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Tarnished and Alfalfa Plant Bugs in Alfalfa: Population Suppression with ULV Malathion

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Tarnished and Alfalfa Plant Bugs[1] in Alfalfa: Population Suppression with ULV Malathion[2]

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Abstract

ULV malathion (9.7 oz AI/acre) was applied to a 16 mi^2 area in August 1968, 1969, and 1970 for western corn rootworm, *Diabrotica virgifera* LeConte, adult control. Nontarget insects in alfalfa, also treated, were monitored. Tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), was reduced 89–98%. Survival of eggs and adult migration resulted in rapid reinfestation of the treated area in 1969 and 1970; adult migration alone was important in 1968. Alfalfa plant bug, *Adelphocoris lineolatus* (Goeze), was reduced 96–98%. Repopulation following the 1969 and 1970 treatments was by development from eggs surviving the treatment. The 1969 treatment resulted in lower populations in the treated area through 3 generations the following year. Migration appeared to be a factor in repopulation only following the 1968 treatment, which failed to reduce the 1st generation the next year. Timing of alfalfa harvest during nymphal development is equally effective in population suppression.

The total environment in a large area was treated with ULV malathion during August of 3 consecutive years in an experimental attempt to suppress populations of western corn rootworm, *Diabrotica virgifera* LeConte. Alfalfa comprised 46 and 41% of the acreage in the treated and control areas, respectively, and the fate of various nontarget insects was determined in that crop. This paper reports the response of tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), and alfalfa plant bug, *Adelphocoris lineolatus* (Goeze), to the treatment.

Methods

ULV malathion (9.7 oz AI/acre) was applied by air to the total environment in a 16 (4×4) mi² area in Dawson County, Nebraska. An adjacent area of equal size served as a control. Treatment dates were Aug. 22–24, 1968, Aug. 14–15, 1969, and Aug. 10–11, 1970. No other insecticides were applied to alfalfa.

Alfalfa fields in both area were sampled with a 15-in. diam sweep net. Sweeping began ca. 100 ft into the field from the border and was continued toward the center of each field until 50 sweeps were obtained. A minimum of 49 fields was sampled in each area both pre- and postspray each year, and at least 30 fields/area on other dates included in Tables 1 and 2. The same fields were sampled throughout the study. Biological data, in part, are based on 8 fields sampled at 7–10 day intervals during the season.

Results

Tarnished Plant Bug

Overwintering adults became active in early May. There were 3–4 generations each year with considerable overlap, and all stages were present from mid-May until frost. Table 1 summarizes populations during the study.

Table 1. Tarnished plant bug populations (number per 50 sweeps), Dawson County, Nebraska, 1968–70

		Treated area		Control area		%
Year	Date	Population	% Nymphs	Population	% Nymphs	Reduction
1968	May 28	2.94	32	3.50	35	
	Aug. 16 (prespray)	24.78	16	33.43	32**[a]	
	Aug. 27 (postspray)	0.49	17	35.27	62	98**[b]
	Sept. 6	3.78	2	25.08	61**	80**
1969	May 28	47.48	86	39.35	84	
	July 9	61.60	56	55.72	61**	
	Aug. 11 (prespray)	24.60	27	46.39	41**	
	Aug. 18 (postspray)	1.39	24	42.97	38	94**
	Aug. 26	10.18	32	36.49	50**	47**
	Sept. 9	28.15	54	24.13	59	
1970	May 1	0.49	8	0.73	6	
	May 26	60.25	83	59.23	84	
	June 22	67.46	25	73.42	26	
	July 9	79.36	78	63.49	64**	
	Aug. 7 (prespray)	89.02	65	89.55	62*	
	Aug. 14 (postspray)	5.88	69	52.84	58**	89**
	Aug. 26	31.23	71	76.98	79**	59**
	Sept. 17	3.74	13	5.30	20	29

a. * or **indicates significant difference in adult:nymph ratio from treated area by χ^2 at 0.05 or 0.01 level.
b. * or ** indicates significantly lower population than control area at 0.05 or 0.01 probability level by *t*-test; % reduction computed by Abbott's correction.

Each year, 89–96% mortality resulted from the treatment, but populations recovered rapidly posttreatment. In 1968, repopulation was due almost entirely to adult migration because on Sept. 6, only 2% of the population in the treated area consisted of nymphs vs. 61% in the control area. Early instars as well as adults were collected following both the 1969 and 1970 treatments, indicating that survival of eggs also was important those years. Each year (except possibly 1968 when sampling was discontinued Sept. 6) populations in the treated area reached the same level as in the control during the fall following treatment. Treatments had no effect on the 1st generation population the following spring.

