The Effects of Swathing on the Survival of Nymphs of *Lygus lineolaris* L. (Heteroptera: Miridae) in Canola

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Cutting canola and placing it into swaths had both immediate and long term effects on plant bug populations. About one-half of the plant bug nymphs on canola were dislodged from the crop when it was cut. Whether the displaced nymphs moved to the swath or not depended on the age of the nymphs and the stage of canola when it was cut. Very few nymphs moved to the swaths when crops were cut when 30-40% of seeds had begun to ripen but many nymphs moved to swaths if crops were cut at an earlier stage. Older nymphs readily fed and reached adulthood on swathed crops but fewer young nymphs completed their development on swathed than on standing crops. As a result plant bug populations decreased more rapidly on swathed crops than on standing crops. The likelihood that swathing could reduce plant bug feeding damage in canola is discussed.

INTRODUCTION

The nymphs of various plant bugs, *Lygus* spp, are known to feed on canola in southern Manitoba from July into early September (Gerber and Wise 1995). The survival of the nymphs in canola depends on the suitability of the crop for feeding. Canola in Manitoba is usually swathed, cut near the base of the plant and placed in windrows, in late August or early September to hasten crop maturity and to ensure uniform ripening of seeds. In most years, plant bug nymphs complete their development in canola before the crop is swathed (Gerber and Wise 1995, Leferink and Gerber 1997), but during years of adverse weather swathing may begin when nymphs are still developing. The objective of this study is to determine if swathing affects the development and survival of plant bug nymphs in canola.

MATERIALS AND METHODS

Canola cv. Excel was seeded at 5.6 kg/ha with a double disc press drill at Glenlea, Manitoba on 12 and 27 May, 1993 using seed treated with granular carbofuran insecticide and a lindane-fungicide (thiram and carbathiin) seed dressing to protect seedlings from flea beetles and diseases. Plots (4 m x 10 m) were separated by a 2 m cultivated strip. On 24 August, the plants in 2 plots at early (crop stage 5.1 of Harper and Berkenkamp 1975) and 4 plots at late (crop stage 5.3) stages of seed ripening were severed at a height of 20 cm and placed into 1 m-wide swaths with a front end swather. Crop stage 5.1 is the recommended stage for plant bug control in canola (Wise and Lamb, 1998a) and stage 5.3 is the recommended time to swath canola in Manitoba (Canola Council of Canada 1993). Three plots each at crop stages 5.1 and 5.3 were left standing. Ten plastic 15 cm-diameter dishes, partially filled with soapy water, were placed in the plots just before swathing, and were examined for plant bugs immediately after swathing.

Plant bugs were collected from 10 randomly selected areas and bulked to give one sample for each plot using a D-Vac sampler with a suction tube aperature of 285 cm^2. In the standing plots, samples were taken by passing the opening of the suction tube horizontally through the canopy to the ground for 15 sec. Swathed plots were sampled by pressing the opening of the D-Vac into the swath also for 15 sec. Samples were taken 1 to 2 h, and daily from 1 to 3, 6 to10, and 14 d after swathing, frozen within 4 h of sampling, and then assessed 2 to 3 days later. All plant bug nymphs and adults were counted, the nymphs were separated by instar (Schwartz and Foottit 1992) and the adults by sex and species (Kelton 1975). Counts of first and second instars were combined because damage to first instars during sampling made their identification difficult.

Nymphal counts in the swathed and standing crops 1 to 2 h and 1 to 2 d after swathing were transformed by $\log_{10}$ and then compared by 2-way ANOVA (SAS Institute Inc. 1990) to determine the immediate effects of swathing for the two seeding dates. The relative abundance of early (1-3) and later instars (4-5) and adults in swathed and standing plots 1 and 2 days after swathing were compared to those 10 and 14 days after swathing by contingency analysis (*G*-test, P=0.05) to determine whether swathing affects the survival of nymphs at different instars. Plant bug populations in swathed and standing crops 3 and 14 days after swathing were transformed as above and compared by 2-way ANOVA to determine differences in nymphal survival and adult development in swathed vs. standing crops for the two seeding dates.

RESULTS

The tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois) comprised 98.8% of all adults collected in swathed and standing crops (*n*=592). *Lygus borealis* (Kelton) was the only other species of plant bug in the samples..

About 50% of the nymphs on crops of both seeding dates were dislodged when the crops were swathed but nymphal populations nearly doubled in the later seeded crops within 2 d (Table 1). The differences in nymphal densities in the swathed and standing crops within 2 h of swathing and 2 d later were not significant ($F_{1,21}$=0.16, *P*=0.69). The interaction of swathing and seeding date ($F_{1,21}$=2.66, *P*=0.12) on the density of plant bugs in the short term were also not significant, but plant bug populations on the crop were higher at the later seeding date ($F_{1,21}$=94.2, *P*<0.001).

