HOP PESTS AND THEIR CONTROL
biennium 1937-1938

by

H. E. Morrison

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Summary

The common red spider Tetranychus telarius Linn, and the hop aphis Phorodon humuli Schrank are the two most important pests of hops in Oregon. Other potentially important pests include the omnivorous leaf tier Cnephasia longana Haw., the onion thrips, Thrips tabaci Lind, the western flower thrips Frankliniella moultoni Hood, the hop butterfly, Polygonia satyrus Edw, the hop merchant, Polygonia interrogationis Fabr., the comma butterfly Polygonia comma Harris, the mourning cloak butterfly Aglais antiopa Linn., the western twelve spotted cucumber beetle, Diabrotica soror Lec., the hop flea beetle Psylliodes punctulata Mels., the fall webworm, Hyphantria cunea Drury, the black ant, Formica fusca Linn. var. and undetermined species of wireworms, leafhoppers, cutworms, loopers, vine borers, mealy bugs and white flies.

The description, life history, economic importance and control measures of the more important of these pests is discussed in this biennial report.

Seasonal history studies were conducted in 1938 by making examinations of hop plants at ten day intervals. Over 4500 hop plants were thus examined and the percentage infestation and density of all hop pests were recorded for each plant. The scarcity of Tetranychus telarius and Phorodon humuli in 1938 was attributed to biological control agents.

An experimental plan of field technique, modified from the type used in Ohio for codling moth experimentation has proven entirely satisfactory for red spider investigations. This plan uses six hills to a plot, provides for replication of plots and makes it possible to test fourteen materials per season in one acre of hops.

Seven dust and seven spray materials were tested in the field against

the red spider. The standard and recommended spray mixture was significantly better than any other spray application but its pesticidal control was not satisfactory. Dinitro-o-cyclohexyl phenol at .8% in walnut shell flour gave 100 percent kill of red spider but caused some burning to baby hop plants which had been surface irrigated. Additional tests with this material at various concentrations produced no foliage injury. A discussion of the pesticidal action of this material is given.

The possibility of a sprinkler type system of irrigation for red spider control is discussed and it is advocated that this problem should be studied before a general movement of this kind among the hop growers takes place.

Several preliminary laboratory tests were made and several materials were discarded as not worthy of field trials. The importance of contacting aphis with nicotine dusts was indicated and the necessity of development of satisfactory methods of dust application is discussed.

Introduction

Oregon is the leading hop producing center of the world and 21,500 acres are devoted to this enterprise. An average of 17,500 pounds of hops (dry weight) are produced each year and the average value received from the sales of this commodity exceeds $3,490,000.00 annually.

Hop pest surveys show that an average of $300,000.00 is expended each year for hop pest control. Non-control of these pests often costs the grower an additional $750,000.00.

In 1937, at the urgent request of Oregon Hop growers, the State Legislature under Legislature Act. H. B. 465, Item 2, appropriated funds for the study of problems affecting the hop industry. $3,000.00 of this sum was assigned to the Department of Entomology for part time investigations into the life history, habits and control of these pests.

This report discusses the experimental progress of hop pest investigations during the biennium 1937-1938 and gives the descriptions, life histories, economic importance and control of the important and potentially important hop pests.

Tetranychus telarius Linnaeus

Description of Tetranychus telarius Linnaeus. (Acarus telaruiu L.)

The original description of Tetranychus telarius is given by Linnaeus in Faunae suecicae, 1761, p. 481. This article was not observed by the writer, but a later edition of Faunae suecicae contains the following description: (Caroli Linnaei Entomologia, faunae suecicae descriptionibus aucta.... London, Piestre et DeLamolliere, 1789. vol. 4, p. 50.) (See O.A.C. Library, QL 463, L 5.)

From v.4, p.44:

GENUS VI.

"ACARUS. Pedes VIII.

Oculi II ad latera capitis.

Tentacula duo, articulata, pediformia."

From v.4, p.50:

"Telarius, 10, A (la tisserand) rubicundo hyalinus; abdomine utrinque macula fusca.

Scop. carn. 1075.

Geoff. paris. 2. p.629. acarus fuscus autumnalis textor.

Fab. 20.

De Geer tom. 7. p.128. n.18. t.7, f.20.-24.

Enum. n. 1077. elliptoideus, pedibus secundis tertiisque distantibus.

Beytr. Zur. nat. p. 35.

Hab. in Europae plantis, minus ventis expositis, caldario inclusis, tela ducens filis parallelis, quibus plantas suffocat hybernaculorum; in tiliae foliis aversis autumno frequens.

Desc. Nudis oculis vix conspicuus. Totus hyalini coloris,

utroque latere ferrugineo.

Obs. Nent ut araneae, foliorum superficiem seta velant, inde foliorum dessicatio. Vento raptae fetae errant, inquit D. Geoff. sed in his fetis vagabundis araneae saepe reperiuntur harum fetarum textores. D. de Geer. V."

A literal translation of this description is given by J. Schuh and the writer as follows:

ACARUS. (mites Gk.) Eight legs. Two eyes on each side of head. Tactile processes two, jointed, footshaped.

Telarius. (Gk. The spinner) (la tisserand-Fr. The spinner) reddish, glass green; dark spots on both sides of abdomen.

Scop. carn. 1075

Geoff. paris. 2. p. 629. Acarus dark colored fall weaver.

Fab. 20.

De Geer. tom. 7. p. 128. n. 18. t. 7, f. 20-24.

Enum. n. 1077. oblong-oval, second legs distant from third.

Beytr, Zur. nat. p. 35.

Hab. In Europe, less exposed from the wind, closed caldarioes, webs running with parallel strands, which plants supply overwintering quarters, in the autumn, frequently on the underside of leaves of basswood.

Description. Bare eyes scarcely conspicuous, entirely grass green in color, dusky on the flank of both sides.

Obs. The spiders spin in this way, they cover the surface of the leaves with hairs, whence the leaves become desiccated. The wandering young are carried away by the wind to quote D. Geoff "But in the wanderings of the progeny of the spiders the weavers will often meet these offspring again."D.de Geer.V.

An excellent description of Tetranychus telarius and its stages is given by H. E. Ewing as follows: (Ore. Agr. Exp. Sta. Bull. 121, 1914).

"Description of Egg. The egg constitutes almost a perfect sphere. It is very small and when laid has a pretty, pearly appearance. The eggs are deposited singly, though generally close together. They may be attached directly to the leaf, or may be attached to the loose strands of the web. When the eggs are first laid they have little color. As they develop, they take on a reddish hue, while slightly before hatching, the carmine eye pigment becomes marked. The egg is covered with a tough shell, which holds much of its shape, even after the larva has emerged. Size of egg, diameter, 0.09 mm."

"Description of larva. When the larva first emerges from the egg, it is a small, almost spherical, flesh colored creature, with both sexes. The body is seen to be divided at its middle by a transverse suture, that part in front of the suture being the cephalothorax, while the part behind the suture is the abdomen. The segments of the legs in the case of the larva are much shorter than in the adult, the patellae and the tibiae being as broad as long in the first two pairs, while they are much longer than broad in the same pairs of legs of the adult. There is also a tendency of the segments of the legs to be swollen. The bristles of the body are shorter and stiffer in the larva than in the adult. Length of larva, obtained as an average from the measurements of several specimens, 0.19 mm.

"Description of protonymph. The protonymph is very similar to the larva except in size, and in the possession of an extra pair of legs,

these being added during the first moult and appearing behind the last pair of legs of the larva. The body of the first nymph retains much of the spherical shape of the larva until the stage is well advanced. The segments of the legs become longer, and the setae of the body also enlarge and are more curved. In the first nymph the abdomen assumes a size which is distinctly larger than that of the cephalothorax. Length of protonymph, 0.27 mm.

"Description of deutonymph. In shape the last nymph is very similar to the adult. About the only difference between this instar and the adult instar is in the absence of sexual characters from the former, and also the total absence of the reddish color, which frequently becomes pronounced in the adult. It is noted that the legs are shorter in proportion to the body than in the adult. The last pair just reaching the tip of the abdomen. As the deutonymph does much feeding, its color markings are rather variable and pronounced, but are not fundamentally different from those of earlier stages. I find the length of the deutonymph to be 0.36 mm.

"Description of the female. Color varying; sometimes green, sometimes yellowish, sometimes a mixture of greenish and yellowish, and sometimes bright orange. In most individuals there is one or more pairs of dark spots which show through the skin. These are situated on either side of the abdomen and toward the anterior end. Rarely the adults will be without black markings. Sometimes there will be a long central black spot in the posterior part of the abdomen.

"Cephalothorax about twice as broad as long. Palpi extending to the tips of the femora of the first pair of legs; palpal claw prominent, curved, about as long as palpal thumb. Palpal thumb slightly swollen at

its base, and bearing a prominent digit at its tip and two digituli just above the digit. Mandibular plate two-thirds as broad as long, and termima ting in a pair of lances or spinae, which are about as long as the plate itself. Stylets, or chelicerea, long, curved, needle-like. On each side of the cephalothorax above or slightly behind the second pair of legs are situated the double eyes. The two corneas are sub-equal in size and shape, and behind them is the eye spot composed of a carmine pigment. The cephalothorax bears dorsally five pairs of bristles; a subrostral pair, a superior pair above and in front of the eyes, and three posterior pairs.

"Abdomen two-thirds as broad as long. Provided above with sixteen curved, simple spines; one shoulder pair, then three transverse rows of four bristles each, and finally a small pair at the tip. Genital area pronounced, somewhat triangular; genital plate curved and bearing a long pair of bristles; anus slit-like, and situated in the projecting papilla.

"Legs slender. Anterior pair of legs the longest; second pair of legs reaching to the tips of the tibiae of the first pair; third pair of legs reaching to the tip of the abdomen; fourth pair of legs reaching beyond the tip of the abdomen by the full length of their tarsi. Tarsal claws of legs strongly bent near their bases, and six cleft. Besides the tarsal claws each tarsus bears four tenent hairs of slightly different lengths situated above claws. By measuring fourteen individuals I get 0.42 mm. for the average length of the females.

"Description of the male. The body of the male is much smaller than that of the female, and somewhat different in shape. The abdomen is slender and somewhat pointed. Relatively, the legs are longer in the

male than in the female. The only color difference in the sexes lies in the color of the legs. The two anterior pairs of legs in the male are normally somewhat reddish, while in the female they are not.

"The male has a prominent, short, stout spur on the tip of the third segment of the palpus, the use of which is unknown. The genital armature of the male consists of the genital slit and the protrusile penis. The penis is short, stout, and has a hook at its end which turns upward and ends in a flattened barb. An average obtained by measuring eleven individuals gives 0.32 mm. for the length of the male.

Synonomy. Acarus telarius L.; A. russulus; A. lintearius; A. socium; A. tini; A. cucumeris; A. rosarum; A. tilarium; A. cinnabarinus; A. haematodes; A. vitis; Trombidium telarius; T. tilarium; T. maius; T. tenuipes; T. socium; Tetranychus telarius; T. russulus; T. tini; T. cucumeris; T. rosarum; T. tilarium; T. ferrugineus; T. urticea; T. fervidus; T. populi; T. piger; T. minor; T. longistaris; T. plumistoma; T. rubescens; T. pilosus; T. 6-maculatus; T. bimaculatus; T. gloveri; T. socius; T. maius; T. tenuipes; T. lintearius; Phytocoptes epidermi; P. gallarum; P. nervorum.

A large part of the above synonomy occurs prior to 1890 by European writers. Ewing expressed the opinion that the American species Tetranychus bimaculatus Harvey; T. sexmaculatus Riley and T. gloveri Banks were identical with T. telarius Linn. and that T. 6-maculatus was only a variety of T. telarius. Most of the confustion in nomenclature of this species is attributed to the wide variation in coloration of the red spider and this variation was shown by Ewing to be due to differences in pigmentation of food plants.

History of Tetranychus telarius.

The common red spider (hop red spider) has a long history. It was first described by Linnaeus in 1761 and many references are made of it in eighteenth century literature. Whitehead reported that it caused considerable damage to hop plantings in Germany and Europe in 1869.

It is not known or how it reached America but it was considered a major economic pest of greenhouses and flower gardens in the New England and Middle Atlantic States in 1855. It spread rapidly to the South and West from this point and by 1883 it was a pest of almond in California. The development of the Hop industry along the Pacific Coast at this time caused the red spider to assume economic importance to this agricultural pursuit.

Life History of Tertanychus telarius.

The adult female red spider overwinters on winter hosts such as grasses, weeds or cultivated plants which carry on some development during the winter months. It is not known definitely whether males have a tendency to die in the fall but nearly all individuals taken in the early spring are females.

The activity of the adult red spider is resumed in the spring and eggs are deposited during April or May, depending on the season. Parthenogenesis is known to occur with this species and the offspring of virgin females are always males.

Eggs are deposited on the under side of leaves and these hatch on an average of six days. The number of eggs deposited by a female averages about eighty and are deposited over a period of about ten days at the rate of eight or more per day.

The length of the larval period varies largely with temperature and in early spring may require 15-17 days. This same stage during the summer requires from 2 to 3 days. The larval period is divided into an active period and a quiescent period. The latter period is relatively short and takes place prior to the first moult. The red spider in this stage has only three pair of legs.

The appearance of the protonymph is similar to that of the larvae but the individuals have developed an additional pair of legs in this stage. This stage is also divided into an active and quiescient period. The average protonymphal period varies from two to four days, depending on temperature.

The deutonymphal stage lasts on an average of three to six days. It has both active and quiescient periods and represents a gradual metamorphosis from the protonymph to the adult. This stage of individual is much more active than the other two stages and will move with great rapidity and sometimes migrate to great distances. This stage of the red spider is capable of spinning webs.

The adult stage of the female is divided into two periods. The first period lasts three to four days and occurs immediately following the deutonymphal moult. Females during this period are not capable of laying eggs. A prolonged egg deposition period follows this preoviposition period and during this time the female deposits eggs over an extended period of time. The average longivity of the adult is about three weeks. There is but one period in the life of the adult male. Sex ratios depend largely upon the season of the year. During midsummer they tend to be 1 to 1. Early in the season there is a tendency to be a preponderence of males. This is attributed to the habit of the virgin female to

produce males. Very little is known concerning the longevity of the male spider. There are seventeen broods of red spiders in South Carolina and approximately nine in the vicinity of Corvallis, Oregon. The red spiders are very prolific and the progeny of a female in the vicinity of Corvallis, oregon, would exceed one trillion.

The coloration of red spiders varies with the plants on which they feed. Ewing has shown that the green color is due to the presence of chlorophyll in the blood or tissues of the red spider. The yellow was attributed to either etiolin or xanthophyll of the plant. The orange color was due to a pigment which was dissolved in the cell fluids of the blood. Carmine was found to be a permanent pigment located behind the corneas of the eyes. Black color did not represent a separate pigment but was due to a concentration of yellow pigment. Brown color was also attributed to a concentration of yellow pigment. These variations in color were shown to be due to the type and amount of food taken from the host plant.

Economic importance of Tetranychus telarius

The common red spider has almost a world wide distribution and has caused economic damage in England, Germany, France, Italy, South America, Mexico, West Indies, Hawaii, Canada and in all of the United States. It is omnivorous and will attack field crops, truck and greenhouse crops, garden and flower gardens, fruit trees, shade trees and ornamentals, weeds and grasses.

The injury of this pest is caused by the puncturing of the leaf surface from the underside and the withdrawel of the liquid contents of the leaf cells. Each puncture usually results in a small white speck or spot on the leaf surface. The specks become more numerous as the attacks con-

tinue and eventually the leaf becomes bronzed and will shrivel and die. The red spider is known to attack the hop clusters in some seasons. The type of injury is the same when this occurs and the clusters turn reddish brown. Clusters injured in this way are not marketable. The devitalization of the plant is believed to reduce the weight and quality of hops and to affect the vitality of the plant the following season.

Seasonal history of *Tetranychus telarius* during the biennium 1937-1938

There was no available hop yard for conducting seasonal observations during 1937, and attention was directed toward pest survey work. Red spiders were first found on hops at Corvallis, Oregon, on June 6, 1937, and cool weather seemingly held them in check until late in July. Infestations were very spotted throughout the Willamette Valley but several yards in the vicinity of Corvallis and Independence, Oregon were severely damaged. There was little red spider injury in the vicinity of Grants Pass, Oregon, but one small yard was completely destroyed at Roseburg, Oregon.

The seasonal history of the common red spider was studied by making periodical observations of the hop foliage in the entomology experimental hop yard, East farm, Corvallis, Oregon. The first appearance of the pest was noted on June 29. Two different methods of counting were employed. Ten leaves from each plant in the yard were selected at random and the number of leaves infested and the number of red spiders per leaf were counted or estimated as accurately as possible. This procedure was repeated every ten days. The percentage of leaves infested was used as a measure of red spider distribution and the population per leaf was used as a measure of population density. Over 4500 hop vines were examined during the season in the collection of this data.

Temperature and relative humidity measurements were taken at the east farm and at the Horst Hop Ranch, Independence, Oregon. Temperatures at the two locations were very similar but the relative humidity at Independence averaged about thirty percent higher than at Corvallis.

Red spiders are reported to favor hot dry weather conditions. The summer months of 1938 met these hot and dry conditions at Corvallis, but red spiders failed to develop to any great extent. The weather conditions at Independence were not as favorable for red spider as those at Corvallis, but populations at Independence were considerably higher than at Corvallis.

The seasonal development of red spiders on untreated hop plants is pictured graphically in the following pages. Density figures (Population per leaf) are magnified 1000 times in order to signify the general slope of the curve. Hops were harvested on September 10, and by that time red spider had almost entirely disappeared.

The seasonal history of red spider is especially interesting on one baby hop plant which was located in the southwest corner of the experimental yard. Very early in the season 100 percent of the leaves were infested and by July 19 populations had reached their maximum density. Red spiders began to decline in numbers soon after this date and by August 2 had been reduced about 66 percent. The percentage of infested leaves had also been slightly reduced at this date. This plant was treated with an oil spray on August 2 and the ultimate effect of this introduced factor is a matter of conjecture.

Parasites and predators were very abundant in the hop yards throughout the Willamette Valley and were probably responsible for holding red spiders in check.

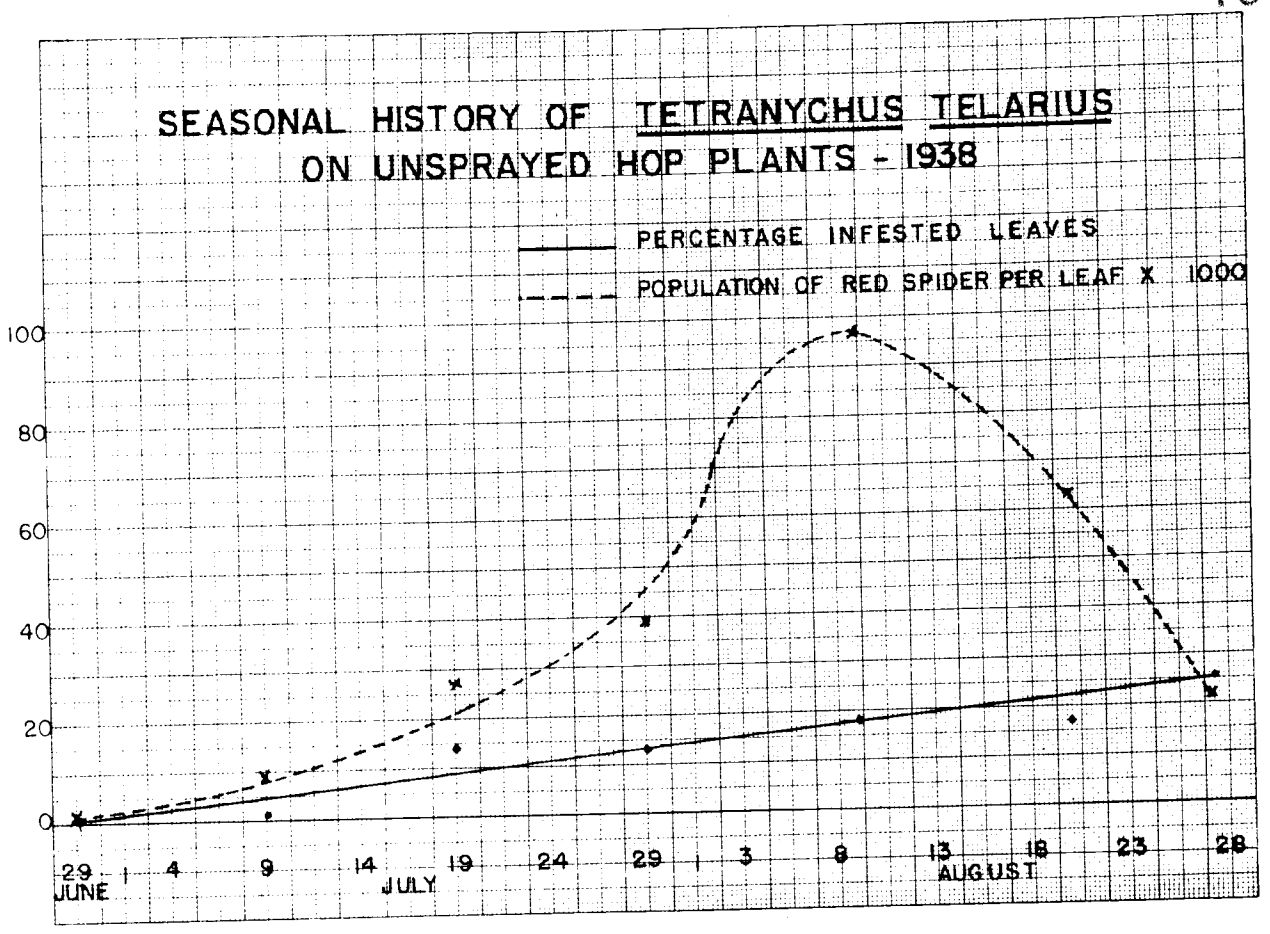

Figure 1

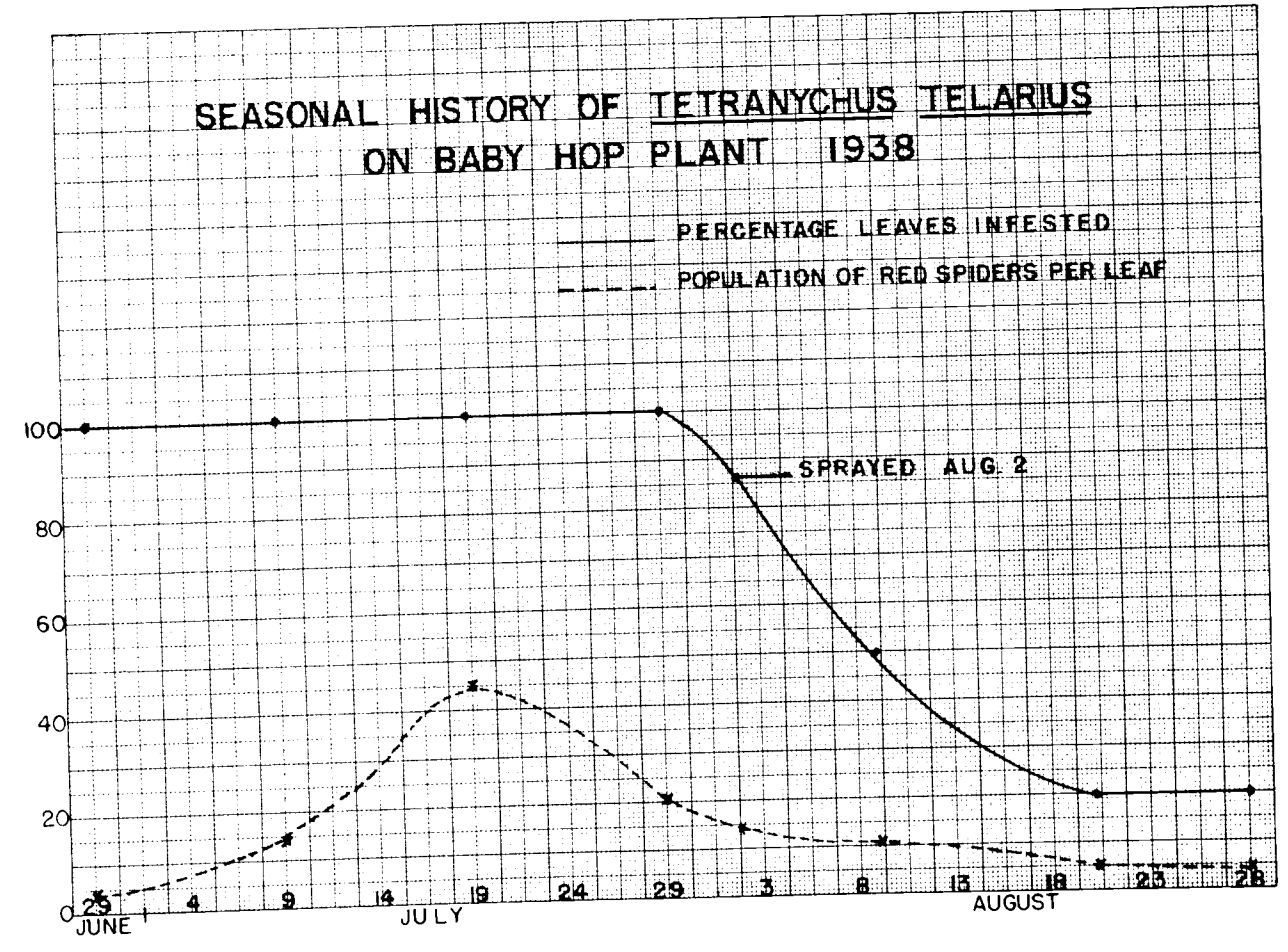

Figure 2

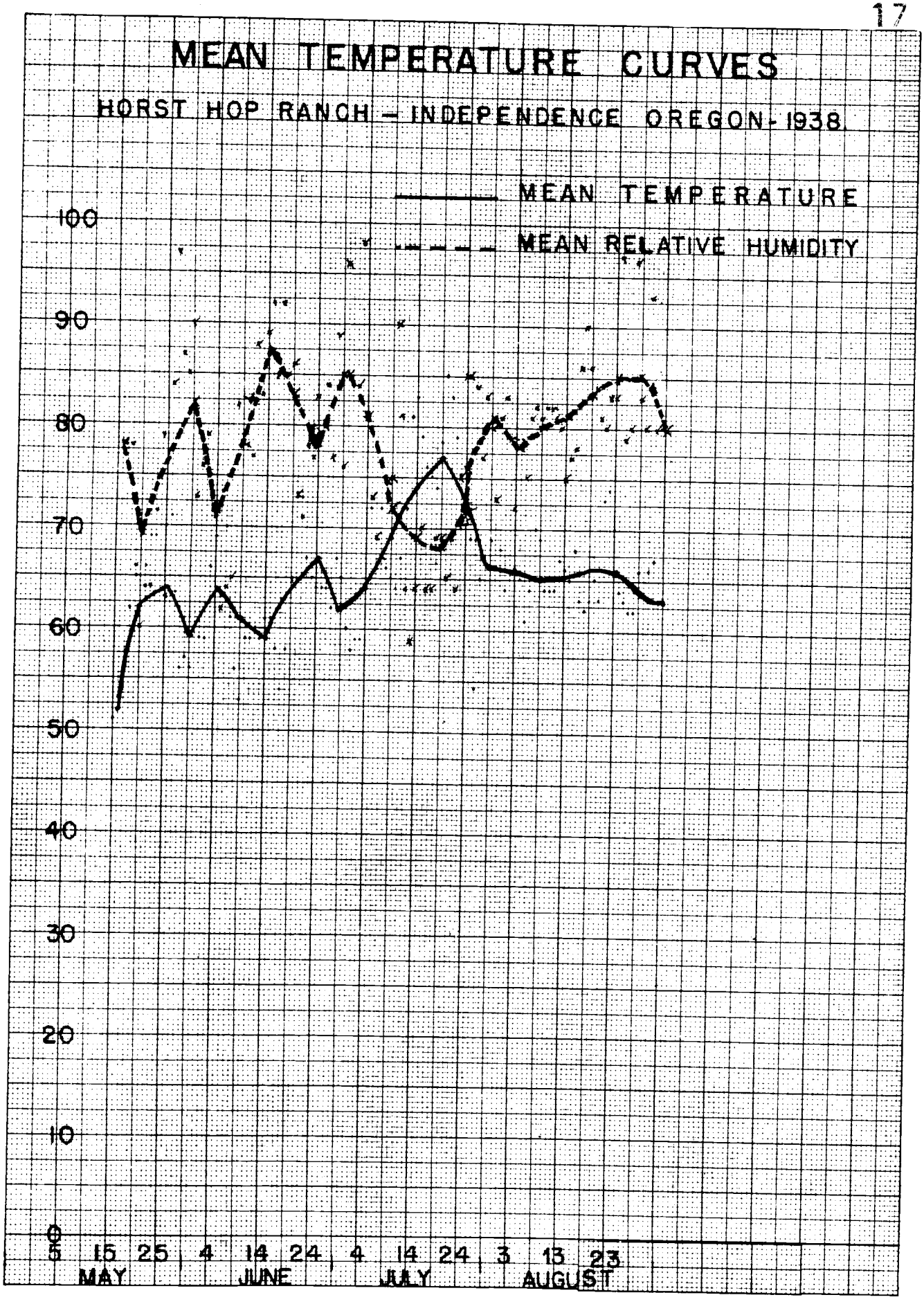
MEAN TEMPERATURE CURVES
HORST HOP RANCH – INDEPENDENCE OREGON - 1938
MEAN TEMPERATURE
MEAN RELATIVE HUMIDITY
100
90
80
70
60
50
40
30
20
10
0
5
15
25
4
14
24
4
14
24
3
13
23
MAY
JUNE
JULY
AUGUST

Figure 3

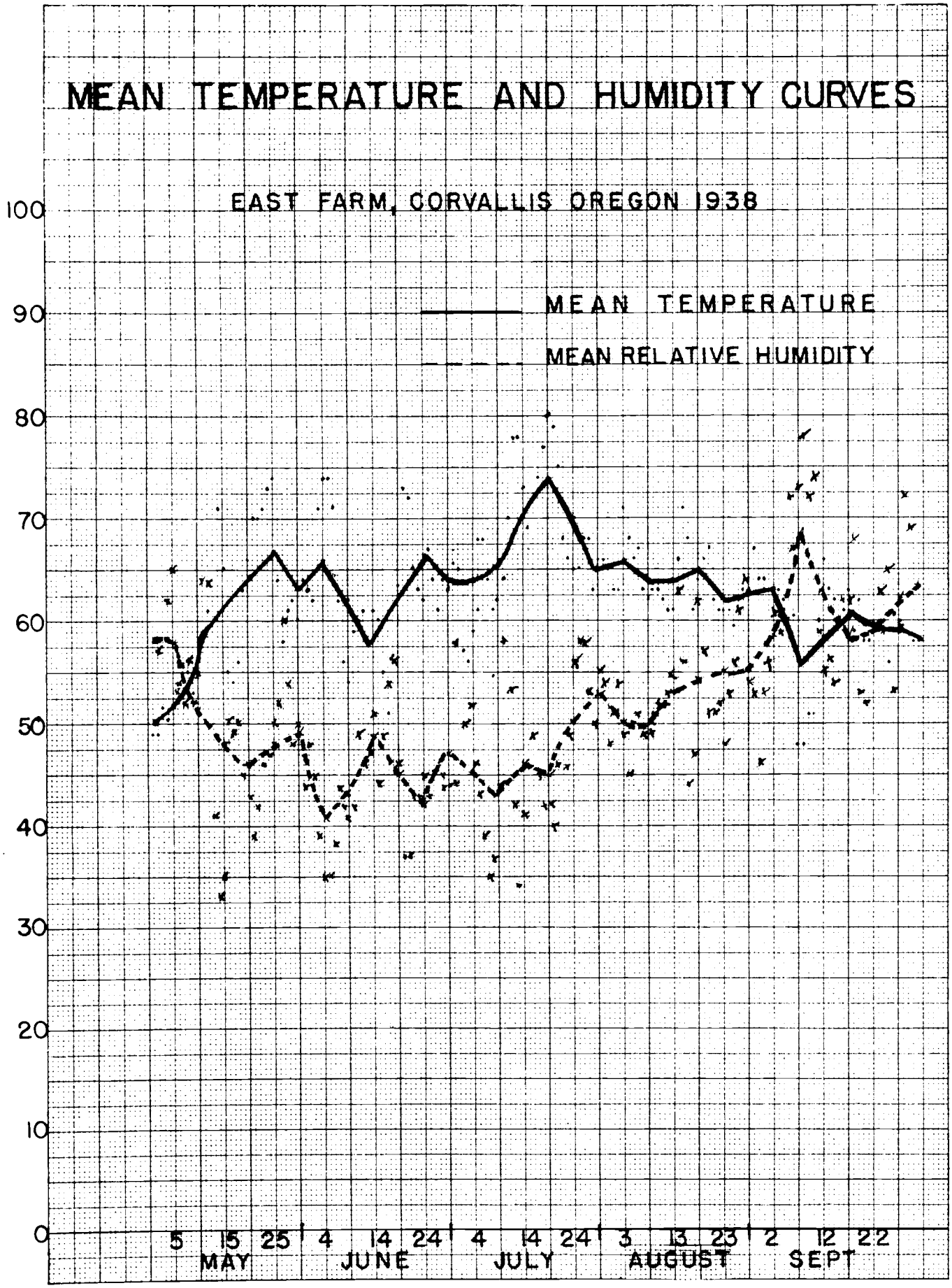
MEAN TEMPERATURE AND HUMIDITY CURVES
EAST FARM, CORVALLIS OREGON 1938
MEAN TEMPERATURE
MEAN RELATIVE HUMIDITY
100
90
80
70
60
50
40
30
20
10
0
5 15 25 4 14 24 4 14 24 3 13 23 2 12 22
MAY JUNE JULY AUGUST SEPT

Figure 4

Mean Temperature Records

Horst Hop Ranch — Independence, Oregon

1938

The following figures are averages of twelve readings taken over a twenty four hour period from a Julien P. Friez and Son Hygro-Thermograph, No. 947, Type 594.

Date	May	June	July	August
1		59	58	62
2		59	59	64
3		66	59	70
4		69	-	69
5		72	72	66
6		70	66	66
7		61	72	65
8		56	66	63
9		53	65	64
10		59	64	64
11		59	67	64
12		60	72	67
13		59	81	66
14		61	83	65
15		61	78	68
16		58	76	63
17	52	54	75	62
18	53	58	74	63
19	62	65	77	65
20	65	73	85	63
21	66	73	83	73
22	69	67	78	74
23	69	65	70	70
24	70	64	68	64
25	71	64	68	63
26	63	64	65	62
27	56	62	69	62
28	57	67	68	66
29	57	65	64	66
30	56	60	66	67
31	60		65	63
Mean	62	63	68	63

Mean Temperature Records

East Farm — Corvallis, Oregon

1938

The following figures are averages of twelve readings taken over a twenty four hour period from a Julien P. Friez and Son Hygro-Thermograph, No. 968, Type 594.

Date	May	June	July	August	September
1	50	63	57	63	64
2	49	62	57	63	63
3	48	71	56	71	63
4	49	74	59	68	62
5	50	74	61	66	60
6	52	72	68	67	63
7	56	62	68	63	48
8	55	56	64	62	48
9	53	54	61	63	51
10	57	59	62	63	51
11	59	60	64	62	60
12	61	61	70	61	66
13	-	58	78	61	63
14	71	61	78	66	62
15	65	60	73	71	60
16	55	55	69	68	61
17	54	51	72	63	63
18	56	57	74	64	59
19	63	66	77	66	62
20	66	73	80	67	58
21	70	72	79	62	58
22	70	65	75	61	59
23	71	63	68	61	59
24	73	62	66	63	60
25	74	67	65	61	56
26	64	64	65	57	63
27	58	61	68	62	60
28	61	64	68	63	59
29	62	63	63	63	58
30	60	58	66	67	58
31	64		65	64	
Mean	60	63	68	64	59

Mean Relative Humidity Records

Horst hop ranch — Independence, Oregon

1938

The following figures are averages of twelve readings taken over a twenty four hour period from a Julien P. Friez and Son Hygro-Thermograph, No. 947, Type 594.

Date	May	June	July	August
1		76	96	83
2		78	84	79
3		71	97	72
4		62	-	78
5		64	73	75
6		65	69	81
7		82	67	82
8		79	74	81
9		78	75	82
10		77	90	82
11		88	81	81
12		83	64	80
13		88	58	75
14		92	64	77
15		85	70	78
16		88	64	86
17	78	92	64	90
18	78	94	69	86
19	66	86	69	84
20	60	73	65	81
21	64	71	69	80
22	64	78	64	83
23	74	77	75	83
24	79	83	85	98
25	63	80	85	79
26	84	84	84	80
27	97	77	77	97
28	87	76	83	83
29	85	83	80	80
30	90	85	73	93
31	73		81	80
Mean	76	80	75	82

Mean Relative Humidity Records

East Farm — Corvallis, Oregon

1938

The following figures are averages of twelve readings taken over a twenty four hour period from a Julien P. Friez and Son Hygro-Thermograph, No. 968, Type 594.

Date	May	June	July	August	September
1	58	48	58	51	56
2	57	45	50	54	62
3	66	39	52	49	59
4	62	35	46	45	60
5	65	35	43	50	72
6	53	38	39	51	67
7	52	44	35	49	73
8	56	42	37	49	78
9	52	41	44	51	72
10	55	42	58	52	74
11	64	49	53	52	59
12	64	46	42	53	55
13	41	47	34	55	56
14	33	51	41	63	54
15	35	44	46	56	60
16	50	49	49	44	62
17	49	54	45	47	62
18	50	56	42	62	68
19	45	46	42	57	53
20	43	37	40	51	52
21	39	37	46	51	59
22	42	43	46	52	59
23	46	43	49	48	63
24	47	45	56	53	59
25	42	43	58	56	65
26	52	45	58	61	53
27	60	45	53	64	58
28	54	44	50	54	72
29	48	44	55	53	69
30	50	44	54	46	63
31	44		48	53	
Mean	51	44	47	53	62

Control of Tetranychus telarius

Cultural methods. McGregor, Parker and Ewing stressed the importance of clean cultivation as a preventive measure against red spiders. Ewing based his conclusions from one observation at Corvallis, Oregon in 1913. In this instance clean culture was studied against careless culture and the results favored clean culture. The writer visited many hop yards during the biennium 1937-1938. Many of the larger yards in 1937 were very cleanly cultivated but showed severe red spider injury. A hop yard near Independence, Oregon was visited in 1938. One portion of the yard was located on the north side of a public road while the other was located on the south side. Both portions were very cleanly cultivated. The south part of the yard was very severely infested with red spider while the north portion was only moderately infested.

Pruning and stripping of leaves, burning of plants after harvesting crop, and banding with tanglefoot are also thought to have some preventive value. There is little evidence that these practices will or will not aid in the control of red spider. The methods of dispersal of red spiders are many. It is known that they migrate for short distances from plant to plant and may travel over the soil, be carried by wind, water, insects, birds, and other agencies.

Irrigation. Florists and nurserymen have long recognized the value of free sprinkling of infested plants with water. The actual effect of water on red spiders is still a matter of conjecture. It has been demonstrated that submergence of mites under water for twenty-four hours, and the maintenance of high humidities has little effect on red spiders.

Perkins demonstrated in 1897 that the application of a strong stream of water to infested plants had the mechanical effect of dislodging red

spiders and that few had a tendency of returning to their former habitat. Ewing in 1914 believed that water treatments favored the development of the predaceous mite Seius pomi Parrott, and in this way promoted the value of biological control of red spiders.

The writer visited a number of hop yards in the vicinity of Grants Pass, Oregon, in 1937. Many of the yards in this area use the flood type method of irrigation. General observations indicated that flooding of the yards did not have a tendency to reduce red spider populations. The infested plants in the flooded areas were more vigorous and apparently enabled to withstand red spider attack better than non-flooded areas.

Several visits were made to the hop yard of Oberson and Gosler in 1938. This yard is located south of Beuna Vista, Oregon and was installed with a sprinkling type system of irrigation. Red spiders were difficult to find in this yard during this year and it is possible that this method of irrigation may have some control value. The vines in this yard were very vigorous throughout the year and produced a satisfactory crop.

The value of this kind of cultural practice must yet be demonstrated, because 1938 was generally free from severe red spider damage. It is also possible that a practice of this sort would contribute toward the dissemination of downy mildew Pseudoperonospora humuli (Miy. and Tak.) Wilson. It is important that the Experiment Station study this problem before many growers invest in an irrigation system of this kind.

Biological control. There are many parasites and predators of Tetranychus telarius, and in some seasons they have been responsible for holding this pest in check. This was demonstrated during the season of 1938 in many of the hop yards throughout the Willamette Valley. A few

of the parasites and predators which are common enemies of red spiders are listed as follows:

Gamasidae (Acarina, Arachnida)

Seius quadriphilis Banks

Macrocheles sp.

Laelaps macrophilis Banks

**Seius pomi* Parrott

Rhyncholophidae

Rhyncholophus pilosus Banks

**Rhyncholophus gracilipes* Banks

Erythracaridae

**Anystis agilis* Banks

Anystidae

**Anystis agilis* Banks

Thripidae (Thysanoptera)

**Scolothrips sexmaculatus* Perg.

Euthrips fuscus Hinds

Euthrips occidentalis Perg.

Anthocoridae (Hemiptera)

**Triphelps insidiosus* Say

Lygaeidae

Geocoris punctipes Say

Capsidae

Rhinacola forticornis Reuter

Coniopterygidae (Neuroptera)

Conventzia hageni Banks

Chrysopidae

Chrysopa rufilabris Banks

Chrysopa quadripunctata Burm.

