SECOND YEAR SUMMARY REPORT - 1992
ALBERTA AGRICULTURAL RESEARCH INSTITUTE PROJECT 90M230
FIELD EVALUATION OF LABORATORY TESTS FOR SOIL PHOSPHORUS

1. Objectives

The first objective of this study was to establish 40 to 50 research sites annually in 1991 to 1993, 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 to crop response to added phosphate (P_2O_5) 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 the different soil areas of Alberta.

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.

2. Methods

2.1 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 (Soil &Crop Mgmt Branch, Alta. Agriculture, Lethbridge) in southern and south-central Alberta; J. Harapiak and N. Flore (Westco Fertilizers Ltd., Calgary) in central Alberta; D.C. Penney and E. Solberg (Soil &Crop Mgmt Branch, Alta. Agriculture, Edmonton) in central and north-central Alberta; and G. Coy (Field Services, Alta. Agriculture, Fairview) in the Peace River region. In 1992, approximately 55 research 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, and some sites where also summerfallow land. When possible, sites were located near old RAYP trials or near CASCI trials. Each cooperator was asked to estimate 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 1992 by each research group in Alberta.

Soil Zone	S&CM Br. Lethbridge	Westco Calgary	S&CM Br. Edmonton	Field Ser. Fairview	No. of Sites
Brown	3F-3S[1]	-	-	-	6
Dk Brown (So Bow R.)	4F-4S	-	-	-	8
Dk Brown (No Bow R.)	2	-	1	-	3
Thin Black (So Bow R.)	3	-	-	-	3
Thin Black (No Bow R.)	2	6	1	-	9
Black	1	8	4	-	13
Grey Wooded (Central.)	-	-	4	-	4
Grey Wooded (Peace R.)	-	-	-	3F-6S	9
Total Sites	22	14	10	9	55

[1] F=fallow
S=stubble

2.1.1 Treatments:

Spring wheat and barley were grown at 55 sites and canola was grown at 53 sites in 1992. At some locations both two-row and six-row barley were grown. Durum wheat was also grown at selected locations. Westco had two sites seeded to wheat and barley only. Westco also had wheat and barley at five Manitoba and two Saskatchewan locations.

At each location, the best rated varieties were used for each crop. Plots were replicated six times. Four phosphate (P_2O_5) 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 30 kg/ha was seed placed and 15 kg/ha was banded prior to seeding. Nitrogen and any other required fertilizers were banded prior to seeding (fall in southern Alberta and spring in central and northern Alberta).

2.1.2 Soil Sampling and Analysis:

Each block was soil sampled separately and in detail. Samples were taken at 0-15 and 15-30 cm depths for analysis. All samples were ground to pass a two mm sieve and boxed. Sufficient soil to fill four boxes per replicate (eight 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, Lethbridge, Kelowna, Norwest modified 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, Saskatchewan modification of the Kelowna method and the new membrane method.

2.1.3 Site Monitoring:

Soil moisture was determined at time of seeding by gravimetric sampling using 15 cm increments to a depth of 90 cm. 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, windspeed, relative humidity, sunlight, and 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, so soil moisture use efficiency could be determined.

2.2 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 in 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: a control; a 150 kg/ha of P_2O_5 one time batch application; a 150 kg/ha of P_2O_5 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 and Pincher Creek site which are cropped to continuous wheat.

3. Results and Discussion

A total of 55 annual sites and six 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 all crops at most sites, except at several sites in the Brown soil zone . Weather in the last two weeks of June and throughout July was wetter and cooler than normal in southern and central Alberta. Conditions where drier than normal throughout most of the growing season in the Peace River region. In mid-June visual response to P fertilizer was observed at a number of locations in both wheat and barley in central Alberta and the Peace River region. At most southern locations visual response was not obvious. At most locations, visual differences were difficult to see by mid-July.

