

FIRST YEAR SUMMARY REPORT
ALBERTA AGRICULTURAL RESEARCH INSTITUTE PROJECT
90M230
FIELD EVALUATION OF LABORATORY TESTS FOR SOIL
PHOSPHORUS

OBJECTIVES

The first objective of this study was to establish approximately 36 research sites in 1991, throughout the cultivated areas of Alberta, to evaluate when spring wheat, barley and canola will respond to phosphate fertilizer. A number of soil test methods will be used to determine plant available phosphorus (P) levels which will be correlated with crop response to added phosphate fertilizer. The information will be used to develop predictive models for each soil test method and recommendations will be formulated as to which tests perform best for each crop in different soil areas.

The second objective is to establish and maintain 6 long term sites on soils known to have high soil P levels and crop to wheat, barley and canola in rotation for a number of years to monitor P draw-down in soil and determine when each crop will begin to respond to added P fertilizer.

METHODS- PHOSPHORUS RATE TRIALS

To meet the first object of establishing P rate trials at a number of locations, the province was divided among four research groups. Plot sites were coordinated by R.H. McKenzie (Soils Branch, Alta. Agriculture, Lethbridge) in southern and south-central Alberta, J. Harapiak and N. Flore (Westco Fertilizers Ltd., Calgary) in central Alberta and D.C. Penney and E. Solberg (Soils Branch, Alta. Agriculture, Edmonton) in central and north-central Alberta and G. Coy (Field Services, Alta. Agriculture, Fairview) in the Peace River area. A total of 46 sites were established (Table 1).

Soils at each site were characterized by soil series and soils were located on the dominant soil type in each area. Sites were on level, uniform land and were not located in corners of fields to avoid previous

double fertilizing. Normally sites were on wheat or barley stubble, except in fallow conditions. When possible, sites were located near old RAYP trials or near CASCI trials. Each cooperator was asked to estimate of how much P fertilizer had been applied to the site in the past 10 years (or more).

Table 1. Number of research sites established in each soil area in 1991 by each research group.

Soil Zone	Soils Br. Lethbridge	Westco Calgary	Soils Br. Edmonton	Field Ser. Fairview	No. of Sites
Brown	3F-3S [†]	-	-	-	6
Dk Brown (So Bow R.)	4F-4S	1	-	-	8
Dk Brown (No Bow R.)	2	-	1	-	3
Thin Black (So Bow R.)	3	-	-	-	3
Thin Black (No Bow R.)	2	3	1	-	6
Black	1	3	4	-	8
Grey Wooded (Central.)	-	-	4	-	4
Grey Wooded (Peace R.)	-	-	-	1F-3S	4
Dark Grey Wooded	-	-	-	1F-3S	4
Total Sites	22	7	10	8	46

[†]F-fallow; S-stubble

Treatments:

Generally, spring wheat, barley, and canola were grown at each site, (Westco only had wheat and barley) using best accepted varieties for each region. Plots were replicated 6 times. Four phosphate (P₂O₅) treatments for each crop were used including: control, 15, 30 and 45 kg/ha seed placed except the 45 kg/ha rate for canola, which was 30 seed placed and 15 kg/ha banded prior to seeding. Nitrogen and any other necessary fertilizers were banded prior to seeding (fall in southern Alberta and spring in central and northern Alberta).

Soil Sampling and Analysis:

Each block was to be soil sampled separately and in detail. Samples were taken at 0-6" and 6-12" depths for analysis. All samples were ground to pass a 2mm sieve and boxed. Sufficient soil to fill 4 boxes per replicate (8 kg/block) were taken for future analysis. Analysis conducted by Alberta Agricultural Soil and Animal Nutrition Laboratory (ASANL) in Edmonton included: N, K, S, pH, E.C. and hand texture. Phosphorus soil test methods conducted included: Miller-Axley, Weak Bray, Lethbridge, Kelowna as well as 0.01 M CaCl with 40 g soil and 50 ml solution to estimate solution P. On a composite soil sample of each site the Hedley P fractionation procedure will be used to characterize the various P fractions at the site. Also, micronutrients, %O.M. and mechanical analysis for soil texture will be determined. Methods conducted by the Saskatchewan soil testing laboratory included: Olsen and the new membrane methods.

