Abundance of *Lygus* spp. (Heteroptera:Miridae) in canola adjacent to forage and seed alfalfa

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ABSTRACT

Our objectives were to document the abundance of lygus bugs (Miridae) in canola after the cutting of adjacent alfalfa hay fields and to document their seasonal activity in canola plots grown in close proximity to alfalfa seed. Cutting alfalfa did not increase abundance of lygus bugs in nearby canola in sites near Barrhead, Alberta (1998-1999), in the Peace River area of British Columbia (2000) or near Carman, Manitoba (2001). In Saskatoon, from 1993-1995, lygus bug numbers remained at low levels in seed alfalfa and canola and there was no indication that the pest species (*L. lineolaris*) in canola moved in significant numbers from the adjacent alfalfa seed field. We conclude that alfalfa forage harvesting generally does not result in massive movement of lygus bugs to nearby canola.

Key words: Lygus bugs, canola, alfalfa, forage harvest

INTRODUCTION

Lygus bugs (Miridae) feed on actively growing meristematic tissue, particularly buds, flowers and immature seeds, which may result in economic losses to many crops throughout North America and Europe (Young 1986). In Alberta the most common *Lygus* (Hahn) species are *L. lineolaris* (Palisot de Beauvois), *L. borealis* (Kelton), *L. elisus* (Van Duzee), and *L. keltoni* (Schwartz) (Cárcamo *et al.* 2002). The latter species does not occur east of Alberta and *L. lineolaris* is rare in the mixed and short grass prairie ecoregions (Schwartz and Foottit

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1998). Lygus bugs are a primary pest of seed alfalfa in western Canada (Craig 1983) and an intermittent pest in canola (both *Brassica napus* L and *B. rapa* L) (Wise and Lamb 1998). Forage alfalfa or alfalfa mixtures are grown on over 4.5 million ha in Canada and less than 30,000 ha are grown for pedigreed seed (Statistics Canada 2001). Harvesting forage alfalfa keeps lygus bugs from reaching pest status in this crop by reducing their survivorship (Harper *et al.* 1990) or increasing their dispersal (Schaber *et al.* 1990).

Depending on the developmental stage of the lygus bug population, cutting alfalfa for hay may increase dispersal onto nearby host crops including canola. Many studies in Canada have documented the species composition and phenology of lygus bugs in alfalfa and canola; however, these studies did not investigate changes in lygus bug numbers in canola following harvest of nearby alfalfa. Gerber and Wise (1995) sugested that *L. lineolaris* first generation adults may move from plots of seed alfalfa to canola. Timlick *et al.* (1993) noted that although alfalfa is an excellent host for lygus bugs, in Manitoba, alfalfa grown for forage is usually cut by the 3rd week of June when most of the lygus bug population is at the nymphal stage (Gerber and Wise 1995). Butts and Lamb (1991), in northern and central Alberta suggested that cruciferous weeds, and not alfalfa, are likely more important sources of lygus bugs colonizing canola because alfalfa tends to harbour mostly *L. borealis*, a species that seldom dominates the pest assemblage in canola (Cárcamo *et al.* 2002). A similar argument was made by Braun *et al.* (2001) based on their studies conducted in central Saskatchewan.

The objectives of this study were to (i) compare lygus bug phenological patterns in canola plots grown adjacent to a seed alfalfa stand and (ii) determine if cutting alfalfa for hay resulted in higher numbers of lygus bugs in canola nearby.

