Prairie Steward

Farming For Your Future Environment

The Newsletter of the Saskatchewan Soil Conservation Association Inc. Fall Issue No. 61, 2011

Quality Vs. Quantity

By Angela Bedard-Haughn
Associate Professor
Department of Soil Science
University of Saskatchewan

Here in the Applied Pedology research group, we focus on how land use and climate change affect, and are affected by, soil properties and processes. Our main emphasis is on dynamics of nitrogen and carbon, which are essential for healthy, productive ecosystems, but in excess can contribute to water quality concerns and greenhouse gas emissions. One of our projects over the past several years has been examining how pulse crops (pea and lentil) in the crop rotation affect the quality of soil organic matter and the rate and timing of nitrogen mineralization. We have long known the importance of pulse crops for fixing nitrogen in the year of production, but there have been reports in the literature of benefits to other crops in the rotation that could not be directly attributed to biologically fixed nitrogen. Typically, much of the fixed nitrogen is removed along with the high protein crop. So what is behind these "non-nitrogen benefits"? And, are there other environmental benefits to pulse crops, beyond reducing the need for economically- and environmentally-expensive chemical inputs?

We did this work at two of the Agriculture and Agri-Food research stations, at Scott and Swift Current (or using soils taken from long-term rotations at these stations). At Scott, the in-field nitrogen mineralization rates were a bit lower at seeding for the rotation including a pulse crop (pea-wheat) compared to continuous wheat (no N fertilizer) or canola-wheat rotations. Mineralization under all of the rotations increased and were about the same by flowering (anthesis), and they all decreased as we moved into harvest, but mineralization for the non-pulse rotations decreased more than the pea-wheat rotation (i.e., mineralization under pea-wheat stayed higher longer). At Swift Current, there was no mineralization effect of including a pulse crop (lentil-wheat) in the rotation (compared to continuous wheat).

What makes these nitrogen results really interesting is that there is a big difference in the *quantity* of residues produced by the different crops in the greenhouse. Generally, canola

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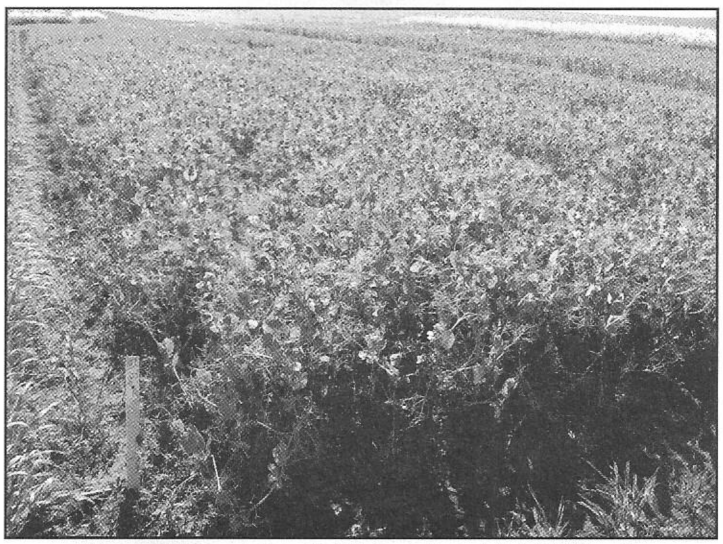

Figure 1: Blooming field pea plot at AAFC-Scott.

In This Issue

President's Message

By Doyle Wiebe, PAg
SSCA President

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See you in Saskatoon!

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Marilyn Martens, Office Manager

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SSCA's Vision is "to be the recognised driver and facilitator of change that leads to conservation agriculture being practiced on prairie agricultural land.

Sustainable Agriculture and Conservation Tillage

Glen Shaw PAg
Executive Director
Soil Conservation Council of Canada

Soil Conservation Council of Canada (SCCC) was formed in 1987 to provide a non-partisan public form at the national level to promote soil and water conservation. It was formed as a result of a recommendation from the Senator Sparrow led Standing Committee on Agriculture, Fisheries and Forestry committee for the need for a national voice to address soil degradation issues. The Soil Conservation Council of Canada believes that eliminating soil degradation and improving soil conservation practices are essential to the long term sustainability of Canada's farmland.

Sustainable agriculture means different things to different people, and different organizations. Despite variances in definitions, a common theme emerges – the economy, the environment and society as a whole. The challenge is to build the balanced combination. SCCC believes that sustainability is not a place we will arrive at; rather it should be a goal for everything we do.

While farmers play a major role in caring for the land, all value chain members; including farmers, governments, and industry have a shared interest and responsibility to safeguarding soil health/soil quality and reducing soil degradation. Because society shares in the benefits of clean air and water they should also share in the costs of producing those Ecological Goods and Services.

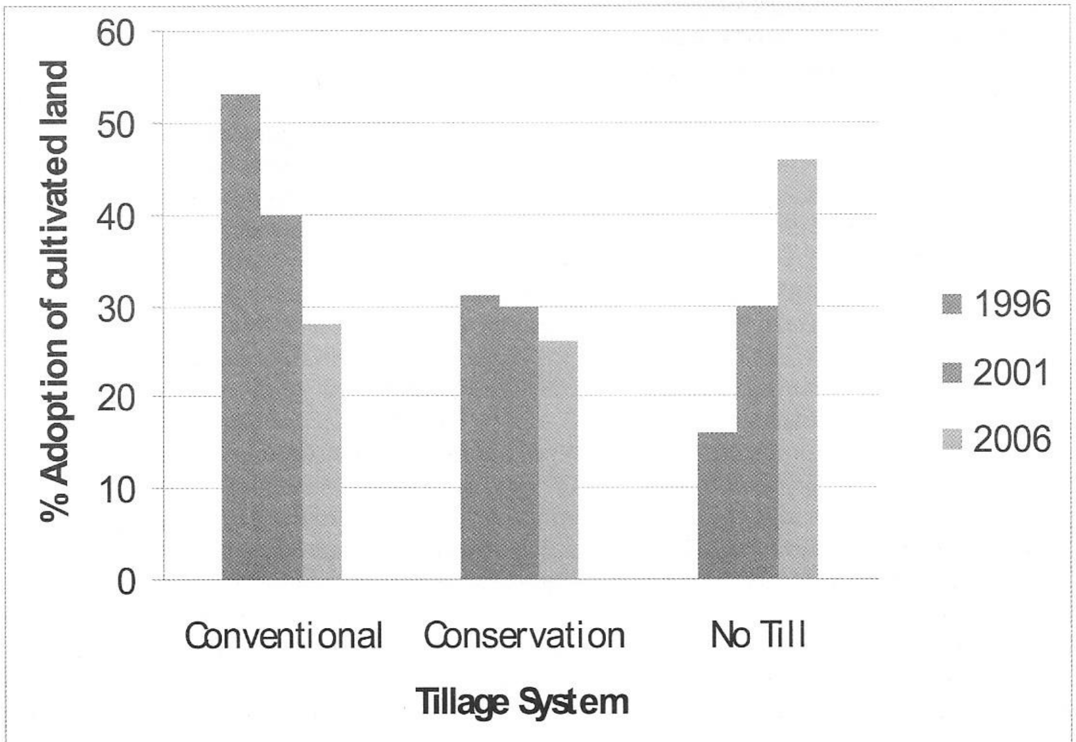
Soil conservation activities account for;

- Economic benefits (labour/ production efficiencies)
- Environmental benefits (improved soil and water quality, reduced erosion, carbon sequestration)
- Social benefits (preservation of natural habitats, water conservation, increased production)

No till or conservation tillage that retains most of the crop residues on the surface is one of the most important practices in reducing soil erosion, improving soil health and the long term sustainability of Canada's farmland. Over the past 20 years Canadian producers have made great strides in the adoption of conservation tillage and no till seeding systems (table 1). From 1991 to 2006 the use of these practices to prepare land for seeding increased from 31% to 72 %. In 2006 46% of the land was seeded with no till in Canada. Saskatchewan leads the way in no till with 60% of the land direct seeded. It is expected that the 2011 Census will show a further increase in conservation agriculture practices.

The Saskatchewan Soil Conservation Association has been a member of SCCC for a number of years and Doyle Wiebe of SSCA currently serves on the SCCC executive committee of the board of directors. The extension and awareness conservation program support provided by SCCC and the Saskatchewan Soil Conservation Association (SSCA) have provided support to producers in the transition from conventional tillage to the adoption of conservation tillage. The job is not done as there are still regions with intensive tillage practices and soil degradation. Conservation/environmental cost sharing programs need to be in place to address the challenges of ensuring the long term sustainability of Canada's agriculture sector.

Table 1: Canadian shift in tillage systems over a decade to 2006.



Each practice is calculated as a percentage of the total land prepared for seeding
Source: Statistics Canada websites, courtesy of Tom Goddard, Alberta Agriculture & Rural Development, Canada, October, 2011

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Soil Molecular Microbiology and Sustainable Agroecosystems: Exploring the Biotic Potential of Soil

By Bobbi Helgason
Research Scientist, AAFC Saskatoon

As a Saskatchewan farm kid who discovered a love for soil science and microbiology during my university studies, I am privileged to work studying agricultural soil microbiology. My area of research is Soil Molecular Microbiology, which leads me to focus on the unseen but wondrous world of bacteria and fungi who provide many important services as decomposers, nutrient suppliers and plant partners. For example, I often study the genetic code (DNA and RNA) of microorganisms to understand how agricultural management affects them and ultimately affects nutrient turnover and storage. Modern tools for studying soil biota have greatly increased the power we have to appreciate the astounding biological diversity housed in our soils and how it contributes to agricultural production. Using these tools, the ultimate goal of my work is to better understand of the capacity of soil and its biota to provide sustained productivity and reduce the environmental footprint of our farming systems.

A number of years ago, after finishing my Masters degree I moved with my husband to Lethbridge where I worked for AAFC studying soil conservation and agricultural greenhouse gas emissions. It was this experience which piqued my curiosity about fungal nitrogen turnover and N_2O emissions in soil and led me back to school to pursue my doctorate at the University of Saskatchewan. Past work by other researchers indicated that fungi were dominant decomposers in no-till systems and thus what better place to try to address fungal influence on nitrogen cycling? After identifying four long-term tillage experiments in each of four soil zones of the Prairies, I worked on assessing no-till and conventionally-tilled microbial communities. We were quite surprised to find that the relative size of bacterial and fungal groups did not change consistently under no-till and thus fungi were in fact not more dominant. It seemed that long-term (25 years) no-till management in these soils resulted in a new steady-state where, thanks in part to diverse crop rotations under both tillage regimes, a lack of physical disturbance did not induce any major shifts in microbial community composition. Notably however, the overall size of the microbial biomass was larger under no-till. This is important as it means that the biological potential to process nutrients and provide other services was significantly greater. For example, a larger microbial community may result in greater capacity to tie up inorganic nitrogen in the short term as fertilizer nitrogen added to the soil may be immobilized in their biomass. This nitrogen can then be released over the course of the growing season. One can think of it as loosely equitable to a rainy day bank account where excess nitrogen can be put away for later and accessed (through mineralization) when demand increases but soil conditions limit the amount of inorganic nitrogen typically available to the crop - sort of like a slow release fertilizer.

A second interesting outcome of this work was that while overall microbial community structure did not undergo any major shifts in the no-till soils, there were changes in the distribution of different microbial groups among aggregates studied in no-till and conventional till soils at Swift Current. For example, large aggregates in no-till soils contained more fungi than aggregates of the same size in conventionally tilled soils. Similarly, arbuscular mycorrhizal fungi, an important symbiotic plant partner in most crops, were far more abundant in no-till aggregates. Fungal hyphae contribute to aggregate stability and the lack of mechanical disruption preserved them within the aggregates. Bacteria within aggregates were under greater stress in the tilled soils, likely due to limitations in the availability of nutrients or moisture.

In summary, it was clear that no-till favored an increased microbial abundance and that interpretation of tillage effects on microorganisms required consideration of the whole cropping system. In our research plots, the systems were very similar except for the difference in the level of physical soil disturbance. The whole system management rather than simply tillage disturbance was predominant for determining microbial community structure.

