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Organic Research Update - Summary

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Date: October 27, 2009

Location: U of S, Saskatoon, SK

- Research Presentations Included:
  - Eric Johnson – AAFC, Scott, SK
  - Steve Shirtliffe – U of S, Saskatoon, SK
  - Diane Knight – U of S, Saskatoon, SK
  - Karen Bailey – AAFC, Saskatoon, SK
  - Myriam Fernandez – AAFC, Swift Current, SK
  - Chantal Hamel – AAFC, Swift Current, SK
  - Sukhdev Malhi – AAFC, Melfort, SK

Presentation #1

Eric Johnson – AAFC, Scott, SK

Eric Johnson – AAFC, Scott, SK

Pre-Emergence Tillage

- Pre-emergent rod weeding in field pea
  - Effective at controlling weeds when timed correctly with large seeded crops seeded deep (field peas were seeded 3” deep)
  - Best treatment for weed control
- Heavy harrow shovel – proof of concept
  - Research is ongoing; used field pea as test crop
  - Doing a field pass at the 3 node stage seemed to impact field pea density and yield negatively
  - Study will continue in 2010 with funding from the Canadian Wheat Board

Eric Johnson – AAFC, Scott, SK

Post-Emergence Tillage

- Tame oats can be harrowed
- Peas are very tolerant of tine harrowing
  - Angle tines to 45º to reduce injury
  - 1st pass should be done at ground crack (early); and do more than one pass to optimize weed control
- Tine harrowing can cause too much crop burial and make weed issues worse
  - Older crops aren't buried as easily, but don't recover as well as younger crops
- Consider higher seeding rates if planning to use post-emergence harrowing

Eric Johnson – AAFC, Scott, SK

Post-Emergence Tillage/Weed Control

- Inter-Row Cultivation
  - Benefits limited by in-row weed competition
- Rotary Hoe: works better than a harrow
  - Maintains surface residue (if min-till rotary hoe)
  - Peas, lentil, cereals tolerant
  - Early weed control important – when crop is just emerging, weeds are small
- Weed clipping: clip weeds above crop canopy
  - No effect on current crop yield, but decreases seed return to the field for following years

Waste of Time:

- Flax Rolling: weeds break off, but flax did not pop back
- Post-emergence mowing in crop

Eric Johnson – AAFC, Scott, SK

Alternative Cropping Study at Scott: Highlights

- Organic Treatment
  - crop yields 25 to 50% lower than high or reduced input (conventional treatments)
  - N-fixing crops do well provided weed competition is low
  - Required less energy inputs primarily due to no fertilizer or pesticide use
  - Energy output: Organic < High or Reduced
  - Organic energy efficiency (output/input) was better than high or reduced
  - Net Economic returns for Organic treatments were higher when price premiums were obtained on half of the crops
  - Large phosphorus deficiencies in organic systems

Presentation #2

Steve Shirtliffe – U of S, Saskatoon, SK

Steve Shirtliffe – U of S, Saskatoon, SK

Increasing Crop Competition with Weeds

- Crop variety – use a competitive one
  - Leafed pea much more competitive than semi-leafless
  - Oat varieties: minimal difference between them
  - Future project: hope to assess intercropping leafed and semi-leafless pea varieties to optimize yield & agronomy
- Seeding Rate:
  - Most effective way to BOTH increase the crop yield and reduce weed growth
  - Most crops should be seeded at least 1.5 times the recommended rate
- Seed Size:
  - Seed large vigorous seed, but if seed size is small most farmers will, by default, seed more seeds per unit area
- Row Spacing:
  - Minimal evidence that narrower is better; it is expensive to convert equipment to narrower spacing

Steve Shirtliffe – U of S, Saskatoon, SK

What is the Effect of Combining 4 different treatments?

