FIELD ECOLOGY, BIOLOGY, DISTRIBUTION AND CONTROL OF THE SPOTTED ALFALFA APHID IN KANSAS

by

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INTRODUCTION

The spotted alfalfa aphid is tentatively designated as Pterocallidium sp. by Louise Russell, and is designated as Therioaphis maculata (Buckton) by Harpaz (13) and Dickson et al. (8). It has become of great economic importance in the past two years. Since its discovery in New Mexico in early 1954, it has rapidly spread into Arkansas, Arizona, California, Colorado, Louisiana, Mexico, Missouri, Nebraska, Nevada, Oklahoma, Texas, Utah and Kansas (5, 6, 8, 10, 14, 16, 18, 19 and 20). The aphid was found in April, 1955, in Sumner and Meade counties by Matthew and Frazier. However, there is also a report indicating that it may have been present in Stanton county in the fall of 1954. Since Kansas ranks second in the nation in alfalfa seed production and eighth in the nation in alfalfa hay production (2, 3), any pest of alfalfa is of much economic importance and interest in Kansas.

There has been much confusion concerning the yellow clover aphid complex. It was first thought that the spotted alfalfa aphid was the same species that has been found on red clover, in the eastern United States, for many years. It has now been decided that the spotted alfalfa aphid is a separate species, due to host preferences and certain morphological and taxonomic characteristics.

The aphids in the yellow clover aphid complex may be either winged or wingless (Plates II, III, IV, and V). A very large percent of the aphid populations are wingless females and most

of the females are viviparous. When a field is first infested, a large percentage of the aphids are winged, but succeeding generations are largely wingless. In the fall some oviparous females were found. The oviparous females are easily distinguished from the viviparous females, in the field, by their distinct orange color. This orange color is caused by the developing eggs showing through the semi-translucent exoskeleton of the female aphid. The eggs, when developing and first hatched, are orange-red in color. As the season progresses, the eggs change from this color to a jet black color (4).

The damage caused by the aphid is of two primary types, and results in a great reduction in yield and in the killing of seedling alfalfa. The aphid feeds on the plant sap and this feeding kills the leaves and causes them to drop off. Furthermore, while feeding, the aphid injects a toxic saliva which retards growth or in the case of young plants will kill them. It also secretes a sugary substance which coats harvesting machinery and causes much difficulty in harvesting. This sugary substance, called honeydew, is a very good host for a black fungus, which also shows up in the harvested crop (5, 6, 7, 8, 9, 10, 14, 16, 18, 19 and 20).

At the present time a completely satisfactory method of natural control has not been found. During wet weather, a fungus disease kills many spotted alfalfa aphids in California and Arizona (6, 7, 12 and 19). Lady beetles and other predacious insects attack and partially control the aphid (1, 5, 6, 7, 8, 10, 19 and 20). Work will be carried out in conjunction with the

United States Department of Agriculture[1] on the release of introduced parasites into infested fields in Kansas.

To quote one author, "The spotted alfalfa aphid is easy to kill but difficult to control" (Dickson and Reynolds, 7). The aphid is readily killed with insecticides but reinfestation can occur very rapidly because of its rapid reproduction rate and its habit of flying and apparently being carried by the winds. Any spots that were skipped in sprayed fields act as sources of reinfestation. Most of the organic phosphate and chlorinated hydrocarbon insecticides will kill the spotted alfalfa aphid. The one to use depends upon the use of the crop (5, 7, 9, 10, 15, 16, 17, 18, 19 and 20).

PURPOSE

The purpose of this study was to investigate the biology, ecology, and distribution of this species, as well as to conduct some observations on predators and some chemical control studies. A portion of the work involved a cooperative survey, supported in part by the USDA, on the host relationships of the spotted alfalfa aphid, the yellow clover aphid, Pterocallidium trifolii, and Myzocallidium riehmi, the sweet clover aphid, throughout Kansas.

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[1] Hereafter referred to as USDA.

EQUIPMENT AND MATERIALS

Survey Equipment

Each person assisting on the surveys had a 15-inch sweeping net, with a fine-mesh bag; a standard mimeographed form (Plate I) for recording data; a common petroleum company road map, on which to mark collection sites; small glass vials containing 70 per cent alcohol; and pencils. A small hand lens, for preliminary identification of the aphids in the field, proved to be an asset.

Chemical Control Equipment

The chemical control experiments near Marion, Kansas, consisted of plots which were treated by aerial spraying. The equipment was owned and operated by a commercial aerial spray company and was piloted by a licensed operator.

The plane was a Piper J-3, powered with a Continental Model C, 85-H. P. engine. It was modified to accommodate a 45-gallon-capacity spray tank. Pressure was supplied with a 3/4-inch gear pump, driven by a 4-bladed propeller. The pump had a brake to stop it during periods of non-usage. The boom was a Sorenson Water Fall boom attached to the wing. The nozzles were placed on the boom, 14 inches apart at the center and decreasing to 9 inches apart at the end. The orifices were Sorenson number D7. They delivered about two gallons of material per acre. (Goodwin, 11)

EXPLANATION OF PLATE I

Example of the standard mimeographed form set up for use on the Kansas state-wide spotted alfalfa aphid surveys, in 1955.

PLATE I

YELLOW CLOVER APHID SURVEY

County _____

Date _____

1/ Location of field	2/ Plant species	3/ Stage Development of crop	4/ APHID ABUNDANCE No./sweep or No./plant	5/ Predators Nos. Kinds Parasites	6/ Disposition of collections	7/ Record Evidence of injury	8/ REMARKS

1/ Location to nearest 1/10 mile.
2/ Examine all legumes.
3/ Newly mown, 2" tall, 4" tall, bloom, etc.
4/ Where unsuccessful in sweeping, examine individual plants. If less than 1 aphid per sweep in 20 sweeps, then use brush method. If then present, record as "trace".
5/ No. per sweep or per sq. ft. (including lady beetles, lace wings, nabids, etc. Also whether larvae or adults.
6/ Collect aphids in vials and indicate where they are sent.
7/ Indicate whether lots of honey dew, or black stems or crop abandoned, if sprayed, etc.
8/ Record any evidence of tolerant or resistant plants and disposition of plants. Also negative findings. Also any temperature, rainfall, or hail conditions. Winged or wingless aphids and location of plants.

The spray materials used were OS-2046,[1] technical material; malathion, 27 percent emulsifiable concentrate; parathion, 51 percent emulsifiable concentrate. The diluent used was diesel fuel, which was purchased from a Marion, Kansas, service station.

METHODS AND RESULTS

Identification of Aphids

The yellow clover aphid complex, of which the spotted alfalfa aphid is a member, is composed of three species. The following key, compiled from various sources, shows their differentiating characteristics.

1. Host-sweet clover: has four rows of tubercules on the dorsum of the abdomen; each tubercule has a relatively short, apically enlarged seta; the third antennal segment has 8-12 circular sensoria confined to the basal one-half. . . . . sweetclover aphid (Myzocallidium riehmi)[2]

2. Host-red clover: has six or more rows of tubercules on the dorsum of the abdomen; each tubercule has a relatively long, apically enlarged seta; the third antennal segment has 7-10 circular sensoria distributed along the entire segment; does not have sclerotized dashes on the ventral surface of the abdomen. . . . . yellow clover aphid (Pterocallidium trifolii)

3. Host-alfalfa; has six or more rows of tubercules on the dorsum of the abdomen; each tubercule has a relatively long, apically enlarged seta; the third antennal segment has 7-10 circular sensoria confined to the basal one-half; has sclerotized dashes present on the ventral surface of the abdomen. . . . . spotted alfalfa aphid (Pterocallidium sp.)

Plates II, III, IV and V show the characteristics mentioned in the key above.

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[1] 2-carbomethoxy-1-methylvinyl dimethyl phosphate.

[2] Scientific names determined by Miss Louise Russell of the United States Department of Agriculture, Insect Identification and Parasite Introduction Section, Washington, D. C.

EXPLANATION OF PLATE II

Diagrammatic drawing of the yellow clover aphid complex.[1]

Fig. A. Dorsal view of the spotted alfalfa aphid and antenna.

Fig. B. Dorsal view of the sweetclover aphid and antenna.

Fig. C. Dorsal view of the yellow clover aphid and antenna.