I am currently working on many different aspects of microbial carbon and nitrogen cycling in agricultural soils. Specifically, current projects examine the effects of pulse crop frequency, residue placement, climate change factors and landscape on microbial abundance and diversity. Much of what I do builds on the capacity of my AAFC and University collaborators, providing a more detailed microbial complement to their work. Our inherently productive Prairie soils sometimes allow us to take their biota for granted. However, as we move forward and encounter new challenges, there is great potential to use an enhanced understanding of biological soil processes to better support producers in ensuring successful and sustainable crop production. Advances in on-farm as well as research technologies make this a particularly exciting time and I am very happy to live and work in Saskatchewan!

How Do Lower-Rate Liquid Starter Fertilizers Compare to Traditional Seed-Row Fertilizer Blends in the Northern Great Plains?

By Tom Jensen
Northern Great Plains Director
International Plant Nutrition Institute

This article was reprinted with permission from the Fall 201, No. 2 IPNI Plant Nutrition TODAY.

Starter Fertilizer is usually applied close to the seed, so that after germination and during early growth the seedling will have access to a source of fertilizer nutrient that will encourage improved growth. Starter fertilizers are usually composed of a low rate of N and a moderate rate of P. They may be formulated to include K, S, and some micronutrients depending on soil supply and crop need. Phosphorus is the main component of starter fertilizers because it is important to root development, and improved root growth helps the crop get off to a good start.

Specialized formulations of liquid starter fertilizer became popular in corn production because, under high yield corn production, the higher relative per acre rates of fertilizer (e.g. 200 lb N; 100 lb P_2O_5; 70 lb K_2O; and possibly 40 lb S) have traditionally been broadcast and incorporated prior to planting. Placement of all the pre-plant fertilizer close to the corn seed-row adversely affected germination, due to ammonia toxicity or fertilizer salt damage. However, placing a liquid starter fertilizer (e.g. a 6-22-4 N-P_2O_5-K_2O formulation) applied at 3 US gal/A, using a retrofit liquid fertilizer kit on existing corn planters, supplied lower rates (i.e. 2 lb N, 7.3 lb P_2O_5, and 1.3 lb K_2O/A) and was found to be beneficial to early seedling growth.

Because of the success of liquid starter fertilizers in corn production it is often thought that they will be of benefit in small grain cereals and broadleaf crops planted in narrower rows. It has been suggested that use of a liquid starter fertilizer could replace traditional applications of seed-row applied granular fertilizer or liquid fertilizer blends. In much of the Northern Great Plains of North America the majority of P fertilizer has already, for decades, been applied as a seed-row application primarily in the form of mono-ammonium phosphate (11-52-0) but liquid ammonium poly-phosphate (10-34-0) is also used in some areas. This application method functions both as a starter and season-long P source. For example, for a target yield of 40 bu/A of spring wheat, traditionally a 65 lb/A blend of 11-52-0 (50 lb product) and potash (0-0-60 at 15 lb product) has been used. This practice supplies rates of N, P, and K that are safe to germinating seeds. Additional N fertilizer is usually applied as a pre-plant band, or a side-band at planting, using urea (46-0-0) or anhydrous ammonia (82-0-0), at a rate of about 70 lb N/A.

The question is whether or not a liquid starter formulation such as 6-22-4, applied in the seed-row at a rate of 3 US gal/A, is as effective as the traditional seed-row blend described above. It is important to compare the rates of N, P, and K applied relative to the harvested grain nutrient removal. The Table below compares nutrient removal in a 40 bu/A wheat crop, as well as the nutrient additions for the dry granular blend and starter liquid fertilizer described above.

The nutrients supplied in the traditional dry granular blend plus the separately banded N are similar to the wheat crop nutrient removals, except for the K, but much of the dominate loam to clay-loam soils of the Northern Great Plains tend to be high in plant available K. The liquid starter practice along with the separately banded N only supplies roughly one-third as much P. This practice is probably adequate for early seedling needs. However, in order to better match crop P removals for the whole season, either the liquid starter fertilizer needs to be applied at a three-fold increased rate, or additional P needs to be applied using a different source.

If a grower who has been using the traditional seed-row fertilizer blends decides to switch over to using the lower P rate liquid fertilizer starter system, there is a possibility that plant available P levels in soils will decline. This will not happen in one growing season, but most likely will be observed over 3 to 5 years. The best way to monitor this is to have soil samples taken and analyzed regularly (e.g. annually or biennially) and if soil test P levels begin to decline, applications of P fertilizer should be increased to better match crop removals.

For more information, contact Dr. Thomas L. Jensen, Northern Great Plains Director, IPNI, 102-411 Downey Road, Saskatoon, SK S7N 4L8. Phone: (306) 652-3535. E-mail: tjensen@ipni.net.

Nutrient removal or addition	N	P_2O_5	K_2O
	lb/A		
Removal in harvested grain	60	24	16
Addition in 3 US gal, Liquid 6-22-4 Starter	2 *	7.3	1.3
Addition in Dry Granular Seed-Row Blend of 50 lb 11-52-0 and 15 lb of 0-0-60	5.5 *	26	9

***70 lb N/A is supplied as pre-plant band using urea or anhydrous ammonia**

Is My Winter Wheat Too Big?

By Mark Akins, PAg, CCA
Conservation Program Specialist
Ducks Unlimited Canada

This fall, seeding winter wheat was a popular choice among Saskatchewan producers. Interest was highest in the south east, where extremely wet conditions prevailed through spring and summer. This difficult weather meant the majority of acres went unseeded and as a result, winter wheat was heavily utilized as a "rescue crop". Over the past 20 years more growers have realized the agronomic, management and financial benefits to the crop and interest has been on the increase. Unfortunately, this interest has not always translated into increased acreage as stubble must be available during the August 15 to September 15 seeding window. Also a stumbling block is the lack of planning and management needed to make sure winter wheat is seeded at the right time and place. These issues have reduced acres in the last few seasons. For those who faced excess moisture in 2011, it seems that growers realized that winter wheat could be just what they need to salvage a bad situation.

A substantial amount of winter wheat has been planted into unseeded land as a way to reclaim wet and weedy fields. Winter wheat is an excellent option for this circumstance,the crop will use some of the excess moisture this fall, compete with weeds and provide a head-start to 2012. Winter wheat fits into this bad situation effortlessly because growers have little or no harvest to conflict with seeding, land to seed is available because it is in some type of fallow and moisture is available to germinate and establish a plant quickly. The biggest issue with seeding in wet conditions is lack of standing stubble to seed into can reduce snow catch and potentially could increase winterkill.

Winterkill depends on a few variables, the most important being soil temperature (influenced by air temperature, stubble and snowfall) as well as plant stage. Producers can't influence the air temperature or snowfall, so stubble and plant stage are the ones you must concentrate on. Seeding winter wheat on crops that can catch and hold a minimum of 4 inches of snow will provide a blanket of insulation to buffer the soil from cold winter temperatures. Also, seeding early in the month long August 15 to September 15 window will allow the plants to germinate, emerge and establish a strong plant that can withstand more winter stress.

Some of the 2011 unseeded land had weed carcasses or past year's stubble that will provide some snow trapping but many producers found little trash survived the seeding operation due to the brittle nature of chemfallow stubble. Luckily most of the fields in that situation were seeded in late August or early September and are three leaf or larger with many tillers per plant. This "large" plant allows optimum sunlight capture, converting that energy into crown tissue, the key component needed to withstand harsh winter conditions and facilitate vigorous early spring growth.

Some inexperienced growers and bystanders are suggesting that too much fall growth has occurred and the crop is at risk of winterkill. "This shouldn't be a concern to growers" says Dr. Brian Fowlerlong time plant breeder and winter wheat expert. He explains that winter wheat does lose its winter hardiness but it is more a function of time and temperature than size of plant. Crop seeded before August 1 would be more likely to have this problem.

Early seeding this fall began in mid August, meaning there is almost no chance that winter wheat plants have grown "too big". As a producer who saw an opportunity to salvage a bad situation with winter wheat, pat yourself on the back, remind yourself you have some seeding done for spring 2012 and plan to maximize that crops yield in 2012 by managing spring fertility, weed control and disease. Also, remember that winter wheat is still a great option in a "normal" year, whatever that is!!!

2010 Potter County Winter Wheat Starter Study

By Dwayne Beck
Research Manager
Dakota Lakes Research Farm
Pierre, South Dakota

Cronin Farms Dakota lakes Research Farm SD Wheat Commission

One field-scale replicated study was conducted in Potter County on winter wheat using 5 starter fertilizer treatments: The following starter (seed placed) treatments were used:

Number	Treatment	Treatment	Nutrient Applied
1	MAP Alone	11-52-0 at 51 lbs/a	6-27-0
2	MAP plus K	11-52-0 plus 0-0-60	6-27-9(7)
3	MAP plus K and S	Treatment 2 plus 20-0-0-24	11-27-9(7)-6
4	MESZ	Micro Essentials with Zinc	8-26-0-7-1
5	MES	Micro Essentials w/o Zinc	8-26-0-7

The "Nutrient Applied" column gives actual N-P2O5-K2O(Cl)-S-Zn applied in lbs of nutrient/acre in that arrangement. MES and MESZ are uniform pellets containing MAP plus both elemental sulfur and ammonium sulfate as sulfur sources. The MESZ also contains zinc sulfate as the zinc source.

There were 4 replications of each treatment. Each plot consisted of 2 passes the full length of the field (1/2 mile) with a 42-foot JD 1895 air seeder. Urea (122 lbs N/acre) sufficient to produce 62.5 bu/acre of winter wheat was mid-row banded at seeding (SDSU 2.4 lbs N/bu). An additional 30 lbs of N/acre was applied as 28-0-0 using stream bar techniques at Feekes 6. This brought the yield goal to 75 bu/acre (180 lbs N/acre as fertilizer plus soil nitrate-N). Smokey Hill wheat at 1.1 million PLS was used along with Raxil seed treatment.

The field was sprayed with bromoxynil plus MCPA herbicide. A fungicide was applied at flag leaf emergence.

Plant and soil samples were collected at Feekes 6. The plots were harvested by taking a single 35 foot wide cut from the center of each plot using a standard JD combine. The grain was weighed in a grain cart. Samples were taken from each plot as grain was unloaded. Both the grain and plant samples were analyzed for major and minor elements by Ward Laboratories in Kearney, Nebraska using ICAP (inductively coupled plasma using an argon gas carrier) techniques.

Pre-season soil tests indicated 20 lbs of nitrate-N/acre; 50 lbs of sulfate-S/acre; and 16 lbs of chlorine/acre. This triggers a recommendation of 24 lbs of P2O5/acre as a band. There would also be a recommendation for at least 21 lbs of Cl/acre. Some laboratories would also recommend sulfur at 7 lbs of S/acre in a band.

The yields were better than anticipated. This resulted in protein that was lower than desired. An additional 10 gal/acre of 28-0-0 (30 lbs N/acre) at Feekes 6 or later would have brought the protein to acceptable levels. There was a visible early-season growth and color response to the treatments that included sulfur. That is common in long-term no-till because sulfur cycles in the organic fraction. This response was not evident by Feekes 6.

The most dramatic response at the Potter County site was the large difference in plant chlorine concentration at Feekes 6. A small (6 lbs Cl/acre) application of chlorine in proximity to the seed more than doubled plant concentrations at that point in time. This period is when the plant is very vulnerable to leaf diseases.