MATERIALS AND METHODS

Lygus activity in canola adjacent to seed alfalfa in Saskatoon

Plots were seeded at the Saskatoon Research Centre farm of Agriculture and Agri-Food Canada, near Saskatoon, Saskatchewan (Fig. 1) in Ortho Clay Loam soil. Alfalfa, *Medicago officinalis* L. cultivar Beaver, was seeded in 1993 in a 0.5 ha solid block at 30 cm row spacings and at a seeding rate of 2.25 kg/ha. From 1994 to1995, an adjacent 0.5 ha block was divided into six blocks each consisting of a pair of plots, 8 m wide and 43 m long, planted to either *Brassica rapa* (cultivar AC Parkland) or *B. napus* (cultivar Legend) and separated from each other by a 1.8 m barrier of barley, *Hordeum vulgare* L. cultivar Harrington. The location of each canola cultivar within each of the six blocks was assigned randomly in each replicate in an overall randomized complete block design. On several occasions in 1993, and weekly throughout the season in 1994-1995, each canola plot and the adjacent width of alfalfa was sampled by taking five subsamples of five 180° sweeps using a standard 38 cm diameter insect net. At the time of sampling, 10 plants per species per replicate were examined and their growth stage determined according to the scale of Harper and Berkenkamp (1975). Samples were transferred to plastic bags, returned to the laboratory, and frozen prior to species determination. Subsamples were averaged to determine the number and species of lygus bug present per replicate plot.

Lygus abundance in canola adjacent to forage alfalfa

Commercial fields of alfalfa and canola (*Brassica napus* of unknown varieties) adjacent to each other or within 50 m were used in the study. Study sites were located at the northern edge of the Parkland region near Barrhead, Alberta (ca.100 km NW of Edmonton) in 1998-1999, near Fort St. John in the Boreal ecoregion of British Columbia in 2000, and in the Southern Parkland region near Carman, Manitoba in 2001 (Fig. 1). Sampling of both crops began at the late bud or flower stages of canola (3.3-4.1 Harper and Berkenkamp 1975) and

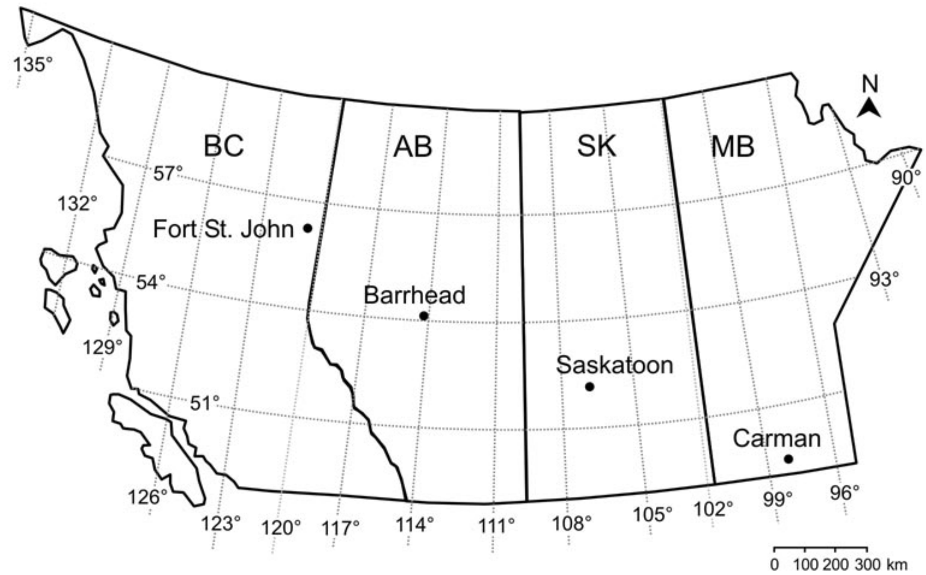

Figure 1. Location of study sites throughout western Canada used to study lygus bug abundance in canola adjacent to alfalfa.

continued weekly until one or two weeks after the cutting of alfalfa. To test the hypothesis that changes in lygus bug numbers in canola were associated with cutting of alfalfa nearby and not by some other area-wide phenomenon, fields were designated *a posteriori* as "cut" if the alfalfa was cut early or "check" if alfalfa was harvested one to two weeks later than the "cut" fields. Number of paired sites ranged from two to seven at each location and year. Canola growth stage was determined as described previously; for alfalfa, percent of the stand flowering or crop height was estimated visually.

