THE GARDEN WEBWORM—*LOXOSTEGE SIMILALIS* GUEN. AS AN ALFALFA PEST IN KANSAS[1]

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The presence of garden webworms in alfalfa is indicated by strands of silk tying the terminal leaves of the main stems and lateral branch stems of alfalfa and many other kinds of plants to form nests or compact enclosures, (Fig. 4). Eventually the entire plant may appear as if it had been seared with a flame. Thin webs may occur on the surface of the ground surrounding the base of plants following the removal of the preceding hay crop; or they may appear also in newly sown alfalfa fields in early fall but they should not be confused with the webbing of *Nomophila* (Smith, 1942). Yellowish-green, black-spotted larvae of the garden webworm feed within these webs (Fig. 3). They are readily confused with the beet webworm (Fig. 2) and the alfalfa webworm (Fig. 1).

The garden webworm has been one of the major pests of alfalfa, corn, and gardens in Kansas for the last 35 years and this paper records observations on its life history, habits, and control which cover a period of 32 years. This is a widely known and distributed pest. It occurs over all of Kansas, as well as over most of the United States and South America. Poos (1951) stated that the most serious damage occurred in California, Nebraska, Iowa, Missouri, New Mexico, Kansas, Oklahoma, and Texas. The garden webworm was first noticed on weeds in Central Missouri in June 1914 (Haseman, 1920). It attacks numerous plants, including many kinds of weeds. It is commonly stated that this insect prefers pigweeds, going to alfalfa only when the weed foliage is destroyed. In recent years, alfalfa on numerous occasions has been almost completely consumed while pigweeds in adjacent fields were only partially attacked.

Seasonal History—The manner of overwintering of the garden webworm is not definitely known, but it is the general impression that it winters in Gulf states as a pupa. Adults have been taken as early as the latter part of March at Manhattan and they regularly occur in April and May and are always battered and badly worn.

Attempts to overwinter this species at Manhattan have been uniformly unsuccessful. Large numbers of adults were either caged or placed in vials and stored under a variety of conditions, but they usually died before December 1. Larvae and pupae likewise have died during the winter. Eggs in cages hatched soon after deposition, if they hatched at all.

First brood larvae begin to appear in the alfalfa fields in early May and are mature by the latter part of May, the moths appearing early in June. The second generation moths appear the last of June and continue to the middle July. These moths give rise to the second generation larvae which attack the second or third alfalfa cuttings, usually the second, and do more or less ser-

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ious injury, depending on their numbers. This attack occurs early in July. The third generation adults begin to appear late in July, and continue throughout August. Few eggs are deposited by this rather large brood of moths although a light third brood of larvae is produced which can be taken during September and October. Adults occur at all times during these months, and up to killing frosts. Most of these third generation larvae succeed in transforming to pupae and probably to adults, though some are killed by the frost. There are, therefore, three complete generations a year in Kansas, the second generation ordinarily being the one causing the greatest amount of injury. Sanborn (1916) stated that there are four or five generations in Oklahoma and that the last brood did not spin webs.

Life Stages—The eggs are deposited in flat scale-like masses which are gray in color (Dean and Smith 1935). In cages, these masses are readily deposited on or more commonly, under the leaves, but they are also deposited on the stems. The masses contain from 1 to 37 glassy or grayish, flat, nearly circular eggs which appear to overlap the other eggs, making up the mass. The eggs average 0.64 mm. in diameter, but some on the outside of masses measure as much as 1.1 mm. the long way. Under magnification, small pentagonal or hexagonal designs with raised edges can be seen on the chorion. The enclosed areas are shining. As development proceeds, they become dull brownish, then smoky black. Just before hatching, they become quite dark and the black heads of the larvae become visible. Hatching is effected either by eating or breaking a hole in the eggshell at the edge or by lifting up the top of the egg sufficiently to enable the larvae to crawl through the opening. The period of embryonic development varies from two to five days during the summer (Table 1).