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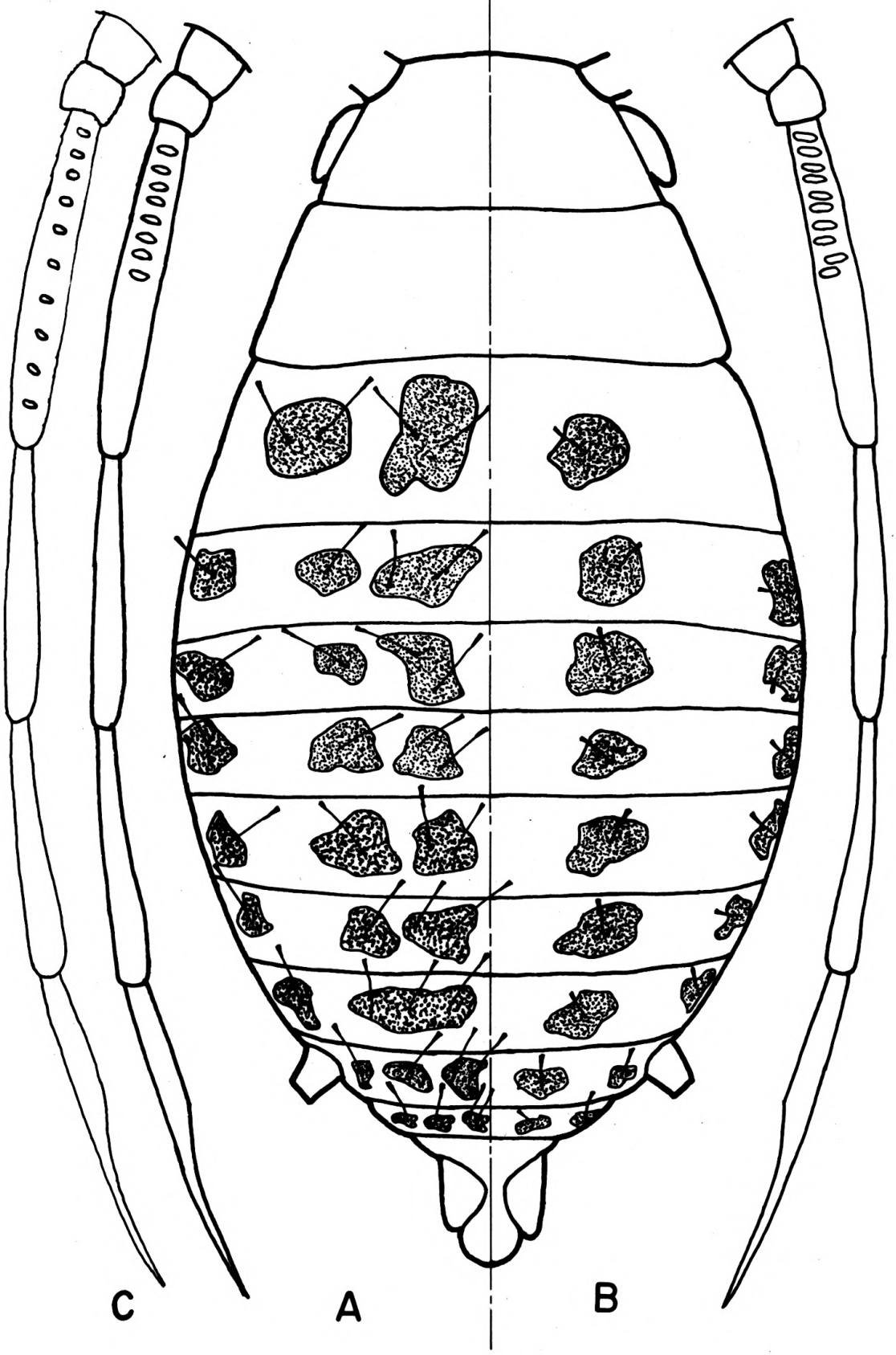
[1]Aphids enlarged 125X. Antenna enlarged 150X.

PLATE II



EXPLANATION OF PLATE III

Fig. 1. Dorsal view of winged, female spotted alfalfa aphid. 25X.

Fig. 2. Dorsal view of wingless, female spotted alfalfa aphid. 40X.

PLATE III

Fig. 1.

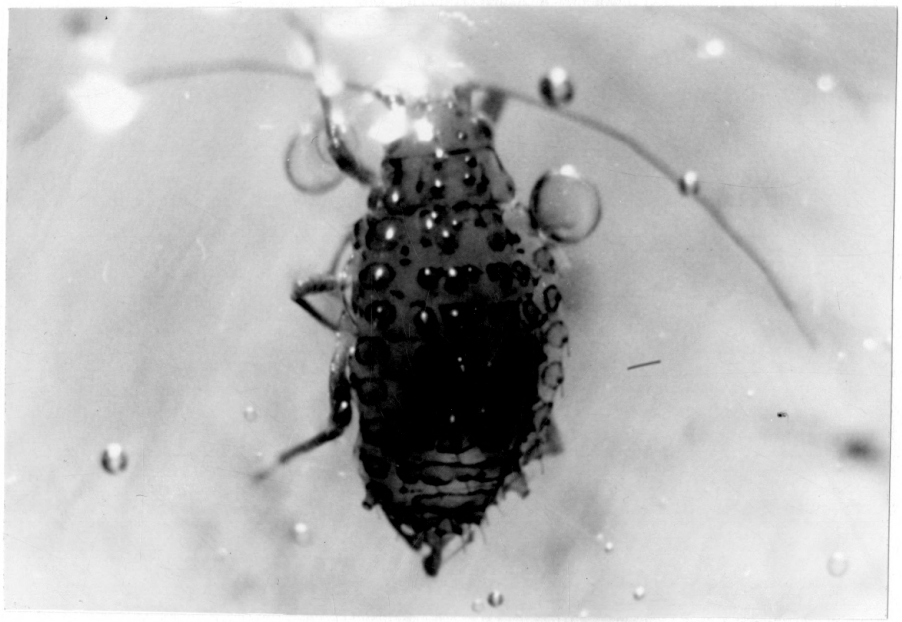


Fig. 2.

EXPLANATION OF PLATE IV

Fig. 1. Dorsal view wingless, female spotted alfalfa aphid. 40X.

Fig. 2. Dorsal view wingless, female yellow clover aphid. 36X.

Fig. 3. Dorsal view wingless, female sweetclover aphid. 30X.

PLATE IV

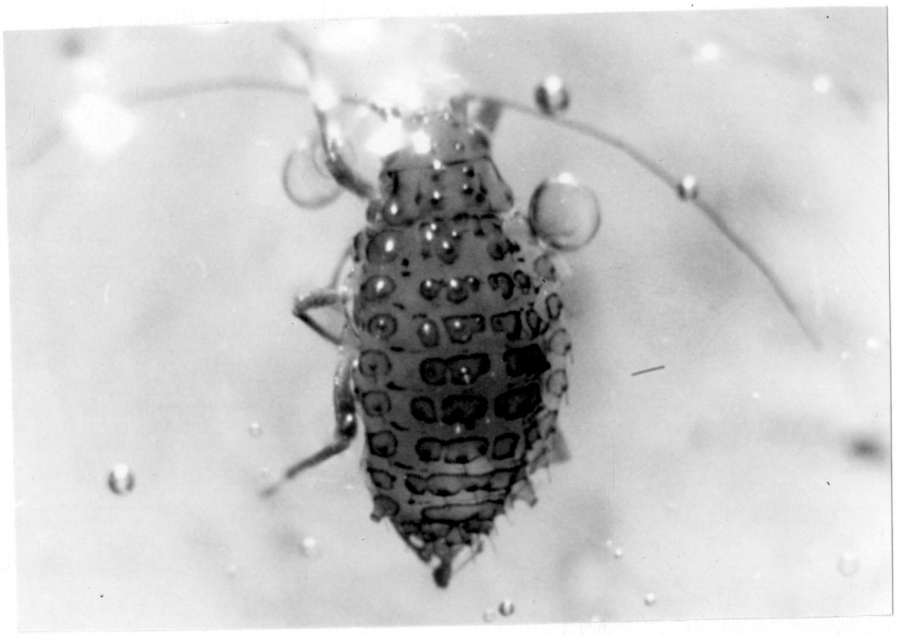


Fig. 1.

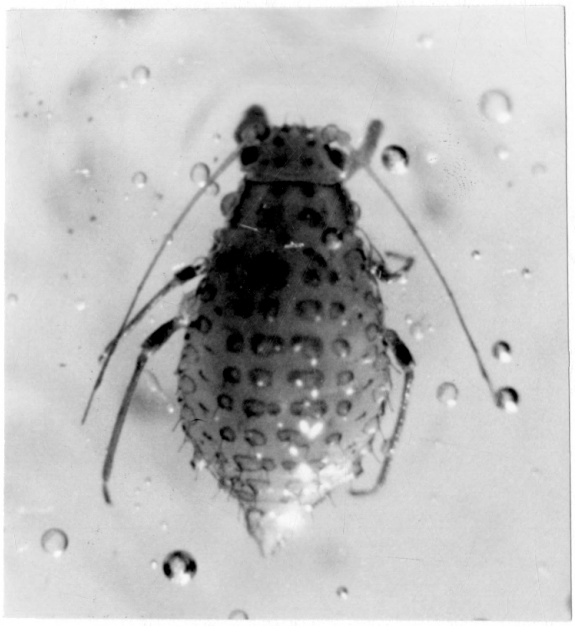


Fig. 2.

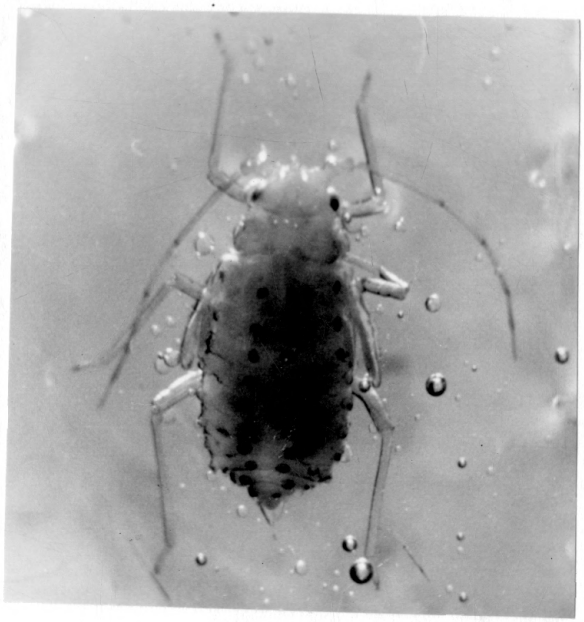


Fig. 3.

