THE EFFECT OF PHOSPHATE PLACEMENT ON THE GROWTH OF SELECTED CROPS

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I. INTRODUCTION

Recent research has shown that phosphate placed in a band below and to the side of the seed can lead to substantial yield increases for crops like flax, rapeseed, and peas. There is a need to test these results under a wider range of soil and climatic conditions and for a wider range of crops.

The objective of this study was to determine the effect of phosphate placement on the growth of fababeans, peas, field beans, lentils, flax and rapeseed under irrigated and dry land conditions.

This was a joint project between the Crop Development Center and the Department of Soil Science, University of Saskatchewan.

II. EXPERIMENTAL METHODS

The soils selected for study included an Elstow loam at Outlook, an Elstow loam on the Goodale farm of the University of Saskatchewan near Floral and a Melfort silty clay loam near Melfort. The site at Outlook had been planted to wheat in 1975, while the other two sites had been summerfallowed in 1975.

The soil analysis (Table 1) showed low available phosphorus levels at both Outlook and Saskatoon. The phosphorus level at Melfort was somewhat higher, but still in a range where phosphorus response would be expected according to current soil test benchmarks.

Table 1. Soil types and analyses for the experimental sites.

Location	Soil Type	NO_3-N Kg/Ha to 60 cm	P --Kg/Ha-- to 15 cm	K	S Kg/Ha to 60 cm	pH
Outlook	Elstow: loam	40	15	595	91	7.5
Saskatoon	Elstow: loam	57	14	---	--	---
Melfort	Melfort Silty clay loam	62	22	---	--	---

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Cultivars used were as follows:

Fababeans	- Erfordia
Peas	- Trapper
Beans	- Aurora
Lentils	- P.I. 179307
Flax	- Redwood 65
Rapeseed	- Tower

Seeding was done with a specially designed press drill with two sets of double-disc furrow openers to allow phosphate placement either with the seed or as a side band application. For the side band application the phosphorus was applied one inch to the side and one inch beneath the seed. The plots were rototilled prior to seeding.

The fertilizer treatments used are presented in Table 2. The phosphorus source utilized was monoammonium phosphate (11-55-0) for all treatments at all locations. No additional nitrogen was utilized for legume crops, but for flax and rapeseed an additional application of nitrogen of 112 kg N/ha was utilized at the Outlook site for all treatments except treatment 7. This nitrogen was applied as surface broadcast ammonium nitrate (34-0-0) applied at seeding time.

Trifluralin (Treflan) at 1.12 kg/ha in 110 l/ha of water was spring applied and incorporated preplant by rototilling for all crops except beans and lentils at Outlook and Melfort. Fall incorporated trifluralin at 1.40 kg/ha was applied at the Saskatoon site. Some additional hand weeding was done at all sites.

At the Outlook site the plot was duplicated to provide both a dryland and an irrigated plot. Irrigation was conducted by a specially designed sprinkler system for small plot work. Tensiometers were installed and irrigation water was applied whenever the tensiometers indicated a moisture tension of approximately 0.5 atmospheres. In addition, seamless aluminum access tubes were installed to allow moisture measurements with the neutron moisture meter.

At approximately three to four weeks after seeding stand counts were taken.

At the Outlook site for all crops except peas, harvesting was done by hand cutting at the soil surface, the three center rows of each crop over a distance of 3m. This allowed determination of straw as well as grain yield. For peas at Outlook, harvesting was with the Hege combine and the straw material was collected, dried and weighed. Recovery of straw material for peas was not complete, and hence the straw yield would be slightly underestimated. At the other two sites all crops were harvested with the Hege combine.

III. RESULTS AND DISCUSSION

3.1 Stand of Crops.

The information obtained on stand counts is presented in Figures 1, 2, and 3 for the Outlook, Saskatoon and Melfort sites respectively. For

Table 2. Treatments used in phsophate placement experiments:

A. For beans, Fababeans, Peas, Lentils.

Treatment Number	P_2O_5 Applied (Kg/Ha)	Placement
1	0	--
2	17	with seed
3	34	with seed
4	50	with seed
5	67	with seed
6	101	with seed
7	0	--
8	17	side-band
9	34	side-band
10	50	side-band
11	67	side-band
12	101	side-band

B. For Flax and Rapeseed

Treatment Number	N Applied (Kg/Ha)	P_2O_5 Applied (Kg/Ha)	Placement of P
1	112	0	--
2	112	17	with seed
3	112	34	with seed
4	112	50	with seed
5	112	67	with seed
6	112	101	with seed
7	0	0	--
8	112	17	side-band
9	112	34	side-band
10	112	50	side-band
11	112	67	side-band
12	112	101	side-band

the Outlook site the irrigated and dryland plots were averaged as the two moisture treatments had been handled identically up to the time that stand counts were taken.

