Herbicide Efficacy and Crop Safety in Spring Planted Garlic

As a short stature, shallow rooted crop garlic is poorly adapted to compete against weeds. Careful weed control over the full duration of the growing season is recommended. Relying on tillage to control weeds in garlic is problematic as the rows are tightly spaced and its coarse shallow root system is sensitive to soil compaction and mechanical damage. Multiple passes of tillage equipment combined with frequent irrigation also tends to promote emergence of several flushes of weeds over the course of the season. For these reasons growers are interested in the potential to use herbicides in garlic. However, the range of herbicides presently registered for use in garlic in Canada is very limited and the limited number of products that are registered have to be used carefully otherwise there is significant potential for crop damage to occur (see http://veg.usask.ca/herbicides-for-weed-control-in-onions-photo-gallery/damage-to-garlic-by-buctril/).

The objective of this project was to do a preliminary assessment of the crop safety and efficacy of one of the herbicides registered for use in garlic in Canada (bromoxonil) along with a potential alternative herbicide – oxyfluorfen. Oxyfluorfen is presently registered for use on onions in Canada and is widely used on garlic in the USA.

The experiment was conducted during the 2016 growing season at the University of Saskatchewan Horticulture Field Research Station in Saskatoon, Saskatchewan. The site has a clay loam soil with a pH of 7.3 and an E.C. of less than 1 dS/m. The trial site has been continuously cropped to vegetables for the past 30 years – and the weed spectrum on site is fairly typical of this type of cropping situation. Common groundsel, red root pigweed, portulaca and round-leaf mallow are the dominant broadleaf weeds, barnyard grass is the only significant grassy weed.

In Saskatchewan, garlic is typically planted in the fall. Next spring, the fall planted crop emerges into established stands of fall annual weeds like stinkweed and shepherds purse as well as early emerging spring annuals. This trial however was planted in the spring, meaning that all of the fall annual weeds were eliminated by the cultivation operations used to prepare the plot for seeding. The test plot was prepared in early April by rotovating the soil, at which time enough nitrogen fertilizer was incorporated to raise the total soil nitrogen level to the recommended rate for garlic of 75 kg/ha. All other nutrients were already present in the soil in adequate quantities for garlic production. The trial was seeded with garlic purchased from local markets. One of cultivars was “Music”. In previous trials Music has proven to be well adapted to Saskatchewan growing conditions. The other cultivar was unnamed and was a product of China (Rooster Brand). This type of garlic has not performed well in previous trials in Saskatchewan. The garlic was hand planted (April 4) at 10 cm spacings within the row, in rows spaced 50 cm apart. Sufficient material was planted to allow each herbicide treatment to be applied on a 4 m long section of row – with an untreated guard row separating the treatments. Each treatment was replicated twice in separate blocks.

The treatments were;

a) Weedy check
b) Hand weeded check – weeds were removed at 10 day intervals by hoeing or hand-pulling
c) Pardner (28% bromoxonil) at 1X label rate (1.0 L product/ha)
d) Pardner (28% bromoxonil) at 2X label rate (2.0 L product/ha)
e) Goal 2XL (24% oxyfluorfen) at 1X label rate for garlic in USA (0.5 L product/ha)
f) Goal 2XL (24% oxyfluorfen) at 2X label rate for garlic in USA (1.0 L product/ha)

NB – Goal is not presently registered for use on garlic in Canada

The herbicides were applied in the equivalent of 400 L/ha of water using a CO2 powered backpack sprayer equipped with 80-02 spray nozzles. The labels of both herbicides stress the importance of applying the product in large volumes of water – otherwise there is an increased risk of crop damage. Each herbicide was applied twice – with the first application (May 20) timed to coincide with the emergence of the first flush of weeds. The garlic was approx. 10 cm tall at that time. The second application (June 15) was timed to coincide with a flush of annual weeds (red root pigweed, portulaca and common groundsel) that occurred as temperatures rose. The garlic was approximately 20 cm tall at the time of the 2nd treatment. It is not recommended to apply bromoxonil to garlic once it exceeds 30 cm in height.

NB – In Canada bromoxonil is registered for only a single application per year on garlic.

Weed control and crop health were evaluated one week after each herbicide treatment. The last hand weeding session coincided with the timing of 2nd application of herbicide. By mid-July both cultivars had begun to senesce indicating that they were ready to harvest. The garlic was dug by hand and the number and weight of the bulbs were determined.

Results

Both cultivars emerged quickly – although fewer plants emerged for the "Rooster" garlic than for the better adapted "Music". Weed growth was rapid in the weedy check and by mid-June the garlic plants in this treatment were completely obscured by weeds. The herbicides caused no obvious damage to the foliage and had no clear impact on the vigor of either cultivar of garlic at any treatment date when applied at either the label recommended or 2X recommended rates. Weed control provided by the oxyfluorfen was clearly superior to that provided by the bromoxonil in terms of the spectrum of weeds controlled, the speed of the control and the duration of the control provided. Bromoxonil did not control barnyard grass whereas the oxyfluorfen provided good control of this weed if applied to young seedlings. Oxyfluorfen also provided superior control of common groundsel – although neither product was able to fully eliminate emerged specimens of this weed or to prevent flushes of this weed from emerging later in the growing season. Neither herbicide effectively controlled round leaf mallow.

