storch



LIFE SCIENCES AND AGRICULTURE EXPERIMENT STATION
UNIVERSITY OF MAINE AT ORONO

JUNE 1976

Financial support for these tests was derived in part from Hatch Funds and in part from grants-in-aid from many of the companies whose products were included in the experiments. These grants-in-aid are noted in the annual reports of the Maine Agricultural Experiment Station. We also gratefully acknowledge the technical assistance of Roger Jardine and our summer field assistants for providing data on numbers of aphids present in the various experimental plots.

No recommendations for the use of any of the insecticides mentioned in this bulletin are made because such recommendations come each year from the Cooperative Extension Service of the University of Maine and are likely to change from time to time depending on registrations and other considerations. Some of the materials tested in these experiments are not yet cleared for use on commercial potatoes.

Anyone wishing to use any of these materials will need to determine their availability and registration status at any given time. This can be done by writing to the Cooperative Extension Service, University of Maine, Orono, Maine, 04473.

TABLE OF CONTENTS

SUMMARY

Aphid populations for the growing seasons of 1970, 1971, and 1972 were variable. It is possible, however, to rate the efficacy of the various insecticides tested in controlling potato infesting aphids in Northeastern Maine. Soil applications of aldicarb and DS 15,647 and foliar application of acephate were the most effective materials tested. The insecticides phosmet (foliar) and phoxim (soil) did not provide much protection against potato infesting aphids in these tests. Bayer 77,049, parathion, Penick SBP 1382, Sandoz-Wander 52,139 and Uniroyal 840 did not provide effective control of potato infesting aphids at the rates used in these tests. All other insecticides tested adequately controlled aphid populations, but their effects on the spread of leaf roll varied. Some of the materials tested were experimental materials and not all are available for commercial use.

Insecticidal Control of Potato Infesting Aphids in Northeastern Maine

Geddes W. Simpson and R. H. Storch
Department of Entomology

The potato crop in Maine may be infested with one or more of 4 species of aphids.[1] If sufficiently numerous, these aphids can cause losses in yield. When virus diseases are present in the seed planted, these diseases may be spread to healthy plants through the natural movements of the aphids within the crop. One of the major virus diseases in Maine is potato leaf roll (*Corium solani* Holmes) which, if abundant, may reduce yields and, in certain varieties, cause net necrosis in tubers produced by recently infected plants. Where leaf roll is concerned, rather small numbers of aphids, especially green peach aphids, can effect considerable transmission of the virus. Thus measures that prevent loss in yield may be unsatisfactory from the standpoint of the seed potato grower and the grower of Green Mountains or Russet Burbank for processing or the fresh market.

This bulletin reports the results of 9 experiments carried out at Aroostook Farm, Presque Isle, Maine, in 1970, 1971 and 1972 as they relate to the control of potato infesting aphids, and the spread of potato leaf roll in Katahdin potatoes.

MATERIALS AND METHODS

All of the experiments were carried out on plots that were 4 rows wide and 50 feet long. These plots were surrounded with oats planted at the same time as the potatoes (Shands *et al* 1950).[2] All plots were planted by hand using seed pieces weighing about 2 oz. each, spaced 12 in. apart in rows 34 inches apart. The seed used was essentially free of leaf roll but 4 seed pieces from plants known to be diseased were placed systematically

[1]The buckthorn aphid, *Aphis nasturtii* Kalt.; the green peach aphid, *Myzus persicae* (Sulz.); the potato aphid, *Macrosiphum euphorbiae* (Thos.); and the foxglove aphid, *Acyrthosiphon solani* (Kalt.).

[2]Shands, W. A., G. W. Simpson, P. M. Lombard, R. M. Cobb and P. H. Lung. 1950. Control of Aphids on Potatoes with DDT When Used with a Fungicide. Maine A. E. S. Bull. 480.

in each plot to provide a source of virus. Such plants were allowed to remain in the plots throughout the season. They were staked in July so that these diseased hills could be avoided when taking tuber samples at harvest time to determine seasonal spread of leaf roll.

Fertilizer formulations at recommended rates were applied prior to hand planting of the seed potatoes. Hilling operations were those customary in the area.

Fungicides were applied regularly for the control of late blight *Phytophthora infestans* (Mont.) DeBary. Maneb was used at increasing rates as the season progressed, starting with a pound to the acre.

Systemic insecticides were applied to the planting furrow, or in a few instances broadcast and worked into the soil just before seed pieces were dropped. The granular formulations were distributed using a plastic tube fitted with a cork in which a hole was drilled. Weighed amounts of the granular insecticides were available in plastic cups — one for each row of each treated plot. Reasonably uniform distribution of the granular materials was obtained by moving along the row at a uniform rate which varied with the different formulations being tested.

In a few instances, liquid formulations of certain insecticides were applied in the row or broadcast and worked into the soil before rowing out.

Foliar insecticides were applied at various intervals using the Slosser sprayer (Slosser 1945).[3] All sprays were applied at the rate of 125 gallons per acre under a line pressure of 200 psi.

Timing of the insecticidal sprays was determined using data from weekly counts of the aphids made in the two center rows of each plot. These counts were based on the examination of 3 leaves (top, middle, bottom) on each of 25 plants in each plot (Shands *et al* 1950[2]). In most instances insecticidal materials were reapplied if and when half of the count plants were found to be infested.

In the fall, after the potato tops had been killed with a chemical top killer or by frost, single tubers were taken from each of 52 hills located in the 4 rows of each plot, avoiding diseased hills marked with stakes in July. These tubers were stored over the winter and planted out the following spring. Plants growing from these tubers were read for leaf roll in July and the amount of spread determined. Since all plants came from tubers produced by plants growing the year before from healthy seed pieces, any leaf roll recorded represented current season spread of the virus.

In these experiments no yields were taken because aphid populations were not large enough to influence yield.

---

[3]Slosser, John W. 1945. An improved sprayer boom for potatoes and other row crops. Agr. Eng. 26:453-55.

Tests. Table 1 shows the treatments in the 3 6x6 latin squares employed in 1970. Table 2 shows similar information for 1971, while the data for 1972 are shown in Table 3.

Analysis of data. The data from the aphid counts were subjected to analyses of variance following transformation of the raw data.

The spread of leaf roll was determined from field readings in the following year.

Results. Information from the 9 tests is presented by years in three sections, one dealing with the green peach aphid, one with the buckthorn aphid and one with the potato aphid. Foxglove aphids were few in number during the three years of these tests.

Table 1. Materials, rates and dates of application in 1970

Treatment number	Insecticide	Rate/acre oz. ai	Dates of application
	Test A		
1	DuPont 1410-L	4	7/30,8/20
2	Penick SBP 1382	6	7/30,8/6,8/20
3	phosmet	16	7/30,8/6,8/20
4	DuPont 1410-L	8	7/30,8/20
5	phosmet	32	7/30,8/20
6	Penick SBP 1382	12	7/30,8/20
	Test B		
1	aldicarb	16	5/29
2	phosalone	2	7/23,8/6,8/20
3	carbofuran	16	5/29
4	parathion	3.2	7/23,8/6,8/20
5	phosalone	4	7/23,8/6,8/20
6	carbofuran	16	7/23,8/6,8/20
	Test C		
1	disulfoton 15 G	16 furrow	5/29
2	disulfoton 6 LC	48 broadcast	5/28
3	Bayer 77,049	4 foliar	7/23,8/6,8/20
4	disulfoton 6 LC	16 foliar	7/23
5	disulfoton 15 G	48 broadcast	5/28
6	Bayer 93,820	8 foliar	7/23,8/6,8/20

Table 2. Materials, rates and dates of application in 1971

Treatment number	Insecticide	Rate/acre oz. ai	Dates of application
	Test D		
1	pirimicarb	8	7/21,8/6
2	aldicarb	48	5/19
3	pirimicarb	16	7/21
4	disulfoton	16	5/19
5	aldicarb	16	5/19
6	disulfoton	8	7/21
	Test E[1]		
1	phoxim	8	6/3
2	phoxim	16	6/3
3	Uniroyal 840	6	7/21
4	Uniroyal 840	18	7/21
5	phoxim	32	6/3
6	acephate	16	7/21,8/6
	Test F		
1	parathion	3.2	7/21,8/6,8/12
2	untreated	—	—
3	untreated	—	—
4	disulfoton 6 LC	16	7/21
5	phosmet	24	7/21,8/6,8/12
6	phosalone	4	7/21,8/6,8/12

[1]Treatments 1, 2 and 5 were sprayed with disulfoton at 16 oz., 8 oz., and 4 oz., aia respectively on August 6.

Table 3. Materials, rates and dates of application in 1972

Treatment number	Insecticide	Rate/acre oz. ai	Dates of application
	Test G		
1	monocrotophos	6.4	7/19,8/10,8/17
2	ethiofencarb	16	7/19
3	Sandoz-Wander 52,139	16	7/19,8/10
4	Sandoz-Wander 52,139	8	7/19,8/10
5	monocrotophos	12.8	7/19,8/10
6	ethiofencarb	8	7/19
	Test H		
1	aldicarb	16	5/31
2	acephate	8	7/19
3	disulfoton	32	5/31
4	phosmet	*	7/19,7/26,8/3,8/10
5	Diamond-Shamrock DS-15,647	24	5/31
6	Diamond-Shamrock DS-15,647	48	5/31
* 8 oz., 16 oz., 32 oz., 32 oz.			
	Test J		
1	demeton	16	5/31
2	pirimicarb	8	8/3
3	disulfoton 6 LC	8	8/3
4	phosalone	4	8/3
5	disulfoton + acephate	16+8	5/31, 8/3
6	disulfoton 6 LC	16	8/3

RESULTS OF INSECTICIDE TRIALS

Section I — The Green Peach Aphid

1970 Tests. *Test A (Table 1) (Figure 1)*

Numbers of aphids. Populations developed slowly and were never large. The insecticides were applied to all treatments on July 30. The low rate of Penick SBP 1382 and phosmet were repeated on Aug. 6. The count on Aug. 14 showed no clear-cut differences. The high rate of Penick SBP 1382 was inferior to the high rate of phosmet but neither differed from the untreated plot. Populations peaked in mid August, but there were no differences found on Aug. 19. All treatments were repeated on Aug. 20. A week later, the low rate of phosmet was inferior to both rates of DuPont 1410-L and of Penick SBP 1382, but none of these differed from the check plot.

Percent of plants populated. On the basis of the percent of plants populated by the green peach aphid on Aug. 27, the low rate of Dupont 1410-L was superior to both rates of phosmet.

Test B (Table 1) (Figure 2)

Numbers of aphids. Populations were never large in these plots. The foliar materials were applied on July 23, August 6 and August 20. In mid August, the best treatment was aldicarb applied in the furrow on May 29. It was superior to the check and to foliar treatments of parathion or phosalone, but did not differ from the remaining treatments. Following the foliar treatments applied on August 20, a foliar spray of carbofuran was superior to a furrow treatment made in late May as well as to parathion and to the high rate of phosalone. It did not differ from a furrow treatment of aldicarb, from the check or from the low rate of phosalone.

Percent of plants populated. These data were similar to those for numbers of aphids, except that at the time of the final count the foliar treatment with carbofuran was superior to the check as well.

Test C (Table 1) (Figure 3)

Numbers of aphids. Populations were low in these plots. At the end of the season, there was some build-up, especially in plots treated with disulfoton at planting time.

Percent of plants populated. Analyses of variance showed no significant differences until the final count on August 24 when three applications of Bayer 93,820 were shown to be superior to all four treatments with disulfoton.

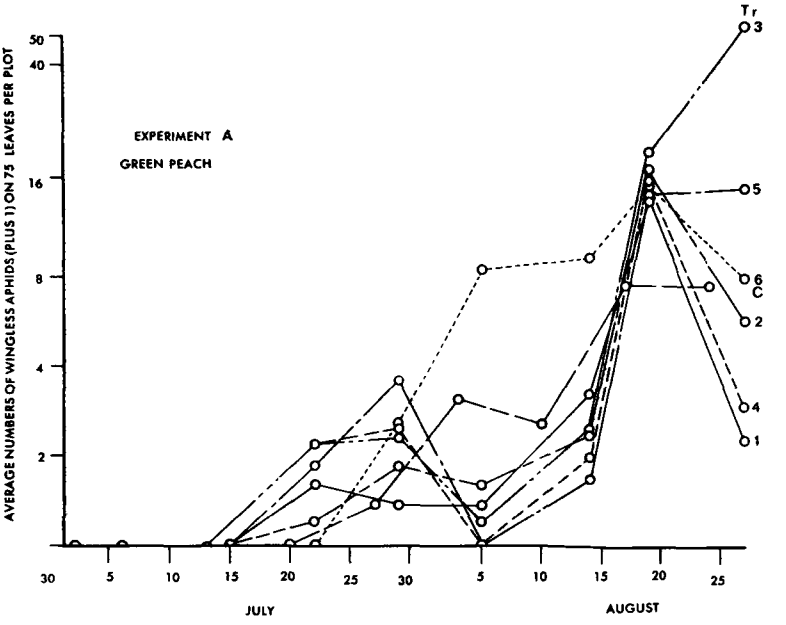


Figure 1. Population trends of the green peach aphid, Test A, 1970.

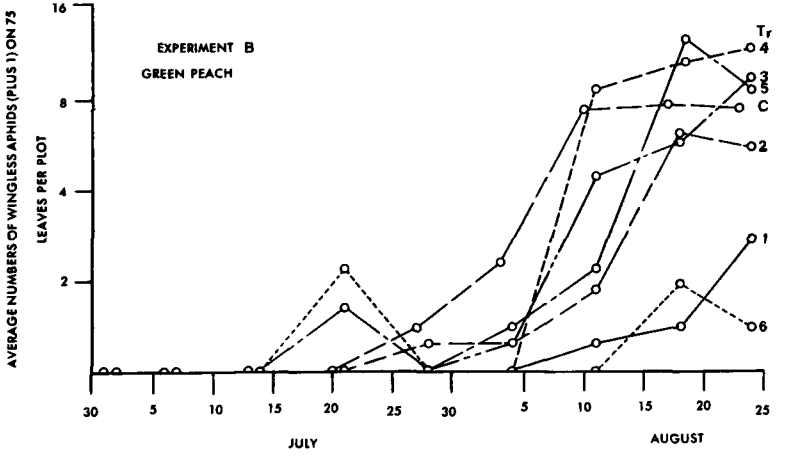


Figure 2. Population trends of the green peach aphid, Test B, 1970.

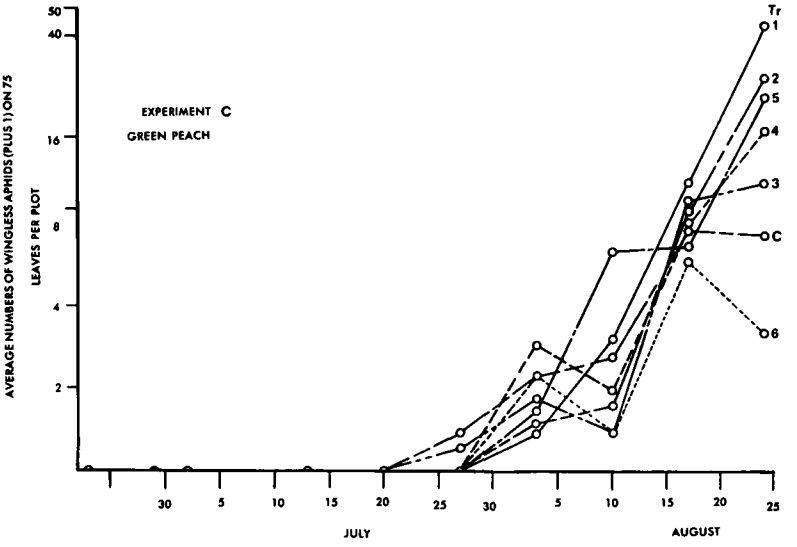


Figure 3. Population trends of the green peach aphid, Test C, 1970.