The larvae are active creatures, light to dark greenish-yellow in color, and have three paris of prominent black spots on most of the segments (Fig. 3). A single seta arises from a small papilla which occurs in each spot. The young larvae eat together during the first instar then scatter and web the leaves and stems in the top of the alfalfa plant within which they feed upon the foliage (Figs. 4, 5, 6). Copious excrementitious black pellets occur in the webbing and render badly damaged hay of small value. When disturbed, the larvae take on a spasm of aimless wriggling which assumes proportions of violence for such small creatures. They throw themselves out of their webs and fall to the ground or drop on silken threads. There are six instar stages of development. A summary of the width of the head and the length of the larvae in the various instars is given in Table 2.

Larvae of the first two instars eat only the epidermis of the under sides of leaves, while later instars consume the entire leaf, usually beginning at the border. They spin some silk soon after hatching. The results of their feeding are quite inconspicuous during the early instars, but in the last two or three instars, both webbing and defoliation are readily observed. The larvae feed largely or wholly during the day. When numerous, there is a web in practically every plant, and during outbreaks several larvae in every plant. Such infested alfalfa has a lighter green color when viewed from a distance. Upon coming closer, the lack of foliage and the ragged appearance of what remains become evident. The webbing, however, is characteristic of this species but

TABLE 1. Length of time required for each larval stage of the garden webworm in rearings at the field insectary at Manhattan, Kansas during July and August.

Stage	Duration, Average days	Maximum No. of days	Minimum No. of days	No. of individuals averaged
Egg	2.8	3	2½	10
Larva	15.9	28	14	29
Prepupa	1.5	3	1	10
Pupa	8.7	13	4	23

TABLE 2. Summary of instar measurements of the garden webworm.

Stage		Average	Maximum	Minimum	No. of larvae averaged
1st instar	(Width of head	0.254mm.	0.26mm.	0.2mm.	30
	(Lenth of larva	2.1	2.5	1.6	
2nd instar	(Width of head	0.37	0.4	0.325	30
	(Length of larva	3.7	4.3	2.2	
3rd instar	(Width of head	0.58	0.7	0.55	21
	(Length of larva	6.1	9.3	4	
4th instar	(Width of head	0.92	1.0	0.8	30
	(Length of larva	9.5	13	6.6	
5th instar	(Width of head	1.10	1.2	1.05	30
	(Length of larva	11.03	14	9	
6th instar	(Width of head	1.34	1.5	1.25	30
	(Length of larva	13.4	20	9	

not a positive identification because the alfalfa webworm (Fig. 1), the beet webworm, *Loxostege sticticalis* (Fig. 2), a geometer—*Haematopsis grataria,* and certain Tortricids also make webbed nests in alfalfa, but their numbers are generally less.

When fully grown, the larvae enter the soil and spin cocoons of silk which extend vertically or nearly so just below the surface of the soil, the upper end often being continuous with it. In cages, they merely crawl below the leaf trash on the ground and form cocoons. The larvae pupate within these cocoons which occur, primarily, around the base of alfalfa plants. The pupal cases are thin and flat, brownish in color, nearly transparent, smooth, and measure on the average 12.5 mm. in length and 3.5 mm. in width. The

cocoon is closed below, but the upper end is open. They are thickly encrusted with soil when dug up.

The pupa is green at first, turning brown gradually until it is a rich reddish-brown. It measures on the average about 8 mm. in length. At the end of the abdomen are three short, stout spines. The average length of the pupal stage is 10 days. The adult emerges by forcing its way through the open end of the cocoon to the surface of the soil. It immediately crawls up a plant and awaits the expansion of the wings which requires approximately an hour.

The moths have a wing spread of approximately half to three-quarters of an inch (Dean and Smith 1935). They are yellowish-brown in color and grayish beneath. There are several zig-zag, brownish or blackish lines across the front wings which are often reduced to spots. The hind wings are light yellowish-brown throughout, except for some smoky-black spots near the margin.