For fababeans there was no effect of phosphorus by either placement method at any location.

For peas, beans, and lentils the side-band phosphate treatment resulted in little change in the crop stand. However, in all cases seed-placed phosphate reduced the stand, particularly at the higher rates.

For flax and rapeseed at both the Outlook and Saskatoon sites side-banded phosphorus had little or no effect on stand whereas seed-placed phosphorus reduced the stand drastically. At Melfort, the stand counts for flax and rapeseed were much higher than at the other two locations, but the data was quite variable and no consistant trend with respect to phosphate placement was noted.

3.2 Grain Yield

The information on grain yield is presented in Figures 4, 5, and 6 for the Outlook, Saskatoon and Melfort sites respectively.

At the Melfort and Saskatoon sites there were no significant responses to phosphorus for any crop with either placement. For peas at both locations and lentils at Saskatoon the side-band placement appeared to give higher yield than seed placement. However, this was due more to yield reduction resulting from stand loss by seed placement than to response to the side-band treatment.

At Outlook under dryland conditions there were no significant responses to phosphorus for beans, lentils, fababeans or flax. Peas and rapeseed appeared to show small responses with the side-band treatment which yielded consistantly higher than the seed-placed treatment.

Under irrigated conditions flax and rapeseed showed small phosphate responses with the side-band treatment but no significant responses with seed placement. At the higher phosphate rates placed with the seed rather large yield reductions occured with flax.

Fababeans under irrigation responded strongly to phosphorus and this response was much higher for the side-band treatment than for seed placement.

It is also interesting to note the relative responses of crops to irrigation. Flax and rapeseed both responded strongly to irrigation and fababean yeilds were increased more than threefold by irrigation. Bean yields were increased by approximately 50 percent, but irrigated bean yields were still only approximately 1500 kg/ha. Peas showed relatively little response to irrigation.

Lentils are obviously not an irrigation crop as the dryland yields were greater than those obtained under irrigated conditions. As little is known about the water requirement of lentils it may require further work to establish appropriate scheduling of water applications.

3.3 Straw yield

The straw yield at Outlook (Figure 7) showed similar trends to that presented for grain yield for all crops except flax. In the case of flax, straw yields indicated very strong response to side-band phosphorus and some response to seed-placed phosphorus for the irrigated treatment.

3.4 Protein Content

The phosphate treatment had no effect on the grain protein content of any crop under study. The overall experiment averages are presented in Table 3 to allow site comparisons and comparisons of the effects of irrigation. It is interesting to note that irrigation increased the protein content of fababeans by approximately 4 percent. It will be recalled that fababean yields were also increased about threefold by irrigation. Irrigation had relatively little effect on the protein content of other crops except for rapeseed, where irrigation reduced the protein content sharply. The protein content of 29.4 percent for dryland rapeseed at Outlook may be somewhat too high, as the samples contained some immature seeds. Previous work has shown protein content of 24 to 26 percent for dryland rapeseed at Outlook and irrigation frequently reduces this to approximately 18 to 20 percent.

IV. CONCLUSIONS

The conclusions stated herein are based on only one year of field data and hence must be treated with considerable caution:

1) Seed-placed phosphorus results in serious stand reductions for flax, rapeseed and peas and results in some stand reduction in beans and lentils. Fababean stands appear to be relatively unaffected by phsophate rate or placement method.

2) Phosphate responses to side-band applications obtained in this study were not equivalent to that measured by other workers for flax, rapeseed or peas. For fababean, the responses obtained here were perhaps greater than that reported by other workers.

3) Lentils are definitely not an irrigated crop and the production of peas under irrigation could also be seriously questioned. In terms of the relative advantage of irrigation fababeans, flax and rapeseed respond very strongly to irrigation. Beans appear to have less potential as an irrigated crop.

Table 3. Site averages for yield and protein content.

		Fababean	Pea	Bean	Lentils	Flax	Rapeseed
		Yield (Kg/Ha)					
Outlook	Dryland	1123	1891	921	1365	1104	666
	Irrig.	4825	1772	1681	987	2627	1783
Saskatoon		1259	1656	1048	1173	998	995
Melfort		2621	1926	--	1044	1548	658
		Protein (%)					
Outlook	Dryland	24.2	22.3	16.6	17.9	22.5	29.4
	Irrig.	28.6	20.1	16.5	20.7	21.6	19.7
Saskatoon		22.6	20.3	23.3	19.2	20.5	22.9
Melfort		26.5	26.6	--	25.7	19.6	21.6

