NEWS & VIEWS

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*Dr. Adrian Johnston, Western Canada Director*

*May 2000*

# Western Canada Research Report

**OPTIMIZING** nutrient management in annual and perennial crop production systems in western Canada is proving to be critical to achieving both environmental and economic sustainability. With nitrogen (N) fertilizer use steadily increasing with annual crops, the plants' demand for phosphorus (P) and potassium (K) is also being increased. The objective of the PPI/PPIC and Foundation for Agronomic Research (FAR) sponsored research projects in western Canada is to support a better understanding of the role of P and K fertilizer management in the horticultural and field crop production systems found in the region.

Crop specific responses to P, K and chloride (Cl) are included in the summaries presented here. They include understanding the field variability of both nutrient supply and crop response to fertilizer P and K additions… evaluating the interaction of P with soil microbial populations…the role of fertilizer P and K in the production and quality of horticultural crops like potato, cranberry and apple. Together, these incremental improvements in our understanding of P and K fertilizer management are vital to our ability to recommend effective management of balanced fertility programs.

These summaries are of current and past research projects sponsored by PPI/PPIC/FAR in western Canada. If you have further questions after reviewing the summaries please feel free to contact either Adrian Johnston or the participating research scientist. Researchers interested in support for P and/or K management research are encouraged to submit proposals to the PPIC office in Saskatoon.

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## Manitoba

### Wheat Cultivar Response to Chloride Fertilizer (Multi-Regional Project)

*Project Leader: Dr. Cynthia Grant, Agriculture and Agri-Food Canada, Brandon Research Centre, Box 1000A, RR #3, Brandon, MB R7A 5Y3, (204-726-7650), cgrant@em.agr.ca*

Understanding the genetic variability in spring wheat cultivar response to Cl fertilization will be of great importance to farmers attempting to optimize crop yield response to fertilizer additions. As part of a Great Plains project evaluating winter and spring wheat variety responses to Cl, spring wheat cultivars common to western Canada were evaluated on two soil types over four years near Brandon, Manitoba.

Averaged across the 15 spring wheat varieties, the Cl fertilization provided a 2 bu/A yield response. The variability in the data was recorded across both the sandy loam and clay loam soil types, among years, and among cultivars. While soil Cl levels were determined as low to moderate, the sandy loam soils provided a more consistent response to pre-plant band applications of Cl fertilizer (3.3 bu/A vs 1.3 bu/A for clay loam). The high yielding Canada Prairie spring white wheat cultivar Karma provided the largest yield response, averaging 7 bu/A over the study. The hard red wheat cultivar AC Barrie, currently grown on 70 percent of all wheat acres in western Canada, showed a 7 bu/A yield response on the sandy loam soil, but a minor (1.3 bu/A) yield reduction on the clay loam soil. It would appear that those cultivars with the highest yield expression were most likely to respond to Cl, and that the sandy loam soil was more likely to be the responsive site. The influence of Cl application on plant disease rating was minimal at most of the trial sites and years. While disease suppression with Cl was noted in certain trials and cultivars, it did not correlate well with grain yield increases. While the lack of consistency in the results makes crop responses difficult to

predict, there were some trends in the data collected in both Canada and the U.S. Great Plains. Soil Cl levels below 30 lb/A are a good indication of a need for added Cl, and plant tissue Cl that was 0.10 to 0.12 percent at the late-boot to heading phase indicates a crop responsive situation. Chloride is an essential nutrient for crop growth, development and yield formation. This research has provided the basis to assist farmers in identifying those situations where the addition of Cl will optimize wheat grain yield.

**The Influence of Fertilizer Placement on Crop and Weed Ecology in Direct-Seeding Systems**

*Project Leader: Dr. Doug Derksen, Agriculture and Agri-Food Canada, Brandon Research Centre, Box 1000A, RR #3, Brandon, MB R7A 5Y3 (204-726-7650), derksen@em.agr.ca*

The rapid expansion of no-till seeding in western Canada has increased demand for information on how time of fertilizer application and placement methods influence the yield response of both wheat and canola. In addition, the amount of soil disturbance associated with fertilizer application and seeding can have a profound effect on the stimulation of weed growth and resulting crop competition. Results from the project indicate that little difference in final grain yield was observed whether fertilizer N was fall or spring band applied. However, sideband application of N at wide (12 inch) row spacing was found to have a detrimental effect on the establishment of both wheat and canola and the yield of wheat at two of the three trial locations. This research will be concluded in 2000.