- Doubling seeding rate
  - Consistently had the best response
- In-crop harrowing
  - Often decreases weed biomass with no yield effect
- Competitive *vs* non-competitive variety
  - Sometimes has an effect but usually not
- Row width – 11.5cm and 23cm
  - An effect was rarely seen
- Combined effect? Additive – more is better

Steve Shirtliffe – U of S, Saskatoon, SK

Green Manure Termination

- Compared Tillage, Mowing, and Roller Crimping
- Fababean and Pea were assessed
- Only 1 year of data so far
- Timing – Significantly less crop re-growth when terminated at late bud than during flowering
- Method - Weed Re-Growth was lowest with crimping, and highest with tillage

Presentation #3

Diane Knight – U of S, Saskatoon, SK

Diane Knight – U of S, Saskatoon, SK

Amend soils with organic materials containing P

- Manures
  - Positive response in P uptake and crop yield following applications of composted manure (10 T/ha and 20 T/ha) in most cases

Acidify soil environment around the roots

- Fungal inoculants
  - Jumpstart tended to increase P uptake and crop yield
  - Jumpstart did not preferentially solubilize Rock P, when both were applied as a treatment

Improve access to soil P

- Green manures: Nitro alfalfa, chickling vetch, Indianhead lentil, oilseed radish, buckwheat, fenugreek
- Green manure P uptake and subsequent wheat yield was greater with legume crops than non-legumes (oilseed radish and buckwheat)

Diane Knight – U of S, Saskatoon, SK

Ongoing projects:

- Evaluating other amendments for P supply
  - Humic acids; Alfalfa pellets; Worm castings; Manure sources; Bioproducts of oil processing (flax meal, mustard meal)
- Co-inoculation: Arbuscular Mycorrhizal Fungi (AMF) and Jumpstart
  - Evaluating effectiveness and survival
- Rotational effects on AMF:
  - Wheat – Lentil; Wheat – Mustard
    Mustard – Lentil; Mustard – Wheat
    Lentil – Mustard; Lentil – Wheat

Diane Knight – U of S, Saskatoon, SK

Ongoing projects:

- Reduced tillage termination (crimper) – assessing soil nutrient status, nitrogen fixation, microbial diversity
  - Field Pea and Faba Bean
- P fertilizer effects on N fixation by field pea
  - Organic treatment – low fertility soils w/wout Jumpstart
- P supplying ability of organically managed soils
  - Soil test extracts for available P
  - PRS probes
  - Seasonal uptake of P by wheat and pea/lentil
  - Mineralization studies examining release of inorganic P over time

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Diane Knight – U of S, Saskatoon, SK

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Phosphorus (P) Fertility on Organic Farms

- Evaluate products & management practices aimed at improving P fertility
- Working on soil P dynamics to better understand P supply in organically managed soils (P pools)

Note:

SK soils are calcareous (calcium containing) soils with neutral to slightly alkaline pHs (pH 6.8-7.8). Phosphate is extremely insoluble @ pH>6.8.

Calcium minerals bind P making it very difficult to access.

Presentation #4

Karen Bailey – AAFC, Saskatoon, SK

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Karen Bailey – AAFC, Saskatoon, SK

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- *Phoma macrostoma* is a fungus isolated from Canada thistle, collected from across Canada.
- Symptoms: photobleaching & root inhibition
- Currently it is under development as a bioherbicide for broadleaved weeds in turfgrass
- Many broadleaved plants are susceptible, but it depends on plant species, plant age, and application method. Grassy-type plants are resistant
- The fungus is grown on grain and formulated as a granule for broadcast application
- *Phoma* is gone from the soil after 12 months; sensitive crops like pea, lentil and canola can be safely grown the following year

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Karen Bailey – U of S, Saskatoon, SK

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Testing *Phoma* for agriculture at Melfort, P.A., and Scott

- Natural weed stands are variable – harder to analyze
- *Phoma* controlled dandelion, field bindweed, annual sow thistle, hemp nettle, Canada thistle, and wild mustard at levels between 60-100%.
- No control of stinkweed, lamb's quarters, wild oat, and smartweed
- The bioherbicide only works in moist soils, but can remain dormant in dry soils up to 4 months until the conditions improve.
- The bioherbicide works best as a pre-emergent for weed seedling control. Less effective when used as a post-emergent control on established weeds.