Chrysopa nigricornis Burm.

*Chrysopa californica Coq.

*Hemerobiidae

Hemerobius pacificus Banks

Itonididae (Diptera)

*Arthrocondax occidentalis Felt.

Arthrocondax carolina Felt.

Mycodiplosis macgregori Felt.

Syrphidae

Baccha clavata Fab.

Allograpta obliqua Say.

*Sphaerophoria cylindrica Say.

Toxomerus duplicatus Wied.

Coccinellidae (Coleoptera)

*Stethorus punctum LeConte

Stethorus picipes Casey

Stethorus utilis Horn.

Stethorus nanus LeConte

Scymnus collaris Melsh.

Scymnus marginicollis Mann.

Microweisea misella LeConte.

Smilia misella LeConte.

Megilla maculata DeGeer

Olla abdominalis Say.

*Hippodamia convergens Guerin

*Hippodamia oregonensis Cor.

*Hippodamia parenthesis Say.

*Hippodamia tibialis Say.

*Cycloneda sanguinea Linn.

Coccinella novemnotata Herbst.

Coccinella 9-notata Hbst.

Noctuidae (Lepidoptera)

Alabama argillacea Hubn.

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* Known to occur in Oregon.

Chemical control. Chemical control is and probably shall remain the most important method of red spider control. This pest is known to be quite resistant to hydrocyanic acid gas, nicotine and other well known fumigants. This is attributed to the fact that their respiratory system is quite different from that of insects.

Many different sprays have been recommended for control of red spider. Flour paste, glue, salt solutions, lime, soap, nicotine-soap, nicotine-oil, miscible oil, sulfur, lime sulfur, and other pesticides have met with varying degrees of success. The claims of one investigator are seldom substantiated by another. Lime sulfur in general has become the most common remedy and the recommended control for red spider on hops in Oregon is as follows:

Commercial concentrate lime sulfur - - 2 gal.
Calcium caseinate (orchard spreader) - ½ lb.
Sublimed or dusting sulfur - - - - - - 5 lbs.
Water to make- - - - - - - - - - - - -100 gals.

Temperature plays an important role when lime-sulfur is used in red spider control. Summer temperatures in Oregon average from 60-65 degrees F. This temperature factor probably explains why the standard recommended lime sulfur formula is sometimes more successful in California than in Oregon. Preliminary checks over the great mass of literature on the subject of chemical control of red spider indicates that the host plant plays an important role in their control. A material may give satisfactory red spider control on a given host plant and under similar climatic conditions, give very unsatisfactory control on a different host plant.

The present problem of Tetranychus telarius on hops.

Spraying hop vines is a tedious, time consuming and costly procedure, which has been very unsatisfactory in certain seasons. Many growers have abandoned the practice of spraying in favor of dusting. This latter method is less costly and less time consuming but its pesticidal efficiency is yet to be demonstrated. Many and various kinds of hop dusters are on the market. Little attention has been given to the standardization of this equipment and it is difficult to find similarly constructed machines.

The writer visited many dusted hop yards during the biennium 1937-1938 and observed that the coverage on the under side of hop leaves was very poor in all instances. All spray recommendations for red spider control stress the importance of contacting the pest in order to obtain satisfactory control. The failure of the dusting practice in red spider control can probably be attributed in part to unsatisfactory methods of application. Various combinations of nicotine, sulfur, and lime dusts were used by different growers in 1937 and growers were divided in their opinion of the pesticidal efficiency. In all instances no untreated vines were allowed to stand for comparative purposes and no conclusions could be drawn.

The problem of red spider control on hops resolves itself about the development of a satisfactory dust and the development of an efficient means of application.

Experimental procedure.

A. Laboratory. A number of hop cuttings (Variety Fuggles) were planted in the greenhouse in the fall of 1937. The baby hops arising from these cuttings were infested with red spider in 1938. A number of materials were given preliminary laboratory tests in an effort to obtain information in advance of field studies. The materials tested and the results obtained are given below:

Treatment	Percentage kill					
	Replications					
	1	2	3	4	Mean	Remarks
Bentonite sulfur (87% sulfur)	40	37	22	30	32	
Dusting sulfur (98% sulfur)	50	39	80	44	53	
Sulfur-Lime (60-40)	53	32	29	41	39	
*Wecoline (1-400)	46	29	57	61	48	Very severe burning.
**DNOCHP .1%	100	100	100	100	100	
DNOCHP .2%	100	100	100	100	100	
DNOCHP .4%	100	100	100	100	100	
DNOCHP .6%	100	100	100	100	100	
DNOCHP .8%	100	100	100	100	100	
Check (untreated)	25	33	35	37	33	

* A new product composed of Alcohol (Solvent #1) 1 qt., triethanalomine 1 oz., Oleic acid (technical) 2 oz., Wecoline (A-B) Cocoanut oil 1 qt. and water 2 qt.

** Dinitro-o-cyclohexyl phenol used with walnut shell flour as a carrier.

B. Field. There are many hinderances to successful field experimentation and variations in climate, soil, plants and pests will often manifest themselves in the final results. The subject of hop field experimental technique has been entirely omitted from literature and the Department of Entomology was confronted with the problem of developing a suitable experimental method.

The Department of Entomology had approximately one acre of hops (Variety, Late Cluster) for field toxicological studies. These plants were planted during the seasons of 1937 and 1938 so that the planting was interspersed with two year old and baby plants in 1938. This yard was divided into two blocks. The northern block (mostly baby plants) was used for application of dusts. This block was divided equally into six plots each of which were subdivided into eight plats. Each plat was composed of six plants (or plant spaces) and was considered as representative of its plot. Dust treatments were assigned to the plats by strict randomization and in this way a treatment appeared once in each plot. Treatments were accordingly replicated as many times as there were plots which in this instance was six times.

The southern block was used for spray treatments and was divided in a similar manner. Treatments in this block were replicated seven times. Diagrams of the experimental layouts are shown on the following pages.

Three different tests were given this method in order to study its feasibility. The population of red spiders per leaf and the percentage of leaves infested with red spider was measured and averaged for each plat prior to spray applications. The number of pounds of hops was measured for each plat at harvest time.

It was assumed that differences in the arithmetic mean of any of these data would indicate that the system of experimentation was not satisfactory

because no factors were introduced to produce such differences. The data were subjected to the biometric principles of analysis of variance and no differences were found to exist between the means. It was therefore concluded that the experimental method was satisfactory and that replication of treatments seven times was sufficient. These measurements could not be applied to the dust block because this consisted mostly of baby vines which did not bear a crop and were not infested with red spider. Data of these studies are submitted on the following pages.

DIAGRAM OF EXPERIMENTAL DUST BLOCKS

Corvallis, Oregon 1938

Plot 1				Plot 2				Plot 3				Plot 4				Plot 5				Plot 6				Plant Nos.
5	5	7	7	3	3	7	7		5	6	6	2	2	5	5	2	2	4	4	1	1	8	8	12
5	5		7	3	3	7	7	5	5	6	6	2	2	5	5	2	2	4	4	1	1	8	8	11
5	5	7	7	3	3	7	7	5	5	6	6	2	2	5	5	2	2	4	4	1	1	8	8	10
6		8	8	2	2		6	2	2	1	1	4	4	7	7	3	3	5	5	7	7	4	4	9
6	6	8	8	2	2	6	6	2	2		1	4	4	7	7	3	3		5	7	7	4	4	8
6	6	8	8	2	2	6	6		2		1	4	4	7	7	3	3	5	5	7	7	4	4	7
1	1	3	3	4	4	5	5		8	4	4	1	1	3	3	7	7	8	8	6	6	3	3	6
1	1	3	3	4	4	5	5	8	8	4	4	1	1	3	3	7		8	8	6	6	3	3	5
1	1	3	3	4	4	5	5	8	8	4		1		3	3	7		8	8	6	6	3	3	4
4	4	2	2	8	8	1	1	7	7	3	3	6	6	8	8	1	1	6	6	2	2	5	5	3
4	4	2	2	8	8	1	1	7	7	3	3	6	6	8	8	1	1	6	6	2	2	5	5	2
	4		2	8	8	1	1	7	7	3	3	6	6	8	8	1	1	6	6	2	2	5	5	1
36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	

Row Numbers

DIAGRAM OF EXPERIMENTAL SPRAY BLOCK

Corvallis, Oregon 1938

Plot 1				Plot 2				Plot 3				Plot 4				Plot 5				Plot 6				Plot 7				Plant Nos.
5	5	7	7	3	3	8	8	5	5	1	1	2	2	3	3	7	7	4	4	1	1	6	6	2	2	4	4	12
5	5	7	7	3	3	8	8	5	5	1	1	2	2	3	3	7	7	4	4	1	1	6	6	2	2	4	4	11
5	5	7	7	3	3	8	8	5	5	1	1	2	2	3	3	7	7	4	4	1	1	6	6	2	2	4	4	10
6	6	2	2	6	6	7	7	4	4	3	3	1	1	8	8	8	8	3	3	5	5	8	8	7	7	1	1	9
6	6	2	2	6	6	7	7	4	4	3	3	1	1	8	8	8	8	3	3	5	5	8	8	7	7	1	1	8
6	6	2	2	6	6	7	7	4	4	3	3	1	1	8	8	8	8	3	3	5	5	8	8	7	7	1	1	7
4	4	8	8	2	2	1	1	6	6	7	7	5	5	4	4	2	2	6	6	7	7	3	3	5	5	3	3	6
4	4	8	8	2	2	1	1	6	6	7	7	5	5	4	4	2	2	6	6	7	7	3	3	5	5	3	3	5
4	4	8	8	2	2	1	1	6	6	7	7	5	5	4	4	2	2	6	6	7	7	3	3	5	5	3	3	4
3	3	1	1	5	5	4	4	2	2	8	8	6	6	7	7	5	5	1	1	4	4	2	2	8	8	6	6	3
3	3	1	1	5	5	4	4	2	2	8	8	6	6	7	7	5	5	1	1	4	4	2	2	8	8	6	6	2
3	3	1	1	5	5	4	4	2	2	8	8	6	6	7	7	5	5	1	1	4	4	2	2	8	8	6	6	1
71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	

Row Numbers

Populations of *Tetranychus telarius* in Spray Block

East Farm — Corvallis, Oregon

July 29, 1938

Population of Red Spider per leaf Prior to Spray Applications

Treat. No.	Replications 1	2	3	4	5	6	7	Mean
1	6	1	0	3	3	3	4	3
2	3	4	3	3	4	7	9	5
3	7	11	1	3	2	1	17	6
4	1	7	0	0	6	1	3	3
5	1	1	0	1	1	12	3	3
6	9	14	1	1	1	2	87	16
7	7	1	6	2	5	2	2	4
8	3	0	6	9	11	1	1	4

Differences necessary for significance at 19-1 odds = 14

Populations of *Tetranychus telarius* in Spray Block

East Farm

Corvallis, Oregon

July 29, 1938

Percentage of Leaves Infested with Red Spider Prior to spray applications

Treat. No.	Replications 1	2	3	4	5	6	7	Mean
1	15	4	0	13	5	12	20	10
2	7	8	12	10	10	17	16	11
3	15	17	2	8	7	7	28	12
4	2	17	0	0	15	3	15	7
5	2	4	0	2	2	25	10	6
6	20	17	5	5	2	8	30	12
7	12	12	14	3	13	8	7	10
8	5	0	12	13	22	5	2	8

Differences necessary for significance at 19-1 odds = 9

Summary of Hop Yield in Spray Block

East Farm — Corvallis, Oregon

1938

Treat. No.	Replications 1	2	3	4	5	6	7	Mean
1	19	18	13	29	25	25	45	25
2	23	30	16	28	18	44	24	26
3	16	14	22	20	15	8	34	18
4	25	20	36	33	10	24	43	27
5	8	9	12	20	16	32	25	17
6	19	21	21	27	9	34	18	21
7	36	22	12	24	25	20	32	24
8	15	31	26	29	18	19	47	26

Per acre factor -- X 114

Differences necessary for significance at 19-1 odds = 10

1938 Spray Toxicity Tests Against Tetranychus telarius

Eight different treatments were applied to the spray block on August 2, 1938. One treatment was allowed to stand as an untreated check for comparative purposes (No.1) The regular and recommended formula was considered as the standard insecticidal treatment (No.2). Other treatments included Lethane (No.3), Powdered glue (No.4), Nicotine sulfate (No.5), Oil (No.6), Quassia (No.7), and Bentonite sulfur -- soap (No.8).

Evaluation of pesticidal efficiency was determined by selecting ten leaves at random from each plat and counting the number of living and dead red spiders by means of a binocular microscope. These measurements were made August 4-6 and final results are based on counts of over 15,000 red spiders. The percentage dead red spiders were averaged by plat and subjected to the biometric principles of analysis of variance.

The standard and recommended lime sulfur treatment (No.2) was found to be significantly better than any other treatment. This spray did not give satisfactory results. The average dead red spiders of this treatment was 59%. An average of 9% red spiders was counted on the check or untreated plots. This allows only a 50% efficiency rating for the lime sulfur treatment. No other spray application, as applied, offered promise for red spider control. The spray treatments gave no indication of foliage injury. Results of these spray treatments are tabulated on the following pages:

Summary of Spray Treatments for Tetranychus telarius

East Farm — Corvallis, Oregon

1938

Treat. No.	Treatment		% Red Spider Dead Replications 1	2	3	4	5	6	7	Mean
1	Check - No treatment		16	17	8	9	7	3	4	9
2	Liquid lime sulfur Calcium caesinate Dusting sulfur Water	2 gal. ½ lb. 5 lb. 100 gal.	94	58	64	69	49	51	37	59
3	Lethane Lethane spreader Water	1 qt. 1 qt. 100 gal.	9	30	53	57	17	51	38	36
4	Powdered glue Water	5 lb. 100 gal.	69	24	56	43	24	23	40	40
5	Nicotine sulfate SS 3 Water	1 qt. 1 qt. 100 gal.	37	3	51	25	40	52	50	37
6	No. 4 oil Ammonium caesinate Water	1 gal. ½ lb. 100 gal.	31	43	20	50	31	53	44	39
7	Quassea extract SS 3 Water	4 gal. 1 qt. 100 gal.	27	39	42	13	54	35	11	32
8	Bentonite sulfur Rosin potash soap Water	6 lb. 1 qt. 100 gal.	14	13	22	48	57	21	14	27

Differences necessary for significance at odds of

19-1 = 19

49-1 = 23

99-1 = 27

Results of Experimental Spray Applications on Tetranychus telarius

August 4-6, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
1-1	16	0	16	1-5	23	0	23
1-1	18	11	29	1-5	18	4	22
1-1	19	25	44	1-5	27	8	35
1-1	13	0	13	1-5	135	4	139
1-1	26	47	73	1-5	7	0	7
1-1	146	2	148	1-5	29	4	33
1-1	218	10	228	1-5	111	12	123
1-1	167	33	200	1-5	264	19	283
1-1	18	0	18	1-5	73	2	75
1-1	22	0	22	1-5	189	14	203
Total	663	128	791		876	67	943
1-2	9	3	12	1-6	15	2	17
1-2	11	8	19	1-6	24	1	25
1-2	23	3	26	1-6	33	0	33
1-2	23	4	27	1-6	4	0	4
1-2	61	11	72	1-6	1	0	1
1-2	18	3	21	1-6	16	2	18
1-2	12	0	12	1-6	15	0	15
1-2	11	4	15	1-6	8	0	8
1-2	17	0	17	1-6	18	0	18
1-2	16	5	21	1-6	30	0	30
Total	201	41	242		164	5	169
1-3	9	0	9	1-7	16	2	18
1-3	13	1	14	1-7	3	0	3
1-3	2	0	2	1-7	24	0	24
1-3	12	0	12	1-7	14	2	16
1-3	16	4	20	1-7	2	0	2
1-3	52	10	62	1-7	22	0	22
1-3	22	0	22	1-7	72	0	72
1-3	21	0	21	1-7	10	0	10
1-3	28	2	30	1-7	30	1	31
1-3	32	0	32	1-7	11	3	14
Total	207	17	224		204	8	212
1-4	32	4	36				
1-4	20	1	21				
1-4	17	0	17				
1-4	151	7	158				
1-4	36	0	36				
1-4	19	0	19				
1-4	69	11	80				
1-4	81	3	84				
1-4	153	21	174				
1-4	22	15	37				
Total	600	62	662				

Results of Experimental Spray Applications on *Tetranychus telarius*

August 4-6, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
2-1	2	0	2	2-5	17	8	25
2-1	1	1	2	2-5	11	17	28
2-1	0	5	5	2-5	8	8	16
2-1	1	6	7	2-5	7	5	12
2-1	0	4	4	2-5	1	0	1
2-1	1	16	17	2-5	3	1	4
2-1	0	30	30	2-5	7	8	15
2-1	0	20	20	2-5	6	11	17
2-1	0	18	18	2-5	8	3	11
2-1	2	3	5	2-5	0	3	3
Total	7	103	110		68	64	132
2-2	33	18	51	2-6	6	3	9
2-2	5	6	11	2-6	30	30	60
2-2	5	4	9	2-6	24	14	38
2-2	5	56	61	2-6	5	34	39
2-2	53	35	88	2-6	5	12	17
2-2	21	34	55	2-6	5	4	9
2-2	8	8	16	2-6	10	11	21
2-2	145	235	380	2-6	34	12	46
2-2	59	65	124	2-6	13	10	23
2-2	22	23	45	2-6	30	40	70
Total	356	484	840		162	170	332
2-3	21	68	89	2-7	19	8	27
2-3	8	13	21	2-7	27	4	31
2-3	0	52	52	2-7	8	12	20
2-3	14	32	46	2-7	12	7	19
2-3	38	29	67	2-7	8	3	11
2-3	8	14	22	2-7	3	5	8
2-3	10	12	22	2-7	14	11	25
2-3	5	2	7	2-7	3	2	5
2-3	11	18	29	2-7	8	5	13
2-3	34	29	63	2-7	5	7	12
Total	149	269	418		107	64	171
2-4	5	11	16				
2-4	8	10	18				
2-4	4	8	12				
2-4	15-	14	29				
2-4	7	30	37				
2-4	3	8	11				
2-4	10	30	40				
2-4	16	25	41				
2-4	3	9	12				
2-4	0	15	15				
Total	71	160	231				

Results of Experimental Spray Applications on Tetranychus telarius

August 4-6, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
3-1	17	2	19	3-5	8	0	8
3-1	9	0	9	3-5	25	8	33
3-1	1	1	2	3-5	9	0	9
3-1	4	1	5	3-5	14	4	18
3-1	5	0	5	3-5	16	5	21
3-1	20	2	22	3-5	7	3	10
3-1	0	2	2	3-5	6	1	7
3-1	20	1	21	3-5	5	0	5
3-1	36	0	36	3-5	12	4	16
3-1	2	2	4	3-5	32	3	35
Total	114	11	125		134	28	162
3-2	6	1	7	3-6	2	4	6
3-2	3	0	3	3-6	8	13	21
3-2	47	26	73	3-6	9	4	13
3-2	13	3	16	3-6	4	7	11
3-2	1	1	2	3-6	5	0	5
3-2	5	3	8	3-6	8	11	19
3-2	8	3	11	3-6	12	13	15
3-2	2	0	2	3-6	8	7	15
3-2	7	1	8	3-6	4	7	11
3-2	2	2	4	3-6	0	6	6
Total	94	40	134		60	62	122
3-3	18	22	40	3-7	8	5	13
3-3	2	3	5	3-7	28	19	47
3-3	7	2	9	3-7	15	27	42
3-3	12	37	49	3-7	6	1	7
3-3	5	7	12	3-7	15	2	17
3-3	21	28	49	3-7	19	8	27
3-3	18	12	30	3-7	3	0	3
3-3	15	17	32	3-7	7	2	9
3-3	38	24	62	3-7	62	39	101
3-3	21	28	49	3-7	5	2	7
Total	157	180	337		168	105	273
3-4	29	70	99				
3-4	8	3	11				
3-4	7	10	17				
3-4	10	7	17				
3-4	13	2	15				
3-4	11	13	24				
3-4	9	11	20				
3-4	2	1	3				
3-4	7	7	14				
3-4	0	2	2				
Total	96	126	222				

Results of Experimental Spray Applications on *Tetranychus telarius*

August 4-6, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
4-1	1	4	5	4-5	10	0	10
4-1	0	5	5	4-5	9	2	11
4-1	0	10	10	4-5	14	1	15
4-1	1	6	7	4-5	7	12	19
4-1	0	3	3	4-5	4	4	8
4-1	0	4	4	4-5	25	8	33
4-1	0	16	16	4-5	12	1	13
4-1	1	8	9	4-5	5	3	8
4-1	17	9	26	4-5	11	0	11
4-1	16	14	30	4-5	8	2	10
Total	36	79	115		105	33	138
4-2	2	2	4	4-6	4	0	4
4-2	5	2	7	4-6	6	3	9
4-2	17	10	27	4-6	11	4	15
4-2	16	10	26	4-6	0	1	1
4-2	35	5	40	4-6	7	2	9
4-2	16	11	27	4-6	5	3	8
4-2	6	5	11	4-6	21	1	22
4-2	16	0	16	4-6	9	6	15
4-2	79	20	99	4-6	8	1	9
4-2	29	4	33	4-6	6	2	8
Total	221	69	290		77	23	100
4-3	8	4	12	4-7	4	8	12
4-3	2	10	12	4-7	11	4	15
4-3	50	16	66	4-7	18	9	27
4-3	104	218	322	4-7	14	7	21
4-3	4	0	4	4-7	7	4	11
4-3	23	23	46	4-7	11	11	22
4-3	17	8	25	4-7	60	20	80
4-3	4	6	10	4-7	14	10	24
4-3	14	7	21	4-7	41	87	128
4-3	10	8	18	4-7	72	10	82
Total	236	300	536		252	170	422
4-4	1	7	8				
4-4	12	5	17				
4-4	7	10	17				
4-4	135	85	220				
4-4	5	7	12				
4-4	5	5	10				
4-4	7	5	12				
4-4	12	7	19				
4-4	6	7	13				
4-4	7	9	16				
Total	197	147	344				

Results of Experimental Spray Applications on *Tetranychus telarius*

August 4-6, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
5-1	7	1	8	5-5	9	3	12
5-1	41	10	51	5-5	19	7	26
5-1	0	16	16	5-5	8	12	20
5-1	5	4	9	5-5	7	3	10
5-1	18	2	20	5-5	13	2	15
5-1	5	7	12	5-5	4	7	11
5-1	6	2	8	5-5	5	5	10
5-1	2	1	3	5-5	8	4	12
5-1	3	4	7	5-5	0	2	2
5-1	0	3	3	5-5	5	7	12
Total	87	50	137		78	52	130
5-2	2	0	2	5-6	6	5	11
5-2	31	2	33	5-6	18	13	31
5-2	8	0	8	5-6	2	5	7
5-2	2	0	2	5-6	14	9	23
5-2	7	0	7	5-6	13	15	28
5-2	9	1	10	5-6	4	7	11
5-2	8	0	8	5-6	32	19	51
5-2	2	1	3	5-6	5	0	5
5-2	3	0	3	5-6	11	28	39
5-2	44	0	44	5-6	7	19	26
Total	116	4	120		112	120	232
5-3	8	5	13	5-7	13	2	15
5-3	4	6	10	5-7	9	11	20
5-3	12	3	15	5-7	12	3	15
5-3	3	9	12	5-7	5	3	8
5-3	11	7	18	5-7	8	6	14
5-3	21	18	39	5-7	7	13	20
5-3	3	5	8	5-7	21	35	56
5-3	8	2	10	5-7	18	23	41
5-3	9	15	24	5-7	10	4	14
5-3	4	17	21	5-7	0	3	3
Total	83	87	170		103	103	206
5-4	52	4	56				
5-4	12	3	15				
5-4	27	3	30				
5-4	52	12	64				
5-4	16	6	22				
5-4	11	7	18				
5-4	59	31	90				
5-4	38	22	60				
5-4	54	13	67				
5-4	5	8	13				
Total	326	109	435				

Results of Experimental Spray Applications on *Tetranychus telarius*

August 4-6, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
6-1	1	4	5	6-5	38	6	44
6-1	2	1	3	6-5	3	4	7
6-1	5	0	5	6-5	3	5	8
6-1	35	6	41	6-5	7	1	8
6-1	12	1	13	6-5	14	0	14
6-1	17	20	37	6-5	8	0	8
6-1	16	4	20	6-5	7	8	15
6-1	6	4	10	6-5	8	4	12
6-1	8	3	11	6-5	20	8	28
6-1	7	6	13	6-5	18	20	38
Total	109	49	158		126	56	182
6-2	42	23	65	6-6	12	18	30
6-2	49	21	70	6-6	58	44	102
6-2	31	28	59	6-6	21	37	58
6-2	18	32	50	6-6	27	25	52
6-2	18	25	43	6-6	18	37	55
6-2	82	57	139	6-6	7	11	18
6-2	54	24	78	6-6	9	7	16
6-2	28	21	49	6-6	15	12	27
6-2	5	19	24	6-6	9	3	12
6-2	19	15	34	6-6	7	12	19
Total	346	265	611		183	206	389
6-3	10	6	16	6-7	6	0	6
6-3	1	1	2	6-7	22	12	34
6-3	4	2	6	6-7	5	17	22
6-3	25	8	33	6-7	29	2	31
6-3	5	0	5	6-7	39	8	47
6-3	15	0	15	6-7	5	10	15
6-3	3	1	4	6-7	23	17	40
6-3	12	1	13	6-7	3	29	32
6-3	21	5	26	6-7	12	4	16
6-3	7	1	8	6-7	26	37	63
Total	103	25	128		170	136	306
6-4	3	0	3				
6-4	21	14	35				
6-4	12	19	31				
6-4	10	18	28				
6-4	8	14	22				
6-4	11	18	29				
6-4	9	12	21				
6-4	18	14	32				
6-4	15	12	27				
6-4	27	14	41				
Total	134	135	269				

Results of Experimental Spray Applications on *Tetranychus telarius*

August 4-6, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
7-1	10	4	14	7-5	4	8	12
7-1	29	5	34	7-5	19	32	51
7-1	4	0	4	7-5	7	18	25
7-1	3	6	9	7-5	18	21	39
7-1	20	8	28	7-5	7	4	11
7-1	31	6	37	7-5	11	8	19
7-1	14	12	26	7-5	4	0	4
7-1	2	3	5	7-5	12	6	18
7-1	5	2	7	7-5	9	17	26
7-1	13	3	16	7-5	8	0	8
Total	131	49	180		99	114	213
7-2	12	8	20	7-6	16	4	20
7-2	7	16	23	7-6	27	10	37
7-2	48	29	77	7-6	2	4	6
7-2	24	19	43	7-6	9	4	13
7-2	9	12	21	7-6	6	2	8
7-2	3	2	5	7-6	8	2	10
7-2	8	11	19	7-6	2	5	7
7-2	78	29	107	7-6	47	21	68
7-2	85	38	123	7-6	20	25	45
7-2	13	17	30	7-6	22	7	29
Total	287	181	468		159	84	243
7-3	8	2	10	7-7	3	2	5
7-3	7	4	11	7-7	41	4	45
7-3	6	1	7	7-7	24	1	25
7-3	14	13	27	7-7	9	2	11
7-3	11	8	19	7-7	4	2	6
7-3	4	4	8	7-7	15	2	17
7-3	10	18	28	7-7	5	0	5
7-3	72	43	115	7-7	16	1	17
7-3	9	11	20	7-7	4	0	4
7-3	7	5	12	7-7	12	3	15
Total	148	109	257		133	17	150
7-4	13	0	13				
7-4	7	1	8				
7-4	15	9	24				
7-4	19	0	19				
7-4	3	0	3				
7-4	4	0	4				
7-4	37	3	40				
7-4	45	8	53				
7-4	6	1	7				
7-4	3	0	3				
Total	152	22	174				

Results of Experimental Spray Applications on *Tetranychus telarius*

August 4-6, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
8-1	2	0	2	8-5	20	8	28
8-1	1	0	1	8-5	8	6	14
8-1	4	5	9	8-5	10	4	14
8-1	3	1	4	8-5	7	23	30
8-1	1	0	1	8-5	5	18	23
8-1	8	0	8	8-5	2	8	10
8-1	10	0	10	8-5	12	5	17
8-1	22	4	26	8-5	13	12	25
8-1	2	0	2	8-5	6	8	14
8-1	16	1	17	8-5	14	37	51
Total	69	11	80		97	129	226
8-2	25	3	28	8-6	11	0	11
8-2	45	14	59	8-6	10	1	11
8-2	2	14	16	8-6	2	8	10
8-2	46	8	54	8-6	20	8	28
8-2	4	0	4	8-6	10	0	10
8-2	2	0	2	8-6	2	0	2
8-2	101	5	106	8-6	7	0	7
8-2	4	0	4	8-6	1	0	1
8-2	54	8	62	8-6	8	2	10
8-2	74	2	76	8-6	13	4	17
Total	357	54	411		84	23	107
8-3	61	8	69	8-7	2	0	2
8-3	5	0	5	8-7	4	0	4
8-3	14	15	29	8-7	16	2	18
8-3	10	3	13	8-7	15	1	16
8-3	19	2	21	8-7	4	8	12
8-3	31	5	36	8-7	8	0	8
8-3	7	1	8	8-7	51	0	51
8-3	2	5	7	8-7	1	1	2
8-3	3	1	4	8-7	2	0	2
8-3	32	13	45	8-7	77	18	95
Total	184	53	237		180	30	210
8-4	31	19	50				
8-4	5	8	13				
8-4	19	37	56				
8-4	4	2	6				
8-4	12	11	23				
8-4	10	8	18				
8-4	8	6	14				
8-4	3	0	3				
8-4	2	5	7				
8-4	18	9	27				
Total	112	105	217				

Figure 5. Spraying for red spider control, experimental hop yard, East Farm, Corvallis, Oregon

Figure 6. Dusting for red spider control, experimental hop yard, East Farm, Corvallis, Oregon

Figure 5

Figure 6

1938 Dust Toxicity Tests Against Tetranychus telarius

Eight different dust treatments were applied July 20, 1938 for red spider control. One treatment was allowed to stand as an untreated check for comparative purposes (No.1). Other treatments included .75% Rhotenone plus wetting agent (No.2), .75% Rhotenone plus wetting agent and lauryl thiocyanide (No.3), .05% Pyrethrums 1 and 2 with and without hydrocarbon oil (No. 4 and 5), Dusting sulfur (No.6), Nicotine-lime-sulfur (No.7), and .8% Dinitro-o-cyclohexyl phenol (No.8). Care was taken to see that dusts were applied to the under sides of leaves. This was accomplished by a modified hand duster with special long attachment.

Counts were made July 26-28 in the same manner as those of the spray block. Populations were less severe in this block and final results are based on counts which were slightly less than 2800 red spiders. The percentage dead red spiders were averaged by plats and subjected to the biometric principles of analysis of variance.

.8% DNOCHP gave excellent control of red spider and was significantly better than any other treatment. This material mixed with walnut shell flour adhered to the leaves excellently and in many instances was noted to have penetrated the tightly woven web of the spiders. Nicotine-lime-sulfur was significantly better than the Pyrethrum and Rhotenone dusts but its performance was considered unsatisfactory. Data of these tests are tabulated on the following pages:

Summary of Dust Applications for Tetranychus telarius

East Farm — Corvallis, Oregon

1938

Treat No.	Treatment	% Red Spider Dead Replications 1	2	3	4	5	6	Mean
1	Check - No treatment	30	4	0	0	4	13	9
2	.75% Rhotenone 98% Sodium lauryl sulfate 2%	20	69	33	25	25	36	35
3	.75% Rhotenone 98% Sodium lauryl sulfate 1% Lauryl thyocyanide 1%	54	13	22	67	0	63	37
4	.05% Pyrethrums 1 & 2-90% Hydrocarbon oils 8% Acid insoluable ash 2%	34	25	18	20	38	30	28
5	.05% Pyrethrums 1 & 2-98% Acid insoluable ash 2%	27	45	90	33	0	33	38
6	.98% Dusting sulfur 90% Organic sulfur compound (1N-1655-A9) 10%	26	49	71	50	38	83	53
7	Nicotine sulfate 5% Lime 55% .98% Dusting sulfur 45%	100	71	19	96	71	44	67
8	DNOCHP .8% Walnut shell flower 99.2%	100	100	100	100	98	100	99

Differences necessary for significance at odds of

19-1 = 28

49-1 = 35

99-1 = 40

Results of Experimental Dust Applications on *Tetranychus telarius*

July 26-28, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
1-1	0	0	0	1-4	4	0	4
1-1	0	0	0	1-4	0	0	0
1-1	0	0	0	1-4	0	0	0
1-1	0	0	0	1-4	0	0	0
1-1	1	0	1	1-4	0	0	0
1-1	1	0	1	1-4	0	0	0
1-1	4	0	4	1-4	0	0	0
1-1	1	6	7	1-4	0	0	0
1-1	2	0	2	1-4	0	0	0
1-1	5	0	5	1-4	0	0	0
Total	14	6	20		4	0	4
1-2	1	0	1	1-5	4	0	4
1-2	33	3	36	1-5	2	0	2
1-2	7	0	7	1-5	10	1	11
1-2	69	0	69	1-5	7	0	7
1-2	5	0	5	1-5	0	0	0
1-2	11	0	11	1-5	0	0	0
1-2	25	0	25	1-5	0	0	0
1-2	21	0	21	1-5	0	0	0
1-2	10	2	12	1-5	0	0	0
1-2	30	4	34	1-5	0	0	0
Total	212	9	221		23	1	24
1-3	5	0	5	1-6	4	0	4
1-3	0	0	0	1-6	2	0	2
1-3	0	0	0	1-6	1	0	1
1-3	0	0	0	1-6	0	1	1
1-3	0	0	0	1-6	0	0	0
1-3	0	0	0	1-6	0	0	0
1-3	0	0	0	1-6	0	0	0
1-3	0	0	0	1-6	0	0	0
1-3	0	0	0	1-6	0	0	0
1-3	0	0	0	1-6	0	0	0
Total	5	0	5		7	1	8

Results of Experimental Dust Applications on *Tetranychus telarius*

July 26-28, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
2-1	6	3	9	2-4	3	1	4
2-1	11	2	13	2-4	0	0	0
2-1	3	1	4	2-4	0	0	0
2-1	2	2	4	2-4	0	0	0
2-1	2	0	2	2-4	0	0	0
2-1	4	0	4	2-4	0	0	0
2-1	1	1	2	2-4	0	0	0
2-1	3	1	4	2-4	0	0	0
2-1	4	0	4	2-4	0	0	0
2-1	5	0	5	2-4	0	0	0
Total	41	10	51		3	1	4
2-2	10	16	26	2-5	0	0	0
2-2	1	2	3	2-5	3	1	4
2-2	0	3	3	2-5	0	0	0
2-2	7	20	27	2-5	0	0	0
2-2	0	0	0	2-5	0	0	0
2-2	0	0	0	2-5	0	0	0
2-2	0	0	0	2-5	0	0	0
2-2	0	0	0	2-5	0	0	0
2-2	0	0	0	2-5	0	0	0
2-2	0	0	0	2-5	0	0	0
Total	18	41	59		3	1	4
2-3	6	3	9	2-6	1	2	3
2-3	0	0	0	2-6	3	0	3
2-3	0	0	0	2-6	2	1	3
2-3	0	0	0	2-6	1	1	2
2-3	0	0	0	2-6	0	0	0
2-3	0	0	0	2-6	0	0	0
2-3	0	0	0	2-6	0	0	0
2-3	0	0	0	2-6	0	0	0
2-3	0	0	0	2-6	0	0	0
2-3	0	0	0	2-6	0	0	0
Total	6	3	9		7	4	11

Results of Experimental Dust Applications on Tetranychus telarius

July 26-28, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
3-1	1	0	1	3-4	0	2	2
3-1	1	0	1	3-4	1	0	1
3-1	11	20	31	3-4	0	0	0
3-1	0	0	0	3-4	0	0	0
3-1	0	0	0	3-4	0	0	0
3-1	0	4	4	3-4	0	0	0
3-1	0	0	0	3-4	0	0	0
3-1	0	0	0	3-4	0	0	0
3-1	6	0	6	3-4	0	0	0
3-1	3	2	5	3-4	0	0	0
Total	22	26	48		1	2	3
3-2	5	1	6	3-5	4	0	4
3-2	9	2	11	3-5	0	0	0
3-2	15	0	15	3-5	0	0	0
3-2	5	1	6	3-5	1	0	1
3-2	5	0	5	3-5	1	0	1
3-2	7	1	8	3-5	0	0	0
3-2	4	0	4	3-5	2	0	2
3-2	15	3	18	3-5	0	0	0
3-2	5	3	8	3-5	0	0	0
3-2	7	1	8	3-5	0	0	0
Total	77	12	89		8	0	8
3-3	7	2	9	3-6	3	0	3
3-3	0	0	0	3-6	0	5	5
3-3	0	0	0	3-6	0	0	0
3-3	0	0	0	3-6	0	0	0
3-3	0	0	0	3-6	0	0	0
3-3	0	0	0	3-6	0	0	0
3-3	0	0	0	3-6	0	0	0
3-3	0	0	0	3-6	0	0	0
3-3	0	0	0	3-6	0	0	0
3-3	0	0	0	3-6	0	0	0
Total	7	2	9		3	5	8

Results of Experimental Dust Applications on *Tetranychus telarius*

July 26-28, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
4-1	26	14	40	4-4	0	0	0
4-1	16	16	32	4-4	0	0	0
4-1	2	0	2	4-4	5	3	8
4-1	11	9	20	4-4	2	0	2
4-1	1	0	1	4-4	4	1	5
4-1	2	0	2	4-4	4	0	4
4-1	20	5	25	4-4	1	0	1
4-1	2	0	2	4-4	0	0	0
4-1	7	1	8	4-4	0	0	0
4-1	23	12	35	4-4	0	0	0
Total	110	57	167		16	4	20
4-2	1	0	1	4-5	0	2	2
4-2	4	2	6	4-5	5	1	6
4-2	24	2	26	4-5	0	0	0
4-2	3	0	3	4-5	0	0	0
4-2	5	0	5	4-5	0	0	0
4-2	0	3	3	4-5	0	0	0
4-2	11	7	18	4-5	0	0	0
4-2	6	5	11	4-5	0	0	0
4-2	8	2	10	4-5	0	0	0
4-2	1	0	1	4-5	0	0	0
Total	63	21	84		5	3	8
4-3	10	1	11	4-6	0	0	0
4-3	15	4	19	4-6	0	0	0
4-3	1	0	1	4-6	0	0	0
4-3	10	2	12	4-6	0	0	0
4-3	5	2	7	4-6	0	0	0
4-3	0	0	0	4-6	0	0	0
4-3	0	0	0	4-6	2	0	2
4-3	0	0	0	4-6	0	0	0
4-3	0	0	0	4-6	0	0	0
4-3	0	0	0	4-6	3	0	3
Total	41	9	50		5	0	5

Results of Experimental Dust Applications on <u>Tetranychus telarius</u>

July 26-28, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
5-1	0	0	0	5-4	2	1	3
5-1	19	12	31	5-4	0	0	0
5-1	1	1	2	5-4	0	0	0
5-1	9	6	15	5-4	0	0	0
5-1	49	10	59	5-4	0	0	0
5-1	20	7	27	5-4	0	0	0
5-1	1	0	1	5-4	0	0	0
5-1	46	17	63	5-4	0	0	0
5-1	6	3	9	5-4	0	0	0
5-1	3	1	4	5-4	0	0	0
Total	154	57	211		2	1	3
5-2	2	0	2	5-5	1	0	1
5-2	1	0	1	5-5	1	0	1
5-2	1	2	3	5-5	0	0	0
5-2	4	9	13	5-5	0	0	0
5-2	15	2	17	5-5	0	0	0
5-2	6	15	21	5-5	0	0	0
5-2	19	8	27	5-5	0	0	0
5-2	3	2	5	5-5	0	0	0
5-2	7	1	8	5-5	0	0	0
5-2	5	12	17	5-5	0	0	0
Total	63	51	114		2	0	2
5-3	1	6	7	5-6	1	0	1
5-3	0	3	3	5-6	1	1	2
5-3	0	0	0	5-6	0	0	0
5-3	0	0	0	5-6	0	0	0
5-3	0	0	0	5-6	0	0	0
5-3	0	0	0	5-6	0	0	0
5-3	0	0	0	5-6	0	0	0
5-3	0	0	0	5-6	0	0	0
5-3	0	0	0	5-6	0	0	0
5-3	0	0	0	5-6	0	0	0
Total	1	9	10		2	1	3

Results of Experimental Dust Applications on Tetranychus telarius

July 26-28, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
6-1	0	0	0	6-4	2	2	4
6-1	0	0	0	6-4	0	0	0
6-1	0	1	1	6-4	0	0	0
6-1	6	0	6	6-4	0	0	0
6-1	19	9	28	6-4	0	0	0
6-1	1	2	3	6-4	0	0	0
6-1	4	0	4	6-4	0	0	0
6-1	2	0	2	6-4	0	0	0
6-1	6	1	7	6-4	0	0	0
6-1	4	2	6	6-4	0	0	0
Total	42	15	57		2	2	4
6-2	9	2	11	6-5	3	1	4
6-2	4	4	8	6-5	1	7	8
6-2	0	3	3	6-5	5	0	5
6-2	16	25	41	6-5	4	0	4
6-2	21	32	53	6-5	0	0	0
6-2	32	42	74	6-5	0	0	0
6-2	80	31	111	6-5	0	0	0
6-2	8	12	20	6-5	0	0	0
6-2	22	8	30	6-5	0	0	0
6-2	19	42	61	6-5	0	0	0
Total	211	201	412		13	8	21
6-3	0	0	0	6-6	0	0	0
6-3	0	1	1	6-6	0	0	0
6-3	1	5	6	6-6	0	1	1
6-3	7	14	21	6-6	1	3	4
6-3	0	0	0	6-6	0	0	0
6-3	0	0	0	6-6	0	0	0
6-3	0	0	0	6-6	0	0	0
6-3	0	0	0	6-6	0	0	0
6-3	0	0	0	6-6	0	0	0
6-3	0	0	0	6-6	0	1	1
Total	8	20	28		1	5	6

Results of Experimental Dust Applications on <u>Tetranychus</u> <u>telarius</u>

July 26-28, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
7-1	0	37	37	7-4	0	4	4
7-1	0	77	77	7-4	0	0	0
7-1	0	56	56	7-4	0	0	0
7-1	0	8	8	7-4	1	9	10
7-1	0	53	53	7-4	0	4	4
7-1	0	3	3	7-4	0	5	5
7-1	0	12	12	7-4	0	2	2
7-1	1	37	38	7-4	0	0	0
7-1	0	9	9	7-4	0	0	0
7-1	0	34	34	7-4	0	0	0
Total	1	326	327		1	24	25
7-2	0	2	2	7-5	2	2	4
7-2	1	0	1	7-5	0	3	3
7-2	0	0	0	7-5	0	0	0
7-2	21	4	25	7-5	0	0	0
7-2	5	20	25	7-5	0	0	0
7-2	5	21	26	7-5	0	0	0
7-2	4	14	18	7-5	0	0	0
7-2	1	0	1	7-5	0	0	0
7-2	0	9	9	7-5	0	0	0
7-2	2	27	29	7-5	0	0	0
Total	39	97	136		2	5	7
7-3	35	4	39	7-6	3	3	6
7-3	0	4	4	7-6	2	1	3
7-3	0	0	0	7-6	0	0	0
7-3	0	0	0	7-6	0	0	0
7-3	0	0	0	7-6	0	0	0
7-3	0	0	0	7-6	0	0	0
7-3	0	0	0	7-6	0	0	0
7-3	0	0	0	7-6	0	0	0
7-3	0	0	0	7-6	0	0	0
7-3	0	0	0	7-6	0	0	0
Total	35	8	43		5	4	9

Results of Experimental Dust Applications on <u>Tetranychus telarius</u>

July 26-28, 1938

Plot No.	Number of red spiders Alive	Dead	Total	Plot No.	Number of red spiders Alive	Dead	Total
8-1	0	8	8	8-4	0	0	0
8-1	0	21	21	8-4	0	0	0
8-1	0	23	23	8-4	0	0	0
8-1	0	36	36	8-4	0	0	0
8-1	0	12	12	8-4	0	0	0
8-1	0	55	55	8-4	0	0	0
8-1	0	41	41	8-4	0	1	1
8-1	0	73	73	8-4	0	0	0
8-1	0	86	86	8-4	0	0	0
8-1	0	8	8	8-4	0	0	0
Total	0	363	363		0	1	1
8-2	0	4	4	8-5	0	0	0
8-2	0	5	5	8-5	0	0	0
8-2	0	2	2	8-5	0	0	0
8-2	0	1	1	8-5	0	0	0
8-2	0	1	1	8-5	0	9	9
8-2	0	5	5	8-5	0	12	12
8-2	0	2	2	8-5	0	13	13
8-2	0	5	5	8-5	0	5	5
8-2	0	1	1	8-5	1	0	1
8-2	0	3	3	8-5	0	0	0
Total	0	29	29		1	39	40
8-3	0	1	1	8-6	0	0	0
8-3	0	0	0	8-6	0	0	0
8-3	0	0	0	8-6	0	0	0
8-3	0	0	0	8-6	0	0	0
8-3	0	0	0	8-6	0	0	0
8-3	0	0	0	8-6	0	0	0
8-3	0	0	0	8-6	0	0	0
8-3	0	0	0	8-6	0	0	0
8-3	0	0	0	8-6	0	0	0
8-3	0	0	0	8-6	0	0	0
Total	0	1	1		0	0	0

Figure 7. Dinitro-o-cyclohexyl phenol dust injury to baby hop plant, East Farm, Corvallis, Oregon

Plant Compatibility Studies in 1938

The dust block was composed mostly of baby hop plants but was interspersed to some extent with two year old plants. The severe dry period during the summer made it necessary to subirrigate the baby plants. The older plants had established themselves and did not require irrigation. Dust applications were made to this block several days after the baby plants had been irrigated and severe burning of foliage resulted. No foliage injury was observed on the older plants. The theory that the irrigation factor might have contributed to foliage injury was tested later in the season. Concentrations of .1%, .2%, .4%, .6%, and .8% were applied to baby plants September 2, 1938. These plants were watched carefully the remainder of the season and no foliage injury was noted. This evidence is not conclusive but indicates that the foliage injury of the baby hop plants may have resulted from subirrigation.