An associated project with this study evaluated the impact of P and K placement on wheat and flax yield response and competitive ability with weeds. Side band application of P and K fertilizer resulted in higher wheat and flax yields and lower wild oat growth and dockage when compared with seed row application. This advantage of side band application indicates that crop response to P and K fertilizer placed in a narrow band with the seed can limit its competitive ability with weeds early in the growing season. Both field and greenhouse studies revealed that wild oat had a much greater ability to take up both P and K than did wheat or flax. This weed response to fertilizer has resulted in additional research which will evaluate how various weed species respond to both specific nutrients and how these nutrients are applied.

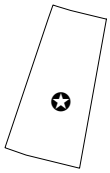
**The Effect of Tillage System and Preceding Crop on Phosphorus Response of Flax**

*Project Leader: Dr. Cynthia Grant, Agriculture and Agri-Food Canada, Brandon Research Centre, Box 1000A, RR #3, Brandon, MB R7A 5Y3 (204-726-7650), cgrant@em.agr.ca*

Flax is a major oilseed crop grown on the western Canadian prairies, with the majority of the production exported into the industrial oil market. Phosphorus fertilization of flax is a challenge as the crop is very sensitive to seed-placed starter P. Banding fertilizer P, either below or below and to the side of the seed row, is the preferred method of application with flax. In the absence of specialized seeding equipment, some farmers have resorted to increasing the P application in preceding crops, an attempt to supply residual P to the subsequent flax crop in rotation. Flax has been shown to have good association with vesicular arbuscular mycorrhizae (VAM) fungi, allowing it to expand its root absorptive surface area and potential P uptake. Growing flax after a mycorrhizal crop and using no-till seeding systems may help the flax rapidly establish an association with VAM and improve its ability to access soil residual P. This newly initiated research project will evaluate the role of preceding crop, tillage system, and P fertilization of the preceding crop in optimizing flax yield and quality.

In 1999, wheat and canola crops were grown at two test locations using various rates of fertilizer P, under both conventional and no-till seeding. While wheat associates with VAM, canola does not. Responses to fertilizer P additions were recorded on canola at both locations and wheat at one location. In 2000, tillage treatments will be carried out, and flax will be seeded into the canola and wheat stubble blocks. Flax will be evaluated for its response to residual fertilizer applications and preceding crop through an assessment of early season P accumulation, VAM infection, and crop yield and quality.

## Saskatchewan



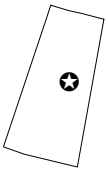
**Effect of Potassium Chloride on Physiological Leaf Spot, Grain Yield, and Quality of Winter Wheat in Saskatchewan**

*Project Leader: Dr. Brian Fowler, Crop Development Centre, 51 Campus Drive, University of Saskatchewan, Saskatoon, SK S7N 5A8 (306-966-4944), brian.fowler@usask.ca*

Winter wheat production in western Canada is dependent on the crop being seeded into standing stubble and

trapping an insulating layer of snow to prevent winter injury of the crop. The acreage of winter wheat is increasing steadily, and new semi-dwarf cultivars have been developed with high yield potential. Some of these new cultivars have been found to show strong physiological leaf spot symptoms when grown under favorable environmental conditions. Research in other areas of the Northern Great Plains has found that additions of potassium chloride (KCl) can help to suppress physiological leaf spot symptoms and increase grain yield.

In this final year of the project, a combined analysis of the four years of data found that additions of KCl suppressed the leaf spot damage in all trials where symptoms were recorded. While the average grain yield response to KCl additions was only 3 percent, sites which also had a higher incidence of root rot showed grain yield increases of up to 13 percent. In addition, KCl applications were found to improve both kernel weight and grain protein yield, important quality characteristics for marketing of the crop. It is important to note that there was no interaction between KCl and cultivars, indicating that where responses to KCl were recorded they were found on all cultivars tested, regardless of their susceptibility to physiological leaf spot. Recommendations that farmers apply KCl to suppress leaf spotting and increase grain yield have been included in the *Winter Wheat Production Manual* published for winter wheat growers in the Northern Great Plains. The manual can be viewed at: http// www.usask.ca/agriculture/plantsci/winter_wheat.

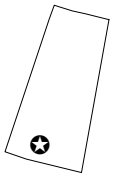


### Maximizing Canola Yield with Balanced Fertilization in the Saskatchewan Parkland

*Project Leader: Dr. S.S. Malhi, Agriculture and Agri-Food Canada, Box 1240, Melfort, SK S0E 1A0 (306-752-2776), malhi@em.agr.ca*

There is growing concern among farmers and agronomists that canola yields in the Saskatchewan Parkland may be restricted by boron (B) supply to the crop during the growing season. Issues of concern include the lack of mobility of B in the crop, its requirements during crop flowering, and its relationship to S additions. Canola is a key crop to farmers across western Canada and the goal of optimizing yield has caused fertilizer N and S rates to increase steadily over recent years. Field trails to evaluate the impact of B fertilizer additions were established on sites where soil and plant sampling indicated low B levels the previous year. A variety of N, S, and B treatments were applied at each of the two trial sites, with B applied prior to seeding, at seeding, and as a foliar spray.