Significant differences, unrelated to the treatments, in both populations and stage of development of the tarnished plant bug are reported in Table 1. Except for the postspray differences, these seem to be due entirely to small differences in maturity of the host plant in the 2 areas. The study area is a major production area for alfalfa dehydration, and commercial harvesting results in the majority of the fields in a given area being clipped at the same time. At the time of the Aug. 11, 1969, samples, 58% of the fields in the control area were 15 in. or greater in height vs. only 38% in the treated area. There were no significant differences at that time in populations or development when fields in the same height classes were compared in the 2 areas. Figure 1 shows populations and development in the control area in 1969 in relation to height.

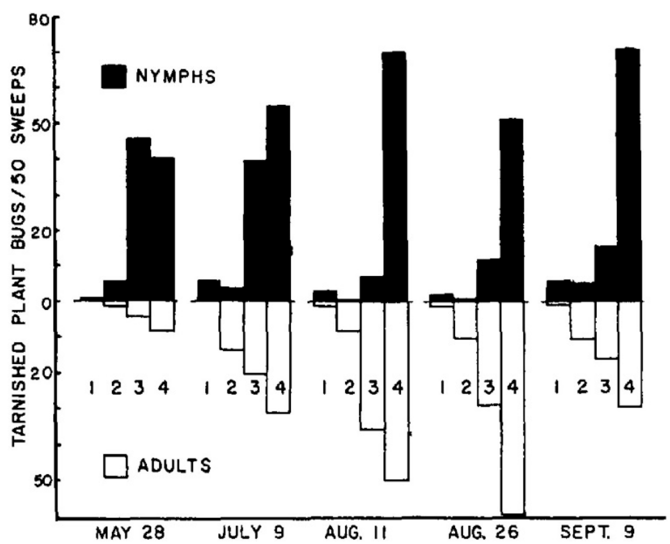

Figure 1. Seasonal tarnished plant but nymph and adult populations in relation to plant height, Dawson County, Nebraska (control area), 1969. 1, 2, 3, 4 = 0–7, 8–14, 15–21, 22+ in., respectively.

Immediately after harvest (fields 1–7 in. in height), most of the population present consisted of a few late-instars. The absence of small nymphs in the new regrowth indicates that eggs are removed by harvest. Very few nymphs were present in fields 8–14 inches in height, but adult populations started to increase. While sweep samples are not directly quantitative, and sweeping efficiency may be related to plant height, the fact that fewer nymphs were usually collected in fields 8–14 inches in height than in either shorter or taller fields indicates that population trends were correctly evaluated. New nymphs were present in 15–21 in. fields and adult populations were still increasing. Highest nymphal populations always were present in fields over 22 in. in height, with new adults present in many mature fields. The only exception to this pattern occurred in late May when the bulk of the population in all fields was 1st-generation nymphs.

Overlapping generations, with survival of eggs, and extensive adult migration seem to preclude any long-term suppression of tarnished plant bug by chemical means, although excellent initial kill of both adults and nymphs can be obtained. Harvest is effective in destroying both eggs and nymphs but permits adults to disperse to other fields. Continuous harvest in this area assures the presence of suitable fields for reproduction within the flight range of adults at all times.

Alfalfa Plant Bug

Hughes (1943) reported 2 generations/year in Minnesota while Craig (1963) reported only 1 and a partial 2nd generation in northern Saskatchewan. In Dawson County, Nebraska, hatching of overwintering eggs began in May. Three generations occurred each year with very little overlap (Fig. 2). This seems to be the 1st report of a 3-generation population.