Site Monitoring:

Soil moisture was determined at time of seeding by gravimetric sampling using 6 inch increments to a depth of 36 inches. Crop growth was monitored and crop growth stages were recorded weekly (use Zadok scale for grains). Rainfall was either daily or weekly at each site. Crops were sprayed for weeds as required.

At 7 strategically located sites, air and soil temperatures were monitored with data loggers. Tissue samples were taken from each treatment (replicates were combined together) for each crop, taking approximately 30 plants, at the 4-6 leaf stage for grain and 28 to 30 days after emergence for canola.

At harvest: yield, % protein and % P in grain, and % oil content in canola were determined. Soil moisture at the site was also determined.

METHODS- PHOSPHORUS DRAW-DOWN TRIALS

To meet the second objective, five sites were established to monitor P draw-down on soils with high residual soil P and known not to respond to added P fertilizer.

In spring 1991, McKenzie established one irrigated and one dryland site in the Brown soil zone at Bow Island Substation. Penney

and Solberg established one site each in the Black soil zone near Josephburg and Gray Wooded soil zone near Cooking Lake. Coy established one site near Manning on a Gray Wooded soil. In the fall of 1991, McKenzie established a site in the Thin Black soil zone near Pincher Creek. McKenzie will also monitor a site (Carmangay) that had added P fertilizer in 1991, for the first time since breaking in 1910.

Soil sampling, analysis and site monitoring were the same as for the rate trials. Treatments at each site included: control, 150 kg/ha of P₂O₅ one time batch application, a 150 kg/ha of P₂O₅ one time batch application plus a 30 kg/ha annual seed placed application, and 15, 30 and 45 kg/ha seed placed application rates. Wheat, barley and canola are grown in rotation at each location except at the Bow Island dryland site which is cropped to continuous wheat, wheat-fallow and wheat-wheat-fallow.

RESULTS AND DISCUSSION

A total of 46 rate trials and 5 long-term draw-down trials were conducted as originally planned by Alberta Agriculture and Westco researchers.

At all sites, germination and emergence was good to excellent for wheat and barley and good at most of the canola sites. Weather in the last two weeks of May and throughout June was wetter and cooler than normal at almost all sites. In mid-June visual response to P fertilizer was observed at a number of locations in both wheat and barley. However, at most locations, visual differences were difficult to see by mid-July. Typically, cereal crops take up to 70% of their P requirements in the first 40 days after emergence. Further, soil P is less available to crops under cool wet conditions. Therefore, response to P fertilizer can be more dramatic under these conditions. This appears to have been the situation in the spring of 1991, which ultimately influenced crop yields.

Approximately, 4.5 sites were lost due to either hail during the growing season or poor fall harvest weather.

A summary of P response for each crop, by each research group (Table 2) and by soil zone (Table 3) is reported. A more detailed summary is provided in Appendix I.

Based on visual observations in June, crop response to added P fertilizer was anticipated at a number of sites. In fact, from Tables 2 and 3, 78% of wheat sites, 89% of barley sites and 82% of canola sites responded to added phosphate fertilizer. The high number of responsive sites was greater than expected.

Soil analysis at ASANL was completed in March, 1992. Soil samples have been sent to the Saskatchewan Soil Testing Laboratory. Because soil analysis is still ongoing, correlation of crop response to the various soil test methods has not yet been done. Also, plant tissue samples from June and grain samples from harvest have yet to be analyzed.

Results of the long term plots (Appendix I) showed no response to added P under irrigated or dryland conditions at Bow Island in the Brown soil zone or at Cooking Lake in the Grey Wooded soil Zone. However, at Josephburg the wheat responded and the canola marginally responded to added P while barley showed no response. At the Grey Wooded site at Manning wheat, barley and canola all responded to added P. Because of high residual P soil test levels, response was not expected at any of the sites.

