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INSECT PESTS ASSOCIATED WITH BIRDSFOOT TREFOIL, *LOTUS CORNICULATUS*, IN WISCONSIN

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ABSTRACT

Insect surveys taken during 1984–1986 in Ashland and Bayfield Counties of northern Wisconsin revealed that several potential insect pest species were common in birdsfoot trefoil, *Lotus corniculatus*. Three plant bug species, including: the tarnished plant bug, *Lygus lineolaris;* alfalfa plant bug, *Adelphocoris lineolatus;* and *Plagiognathus chrysanthemi* were abundant in most sampled fields. *P. chrysanthemi* was the most abundant species, was only present in the northern locations, and completed one generation per year. *A. lineolatus* and *L. lineolaris* were second and third in abundance, respectively, and completed two generations per year. Population levels of the potato leafhopper, *Empoasca fabae,* exceeded a combined total of 45 nymphs and adults per sweep in a southern Wisconsin location but were uncommon in northern Wisconsin. Present, but less abundant, were the trefoil seed chalcid, *Bruchophagus platypterus;* meadow spittlebug, *Philaenus spumarius;* and pea aphid, *Acyrthosiphon pisum,* all occurring at densities of less than one insect per sweep.

Birdsfoot trefoil, *Lotus corniculatus,* has become an important perennial forage legume in parts of the United States and Canada. Trefoil is frequently grown on poorly drained soils which are marginal for alfalfa, *Medicago sativa,* production (Rohweder 1972). Likewise, trefoil has become a popular forage for growers in northern Wisconsin and grows well on the clay soils of the Superior Lowland. Subsequently, Ashland, Bayfield and Douglas counties of northern Wisconsin, aided by ample moisture, moderate humidity and long daylengths, have collectively become an important trefoil seed producing region. Despite the increasing popularity of trefoil, little has been reported on the insect pests associated with forage or seed production, especially in the Midwest.

Neunzig and Gyrisco (1955) reported that the meadow spittlebug, *Philaenus spumarius* (L.); potato leafhopper, *Empoasca fabae* (Harris); and several plant bug species, including the alfalfa plant bug, *Adelphocoris lineolatus* (Goeze); tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois); and *Plagiognathus chrysanthemi* (Wolff) were abundant in trefoil grown in New York and were responsible for bud and flower drop, plant stunting, and other types of damage. Other damaging insects included the trefoil seed chalcid, *Bruchophagus platypterus* (Walker), the larvae of which fed on the developing seeds. Guppy (1958) found that *A. lineolatus, L. lineloaris, P. chrysanthemi* and the rapid plant bug, *Adelphocoris rapidus* (Say), attack trefoil and several other legumes in Ontario, Canada. *A. lineolatus* and *L. lineolaris* have recently been reported to damage trefoil in Minnesota (Elling et al. 1985) and Michigan (Copeland et al. 1984).

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Copeland et al. (1984) also reported that the potato leafhopper, meadow spittlebug, and pea aphid appear to be potential trefoil pests in Michigan.

The purpose of this study was to identify the more abundant insect pests of trefoil in Wisconsin, study their seasonal distribution and occurrence, and consider their damage potentials to trefoil. Trefoil seed producers in northern Wisconsin have frequently applied insecticides without knowing when or how often to spray, or which insect species to target. However, the growers have indicated that one or more insecticide applications during the growing season appear to increase seed yields.

MATERIALS AND METHODS

Several trefoil fields, cultivars Leo, Maitland, and Norcen were sampled in Ashland and Bayfield Counties of northern Wisconsin during 1984–1986 from 15 May through 30 September, and one trefoil field (cultivar Empire) in Columbia County in southern Wisconsin was sampled 1 June through 31 August 1986.

Samples were taken with a 38 cm diameter sweep net at ca. biweekly intervals during 1984 and ca. weekly intervals during 1985 and 1986. Twenty pendulum sweeps per sample and ten samples per field were taken while walking a U-shaped pattern through each field. Samples were immediately transferred to nylon mesh bags and placed in a freezer for subsequent sorting.

