Demonstration of Herbicides for Weed Control in Onions

Thorough, consistent weed control is essential for successful onion production. Onions remain sensitive to weed competition for the entire growing season. Presently weed control in onions is achieved through mechanical tillage and/or application of herbicides. Herbicides have several potential advantages over tillage for controlling weeds in onions. Well timed application of an appropriate herbicide can provide long lasting weed control - including the weeds growing within the row. Chemical weed control may also be achieved at a lower overall cost than repeated tillage operations – especially if hand weeding is required to deal with weeds within the rows that are typically missed by standard between-row tillage.

This project demonstrated the efficacy and crop safety of a range of herbicides for use in yellow onion production.

Trials were conducted in 2011 and 2012 at the University of Saskatchewan Horticulture Field Research Facility in Saskatoon. This site has been in long term production of horticultural crops and has a "typical" spectrum of broadleaf weeds seen in vegetable fields. Grassy weeds are uncommon. Both fields used in the trials were in summer fallow the previous year. Summer fallowing is a common practice in land designated for onion production – as it reduces the weed pressure. In early May of each year the fields were prepared by fertilizing to recommended levels and then rotovating. About 10 days later, two popular, locally-adapted cultivars of yellow onions (Norstar and Copra) were seeded using a small plot seeder. The onions were seeded in 5 m long rows spaced 0.5 m apart. Just prior to emergence of the onion crop a 1% solution of the non-selective herbicide glyphosate was applied over the entire plot. This treatment burned off all the weeds that had emerged prior to emergence of the onion crop. This "stale seedbed" approach provided the onion crop with a crucial 2-3 weeks window to develop without any significant weed pressure.

In both years the first application of the test herbicides occurred when the crop was at 2 true leaf stage (June 12 in 2011 and June 30 in 2012). This is the recommended stage of crop development for safe application of the weed control products utilized in this project. The second flush of weeds was just beginning to emerge at this time. The sprays were applied with a CO2-powered small plot sprayer equipped with 80-01 nozzles operating at 270 kPa pressure using the equivalent of 80L H2O/ha. Two adjacent rows were treated with each herbicide – with an unsprayed check row separating each treatment.

The products tested, the rates applied and the recommended crop stage for treatment were;

- Trmt 1- Chateau (51 WDG) (flumioxazin) @ 28-56 g/a. Apply at 4-6 leaf stage
- Trmt 2 - Goal (4SC) (oxyfluorfen) @ 230 ml/a. Apply after 2 leaf stage
- Trmt 3 - Buctril (bromoxynil) @ 94-236 ml/a. Apply at 2-5 leaf stage
- Trmt 4 - Dual Magnum (7.6E) (metolachlor) @ 330-615 ml/a. Apply after 2 leaf stage
- Trmt 5 - Prowl (3.8 ACS) (pendimethalin) @ 340-950 ml/a. Apply after 2 leaf stage

Where a range of product concentrations were recommended on the label, the first application used the lowest concentration recommended, while the 2nd application used the highest concentration recommended. Herbicide tolerance tends to increase as the crop matures, so low dosages are preferred when treating young plants. Similarly weeds' tolerance of herbicides tends to increase as the plants increase in size and maturity – so higher herbicides dosages are required to achieve effective control of more mature weeds.

In both years there appeared to be some loss of crop vigor associated with this first application of the herbicides. Crop growth slowed, some leaves yellowed and others died back from the tips.

The % ground cover by weeds was evaluated two weeks after the first application of the herbicides (Fig. 1). All of the herbicides provided at least some degree of control at this time, with the Chateau and Goal providing almost complete weed control.