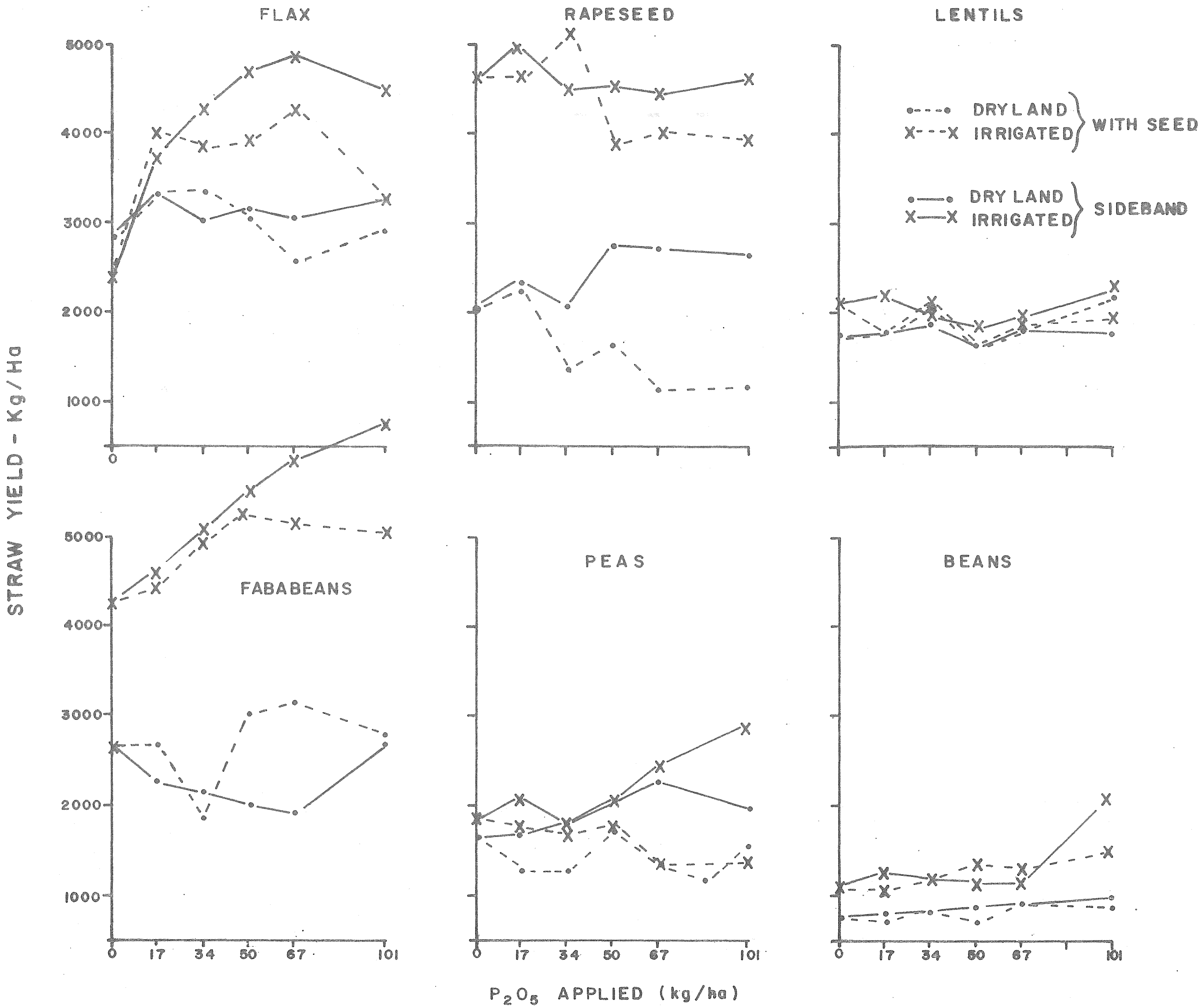

FIGURE 7 THE EFFECT OF PHOSPHATE RATE AND PLACEMENT ON STRAW YIELD OF CROPS - OUTLOOK

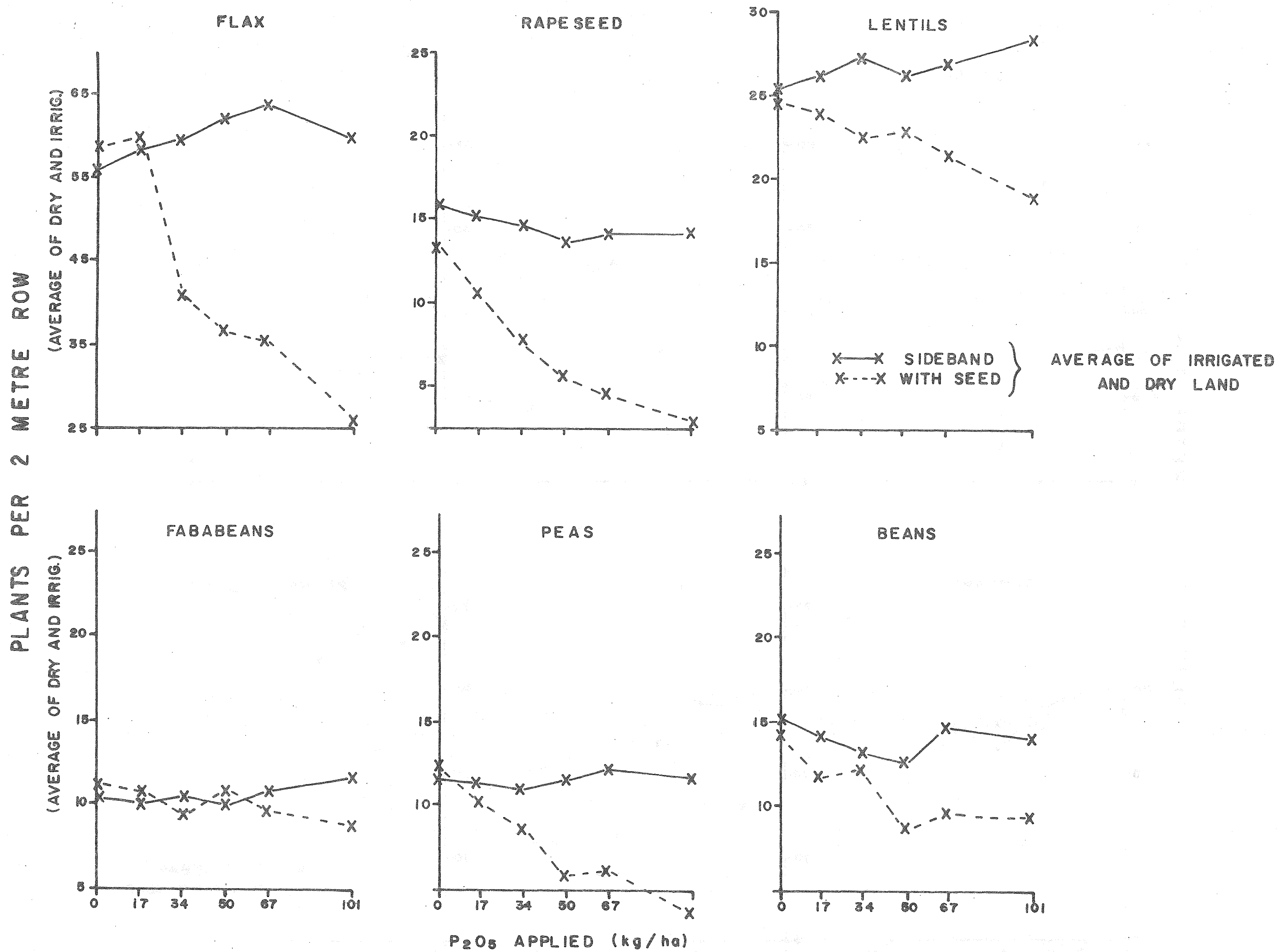