1971 Tests

Test D (Table 2) (Figure 4)

Numbers of aphids. Populations were low in these plots. By mid August, populations in the plots treated with disulfoton at planting time were significantly larger than populations in plots treated otherwise, indicating a loss in residual toxicity; aldicarb retained its effectiveness throughout the season but the two rates did not differ. On August 24, aldicarb was superior to other treatments except for two applications of the low rate of pirimicarb.

Percent of plants populated. The high rate of aldicarb prevented the establishment of aphid colonies throughout the season. The low rate kept populations at a very low level through August 24. Both rates were superior to all but two applications of the low rate of pirimicarb.

Test E (Table 2) (Figure 5)

Numbers of aphids. Populations were very low in these plots as well as in the associated check. Phoxim as a furrow treatment had no apparent effect on the aphids. These three treatments were then used to test three rates of disulfoton on August 6. Analyses of variance showed no clear-cut differences. Acephate was superior to the check a week after the first treatment. On August 25, after a second application, this treatment was

better than all others except for treatment 5 which had been sprayed with disulfoton on August 6.

Percent of plants populated. The four sprays on August 6 resulted in reductions in numbers of infested plants that differed from the check. On August 25, acephate and one of the disulfoton treatments were different from the check but the rates of disulfoton were not different, nor did they differ from the two treatments receiving the Uniroyal material.

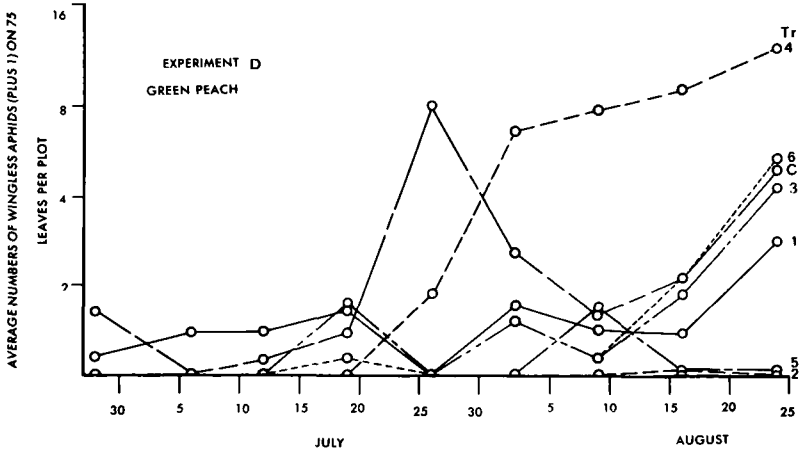


Figure 4. Population trends of the green peach aphid, Test D, 1971.

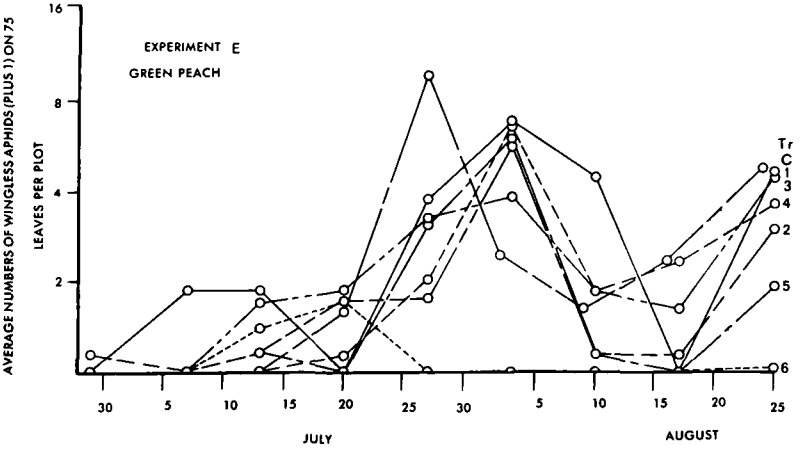


Figure 5. Population trends of the green peach aphid, Test E, 1971.

Test F (Table 2) (Figure 6)

Numbers of aphids. Populations were low following the first treatments on July 21. From mid August on, populations increased in the plots treated with parathion or phosmet. The differences were highly significant. Plots treated with disulfoton or phosalone did not differ from the untreated plots. This is the first time that resistance to parathion has been encountered in our experimental work in Maine.

Percent of plants populated. While there were no clear-cut differences, the percent of plants populated in plots treated with parathion or phosmet tended to increase during August at a time when, in the untreated plots, fewer plants were found to be infested.

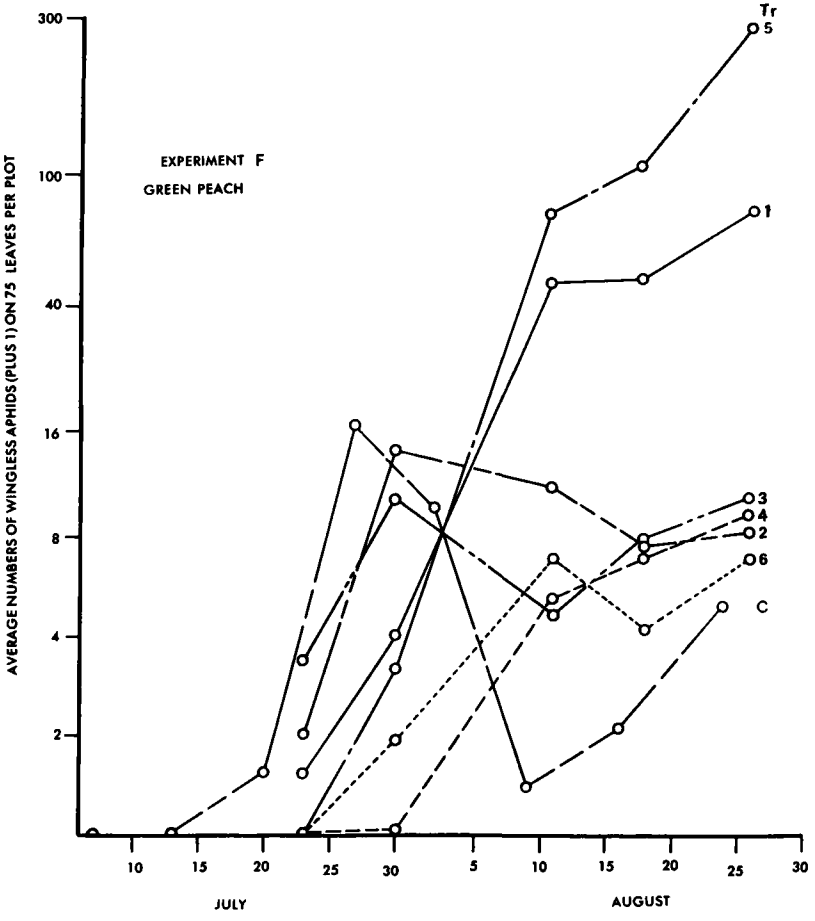


Figure 6. Population trends of the green peach aphid, Test F, 1971.

1972 Tests *Test G (Table 3) (Figure 7)*

Numbers of aphids. Just before the first application of the sprays, the check plot had fewer aphids than the others. Following the treatment of July 19, all treated plots had significantly fewer aphids than the check. Except for the count of August 21 when it differed only from the low rate of monocrotophos, populations rose to high levels, following the last application on August 17. The two rates of Sandoz-Wander 52,139 did not differ significantly but the high rate was always numerically superior.

Percent of plants populated. Following the application of July 19, the high rates of ethiofencarb[4] and Sandoz-Wander 52,139 resulted in zero counts and a significant difference between these and the other plots. The other four treatments were superior to the check. At the next count, the check and the low rate of monocrotophos did not differ but were inferior to the remaining treatments. The first count in August showed the high rate of ethiofencarb continuing to be better than the other treatments. The low rate was also better than all treatments except for the high rate of Sandoz-Wander 52,139. The materials other than ethiofencarb were re-applied on August 10. While there was some reduction following the treatment, the high rate of ethiofencarb was still significantly better than the other treatments. At that time the high rate of Sandoz-Wander 52,139 among the remaining treatments differed only from the low rate of monocrotophos. After mid August, the numbers of infested plants increased more rapidly in the treated plots than in the check from which all treatments differed significantly. At the time of the final count all plants in plots treated with either rate of monocrotophos were found to be infested.

Test H (Table 3) (Figure 8)

Numbers of aphids. The formulation of phosmet used was ineffective and the counts showed no difference from or inferiority to the check throughout the season. Aphids were able to colonize the plots treated with disulfoton by the first of August. The population continued to increase in these plots during the rest of the month to a greater extent than in the check but these differences were significant only on August 23.

A single treatment with acephate on July 19 reduced populations to a low level until mid August. They remained below the check numerically but did not differ statistically. Single applications of aldicarb or Diamond-Shamrock DS-15,647 gave all season protection against the green peach aphid. The high rate of DS-15,647 was significantly better than the low rate after mid August. The high rate of DS-15,647 was also better than the aldicarb.

Percent of plants populated. On July 25, all of the furrow treatments were significantly better than the foliar ones; these latter did not differ from

[4]= ® Croneton=HOX 1901.

the check. During August, disulfoton treated plots became infested and counts in late August showed all plants to be infested. This was also true of the plots treated four times with phosmet. In mid August, plots treated with aldicarb had significantly fewer plants populated than any other plots. Later in the month, the number of plants infested in these plots increased somewhat and only the high rate of DS-15,647 was significantly better than other treatments.

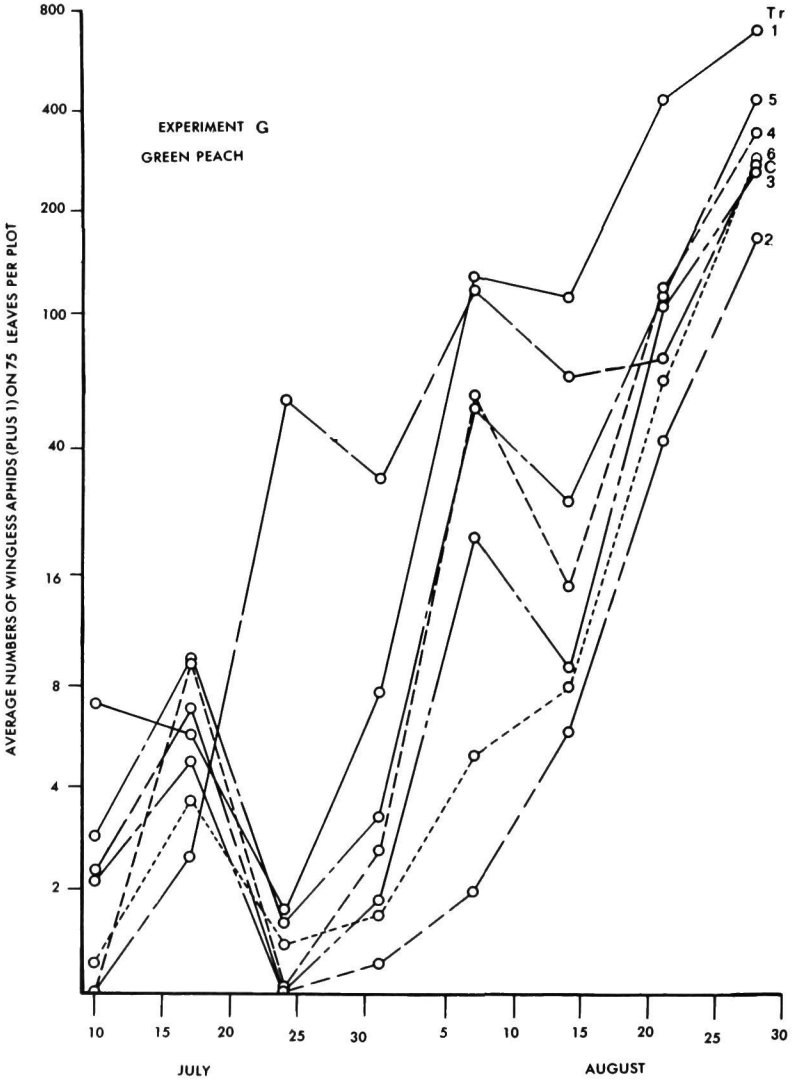


Figure 7. Population trends of the green peach aphid, Test G, 1972.

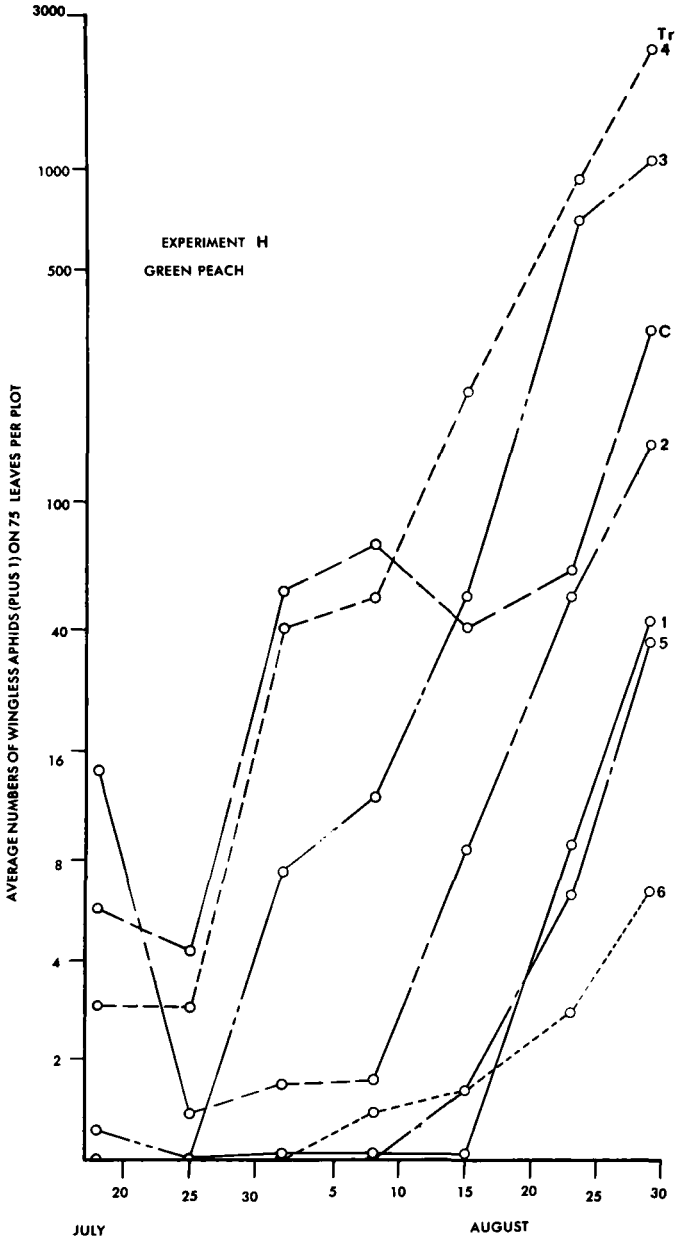


Figure 8. Population trends of the green peach aphid, Test H, 1972.