Potter County Winter Wheat Starter Study 2010
South Dakota Wheat Commission Funded Project

Treatment	Yield (bu/a)	Grain Protein	Chlorine at Feekes 6	Sulfur at Feekes 6	Grain Chlorine	Grain Sulfur
MAP Alone	89.9	10.7	0.13	0.27	0.060	0.127
MAP plus K	91.4	11.1	0.38	0.27	0.065	0.130
MAP plus K and S	93.3	10.9	0.34	0.31	0.065	0.130
MESZ	92.1	11.1	0.15	0.27	0.065	0.130
MES	94.9	11.6	0.12	0.27	0.063	0.137

This is especially true when it is seeded into spring wheat stubble. This factor should be investigated further. ●

Some Important Findings of Soil Fertility Research (Melfort Research Farm)

Sukhdev S. Malhi
Research Scientist
Nutrient/Residue
AAFC, Melfort

Research Title: Improved Nutrient Cycling and Fertilizer Management for Sustainable Crop Production, Produce Quality, Economic Returns, Soil Quality and Environment

Overall Objective of Research:

To develop crop, soil and fertilizer management technologies that conserve or enhance soil organic matter, improve soil quality/health, recycle and utilize nutrients within soil-plant systems effectively and efficiently, maintain optimum economic sustainable crop productivity and minimize potential damage to the environment from greenhouse gas (GHG including nitrous oxide [N2O]) emissions to the atmosphere and nutrient leaching to ground water. This can be done through efficient nutrient cycling and management by using strategies of maximum nutrient use efficiency, and minimum nutrient loss (run-off, leaching, volatilization, dentrification, etc.) from the soil-plant systems. In efficient nutrient cycling, the nutrient requirements of the growing crop are met but not greatly exceeded at any stage of growth. Fertilizer is the major energy expenditure and input costs involved in continuous cropping systems and about 80% of the fertilizer consumption is concentrated in the Parkland region. Therefore, it is critical that the management of applied nutrients be as efficient as possible to maximize economic benefits while minimizing losses to the environment.

Summary of Research Findings:

Optimizing Seed Yield and Quality of Brassica Oilseed Crops with S Fertilization (S. S. Malhi)

- In the Prairie Provinces, there are about 3.5 million ha of agricultural land under canola production. Canola is the major cash crop in the Parkland region. Being a high protein oilseed crop, canola has high requirements for S. As S is immobile 900ghin plants, deficiency of S can occur at any growth stage and cause considerable reduction in seed yield. In order to prevent seed yield loss due to S deficiency, a constant supply of available S to canola plants is thus needed throughout the growing season.
- Low canola yields in farm fields in northeastern Saskatchewan (especially on Gray Wooded soils) were found due to insufficient amounts of available S in soil. In our experiments on S-deficient soils, canola showed severe S-deficiency symptoms when N was applied without S (N induced S deficiency) and soils at these sites were thus considered to be extremely deficient in available S for crop growth.
- The severity of S deficiency, increase in seed yield of canola from applied S and seed quality varied with cultivars. Our findings suggest that sulphate-S fertilizer application rates for optimum seed yield should be similar for the B. oilseed species/cultivars on S-deficient soils, but higher yielding species/cultivars would produce greater seed yield by using S and other nutrients more efficiently.
- The use of S fertilizer was critical to obtain a positive response of canola to N fertilization and to avoid negative effects from N fertilization of canola in S-deficient soil conditions. The relative response of canola to S fertilizer application was generally greater at high N rates. Our findings indicate an increased requirement for S application on S-deficient soils when a high rate of N is applied to attain optimum canola seed yield and quality.
- The ideal time for S fertilizer application is in spring at seeding, but if S deficiency on canola occurs in the growing season, application of sulphate-S can correct S deficiency and restore seed yield substantially at bolting and moderately at early flowering. Foliar application of sulphate-S fertilizer on canola as late as 10% bloom was found effective in correcting S deficiency in canola. Topdressing of sulphate-S fertilizer at bolting and flowering also corrected S deficiency in canola, but tended to produce less seed yield than foliar applied S in few cases, depending on soil moisture conditions.
- Sulphate-S (SO4-S) is the only form available to plants. Now, there are a wide variety of commercial fertilizers that contain elemental S, which may cost less per unit of S than sulphate-S fertilizers. However, the effectiveness of these fertilizers depends on how quickly the S is oxidized in soil to plant-available sulphate. Granular elemental S fertilizers were not found effective in the first year of application, and also were not as effective as sulphate-S fertilizers in improving seed yield of canola on S-deficient soils, even after four annual applications,

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The Long-Term Memory of Weed Seed Banks

By Anne Légère
Research Scientist
Weed Science/Agroecology
AAFC, Saskatoon

There is an old and persistent rumor out there suggesting that "one year of seeding makes seven years' weeding" (Harland & Wilkinson, Lancashire Legends, 1873). An American version even extends the curse to "ten years' weeding" (Rural American, 1866). The dire consequences of letting weeds go to seed and form persistent seed banks hasn't changed, even in 21st century agriculture. This is currently evident in some areas of central and southern US where glyphosate resistant weeds have gotten out of hand, partly because of their prolific seed producing habit. Closer to home and in a different context, we questioned whether this would hold true in conservation tillage systems, as practiced in a cool humid climate.

Weed seed banks are an intrinsic component of most agricultural soils, and as such are a potential target for management. Tillage interferes with the life cycle of weeds, mainly by destroying seedlings and triggering germination, by moving seeds around, and generating more vegetative plant parts, thus ensuring the multiplication of certain perennial species (e.g. by breaking and moving rhizome pieces). Tillage intensity determines the environmental conditions conducive to seed dormancy or to microbial growth potentially leading to seed decay. No-till systems have proportionally more weed seeds at or near the soil surface, which may be in a better position for germination. However, these seeds are also exposed to a variety of potentially detrimental factors including cooler and more humid environmental conditions associated with the presence of crop residues, and a greater concentration of microorganisms, granivorous arthropods, and surface applied nutrients. Seed concentration in this surface soil layer is highly dependent on regular seed input and could be expected to be less in no-till than in tilled systems if few or no new weed seed were added to the system. In spite of no active physical action from tillage implements in no-till systems, weed seeds do move in the soil. Weed seeds may be carried by water or subject to the passive action of gravity, freezing-thawing cycles, falling into cracks created by shrinking-swelling, particularly in heavy clay soils, or in burrows created by earthworms. Seed movement may also result from the active effects of invertebrates caching seed or feeding on seed which are expelled in casts

Adoption of conservation tillage in the Canadian east has been much slower than in the west. In Québec, where I have been involved in conservation tillage studies since the late 1980's, adoption of reduced tillage and no-till, as measured by soil cover, has increased between 1991 and 2006 (Eilers et al. 2010). However, in spite of 66% of the Québec farmland being reported as having high or very high soil cover, all of the land in the St. Laurence lowlands has low soil cover. This is where the main annual crops are grown. Conservation tillage started gaining more attention in this area in the mid-1980's, in response to soil degradation reports. An experiment was initiated at that time (1987) at La Pocatière, Québec, in order to demonstrate the feasibility of conservation tillage for cereal based cropping systems. As time passed, the 3-year project became a long-term study. This provided us with the opportunity to determine tillage effects on weed seed banks over time (Légère et al. 2011). We assessed the weed seed bank in 1993 after four cycles a 2-year cereal-forage rotation, and again in 2006, after two cycles of a 4-year cereal-oilseed rotation. We also investigated if the total seed bank or that of any of its constituent weed species would provide evidence in 2006 for residual effects of previous herbicide use (prior weed management treatments applied 1987-1993).

We measured the weed seed banks in three tillage systems: moldboard plow (MP), chisel plow (CP), and no-till (NT). Soil seed banks were sampled in the spring in 1988, 1993, and 2006. Soil cores were taken just prior to secondary tillage with a 1.8 cm diameter auger to a depth of 15 cm. Sixty soil cores were sampled systematically in each plot, according to the 1987 three-factor plot plan in order to check for actual (1993) and residual (2006) effects of different weed management treatments. Autumn seed bank data collected yearly from 1989-1992 were used to further assess tillage effects on variation of seed bank size over time.

Individual soil samples (no bulking) were stored at 4 C in darkness until processed. Large clods were broken by hand into smaller fragments, and cleaned of roots and rhizomes. Each sample was spread in a 5 cm deep layer in a perforated plastic container. Containers were placed in a greenhouse with a 16h photoperiod with a thermal period of 25 C (light) and 15 C (darkness). Samples were kept in the greenhouse for three months (first growing period), placed in cold storage at B4 C for three months and returned to the greenhouse for another three months (second growing period). Seedling emergence and mortality were monitored daily. Weed seedlings were identified and counted. Soil samples were stirred midway through each growing period and at the beginning of the second period. The total number of seedlings per species per sample was summed over both germination periods.

Total seed bank density (number of weed seed per unit area at a 15 cm depth) generally increased as tillage was reduced (Figure 1), with some variations due to weed management in 1993 and crop rotation in 2006. Crop rotations generally had smaller seed

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Conservation Agriculture 2012

THE 24TH ANNUAL CONFERENCE OF THE SASKATCHEWAN SOIL CONSERVATION ASSOCIATION

January 11, 2012
Saskatoon Inn
In conjunction with Crop Production Week

Wednesday, January 11, 2012 Saskatoon Inn: Ballroom B

8:00 a.m. **Registration Opens**
8:45 a.m. **Welcoming & Opening Remarks**

-Morning Session –

9:00 a.m. **Climate Change and Crop Risk Management**
Keynote Speaker - Dr. Paul Bullock, Department of Soil Science, U of Manitoba

10:00 a.m. **Refreshment and Networking Break**

10:30 a.m. **Lowering Carbon Footprint by Diversifying Cropping Systems**
-Dr. Yantai Gan, AAFC, Swift Current

11:15 a.m. **Carbon credits – Policy and Legislation**
- Doyle Wiebe, Saskatchewan Soil Conservation Association

12:00 p.m. **Luncheon and Awards Presentations**

-Afternoon Session –

1:00 p.m. **Farming with Social Media and Smart Phones**
-Ian Boyd, Saskatchewan Soil Conservation Association

1:30 p.m. **Variable Rate Fertilizer andInter-row Seeding Study**
- Michael Bevans, AgTech Centre, Lethbridge

2:00 p.m. **Precision Agriculture and Variable Rate Technology**
-Ty Faechner, ARECA, Edmonton

2:30 p.m. **Refreshment and Networking Break**

3:00 p.m. **Glyphosate Resistant Weeds**
-Dr. Hugh Beckie, AAFC, Saskatoon

3:30 p.m. **Beneficial Microorganisms**
-Dr. Chantal Hamel, AAFC, Swift Current

4:00 p.m. **Longterm Crop Rotations**
-Dr. Reynald Lemke, AAFC, Saskatoon

4:30 p.m. **SSCA AGM**

For More Information

1-800-213-4287

www.SSCA.ca

Soils and Crops Bearpit:
Tuesday Evening 7:30 – 9:00 pm
Saskatoon Inn – Wig and Pen
For SSCA Members and Conference Participants
Cash Bar

Attention CCA's:

- Conference Approved for **6.0** CEU's
  (SW – 2.5; CM – 2.0; NM – 0.5; PM – 0.5; PD – 0.5)
- Tuesday Bearpit Approved for **1.5** CEU's
  (SW – 0.5; NM – 0.5; PM – 0.5)

Accommodation: **Saskatoon Inn (306-242-1440)**
Rooms must be reserved before Dec 11/11 to receive the conference rate.

Room	Single Rate	Double Rate
Standard 2 Queens	$117	$117
Standard 1 King	$117	$117
2nd Floor King Suite	$174	$174

Conservation Agriculture 2012 Conference Registration Form

Phone (306)695-4233 or Fax (306)695-4236 or
Mail to: SSCA, Box 1360, Indian Head, SK S0G 2K0

Name 1: ______________________________

Name 2: ______________________________

Address: ______________________________

City: ____________________ Postal Code/Zip Code: __________

Telephone: ____________________ Fax: ____________________

E-mail: ______________________________

Representing: ____________________ RM#: __________

Producer: YES / NO (circle one) SSCA Member: YES / NO (circle one)

Conference Fees: Check appropriate boxes

SSCA Members		
Before/On January 05, 2012	$45.00	☐
additional farm unit member	$40.00	☐
After January 05, 2012	$50.00	☐
additional farm unit member	$45.00	☐

Non-Members		
Before/On January 05, 2012	$70.00	☐
After January 05, 2012	$75.00	☐

1 Year membership	$100.00	☐
3 Year membership	$250.00	☐
Additional Farm Unit Membership (one time fee)	$25.00	☐

Total Enclosed $__________
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Visa MasterCard Cheque (Payable to SSCA)

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Expiry Date__________

Name on credit card (please print)______________________________

Signature______________________________

Cancellation: *SSCA will provide refunds if notified before 12 noon, January 5, 2012*

QUALITY VS. QUANTITY...CONTINUED FROM PAGE 1

produced much greater (about three-fold more) quantities of straw residues than lentil, pea, or wheat. The quantities of root residues were a bit higher overall from plants grown in Swift Current soil compared to Scott; crop-wise, there was a bit more root residue under lentil than wheat at Swift Current, and a bit more under canola than under pea or wheat at Scott. We used a ^{13}C-labeling technique to look at how long carbon from each of these residue sources stayed in the soil, where all the different crops were ^{13}C-labeled in the first year and their decomposition was traced into a second year under wheat production. We found that at the end of that second growing season there was more carbon remaining in the soil from the lentil residues than the wheat residues at Swift Current, and similar amounts of carbon remaining from the canola and pea residues at Scott (and more than remained from wheat), despite the differences in quantity produced.

