Volunteer Canola - Biology and Management
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Introduction
The relative abundance of volunteer canola has increased significantly over the past three decades in western Canada (Thomas and Wise 1983; Thomas et al. 1996). This species often ranks among the most abundant weeds in these cropping systems. Weedy characteristics such as long seedbank persistence for a domesticated species contribute to the abundance and recurrence of this species as a weed. In addition, the commercial release of herbicide-resistant genotypes have made control of volunteer canola more challenging in some crops. This paper briefly summarizes the biology and management of volunteer canola focusing on recent developments using tank mixed herbicides to manage this weed in challenging situations.

Biology of Volunteer Canola
Canola possesses a number of characteristics that contribute to its weediness. The siliques (pods) of mature canola plants shatter easily when dry causing high yield losses in this crop before and at harvest. Average yield losses over two years in Saskatchewan were about 107 kg ha\(^{-1}\) or 5.9% of the yield (Gulden et al. 2003a). Relative to other crops, individual seeds of canola are small (one thousand kernel weight < 4 g) and in conjunction with high seed losses, this results in large seedbank inputs (about 3,000 viable seed m\(^{-2}\)) at the time of harvest which equates to many times the normal seeding rate of this crop. Thus, even low seedbank persistence can potentially cause high volunteer populations in subsequent years.

Seeds of canola possess several characteristics that facilitate seedbank persistence. First, seeds are round which is an effective self-burial mechanism. Seeds roll into crevices and depressions in the soil surface and are easily buried with wind and water assisted soil movement. Second, volunteer canola seeds can develop a stress induced seed dormancy that prevents germination of the seed under ideal conditions (Pekrun et al. 1997). Seed dormancy is most effectively induced during water stress (-1.5 MPa) at 15-20 C over a period of several weeks (Gulden et al. 2004a), although hypoxic conditions also induce this physiological status (Pekrun et al. 1997). Dormancy is removed effectively by short exposure to cool temperatures (2-4 C) (Gulden et al. 2004) or a flash of white light (Pekrun et al. 1998). This causes seedbank behaviour typical of summer-annual weeds where increasing soil temperatures induce seed dormancy to prevent seedling recruitment at a time of year when the life cycle of the plant cannot be completed (Gulden et al. 2004b). These characteristics allow volunteer canola seeds from a single cohort to persist in the seedbank for at least three years in western Canadian cropping systems (Gulden et al. 2003b).

Herbicide-resistant cultivars of canola were released for commercial production about one decade ago. This also can be viewed as a weedy characteristic as this complicates management of volunteer canola in some crops. Two years ago in Manitoba, fall-germinated volunteer canola seedlings survived the winter and acted as a winter-annual species. This resulted in multiple flushes of volunteers and may impact the timing of herbicide applications for effective management in the following spring.
Management of Volunteer Canola

Cultural Management
Management of volunteer canola begins at the time of harvest. Gulden et al. (2003a) found that harvest losses are unique to producers. Over the two years of the study, harvest losses were consistently low for some producers (about 3% of harvested yield), while harvest losses of other producers were consistently high (9 to 10% of harvested yield). These findings indicate dissimilar diligence at harvest among producers. High harvest losses not only result in decreased economic returns, but also exacerbate subsequent volunteer canola populations.

The seedbank dynamics of volunteer canola are influenced by seed location in the soil profile. The volunteer canola seedbank near the soil surface is transient with limited persistence through the first winter and complete mortality by mid-summer of the year following a canola crop (Gulden et al. 2004b). Harsh environmental conditions near the soil surface likely caused these high rates of seed mortality. On the other hand, volunteer canola seed buried at 10 cm persisted for several years and displayed a summer-annual dormancy cycle. These results and those observed in winter canola in Europe (Pekrun and Lutman 1998) indicate that seed burial should be avoided to minimize long-term persistence of this weed. Similar long-term persistence of volunteer canola in zero tillage compare to conventional tillage in Saskatchewan, however, suggested sufficient seed burial during the planting operation to facilitate long-term persistence of this weed (Gulden et al. 2003b).

The impact of several factors on the maximum potential for development of seed dormancy was investigated. Among these factors, genotype was most influential in defining the potential for development of secondary seed dormancy. The contributions of time of swathing, year, and location were negligible to the potential for the development of seed dormancy in this species. These results indicated that producers have little opportunity to influence this characteristic through management other than the choice of the variety they plant.

Management with Herbicides
Seedling recruitment of volunteer canola occurs in spring before and after planting the crop (Gulden et al. 2003b; Lawson et al. 2006). There are many pre- and post-applied herbicide options to manage conventional and herbicide-resistant volunteer populations in most crops, however, controlling volunteer canola populations in some rotational crops may be more challenging due to crop injury from residual pre-applied herbicides or herbicide-resistance of the crop to the same mode of action as the volunteer canola population. Moreover, high levels of seedbank persistence can result in economically detrimental populations of volunteer canola for several years after the last canola crop was grown. This must be taken into consideration when choosing rotational crops. Nevertheless, recent developments have increased the herbicide options including challenging situations.

Several products containing active ingredients in group 14, a relatively new herbicide group for western Canada, are being introduced to manage all types of volunteer canola. One of these is CleanStart, a glyphosate-carfentrazone tank mix to target glyphosate-resistant volunteer canola in GR soybean is already available. Carfentrazone, the non-glyphosate active compound in Cleanstart, inhibits proto-porphyrinogen oxidase (PPO) and is a fast acting contact herbicide. Water soaked lesions appear soon after treatment and susceptible plants die within a few days. The efficacy of this herbicide on volunteer canola is high on young seedling (>90%), however, efficacy drops dramatically once volunteer canola plants are at the four leaf stage or beyond (Johnson, unpublished data). Thus, early scouting and application are essential for effective management of volunteer canola.
Other options for managing Roundup Ready volunteer canola exist. In soybean, reduced rates of Pursuit have been investigated (Monsanto 2007a). One-half and three-quarter rates of this herbicide tank mixed with glyphosate have proven effective at controlling volunteer canola in this crop. Other effective pre- and post-emergence herbicide options for managing volunteer canola in soybean (Monsanto 2007a) and other crops (Monsanto 2007b) have been investigated.

Conclusion

In conclusion, management of volunteer canola should begin at the time of harvest, although low seed losses at harvest is unlikely to eliminate subsequent volunteer canola populations altogether. A number of herbicide options to manage volunteer canola are available including modes of action that control all types of canola volunteers. Most of these products, however demand early identification of volunteer canola populations as these products are most efficacious at early (3 leaf or less) growth stages. This must be taken into account when over-wintering populations of volunteer canola are present.

References