Samples of 20 sweeps with a 38 cm sweep net were taken at five positions within each crop separated by approximately 10 m: at the edge next to the interface and at approximately 20, 40, 60, and 80 m into each crop. In 1998 at Barrhead only three positions and 10 sweeps were collected at about 10, 20 and 30 m into each crop and at Fort St. John in 2000, 100 sweeps were taken in subsets of 10 sweeps beginning about 25 m into the stand and at 10 m intervals from two sites. Sweeping efficiency is expected to differ in alfalfa and canola, particularly during the pod stages of canola when this crop is difficult to sweep. However, this should not confound results because our objectives were to compare lygus bug numbers among canola fields and not between the two crops. All fields were standard commercial size fields greater than 32 ha. All samples were stored in plastic bags and transferred to 70% ethanol in the lab for identification to species following the revision by Schwartz and Foottit (1998). Because only adults are thought to disperse long distances (Schaber *et al.* 1990), juveniles were not always kept from every site or collection and never identified to species.

Data Analysis

The number of weekly samples before and after alfalfa cutting at each canola field varied from one to three. Therefore, the average number of lygus adults per week in alfalfa before cutting and in canola before and after alfalfa cutting were calculated for the cut and check treatments and means were compared using Analysis of Variance (Statistix® for Windows, version 7). For data with heterogeneous variances, the Kruskal-Wallis non-parametric test was used.

RESULTS AND DISCUSSION

Lygus activity in canola adjacent to seed alfalfa

The abundance of lygus bugs was very low in all crops at Saskatoon in 1993 and 1994; therefore, only the 1995 data are shown. *Lygus borealis* and *L. lineolaris* were abundant in both crops and *Lygus elisus* was rare (Figs. 2a-c). The first generation adults of *L. borealis* in alfalfa peaked in early July and a smaller peak of *L. lineolaris* occurred on July 20th. Adults were observed in canola during the early flower stage in early July at the same time as first generation lygus bug adults peaked in alfalfa. However, alfalfa was not the source because the alfalfa peak involved *L. borealis* and the canola peak consisted of *L. lineolaris*. This result supports the observations by Butts and Lamb (1991) and Braun *et al.* (2001) that at some sites the two crops are dominated by different species and in such situations alfalfa may not be the major source of lygus bugs in canola. According to Gerber and Wise (1995), *L. lineolaris* populations peak in alfalfa when first generation females become reproductive and move out of alfalfa to other hosts. Our results, however, support the speculation by Butts and Lamb (1991) and Braun *et al.* (2001) that cutting alfalfa does not increase lygus numbers in canola.

Brassica napus had consistently fewer lygus bugs than *B. rapa* and alfalfa (Figs. 2b and c). Lygus bugs moved to canola starting at the bud stage and peaked during flowering. The higher abundance of lygus bugs in *B. rapa* than in *B. napus* was also observed by Butts and Lamb (1991), and can be attributed to earlier flowering in *B. rapa* and not to lygus bug feeding preferences.

Lygus abundance in canola adjacent to forage alfalfa

Lygus lineolaris was the dominant species in canola throughout the study at all sites; *L. borealis* was more abundant in alfalfa than canola and was the more common species in this crop at Barrhead in 1998 and Fort St. John in 2000 (Table 1). Other species such as *L. elisus* were rare and *L. keltoni* was found in small numbers only in Alberta and British Columbia. There were no significant differences in overall lygus bug abundance or any of the species between alfalfa fields before cutting (P > 0.05, ANOVA or Kruskal-Wallis test) at any of the study sites in any year. Therefore, differences in lygus abundance between adjacent canola after hay harvest were not caused by initial lygus bug numbers in the respective alfalfa fields.

Table 1

Number and percent of total (in parenthesis) of *Lygus* species at the various study sites.

	Alberta 1998		Alberta 1999		B.C. 2000		Manitoba 2001	
Lygus species	alfalfa	canola	alfalfa	canola	alfalfa	canola	alfalfa	canola
L. lineolaris	59 (40)	501 (82)	188 (70)	888 (85)	94 (47)	356 (85)	781 (91)	552 (96)
L. borealis	86 (58)	101 (17)	66 (25)	120 (12)	99 (50)	54 (13)	78 (9)	20 (4)
Total lygus adults*	149	610	268	1038	200	419	859	572
# Sweeps	850	850	1700	3000	900	1100	3300	3900

* Includes *L. keltoni* and *L. elisus*

In 1998 near Barrhead, alfalfa was cut for hay in four of the seven fields between the 18 and 24 of June. Abundance of lygus bugs in the adjacent canola fields did not change when alfalfa was cut (Fig. 3). In 1998, lygus bug populations reached outbreak levels with over 400,000 ha of canola throughout Alberta sprayed for their control. However, there were relatively few lygus bugs in the alfalfa fields adjacent to canola in our study sites. This suggests that alfalfa was not the major source of lygus bugs that colonized canola during the bud and early flower stages.