Two sites were lost due to hail, three to drought and one site remains unharvested due to 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, 89% of wheat sites, 96% of barley sites and 77% of canola sites responded to added phosphate fertilizer. The high number of responsive sites was similar to 1991 and greater than expected.

Soil analysis at ASANL was completed in March, 1993. 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 been analyzed.

Table 2. Summary of 1992 responsive, marginally responsive and non responsive sites by research group.

Crop	Type of Response[1]	S&CM Br. Lethbridge	Westco Calgary	S&CM Br. Edmonton	Field Ser. Fairview	Total Sites
Wheat	Response	13	4	4	4	25
	Mar. Resp.	9	4	4	3	20
	No response	2	1	2	1	6
Barley	Response	13	12	9	6	40
	Mar. Resp.	9	1	0	2	12
	No response	1	0	1	0	2
Canola	Response	2	5	5	3	15
	Mar. Resp.	11	3	2	2	18
	No response	5	3	0	2	10

[1]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.

Results of the long term plots (Appendix I) showed response to added P under both irrigated and dryland conditions at Bow Island in the Brown soil zone, which is opposite to 1991 results. In 1991 wheat, barley and canola at Cooking Lake in the Grey Wooded soil zone did not respond to added P, however, in 1992, all crops responded to P fertilizer. At Josephburg in 1991, the wheat responded and the canola marginally responded to added P while barley showed no response, while in 1992, wheat and barley responded

to P. In 1991, at the Grey Wooded site at Manning wheat, barley and canola all responded to added P. The site was not harvested in 1992.

Table 3. Summary of 1992 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	2	7	5	6	1	4	25
	Mar. Resp.	2	5	4	3	3	3	20
	No response	2	1	1	1	0	1	6
Barley	Response	3	6	9	12	4	6	40
	Mar. Resp.	3	3	4	0	0	2	12
	No response	0	2	0	0	0	0	2
Canola	Response	0	1	2	6	3	3	15
	Mar. Resp.	4	5	4	2	1	2	18
	No response	2	3	1	2	0	2	10

†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.

4. Field Plans for 1993

In 1993, the number of trial locations in the province will again be divided among the four research groups as in 1991. A total of 55 sites are proposed. For the five P draw-down trials, work will continue as proposed.

Methods of site selection, soil sampling and analysis, and monitoring will be the same in 1993 as in the past. Many of the 1993 sites will be in the same fields as in the past two years, to allow for comparison of crop response variation among years.

5. Budget for 1992-1993

A statement of expenditure from April 1, 1992 to Feb. 2 1993 is provided in Appendix II. The total revenue from all sources was $109,961.34. Approximately $96,000 was used for manpower at Lethbridge, Edmonton and Fairview to conduct field plots and for manpower in ASANL

for soil analysis. The remaining amount was used for truck rental, gas and travel to plot sites, as well as various materials and supplies.

Table 4. Number of proposed research sites to be established in each soil area in 1993 by each research group.

Soil Zone	S&CM Br. Lethbridge	Westco Calgary	S&CM Br. Edmonton	Field Ser. Fairview	No. of Sites
Brown	3F-3S[1]	-	-	-	6
Dk Brown (So Bow R.)	4F-4S	-	-	-	8
Dk Brown (No Bow R.)	2	-	1	-	3
Thin Black (So Bow R.)	3	-	-	-	3
Thin Black (No Bow R.)	2	6	1	-	9
Black	1	6	5	-	12
Grey Wooded (Edm.)	-	-	4	-	4
Grey Wooded (Peace R.)	-	-	-	2F-8S	10
Total Sites	22	12	11	10	55

[1] F=fallow
S=stubble

6. Summary

Overall, the second year of the project was quite successful. There were over 50 P rate trails initiated, which was 10 more sites than proposed. Also, good 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.