The wings, when folded, nearly form an isosceles triangle in outline. When a person walks through a field, the moths fly up ahead for a distance of 3 to 10 yards then drop down excitedly and seek shelter on the under side of the leaves or on the lower parts of the plant. They are rarely seen during the day unless disturbed, but they become active in the evening and remain so at least during the early part of the night.

Copulation was not observed during the period of this study. There is a preoviposition period of approximately four days, after which a maximum of 493 eggs, judging from an ovule count, may be deposited. Usually only a few eggs were deposited in cage rearings, the maximum being 170 eggs. The adults are short-lived, except in the fall when they could be kept alive for a month or more. Usually they died within two weeks, the majority dying in two or three days.

Food Plants—Garden webworms feed upon a great variety of plants. During the outbreak of 1923, they were taken on practically all kinds of garden truck—such as Irish and sweet potatoes, melons, tomatoes, cabbage, cauliflower, spinach, onions, radishes, and peppers. They attacked the fruit of the melons as well as the flowers. They were common on many kinds of weeds such as the giant ragweed, *Ambrosia trifida,* and the common ragweed, *A. artemisifolia* L.; on lambsquarters, *Chenopodium album* L.; on pigweeds, *Amaranthus* spp.; smart weeds, *Polygonum* spp., both narrow and broad-leafed dock, *Rumex* spp., and many other kinds of weeds. No plants in the heavily infested areas were clearly immune. Alfalfa appears to be its favored food plant and not weeds, as is so often stated. It was observed that certain varieties of alfalfa at the College farm were more heavily injured by this insect during the outbreak of 1923 than were others. This difference was thought to have been due to difference in the stage of growth of the different varieties at the time of maximum egg laying, rather than to any differences inherent in the varieties of alfalfa. The moths of this species feed at alfalfa blossoms from late in the day until dark.

CONTROL

Natural Enemies—This insect is attacked by what appears to be the same bacterial and fungus diseases which attack many of the other alfalfa insects.

These diseases, however, are not common, and are, therefore, not major factors in the control of this pest.

Parasites—Bracon vulgaris Cress (Faur.) (Fam. Braconidae, Det. A. B. Gahan) was reared a few times during August, 1919 and 1920. It emerged from the webworm cocoon. *Cardiochiles explorator* (Say) (Fam. Braconidae, Det. A. B. Gahan) was reared during July several times. *Nemorilla maculosa* (Meig.) (Fam. Tachinidae) was reared from a larva in August, 1924. It was 14 days in the pupal stage. *Winthemia quadripustulata* (Fab.) (Fam. Tachinidae) was reared many times from parasitized larvae. The pupal stage normally lasted 12 to 15 days.

Predators—Birds such as grackles, robins, and several varieties of sparrows were the chief predators seen. They devour larvae especially after the alfalfa is cut while these and other caterpillars which attack alfalfa are crawling about on the ground or on the curing hay.

Cultural Control—The usual recommendation for the control of the garden webworm formerly was to cut the alfalfa as soon as it began to show severe injury. The crop is thereby saved and the larvae are forced to migrate to other sources of food or perish. In so doing, most die from exposure or are caught by birds and other predators. This has worked out very well in general in controlling the insect (Fig.7). However, Granfield (1951) reported that cutting alfalfa much before the full bloom stage results in injury to the plant, which brings about a reduction in the stand and encroachment of grasses.

Chemical Control—A series of experiments have been under way in Kansas to control these pests by use of the newer insecticides. Plots were first laid out in 1947 on the Agronomy Farm at Manhattan, Kansas. One plot was dusted with 1.65 pounds of actual DDT to the acre. This plot was paired with an untreated check plot. Garden webworm larvae were just beginning to damage the alfalfa at the time the insecticide was applied. Ninety-five percent control was obtained and the final results are shown in the comparison of seed yields. The treated plot yielded 130 pounds of seed per acre while the check plot yielded only 45 pounds per acre, an increase of 298 percent. During the 1947 season the third generation larvae attacked alfalfa at Manhattan which is somewhat unusual. Also unusual in this year were the webs which this generation placed on seedling alfalfa and anchored to the soil surrounding the plants. Plots 15 by 40 feet were staked out in an alfalfa field using insecticides and rates as given in Table 3. Since the stand of the alfalfa was thin, the sweep net method of population sampling was discarded and counts made on the square yard basis. The insecticide applications were made with a Root rotary hand duster on August 29. DDT used at the rate of 2.8 pounds per acre gave 96 percent control, at 4.6 pounds per acre 93 percent control and 9.1 pounds per acre 98 percent control at the end of one day. Rotenone, Rhothane, and Cryolite gave 27 percent, 36 percent, 29 percent control, respectively.

