Chapter 6: Weed Control

Important weeds and their impact

Weeds can be a serious problem in flax if left uncontrolled. Because flax does not compete well with weeds, compared with other crops such as cereal grains, weeds have an excellent chance to develop in flax thereby reducing flax yield and seed quality. Excessive weed populations reduce availability of water and nutrients to the crop. As flax is slow to grow, weeds allowed to establish can easily overtop young flax seedlings and lead to substantial yield reductions. This may also result in increased harvest difficulties and higher dockage in harvested grain. Competition with weeds can also reduce flax oil quality by lowering the iodine number. Clean fields at harvest are critical for flax fiber production where the presence of weeds complicates processing the flax fibers and increases production costs. Sound agronomy and crop management throughout the growing season, in addition to the use of effective herbicides at the correct time, are critical to achieve optimum flax yields, minimal dockage and high oil quality.

Refer to the Guide to Crop Protection publication available on provincial department of agriculture websites. The Guide to Crop Protection is updated annually and contains pertinent additional information on weed control management including a listing of currently registered herbicides.

Troublesome weed species

Weed surveys across the Prairie Provinces have been conducted by Agriculture and Agri-Food Canada Saskatoon for the past five decades. Weeds are surveyed in mid-summer, after in-crop herbicides have been applied. The top ten weeds found in flax crops ranked by relative abundance (Leeson et al. 2005) were:

1. Green foxtail
2. Wild oats
3. Wild buckwheat
4. Redroot pigweed
5. Volunteer wheat
6. Lamb's-quarters
7. Canada thistle
8. Pale smartweed
9. Russian thistle
10. Wild mustard

It is important to note that these are mid-season residual weed species that remained after in-crop weed management had been completed and their relative abundance is based on the number of each species present. Weeds with the highest abundance may not necessarily result in the greatest yield loss in flax. For example, even though green foxtail is the most abundant weed in flax, yield loss caused by green foxtail plants is about 10 times less than for the same number of wild oat plants.

Relative abundance of a weed species often varies somewhat among regions and this is also observed in the top ten weeds in flax among the four ecoregions of the Canadian Prairies. The top ten weeds in the Aspen Parkland ecoregion included chickweed, hemp-nettle, cleavers, field horsetail, stinkweed, kochia, barnyard grass, dandelion, and yellow foxtail. More than half of all flax fields surveyed was located in the Aspen Parkland ecoregion.

Production Tip

Control weeds with proper use of recommended herbicides and other weed management strategies.

Market News

With the current trends towards healthy eating, flax consumption will continue to rise.

There is no substitution for sound agronomy

Flax is not a very competitive crop and herbicide options for weed control remain limited. Therefore, an integrated weed management strategy is the best approach for flax production. The goals of integrated weed management are to establish and maintain the most competitive crop stand possible. Crop and weed management strategies work better in combination, resulting in better and more comprehensive weed management than any of the strategies used alone.

An integrated weed management approach for flax begins with effective weed management in the preceding crops in the rotation. Weed control in preceding crops impacts the amount of weed seeds added to the weed seedbank thereby affecting the number of weeds that emerge during flax production. Growing competitive crops with effective herbicide programs in rotation with flax to manage grassy and broadleaf weeds throughout the rotation is critical. A competitive flax crop will also provide protection against yield losses caused by herbicide-resistant weed biotypes that may not be managed by the herbicide choices available for use in flax.

Using sound agronomic management practices to establish a competitive flax crop in combination with pre-emergent or in-crop herbicides to manage weeds is of great benefit. Establishing a flax crop that results in early ground cover will enhance its ability to compete with weeds and also provides excellent insurance against other pests that could impact productivity. A uniformly dense canopy provides excellent insurance for maximum production under less than ideal conditions including that resulting in reduced herbicide performance. In addition, a uniform and dense flax stand can extend the window for herbicide application before weed competition reduces flax yield. Key factors that contribute to successful weed management in flax production include the following:

Flax is an excellent and profitable crop to raise in rotation with many other crops grown in Canada.

a. Planting a competitive variety

b. Narrow-row spacing

c. Higher seeding rates

d. Adequate fertilization and optimum fertilizer placement

e. Early seeding date

f. Early and effective weed management

a. Many crops have varieties with different abilities to compete with weeds. Often, taller varieties with more early-season vigour that tiller or branch more and have greater leaf production tend to be more competitive. Initial results from ongoing research on flax indicates that weed biomass in a taller flax cultivar was half that of a shorter cultivar, irrespective of planting densities, planting date, and whether or not a herbicide was used. The more competitive flax cultivar performed particularly well in the presence of herbicides where weed biomass was reduced by 70% to 87%.

b. Reducing row spacing can be an important mechanism to speed up canopy closure and thereby increasing the crop's competitive ability with weeds. Narrow-row spacing maximizes solar absorbance by the crop early in the season, which can increase total crop biomass production and crop yield. More research is required to quantify the impact of row spacing, seed row width and weed management on yield and dockage.

