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HARROWING ON SASKATCHEWAN FARMS

Final Research Report W2008-15

INTRODUCTION

Most weed management in organic systems involves preventing problems by tilling weeds prior to seeding and by using best agronomic practices to give the crop a competitive edge. Once the crop has emerged, harrowing gives one more option to remove weed seedlings.

Harrowing works best when it is selective; when it kills or damages weeds but not crop plants. This is most likely if the weeds are small-seeded species like lamb's-quarters, pigweed or green foxtail, emerging from shallow depths after the crop is established.

Harrowing recommendations for Saskatchewan are based primarily on the research done by Eric Johnson (Agriculture and Agri-Food Canada) and Steve Shirtliffe (University of Saskatchewan). They found harrowing to be most effective when 65 to 90% of the crop is buried. The type of implement used to harrow is less important than the aggressiveness of the operation.

In plot experiments, Steve and Eric found that pulses and cereals generally tolerate harrowing quite well. For oat, barley and wheat, tolerance was best up to the 4 or 5 leaf stage. For lentil and field pea, tolerance to harrowing was best before the plants are 10 cm tall; for faba bean, between 5 and 15 cm tall.

Despite these successes, post-emergence harrowing is not a routine procedure for most organic farmers. In a study of organic production methods in Saskatchewan from 1996 to 2001, Rachel Buhler found that only 11 to 21% of fields were harrowed after crop emergence. Approximately 80% of these received a single pass.

Harrowing on the farm (Susan Howse)

METHODS

The purpose of this study was to see what level of success organic farmers were having with post-emergence harrowing. We were interested in the effect of harrowing on both the weeds and the crop.

We asked producers who were planning to harrow a crop to leave a strip that was not harrowed, so that we could compare harrowed to not harrowed. The farmers chose which fields and crops they were going to harrow, and harrowed with their own equipment at times that they determined to be appropriate.

In 2003, 6 producers allowed us to monitor their harrowing operations, making 8 paired comparisons. In 2004, this number was reduced to 3 producers with 4 comparisons, due to the very wet spring and summer. In 2005, we monitored 8 producers with 14 comparisons and in 2006, 3 producers were monitored with 8 comparisons.

Harrowed (left) and not harrowed (right) (Brenda Frick)

In total, we had 34 paired comparisons over 4 years.

Our goal was to monitor the effect of harrowing in normal farm practice, so we accepted fields seeded to a variety of different crops. We included 3 barley, 2 lentil, 5 pea, 1 oat, 3 flax and 20 wheat fields.

We counted weeds and crop plants shortly after harrowing in 20 quadrats, each 50 cm x 50 cm, within each strip. Crop and weed biomass and crop yield samples were taken by hand at maturity, in 5 quadrats per strip of 50 cm x 1 m each.

RESULTS – WEED CONTROL

Weed counts in harrowed and non-harrowed or leave strips indicate both death due to harrowing and any other events between harrowing and counting, such as weed emergence stimulated by the harrowing treatment, competition between crop and weeds, etc. Weed counts are notoriously variable, so even large differences can fail to be significant statistically.

Post-emergence harrowing was generally effective at reducing weed populations (Figure 1). On average, weed numbers in harrowed areas of the field were 60% of those in the leave strips (that were not harrowed). In some instances weed counts in the harrowed area were as low as 20% of those in the leave strip.

Of the 34 comparisons, only 5 showed higher weed numbers after harrowing. In these instances, harrowing may have stimulated weed germination or facilitated weed survival. Comparisons where weed numbers were higher after harrowing occurred in 3 of 4 years, in 4 of 6 crop types for 5 of 13 producers. There was apparently no pattern to these harrowing failures.

Weed biomass indicates the competitive effect of weeds. On average, weeds in harrowed strips weighed 73% of weeds in the leave strips. In some cases, weeds had significantly less biomass, as low as 14% in the harrowed strips. In three comparisons, weeds had more than twice the biomass in harrowed areas.

Taken together, these results indicate that harrowing can reduce the number and the size of weeds. This will both reduce their competitive effect in the year of harrowing, and reduce their reproductive success, and thus their effect in future years. However, there is the opportunity for harrowing to fail and for weed numbers and size to be greater in harrowed areas.

Harrowed field with weeds in unharrowed strip clearly showing (Susan Howse)