As found in the two previous years of this project, canola responses were positive to N and S fertilizer additions at the 1999 study locations. Boron fertilizer additions provided no consistent yield response that would support recommendations. As a result, the researchers recommend that farmers considering the use of B either apply test strips across fields or leave check strips when applying the fertilizer to make their own assessment of crop response. Landscape variability and year-to-year differences in environmental conditions require that we continue to monitor the effect of B fertilizer additions on canola yield and quality. In addition, soil and plant analysis methods need to be evaluated to determine if they are accurately estimating B levels in western Canada and that these levels confirm the presence or absence of a B deficiency.

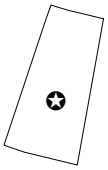


### The Effect of Potassium Chloride to Counteract the Negative Effects of Urea Side-Banded on Plant Establishment Using Different Placement Configurations and Soil Types

*Project Leader: Dr. Guy Lafond, Agriculture and Agri-Food Canada, Indian Head Experimental Farm, Box 760, Indian Head, SK S0G 2K0 (306-695-5220), lafond@em.agr.ca*

The application of KCl fertilizer in bands with urea has been suggested as an effective means of reducing urea toxicity from the accumulation of both $NH_3$ and nitrite ($NO_2$) in the soil. Accumulations of free $NH_3$ can be very toxic to the roots of newly developing seedlings. Creating an acidic (low pH) environment in the vicinity of a urea band will temporarily reduce the process of urea hydrolysis, allowing seedling germination in the absence of free $NH_3$. With the rapid expansion of no-till seeding systems in western Canada, many farmers are now applying all of their urea fertilizer in a side band close to the seedrow at seeding. There are several reports from research trials that even when side-banded away from the seed, stand reductions occur with the application of high rates of urea. This new two-year project was established to evaluate the impact of urea side-banded with KCl on the establishment of spring wheat and flax seedlings in no-till production systems.

Results from the first year of this study show that increasing side-banded urea N rates resulted in a significant reduction in flax establishment, while the impact on wheat was minor. Increasing the urea band separation from 1 inch side x 1.5 inch below to 1 inch side x 3 inch below reduced the negative effects on the flax. While the addition of KCl to the urea bands did not reduce the negative effect on flax or wheat seedling establishment, it did improve flax grain yield by 19 percent at a sandy loam trial location. A review of soil samples from the location revealed that while K levels were high, Cl levels were well below the sufficiency range. A second year of data collection is planned for 2000.

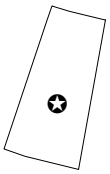


### Field Crop Response to Potassium on Soils with High Extractable Potassium and Varying Soil Supply Rates of Potassium

*Project Leader: Mr. Ken Greer, Western Ag Innovations, 208-111 Research Drive, Saskatoon, SK S7N 3R2 (306-978-1777), kengreer@westernag.ca*

Crop responses to K on many western Canadian soils, even on soils testing high in K, have many people questioning the soil testing procedures used and/or the method by which K varies within fields. Using the Plant Root Simulator (PRS) probe, an ion exchange membrane system for measuring soil nutrient supply rate, a project was initiated in the semi-arid region of Saskatchewan to evaluate crop responses to fertilizer K on soils which are regarded as non-responsive using traditional K extraction methods.

Using PRS probes, the K supply rates of three fields were determined using grid sampling. Maps generated from this grid-sampling pattern indicate large areas of the field that were both deficient and adequate in K supply. These fields were planted to spring wheat, canola and flax in 1999 with 90 foot wide strips of 0, 19 and 37 lb $K_2O$/A applied at seeding. Unfortunately, hail damage resulted in loss of the canola and wheat field tests. However, preliminary results from the flax field indicate a positive grain yield response to added K relative to the check in certain landscape positions, while no response was observed in others. Further evaluation of the data will require an overlay of topographic information from the field so that specific landscape elements can be identified for their responsiveness to K fertilizer additions.