Translation: the pulse crops may produce less residue overall, but these residues seem to function like slow release fertilizer, providing comparable to higher rates of nitrogen mineralization with the added bonus that they contribute comparable to greater amounts of carbon to the soil as well. This suggests that although pulse residue *quantity* is lower, its *quality* is contributing to soil quality benefits. These benefits are all in addition to the pulse perks of fixing a significant proportion of their own nitrogen! I know we're not there yet in terms of providing complete environmental cost-benefit accounting of different crop rotations, but it seems like including pulse crops is a real win-win plan.

We are incredibly grateful to the folks at Agriculture and Agri-food Canada who established and maintained these long-term plots at Scott and Swift Current. This research was funded by the Saskatchewan Pulse Growers and the Pulse Research Network (PURENet) under the Agricultural Bioproducts Innovation Program (ABIP).

PAMI Projects

By Nathan Gregg
Project Manager
Applied Agricultural services
PAMI (Prairie Agricultural Machinery Institute)

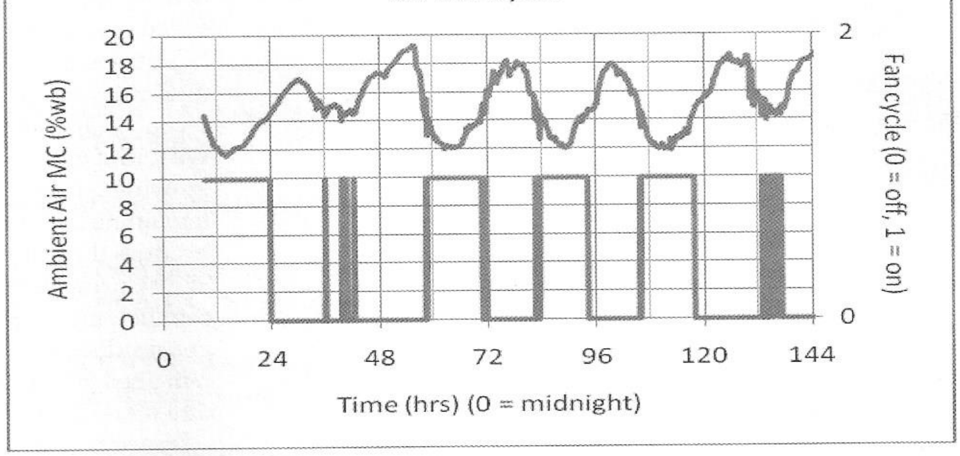
Increasing the Operational Efficiency of Natural Air Drying

Grain moisture management is essential prior to and during grain storage to minimize the chance of grain spoilage. Although hot air dying systems can be used as an effective method of drying grain, they have high energy requirements and can result in grain damage or shrinkage. Alternatively, natural air drying (NAD) systems (aeration without heat addition) help maintain grain quality and offer environmental benefits due to energy savings.

NAD systems are common, but because of the inherent dependency on variable air conditions for drying the grain, the systems often operate inefficiently. When the air is damp, very little drying occurs. In fact, if the fan operates over an extended period of damp weather, wetting can occur. Farmers commonly turn the fan on and let it run continuously until the grain at the top of the bin is dry. This means the grain at the bottom of the bin will be overdry and the fan likely ran during periods when no little to no drying occurred.

The goal of this project was to develop an automated control strategy that would automatically turn the fan on and off based on the condition of the grain and ambient air. An automatic system can help prevent grain spoilage and overdrying, while reducing the fan's total power consumption.

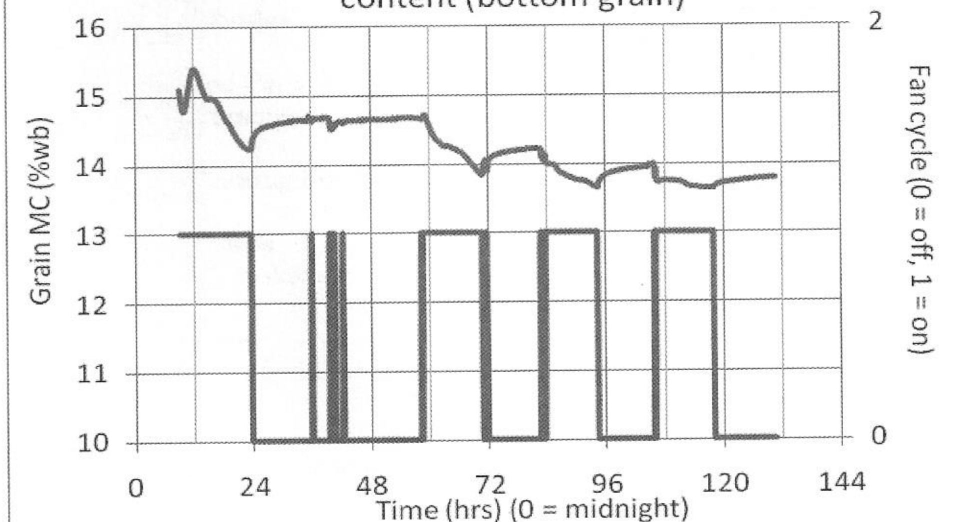
Figure 1: Effect of ambient air moisture content on fan cycle



The Prairie Agricultural Machinery Institute (PAMI) developed an automated control system for a NAD system based on the moisture content (MC) of the grain and of the ambient air. The grain moisture content was estimated from in-grain temperature and relative humidity (RH) at four grain depths. Validation testing showed that the calculated grain moisture content was within 1% of the actual grain moisture content measured by a Labtronics Model 919 grain moisture meter.

Lab scale testing helped to determine the air moisture level that would dry grain at several grain moisture levels. The controller was programmed to automatically turn on the fan when the ambient air was "likely to dry" the grain. The controller could also help rewet overdry grain by turning the fan on when the ambient air was "likely to wet" the grain. The effect of the ambient air moisture content (blue line) on the fan cycle (red line) (Editor note - red line is the bottom line) is shown in Figure 1. Generally, the air was "likely to dry" between 11 am and 10 pm on most days.

Figure 2a: Effect of fan cycle on grain moisture content (bottom grain)



PAMI completed a drying trial using wheat in a 2200 bushel hopper bottom bin with a rocket aeration system. The bin was loaded with wheat at 16% moisture content and was dried to an average 14% moisture content in 12

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2011 Season at the Western Applied Research Corporation

By Anne Kirk
Research Manager
Western Applied Research Corporation

The Western Applied Research Corporation (WARC) is a non-profit producer based organization that conducts and facilitates practical field research and demonstration. WARC helps to direct research projects through the provincial AgriARM program and in association with Agriculture and AgriFood Canada at the Scott Research Farm. WARC's mandate is to transfer technology from research to Saskatchewan producers and to identify and evaluate research and technology for Saskatchewan producers. WARC helps to link producers in NW Saskatchewan to researchers and extension.

Many of the research projects that WARC conducts came about as the result of ideas and/or issues that were brought up by producers. WARC helps to facilitate field-scale demonstrations on producer fields and also conducts plot-scale research at the Scott Research Farm. WARC is directed by a seven member Board of Directors that represents livestock and grain producers from across NW Saskatchewan.

In the 2011 season WARC was involved in a number of research projects and demonstrations. A summary of a few of the demonstrations conducted by WARC that were funded through the Saskatchewan Ministry of Agriculture's Agricultural Demonstration of Practices and Technologies (ADOPT) program follows.

Optimum Camelina Seeding Dates and Depths

WARC received two years of ADOPT funding to evaluate optimum camelina seeding dates and depths at the Scott Research Farm. Camelina is a new crop to Saskatchewan and more research is needed to determine the best agronomic practices for this crop. Seeding depth and date are two of the agronomic factors that affect crop establishment and yield potential. It is important to produce a competitive crop early in the season since there are few herbicide options and camelina has poor weed competition early in its lifecycle. In 2010 and 2011 the treatments that germinated and emerged in the fall did not yield as high as the fall dormant seeded and spring seeded camelina. Camelina planted in Early October had good emergence in the fall but low plant densities in the spring, therefore it did not survive the winter. Seeding camelina in mid-May at Scott resulted in the highest plant density and yield in both years of the trial. In terms of seeding depth, the results varied by year at Scott with the 0.5 and 1.5 cm seeding depth resulting the greatest yield in 2010 and the 1.5 and 2.5 cm seeding depth resulting in the greatest yield in 2011. Broadcast seeding did not produce a uniform plant stand in either year. Seeding date and depth trials also occurred at Indian Head and Swift Current.

Inputs to Target High Canola Yield

Canola is currently a financially lucrative crop; therefore, producers are continuously looking to target higher yield. WARC and the Northeast Agricultural Research Foundation (NARF) set up a demonstration to determine if economic yield benefits in canola can be achieved by adding inputs or management practices in which information on economic return is uncertain. An input package to target 50 bushels/acre was the starting point and consisted of the variety 9557S, an average seeding rate of 4 lb/acre, fertility based on soil test recommendations and in crop weed control as necessary. New or additional inputs were added individually to see if yields could be enhanced further. The additional inputs were micronutrients, Avail treated phosphorus, 40 lb/ac more N at time of seeding, increased seeding rate to 5 lb/ac, foliar fungicides and bioboost seed treatments. The final treatment was a combined application of all additional inputs. Yields did not differ significantly between treatments at either Scott or Melfort, indicating that applying additional inputs did not provide an economic return in 2011.

Rates of Seed-Placed ESN and Agrotain Treated Urea in Wheat

Seed placed urea fertilizer causes damage to seeds and seedlings through ammonia toxicity. If cereals are exposed to high concentrations of urea they can suffer permanent damage. There are circumstances where producers may want to apply higher rates of N fertilizer than the guidelines for sale application allow. Treated urea products such as ESN and Agrotain are of interest to producers because they are said to increase the amount of N that can be safely placed with the seed. A demonstration was conducted at Scott, Melfort and Swift Current to demonstrate the benefits and limitations of treated urea products. The demonstration included untreated urea, ESN treated urea and Agrotain treated urea. The three types of urea were placed with the seed at 20 lb/ac (the maximum recommended safe rate for the equipment used), 40, 80 and 160 lb/ac. Urea was pre-banded on all treatments to bring the combined total N to 160 lb/ac. Increasing the rate of seed-placed urea decreased yield at Scott (Figure 1) and Swift Current. Agrotain treated urea did not provide a benefit at Scott and Swift Current, while ESN did provide better seed safety, particularly at Swift Current. Melfort received rain in early June that flushed away the soluble N which allowed the plants to recover. Therefore, there was no difference in yield at Melfort between urea products

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South Dakota Wheat Commission Report for 2010

By Dwayne Beck
Research Manager
Dakota Lakes Research Farm
Pierre, South Dakota

Summary of work 1983 to 2009

The James Valley Research Center and subsequently the Dakota Lakes Research Farm have had a long and diverse relationship with wheat production and wheat producers (and consequently the SD Wheat Commission) in South Dakota for many years. Support by the wheat growers through their SD Wheat Commission was imperative to allow most of the work at these two locations to succeed. This brief summary will outline the work that has been done since 1983.