In 1999, lygus abundance for individual species or pooled totals were similar between canola fields adjacent to alfalfa that were cut in early or mid July (Fig. 4, P > 0.05, ANOVA

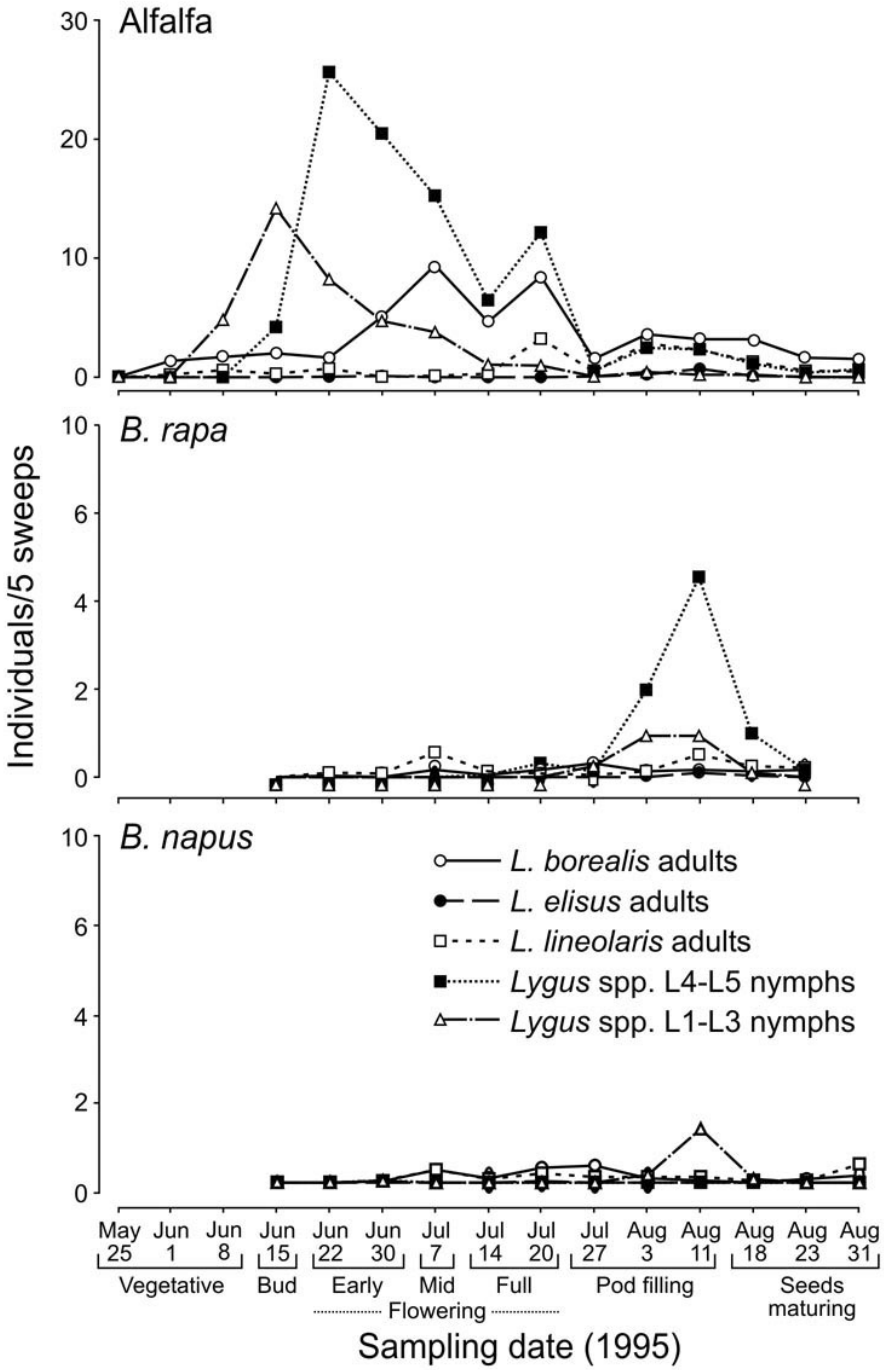

Figure 2. Lygus phenology at Saskatoon in 1995 in (a) seed alfalfa, (b) Parkland canola, *B. rapa*, (c) Legend canola, *B. napus*. Canola crop stages shown under dates.

or Kruskal-Wallis tests). Lygus abundance was lower in 1999 than in 1998, and were again lower in alfalfa than in canola early in the season. This