7. Acknowledgements

The researchers involved in this project very gratefully acknowledge the following agencies for financial or in-kind support to this project:

Alberta Agricultural Research Institute
Western Grains Research Foundation
Alberta Canola Producers Commission
Westco
Sherritt Gordon
Cominco
Potash and Phosphate Institute
Plains Innovative Laboratories

The researchers also very gratefully acknowledge the co-opertation, patiences and interest of the many Alberta farmers that have allowed us access to their farms, to establish and run our experiments in the past two years.

Submitted March 15, 1993.

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Appendix I

1

1992 PHOSPHORUS PROJECT
YIELD RESPONSE TO PHOSPHORUS

STATION: ALBERTA AGRICULTURE LETHBRIDGE

LOCATION SHORT TERM PLOTS	CROPPING SYSTEM	WHEAT				BARLEY				CANOLA	
		HRSW		DURUM		2-ROW		6-ROW			
BROWN		*	BU/AC INCREASE	*	BU/AC INCREASE	*	BU/AC INCREASE	*	BU/AC INCREASE	*	BU/AC INCREASE
BOW ISLAND	FALLOW	R	6.6	–	–	R	12.5	–	–	MR	
	STUBBLE	NR		–	–	MR		–	–	MR	
FOREMOST	FALLOW	R	9.7	–	–	MR		–	–	NR	
	STUBBLE	MR		–	–	R	5.2	–	–	NR	
PURPLE SPRINGS	FALLOW	MR		–	–	MR		–	–	MR	
	STUBBLE	NR		–	–	R	6.4	–	–	MR	
DARK BROWN											
CARMANGAY	FALLOW	R	5.7	–	–	R	9.9	–	–	MR	
	STUBBLE	R	10.8	–	–	R	17.1	–	–	NOT HARV.	
CLARESHOLM	FALLOW	MR		–	–	MR		–	–	NR	
	STUBBLE	R	9.8	–	–	R	10	–	–	R	6.1
DRUMHELLER	STUBBLE	R	5.8	MR		MR		–	–	MR	
LETHBRIDGE	FALLOW	R	7.1	–	–	NR		–	–	NR	
	STUBBLE	R	5.2	–	–	R	6	–	–	MR	
STRATHMORE	STUBBLE	MR		MR		MR		–	–	MR	
VULCAN	FALLOW	MR		–	–	R	5.5	–	–	NR	
	STUBBLE	R	6.1	–	–	R	6.9	–	–	MR	
THIN BLACK											
AIRDRIE	STUBBLE	R	5.7	–	–	MR		MR		NOT HARV.	
HIGH RIVER	STUBBLE	R	9.2	–	–	R	8.1	R	12.9	MR	
PINCHER CREEK	STUBBLE	MR		–	–	MR		R	7.5	R	6.7
SPRING COULEE	STUBBLE	NOT HARVESTED									
THREE HILLS	STUBBLE	R	5.7	MR		R	13.8	–	–	MR	
BLACK											
OLDS (1)	STUBBLE	R	7.0	–	–	NOT HARVESTED					
LONG TERM PLOTS BROWN											
BOW ISLAND (DRY)	STUBBLE	MR		–	–	–	–	–	–	–	–
BOW ISLAND (IRR.)	STUBBLE	R	8.5	–	–	–	–	R	10.1	R	8.5
THIN BLACK											
PINCHER CREEK	STUBBLE	MR		–	–	–	–	–	–	–	–

*= 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.