Work at the James Valley Research Center focused mostly on spring wheat breeding and management because spring wheat was the predominant crop in this area in the 1980's and before. Key issues of interest were wheat quality, yield, foliar diseases, weed control, and hessian fly problems. Winter wheat was of interest to producers there but winter-hardiness concerns limited its use. A winter wheat based tillage study was being conducted near Raymond, SD using some resources from the James Valley Research Center.

During the first part of the 1980's most of the wheat research was performed by or in cooperation with scientists and graduate students from the main campus. These projects included:

- Spring Wheat Breeding.
- Chemical control of hessian fly.
- Chloride fertilization of spring wheat
- Chloride by water interactions
- Sulfonylurea herbicides for wheat (carry-over)
- Nitrogen timing to influence grain protein

There were other projects as well. But most were focused on managing the existing farming system. Much of the work conducted at that time (sulfonylurea herbicides and chloride soil testing) has found its way into normal usage. Other concepts needed more development like the use of no-till with wheat production or managing protein content of wheat with nitrogen timing. Still others like the hessian fly problem ceased being an issue. We suspect increased rotational diversity played a major role.

Concurrent with this activity, the staff of the James Valley Research Farm began to work on developing more diverse dryland cropping systems for this area. Key to this effort was the need to manage moisture better by reducing or limiting tillage and maintaining higher levels of surface residue. The key cog in this early work was a no-till rotation study conducted on private land near the James Valley Research Center. This study was seminal in establishing the economic and agronomic value of adding diversity (more crops) and intensity (more high water-use crops) to the rotation. This work and the principles it developed remain as a cornerstone of present no-till philosophy. This concepts and the work itself were published as and Experiment Station Publication B-063 "No-till Guidelines for the Arid and Semi-Arid Prairies" in 1990. An electronic version can be found at the www.dakotalakes.com web site.

The James Valley Research Center closed at the end of the 1989 growing season and operations were moved to the Dakota Lakes Research Farm near Pierre. The efforts at the off-station rotation study near Redfield continued through its completion. This work could be summarized with the following quote taken from the 1990 report to the Wheat Commission.

"The bottom line of this research so far seems to indicate that in order to take the moisture savings that occur with no-till and turn it into profit, wheat producers may have to utilize rotations which are more intensive than they would commonly grow using conventional tillage. This may affect wheat acreage slightly but will substantially increase the diversity and profitability of the wheat producer"

On-station work at the Dakota Lakes Research Farm east of Pierre initially focused on hosting both winter and spring wheat nurseries. Three dryland rotations were established to create differing conditions for researchers. One rotation has winter wheat in a low residue (high winter-kill) and low-disease pressure sequence. Another has wheat in a high residue (low winter-kill) and high disease situation. A third rotation has moderate levels of each. In addition wheat is used in most of the irrigated rotations. This allows seed increase work of breeding material to take place without danger of drought. The irrigation also facilitates doing water response studies. Several of these were done in the last 10 years focused specifically at nitrogen and water response interactions.

Efforts of the station staff initially involved starting a comprehensive study on no-till crop rotations. This focused on winter wheat systems and was performed at an off-station location west of the Missouri River (on soils developed from Pierre Shale)) in 1992. This study was concluded in 2002.

The results from this work had extensive impact throughout the Great Plains. It demonstrated that winter wheat could be produced more profitably by growing it in rotation with other crops as compared to using summer fallow. It also proved that a two-year break between wheat crops was needed to

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SOME IMPORTANT FINDINGS OF SOIL FERTILITY RESEARCH (MELFORT RESEARCH FARM)...CONTINUED FROM PAGE 8

particularly when the S fertilizers were applied in spring.

- Dispersion of elemental S particles from granular elemental S fertilizers in soil to enhance microbial oxidation of elemental S particles to sulphate-S in soil was considered as the major problem for lack of effectiveness of granular elemental S fertilizers.
- In our other experiments with spring applied S on S-deficient soils, the findings demonstrated that S deficiency in canola can be prevented by broadcast/spread surface-application of elemental S fertilizers that contain S particles in suspension or powder formulation producing seed yield comparable to sulphate-S fertilizer. Autumn-applied elemental S usually produced greater seed yield than spring-applied elemental S, most likely because of dispersion of elemental S particles in soil and their subsequent oxidation to sulphate-S.
- New research is underway near Star City to determine the feasibility of Rapid Release Micronized Elemental S (RRMES - a new granular elemental S fertilizer from Sulphur Solutions Inc., Calgary, Alberta) in preventing S deficiency in canola when applied in spring at seeding. Our preliminary results suggest that RRMES has the potential to prevent S deficiency in canola and optimize seed yield. This study will continue for two more growing seasons in order to make valid conclusions.

Copper Fertilizer Management for Optimum Seed Yield and Quality of Crops (S. S. Malhi, R. E. Karamanos and E. Solberg)

- Deficiency of copper (Cu) in the Canadian prairie soils is not widely spread, but whenever it occurs it can cause a drastic reduction in seed yield and quality of most cereals, especially of wheat.
- Broadcast-incorporation of granular Cu fertilizers prior to seeding at 3-5.6 kg Cu ha-1 rate was usually sufficient to prevent Cu deficiency in wheat, and improve seed yield and quality.
- At lower rates (<2.0 kg Cu ha-1), broadcast-incorporation of granular Cu fertilizers was not effective, while surface spray-broadcast followed by incorporation of liquid Cu fertilizers was much more effective in increasing seed yield of wheat in the first year of application. Surface-broadcast without incorporation and seedrow-placed granular Cu fertilizers were much less effective in improving seed yield of wheat than their foliar or soil incorporated applications.
- In the growing season, foliar applications of Cu at 0.20 to 0.28 kg Cu ha-1 to wheat at the Feekes 6 (first node of stem visible at base of shoot or stem elongation), Feekes 10 (sheath of last leaf completely grown or flag-leaf) and early boot growth stages were very effective in restoring seed yield, while Cu applications at the Feekes 2 (4-leaf) or Feekes 10.5 (complete heading) growth stage did not have a consistent effect to correct damage caused by Cu deficiency.
- Some Cu fertilizers (e.g., Cu oxide) were less effective than others in preventing/correcting Cu deficiency.
- Soil application at relatively high rates produced residual benefits in increasing seed yield for a number of years.
- The sensitivity of crops to Cu deficiency is usually in the order of (wheat, flax, canary seed) > (barley, alfalfa) > (timothy seed, oats, corn) > (peas, clovers) > (canola, rye, forage grasses).
- Stem melanosis in wheat was associated with deficiency of Cu in soil and the disease was reduced substantially with Cu application.
- High level of available P in soil was observed to induce/increase severity of Cu deficiency in wheat. Soil analysis for DTPA-extractable Cu in soil can be used as a good diagnostic tool to predict Cu deficiency, but there was a poor relationship between total Cu concentration in shoots and degree of Cu deficiency in crops.
- Application of Cu fertilizers to wheat on Cu-deficient soils also generally improved seed quality.
- Because Cu deficiency in crops often occurs in irregular patches within fields, foliar application may be the most practical and economical way to correct Cu deficiency during the growing season, as lower Cu rates can correct Cu deficiency.

Preventing Nutrient Deficiencies in Organic Crops for Sustainable Production (S. S. Malhi, S. A. Brandt, R. P. Zentner and K. S. Gill)

- There is a great interest in organic farming in Canada. In the Canadian Prairies, most organically farmed soils are deficient in available N, many low in available P, and some contain insufficient S and K for optimum crop yield. Maintaining high soil fertility is an important issue facing organic agriculture in Canada. In organic farming, inorganic fertilizers/chemicals are not applied to increase crop yields, but adequate amounts of nutrients are essential for high crop production.
- Field experiments are being conducted in Saskatchewan and Alberta, to determine the feasibility of amendments [compost, alfalfa pellets, wood ash, rock phosphate, Penicillium bilaiae and MykePro, thin stillage, fish food additive, distiller grain, glycerol, gypsum, rapid release micronized elemental S (RRMES)] and management practices [intercropping non-legumes (cereals, oilseeds) with legumes (pea), legumes grown for green manure or in rotations, diversification of deep taproot and shallow fibrous root crops] in improving yield and nutrient uptake for organic crops.
- In the two 3-year experiments on organic farms, compost and alfalfa pellets increased yield and nutrient uptake of wheat, barley and pea. However, rock phosphate, Penicillium bilaiae and MykePro had little or no effect on crop yield and nutrient uptake. This was most likely that the soil was not deficient in available P, so new field research is planned in 2012 on an extremely P-deficient soil (where alfalfa has failed

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Seeding Canola in Saturated Soils!

By Lana Shaw, P.Ag
SERF Research Manager
and Elaine Moats, P.Ag
Regional Crops Specialist
Saskatchewan Ministry of Agriculture

The spring of 2011 brought extraordinarily wet conditions to southeastern Saskatchewan. So much so that farmers really had to struggle to get what little crop seeded that they did. For many, canola was the only crop that they were able to get in using various methods of seeding!

This presented an opportunity for Lana Shaw, Research Manager and the staff of the South East Research Farm (SERF) at Redvers. They recognized the need to document the results that farmers achieved through their efforts to seed canola! With the support of SaskCanola they surveyed farmers who had tried to establish canola on saturated fields using various seeding methods. The results may come in handy should this situation happen again!

Thirty-two fields were surveyed in an area stretching from Moosomin to Carnduff. Some of the early seeded fields were "mudded-in" with air drills. Others were broadcast by airplane and Valmar-type spreaders. All but one of the broadcast fields was harrowed. Three fields were volunteer canola, one of which was baled.

SERF staff collected information from the farmers including seeding dates, methods, fertilizer rates and weed control. They also did plant counts. The farmers provided their best estimate of yields. A summary of the yield and plant populations is included in Table 1.

Almost all of the fields had been fertilized, either with fall applied anhydrous, or in the spring with the air drill or broadcast granular or a post emergent liquid application. The rates of fertilizer varied but Lana noted that the rate of nitrogen fertilizer did not appear to be a limiting factor in this situation.

There were no conventionally seeded fields planted after May 25th as the fields were too wet to support heavy equipment. Fourteen of the broadcast seeded fields were seeded after May 20th.

Three of the surveyed fields were seeded by airplane. Two had higher than average yields while the yield of the third was limited by weed control and lack of fertilizer.

Most of the fields had been sprayed at least once with a post emergent product such as glyphosate of Liberty. Because of the poor growing conditions weed control was an important issue for all fields.

Table 1: Canola plant populations and seed yield for 32 Southeast Saskatchewan extremely wet fields in 2011 (provided by Lana Shaw, P.Ag Research Farm Manager, South East Research Farm, Redvers, SK)

	# Fields	Average Seeding Date	Average Plants/m2	Average Yield bu/ac	Range Yield bu/ac
Aerial Application	3	June 4	107	19.8	7.5-28
Air Drill	10	May 18	90	21.6	16-30
Broadcast & Harrow	16	May 28	99	18.1	5-28
Volunteer	3	n/a	111	5	0-10
Average (excluding volunteer)	32 total	May 24	97	19.5	

Seeding rates for the air drill and broadcast fields were similar (4-5 lbs/acre) while the two successful aerial seeded fields increased their seeding rate to 6.5 lbs/acre.

What was learned from all of this?

- When seeding conditions are extremely wet there may be options other than drills available for seeding.
- Traditional seeding rates can work when broadcast seeding with ground equipment under wet conditions when you can achieve good seed to soil contact with either harrowing or heavy rains.
- Increasing seeding rates for aerial application can help reduce the risk of less seed to soil contact.
- Weed control is a must.
- Under these extreme conditions, fertilizer rates can be adjusted to reduce financial risk.
- Volunteer crops are more likely to be disappointing due to a combination of plant populations and genetics.
- Producers still have to answer the question "How does this practice fit with the canola rotation?"