The use of DN (Dinitro-o-Cyclohexyl phenol) and related compounds in California

DN dust is in rather extensive semi-commercial use at the present time in Southern California for the control of citrus red spider (Tetranychus citri, MacGregor). Four thousand (4000) or more acres have received either one or two applications at the rate of 1-1½ pounds per tree of 0.8 per cent dinitro-o-cyclohexyl phenol dissolved in a suitable solvent and absorbed in walnut shell flour. A total of almost 500,000 pounds has been used according to Mr. H. C. Lewis, entomologist of the California Fruit Growers Exchange.

In order to avoid the possibility of serious plant injury, the use of this product has been admirably safeguarded as follows: It is sold directly to the grower by the Dow Chemical Corporation of Long

Branch, California, at the rate of 5½ cents per pound applied to the tree. Dr. David T. Prendergast, a graduate of the University of California, and his permanent assistant, Lee Braucher, along with two others (also graduate entomologists) actually make the dust application or are present when applications are made. These men determine whether the time and conditions (such as the immediate and forecast temperatures), relative humidities, windiness, abundance and stages of the mites, condition of the trees warrant the application. They also determine the amount to be applied. The grower must agree to all these conditions and regulations of the treatment or else none is made. Application is made with the large "fishtail" type, high volume, low velocity dusters. (These were designed and developed by the Department of Agricultural Engineering of the University of California and are the only kind of power dusters used in this State. It is the use of these dusters that accounts for the thoroughness, the coverage, and the efficiency of dust treatments on trees in California). A careful check is made at definite intervals of the results obtained wherever DN dust has been used. This system of safeguarding the use of a new product has been aptly called commercial experimentation. As a result, no injury of importance has occurred in the "interior" valleys. One case of injury to citrus occurred at Santa Paula which is on the coastal plain where heavy salt-laden fogs occur.

The reason citrus growers are so enthusiastic about DN is that it offers them a citrus mite control without complicating other pest control procedures or the necessity of using oil merely to control this pest. If complete control of spiders is desired, two applications are made at 10-14 day intervals, the time of the second application

being determined by the maximum hatch of the eggs surviving the first application and by the age of the oldest of these survivors. Where subsequent oil applications are necessary (in a few weeks to three months) for resistant red and black scale control, one application only is made.

It was understood that those who developed DN dust, namely, Drs. A. M. Boyce of the Citrus Experiment Station of the University of California and J. F. Kagy of the Crop Protection Institute, who worked with Dr. Boyce, showed that the product used in the right manner and in the right place had possibilities. Likewise, it was evident that the product had very definite limitations in the way of specific action on pests, plants and conditions. Such limitations have been corroberated by further experiments conducted by Drs. Boyce, S. B. Bailey, K. E. Maxwell, Leslie Smith, H. C. Lewis and Mr. John Lammiman.

DN dust is a specific for the control of citrus red spider (Paratetranychus citri, MacGregor), the common red spider (Tetranychus telarius, Linn.) and the brown or clover mite (Bryobia praetiosa, Koch.). On the other hand, it does not control the Pacific mite (Tetranychus pacificus, MacGregor), a pest of importance on deciduous fruit and particularly of grapes. According to Dr. A. M. Boyce, the DN dust actually acts as a stimulant to the rust or silver mite (Phyllocoptes oleivorus, Ashmead) of oranges and lemons, a pest easily controlled by lime-sulfur or wettable sulfur sprays. Neither is it effective in the control of the citrus bud mite (Eriophyes sheldoni, Ewing), a new species of importance on lemons in the Santa Paula district.

In view of its high efficiency against some of the mites, one might expect DN dust to be an effective product against certain easily controlled, soft-bodied pests such as the walnut aphis. This aphid is readily controlled by a 2 per cent nicotine dust (5 pounds B.L. 40 on 95 pounds lime), but DN dust has little effect even on the new-born young.

Its efficiency against various species of thrips is of comparatively low order.

All the foregoing indicate a highly specific action against various pests. This same specificity is shown in plant reaction. Tests on grapes by Drs. Boyce (Riverside), Leslie Smith (Santa Clara) and Mr. John Lammiman (Davis) show that this plant is extremely sensitive and severe burning results from DN dust applications. On the other hand, English walnut is very tolerant, as Dr. Boyce has trees that have tolerated an accumulated seasonal load of 40 pounds per tree of the product without a trace of injury. Citrus in the interior valleys has tolerated 3 pounds per tree. DN dust burns when temperatures are too high. Hence it is not applied when forecasts predict periods of temperatures over 95° F., nor is it used on citrus in such hot low valleys as the San Fernando Valley. It cannot be safely used in the foggy coastal plain areas where the salts of the ocean drift cause it to react and result in plant injury.

In Southern California, these limitations are not particularly serious for the following two reasons: (1) All pest control operations are conducted either by qualified and responsible operators or supervised by the entomologists employed by the larger ranches; (2) the concentration of large acreages of fruits in favorable valleys offers a

large outlet for any highly effective, even though quite specific, product.

In Northern California, these limitations are of major importance because growers there do their own pest control operations.

Experimental Programs in Progress

In Southern California, Dr. Boyce is continuing extensive tests with DN, its derivatives and related compounds as follows:

(1) Testing of emulsions of the parent compound in suitable solvents (not revealed). These appear to be safe on many plants and probably more effective than the DN dust on pests other than mites.

(2) Testing of derivatives of DN. It is well known that the alkali and calcium salts cause injury to plants. On citrus fruits, this resembles melanose and appears to be due to the deposition and concentration of crystals in spots. The menoethanolamine derivative which is crystalline and partially soluble in water caused similar injury, whereas the triethanolamine derivative, which is a liquid and completely soluble in water, has caused no injury so far and appears to be an interesting and promising lead. This work has revealed that none of the derivatives or salts of dinitro ortho cyclohexyl phenol are as effective against mites as the parent compound, but are more effective against other pests than the parent material.

At the University of California, Los Angeles, Dr. Ralph H. Smith is starting an investigation of DN dust on ornamentals. This investigation of the insects attacking ornamental plants in California is an entirely new and undeveloped field about which little or nothing is known at present. For example, Scotch Broom (Cytisus spp.) is a common ornamental and harbors a number of species of mites. Everywhere

throughout California the native sycamore was heavily infested with mites, at least two species being present. Privet is also a host for another mite (Tenipalpus californicus).

At the Santa Clara Station, Dr. Leslie Smith has found that 3 percent DN in oil, or 4 percent Dow oil are good ovicides (applied as dormant sprays) for the control of the mealy plum louse on plums and prunes and black cherry aphis. However, ¼ pound DN per 100 gallons with lye (or a tank mix of sodium dinitro ortho cyclohexyl henate) is even better and will probably displace tar oils now in use both on a cost and efficiency basis. DN costs $2.00 per pound, or, in such use, 50 cents per 100 gallons, whereas tar oils are effective concentrations of 1½-2 per cent tar oil and cost $1.00 per 100 gallons. "Loro" cannot compete on a cost basis.

It has also been found that dormant sprays of DN compounds act as a cure for delayed foliation, a problem of particular importance in seasons following unusually warm winter in the southern half of California. Although the sodium dinitro ortho cyclohexyl phenate was highly effective in black scale control on citrus, it cannot be used because it burns young growth and terminals and has no advantage over standard 1 2/3 percent oil which sometimes has a similar effect. The product offering most promise seems to be 0.5 percent rotenone-3 percent total extractives.

Products Having a Usefulness Similar to DN Dusts

Dr. A. M. Boyce has been investigating the alkyl cyclohexylamines and has found that Santobane (which he said was beta, beta amyl cyclohexylamine) appears to have promise as an acaricide. He has at least

three other cyclohexylamines under test, but did not reveal their nature. One of the interesting revelations of this work was that compounds which caused serious plant injury at 1-400 and 1-800 concentrations in aqueous dispersions on lemons caused no injury when used as 10 percent dusts on walnut shell flour. He said that amines work particularly well on walnut shell flour, which suggests a usefulness for our IN-930-pyrethrum combinations.

Dr. James Marshall at Wenatchee had tried amyl benzyl cyclohexylamine on apples for combined codling moth and two spotted mite control. The experiment was a failure. No persistent heavy mite populations developed, the material severely injured the trees and gave no codling moth control. The sprayed trees looked worse than the checks.

Perhaps the most unusual use for dinitro compounds is in the control of the dead arm disease of grapes (Cryptosporella viticola). Dr. W. B. Hewitt of the University of California at Davis is using Elgetol (dinitro ortho cresol) and DN to kill the organism on the foliage in much the same manner that Dr. G. W. Keitt of the University of Wisconsin is using copper-calcium arsenite in apple scab control.

At Davis, Sinex (dinitro naphthalene) is being tested as a weed killer by Drs. S. A. Crafts and L. G. Westgate (Crop Protection Institute).

One of the most important features in mite control in California is the fact that these animals divide themselves roughly into two groups: those that are controllable by sulfur and those which are not. At the present time, there appears to be no pesticide which is equally effective on both. Neither is there any pesticide which is entirely safe to plants under the high temperature conditions that prevail in most of the areas in California where mites are injurious. It is evident, however, that

any product, even if decidedly specific in its action for certain of the most important mites, may be used in large quantities just as is evident with DN dust at the present time.

The Hop Aphis

Description of the hop aphis Phorodon humuli Schrank

The hop aphis Phorodon humuli was described by Franz Schrank in 1801 (Fauna Boica, Vol.2, Pt.1, p.110) and is given as follows:

> Hopfen F. 1199 Weislichtgrün, einfärbig; zwey Hornchen am Vorende: die Fühlhörner am Grunde mit einem Zahne.
>
> Aphis Humuli
>
> Wohnort: an der Unterseite der Hopfenblätter.
>
> Anm. Die Saftepizen fast parallel, ein wenig einwärts geneigt.
>
> Diess ist der Mehlthau des Hopfens; in der That eine Anzeige, dass der Stock krank sey, aber nicht die Ursache der Krankheit.

Translated into English the literal interpretation of this description follows:

> Whitish-green, univolorous; two little horns at the anterior end; antennae at base with a tooth.
>
> Aphis Humuli
>
> Habitat: On the underside of the hop leaves.
>
> Note: The honey tubes nearly parallel, a little inwardly inclined.
>
> This is the mildew of the hop; in fact an indication that the plant is diseased, but not the cause of the disease.

The various forms of the hop aphis are described by Theobold (The plant lice or Aphididae of Great Britain., Vol.1, p.273-276, Headly Bros, London, 1926.) and are given as follows:

Egg, on Prunus.

Color; greenish at first, turning to black. Size .4 x .7 mm.

Stem Mother (Fundatrix) on Prunus.

Alate viviparous female (first migrant). Pale green to apple green, paler beneath. Head dark brownish; a dark line or band on pronotum; dark brown thoracic lobes. Abdomen with dark transverse bars and 3 to 4 black lateral spots. Anal plate black. Cauda green. Cornicles green. Legs green, apices of femora and tibia brown; tarsi black. Eyes reddish-brown. Wings large, the cubitus and stigma greenish-yellow. Antennae about as long as body; green to dusky-green, especially at apex; segments i. and ii. darkened, base of iii. palest; segment i. larger than ii., with a blunt apical process on the inner side; iii. longer than iv. and not quite as long as vi., with 27 to 33 sensoria over its whole length; iv. very slightly longer than v., with 3 to 6 irregularly disposed sensoria; v. less than half length of vi.; the flagellum long. Head with small lateral processes and the median ocellus on a prominent process. Rostrum reaching nearly to second coxae, which are close to the third and some way from the first. Cornicles shorter and thicker than segment iii. of antennae, darker green in some than others, imbricated, projecting well beyond the cauda. Cauda one third to less the length of the cornicles, spinose, bluntly acuminate, expanded basally, with 5 or more pairs of rather long hairs.

Apterous viviparous female (on Prunus). Yellowish-green, with 3 deeper green irregular lines on the body, the median one more regular

than the lateral, the latter frequently zig-zag. Elongated oval in form. Head rather narrow. Eyes small and red. Legs and antennae green, reaching the second coxae. Legs nearly equi-distant apart. Frontal tubercles porrected, prominent, not quite reaching the level of the apex of antennal segment i. Segment i. of antennae much larger than ii., with a blunt apical process on inner side; iii. longer than iv., and equal to or rather longer than vi.; v. about as long as iv.; basal area of vi. about one-third of flagellum. Cornicles green, as long as or slightly longer than antennal segment iii. and thicker; faintly imbricated. Cauda green, much shorter than cornicles; apinose, with 3 pale hairs each side. Anal plate green. Tibia with short hairs. Length 2.7 to 3 mm.

Apterous viviparous female (on Hop). Somewhat similar to the former, but narrower, more shiny and transparent; the three dorsal stripes not so well developed; body rather narrower. Frontal tubercles large and somewhat different in form to the former. Segment i. of antenna larger than ii., with a well-defined blunt tooth on its inner margin towards the apex; otherwise very similar. Cornicles and cauda similar in colour, but the former not so straight and longer than antennal segment iii. Rostrum reaching to second coxae. Length 1.3 to 2 mm.

Alate Viviparous female (Return migrant on Hops). Very similar to spring migrant. Antennal segment iii. with 23 to 30 sensoria; iv. with 3 to 8. Abdomen with 3 to 4 lateral dark spots, as well as the usual transverse dark bars. Cornicles, cauda and legs much as in former. Anal plate dark. Femora dark, except at base; tibia green, except just at apices; tarsi dark. Length 1.7 to 1.9 mm.

Male. Alate. Green; head and thorax dark. Abdomen with 3 large dark lateral spots, a dark dorsal patch and one at base of each cornicle, caudad; anal plate dark. Cauda and cornicles dark. Antennae dark green. Legs green, except apices of femora, tibia and the tarsi. Antennae longer than body; segment i. larger than ii., with a dentate process apically; iii. longer than iv., with 23 to 25 sensoria; iv. slightly longer than v., with a few sensoria. Eyes large, dark. Rostrum not reaching to second coxae. Sternal plate dark. Cornicles thin, cylindrical, much shorter than antennal segment iii. Cauda much thicker and shorter than cornicles. Claspers dark. Wings much longer than body. Length 1.5 to 1.8 mm.

Oviparous female. Apterous. Yellowish-green; antennae green at base, dusky at apex. Legs green, except hind tibiae which are dusky. Cornicles, cauda and rostrum yellowish-green. Antennae shorter than body; segment i. much larger than ii., with a large dentate process near apex of inner edge; iii. a little longer than iv. and a little shorter than vi.; iv. and v. about equal; flagellum of vi. rather short. Frontal processes of head very prominent. Cornicles cylindrical, somewhat curved inwards, about as long and slightly thicker than segment iii. of antennae. Cauda broad, about half length of cornicles. Legs rather short and thick; many sensoria on hind tibiae except just near apices. Length .8 to 1.0 mm.

History of Phorodon humuli.

The earliest mention of the hop aphis was by Orth, a German priest, but it was not described until 1801 when Schrank named it Phorodon humuli. It was present in England in 1807 but apparently did not become very important until 1843. It was imported into the United States about 1863

and in 1886 caused very severe damage to the hop yards of New York and Wisconsin. The first appearance of the pest on the Pacific Coast was 1890 and since then it has remained one of the most important problems of Hop Growers. It is now known to occur in Japan, Formosa, India, Germany, France, England, Italy, Poland, Russia, Denmark, Hungary, Latavia, Belgium, Jugoslavia, Czechoslovakia, Canada and the United States. It is of major economic importance in the hop growing sections of Oregon, Washington, California, and New York, but also occurs in Idaho, Colorado, Wisconsin, Ohio, Connecticut, Maine, Illinois, and Vermont. Hops and prunes are its common hosts but it has also been taken from plum, cherry, Blackthorn, apple, rose, asparagus, and nettle.

Life History of Phorodon humuli.

The hop aphis overwinters in the egg stage on prune and perhaps other closely allied hosts. There has been some evidence that they may overwinter as eggs or adults on the roots of hop vines but this has not been substantiated. The eggs on Prune hatch about the Middle of April. The emerging aphids are wingless viviparous females (stem mothers) and after about two weeks deposit living young on the foliage of the primary host (prune). Two or more generations are passed on the primary host before alated spring migrants are developed. This occurs about the middle of May. The spring migrants fly to hop vines and deposit living young. They are very weak fliers, but when aided by wind may migrate one half mile or more. The infestation in a hop yard generally varies inversely with the distance from the primary host. Approximately ten days are required for the young to become mature at this time of the year. Females deposit on an average of thirty

Figure 8. Section of hop cone showing sooty mould development.

Figure 9. Bract of hop cone, showing growth of sooty mould, Cladosporium spp.

Figure 8

Figure 9

or forty offspring and eleven or more generations may occur on hops during the summer months. There are four nymphal instars.

The male aphids appear as an estimated twelfth generation about the middle of September. Both male and female aphids develop wings about this time and migrate to the primary host (prune). Eggs are deposited from the latter part of September and throughout October.

Economic importance of Phorodon humuli.

The hop aphis injures the hops in two ways. They devitalize the plant by extracting the sap. This results in a decrease in yield and weakens the vitality of the plant. They also secrete honeydew which supports the development of the black fungus smut or sooty mould Cladosporium spp. This develops in the clusters of the hops, causes them to become permanently discolored and greatly lowers their market value.

Seasonal history of Phorodon humuli in 1937.

The first aphis was taken on hops at Corvallis, Oregon, on June 3, 1937. From this date until July 6 aphids were slow in establishing themselves. Parasites and predators seemingly held them in check until after July 15 when they were very noticeably on the increase throughout the Willamette Valley. Dust and spray applications gave temporary reductions in populations but late in August they were again very abundant. Cool moist weather supported the development of sooty mould in September and it was estimated that over 12,000 bales of hops were not picked because of this development.

Seasonal History of Phorodon humuli in 1938.

The department of Entomology was well equipped to study the seasonal

development of the hop aphis in 1938. Examinations were made of the hop plants in the experimental yard in the same manner as was described for Tetranychus telarius (Page 30). The first appearance of hop aphis on hop occurred May 23. They remained very few in number until the latter part of June when they seemingly began to increase. Populations and percentage infestation counts showed that they were definitely decreasing by July 19, and by the end of the season very few could be found. Populations did not occur in sufficient numbers for the testing of insecticides in the field. The seasonal history is pictured graphically on the following page. Population per leaf (a measure of population density) was magnified 1000 times in order to show the slope of the curve. Parasites and predators were responsible for holding this pest in check during 1938. Sooty mould did not occur in the experimental hop yard at the east farm and there were no reports of it throughout the Willamette Valley.

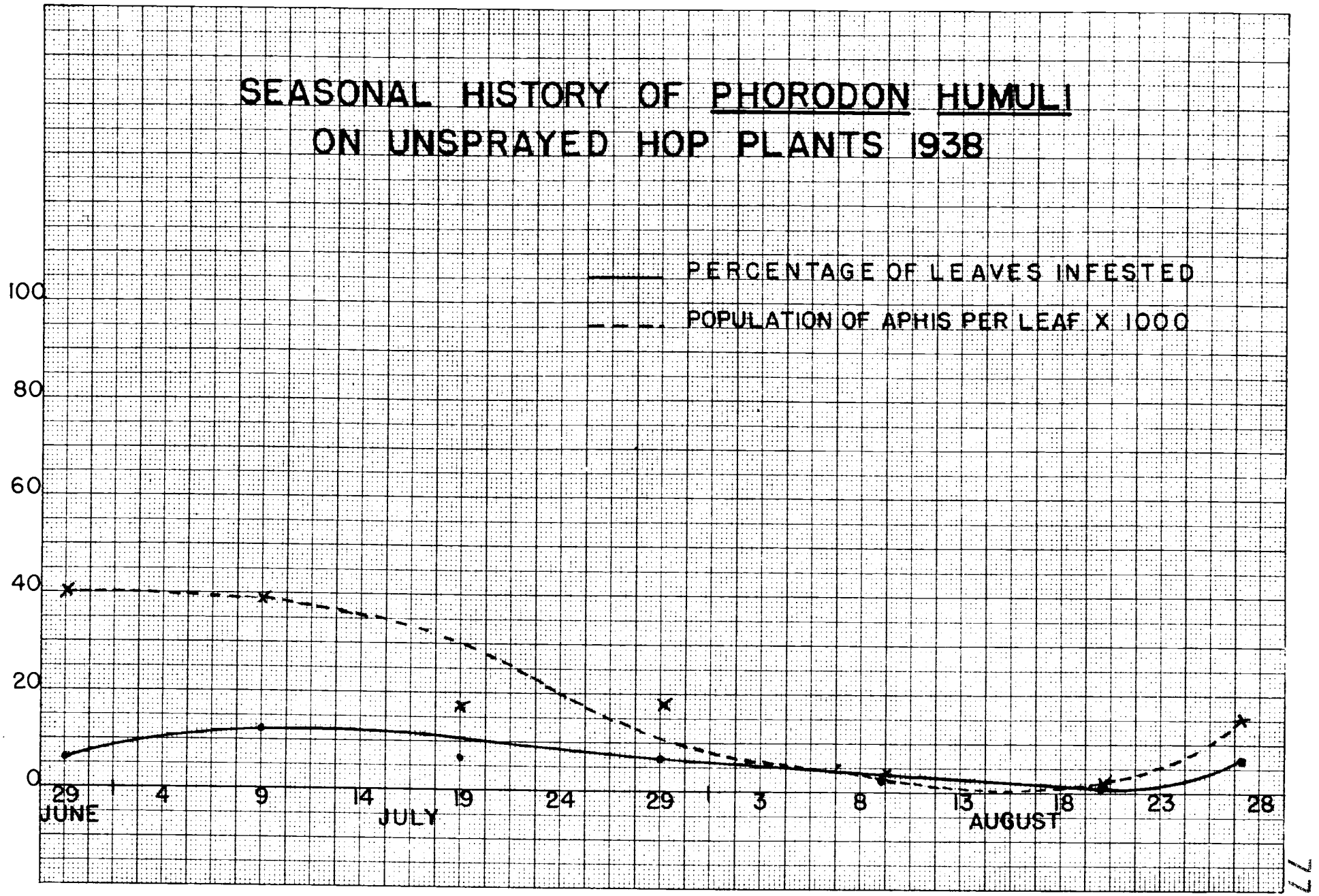
SEASONAL HISTORY OF PHORODON HUMULI
ON UNSPRAYED HOP PLANTS 1938
PERCENTAGE OF LEAVES INFESTED
POPULATION OF APHIS PER LEAF X 1000
100
80
60
40
20
0
29
JUNE
1
4
9
14
19
JULY
24
29
1
3
8
13
18
AUGUST
23
28

Figure 10

Control of Phorodon humuli.

1. Cultural methods. A number of cultural methods such as the stripping of lower leaves and suckers from the vines, hand picking and destroying infested leaves, fertilization and irrigation, have been recommended as aids toward hop aphis control. These are common practices among hop growers throughout Oregon and may have supplementary control value. Cultural methods of this kind usually require additional control practices.

2. Biological control. Parasites and predators often play an important role in hop aphis control. This was demonstrated during the season of 1938 when the number of infested leaves in the experimental hop yard at Corvallis did not exceed twelve (12) percent. Hop aphis were very hard to find during August and September and averaged only 3% infested leaves. Population of aphis per leaf at this time averaged .001 per leaf. Aphis are normally at their maximum abundance during this period.

The biological control of insect pests varies greatly from year to year. Many factors are involved in this phenomenon but in general, the control value fluctuates with the seasonal development of the pest and its enemy. There has been no attempt made to study this method of control on hop aphis. Investigations of this kind are prolonged and costly but some effort should be made in this direction.

Spray and dust applications for hop pest control have been noted to kill off many of the natural enemies of hop pests. This fact is not generally considered by hop growers. Improper timing and application of materials of this kind may in some instances do more harm than good. A list of the common natural enemies of the hop aphis is given as follows:

Anthocoridae -- Hemiptera

*Triphleps insidiosus Say.

Chrysopidae -- Neuroptera

*Chrysops californica Coq.

Hemerobiidae

*Hemerobius pacificus Banks.

Syrphidae -- Diptera

*Syrphus opinator O. S.

*Syrphus americanus Wied.

Coccinelledae -- Coleoptera

*Hippodamia convergens Guer.

*Coccinella abdominalis Say.

*Coccinella californica Mannh.

*Chilorcus orbus

*Cycloneda sanguinea Linn.

3. Chemical control. Spraying with nicotine sulfate-soap or quassia-soap has long been the favored means of hop aphis control. Nicotine sulfate is very rapid in its toxic action but is very volatile and will lose its insecticidal value shortly after application. It is necessary that the aphis are contacted by the spray for optimum results. The common formula used by hop growers is:

Nicotine sulfate (40%) - - - - - 1/3 pt.
Whale oil soap - - - - - - - - - 4 to 5 gal.
Water - - - - - - - - - - - - - 100 gal.

Quassia is the extract from the wood of Picraena excelsa, a Jamaican tree which contains the alkaloid quassin ($C_{32}H_{42}O_{10}$). Quassin is extracted from the chips of the tree by soaking them in water for 24 hours and then boiling them for several hours.

---

* Known to occur in Oregon

There is no standardized quassia formula and hop growers commonly use a rule of thumb method of preparing it. A formula sometimes used by hop growers in the Willamette Valley is given as follows:

Extract of 5 lbs. of chips - - - - 3 gal.
Whale oil soap - - - - - - - - - - - 5 lbs.
Water - - - - - - - - - - - - - - -100 gal.

The insecticidal nature of quassia is not known. It is not as rapid as nicotine sulfate but seemingly has a prolonged or residual effect. It is believed by many hop growers that quassia is absorbed by the plant and acts as a repellent. This material has been used in the Pacific Northwest since 1889 despite the repeated warnings by C. V. Riley and L. O. Howard (Entomologists U.S.D.A.) that the material was of no value. Quassia has now stood the test of fifty years among hop growers and apparently is specific for hop aphis control. Toxicological investigations with quassia should be undertaken in both field and laboratory in order to determine its insecticidal efficiency.

A number of the larger hop growers of Oregon have abandoned the practice of spraying in favor of dusting for hop aphis control. Nicotine-lime or nicotine-lime-sulfur dusts are commonly used. The formula for these dusts is as follows.

1. Nicotine sulfate (40%)- - - - - 10 lbs.
   Lime - - - - - - - - - - - - - - 50 lbs.
   Filler- - - - - - - - - - - - - - 40 lbs.

2. Nicotine sulfate (40%)- - - - - 5 lbs.
   Lime - - - - - - - - - - - - - - 50 lbs.
   Dusting sulfur- - - - - - - - - 45 lbs.

Dusting for hop aphis control has been carried on in Oregon for five years with not too much success. Successful dusting has the limiting factors of strong air currents and the inability to contact the aphis on the under side of the leaves. Still air currents may be found in the early

morning but at this time temperatures are below the threshold for maximum insecticidal efficiency.

Preliminary studies were made in the laboratory to determine the necessity of contacting aphis with nicotine sulfate dust. Hop aphis were not present in sufficient numbers for test purposes and an undetermined species of aphis on Cosmos were substituted.

The standard embroidery hoop method was used in preliminary study. This method is employed by the E. I. du Pont de Nemours and Co. for aphicidal investigations. A fine mesh scrim cloth is drawn tightly through a six inch embroidery hoop. A leaf or portion of a plant which is infested with fifty or more aphis is cut from the plant and treated with a given insecticide. The treated aphis are then placed on the scrim cloth and covered with a four inch petri dish. This prevents aphids from escaping. Air circulates over the treated aphids from around the edges of the petri dish, and prevents a concentration of toxic gases and build up of temperatures. A pan of water may be placed beneath the embroidery hoop if humidity control is desired. The number of living and dead insects is counted after a twenty four hour period. The toxicity differential between adult and nymphs is controlled by only recording the adult aphids. Moribund aphids are generally considered as living.

The aphids used in this study were dusted with .10, .066, .050, and .033 ounces of 5% nicotine sulfate-lime dust. A similar amount of material was deposited under the embroidery hoop in a second series of tests. These aphids were not contacted with the dust in this series and any kill was considered due to the fumigatiory action of the nicotine. The results of these tests are tabulated as follows:

Aphis contacted with dust

Amount	Number alive	Number dead	Total	Percent dead
.10 oz.	0	174	174	100
.066 oz.	0	216	216	100
.05 oz.	4	203	207	98
.033 oz.	15	199	214	93
Check - untreated	80	0	80	0

Aphis not contacted with dust

Amount	Number alive	Number dead	Total	Percent dead
.10 oz.	20	84	104	80
.066 oz.	93	21	114	20
.50 oz.	309	0	309	0
.033 oz.	78	0	78	0
Check - untreated	304	0	204	0

This experiment was very crude and aphids were not present in sufficient numbers for replications of treatments. The aphids not contacted were never farther removed than one inch from the dust. It is strongly indicated that contacting of aphids by the dust is necessary for maximum insecticidal efficiency.

One very important problem in these hop investigations is the development of a satisfactory method of dust application. The equipment which is now used for hop dusting does not give adequate coverage on the under side of the leaves. Hop aphids and red spiders dwell in this habitat and it is essential that this problem is solved if and when a suitable pesticide is developed for their control.

Cnephasia Longana Haw.

History of Cnephasia longana (Omnivorous leaf tier -- Flax worm).

Cnephasia longana was described by H. A. Haworth early in the eighteenth century and since that time there has been few scattered references on its toxonomic position and host plants. It is apparently well distributed over Europe and there are records of it from Holland, England, Southern Europe and the Canary Islands. It was first taken in America in 1929 by J. J. Inskeep, County Agent of Clackamas County, Oregon, who reported it causing damage to strawberries. It is now spread around the North Howell, Silverton, Mt. Angel, Woodburn, Hubbard and Canby districts of Oregon and has been reported attacking iris and strawberry in the State of Washington. This insect has been studied during the last four years by Mr. W. D. Edwards and Mr. G. R. Ferguson of the Department of Entomology, Oregon State Agriculture College, Corvallis, Oregon. The account of C. nephasia in this report has been taken from their unpublished reports of 1936-1937-1938.

Description of Cnephasia longana.

Genus Cnephasia Curtis *Palpi shorter than the head, ascending, densely clothed with long scales, especially on the upper edge of the second joint, the terminal joint exposed; maxillae short. Antennae rather long, slender, finely pubescent within the males, simple in the females; head small, with a tuft on the crown; eyes lateral, subglobose; thorax not crested; wings deflexed during repose; anterior somewhat lanceolate, rounded at the apex, and generally marked with transverse irregular bands, rarely immaculate; posterior ovatetriangular, entire; abdomen moderate, carinated on the back, and with a tuft at the apex; stouter and obtuse in the females: legs slender, short.

* Stephens, J. F. Illustrations of British Entomology. Haustellata IV London. 1827-1835. p. 12 7.

Species longana Haworth **

Synonomy. Cnephasia longana, C. ictericana, C. ioewiana, C. stratana, C. insolatana, C. luridalbana.

T. (The long-winged) alis albo-cinereis longiusculis, fusco maculatim fasciatis.

Habitat in Pascuis. Imago vix frequens.

Expansio alarum 9-10 lin.

Discriptio. Alae anticae longiusculae seu certe longiores quam in caeteris ratione magnitudinis, apice retundatae; cinereo-albae; maculis subtribus irregulariter confluentibus transversis fuscis ante medium; aliisque tribus majoribus posticis, magisque confluentibus irregularibusque. Juxta apicem, alae subinde fusco reticulatae sunt. Posticae albicantes. B. Omnino pollidior maculis plus minus evanescentibus. Forte exemplarium senectum.

A literal translation of the above description is given by J. Schuh and the writer as follows:

T. (The long-winged) Wings ashy white, rather long, covered with dark bands.

Habitat In pastures. Imago scarcely frequent.

Size. Wings 9-10 lines.

Description. Anterior wings somewhat long or certainly longer than the others by the observation of size, apex rounded; ashy-white; dark irregular transverse confluent spots below and before the middle; and three other larger behind, more confluent and irregular. Near the apex, wings are continually reticulated with black. Becoming white posteriorly.

B. Totally paler, with more or less evanescent spots. Strong similarity of old age.

** Haworth, H. A. Lepidoptera Brittannica Londini 1803-1839, p.463.

Description of various stages of Cnephasia longana.

Egg. The egg, when first deposited, is light salmon in color, but turns darker if the egg is fertile or lighter if infertile. It is about 1/32 inch in diameter, has no definite shape, though it is generally round but flattened at the point of attachment. During incubation the egg becomes somewhat irregular or collapsed in appearance.

Larvae. The larva is a typically naked Tortricid about 7/16 of an inch long. The color changes as the larva grows. After hatching, the body retains the salmon color of the egg and this persists through the overwintering period in the hibernaculum. Shortly after the resumption of activity in the spring, the insect's body varies from a light to dark gray and the head capsule and shield become very dark. When a length of from 1/4 to 3/8 inch is reached, a longitudinal stripe appears slightly to each side of the dorsal surface, though these disappear or become very faint shortly before pupation, and the larva turns to a creamy brown. The head capsule and shield become and remain tan in color after 1/4 of an inch is reached, except immediately after each molt when they are very light. There are five ocelli on each side of the head close to the base of the antennae and slightly lateral, that are arranged in a compact group. The mandibles are dark brown and small. One pair of true legs is found on each thoracic segment and a pair of prolegs on the 3rd, 4th, 5th, 6th, and 10th abdominal segments. Characteristic of the larvae of the genus Cnephasia is the absence of seta VI on the 9th abdominal segment.

Pupa. The pupa is typically lepidopterous, 9/32 of an inch in length; abdomen somewhat lighter than the rest of the body. The first to sixth abdominal segments have a double row of short spines on the dorsal side. These spines grow smaller progressing posteriorly until

they are mere indications on the sixth segment. The anterior of these two rows of spines start at a spiracle and run over the back, ending at the spiracle on the other side. On each side of the pupa, running parallel with the spines, there are three setae and another slightly ventral and anal in direction from the spiracle may be found.

Adult Male. The adult male is a Tortricid, measuring 9/32 of an inch in length and with a wing spread of 3/4 inch. In color the forewing, body, head, patagia, and collar are of a grayish-yellow; the rear wings appear slightly less yellow, due possibly to a lesser number of scales. The under side of the forewing appears to be darker than the upper side, while on the rear wing both sides are of the same shade. The anal margin of the hind wing, from apex to base, has a fringe of long gray hairs, which attain a length of almost half the width of the rear wing on that portion of the margin close to the base. The apexes of the wings are somewhat rounded, giving the appearance of the typical Tortricid.

The antennae are grayish-yellow, though somewhat darker than the wings. The palpi are covered with scales; broad at the tip; somewhat ascending; reaching slightly above the vertex of the head.

Front portion of the tibia and femur of the forelegs is washed with brown and the tarsi are dark brown. The femur and tibia of middle and hind legs are grayish-white; tibial spurs are yellowish-gray. Middle legs are clothed with scales except on the tibia where there is a brush of hairs.

The anal tuft is fan-shaped and yellowish-gray in color.

Adult Female. The female moth is similar in size and shape to the male but differs in color. The forewing is grayish with brown markings. The brown upon the forewing varies from a few mottled spots to, in extreme cases, practically covering the entire wings.

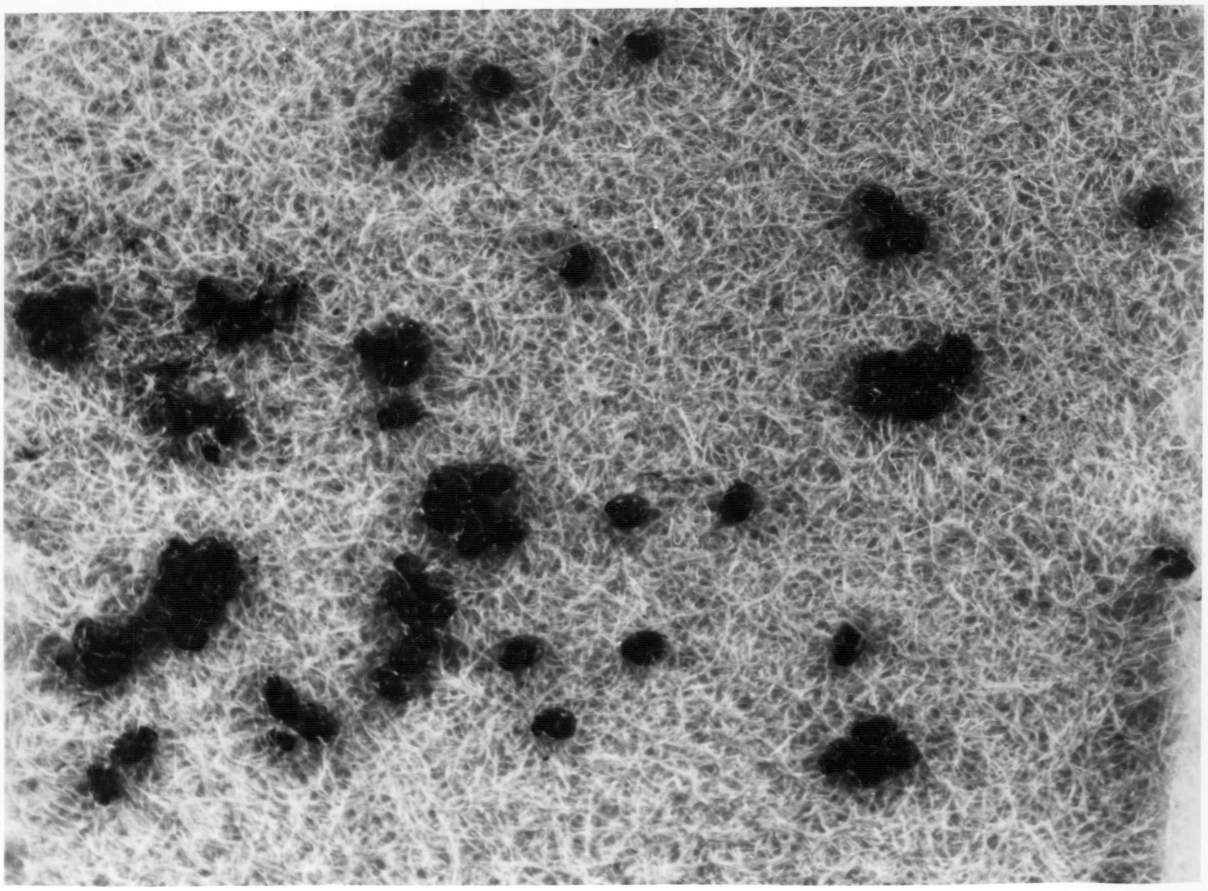

Figure 11. Eggs of Cnephasia longana Haw.