EXPLANATION OF PLATE V

Fig. 1. Ventral view wingless, female spotted alfalfa aphid. 33X.

Fig. 2. Ventral view wingless, female yellow clover aphid. 35X.

Fig. 3. Ventral view wingless, female sweetclover aphid. 32X.

PLATE V

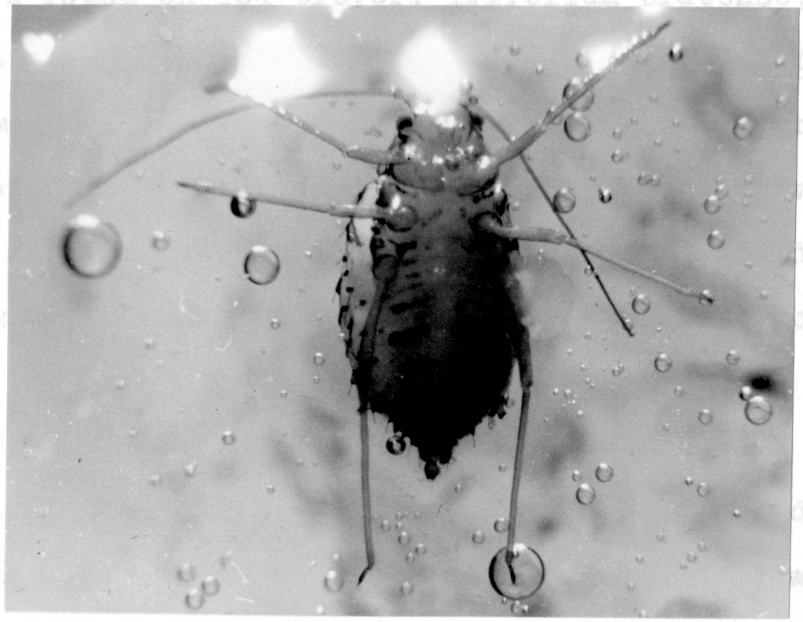


Fig. 1.

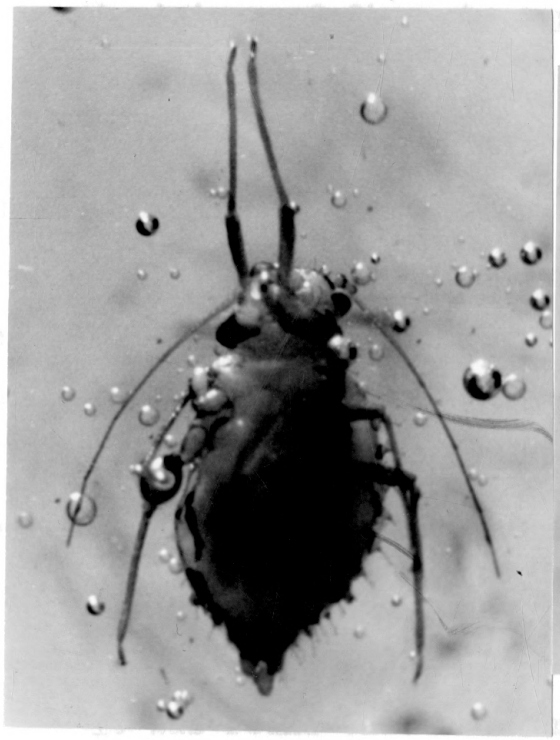


Fig. 2.

Fig. 3.

The name of the yellow clover aphid is somewhat confusing. This aphid is found on red clover, Trifolium pratense, and not as a rule on yellow clover, Melilotus indica or M. officinalis. It was no doubt given its name due to its yellow color. It would seem more appropriate that the name of the yellow clover aphid be changed to the yellow red-clover aphid. This would eliminate the confusion of the name in relation to the common host plant.

Survey Methods and Results

A standard method of sampling and recording aphid populations was set up so that, although different persons were involved in the survey, the end results would be the same. The standard method of sampling was set up for both accuracy and convenience.

A minimum of five stops per county was made where possible, and these stops were distributed both ecologically and geographically. The data obtained were recorded on the above-mentioned forms.

When there were numerous host plants of a given species available in the immediate vicinity, several plants were sampled. All species of legumes present were examined.

Sweeps were made with a 15-inch net and the swing included an arc of approximately 180 degrees. Samples were taken in three locations in every field sampled and the average number of aphids and predators per sweep were recorded on the mimeographed form.

It was found that black nets aided in observation of the aphid and therefore it was suggested that the nets be dyed black.

If less than one aphid per sweep was found in twenty sweeps,

the surveyor reverted to the brush method. When employing the brush method, the net was held alongside the plants, near the ground, and the plants were brushed toward the net, with the hand. If no aphids were observed by this method, a few individual plants were carefully observed. If still no aphids were observed, the surveyor proceeded to the next nearest field.

At least one sample of aphids per host per county was collected and placed in the vials containing 70 percent alcohol. Recorded on the vial label was the following information: (1) county where collected; (2) distance from field to nearest town, to the nearest 0.1 mile; (3) date collected; (4) the species of host plant that the sample was collected on; and (5) the collector's name.

The stops made and the route followed were marked on an ordinary road map.

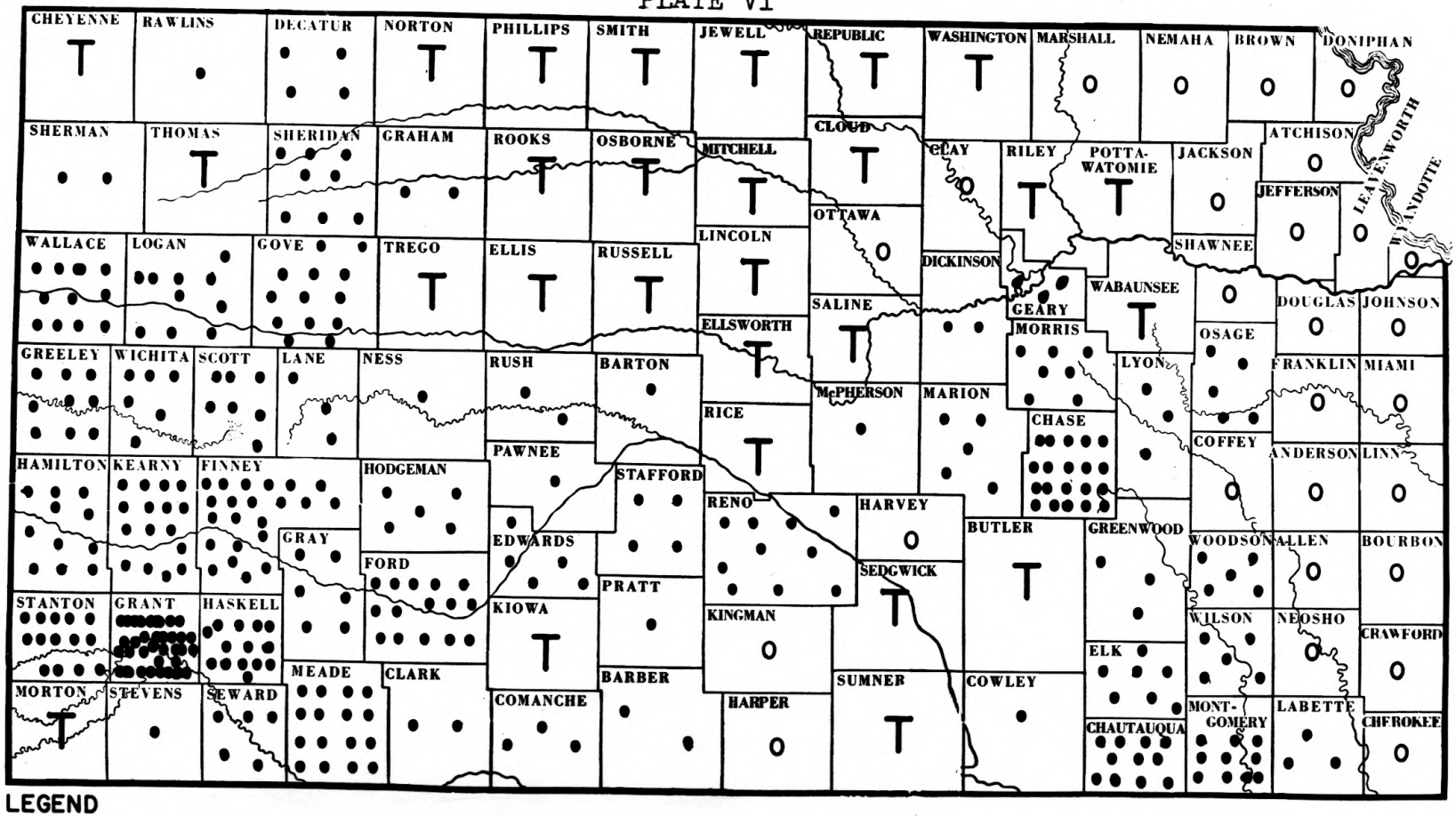
The first survey, August 1-20, 1955, covered the entire state of Kansas. The spotted alfalfa aphid was found in 80 of the 105 counties (Plate VI). The sweetclover aphid was found in ten counties. The yellow clover aphid was found in four counties (Plate VII).