FIGURE 1. EFFECT OF PHOSPHATE RATE AND PLACEMENT ON STAND OF CROPS-OUTLOOK

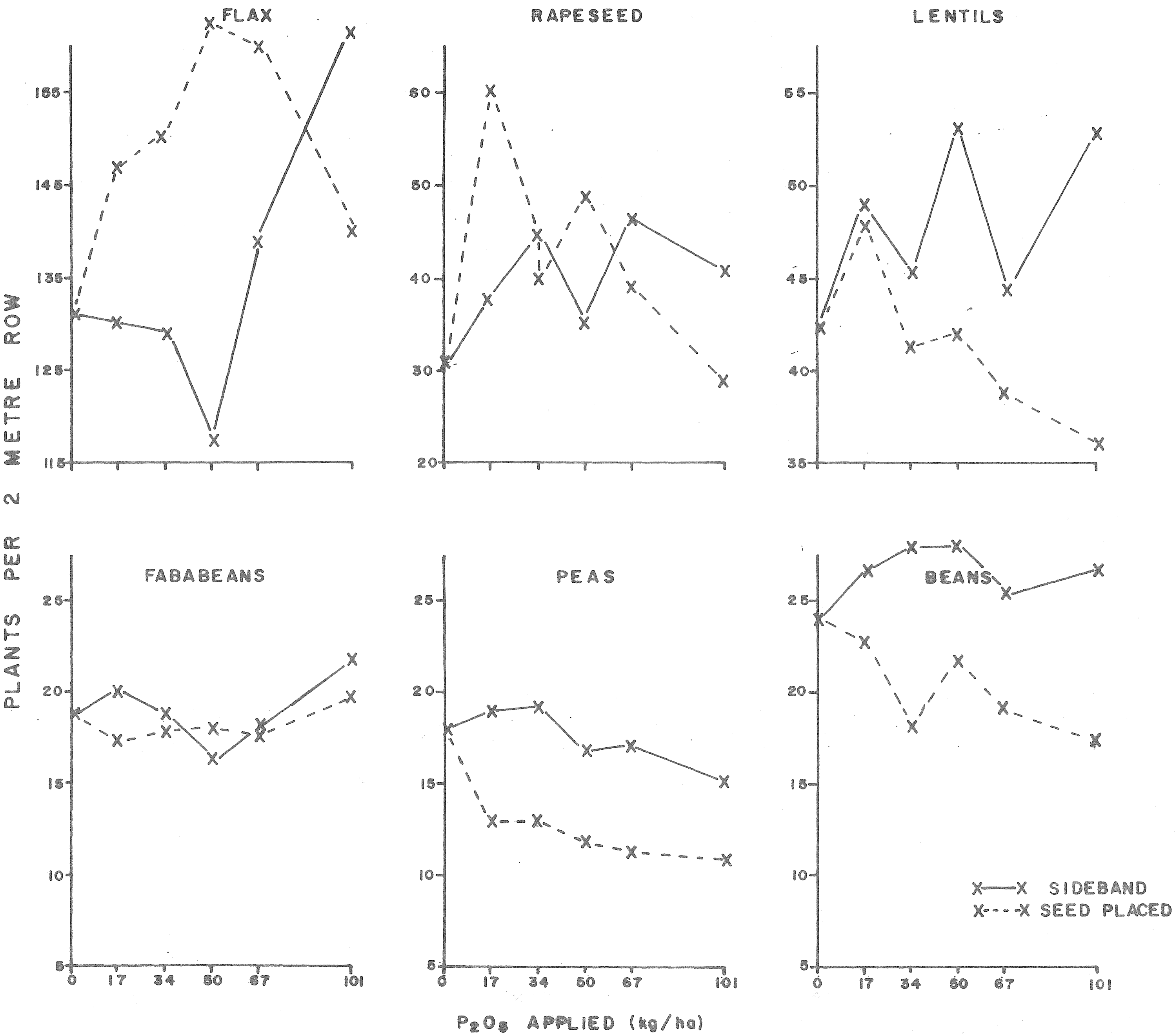

FIGURE 3. EFFECT OF PHOSPHATE RATE AND