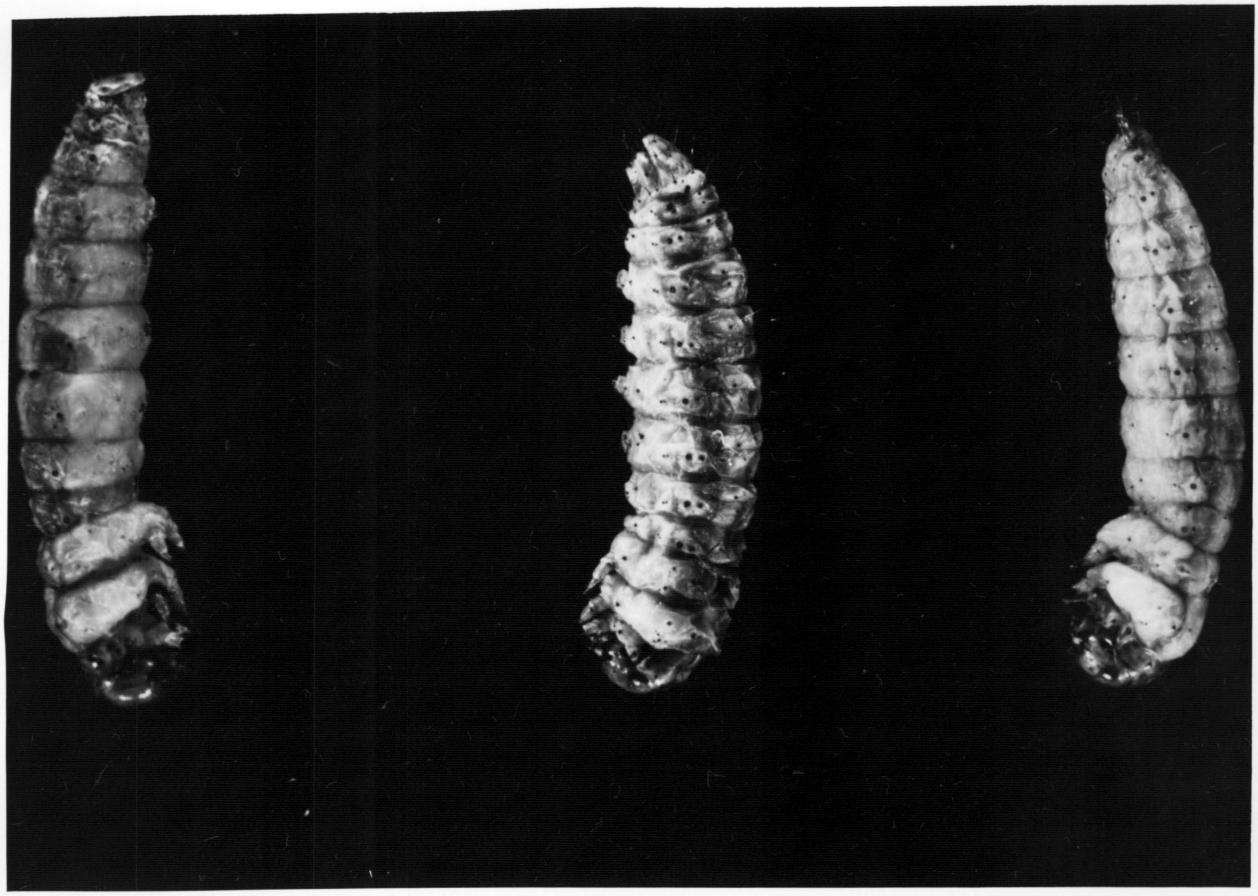

Figure 12. Larvae of Cnephasia longana Haw.

Figure 13. Prepupae of Cnephasia longana Haw.

Figure 14. Pupae of Cnephasia longana Haw.

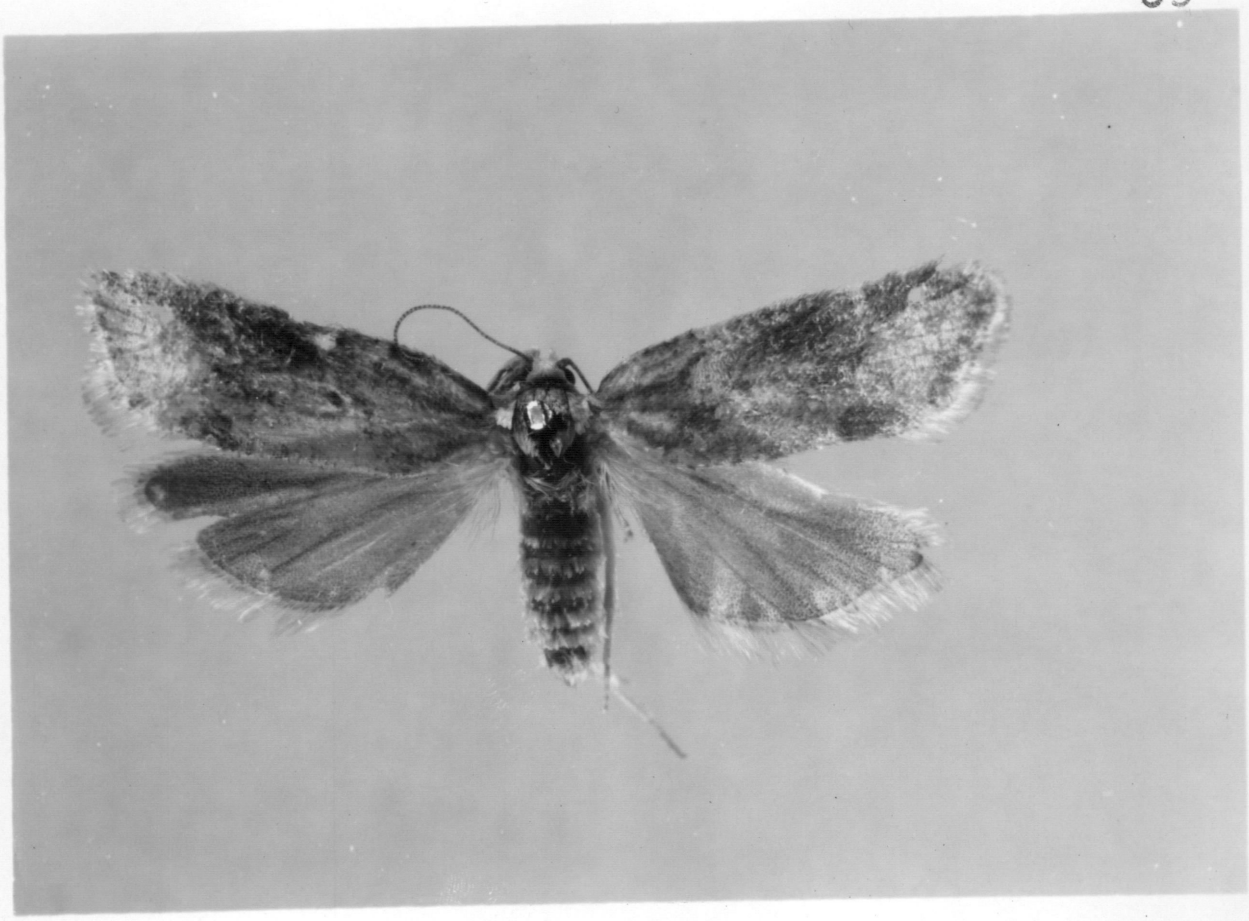

Figure 15. Adult female, Cnephasia longana Haw.

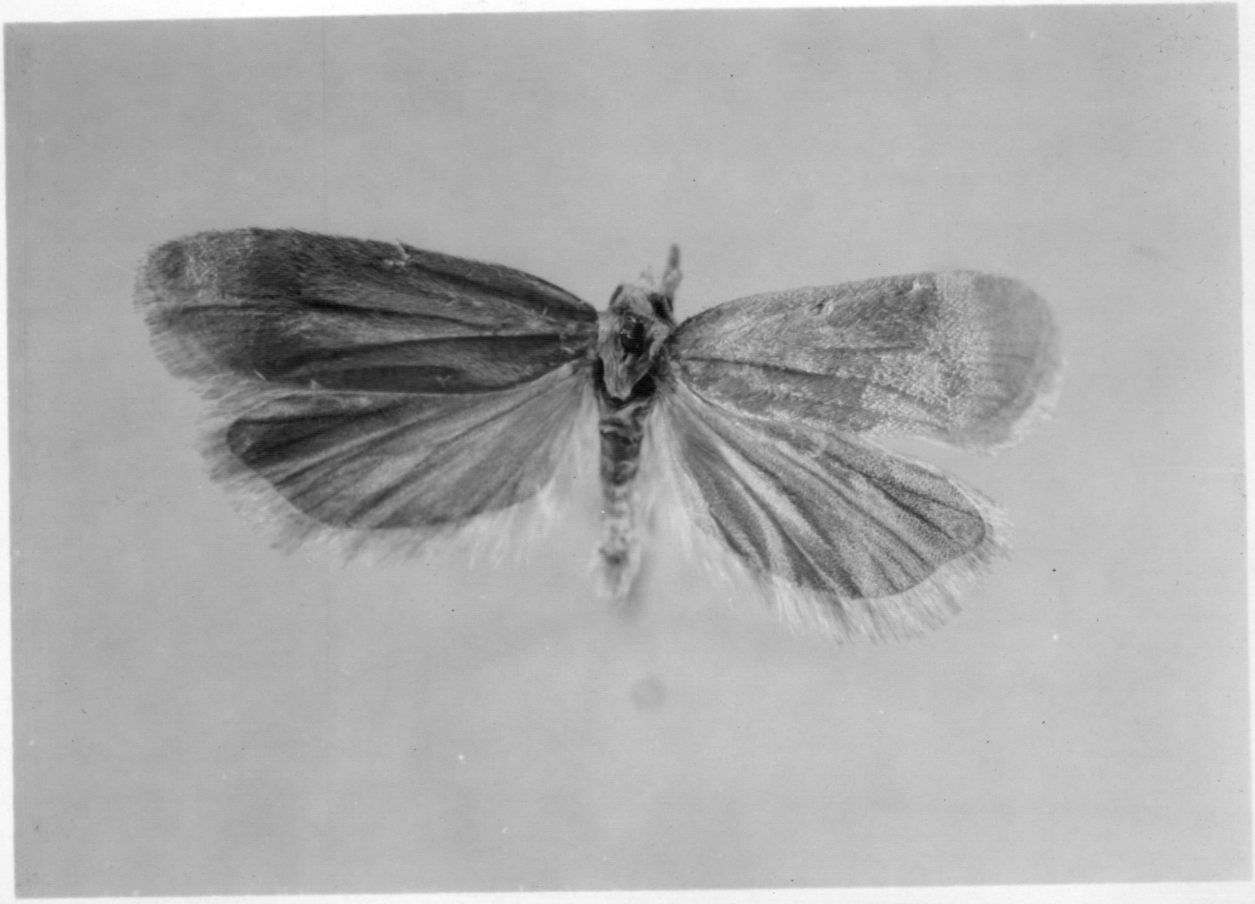

Figure 16. Adult male, Cnephasia longana Haw.

Life History of Cnephasia longana Haw.

The omnivorous leaf tier Cnephasia longana overwinters as first instar larvae. Activity is resumed from the last of March and continues throughout April. The young larvae are carried by wind and air currents at this time and in this way are enabled to establish themselves over a wide area. The first and second instar larvae are typical leaf miners of various plants. The larvae of the third instar apparently leave the internal part of the leaf and feed on the external surface. There are six larval instars during which the larvae pass through a progressive series of color variations (salmon color to light grey). The larvae become mature during June and July. The insect then passes through a very short prepupal period before pupation occurs. The duration of the pupal stage averages about two weeks and may be found in the field from the middle of June to the middle of July. Adult moths emerge from the beginning of July until the first of August and probably feed on flower nectar. Female moths will deposit an average of 65 eggs and deposition begins several days after emergence from the pupae. Eggs are deposited singly and in clusters over a period of a week or more. There is apparently no difference between the number of eggs laid by virgin or fertile females. The eggs hatch on an average of about two weeks and the newly hatched apparently do not feed, but establish themselves in protected locations where they spin a hibernacula and overwinter in this condition. There is but one generation of the omniverous leaf tier a year and approximately eleven months are spent in the larval stage. The larvae is active only two of these months while nine are spent in hibernation.

Economic Importance of Cnephasia longana.

The Omnivorous leaf tier is known to attack 95 different species of

Figure 17. Injury to terminal tips of hops by Cnephasia longana Haw.

plants. Thirty-three of these plants are of economic importance. Considerable damage to flax and strawberries has been reported during the last three years. Other economic plants include sugar beets, iris, peas, vetch, clover, alfalfa, gooseberries, walnuts, hops, birch, and poplar seedlings. The injury to hops occurred in yards in the vicinity of Woodburn and Mt. Angel, Oregon. These yards were in close proximity to flax fields and apparently hops are not a favored host plant of this insect. The damage is caused by larval feeding and destroying the terminal buds of the hop vine. The lateral shoots which develop at this point add increased labor costs to the practice of stringing the vines.

Control of Cnephasia longana.

1. Biological Control. A number of parasites are natural enemies of C. longana, and in some instances are noted to exert considerable influence on the relative abundance of the host. A list of these parasites is given as follows:

Phytodietus burgessi Cress.

Glypta sp.

Dioctes eureka Ashm.

Microbracon hyslopi Vier.

Microbracon gelechiae Ashm.

M. gelechinae has been the most effective parasite of C. longana averaging in some instances from 15 to 20 percent control. There are also a number of undetermined parasites and predators which likely play some role in this phase of control. Investigations into the mass production and liberation of these parasites have not been attempted but this important possibility of control should not be overlooked.

2. Cultural methods. Crop rotation studies have shown some possibilities for control of C. nephasia on flax. Populations of this insect were consistently low over a two year period when flax was planted on new ground. Infestation on the other hand was consistently high when flax was planted after legumes. Control of this kind may prove to be satisfactory of C. longana on flax but different control methods are necessary on strawberries and hops. It is also possible that cultural control of C. longana on flax may increase its economic importance to hops and other crops.

3. Chemical control. Preliminary toxicological investigations were undertaken in the field and laboratory by G. R. Ferguson during the biennium 1937-1938. Laboratory studies showed that lead arsenate, calcium arsenate, sodium fluosilicate, barium fluosilicate sodium fluoaluminate, pyrethrum and rhotenone dusts did not give satisfactory kill. Dinitro-o-cyclohexyl phenol at .8% in walnut shell flour gave 70% kill in the laboratory. This material was also shown to be very toxic to flax plants. DNOCHP is a new material which is in the experimental stage of development. It was used on hops during 1938 and gave satisfactory results on red spider. A discussion of its action on plants and pests is given on page 60.

Field tests indicated that rhotenone and pyrethrum dusts had some promise of control on strawberries but results were not conclusive.

THRIPS

Three species of thrips were taken from hops (Late cluster variety) at the experimental yard east farm Corvallis, Oregon, July 30, 1938. They were determined by Dr. Floyd Andre of the United States Department of Agriculture at Washington, D. C. as Thrips tabaci Lindeman, (Onion thrips), Franklineilla multoni Hood (Western flower thrips), and Aeolothrips melaleucus Haliday. The descriptions of these species are given as follows:

Family - AEOLOTHRIPIDAE (1)

The antennae are nine segmented. Ocelli are present in both sexes. The maxillary palpi are three segmented, and the labial palpi two or four segmented. The wings are large, broad, and rounded at the outer ends. In addition to a heavy ring vein, each fore wing has two longitudinal veins extending from its base to tip, where they unite with the ring vein on each side of the tip, while the hind wings have only a vestige of a median longitudinal vein. Four or five cross veins are present in each fore wing. The fore wings are without a fringe upon the front edge, though some more or less stout hairs are present in some species. Both sexes bear a peculiar hook-like appendage on the underside of the second segment of each fore tarsus. The ovipositor of the female is bent upward so that its convex side is ventral. The males have the first abdominal segment much longer than the second. The members of this family run rapidly, having very long legs, but they do not appear to have the power of springing.

Genus - AEOLOTHRIPS Haliday (1)

Head about as broad as long. Ocelli present in both sexes. Antennae nine segmented, the last three or four segments being very much shorter than the preceeding and closely joined together, third segment much longer than any other. Maxillary palpi three segmented, geniculate. Prothorax about as long or a little longer than the head, without large bristles. Legs very long and slender; fore femora somewhat thickened in both sexes; hind femora broadened; fore tibiae unarmed; second fore tarsal segment, in both sexes, with hook-like appendage. Wings usually present in both sexes; fore wing somewhat narrowed before the middle; fore part of ring vein furnished with very short hairs, which hardly overreach the edge of the wing. Fore wings white, with two broad, dark cross bands. First abdominal segment of the males much longer than the second, and the ninth segment is drawn out at the hind angles into short clasping organs or hooks.

Species melaleucus Haliday (2)

"This species comes near fasciatus. The third antennal joint is wholly whitish and the fourth is yellowish basally; the whole of the fore wing is dark brown except the base and apex and a median patch on the fore margin occupying about one sixth the length and extending in depth to about the hind vein." Haliday's original description may be translated as follows: "Black: base of fore wing, a spot on mid costa and the apex white, third joint of antennae elongated, white."

Bagnall saw only two females taken at Besselsleigh, Berks, England. On Hazel (Corylus)

Figure 18. Female, Aeolothrips melaleucus Haliday

Family THRIPIDAE (1)

"The members of this family have from six to eight segmented antennae (apparently nine segmented in Anaphothrips striatus and Pseudothrips inequalis); the segments beyond the sixth are usually short and form what is called the style. Maxillary palpi are usually three, sometimes two segmented; labial palpi never composed of more than two segments. The wings of Thripidae are usually slender, gradually tapering more or less and pointed at the tips. The fore wings, as a rule, present two parallel longitudinal veins, the front one running from the base to near the tip of the wing; the hind vein appears usually as a branch from the fore vein at about one-third the length of the wing. Wometimes, however, all connection between these veins is wanting. Cross veins are rarely visible, though traces of them can sometimes be seen. The ring vein is not usually very heavy or prominent. A fringe is generally present upon the front margin of the fore wing, but may be vestigial, More or less stout spines are found along the veins and costa of the fore wing. The hind wing has one median, longitudinal vein without spines and no cross or ring veins, but the costa bears a fringe. The ovipositor of the female is bent downward, i.e., concave side ventral."

Genus - THRIPS Linnaeus (1)

"Ocelli present. Antennae seven segmented (style one segmented). Maxillary palpi three segmented. Prothorax regularly somewhat longer than the head; two long spines always present upon its posterior angles. Fore legs usually unarmed. Wings usually present, moderately broad, with fore fringe developed and veins set with short spines. The species belonging here have the power of springing."

Species tabaci Lindeman (1)

"Female. Length about 1.1 mm.; width about one-fourth the length. Color quite uniformly light yellowish varying to brownish yellow.

Head one-fifth wider than long; cheeks slightly arched behind the eyes; frons slightly arcuate between them; occiput indistinctly transversely striated; hairs upon the head few and minute; eyes not protruding, coarsely granulated, very dark red by reflected light, black by transmitted light, sparsely pilose; ocelli subapproximate, standing well back to the line of the hinder edge of the eyes but posterior ocelli not contiguous with margins of the eyes; color light yellow, margined inwardly with light brown crescents. Maxillary palpi three segmented; first and third segments equally long, second shorter. Antennae seven segmented; relative lengths of segments as follows:

$$\frac{1}{4.4}\quad\frac{2}{8.7}\quad\frac{3}{11.1}\quad\frac{4}{10}\quad\frac{5}{8.6}\quad\frac{6}{10.6}\quad\frac{7}{4}$$

Segment one short and globose; two barrel-shaped; three to five pedunculate, elongated ovoid; five joined by moderately broad surface to base of six which tapers somewhat from its middle to its apical end; seven tapering slightly, blunt at apex. Segment one lightest in color, clear light yellow; two, six and seven uniformly light greyish brown; three light brownish yellow; four and five colored like three at their bases but apices nearly as dark as six.

Prothorax as long as head, one-half wider than long; pronotum, indistinctly transversely striated and sparsely clothed with small spines; each hind angle bears a pair of very stout, conspicuous spines, and between these pairs, along the hind edge of the pronotum, stands a row of three smaller spines on each side. Metathorax one-third wider than prothorax; metanotal plate bears a few small spines.

Wings about one-fourteenth as broad as long, slightly colored with light yellow; costal fringe of fore wings composed of short, stout bristles intermixed with a row of shorter spines. Fore longitudinal vein bears from ten to twelve spines arranged in three groups as follows: Two groups upon the basal half of vein, the first of three of four spines, the second group of three, and beyond the middle of the wing four to six spines scattered at considerable distances along the vein to its tip; when only four are present in the last group they stand out at nearly equal distances apart; hind vein bears from fourteen to seventeen spines. Occasionally one or two cross veins may be seen between the fore vein and the costal at one and two-thirds its length, but usually they are not present; hind vein arises from the fore vein at about the middle of the second group of spines. Hairs composing posterior fringes on both wings are long, slender, wavy and light colored. Legs concolorous with body or somewhat lighter, quite long and slender; second segments of tarsi much longer than first; spines on inner side of hind tibiae weak, except the pair at its extremity; legs sparsely clothed with fine hairs.

Abdomen as wide or slightly wider than the mesothorax, about twice as long as wide; each dorsal plate of segments two to eight marked near its anterior edge with a narrow, transverse line of dark chestnut-brown color, widest at its middle and tapering gradually toward the sides, disappearing at the upper edge of the groups of three to five short spines which stand upon these segments just above the pleural plates. Posterior edge of ninth segment bears a circlet of eight long, stout spines, most prominent dorsally; terminal segment bears six spines which are nearly as long as preceeding; besides these long spines both of these segments bear a few finer spines. Redescribed from many specimens."

Figure 19. Female Thrips tabaci Lind.

"Male. Head and abdomen yellowish white; thorax yellow. The first two antennal segments white; the third at the end very weakly; the fourth and fifth more strongly shaded with gray; the sixth is gray, at the base or even to the middle white; the seventh segment entirely gray. Wings present. Uzel."

Synonomy. Limothrips tritici; Thrips sp.; Thrips striatus; Thrips alli; Thrips communis; Thrips tabaci; Onion thrips.

Genus - FRANKLINIELLA Karny 1910 (1)

Synonomy. Euthrips, Targioni - Tozzetti; Physopus, Amyot and Serville; Frankliniella; Karny, (accepted as Frankliniella by Hood 1914 and Morgan 1925).

"Ocelli usually present but sometimes more or less rudimentary. Antennae eight segmented. Maxillary palpi three segmented. Prothorax as long or somewhat longer than the head with two spines upon each hind angle and one similar spine upon each anterior angle in many species, but this is wanting in others. Legs usually unarmed, but in a few species with a stout tooth on the under side of the fore tibia at end. Wings usually fully developed but sometimes reduced. When present they are moderately broad, have two longitudinal veins which are set with numerous stout spines at regular intervals in those species having a spine at the fore angle of the pronotum. Spines upon abdomen moderately stout; anal spines long and slender. These species are active and can spring.

Species - moultoni Hood (3)

Synonomy. Euthrips tritici californicus; Frankliniella Moulton 1907; tritici moultoni Hood 1914; Frankliniella moultoni Morgan 1925; Western flower thrips.

"Taken in company with Euthrips tritici (Frankliniella tritici) in the blossoms of almost all wild and cultivated plants. The variety is distinguished from the species by the following characters: General color uniformly dark brown; thorax orange brown; segment 1 of antennae brown, unicolorous with head; segment two uniformly darker brown. Habitat California, Oregon, Washington."

Note: A description of Frankliniella tritici must be carried along at this point because Moulton contrasted the distinguishing characters of Frankliniella moultoni with F. tritici rather than making a complete description.

Frankliniella tritici Fitch (1)

Synonomy. Thrips tritici; Euthrips tritici; Frankliniella tritici.

"Female. Length about 1.22 mm.; width about 0.26 mm. General color brownish yellow, thorax tinged with orange. Head three-fourths as long as broad and four-fifths as long as prothorax, but slightly withdrawn therein; cheeks but slightly arched behind the eyes and converging slightly posteriorly; anterior margin very nearly straight; back of head transversely striated. Eyes large, dark, and slightly pilose, occupying together about three-fifths the width of the head; ocelli present, subapproximate, pale yellow, marginated inwardly with bright reddish orange crescents; spines between ocelli on each side long and conspicuous; postocular spines shorter. Maxillary palpi three segmented. Antennae nearly two and one-half times as long as head; relative lengths of segments:

$$\frac{1}{6} \quad \frac{2}{8.7} \quad \frac{3}{13} \quad \frac{4}{12.3} \quad \frac{5}{8.8} \quad \frac{6}{12.5} \quad \frac{7}{2.2} \quad \frac{8}{4}$$

Color: One pale yellow; two light brown, base sometimes yellowish; three light yellow in basal half, remainder shaded light brown; four and five brown, yellowish at bases; six, seven, and eight brown. Spines upon antennal segments, especially two to five, quite stout and conspicuous.

Prothorax rather rounded, three-fourths as long as broad; one pair of stout spines at each angle, also one short anteriorly directed spine standing close to lower one of each fore pair; between each posterior pair and median line stands a row of five spines, number four alone being large; color of prothorax pale orange-yellow. Mesothorax rounded at anterior angles; mesonotal plate with one stout spine at each lateral angle and two pairs of small spines on posterior margin. Metathorax tapering but slightly posteriorly; metanotal plate bearing four spines close together at anterior edge, the middle pair being much more stout and conspicuous. Wings nearly reaching the end of abdomen; breadth at middle about one twelfth their length; shaded but slightly; each fore wing has two longitudinal veins extending from base to tip of wing; spines on veins at regular intervals; costa twenty-six to twenty-eight; fore vein twenty to twenty-two; hind vein fifteen to eighteen; scale five, interior of scale one; a light, sparse fringe on costa of each wing; posterior fringes heavy and wavy. Legs clear pale yellow, sometimes slightly shaded with light brown above, quite thickly set with short brown spines; a pair of stout spines at extremity of each tibia; rows of spines on inner side of hind tibiae rather weak.

Abdomen cylindrical-ovate, pointed at apex; dark brown stripe across segments two to seven near their anterior edges; dorsal plates, except nine and ten, shaded more or less with brown; three or four

moderately stout brown spines stand out prominently upon the pale yellow sides of segments two to eight; terminal spines long, stout, and dark colored; tip of abdomen dark brown. Redescribed from eight females."

"Male. Length about 0.7 mm. (0.64 to 0.80 mm.); width of mesothorax 0.195 mm. (1.18 to 0.22 mm.). General color pale yellow, darkest upon pterothorax.

Eyes somewhat smaller than those of female. Antennae about two and one-third times as long as head. Relative lengths of segments as follows:

1	2	3	4	5	6	7	8
4.3	8	11	10.3	7.9	10.1	1.6	2

Wings large and reaching beyond the tip of abdomen. End of abdomen (ninth segment) bluntly conical; tenth segment retracted and not reaching the tip of the ninth; nine bears four pairs of long, stout, dark spines, of which one pair stands on each side near the tip; near the middle above stand two short spines described from four specimens."

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(1) Hinds, W. E. Contributions to a monograph of insects of the order Thysanoptera inhabiting North America. Proc. U. S. Nat. Mus., Vol. 26, No. 1310, pp. 79-243. 1903.

(2) Bagnall, R. S. Ent. Mo. Mag. 56, p. 60-62, 1920.

(3) Moulton, Dudley. U. S. D. A. Tech. Series, No. 21, p. 28, 1911.

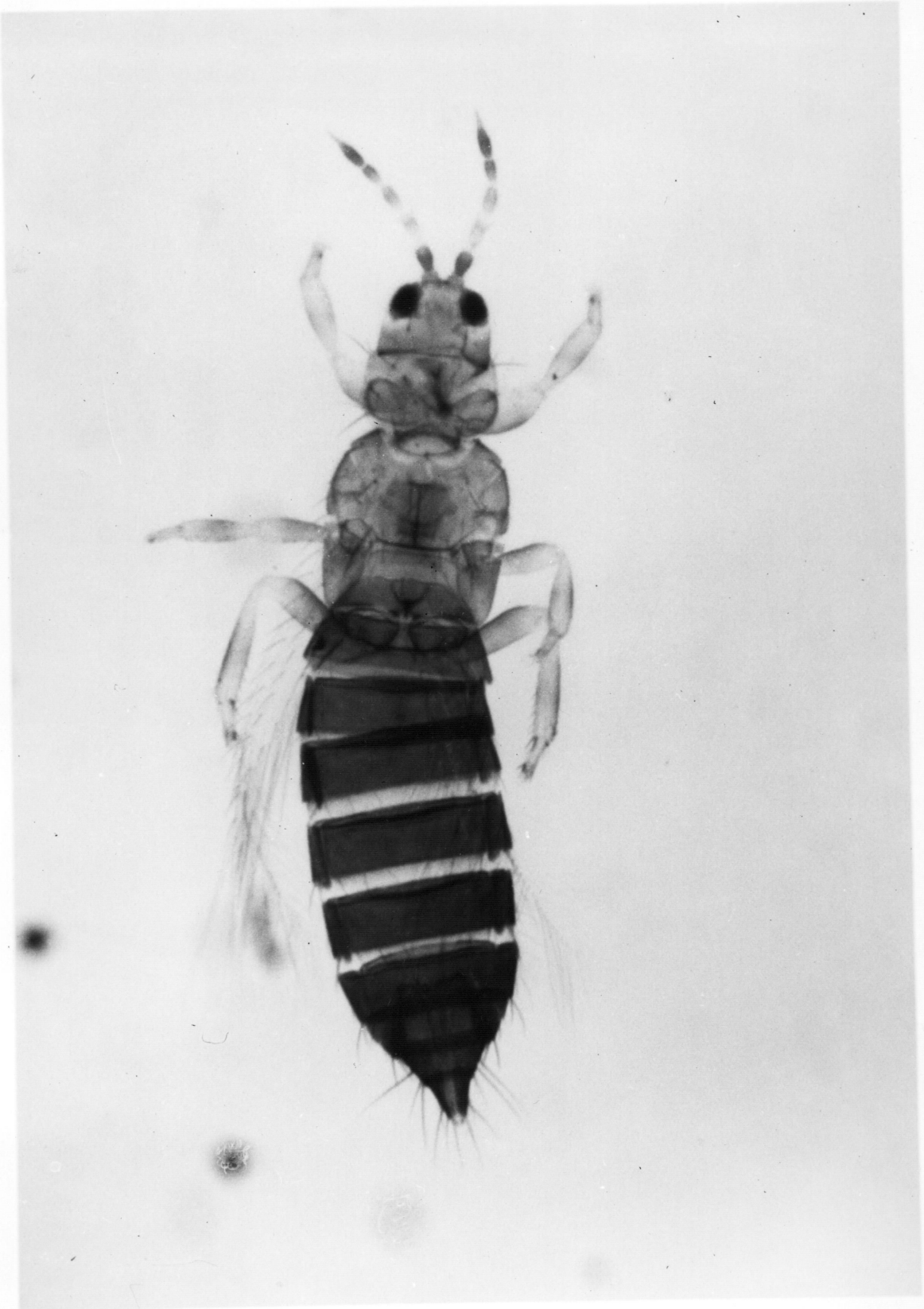

Figure 20. Female, Frankliniella moultoni Hood

Life History of Aelothrips melaleucus Haliday.

This species was described by Bagnall in 1920 from two females taken on Hazel at Besselsleigh, Berks, England. Ross and Putman observed a few nymphs of A. melaleucus attacking red spider in the field. Under experimental conditions the nymphs also fed on Oriental fruit moth eggs. (Economic insect fauna of Niagara peach orchards, Vineland Station, Ontario, Canada. 46 Ann. Rept. Ent. Soc. Ontario. 1933).

Moulton, (Canad. Ent. 61, p. 286, 1929) captured one specimen on Viburnum sterile at Vernon, B.C. He mentioned the similarity and possible synonomy of A. melaleucus with A. annectans Hood and A. auricestus Treherne. A. annectans is distributed throughout Maryland, Virginia, New York and is frequently taken in British Columbia where it is thought to be predaceous on Onion thrips. A. auricestus has been collected and described by Treherne in British Columbia. (Canad. Ent. 51, 1919).

The life history of A. melaleucus has not been studied, and after a thorough review of literature, this species was apparently taken for the first time in the United States by the writer from Late Cluster hop vines, Corvallis, Oregon, July 30, 1938.

Life History of the western flower thrips.

The western flower thrips (Frankliniella moultoni Hood) was originally described as a variety of F. tritici and has been frequently taken with this latter species in blossoms of many wild and cultivated plants. Little attention has been given the western flower thrips prior to 1934 when it was learned that it was a vector of the tomato spotted. Little is known of its life history and most information has been taken from unpublished notes. The adults and/or larvae probably overwinter in alfalfa or other

green fields in California and migrate to citrus orchards early in the spring. Considerable damage has been reported to grapefruit in certain seasons. The eggs are deposited in the mature fruit which causes them to become severely silvered. The average length of the egg stage is about five days. Larvae attack the blossoms and newly formed fruit causing them to fall from the tree. The average larval period is about two weeks. Pupation occurs in the soil and six to eight days are required to complete the prepupal and pupal stages. The average life cycle of F. moultoni is about twenty-five to twenty-six days. Females are believed to live on an average of three weeks. Larval action on grapefruit is limited to about two weeks and after this time this thrips apparently moves to a different host. No control measures against F. moultoni have been reported.

Life History of Onion thrips.

The onion thrips, (Thrips tabaci Lind) was introduced from Europe and was first noticed in the United States in 1872. Its spread was very slow until 1907 when it appeared simultaneously over all the United States. Since then it has attracted more or less attention throughout the United States, Canada, and Mexico.

This insect attacks many plants such as onion, cabbage, beans, peas, and nearly all vegetable and truck crops. Flower and ornamental plantings are often severely damaged in greenhouses and nurserys. Numerous weeds, grasses, grains and other field crops are listed among its host plants. It has been proven to be a vector of the tomato spotted wilt and the pineapple yellow spot and thought to be a vector of a streak in peas and the spinach mosaic.

Adults and nymphs overwinter on plants or refuse in or about the field. The females lay their eggs early in the spring by depositing in the leaves and tissue of plants. The egg hatches in about five to six days and the nymphs attain their growth in about two weeks. Pupation occurs in the soil and about six to ten days is required for the nymphs to pass through the prepupal and pupal stages. The average life cycle of this thrips is about twenty-six days in New York and twenty-one days in Texas. The female lives about three weeks and will deposit approximately 40 to 50 eggs. There are about three or four generations per year in New York and five or more in Texas. Nicotine Sulphate spray (1-400) with the addition of approximately 1 percent of soap is commonly recommended for the control of this insect.

Economic importance of thrips to hops.

Thrips are considered of minor economic importance to hops but little is known of their relationship to this host. Species of the genus Aeolothrips are generally considered to be predaceous on other insects, but Childs (J. E. E. 20, 805-808, 1927) found that A. fasciatus was responsible for "pansy spot" (an oviposition injury) on apples.

A. melaleucus was taken with the western flower thrips and the onion thrips on hop plants and was probably predaceous on these and other insects.

Decided silvering of hop leaves was noted and attributed to thrips injury on many of the hop vines at the Experimental hop yard, Corvallis, Oregon, in 1938. The onion thrips and/or the western flower thrips were probably responsible for this damage. Both species are proven vectors of certain virus diseases and may contribute to the virose symptoms which are sometimes noted in many hop yards throughout the Willamette

Valley. The reddening or russeting of mature clusters which is commonly attributed to moisture or fertilizer factors may be thrips feeding injury. Studies on the life history, economic importance, biology, habits and control of thrips should be undertaken.

Hop Butterflies

Several butterflies of the genus Polygonia sometimes cause trouble to hop growers. The descriptions of these species, P. satyrus, P. interrogationis, and P. comma are given as follows: (Scudder, S. H., Butterflies of Eastern U. S. and Canada., Vol.1, 1889.)

Polygonia satyrus Edwards:

Synonomy. Vanessa satyrus; Grapta satyrus; Nymphalis satyrus; Polygonia satyrus satyrus; Grapta marsyas; Nymphalis marsyas; Polygonia marsyas; Vanessa satyrus var. marsyas; the wandering comma; comma butterfly; hop butterfly.

"Imago. Head covered with long ferruginous and olivaceous hairs, the latter predominating along the middle, the former at the sides, mingled next the outer bases of the antennae with yellow hairs; behind the eyes a fringe of mingled ferruginous, dusky ferruginous and yellow scales. Sides of palpi pale buff on the basal half with scattered ferruginous hairs, the apical joint dark ferruginous, extending baseward in a tongue along the upper part of the middle joint as far as the eye, the upper edge nevertheless buff, and a line along the inferior edge of the fringe ferruginous; antennae black-brown above, feebly flecked with scattered, dull, pale scales, naked and testaceous along the inner side, beneath white in triangular patches, as long as the joints, having their apices at the tips, or only on basal half, the apical black-brown; club black-brown above, more abundantly and distinctly flecked with yellow, white and ferruginous scales, within and beneath naked, bright castaneous, all of the last three joints naked, luteous. Tongue luteous at base, with the sides infuscated, beyond blackish laterally.

"Thorax covered above with silky olivaceous and greenish-gray hairs, beneath with mingled yellowish white and pale ferruginous hairs, the latter predominating. Fore legs with similar hairs, but also clothed with velvety black scales down the middle, and with pale buff and silvery white scales on the sides; other femora heavily clothed with mingled tawny and dark ferruginous scales, flecked with pale scales of various tints, and especially often fringed with a line of yellow scales along the lower inner edge; tibiae and tarsi uniform pale buff. Spines, spurs and claws castaneous, the last deepest; paronychia pale castaneous; pulvillus black.

"Wings above rather light fulvous orange, deepening toward the base, marked with black and fuscous or fusco-ferruginous. Fore wings with the upper portion of the outer border slightly concave, the subcostal dentation distinctly less than rectangular, that at the tip of the lower median nervule hardly less prominent, sometimes not more than rectangular, the whole outer margin distinctly crenulate. The costal edge is indistinctly yellow, rather inconspicuously interrupted with black on the basal half. In the cell and the interspaces below it are black spots, which exactly repeat those of P. comma, excepting those of the lower median interspace, the outer of which is usually rectangular in form, and the inner, at the extreme base, larger and more distinct than in comma, where it often is almost absent; here it is sometimes almost as large as that below it. The outer dark margin is precisely as in comma, excepting that it is nearly obscured by grayish below the lower median nervule, or at least below the middle of the medio-submedian interspace. The markings at the apex of the wings, within the dark border, are also exactly

as in comma, excepting that the band depending from the costa, midway between the apex of the cell and the tip of the wing, is darker ferruginous, decidedly fuscous or even blackish. On the lower half of the wing there are sometimes no markings just within the border, excepting a dusky, more or less ferruginous, triangular spot with blurred edges, in the middle of the outer half of the medio-submedian interspace, and faint triangular lunules seated on the dark margin, scarcely paler than the ground; but these lunules are usually distinctly paler, and following them on the inner side there are often some deep ferruginous fleckings, forming, with the dusky spot below, a ferruginous cloud. Toward the base of the wing the orange becomes much deeper and warmer, and at the extreme base is somewhat infuscated; along the lower margin it is more or less obscured by grayish fuscous; fringe as in comma. Hind wings with the outer border considerably crenulate, the dentation of the upper median nervule twice as long as broad, scarcely tapering, rounded at the tip, especially at the upper corner; the costal projection considerable, strongly rounded; the upper subcostal rectangular. Three distinct black spots in the basal half of the wing; one an oblique, transverse bar depending from the middle of the costa and reaching the middle subcostal nervule, followed above by a slightly paler tint to the wing; an obliquely transverse bar at the extreme base of the lower subcostal and upper half of the subcosto-median interspace, parallel to the first, and with its outer margin sometimes almost continuous with the inner margin of the first, but ordinarily removed inward by half its width; the third a triangular patch at the extreme base of the upper median interspace, occasionally followed toward the base by an obscure grimy extension which loses itself in the considerable infuscation of the base of the wing.