FIELD PLANS FOR 1992

In 1992, the number of trial locations in the province will again be divided among the four research groups as in 1991. Up to 52 sites are proposed (Table 4). For the five P draw-down trials, work will continue as proposed and a new site at Pincher Creek will be initiated.

Methods of site selection, soil sampling and analysis, and monitoring will be the same in 1992 as in 1991. A number of the 1992 sites will be in the same fields as 1991, to allow for comparison of crop response variation among years.

Table 2. Summary of responsive, marginally responsive and non responsive sites by research group.

Crop	Type of Response†	Soils Br. Lethbridge	Westco Calgary	Soils Br. Edmonton	Field Ser. Fairview	Total Sites
Wheat	Response	9	6	6	4	25
	Mar. Resp.	6	1	3	2	12
	No response	7	2	1	1	11
Barley	Response	13	8	8	5	34
	Mar. Resp.	6	1	0	2	9
	No response	2	0	2	0	4
Canola	Response	10	-	2	5	17
	Mar. Resp.	7	-	5	2	14
	No response	5	-	1	1	7

†Response-yield increase greater than 5 bu/ac.

Marginal response-yield increase between 2 and 5 bu/ac.

No response-less than 2 bu/ac yield increase.

Table 3. Summary of responsive, marginally responsive and non responsive sites by soil zone.

Crop	Type of Response†	Brown	Dark Brown	Thin Black	Black	Gray Wooded (Central)	Gray Wooded (Peace R.)	Total Sites
Wheat	Response	3	6	5	5	2	4	25
	Mar. Resp.	1	4	3	0	2	2	12
	No response	2	4	2	2	0	1	11
Barley	Response	3	10	7	5	4	5	34
	Mar. Resp.	2	1	3	1	0	2	9
	No response	1	0	1	2	0	0	4
Canola	Response	5	2	3	1	1	5	17
	Mar. Resp.	0	6	1	2	3	2	14
	No response	1	3	1	1	0	1	7

†Response-yield increase greater than 5 bu/ac.

Marginal response-yield increase between 2 and 5 bu/ac.

No response-less than 2 bu/ac yield increase.

Table 4. Number of proposed research sites to be established in each soil area in 1992 by each research group.

Soil Zone	Soils Br. Lethbridge	Westco Calgary	Soils Br. Edmonton	Field Ser. Fairview	No. of Sites
Brown	3F-3S	-	-	-	6
Dk Brown (So Bow R.)	4F-4S	1	-	-	9
Dk Brown (No Bow R.)	2	1	1	-	4
Thin Black (So Bow R.)	3	1	-	-	4
Thin Black (No Bow R.)	2	3	1	-	6
Black	1	2	5	-	8
Grey Wooded (Edm.)	-	-	5	-	5
Grey Wooded (Peace R.)	-	-	-	1F-4S	5
Dark Grey Wooded	-	-	-	1F-4S	5
Total Sites	22	8	12	10	52

BUDGET FOR 1991-1992

A statement of expenditure from April 1 to January 15, 1992 is provided in Appendix II. The total revenue from all sources was \$101,000.00. Approximately \$86,000 was used for manpower at Lethbridge, Edmonton and Fairview to conduct field plot work, and for manpower in ASANL for soil analysis. Approximately \$7,200 was used to purchase weather and soil monitoring equipment. The remaining amount was used for truck rental, gas and travel to plot sites, as well as various materials and supplies.

SUMMARY

Overall, the first year of the project was quite successful. There were 46 P rate trails initiated, which was 10 more sites than proposed. Response to P fertilizer was observed early in the growing season at a number of locations and was measured in final grain yield. Once soil, tissue and grain analysis is complete, statistical analysis will be conducted to correlate crop response with the different soil P test methods.

Submitted March 20, 1992.

Ross H. McKenzie, Project Manager.
Soil Fertility Specialist,
Alberta Agriculture, Lethbridge.