Test J (Table 3) (Figure 9)

Numbers of aphids. Just before the application of the foliar sprays on August 3, populations in the two series of plots receiving furrow systemics on May 31 were significantly lower than populations in the other series of plots. Following the foliar applications, all treated plots had populations significantly lower than the check. By mid August, aphids were present in the plots treated with demeton. They were significantly higher than in other plots but significantly below the check. Populations continued to increase during August. At the time of the last count on August 30, populations in plots treated with disulfoton in May and with a half pound of acephate on August 3 were significantly lower than in any of the other treatments. The treatment with pirimicarb was significantly better than demeton, the low rate of disulfoton applied as a foliar spray or phosalone.

Percent of plants populated. A rather small percentage of the plants in these plots was found infested during July. In early August, plots treated with demeton or disulfoton in May were superior to the other treatments. In mid August, plots treated with demeton in May were superior to the check but inferior to the other treatments that had been applied by that time. The check plots had a higher percentage of plants infested than the treated plots until August 24 at which time only the plots treated with disulfoton in May and then with acephate in August were significantly better. This was also the case at the time of the last count on August 30.

Section II — The Buckthorn Aphid

1970 Tests. *Test A (Table 1) (Figure 10)*

Numbers of aphids. Just before the first application of insecticides on July 30, populations were reasonably uniform and there were no real differences among the plots in this experiment. Following the first differential treatment, the high rate of DuPont 1410-L was superior to both treatments of Penick SBP 1382 but did not differ from the rest of the materials. Two materials, the low rate of Penick SBP 1382 and phosmet, were re-applied on August 6 and all materials were re-applied on August 20. A week later, plots treated with DuPont 1410-L were superior to all others except the high rate of phosmet. These three were superior to the check.

Percent of plants populated. The data available show a situation rather similar to that for numbers of aphids. However, at the last count, all materials were superior to the check. The two rates of the DuPont material and the high rate of phosmet were superior to both rates of Penick SBP 1382.

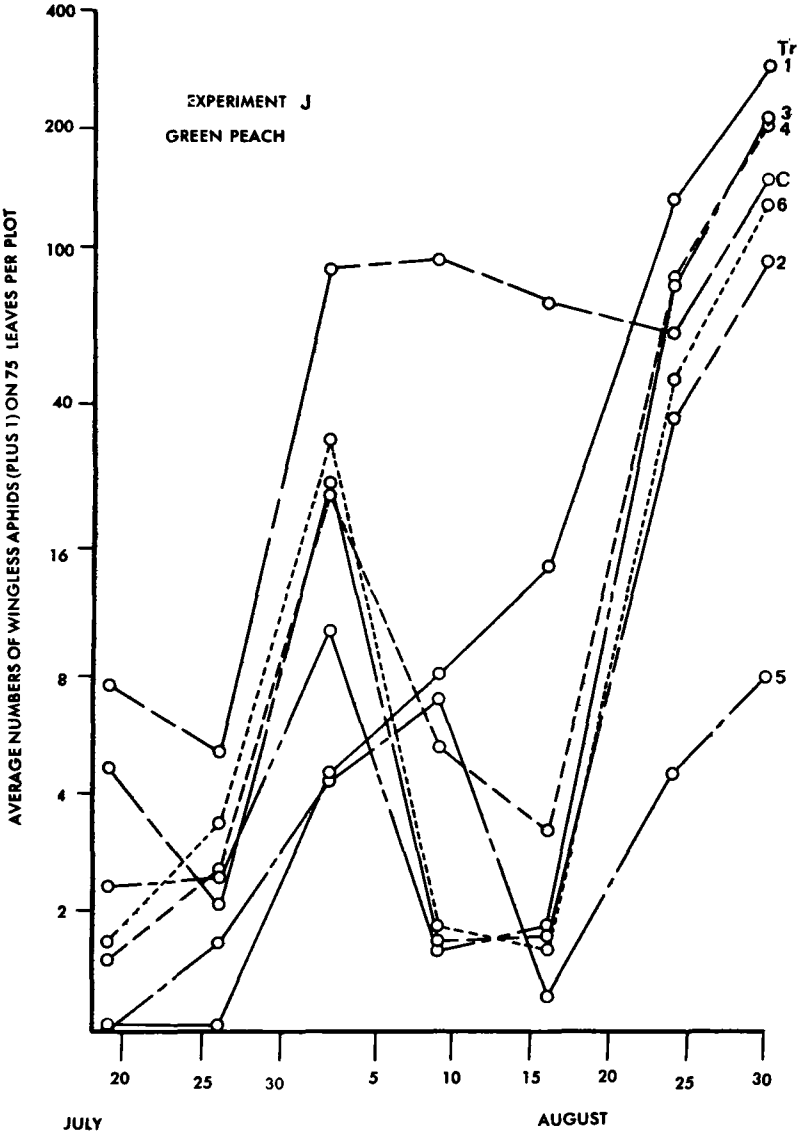


Figure 9. Population trends of the green peach aphid, Test J, 1972.

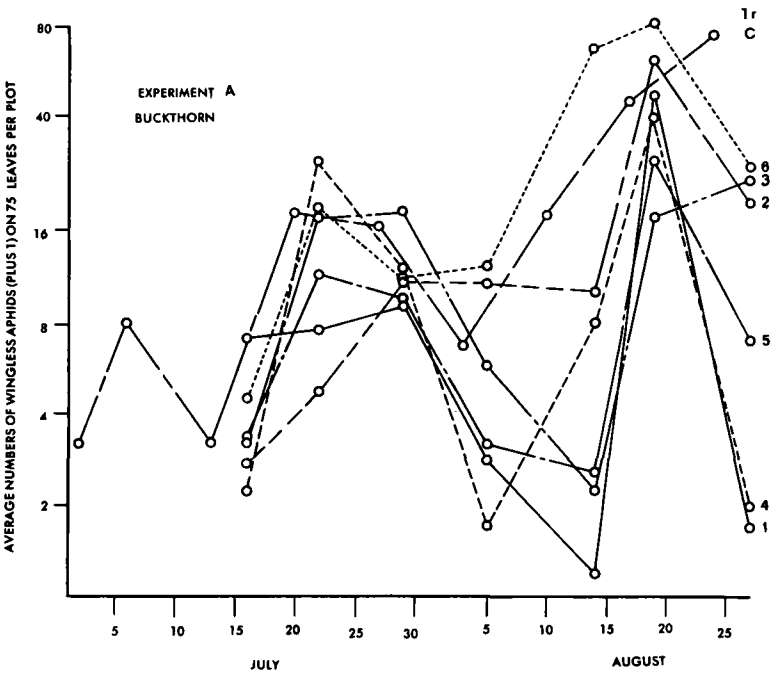


Figure 10. Population trends of the buckthorn aphid, Test A, 1970.

Test B (Table 1) (Figure 11)

Numbers of aphids. The granular insecticides applied at planting time differed from the check and from all but one of the pre-application foliar treatments. All of the foliar materials were effective and resulted in counts that differed from the check. This was true again following re-application of the foliar materials on August 6. Following the application on August 20, all materials were superior to the check. By that time, however, the granular application of carbofuran, while superior to the check differed from the granular application of aldicarb and all of the foilar applications.

Percent of plants populated. Before the foliar materials were applied, there were no differences in the plots to be sprayed. Following the first application of foliar materials, all treatments were better than the check. Following the second application of the foliar material all treatments were again better than the check. By mid August, plots treated twice with parathion did not differ from the check but did differ from the other

treatments. Aldicarb and the foliar application of carbofuran were superior to the low rate of phosalone and the furrow application of carbofuran. After a third application of the foliar materials, all treatments were superior to the check and to the furrow treatment of carbofuran, which in turn was better than the check. Aldicarb retained its effectiveness beyond the time when carbofuran "broke."

Test C (Table 1) (Figure 12)

Numbers of aphids. As would be expected, plots receiving granular insecticides differed from those about to receive foliar materials. All of the foliar materials were effective. A single application of disulfoton 6LC was found to provide control for the remainder of the season. The 2 Bayer materials were applied 3 times to achieve the same results.

Percent of plants populated. The figures for the check plots showed an increase during August. The treatments were generally satisfactory altho only the broadcast treatments involving disulfoton were invariably better than the check.

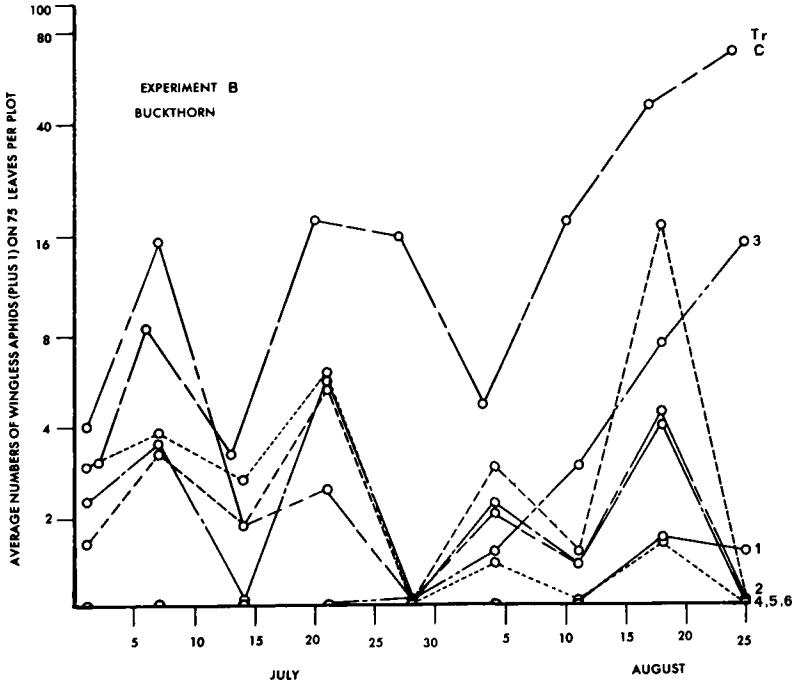


Figure 11. Population trends of the buckthorn aphid, Test B, 1970.

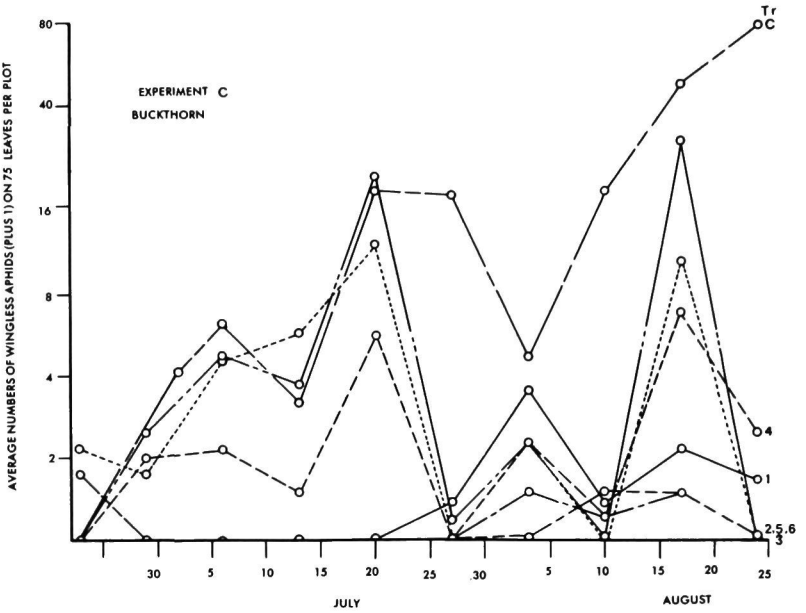


Figure 12. Population trends of the buckthorn aphid, Test C, 1970.

1971 Tests. *Test D (Table 2) (Figure 13)*

Numbers of aphids. The furrow treatments with aldicarb or disulfoton were better than the check from mid July on. The foliar treatments were effective for a while following application but later the differences were less clear-cut.

Percent of plants populated. Before foliar materials were applied, the plots treated with granular materials differed from those to be sprayed. Following the first foliar application, all plots were better than the check, indicating the effectiveness of all materials tested. A second application of the low rate of pirimicarb kept the percent of plants populated below that in the check for the remainder of the season. The granular materials differed from the foliar materials at the time of the last count.

Test E (Table 2) (Figure 14)

Numbers of aphids. The furrow treatments of phoxim were ineffective. These treatments did not differ from the check in late July. At that time, following application of foliar sprays, these sprays were all better than any of the other treatments. Plots receiving the furrow treatments of phoxim in early June were treated with disulfoton in early August. Fol-

lowing this treatment, all plots except the low rate of Uniroyal 840 were superior to the check. At the time of the final count, all but the two rates of Uniroyal 840 differed from the check.

Percent of plants populated. Following the initial foliar application, these treated plots were superior to those receiving an early furrow application of phoxim. The furrow treated plots did not differ from the check. The Uniroyal 840 treatments showed less residual action than those receiving acephate in early August when these plots were superior to all others. At the time of the final count, the treated plots did not differ among themselves but all except the low rate of Uniroyal 840 were superior to the check.

Test F (Table 2) (Figure 15)

Numbers of aphids. Before the foliar treatments were applied, populations were similar in all plots. Following the first foliar applications, there were no clear-cut differences, largely because of small aphid populations. A week later, however, all treated plots were superior to the three untreated ones. In mid August, phosmet did not differ from two untreated series. At the end of August, there were no clear-cut differences.

Percent of plants populated. No differences were found in the counts made before foliar applications were applied. At the end of July all treated plots were superior to the untreated ones. In mid August, the two untreated series in the experiment differed significantly from the series receiving foliar insecticides.

1972 Tests *Test G (Table 3) (Figure 16)*

Numbers of aphids. While populations were small in mid July, no differences between treatments were found prior to the first applications of foliar insecticides. All materials gave excellent control and the treated plots were superior to the check for the remainder of the growing period. Monocrotophos, applied 2 or 3 times gave better control of aphids in late August than the other materials. A single application of ethiofencarb at the high rate, gave good control for the remainder of the season and in late August was better than the low rate or either rate of Sandoz-Wander 52,139. Both rates of Sandoz-Wander 52,139 were much better than the check.

Percent of plants populated. All materials reduced the infestation effectively soon after application. Until the end of August, there were statistical differences between the treated plots and the check. At that time only the plots treated with monocrotophos still differed from the check.

Test H (Table 3) (Figure 17)

Numbers of aphids. The furrow treatments provided excellent control throughout the growing season, and were consistently better than the check. Acephate was effective for some time but by mid August populations differed from those in the furrow treatments. Phosmet, applied at increasing rates, did not differ from the check until mid August and was less effective than the furrow treatments until the end of August when it did not differ from disulfoton and the low rate of Diamond-Shamrock DS-15,647.

