

NEWS & VIEWS

A regional newsletter published by the
Potash & Phosphate Institute (PPI) and the
Potash & Phosphate Institute of Canada (PPIC)



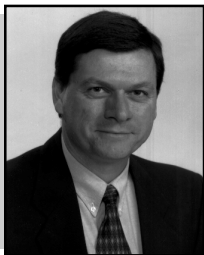
Dr. Adrian Johnston,
Western Canada Director
June 2001

Western Canada Research Report

AN IMPROVED UNDERSTANDING of the terms fertilizer-use efficiency (FUE) and maximum economic yield (MEY) has likely never been as important to western Canadian agronomists and farmers as it is today. The objective of PPI/PPIC and Foundation for Agronomic Research (FAR) sponsored research projects in western Canada is to support a better understanding of the role of phosphorus (P) and potassium (K) fertilizer management in FUE and MEY 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 impact of P on new crops like chickpeas and the role of fertilizer P and K in the production and quality of horticultural crops like potato and apple. Together, these incremental improvements in our understanding of P and K fertilizer use are vital to our ability to recommend effective management of balanced fertility programs.

Presented here are the summaries of current and past research projects being sponsored by PPI/PPIC/FAR in western Canada. If you have further questions after reviewing the summaries, please feel free to contact either Dr. 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 Saskatoon address below.



Agronomic market development information provided by:
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Manitoba



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 the time of fertilizer application and placement methods influence crop yield response. 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.

Variation observed in crop establishment with nitrogen (N) fertilizer placement methods was seldom reflected in final grain yields, indicating that large differences in crop stand are required before the final yield of spring wheat or canola can be influenced. Little difference in final grain yield was observed whether fertilizer N was fall or spring band applied or side banded at seeding. However, at the high pH Brandon site, sideband application of N at wide (12-inch) row spacing was found to have a detrimental effect on the establishment and yield of both wheat and canola. Fertilizer timing, fall vs spring application, did influence grain protein in many instances. The improved protein with spring application indicated that there were some over-winter losses of N from the system. Crop water use was rarely influenced by either fertilizer N placement or herbicide rates. In fact, the lack of many significant crop development or yield effects due to herbicide rates used in this study indicates that reducing herbicides was of little agronomic importance.



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 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. In the absence of specialized seeding equipment, some farmers have resorted to increasing the P application to preceding crops in 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 residual soil P. The objective of this research is to evaluate the role of preceding crop, tillage system, and P fertilization of the preceding crop in optimizing flax yield and quality.

In 1999, seed yield of wheat and canola was similar under conventional till (CT) and no-till (NT). Where differences existed, seed yield was higher under NT. In contrast, in 2000, seed yield was consistently higher under CT than NT due to delayed seeding in 1999 and cold, wet conditions throughout 2000. There was no P by tillage interaction in either year, indicating that P response of wheat and canola was similar under the two tillage systems. Flax yield in 2000 was generally similar under NT and CT management. Where differences existed, yield was higher under NT, as the flax site was on a well-drained upper slope position, which may have enhanced aeration. Seed yield of flax was higher when grown after wheat than after canola at both locations under both tillage systems. This may reflect increased mycorrhizal infection on the wheat stubble (samples being analyzed). When P fertilizer was side banded at seeding, the flax showed either no yield response or a minor yield decline relative to the unfertilized check. Additional P fertilization of the preceding crop led to higher flax seed yield the following year at one of the two locations, with the effect being greater when wheat was the preceding crop as compared to canola. It may be a useful strategy for producers to increase P application in preceding crops, rather than fertilizing the flax crop directly, in order to increase P availability while eliminating the risk of seedling damage.