SERF was certainly disrupted by the wet spring of 2011! While their spring seeding program was derailed they were able to continue with their winter wheat fertility program, their forage program which includes a grazing project comparing the effect of moderate vs. heavy grazing of perennial legumes, the demonstration of leafy spurge control with herbicides and their camelina seeding date and depth trial.

For more information about the work of SERF, contact:

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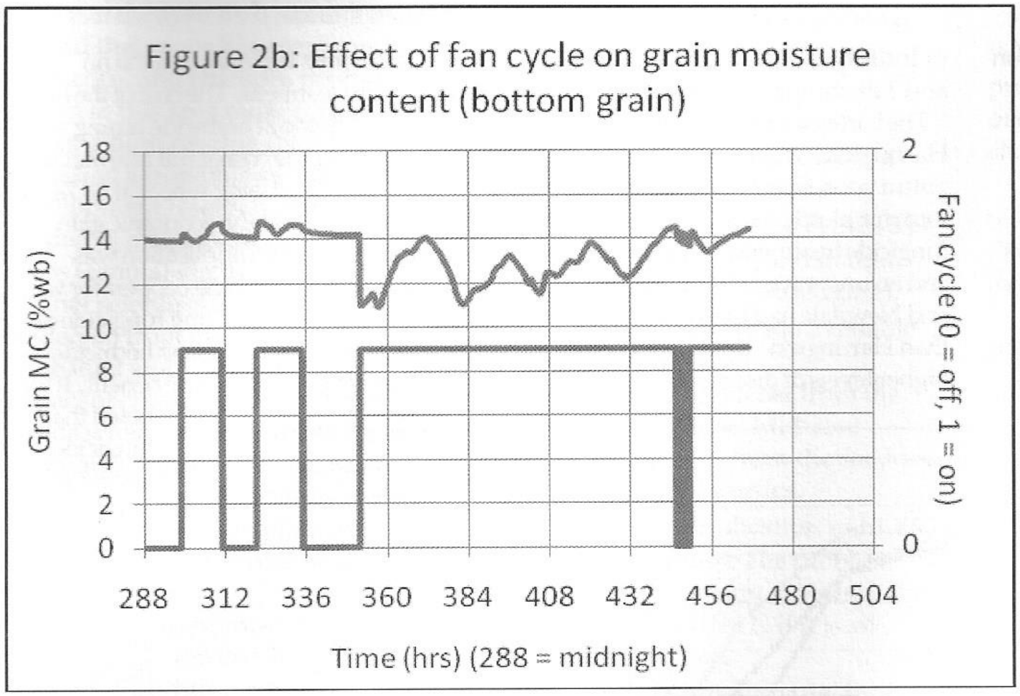
or
Elaine Moats, Regional Crops Specialist, Saskatchewan Ministry of Agriculture
Phone: (306) 848-2856
Email: Elaine.moats@gov.sk.ca



days, during which the fan operated 45% of the time. The effect of the fan cycle on the moisture content of the grain at the bottom of the bin is shown in Figures 2a and 2b. At the beginning of the trial (Figure 2a), the grain moisture content dropped noticeably when the fan was on (when the air was "likely to dry"). When the fan was off, the moisture content increased slightly, likely due to moisture migration within the kernels. In Figure 2b, the fan operated continuously in an attempt to rewet the overdry grain at the bottom of the bin. During the last two days of the trial, the moisture in the grain at the bottom of the bin was increased from 11% to 13.5%.

Theoretically, optimizing the operation of a NAD fan can lead to significant energy savings in addition to minimizing overdry grain and decreasing the potential for grain spoilage. A five horsepower fan, similar to the one used in this test, running continuously for 30 days requires 2,980 kW-hr of electricity. This amounts to a monthly cost of $300 (based on $0.10/kW-hr). An automated control system for a NAD fan can cut that energy bill in half.

PAMI is aware of a commercial system available to automatically monitor grain condition and control fans, heaters, and vents on very large bins. This system uses a similar strategy to the one PAMI developed and tested, but may not be affordable for the average-sized farm. The PAMI control strategy can be simply implemented with inexpensive temperature and RH sensors (minimum of four per bin), relays to switch the fan on and off, and a controller to execute the algorithm. For more information on PAMI's NAD control strategy, contact Joy Agnew at PAMI in Humboldt (jagnew@pami.ca, 306-682-5033, or 1-800-567-7264).

In addition to the NAD tests, PAMI has been working on several other agricultural research projects:

Solid State Anaerobic Biodigestion

PAMI's Applied Bioenergy Centre (ABC) designed and commissioned a pilot-scale solid state anaerobic digestion facility at the Termuende Research Ranch near Lanigan, SK. Anaerobic digestion breaks down organic waste material and produces biogas and digestate material. The biogas produced can be used for energy production while the digestate can be used as a fertilizer. Solid state digestion differs from traditional liquid digestion in that it can process solid organic material in it's natural (dry) form. During solid state digestion, very little water is required and no wastewater is generated. The goal of PAMI's pilot facility is to demonstrate the feasibility of solid state digestion in the Canadian climate and to conduct research on optimizing the operating parameters such as leachate recirculation. Research trials will continue in 2012 and industry specific trials are targeted to begin in 2013. Funding for this project was provided by Western Economic Diversification, the Saskatchewan Ministry of Agriculture's Agriculture Development Fund and Natural Resources Canada.

Uniformity of Solid Manure Land Application

PAMI is performing research on the agronomic and environmental impacts of the uniformity of solid manure application. Plots were established to determine the effect of application uniformity and rate on crop yield, soil nutrient build-up, and nutrients in run-off over two growing seasons. PAMI's prototype solid manure applicator was used to control the transverse uniformity of composted beef manure as well as the application rate (2 application rates and 3 levels of uniformity were used). Urea was also applied to half of the plots to determine if uniformity affects bare soil differently from fertilized soil. Samples from the first growing season are currently being analyzed by the Soil Science team at the University of Saskatchewan. Second year applications and sample collection will begin in May, 2012. Project funding was provided by the Saskatchewan Agriculture Development Fund.

Biomass Logistics Study

PAMI is conducting a biomass logistics study to help determine the potential for bioenergy and bioproducts in Saskatchewan. With increasing costs of fossil fuels,

... CONTINUED PAGE 20

at the different seed placed application rates.

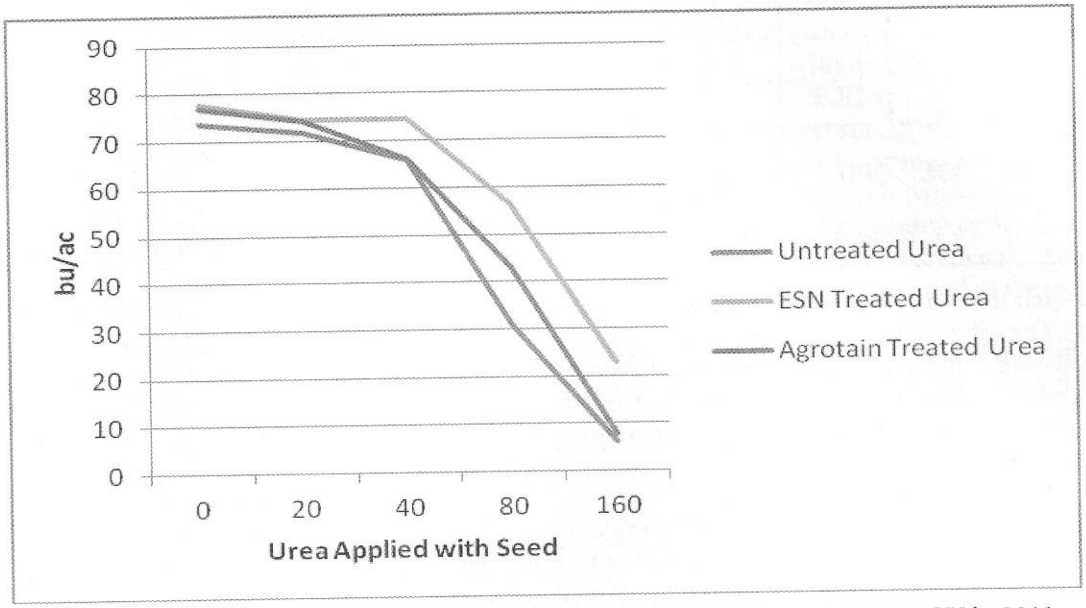


Figure 1: Wheat yield (bu/ac) at different rates of seed applied urea at Scott, SK in 2011.

Maximizing Benefits from Foliar Fungicides on Wheat and Barley

Industry agronomists suggest that producers in northern Saskatchewan consider applying foliar fungicides to cereals as a routine practice. WARC conducted a demonstration trial at the Scott research farm to assess the impact of fungicide and genetics on the level of leaf spotting diseases, yield, and quality of barley and wheat. For each crop three varieties that differed in resistance to leaf diseases were planted and three fungicide treatments were sprayed on each at flag leaf. The wheat varieties included AC Barrie (susceptible), Infinity (resistant) and 5603 HR (resistant), and the fungicides treatments were Tilt, Headline and an unsprayed check. Flag leaf disease levels did not appear to differ between varieties, although they did differ between treatments. Headline treated wheat had the lowest disease levels and the unsprayed wheat had the highest disease levels. In terms of yield, 5603 HR yielded about 10 bu/ac higher than AC Barrie and Infinity. Fungicide treated wheat yielded higher than untreated wheat, with Headline, Tilt and unsprayed wheat yielding an average of 60, 58 and 55 bu/ac, respectively. Thousand kernel weights did not differ between fungicide treatments. Test weight did not differ between fungicide treatments for AC Barrie and 5603 HR, but lower test weights were seen in Infinity for the unsprayed check and Tilt compared to Headline.

The barley varieties included Harrington, AC Metcalfe and Newdale, with a poor, fair and good rating for spot form net blotch, respectively. The fungicide treatments were Tilt, Proline and an unsprayed check. AC Metcalfe and Newdale had lower levels of disease than Harrington. Unsprayed barley had higher levels of disease than sprayed barley. In terms of yield, Newdale barley yielded higher than the other two varieties. Fungicide treated barley yielded higher than untreated barley with yields of 101, 97 and 87 bu/ac for Tilt, Proline and untreated barley, respectively. Fungicide application resulted in 10 to 14 bushel/acre increase in yield as well as higher kernel weight and higher percentage of plump kernels than untreated barley.

A field-scale demonstration to evaluate fungicide timing on wheat was conducted near Radisson, SK. Treatments consisted of no fungicide, a half rate of fungicide at herbicide timing, fungicide at flag leaf, and fungicide applied at both herbicide timing and at flag leaf. The greatest yield resulted from fungicide application of a half rate at herbicide timing combined with full rate at flag leaf stage, followed by fungicide at herbicide timing. There was no yield difference in the strips that had fungicide applied at flag leaf only and the no fungicide treatment. The cost of the half rate of fungicide at herbicide timing was $3.50/ac and the cost of full rate at flag leaf was $7/ac. Using wheat at $8.74/bushel shows that the economic gain from the combined application was $38.47/ac this year. The cooperator was happy to see that applying fungicide at the same time as the in-crop herbicide application provided some benefit. It was noted that the fungicide treated strips remained greener and were later maturity than the untreated strips.

This is a brief summary of some of the ADOPT projects that were conducted by WARC in 2011. WARC was also involved in a canola seeding speeds demonstration, cleavers control demonstration and salinity tolerant forages demonstration as well as the following research projects; integrated weed control in lentils, canola variety shatter tolerance, response of canola to low plant populations and evaluation of reseeding options. For more information on WARC's current and past projects please contact Anne Kirk or visit our website at www.warc.ca. If you would like to contact the WARC research manager or one of the board members with ideas and/or questions on any of the research we are conducting you can find our contact information on our website.

The Crop Opportunity and Scott Research Update will take place on March 8, 2012 at the Alex Dillabough Centre in Battleford. Registration information and our agenda can be found on our website: www.warc.ca.

optimize the system. It simultaneously proved that crops like sorghum, flax, peas, corn, and chickpea could be grown in this area more consistently be using high residue rotations. It also identified agronomic and market development research that was needed to make these and other new crops (canola) viable.

