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Managing cabbage seedpod weevil in canola using a trap crop—A commercial field scale study in western Canada

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Abstract

Cabbage seedpod weevil is a relatively new pest of canola (oilseed rape) in the Prairie Ecozone of western Canada. In some years, in southern Alberta, farmers have had to resort to costly aerial insecticide applications to protect their canola crops. In this study, we evaluated perimeter trap cropping as a strategy to manage weevils in large commercial fields of canola. A total of 11 experimental fields (with perimeter trap crops) and nine conventional fields without trap crops were studied from 2000 to 2003. Field perimeters of *Brassica rapa* planted at the same time as the main crop of *B. napus* flowered ~1 week earlier and effectively concentrated weevil populations that were sprayed with insecticide. The perimeter trap crop kept weevil populations below threshold levels in the main crops when fields were large and square (1600 m × 1600 m). However, further research is required to develop management tools that augment the efficacy of trap crops in situations where fields are small or narrow (<400 m wide), especially when populations are several times the economic threshold. Pod damage was less than 12% in the main crops of experimental fields where only the trap crops were sprayed which was comparable to that of conventionally managed fields. The savings in chemical insecticides, labor and time, as well as possible integration with other IPM strategies such as biocontrol, make perimeter trap cropping an important tool for cabbage seedpod weevil management.

Keywords: *Ceutorhynchus obstrictus* (= *Ceutorhynchus assimilis*); Perimeter trap cropping; Oilseed rape; Insect pest damage; Cultural control; IPM

1. Introduction

The cabbage seedpod weevil (*Ceutorhynchus obstrictus* Marsham = *Ceutorhynchus assimilis*, Colonnelli, 1993) is a seed pest of brassicaceous crops in Europe and North America but was not reported from the Prairie Ecozone of western Canada until 1995 (Butts and Byers, 1996). Its biology, distribution and management with insecticides were documented recently in southern Alberta (Fox and Dosdall, 2003; Dosdall and Moisey, 2004; Cárcamo et al., 2005; Dosdall et al., 2006) and a general review was published by Cárcamo et al. (2001). The cabbage seedpod weevil is univoltine and adults overwinter in caragana (*Caragana arborescens* Lam.) and other tree shelter belts (Ulmer and Dosdall, 2006). They emerge in April and May, when air temperature reaches 15–18 °C, to feed on buds and flowers of early flowering brassicaceous weeds such as *Sinapis arvensis* L. and *Descurainia sophia* L. (Fox and Dosdall, 2003; Ulmer and Dosdall, 2006). In early to mid June they migrate to canola (*Brassica napus* L.) fields at the bud and early flower stage. Research on the spatial distribution of *C. obstrictus* in brassicaceous crops in Europe (Risbec, 1952; Free and Williams, 1979) and canola in Alberta (Dosdall et al., 2006) showed a clear pattern of aggregation along field edges during early flower. Although adults feed on buds and flowers, crop loss is primarily associated with larvae feeding inside canola pods, destroying 3–6 seeds/pod (McCaffrey et al., 1986). Egg to adult development takes 31–58 days in southern Alberta (Dosdall and Moisey, 2004). New generation adults continue feeding on late maturing pods or other green

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brassicaceous plants for at least 2 weeks before migrating to overwintering habitats from late August to October (Cárcamo, unpublished data). Economic yield losses in the order of 10–35% occur when more than 25% of pods are damaged by weevil larvae (Lerin, 1984; McCaffrey et al., 1986; Buntin, 1999; Dosdall, unpublished data). The only current management strategy is insecticide application, usually a pyrethroid (Cárcamo et al., 2005), when weevils reach a threshold of 3–4 adults per sweep at 10% flower (Dosdall et al., 2001). This nominal economic threshold is based on average number of weevils in several samples of 10, 180° walking sweeps (Dosdall et al., 2001).

Trap cropping is a cultural control strategy that exploits insects' preferences for certain plant species or growth stages of a plant by attracting the pest species away from a nearby main crop (Hokkanen, 1991; Shelton and Badenes-Perez, 2006). Insect pests concentrated in the trap crop are controlled with insecticides, or when available, other cultural control methods, biological pesticides or biocontrol agents. The trap crop eliminates the need to spray the entire field and minimizes negative effects on natural enemies in the main crop. Earlier-flowering winter and spring oilseed rape varieties have been used successfully as trap crops to control the pollen beetle (*Meligethes aeneus* Fabricius) in Finland (Hokkanen et al., 1986). The trap crop concept has been tested successfully in Canada with wheat stem sawfly (Seamans, 1928), grasshoppers (Olfert, 1986) and wireworms (Vernon et al., 2000) and with many other insects and crops around the world (Shelton and Badenes-Perez, 2006).