Percent of plants populated. After three applications, plots treated with phosmet were better than the check but inferior to all other treatments. In late August, aldicarb, disulfoton and the high rate of DS-15,647 were better than the other treatments. At that time, among the remaining treatments, only the low rate of DS-15,647 differed from the check. The single treatment of acephate was not effective beyond the middle of August.

Test J (Table 3) (Figure 18)

Numbers of aphids. Just before the application of the foliar materials, the plots to be sprayed did not differ from the check. These plots did, however, differ significantly from the plots receiving furrow treatments in May. All of the foliar materials were highly effective and populations differed from the check but not from those found in plots receiving the furrow treatments. After three weeks, the plots treated with granular disulfoton and then sprayed with acephate were significantly better than any of the others. Plots treated in May with demeton or sprayed in early August with disulfoton had somewhat higher populations but were superior to the remaining treatments. The final count showed some build-up in all plots except those treated with acephate and granular disulfoton.

Percent of plants infested. The plots treated with granular materials differed from those to be sprayed but the latter were similar just before the treatments were applied. All of the foliar materials were effective and all treatments were better than the check but did not differ among themselves. After two weeks, plots treated earlier with pirimicarb, disulfoton or acephate had significantly lower populations than the other materials. All treatments were much better than the check. By the end of the season, plots treated in early August with pirimicarb or phosalone no longer differed from the check. The plots treated with acephate continued to differ from the other treatments.

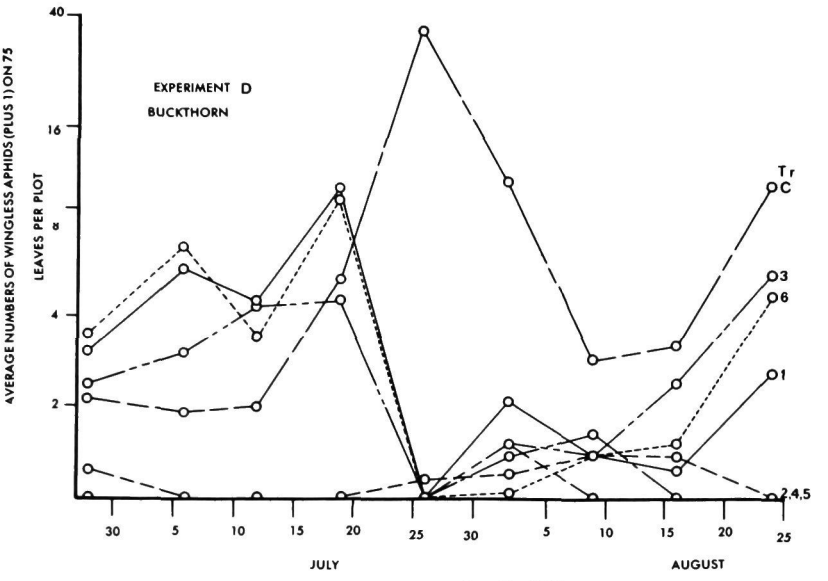


Figure 13. Population trends of the buckthorn aphid, Test D, 1971.

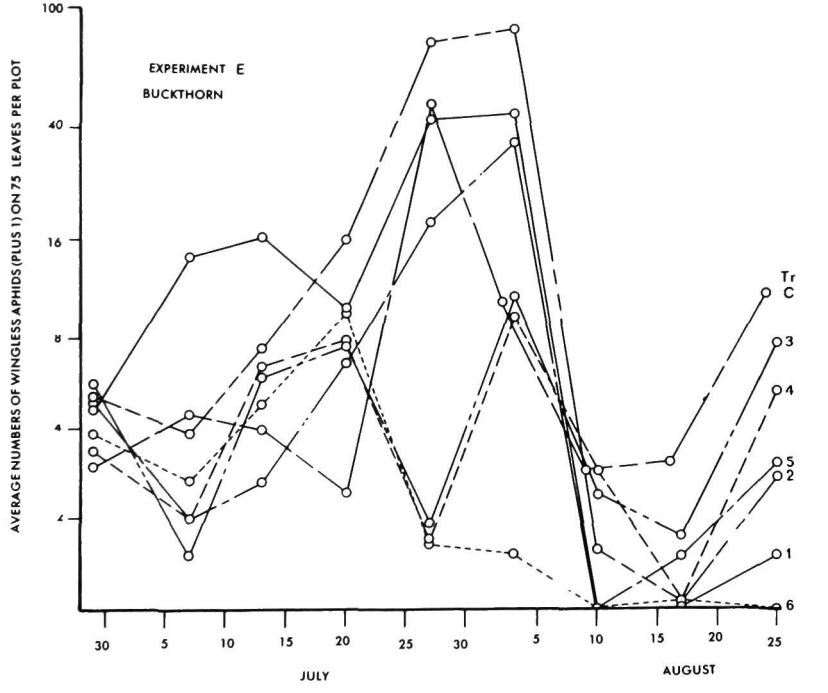


Figure 14. Population trends of the buckthorn aphid, Test E, 1971.

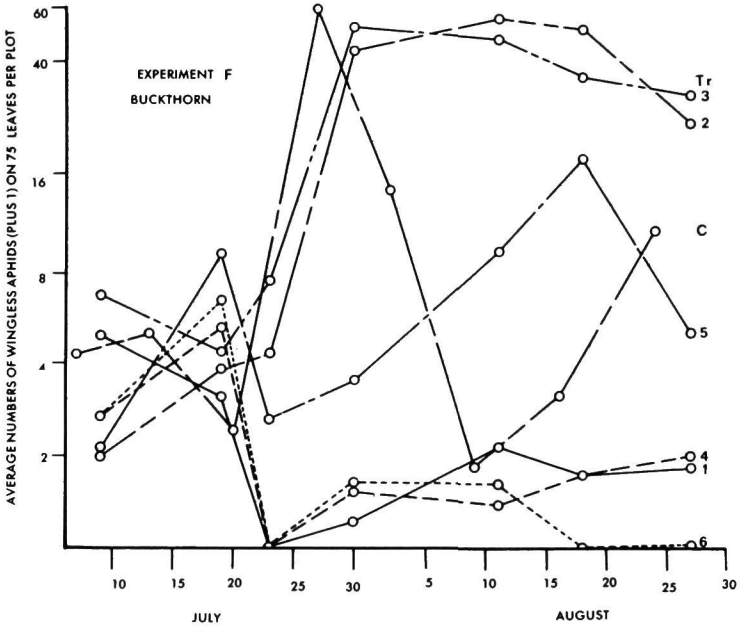


Figure 15. Population trends of the buckthorn aphid, Test F, 1971.

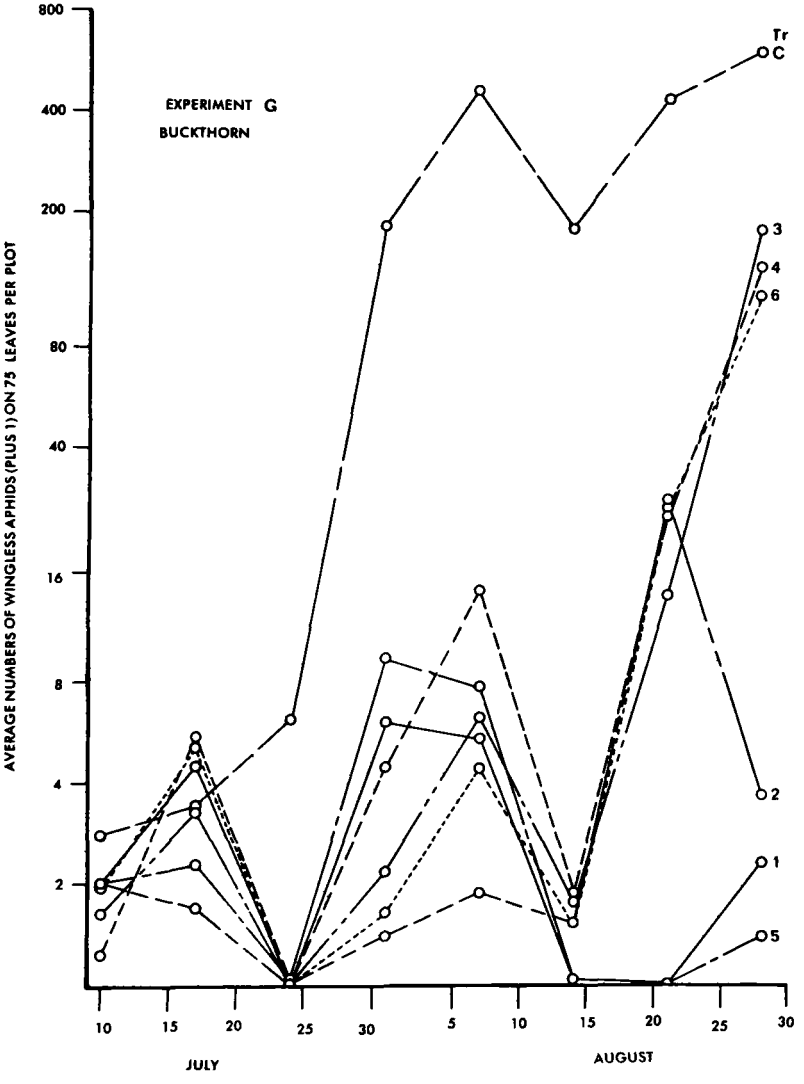


Figure 16. Population trends of the buckthorn aphid, Test G, 1972.

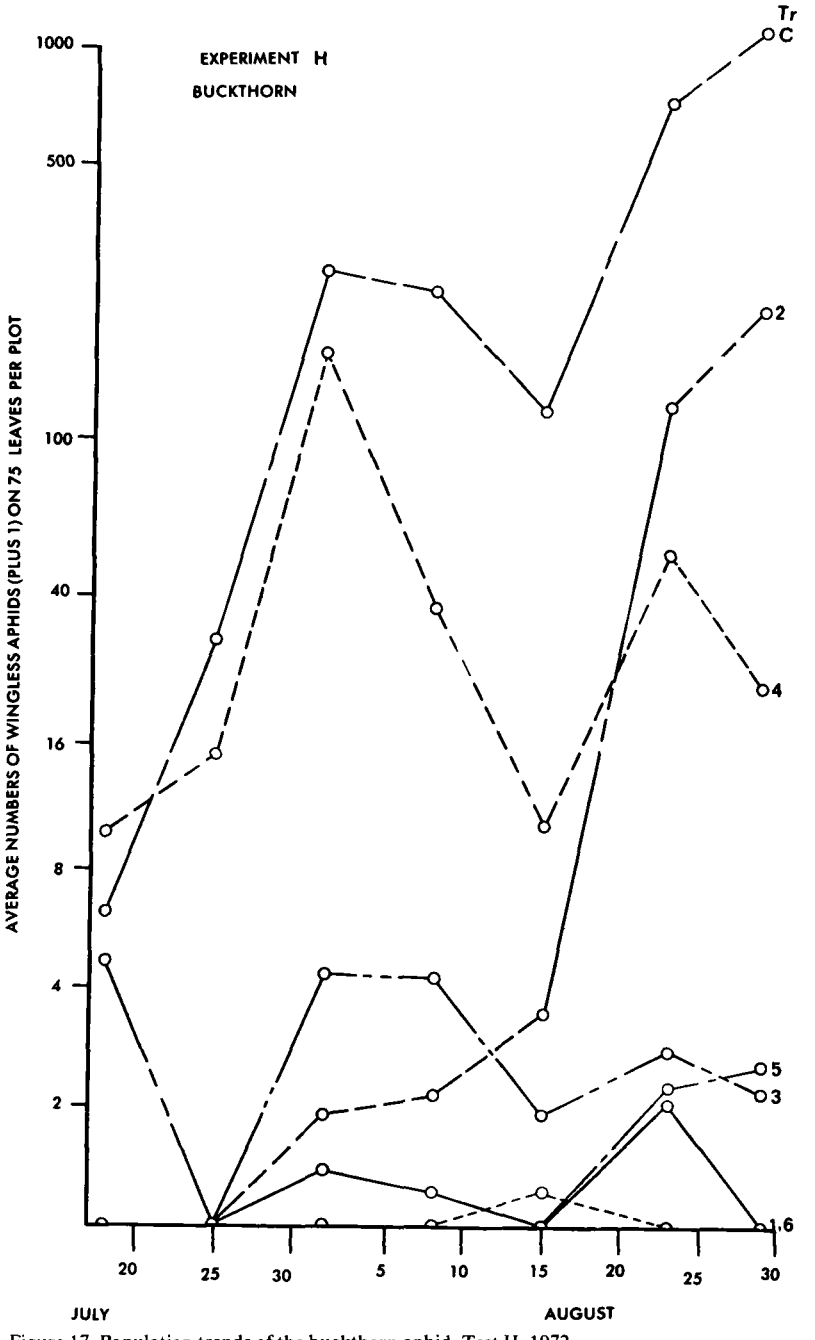


Figure 17. Population trends of the buckthorn aphid, Test H, 1972.

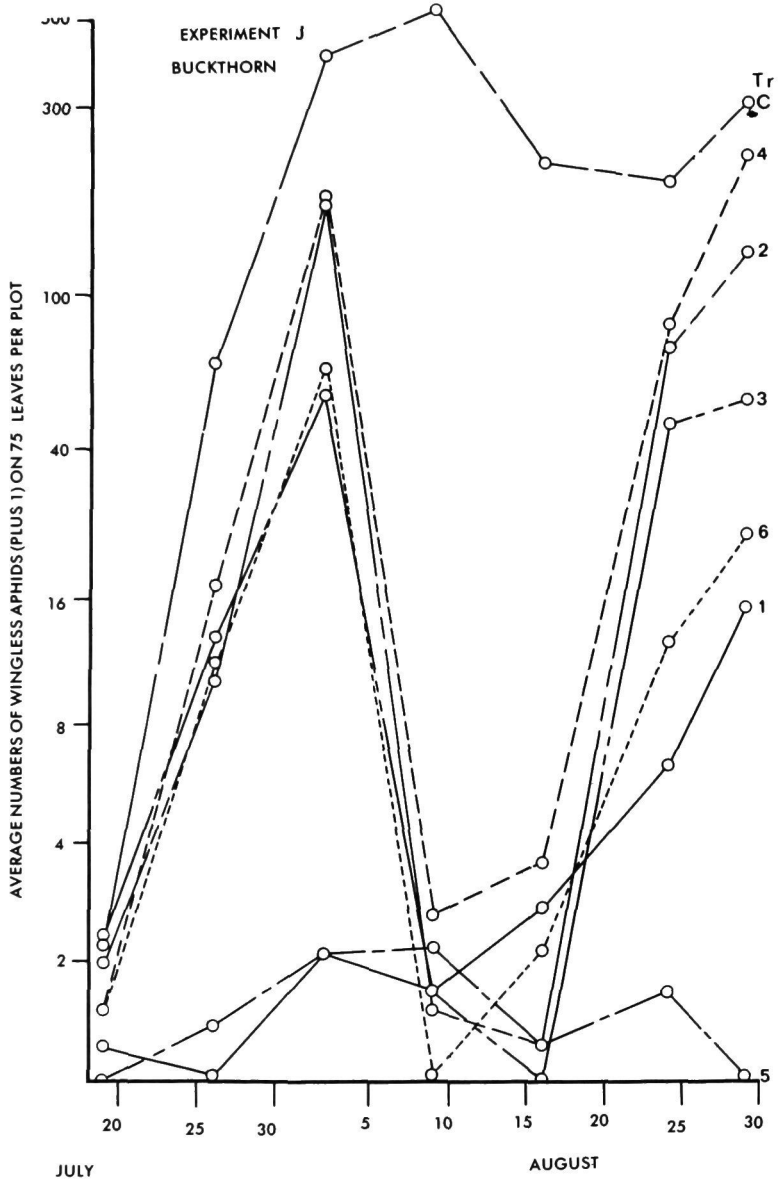


Figure 18. Population trends of the buckthorn aphid, Test J, 1972.