The outer margin of the wing has a dark border of the same width as that of the costal margin, deepest within, but not nearly so dark as on the fore wings, being fusco-ferruginous at darkest and sometimes merely ferruginous, its outer half more or less obscured by gray or pale tawny; it is followed within, in the heaviest marked specimens, by a similar but more cloudy belt united with it at the costal extremity and separated from it by a series of laterally connected, ill-defined, pale lunules, generally clearer than the ground color of the wing, sometimes reduced to small, pale spots, roundish in the upper, transverse in the lower half of the wing; fringe much as in fore wing.

"Beneath, varying from dark to light brown on the basal half, more or less ashen gray, especially in the male, on the outer half, the whole often tinged strongly in the male with dull olivaceous. Fore wings with the position of the markings and their general tone and value precisely as in comma (the sexes differing also as there), excepting that the linear streaks in the cell are more decidedly longitudinal, almost completely parallel to the subcostal nervure, with scarcely any obliquity, the lower of the two outer ones unmargined and independent, often obscure, and nearly twice as long as the others. The same is true of the hind wings, including the central silvery comma, the only distinction lying in the less vivid variegation of the colours in satyrus, the more distinctly black-edged margin of the basal field and in the male the more frequent and pervading yellow ground tints.

"Abdomen above black with tawny scales and hairs; beneath of the prevailing tone of the under surface of the wings. Appendages of the male: upper organ exactly as in comma; clasps fully twice as broad as

long, broadest below, the angles well rounded, the upper posterior angle produced to a small, triangular, incurved lobe, almost pointed at the tip; basal process of upper margin very similar to that of comma but its apical half bent downward at a stronger angle.

Measurements in millimeters	MALES			FEMALES		
	Smallest	Average	Largest	Smallest	Average	Largest
Length of fore wings	22.	26.	27.5	26.		28.
antennae.		14.6				14.
hind tibiae and tarsi	7.5	9.3	9.25	9.		8.75
fore tibiae and tarsi	3.75	.5	.5	3.5		4.5

Described from 5 males, 2 females.

"Caterpillar. Last stage. Head black, angular, with a spiny tubercle at each of the upper angles; body black, with a broad, greenish white, dorsal stripe, which on the anterior segments is clouded with black; on each segment, on this stripe, is a fine V-shaped, black mark, having its angle at the dorsal spine; an infrastigmatal greenish white line. Dorsal, laterodorsal, and infrastigmatal spines greenish white; laterostigmatal spines black; the spinules of all the spines concolorous, excepting that those near the tip of the pale spines are blackish (adapted from Stretch).

"Mr. H. Edwards found in California little variation in the caterpillar, "the markings...being remarkably constant in every instance." Mr. Mead, on the contrary, found much variation in Colorado.

"Chrysalis. "Fawn colored, with a few darker markings irregularly placed" (H. Edwards), especially next the inner margins of the wing covers, and on the abdomen; the base of the wings is sometimes obscurely darker than the tip, the two separated by an oblique line extending from the apical wing tubercle to the middle of the antennae, the surface being slightly angulated along this line; on the abdomen, a distinct, dark, sometimes black, stigmatal band, bounded above by the upper edges of the stigmata, below by the infrastigmatal tubercles, darkest below and in its continuation on the sides of the cremaster; a slender, clearer, dorsal line, and from the fourth segment backward a series of clouded oblique stripes from the laterodorsal tubercles backward and inward; the tips of these tubercles and all the suprastigmatal series paler than the ground; the metathoracic and first two abdominal tubercles of the laterodorsal series "silver, the posterior with a trace of gold" (H. Edwards); mesonotal tubercle high, compressed, fully as high as broad, nearly as high anteriorly as posteriorly, and shaped generally much as in interrogationis. Fourth abdominal laterodorsal tubercles conical, the curve of their separation exactly as in interrogationis. Length, 21 mm; height at mesonotal tubercle, 8.5 mm."

Polygonia interrogationis Fabr:

Synonomy. Papilio interrogationis; Cynthia interrogationis; Grapta interrogationis; Vanessa (Grapta) interrogationis; Polygonia interrogationis; Vanessa c-aureum; Nymphalis interrogationis; Grapta interrogationis var fabricii; Vanessa p. interrogationis; Grapta fabricii; Vanessa fabricii; Nymphalis fabricii; Polygonia interrogationis umbrosa; Papilio c-aureum; Grapta c-aureum; Vanessa interrogationis; Grapta interrogationis umbrosa; Grapta umbrosa; Grapta crameri; The violet tip; semicolon butterfly; Semicolon vaness; hop merchant.

"Imago. Head covered above with olivaceous hairs posteriorly, and vinous with many intermingled pale or whitish ones in the middle and anteriorly, the sides with reddish fulvous scales backed by whitish ones; palpi pale or whitish straw color beneath; on the sides, the first joint white with a few scattered fulvous scales, the middle joint white on the basal outer half, the apical upper half being brownish fulvous and the superior fringe the same, mingled with yellowish, especially at the apex; apical joint like the apical half of the middle joint, the lower outer surface with distant, delicate, not very long, black hairs; antennae above blackish, some of the basal joints very delicately annulate, with fulvous at their base; beneath, where naked, pale luteous, edged exteriorly on the scaled portion, continuously or nearly so with white, much more broadly at the bases of the joints than at their apices, extending to about the middle of the basal half of the club; club like the stalk, excepting that the apical three joints are bright luteous above, luteo-fuscous below; tongue very pale luteous, darker in the middle at the base and darker beyond the first whorl.

"Thorax covered above with olivaceous brown scales and hairs, beneath with mingled vinous brown and pale hairs; fore legs fringed with the same, but dark reddish brown mingled with black in a slender stripe down the middle of the front; femora of the other legs nacreous, excepting on the inner under surface which is reddish brown, sprinkled with a few pale scales, and the tip which is yellowish or white; rest of legs pale straw yellow with a brownish tinge, paler on the tarsi than on the tibiae. Spines dark reddish brown, sometimes luteo-castaneous; spurs yellowish, tipped with reddish brown; claws castaneous, paler at base, darker at tip and along the under edge; paronychia yellow; pulvillus black.

"Wings above dark fulvous orange, clouded on apical half with dark cinnamoneous brown or dark ferruginous and spotted on basal half with black. Fore wings with upper portion of outer border straight, receding at an angle of about 45°; dentation at tip of lower median nervule slight, angulated; lower angle produced considerably downward, well rounded; outer margin scarcely crenulate, powdered at base as far as origin of first median nervule with scarcely perceptible darker scales; costal edge yellowish, faintly marmorate with reddish; in the middle of the cell are two rather small, roundish, slightly unequal, black spots, the upper smaller, subquadrate, transverse, depending from the subcostal nervure at its first divarication, reaching from one-quarter to one-third way across the cell; the lower a little further from the base, opposite a point midway between the first and second median nervules, in the middle of the lower half of the cell, but not touching the median nervure, roundish, or, if ovate, longitudinal, slightly larger than the upper. Crossing the apex of the cell, the boundary veins of which pass through the middle of its interior half, is a large transverse bar, reaching below the median nervure, which it generally touches only by its inner edge, fading out above the subcostal nervure, of variable shape, but usually narrower below than above and in the middle one-half as broad as its length. Subparallel to the median nervure, and distant from it by nearly the width of the cell, is a nearly straight series of three pretty large, subequal, roundish spots in the median and medio-submedian interspaces, the upper and lower nearer the upper border of their interspace than the middle spot and generally touching it; midway between the lower median spot and the base of the same interspace is a more or less distinct blackish or reddish spot, the continuation of the medio-submedian spot, but clearly

separated from it by the fulvous nervule; in the subcosto-median interspace, separated but a little from the transverse bar at the tip of the cell is a longitudinal, triangular, blackish fuscous dash or spot, its borders blurred, its apex outward and generally near the bottom of the interspace; it is about as large as the upper median spot. Beyond this, and separated from the basal portion by a limit which passes in a bent and curved direction from the costal margin, opposite the base of the third superior subcostal nervule, to just beyond the middle of the subcosto-median interspace, and through the middle of the median nervules to the inner border, where the submedian first approaches it closely, the wing is clouded with the cinnamoneous tint, infuscated and sometimes deepening into black by more or less frequent black flecks, on either side of the median area, and enclosing a somewhat obscure, sinuous, submarginal series of orange fulvous spots in all the interspaces, subparallel to the outer border, their outer limits distant from the outer border by the width of an interspace below the subcostal area, and by double that distance in the upper part of the wing; the spots subtriangular, their apices inward, ill-defined, of variable size, the upper ones often connected; the outer border is sometimes a little infuscated next their outer limits, and in the lower two subcostal interspaces generally deepens to a minute blackish crescent, followed by a short fulvous line; the whole outer border is rather narrowly edged with a pale bluish bloom, broadest next the nervule tips, and following them a short distance in the subcostal region; fringe cinnamoneous, tinged with dusky olivaceous in the middle of the wing, interrupted with yellowish in the interspaces in the upper half of the wing and more or less overlaid by the bloom. Hind wings with the outer border very little crenulate, the tail of the upper median

nervule two or three times as long as broad, the sides nearly parallel; the projection at the upper subcostal nervule slight, a little angulated, that at the lower angle small. Color the same orange and cinnamoneous tints as on the fore wings; the latter tint occupying relatively more of the outer portion than on the fore wings, and sometimes suffusing nearly the whole of the wing and particularly the lower half; there is a large transverse black bar crossing the upper subcostal and most of the costo-subcostal interspaces, broken by the upper subcostal nervule, which it strikes in the middle of its basal half, a little further out below it than above; there are two other small black or blackish spots; one occupying the extreme base of the upper median interspace, the other following the extreme base of the lower subcostal nervule and crossing part of the base of the upper subcostal interspace in direct continuation of it; there is a submarginal series of indistinctly limited, triangular, fulvous spots similar to those of the fore wings, parted at the upper median nervule and lying at a distance from the outer border, to which they are parallel, by a little more than on the lower half of the fore wings; whole outer border, including the whole of the tail, and also the costal nervure edged as in the fore wing; fringe cinnamoneous, interrupted in the interspaces by pale olivaceous brown, overlaid in part by the bloom.

"Beneath of a general wood brown tint of varying shades, made up of a very intimate and varying commingling of ochrey yellow and paler or deeper cinnamoneous scales, nearly the whole, but especially the basal two-thirds, more or less but almost always very slightly, washed with an exceedingly delicate pale bluish-hoary or plumbeous bloom, all the contrasts much more distinct in the male than in the female. Fore wings

with the basal fourth of the costal margin as far as the costal nervure white or yellowish white, heavily mottled with cinnamon brown; the limits of the transverse patch at the tip of the cell above are marked beneath by slender crenulate threads of cinnamon brown, between which the wing is a little darker reddish, especially in the male; from a point on the upper median nervule, as far beyond the tip of the cell as that is beyond the second divarication of the median nervure, a straight, cinnamoneous line runs to the middle of the basal four-fifths of the submedian nervure; at and within this mark, the inner border, as far as the submedian, is transversely and slenderly striped with dusky; and beyond this line, with alternating narrow bars of ochraceous and ferruginous; following this transverse line interiorly is a rather broad and nearly equal band, darker than most of the wing, made up of ferruginous tints, darker and more pronounced in the male than in the female, the tint diminishing in depth interiorly, so that in the female it is hard to determine its inner limit, but which in the male is seen to be halfway to the base of the lower median interspace; crossing the middle of the cell is a cloudy plumbeous, irregular, zigzag, slender, reddish-edged stripe connecting the base of the first subcostal and median nervules, often parted in the middle and much more distinct in the male than in the female; a similar, quite small, ovate spot, parallel to the subcostal nervure, is seated on the median nervure a short distance from its base; in the outer half of the wing, excepting near the costal and outer borders, the nervules are delicately traced in yellow; the wing is palest in this same region, being ochraceous tinged slightly with ferruginous, and so presenting a considerable and sharply defined contrast with the mesial band in the male, but scarcely paler than the wood brown of the whole wing in the female; it is palest

next the costal margin, but is interrupted by a large reddish fuscous cloud in the middle of the outer half of the border, more distinct in the male than in the female, and which reaches nearly or quite to the upper median nervules; there is a sinuous series of nine blackish, sometimes indistinctly blue-edged dots in all the interspaces which open on the outer border, (two in the medio-submedian interspace) obsolete or obsolescent in the female, very inconspicuous in the male; the first is considerably nearer the base than the second, which is in the middle of the basal two-thirds of the apical subcostal interspace; below this they regularly recede farther from the outer border (that in the upper median in the middle of its interspace) until the lower median nervule is passed, where they are at the same distance from it as in the lower median interspace; beyond these the wing becomes darker again and is profusely mottled with most delicate, short, transverse threads of dark and paler cinnamoneous and ochraceous, much darker in the male than in the female, the apex and lobe of the outer inferior angle more or less covered with bloom, little dots of which--noticeable only by the lens--occur midway between the sinuous row of black dots and the outer border of the wing; fringe cinnamoneous, the apical half, except at the nervule tips and the falcation, marked with white. Hind wings with an irregular mesial band of similar width and color to that of the fore wings, and like that deepest in tint externally; the outer edge, starting from the middle of the costal border, passes with a more or less irregular and considerable curve, opening inwards, to the vein closing the cell; here it stops and starts again in the median area from the base of the straight portion of the upper median nervule, passing in a straight line to the middle of the medio-submedian interspace opposite the middle of the lower median

nervule, and is then bent and directed toward the deepest part of the excision of the inner border; its inner limit is more regular and like the exterior is edged above the subcostal with a dark cinnamoneous line; the cell is bounded apically by a rather slender arcuate stripe of nacreous silver, its upper extremity just failing to reach the subcostal nervule and generally slightly produced toward the outer border, previous to which it is sometimes slightly strangled; beyond this, next the median nervule is a silvery dot, not so far from the inferior extremity of the silvery stripe as the length of the stripe; the base of the precostal nervure has also a white or silvery dot. In the apical half of the wing an arcuate series of dots like those in the fore wing, that in the lower median interspace in the middle of the outer two-thirds of the interspace; in the male the dots are in the middle of a faint, rather broad, double arcuate, darker band, one in the upper and one in the lower half of the wing, parallel to the outer border; and midway between the dots and the outer border is another series, like those of the fore wings, of pale dots; the outer border quite resembles that of the fore wings in both sexes, except in wanting the bloom at the upper outer angle of the wing; fringe much as in the fore wings.

"Abdomen above black, heavily covered with fulvous hairs and scales; beneath with intermingled hoary and fulvous scales, giving it a grayish appearance. Abdominal appendages: upper organ; hook slenderer at the base than in the other species, tapering throughout, as long as the body, very slightly arched, bluntly pointed. Clasps nearly twice as broad as long, slightly longer below than above, quadrate with rounded angles, the upper hinder angle produced to a small, rounded, incurved, triangular lobe about as long as broad; upper border producing at base a long and

slender process longer than the clasp, on the basal half one-fifth as broad as the whole length, equal, curved strongly inward and directed a little backward, compressed, beyond twisted so as to become depressed, tapering regularly to a blunt point, nearly horizontal and directed backward and considerably inward; interior finger long and slender, tapering only at tip, a little curved and scarcely surpassing the upper border of the clasp.

POLYGONIA INTERROGATIONIS FABEICII.

Measurements in millimetres. Length of tongue 12.	MALES			FEMALES		
	Smallest	Average	Largest	Smallest	Average	Largest
Length of fore wings.	31.5	32.	33.75	34.	35.	36.
antennae.	16.	16.75	17.5	17.	17.35	17.75
hind tibiae and tarsi	10.4	10.6	11.1	10.75	11.	11.
fore tibiae and tarsi	5.25	5.4	6.2	5.25	5.1	5.65

POLYGONIA INTERROGATIONIS UMBROSA.

Measurements in millimetres.	MALES			FEMALES		
	Smallest	Average	Largest	Smallest	Average	Largest
Length of fore wings.	28.	29.5	30.75	28.25	32.5	36.
antennae.	15.	16.	16.2	14.	15.5	17.
hind tibiae and tarsi	9.4	9.8	10.	7.6	10.	10.6
fore tibiae and tarsi	5.	5.	5.	4.	5.	5.25

Described from 8 males, 13 females.

"Egg. Considerably higher than broad, somewhat narrowed apically, broadest below the middle, with nine to eleven, commonly ten, strongly compressed ridges, growing higher toward the summit, where they are nearly half as high as the width of the interspaces at that point; interspaces gently concave throughout, broken up by very faint lines .025 mm. apart. Color (C. V. Riley) at first dull bluish green, afterward becoming grayish green with silvery reflections, the ridges white. Height, .95 mm.; breadth, .7 mm.

"Caterpillar.

First stage. Head smooth, piceous with a bronze tinge, the hairs and all appendages black; coronal papillae scarcely perceptible. Body rather pale green, strongly tinged with ferruginous on posterior half, the anterior section of the segments on anterior half pallid above the lateral line, setting off the papillae which are everywhere brownish fuscous; hairs erect, black, generally bent in some part of their course, the angle rounded; the inclination is not uniform, but is usually forward on the laterodorsal row, forward on the laterostigmatal. Spiracles brownish fuscous. Legs and tips of prolegs blackish fuscous; rest of prolegs like ventral surface of body, which is paler green and more uniform than above. Length of body, 3 mm.; breadth of head, .5 mm.

Second stage. Head shining bronze black, the hemispheres surmounted by a compound tubercle, stouter and slightly shorter than those of the abdominal segments, all the hairs on the head arising from distinct papillae; all appendages black. Body olive green, slenderly and inconspicuously streaked with pallid white in maculate strigae which follow the lines of the spines; spines piceous, hairs blackish fuscous;

spines of second and third thoracic segments slightly larger than the others, all the rest uniform, with subapical and extreme basal circlets of hair bearing papillae. Spiracles and prolegs color of body. Legs dark brownish fuscous. Length 6.5 mm.; breadth of head, .75 mm.

Third stage. Head shining bronze black, most of the papillae white, the coronal spines with elongate papillae, all the hairs pallid. Body olive green, varying in different individuals from rather light to very dark, distinctly strigate with white as in preceding stage, the dorsal striga double; dorsal and laterodorsal spines variable in coloration, those of the third thoracic and second abdominal sometimes, of the fourth and sixth abdominal segments generally, amber yellow, sometimes including and sometimes not, an annulus around the base of the spines; the other spines are generally black, sometimes tinged with olivaceous, occasionally pallid tipped; the hairs and thorns generally dark. Spiracles black with a distinct yellow annulus. Legs and outer side last joint of prolegs black. Length, 13 mm.; breadth of head, 1.35 mm.

Fourth stage. Closely resembling the final stage, but with a darker head. Length, 22 mm.; breadth of head, 2.25 mm.

Fifth stage. Head uniform in color, varying from a fuscous brown to a rather pale yellowish brown, the field of ocelli black; summit spine stout at base and not long, the lateral spinules emitted below the middle, the basal portion about as broad as long, the spinules moderately slender and rather shorter than the apical portion of the main stem, which scarcely tapers. Body varying from luteo-castaneous to rufo-castaneous, with broad, but irregular dorsal, laterodorsal, laterostigmatal and ventrostigmatal, black or rich black-brown stripes, narrowly and interruptedly edged, at least above the spiracles, with pale

yellow or pallid, sprinkled with ivory-white papillae (also found in the interspaces) and much broken and obscured, especially on the dorsal half of the body, with irregular strigae and blotches of pale yellow; on the thoracic segments the stripes are by this means, and by the confluence of some of the black parts of adjoining stripes, completely obliterated as such, and irregular, much broken, transverse, black, vermicular strigae take their place, and here there is a distinct and regular pale yellow dorsal line; there is also a rather slender, more or less interrupted and variable ventral stripe, and the bases of the prolegs are heavily clouded with black externally, merging into the ventrostigmatal band; laterodorsal spines of the second thoracic segment noticeably longer and rather stouter than the others; spines having the five spinules which form the wreath placed at an angle of about 40° with the apical part of the main stem, which is destitute of pile but generally bears three or four spinules of considerable magnitude. Most of the spines are luteous, though often rufous above the spiracles, and the thoracic ones or their spinules are often wholly blackish. Length, 35 mm.; breadth of head, 3.25 mm.

"Chrysalis. Paler or darker wood brown, tinged with dark olivaceous, the head and thorax, but not the appendages, sometimes more or less livid or clay-brown. Abdomen with a pale dorsal stripe, enlarging in the middle of each segment and bordered more or less conspicuously with greenish brown; a dusky infrastigmatal line, generally accompanied above by a moderately broad, greenish fuliginous band, bounded by the upper margin of the spiracles; a moderately broad, greenish fuscous, ventral stripe, margined with brown. The extremity of the tongue, occasionally

the whole of it, and sometimes also the antennae, blackish. The whole body more or less faintly marked with an irregular web of dark brown in impressed lines, on the wings forming a large, irregular and imperfect, quadrate mesh, the lines crossing the equally marked veins. The laterodorsal tubercles of the metathorax and first to third abdominal segments are metallic on their posterior surface to a greater or less extent, generally silvery-nacreous; while the anterior face of most of them in favorable light shows a golden reflection. The other laterodorsal tubercles have a pale annulus at base, a dusky or blackish annulus above it, and are castaneous at tip, all these dorsal tubercles are dull yellow, as are sometimes the generally pallid suprastigmatal tubercles, edged anteriorly with black; but the last, on the first and second abdominal segments, are dull golden with no black edging. Ocellar prominences short, conical, blunt-tipped, separated at base by a truncate front. Mesothoracic tubercle high, subquadrate, strongly compressed, subtruncate at tip, the front margin at first parallel to the hind, then curving, the anterior angle much more curved than the posterior; it is generally more or less marked with blackish fuscous on the sides. Length, 20-23 mm.; of ocellar prominences, 1-1.5 mm.; distance of these apart at tip, 2.75-3.25 mm.; width of thorax, 6.25-7.4 mm.; of abdomen, 5.75-7 mm.; height of thorax including tubercle, 7-7.75 mm.; of abdomen, 5.75-6.75 mm."

Polygonia comma Harris:

Synonomy. Vanessa comma; Grapta comma; Polygonia comma; Vanessa c-album; Grapta c-album; Vanessa (Grapta) c-album; Grapta comma harrisii; Nymphalis comma; Polygonia comma var harisii; Grapta dryas; Nymphalis dryas; Polygonia dryas; Grapta comma var. dryas; Polygonia comma var. dryas.

The orange merchant; The comma butterfly; White c-butterfly; Comma vaness; The hop merchant.

"Imago. Head covered with long whitish, dusky, and pale olivaceous hairs, with a slight tuft of yellowish ones outside the base of each antenna; behind the eye covered with mingled pale and tawny scales. Basal half of palpi pale buff, tinged faintly with greenish, and bordered along the base of the inferior fringe with dark tawny scales; fringe itself buff, with intermingled black hairs, and along the middle of its inferior surface a row of dark tawny mingled with fuscous scales; the basal half of the middle joint sometimes white above; apical half of palpi dark ferruginous tawny, the fringes the same, but tipped especially toward base with pale or more yellowish buff. Antennae blackish brown above, the inner inferior surface, excepting a few basal joints, naked and luteous, the outer inferior surface and all the inferior surface of the basal joints, white, the apical half outwardly, the basal joints wholly, interrupted with blackish, on the apical half of the antennae mingled with fulvous; club blackish, with a few obscure, dark, tawny scales, beneath blackish fuscous, the apical three joints luteous. Tongue pale luteous, the apical two-thirds infuscated at the edges.

"Thorax covered above with silky olivaceous hairs, beneath with vinous-brown, hoary-tipped hairs. Fore legs yellowish buff, marked down the middle with a black stripe; femora of other legs dusky, heavily flecked with pale scales, the slight inferior fringe buff, edged at base interiorly with black; inner side of upper surface of tibiae buff, the outer side and the tarsi whitish or very pale buff. Spines castaneous, darkest on the tarsi, spurs similar, reddish toward tip. Claws dark reddish fuscous; paronychia pale fuscous; pulvillus black.

"Wings above dark fulvous orange, marked with black and fuscous. Fore wings with the upper portion of the outer border slightly concave, the dentation rather less than rectangular, that at the tip of the lower median nervule rather prominent and angulated; outer border a little crenulate. The costal edge is rather conspicuously yellowish, pretty uniformly and minutely interrupted with blackish; in the cell, at the base of the median interspaces, and in the middle of the medio-submedian interspace are roundish spots, and at the tip of the cell a transverse bar--all of which repeat exactly in color, form and relative position the similar markings of interrogationis; there is, however, no spot (nor trace of a spot in any specimens I have been able to examine) near the base of the subcosto-median interspace. The outer border, to the depth of half an interspace--above the lowest subcostal to a much greater depth--blackish, its inner limit often deeper than the rest, and its outer limit narrowly edged with a generally faint bluish bloom. In the middle of the lower two subcostal interspaces, midway between the last divarication of the subcostal nervure and the outer border, are two black dots, preceded by a faint yellowish tawny, minute crescent, and followed by a short, slender, longitudinal dash of the same; the yellow crescents preceding the dots are surmounted by a larger, more distinct, paler crescentic spot crossing two interspaces, and forming a series with the others; the dashes beyond the black dots form part of a series of submarginal fulvous lunules which occupy all the interspaces below them, seated on the outer dark margin and only conspicuous when the outer part of the wing is clouded somewhat with ferruginous; this series is sometimes almost entirely wanting, at

others is present to such a degree as to form a transverse band, attenuated in the middle, but broad, and, on the heaviest marked individuals, deepening into blackish above and below; it occupies the same position as in interrogationis; fringe black, most distinctly so at the nervure tips, broadly interrupted in the interspaces with dusky fulvous or with whitish, the latter particularly in the median interspaces. Hind wings with the outer border somewhat crenulate, the tail of the upper median nervule longer than broad, a little incurved and scarcely tapering, the projection at the tip of the costal slight, angularly rounded, that at the upper subcostal rather prominently rounded. A transverse blackish bar crosses the costo-subcostal and first subcostal interspaces, in the latter at a little greater distance from the base than in the former, and removed by a little more than its own width from the base of the interspace; parallel to it a narrow, transverse, blackish bar reaches from near the base of the middle subcostal nervule, across the base of the lower subcostal to the middle of the vein closing the cell; the extreme base of the upper median interspace is filled by a triangular blackish spot, about as large as the central bar, and occasionally the lower median interspace is infuscated a little below it; the outer two-fifths of the wing is of a much darker ferruginous tint, sometimes deepening into blackish, especially outwardly; inwardly it blends gradually into the basal color; crossing the middle of this darker portion, its outer edge at a distance of more than half an interspace's width from it, is a series of yellowish fulvous, roundish or triangular spots with ill-defined edges, becoming more or less transversely linear below the upper median nervule, nowhere so high as broad, and always clearly covered with a hoary bluish bloom, most con-

spicuous at the nervule tips; fringe blackish, broadly interrupted in the interspaces with whitish, partly overlaid by fuscous scales.

"Beneath, dark brown on the basal half of the fore wings, limited by a bent line, the limbs of which are usually a little concave, opening outward, running from the costal margin (close to the tip of the costal nervure) to the base of the straight portion of the upper median nervule, and thence to the inner margin before its middle. Within this area the male has the following markings, some of which in the female are always very obscure, and others at a distance from the costal margin, wholly obsolete: the darker portions are outwardly and more or less distinctly limited as a band by a bent line, the upper half of which reaches to the median nervure and is parallel to the similar portion of the outer bent line, and so far distant from it as to make this part of the band fully three-fourths as broad as its length; the lower half is also subparallel to the lower part of the outer bent line, but the band is only half as wide as above and tapers toward the inner border; above the middle of the cell the band is bordered on either side by a zigzag thread of black, and there are also a few similar marks within it; it is followed interiorly by a hoary patch, while in the cell are three oblique, mostly black edged, dark brown, linear streaks, about as long as half the width of the cell, one seated, on end, on the median nervure close to the base and directed parallel to the subcostal nervure, a second on the same nervure at its first divarication directed toward the upper outer angle of the cell, and a third depending from the costal margin directed between the first two; the whole costal margin is irrorate with blackish ferruginous and whitish or yellowish; the apical half of the wing is paler, being ashy brown (female) or hoary ash (male), excepting the outer border and a quadrate clouded, darker portion, some-

what darker and much more distinct in the male than in the female, occupying the whole apex of the wing above the lower subcostal interspace and beyond the origin of the third superior subcostal nervule, darkest at its interior and inferior borders, and enclosing in its middle next the costal margin an obscure paler spot, reaching to the next, at the lower subcostal nervule. This paler part of the wing is frequently tinged with olivaceous in the male, particularly outwardly and near the inner margin, and in both sexes it is varied by frequent, short, transverse, delicate threads of blackish and reddish brown or fuscous; there is a transverse row of black dots, often obsolete in some of the interspaces and never conspicuous, but almost always present in the lower two subcostal, lower median and medio-submedian interspaces, in a similar position to those of interrogationis; the outer margin above the subcostal angulation is slightly paler than the surrounding parts in the female, but in the male is deeper and generally distinctly and rather broadly olivaceous; below the angulation and excepting the extreme lower angle, which is like the apex, the margin is dark like the base in the female, but in the male is greatly variegated, being olivaceous brown enlivened by many blackish, fuscous, and dark ferruginous scales, mostly arranged in transverse rows, and limited, parallel to and at half an interspace's distance from the outer border, by a slender black stripe, enclosing an interrupted thread of bluish green scales; the first inferior subcostal nervule is broadly bordered with ferruginous to its tip. Fringe much as above. Hind wings of the same general hues as the fore wings, the darker base separated from the paler external portion by a black bordering thread, which in the upper half of the wing has a sinuous course, from the middle of the outer

two-thirds of the costal margin to the lower subcostal nervule at a short distance from its base, where it is interrupted by a silver comma; the lower half has a crenulate, nearly straight, general course from the upper median nervule, an interspace's width from its base, toward the deepest part of the excision of the inner margin of the wing. Within this the wing is nearly uniform dark brown in the female, with rather distant, short, transverse, inconspicuous threads of blackish ferruginous, but in the male it is considerably, although rather obscurely, variegated; on the basal fourth of the wing, above the subcostal nervure, there is a large, ashy patch, and dusky irregular streaks cross the basal half of the cell; the outer portion is darkest and forms an indistinct, broad, intramesial band, while the transverse threads of the female are also not wanting; at the apex of the cell is a rather heavy silvery comma, generally rather broader in the male than in the female, strongly curved, sometimes rather bent at its lower inner side, opening toward the tip of the costal nervure, its extremities usually thickened, particularly in the male, the upper extremity just failing to reach the subcostal nervule, the lower half following the upper median nervule from the gradually growing dark again toward the outer margin, and with a very obscure, almost obsolete, series of blackish dots, arranged as in interrogationis; in the male it is intensified by a lilaceous hue, reaching nearly to the series of black dots which are scarcely more noticeable than in the female; parallel to the outer border is a very obscure series of yellowish spots, the counterparts of those on the upper surface, followed above the middle of the subcostal area by slight ferruginous, below by blackish and bluish, markings; the upper portion of the dentation, from its very base, is bordered equally, without regard to the nervures, by a band, as broad as the dentation, of mingled black,

fuscous and lilaceous scales; the other parts of the border are yellowish olivaceous, more or less infuscated. Fringe as above.

"Abdomen above black, heavily covered with fulvous hairs and tawny scales; beneath with mingled scale-like hairs of the colord prominent on the under surface of the wings. Appendages of the male: upper organ much stouter at the base than in the previous species, tapering only on the basal half, somewhat arcuate, pointed, fully as long as the body with an inferior tooth at base. Clasps twice as broad as long, quadrate with rounded angles, the upper, hinder angle produced to a moderately long, equal, incurved lobe, fully half as long as the clasp, twice as long as broad, rounded at the apex, directed upward and backward; upper border producing at base a long and slender process, much longer than the clasp, broadest in the middle, tapering but little toward the base but rapidly and pretty regularly toward the pointed apex, which is distinctly excised on the inner edge; at its base it is strongly bent and slightly twisted to as to become horizontal and depressed, directed backward and slightly inward; beyond it curves a little downward and at the middle curves strongly inward; interior finger long and slender, tapering a little on the basal half, approaching throughout the hinder edge of the clasp and scarcely surpassing the upper edge.

POLYGONIA COMMA HARRISII.

Measurements in millimetres.	MALES			FEMALES		
Length of tongue 10.5	Smallest	Average	Largest	Smallest	Average	Largest
Length of fore wing .	24.25	25.25	25.5	24.75	27.25	27.25
antennae.	13.5	13.75	14.	13.2	14.5	14.5
hind tibiae and tarsi	8.5	8.5	9.	9.	9.	9.
fore tibiae and tarsi	4.5	4.5	4.75	4.	4.75	4.75

POLYGONIA COMMA DRYAS.

Measurements in millimetres.	MALES			FEMALES		
	Smallest	Average	Largest	Smallest	Average	Largest
Length of fore wing .	24.	25.5	26.75	25.25	28.5	28.5
antennae.	13.	13.25	14.		13.75	13.75
hind tibiae and tarsi	8.1	8.5	8.75	8.	9.	9.
fore tibiae and tarsi	4.	4.4	4.5	4.	4.4	4.4

Described from 8 males, 7 females.

"Egg. Short blunt ovate in shape, broadly rounded beneath, above a little flattened, broadest in the middle of the lower two-thirds, with eleven strongly compressed vertical ribs which increase in height from base to summit, more rapidly above; surface between them scarcely concave, smooth, crossed by exceedingly fine lines, which traverse also the ribs and make them appear striate. The ribs are about .06 mm. high at the top, but only one-third of that in the middle of the egg; they are about .22 mm. apart, and the cross lines .02 mm. apart. Color of egg pale green, glistening, the ribs pale. The termination of the ribs above leaves a free central space .17 mm. in diameter. Micropyle rosette .065 mm. in diameter, made up of a cluster of nearly equal hexagonal cells, about .01 mm. in diameter. Height of egg, .8 mm.; width at greatest, .7 mm.; at summit, .4 mm.

"Caterpillar.

First stage. Head piceous. Body above varying with age from a pale straw color to a dull rather dark green, the anterior portions of the segments livid, but with the last two segments varying from light to

purplish brown; beneath yellowish green. Papillae and hairs black. Legs and prolegs dusky. Length 2.75 mm.

Second stage. Head dark brown (probably piceous). Body brown-black or black, with whitish lines at the incisures. Spines black, arising from papillae which are black, or, in those with white lines, white on the third thoracic and second, fourth, and sixth abdominal segments; hairs black. Legs black; prolegs olivaceous. Length, 3.3 mm. (After Edwards.)

Third stage. Head piceous, most of the papillae black, the others white, the hairs pellucid or dusky. Body reddish brown, heavily traversed by transverse dusky lines, becoming blackish next the base of the spines; the infrastigmatal fold sometimes a little pale. Spines black, excepting the laterodorsal series on the fourth and sixth abdominal segments, and sometimes the tips of some of the dorsal ones in the same vicinity, which are white; hairs dusky pellucid. Legs black; prolegs, excepting at base, dusky. Length, 8 mm.

Fourth stage. Head piceous, the coronal tubercles black, the papillae white or black, the white predominating. Body black, the segments crossed posteriorly by two or three more or less slender white lines, sometimes broadening into spots, and anteriorly by an oblique whitish bar, extending backward on either side from the outer base of the dorsal spines; an infrastigmatal yellow band, above which an oblique bar, and some minute white spots on the posterior part of each segment. Spines of dorsal series always, and of laterodorsal usually, white, the others variably black or white; spiracles black, with a distinct white annulus. Length, 10 mm. (After Edwards)

Fifth stage. Head light pea-green, the summit spine mostly black, very stout and not long, the lateral spinules emitted near the middle, the basal half nearly as broad as long, the spinules stout and of equal length with the apical half of the main stem; tubercles usually spiniform, sometimes hemispherical, pellucid, each tipped with a long white bristle; ocelli and mouth parts black. Body light pea-green, with yellowish blotches which predominate upon most of the abdomen; there is a small spot of a dull, dark, orange color just in front of and above the laterostigmatal spines of the fourth to sixth abdominal segments. Spines furnished with a wreath of five spinules, which are placed at an angle of about 60° with the apical portion of the stem; below them are seldom more than one or two spinules of any magnitude, and this portion of the main stem is covered with short, exceedingly delicate pile; they as well as the spinules are generally colorless, and the bristles black, but sometimes the terminal half of the spinules is also black; the spiniform tubercles are white or greenish. Spiracles black. Legs pale testaceous. Length, 25 mm.

Chrysalis. Nearly uniform pale wood brown, tinged, especially in certain lights, with pale green and streaked very faintly across the middle of the wings with the same; tongue and legs faintly tinged with pale salmon, the tongue infuscated at tip, the legs interrupted with pale green; joints of antennae marked with faint fuscous lines; ocellar tubercles conical, pointed, pretty regular, the outer margin continuous with the sides of the prothorax, the inner inclined toward each other at nearly a right angle, although they do not meet but form an angle of 130° with the front of the head; the tubercles above and the thoracic ridge marked with greenish fuscous; mesonotal tubercle moderately high,

much the highest posteriorly, where it is about half as high as long, posterior border straight and nearly perpendicular, perhaps turned forward a little, anterior border curving regularly and broadly up to the highest point; middle of each half of metathorax and of the first to third abdominal segments with a large mercurial spot, that of the metathorax largest and centred with blackish, that of the second segment situated on the posterior half of the tubercle, that of the third segment faint and diffused; all excepting the last bounded, laterally at least, by fuscous lines; beyond a slightly paler dorsal band, made more conspicuous by a brownish fuscous line which edges it; posterior surface of the laterodorsal tubercles edged on either side with brownish fuscous streaks; a stigmatal, open, brownish fuscous band, tinged with greenish and much more distinctly marked along its under border; on the fifth and sixth segments, a slightly infuscated ventral band, edged more distinctly with fuscous; outer edges of the cremaster black; spiracles pale brown with black lips. Length, 21 mm; height at thorax, 7.25 mm.; height at first abdominal segment, 5 mm."

Life history of Polygonia satyrus

The life history of P. satyrus has never been completely worked out. Larvae appear in June and the butterfly is taken in July. It is likely that there are two broods of this insect but there is no data to support this supposition. P. satyrus is widely distributed throughout the Pacific coast and has been captured in New York and Ontario.

Life History of Polygonia interrogationis

The adult butterflies overwinter and reappear early in May. Oviposition occurs from late May to early June and eggs hatch in from ten to eleven days. The larvae which are sometimes gregarious, grow rapidly,

and after a pupal period of about two weeks, emerge as adults in July. They continue on the wing and deposit eggs throughout July and August. The second brood of butterflies emerge throughout September. There are two broods in northern United States and three or more in the southern climates. It is widely distributed east of the Rocky mountains and may occur along the Pacific Coast.

Life history of Polygonia comma

There are two broods of P. comma in New England, The adults hibernate and reappear on the wing from March to May. The eggs which are deposited during this time hatch from four to five days and the larvae grow rather slowly. Pupation begins about the beginning of July and a new brood of adults appear about the middle of the month. Eggs are deposited late in July and throughout August, and larvae make their first appearance about the first of September. Adults emerge from pupation from the middle to last of September and hibernate soon afterwards. Three broods occur in southern climates. It is widely distributed east of the Rocky mountains and may possibly occur in the Pacific States.

Economic importance of hop butterflies

Polygonia interrogationis and P. comma often are quite destructive to hops in eastern United States. The chrysalids are known to eastern hop growers as "hop merchants" because the price of hops is believed to fluctuate with the fluctuation of the silver and gold spots of the puparium. These insects are usually held in check by biological factors and seldom are numerous enough to require special control measures. Elm, hackberry, nettle, hop, linden, basswood, lime, white-wood, ambrosia, and current are listed among the host plants of P. interrogationis and P. comma but hops and elm appear to be preferred.

Pologonia satyrus in the Pacific States is closely related to P. comma in its food habits and is known to feed on nettles and hops. It is not likely that P. satyrus will ever be of economic importance to hops in the Pacific States but studies on its biology and control should be undertaken.

The Mourning Cloak Butterfly (1)

The mourning cloak butterfly, Aglais antiopa Linn. (Family Nymphalidae, Subfamily Nymphalinae) caused some injury to hop vines in 1938 at the Pankalla Hop Ranch, Corvallis, Rt. 1, Oregon. A description of the various stages of this insect is given as follows:

Synonomy. Papilio antiopa Linn; Aglais antiopa Dalm; Vanessa antiopa Ochs.; Hamadryas angulata antiopa Hubn.; Nymphalis antiopa Latr.; Papilio morio Retz; Euvanessa antiopa Scud. The mourning cloak butterfly; Trauermantel; Camberwell beauty; Morio; Antiopa butterfly; willow butterfly; yellow bordered butterfly; white-border; grand surprise.

"Imago. Head covered above with a profuse admixture of dark brown, fulvous, white and black hairs, the latter longer than the others; at the base of the antennae is a tuft of dull, pale yellow hairs; there are many straw yellow scales behind the lower part of the eyes and a few skirt the upper part also, backed by dark brown scales. Palpi pale dirty straw yellow, with a slender streak of blackish down the middle of the sides of the basal half and a similar streak along the upper edge of the sides of the apical half, the last joint and much of the rest infuscated, the long spinous hairs which fringe the palpus above and below black, with pale yellow, black tipped apices. Antennae blackish brown, the inner side of the stalk and base of the club touched, especially on the basal half of the joints, with white; beneath, excepting near the base and on the club, dark, dull castaneous; three apical joints of club, equally above and below, luteous. Tongue pale luteous, the apical half dark luteous; papillae indian-club shaped, about five times

as long as broad, appressed, truncate and cup-shaped at tip, the central filament slender, bluntly pointed, half as long as the width of the papilla, the edge of the cup with four or five thorns half as long as the filament; not crowded, with room for twice the number in the space occupied, which is about the apical seventh of the tongue.