Impact of Nitrogen, Phosphorus and Potassium Chloride Fertilizer Management on the Growth and Yield of Oats

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

Oats grown for the milling and livestock feed markets have become a profitable crop diversification option for farmers in western Canada. Approximately 4 million acres are currently grown, with acreage continually expanding. However, there is limited research available on fertilizer management of oats. Studies were initiated in 2000 to determine the effect of N, P and K on the growth, yield and quality of oats. Field experiments were conducted at two locations in southern Manitoba (clay loam and sandy loam soils) containing low to moderate levels of soil nitrate-N ($\text{NO}_3\text{-N}$) and extractable P.

Preliminary analysis of yield data showed positive effects of N and P on oat growth and/or yield, but minimal effects of K; no interactions among the nutrients were evident. Nitrogen application increased crop biomass yield at tillering at the sandy loam site and increased biomass yield at heading at both field sites. In addition, grain yield increased with N applications of up to 70 lb N/A on the sandy loam soil and with applications up to 35 lb N/A on the clay loam soil. Phosphorus application resulted in a significant linear increase in plant biomass at tillering at both sites and heading biomass at the clay loam site. Presumably, cool conditions early in the growing season combined with marginal soil P levels contributed to this early-season crop response. However, despite these marked early-season effects, P application had no effect on grain yield at either site. Application of potassium chloride (KCl) had little effect on either biomass or grain yield of oats at either field site. While increasing N rate reduced the bushel weight of the oats at both locations, increasing P rate had the opposite effect at the sandy loam site. Potassium had no effect on oat test weight.



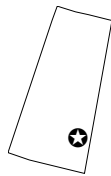
Impact of Production System and Nutrient Addition on Grain Quality in Long-term Rotation Studies in Western Canada

Project Leaders: Dr. Martin Entz, Plant Science Department, University of Manitoba, Winnipeg, MB R3T 2N2 (204-474-6077), m_entz@umanitoba.ca and Mr. Stewart Brandt, Agriculture and Agri-Food Canada, Box 10, Scott, SK S0K 4A0 (306-247-2011), brandts@em.agr.ca

Two alternative management projects are currently being conducted in western Canada, using cropping diversity and level of external inputs to assess crop

production. Both projects were designed to provide a baseline from which to assess the impact of how diversity of crops grown in rotation and the inputs used can impact production, pest populations, soil quality and economic returns. Grain samples have been saved for each of these projects; however, little or no evaluation of samples has been carried out. Flax grain samples from the University of Manitoba study were collected from the end of the first and second four-year rotation cycle. Wheat grain and straw samples were collected from year four after the end of the first cycle of the Agriculture and Agri-Food Canada study. These samples have been submitted for a complete micro and macronutrient assessment with the goal of determining how management input is influencing crop nutrient uptake.

Saskatchewan



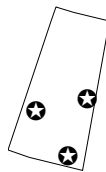
Use of Potassium Chloride to Counteract the Negative Effects of Side-Banded Urea on Plant Establishment

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 use of urea fertilizer as an N source has increased dramatically during the last 20 years, and its higher toxicity relative to ammonium nitrate (NH_4NO_3) requires careful management. The objective of this study was to determine if adding KCl (0, 15 and 30 lb $\text{K}_2\text{O}/\text{A}$) to a urea band (0, 60 and 120 lb N/A) placed either in a 1" x 1.5" (side and below) or 1" x 3" (side and below) configuration could potentially reduce the toxic effects of urea reflected in an increase in plant populations. Research has shown that adding KCl can reduce ammonia (NH_3), nitrous oxide (N_2O), and the pH as a result of the delay in urea hydrolysis. This concept was tested in flax and spring wheat on a clay loam and a sandy loam soil.

Adding KCl to the fertilizer band did increase the safety to the seedlings against the toxic effects of side banded urea, regardless of the separation between the seed and fertilizer. However, on both crops and soil types, seedling stand reductions were recorded. An interaction was recorded between urea-N and KCl in flax in 1999 such that the maximum yield of flax with N was obtained at a lower rate of N in the presence of KCl where soil Cl levels were low. This was only observed in 1999 on the sandy loam soil. In terms of separation between seed and fertilizer, the greater separation resulted in more soil disturbance and sometimes a decrease in plant numbers, but never a decrease in yield. In fact, in 1999 for spring wheat, researchers observed an improvement in grain yield with the larger separation at all levels of N on both soil types, even with the check receiving no N. These results

suggest that while addition of KCl to urea bands may minimize any negative impact on germinating seedlings, only when soil K or Cl levels were low was it reflected in any grain yield increases.