further suggests that most lygus bugs found in canola came from sources other than alfalfa.

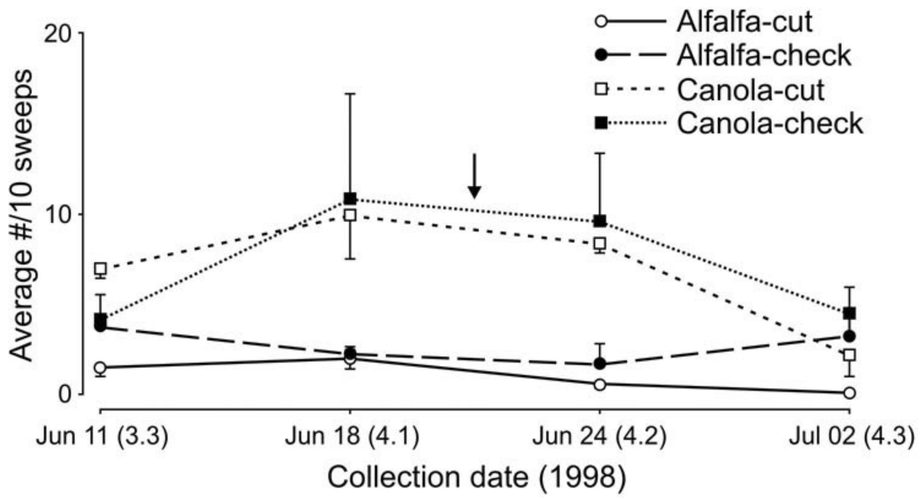

Figure 3. Adult lygus bug abundance in alfalfa and canola near Barrhead in 1998. Entries are means of 4 fields and 3 fields for the cut and check treatments, respectively ± 1 standard error of the mean. Thirty sweeps were taken per field on each collection date. Numbers in parentheses are canola crop stages (Harper and Berkenkamp 1975). Arrows indicate period when alfalfa adjacent to canola was cut.