The best control for the five day period resulted from the use of DDT applied at the rate of 9.1 pounds per acre. The next best control was given by the combination of DDT-BHC which gave 97 percent control while the 4.6 and 2.8 pounds actual DDT treatments gave 95 percent control. The

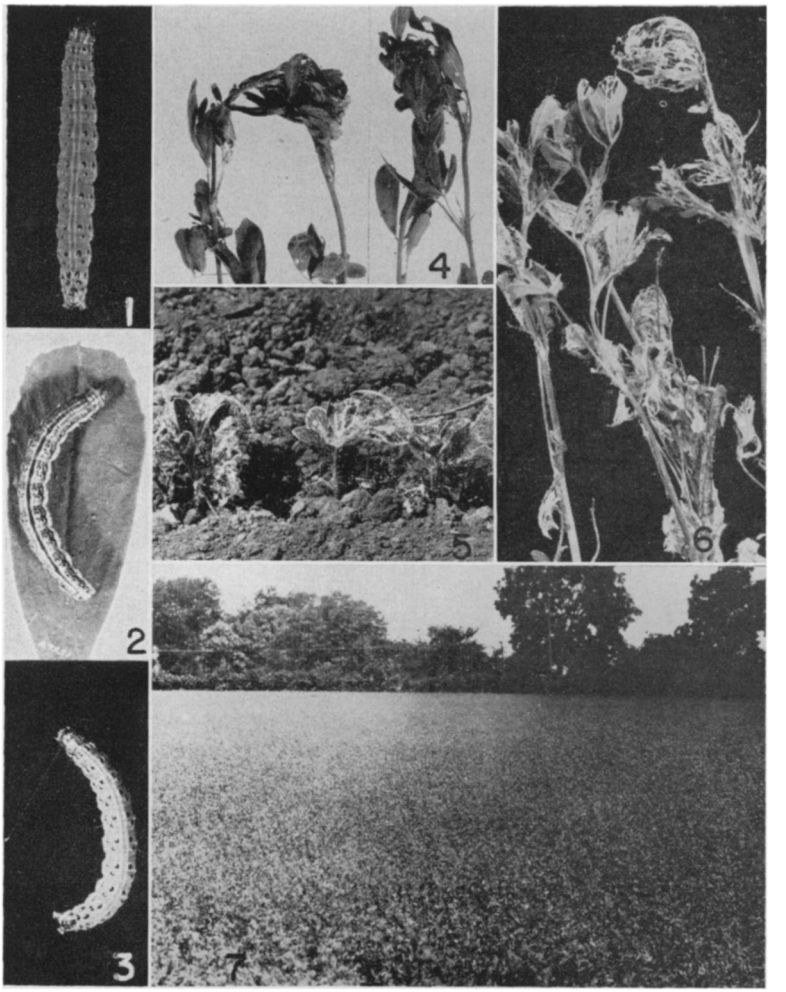
TABLE 3. Number of the larvae of the garden webworm per square yard following insecticide application. Old Horticultural Farm, Manhattan, Kansas. 1947.

