

Cropping System Influence on Crop Yields

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Background

Producers who choose not to use fertilizer and pesticide inputs must rely on other methods of meeting crop nutrient needs and controlling pests. These alternatives may not meet the standards one has learned to expect under conventional farming methods. Yields are often used as a method to compare the viability of such alternative cropping systems.

Methods

The study was initiated in 1990 at two (2) Ontario Ministry of Agriculture and Food (OMAF) research sites in NW Ontario - on an Oskondaga silt loam in Thunder Bay district and Emo clay loam in Rainy River district.

Three (3) cropping systems were evaluated:

1. A typical livestock (LS) based rotation (barley, barley seeded down (sd), and 3 years of alfalfa) using herbicides for weed control and fertilizer, manure and legume N credits to meet nutrient needs.
2. Continuous cereal rotation (barley) using herbicides for weed control and fertilizer to meet nutrient needs.
3. Low Input, Sustainable Agriculture or LISA rotation with the following sequence:
 - faba beans – harvested and manured prior to fall plowing
 - barley underseeded to red clover (sd), just prior to weeder harrowing
 - red clover forage with 2 cuts before fall plowing
 - mixed grain of a barley, oats and pea mixture
 - buckwheat plowdown followed by ryegrass covercrop

The study was conducted between for 5 years (1990-94) for a full rotation with every crop included in the rotation every year

The plots were a RCB design with 4 replicates and individual plots were 20' wide by 100' deep.

Livestock and continuous barley used commercial fertilizer as per OMAF recommendations. The last alfalfa crop received 10t/ac beef manure before fall plowing. On average, the beef manure supplied 60lb N, 24 lb P₂O₅ and 135 lb K₂O/ac at Thunder Bay and 90 lb N, 46 lb P₂O₅ and 260 lb K₂O/ac at Emo.

At the beginning of the study, Kapuskasing Rock Phosphate was applied at 0.4 t/ac to one half of each LISA plot. At 32.1% total P₂O₅ and 1.4% available P₂O₅ this supplied 290 lb total P₂O₅ /ac or 12 lb available P₂O₅ /ac. Beef manure was applied after faba bean harvest at 10 t/ac.

Weed control in the LISA system relied on weeder harrowing in all annual crops.

- Yields were harvested from 2 areas of each plot. Cereal yields are based on a 48 lb bu weight.
- Forages were harvested according to a 2-cut system and are reported on a DM basis.
- Results were analysed according to ANOVA and significant differences are noted in the following figures when different letters appear above the yield bar.

Rotation influence on cereal yields

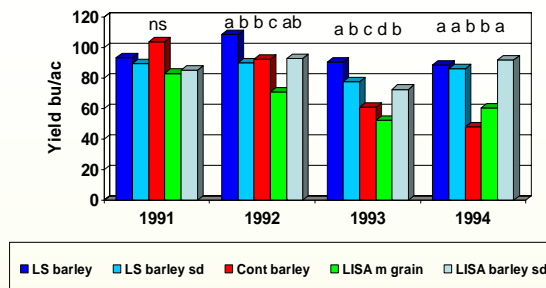


Figure 1. Cereal yields at Thunder Bay.

- At Thunder Bay LS barley, following alfalfa, consistently had the greatest yields. (Fig 1)
- The second year LS barley (sd) and LISA barley (sd) yielded similarly through the study
- Continuous barley started with high yields but declined with a buildup of disease (net blotch) and apparent lack of nitrogen (Fig 2)
- The LISA mixed grain (barley/oats/peas) consistently yielded the lowest.



Figure 2. Barley growth in Thunder Bay in 2004 (LS barley on left, continuous cropped barley on right)

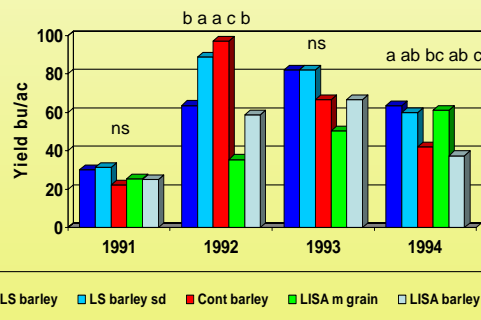


Figure 3. Cereal yields at Emo.

- Yield rank of cereals at Emo varied from year to year (wet conditions reduced all yields in 1991). (Fig 3)
- As at Thunder Bay, continuous barley tended to decline in rank over time.
- LS cereals consistently yielded more than LISA cereals

Rotation influence on forage yields

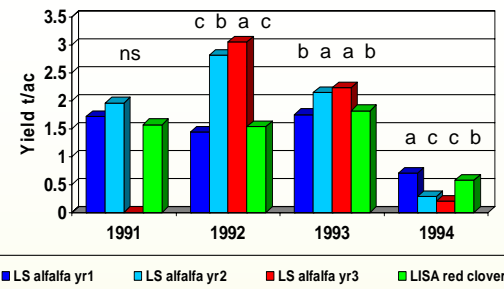


Figure 4. Forage crop yields at Thunder Bay.

- At Thunder Bay, 1st production year alfalfa yielded similar to the LISA red clover. (Fig. 4)
- Highest yields were from 2nd and 3rd year alfalfa, except in 1994 when forage cut the previous year (2003) suffered more severe winter injury from lack of snow cover, cold temperature and ice encasement.

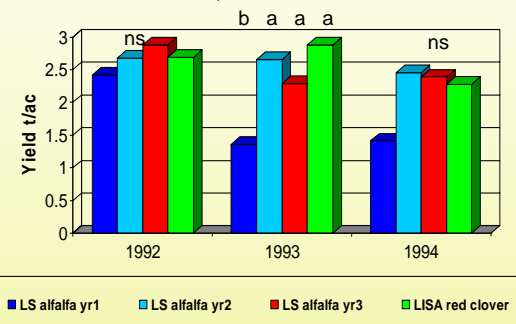


Figure 5. Forage crop yields at Thunder Bay.

- 1st production year alfalfa generally yielded less than more established alfalfa and LISA red clover at Emo. (Fig 5)
- LISA red clover yielded similarly to 2 and 3 yr old alfalfa stands.
- Red clover may have tolerated the high rainfall and variable drainage at the Emo site better than alfalfa.

Summary

- Livestock cereals yielded 18% and 43% more than LISA cereals at Thunder Bay and Emo, respectively – but cannot be attributed to a single factor
- Soil and tissue measurements suggested N was not yield limiting for LISA cereals. This rotation included manure, red clover, faba beans and peas (with the mixed grain).
- Weeds were slightly more prevalent in LISA plots, and crop stands were thinned somewhat by weeder harrowing.
- The peas and oats in the LISA mixed grain may have contributed less yield than barley.
- LISA barley followed manure application and yielded more than mixed grain possibly due to the supplied phosphorus (P), since soil P levels were greatly depleted under the LISA system.
- Forage yields are difficult to compare due to the different species and age of stands, but it appears yields were not suffering under the LISA rotation.
- The largest impediment to yield under LISA production is believed to be lack of P.