The "Leo" field located on the University of Wisconsin-Ashland Agriculture Research Station in Bayfield County was planted during May 1983. This field received no insecticide applications and forage was harvested once in July 1984, but was not harvested during 1985 or 1986.

The "Maitland" field, planted during August 1983, was a privately owned seed production field located in Ashland County. The field received one insecticide application during July 1984, two during 1985 (June and July), and one during June 1986. The field was harvested for seed during August each year.

The "Norcen" field was also a privately owned commercial seed production field located in Ashland County and was planted in August 1981. This field received a July insecticide application and was harvested for seed during August 1984. In 1985, because of the dense weed growth and uneven trefoil distribution, a nearby one-year-old "Norcen" field was sampled. The cooperating grower applied an insecticide in June and harvested the seed during August. Because of severe winterkilling of plants, this field was replaced with an adjacent "Norcen" field during 1986 which was seeded during May 1985. This field received an insecticide application in June and the seed was harvested during August 1986.

The "Empire" field seeded during May 1985, was located in southern Wisconsin on the University of Wisconsin-Arlington Agriculture Field Station in Columbia County and was sampled only during 1986. In addition to sweep net samples, a D-vac® sampler was used for monitoring potato leafhopper populations. Ten samples at 10 sucks per sample were taken while walking a U-shaped pattern through the field. Fleischer et al. (1982) describes a procedure for transforming adult potato leafhopper densities estimated with a D-vac to sweep net densities. Thus, the potato leafhopper densities were all converted from D-vac to sweep net estimates using this method. This field was neither harvested nor sprayed.

Only those potentially damaging insects that were numerous and consistently present were counted and identified to species. The other insects, including infrequently collected but potentially damaging species, beneficials and non-pests were noted but not counted.

RESULTS AND DISCUSSION

Surveys indicated that *A. lineolatus*, *L. lineolaris*, and *P. chrysanthemi* were abundant in fields which were sampled in northern Wisconsin during all three years of the study.

Adelphocoris lineolatus completed two generations per year in Wisconsin trefoil with first generation nymphs occurring from May through June and adults observed primarily from late June through July (Fig. 1A). Second generation nymphs were collected throughout August, followed by adults in late August and into September. *Adelphocoris lineolatus* is known to overwinter in the egg stage (Hughes 1943), which is consistent with the phenology we observed.

Lygus lineolaris had two generations per year in Wisconsin trefoil and adults were collected at very low densities throughout May and early June (Fig. 1B). First generation nymphs occurred throughout June and early July, and subsequent adults were observed during July and early August. Second generation nymphs occurred in August and adults were present from late August through September. Hughes (1943) indicated that *L. lineolaris* overwinters in the adult stage, which is consistent with the phenological pattern we observed.

Plagiognathus chrysanthemi completed one generation per year in sampled fields with nymphs occurring from May through June, and adults observed from ca. mid-June through mid-August (Fig. 1C). Guppy (1963) indicated that *P. chrysanthemi* overwinters as eggs, which conformed to the pattern we observed.

Population trends were similar for all fields (Figs. 2, 3 and 4) except when populations were disrupted by insecticide applications or harvest. In the one-year-old stands, however, *A. lineolatus* and *P. chrysanthemi* populations were generally lower (Figs. 2-1984, 3-1984, 4-1985 and 4-1986) than in two- and three-year-old stands. This was probably the result of these two species being unable to fully colonize and subsequently oviposit in newly-seeded trefoil before the end of the growing season.

During the early portion of the growing season (May–July), *P. chrysanthemi* tended to be the most abundant of the three plant bug species in the northern Wisconsin locations (Figs. 2–4). *A. lineolatus* was generally the second most abundant and *L. lineolaris* the least abundant of the three species.

Sweep samples indicated that *P. chrysanthemi* was not present in the "Empire" field in southern Wisconsin; *A. lineolatus* and *L. lineolaris,* however, were detected at densities comparable to those in the northern fields (Fig. 5).

Plant bug feeding in relation to trefoil development.