c. Increased seeding rates can have many benefits. Higher seeding rates contribute to rapid and even stand establishment and in conjunction with narrow-row spacing, contribute to rapid ground cover which is key to establishing a competitive crop canopy. Later in the season, high density stands lead to more rapid and even crop maturation. Initial results from ongoing research show that increasing seeding rates from about 40 to 80 seeds per square foot (400 to 800 seeds per square meter) can reduce season-long weed biomass production by half, whether herbicides are used or not.

d. Studies at Agriculture and Agri-Food Canada Lethbridge have shown that banding fertilizer beside each row or beside alternate rows at the time of seeding is much more effective than broadcasting fertilizer. This practice resulted in dramatically reducing weed populations in cereal crops over a period of three years. Adequate fertilization, side-banded adjacent to seed rows, enhanced crop uptake of fertilizer and reduced fertilizer availability to weeds. Although no data for this exists for flax production, it is likely that this principle also applies.

e. Early seeding dates are associated with increased yield for most crops grown in Western Canada. Early planting results in a crop better positioned to compete with later emerging weeds, such as green foxtail or redroot pigweed.

f. Flax, however, is impacted by early and late emerging weeds. The important factor is to maximize the number of days between the emergence of the flax crop and the emergence of weeds. Weeds that emerge before the crop will be more advanced and cause greater reduction to crop yield than the same weeds emerging after crop emergence. Flax yield was reduced by 80% when the final pre-seed tillage pass to control weeds occurred five days before planting, compared to that completed on the same day as planting the crop. Thus, timely weed management just prior to planting by whatever means, is critical to ensure that crop emergence is ahead of weed emergence by as many days as possible.

Given that flax is typically not a good competitor with weeds, early in-crop management of weeds is important to prevent yield loss. New research is required to quantify the impact of early weed management, flax yield and dockage.

Integrated weed management

Used alone, weed management techniques are effective; however, the real benefits of weed management occur when multiple techniques are used in combination. First year results of a multi-year, multi-location study show that by combining a taller cultivar with higher seeding rates and herbicide application; late season weed biomass production was reduced 20-fold compared to the shorter cultivar with lower seeding rate and no in-crop herbicide application. Clearly, integrated weed management techniques are effective and essential for flax production.

Herbicides for weed management in flax

Early removal of weeds is necessary to minimize crop losses caused by weed competition. Weeds at the seedling stage are more easily controlled by herbicides than at any other growth stage. Early treatment usually decreases the risk of herbicide injury to the flax crop. Risk of injury is also reduced by using correct water volumes, usually 110 l/ha (10 gallons/acre). The performance of many herbicides can also be affected by soil moisture conditions, air and soil temperatures and humidity, as well as other environmental factors. **Always read and follow label instructions carefully when using herbicides.**

Herbicides continue to be a key component of weed management programs in conventional flax production. According to the 2014 Manitoba and Saskatchewan Guide's to Crop Protection, a total of 15 different pre- and post-emergence herbicides are registered for early season weed control in flax. These herbicides, however, only comprise six different modes of action (Groups 1, 3, 4, 6, 8, 14) and only three of these modes of action are registered for in-crop use (Group 1, 4, 6). Each of these three herbicide Groups has a limited spectrum of weeds they manage with limited species spectrum overlap between Groups (only Group 6 shares species with Group 1 and Group 4). This limited overlap in weed control with the registered modes of action for in-crop herbicides means that flax growers should be aware of their weed populations and whether they have herbicide-resistant weed biotypes. For example, grassy weeds resistant to Group 1 herbicides are common in many fields in Western Canada and therefore, good records of herbicide-use histories and herbicide performance is essential.

PRE-EMERGENT HERBICIDES

Pre-emergent herbicides include pre-plant soil-incorporated herbicides and herbicides applied to weeds that emerge before the crop. Sulfentrazone (see provincial Guide to Crop Protection for product names and instructions for use), a Group 14 (PPO inhibiting) herbicide, has recently been registered for use in flax and can provide excellent control of some difficult-to-control broadleaf weed species. This is a pre-emergent, soil-applied herbicide that does not require incorporation by tillage but relies on rainfall for incorporation/activation. This herbicide also has a restricted range of soil organic matter and soil pH values to work effectively and these ranges need to be adhered to. Other pre-emergent herbicides include soil applied or incorporated herbicides in Groups 3 and 8, as well as glyphosate or other pre-emergent burn-down products. Research conducted at Morden Agriculture and Agri-Food Canada indicates that glyphosate applied in a high residue system (cereal stubble) within seven days before flax emergence could impact flax stand establishment and yield.

POST-EMERGENT HERBICIDES

Spring applied post-emergent herbicides (see provincial Guide to Crop Protection for recommended product brands) are most effective when applied to weeds at the seedling stage. These herbicides are applied after the weeds have emerged and the flax seedlings are 2 to 12 cm (1 to 5 inch) tall. Check the growth stages of both crop and weeds, and then follow recommended instructions on the herbicide label.

