Mechanical Weed Control In Low Input Sustainable Systems

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Background

Many growers may choose not to use herbicides for weed control; such as for pesticide-free, transition-to-organic or in organic crop production. Weed control is still needed but requires use of alternative strategies and tools. The following two (2) studies were undertaken to evaluate the effectiveness of the weeder harrow and to determine weed control within a Low Input Sustainable Agricultural (LISA) rotation. These studies were conducted at two (2) Ontario Ministry of Agriculture and Food (OMAF) research station sites in NW Ontario - on an Oskondaga silt loam in Thunder Bay district and Emo clay loam in Rainy River district.

Method – Study A

In Study 1, a Lely weeder harrow was operated in Chapais barley at 3 timings, or combination of timings. This evaluation took place at 2 sites in Thunder Bay (A and B) and one site in Emo in 1992.

Treatment
1. Weedy check
2. Herbicide check (Refine Extra herbicide)
3. Pre-emergent or blind harrow (PRE) before barley emergence
4. Early post-emergent harrow (EP) at 2-leaf stage of barley
5. Late post-emergent harrow (LP) at 4-leaf stage of barley
6. PRE followed by EP harrow
7. PRE followed by LP harrow

The Lely weeder harrow was operated at 6-9 km/hour. Adjustable harrow teeth were adjusted according to soil condition to uproot weed seedlings. The PRE harrowing strategy is to uproot weed seedlings at the “white-root” stage before the crop emerges (Fig 1). Post –emergent harrowing is intended to uproot or bury emerged weeds, while the deeper seeded crop remains firmly anchored (Fig 2).

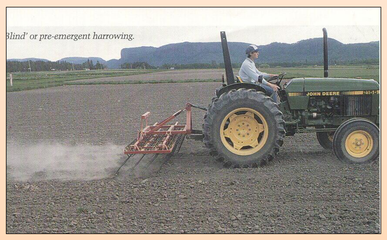

Figure 1. Blind harrowing

Figure 2. Post-emergent harrowing

Weed populations and crop populations were determined prior to harrowing, immediately after harrowing and 1 week later, in order to assess the effectiveness. Plots were replicated 4 times in a RCB design.

Method – Study B

An established 5 year crop rotation study at Thunder Bay and Emo, included Low Input Sustainable Agriculture (LISA) strategies for managing weeds.

Such non-herbicide strategies included: plow-down red clover and buckwheat, fall and spring tillage for annual crops, and weeder harrowing as described above as determined by soil conditions and weed populations.

This strategy was compared to a typical livestock based rotation and continuous cereals using herbicides for weed control.

In the LISA rotation, red clover was established by broadcast seeding into barley just prior to post-emergent weeder harrowing.

Weed populations were determined over the course of the study, and included untreated or check plots where harrowing was not conducted.

Results – Study 1

- Initial weed populations were very low with little rain after barley seeding, so blind harrowing (PRE) had no impact on weed control.
- The most prevalent weeds that later emerged were wild mustard, wild buckwheat and hemp nettle, with barnyard grass in Emo.
- Weed removal with early and late POST harrowing is shown in Figure 3.

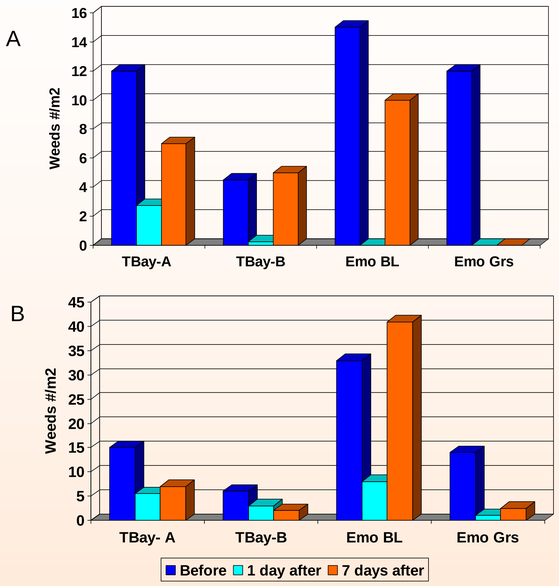

Figure 3. Weed removal and control by harrowing at 2 leaf stage of barley (A) and at the 4 leaf stage of barley (B).