Karen Bailey – U of S, Saskatoon, SK

Canada Thistle Control:

- Pre-emergent and post-emergent applications reduced the number of thistle and biomass. Post-emergent in-crop applications difficult to get good coverage with the bioherbicide.
- There was no clear dose response with the post-emergent applications so the lowest rate was not determined.

Wild Mustard Control:

- After late season rain, the bioherbicide became active and provided greater than 80% control of emerging wild mustard seedlings at all rates of application

Presentation #5

Myriam Fernandez – AAFC
Swift Current, SK

Myriam Fernandez – AAFC Swift Current, SK

Alternative Cropping Study at Scott, SK

- Organic management reduced *Fusarium* root/crown infection
  - *F. avenaceum* and *F. culmorum* – two of the most common crown/root and Fusarium head blight pathogens in SK highest in reduced till
  - Saprophytic species more common in organic management
- Highest levels of common root rot were found with high tillage intensity

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Myriam Fernandez – AAFC Swift Current, SK

At SPARC, Swift Current, 5 acres has been put aside for organic research. Has had 4 yrs of field pea green manure on this site.

- New Agronomic Trial will begin in 2010
- Objective:

Investigate impacts of **tillage reduction** and **mixed cropping sequences** on weed control, soil fertility, and crop production under organic management in the Brown soil zone of SK

Presentation #6

Chantal Hamel – AAFC
Swift Current, SK

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Chantal Hamel – AAFC Swift Current, SK

Arbuscular Mycorrhizal Fungi (AMF) Research

- Durum breeding at SPARC
  - Varieties differ in response to AMF
  - Symbiotic durum can be selected

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Chantal Hamel – AAFC Swift Current, SK

Working on forecasting tools that will help predict the AMF contribution to phosphorus uptake in wheat

- Soil type influences AMF distribution
  - Vertisols and Black and Brown Chernozems may need inoculation
- The effect of soil type could be compounded by the effect of climate
- Cropping practices must be considered, as some crops are not hosts for AMF
- Currently working on a soil testing model that includes AMF factors to predict nutrient availability

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Presentation #7

Sukhdev Malhi – AAFC
Melfort, SK

Sukhdev Malhi – AAFC Melfort, SK

Organic soil fertility: management practices and soil amendments were assessed

Management Practices

- ✓ **Crop diversification/rotation with deep taproot and shallow fibrous root crops**
- ✓ **Crop residue**
- ✓ **Green manure**
- ✓ **Legumes for seed/forage**
- ✓ **Cereal-legume intercropping**

Amendments

- ✓ ***Penicillium bilaiae***
- ✓ **Rock phosphate**
- ✓ **Elemental S**
- ✓ **Gypsum**
- ✓ **Compost-manure**
- ✓ **Wood ash**
- ✓ **Alfalfa pellets**
- ✓ **Rock P composted in manure**

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Sukdev Malhi – AAFC Melfort, SK

Alternative Cropping Study at Scott, SK

- Organic systems had low extractable soil phosphorus in the surface and subsoil layers
- Legumes provided nitrogen to the soil

Sukdev Malhi – AAFC Melfort, SK

Soil Fertility Amendments

- Manure was the best source of phosphorus
- Rock P disappointing
  - no economic return in year of application; long-term maintenance of soil P. Future plans are to use finely-ground Rock P to hopefully increase availability to the crop.
- Wood Ash improved P availability and increased seed yield in barley and pea

Organic Research Update - Summary

Sulfur (S):

Gypsum – provides S in a crop available form to improve yields on S-deficient soils in organic farming systems.

Granular elemental S fertilizer - not effective in preventing S deficiency in crops in the first year of application, especially when applied in spring. Depending on soil type and climatic conditions, elemental S may have the potential to prevent S deficiency in organic crops on S-deficient soils under certain conditions, such as autumn application, surface-broadcast spread/spray of suspension or powder formulations, and long-term annual use of ES fertilizers on the same land.

Alfalfa Pellets: nutrient supply from these will be assessed in field conditions

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For More Information!!

To Download the Detailed Presentations

Go To:

http://organic.usask.ca/

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