Insecticide	Rate in pounds of toxicant per acre	Before treatment	DAYS AFTER TREATMENT					
			One		Three		Five	
			Number	Percent control	Number	Percent control	Number	Percent control
Check	——	350	349	—	126	—	115	—
DDT 10%	9.1	323	8	98	6	98	0	100
BHC 5% and DDT	2.0 2.0	478	17	96	2	98	0	100
DDT 3%	2.8	360	15	96	7	98	5	96
DDT 5%	4.6	355	25	93	3	98	0	100
BHC 3% gama	2.4	366	68	81	31	75	17	87
BHC 1% gama	0.7	342	159	54	110	13	57	50
Cryolite	32.0	342	249	29	80	37	84	27
Rhothane	3.0	269	224	36	131	0	122	0
Rotenone	10.8	295	256	27	114	10	151	0

TABLE 4. Buffalo alfalfa seed yields in garden webworm control plots and in the plots treated at the first growth and bud stage of development. Fort Hays Experiment Station, Hays, Kansas. 1949.

Treatment	Stage of growth when treated	Average pounds of seed harvested per acre	Percent increase or decrease on check plot
Check (untreated)		806	——
BHC	bud stage	1,073	33
DDT	bud stage	1,050	30
Parathion	bud stage	1,000	24
Aldrin	bud stage	985	22
Dieldrin	bud stage	853	6
Toxaphene	bud stage	642	—20
Chlordane	bud stage	595	—26
Check	untreated	529	——
BHC + DDT	6-8 in. tall	879	66
BHC + DDT	bud stage	872	65
BHC + DDT	6-8 in. tall and bud stage	1,145	116

2.4 pounds gamma BHC gave 80 percent control and 0.7 pounds of BHC gave 45 percent control of the garden webworm. Cryolite, rotenone, rhothane were virtually worthless in controlling the garden webworm. For all practical purposes, the 2.8 pounds DDT to the acre gave complete control of the larvae of the garden webworm and would have given the cheapest control during this experiment on a field basis.



EXPLANATION OF THE ILLUSTRATIONS

All photographs are original and were taken during work at Manhattan by the senior author.

1. Full grown larva of the alfalfa webworm, *Loxostege commixtalis* Walker, from alfalfa. August 27, 1932.
2. Full grown beet webworm, *L. stictacalis* Linn., from lambsquarters, August 27, 1932.
3. Full grown garden webworm to show the segmental markings, *L. similalis* Guen. August 27, 1932.
4. Tops of alfalfa plants webbed together to form the early stage of the so-called "nests" before serious foliage damage has been done. July 9, 1923.
5. Serious foliage damage to young soy-bean plants by garden webworms which migrated from an adjoining alfalfa field. July 3, 1931.
6. Severe foliage injury to the second growth of alfalfa by garden webworms. July 21, 1923.
7. The previous cutting of the portion of the field at the left was made at the normal time, so the new growth received maximum egg deposition and consequently severe foliage damage resulted. The previous cutting of the portion of the field at the right was delayed beyond the normal cutting time, and the new growth was only lightly infested by garden webworm. July 21, 1923.

No garden webworm problem developed in 1948. A few moths of this species were present in the alfalfa fields but the number of larvae produced was not sufficient to warrant an experiment.

An infestation developed on the second cutting seed crop during 1949. The total number of garden webworm larvae taken in five sweeps of an insect net in the untreated alfalfa reached serious numbers. The larvae started webbing the ends of the alfalfa stems at the time of flower bud formation. Their damage to seed production was enormous for those seed-growers that did not have their fields under constant observation. Parathion gave 95 percent control of the infestation. The control was not only high but indications of effectivenes were apparent within six hours of application. Toxaphene also gave 85% control but required 24 hours to become effective while DDT gave 83 percent control but required 36 hours to become effective. Analysis of the data showed the slope of the line for the rate of kill of each of these insecticides to be equal after they became effective.