- EP harrowing uprooted or buried 78-100% of the broadleaf weed seedlings at the cotyledon to 2 leaf stage (Fig 3A) but many broadleaf weeds recovered within 1 week.
- LP harrowing uprooted 55-80% of broadleaf weeds, with continued control in Thunder Bay, but rainfall after harrowing in Emo lead to weed recovery (Fig 3B).
- Barnyard grass in Emo was controlled well by either EP or LP harrowing.
- Rainfall in the 3 weeks following harrowing prompted weed germination and emergence in all plots, but barley had grown to 6-8” tall and effectively shaded these late emerging weeds.

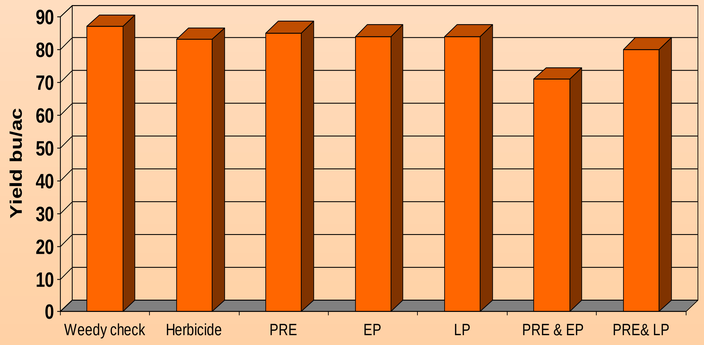

Figure 4. Barley yield as affected by weed control measures (3 site mean).

- The weed populations were slight and did not reduce barley yield (Fig 4)
- Blind harrowing (PRE) delayed crop emergence at 1 site
- Harrowing at the 2 or 4 leaf stage removed or covered 10-35% of the barley stand, but final populations were reduced only 4-12%
- The combination of blind and early POST harrowing (PRE & EP) delayed heading by 2 days and reduced yield by 20%
- Greater yield differences due to control treatments would be expected as weed density increased.

Results – Study 2

- Weed density was greater than Study 1, with the most prevalent annual weeds were wild mustard, wild buckwheat and hemp nettle, with barnyard grass in Emo.

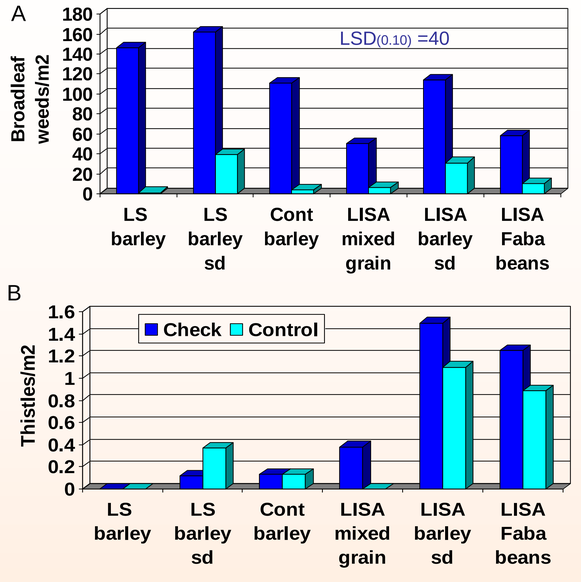

Figure 5. Annual broadleaf weed populations in Thunder Bay (A) and Canada thistle populations in Emo (B).

Note:
LS = livestock rotation
sd = seeded down

Figure 6. Perennial weed infestations in LISA rotations – Canada and sow thistle at Thunder Bay (left) and Canada thistle in Emo (right).

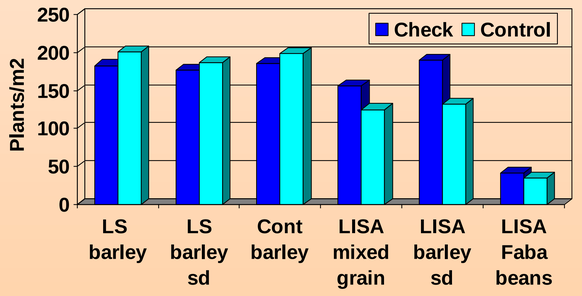

Figure 7. Crop stands following weed control measures in Thunder Bay (1994).

- Annual weed control was largely satisfactory at both Thunder Bay and Emo under the LISA rotation with the weeder harrow (Figure 5A)
- Perennial weeds became increasingly the major weed problem.
- Cereal crop stands were frequently reduced by weeder harrowing (Fig 7)

Summary

- Annual broadleaf weed populations were not excessively high and were often adequately controlled through use of the weeder harrow in cereals.
- Duration of annual weed control was dependent upon dry weather after uprooting weeds and strong crop competition.
- Crop injury was observed as stand thinning and delayed growth.
- Perennial weeds are not controlled adequately with the weeder harrow in a LISA system. Other strategies are needed.