PLACEMENT ON STAND OF CROPS — MELFORT

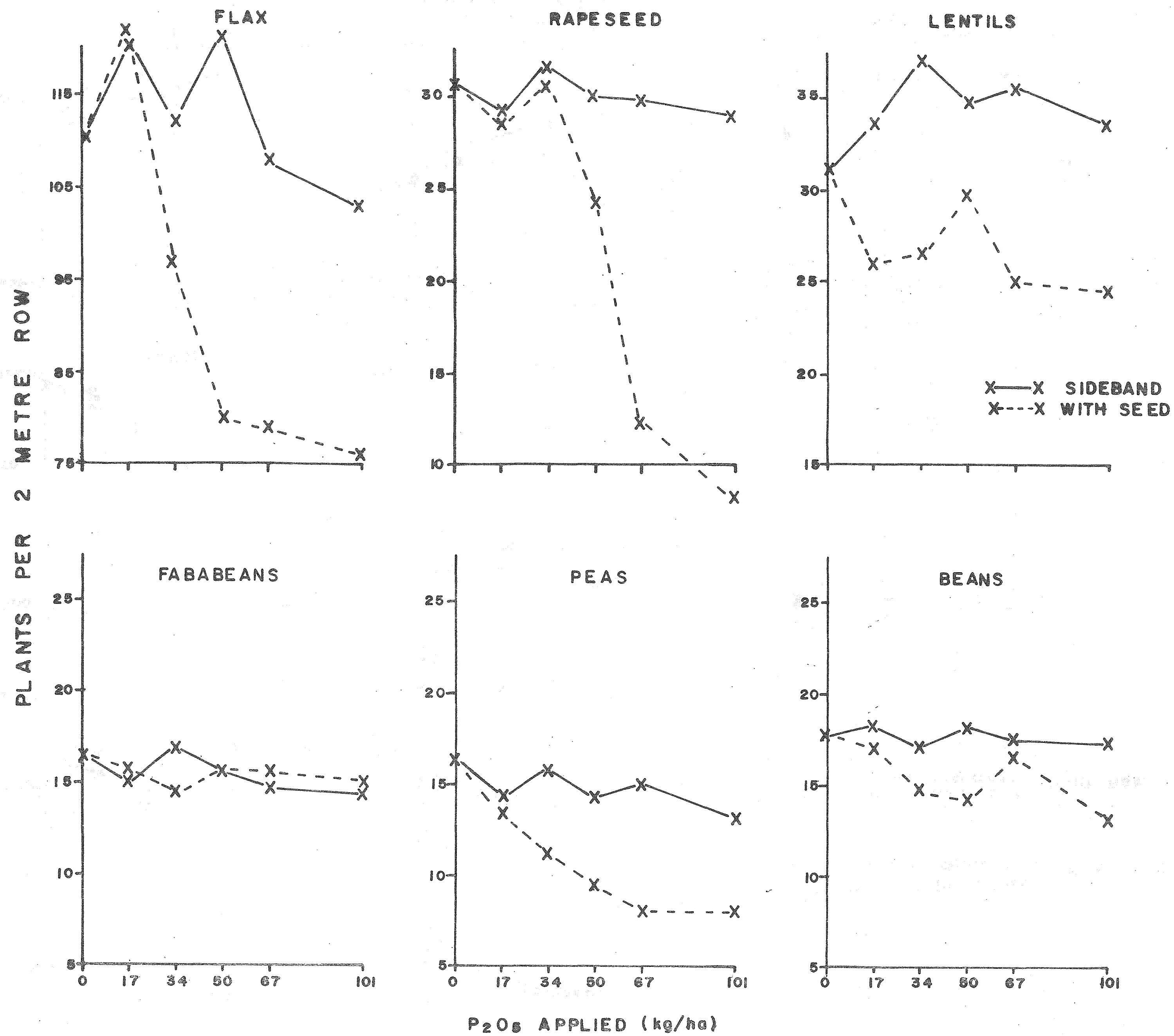

FIGURE 2. EFFECT OF PHOSPHATE RATE AND PLACEMENT ON STAND OF CROPS — SASKATOON.