Other scientists like Randy Anderson from the USDA-ARS published work on the beneficial impact of crop rotations in controlling weeds when low-disturbance no-till techniques were employed. Many of the winter kill, weed control, disease, and insect issues that plagued tillage-based short rotations are no longer a factor.

The most important change in wheat production in the last 20 years has been the realization that wheat is a crop that would respond to management better in the diverse rotations being used than it did under low-diversity conditions. This has led to the work that predominates the last 8 years of effort specifically focused on wheat at the Dakota Lakes

Research Farm. The first part of this work 2003 to 2008 was done with Cheryl Reese, David Clay, and Greg Carlson. This effort was a follow up on work done a Redfield in the 1980's by Ruth Beck. The goal was to define ways to manage nitrogen for higher yields, better quality, and more efficiency. It involved both winter and spring wheat. It included irrigated and dryland. On-station and farmer managed were used. This is a very comprehensive suite of studies. We look forward to reading the complete summary when it is compiled.

It would probably not be out of line to summarize the results of the early work at Redfield and the studies of Cheryl Reese between 2003 and 2008 as follows:

- Making nitrogen (fertilizer or soil N) available to wheat too early increases lodging, causes excessive tillering, wastes water, and does other bad things.
- Heads on later tillers are more likely to be impacted by heat meaning the grain is lighter.
- Varied maturity of main stems and tillers makes timing fungicide applications difficult.
- Abortion of tillers when conditions become dry provides a source of disease inoculums.
- Early nitrogen (before Feekes 5 or 6) encourages tillering and makes stem length longer (more lodging).
- Nitrogen can be made available later in the season by:

Placing nitrogen farther from the seed at planting time. Mid-row banding at 5 inches from the seed was sufficient in these studies.

- Delaying N application until V5 or V6 (post tillering). The problem here is that lack of rain may limit the efficiency of the later N if it is all applied at this time.
- Using slow-release or delayed release N sources (ESN). In a dry year, this may not release quickly enough.
- Using legume or non-legume cover crops that will release N later in the wheat year.
- Or some combination of the above techniques.
- Sulfur may be as important as N in some cases.
- Using real-time optical methods (Green Seeker) to vary N rates is NOT ready for use by producers.

During this same period of time, the station staff have been evaluating techniques for using fungicides in wheat crops. The summary of that work is that they work when they are needed and that they are not needed every year. Scouting, knowing the characteristics of your varieties, the properties of the fungicides, and using weather forecasts and disease models will produce the best results. The last two years have been used to evaluate some of the new and different products that have come onto the market.

THE WORD IN 2010 FOR WHEAT IS PROTEIN:

- Protein content and characteristics are dependent on genetics, environment, and MANAGEMENT
- Protein itself is not important. What is important is the fact that protein is used as the primary means of estimating wheat quality characteristics in the country.
- Quality like beauty, it is difficult to define: IT DEPENDS ON THE CIRCUMSTANCES AND THE POINT OF VIEW:

TO MILLERS (More Specifically) BAKERS: It depends on the product and the process they use.

TO ELEVATORS AND OTHER MERCHANDISERS: Efficiency and predictability are paramount.

TO FARMERS:

- Quality means agronomic characteristics like disease resistance, winter-hardiness, lodging resistance, etc.
- Quality means yield potential and yield stability.
- Quality means producing a product that is in demand and one that can be moved through marketing channels well.

TO THE CONSUMER:

- Quality can mean many different things.
- The final product is important in that it must have the right taste, texture, value, etc.
- Other factors like food safety, environmental benefit, sustainability, climate friendly, salmon safe, locally produced, non-GMO, etc. are beginning to add to the perception of quality. One example with wheat is Shepherd's Grain www.shepherdsgrain.com

THE DAKOTA LAKES RESEARCH FARM'S ROLE

- Support the wheat breeding program.
- Conduct studies on NO-TILL systems that contain wheat (and other crops). The biggest boost in wheat yields and quality in this area is associated with better crop rotations and use of no-till.
- Conduct and cooperate on studies looking specifically at the management

... CONTINUED PAGE 22

PAMI PROJECTS...CONTINUED FROM PAGE 17

greenhouse gas emission concerns , and the potential for net-zero carbon emissions, use of bioenergy and bioproducts around the world has been on the rise. This study includes a detailed summary of potential dedicated bioenergy crops and agricultural crop residues for use in these sectors, along with corresponding yields and agronomic practices involved. The supply chain as a whole - from field to biorefinery - will be assessed, including transportation, storage, densification, processing options, energy value and inputs, and associated costs. This project will be complete in March of 2012. Funding for this project was provided by PAMI's Applied Bioenergy Centre.

PAMI Plot Drill Upgrade

PAMI has used its plot drill to conduct agronomic plot trials for research and development (R & D) initiatives such as opener comparisons, fertility trials, packing experiments, row spacing testing, and prototype development for nearly 20 years. As time and technology have advanced, the limitations of depth control and seed-placement accuracy intrinsic to the "air seeder" technology that the plot drill was based on became more apparent. PAMI decided to upgrade its plot drill to independent depth control shank assemblies common on many modern air drills. This technology uses independent gauge wheels on each shank to maintain precision depth control, and hydraulic pressure to regulate packing pressure and trip-out force.

By utilizing the latest in air drill technology, PAMI is better able to perform R & D projects that replicate conditions and equipment found in the field. PAMI's updated 10' wide plot drill is capable of accommodating multiple different openers, various opener styles, and adjustable row spacings. The drill is set up to handle many seeds (small forages to large grains), anhydrous ammonia, dry and liquid fertilizers, and all with accurate, independent depth control. PAMI's experienced field crew is well-equipped to tackle future R & D initiatives.

Zero-till Opener Evaluation for Pasture Rejuvenation

With funding support provided by the Saskatchewan Agriculture Development Fund, PAMI conducted a project in cooperation with our Western Beef Development Centre colleagues to evaluate different opener styles on their suitability for seeding into existing forage stands. This demonstration project compared the performance of six different opener styles (knife, paired-row deep band, paired-row same plane, sideband deep band, sideband same plane, and twin shank) while seeding alfalfa into an established crested wheat grass stand. Draft measurements for each opener style were obtained. A pre-seeding herbicide application to suppress the existing forage growth was also included in the experiment as a variable. Emergence counts and yield data were gathered on all plots. Initial results indicate that the burn-off herbicide treatment had a significant positive effect on alfalfa emergence and yield, while the opener style did not appear to be a significant factor in alfalfa establishment. Further results will be compiled this winter. PAMI gratefully acknowledges the support of our cooperators - Atom Jet Industries, Bourgault Tillage Tools, Case New Holland, Dutch Industries, Morris Industries, and SeedMaster.

For more information on these PAMI projects, please contact Joy Agnew (jagnew@pami.ca) or Nathan Gregg (ngregg@pami.ca) at PAMI in Humboldt - 306-682-5033, or 1-800-567-PAMI (7264).

to grow without p fertilizer) to determine the feasibility and contribution of amendments in preventing P deficiency and improving crop yield.

- In other field experiments where comparisons were made between organic and conventional treatments, legumes in rotations, legume green manure, crop residue return, thin stillage, fish food additive and distiller grain helped to improve crop yields.
- Our results also suggested the use of gypsum and RRMES in preventing S deficiency, and wood ash in improving P and/or S availability to increase crop yield, provided N was not lacking in the soil.
- Intercropping of wheat, barley or canola with pea usually produced higher yield per unit area basis than when these crops were grown as sole crops.
- Compared to conventional input system, organic system, in spite of 30-40% lower crop yields, resulted in favourable economic performance and energy use efficiency because of lower input costs and price premiums.
- Our findings suggest that the integrated use of amendments and management practices has the potential for high sustainable crop production, most likely by preventing nutrient deficiencies in organic crops.

Improving Forage and Seed Yield and Longevity of Stands with Balanced Fertilization (S. S. Malhi)

- In northeastern Saskatchewan, alfalfa [Medicago sativa Leyss] is an important forage crop grown for animal feed and seed production. After about 3 years of production, an alfalfa stand will not usually maintain its original productivity, resulting in lower yields in many fields (or in certain areas of the field).
- Weed infestation/competition in older alfalfa stands results in substantial loss in yield, and economic loss. Lower alfalfa can also occur due to depletion of soil fertility, because alfalfa has high requirements for phosphorus (P), sulphur (S), potassium (K), and some micronutrients, such as boron (B). Because of low yields and weed infestation, a large acreage of alfalfa fields is terminated every year in Saskatchewan, predominantly by tillage. Termination of a stand increases the cost of production due to tillage and reseeding, and can also result in substantial nitrate-N loss through leaching and/or denitrification, soil erosion and deterioration of soil quality.
- If one nutrient is deficient in soil, crop growth will be poor even if other nutrients are abundant, and this can affect the longevity of alfalfa seed stands (even if there is little effect on yield).
- The results of our farm field survey trials suggested that poor seed yields in most alfalfa stands were due to nutrient deficiencies and/or a soil fertility imbalance, as evidenced by soil tests undertaken to determine the concentration of available nutrients.
- The findings of our field research experiments indicated that balanced application of P, K or S fertilizer nutrients was essential to obtain optimum yield of forage and/or seed in most cases under normal soil moisture conditions. Our findings also suggest the importance of balanced fertilization or soil fertility in increasing longevity of alfalfa stands.
- Our findings suggest that when a soil is testing low (or deficient) in a nutrient and alfalfa growth is reduced, then alfalfa forage producers should consider application of fertilizers to supply adequate amounts of nutrients lacking in the soil.
- However, for alfalfa seed production, even after conducting soil and plant tissue analyses, it is still difficult to accurately predict if a profitable alfalfa seed yield response to fertilization will occur, particularly when the soils are testing marginal in some nutrient levels and seed yields are often reduced by dry weather conditions and/or frost damage. Therefore, in order to save money and optimize the use of fertilizers, alfalfa seed producers can use the following suggestions: Apply fertilizers in test strips to find out if there is any increase in alfalfa seed yield and only then consider fertilization of the whole field on a regular basis. If there is a plan in place to use fertilizers on the alfalfa seed field, leave some strips without fertilizers in the field to compare alfalfa seed yields with and without applied fertilizer.

Influence of Long-term Tillage, Crop Residues, Fertilization and Land Use on Soil Quality and Productivity (S. S. Malhi and M. Nyborg)

- Soil organic carbon (SOC) reserves in western Canada have diminished considerably since the initial cultivation of native prairie grasslands approximately 100 years. The decline of SOC was the result of the conversion from native prairie (perennial grass system) to a cultivated annual cropping system, especially with summer fallow. Long-term field experiments were conducted in the Parkland region of western Canada to determine the impact of management practices, such as reduced tillage, improved fertilization and crop rotations including perennial forage can increase the amount of organic C and/or N stored in the soil.
- Reducing tillage and returning straw increased soil organic C and N, and aggregation. Application of appropriate fertilizers to crops under ZT improved organic C and N in soil.
- Balanced fertilization to perennial grassland improved soil quality, and minimized accumulation and downward

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of wheat. This includes work on fertility, disease management, etc.

THINGS THAT WE HAVE LEARNED OVER THE LAST 25 YEARS RELATIVE TO WHEAT.

- Making nitrogen (fertilizer or soil N) available to wheat too early increases lodging, causes excessive tillering, wastes water, and does other bad things.
- Heads on later tillers are more likely to be impacted by heat meaning the grain is lighter.
- Varied maturity of main stems and tillers makes timing fungicide applications difficult.
- Abortion of tillers when conditions become dry provides a source of disease inoculums.

Nitrogen can be made available later in the season by:

- Placing nitrogen farther from the seed at planting time.
- Delaying N application until V5 or V6 (post tillering)
- Using slow-release or delayed release N sources (ESN)
- Using legume or non-legume cover crops that will release N later in the wheat year.
- Or some combination of the above techniques.

Sulfur may be as important as N in some cases.

Using real-time optical methods to vary N rates is NOT ready for use by producers.