Section III — The Potato Aphid

1970 Tests *Test A (Table 1) (Figure 19)*

Numbers of aphids. Before differential treatments were applied at the end of July, populations in all plots were quite uniform. Following the initial treatments, only the high rate of DuPont 1410-L resulted in a marked reduction in population. A second application of the low rate of phosmet resulted in both rates of this material being superior to other treatments. Only at the end of August did the check differ from the treated plots. There were no clear-cut differences among the treatments although the high rate of DuPont 1410-L did differ from phosmet and the two rates of Penick SBP 1382.

Percent of plants populated. Populations were well distributed among the plots in the experiment. There were no real differences prior to the first application. Only DuPont 1410-L reduced the numbers of plants populated below those in the check. The low rate of DuPont 1410-L and the high rate of phosmet, while not differing from the check or the low rate of phosmet, were superior to both rates of Penick SBP 1382. A second application of the low rate of phosmet reduced the number of plants infested to a greater extent than found in other treatments. The two rates of phosmet did not differ in mid August. At the end of the season, all treated plots were superior to the check following retreatment on August 20.

Test B (Table 1) (Figure 20)

Numbers of aphids. Just before the foliar treatments were begun on July 23, the two furrow treatments were superior to the others which did not differ among themselves or from the check. The plots treated with granular carbofuran became infested in mid July. During August this treatment was either inferior to or did not differ from the check. On the other hand, the plots treated with a granular formation of aldicarb were always better than the check throughout the season. At the end of July, all treatments were superior to the check. The foliar applications were re-applied early in August and again reduced populations significantly but only for a short time. The high rate of phosalone and the carbofuran, while inferior to the granular formulation of aldicarb, were better than the check. Following a third application, on August 20, all of the foliar materials were better than the check. While both rates of phosalone were superior to the check, they were inferior to parathion, carbofuran and the granular formulation of aldicarb.

Percent of plants populated. The data here indicated that the relations were essentially the same as those indicated for numbers of aphids. Aldi-

carb kept populations from developing on nearly 94% of the plants at the peak, when compared with those found in the check.

Test C (Table 1) (Figure 21)

Numbers of aphids. The plots receiving the soil treatments had populations distinctly different from the remaining plots just before foliar materials were applied. The foliar applications made on July 23 did not result in any clear-cut differences but a re-application of the two Bayer materials on August 6 resulted in excellent control. At that time all treated plots were better than the check.

On August 17, the Bayer 77,049 did not differ from the check while the Bayer 93,820 was superior to Bayer 77,049 but inferior to the other treatments. Following another spray with the Bayer materials, a count showed an effective reduction in populations and all treatments were superior to the check.

Percent of plants populated. The count made just before foliar materials were applied, showed that the soil treatments had prevented infestations from starting, while the other plots were infested. The initial foliar treatments varied in effectiveness. The disulfoton treatment reduced the number of plants infested to the point where it was different from the check but the Bayer materials were not effective. However, a second application of these materials did reduce the number of plants infested in these plots and all treatments were superior to the check. A week later, the percent of plants infested in the plots treated twice with Bayer 77,049 had increased and no longer differed from the check. Plots treated with Bayer 93,820 had significantly fewer plants infested but differed from the other treatments. After a third application of the Bayer materials, the percent of plants infested in the treated plots was significantly below that in the check.

1971 Tests *Test D (Table 2) (Figure 22)*

Numbers of aphids. Just before the first application of foliar materials, populations on as yet untreated plots were substantial and differed statistically from those on plots receiving granular materials in mid May. Following the application of the foliar materials, all treated plots differed from the check. In early August, the plots treated with granular materials were again different from the check. The foliar application of disulfoton was superior to the check but did not differ from the two rates of pirimicarb. The high rate of aldicarb was better than the low rate but neither differed from disulfoton. At the end of the season, all treatments were superior to the check and the three treatments involving granular materials were better than the foliar applications.

Percent of plants populated. Following the foliar application of July 21, all treatments were significantly better than the check. The high rate of aldicarb was better than disulfoton or pirimicarb but the actual differences were slight. In early August, the granular materials were again better than the foliar ones with only the foliar application of disulfoton differing from the check. At the end of the season, plants treated with the granular materials in mid May were not infested. Plants treated with the low rate of pirimicarb or disulfoton were infested to a lesser extent than the check or those treated with the high rate of pirimicarb.

Test E (Table 2) (Figure 23)

Numbers of aphids. The furrow treatments with phoxim had no effect on aphid populations. Just before the foliar treatments were applied only one series of plots had populations that differed from the check. Following the first foliar applications, only acephate reduced populations; the other treatments did not differ from the check. Following a treatment on August 6 with acephate and three rates of disulfoton, populations in these 4 series of plots were significantly lower than in the check or in the plots treated with Uniroyal 840. At the end of the season, after aphid populations had been reduced by fungi, the Uniroyal treatments were distinctly better than the check but inferior to the other treatments.

Percent of plants populated. Before the foliar materials were applied, there were three series of plots that differed from the check by relatively small percentages. After the application of July 21, only acephate was shown to be effective in reducing the number of plants infested. Following the application of 3 rates of disulfoton and the reapplication of acephate on August 6, these plots had significantly fewer plants infested than the check and the 2 series of plots receiving Uniroyal 840. This relationship continued to the end of the season.

Test F (Table 2) (Figure 24)

Numbers of aphids. There were no substantial differences among plots prior to the first application of insecticides on July 21. Parathion and disulfoton gave excellent control. Phosalone gave good control but was inferior to parathion and disulfoton. Phosmet was ineffective.

Percent of plants populated. Just before the application of insecticides, 3 series of plots had a higher percentage of plants infested than did the check; the other 3 series did not differ from the check. Parathion and disulfoton reduced the number of plants infested to very low levels — below that achieved by phosalone. Phosmet kept the number of infested plants from increasing but still did not differ statistically from the check. Disulfoton kept the number of plants infested at a low level that was dif-

ferent from the rest. Parathion and phosalone were less effective but were still better than the check. Re-applications of parathion, phosalone and phosmet did not result in clear-cut differences. At the end of the season, only phosmet did not differ from the check.

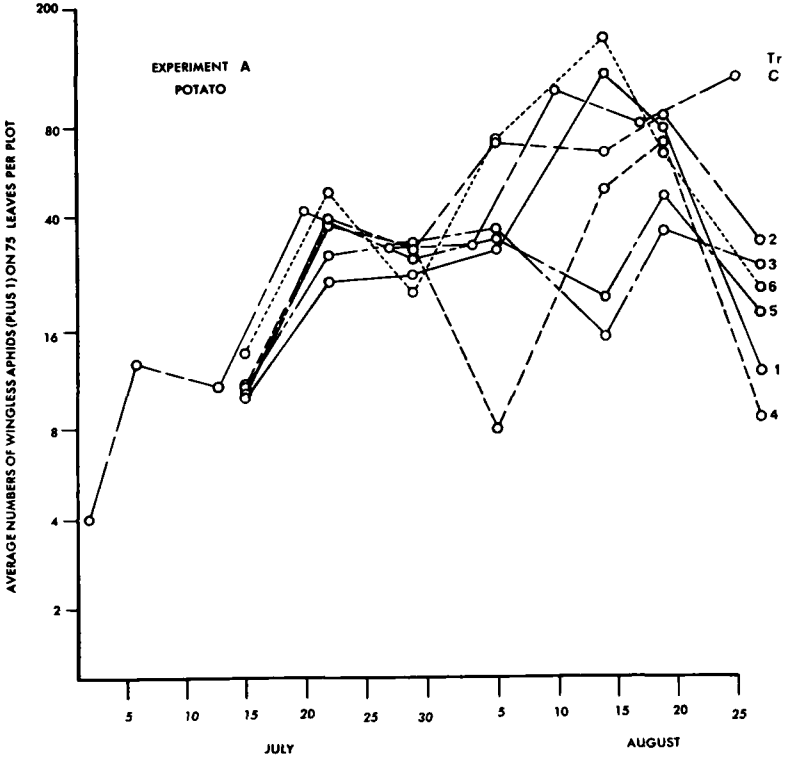


Figure 19. Population trends of the potato aphid, Test A, 1970.

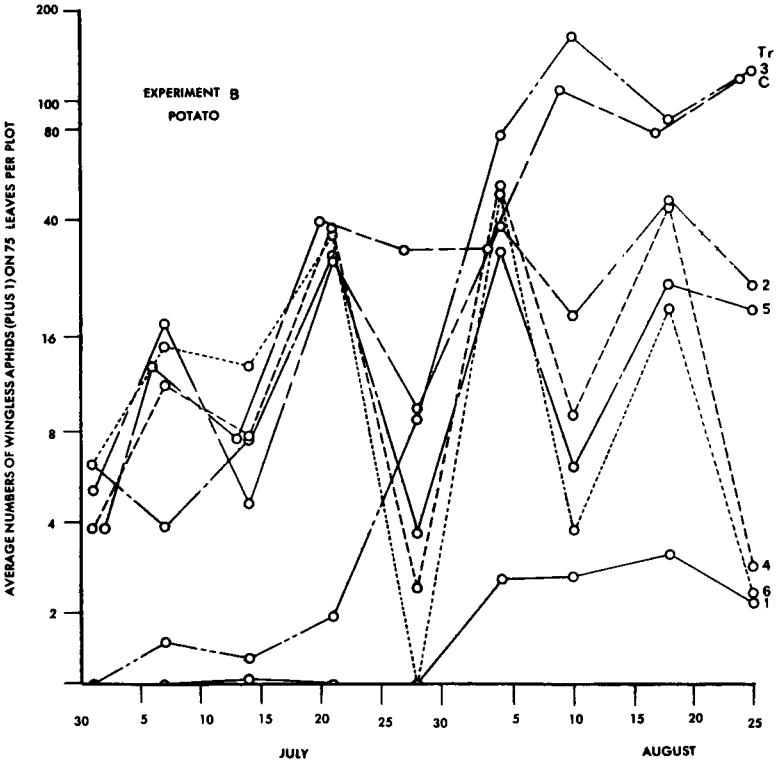


Figure 20. Population trends of the potato aphid, Test B, 1970.

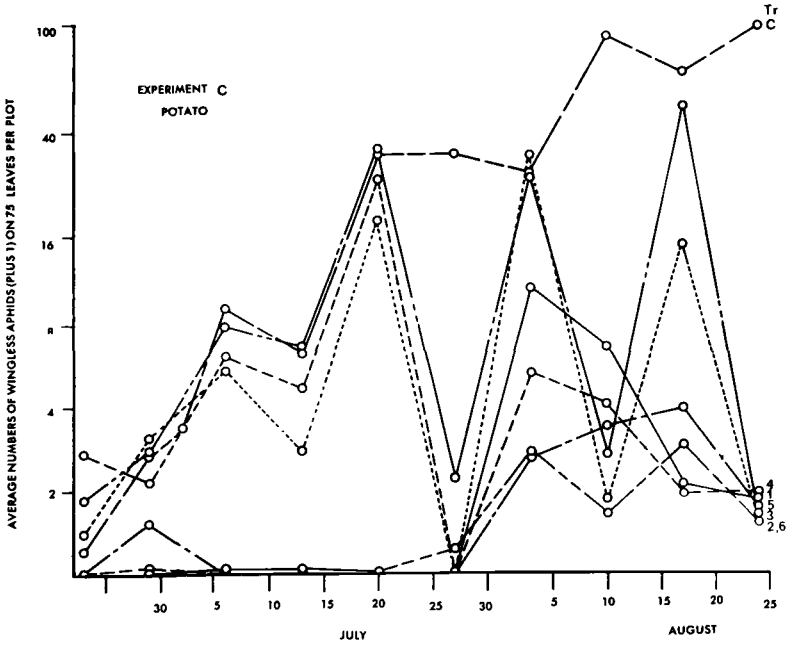


Figure 21. Population trends of the potato aphid, Test C, 1970.

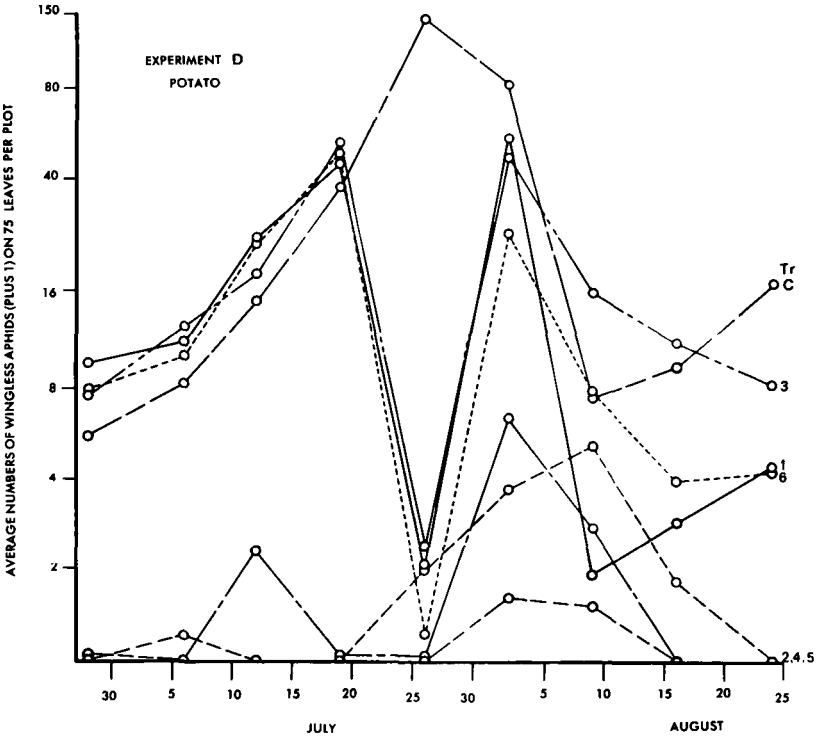


Figure 22. Population trends of the potato aphid, Test D, 1971.