On the second survey, September 24-October 20, 1955, only 39 of the 105 counties were checked. Since the general distribution of the aphids was known, only random areas were checked for abundance of aphids. Special effort was made to check most of the counties in which the spotted alfalfa aphid was not found on the first survey. The spotted alfalfa aphid was found in all counties checked and ranged in numbers from traces to an average of

EXPLANATION OF PLATE VI

Distribution of the spotted alfalfa aphid as recorded on a survey in Kansas, August 1-20, 1955. Each solid dot represents 10 aphids per sweep.

PLATE VI



LEGEND

T = LESS THAN 10 APHIDS PER SWEEP

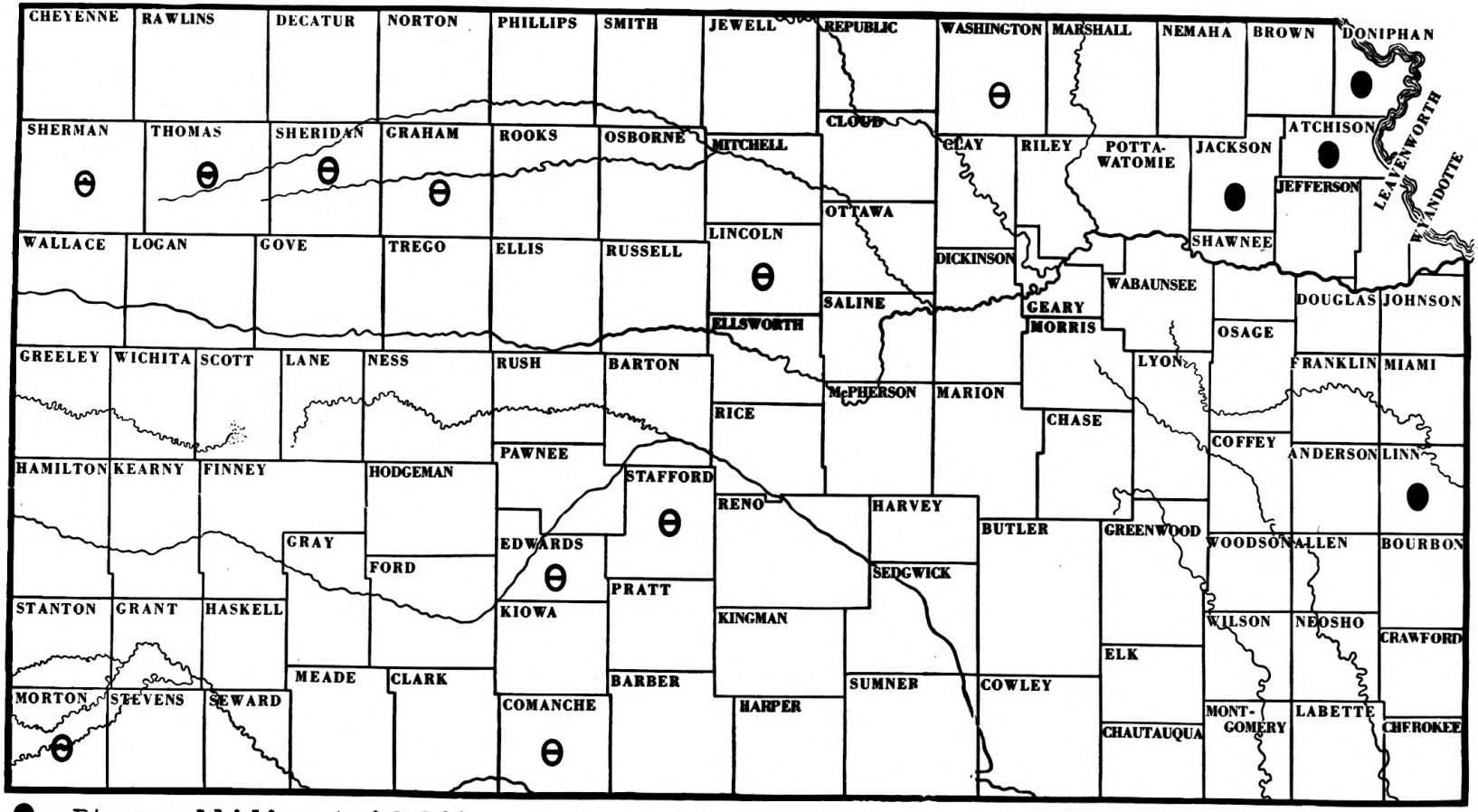
O = NO APHIDS

● = 10 APHIDS PER SWEEP

EXPLANATION OF PLATE VII

Distribution of the yellow clover aphid (*Pterocallidium trifolii*) and the sweetclover aphid (*Myzocallidium riehmi*) as recorded on a survey in Kansas, August 1-20, 1955.

PLATE VII



● = Pterocallidium trifolii

Θ = Myzocallidium riehmi

60 per sweep per county (Plate VIII). The sweetclover aphid was found in two counties. The yellow clover aphid was found in four counties (Plate IX).

The populations were not constant throughout the area. This might be caused by differences in alfalfa acreages, stage of growth, humidity of air and soil, moisture content of the plants and velocity of the wind. The spotted alfalfa aphid seemed to prefer alfalfa that was not newly mown and that was succulent in growth. The wind had an effect on the counts, because when the wind blew the plants, a large number of aphids were thrown on the ground. Further studies should be conducted on the above-mentioned factors, to determine the actual effect that they have on the aphid.

The yellow clover aphid and sweet clover aphid populations decreased in numbers on the second survey, primarily due to the harvest and death of the host plants. The sweetclover aphid was found primarily in the western part of the state, while the yellow clover aphid was found only in the northeastern part of the state, since that is the only area of the state where red clover is grown to any appreciable amount.

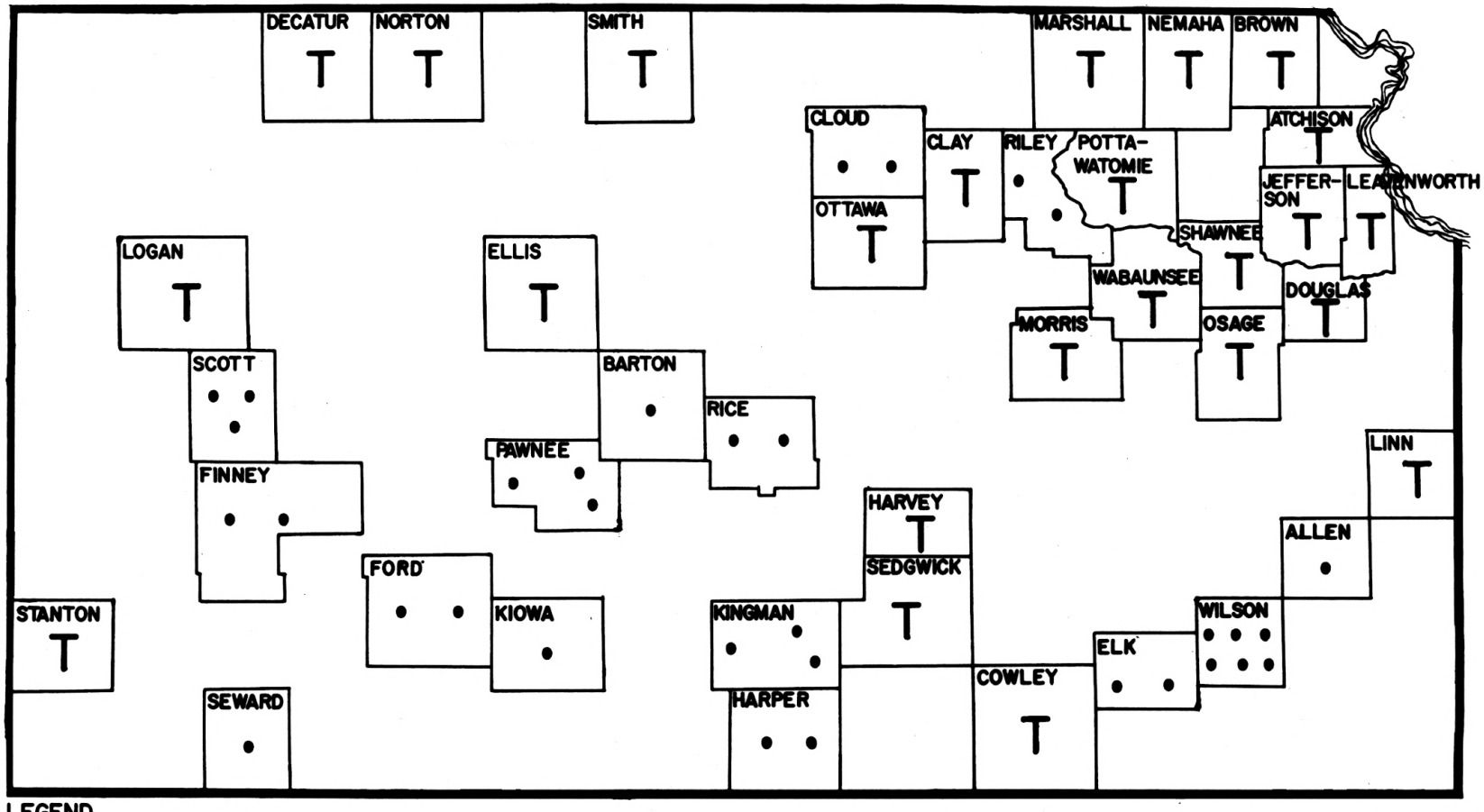
Chemical Control Methods and Results

As was mentioned before, the chemical control experimental plots near Marion, Kansas, were sprayed by airplane. The time of application was from 10AM to 1PM. The wind was from the west and wind velocity was 10 to 12 miles per hour. The fields were therefore sprayed north and south. The speed of flight, while

EXPLANATION OF PLATE VIII

Distribution of the spotted alfalfa aphid as recorded on a survey in Kansas, September 24-October 20, 1955.