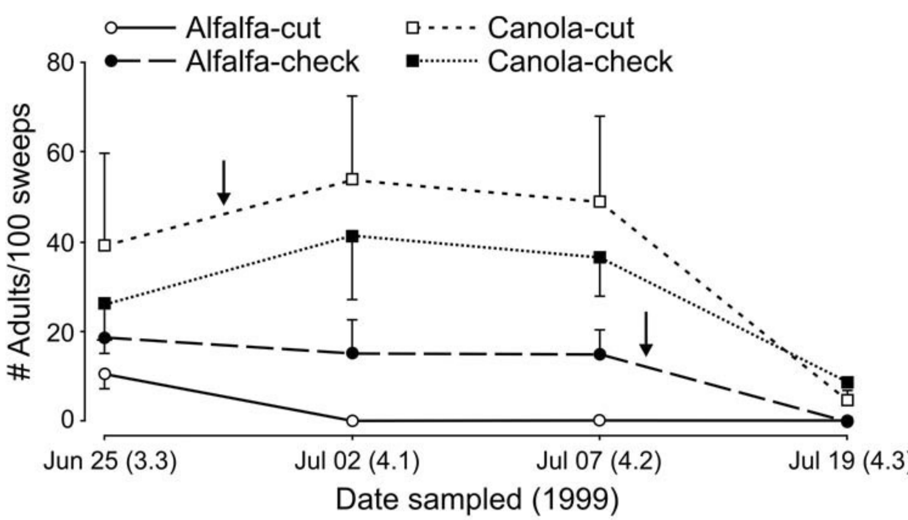

Figure 4. Adult lygus bug abundance in alfalfa and canola near Barrhead in 1999. Entries are means of 4 fields for the cut and check treatments ±1 standard error of the mean. 100 sweeps were taken per field on each collection date. Numbers in parentheses are canola crop stages. Arrows indicate period when alfalfa adjacent to canola was cut.

In 2000, flooding and frost destroyed the fields near Barrhead but two pairs of alfalfa and canola fields were sampled near Fort St. John (Fig. 5). Lygus bugs have only one generation per year in this northern agricultural region, therefore, the adults sampled were considered overwintered adults. It is unknown if these older overwintered adults are as dispersive as the parous females of the new generation (Stewart and Gaylor 1991, 1994; Gerber & Wise 1995). At Site 1 (Fig. 5) alfalfa was cut on July 21 and lygus bug adults continued to decrease in the nearby canola as juvenile numbers increased. The peak in number of overwintered adults in canola occurred towards the end of June, increasing from about 60 to 100 per 100 sweeps. A corresponding decrease from 42 to 25 adults per 100 sweeps was observed in the adjacent alfalfa (Fig. 5). At Site 2 (Fig. 5), alfalfa was cut after July 31 and a very small increase in abundance of *L. lineolaris* was observed in the adjacent canola field. The highest count, however, had occurred on the first sampling date on 7 July. As shown for Field 2 in Fig. 5, there was already a large number of lygus bug nymphs by the end of July (2 per sweep) at the time when the alfalfa was cut, indicating that the damaging populations found in canola at the pod stage had developed within the field. Lygus bug movement to canola from alfalfa or other hosts at this time was likely to be of little consequence given the large number of juveniles already present in canola.

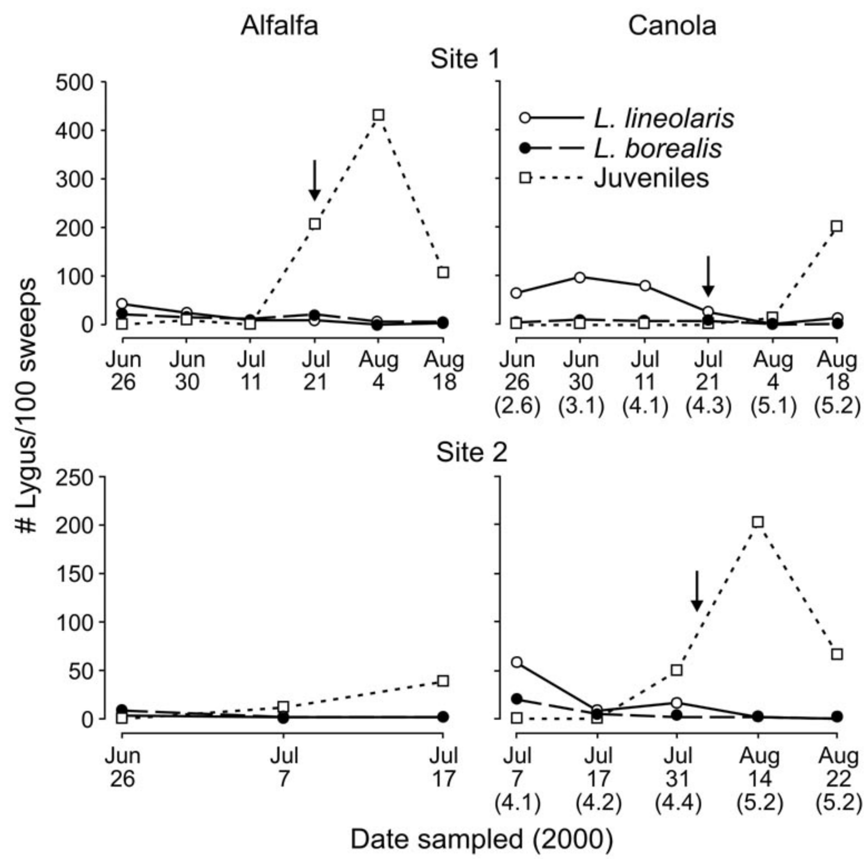

Figure 5. Lygus bugs in canola and alfalfa near Fort St. John, B.C. in 2000. Entries are total bugs caught in 100 sweeps per field at each sampling date. Numbers in parentheses are canola crop stages. Arrows indicate approximate date alfalfa was cut.