Peak plant bug populations (which included primarily *P. chrysanthemi* and *A. lineolatus*) usually occurred during June and early July (Figs. 2–4). This is most easily seen in the unsprayed and unharvested "Leo" field during 1985 and 1986 (Fig. 2). Coincidentally, peak flower production (which was visually observed and recorded) generally occurred during this same period (June through early July). Results from feeding experiments (Wipfli 1987) suggested that trefoil plants are most sensitive to plant bug feeding during bud and blossom setting and exhibit severe bud and flower abortion in response to plant bug feeding.

Plant bug damage can be so severe during June and July that the trefoil plants are unable to produce flowers, (i.e. trefoil flower buds are immediately aborted in response to plant bug feeding). This phenomenon was noted at several locations but was especially apparent in the "Leo" field where mirid densities commonly exceeded 15 per sweep. A natural break in the mirid populations (between generations) was observed during late July (Fig. 2, 1985 and 1986), and subsequent flower production was observed in early August.

Several other potentially injurious insect species were present. The trefoil seed chalcid, *Bruchophagus platypterus* (Walker) was present in all fields sampled in the northern part of the state, but at densities below one or two per sweep in most cases. The meadow spittlebug was common but was not considered to be an important pest during the three sampling years, when less than one spittle mass per four or five plants was observed in the most heavily infested fields. Although there is no established spittlebug threshold for trefoil seed production, this is well below the level for alfalfa forage of one spittle mass/stem (Wedberg et al. 1988).

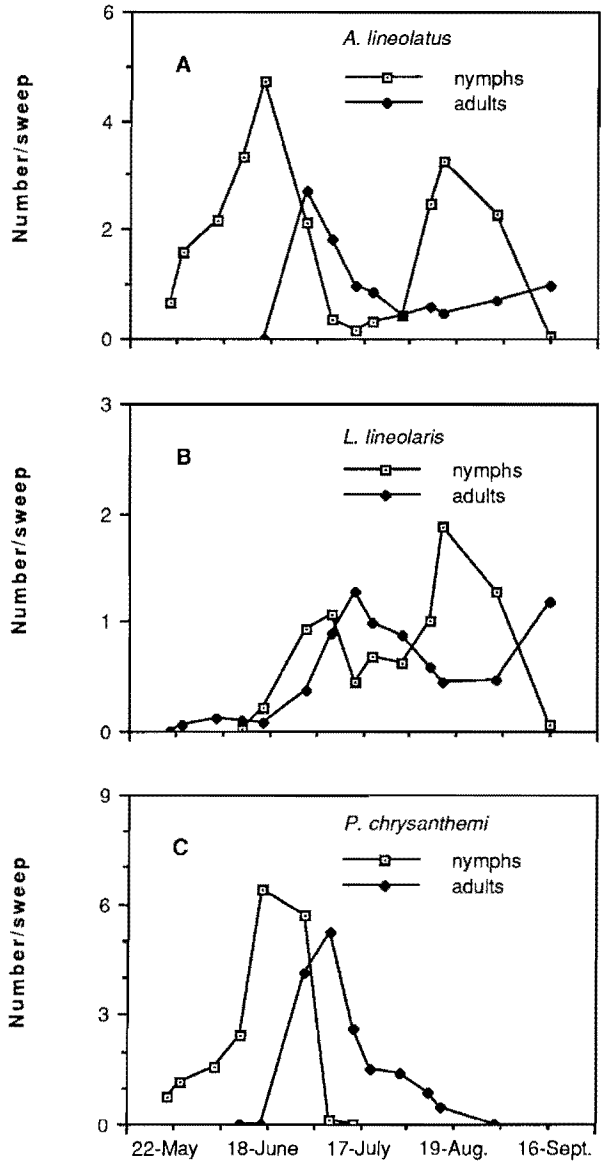

Figure 1. Nymph and adult *Adelphocoris lineolatus, Lygus lineolaris,* and *Plagiognathus chrysanthemi* seasonal occurrence in the Leo field—1985.