1. SOME HAIL DAMAGE.

1992 PHOSPHORUS PROJECT
YIELD RESPONSE TO PHOSPHORUS

STATION: ALBERTA AGRICULTURE FAIRVIEW

LOCATION SHORT TERM PLOTS GRAY WOODED	CROPPING SYSTEM	WHEAT *	WHEAT BU/AC INCREASE	BARLEY *	BARLEY BU/AC INCREASE	CANOLA *	CANOLA BU/AC INCREASE
FAIRVIEW	STUBBLE	R	17.0	R	22.0	NOT HARV.	
GIROUXVILLE	STUBBLE	R	10.5	R	17.1	R	22.0
GRANDE PRAIRIE	STUBBLE	MR		R	8.0	NR	
HAWK HILLS	FALLOW	NR		MR		NR	
HIGH LEVEL	STUBBLE	NOT HARVESTED					
McCLENNAN	STUBBLE	R	12.0	R	22.8	R	9.9
RYCROFT	FALLOW	R	5.0	R	7.8	MR	
TEEPEE CREEK	STUBBLE	MR		R	9.8	MR	
WOKING	FALLOW	MR		MR		R	5.3
LONG TERM PLOTS GRAY WOODED							
MANNING	NOT HARVESTED						

*= 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.

1992 PHOSPHORUS PROJECT
YIELD RESPONSE TO PHOSPHORUS

STATION: ALBERTA AGRICULTURE EDMONTON

LOCATION	CROPPING SYSTEM	WHEAT		BARLEY		CANOLA		OATS	
SHORT TERM PLOTS		*	BU/AC INCREASE	*	BU/AC INCREASE	*	BU/AC INCREASE	*	BU/AC INCREASE
DARK BROWN									
WAINWRIGHT	STUBBLE	NR		NR		NOT HARV.		–	–
GRAY WOODED									
ATHABASCA	STUBBLE	MR		R	20.9	R	8.0	–	–
HYLO	STUBBLE	R	5.3	R	11.7	MR		R	12.1
RIMBEY	STUBBLE	MR		R	13.6	R	9.1	–	–
THORSBY	STUBBLE	MR		R	13.3	R	7.7	–	–
THIN BLACK									
CAMROSE	STUBBLE	MR		R	5.7	NOT HARV.		–	–
BLACK									
BEAR HILLS	STUBBLE	NR		R	5.8	R	7.8	–	–
LAMONT	STUBBLE	R	12.0	R	17.6	NOT HARV.		–	–
LEGAL	STUBBLE	R	9.6	R	19.4	R	6.0	–	–
MILLET	STUBBLE	R	6	R	15.3	MR		–	–
LONG TERM PLOTS									
BLACK									
JOSEPHBURG	STUBBLE	R	5.0	R	6.1	–	–	–	–
GRAY WOODED									
COOKING LAKE	STUBBLE	MR		R	15.5	R	6.7	–	–

*= 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
YIELD RESPONSE TO PHOSPHORUS

STATION: WESTCO FERTILIZER LTD.

LOCATION SHORT TERM PLOTS	CROPPING SYSTEM	PREVIOUS CROP	WHEAT *	WHEAT BU/AC INCREASE	BARLEY *	BARLEY BU/AC INCREASE	CANOLA *	CANOLA BU/AC INCREASE
THIN BLACK								
AIRDRIE	STUBBLE	BARLEY	MR		MR		MR	
CALGARY	STUBBLE	BARLEY	NR		R	6.6	R	5.1
CROSSFIELD	STUBBLE	CANOLA	NOT HARV.		R	17.0	–	–
CROSSFIELD W	STUBBLE	CANOLA	NOT HARVESTED					
IRRICANA	STUBBLE	HRSW	R	6.7	R	15.5	NR	
	FALLOW		R	6.5	R	12.9	MR	
BLACK								
BENTLY	STUBBLE	HRSW	MR		R	6.6	NR	
CAMROSE	STUBBLE	BARLEY	R	9.3	R	17.9	–	–
CARSTAIRS	STUBBLE	BARLEY	NOT HARV.		R	18	R	8.1
	STUBBLE	CANOLA			R	29.1	R	5.5
	FALLOW				R	14.7	R	8.2
LACOMBE	STUBBLE	BARLEY	MR		R	6.9	NR	
RED DEER	STUBBLE	CANOLA	MR		R	11.4	MR	
WETASKIWIN	STUBBLE	BARLEY	R	5.4	R	14.3	R	5.5

*= 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.