PLATE VIII



LEGEND

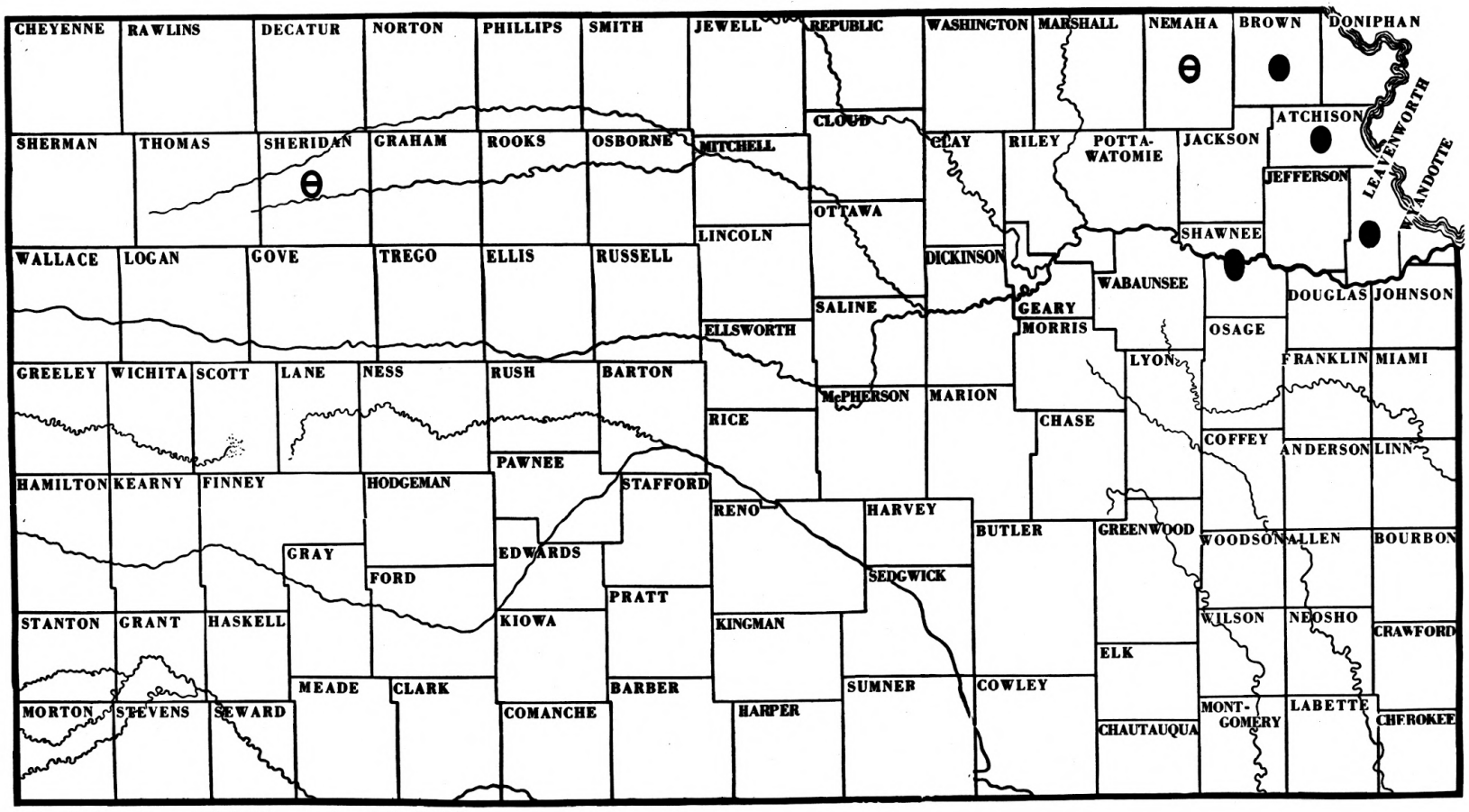
T = LESS THAN 10 APHIDS PER SWEEP

● = 10 APHIDS PER SWEEP

EXPLANATION OF PLATE IX

Distribution of the yellow clover aphid and the sweetclover aphid as recorded on a survey in Kansas, September 24-October 20, 1955.

PLATE IX



● = Pterocallidium trifolii

Θ = Myzocallidium riehmi

spraying, was approximately 65 miles per hour and the height of flight was four to eight feet above the surface of the alfalfa.

The rates of application were as follows: malathion, eight ounces per acre; parathion, four ounces per acre; and OS-2046, four ounces per acre.

Parathion and malathion were emulsifiable concentrates and OS-2046 had to have an emulsifier, Atlox 1045A, added.

The proper amount of insecticide concentrate was mixed with enough diesel fuel to get a total solution of two gallons per acre.

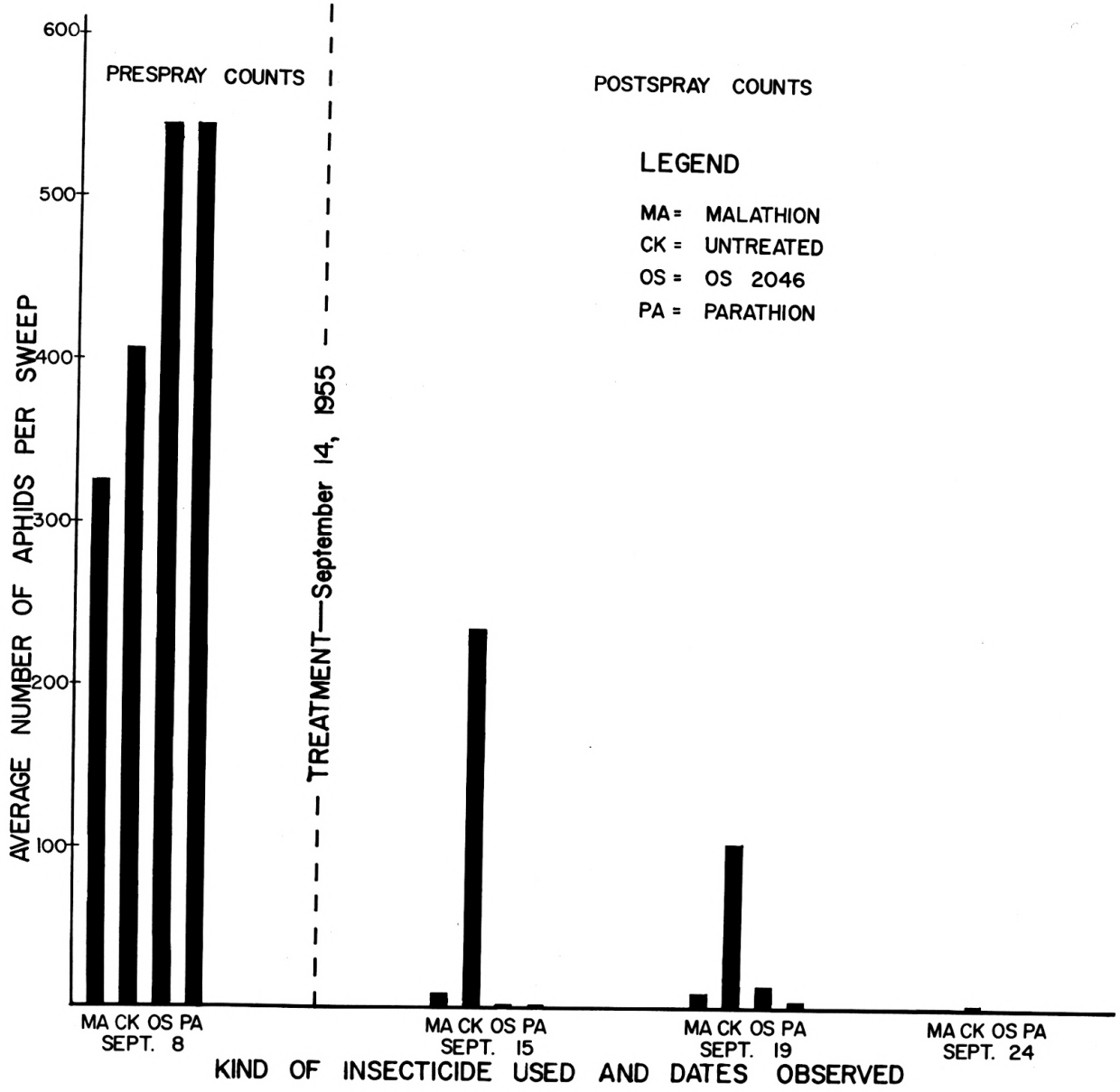
Observations were made on the spotted alfalfa aphid and predator populations, 1 day, 5 days and 10 days after spraying (September 14). On the ninth day after spraying, the area received about 3.5 inches of rain in approximately one hour. This rain beat the aphids and predators off the plants and evidently drowned or otherwise destroyed many of them. Very few spotted alfalfa aphids and predators were found on the tenth day observation.