Buntin (1998) assessed the efficacy of a trap crop (4.9 m wide) to manage weevils using spring canola, seeded in fall, around the perimeter of a conventional winter cultivar (0.35 ha plots). The spring cultivar, which flowered 2–3 weeks earlier, attracted more weevils than the main crop. However, despite an application of insecticide to control the weevils in the trap crop, the main crop sustained economic levels of damage and yield losses. Buntin (1998) speculated that trap cropping might work better using large commercial fields under more moderate weevil abundances. Buechi (1990) also failed to reduce losses caused by *C. obstrictus* in oilseed rape (*B. napus)* by using turnip rape (*B. rapa*) as the trap crop. However, he did not spray the trap crop to kill the adults which apparently preferred to oviposit in *B. napus*. Our objective was to determine if earlier flowering canola strips along the borders of large commercial canola fields could concentrate populations of *C. obstrictus* for control with insecticides and prevent economic damage in the remainder of the fields.

2. Materials and methods

2.1. Study sites

This study was conducted in commercial canola fields in southern Alberta, western Canada, within a 100 km radius of Lethbridge (49°37′N, 112°39′W). The study area encompasses two eco-regions of the Prairie Ecozone (Ecological Stratification Working Group, 1995). Most of the sites near Stirling (49°31′N, 112°25′W) and Skiff (49°35′N, 111°37′W) were under dryland agriculture in the dry grassland eco-region in the brown chernozemic soil zone with a mean annual precipitation ranging from 250 to 350 mm. Sites near Coaldale (49°42′N, 112°31′W), Coalhurst (49°49′N, 113°00′W) and Nobleford (49°41′N, 112°30′W) were mostly irrigated fields located in the mixed grassland eco-region with mean annual precipitation of 350–450 mm.

2.2. Experimental design and trap crop establishment

From 2000 to 2003, a total of 11 fields ranging in size from 32 ha (1 field) to over 100 ha (7 fields) with trap crop strips and nine conventional fields (32–262 ha) without perimeter border manipulation were studied (Table 1). Replication of commercial fields was not feasible because the production practices used by farmers varied with respect to canola species and varieties, methods to establish the trap crop, and seeding date and rate (Table 1). Since each field was very large (at least 800 m × 400 m = 32 ha), three or four transects, at least 200 m apart, starting near the edge of each field and towards the middle were established and re-visited during the growing season in each field to quantify the distribution of weevils.

Four approaches were followed to establish earlier flowering trap strips (20–30 m) around the main crops. Method 1 was to plant *B. rapa* around a main crop of *B. napus* on the same day (Trap crops 1 and 11). Because *B. rapa* flowers at least 1 week before *B. napus* (Thomas, 2002), the earlier flowering trap strip is guaranteed regardless of drought or cold weather. Method 2, a variation of this approach (Trap crops 2 and 4), was to plant a 1:1 mixture of the two canola species in the trap strip to reduce potential yield losses that may be associated with strips of only *B. rapa*. For Method 3, some growers chose two herbicide-tolerant cultivars that differed by 2–3 days in maturity and staggered their seeding to establish the earlier flowering trap crop (Trap crops 3, 5 and 9). For Method 4, growers planted the same variety throughout the entire field but delayed seeding the main crop by at least a week (Trap crops 6, 7, 8 and 10). In two fields (Trap crops 7 and 8), trap strips were fall-sown in mid-November of the previous year to maximize the gap in growth stages. In southern Alberta, growers tend to plant canola as early as possible, usually in mid to late April, to take advantage of spring moisture and avoid the high summer temperatures that scorch flowers. This latter method of establishing the trap strip had the disadvantage that drought or cold weather could delay the emergence of the trap crop thereby removing the gap in growth stages. All but two of the experimental trap crop fields had the trap strip planted around the complete perimeter of the field. The exceptions were Trap crop 4 which had a trap strip established only