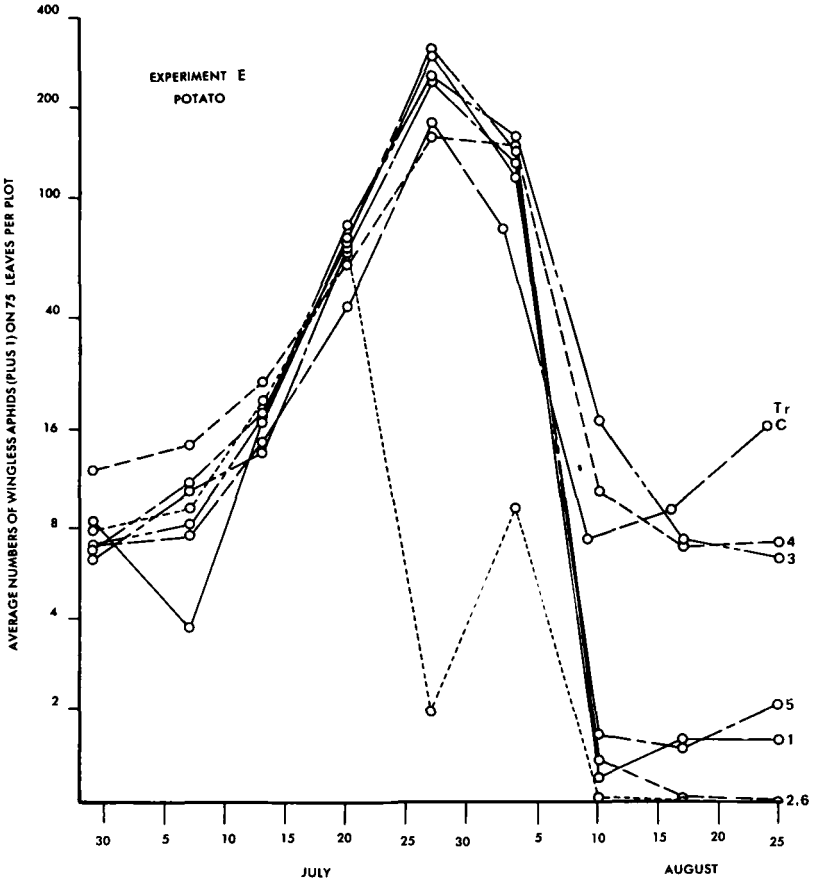


Figure 23. Population trends of the potato aphid, Test E, 1971.

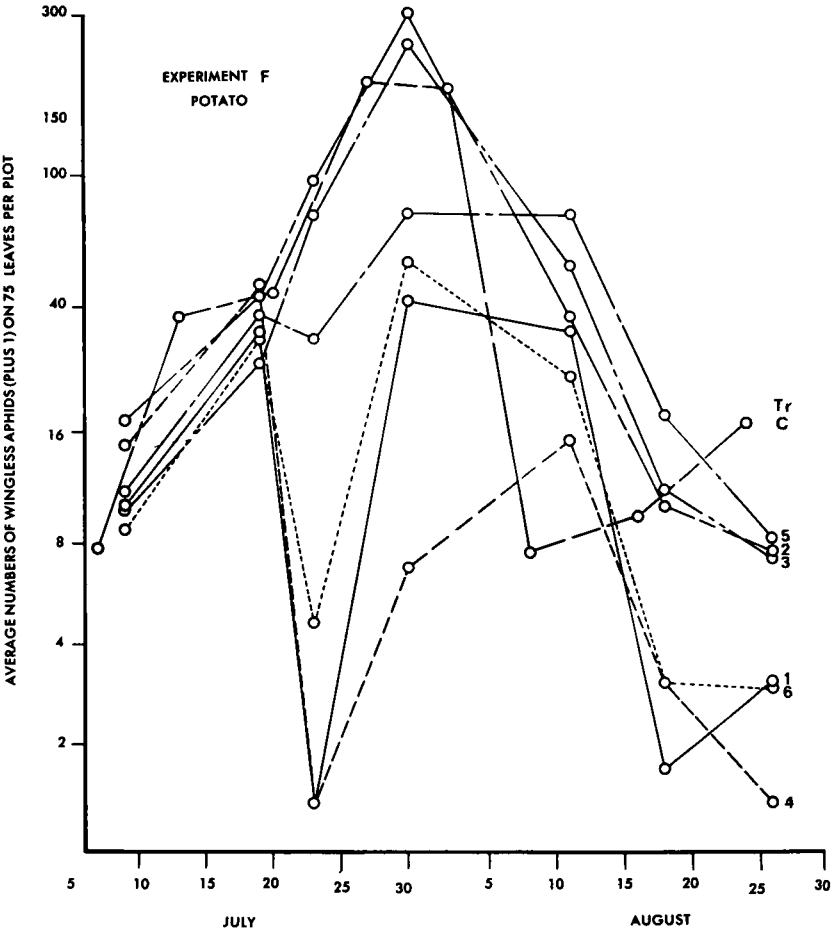


Figure 24. Population trends of the potato aphid, Test F, 1971.

1972 Tests *Test G (Table 3) (Figure 25)*

Numbers of aphids. Before the first application of insecticides, no differences were found among treatments. Following the first application of insecticides, all materials reduced populations to low levels. Before the second application of insecticides, all treatments were better than the check but the high rates of ethiofencarb and monocrotophos were better than the remaining treatments. Following the second treatment of four of the six materials, the high rates of Sandoz-Wander 52,139 and monocrotophos were better than the check. A third application of the low rate of monocrotophos resulted in both rates of this material being better than the other treatments. The high rate of Sandoz-Wander 52,139 was better than the check but did not differ from the low rate of the same material. At the time of the final count, both rates of monocrotophos were better than the other materials which at that time did not differ from the check.

Percent of plants populated. There were no significant differences among plots prior to the first application of insecticides. All of the materials reduced the number of infested plants significantly but there were no differences among the insecticides.

This situation held through July but by early August only the high rate of monocrotophos was significantly better than the rest. The two treatments with ethiofencarb differed from the check and the low rate of Sandoz-Wander 52,139 but not from the low rate of monocrotophos or the high rate of Sandoz-Wander 52,139, both of which were better than the check. Four of the materials were re-applied on August 10 and the following count showed all treatments to be better than the check. The two treatments with ethiofencarb which had not been repeated, now differed from the four materials that were re-applied. Following a third application of monocrotophos, both rates differed from the other four treatments. At this time, only the high rate of Sandoz-Wander 52,139 differed from the check. At the time of the final count, both rates of monocrotophos were distinctly superior to the other treatments and to the check.

Test H (Table 3) (Figure 26)

Numbers of aphids. Before the application of foliar insecticides, the two series of plots to be sprayed were different from those receiving granular materials in May, but were not different from the check. Following the spray application on July 19, all treated plots differed from the check but the plots receiving phosmet were inferior to the other treatments. After a second application of phosmet at double the earlier rate, the count showed no difference between these plots and the check, whereas all other treatments were superior to the check and to the plots treated with

phosmet. A third application of phosmet at double the rate of the second application resulted in populations different from the check but inferior to all other treatments. At this time, plots treated with acephate on July 19 had populations that did not differ from those in plots treated with disulfoton in May. Both treatments were better than phosmet but inferior to plots treated with aldicarb or Diamond-Shamrock DS-15,647 in May.

Phosmet was applied again on August 10 and populations in these plots did not differ from those in plots treated once earlier with acephate or disulfoton but they were inferior to those treated with aldicarb or Diamond-Shamrock DS-15,647.

Populations in the check plots were reduced by fungi in mid August and the count on August 23 showed that only the high rate of Diamond-Shamrock DS-15,647 kept populations below those in other plots. The other treatments did not differ from the check at this time.

At the end of August, plots treated with aldicarb, disulfoton or Diamond-Shamrock DS-15,647 (high rate) in May, were superior to the other treatments and to the check.

Percent of plants populated. These data followed the same pattern as indicated above for numbers of aphids. Early in August, the high rate of Diamond-Shamrock DS-15,647 was found to be significantly better than the other treatments, a relationship not shown for number of aphids where this treatment was different only from the phosmet spray.

Test J (Table 3) (Figure 27)

Numbers of aphids. Before the foliar treatments were applied, the two series of plots treated in May were practically free of aphids and so were distinctly different from the remaining treatments. A single application of foliar materials was made on August 3. All treatments were highly effective. Acephate following the furrow treatment with disulfoton, was superior to the other treatments which in turn were superior to the check. By mid August, populations in the plots treated with phosalone had increased to the point where they were different from the other treatments but still far better than the check. The plots treated with disulfoton and acephate remained better than other treatments through August. The plots treated with demeton or the two rates of disulfoton 6 LC differed from the acephate plots but were better than the check or the plots treated with pirimicarb or phosalone.

Percent of plants populated. The data for the percent of plants populated showed trends almost exactly like those shown by numbers of aphids. It is evident that phosalone showed somewhat less residual activity than pirimicarb.

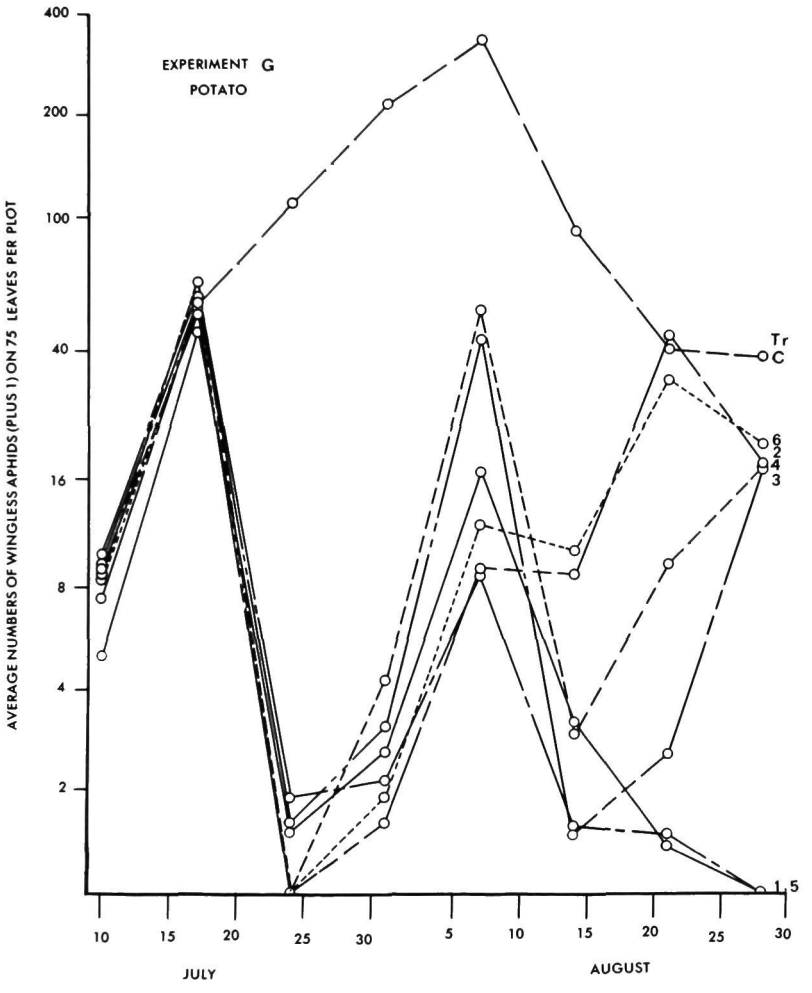


Figure 25. Population trends of the potato aphid, Test G, 1972.

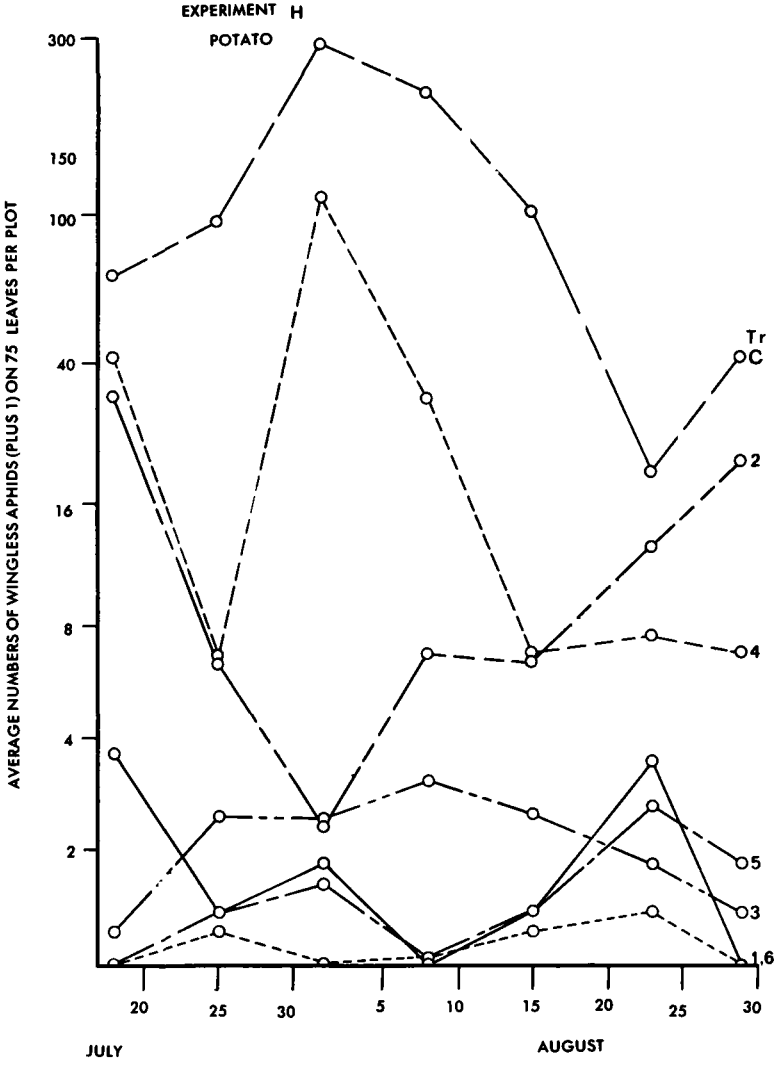


Figure 26. Population trends of the potato aphid, Test H, 1972.

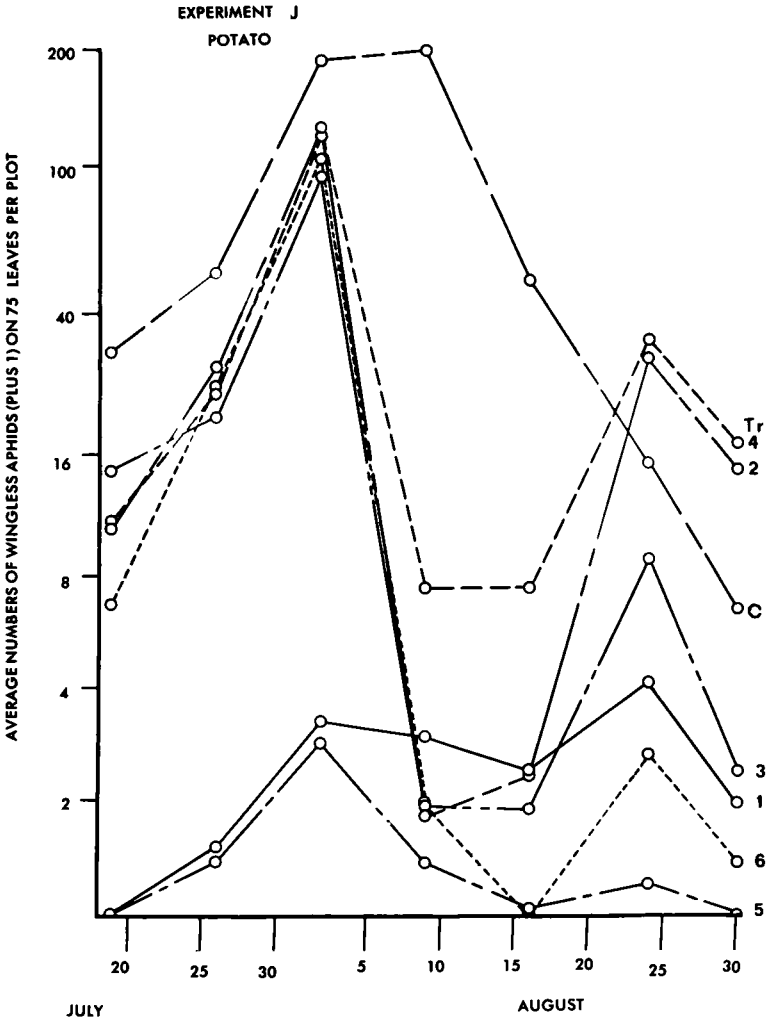


Figure 27. Population trends of the potato aphid, Test J, 1972.