### Management for Maximum Economic Yield of Open Pollinated and Hybrid Canola

*Project Leader: Mr. Stewart Brandt, Agriculture and Agri-Food Canada, Box 10, Scott, SK S0K 4A0 (306-247-2011), brandts@em.agr.ca*

Hybrid varieties of canola are new to farmers in western Canada, and there is a lack of understanding as to the level of management and inputs required to optimize production relative to established open pollinated varieties. Inputs that are seen as critical to optimizing yield include seeding rate (crop establishment), fertility level (N, P, K, and S), and fungicide use for control of white mold (*Sclerotinia* spp.). Research is currently being carried out at three locations in Saskatchewan to evaluate the response of new hybrid and open pollinated canola cultivars to various levels of these three inputs on crop yield, quality, and disease response.

In this initiation year, each of the project sites experienced above normal precipitation and below normal air temperatures, leading to excellent growing conditions for canola. Grain yields showed a positive response to increasing fertilizer rates, with the hybrid cultivar having a minor yield advantage to the open pollinated cultivar. The heavier crop canopy with increasing fertilizer application on the hybrid canola resulted in a higher incidence of white mold at one of the test locations. In general, where white mold infection was low there was no response to the application of a fungicide. However, at one location, maximizing grain yield response to increasing fertilizer application rates was achieved only with the use of a fungicide. Similarly, increasing seeding rate above the currently recommended level also improved the canola crop response to a higher fertilizer application rate. Continuation of this project will assist in developing recommendations for the management of high yielding canola, in particular those management inputs that are critical to improving crop response with increased fertilizer rates.

## Alberta

### Site-Specific Management of Potatoes

*Project Leader: Dr. Colin McKenzie, Alberta Agriculture, Food and Rural Development, Crop Diversification Centre South, SS #4, Brooks, AB T1R 1E6 (403-362-1300), mcKenzie@agric.gov.ab.ca*

This completed project evaluated the use of yield monitoring technology and global positioning systems (GPS) to determine optimal fertility management of irrigated potato production in southern Alberta. The variability in potato yield was compared to soil and petiole samples collected through the growing season and geo-referenced with a portable GPS.

Despite large applications of fertilizer P, potatoes grown in fields where manure had not been applied showed low levels of petiole P from mid-season onward. Strips of additional fertilizer P above that recommended by soil testing resulted in slight yield increases, indicating that current P recommendations may be limiting potato yields. The lack of response to additional P on manured fields indicates that late season crop P requirements are being met from the season-long release from the manure. Cool soil and air temperatures were attributed to the low early season petiole K levels measured. As the growing season progressed, petiole K levels moved into the adequate and high range. Continued research will evaluate these low petiole K levels early in the growing season to determine if they are limiting final tuber yield of the potato crop.

**Landscape Management of Agronomic Processes for Site-Specific Farming**

*Project Leader: Mr. Len Kryzanowski, Alberta Agriculture, Food and Rural Development, Agronomy Unit, 9th Floor, O.S. Longman Bldg., 6909 – 116 St, Edmonton, AB T6H 4P2 (780-427-6361), len.Kryzanowski@agric.gov.ab.ca*

This newly initiated three-year project is focusing on how landscape-scale variability influences soil properties and processes that are related to release of N, P, K, and sulfur (S), and crop responses to both soil and fertilizer N, P, K, and S. The long-term objective of the project is to develop agronomic models which will assist farmers in making fertilizer management decisions based on landscape units.

The field test site chosen for this trial has rolling topography in the Black soil zone of eastcentral Alberta. The cooperating farmer has been using a combine yield monitor and GPS to measure yield variability on his farm, as well as variable rate fertilizer application to compensate for in-field differences in soil residual nutrients. Soil and crop measurements were conducted in 1999 using both grid and landscape transect sampling to assess crop establishment, growth and development, and soil nutrient supply. Crop biomass production increased from the upland shoulder to backslope to depressional footslope landscape positions. The higher productivity of footslope positions resulted in higher nutrient demands and was reflected in increased uptake of N, P, K, and S. Ion exchange membrane probes were used to measure soil nutrient supply rates throughout the growing season and revealed that the moisture and temperature conditions characteristic of the landscape controlled nutrient release. These landscape-based nutrient dynamics will be used to test mechanistic simulation models for their ability to predict soil nutrient supply and aid in refining fertilizer recommendations.

**Soil–Carbon–Food Symposium, Predicting the Future from the Past**

*Project Leader: Dr. Jim Robertson, Department of Renewable Resources, 442 Earth Sciences Building, University of Alberta, Edmonton, AB T6G 2E3 (780-492-6466).*

This one-year contribution supported a symposium held at the University of Alberta in July, 1999, to discuss the global, North American and western Canadian perspective on soil organic matter and carbon (C) budgets. Participants from around the world discussed how sustainable farming practices could be used to maintain and improve soil organic matter and soil fertility. The meeting also focused attention on the 70 years of research carried out at the University of Alberta Breton plots. These long-term rotation study plots have provided vital information on the impact that cultural and nutrient management practices have had on soil quality and productivity. The important role of P fertilization on these Gray wooded soils has been clearly demonstrated over the years, and the impact of fertilizer additions on soil organic matter and nutrient supplying power continues under study. In addition, the long-term data set from these studies provides the information necessary to test computer simulation models and provide refinements that improve their effectiveness.