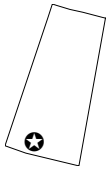


Management for Maximum Economic Yield of Open Pollinated and Hybrid Canola

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 yield 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 sulfur (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 varying these three inputs on crop yield, quality and disease response.

To date, five location-years of data have been collected. Seeding rates lower than recommended generally delayed crop maturity and reduced yield at one location where stand establishment was low. A seed rate by N rate interaction at two location years suggested that higher plant densities might require higher fertility when moisture is abundant. Increased levels of fertility generally increased yield and protein content, although increasing fertility levels above recommended rates did not always increase yield significantly. In 2000, the hybrid variety was consistently higher-yielding than the open pollinated variety. Disease incidence and severity (Blackleg and Sclerotinia) have been low, and fungicide responses have been small or non-existent. In a separate N rate by cultivar trial, the hybrid variety generally yielded more than the open pollinated variety at all N rates. At two of the three locations, yield of the hybrid was maximized at higher N rates than the open pollinated variety. These results suggest that the hybrid not only used N more efficiently, but required more N to optimize yield. Preliminary economic analyses suggest returns would have been optimized at higher N rates for the hybrid variety at these two locations.

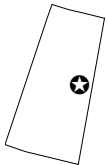


Optimizing Phosphorus Fertilization and Inoculation in Chickpea and Lentil

Project Leader: Dr. Yantai Gan, Agriculture and Agri-Food Canada, Box 1030, Swift Current, SK S9H 3X2 (306-778-7246), gan@em.agr.ca

Saskatchewan is the world's largest exporter of lentils and has the fastest expanding acreage of chickpeas. These two drought tolerant pulse crops have been integrated into the farming systems in the semi-arid regions of western Canada as a means of diversifying crop production and improving whole-farm economics. In order to expand our knowledge with these new crops, a three-year project was initiated at two locations in the semi-arid region of Saskatchewan, evaluating the effect of fertilizer P on crop development and grain yields for desi-chickpea, kabuli-chickpea, and lentil grown on soils with a medium level of residual soil P.

When compared to the no-P check treatment, the application of 15 lb P₂O₅/A with the seed did not have an effect on plant density or plant maturity with any of the three crops. The addition of P fertilizer resulted in minor grain yield increases for desi-chickpea (4.5 percent), kabuli-chickpea (2.2 percent), and lentil (2.9 percent). Fertilizer P application improved the harvestability of chickpeas by increasing the plant height by 0.5 inches and by lifting the pod position on the stem by about 0.6 inches. Continued data analysis will determine whether fertilizer P has any effect on the kernel size of kabuli-chickpea, since there is a substantial price premium paid for large-sized (>9 mm) kabuli-chickpea.



Improving Forage Production and Longevity of Alfalfa Stands with Balanced Fertilization

Project Leader: Dr. S.S. Malhi, Agriculture and Agri-Food Canada, Box 1240, Melfort, SK S0E 1A0 (306-752-2776 ext. 230), malhis@em.agr.ca

In northeastern Saskatchewan, alfalfa is grown on approximately 200,000 acres for the dehydrated alfalfa pellet market. Alfalfa for seed is grown on over 120,000 acres in western Canada. In the absence of nutrient inputs, alfalfa cannot maintain its original productivity after about three years of production, a result of weeds dominating the stands. Improved soil fertility can make alfalfa out compete weeds and increase the longevity of stands by several years. This research was initiated to determine the influence of balanced fertilization on forage production, seed yield, longevity of alfalfa seed stands, weed populations, and disease severity.