DISCUSSION OF RESULTS OF INSECTICIDE TRIALS

As has happened in the past, there were some differences in response to the various materials, depending on the aphid species. Where different rates were used, there were some differences but usually an additional application of a low rate was as satisfactory as the high rate applied less often. Results in some years were not clear-cut, partly because of low populations in the check plots. A few materials were unsatisfactory for aphid control.

Green peach aphid

No differences were found between a 1/2# and a 1/4# rate of DuPont 1410-L applied twice (Table 1A) during the season.

The application of Penick SBP 1382 at 12 oz./a. was no better than three applications at 6 oz./a. even though less material was applied during the season.

Phosmet applied twice at 2#/a did not differ from 3 applications at one pound even though less material was applied.

Analyses of variance showed no significant differences between the various treatments and the check.

A furrow application of 1 pound/a of aldicarb at planting (Table 1B) gave control all season and was significantly different from the check. In mid August aldicarb was better than two applications of parathion at 3.2 oz./a.; also better than two applications of phosalone at 4 or 2 oz./a. Two applications of carbofuran at 1 pound/a. were better than two of parathion or phosalone at either date, but populations in the plots treated with carbofuran did not differ from those in the check. A third foliar application of carbofuran was better than a furrow application of the same material at planting time. It was also better than 3 applications of parathion or either rate of phosalone but again populations in the plots sprayed three times with carbofuran did not differ from those in the check. Aldicarb as a furrow treatment was thus better than carbofuran as a furrow treatment or as a foliar spray and also better than 3 applications of parathion or either rate of phosalone. In the test (Table 1C) involving disulfoton and certain Bayer materials, populations were very low all season and therefore the results were not clear-cut. After two applications of Bayer 77,049, 4 oz. or Bayer 93,820, 8 oz., the counts showed both to be better than a pre-plant broadcast treatment of 3# of disulfoton 6 LC. After 3 applications of Bayer 77,049, populations were still not different from the check but were better than any of the 4 disulfoton treatments. At the end of the season there were no differences between a 1# furrow application of disulfoton, 3# broadcast as granular or 6 LC at planting or a single foliar application at 1# in late July.

Three pounds of aldicarb at planting (Table 2D), were slightly better than one pound but not significantly so. Both rates were better than the check throughout the season. The furrow treatment of disulfoton showed less residual action and was inferior to aldicarb at the end of the season. Two applications of pirimicarb at a half pound were similar to a single application at 1 pound. The former treatment did not differ at the end of the season from aldicarb.

Phoxim (Table 2E) applied to the soil at planting time had no effect on aphid populations. Acephate at a pound to the acre, reduced populations well below the check when applied in late July. Disulfoton 6 LC applied at 3 rates (1 pound, 1/2 pound, 1/4 pound) on August 6 was equally effective in reducing populations below those in the check. Uniroyal 840 applied at 1/2 or 1 pound in late July was not especially effective but at the end of the season, both rates were better than the check but poorer than acephate or the 3 rates of disulfoton.

Phosmet at 24 oz./a. and parathion at 3.2 oz./a. were applied 3 times (Table 2F) but both failed to reduce populations. A single application of disulfoton at 16 oz./a. in late July was as satisfactory as 3 applications of phosalone at 4 oz./a. beginning at the same time.

Ethiofencarb (Table 3G), Sandoz-Wander 52,139 and monocrotophos were all effective in reducing populations when applied on July 19. A single application of ethiofencarb at 1 pound/a kept populations below other treatments all season. Ethiofencarb at a half pound was effective for three weeks. Sandoz-Wander 52,139 at 1/2 or 1 pound was not different but was inferior to ethiofencarb at 1 pound except for the count of August 1. Monocrotophos at 6.4 oz./a. applied 3 times gave generally poor control. At 12.8 oz./a., control was somewhat better but was not significantly different from the check after two weeks.

A formulation of phosmet (Table 3H) was effective until mid August. Disulfoton followed by acephate at 1/2 lb. in early August was highly effective for the remainder of the season. Pirimicarb at 1/2 pound and phosalone at 1/4 pound were effective. Pirimicarb was better than phosalone but inferior to disulfoton followed by acephate.

Buckthorn aphid

Following the application of July 30 (Table 1A), the high rate of DuPont 1410-L reduced populations to a point below that achieved with Penick SBP 1382 at 6 or 12 oz./a. Neither of these materials or phosmet at 2 pounds reduced populations significantly below populations on the untreated plots. A second application of the low rate of Penick SBP 1382 and phosmet showed phosmet to be better than the Penick material. All materials were re-applied on August 20. Both rates of DuPont 1410-L

were better than all except the high rate of phosmet. These 3 treatments were better than the check.

Aldicarb (Table 1B) at 1 pound was better than the check all season. Carbofuran in the furrow at a pound was better than the check except for one count in early August. Three foliar applications of carbofuran at 1 pound were better than the check. Either phosalone at 2 or at 4 oz./a. was better than the check except in early August. Parathion at 3.2 oz./a. was better than the check except during the first half of August.

Furrow and broadcast treatments of disulfoton (Table 1C) at 1 or 3 pounds to the acre were better than the check except for one count in early August. Disulfoton 6 LC at 1 pound was better than the check except for one count in early August. Three applications of Bayer 77,049 at 1/4 lb./a. and of Bayer 93,820 at a half pound were similar to disulfoton 6 LC applied once, except at the end of the season.

Aldicarb at 1 or 3 pounds and disulfoton at 1 pound in the furrow (Table 2D) were effective during the entire season. Pirimicarb at 1 pound and disulfoton 6 LC at 1/2 pound were effective when applied in late July. Pirimicarb at 1/2# applied twice was as effective as 1# applied once.

Phoxim (Table 2E) applied to the soil at planting time was ineffective against the buckthorn aphid. Uniroyal 840 at 1/2 or 1 pound and acephate were effective for a short time. Acephate had longer residual activity than Uniroyal 840. Disulfoton 6 LC applied on August 6 at 1/4, 1/2 or 1 pound was effective for the rest of the season. At the end of the season the high rate of disulfoton 6 LC and the Chevron material (acephate) were better than either rate of Uniroyal 840 applied once on July 21.

Disulfoton 6 LC (Table 2F) at one pound applied once was as good, at the end of the season, as 3 applications of parathion at 3.2 oz./a. or 3 applications of phosalone at 4 oz./a. These three materials and phosmet at 24 oz./a. did reduce populations after the first application but by the end of the season, two additional applications of phosmet failed to keep populations below those in untreated plots.

In a test (Table 3G) in which populations increased normally in the check plots in July and August, monocrotophos at 6.4 oz. or 12.8 oz./a., ethiofencarb at 1/2 or 1 pound per acre and Sandoz-Wander 52,139 at 1/2 or 1#/a., all reduced populations following applications on July 19. The monocrotophos and the Sandoz-Wander materials were re-applied on August 10 and the low rate of the former once again on August 17. Populations in the treated plots were below those in the check all season. The high rate of ethiofencarb was better than the low rate and both were satisfactory. The low rate of ethiofencarb was not different from the two rates of Sandoz-Wander. Two applications of monocrotophos at the high rate were equal to 3 at the low rate.

All materials were satisfactory.

Aldicarb at 1 pound (Table 3H) and Diamond-Shamrock 15,647 at 3 pounds/a. gave excellent all season control under conditions that resulted in fairly high populations in the check plots. One and a half pounds of the Diamond-Shamrock material were satisfactory until late in the season when it differed from the high rate. Disulfoton at 2 pounds differed from aldicarb and the Diamond-Shamrock material on two occasions in August but was reasonably satisfactory. One application of acephate at a half pound was better than the check until late in August. Phosmet at increasing rates was applied 4 times. It was relatively unsatisfactory possibly because of the formulation used in 1972. It differed from the check only on August 15 and 29.

Demeton (Table 3J) at a pound and disulfoton plus acephate at a pound and a half pound respectively were better than the check all season. Pirimicarb at a half pound, phosalone at 1/4 pound and disulfoton 6 LC at one or a half pound gave excellent control following application on August 3 but there was some buildup of aphid populations late in the season. The high rate of disulfoton 6 LC was better than the low rate only at the end of August. The single application of phosalone was better than the check through mid August but did not differ at the end of the month. The application of pirimicarb acted in the same way.

Potato aphid

The study of chemical control of the potato aphid has been complicated for many years by the action of entomogenous fungi. In most years, the fungi became active in July and often drastically reduced populations of this aphid in August. Populations in the check plots may thus drop rapidly, making it difficult to interpret results in the treated plots.

An application on July 30 (Table 1A) of DuPont 1410-L at 1/4 or 1/2 pound/a.; of phosmet at 1 or 2 pounds/a. or of Penick SBP 1382 at 6 or 12 oz./a. resulted in a significant reduction only from the high rate of DuPont 1410-L. Following a third application of the low rates of Penick and phosmet and a second application of the other four treatments, all treated plots were significantly better than the check. Thus at both rates used, DuPont, Penick and phosmet were all better than the check.

Aldicarb and carbofuran at 1 pound in the furrow (Table 1B) were effective through mid July. Aldicarb continued to be effective but the plots treated with carbofuran had more aphids in August than the check plot.

Phosalone at 2 or 4 oz./a. and parathion at 3.2 oz./a. were effective for a short time when first applied in late July. These materials were re-applied twice in August with reasonably satisfactory effects. In mid August the high rate of phosalone and carbofuran at 1 pound foliar dif-

fered from the check but were also inferior to aldicarb in the furrow at planting time. After the application of August 20 (Table 1B), aldicarb, parathion and carbofuran foliar were better than either rate of phosalone. Both rates of phosalone were, however, better than the check or carbofuran in the furrow.

Furrow or broadcast applications of disulfoton at 1 and 3 pounds/a. (Table 1C) were better than the check except on August 3 when the one pound rate in the furrow did not differ. Bayer 77,049 at a quarter pound and 93,820 at 1/2 pound required two applications to reduce aphid populations. Bayer 77,049 after two applications was better than Bayer 93,820 and both were still better than the check. At the end of August all materials, including a 1 pound foliar application of disulfoton in late July were better than the check.

Aldicarb at 1 or 3 pounds and disulfoton at 1 pound (Table 2D) were effective and differed from the check except on August 9 when populations in plots treated with disulfoton did not differ from those in the checks.

Pirimicarb at 1/2 or 1 pound per acre and disulfoton 6 LC at 1/2 pound, reduced populations soon after application but showed little residual activity after two weeks. The disulfoton showed somewhat longer residual action than pirimicarb.

The low rate of pirimicarb was re-applied on August 6. For the remainder of the season, this treatment was better than the higher rate applied once on July 21.

At the end of the season all furrow applications were better than any of the foliar applications. The high rate of pirimicarb was inferior to two applications at the low rate; also to the foliar application of disulfoton but all treatments were better than the check.

Phoxim (Table 2E) had no effect on populations of the potato aphid. Acephate at 1 pound reduced populations while Uniroyal 840 at 1/2 or 1 pound did not. Acephate was repeated on August 6 and again reduced populations.

At the end of August all treated plots were significantly better than the check.

Phosmet at 1 1/2 pound per acre (Table 2F) was ineffective against the potato aphid in this trial.

Parathion at 3.2 oz./a. and disulfoton 6 LC at 1 pound/a. were better than phosalone at 4 oz./a. following the first application. Disulfoton was not repeated and showed considerable residual activity except for the count of August 11 when the check was markedly reduced by fungal activity. Parathion and phosalone were re-applied twice; following the 3rd application, these two and disulfoton were better than the rest, including the check. At the end of August, populations in all plots had been

affected by fungus. At that time the single application of disulfoton was better than all other treatments except 3 applications of phosalone. The latter was better than phosmet and the check but did not differ from parathion.

Monocrotophos at 6.4 or 12.8 oz. per acre (Table 3G), ethiofencarb at 1/2 or 1 pound per acre and Sandoz-Wander 52,139 at 1/2 or 1 pound per acre gave good control of the potato aphid when applied on July 19.

The high rate of ethiofencarb and monocrotophos showed greater residual activity than the low rate of these materials and both rates of Sandoz-Wander 52,139.

Monocrotophos and Sandoz-Wander 52,139 were reapplied on August 10, again with good results.

The high rates of monocrotophos and Sandoz-Wander 52,139 were better than the other treatments, and all treatments were superior to the check.

A third application of monocrotophos on August 17 brought both treatments below the other materials.

The high rate of Sandoz-Wander 52,139 applied twice was inferior to both ethiofencarb treatments toward the end of the season.

Monocrotophos treatments, at the end of the season, were better than ethiofencarb or Sandoz-Wander 52,139. At that time, these two treatments, ethiofencarb applied on July 19, and Sandoz-Wander 52,139 applied twice on July 19 and on August 10, did not differ from the check. Populations in all plots had, by this time, been reduced appreciably by fungus.

Phosmet (Table 3H) applied at increasing rates was ineffective against the potato aphid in this trial.

Aldicarb at 1 pound and Diamond-Shamrock 15,647 at 1 1/2 or 3 pounds/a. in the furrow were better than a half pound of acephate or phosmet at increasing rates of 1/2, 1 or 2 pounds per acre.

On August 23, only the high rate of Diamond-Shamrock 15,647 differed from the check but on August 29, aldicarb, disulfoton at 2 pounds per acre and both rates of Diamond-Shamrock 15,647 differed from the single application of acephate or 4 of the phosmet. These two did not differ from the check which had been reduced by fungus.

Demeton (Table 3J) at a pound to the acre in the furrow at planting time differed from the check except at the time of the last count on August 24. Pirimicarb at a half pound, phosalone at a quarter pound and disulfoton 6 LC at 1/2 or 1 pound/a. were all effective in reducing populations when applied on August 3. Phosalone showed somewhat less residual toxicity than pirimicarb or disulfoton 6 LC.

When acephate at a half pound was applied on August 3 to plots treated with a pound of disulfoton in the furrow at planting time, popula-

tions were kept at a low level and differed from other treatments and the check except on August 16 when it differed only from the check and the phosalone treatment.

RESULTS AND DISCUSSION OF LEAFROLL SPREAD

The data concerning the spread of leafroll were subjected to analyses of variance using the square root transformation. Comparisons were made within each latin square and again with associated, untreated checks. The results were compared using Bayes LSD figures.