## British Columbia

**Influence of Mineral Nutrition, Aluminum, Carbohydrate Metabolism, and Plant Hormones on Cranberry Flower Induction and Alternate Bearing**

*Project Leader: Dr. David McArthur, Department of Plant Science, Suite 248-2357 Main Mall, University of British Columbia, Vancouver, BC V6T 1A4 (604-822-4384), mcarthur@interchange.ubc.ca*

The public closely monitors cranberry production in the coastal region of British Columbia, given that it is one of the province's most environmentally sensitive regions. Management practices, and in particular the use of fertilizers, must be justified as essential to improving the production, quality and profitability of the cranberry crop.

Ensuring a proper balance of nutrients is critical to both floral induction and cranberry bud formation. Use of ammonium nitrate ($NH_4NO_3$) as the N source resulted in 37 percent more floral buds and 42 percent more flower primordia than when ammonia ($NH_3$) was used exclusively. While use of $NH_4NO_3$ also improved the K, calcium (Ca) and zinc (Zn) status of cranberry plants, it resulted in a decline in the plant manganese (Mn) concentrations. Fertilizer management of cranberry is complicated, given the very acidic nature of the wetlands used for production. High levels of aluminum (Al) in the soil under these conditions interfere with P availability and crop growth.

## Effect of Fertilization, Nitrogen Fertigation, and Crop Load on Potassium Nutrition and Fruit Quality of High Density Apples under Atmometer Scheduled Irrigation

*Project Leader: Dr. Denise Nielsen, Agriculture and Agri-Food Canada, Pacific Agriculture Research Centre, Summerland, BC V0H 1Z0 (250-494-7711), neilsend@em.agr.ca*

Apples from irrigated high-density orchards on coarse textured soils in British Columbia are commonly found to be K deficient, due in part to N fertilizer additions and over-irrigation. With drip irrigation, where water additions are a function of water loss by evaporation (atmometer based), K deficiencies can be corrected by fertigation. Managing the balance of nutrients through both the non-fruiting and fruiting periods of growth requires careful attention to apple yield potential, as low yield in the presence of high plant K can inhibit tissue Ca level and lead to reduced storage qualities such as soft fruit.

The first apple crop in this project was harvested in 1999. While a light bloom and disease limited yield potential of Gala apples, nutrient treatments were found to influence crop grade. All of the apples from the study received the top grade for color, however, only those fruit which received early season N or K met the size requirements for top grade. The addition of K can also reduce fruit Ca concentrations, causing poor fruit storage. The Gala apple variety used in this study has high Ca accumulation rates. As a result, no imbalance with K was observed in 1999. The influence of fertilizer K on both production and quality will be a major focus of this research in 2000.

## Practical Aspects of Phosphorus Nutrition in Field Corn in Relation to VAM Colonization: 1) Relationships on Manured Soils and 2) Supplying Phosphorus Strategically as Insurance against Poor VAM Colonization

*Project Leader: Dr. Shabtai Bittman, Agriculture and Agri-Food Canada, Pacific Agricultural Research Centre, Agassiz, BC V0M 1A0 (604-798-2221), bittman@em.agr.ca*

Early season P deficiencies in corn seedlings grown on high P soils have been reported when starter fertilizer P is not used in the coastal region of British Columbia. Corn roots have been shown to establish a strong association with vesicular arbuscular mycorrhizae (VAM) fungi. In some cases the association of the plant with VAM increases root surface area enough to meet seedling P requirements. However, this network of VAM fungi filaments in the soil is easily disrupted with tillage or growing a previous crop that does not form an association with VAM. As a result, starter P management requires careful consideration for cropping systems management.

This research continues to show that VAM colonization of corn seedlings is seriously diminished and P deficiency extreme when either intensive pre-seeding tillage is used or a crop like canola is grown prior to corn in rotation. Canola does not associate with VAM fungi. As a result, the VAM population is diminished during the canola production year. The addition of starter P with corn under these management situations where the VAM fungi population has been disrupted corrects the seedling P deficiencies. Growers in this region of British Columbia now have good guidelines to help them in managing the P nutrition of their corn crops. ■

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