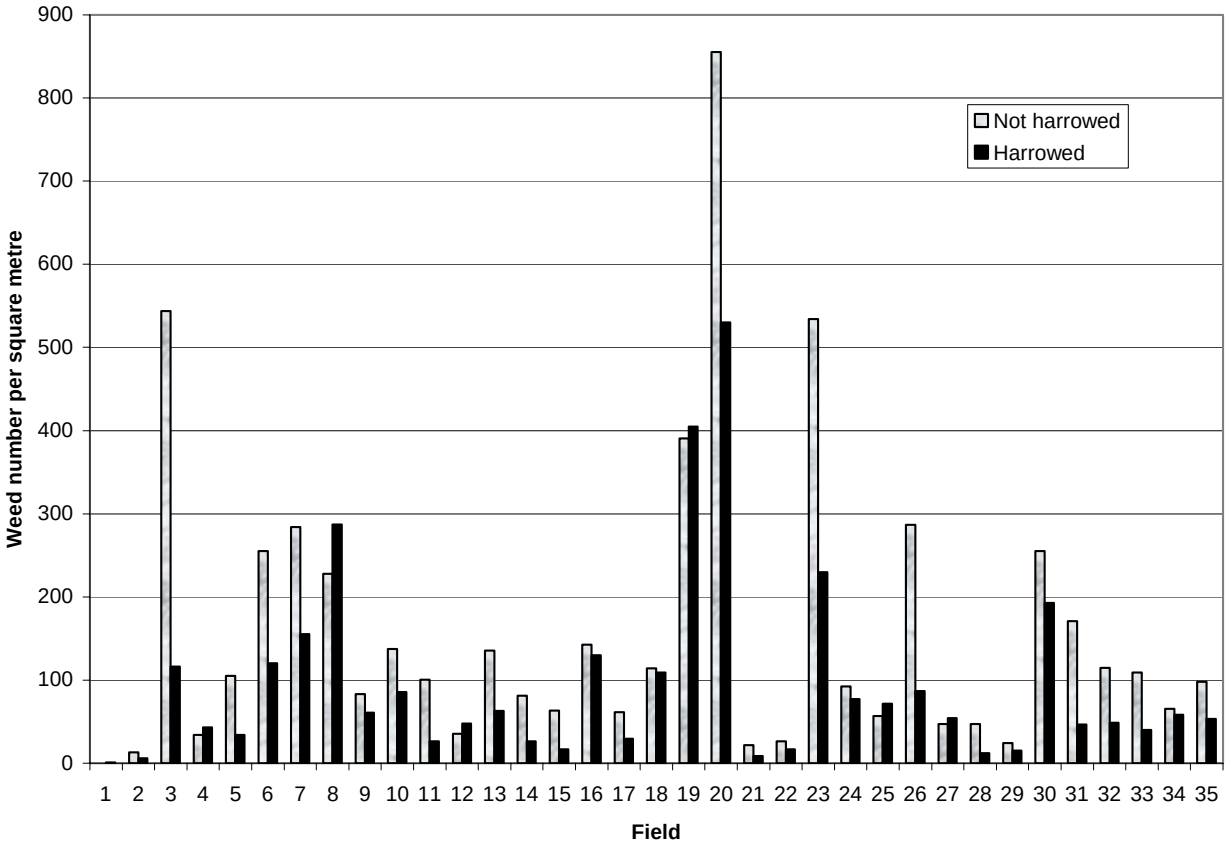

Figure 1. Effect of harrowing on weed density in Saskatchewan grain and pulse fields

RESULTS – CROP DAMAGE

Crop numbers in harrowed areas were on average 90% of those in leave strips. This was a slight but rarely significant difference. Crop biomass was not affected by harrowing, with harrowed areas having on average 97% of the biomass of leave strips. Biomass is usually very closely related to yield. This suggests that yield would likely be similar in harrowed and leave strips.

These results indicate that although some minor damage may be done to the crop by harrowing, it is generally able to recover. However, crop biomass did not increase due to the reduction in weed numbers and biomass.

MULTIPLE PASSES

In addition to the simple comparisons of harrowed to not harrowed, we also had 11 comparisons that include a leave strip, a single pass of the harrows and two passes of the harrows a week to 10 days apart.

Weeds were reduced even further by a second harrow pass. On average, weeds were reduced to 60% in number and 74% in biomass by a single harrowing pass. They were reduced to 30% in number and 47% in biomass with the use of 2 passes.

Crops were less affected by harrowing than were weeds. Although crop numbers were reduced to 73% and 67% by one and two passes, respectively; crop biomass was reduced a lesser amount: to 91% and 86%, respectively.

Red Fife wheat harrowed 0, 1 or 2 times (Marc Loiselle)

THE BOTTOM LINE...

Harrowing:

- ✓ Significantly reduced the number of weeds
- ✓ Significantly reduced weed biomass
- ✓ Caused a small reduction in the number of crop plants
- ✓ Generally did not reduce crop biomass

Two harrowing passes often gave better results than one harrowing pass. Harrowing could be a useful weed management tool for organic producers.

CONCLUSION

Harrowing as practiced on the farm is often (but not always) very effective at reducing weeds. It is less effective at improving yield, at least in the year of harrowing.

A second harrowing pass may improve weed kill, while damaging the crop only a small amount more than a single harrowing pass.

The real advantage of harrowing may be as a long term weed management technique. By reducing weed populations in the harrowed crop, potential problems in future crops are reduced.

REFERENCES

Buhler, R.S. 2005. Influence of management practices on weed communities in organic cereal production systems in Saskatchewan. M. Ag. Thesis, University of Saskatchewan.

Shirtliffe, S. and Johnson, E. 2004. Novel Mechanical Weed Control in Organic Crop Production. Final Report #20030400 to ADF.

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