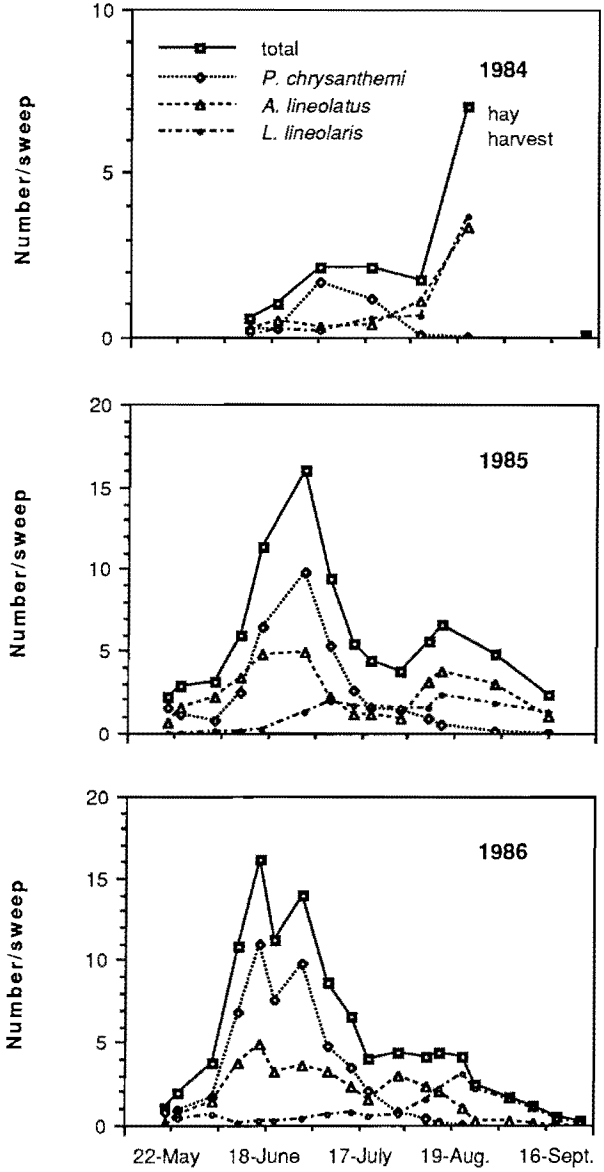

Figure 2. Sweep counts of *Adelphocoris lineolatus, Lygus lineolaris,* and *Plagiognathus chrysanthemi* in the Leo field—1984–1986.