The three insecticides had an immediate effect on the aphids (Plate X). One day after spraying (September 15), populations were observed to be less than 10 per sweep in the malathion plot and only an occasional aphid was found in the OS-2046 and parathion plots. Aphid populations in the OS-2046 and parathion plots had started a slight increase in five days (September 19). The aphid population in the malathion plot stayed constant. On the tenth day (September 24) no aphids were observed in any of the chemical control plots, probably due to the heavy rain on the previous day.

EXPLANATION OF PLATE X

Aphid counts on the spotted alfalfa aphid chemical control experimental plots near Marion, Kansas, September, 1955.

PLATE X


600
500
400
300
200
100
AVERAGE NUMBER OF APHIDS PER SWEEP
PRESPRAY COUNTS
POSTSPRAY COUNTS
TREATMENT—September 14, 1955
LEGEND
MA = MALATHION
CK = UNTREATED
OS = OS 2046
PA = PARATHION
MA CK OS PA
SEPT. 8
MA CK OS PA
SEPT. 15
MA CK OS PA
SEPT. 19
MA CK OS PA
SEPT. 24
KIND OF INSECTICIDE USED AND DATES OBSERVED

From the results obtained, it was shown that chemical control against the spotted alfalfa aphid was effective for immediate kill, but thorough application was necessary.

Biological Control Methods and Results

During the chemical control experiments near Marion, Kansas, one isolated two-acre field was left untreated as a check and to determine the effectiveness of biological control as compared to chemical control of the spotted alfalfa aphid. The observations extended from September 8 through September 24.

Table 1. Number of predators collected in twenty sweeps on biological control plots near Marion, Kansas, September 19, 1955.

Species	Number of adults	Number of immatures	Total	% total number of predators
Hippodamia convergens	211	163	374	78.9
Cycloneda munda	14	0	14	2.2
Olla abdominalis	2	0	2	0.6
Chrysopa oculata	43	2	45	9.6
Chrysopa plorabunda	0	37	37	7.9
Nabis sp.	3	0	3	0.8
		Total	475	

Six species of predators were found (Table 1). They belonged to three orders: Coleoptera, Neuroptera and Hemiptera. The one found in largest numbers was the convergent lady beetle, Hippodamia convergens Guer., which composed 78.9 percent of the total number of predators.

The results of the predators on the spotted alfalfa aphid are shown in Plate X, by comparing columns CK, which show a continual decline in the spotted alfalfa aphid population.

Observations were made on the biological control experiments

on the same days as they were made on the chemical control experiments. This area also received the heavy rain.

Biological control offers some degree of control, but it lags behind the aphid population and does not get immediate results.

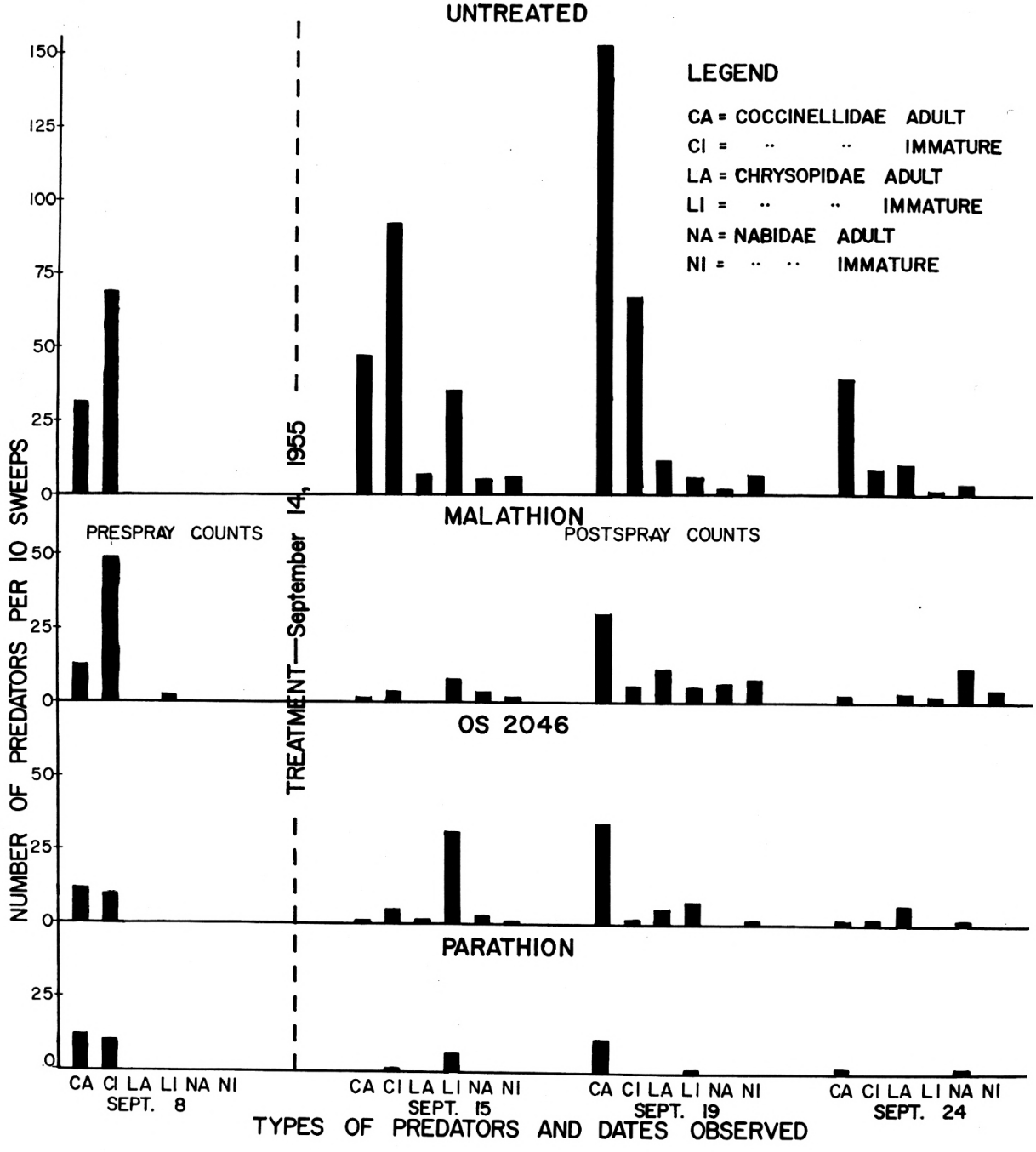
Observations were also made on the effect of insecticides on predators in the chemical control experiments. Before spraying, only counts of lady beetles were taken, with one exception. After spraying, it was found that other species of predators were also present, so the later counts included these predators. The counts in the untreated, biological control plot acted as checks on the effect of the insecticides on the predators. Based upon comparison to the untreated field, all the insecticides had an adverse effect on the predators (Plate XI). Parathion had the most destructive effect on all predators. OS-2046 was second most destructive to the predator complex with the exception of the chrysopid larvae. It appeared from these observations that chrysopids, especially the immature forms, were better able to survive OS-2046 than other species of predators. Furthermore, OS-2046 seemed less toxic to chrysopid immatures than either parathion or malathion. Malathion also had some adverse effect on predators.

The spotted alfalfa aphid population started to build up again, in the treated fields, after spraying, while in the untreated plot, the population kept decreasing (Plate X). This continual decline was due to the fact that the predators were not destroyed but maintained their influence over the aphid, while in

EXPLANATION OF PLATE XI

Effect of chemical control on predator populations on the spotted alfalfa aphid chemical control experimental plots near Marion, Kansas, September, 1955.

PLATE XI


UNTREATED
LEGEND
CA = COCCINELLIDAE ADULT
CI = " " IMMATURE
LA = CHRYSOPIDAE ADULT
LI = " " IMMATURE
NA = NABIDAE ADULT
NI = " " IMMATURE
150
125
100
75
50
25
0
TREATMENT—September 14, 1955
MALATHION
PRESPRAY COUNTS
POSTSPRAY COUNTS
50
25
0
OS 2046
50
25
0
PARATHION
25
0
NUMBER OF PREDATORS PER 10 SWEEPS
CA CI LA LI NA NI
SEPT. 8
CA CI LA LI NA NI
SEPT. 15
CA CI LA LI NA NI
SEPT. 19
CA CI LA LI NA NI
SEPT. 24
TYPES OF PREDATORS AND DATES OBSERVED

the treated plots, the predators were destroyed and were not able to prevent the aphids from rebuilding their populations. The initial source of this reinfestation possibly resulted from aphids surviving in narrow untreated strips that may have been accidentally left untreated, or from surrounding untreated fields.

Overwintering Studies and Results

Since the spotted alfalfa aphid had become a major economic pest of alfalfa in Kansas, and it is known to overwinter in states to the south, it was necessary to know if the aphid overwinters in Kansas.

To accomplish this observations in alfalfa fields around Manhattan were made weekly or as often as weather and field conditions permitted, whichever was shorter, during the fall and winter of the 1955-1956 season. Observations were made at 10 different places in different fields around Manhattan, at each date of observation.