Hand harvested alfalfa seed samples gave yields of 806 pounds per acre in the check plots, Table 4, compared with 1,073 pounds for the BHC plot. The insecticides also control leafhoppers and plant bugs so that the increase in seed yield should not be credited wholly to garden webworm control. These plots were located within 100 yards of an apiary and this alfalfa was the only alfalfa in bloom at the time. The honeybee colonies numbered five to seven colonies per acre. BHC, DDT, parathion, and aldrin gave the greatest increases in yield. Two of the toxaphene plots developed difficulties associated with moisture. After the experiment was completed, investigations revealed a gravel underlay under parts of the field which, unfortunately, included toxaphene plots in two different blocks.

In an experiment to determine the most practical number of insecticide treatments to apply to alfalfa being left for seed, there were few garden webworms in the plots treated when plant growth was in the bud stage in comparison with the check plots and fewer still in the plots treated when regrowth, following the first cutting reached six inches and at the bud stage of development. Alfalfa seed yields in the garden webworm and DDT and BHC (0.175 γ) spray control plots in 1949 as given in Table 4, shows a 65 percent increase in yield by treating at the bud stage; 66 percent increase in yield when treated at both stages of development.

There were no garden webworm problems in the western half of Kansas in 1950 but there were a few moths present in the alfalfa fields at all times. However, rainfall made the vegetative growth so heavy that the few larvae produced made no inroads on the production. Since the production of a seed crop was impossible under such rainfall conditions the alfalfa was cut for hay at the time of the second or third instars of the garden webworm.

This insect was present in the vicinity of Hays, Kansas in greater numbers during 1951 than in 1949. In 1951 the production of both alfalfa hay and seed was impossible without applying chemical control. To have attempted to obtain a seed crop after allowing the garden webworm to take the second crop would have postponed the seed crop until too late for best yields, Grandfield and Franklin (1952).

In the experiment in 1951 the average number of larvae per 25 sweeps of an insect net before treatment varied from 93.3 to 146.7 (Table 5). The first day after spraying, the average for the check plots was 160.7 larvae per 25 sweeps. Metacide gave 97 percent control of the garden webworm and DDT 95 pecent control 24 hours after treatment. Parathion and toxaphene gave 81 percent and dieldrin 77 percent control. Insecticides which gave good control for the season were: DDT 94 percent, toxaphene 90 percent, dieldrin 89 percent, metacide 88 percent, and parathion 86 percent.

The alfalfa seed yield also reflected the percentages of control of the garden webworm as shown in Table 6. The yields fell into three groups. The best yields were given by methoxychlor, dieldrin, and DDT with 40.8, 39.9, and 38.8 pounds per acre, respectively. On a percentage basis this was an increase of 189, 183, 175 percent, respectively over the yield of the check plots. The second group of insecticides gave yields as follows: chlordane 26.6, toxaphene 25.4, and DDT 24.9 which on a percentage basis was an increase over the check plots of 89, 80, 77 percent, respectively. The third group of insecticides gave yields as follows: aldrin 20.9, metacide 19.3, and parathion and pestox each 17.1 pounds or on a percentage basis an increase of 48, 37, 21 percent, respectively, over the yields of check plots. These low yields resulted from the record rainfall that occurred during July and August which made an alfalfa seed crop impossible. The rainfall and weather conditions also prevented adequate pollination of the flowers which developed.

In an experiment to determine whether one or two applications of insecticide were needed for control, one series of plots was treated with one pound DDT and ¾ pound toxaphene mixture on July 16; a second series of plots was treated July 26; a third series of plots was treated on July 16 and 26, and the fourth series received no treatment. The treatment on July 16 was applied when the alfalfa plant growth had reached 6 to 8 inches in height while the treatment of July 26 was applied at the bud stage of plant growth. There were 11 to 16 garden webworm larvae present in 25 sweeps of a 15-inch insect net on July 16, when the plant growth was only 6 inches in height. In those plots which were treated on this date, 85 to 89 percent control of the garden webworm was obtained, and by the third day, 97 to 99 percent control. These plots which received both treatments had 100 percent control. Control was maintained at the 82 percent level or higher for those plots which received the early treatment only. Good control, 89 percent or higher, was obtained in the plots at the bud stage of plant growth. However, considerable injury had been done by this time.