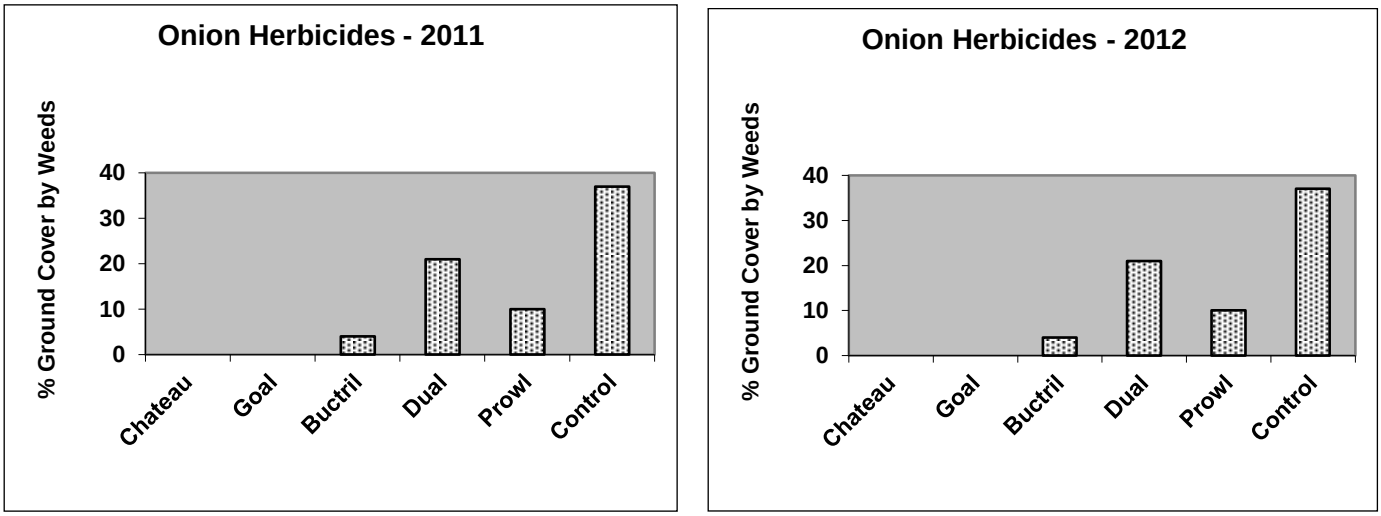
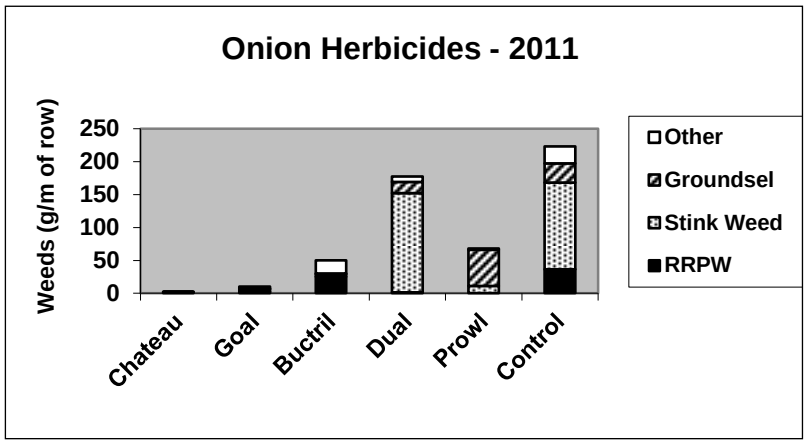
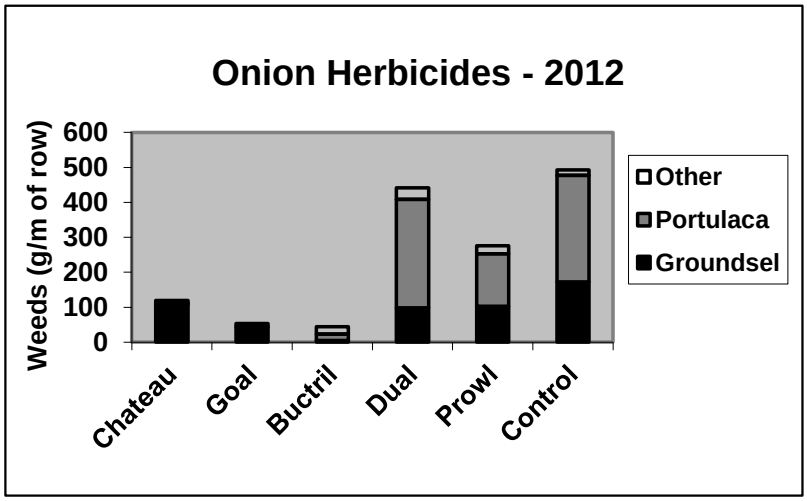


Figure 1. Percent ground cover by weeds 2 weeks after application of various onion herbicides in 2011 and 2012.