Alfalfa forage yields were significantly increased with the addition of S fertilizer in 2000, while P and K had no

effect. However, the alfalfa seed yield was significantly increased over the unfertilized check with the addition of P and K alone, with further yield increases recorded when S was added. Ratings of the stand for weed populations and disease revealed no differences among treatments in the first year of this project. Continued monitoring of this site will help to identify the rate of nutrient draw down by the alfalfa and its impact on alfalfa hay and seed yield and quality.



The Effect of Phosphorus and Sulfur on the Yield Variability of Canaryseed

Project Leader: Mr. William May, Agriculture and Agri-Food Canada, Indian Head Experimental Farm, Box 760, Indian Head, SK S0G 2K0 (306-695-4244), mayb@em.agr.ca

The biggest production problem faced by farmers growing canaryseed is the year-to-year variability in seed yield. The cause of this fluctuation in yield is not known. One aspect that has not been addressed is the effect of K and S on yield. An experiment was designed to evaluate K and S additions at five locations in Saskatchewan.

The results from the first year of this two-year project were mixed. Canaryseed yield increased as K rate was increased at two locations, while at two other locations, the 15 lb/A rate lowered yield, and the 30 lb/A rate increased yield relative to the unfertilized check. Only at one of the trial locations did yield not respond to K fertilizer. The addition of S fertilizer decreased yield at one location and increased yield at another, while no response was recorded at the remaining three. While these results are preliminary, there appears to be some evidence that K may have an effect on the yield of canaryseed.

Alberta



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 project is focusing on how landscape-scale variability influences soil properties and processes that are related to the soil's release of N, P, K, and 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 east-central Alberta. The cooperating farmer has been using a combine yield monitor and global positioning system (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.

Using ion exchange probes, placed in the soil at two-week intervals, the pattern of plant nutrient availability was measured throughout the growing season. The drier and more eroded shoulder position in the field showed the lowest soil P supply rates, less than that measured in the backslope (mid) and footslope (lower) positions. However, little difference was observed between the backslope and footslope positions in soil P supply rates. Soil K supply showed a progressive response decreasing from the footslope to the backslope and then the upper shoulder position. Soil K appears to be influenced by soil moisture conditions and possibly the higher historic crop residue that was produced at the footslope position. Ion exchange probes were also installed using root exclusion tubes, as a means of determining the soil P and K supply rate in the absence of crop uptake. These results were similar to those obtained from probes used in crops. The results to date indicate that the differences in nutrient dynamics reflect those soil processes controlled by temperature and moisture. Future work will evaluate the nutrient dynamics and crop growth functions of the model Ecosys. In addition, other models (EPIC and DSSAT) will be evaluated using the data from this site.



Development of Agronomic Practice for Chickpea Production in Alberta

Project Leader: Dr. Ross McKenzie, Alberta Agriculture, Food and Rural Development, Agriculture Centre, Bag Service 3014, Lethbridge, AB T1J 4C7 (403-381-5842), ross.mckenzie@agric.gov.ab.ca

Chickpea production on the western Canadian prairies has been expanding consistently in the past few years, with an estimate that production will exceed 1 million acres in the next five years. The objective of this study is to evaluate two types of chickpeas under varying management treatments in order to develop agronomic production practices for southern Alberta. In 2000, the first year of this three-year study, experiments evaluated chickpea response to variety, inoculant, N, P, S, seeding date, and seeding rate.

Severe drought conditions existed in 2000 and as a result may have reduced the chance of response to input management. It was evident that chickpeas are a drought tolerant crop, and last year's data show that the Desi type of chickpea may be more drought tolerant than the Kabuli type at all of the four test locations. Yield response to

applied inoculant was significant at only one location. There was no significant yield response to N fertilizer in 2000, although results showed that protein, bushel weight, and calcium (Ca) content all responded positively to applied N fertilizer. The addition of P showed a trend of increasing yield at two locations. Yield response to sulfate-S ($\text{SO}_4\text{-S}$) was significant at one location. Differences in seeding date have resulted in a significant yield, bushel weight, and protein response, and differences in seeding rates have resulted in a yield response.