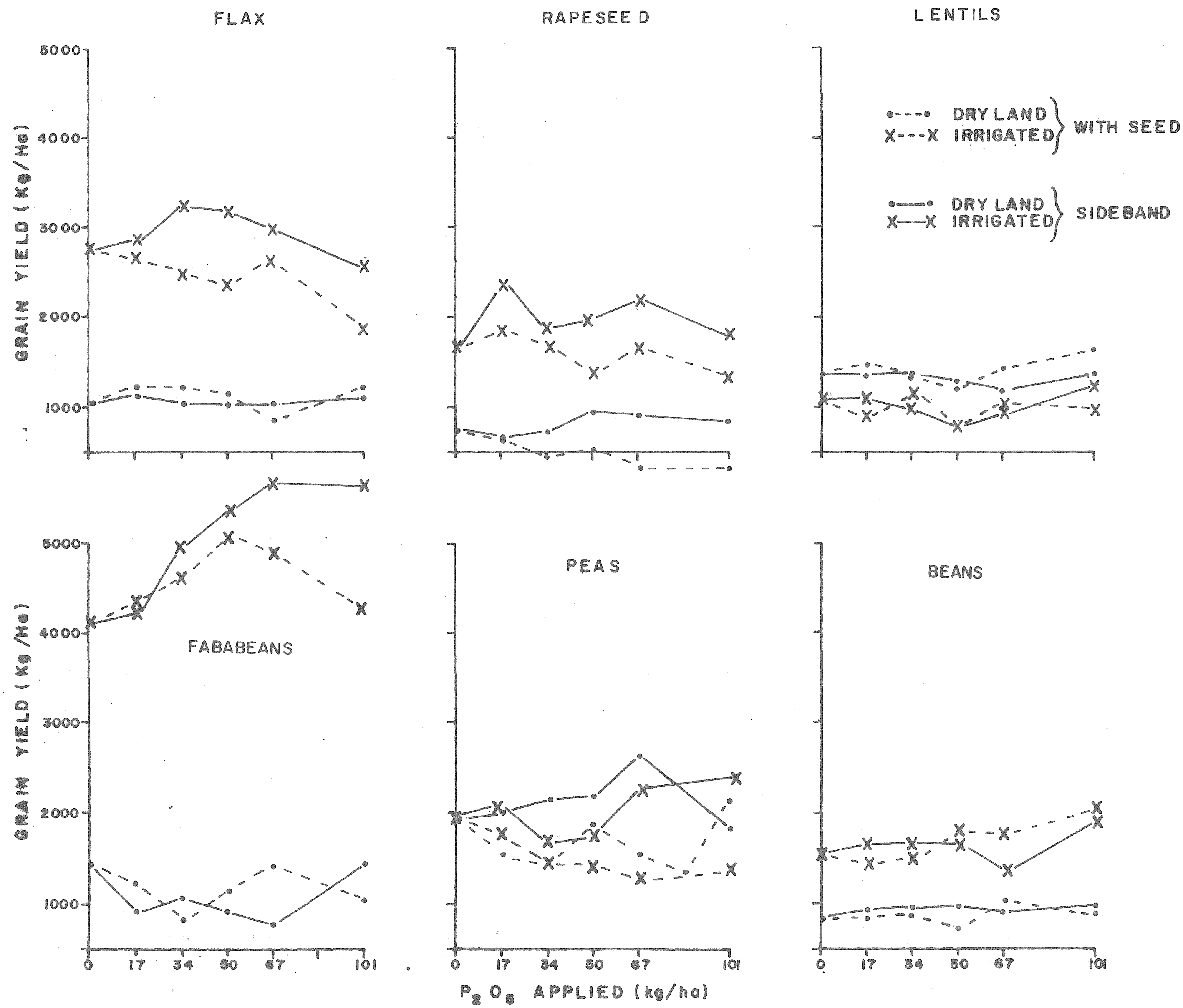

FIGURE 4. EFFECT OF PHOSPHATE RATE AND PLACEMENT ON GRAIN YIELD OF CROPS — OUTLOOK