"Thorax covered above with fulvo-maroon hairs and below with coarser white, or yellow tipped black hairs; fore legs black, covered with similar hairs; femora of other legs dark fuliginous brown, enlivened above and at tip with some pale yellowish brown scales; tibiae and tarsi wholly pale yellowish brown, the tarsi growing a little dusky toward the tip; spurs red, tipped with black; spines black, claws dark red, paronychia blackish.

"Wings above dark, rich maroon, ornamented with black, blue and yellow; on the fore wings the maroon verges toward black or blackish brown along the costal border, above the subcostal nervure and its first inferior branch; the costal edge and the whole margin to the costal nervure on the basal half of the wing largely flecked with short, slender, broken transverse lines of straw yellow; at the tip of the first superior branch of the subcostal nervure a small, transverse, yellowish spot depends from the costal margin just crossing the black area, and directed slightly outwards; further on, midway between this and the apex, is a similar spot, equally narrow and having a similar direction, which reaches the first inferior subcostal nervure, sometimes attenuated below; directly beyond this spot commences a transverse, equal, black band, having strongly crenulate borders, slightly narrower than the marginal band and subparallel to the outer margin; it encloses, in each of the interspaces which open on the outer margin, a not very large, longitudinal, suboval or sub-

triangular, dark, caerulean blue spot, broadest outwardly; outer margin for fully the width of an interspace pale straw yellow (in hibernated specimens whitish), largely flecked, especially on the upper half of the wing, particularly in the neighborhood of the nervules, and most of all at the dentation of the wing formed by the prolongation of the first inferior subcostal nervule, with exceedingly short, transverse, irregular threads of blackish brown, frequently mingled on the dentation with pale bluish scales. Fringe at the nervure tips blackish, marked with dirty brown, on the interspaces whitish flecked with dirty brown. Hind wings with the maroon base less deep than on the fore wings, being more or less specked with dark brown; the black submarginal band encloses blue spots similar to, but usually larger than, those on the fore wings, sometimes nearly regular; outer margin similar to that of the fore wings in color and width, but narrowing toward the anal angle, flecked, especially (as a general thing) in the median area, with transverse, rather short, irregular threads of blackish scales, coarser and more distinctly separated than on the fore wings, less profusely and generally distributed, but still more abundant upon the nervules than elsewhere, and nearly concealing the yellow at the extremity of the upper median nervule, which forms the dentation. Fringe white, occasionally flecked lightly with dusky at the nervure tips.

"Beneath, very dark plumbeo-metallis blue, profusely streaked with short, transverse, straight, black lines, composed irregularly of from one to three rows of scales, and enlivened very slightly with scattered dull, pale ferruginous, whitish and pale straw yellow scales, collected to a certain extent in delicate clusters, and generally found in the immediate vicinity of the nervules; scattered over all the wings, but

more abundantly on the hind pair, and nearly absent from the lower half of fore wings, are infrequent, long, longitudeinally recumbent, blue black, spinous hairs, tipped with yellowish brown. On the fore wings the two costal spots of the upper surface appear, but less distinctly, and of a grayish white; the marginal band is of the same width as above, but is here preceded not by a black band and blue spots, but by a strongly crenate, slender, equal, inconspicous stripe (corresponding in direction to the exterior margin of the black band of the upper surface) of disconnected, dark metallic blue scales on a black base; marginal band sordid white, heavily flecked, especially down its middle and particularly at the dentation of upper half, with short, more or less connected and blended, transverse streaks of black, dark plumbeous and dull dark bluish scales, most conspicuous in the upper half of the wing; at either side, but especially outwardly, the band is washed with very pale yellowish and externally with pale yellowish brown. Fringe white, broadly interrupted at the nervure tips, especially in the upper half of the wing, with pale slate brown. Hind wings closely resembling the fore wings in the submarginal, strongly crenate stripe of bluish scales, and in the outer border, the dentation of the upper median nervure being similar to the upper dentation of the fore wings. The base of the wings is similar, but the transverse black lines collect to form slender, rather indistinct, often obsolete stripes, one crossing the middle of the wing in an irregular course, the other, less distinct and generally present only in the middle of the wing, lying midway between the first and the marginal band; on the lower half of the wing the spinous hairs are not recumbent. Fringe whitish.

"Abdomen above black, the base with many maroon hairs, beneath dirty yellowish white or yellowish brown, with intermingled black hairs tipped

with brownish yellow, the last segment usually blackish. Male appendages: upper organ; hook narrowing rapidly before the middle, but a little rounded, beyond a little compressed, tapering, very bluntly pointed, but little curved. Clasps about two and half times broader than long, the posterior edge roundly and broadly excised on the upper half, the upper outer angle produced a very little, slightly angulated, slightly incurved and delicately covered with prickles at the edge; upper basal process compressed a little, sulciform, the inner edge a little thickened, roundly bent at a right angle at the middle of its basal two-thirds, the outer border similarly bent at the base, up to this point equal, beyond tapering rapidly to a little produced, arcuate and finely pointed apex; it is nearly four times as long as the breadth of the base, directed at first backward and considerably upward and bent a little inward, beyond directed backward and curving inward; interior finger finely pointed, nearly straight, and reaching the edge of the outer border of the clasp at the lower portion of its excision.

Measurements in millimeters. Length of tongue (13.5-14.5)	MALES			FEMALES		
	Smallest	Average	Largest	Smallest	Average	Largest
Length of fore wings--	31.	37.	39.	32.	44.	44.
Antennae----------	14.	17.	17.5	14.2	19.5	19.5
Hind tibiae & tarsi-	9.	11.25	11.5	10.	12.	12.
Fore tibiae & tarsi-	4.4	5.	5.5	4.2	5.5	5.5

"Egg. Laminate ribs, seven to eight in number, .045 mm. in height at the edge of the summit, leaving on the summit a free space, .31 mm. in diameter; surface glistening, smooth, broken by delicate transverse lines, .02 mm. apart, which become more prominent on either side of the ribs, forming buttresses for their support. Micropyle .09 mm. in diameter, consisting of a central circle .025 mm. in diameter, followed by two series of rounded polygonal cells, about half the outer row as large as the inner, the other half considerably larger, the inner ones averaging .012 mm. in diameter, separated by rather prominent ridges. The micropyle is followed directly by very large, transverse, polygonal or hexagonal cells, often stretching across from one rib to another, as the succeeding row always does, or rather to the slender, zigzag ridges which are the continuation of the ribs. Color when laid, pale olivaceous yellow, changing afterwards to dark yellowish brown, and just before hatching to inky black; ribs pellucid. Height, .88 mm.; breadth, .74 mm.

"Caterpillar.

"First stage. Head shining piceous with a few pretty long hairs; ocelli black; basal joint of antennae pale; mouth parts blackish, excepting the upper edge of labrum which is pale. Body dull brownish olivaceous, the first thoracic segment infuscated; warts of the color of the body tipped with black; hairs exceedingly long, sometimes a little curved, brownish; legs dull luteous, the apical third blackish; prolegs of the color of the body, each with a moderately long hair projecting from the anterior portion of the base. Length of body, 2 mm.; breadth of body, .4 mm.; length of hairs on body, .4 mm.; breadth of head, .6 mm.

"After eating a single night the bodies become plump and distended as if they had eaten to repletion; they also change to a brownish, olivaceous color, and have a wiry look.

"Second stage. Head shining piceous, with a few not very long, curving, black hairs. Body yellowish brown, the first thoracic segment blackish; a dusky, straight, dorsal line and dusky, wavy, longitudinal stripes on the sides. The armature in this stage is intermediate between the juvenile and adult stages, consisting of small tubercles bearing each a curving black hair, arranged like the spines of the later stages. Legs blackish fuscous; prolegs yellowish brown, tipped with fuscous. Length, 6 mm.; breadth, .75 mm.

"Third stage. Head shining piceous. Body black, mottled with dark gray, the dorsal stripe consisting of two contiguous, oblong, oval patches of dull ferruginous, separated either in whole or in part by a narrow line of black; the body is armed now with shining piceous spines nearly a millimetre in length, each bearing at tip a long, pale hair, and at the sides a few short, black hairs projecting directly from the spine and not mounted as afterwards upon spinules; hairs of first segment pale. Legs shining piceous. Length, 15.5 mm.; breadth, 2 mm.

"Fourth stage. The fourth stage differs but little from the fifth and scarcely warrants a separate description. In it the dorsal spots are divided by the dorsal line which becomes obliterated in the last stage and the spinules of the spines have not attained their normal size, although conspicuous.

"Last stage. Head dull, bronze black, the warts black, giving rise to white hairs, arranged to some degree in vertical rows converging toward the summit of either hemisphere; mouth parts black. Body velvety black, covered with white warts, often narrowly encircled with fainter

white and giving rise to white hairs; the third thoracic and first to seventh abdominal segments with a large, dorsal, orange red spot reaching as far as the inner base of the laterodorsal spines; spines bright, bronze-black, minutely wrinkled transversely, the hairs black. Legs bright bronze black; prolegs reddish testaceous, the hooklets reddish brown. Length, 50 mm.; breadth of body, 7 mm.; length of spines, 5.75 mm.; breadth of head, 4 mm.

"The exact stage of growth of this caterpillar is easy to determine, for no matter what the size may be, however fostered by abundance or emaciated by insufficiency of food, there are certain structural features characteristic of each stage. In the first stage the body is armed with hairs arising from little warts, none of which are placed in a median dorsal series; in the second stage the body is furnished with similar hairs having an entirely distinct distribution, some of them forming a dorsal series. In the third stage the body is armed with spines, emitting little, bristly hairs directly from its sides without the intervention of spinules; in the fourth the spines are the same, but the lateral bristles are mounted on very short spinules scarcely longer than the width of the spine; while in the fifth stage the same spines bear long spinules, often nearly one-third of their own length, with apical thorns.

"Chrysalis. Dark yellowish brown, more or less marked with blackish fuscous, often covered, especially on the thorax and appendages with a very pale, bluish gray bloom and often tinged with roseate; dorsal and lateral surfaces of ocellar prominences and the sides of the dorsal tubercles of mesonotum, streaked with black; basal joint of antennae and laterodorsal tubercles of mesonotum infuscated; abdomen dotted infrequently with blackish

fuscous, the dots arranged somewhat in transverse rows; very obscure, infuscated, stigmatal and ventral bands; sides and front of the basal half of the laterodorsal abdominal tubercles black, their apical half red tipped with black; smaller tubercles black; spiracles black with obscure lips; sides of the cremaster black; wall of the preanal button luteous, bordered inwardly with blackish. Length, 25-28.5 mm.; breadth of ocellar prominences, 4-4.5 mm.; height of thorax, 9-9.75 mm.; breadth of body, 9.5-9.75 mm.; height of abdomen, 8.5-9.5 mm.

"The above describes the usual form, but there frequently occurs an individual of a gray appearance, so different in general aspect as to merit a special description. Whole body speckled gray, formed by blackish fuscous spots and streaks on a livid white ground, the paler color sometimes tinged with faint purplish; the upper and most of the under surface of the ocellar prominences are black; the sides of the dorsal tubercle of mesonotum are also black, but the posterior flank and the superior edge are pale and from the anterior end a narrow, obscure, pale band runs toward either ocellar prominence, and from the posterior end a faint, interrupted, pale, dorsal streak extends over the abdomen; the apical half of the tongue is black and and the nervure tips are marked by a pale dot; on the abdomen there is a broad, dusky, ventral band and a narrow, dusky, stigmatal stripe; the laterodorsal tubercles are black at base, red at apex, tipped with black; the other warts and tubercles are wholly black; the upper edges of the cremaster are pale, the lower black."

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(1) Scudder, S. H., Butterflies of Eastern United States and Canada, Vol.1, pp. 397-412, 1889, Cambridge, Massachusetts.

Figure 21. Larvae of Aglais antiopa Linn.

Figure 22. Pupae of Aglois antiopa Linn.

Figure 23. Adult mourning cloak butterfly, A. antiopa Linn.

Figure 24. Injury of Aglais antiopa Linn. larvae to hop vines.

Life history of Aglais antiopa

The adult butterfly vershibernates* late in the fall in crevices, debris and other protected places. There is some evidence that some overwintering may occur in the pupal stage but this has not been satisfactorily confirmed. Activity is resumed early in the spring, and the adults may be seen from February to July. Oviposition generally occurs over a brief period from the beginning until the middle of May. Eggs are laid in both regular and irregular clusters and one individual has been recorded as having deposited over two hundred eggs. The average number of eggs per female is believed to be considerably less than this.

Approximately two weeks are required for the eggs of the first brood to hatch. The young larvae are highly gregarious and spin a slight silken thread as they feed. This gregarious habit is lost to a certain extent as they develop into their fifth and last instar. The larvae are fully developed about the last of June and pupation occurs after the caterpillar has suspended itself to some nearby object. There are two broods of this butterfly in northern United States and probably three broods in the southern part of the country. The adult of the second brood emerges from the beginning to the middle of July and eggs are deposited soon afterward. They hatch in about nine days and the larvae become fully developed and pupate during the month of August. The pupal period lasts about two weeks and the overwintering adults emerge from September to October and remain on the wing as late as November when weather conditions are favorable.

*Vershibernation (Latin--Verso; to turn about often: hiberna; time for going into winter quarters) defined as the alternating occurrence of mobile and quiescent periods during the winter months. Examples: Diabrotica soror, Aglais antiopa and many others.

Economic importance of Aglais antiopa to hops

Mr. Pankalla of the Pankalla Hop Ranch, Rt. 1, Corvallis, Oregon, brought a number of A. antiopa larvae to the attention of the entomology department during the latter part of July 1938. The caterpillars at this time were in their last instar and had completely defoliated ten hop vines. This was the first record of A. antiopa feeding on hops and apparently it was a chance occurrence in this instance. The favorite host plant of the mourning cloak larvae is willow, poplar, and elm, and in certain years they have been numerous enought to cause serious economic damage to shade trees throughout the New England States. Occasionally they have been noted feeding on birch, hackberry, linden, nettles, and roses so that some latitude of choice of food plant must be allowed them. It is not likely that A. antiopa will ever be an important hop pest.

The caterpillars in this instance were controlled by Mr. Pankalla by hand picking. Several of the larvae which were brought to the entomology department were parasitized by chalcid fly larvae which escaped before identification could be made.

Diabrotica soror Lec.

Description of Diabrotica soror Lec.

Genus Diabrotica * "Head not inserted as far as the eyes, front transversely impressed, vertex foveate, a carina between the antennae. Eyes broadly oval, entire; labrum rather large, truncate, or feebly emarginate. Antennae slender, at least longer than half the body, sometimes longer than the body, second and third joints often very small; maxillary palpi moderately stout, the terminal joint conical, shorter and narrower than the preceeding. Thorax broader than long, sometimes nearly square, the margin distinct, slightly reflexed, disc usually bifoveate; scutellum actually oval at tip. Elytra with a very distinct and slightly reflexed side margin, the epipleurae long, narrower behind. Legs moderately long and slender; tibiae slender, the middle and posterior pairs with terminal spurs, the outer edge carinate from knee to tip, except in a few species; first joint of hind tarsus at least as long as the next two, sometimes nearly as long as the next three; claws bifid."

"In the majority of the species the second and third (antennal) joints are small, together scarcely as long as the fourth, sometimes only half as long; several species have the third joint nearly or quite as long as the fourth, while the second remains small. When the third joint is equal, or nearly so, to the fourth, it will be found to be densely punctured and pubescent like the fourth, but when that joint is small it will be found smooth and like the second in structure."

"The male sexual characters are feeble. All have the last ventral truncate, and in some broadly emarginate. A few have the first joint of the anterior tarsi dialated."

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* Horn, Geo. H., Trans. Am. Ent. Soc., XX, p.89, 1893.

Species soror Lec. (Western 12-spotted cucumber beetle). **

Elytra irregularly, not closely punctate, the surface without striae, tibiae with a distinct carina extending the entire length of the outer edge; antennae with segments two and three small, together rarely longer than the fourth, usually shorter; elytra yellow or greenish yellow, together with three arcuately transverse series of four black spots; venter and legs black; length 5-7 mm.

Variation. Three color forms of this species are common: (A) with elytra spots non-confluent, (B) with middle spots confluent, (C) with middle and anterior spots confluent.

Description of immature stages of Diabrotica soror. ***

"Egg. Length, .7 mm.; width, 5 mm.; oval, dirty white in color; surface finely sculptured by minute hexagonal pitted areas. These areas under a higher power lens show several irregular depressions within their own surface.

"Full-grown larva. Length, 12 mm.; width, 1.3 mm.; body cylindrical, slightly tapering toward the head; the twelve segments behind the head indistinctly separated. General color, except the head, dorsal shield and last abdominal segment, dirty white, often becoming more yellowish before pupation. Head dark brown above and on the sides, same color as rest of body below; posterior margin with a deep, quite broad, V-shaped incision, ending in a broad deep suture which runs cephalad for nearly one-third the length of the head, then divides into two well-marked sutures which extend to the base of the antennae. These sutures divide the head into three distinct parts, the anterior part being the largest,

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** Beller, S. and Hatch, M. H., Coleoptera of Washington: Chrysomellidae. Univ. of Wash., Publ. in Biol., Vol. 1, No. 2, pp. 106-107, 1932.

*** Doane, R. W., The immature stages of Diabrotica soror, Jour. N. Y. Ent. Soc., Vol. V., pp. 15-17, 1897.

the other two parts are equal and constitute the posterior and part of the lateral portions of the head. There is a dark median line ending at the tip of a small V-shaped incision in the anterior margin of the head, and a few rather strong hairs scattered over the surface of the head. Antennae white, three-jointed; first joint a little broader than its length, second joint the shortest, narrower than the first, third joint cone-shaped, its greatest width about equal to its length. No eyes. Labrum same color as rest of the head. Mandibles dark brown, darker at tips, other mouth parts and appendages whitish. Cervical shield brown, paler than the head, broadly shield-shaped with quite a broad median white line, a few rather long hairs and several shorter ones scattered over the surface. The remainder of the pro-thorax, the meso- and meta-thorax same color as the rest of the body. Legs pale, three-jointed, supported by dark brown chitinous framework; several short rather stout hairs on each segment; a whitish, elliptical, striated lobe arising beside the single brown tarsal claw. Segments four to eleven, all similar, skin wrinkled, somewhat papillose, a few scattering hairs over each segment; on the lateral margin of each segment is a long stiff hair just posterior to one and sometimes two smaller and shorter hairs. Dorsal shield of posterior segment semicircular in outline, dark brown, finely sculptured so as to produce numerous hexagonal pitted areas much resembling the markings on the eggs; several strong marginal hairs and two sub-triangular processes near the posterior end. A single fleshy proleg.

"The larva agrees almost perfectly with Prof. H. Garman's description of the larva of D. 12-punctata as given in Psyche, Vol. VI, p. 48. The only special difference I would note is in the description of the dorsal shield of the posterior segment which he describes as follows: "Dorsal shield of posterior body segment nearly circular in outline, brown, with

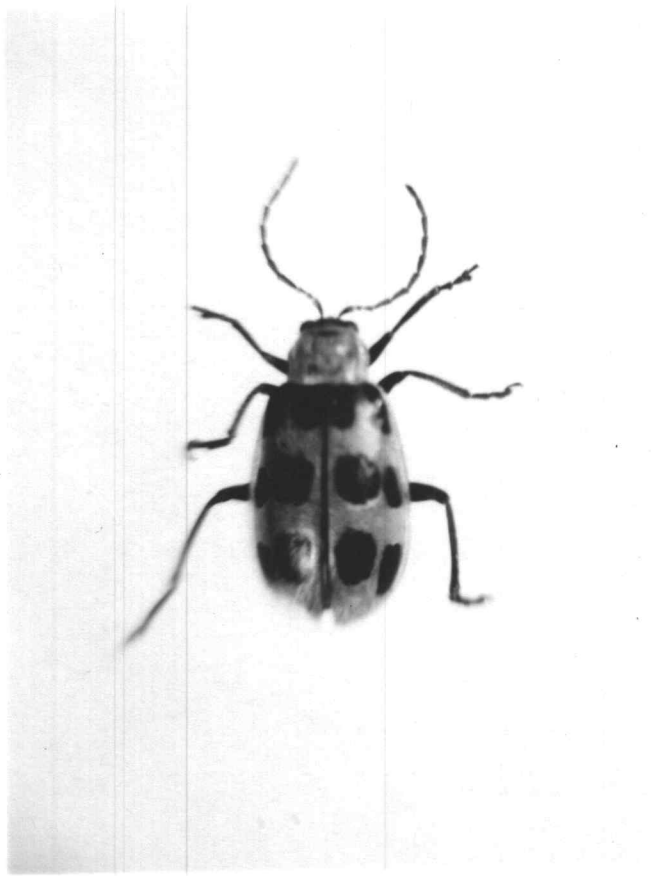

Figure 25. Adult Diabrotica soror.

numerous minute black specks, slightly rimmed at posterior margin, and in young examples obscurely bituberculate; burnished with several strong marginal hairs, and with four minute, striate, centrally-placed spatulate appendages.

"Pupa. Whitish or straw-colored. Length .4 mm., width .2 mm. Scattered brown hairs over the body arranged as follows: six on the head arranged in three transverse pairs, one pair close to the base and just cephalad of the antennae, one just caudad of the antennae, and one near the meso-dorsal angle of the eyes; ten on the prothorax, one pair on the anterior margin, one pair near the lateral margin, and one pair near the posterior margin, a pair just anterior and a larger pair just posterior to the middle near the mesal line; an arched row of four hairs each on the meso- and meta-thorax; a pair in the middle and one on each side of each abdominal segment; last three segments with another pair slightly anterior to and more widely separated than the median pair; last segment also with a pair between and a pair in the bases of the caudal spines, and another pair just anterior to the lateral pair. Caudal spines usually slightly curved, brownish at tips. Each femur with three hairs near the extremity. Wing pads clear white, covering the proximal part of the posterior femor. Antennae curving outward around the femora of the meso- and meta-thoracic legs, then meeting on the median ventral line between them.

"As the pupa grows older the eyes, wing parts, parts of the legs and antennae and the tips of the mandibles begin to turn much darker.

Life history of Diabrotica soror.

There is no complete published account of the life history of this insect. The fertilized female vershibernates and occasionally can be

found feeding on warm days in the winter. Few males survive the winter months. The females become active late March to early April and deposit eggs beneath the surface of the soil near the roots of food plants. The duration of the egg and larval stages has not been studied. The young larvae feed on the roots of many different host plants and when mature form a pupal cell near the surface of the ground. They remain in this cell approximately two weeks before pupating. The pupal period lasts approximately two weeks. Adult beetles emerge, appear the latter part of June to the beginning of July. The beetles of this generation migrate to gardens, orchards, hop yards, and other favored localities where they feed until cold weather inhibits their activity in the fall.

Economic importance of Diabrotica soror.

This insect is distributed generally in the states west of the Rocky Mountains and has been increasing in its economic importance since 1910. The larvae feed on the roots of corn, potatoes, legumes and other crops and at times cause considerable damage. The adult beetles are omniverous and attack nearly all truck and vegetable crops, flowers, orchards and field crops. Hops is not generally considered one of their preferred hosts but occasionally considerable damage has been attributed to them.

Control of Diabrotica soror.

There are probably many natural enemies of Diabrotica soror but few have been reported. Chittenden mentions the tachina fly Celatoria diabroticae Shim. (C. crawii Coq.) and the spider Xysticus gulosus Keys.

Many attempts have been made to control this insect by the use of poison sprays and dusts. Hydrated lime or gypsum have the tendency to repell the adult beetles from the dusted plants. Pyrethrum sprays and

dusts are reported to kill the adults when the material contacts them. Mote and Thompson have had good results with the airplane dusting of calcium arsenate and pyrethrum. Mechanical dusting with these materials from the ground were not as effective. G. R. Ferguson in a supplementary report to the Oregon Experiment Station, 1938, conducted laboratory tests with Pyrethrum, Cubé root, calcium arsenate, lead arsenate, sodium silicofluoride, sodium aluminofluoride, barium silicofluoride and tartar emetic, nicotine sulphate, phenothiazine and dinitro-o-cyclohexyl phenol in spray and/or dust form. Adult beetles were introduced to treated bean leaves in these trials. Relative effectiveness of these materials was based on the concentration required to kill fifty percent of the beetles. The most effective materials were pyrethrum, calcium arsenate, sodium and barium silicofluoride.

Pyrethrum is very active chemically and its toxic effect is very short. Satisfactory control with this material necessitates the contacting of the insect with the material. This is not possible when applications are made mechanically from the ground because the beetles are prone to fly at the slightest disturbance. The beetle is strangely resistant to stomach poisons and very high dosages are necessary to kill them. The application of an arsenical or fluosilicate poison to hops is not feasible because of the residue problem. Further toxicological tests with new or untried poisons should be continued in the laboratory.

Psylliodes punctulata Mels.

Description of Psylliodes punctulata.

Genus Psylliodes Latr.* "Head oval, deeply inserted, the front inclined, or nearly vertical, without carina, but forming a broad flat plate, tubercles not distinct, usually with an arcuate impressed line, which marks the lower edge of the tubercles (entirely absent in sublaevis), clypeus truncate, labrum moderately prominent, entire. Antennae 10-jointed, separated at base, inserted at the inner border of the eye, filiform, slightly thicker externally, first joint slender clavate, joints 2-3-4 nearly equal, 5-9 gradually slightly shorter, tenth longer, acute at tip. Maxillary palpi slender, second joint slender clavate, third obconical, acute at tip. Thorax transverse, narrowed in front, base broadly arcuate, with distinct marginal line, obliterated at middle. Elytra oblong oval, usually widest slightly in front of middle. Prosternum moderately separating the coxae and not depressed between them, dilated at apex and with the epimera closing the cavities. Mesosternum moderately long, slightly oblique. Legs moderate in length, posterior femora much thickened, deeply sulcate beneath for the tibiae. Anterior and middle tibiae slender, the outer edge rounded, posterior tibiae broader toward apex, the posterior edge sinuate near apex and with a border of short ciliae, the tip prolonged beyond the insertion of the tarsi and terminated by a short spur. Posterior tarsi long and slender, the first joint more than half the length of the tibiae, the third joint narrowly bilobed, the fourth slender and with moderately long simple claws.

"This genus is probably one of the most easily recognized of the tribe by the structure of the antennae and posterior tibiae. The apex of the

* Horn, G. H., Trans. Am. Ent. Soc. XIV, 1889, 309-311.

posterior tibia is not simply prolonged beyond the insertion of the tarsi, but is excavated slightly externally. These tarsi resemble those of Longitarsus, although the first joint is really longer in proportion to the tibia.

"In the "Benera" Chapuis states that the anterior coxal cavities are open, but the error has already been noticed, and, in 1873, Crotch had placed the genus in the series with closed cavities.

"The European species do not seem to exhibit any well defined sexual characters, but these are quite well marked in all our species, although less distinct in sublaevis.

Species punctulata Mels.* "Form elongate oval, little narrower in front, moderately convex piceous, surface dark bronzed shining. Antennae a little longer than half the body, three basal joints pale, the outer joints brownish. Head sparsely indistinctly punctate, the surface usually slightly alutaceous. Thorax a little more than half wider at base than long, distinctly narrowed in front, sides feebly arcuate, distinctly obliquely truncate at front angles with feeble post-apical angulation, disc moderately convex, the punctures rather coarse, but not dense, the intervals usually distinctly alutaceous. Elytra not wider at base than the thorax, humeri obliquely rounded, sides moderately arcuate, widest in front of middle, disc moderately convex, punctato-striate, striae feebly impressed, punctures coarse, rather close, but not serrate, intervals slightly convex, scarcely wider than the striae, each with a single series of fine punctures. Body beneath piceous, shining. Abdomen distinctly punctate and alutaceous, the punctures coarser, more deeply impressed and sparser along the middle, denser at the sides, sparsely pubescent. Anterior and middle femora piceous, the posterior distinctly bronzed, the

* Horn, G. H., Trans. Am. Ent. Soc. XIV, 1889, 309-311.

tibiae rufotestaceous, darker at middle. Length .08--.10 inch.; 2--2.5 mm.

"The male has the first joint of the anterior tarsi broadly dilated. The last ventral segment is sinuate each side, the middle of disc near apex with a semi-oval depression.

"This species is the commonest form taken everywhere in the eastern region. It is the most elongate of the species. The thorax is usually comparatively coarsely and closely punctate with the intervals distinctly alutaceous. Specimens rarely occur with the thorax rather finely and sparsely punctate. The punctures of the elytral striae are always closely placed, almost crenate, and by this means (in the absence of the male) the species may be separated from convexior.

"Widely distributed: Massachusetts and Canada, westward to Washington, Vancouver and California, Nevada, Utah, Kansas, Colorado and Texas."

Description of the various stages of Psylliodes punctulata.

Egg. The eggs of the hop flea beetles are approximately .33 mm. long and .15 mm. wide. They are ellipto-cylindrical in shape and quite yellow in color.

Larvae. The larvae are delicate, slender, white, grublike individuals when first emerging from the egg. They are about one half millimeter in length. After a few hours the head darkens and the body turns grey with a dark patch on the last segment of the abdomen. The number of instars and the development of the larvae has not been completely worked out.

Pupae. The pupae are pearly white when newly formed and are much like the adult beetle in form. The sheaths for the adult appendages are free from the body, and the legs, wing pads and antennae although folded up, are easily distinguished.

Adults. The adult beetles are pale for several hours after emerging from the puparium. They later become dark smooth bronzy black individuals

and vary from 2 to 2.5 mm. in length and 1 to 1.5 mm. in width. The hind legs are especially adapted for jumping. The specific name punctulata refers to the pitted condition of the head, thorax and elytra. The adult male beetles are similar in appearance to the females but are generally smaller in size. Males are distinguishable by the semi-oval depression near the apex of the last ventral segment.

Life history of Psylliodes punctulata.

The adult beetles vershibernate in the fall of the year and resume activity whenever temperatures reach 45 to 50 degrees F. They feed on nettles and other hosts at this time. Continuous activity is generally resumed early in March and the adults reach a peak of abundance about the middle of May. Generally the beetles have disappeared by the beginning of June. Feeding on the foliage of hops is general during this active adult period.

Eggs are deposited from one to two inches beneath the soil surface during this early spring period. They are deposited either singly or in clusters and one female will lay from four to sixteen eggs. Warm moist soil is favorable for incubation and eggs hatch in about two weeks at this time of the year.

The larvae feed on the roots of hops and other plants and require about five weeks to reach maturity. The number of larval instars has not been determined. They pass through a prepupal period of about two weeks before pupating. The true pupal stage requires about two and one half weeks.

The summer brood of adults appears the latter part of July and feed on hop foliage until cool weather in the fall inhibits their activity. The beetles are fully mature four to five days after emergence. There is one generation per year.

Economic importance of Psylliodes punctulata.

The hop flea beetle is distributed throughout the United States and Canada and has been taken from Ontario to Florida and British Columbia to Southern California. It attacks nettles hops, radishes, mangles, mustard, rhubarb, tomato, lambs-quarters, watermellon, cabbage, chickweed, clover, cucumber, dock, potato, sorrel and turnips. Hops is however its preferred host plant.

It was present in the Chilliwack Valley, British Columbia as early as 1894 but did not become of economic importance until 1903. They became very destructive to hop yards between 1903-1908 in the Chilliwack and Agassiz Valleys, British Columbia. The infestations at this time resulted in a loss of 75% of the hop crops in these localities. Parker (U.S.D.A. Bull. 82, pt.4, 1910) and (U.S.D.A. Bull. 66, 1909) investigated the insect at this time and pictured entire hop yards which were destroyed by the ravages of this pest. Great fear was held by the hop growers of Washington, Oregon and California but after 1910 they decreased in numbers and are not considered to be of serious economic importance at this time. Very few beetles were noted in Oregon hop yards during the biennium 1937-1938. They continue to threaten the hop industry however, and probably will break out in great numbers at some future date.

Control of Psylliodes punctulata.

Biological control. Natural enemies are probably responsible for the decline of hop flea beetle populations. This control measure has not been studied but Parker mentions the possibility of bacterial diseases. He stated also that two species of centipedes and carabid larvae were abundant in hop yards and that they were probably predaceous on hop flea beetle larvae.

Cultural control. Parker found that approximately 85 percent of the beetles on a hop vine could be captured and destroyed by brushing them from the vine with a feather duster onto a tarred piece of canvas. This method was slow but fairly effective. Another effective preventive measure was the application of tanglefoot to each hop vine approximately two feet above the ground level. This prevented the beetles from reaching and feeding on foliage. Large numbers of beetles were destroyed by jarring the trellis poles and collecting the beetles on a tarred piece of canvas. The destruction of vine stubs and string pegs also aided in the mechanical control of this pest. Rolling of the hop yard with a heavy roller was found to be impractical in the control of hibernating beetles. Cultivation and fertilization was believed to aid in the control of flea beetles. Light traps, trap corps and trap shelters were found to have little value.

Chemical control. Parker tried a number of insecticides against the hop flea beetle and found that lime, bordeaux mixture, bordeaux-tobacco were repellants and had some insecticidal value. 5-5-50 bordeaux burned the terminal bud and caused many lateral shoots to develop. Resin lye and whale oil soap were ineffective. Kerosene emulsion and nicotine sprays were effective but it was necessary to contact the beetles. Laboratory results showed that lead arsenate at the rate of 10 pounds per 100 gallons of water was quite toxic.

No toxicological investigations on this insect have been attempted since the time Parker made these studies. Since that time Rhotenone and Pyrethrum have been found effective against other types of flea beetles. Many new insecticides have been developed since 1909 and these may have insecticidal value on this insect. Laboratory insecticidal investigations

should be conducted with these materials in case the Experiment Station is challenged by a severe outbreak of this insect.

Formica fusca

Formica fusca was described by Linnaeus in 1758 (Sys. Nat. Ed. 10, 1758, o p. 580.). The following description has been taken from the writings of Linnaeus in Faunae suecicae descriptionibus aucta, Vol. 3, pp. 332-334, 1789 (O.A.C. Lib. 463, L.5):

GENUS X

Formica squamula erecta, Thoraci abdominique interjecta.

Aculeus foeminis & neutris reconditus

Alae maribus & foeminis; sed neutris nullae

fusca. 3 F. (la brune) cinereo-fusca, tibiis pallidis.

Faun. Suec.l.n.1021 Formica fusca.

Raj. ins. 69. Formica media, nigro colore splendens.

Fab. 9 nigra, ore. thoracis apice pedibusque ferrugineis

Enum. n. 833.

De Geer. tom. 2. p. 1082 t. 42,nigra nitida, squama petiolari.

Geoff. ins. t. 2. p. 428 n.5

Mull. Lin. nat. cl. v. p. 912

Hab. in Europae terra sabulusa. Ascendit arbores. In ejus acervis hab. scarabaei aurati Larva. V.

Desc. Corpus cinero-fuscum, pilis cine-ras centibus minutissimis vestitum, unde certo modo ad lucem visum, videtur nigrum, alias cinereum. Caput fere thorace angustius. Thorax teretius culus. Squama integerrima, quadrato-emarginata. Antennae infimo articulo longissimo rufo Femora fusca Tibiae pallidae. P. Forskaehl Faun. 1722.

Obs. Harum formicarum acervi ubique in sylvis obvii.

In his acervis formicae oper ariae apterae, foeminae & mares. Nymphae ut ova falso a rusticis considerantur. V.

A literal translation of the Linnaeus description is given by Mr. J. Schuh and the writer as follows:

GENUS X

Formica. (An ant) Scale erect, between thorax and abdomen.

Sting concealed in females and neuters.

Wings on males and females but none on neuters.

Species fusca. ♂ French (dusky) Dark ashy colored, tibia pallid.

Faun. Suec. 1. n 1021 Formica fusca.

Raj. ins. 69. Formica media, black shiny color.

Fab. 9 Black on the edge of thorax and rusty on tips of legs.

Enum. n. 833.

DeGeer. tom. 2 p. 1082 t. 42. Scale of petiole black shiny.

Geoff. inst. t. 2. p. 428 n. 5

Mull. Lin. nat. cl. v. p. 912.

Habitat. On sandy soil of Europe. Climbs trees. In their mounds live the larvae of Scarabaei aurati v.

Description. Body dark ashy grey, covered with very small matted ashy hairs, whence seen in a certain manner will appear black, at another time ashy colored. Head nearly as narrow as thorax. Thorax almost rounded. Scales entire, quadriemarginated. Last joint of antennae very long, reddish Femora dark colored Tibiae pallid. P. Forskaehl Faun. 1722.

Observation. The mounds of these ants are always found

in the forest. In these ant mounds are wingless workers, females and males. Nymphs and eggs when wrongly away from the mounds will be carefully cared for.

Description of castes of Formica fusca fusca *

"Worker. Length 4-6.5 mm.

Body rather slender. Head longer than broad, narrower in front than behind, with straight posterior and lateral borders. Eyes large. Mandibles 8-toothed. Clypeus sharply carinate its entire length, with entire, rounded, projecting anterior border. Frontal carinae moderately diverging behind. Antennae rather slender, the scapes slightly thickened towards their tips, the basal joints of the funiculus scarcely longer and but little more slender than the penultimate joints. Maxillary palpi moderately long. Thorax narrow; pro- and mesonotum but slightly convex, rather depressed above; meso-epinotal constriction shallow; epinotum with subequal base and declivity, both straight in profile, the former horizontal, the latter sloping, meeting at a distinct but obtuse angle. Petiole narrow, cuneate in profile, with convex anterior and flattened posterior surface, its border rather sharp, entire and broadly rounded when seen from behind. Gaster small, legs rather slender.

"Subopaque and very finely and sharply shagreened; mandibles coarsely striatopunctate; clypeus finely longitudinally striate. Frontal area subopaque, only the sutures surrounding it shining.

"Hairs and pubescence whitish, the former short, erect, very sparse, confined to the upper surface of the head, thorax and gaster, coxae and venter. Eyes hairless. Pubescence dense on the head, thorax, and gaster, longest on the gaster, giving the surface a slightly pruinose, but not a silky appearance.

"Black; mandibles, scapes, basal joints of funiculi, and legs deep red, femora and tibiae, except the knees, often darker.

"Female. Length 7-10 mm.

Smaller than the females of rufa, but the gaster proportionally larger and more elliptical. Thorax broader than the head, which, excluding the mandibles, is as broad as long. Petiole compressed anteroposteriorly and broader than in the worker. Wings long.

"Sculpture, pilosity, and color much as in the worker, except that the gaster is very smooth and shining, with much more dilute pubescence. Wings nearly colorless or very slightly yellowish; stigma brown.

"Male. Length 8-10 mm.

Body slender, mandibles narrow, pointed, often, if not always, denticulate. Head broad behind and considerably narrowed in front, with large eyes, straight posterior border and cheeks and rounded posterior corners. Clypeus convex, bluntly carinate. Thorax broader than the head. Petiole transverse, somewhat compressed anteroposteriorly towards the superior border, which is blunt and, seen from behind, with a broad and very shallow median excision. Gaster rather long and narrow. Stipes but little longer than the volsellae and sagittae.

"Head and thorax, including the mandibles and frontal area, subopaque. Gaster distinctly shining.

"Hairs and pubescence much as in the worker, the former absent on the upper surface of the gaster. Eyes hairless.

"Black; gaster often more brownish; scapes and tips of mandibles dark brown; legs and genitalia yellow. Bases of the coxae and sometimes also the last tarsal joint of each foot, black. Wings grayish hyaline, scarcely darker than in the female.

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* Wheeler, W. M., Bull. Muse. Comp. Zool., Vol. LIII, No. 10, Cambridge, Mass., Oct. 1913.

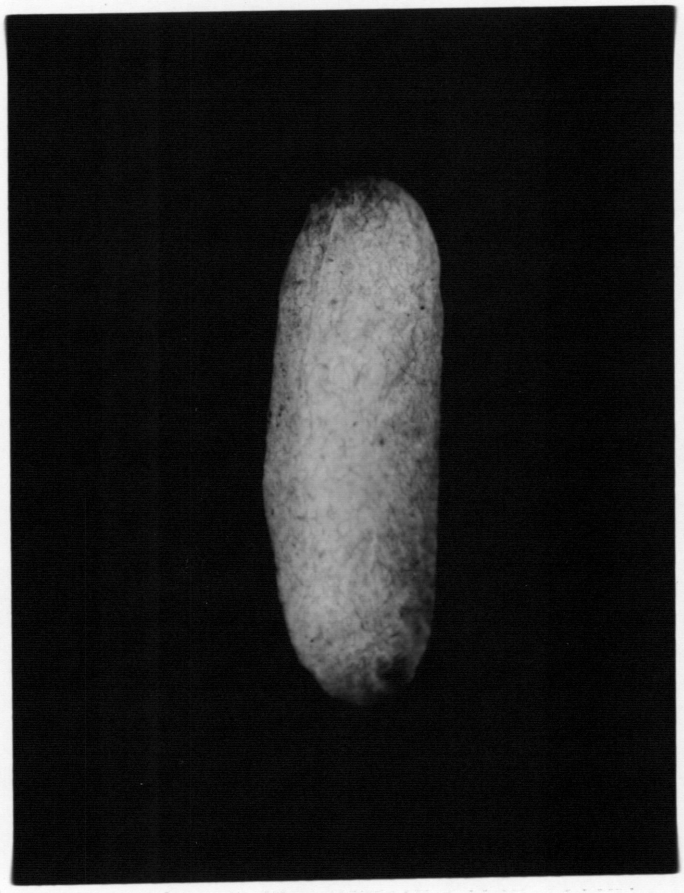

Figure 26. Pupae, Formica fusca fusca.