The seed yield in the untreated plots averaged 41.3 pounds per acre. The plots treated at 6-8 inches in height yielded 69 pounds per acre, the plots treated at the bud stage yielded 78.3 pounds per acre, and the plots treated at both stages of growth yielded 103 pounds per acre. This was an increase of 32 percent over the yield of the plots treated at the bud stage, an increase of 49 percent over the yield of the plots treated when 6-8 inches high and an increase of 149 percent over the yield of the untreated plots.

The outbreak in 1951 was as severe as that reported in 1923. It was larger than the outbreak which occurred in 1934 (Dean and Smith, 1935).

TABLE 5. Number of larvae of the garden webworm obtained per 25 sweeps of a 15 inch insect net in the garden webworm control experiment, buffalo alfalfa field 305, Fort Hays Experiment Station, Hays, Kansas, 1951.

Insecticide treatment	Before treatment July 25	After treatment							Average July 26-August 8
		July 26	July 27	July 28	July 30	Aug. 1	Aug. 4	Aug. 8	
Check	120.3	160.7	125.7	64.7	113.7	75.7	45.7	10.3	85.2
DDT	105.7	7.3	8.7	1.0	3.0	10.0	1.7	1.0	4.7
Percent control	—	95	93	98	97	87	96	90	94
Toxaphene	108.0	30.7	12.3	7.0	2.7	3.3	1.7	1.0	8.4
Percent control	—	81	90	89	98	96	96	90	90
Dieldrin	98.3	37.7	12.7	5.0	3.3	8.0	1.0	0.3	9.7
Percent control	—	77	90	92	97	89	98	97	89
Metacide	146.7	5.0	9.3	14.3	32.6	6.7	2.3	0.3	10.0
Percent control	—	97	93	78	71	91	95	97	88
Parathion	126.0	30.7	9.3	21.0	17.0	5.0	1.0	0.7	12.1
Percent control	—	81	93	68	85	93	98	93	86
Aldrin	140.1	64.0	52.7	24.0	9.3	8.7	4.7	0.3	23.4
Percent control	—	60	58	63	92	89	90	97	73
TEP	130.3	62.0	28.3	32.7	92.3	18.0	11.7	4.0	35.6
Percent control	—	61	77	49	19	76	74	61	58
Methoxychlor	124.3	87.6	65.7	36.3	68.3	15.7	11.3	4.3	41.3
Percent control	—	45	48	44	40	79	75	58	52
Chlordane	93.3	168.0	48.7	41.7	34.3	15.0	5.0	1.7	44.9
Percent control	—	0	61	36	70	80	89	84	47
Pestox	134.3	69.3	68.3	49.7	75.7	35.7	44.7	6.7	50.0
Percent control	—	57	46	23	33	53	2	35	41

TABLE 6. Alfalfa seed yields in the garden webworm control experiment, Buffalo alfalfa field 305, Fort Hays Experiment Station, Hays, Kansas, 1951.

Insecticide	Rate in pounds per acre	Average seed yield in lbs. per acre Average	Percent increase
Check	——	14.1	——
Methoxychlor	2.0	40.8	189.4
Dieldrin	0.5	39.9	183.0
DDT	2.0	38.8	175.2
Chlordane	1.0	26.6	88.7
Toxaphene	1.5	25.4	80.1
TEP	0.5	24.9	76.6
Aldrin	0.5	20.9	48.2
Metacide	0.5	19.3	36.9
Parathion	0.5	17.1	21.3
Pestox	1.0	17.1	21.3

No garden webworm outbreak occurred in Kansas in 1952. Moths were abundant on the third cutting of the alfalfa at Hays, Kansas at the bud stage of plant growth. Estimates of the population averaged 25 moths per square

yard. All of the alfalfa in this field was treated with 1½ pound of toxaphene per acre and no larvae developed.

Summary—This paper summarizes observations on the biology and control of the garden webworm in Kansas by the authors over a period of 32 years. This insect does not overwinter in the latitude of Kansas, but flies in from the south and lays eggs on its favorite host plants. This insect is not present in harmful numbers every year, serious outbreaks having occurred in 1923, 1934, 1949, and 1951.