Surveys were made during January, February and early March in Cowley, Ellis, Finney, Harvey, Marion and Sedgwick Counties, in addition to the usual Manhattan observations, to determine if overwintering aphids could be found.

The fall and early winter observations were made with the aid of a sweep net. When the aphid populations got so low that they could not be found by this method, other means were used. The individual plants; trash surrounding the plants; roots; and soil, especially soil having cracks and crevices, were examined. Different habitats where the aphid might be able to overwinter, such as

trash on the ground, along buildings, haystacks, along banks of streams near alfalfa fields, were examined.

Aphids were found in the Manhattan area through the fall period up to and including January 4, 1956. Weather conditions changed so that no observations were made again until January 14, 1956, when no aphids were found after considerable search. No aphids were found up to and including April 6, 1956, in the Manhattan area.

Ten fields were examined in Cowley county on February 13, of which four were found to have live aphids present. Both wingless adults and nymphs were found. They were found on the lower surface of the leaves and on trash on the ground, under the plants.

Four fields were carefully examined in Ellis county in January. No live aphids were found in any of the fields.[1]

Four fields, that had known infestations last fall in Finney county, were examined daily for six days, the week of January 23-28. No live aphids were found. The places observed included: irrigation ditches, open fields, along shed foundations, base of haystack and irrigation borders.[2]

Two fields in Harvey county were examined on March 3. No aphids were found. Samples from one field were brought back to the laboratory for close examination, but no aphids were found.

Nine fields in Marion county were examined on March 3. No aphids were found. Two of these fields were known to have been

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[1]Observations by T. L. Harvey.

[2]Observations by Lester J. DePew.

infested with aphids the preceding fall.

One field in Sedgwick county was examined on February 14, and one adult wingless aphid was found. This field was examined again on March 3 and another wingless adult was found along with two nymphs. Another field was examined, but no aphids were found.

One field in Wabaunsee county was examined on March 21[1] and March 27 and a few adults and nymphs were found after much examination.

Therefore, it is highly probable that, as the alfalfa starts to produce new green plants in the spring, as the season progresses to the North, according to Hopkins' Bioclimatic Law, the aphids will move north with the new growth season.

Since the aphid overwintered in the southern part of the state and living aphids were not found in the northern part, it was indicated that temperature had a bearing on the overwintering. The average temperature of Winfield, where the aphid did overwinter, and the average temperature at Manhattan, where the aphid did not appear to overwinter, were compared (Plate XII). The average temperatures, of every two days, for November and December, 1955; and January and February, 1956, were used. The average temperature at Winfield ranged from 21 degrees F. above to 4 degrees F. below the average temperature at Manhattan (Plate XII). The lowest temperature at Manhattan was -7 degrees F. and the lowest at Winfield was 3 degrees F. The temperature at Winfield was below the temperature at Manhattan, eight days out of

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[1]Observations by David L. Matthew, Jr.

EXPLANATION OF PLATE XII

Fig. 1. A comparison between the average temperature at Manhattan and Winfield for November, December, 1955, and January, February, 1956. The Manhattan temperature is based on 0 and the line shows the variation of the Winfield temperature from the Manhattan average temperature.

Fig. 2. The maximum, minimum and average temperatures at Manhattan for the months of November, December, 1955, and January, February, 1956. The heavy line was used to compute 0 in Fig. 1.

PLATE XII

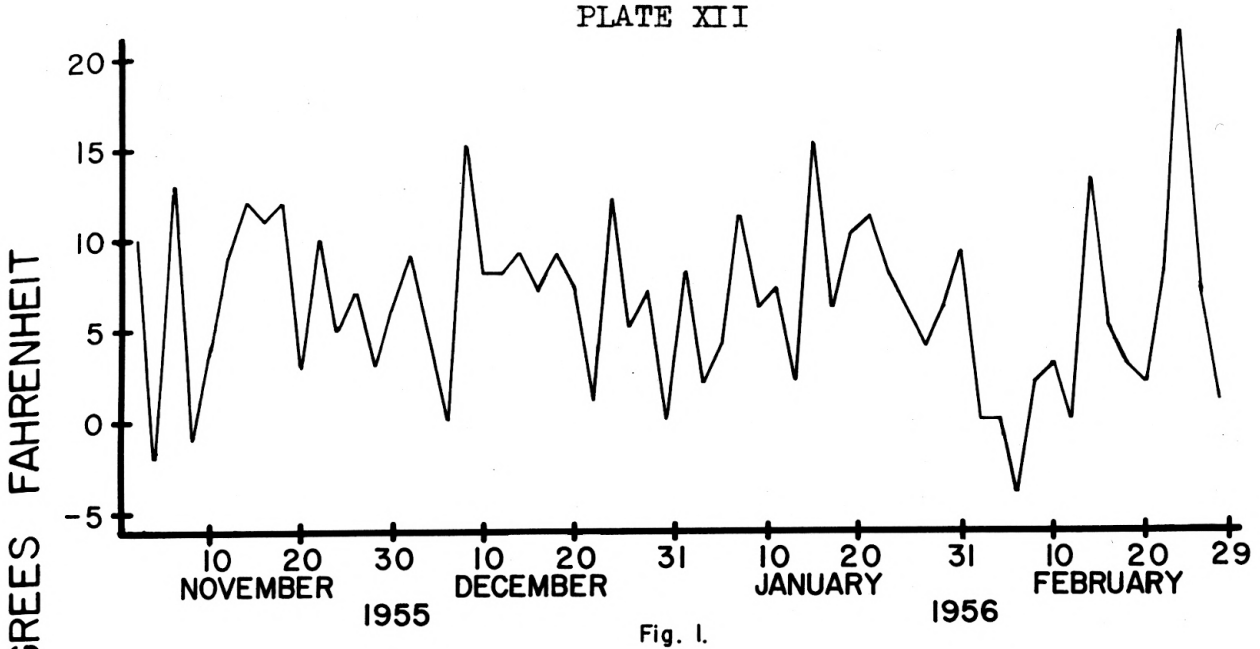


Fig. 1.

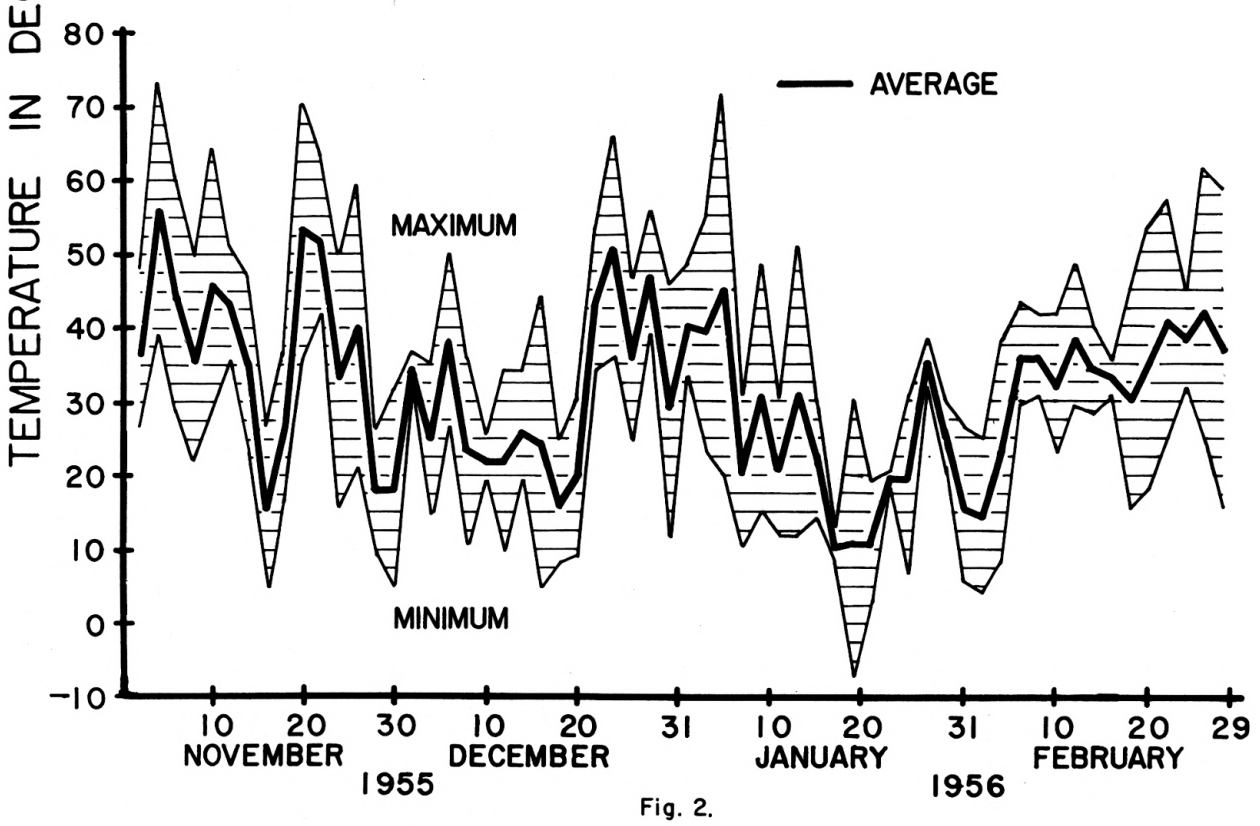


Fig. 2.

the four months time. The rest of the time it was from 1 degree F. to 21 degrees F. above. Therefore, the average temperature at Winfield was 6.7 degrees F. higher for the four-month period than the average temperature at Manhattan.