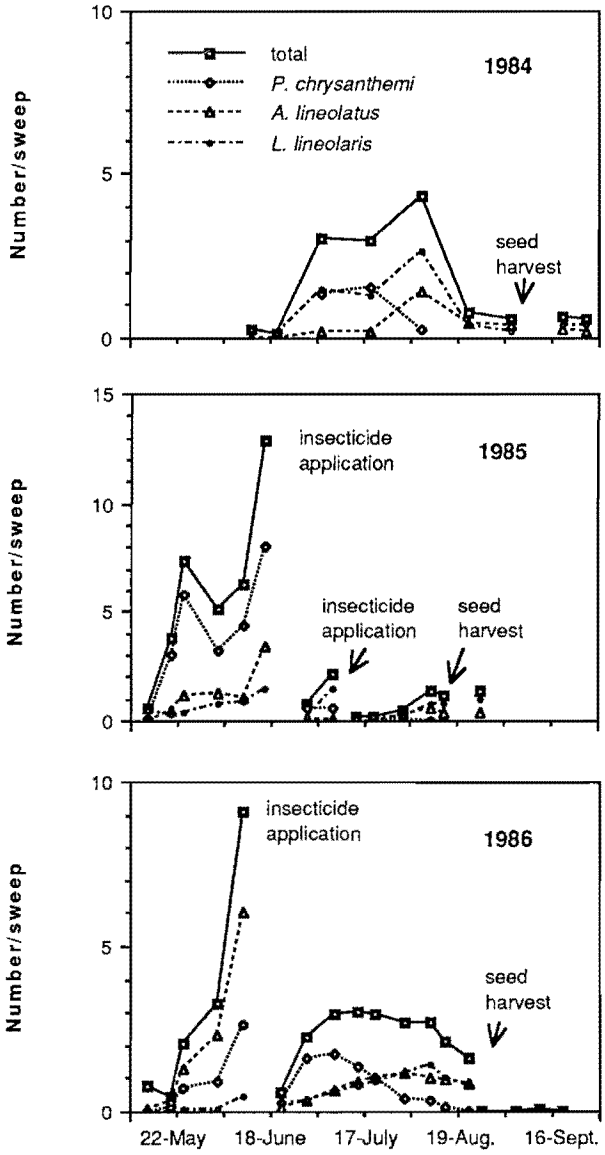

Figure 3. Sweep counts of *Adelphocoris lineolatus, Lygus lineolaris,* and *Plagiognathus chrysanthemi* in the Maitland field—1984–1986.

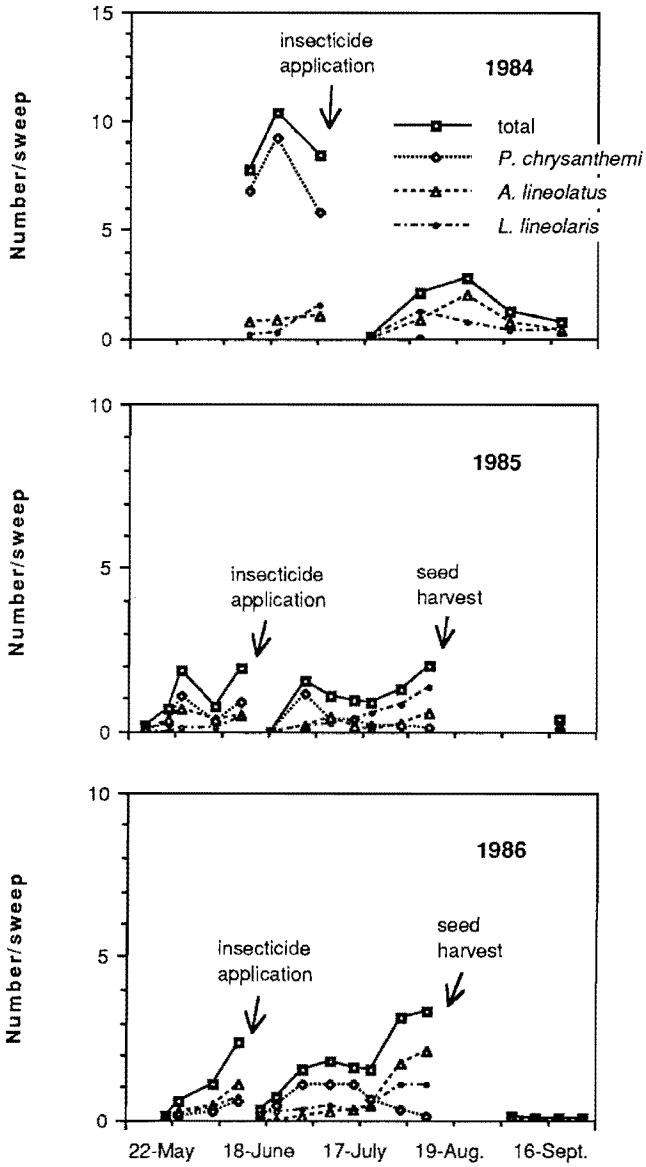

Figure 4. Sweep counts of *Adelphocoris lineolatus, Lygus lineolaris,* and *Plagiognathus chrysanthemi* in the Norcen fields—1984 = three-year-old stand; 1985 & 1986 = one-year-old stands.