1970

There was little spread of leafroll in these experiments. In the treated plots there was a range of from 0 to 1.9% with a reading of 1.0% in the untreated plots. Since leafroll spread is largely related to the presence and activity of green peach aphids, one can assume some relationship among the activity of the insecticide, vis-a-vis these aphids, the influence of the insecticide on the behavior of these aphids, and the availability of the virus itself. In all of these experiments, the availability of the virus was similar in all plots, since diseased tubers were introduced into all plots at planting time.

Test A (Table 4)

Populations of the green peach aphid were low early in the season but later increased numerically in the treated plots to a greater extent than in the check. While differences were small, there was less spread of leafroll in the plots treated with Penick SBP 1382 than in the check. The spread in plots treated with phosmet was essentially similar to that in the check, while in plots treated with DuPont 1410-L, there was somewhat greater spread of leafroll than in the check. However, in this experiment, no statistical differences were found, either within the experiment or when the analysis was made including the associated, untreated check.

Test B (Table 4)

Populations of the green peach aphid were low and developed late in the season in these plots. There was no spread of leafroll in the plots treated with aldicarb which kept aphids at a lower level than that found in some of the other plots but not below that in plots treated 3 times with carbofuran where spread of leafroll was similar to that in the check and numerically greater than in any of the other treatments in this experiment.

A major difference between plots treated with aldicarb and those sprayed with carbofuran is found in the time when green peach aphids were first noted. These aphids were present in the plots sprayed with carbofuran before the first application was made on July 23, while plots treated with aldicarb were not found to be infested until August 11.

Although populations of the green peach aphid in the plots treated with parathion were numerically higher than in other treatments, spread of leafroll was below that in the check.

Spread in plots treated with phosalone was greater than in plots treated with aldicarb but less than in the check.

Spread in plots treated with granular carbofuran in the furrow at planting time was somewhat less than in plots sprayed later in the season with this material but more than in plots treated with aldicarb.

Analyses of variance showed no statistically significant differences either within the experiment or when the analysis was made using the associated, untreated check.

Test C (Table 4)

Populations of the green peach aphid were late in becoming established in these plots and were never abundant. There was a considerable increase in populations toward the end of August, more so in the treated plots that in the check except for plots treated twice with Bayer 93,820. In spite of this, spread of leafroll in the plots treated with Bayer 93,820 was nearly twice that in the check and more than in plots treated otherwise. In the plots treated with disulfoton or Bayer 77,049, spread of leafroll was less than in the check. Of the 4 disulfoton treatments, the greatest spread of leafroll was in plots having the highest populations of the green peach aphid late in the season.

Analyses of variance showed some significant differences in this experiment. Spread of leafroll in plots treated with Bayer 93,820 (Treatment 6) was significantly greater than in plots treated with other materials. When the analysis included the associated, untreated check (Treatment 7), the relations were found to be somewhat different. In this instance, spread in plots treated with Bayer 93,820 (Treatment 6) did not differ from that in the check (Treatment 7) or in plots treated with disulfoton 15 G in the furrow (Treatment 1) or with Bayer 77,049 (Treatment 3) but did differ statistically from spread in plots treated with disulfoton 6 LC, both broadcast at planting (Treatment 2) or sprayed in July (Treatment 4) or treated with disulfoton 15 G broadcast at planting time (Treatment 5). Treatments other than Bayer 93,820 were not statistically different from one another.

Table 4. Leafroll spread in the plots of the 1970 insecticide trials.
(See Table 1 for rates and dates of application).

Treatment Number	Insecticides	Leafroll Spread %	Analyses of variances using $\sqrt{x+.05}$ (reconverted means)	
		Test A	*Without Check*	*With Check*
1	Dupont 1410-L	0.7	0.22	0.22
2	Penick SBP 1382	0.3	0.13	0.13
3	phosmet	1.0	0.38	0.38
4	DuPont 1410-L	1.6	0.65	0.65
5	phosmet	0.7	0.27	0.27
6	Penick SBP 1382	0.3	0.13	0.13
7	Check	1.0	—	0.38
			NS	NS
		Test B		
1	aldicarb	0	0	0
2	phosalone	0.7	0.27	0.27
3	carbofuran	0.7	0.27	0.27
4	parathion	0.3	0.13	0.13
5	phosalone	0.3	0.13	0.13
6	carbofuran	1.0	0.38	0.38
7	Check	1.0	—	0.38
			NS	NS
		Test C		
1	disulfoton 6LC	0.7	0.27 b	0.27 ab
2	disulfoton 6LC	0.3	0.13 b	0.13 b
3	Bayer 77,049	0.7	0.27 b	0.27 ab
4	disulfoton 15G	0	0 b	0 b
5	Bayer 93,820	0	0 b	0 b
6	disulfoton 15G	1.9	0.94 a	0.94 a
7	Check	1.0	—	0.38 ab

1971

Leafroll spread to a greater extent in the 1971 experiments than in those of 1970. Spread was recorded in the check and in all of the variously treated plots in all three experiments except for one treatment with pirimicarb. In only 4 of the 18 treatments in 1971 was spread of leafroll less than in the untreated check. Spread of leafroll in the treated plots ranged from 0 to 3.6 percent. The spread in the untreated check was recorded as 0.6 percent.

Test D (Table 5)

Green peach aphid populations in the check differed from those in plots treated with aldicarb on two count dates in August, yet spread of leafroll was not essentially different. However, the greatest spread of leafroll was in plots treated with granular disulfoton and where, in mid August, green peach aphid populations were significantly higher than in the check.

No spread of leafroll was found in plots treated with a pound of pirimicarb in late July. However, in plots treated twice with a half pound of the same material, spread was greater than in the check.

The range in this experiment was from 0 to 3.3 percent spread of leafroll.

Analysis of variance showed some significant differences. Leafroll spread was significantly greater in plots treated with one pound of disulfoton per acre at planting time (Treatment 4) than it was in plots treated with aldicarb at either one (Treatment 5) or 3 pounds per acre (Treatment 2), or sprayed once with pirimicarb at one pound per acre (Treatment 3). Spread was also significantly greater than in the associated, untreated check (Treatment 7).

The analysis showed no significant differences among disulfoton at one pound per acre at planting time (Treatment 4), disulfoton at one half pound sprayed on July 21 (Treatment 6) or pirimicarb (Treatment 1) sprayed at a half pound twice, once in July and again in August.

Treatments other than number 4 did not differ among themselves.

Test E (Table 5)

Acephate at one pound active, applied during the third week in July and again the first week in August kept green peach aphids below a detectable level from the time of the first application until the count of August 25.

These differences in aphid populations were significant for both numbers and percent of plants populated except on August 3.

Spread of leafroll was less in these plots than in the check or in plots treated otherwise.

Three series of plots treated with disulfoton on August 6 showed considerably more spead of leafroll than was found in the check. The treatment with disulfoton may have been made too late in the season to prevent spread of leaf roll. The earlier furrow treatments with phoxim had no effect on aphid populations in these three series of plots.

Although the two rates of Uniroyal 840 did not result in significantly different populations of the green peach aphid, the high rate (Table 5) reduced the spread of leafroll to 1/5 of that found in the plots treated with the low rate of this material. Neither rate reduced spread below that found in the check.

Analysis of variance showed that leafroll spread in plots treated with the low rate of Uniroyal 840 (Treatment 3) was significantly greater than in plots treated with the high rate (Treatment 4) of this material, or with acephate (Treatment 6) or in the untreated, associated check (Treatment 7). Non-significant differences were found among the plots treated in August with varying amounts of disulfoton. These three treatments (1, 2,

and 5) did not differ either from the low rate of Uniroyal 840 (Treatment 3).

Test F (Table 5)

Green peach aphid populations rose to rather high levels toward the end of the season in plots treated three times with parathion or phosmet (Table 2). From early August on, significant differences were found.

Populations in the two untreated series of plots within the experiment were numerically, consistently higher than in the outside check but differed significantly only in one case in mid August.

Phosalone applied 3 times kept spread of leaf roll to 50% of that in the outside check and well below that found in the inside checks.

Phosmet kept spread of leaf roll below that found in plots treated with materials other than phosalone and below that in the inside checks.

The largest amount of spread was found in the plots treated three times with parathion.

The range of spread in this experiment was from 0.3% to 3.6%. The outside check showed spread of 0.6% while the two inside checks averaged 2.6%. Analyses of variance showed no statistically significant differences in this experiment.

Table 5. Leafroll spread in the plots of the 1971 insecticide trials. (See Table 2 for rates and dates of application).

Treatment Number	Insecticides	Leafroll Spread %	Analyses of variances using $\sqrt{x+.05}$ (reconverted means)	
		Test D	*Without Check*	*With Check*
1	pirimicarb	1.0	0.38 ab	0.38 ab
2	aldicarb	0.3	0.13 b	0.13 b
3	pirimicarb	0	0 b	0 b
4	disulfoton	3.3	1.48 a	1.48 a
5	aldicarb	0.7	0.22 b	0.22 b
6	disulfoton	2.0	0.81 ab	0.81 ab
7	Check	0.6	—	0.27 b
		Test E		
1	phoxim & disulfoton	1.6	0.80 ab	0.80 ab
2	phoxim & disulfoton	1.3	0.55 ab	0.55 ab
3	Uniroyal 840	3.6	1.56 a	1.56 a
4	Uniroyal 840	0.7	0.30 b	0.30 b
5	phoxim & disulfoton	1.6	1.01 ab	1.01 ab
6	acephate	0.3	0.13 b	0.13 b
7	Check	0.6	—	0.27 b
		Test F		
1	parathion	3.6	1.36	1.36
2	untreated	2.9	1.37	1.37
3	untreated	2.3	0.71	0.71
4	disulfoton	1.6	0.65	0.65
5	phosmet	1.3	0.55	0.55
6	phosalone	0.3	0.13	0.13
7	Check	0.6	—	0.27
			NS	NS

1972

Leafroll spread in these experiments varied between 0 and 3.2 %. Green peach aphid populations reached rather high levels in all three experiments, with the highest levels being reached in late August. Populations in most of the treated plots tended to exceed those in the checks.

Test G (Table 6)

Ethiofencarb applied once in mid July (Table 3) prevented spread of leafroll in both series of plots. It also kept populations of the green peach aphid at low levels until late in August.

Sandoz-Wander 52,139 at the high rate (Table 3) applied twice was as effective in preventing spread of leafroll as was ethiofencarb.

Monocrotophos (Table 3) did not prevent spread of leafroll. In both series of plots there was more spread than in the check and there was more spread in plots treated with the low rate than in plots receiving the higher rate. This material allowed green peach aphid populations to increase materially in August.

Analyses of variance showed distinct differences when the check plot was included in the computation. There was significantly more spread in plots treated with the low rate of monocrotophos (Treatments 1 and 5), or with the low rate of Sandoz-Wander 52,139 (Treatment 4) than in the plots treated with the high rate of Sandoz-Wander 52,139 (Treatment 3) or with ethiofencarb (Treatments 2 and 6).

When the analysis was made without the check, the two treatments with monocrotophos (1 and 5) were found to be similar. However, the low rate differed from all other treatments. The high rate of monocrotophos (Treatment 5) was found not to differ from the low rate of Sandoz-Wander 52,139 (Treatment 4) which in turn was not different from the remaining treatments, except for Treatment 1.

Test H (Table 6)

Populations of the green peach aphid varied widely in this experiment (Table 3). Populations in plots treated with disulfoton or phosmet greatly exceeded those found in the check. On the other hand, populations were low in plots treated with aldicarb, acephate, or Diamond-Shamrock DS 15647. Leafroll spread varied from 0 to 3.3%, with an average reading in two checks of 1.1% (Range 0 to 2.2%). The high rate of DS 15,647 kept aphids at a very low level all season and prevented the spread of leafroll in these plots. The low rate of this material was also quite effective in controlling green peach aphids but leafroll spread to the extent of 0.6%. While there were no significant differences between green

peach aphids in plots treated with disulfoton or phosmet, leafroll spread to a greater extent in plots treated with phosmet (3.3%) than in those treated with disulfoton (2.9%). Aphids were numerically more abundant in the plots treated with phosmet that in those treated with disulfoton.

Analyses of variance were made with and without the checks located on either sides of the latin square.

Spread of leafroll was significantly greater in plots treated with disulfoton at planting (Treatment 3) or sprayed with phosmet (Table 3; Treatment 4). The remaining treatments were not found to differ.

Where both checks were included in the analysis, it was found that significantly less spread occurred in the plots treated with Diamond-Shamrock DS 15,647 (Treatments 5 and 6) than in plots treated otherwise.

This was also the case when only one of the adjacent checks was included in the analysis. When the other check was substituted however, it was found that only the high rate of Diamond-Shamrock DS 15,647 resulted in significantly less spread of leafroll while the other treatments were not found to differ.

The Diamond-Shamrock material, applied in the furrow at planting time was outstanding in these experiments in its ability to control aphid populations and reduce leafroll spread to very low levels.

Test J (Table 6)

Populations of the green peach aphid were not high in this experiment, although there was some buildup by the end of August except in plots treated with disulfoton followed by a foliar spray of acephate. Spread of leafroll did not occur in plots treated with a half pound of disulfoton 6 LC or with phosalone. There was considerably less spread (0.3%) than in the checks (average 1.1%) in plots treated with pirimicarb or with a pound of disulfoton 6 LC. In plots treated with demeton or with disulfoton in the furrow followed in mid August with a foliar application of acephate, spread was recorded at 0.9%.

Analysis of variance with or without the adjacent, untreated check showed no significant differences among the materials tested in this latin square.

Table 6. Leafroll spread in the plots of the 1972 insecticide trials.
(See Table 3 for rates and dates of application).

Treatment Number	Insecticides	Leafroll Spread %	Analyses of variances using $\sqrt{x+.05}$ (reconverted means)	
		Test G	*Without Check*	*With Check*
1	monocrotophos	3.2	1.45 a	1.45 a
2	ethiofencarb	0	0 b	0 b
3	Sandoz-Wander 52,139	0	0 b	0 b
4	Sandoz-Wander 52,139	1.2	0.47 a	0.47 a
5	monocrotophos	2.2	1.08 a	1.08 a
6	ethiofencarb	0	0 b	0 b
7	Check	1.1	—	0.88 a
		Test H 1		
1	aldicarb	0.6	0.27 b	0.27 a
2	acephate	0.6	0.27 b	0.27 a
3	disulfoton	2.9	1.26 a	1.26 a
4	phosmet	3.3	1.31 a	1.31 a
5	Diamond-Shamrock DS 15,647	0.3	0.13 b	0.13 b
6	Diamond-Shamrock DS 15,647	0	0 b	0 b
7	Check (North)	0	—	0 b
		Test H 2		
1	aldicarb	0.6	0.27 b	0.27 a
2	acephate	0.6	0.27 b	0.27 a
3	disulfoton	2.9	1.26 a	1.26 a
4	phosmet	1.3	1.31 a	1.31 a
5	Diamond-Shamrock DS 15,647	0.3	0.13 b	0.13 a
6	Diamond-Shamrock DS 15,647	0	0 b	0 b
7	Check (South)	2.2	—	0.88 a
		Test J		
1	demeton	0.9	0.38	0.38
2	pirimicarb	0.3	0.13	0.13
3	disulfoton 6LC	0	0	0
4	phosalone	0	0	0
5	disulfoton & acephate	0.9	0.31	0.31
6	disulfoton 6LC	0.3	0.1	0.1
7	Check (North)	0	—	0
			NS	NS