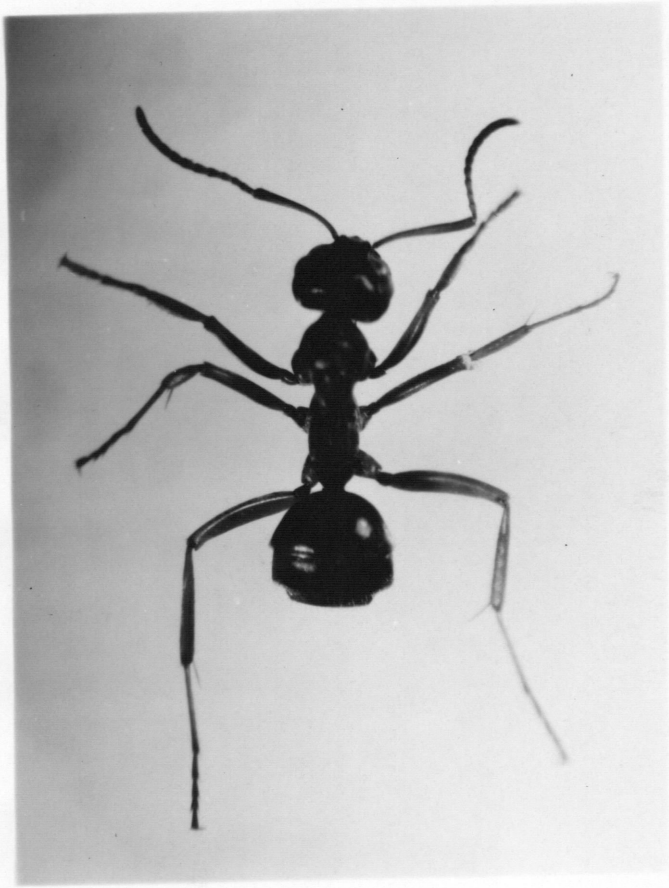

Figure 27. Worker, Formica fusca fusca

Life history of Formica fusca.

The life history of Formicidae varies greatly with the genera, subgenera, species, subspecies and varieties. The ant colony is composed of three general castes, the queen or fertile female, the worker (generally sterile female) and the male.

A colony is generally started after the winged males and females take their nuptial flight. They lose their wings soon afterward and the male dies. The female generally seeks a suitable location and deposits her eggs. The eggs are small elongated and white to yellowish in color. These hatch from two to six weeks and the larvae are white legless grubs somewhat narrowed toward the head. The larval period varies from one to four months. Some of the pupae of F. fusca are covered with silken cocoons while others are naked. Three or four weeks are spent in this transition period.

The adult ants of the first brood are generally small and are composed entirely of workers. Subsequent broods are larger in size and the workers take on specialized duties. Eggs and pupae are carefully guarded and cared for by the workers. They maintain optimum temperature and humidity conditions for the eggs and pupae by transporting them from place to place. The workers are generally sterile but are known to lay eggs from time to time and these are believed to develop into male ants.

The food of Formicidae varies greatly. Many species feed on sugars or sugar secretions while others are predaceous and have a protein diet.

The habits of Formicidae vary with the species and subspecies. Formica fusca and its allies are generally timid and are often captured by other species of ants and either eaten or held as slaves. As slaves, they carry on specialized duties in a new ant colony. There are numerous

reports of the predaceous habits of F. fusca and when occurs it is believed that F. fusca is collecting food for some protein feeding slave holder.

Economic importance of Formica fusca.

Reports were brought to the Department of Entomology by Dr. R. B. Fore and Mr. G. R. Hoerner of the Experiment Station that ants were causing considerable injury to hop roots in the vicinity of Yakima, Washington and Hermiston, Oregon. Specimens of these ants were obtained by mail and sent to the United States Department of Agriculture for determination. They were identified by Dr. M. R. Smith as Formica fusca Linn. variety. A review of the mass of literature on the subject of ants showed that Formica fusca and its varieties have never been considered of great economic importance. There have been occasional references to their predaceous habits and at times probably serve as a pollenization agent. There is no mention of plant injury by Formica fusca or its varieties. There are several possible explanations to meet the available data.

1. The species obtained may have been slaves to another colony of ants which were causing the damage to the hop vines.

2. The presence of F. fusca about the vines may have been due to their attack on a primary host of the hop plant.

3. They may have been feeding on the secretion of hop plant resulting from the attack of a primary host of the hop.

4. This variety of Formica fusca may have been directly responsible for the hop injury.

The problem is very interesting and efforts should be made to collect

more data on this subject and establish the correct economic status of this insect.

Control of Formica fusca.

There are numerous ways of controlling ants. Trapping, spraying or dusting with contact poisons and the use of poison barriers are sometimes effective in reducing numbers but do not result in complete eradication.

Soil fumigants such as calcium cyanamid, carbon disulfide chloropicrin and others are quite effective but require caution in their application.

Poison baits are commonly used for ant control. The workers collect and carry food to the colony where it is regurgitated and fed to larvae, worker, male and female ants. Poisoned food is effective in the eradication of ant colonies in this way. It is necessary to determine the kind of food the ants are accustomed to collect before attempts are made to poison them. Several of the sugar and protein baits are listed as follows:

1. Granulated sugar - - 50%
   Strained honey - - - 15%
   Glycerin - - - - - - 10%
   Water - - - - - - - 25%

   Add 25% of an acqueous solution of thallium sulphate (1-2000) to the above boiled bait.

2. Boiled sugar - - - - 97%
   Paris green - - - - 3%

3. Tartar emetic 1 to 500 in cheap table syrup.

4. Granulated sugar - - 65%
   Strained honey - - - 30%
   Water - - - - - - - 5%

   Add 5% of a hot acqueous solution of tartar emetic (1-1000) and sodium arsenite (1-80) to the above mixture.

5. Tartar emetic - - - - 10%
Lard or bacon grease- 90%

All of the above proportions are computed by weight. Care must be exercised in the uses of poison baits because they are quite toxic to all kinds of animal life when taken internally.

Hyphantria cunea Drury

The fall webworm was described by Drury (Ill. Exot. Ent. 1, pl.18, f. 4, 1770) in 1770. The original description has not been seen but the following description is taken from an article by C. V. Riley (Fifth Rept. of the Entomol. Comm.; House. Miscel. Documents. 1st Session. 51st. Congress, Vol. 41, pp. 245-247, 1889-1890).

Description of Hyphantria cunea Drury.

Egg. "The egg, measuring .4 mm. is of bright golden-yellow color, quite globular and ornamented by numerous regular pits, which give it under a magnifying lens the appearance of a beautiful golden thimble."

Larva. "The caterpillars just born are pale yellow with two rows of black marks along the body, a black head and with quite sparse hairs. When full grown they generally appear pale yellowish to greenish, with a broad dusky stripe along the back and a yellow stripe along the sides; they are covered with whitish hairs, which spring from black and orange-yellow warts. The caterpillar is, however, very variable both as to depth of coloring and as to markings. Close observations have failed to show that different food produces changes in the coloration; in fact nearly all the various color varieties may be found upon the same tree. The fall generation is, however, on the whole, darker, with browner hairs than the spring generation."

Pupa and cocoon. "The cocoon itself is thin and almost transparent, and is composed of a slight web of silk intermixed with a few hairs, or mixed with sand if made in the soil.

The pupa is of a very dark-brown color, smooth and polished, and faintly punctate; it is characterized by a swelling or bulging about

the middle. It is .60 inch long and .23 inch broad in the middle of its body, or where it bulges a little all round."

The moth. "The moths vary greatly both in size and coloration. They have in consequence of such variation received many names such as cunea Drury, textor Harr., punctata Fitch, punctatissima Smith. But there is no doubt, as proven from frequent breeding of specimens, that all of these names apply to the very same insect, or at most to slight varieties, and that Drury's name cunea, having priority, must be used for the species.

The most frequent form observed in the vicinity of Washington is white, with a very slight fulvous shade; it has immaculate wings, tawny-yellow front thighs and blackish feet; in some specimens the tawny thighs have a large black spot, while the shanks of the upper surface are rufous. In many, all the thighs are tawny yellow, while in others they have scarcely any color. Some specimens (often reared from the same lot of larvae) have two tolerably distinct spots on each front wing--one at base of fork on the costal nerve and one just within the second furcation of the median nerve. Other specimens, again have their wings spotted all over and approach the form punctatissima, described as the "Many-spotted Ermine-moth" of the Southern states. The wings of the moths expand from 1¾ inches to 1 3/8 inches. The male moth, which is usually a little smaller, has its antennae doubly feathered beneath, and those of the female possess instead two rows of minute teeth."

Life history of Hyphantria cunea Drury.

This insect overwinters in the pupal stage and adults make their appearance about the middle of June. They mate soon after emergence and the female deposits approximately 500 eggs on the under side of

foliage. The color of the egg changes to leaden grey about twenty-four hours before hatching. The incubation period during the spring months averages about two weeks.

The newly hatched larvae average about 1/25 of an inch in length. They are gregarious in habit and spin silken webs which enclose the foliage on which they feed. The web becomes more pretentious as the larvae increase in size. There are six larval instars and the mature webworms average about one inch in length. They lose their gregarious instinct after reaching maturity and leave the web. Larvae are mature about the latter part of July and spend several days in a prepupal stage after which they spin a thin silken cocoon on the ground, in debris or in any sheltered place. The pupal stage lasts about one week and the adult moths of the summer brood emerge about the middle of August. The summer brood of eggs hatch in about one week and the summer brood of larvae become mature about the latter part of September. They pupate and overwinter in this stage.

Economic importance of Hyphantria cunea.

The fall webworm was considered an exotic species in 1770 but became a pest of shade and forest trees in the latter part of the eighteenth century. It remained an economic pest until about 1920 and since that date its appearance has been very intermittant.

It is a general feeder and over one hundred and twenty-five food plants have been listed by the United States Department of Agriculture. Hops is included in this list. The real damage consists of the damage to the leaf tissue of the host plant but the esthetic value of shade and ornamental plantings are often destroyed by the unsightly webbing of the larvae.

Control of Hyphantria cunea.

Biological control. Natural checks of a diversified nature and in considerable abundance prey on this species. Insectivorous birds, and mammals, egg parasites, internal parasites, predaceous enemies and diseases are among these natural agencies. It is believed that the combination of these biological control factors are responsible for the decline in economic importance of this pest.

Mechanical control. The most economical method of control of the fall webworm is the pruning and burning of infested leaves and branches. This is practical when infestations are not widespread.

Chemical control. The fall webworm is easily controlled by arsenical sprays at the rate of three pounds per hundred gallons of water. Spraying or dusting after the formation of the web is ineffective because of the protection of the web. Arsenical sprays or dusts are not possible on hops because of the residue problem. McIndoo reported that derris powder (1 lb. to 65 gal.) was effective in the control of this pest and this material may offer promise if and when Hyphantria cunea again becomes a problem in the Oregon hop yards.

Less important hop insect pests

There are a number of undetermined species of wireworms, leafhoppers, and loopers that occasionally cause damage to localized sections of hop yards. These were not abundant during the biennium 1937-1938 and no work was done with them.

There are more than fifty species of cutworms in Oregon and the more important of these are the variegated cutworm, Lycophotia margaritosa Hubn, the olive green cutworm, Neuria procincta Grote, and the greasy cutworm, Agrotis ypsilon Rott. No specimen has been taken from the hop yards during the biennium 1937-1938.

Occasional reports have been brought to the Experiment Station that certain vine bores have been causing damage. The hop vine borer Gortyna immanis has been a pest of New York hop yards for over 70 years but it is not known to exist in Oregon. R. O. Magie writes in Farm research (Vol. V, No. 1, Jan. 1939, P.11) that calcium cyanamid is effective control at the rate of four pounds per acre when placed within an inch or two of the borers. It is not recommended because of possible injury to the plant.

Hops raised in the greenhouse during the 1938 season were severely infested with mealy bugs and white flies probably Pseudococcus citri Risso and Trialeurodes vaporariorum Westw. An occasional white fly was found on hop foliage in the field at Corvallis but they were not present in sufficient numbers to cause damage.

Need for further work

The Department of Entomology has of necessity used considerable time and funds in instituting research into the many diverse hop problems. Investigations of the many hop pests are important enough to require the full and undivided attention of one investigator. The following is a summary of the more important phases of this project which requires additional and continued research:

1. Field toxicity tests. The ultimate goal of the Department of Entomology is to cooperate with the U. S. Department of Agriculture in the development of a spray or dust which will successively control aphis, red spider and downy mildew. Some measure of success has been accomplished this year, but continued pesticidal and plant compatibility studies are essential.

2. Added facilities needed. Many additional facilities are needed in order to continue important phases of the work. The Station is not equipped to carry on a spray program in the new 15 acre hop yard because of inadequate spray machinery.

3. Overhead irrigation as a means of red spider control. Several Oregon hop growers have installed overhead sprinkling systems in hop yards. These yards were visited several times during the season of 1938 and it was found that the plants were remarkably free from red spider. Irrigation of this type is known to effectively control red spiders on other crops. It is also possible that the station study this problem from many viewpoints before a general movement toward irrigation of this kind takes place.

4. Laboratory studies. Additional laboratory and greenhouse facilities are needed in order to test many possible means of pest control. Research of this kind enables the investigator to study and discard many worthless materials without subjecting them to costly field trials.

5. Life histories and control of minor hop pests. Continued efforts should be directed toward the identification of many minor hop pests and to study their life history and possible means of control. The hop growers around Hermiston, Oregon are anxious to have control investigations of the ant, Formica fusca L. var. which is causing considerable damage to hop crowns. Various insects such as cutworms, wireworms, leafhoppers, loopers, vine borers, mealy bugs, and white flies require identification, life history, and control investigations.

6. Development of satisfactory method of dust applications. Red spiders and aphids must be contacted by pesticides in order to ob-

tain maximum toxic efficiency. A concentrated effort should be made by the Experiment station to develop a satisfactory means of application of dusts to pests that habitate the under sides of the hop leaves. Present dusters do not meet this requirement.

1938 HOP PEST POPULATION DATA

Experimental hop yard East Farm, Corvallis, Ore.

Definition of terms

Treatment number. First number in column denotes number of treatment.
Second number in column denotes replication number.

Vine number. Numbers in column shows location of plant.

Age. Numbers in column denotes age of plant as either baby or two year old plant.

% infestation. Percentage of leaves infested with hop pest (ten leaves counted per plant) a measure of distribution.

Pop./leaf. Population per leaf -- a measure of pest density (total pests of ten leaves recorded -- for population per leaf, divide by ten.)

Ala. Alate hop aphis

Apt. Apterous hop aphis

Treatment number 1- Check

Hop Pest Project — Corvallis, Oregon — 1938

Date July 9 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
1-1			-	-	-	-	-	-	
			-	-	10	-	2	-	
			-	-	30	-	8	-	
			20	15	20	-	5	-	
1-2			-	-	-	-	-	-	
			-	-	20	-	19	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-3									
			-	-	10	-	3	-	
			-	-	20	-	3	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-4			-	-	10	-	3	-	
			-	-	30	-	9	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
1-5			-	-	20	-	8	-	
			-	-	10	-	4	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			10	14	20	-	5	-	
1-6			-	-	20	-	2	-	
			-	-	10	-	1	-	
			-	-	10	-	8	-	
			-	-	30	-	7	-	
			-	-	30	-	5	-	
1-7			-	-	-	-	-	-	
			-	-	30	-	3	-	
			10	7	20	-	9	-	
			-	-	10	-	2	-	
			-	-	30	-	15	-	
			-	-	40	-	28	-	
1-8									

Treatment number 1- Check

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
1-1			10	4	-	-	-	-	
			20	7	10	-	2	-	
			20	8	-	-	-	-	
			10	4	30	-	12	-	
1-2			-	-	-	-	-	-	
			10	3	-	-	-	-	
			10	1	20	3	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-3									
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-4			-	-	-	-	-	-	
			20	7	30	-	9	-	
			-	-	-	-	-	-	
			10	5	10	-	5	-	
			40	8	20	-	6	-	
			10	1	20	-	4	-	
1-5			-	-	10	-	3	-	
			-	-	20	-	3	-	
			10	1	-	-	-	-	
			-	-	10	-	3	-	
			-	-	-	-	-	-	
			20	14	-	-	-	-	
1-6			50	14	~~10~~	-	~~3~~	-	
			10	1	20	-	4	-	
			-	-	-	-	-	-	
			-	-	20	-	2	-	
			-	-	-	-	-	-	
1-7			-	-	10	-	2	-	
			-	-	-	-	-	-	
			50	12	20	-	4	-	
			30	10	-	-	-	-	
			-	-	-	-	-	-	
			30	3	20	5	-	-	
1-8									

Treatment number 1 Check

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
1-1			20	2	-	-	-	-	
			10	5	-	-	-	-	
			-	-	10	-	1	-	
			-						
			30	9	20	-	6	-	
			-						
1-2			-	-	-	-	-	-	
			20	18	50	-	28	-	
			-	-	60	-	8	-	
			10	5	-	-	-	-	
			20	2	-	-	-	-	
1-3									
			-	-	10	-	5	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-4			-	-	10	-	1	-	
			20	15	-	-	-	-	
			-	-	10	-	2	-	
			10	2	20	-	3	-	
			40	18	-	-	-	-	
			50	8	-	-	-	-	
1-5			-	-	-	-	-	-	
			-	-	10	-	1	-	
			-	-	20	-	2	-	
			-	-	-	-	-	-	
			40	44	-	-	-	-	
			-	-	10	-	3	-	
1-6			-	-	-	-	-	-	
			-	-	20	-	2	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-7			-	-	40	-	5	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			20	12	-	-	-	-	
			-	-	10	-	2	-	
			20	8	-	-	-	-	
1-8									

Treatment Number 2

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
2-1	73-7	2	-	-	10	2	-	-	1 thrips
	73-8	1	-	-	-	-	-	-	
	73-9	2	-	-	20	10	-	-	
	74-7	1	-	-	-	-	-	1	
	74-8	1	-	-	10	1	-	-	1 white fly
	74-9	2	-	-	10	3	-	1	
2-2	75-4	2	-	-	-	-	-	-	
	75-5	1	-	-	-	-	-	-	
	75-6	2	-	-	10	3	-	-	
	76-4	2	-	-	-	-	-	-	
	76-5	1	-	-	-	-	-	-	
	76-6	2	-	-	30	12	-	-	
2-3	79-1	2	20	2	-	-	-	-	
	79-2	2	-	-	6 0	25	-	-	
	79-3	2	-	-	20	43	-	-	
	80-1	1	-	-	-	-	-	-	
	80-2	out							
	80-3	1	-	-	100	13	-	-	
2-4	83-10	2	-	-	-	-	-	-	
	83-11	2	-	-	-	-	-	-	
	83-12	1	-	-	-	-	-	-	
	84-10	2	-	-	40	35	-	1	
	84-11	1	-	-	-	-	-	-	1 Diabrotica
	84-12	1	-	-	-	-	-	-	
2-5	87-4	2	-	-	-	-	-	-	
	87-5	-	-	-	-	-	-	-	8 thrips
	87-6	2	-	-	10	1	-	-	
	88-4	1	-	-	-	-	-	-	
	88-5	1	-	-	-	-	-	-	1 thrips
	88-6	out							
2-6	93-1	2	-	-	40	15	-	-	
	93-2	2	-	-	50	30	-	-	
	93-3	2	-	-	-	-	-	-	
	94-1	2	-	-	-	-	-	1	
	94-2	2	-	-	10	3	-	-	
	94-3	2	-	-	40	12	-	1	
2-7	95-10	out							
	95-11	1	-	-	-	-	-	-	3 thrips
	95-12	1	-	-	-	-	-	-	
	96-10	2	-	-	-	-	-	-	1 thrips
	96-11	2	-	-	-	-	-	-	
	96-12	1	-	-	-	-	-	-	
2-8									

Treatment Number 2

Hop Pest Project — Corvallis, Oregon — 1938

Date July 7 1938 — Spray-Dust Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
2-1			-	-	-	-	-	-	2 thrips
			-	-	-	-	-	-	
			-	-	20	-	6	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	20	-	3	-	
2-2			-	-	10	-	1	-	
			-	-	20	-	4	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
2-3			-	-	-	-	-	-	
			-	-	50	-	14	-	
			-	-	20	-	6	-	
			-	-	10	-	2	-	
			—						
			-	-	-	-	-	-	
2-4			-	-	10	-	7	-	
			-	-	20	-	7		
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
2-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	2 thrips
			-	-	10	-	3	-	
			-	-	20	-	4	-	
			—						
2-6			-	-	60	-	23	-	
			-	-	30	-	27	-	
			-	-	40	-	23	-	
			-	-	-	-	-	-	
			-	-	10	-	2	-	
			10	11	30	-	2	-	
2-7			—						
			30	12	10	-	5	-	
			10	3	10	-	4	-	
			-	-	10	-	2	-	
			-	-	20	-	2	-	
			-	-	30	-	11	-	
2-8									

Treatment number 2

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — Spray ~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Apt.		
2-1			20	10	-	-	-	-	
			-	-	-	-	-	-	
			20	8	20	-	8	-	
			-	-	-	-	-	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
2-2			-	-	-	-	-	-	
			20	7	20	-	5	-	
			10	3	-	-	-	-	
			30	11	20	-	10	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
2-3			20	5	-	-	-	-	
			10	2	10	1	-	-	
			20	8	20	-	3	-	
			-	-	10	-	2	-	
			—						
			10	2	-	-	-	-	
2-4			20	7	-	-	-	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
			30	9	-	-	-	-	
			10	1	-	-	-	-	
			-	-	-	-	-	-	
2-5			-	-	-	-	-	-	
			40	18	-	-	-	-	
			-	-	-	-	-	-	
			-	-	20	-	19	-	
			10	1	40	-	6	-	
			—						
2-6			-	-	50	-	12	-	
			20	7	50	-	15	-	
			20	4	60	-	27	-	
			20	13	-	-	-	-	
			10	8	-	-	-	-	
			30	12	-	-	-	-	
2-7			—						
			10	1	-	-	-	-	
			-	-	-	-	-	-	
			60	21	10	-	3	-	
			10	3	20	-	3	-	
			20	3	10	-	9	-	
2-8									

Treatment number 2

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
2-1			20	2	-	-	-	-	
			10	5	-	-	-	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
			30	9	20	-	6	-	
			-	-	-	-	-	-	
2-2			-	-	-	-	-	-	
			20	18	50	-	28	-	
			-	-	60	-	8	-	
			10	5	0	-	-	-	
			20	2	-	-	-	-	
			-	-	-	-	-	-	
2-3			-	-	-	-	-	-	
			-	-	10	-	5	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			—						
			-	-	-	-	-	-	
2-4			-	-	10	-	1	-	
			20	15	-	-	-	-	
			-	-	10	10	-	2	
			10	2	20	-	3	-	
			40	18	-	-	-	-	
			50	8	-	-	-	-	
2-5			-	-	-	-	-	-	
			-	-	10	-	3	-	
			-	-	10	-	1	-	
			-	-	20	-	2	-	
			40	44	-	-	-	-	
			—						
2-6			-	-	-	-	-	-	
			-	-	20	-	2	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
2-7			—						
			-	-	40	-	5	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			20	12	10	-	2	-	
			20	8	-	-	-	-	
2-8									

Treatment number 3

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — Spray ~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
1	71-1	2	-	-	10	2	-	-	
	71-2	1	-	-	-	-	-	-	
	71-3	2	20	9	20	18	-	-	
	72-1	2	-	-	70	25	-	-	
	72-2	2	-	-	20	2	-	-	
	72-3	2	-	-	30	32	-	-	2 thrips
2	75-10	1	-	-	-	-	-	-	1 Diabrotica
	75-11	2	-	-	-	-	-	-	
	75-12	2	-	-	10	3	-	-	1 Diabrotica½
	76-10	2	-	-	10	3	-	-	
	76-11	1	-	-	-	-	-	-	
	76-12	1	10	1	-	-	-	-	
3	81-7	1	-	-	-	-	-	-	
	81-8	2	-	-	-	-	-	-	
	81-9	1	-	-	-	-	-	-	
	82-7	2	-	-	20	12	-	-	
	82-8	1	-	-	-	-	-	-	
	82-9	2	-	-	-	-	-	-	
4	85-10	1	-	-	-	-	-	-	
	85-11	2	-	-	-	-	-	-	
	85-12	2	-	-	10	4	-	-	
	86-10	1	-	-	-	-	-	-	
	86-11	2	-	-	30	15	0	-	
	86-12	1	-	-	-	-	-	-	
5	89-7	1	-	-	-	-	-	-	
	89-8	1	-	-	-	-	-	-	
	89-9	2	-	-	-	-	-	-	
	90-7	2	-	-	-	-	-	-	
	90-8	1	-	-	-	-	-	-	
	90-9	2	-	-	10	2	-	-	
6	93-4	2	-	-	-	-	-	-	
	93-5	2	-	-	10	1	-	-	
	93-6	1	-	-	-	-	-	1	
	94-4	2	-	-	-	-	-	-	1 thrips
	94-5	1	-	-	-	-	-	-	1 thrips
	94-6	1	-	-	-	-	-	-	
7	97-4	1	-	-	-	-	-	-	
	97-5	2	-	-	50	7	-	-	
	97-6	2	10	9	40	15	-	-	
	98-4	2	-	-	-	-	-	1	
	98-5	1	-	-	40	27	-	-	
	98-6	2	-	-	10	3	-	-	
8									

Treatment number 3

Hop Pest Project — Corvallis, Oregon — 1938

Date July 9 1938 — Spray ~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
~~3~~-1			10	1	30	-	7	-	2 thrips
			-	-	-	-	-	-	
			-	-	40	-	7	-	
			-	-	20	-	4	-	
			30	20	30	-	4	-	
			-	-	30	-	4	-	
~~3~~-2			-	-	-	-	-	-	
			-	-	-	-	-	-	
			20	9	-	-	-	-	
			-	-	-	-	-	-	1 white fly
			-	-	-	-	-	-	
			-	-	-	-	-	-	
31-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	20	-	12	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 spittle bug
~~3~~-4			-	-	-	-	-	-	1 Diabrotica
			-	-	10	-	11	-	
			-	-	40	-	21	-	
			-	-	-	-	-	-	
			-	-	10	-	2	-	
			-	-	-	-	-	-	
~~3~~-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	40	-	21	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	10	-	3	-	
~~3~~-6			-	-	-	-	-	-	
			-	-	30	-	3	-	
			-	-	10	-	1	-	
			-	-	30	-	5	-	
			-	-	20	-	4	-	
			-	-	-	-	-	-	
~~3~~-7			10	3	10	-	5	-	
			10	6	10	-	3	-	
			-	-	-	-	-	-	
			20	3	20	-	4	-	
			-	-	10	-	7	-	
			-	-	-	-	-	-	
~~3~~-8									

Treatment number 3

Hop Pest Project — Corvallis, Oregon — 1938

Date July19 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
B-1			20	10	-	-	-	-	
			-	-	-	-	-	-	
			10	1	-	-	-	-	
			30	12	-	-	-	-	
			30	18	20	-	5	-	
			-	-	10	-	12	-	
B-2			10	7	-	-	-	-	
			-	-	-	-	-	-	
			90	60	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-3			-	-	-	-	-	-	
			-	-	10	-	2	-	
			10	1	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-4			-	-	-	-	-	-	
			20	8	10	-	2	-	
			-	-	10	-	7	-	
		1	10	2	30	-	15	-	
			20	9	10	-	1	-	
			-	-	-	-	-	-	
B-5			-	-	-	-	-	-	
			-	-	20	-	6	-	
			20	4	-	-	-	-	
			20	10	-	-	-	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
B-6			10	1	40	-	16	-	
			30	6	10	-	1	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-7			-	-	-	-	-	-	
			20	8	20	-	3	-	
			40	30	-	-	-	-	
			60	31	-	-	-	-	
			50	30	-	-	-	-	
			-	-	-	-	-	-	
B-8									

Treatment number 3

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
~~3~~-1			30	3	-	-	-	-	
			50	37	10	-	4	-	
			10	5	10	-	14	-	
			10	3	30	-	3	-	
			-	-	-	-	-	-	
			10	1	20	-	4	-	
~~3~~-2			-	-	10	-	1	-	
			-	-	10	-	1	-	
			-	-	20	-	5	-	
			-	-	10	-	2	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
~~3~~-3			-	-	-	-	-	-	
			10	1	10	-	2	-	
			-	-	~~1~~ 0	-	1	-	
			-	-	-	-	-	-	
			10	1	-	-	-	-	
			-	-	-	-	-	-	
~~3~~-4			-	-	10	-	1	-	
			30	14	10	-	1	-	
			20	14	10	-	3	-	
			30	7	40	-	8	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
31-5			-	-	10	-	1	-	
			20	2	30	-	5	-	
			20	7	30	-	5-	-	
			40	60	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
31-6			10	2	-	-	-	-	
			10	2	10	-	2	-	
			-	-	10	-	1	-	
			30	4	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
31-7			-	-	10	-	5	-	
			10	1	20	-	5	-	
			~~20~~	5	-	-	-	-	
			-	-	-	-	-	-	
			30	5	-	-	-	-	
			20	6	10	-	1	-	
31-8									

Treatment number 4

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
~~4~~-1			20	4	10	-	6	-	
			-	-	10	-	5	-	
			10	1	10	-	1	-	
			30	3	50	-	8	-	
			-	-	10	-	1	-	
			-	-	20	-	2	-	
~~4~~-2			10	2	10	-	2	-	
			-	-	-	-	-	-	
			-	-	10	-	3	-	
			-	-	10	-	1	-	
			100	82	-	-	-	-	
			10	1	-	-	-	-	
~~4~~-3			10	3	10	-	1	-	
			-	-	-	-	-	-	
			10	2	-	-	-	-	
			-	-	-	-	-	-	
			40	6	10	-	1	-	
			-	-	-	-	-	-	
~~4~~-4			10	2	10	-	1	-	
			-	-	-	-	-	-	
			10	1	20	-	4	-	
			-	-	-	-	-	-	
			10	1	-	-	-	-	
~~4~~-5			20	4	-	-	-	-	
			-	-	-	-	-	-	
			30	7	-	-	-	-	
			100	80	-	-	-	-	
			-	-	-	-	-	-	
			20	6	20	-	4	-	
~~4~~-6			-	-	-	-	-	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
			-	-	20	-	7	-	
			-	-	-	-	--	-	
			20	6	-	-	-	-	
~~4~~-7			20	4	-	-	-	-	
			10	1	30	-	6	-	
			-	-	40	-	13	-	
			10	~~8~~ 8	-	-	-	-	
			10	3	-	-	-	-	
~~4~~-8									

Treatment number 5

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Apt.		
5-1	71-10	out							
	71-11	2	10	3	30	22	-	-	3 thrips
	71-12	1	-	-	-	-	-	-	
	72-10	1	-	-	-	-	-	-	
	72-11	1	10	1	-	-	-	-	
	72-12	1	10	1	-	-	-	-	2 thrips
5-2	75-1	-	-	-	-	-	-	-	
	75-2	out							
	75-3	2	-	-	30	7	-	-	
	76-1	1	10	1	-	-	-	-	
	76-2	2	-	-	20	2	-	-	
	76-3	2	10	15	20	2	-	-	
5-3	79-10	1	-	-	-	-	-	-	
	79-11	2	-	-	-	-	-	-	
	79-12	1	-	-	-	-	-	-	
	80-10	2	-	-	-	-	-	1	
	80-11	2	-	-	20	12	-	-	
	80-12	1	-	-	-	-	-	-	1 Diabrotica
5-4	83-4	2	-	-	-	-	-	-	
	83-5	2	-	-	-	-	-	1	
	83-6	2	-	-	10	1	-	-	
	84-4	1	-	-	-	-	-	-	
	84-5	1	-	-	-	-	-	-	
	84-6	2	-	-	-	-	-	-	
5-5	87-1	1	-	-	-	-	-	-	
	87-2	1	-	-	-	-	-	-	
	87-3	1	-	-	20	4	-	-	
	88-1	2	-	-	10	8	-	-	
	88-2	2	-	-	40	20	-	-	
	88-3	2	-	-	20	6	-	-	
5-6	91-7	1	-	-	-	-	-	-	
	91-8	2	-	-	-	-	-	-	
	91-9	2	-	-	20	4	-	-	
	92-7	1	-	-	-	-	-	-	
	92-8	2	-	-	60	25	-	-	
	92-9	2	-	-	-	-	-	-	
5-7	95-4	2	-	-	-	-	-	5	
	95-5	2	-	-	10	1	-	-	5 thrips
	95-6	1	-	-	10	1	-	1	
	96-4	1	-	-	-	-	-	3	
	96-5	1	-	-	10	1	-	-	
	96-6	1	-	-	-	-	-	-	
5-8									

Treatment number 5

Hop Pest Project — Corvallis, Oregon — 1938

Date July 9 1938 — Spray ~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
5-1			—						
			-	-	70	-	38	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	2 Diabrotica
			10	5	-	-	-	-	
5-2			-	-	-	-	-	-	
			—						
			-	-	50	-	10	-	
			-	-	-	-	-	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
5-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	20	-	6	-	2 thrips
5-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	20	-	6	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
5-5			-	-	-	-	-	-	
			-	-	-	--	-	-	
			-	-	-	-	-	-	
			-	-	30	5	-	-	
			-	-	40	-	8	-	
			-	-	20	-	8	-	
5-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			10	10	-	-	-	-	
			-	-	-	-	-	-	
			-	-	30	-	38	-	
			-	-	-	-	-	-	
5-7			-	-	30	-	10	-	
			-	-	30	-	8	-	
			-	-	40	-	10	-	
			-	-	70	-	24	-	
			-	-	10	-	1	-	
			-	-	20	-	1	-	
5-8									

Treatment number 5

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — Spray ~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
5-1			—						
			-	-	-	-	-	-	
			-	-	20	-	15	-	
			-	-	-	---	-	-	
			-	-	-	-	-	-	
			10	7	10	-	5	-	
5-2			-	-	-	-	-	-	
5			—						
			20	6	30	-	7	-	
			-	-	-	-	-	-	
			-	-	10	-	6	-	
			-	-	20	-	16	-	
5-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	20	-	3	-	
			-	-	50	-	15	-	
			-	-	-	-	-	-	
5-4			-	-	-	-	-	-	
			10	2	-	-	-	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
5-5			-	-	10	-	2	-	
			-	-	-	-	-	-	
			-	-	30	-	5	-	
			-	-	20	-	4	-	
			10	1	30	-	13	-	
			-	-	-	-	-	-	
5-6			20	12	-	-	-	-	
			-	-	-	-	-	-	
			80	40	10	-	3	-	
			-	-	-	-	-	-	
			10	2	-	-	-	-	
			40	4	10	-	2	-	
5-7			-	-	-	-	-	-	
			10	3	20	-	5	-	
			30	9	-	-	-	-	
			-	-	70	-	28	-	
			20	3	30	-	5	-	
			-	-	-	-	-	-	
5-8									

Treatment number 6

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
6-1	71-7	1	-	-	-	-	-	-	
	71-8	1	40	18	-	-	-	-	
	71-9	2	-	-	20	3	-	-	
	72-7	1	-	-	10	1	-	-	
	72-8	2	-	-	20	28	-	-	
	72-9	2	-	-	20	3	-	1	
6-2	75-7	2	10	15	30	18	-	-	
	75-8	2	1	-	10	3	-	-	
	75-9	1	-	-	-	-	-	-	
	76-7	2	-	-	100	54	-	-	2 thrips
	76-8	out							
	76-9	1	-	-	-	-	-	-	
6-3	79-4	2	-	-	-	-	-	-	
	79-5	2	-	-	-	-	-	-	
	79-6	1	-	-	-	-	-	-	
	80-4	1	-	-	-	-	-	-	
	80-5	1	-	-	-	-	-	-	
	80-6	2	-	-	-	-	-	-	1 thrips
6-4	83-1	1	-	-	-	-	-	-	
	83-2	2	-	-	-	-	-	-	
	83-3	2	-	-	-	-	-	-	
	84-1	2	-	-	-	-	-	-	
	84-2	2	-	-	-	-	-	-	
	84-3	2	-	-	30	12	-	-	
6-5	89-4	1	-	-	-	-	-	-	
	89-5	1	-	-	-	-	-	-	
	89-6	1	-	-	-	-	-	-	1 spittle bug
	90-4	2	-	-	-	-	-	-	
	90-5	2	-	-	10	1	-	-	2 thrips
	90-6	1	-	-	-	-	-	-	
6-6	93-10	2	-	-	-	-	-	1	
	93-11	1	-	-	10	4	-	-	1 thrips
	93-12	2	-	-	20	3	-	-	
	94-10	2	-	-	10	1	-	1	
	94-11	2	-	-	20	5	-	-	
	94-12	2	-	-	-	-	-	-	
6-7	97-1	1	10	2	-	-	-	-	
	97-2	2	-	-	10	5	-	-	
	97-3	2	-	-	-	-	-	-	
	98-1	1	100	30	10	1	-	1	
	98-2	1	-	-	-	-	-	-	
	98-3	2	-	-	-	-	-	-	
6-8									

Treatment number 6

Hop Pest Project — Corvallis, Oregon — 1938

Date July 9 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
6-1			-	-	-	-	-	-	
			10	18	-	-	-	-	
			20	30	10	-	9	-	
			-	-	-	-	-	-	
			-	-	50	-	12	-	
			-	-	-	-	-	-	1 white fly
6-2			10	10	-	-	-	-	
			-	-	-	-	-	-	
			20	5	-	-	-	-	
			10	4	10	-	1	-	
			-	-	-	-	-	-	1 thrips
6-3			-	-	20	-	2	-	
			-	-	20	-	10	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
6-4			-	-	-	-	-	-	
			-	-	20	-	4	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
6-5			-	-	-	-	-	-	
			-	-	10	-	3	-	
			-	-	-	-	-	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
			-	-	10	-	2	-	
6-6			-	-	-	-	-	-	
			-	-	50	-	13	-	
			-	-	10	-	1	-	
			30	7	-	-	-	-	
			-	-	30	-	6	-	
			-	-	-	-	-	-	
6-7			-	-	-	-	-	-	
			-	-	20	-	7	-	
			100	142	20	-	5	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
6-8									

Treatment number 6

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
~~6~~1		-	-	-	-	-	-	-	
			-	-	-	-	-	-	
			90	27	-	-	-	-	
			-	-	30	-	7	-	
			-	-	20	-	5	-	
			30	25	50	-	15	-	
~~6~~2			70	60	-	-	-	-	
			30	23	20	-	5	-	
			10	2	-	-	-	-	
			-	-	20	-	7	-	
			-	-	10	-	4	-	
~~6~~3			-	-	-	-	-	-	
			-	-	10	-	3	-	
			10	1	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			20	2	-	-	-	-	
~~6~~4			-	-	-	-	-	-	
			-	-	3-	-	13	-	
			-	-	-	-	-	-	
			10	1	-	-	-	-	
			20	5	-	-	-	-	
			-	-	20	-	2	-	
~~6~~5			-	-	-	-	-	-	1 white fly
			-	-	20	-	5	-	
			10	1	- -	-	-		
			-	-	10	-	-1	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
~~6~~6			-	-	-	-	-	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
			20	4	-	-	-	-	
			30	6	~~1~~0	-	1	-	
			-	-	-	-	-	-	
~~6~~7			60	12	-	-	-	-	
			20	7	30	-	12	-	
			-	-	20	-	8	-	
			100	~~5~~00	-	-	-	-	
			-	-	10	-	6	-	
			-	-	-	-	-	-	
~~6~~8									

Treatment number 6

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
~~6-1~~			-	-	20	-	2	-	
			30	10	10	-	1	-	
			70	50	-	-	-	-	
			-	-	-	-	-	-	
			30	14	-	-	-	-	
			10	3	10	-	2	-	
~~6-2~~			20	12	10	-	2	2	
			-	-	30	-	5	-	
			-	-	-	-	-	-	
			10	2	-	-	-	-	
			10	1	-	-	-	-	
~~6-3~~			-	-	10	-	2	-	
			-	-	20	-	2	-	
			-	-	10	-	1	-	
			-	-	30	-	4	-	
			-	-	-	-	-	-	
			40	28	-	-	-	-	
~~6-4~~			~~80~~	~~28~~	-	-	-	-	
			20	2	10	-	2	-	
			-	-	10	-	2	-	
			30	11	-	-	-	-	
			30	4	-	-	-	-	
			-	-	-	-	-	-	
~~6-5~~			20	4	10	-	1	-	
			20	3	10	-	5	-	
			-	-	10	-	3	-	
			30	15	-	-	-	-	
			-	-	10	-	1	-	
			-	-	10	-	2	-	
~~6-6~~			10	1	10	-	5	-	
			-	-	10	-	4	-	
			30	45	-	-	-	-	
			-	-	-	-	-	-	
			40	15	30	-	10	-	
			-	-	~~10~~	-	15	-	
~~6-7~~			-	-	10	-	4-	-	
			~~80~~	~~15~~	~~30~~	-	~~10~~	-	
			-	-	-	-	-	-	
			~~100~~	~~200~~	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
~~6-8~~									