All post-emergent applications of herbicides must be applied within the pre-harvest interval indicated on the herbicide labels. This ensures that herbicide residues are reduced to acceptable levels when the crop is harvested and marketed.

PRE-HARVEST HERBICIDES

Formulations of glyphosate registered (see provincial Guide to Crop Protection for recommended product brands) for pre-harvest weed control are applied when the flax is mature. These herbicides control perennial weeds before the weeds are cut. Perennial weeds controlled by pre-harvest applications of glyphosate include quackgrass, Canada thistle, common milkweed, toadflax, and dandelion. For the developmental stages of these weeds that are controlled by pre-harvest glyphosate please refer to the 'Herbicide Options to Enhance Harvesting FAQ' webpage maintained by Saskatchewan Agriculture. Sufficient time for the herbicide to translocate to the root systems of the weeds prior to harvesting the crop is required for high efficacy on the target weeds. In other

crops, early applications of pre-harvest glyphosate can result in glyphosate residue in harvested seed above the minimum residue level which may affect marketability. It is advisable not to apply pre-harvest glyphosate or other translocated pre-harvest herbicides until the flax seeds have reached sufficient maturity to minimize this risk.

Herbicide injury to flax

Flax is sensitive to a number of herbicides and can easily be injured by them. There also is anecdotal evidence that sensitivity to herbicides varies among flax cultivars. Weed control recommendations for flax are published annually in the Guide to Crop Protection by provincial departments of agriculture. For these publications and for the latest information and specific recommendations for your area, consult the provincial departments of agriculture, weed supervisor or your appropriate technical representative.

Herbicide-resistant weed biotypes

Limited effective herbicide modes of action can make managing herbicide-resistant weed biotypes challenging as alternate modes of action may not be available, particularly in flax production. Integrated crop management methods when used in conjunction with herbicides will assist greatly in reducing the impact of herbicide-resistant weeds in flax.

When choosing a product for weed control, records from previous years must be checked to ensure that the same herbicide (or a member of the same herbicide Group) is not used continuously on that field. Frequent use of a herbicide Group may lead to the development of weed resistance to that group of herbicides. Herbicide rotations and rotation of herbicide mixtures within crops and between crops are recommended to reduce evolution of and selection for herbicide-resistant weed populations.

Control of volunteer flax in other field crops

Flax is not a strong competitor, so volunteer flax does not usually result in significant yield losses in competitive crops like cereals and canola. However, volunteer flax can cause considerable difficulty at harvest time because they can remain green long after the main cereal or canola crop is mature. This interferes with harvesting and can cause grain storage problems.

Despite the sensitivity of flax to many different herbicide modes of action, there are few herbicides that provide sufficient control, or even suppression, of volunteer flax in broadleaf crops. Glyphosate is one of these herbicides and flax is highly sensitive to it. In fact, glyphosate drift from in-crop use in glyphosate resistant crops can be harmful to neighbouring flax crops. Quinclorac herbicide provides excellent control of volunteer flax in wheat. Quinclorac also provides control of cleavers and green foxtail. Products or mixtures that contain dichlorprop (see provincial Guide to Crop Protection for recommended product brands) will provide some suppression of volunteer flax in cereal crops. Use the maximum recommended rates. Products that include 2,4-D LV ester will be slightly more effective to control flax than 2,4-D amine or MCPA.

Because of the poor level of control likely to be achieved with herbicides, crop management practices are important to control volunteer flax. A competitive cereal crop managed for maximum competitiveness (early seeding, shallow seeding depth, adequate banded fertilizer, competitive cultivar sown at maximum seeding rate for the area) and treated with one of the herbicides mentioned above, should maximize the level of volunteer flax suppression.

Flax performance under reduced in-crop herbicide use

A rotation including flax with reduced in-crop herbicide use was established at the University of Manitoba in 2000 and has been reviewed in detail in the Prairie Soils and Crops Journal that is available free online (http://www.prairiesoilsandcrops.ca/articles/volume-5-2-screen.pdf). For more than a decade, this rotation has shown that weed populations and seedbank densities are influenced by weed management programs used throughout the rotation. Nevertheless, continuously skipping in-crop herbicides in oats, a very competitive crop, had little impact on yield and did not affect adjusted gross returns in flax or other crops in rotation negatively, compared to using in-crop herbicides in all crops in the rotation. In fact, adjusted gross returns tended to be greater when in-crop herbicides were not used in oats over the duration of the study as the cost of herbicides outweighed the benefits of weed management. However, omitting in-crop herbicides in flax, in addition to omitting in-crop herbicides in oats, did reduce flax yield and adjusted gross returns noticeably. The effects of omitting in-crop herbicides on adjusted gross returns in flax and oats, however, were only observed in the flax crop with no obvious effect in the other crops in rotation (cereals and/or canola). Integrated weed management practices have not been optimized in this rotation.