The efficacy of the treatments was evaluated again at 4 weeks after spraying – this time by harvesting all the weeds growing within the rows, separating the weeds into species, and then weighing each type of weed (Fig. 2)

Figure 2. Weed growth in onions at 4 weeks after application of various herbicides in 2011 and 2012.





In 2011 stinkweed represented the dominant weed in the non-sprayed controls at this point in the growing season. Chateau and Goal provided almost complete weed control through 4 weeks after application. Buctril provided excellent control of the stinkweed but was ineffective against red-root pigweed and roundleaf mallow.

Purslane (aka. portulaca) was the dominant weed in 2012. Goal and Chateau provided excellent control of this weed, but were less effective against common groundsel. Buctril provided effective control of groundsel and portulaca. Dual and Prowl provided limited control of the weed species present at this stage in the 2012 growing season

The herbicides were applied for a second time once the crop reached the 4-6 leaf stage (July 4 in 2011 and July 14 in 2012). As all weeds were removed for assessment just a few days ahead of this second application, the herbicides were applied to largely "weed free" ground. The non-sprayed control treatments would also have been rendered "weed free" at this time.

In both years, the weed control achieved using the 2nd herbicide application was not as thorough as with 1st application – this could reflect the rapid development of weeds missed in 1st round of spraying and hand weeding. One month after the 2nd herbicide treatments were applied the weeds in each plot were again harvested and weighed (Fig. 3). Dandelion and curled dock were dominant in all plots in 2011, whereas portulaca and groundsel were predominant at this stage of the 2012 growing season.

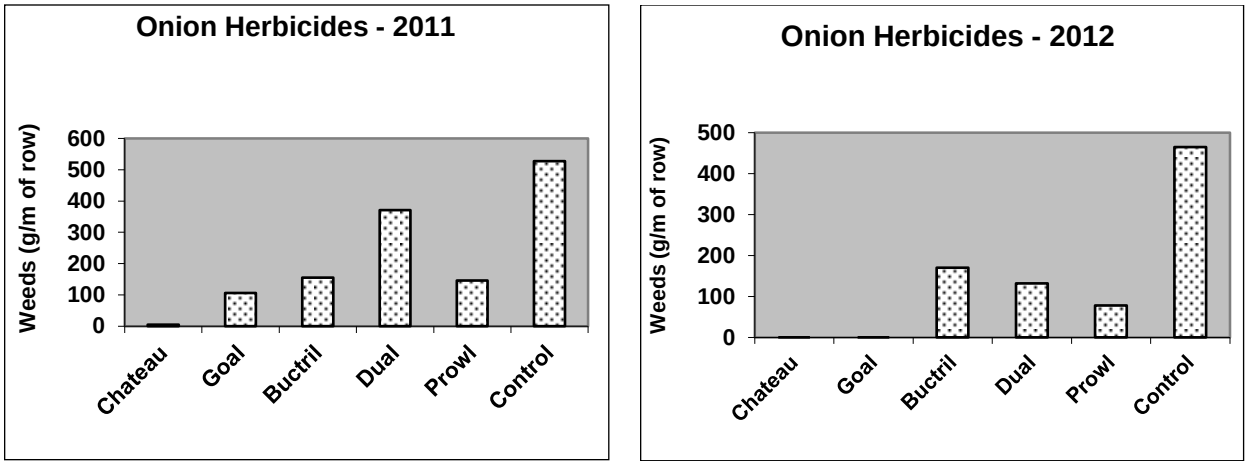


Figure 3. Weed growth in onions treated with various herbicides - 1 month after 2nd application in 2011 and 2012.

In 2011 the Chateau treatment provided superior weed control relative to all other products at the 2nd application. In 2012 both the Goal and Chateau treatments rendered the plots effectively weed-free through to one month after the 2nd herbicide treatment. All the other herbicides also reduced weed growth to some degree relative to the non-treated controls.
In late September of each year the onions were lifted and topped, then the number and weight of bulbs in each herbicide treatment row was determined (Fig 4). Crop quality in 2011 was excellent but the average bulb size was relatively small. Overall yields in 2011 were around 20t/a - which is below average. Yields were higher in the 2012 trial.