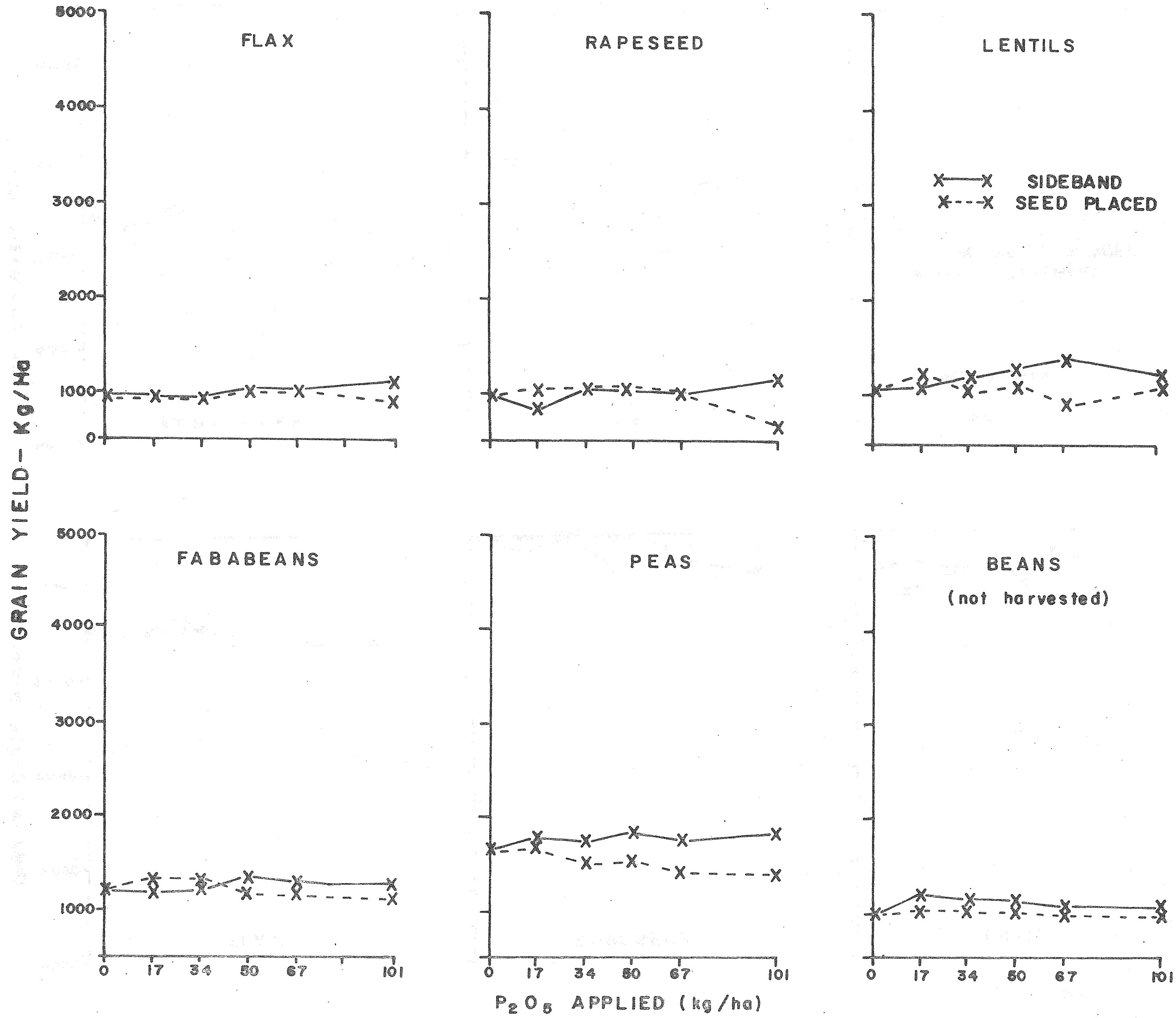

FIGURE 5. EFFECT OF PHOSPHATE RATE AND PLACEMENT ON GRAIN YIELD OF CROPS — SASKATOON