1991 PHOSPHORUS PROJECT

STATION: ALBERTA AGRICULTURE LETHBRIDGE

LOCATION SHORT TERM PLOTS	CROPPING SYSTEM	WHEAT				BARLEY				CANOLA	
		HRSW		DURUM		2-ROW		6-ROW		*	BU/AC INCREASE
		*	BU/AC INCREASE	*	BU/AC INCREASE	*	BU/AC INCREASE	*	BU/AC INCREASE		
BROWN											
BOW ISLAND	FALLOW	R	11.9	-	-	R	10.9	-	-	R	10.6
	STUBBLE	R	8.1	-	-	R	15.6	-	-	R	5.8
FOREMOST	FALLOW	NR		-	-	NR		-	-	R	8.2
	STUBBLE	NR		-	-	MR		-	-	NR	
PURPLE SPRINGS	FALLOW	R	5.3	-	-	R	9.5	-	-	R	5.1
	STUBBLE	MR		-	-	MR		-	-	R	6.5
DARK BROWN											
CARMANGAY	FALLOW	R	13.8	-	-	R	20.2	-	-	MR	
	STUBBLE	NR		-	-	MR		-	-	NR	
CLARESHOLM	FALLOW	R	7.7	-	-	R	6.4	-	-	MR	
	STUBBLE	MR		-	-	R	14.3	-	-	NR	
DRUMHELLER	STUBBLE	MR		R	5.8	R	7.0	-	-	MR	
LETHBRIDGE	FALLOW	R	10.9	-	-	R	10.5	-	-	R	6.0
	STUBBLE	MR		-	-	R	13.4	-	-	NR	
STRATHMORE	STUBBLE	NR		NR		R	11.1	-	-	R	5.8
VULCAN	FALLOW	NR		-	-	R	7.2	-	-	MR	
	STUBBLE	MR		-	-	R	10.2	-	-	MR	
THIN BLACK											
CROSSFIELD	STUBBLE	R	8.1	-	-	MR		MR		MR	
HIGH RIVER	STUBBLE	R	8.9	-	-	R	15.3	MR		R	6.3
MAGRATH	STUBBLE	NR		-	-	MR		R	5.5	R	5.3
PINCHER CREEK	STUBBLE	R	9.3	-	-	MR		R	11.9	R	7.8
THREE HILLS	STUBBLE	MR		NR		-	-	-	-	NR	
BLACK											
OLDS	STUBBLE	NR		-	-	NR		NR		MR	
LONG TERM PLOTS											
BROWN											
BOW ISLAND DRY	STUBBLE	NR		-	-	-	-	-	-	-	-
BOW ISLAND IRR.	STUBBLE	NR		-	-	-	-	NR		NR	

*= R(RESPONSE TO P2O5>=5 BU/AC); MR(MARGINAL RESPONSE TO P2O5<5 AND >=2 BU/AC)
 NR(RESPONSE TO P2O5<2 BU/AC)
 BU/AC INCREASE= YIELD INCREASE FROM CHECK TO HIGHEST YIELDING TREATMENT.
 -= CROP NOT GROWN AT THIS SITE.

1991 PHOSPHORUS PROJECT

STATION: WESTCO FERTILIZER LTD.

LOCATION SHORT TERM PLOTS	CROPPING SYSTEM	PREVIOUS CROP	WHEAT		BARLEY	
			*	BU/AC INCREASE	*	BU/AC INCREASE
DARK BROWN						
CHAMPION	STUBBLE	WHEAT	NR		-	-
	FALLOW	CHEM.	R	9.2	-	-
	FALLOW	CONV.	R	5.8	-	-
THIN BLACK						
AIRDRIE	STUBBLE	BARLEY	NR		R	6.6
	STUBBLE	BARLEY	R	5	R	13.3
CARSTAIRS	STUBBLE	BARLEY	-	-	R	9.1
	FORAGE BREAKING		-	-	R	14.5
IRRICANA	FALLOW		R	16	R	6
	STUBBLE	BARLEY	MR		R	6.8
BLACK						
BENTLY	STUBBLE	WHEAT	-	-	R	6.5
	STUBBLE	CANOLA	-	-	R	9.3
CROSSFIELD	STUBBLE	CANOLA	R	5.8	MR	
LACOMBE	STUBBLE	BARLEY	R	11.8	-	-

*= R(RESPONSE TO P2O5 >= 5 BU/AC)
 MR(RESONSE TO P2O5 < 5 BU/AC AND >= 2 BU/AC)
 NR(RESONSE TO P2O5 < 2 BU/AC)
 BU/AC INCREASE= YIELD INCREASE FROM CHECK TO HIGHEST
 YIELDING TREATMENT.
 -= CROP NOT GROWN AT THIS SITE.