Since the spotted alfalfa aphid did overwinter this year in parts of Kansas, were the temperatures normal or were they above or below normal? The monthly departure from normal shows that for the four-month period, temperatures were from 0.2 degrees F. to 6.4 degrees F. below normal with the exception of December in which Garden City and Winfield were slightly above normal and February in which both Manhattan and Winfield were also above normal. However, with the exception of the above-mentioned temperatures, the majority of the temperatures were below normal (Plate XIII) if temperature has an important role in overwintering, which it appears to have, it is to be expected that the spotted alfalfa aphid can be found overwintering farther north in more normal years.

Further work should be conducted to determine the minimum critical temperature, threshold of development and length of exposure needed for lethal effect on the spotted alfalfa aphid.

CONCLUSIONS AND SUMMARY

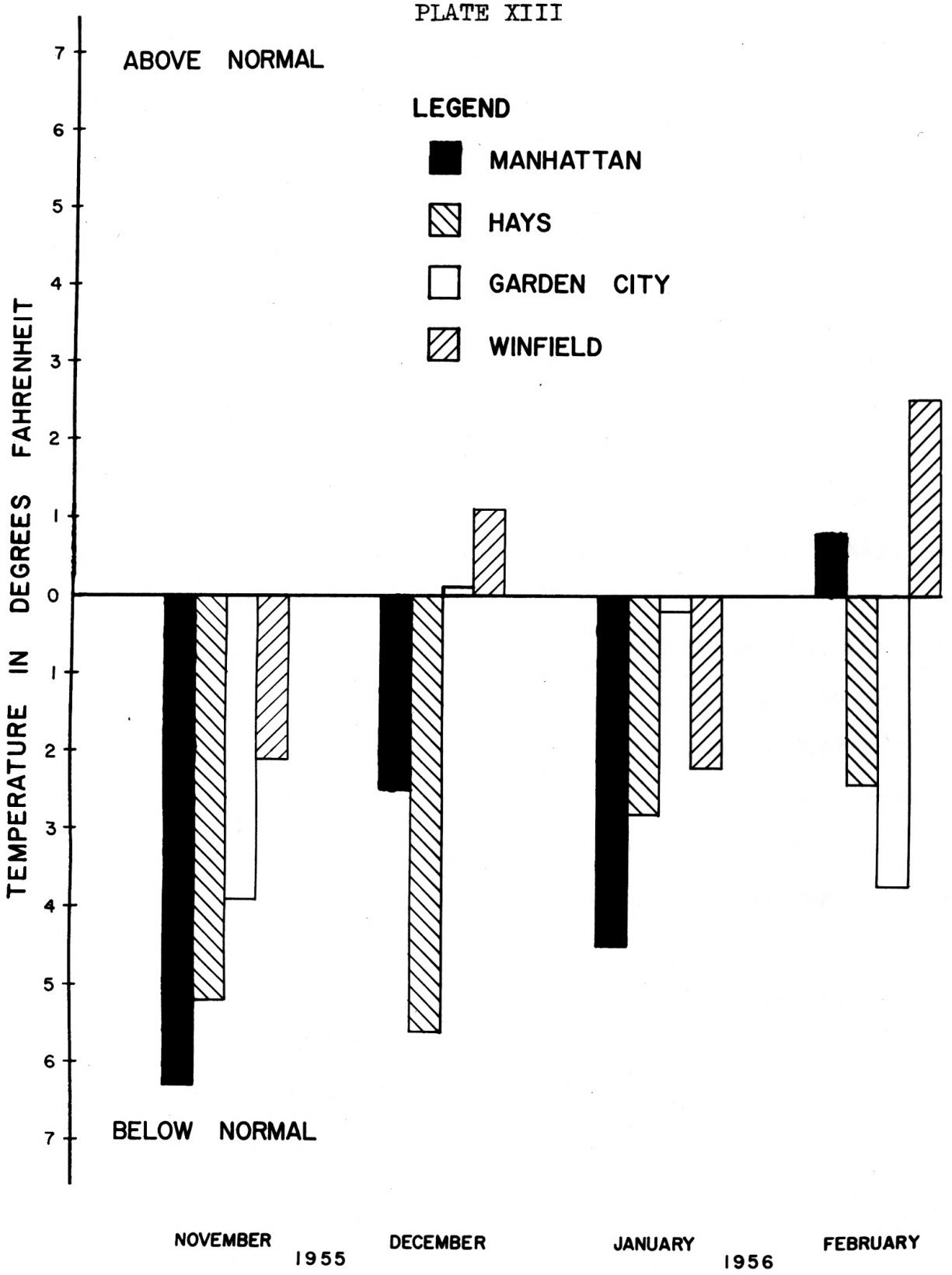
Since the entrance of the spotted alfalfa aphid into Kansas, during the fall of 1954, it has caused much alarm to alfalfa growers. Little is known of the taxonomy, biology, ecology, distribution and control of this insect.

Initially it was necessary to determine the taxonomic posi-

EXPLANATION OF PLATE XIII

This shows the departure from normal of the temperature at Manhattan, Hays, Garden City and Winfield for November, December, 1955, and January, February, 1956.

PLATE XIII


ABOVE NORMAL
LEGEND
MANHATTAN
HAYS
GARDEN CITY
WINFIELD
TEMPERATURE IN DEGREES FAHRENHEIT
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
BELOW NORMAL
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
1955
1956

tion of the spotted alfalfa aphid. The three members of the yellow clover aphid complex were studied and determined as three distinct species, by differences in morphological characteristics, as determined by Russell and Essig, and by host plants.

Surveys were made to determine the spread of the aphid. By October, 1955, it was found to be in almost every county of the state.

Insecticidal and biological control studies were conducted near Marion, Kansas. Three organic phosphorus insecticides: malathion, parathion and OS-2046, were used at eight-ounce, four-ounce, and four-ounce rates per acre, respectively. All of the three insecticides lowered the aphid population very quickly; and the experiment was terminated with a 3.5-inch rain.

Predators were effective in controlling the aphids, but did so at a slower rate than chemical control. Also, the use of insecticides reduced the population of the predators. Therefore, while insecticides greatly reduced the aphid population, predators were not present to further reduce the numbers of aphids or at least to prevent the aphid population from increasing in numbers.

The spotted alfalfa aphid was found to overwinter as adults in the southern part of Kansas during the winter of 1955-1956. Data available from Garden City, Hays and Manhattan indicated that this insect probably did not overwinter in these areas of the state. However, because of the ability of the aphid to fly and rapidly spread, this pest probably will present a serious threat to alfalfa growers throughout Kansas.

There appears to be a correlation between temperature and overwintering of the spotted alfalfa aphid. It overwintered at Winfield which had a higher average temperature during the winter than did Manhattan. The temperatures this winter (1955-1956) were below normal, based on a four-month average. It can also be expected that the aphid will be found overwintering farther north in more normal years.

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FIELD ECOLOGY, BIOLOGY, DISTRIBUTION AND CONTROL OF THE SPOTTED ALFALFA APHID IN KANSAS

by

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AN ABSTRACT OF A THESIS

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1956

The purpose of this study was to investigate the biology ecology and distribution, and to conduct some observations on predators and chemical control, of the spotted alfalfa aphid, Pterocallidium sp. as named by Miss Louise Russell, or Therioaphis maculata (Buckton) as named by Dr. E. O. Essig.

At first there was some confusion regarding the taxonomic position of the spotted alfalfa aphid. It is now known to be a separate species from the other two members of the yellow clover aphid complex, viz., the yellow clover aphid Pterocallidium trifolii (Mon.) and the sweetclover aphid Myzocallidium riehmi (Boerner). Keys to separate these three species are provided.

The spotted alfalfa aphid was found in the western three-fourths of the state during a survey in August, 1955. A September survey indicated its presence in virtually all Kansas counties.

The spotted alfalfa aphid can be controlled to a large degree with insecticides. Malathion at the rate of eight ounces per acre and parathion and OS-2046 at four ounces per acre were applied by aerial spray. Prespray counts showed 300 to 550 aphids per sweep, while one day after spraying there were 10 or less aphids per sweep. There was no appreciable increase five days after spraying. The experiment was terminated by a heavy rain nine days after spraying.

The untreated (check) field for the chemical control experiment was also observed for biological control. Lady beetles, principally Hippodamia convergens Guer. were the predominant pred-

ators. The aphid population decreased from 400 per sweep to 100 per sweep 11 days later and only traces remained after the heavy rain.

It was found that the three insecticides had an adverse effect on the predators. There was some indication that OS-2046 had a less lethal effect on immature lacewings than did the other two insecticides.

Overwintering studies showed that the aphid was not found in the Manhattan area after January 14, but it was found in the southern part of the state in February. It was not found in the Hays and Garden City area in January. The lowest temperature at Manhattan during the winter was -7 degrees F., while at Winfield the lowest temperature was 3 degrees F. The overall average temperature at Winfield was 6.7 degrees F. above the average at Manhattan. The departure from normal showed that this winter's overall temperatures were about 2.5 degrees F. below normal. The aphid may be expected to overwinter farther north during more normal years.