The first brood larvae appear in the alfalfa field in early May, the second generation early in July, and the third in August. There may be a light brood in September and October. Adults occur at all times during these months and up to killing frost. Eggs are deposited in flat scale like masses containing 1 to 37 glassy or greyish flat circular eggs which contain small pentagonal or hexagonal designs that have enclosed areas which are shiny. As development proceeds they become dull brownish, then smoky-black and quite dark just before hatching. The larvae are active creatures, light to dark greenish-yellow in color, have three pairs of prominent black spots on most of the segments, and a single seta which arises from a small papilla which occurs in each spot. The larvae are gregarious during the first instar stage, then scatter and web the leaves and stems in the top of the alfalfa plant, within which they feed and develop.

When disturbed, the larvae take on a spasm of aimless wriggling. They eat only the epidermis of the underside of the leaves in the early instars, while the later instars consume the entire leaf. When fully grown, the larvae enter the soil and spin coccoons of silk in which they pupate. The pupa is green at first then turning brown gradually until it is a rich yellowish-brown.

No garden webworm outbreaks occurred in Kansas in 1948, 1950, or 1952. This may have been due in part to weather conditions, in part to the timing of the cutting of the alfalfa which may have occurred at an adverse time for the garden webworm. When the garden webworm life cycle and the cycle of the alfalfa cutting are synchronized, damage can occur on every cutting of the alfalfa except the first in eastern Kansas.

The worst outbreak of the garden webworm in Kansas history occurred during 1951. The alfalfa in large areas of Kansas was completely destroyed by the garden webworm on the second and third cuttings. Only those growers of alfalfa that applied insecticides received either a hay or a seed crop.

The best control of the garden webworm was obtained by the use of DDT, toxaphene, dieldrin, metacide, and parathion. Parathion gave the most rapid control while toxaphene and DDT were 24 to 36 hours longer in giving control.

DDT applied at two pounds per acre gave better control and a higher yield of alfalfa seed than did the application of one pound of DDT. Also, the application of insecticides when the alfalfa was only six to eight inches in height and the bud stage of development, gave greater yields than did the application of insecticide at bud stage alone or when the alfalfa had reached six inches in height, or when no application was made. A part of the credit for increased seed yields in the garden webworm experiments is due to the control of leafhoppers and plant bugs by the insecticides.

Under most conditions the use of two pounds of DDT per acre applied when the first webs appear will give the best control. For the protection of the seed crop or on the early plant growth following the removal of a hay crop, this is the Kansas recommendation.

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BRACHYPTEROUS FORM OF *HEBRUS CONSOLIDUS* UHLER (HEMIPTERA, HEBRIDAE)

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Only a single species of the genus *Hebrus* Curtis having both a macropterous and brachypterous form has been described from the Western Hemisphere at the present time. In a recent shipment of Hebridae received from Harold C. Chapman, Entomologist for the Bureau of Entomology and Plant Quarantine, I discovered a series of brachypterous *Hebrus consolidus* Uhler. Drawings and comparison of the two forms with a complete description of the brachypterous specimens follow.

Brachypterous form

Size: Male; length, 1.53 mm. to 1.95 mm.; width across humeri, 0.68 mm. to 0.70 mm. Female; length, 2.00 mm. to 2.55 mm.; width across humeri, 0.69 mm. to 0.73 mm.

Color: Head fusco-ferruginous, anterior portion of face darker, compound eyes fuscous; antennae testaceous, distal segments darker; pronotum fuscous, nearly concolorous in most specimens; scutellum fuscous, lighter toward apex in some specimens; hemelytra with viens fuscous, median portion lighter, membrane fuliginous, fumose near outer border, pure white area near base; abdomen fuscous, connexivum fusco-testaceous. Underparts: head with buccula testaceo-sulphureous to testaceous, rostrum testaceous; all