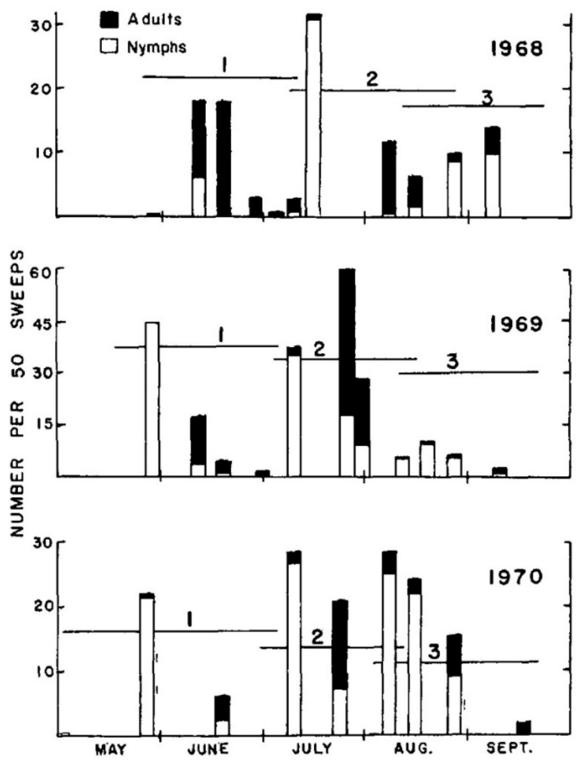

Figure 2. Seasonal populations of adults and nymphs of alfalfa plant bug in Dawson County, Nebraska (control area), 1968–70. Horizontal lines indicate seasonal occurrence of generations 1–3.

Hughes (1943) and Craig (1963) report that 1st generation eggs are distributed the full length of alfalfa stems but that eggs of the overwintering generation are laid in basal parts of the stem. While no data were obtained on oviposition habits, other results suggest that a high proportion of the eggs of all generations must have been laid in the basal part of plant stems in this area. Most fields were clipped at 1–3 in. and only date, not height, of clipping seemed to influence the subsequent generation. In all cases, there was a significant correlation between the number of adults maturing in a field and nymphal population the following generation. The duration of a complete lifecycle closely approximates the average interval between clippings, ca. 40 days, and individual fields tend to maintain, or lack, populations throughout a season depending upon the date of the 1st clipping in the spring.

Craig (1963) and Hughes (1943) consider adult migration important in establishing infestations. However, Popova (1963) found a significant correlation between field age and populations, a situation not prevailing for other plant bugs, and suggesting more limited migration. When this study began in 1968, populations were correlated with field age (r = 0.418*) but this correlation did not persist. The correlation seemed to be due primarily to light infestations in fields seeded the preceding season. Only a few new fields were added after 1968, the same fields being sampled throughout the study.

Adult populations in fields unharvested during nymphal development were always correlated with the number of nymphs present earlier (r = 0.490** to 0.968**). Harvesting resulted in loss of both nymphs and adults. Only during the 1st generation in 1970 was the adult population correlated with nymphal population in fields harvested during nymphal development (r = 0.537**); however, harvested fields had only 11% as many adults as unharvested, although the original nymphal populations were equal. In other cases, adults were not correlated with nymphs in fields clipped during nymphal development (r = –0.116 to –0.300). Unlike tarnished plant bug, few adults ever occurred in fields less than 15 in. in height. If migration of 1st- or 2nd-generation adults occurred, it must have been between fields over 15 in. in height where such migration would be confounded with adults which matured in the same fields. Migrants into shorter fields would be able to oviposit, but the next generation probably would again be lost to harvesting. The fact that nymphs did not appear in such fields further supports the observation of minimal migration. Only in the fall after the last clipping has been removed could there be any advantage accruing to the alfalfa bug by migration within this area, since the harvest sequence might be different the following year.

Table 2 is a summary of populations observed during this study. Each year the treatment resulted in 96–98% reduction in the population. During all years, survival was primarily as eggs as indicated by the presence of 1st-instars in the 1st posttreatment samples. The proportion of the population which was nymphal was significantly higher 2–3 weeks after treatment in the treated area in both 1969 and 1970. Differences in the 1st posttreatment samples are based on too few survivors to be meaningful.

Table 2. Alfalfa plant bug populations (number per 50 sweeps), Dawson County, Nebraska, 1968–71

Year	Date	Treated area		Control area		%
		Population	% Nymphs	Population	% Nymphs	Reduction
1968	Aug. 16 (prespray)	4.8	32	7.3	25	
	Aug. 25 (postspray)	0.1	67	9.9	86	98**[b]
	Sept. 6	0.9	89	13.8	73	90**
1969	May 28	35.5	100	36.5	100	
	July 9	33.8	93	41.8	93	
	Aug. 11 (prespray)	4.2	88	6.8	94	
	Aug. 18 (postspray)	0.2	100	8.4	95	96**
	Aug. 26	1.6	100	6.2	87	58*
	Sept. 9	1.6	98	2.7	33**[a]	4
	Oct. 7	0.9	8	1.2	0	–21
1970	May 26	13.7	94	30.4	94	**
	June 22	6.9	28	8.8	29	
	July 9	16.2	88	41.7	94**	*
	Aug. 7 (prespray)	21.8	88	34.2	89	*
	Aug. 14 (postspray)	0.4	94	24.5	90	97**
	Aug. 26	2.1	91	15.2	60**	78**
	Sept. 17	2.3	30	1.8	25	–100
1971	June 2	4.2	97	9.2	99	
	July 19	60.1	85	66.2	82*	

a. * or **indicates significant difference in adult:nymph ratio from treated area by χ^2 at 0.05 or 0.01 level.
b. * or ** indicates significantly lower population than control area at 0.05 or 0.01 probability level by *t*-test; % reduction computed by Abbott's correction.