In 2001 only sites in Manitoba were sampled. Lygus bug population dynamics prior to July 10 were not studied because of late planting of canola and delayed plant growth. The abundance of either *Lygus* species or combined lygus bug abundance was the same between alfalfa fields prior to cutting it on the second week of August, or between the corresponding canola fields prior to alfalfa hay harvest (P > 0.05, ANOVA). On August 14-16 and August 22-23, after alfalfa was cut, weekly averages of lygus abundance was higher in canola adjacent to uncut alfalfa than in canola adjacent to cut alfalfa (Fig. 6, F= 111.51, d.f.= 1.5, P < 0.01). Average weekly numbers of lygus bugs in canola adjacent to cut alfalfa were the same before and after cutting (17 vs 8 per 100 sweeps from July 10 to August 8 and from August 14 to August 23, respectively, ANOVA, P > 0.05). In canola fields adjacent to uncut alfalfa, the average weekly catches for these same periods were 11 and 53 lygus bugs per 100 sweeps (F= 23.7, d.f.= 1.2, P < 0.05). The results from Manitoba in 2001 suggest that cutting of alfalfa between August 9 and August 13 failed to result in movement "en masse" of lygus bugs from alfalfa to canola. Therefore, the risk of lygus bug damage in canola at early pod stage was not affected by cutting the adjacent alfalfa stand.

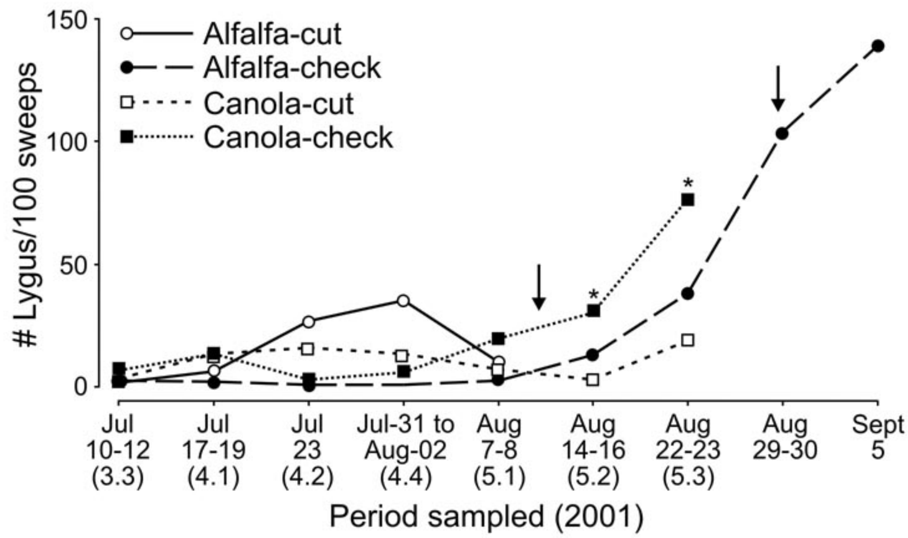

Figure 6. Lygus bug adults near Carman, Manitoba in 2001. Entries are averages for 1 to 5 fields depending on availability and access. One hundred sweeps were collected at each site on each sampling date. Asterisks indicate dates with significant differences between canola fields adjacent to cut and uncut alfalfa.

Because nymphs were not collected rigorously for the Manitoba portion of the study, it is not possible to determine if the large number of lygus adults found in canola adjacent to uncut forage alfalfa moved to canola as adults or developed within the canola stand from nymphs. It is unlikely that lygus bugs would move to canola at the pod stage since the plants may no longer be attractive (Butts and Lamb 1991). Instead, in August, lygus bugs may move to more succulent hosts to feed in preparation for the winter.