- Environment makes a difference. All wheat is high protein in a dry and hot year.. It is hard to maintain protein in a cool and moist year BUT it can be done.
- N management makes a difference BUT it is not the sole determinant.
- Variety makes a difference BUT that is not consistent. Some varieties make good quality under certain conditions and not others. Some varieties are more consistent over environments.
- Protein content is not always an accurate predictor of quality differences.
- Farmers producing "high quality" wheat are often not paid for their efforts.
- Sacrificing yield for quality has seldom paid, so the goal has to be high-yield AND high quality.
- Variation in uniformity in a field is much more of an issue than blending at the bin site.
- Good no-till systems reduce across field variability because the water enters the soil where it falls. Eroded knobs can be restored to better productivity further reducing variability.

The goal is to maximize grain fill period by controlling tillering to produce mostly during the grain fill period. Start grain-fill early and finish late. At Dakota lakes this is accomplished by planting thicker than the current recommended rate for winter wheat (we use 1.2 to 1.4 million pure live seeds vs the standard 950,000) under normal conditions at optimum planting date. We go higher for late planting and poor conditions. Withhold N until after tillering. The goal is to have 55 to 65 HEADS/square foot with an average tiller count early heads and early flowering. Fungicides can be used to protect the plant (heads per root system) of 2 to 2.2. This equates to 2.6 million heads more or less.

Example:

1,300,000 PLS * 0.9 mortality * 2.1 heads/plant/43560 sq ft=56 plants/sq foot. This is 504 per square yard or 2.4 million per acre. If you want this many heads with 960,000 seeds the number of tillers would have to be over 3. For spring wheat the goal is 1.7 heads/plant so the seeding rate is higher.

One way to see why we use is this approach is to go into your fields a few weeks after heading and pull whole plants. You can then separate them by root system and count the tillers. When you do this note the relative size of the different heads. We want more of the big (early) heads. Having a higher percentage of early heads also makes applying fungicides easier.

The following report covers the work funded partially by the wheat commission in 2009.

Progress in 2009

The 2009 season was variable regarding its impact on wheat production in central South Dakota. Lack of fall and early season precipitation created issues with winter survival. The cool temperatures allowed reaching yield levels that would not have occurred if it had turned hot.

Three trials were conducted with farmer cooperators testing non-traditional products. The focus in 2009 was on biological inoculants, specifically Accolade by INTX Microbials and QuickRoots from TJ Technologies. Both of these products are seed treatments designed to introduce beneficial organisms into the seed zone where they help with either root growth, root efficacy, or by providing enhanced nutrient availability. The Extension Educators in Lyman, Sully, and Hughes/Stanley Counties were very instrumental in conducting these studies as were the farmer cooperators.

These products can be highly effective in situations where the soil biological community has been adversely impacted by tillage, flooding, or soil fumigation. The 2009 studies were conducted by producers that have used either low-disturbance or moderate disturbance no-till systems for a number of years. Response to biological inoculants of this type would be less likely under these conditions.

Progress in 2009			
Product	Company	Organism	Comments
Accolade	INTX Microbials	Azospirillum brasilense	N2 fixing rhizobacteria
QuickRoots	TJ Technologies	Bacillus subtillis and Trichoderma virens	Bacteria and fungi

banks with fewer species than the monoculture. In 1993, seed banks with minimum weed management were twice as dense as those with intensive or moderate weed management (approx. 6000 vs. 3000 seed m-2). By 2006, seed density averaged 6838 seed m-2 across the previous intensive and moderate weed management treatments, regardless of tillage, but was nearly twice as large in NT (12,188 seed m-2) compared to MP (4770 seed m-2) and CP (7117 seed m-2) with minimum weed management (LSD0.05=4488).

Species with abundant seed banks responded differently to treatments. Barnyard grass and green foxtail had larger seed banks in the monoculture than in the crop rotation. Common lamb's quarters and pigweed species had large seed banks in tilled treatments in the rotation whereas yellow foxtail and field pennycress contributed to the large seed banks observed in NT treatments. The latter two species were also associated with residual effects of weed management treatments (terminated 12 years earlier) in NT. Weed species responded differently to treatments, with the seed banks of some species clearly being favored under certain treatments whereas others would nearly be eliminated. This explained some of the weak treatment effects observed for total seed bank density.

It was impossible to determine whether the greater seed bank size in 2006 compared to that in 1993 resulted from a progressive seed accumulation over time, changes in crop sequence (moving from a cereal-forage to an annual crop rotation), and variations in weed control efficacy, or recent environmental conditions that would have favored weed seed production of certain species. Autumn seed bank data (1988-1992) clearly illustrate the magnitude and speed of change in total abundance over time, this effect being somewhat independent and often larger than treatment effects (Figure 1). Choosing any two points in time over these four years would have generated very different conclusions concerning potential directional changes (increasing/decreasing) in total seed density. Fluctuations as observed in our study would suggest important environmental effects on total seed bank size and weed seed bank composition. Environmental and biological factors acting over winter greatly reduced treatment effects on spring seed bank composition.

Results from this study confirmed strong but contrasting effects of tillage, crop rotation and weed management on seed banks of individual weed species which resulted in weak overall effects on total seed density. Conclusions concerning effects of crop production factors on total weed seed density should thus be made with caution. Evidence of persistent effects from past weed control on weed seed banks, attributed to previous herbicide treatments terminated 12 years earlier, confirmed the strength and persistence of the filtering effect of herbicides on weed populations. Although seed banks provided evidence of the presence of perennial weed species, they could not allow an estimation of their relative importance. Estimation of vegetative propagules in the soil would appear essential to the proper assessment of conservation tillage effects on weed population dynamics. Results emphasized the need to contain weed seed production, particularly in NT. This issue is of crucial importance for the sustainability of NT in the current context of herbicide resistance and in particular of the rapid evolution of glyphosate resistant weeds, many of which are extremely prolific seed producers.

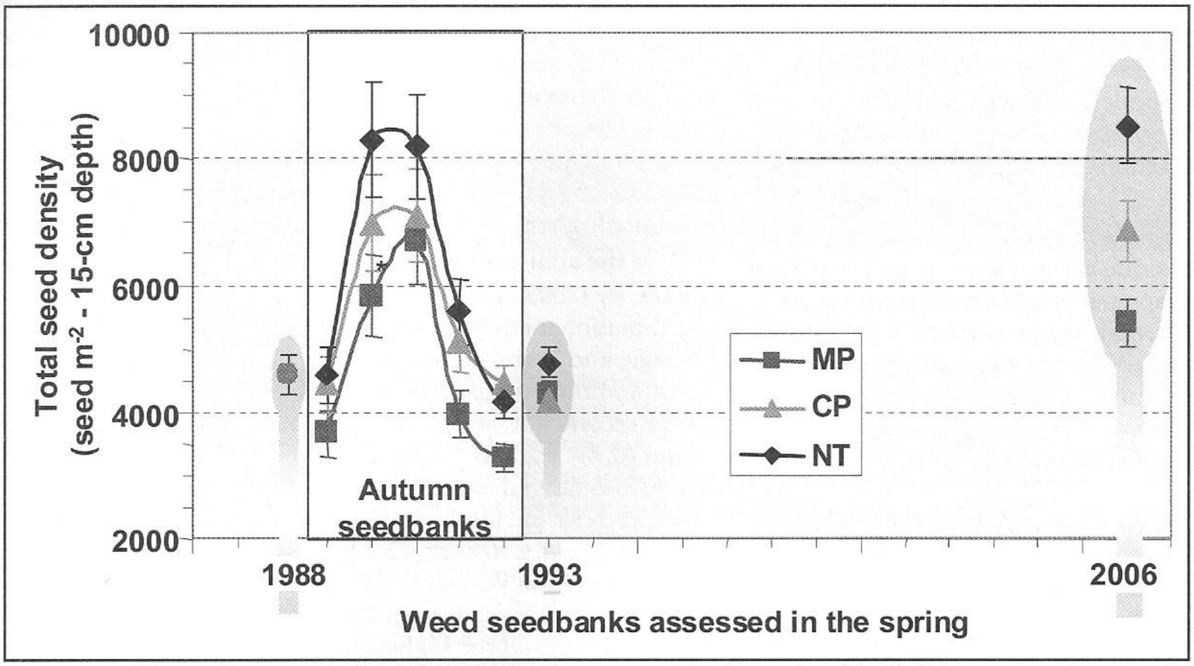

Figure 1. Tillage effects on total seedbank density assessed in the spring (shaded grey zone: 1993, 2006), and in the autumn (un-shaded zone: 1989-1992). Vertical bars are for standard error of the mean.

Eilers, W., MacKay, R., Graham, L., Lefebvre (eds). 2010. Environmental Sustainability of Canadian Agriculture: Agri-environmental Indicator Report Series - Report #3. Agriculture and Agri-Food Canada, Ottawa, Ontario. 235 p.

Légère A., Stevenson F.C., Benoit D.L.. 2011.The selective memory of weed seedbanks after 18 years of conservation tillage. Weed Science 59:98-106.

SOME IMPORTANT FINDINGS OF SOIL FERTILITY RESEARCH (MELFORT RESEARCH FARM)...CONTINUED FROM PAGE 21

movement of nitrate-N in the soil profile.

- Conversion of marginal cropped land to forage has a positive impact on soil quality. Total soil C and rates of release of available N were greater in grassland soil (after five to ten years in forage systems) than cultivated land.
- The majority of the increase in organic C and N occurred in the surface soil and was in the light fraction organic matter.
- Our findings suggest that elimination of tillage, retaining crop residue and proper nutrient/fertilizer management practices can be used increase organic matter in soil, store more water in soil, reduce soil erosion, minimize nitrate leaching and other gaseous N losses, and would gradually improve soil productivity.

Influence of Tillage, Crop residue, Controlled-Release N Fertilizer and Liquid Swine Manure Management on Greenhouse Gas Emissions (S. S. Malhi, R. L. Lemke and J. J. Schoenau)

- Tillage, crop residue, fertilizer and manure are important management practices for sustaining high soil productivity and quality, but they also affect greenhouse gas (GHG) emissions from soil to the atmosphere. The following is summary of results of our field experiments in Saskatchewan to determine the impact of these practices on nitrous oxide (N2O) emissions and ammonia (NH3) volatilization.
- In the 8-year (1998 to 2005) study at Star City with tillage (no-tillage - NT, and conventional tillage - CT), straw (straw retained and straw removed) and N rates (0, 40, 80, and 120 kg N ha-1), N20 emissions were usually higher under CT than NT.
- In the alfalfa termination study at Star City (2003 to 2007) with 3 termination methods (herbicide - NT, tillage, and herbicide + tillage), 3 termination timings (after first cut, after second cut, and spring) and 4 N rates (0, 40, 80, and 120 kg N ha-1), N2O loss ranged from 150 to 849 g N ha-1 yr-1. Herbicide-NT termination method had the lowest N2O-N loss in the termination year or in the first crop year following termination, while tillage had the highest N2O-N loss. The N2O emissions during snow melt period were substantially higher in 3 of 4 years.
- In the controlled-release urea (CRU) 3-year study at Star City, N2O-N loss was reduced by using polymer-coated urea (PCU) compared to urea.
- In the liquid swine manure (LSM) study (initiated in 2000 at Star City) with LSM application at 3000, 6000 and 9000 L ha-1 for 1x (annually), 2x (after every 2 years) and 3x (after every 3 years) rates, respectively, N2O emissions from LSM were higher than on urea, and LSM 3x rate had higher N2O emissions than 1x rate.
- In the 3-year study (2006-2008) at two sites (Star City and Swift Current) with application of anaerobically digested swine manure (ADSM) and conventionally treated swine manure (CTSM) at 1x and 3x rates in autumn and spring, and annual spring application of urea-ammonium nitrate (UAN) solution at 1x rate, NH3 loss ranged from < 1 to 10 kg N yr-1, and NH3 loss from ADSM was equal to CTSM, except for CTSM at 3x rate it was higher than other treatments. Nitrous oxide losses were highest from CTSM > ADSM = UAN.
- In conclusion, proper soil, crop, fertilizer and manure management practices can reduce the potential for GHG emissions from soil to the atmosphere, and this is good for the environment.

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