Both bromoxonil and oxyfluorfen have a 56 day pre-harvest interval when applied to garlic. While the oxyfluorfen was clearly superior in terms of the duration of weed control provided, the 56 day pre-harvest interval was more than enough time for a thick weed canopy to develop in all the treatments before the crop was ready for harvest. Newly emerged common groundsel and escapes of barnyard grass and mallow were the dominant weeds at harvest time.

The vigor of the "Rooster" garlic was very poor and in all treatments the crop was overwhelmed by the weed escapes. Consequently, no useful yield data could be collected for that cultivar. In the more vigorous "Music" garlic, the number of bulbs harvested was similar in all treatments (Fig. 1). This suggests that all the herbicide treatments were "safe" – at least from the perspective of causing death of the crop.

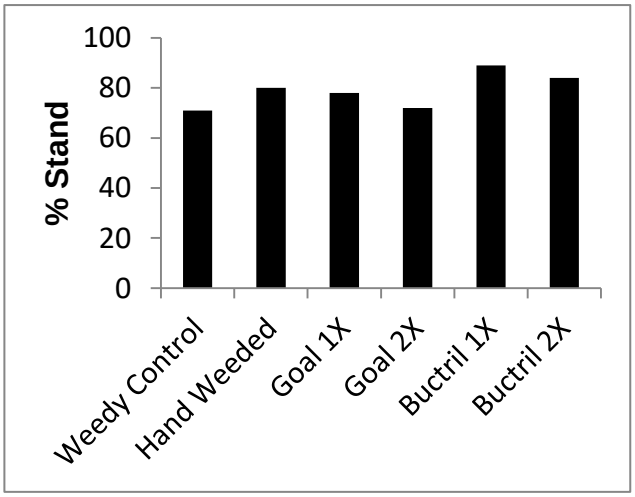

Fig 1. Stand % at harvest for spring-planted Music garlic grown with various weed control treatments.

While yields from the weedy check treatment were considerably lower than for the other treatments (Fig. 2), they were still better that expected given the severity of the weed competition encountered in

this trial. The fact that garlic is adapted to grow in cold wet conditions may have given it a useful edge against weed competition for the first few weeks of the growing season. Yields for both oxyfluorfen treatments were comparable to the hand weeded check – but both bromoxonil treatments produced higher yields. While bromoxonil was not as effective as oxyfluorfen (or the hand weeded check) for controlling weeds, it appears that the oxyfluorfen (and hand weeding) treatments were in some way reducing the yield potential of the garlic crop in a manner that more than offset the impact of greater weed competition. Hand weeding definitely has the potential to damage the crop, especially when large deep rooted weeds like round leaf mallow and barnyard grass are pulled from around shallow rooted crops like garlic. The manner by which the oxyfluorfen treatments were negatively impacting yields is less clear. While the potential for oxyfluorfen to cause crop stress is well established (see product label for symptoms), there were no indications of damage to either of the garlic cultivars tested at any time for either treatment rate.

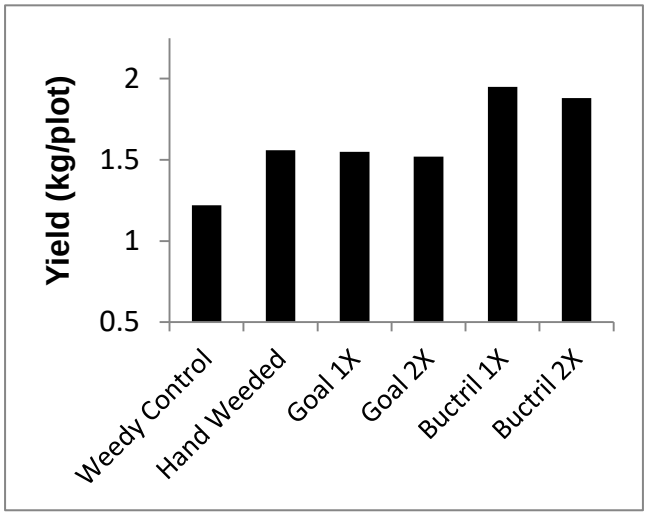

Fig 2. Yields for spring planted Music garlic grown with various weed control treatments.

In summary – application of the registered herbicide bromoxonil to spring planted garlic was crop safe but the resulting weed control was limited in terms of the spectrum of weeds controlled and the duration of control provided. Sticking with the single application presently approved for use in Canada would further limit the efficacy of the bromoxonil treatment. Oxyfluorfen provided superior weed control as it killed emerged weeds and also suppressed germination of subsequent weed flushes. In closely related crops like onion oxyfluorfen is approved for multiple uses over the course of the growing season which would enhance the degree of weed control achieved. However the results from this study suggest that the multiple applications of oxyfluorfen may be causing some form of hidden damage to the garlic crop leading to suppressed yields. The validity of this finding and its underlying cause should be further investigated. Alternating between application of bromoxonil and oxyfluorfen may provide effective weed control with less risk of selection for herbicide tolerance while also enhancing crop safety.