Although treatment date was advanced each year, each treatment was applied to the population shortly after most nymphs had hatched (Fig. 2). This resulted from the successively earlier development during the 3 years that treatments were applied. May 1968 was 5°F below normal with July and August temperatures also well below normal, and all generations were delayed. May 1970 was 3°F above normal, and a few adults already were present the last week in May with the following generations also advanced. Thus, factors other than developmental stage of the population must be sought to explain differences in long-term suppression resulting from the 3 treatments.

The 1968 treatment had no significant influence on the size of the 1st generation the following season. Sampling was discontinued too early in 1968 to determine the ultimate posttreatment adult population. Due to the lateness of the 1968 season and low 3rd-generation population, it was considered possible that part of the 2nd-generation eggs may have diapaused, comparable to the situation reported by Craig (1963). However there was no correlation between the number of 2nd-generation adults and 1st-generation nymphs the following year, whereas the usual relationship between 2nd-generation adults and 3rd-generation nymphs did occur. More likely, late fall migration of adults was responsible for reinfesting the treated area in 1968. The best evidence for this is that 6 of 12 new seedlings made in late July or early August 1968 had infestations the following year. These fields could not have obtained 2nd-generation eggs but must have been infested after sampling was discontinued Sept. 6 (only 11% of the population was adult at that time), since no alfalfa plant bugs were present in any of these fields in samples taken on or before that date. If such migration occurred, it was fairly extensive since there was no significant difference between the border and the center of the treated area the following year. This was the only instance during the entire study in which adult migration may have been a factor in recovery of populations in the treated area.

Certainly adult migration was unimportant in either 1969 or 1970 when sampling was continued late into the fall. Although populations were equal in both areas in the last samples taken in 1969 and 1970, the population in the treated area could be explained by development from eggs hatching posttreatment and should be compared with the higher adult population achieved much earlier in the control area to explain the potential number of overwintering eggs and 1st-generation populations the following seasons. Populations in the treated area developed almost entirely in fields less than 6 in. tall at the time the treatment was made. While some nymphs were present posttreatment in tall fields, those fields were again harvested before nymphs reached maturity and those populations lost due to clipping.

The 1969 treatment suppressed populations in the treated area throughout 1970. Suppression might have been even greater had it not been for the high percentage of fields in the treated area favorable for development of late-hatching eggs. The 1st generation in 1970 was correlated with adult populations the preceding fall (r = 0.551** and 0.661** in the treated and control areas, respectively).

Less than 1/2 as many alfalfa plant bugs were present the 1st generation in 1971 in the treated area. Because of extreme variation, this difference was not significant. However the high correlation with adults present the preceding fall (r = 0.819**) suggests that the difference was real and due to population suppression achieved the preceding season. Second-generation populations in 1971 were similar in both areas. The large increase over the 1st generation can be attributed to the few fields harvested during development of 1st generation nymphs (only 5 of 30 in the treated area vs. 14 of 43 in the control area).

These results indicate that with proper timing of treatments, long-term suppression of alfalfa plant bug may be possible. Treatments applied between last egg hatch and 1st adults of any generation would be most effective. Suppression was enhanced by the minimal overlap between generations, a situation not reported by other workers dealing with a 2-generation population. Equally good results, however, could be expected by timing cuttings in the same manner. Migration by neither 1st nor 2nd generation adults was detected and, even if occurring, would not result in reinfestation of fields harvested during nymphal development because those fields would ordinarily again be harvested prior to completion of the subsequent generation. Timing of 1st cutting of alfalfa largely determined populations for the remainder of the season in individual fields. Fall migration possibly was important during 1 of 3 years in infesting new seedlings.

Notes

1. Hemiptera (Heteroptera): Miridae.
2. Published with the approval of the Director as Paper No. 3682 Journal Series, Nebraska Agricultural Experiment Station, and Contribution No. 375 of the Department of Entomology, University of Nebraska, Lincoln 68503. Research reported was conducted under Project No. 17-016. Received for publication Sept. 13, 1973.

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