1991 PHOSPHORUS PROJECT

STATION: ALBERTA AGRICULTURE EDMONTON

LOCATION SHORT TERM PLOTS	CROPPING SYSTEM	WHEAT		BARLEY		CANOLA		OATS	
		*	BU/AC INCREASE	*	BU/AC INCREASE	*	BU/AC INCREASE	*	BU/AC INCREASE
DARK BROWN									
WAINWRIGHT	STUBBLE	R	6.5	R	5.3	MR		-	-
GREY WOODED									
RIMBEY-TONA	STUBBLE	MR		R	8.9	R	6.1	-	-
ATHABASCA	STUBBLE	R	12.4	R	17.1	MR		-	-
GRASSLANDS	STUBBLE	R	5.0	R	9.1	MR		-	-
HYLO	STUBBLE	MR		R	15.6	MR		R	8.6
THIN BLACK									
AMISK	STUBBLE	MR		NR		-	-	-	-
BLACK									
BEAR HILLS	STUBBLE	NR		NR		-	-	-	-
LAMONT	STUBBLE	R	6.9	R	23.2	MR		-	-
LEGAL	STUBBLE	R	6.1	R	13.1	R	9.1	-	-
NAKONECHNY	STUBBLE	R	6.6	R	23.3	NR		-	-
LONG TERM PLOTS									
BLACK									
JOSEPHBURG	STUBBLE	R	8.9	NR		MR		-	-
GREY WOODED									
COOKING LAKE	STUBBLE	NR		NR		NR		-	-

* = R(RESPONSE TO P2O5 >= 5 BU/AC)

MR(RESPONSE TO P2O5 < 5 BU/AC AND >= 2 BU/AC)

NR(RESPONSE TO P2O5 < 2 BU/AC)

BU/AC INCREASE = YIELD INCREASE FROM CHECK TO HIGHEST
YIELDING TREATMENT.

- = CROP NOT GROWN AT THIS SITE.

1991 PHOSPHORUS PROJECT

STATION: ALBERTA AGRICULTURE FAIRVIEW

LOCATION SHORT TERM PLOTS	CROPPING SYSTEM	WHEAT		BARLEY		CANOLA	
		*	BU/AC INCREASE	*	BU/AC INCREASE	*	BU/AC INCREASE
GREY WOODED							
FAIRVIEW	FALLOW	R	6.2	R	22.1	R	17.8
GIROUXVILLE	STUBBLE	-	-	-	-	R	6.3
GRANDE PRAIRE	STUBBLE	R	6.7	R	8.7	R	9.2
HANK HILLS	STUBBLE	MR		MR		MR	
HIGH LEVEL	STUBBLE	NR		MR		NR	
McCLENNAN	STUBBLE	R	7.4	R	11.7	R	7.2
RYCROFT	FALLOW	R	7.5	R	13.0	R	4.6
TEEPEE CREEK	STUBBLE	MR		R	9.5	MR	
LONG TERM PLOTS GREY WOODED							
MANNING	STUBBLE	R	11.8	R	15.2	R	9.9

* = R(RESPONSE TO P205 \geq 5 BU/AC)
 MR(RESONSE TO P205 $<$ 5 BU/AC AND \geq 2 BU/AC)
 NR(RESONSE TO P205 $<$ 2 BU/AC)
 BU/AC INCREASE = YIELD INCREASE FROM CHECK TO HIGHEST
 YIELDING TREATMENT.
 - = CROP NOT HARVESTED AT THIS SITE