Based on the observations from sites in the Parkland and Boreal eco-regions of the prairies we conclude that cutting alfalfa in these regions does not result in massive movement of adult lygus bugs into nearby canola. These results cannot be generalized to more southern regions such as the short grass prairie of Alberta where a different species assemblage occurs and lygus bugs have 2 or 3 generations. Mark-recapture studies or molecular DNA investigations are needed to assess the relative importance of various spring hosts as sources of lygus bugs that may reach pest status in canola in the summer.

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REFERENCES

Braun, L., M. Erlandson, D. Baldwin, J. Soroka, P. Mason, R. Foottit and D. Hegedus. 2001. Seasonal occurrence, species composition, and parasitism of *Lygus* spp. (Hemiptera: Miridae) in alfalfa, canola, and mustard. The Canadian Entomologist 133: 565-578.

Butts, R.A. and R.J. Lamb. 1991. Seasonal abundance of three *Lygus* species (Heteroptera: Miridae) in oilseed rape and alfalfa in Alberta. Journal of Economic Entomology 84: 450-456.

Cárcamo, H.A., J. Otani, C. Herle, M. Dolinski, L. Dosdall, P. Mason, R. Butts, L. Kaminski and O. Olfert. 2002. Variation of *Lygus* (Hemiptera: Miridae) species assemblages in canola agroecosystems in relation to ecoregion and crop stage. The Canadian Entomologist 134: 97-111.

Craig, C.H.1983. Seasonal occurrence of *Lygus* spp. (Heteroptera: Miridae) on alfalfa in Saskatchewan. The Canadian Entomologist 115: 329-331.

Gerber, G.H. and I.L. Wise. 1995. Seasonal occurrence and number of generations of *Lygus lineolaris* and *L. borealis* (Heteroptera: Miridae) in southern Manitoba. The Canadian Entomologist 127: 543-559.

Harper, F.R. and B. Berkenkamp. 1975. Revised growth stage key for *Brassica campestris* and *B. napus*. Canadian Journal of Plant Science 55: 657.

Harper, A.M., B.D. Schaber, T.P. Story and T. Entz. 1990. Effect of swathing and clear-cutting alfalfa on insect populations in southern Alberta. Journal of Economic Entomology 83: 2050-2057.

Schaber, B.D., A.M. Harper and T. Entz. 1990. Effects of swathing alfalfa for hay on insect dispersal. Journal of Economic Entomology 83: 2427-2433.

Schwartz, M.D. and R.G. Foottit 1998. Revision of the Nearctic species of the genus *Lygus* Hahn, with a review of the Palaearctic species (Heteroptera: Miridae). Memoirs on Entomology, International 10, Associated Publishers, Gainesville, FL, USA.

Statistics Canada 2001. Census of Agriculture. http://www.statcan.ca/english/Pgdb/econ100a.htm.

Statistix for Windows. 2000. Statistix 7 User's Manual. Analytical Software, Tallahassee, FL

Stewart, D.D. and M.J. Gaylor. 1991. Age, sex and reproductive status of the tarnished plant bug (Heteroptera: Miridae). Environmental Entomology 20: 1387-1392.

Stewart, D.D. and M.J. Gaylor. 1994. Effects of age, sex and reproductive status on flight of the tarnished plant bug (Heteroptera: Miridae). Environmental Entomology 23: 30-84.

Timlick, B.H., W.J. Turnock and I. Wise. 1993. Distribution and abundance of *Lygus* spp. (Heteroptera: Miridae) on alfalfa and canola in Manitoba. The Canadian Entomologist 125: 1033-1041.

Wise, I.L. and R.J. Lamb. 1998. Economic threshold for plant bugs, *Lygus* spp. (Heteroptera: Miridae), in canola. The Canadian Entomologist 130: 825 – 836.

Young, O.P. 1986. Host plants of the tarnished plant bug, *Lygus lineolaris* (Heteroptera: Miridae). Annals of the Entomological Society of America 79: 747-762.