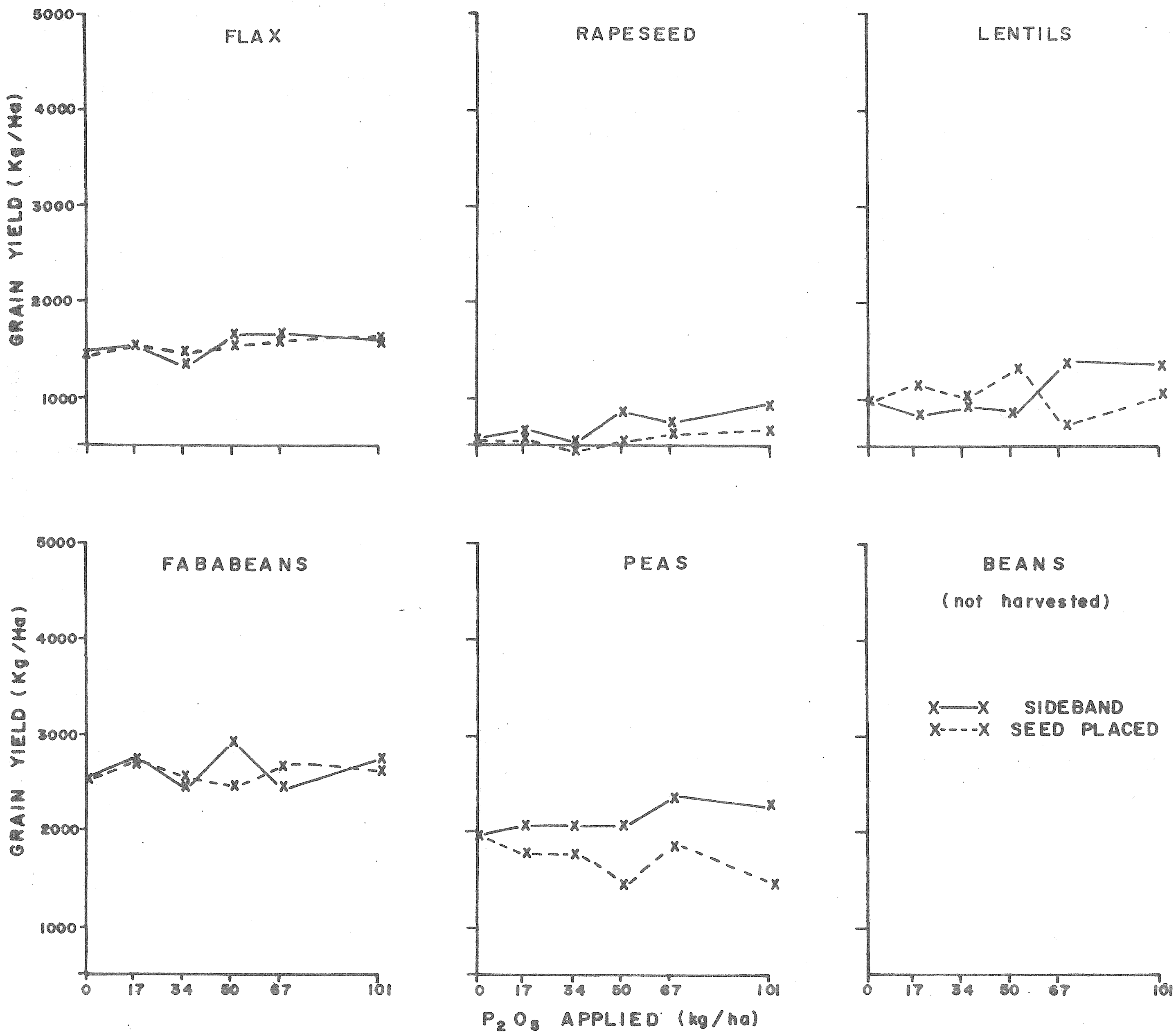

FIGURE 6. EFFECT OF PHOSPHATE RATE AND PLACEMENT ON GRAIN YIELD OF CROPS – MELFORT