In the standing crop of the early seeded test, the frequency of young (1-3 instars), old (4-5 instars), and adult stages of plant bugs was the same for samples taken 1 to 2 d and 10 to 14 d after plots had been swathed (^{2}=0.9, *P*=0.63). Swathing had no effect on the frequency of these stages 1 to 2 d after swathing (^{2}=2.2, *P*=0.34) but reduced the frequency of young nymphs 10 to 14 d after swathing (^{2}=17.5, *P*<0.01) when swathed crops were compared to standing crops (Table 2). The frequency of young nymphs also decreased for populations in swathed crops 1 to 2 vs. 10 to 14 d after swathing (^{2}=18.8, *P*<0.01). Swathing reduced the frequency of young instars in late seeded crops relative to standing crops after 1 to 2 d (^{2}=18.5, *P*<0.01) (Table 2). The frequency of young instars in swathed plants remained low for up to10 to 14 d (^{2}=31.0, *P*<0.001).

During the 3 to 14 d interval after swathing plant bug populations in plots decreased more rapidly in swathed crops than populations in standing crops ($F_{1,21}$=7.38, *P*=0.013) with the rate of decline being similar for the two seeding dates based on a non-significant interaction ($F_{1,21}$=0.45, *P*=0.51) (Table 3). In late seeded plots, plant bug populations remained stable in the standing crops but dropped nearly 4-fold in swathed crops. Populations in both the standing and swathed crops decreased in early seeded crops but the decline in swathed crops of >6-fold was over double that of the <3-fold drop in standing crops.

DISCUSSION

Swathing can have an immediate effect on plant bug populations on canola by dislodging the nymphs from the crop. About one-half of the nymphs fall to the ground during swathing, but most are able to crawl back to the crop. The nymphs ability to return to the crop in the swaths depends on the instar of the nymph and the crop stage of the canola when it is swathed. Young nymphs (1-3 instars) are less apt to return to swaths than older nymphs and fewer dislodged nymphs return to crops cut at the recommended 30-40% seed ripening stage than to earlier cut crops. Nymphs found on swathed canola can continue to feed and develop for at least 14 d after swathing and reach maturity.

The swathing of canola can affect plant bug populations, although the effects are marginal on later instars which continue to develop on both swathed or standing crops. However, young nymphs are more likely to die or migrate from swathed crops than young nymphs on standing crops. This effect of swathing on young nymphs is more pronounced when crops are swathed at a later crop stage because the crops quickly become unsuitable for feeding. The poor development of young nymphs on swathed crops causes plant bug populations to decrease more rapidly than on standing crops.

In conclusion, swathing will reduce plant bug populations on canola cut at the recommended 30-40% seed ripening stage but plants bugs can continue to develop within the swath. This reduction is more rapid than on crops cut at earlier crop stages, and may be sufficient to preclude the use of an insecticide when populations are near but below the economic threshold (Wise and Lamb 1998b). However, swathing would not likely sufficiently reduce feeding injury in crops cut at earlier crop stages or when plant bug populations far exceed the economic threshold. Further studies on whether feeding by plant bugs causes the same level of yield loss to canola in swathed versus standing crops are needed.

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Table 1. Mean±SD (*n*) densities (per m²) of plant bug nymphs in drop trays and swaths for canola swathed on the same date compared to densities in the standing crop.

Seeding	1 to 2 h after swathing			1 to 2 d after swathing	
date	Tray	Swath*	Crop	Swath	Crop
May 12	33±17(4)	33±18(4)	32±10(2)	25±10(4)	46±0(2)
May 27	114±62(2)	126±39(2)	225±40(3)	211±25(2)	199±110(3)

* Swathing effect on plant bug density not significant (2-way ANOVA, $F_{1,21}$=2.66, *P*=0.12) (SAS Institute Inc. 1990).

Table 2. Frequency (%) of young (1-3) and old (4-5) instars and adults of *Lygus lineolaris* on standing and swathed canola sampled 1 to 2 d and 10 to 14 d after swathed plots were cut.

Seeding date	Days after swathing	Swathed crop				Standing crop				χ^2
		1-3	4-5	A	*n*	1-3	4-5	A	*n*	
May 12	1-2	14	56	30	86	18	61	21	82	2.2
	10-14	0	29	71	35	16	56	28	50	17.5*
May 27	1-2	33	59	8	213	49	47	4	444	18.5*
	10-14	11	53	36	154	16	70	14	374	31.0*

*Frequencies of plant bug stages in swathed vs. standing crops are significantly different (*G*-test, $P<0.01$).

Table 3. Mean±SD (n) densities (per m²) of plant bugs on swathed and standing crops taken 3 d and 10 to 14 d after crops were swathed.

Seeding	3 days		10 to 14 days	
date	Swathed*	Standing	Swathed	Standing
May 12	39±15(4)	73±13(3)	6±5(4)	26±6(3)
May 27	243±54(2)	249±77(3)	63±39(2)	230±60(3)

* Swathing effect on plant bug density significant ($F_{1,23}$=7.38, P=0.013) and independent of seeding date ($F_{1,23}$=0.45, P=0.51) (2-way ANOVA, SAS Institute Inc. 1990).