Treatment number 7

Hop Pest Project Corvallis, Oregon 1938

Date June 29 1938 Spray-Dust Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
T-1	73-10	2	-	-	-	-	-	1	
	73-11	1	30	10	-	-	-	-	
	73-12	2	-	-	-	-	-	-	
	74-10	1	-	-	-	-	-	-	
	74-11	2	-	-	30	19	-	-	
	74-12	2	-	-	50	14	-	-	1 thrips
T-2	77-7	2	-	-	20	2	-	-	
	77-8	1	-	-	-	-	-	-	
	77-9	out							
	78-7	2	-	-	10	14	-	-	
	78-8	2	-	-	-	-	-	-	2 thrips
	78-92	2	-	-	-	-	-	-	3 thrips
T-3	81-4	2	-	-	10	1	-	-	
	81-5	1	10	-	-	-	-	-	
	81-6	out							
	82-4	2	10	8	30	10	-	-	
	82-5	1	-	-	-	-	-	1	2 thrips
	82-6	1	-	-	-	-	-	-	
T-4	85-1	2	-	-	-	-	-	-	
	85-2	2--	-	-	50	38	-	-	
	85-3	1	10	3	-	-	-	-	
	86-1	2	-	-	30	3	-	-	
	86-2	2	-	-	50	69	-	-	
	86-3	2	-	-	-	-	-	-	
T-5	87-10	2	-	-	20	12	-	-	
	87-11	2	-	-	-	-	-	-	
	87-12	2	-	-	20	4	-	1	
	88-10	2	-	-	-	-	-	-	
	88-11	1	-	-	-	-	-	1	
	88-12	1	-	-	30	5	-	-	
T-6	91-4	2	-	-	-	-	-	-	
	91-5	2	-	-	-	-	-	-	
	91-6	2	-	-	-	-	-	-	
	92-4	2	-	-	30	24	-	-	1 thrips
	92-5	1	-	-	-	-	-	-	1 thrips
	92-6	1	-	-	-	-	-	1	
T-7	95-7	2	-	-	20	14	-	-	
	95-8	out							
	95-91	1	-	-	-	-	-	-	1 thrips
	96-7	2	-	-	-	-	-	-	1 thrips
	96-8	1	-	-	-	-	-	-	
	96-9	2	-	-	40	15	-	-	
T-8									

Treatment number 7

Hop Pest Project — Corvallis, Oregon — 1938

Date July 9 1938 — Spray~~-Dust~~, Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
T-1			- -	-	10	3	-	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			10	5	-	-	-	-	
			10	4	40	-	8	-	
			-	-	60	-	12	-	
T-2			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	10	-	1	-	
			-	-	30	-	3	-	
			-	-	-	-	-	-	
T-3			-	-	-	-	-	-	1 thrips
			-	-	-	-	-	-	
			10	5	20	-	7	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
T1-4			-	-	10	-	5	-	
			-	-	20	-	16	-	
			-	-	-	-	-	-	
			-	-	30	-	11	-	
			-	-	40	-	47	-	
			-	-	-	-	-	-	
T1-5			-	-	10	-	1	-	
			-	-	40	-	19	-	1 Canphasia
			-	-	50	-	21	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	20	-	5	-	
T1-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	50	-	12	-	
			-	-	20	-	3	-	
			-	-	50	-	13	-	
T1-7			-	-	70	-	7	-	
			-	-	30	-	8	-	
			-	-	30	-	30	-	
			-	-	10	-	2	-	
			-	-	20	-	11	-	
T-8									

Treatment number 7

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — Spray ~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
17-1			30	15	-	-	-	-	1 thrips
			-	-	-	-	-	-	
			10	7	-	-	-	-	
			10	9	-	-	-	-	
			-	-	-	-	-	-	
			20	10	-	-	-	-	
17-2			-	-	-	-	-	-	
			-	-	-	-	-	-	
			—						
			40	4	-	-	-	-	
			-	-	40	-	17	-	
			20	2	-	-	-	-	1 white fly
17-3			20	15	10	-	2	-	
			-	-	-	-	-	-	
			—						
			50	16	10	-	2	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
17-4			20	12	50	-	9	-	
			-	-	40	-	10	-	
			-	-	-	-	-	-	
			-	-	40	-	4	-	
			-	-	50	-	23	-	
			-	-	20	-	6	-	
17-5			40	18	40	-	16	-	
			40	7	-	-	-	-	
			-	-	10	-	1	-	
			20	14	-	-	-	-	
			-	-	-	-	-	-	
			-	-	30	-	3	-	
17-6			-	-	40	-	7	-	
			-	-	-	-	-	-	
			10	3	30	-	10	-	
			-	-	10	1	-	-	
			30	4	-	-	-	-	
			10	2	20	-	2	-	
17-7			-	-	10	-	2	-	
			—						
			-	-	10	-	4	-	
			20	6	10	-	1	-	
			-	-	-	-	-	-	
			20	3	50	-	19	0	
17-8									

Treatment number 7

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
T-1			20	5	-	-	-	-	
			10	1	10	-	1	-	
			10	2	-	-	-	-	
			20	2	30	-	8	-	
			50	7	10	-	3	-	
			20	2	30	-	4	-	
T-2			-	-	10	-	3	-	
			-	-	-	-	-	-	
			30	28	-	-	-	-	
			-	-	10	-	2	-	
			20	7	-	-	-	-	
T-3			20	5	-	-	-	-	
			10	1	10	-	1	-	
			60	36	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
T-4			20	7	10	-	12	-	
			-	-	10	-	1	-	
			-	-	10	-	2	-	
			-	-	-	-	-	-	
			30	5	20	-	2	-	
			30	8	-	-	-	-	
T-5			10	1	-	-	-	-	
			10	5	10	-	1	-	
			10	1	-	-	-	-	
			60	70	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
T-6			-	-	30	-	42	-	
			-	-	10	-	3	-	
			10	2	10	-	1	-	
			10	7	~~0~~	~~0~~	~~0~~	~~0~~	
			40	27	-	-	-	-	
			-	-	-	-	-	-	
T-7			10	4	10	-	2	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			40	5	-	-	-	-	
			-	-	-	-	-	-	
T-8									

Treatment number 8

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — Spray ~~-Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
~~8~~-1	73-4	2	-	-	10	1	-	-	
	73-5	2	-	-	-	-	-	-	
	73-6	2	10	5	30	8	-	-	7 thrips
	74-4	2	-	-	30	5	-	-	
	74-5	1	-	-	10	1	-	-	
	74-6	1	-	-	30	4	-	-	
~~8~~-2	77-10	~~2~~	-	-	10	3	-	-	
	77-11	1	-	-	-	-	-	-	
	77-12	2	-	-	20	20	-	-	
	78-10	2	-	-	-	-	-	-	5 thrips
	78-11	1	-	-	30	3	-	-	
	78-12	2	-	-	20	9	-	-	
~~8~~-3	81-1	2	-	-	10	3	-	-	
	81-2	2	-	-	20	8	-	-	
	81-3	2	10	4	10	~~8~~	-	-	
	82-1	2	-	-	10	5	-	-	
	82-2	2	10	12	-	-	-	-	
	82-3	out							
~~8~~-4	85-7	2	-	- -	-	-	-		
	85-8	1	-	-	10	-	1	-	
	85-9	2	10	12	-	-	-	-	15 thrips
	86-7	~~2~~	-	-	50	40	-	-	7 thrips
	86-8	1	-	-	-	-	-	-	
	86-9	2	-	-	40	11	-	-	
~~8~~-5	87-7	2	-	-	-	-	-	-	
	87-8	1	-	-	-	-	-	-	
	87-9	2	-	-	-	-	-	-	
	~~88~~-7	2	-	-	20	3	-	-	
	88-8	out							
	88-9	2	-	-	40	52	-	-	
~~8~~-6	93-7	out							
	93-8	2	-	-	-	-	-	-	
	93-9	~~1~~	-	-	10	1	-	-	
	94-7	1	-	-	-	-	-	-	
	94-8	out							
	94-9	2	-	-	-	-	-	1	
~~8~~-7	95-1	2	-	-	-	-	-	-	
	95-2	2	-	-	-	-	-	-	
	95-3	~~2~~	-	-	-	-	-	-	
	96-1	1	-	-	-	-	-	-	
	96-2	2	10	1	20	10	-	-	
	96-3	2	-	-	30	3	-	-	
8-8									

Treatment number 8

Hop Pest Project — Corvallis, Oregon — 1938

Date July 9 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
8-1			-	-	10	-	5	-	
			-	-	-	-	-	-	
			10	12	30	-	3	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	20	-	3	-	3 thrips-1 Diab.
			-	-	-	-	-	-	
8-2			-	-	10	-	3	-	
			-	-	30	-	4	-	
			-	-	20	-	14	-	
			10	5	10	-	2	-	
			-	-	-	-	-	-	
			-	-	10	-	1	1	
8-3			-	-	10	-	12	-	
			-	-	-	-	-	-	
			-	-	20	-	3	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
8-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			10	1	-	-	-	-	
			-	-	40	-	26	-	1 St. cu. beetle
			-	-	20	-	2	-	
			-	-	10	-	1	-	
8-5			-	-	-	-	-	-	
			-	-	20	-	3	-	
			30	32	10	-	18	-	
			-	-	10	-	4	-	
			--	-	50	-	37	-	
8-6									
			-	-	20	-	14	-	
			-	-	60	-	11	-	
			-	-	-	-	-	-	
			-	-	30	-	9	-	
8-7			-	-	30	-	8	-	
			-	-	-	-	-	-	
			-	-	10	-	4	-	
			-	-	-	-	-	-	
			10	12	20	-	14	-	
			-	-	30	-	15	-	
8-8									

Treatment number 8

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — Spray-~~Dust~~ Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
~~8~~-1			-	-	-	-	-	-	
			-	-	10	-	1	-	
			20	15	-	-	-	-	
			-	-	10	-	1	-	
			-	-	20	-	12	-	
			10	1	-	-	-	-	
~~8~~-2			-	-	30	-	9	-	1 stink bug
			-	-	-	-	-	-	
			-	-	40	-	9	-	
			-	-	20	-	9	-	
			-	-	30	3	-	-	
			-	-	-	-	-	-	
~~8~~-3			-	-	-	-	-	-	
			-	-	20	-	3	-	
			10	2	-	-	-	-	
			-	-	10	-	1	-	
			50	28	-	-	-	-	
~~8~~-4			10	3	-	-	-	-	
			-	-	10	-	2	-	
			70	50	10	-	2	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	10	-	1	-	
~~8~~-5			70	30	60	-	18	-	
			-	-	-	-	-	-	
			30	~~8~~0	-	-	-	-	
			10	6	30	-	12	-	
			-	-	-	-	-	-	
~~8~~-6									
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	20	-	2	-	
			20	3	30	-	7	-	
~~8~~-7			-	-	10	-	2	-	
			-	-	10	-	1	-	
			-	-	10	-	1	-	
		-	-	-	-	-	-	-	
			30	2	20	-	20	-	
			10	1	20	-	5	-	
~~8~~-8									

Treatment number 8

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1938 — Spray-Dust Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
S-1			-	-	-	-	-	-	
			-	-	10	-	2	-	
			-	-	20	-	4	-	
			50	17	10	-	2	-	
			60	14	-	-	-	-	
			-	-	-	-	-	-	
S-2			20	3	10	4	-	-	
			-	-	10	-	1	-	
			-	-	30	-	5	-	
			20	18	-	-	-	-	
			-	-	-	-	-	-	
			-	-	20	-	2	-	
S-3			10	3	10	-	2	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
			-	-	10	-	2	-	
			20	6	-	-	-	-	
S-4			-	-	10	-	1	-	
			10	1	-	-	-	-	
			20	11	10	-	9	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			10	2	20	-	4	-	
S-5			10	2	-	-	-	-	
			-	-	-	-	-	-	
			20	7	-	-	-	-	
			10	2	10	-	1	-	
			-	-	-	-	-	-	
S-6									
			10	2	10	-	1	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			20	5	-	-	-	-	
S-7			10	1	10	-	1	-	
			-	-	-	-	-	-	
			-	-	20	-	7	-	
			-	-	-	-	-	-	
			10	16	-	-	-	-	
			-	-	10	-	4	-	
S-8									

Treatment number 1- Check

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — ~~Spray~~ Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Apt.		
1-1	36-4	2	-	-	~~1~~0	-	-	-	
	36-5	2	-	-	10	18	-	1	
	36-6	2	-	-	-	-	-	-	2 thrips-1 w. fly
	37-4	~~1~~	-	-	-	-	-	-	
	37-5	~~2~~	-	-	-	-	-	-	
	37-6	2	-	-	-	-	-	~~1~~	
1-2	42-1	~~1~~	-	-	-	-	-	-	
	42-2	~~2~~	-	-	~~1~~0	2	-	-	
	42-3	2	-	-	-	-	-	-	
	43-1	2	-	-	10	~~1~~	-	-	
	43-2	2	-	-	-	-	-	2	
	43-3	2	-	-	-	-	-	1	
1-3	46-7	out							
	46-8	1	-	-	-	-	-	-	
	46-9	1	-	-	-	-	-	-	
	47-7	1	-	-	-	-	-	-	
	47-8	1	-	-	-	-	-	-	
	47-9	1	-	-	-	-	-	-	
1-4	48-4	1	-	-	-	-	-	-	
	48-5	1	-	-	~~1~~0	1	-	-	
	48-6	1	-	-	10	1	-	-	
	49-4	1	-	-	-	-	-	-	
	49-5	1	-	-	-	-	-	-	
	49-6	1	-	-	-	-	-	-	
1-5	52-1	out							
	52-2	1	-	-	-	-	-	-	
	52-3	1	-	-	-	-	-	1	
	52-4	1	-	-	-	-	-	-	
	52-2	1	-	-	-	-	-	-	
	52-5	1	-	-	-	-	-	-	
1-6	56-10	1	-	-	-	-	-	1	
	56-11	1	-	-	-	-	-	1	
	56-12	1	-	-	-	-	-	1	
	57-10	1	-	-	-	-	-	1	1 thrips
	57-11	1	-	-	-	-	-	-	
	57-12	1	-	-	-	-	-	2	
1-7									
1-8									

Treatment number 1- Check

Hop Pest Project | Corvallis, Oregon | 1938

Date July 19 1938 | ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
1-1			30	7	40	-	15	-	
			-	-	30	-	30	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	10	-	1	-	
1-2			-	-	10	-	2	-	1 white fly
			-	-	20	-	4	-	
			10	3	10	-	5	-	
			-	-	10	2	-	-	
			-	-	40	-	11	-	-
			-	-	40	-	28	-	
1-3									
			10	3	-	-	-	-	
			-	-	-	-	-	-	
			-	-	10	-	1	-	
			-	-	40	-	24	-	
			-	-	-	-	-	-	
1-4			-	-	-	-	-	-	1 white fly
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-5									
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	--	-	- -	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-7									
1-8									

Treatment number 1 Check

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1938 — ~~Spray~~-Dust Block Spray

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
1-1			-	-	-	-	-	1	
			-	-	2 0	-	10	-	
			-	-	-	-	-	-	
			-	-	10	-	3	-	
			-	-	-	-	-	-	
			-	-	10	-	2	-	
1-2			-	-	20	-	9	-	
			-	-	-	-	-	-	
			-	-	10	-	1	-	
			-	-	20	-	7	-	
			-	-	40	-	8	-	
			-	-	70	-	20	-	
1-3									
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 white fly
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
1-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	--	-	-	-	-	
1-5									
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			- -	-	-	-	-	-	
			-	-	- -	-	-	-	
			-	-	-	-	-	-	
1-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-7									
1-8									

Treatment number 1- Check

Hop Pest Project — Corvallis, Oregon — 1938

Date August 9 1938 — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
1-1			50-	36	-	-	-	-	
			10	1	10	-	1	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			20	4	-	-	-	-	
			-	-	20	-	6	-	
1-2			-	-	20	-	2	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 thrips
			-	-	-	-	-	-	
			-	-	10	1	-	-	
			-	-	-	-	-	-	
1-3									
			-	-	-	-	-	-	1 thrips
			-	-	-	-	-	-	2 thrips
			-	-	-	-	-	-	1 thrips
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 thrips
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-5									
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 thrips
1-6			-	-	-	-	-	-	
			-	-	-	-	-	-	2 thrips
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 thrips
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-7									
1-8									

Treatment number 1 Check

Hop Pest Project | Corvallis, Oregon | 1938

Date August 20 1938 | Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
1-1			90	62	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			10	2	-	-	-	-	
			-	-	10	-	5	-	
1-2			-	-	20	-	9	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	40	-	6	-	
1-3									
		-	-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-5									
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
1-7									
1-8									

Treatment number 2

Hop Pest Project | Corvallis, Oregon | 1938

Date July 8 1938 | ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
1			—						
			-	-	10	-	2	-	
			-	-	10	-	2	-	
			-	-	-	-	-	-	
			-	-	20	-	8	-	
			-	-	40	-	12	-	
2-2			-	-	-	-	-	-	1 thrips
			-	-	30	-	14	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
2-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	20	-	3	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabrotica
			—						
2-4			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
2-5			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
2-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
2-7									
2-8									

Treatment number 2

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
B-1			~						
			-	-	10	-	7	-	
			-	-	20	-	4	-	
			-	-	-	-	-	-	
			-	-	60	-	12	-	
			-	-	40	-	8	-	
B-2			-	-	-	-	-	-	
			-	-	30	-	8	-	
			-	-	-	-	-	-	
			-	-	30	-	15	-	
			-	-	20	-	7	-	
			-	-	-	-	-	-	
B-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	60	-	13	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			~						
B-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	--	-	
			-	-	-	-	-	-	
B-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-7									
B-8									

Treatment number 2

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1838 — -Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
P-1									
			-	-	20	-	10	-	
			-	-	40	-	50	-	
			-	-	-	-	-	-	
			-	-	40	-	25	-	
			-	-	30	-	18	-	
P-2			-	-	-	-	-	2	
			-	-	50	-	18	-	
			-	-	-	-	-	-	
			10	1	60	-	56	-	
			-	-	20	-	11	-	
			-	-	-	-	-	-	
P-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	1 Diabrotica
P-4			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
P-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
P-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
P-7									
P-8									

Treatment number 3

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
3-1	38-4	1	-	-	-	-	-	-	
	38-5	2	-	-	40	35	-	-	1 thrips
	38-6	1	-	-	-	-	-	-	
	39-4	1	-	-	-	-	-	-	
	39-5	2	-	-	-	-	-	-	
	39-6	2	-	-	20	9	-	1	
3-2	40-10	1	-	-	-	-	-	-	
	40-11	2	-	-	10	2	-	-	1 thrips
	40-12	2	-	-	30	36	-	-	2 thrips
	41-10	2	-	-	10	7	-	-	
	41-11	2	-	-	10	2	-	-	1 thrips
	41-12	2	-	-	30	24	-	-	
3-3	46-1	1	-	-	-	-	-	-	
	46-2	1	-	-	-	-	-	-	
	46-3	1	-	-	-	-	-	1a	
	47-1	1	-	-	-	-	-	-	
	47-2	1	-	-	-	-	-	-	
	47-3	1	-	-	-	-	-	-	
3-4	50-4	1	-	-	-	-	-	1	
	50-5	1	-	-	-	-	-	2	
	50-6	1	-	-	-	-	-	-	
	51-4	1	-	-	-	-	-	-	
	51-5	1	-	-	-	-	-	1	
	51-6	1	-	-	-	-	-	-	
3-5	52-7	1	-	-	-	-	-	2	
	52-8	1	-	-	-	-	-	3	
	52-9	1	-	-	-	-	-	2	
	53-7	1	-	-	-	-	-	10	
	53-8	1	-	-	-	-	-	3	
	53-9	1	-	-	-	-	-	-	
3-6	58-4	1	-	-	-	-	-	-	
	58-5	1	-	-	-	-	-	-	
	58-6	1	-	-	-	-	-	-	
	59-4	1	-	-	-	-	-	-	
	59-5	1	-	-	-	-	-	-	1 leaf hopper
	59-6	1	-	-	-	-	-	-	
3-7									
3-8									

Treatment number 3

Hop Pest Project — Corvallis, Oregon — 1938

Date July 8 1938 — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
B-1			-	-	-	-	-	-	
			-	-	10	-	3	-	
			-	-	-	-	-	-	
			-	-	10	-	2	-	
			-	-	20	-	2	-	
			-	-	90	-	52-	-	
B-2			-	-	-	-	-	-	
			-	-	40	-	12	-	3 Diabrotica
			-	-	30	-	15	-	
			-	-	20	-	16	-	
			-	-	20	-	11	-	
			-	-	10	-	2	-	
B-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	- -	-	-	-	-	
			-	-	-	-	-	-	2 thrips
			-	-	-	-	-	1	
			20	2	-	-	-	-	
B-4			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 thrips
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabtotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-6			-	-	-	-	-	-	
			-	-	-	-	-	-	3 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-7			-						
B-8									

Treatment number 3

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
D-1			-	-	-	-	-	-	
			-	-	20	-	16	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	20	-	5	-	
			-	-	40	-	16	-	
D-2			-	-	-	-	-	-	
			-	-	30	-	6	-	
			30	56	60	-	35	-	
			20	18	20	1	10	--	-
			-	-	-	-	-	-	
			-	-	20	-	5	-	
D-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
D-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	10	-	2	-	
			-	-	-	-	-	-	
D-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			--	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
D-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
D-7									
1-8									

Treatment number 3

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1939 — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
3-1			-	-	-	-	-	-	2 white fly
			-	-	50	-	20	-	
			-	-	-	-	-	-	
			-	-	10	-	1	1	
			-	-	10	-	1	-	
			-	-	90	-	60	-	
3-2			-	-	-	-	-	-	
			-	-	80	-	24	-	
			-	-	100	0	50	-	
			-	-	40	-	42	-	
			-	-	-	-	-	-	
			-	-	10	-	1	-	
3-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 white fly
3-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	--	
3-5			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	4	
			-	-	-	-	-	-	
3-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
3-7									
1-8									

Treatment number 4

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
4-1	36-1	out							
	36-2	2	-	-	20	24	-	-	
	36-3	1	-	-	-	-	-	-	
	37-1	2	-	-	10	10	-	-	
	37-2	1	-	-	-	-	-	-	
	37-3	2	-	-	-	-	-	-	
4-2	40-4	2	-	-	30	12	-	-	
	40-5	2	-	-	-	-	-	1	
	40-6	2	-	-	10	2	-	-	
	41-4	1	-	-	-	-	-	1	1 thrips
	41-5	2	-	-	-	-	-	-	
	41-6	2	-	-	-	-	-	-	
4-3	46-4	1	-	-	-	-	-	-	
	46-5	1	-	-	-	-	-	-	
	46-6	1	-	-	-	-	-	-	
	47-4	out	-	-	-	-	-	-	
	47-5	1	-	-	-	-	-	-	
	47-6	1	-	-	-	-	-	1	
4-4	48-7	1	-	-	-	-	-	-	
	48-8	1	-	-	-	-	-	-	
	48-9	1	-	-	-	-	-	-	
	49-7	1	-	-	-	-	-	-	
	49-8	1	-	-	-	-	-	-	
	49-9	1	-	-	-	-	-	-	
4-5	54-10	1	-	-	-	-	-	-	
	54-11	1	-	-	-	-	-	1	
	54-12	1	-	-	-	-	-	-	
	55-10	1	-	-	-	-	-	-	
	55-11	1	-	-	-	-	-	1	
	55-12	1	-	-	-	-	-	1	
4-6	58-7	1	-	-	-	-	-	2	
	58-8	1	-	-	-	-	-	-	
	58-9	1	-	-	-	-	-	1	
	59-7	1	-	-	-	-	-	-	
	59-8	1	-	-	-	-	-	-	
	59-9	out							
4-7									
4-8									

Treatment number 4

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
4-1	36-1	out							
	36-2	2	-	-	20	24	-	-	
	36-3	1	-	-	-	-	-	-	
	37-1	2	-	-	10	10	-	-	
	37-2	1	-	-	-	-	-	-	
	37-3	2	-	-	-	-	-	-	
4-2	40-4	2	-	-	30	12	-	-	
	40-5	2	-	-	-	-	-	1	
	40-6	2	-	-	10	2	-	-	
	41-4	1	-	-	-	-	-	1	1 thrips
	41-5	2	-	-	-	-	-	-	
	41-6	2	-	-	-	-	-	-	
4-3	46-4	1	-	-	-	-	-	-	
	46-5	1	-	-	-	-	-	-	
	46-6	1	-	-	-	-	-	-	
	47-4	out	-	-	-	-	-	-	
	47-5	1	-	-	-	-	-	-	
	47-6	1	-	-	-	-	-	1	
4-4	48-7	1	-	-	-	-	-	-	
	48-8	1	-	-	-	-	-	-	
	48-9	1	-	-	-	-	-	-	
	49-7	1	-	-	-	-	-	-	
	49-8	1	-	-	-	-	-	-	
	49-9	1	-	-	-	-	-	-	
4-5	54-10	1	-	-	-	-	-	-	
	54-11	1	-	-	-	-	-	1	
	54-12	1	-	-	-	-	-	-	
	55-10	1	-	-	-	-	-	-	
	55-11	1	-	-	-	-	-	1	
	55-12	1	-	-	-	-	-	1	
4-6	58-7	1	-	-	-	-	-	2	
	58-8	1	-	-	-	-	-	-	
	58-9	1	-	-	-	-	-	1	
	59-7	1	-	-	-	-	-	-	
	59-8	1	-	-	-	-	-	-	
	59-9	out							
4-7									
4-8									

Treatment number 4

Hop Pest Project | Corvallis, Oregon | 1938

Date July 8 1938 | ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
4-1									
			-	-	30	-	12	-	
			-	-	-	-	-	-	1 thrips
			-	-	20	-	8	-	
			-	-	10	-	1	-	1 Diabrotica
			-	-	80	-	12	-	
4-2			-	-	30	-	18	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	30	-	17	-	
			-	-	20	-	3	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
4-3			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
4-4									
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
4-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
4-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
4-7									
4-8									

Treatment number 4

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
4-1			—						
			10	5	40	-	15	-	
			-	-	-	-	-	-	
			-	-	80	-	21	-	
			-	-	70	--	36	-	
			-	-	20	-	12	-	
4-2			60	25	20	-	12	-	
			-	-	10	-	2	-	
			-	-	10	-	1	-	
			-	-	20	-	17	-	
			-	-	30	-	18	-	
			-	-	50	-	36	-	
4-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			—						
			-	-	-	-	-	-	
			-	-	-	-	-	-	
4-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
4-5			-	-	-	-	-	-	
			-	-	-	-	--	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
4-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			—	-	-	-	-	-	
4-7									
4-8									

Treatment number 4

Hop Pest Project Corvallis, Oregon 1938

Date July 29 1938 Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
4-1			—						
			-	-	30	-	8	-	
			-	-	-	-	-	-	
			-	-	100	-	50	-	
			-	-	-	-	-	-	
			-	-	20	-	2	-	5 thrips
4-2			10	12	30	-	7	-	
			-	-	-	-	-	-	
			-	-	60	-	35	-	
			-	-	-	-	-	2	
			-	-	-	-	-	-	
			-	-	10	-	3	-	
4-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			—						
			-	-	-	-	-	1	
			-	-	-	-	-	-	
4-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
4-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	--	-	-	
4-6			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			--	-	-	-	-	-	
4-7									
4-8									

Treatment number 5

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
~~5~~-1	36-10	2	-	-	-	-	-	2	
	36-11	2	-	-	-	-	-	-	
	36-12	1	-	-	-	-	-	-	
	37-10	2	-	-	-	-	-	-	1 thrips
	37-11	2	-	-	-	-	-	-	
	37-12	2	-	-	20	-	11	-	
~~5~~-2	42-4	2	-	-	10	-	1	-	
	42-5	2	-	-	10	-	10	-	
	42-6	2	-	-	10	-	4	1	
	43-4	2	-	-	10	-	1	-	
	43-5	2	-	-	30	-	34	-	1 thrips
	43-6	2	-	-	10	-	2	-	
~~5~~-3	44-10	1	-	-	-	-	-	-	
	44-11	1	-	-	-	-	-	-	
	44-12	out	-						
	45-10	1	-	-	-	-	-	-	
	45-11	1	-	-	-	-	-	-	
	45-12	1	-	-	-	-	-	-	
~~5~~-4	50-10	1	-	-	-	-	-	-	
	50-11	1	-	-	-	-	-	3	
	50-12	1	-	-	-	-	-	1	1 spittle bug
	51-10	1	-	-	-	-	-	1	1 thrips
	51-11	1	-	-	-	-	-	1	
	51-12	1	-	-	-	-	-	-	
~~5~~-5	54-7	1	-	-	-	-	-	2	
	54-8	out	-	-	-	-	-	-	
	54-9	1	-	-	-	-	-	-	
	55-7	1	-	-	-	-	-	-	
	55-8	1	-	-	-	-	-	2	
	55-9	1	-	-	-	-	-	-	1 leaf hopper
~~5~~-6	58-1	1	-	-	-	-	-	-	
	58-2	1	-	-	-	-	-	1	
	58-3	out							
	59-1	1	-	-	-	-	-	-	
	59-2	1	-	-	-	-	-	1	
	59-3	1	--	-	-	-	-	-	
~~5~~-7									
~~5~~-8									

Hop Pest Project — Corvallis, Oregon — 1938

Date July 8 1938 — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
5-1			-	-	40	-	11	-	
			-	-	-	-	-	-	
			-	-	20	-	6	-	
			-	-	-	-	-	-	1 Diabrotica
			30	60	-	-	-	-	
			-	-	80	-	14	-	
5-2			-	-	-	-	-	-	
			-	-	10	-	3	-	
			-	-	-	-	-	-	1 Caterpiller
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	40	-	22	-	1 Diabrotica
5-3			-	-	30	-	13	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
5-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
5-5			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabrotica
5-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
5-7			-	-	-	-	-	-	
5-8									

Treatment number 5

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — Spray-Dust Block ~~Spray~~ Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
5-1			-	-	20	-	3	-	
			-	-	-	-	-	-	
			-	-	30	-	9	-	
			-	-	40	-	15	-	
			50	7	-	-	-	-	
			-	-	80	-	40	-	
5-2			-	-	10	-	3	-	
			20	13	10	-	5	-	
			-	-	40	-	22	-	
			-	-	10	-	3	-	
			-	-	60	-	21	-	
			-	-	50	-	22	-	
5-3			-	-	-	-	-	-	
			-	-	-	-	-	-	1 white fly
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
5-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
5-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
5-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
5-7									
5-8									

Treatment number 5

Hop Pest Project — Corvallis, Oregon — 1938

Date Jyly 29 1938 — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
5-1			-	-	30	-	11	-	
			-	-	-	-	-	-	
			-	-	20	-	3-	-	
			-	-	10	-	3	-	
			-	-	-	-	-	1	1 Diabrotica
			-	-	30	-	13	-	
5-2			-	-	20	-	16	-	
			-	-	-	-	-	-	
			-	-	30	-	5	-	
			-	-	10	-	2	-	
			-	-	100	-	54	-	
			10	1	30	-	12	-	
5-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
5-4			-	-	-	-	-	-	
			-	-	-	-	-	1q	
			-	-	-	-	-	3	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
5-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
5-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
5-7									
5-8									

Treatment number 6

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
6l-1	36-7	2	-	-	-	-	-		
	36-8	2	-	-	-	-	-	-	
	36-9	1	-	-	-	-	-		
	37-7	-	-	-	30	8	-	-	
	37-8	1	-	-	-	-	-	-	
	37-9	out							
6l-2	42-7	2	-	-	-	-	-	-	
	42-8	2	-	-	10	1	-	-	
	42-9	out							
	43-7	2	-	-	-	-	-	-	
	43-8	2	-	-	-	-	-	-	
	43-9	1	-	-	-	-	-	-	
6l-3	46-10	1	-	-	-	-	-	1	
	46-11	1	-	-	-	-	-	-	
	46-12	1	-	-	-	-	-	-	
	47-10	1	-	-	-	-	-	-	
	47-11	1	-	-	-	-	-	-	
	47-12	1	-	-	-	-	-	-	
6l-4	48-1	1	-	-	-	-	-	-	
	48-2	1	-	-	-	-	-	-	
	48-3	1	-	-	-	-	-	-	
	49-1	1	-	-	-	-	-	-	
	49-2	1	-	-	-	-	-	-	
	49-3	out							
6l-5	54-1	1	-	-	-	-	-	-	
	54-2	1	-	-	-	-	-	-	
	54-3	1	-	-	-	-	-	-	
	55-1	1	-	-	-	-	-	-	
	55-2	1	-	-	-	-	-	-	
	55-3	1	-	-	-	-	-	-	
6l-6	56-4	1	-	-	-	-	-	-	
	56-5	1	-	-	-	-	-	-	
	56-6	1	-	-	-	-	-	-	1 thrips
	57-4	1	-	-	-	-	-	-	
	57-5	1	-	-	-	-	-	-	
	57-6	1	-	-	-	-	-	-	
6l-7									
6l-8									

Treatment number 6

Hop Pest Project — Corvallis, Oregon — 1938

Date July 8 1938 — ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
6-1			-	-	-	-	-	-	
			-	-	10	-	1	-	
			-	-	10	-	1	-	1 Diabrotica
			-	-	10	-	2	-	
			-	-	-	-	-	-	
6-2			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	40	-	20	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	1 Diabrotica
6-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
6-4			-	-	-	-	-	-	
			-	-	-	-	-	-	2 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
6-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 thrips
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
6-6			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	2 thrips
			-	-	-	-	-	-	
			-	-	-	-	-	-	
6-7									
6-8									

Treatment number 6

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
~~6~~-1			-	-	~~20~~	-	3	-	
			-	-	-	-	-	-	
			-	-	10	-	3	-	
			-	-	-	-	-	-	
			-	-	10	-	2	-	
6-2			70	67	~~20~~	-	5	-	
			-	-	30	-	6	-	
			-	-	40	-	11	-	
			-	-	10	-	3	-	
			-	-	-	-	-	-	
6-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	10	-	7	-	
~~6~~-4			-	-	-	-	-	-	1 white fly
			30	3	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
~~6~~-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	--	-	-	
~~6~~-6			-	-	-	-	-	-	1 white fly
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			10	1	-	-	-	-	
~~6~~-7									
~~6~~-8									

Treatment number 6

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1938. — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
6-1			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-		
			-	-	10	-	5	-	1 Diabrotica
			-	-	-	-	-	-	
6-2			-	-	-	-	-	-	
			-	-	80	-	43	-	
			-	-	10	-	4	-	
			-	-	10	-	1	1	
			-	-	-	-	-	1	
6-3			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	3	
			-	-	-	-	-	2	
6-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
6-5			-	-	10	-	1	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
6-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
6-7									
6-8									

Treatment number 7

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
T-1	38-10	2	-	-	10	1	-	-	
	38-11	Out							
	38-12	2	-	-	-	-	-	-	
	39-10	1	-	-	-	-	-	-	2 thrips
	39-11	1	-	-	-	-	-	1	
	39-12	1	-	-	-	-	-	-	
T-2	42-10	1	-	-	-	-	-	-	2 thrips
	42-11	2	-	-	-	-	-	-	
	42-12	1	-	-	-	-	-	-	1 thrips
	43-10	1	-	-	-	-	-	-	
	43-11	2	-	-	10	2	-	1	
	43-12	1	-	-	-	-	-	1	
T-3	44-1	out							
	44-2	1	-	-	-	-	-	-	
	44-3	1	-	-	-	-	-	-	
	45-1	1	-	-	-	-	-	-	
	45-2	1	-	-	-	-	-	-	
	45-3	1	-	-	-	-	-	-	
T-4	50-7	1	-	-	-	-	-	-	
	50-8	1	-	-	-	-	-	4	
	50-9	1	-	-	-	-	-	1	1 plant bug
	51-7	1	-	-	-	-	-	1	
	51-8	1	-	-	-	-	-	-	
	51-9	1	-	-	-	-	-	2	
T-5	52-4	1	-	-	-	-	-	7	
	52-5	1	-	-	-	-	-	1	
	52-6	1	-	-	-	-	-	-	
	53-4	out							
	53-5	out							
	53-6	1	-	-	-	-	-	3	
T-6	56-7	1	-	-	-	-	-	-	
	56-8	1	-	-	-	-	-	1	
	56-9	1	-	-	-	-	-	1	
	57-7	1	-	-	-	-	-	5	
	57-8	1	-	-	-	-	-	-	
	57-9	out							
T-7									
T-8									

Treatment number 7

Hop Pest Project — Corvallis, Oregon — 1938

Date July 8 1938 — ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
T-1			-	-	30	-	-	-	
			-	-	10	-	1	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
			-	-	10	-	3	-	
T-2			-	-	-	-	-	-	
			-	-	10	-	3	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	10	-	2	-	
			-	-	-	-	-	-	
T-3									
			-	-	-	-	-	-	
			-	-	10	-	1	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
T-4			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
T-5			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
T-6			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	2 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
T-7									
T-8									

Treatment number 7

Hop Pest Project | Corvallis, Oregon | 1938

Date July 19 1938 | Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
7-1			70-	28	10	-	1	-	
			—						
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 thrips
			-	-	40	-	10	-	
			-	-	-	-	-	-	
7-2			-	-	-	-	-	-	
			-	-	30	-	5	-	
			-	-	-	-	-	-	
			-	-	10	-	4	-	
			-	-	10	-	1	-	
			-	-	10	-	1	-	
7-3			—						
			-	-	-	-	-	-	2 white flies
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
7-4			-	-	-	-	-	-	
			20-	7	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
7-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			—						
			—						
			-	-	-	-	-	-	
7-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			—						
7-7									
7-8									

Treatment number 7

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1938 — ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
V-1			-	-	-	-	-	-	
			—						
			-	-	-	-	-	-	1 white fly
			-	-	-	-	-	-	
			-	-	10	-	1	-	
			-	-	-	-	-	-	
V-2			-	-	20	-	8	-	1 white fly
			-	-	20	-	16	-	
			-	-	-	-	-	2	
			-	-	-	-	-	1	1 Diabrotica
			-	-	30	-	8	-	2 thrips
			-	-	20	-	8	-	10 thrips
V-3			—						
			-	-	-	-	-	-	
			-	-	-	-	-	2	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	3	
V-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabrotica
V-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			—						
			—						
			-	-	-	-	-	-	
V-6			-	-	-	-	-	1	
			-	-	-	-	-	5	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
V-7			-	-	-	-	--	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			—						
V-8									

Treatment number 8

Hop Pest Project — Corvallis, Oregon — 1938

Date June 29 1938 — ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
T-1	38-7	1	-	-	10	2	-	-	
	38-8	2	-	-	10	4	-	-	
	38-9	2	-	-	20	12	-	-	
	39-7	2	-	-	-	-	-	-	
	39-8	2	-	-	20	4	-	-	
	39-9	2	-	-	10	1	-	-	
T-2	40-1	1	-	-	-	-	-	-	1 thrips
	40-2	2	-	-	10	3	-	-	
	40-3	2	-	-	-	-	-	-	
	41-1	1	-	-	-	-	-	-	
	41-2	2	-	-	-	-	-	-	1 thrips
	41-3	2	-	-	-	-	-	1	1 thrips
T-3	44-4	1	-	-	-	-	-	-	
	44-5	1	-	-	-	-	-	1	
	44-6	out							
	45-4	1	-	-	-	-	-	-	
	45-5	1	-	-	-	-	-	-	
	45-6	1	-	-	10	1	-	-	
T-4	50-1	1	-	-	-	-	-	-	
	50-2	1	-	-	-	-	-	-	
	50-3	1	-	-	-	-	-	-	
	51-1	1	-	-	-	-	-	-	
	51-2	1	-	-	-	-	-	-	
	51-3	1	-	-	-	-	-	-	
T-5	54-4	1	-	-	-	-	-	-	
	54-5	1	-	-	-	-	-	1	
	54-6	1	-	-	-	-	-	-	
	55-4	1	-	-	-	-	-	-	
	55-5	1	-	-	-	-	-	-	
	55-6	1	-	-	--	-	-	1	1 thrips
T-6	58-10	1	-	-	-	-	-	1	
	58-11	1	-	-	-	-	-	-	
	58-12	1-	-	-	-	-	-	-	
	59-10	1	-	-	-	-	-	2	
	59-11	1	-	-	-	-	-	1	
	59-12	1	-	-	-	-	-	-	
T-7									
T-8									

Treatment number 8

Hop Pest Project — Corvallis, Oregon — 1938

Date July 8 1938 — Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
B-1			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	30	-	3	-	
			-	-	10	-	1	-	1 Diabrotica
			-	-	40	-	28	-	
			-	-	10	-	1	1	
B-2			-	-	20	-	2	-	
			-	-	20	-	2	-	
			-	-	10	-	2	-	
			-	- -	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-5			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 Diabrotica
B-6			-	-	-	-	-	-	1 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	2 Diabrotica
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-7									
B-8									

Treatment number 8

Hop Pest Project — Corvallis, Oregon — 1938

Date July 19 1938 — *Spray-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
B-1			-	-	80	-	9	-	
			60	13	20	-	5	-	
			-	-	20	-	11	-	
			10	5	20	-	18	-	
			20	17	40	-	12	-	
			-	-	30	-	5	-	
B-2			-	-	-	-	-	-	
			10	7	40	-	15	-	
			-	-	20	-	12	-	
			-	-	-	-	-	-	
			-	-	20	-	5	-	
			-	-	-	-	-	-	
B-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	1 white fly
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-7									
B-8									

Treatment number 8

Hop Pest Project — Corvallis, Oregon — 1938

Date July 29 1938 — ~~Spray~~-Dust Block Dust

Treat. No.	Vine No.	Age	Red Spider Data		Hop Aphis Data			Flea Beetle Pop.	Remarks
			% Infest.	Pop/ Leaf	Infest.	Pop/leaf Ala.	Pop/leaf Apt.		
B-1			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	30	-	17	-	
			-	-	10	-	2	-	
B-2			-	-	-	-	-	-	1 white fly
			-	-	20	-	3	-	
			-	-	40	-	42	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	2 thrips
			-	-	-	-	-	-	
B-3			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
B-4			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-5			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
B-6			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
			-	-	-	-	-	-	
			-	-	-	-	-	-	
			-	-	-	-	-	1	
B-7									
B1-8									