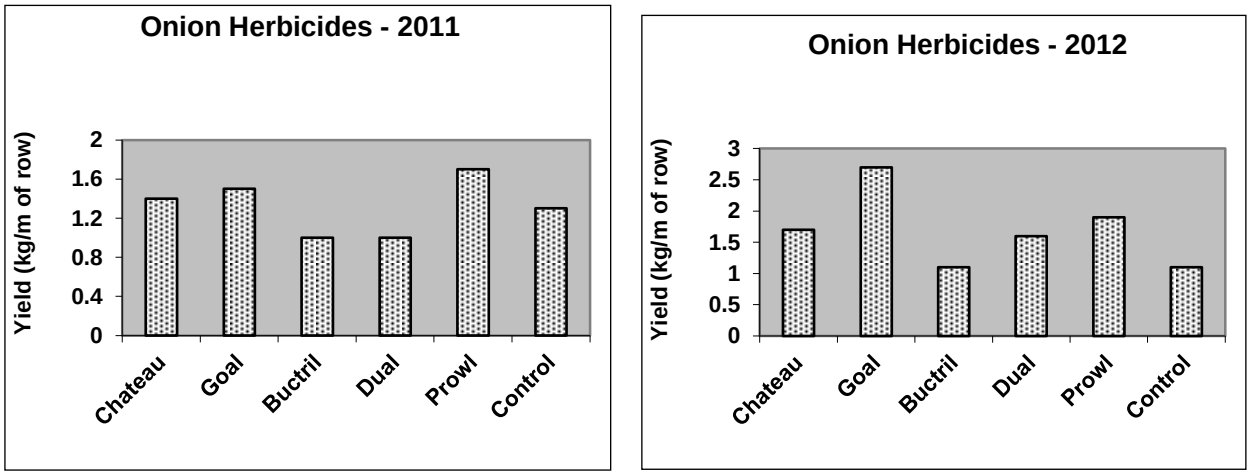


Figure 4. Yields obtained from onions treated with various herbicides.

In both years the herbicide treatment effects on yields did not correspond to expectations. While all of the herbicides had provided at least some weed control, yields in the unsprayed control treatments were often similar to the herbicide treated plots (Fig. 4). Also the herbicide treatments that had provided the most effective weed control (Chateau and Goal) often did not produce the highest crop yields. This suggests that either; a) the weed pressure encountered by the unsprayed control treatments was not sufficient to cause any yield reduction or b) while the herbicides may have been providing effective weed control they

were also causing some crop toxicity – resulting in a yield loss. Option a) seems unlikely as a large numbers of weeds were recovered from the unsprayed control plots and onions are renowned for their sensitivity to weed competition from seedling stage through to crop maturity. The impact of the weed competition on the unsprayed check treatment may have been reduced by the fact that the crops were maintained under near-ideal conditions, competition between the onion crop and the weeds for fertility or water would have been minimal. Also all weeds were removed from the unsprayed check plots on two occasions in each growing season, which would have reduced completion with the crop. However, crop toxicity effects seems the more likely explanation for the observed results, especially as symptoms of crop damage were observed in both years in the Chateau treatments. Goal and Buctril are also known to cause some damage to the foliage of onions, especially if applied under unfavorable growing conditions.

Conclusions and Recommendations

This project demonstrated the potential to achieve a high degree of control of broadleaf weeds in onions using herbicides. Goal and Chateau both provided long lasting control of a wide spectrum of weeds commonly found in vegetable fields. Goal herbicide has been widely used by growers for many years, whereas Chateau has only recently been registered for use in vegetable crops in Canada. The results suggest that, while Chateau is highly effective, it may be toxic to the crop, even at label recommended dosages. Greater crop safely might be expected if lower rates of Chateau were used – however the potential impact on efficacy of weed control would need to be considered. Further investigation of Chateau may also be warranted as it is more readily available than Goal and also costs less to apply. While Prowl was less effective as a herbicide than Goal or Chateau it had the advantage of being very crop safe.

The apparent yield loss observed for the herbicide treatments is a concern, as all products were applied using recommended methods and recommended product concentrations to relatively healthy vigorous crops. While the results suggest that using herbicides to control weeds in onions may cause some unavoidable reduction in the onion crops yield potential – using alternative means of weed control such as mechanical tillage between the rows supplemented with hand weeding within the rows may also cause a yield loss due to physical damage to the crop. Hand weeding is also prohibitively costly.