British Columbia



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

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

The production of apples in irrigated high-density orchards on coarse-textured soils in British Columbia has been found to be limited by K deficiencies, due in part to N fertilizer additions and over-irrigation. With the development of a drip irrigation system, 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.

Fruit quality responses to combinations of crop load and nutrient supply are complex. In the second harvest year of this study, heavy crop load decreased fruit size, soluble solids, and malic acid content, but increased the soluble solids to acid ratio. Regardless of N timing, fruit N content increased, and red color decreased as N application rate increased. Yields were highest when N was applied early in the growing season. While there were no significant effects of applying K on fruit quality, fruit size was largest for trees receiving K. Potassium applications did not reduce fruit Ca content, and overall fruit Ca content was well above the recommended threshold. Similarly, there were no significant effects of K on fruit or leaf K concentrations, although both leaf and fruit K concentrations were highest for trees receiving K. The results of this study indicate that K addition in high density irrigated apple orchards can improve fruit size without negatively impacting on the storage characteristics.



Effectiveness of Applied Phosphorus for Field Corn in Relation to Cropping Practices and 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 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 by growing a previous crop that does not form an association with VAM. As a result, starter P management

requires careful consideration of the cropping and tillage system.

The results of this research confirm previous studies that have shown the colonization of corn by VAM is influenced by previous crop in rotation. While the differences were small, the trend over several trials was that corn yields were increased and the crop matured earlier, as shown by lower percent dry matter (DM), when grown on corn stubble than after fallow or canola, even when adequate P was applied. Early season colonization of corn roots by VAM had a positive effect on seedling P concentration. This research also found that the colonization of corn roots by VAM was not negatively influenced by side banded P application, a treatment that in most instances improved the final silage yield and dry matter content. Side banding P fertilizer can correct for low P uptake by corn roots with poor VAM colonization. However, this still may not fully alleviate the impact of low plant P on corn silage yield and dry matter content when there is poor root colonization by VAM. ■

InfoAg 2001 set for August 7-8-9

The Adam's Mark Hotel at the Indianapolis, IN, airport has been selected as the site. The fifth in our series of conferences on site-specific crop and soil management systems and internet technology for agriculture, InfoAg 2001 will provide updates on the technology, guidance on interpretation of GIS data sets, and a preview of what is coming in site-specific nutrient management. Details available at:

www.ppi-far.org/infoag
or call Phyllis Pates at 605-692-6280.

Mark Your Calendars — March 5-6, 2002

Great Plains Soil Fertility Conference – Denver, CO

Make plans now to be at the Great Plains Soil Fertility Conference March 5-6, 2002. This meeting provides an excellent opportunity to hear about new research on fertilizer management, soil testing, precision farming, and a number of other related nutrient management topics. For further details on the conference, contact Phyllis Pates at ppates@ppi-far.org or 605-692-6280.

Have you seen the PPI-PPIC-FAR Website?

The website has undergone a number of changes, with updates being added weekly to educate and inform the public on the management and use of P and K fertilizers. Features include basic information on P and K fertilizer production and use, crop nutrient uptake values, and on-line games for students to help them learn more about the role of fertilizers in quality food production. See www.ppi-ppic.org.

As part of the PPI-PPIC-FAR website update in September 2000, regional directors now have a website dedicated to topics of interest in their area. The western Canada web page includes crop production and fertilizer-use statistics for the region, summaries of research projects sponsored in part by PPI/PPIC/FAR in western Canada, recent papers presented at meetings on fertilizer use and crop management, and links to fertilizer use statistics for Canada.

See www.ppi-ppic.org/westerncanada

Take a look and book-mark the site as the one-stop source of P and K fertilizer management information!