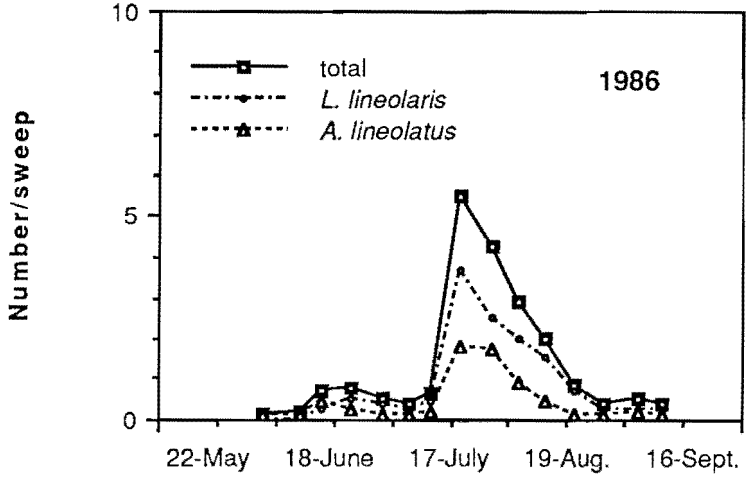

Figure 5. Sweep counts of *Adelphocoris lineolatus* and *Lygus lineolaris* in the Empire field—1986.

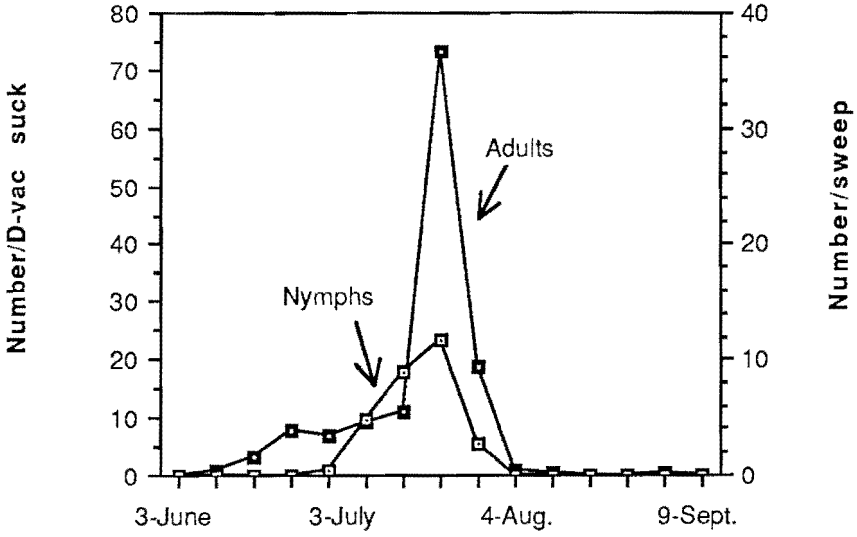

Figure 6. Sweep and D-vac® counts of the potato leafhopper, *Empoasca fabae* in the Empire field—1986.

Also present were the potato leafhopper and pea aphid, although neither exceeded a density of one insect per sweep in the northern fields. The potato leafhopper, however, became very abundant at the southern location, reaching densities (nymphs + adults) of nearly 50 per sweep (Fig. 6).

In conclusion, *P. chrysanthemi*, *A. lineolatus*, and *L. lineolaris* were the most abundant

pests of birdsfoot trefoil and, due to their feeding habits, appear to be the most important and destructive pests. *P. chrysanthemi* and *A. lineolatus* appear to be the two most important pests of trefoil, primarily because they were abundant early in the growing season (through June and into the first part of July), a critical period for bud and flower development and subsequent seed set (Wipfli 1987). *P. chrysanthemi* has one generation per year and was the most abundant of the three mirids in northern Wisconsin during 1984–1986, reaching densities of more than twice that of *A. lineolatus* and five to ten times that of *L. lineolaris*. *Adelphocoris lineolatus* was the second most abundant species, with a second generation occurring during trefoil pod set. This second generation reached high levels in some fields and may be economically important late in the season (late July through early August) during pod set. Wipfli (1987) reported that *A. lineolatus* damaged developing trefoil seeds causing significant seed shriveling. *Lygus lineolaris* was the least abundant species and was uncommon in some fields. As with *A. lineolatus*, *L. lineolaris* had a second generation during pod set at densities usually slightly higher than the first generation, but remained low relative to *A. lineolatus*.

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