A Review of Current Potassium Research in Saskatchewan

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The status of potassium (K) research in Saskatchewan has been reviewed periodically in the past (Halstead, 1969, 1970). The early field work by C.D.A. workers at Indian Head, Melfort and Scott (1951-55) and the Department of Soil Science (Rennie and McKercher, 1960-63) delineated the potentially deficient soils requiring additional research These were typically coarse textured soils, sometimes peaty in the surface, located in the north and north-eastern portion of the province. Although Gray Black and Gray soils are mainly implied, coarse textured soils in the Black zone may also require K.

Data compiled in soil testing has revealed a general decrease in available K with increase in weathering (Fig. 1). The minerology of this observation has been researched by Huang (1971) and related to the K-feldspar content of these soils.

The availability index for K used by the Saskatchewan Soil Testing Laboratory is 0.5M $NaHCO_3$ (pH 8.5) extractable K. The availability categories and K_2O requirement guidelines were formulated in 1968 on the basis of comparisons between $NaHCO_3$ and NH_4Ac extractable K (Halstead, 1969). These guidelines (Table 1) have remained essentially unaltered since that time. The object of this study was to review these recommendations on the basis of findings in a five-year (1967-72) potassium research project conducted in north-eastern Saskatchewan by the Department of Soil Science.

Research Methods

A total of 40 K-response trials were conducted in the period 1967-72 as summarized in Table 2. These trials were chosen on the basis of soil tests submitted to the laboratory. The designs and treatments varied somewhat. In the first years, 10-30-10 (seed placed) and 0-0-60 broadcast were compared with an 11-48-0 control treatment

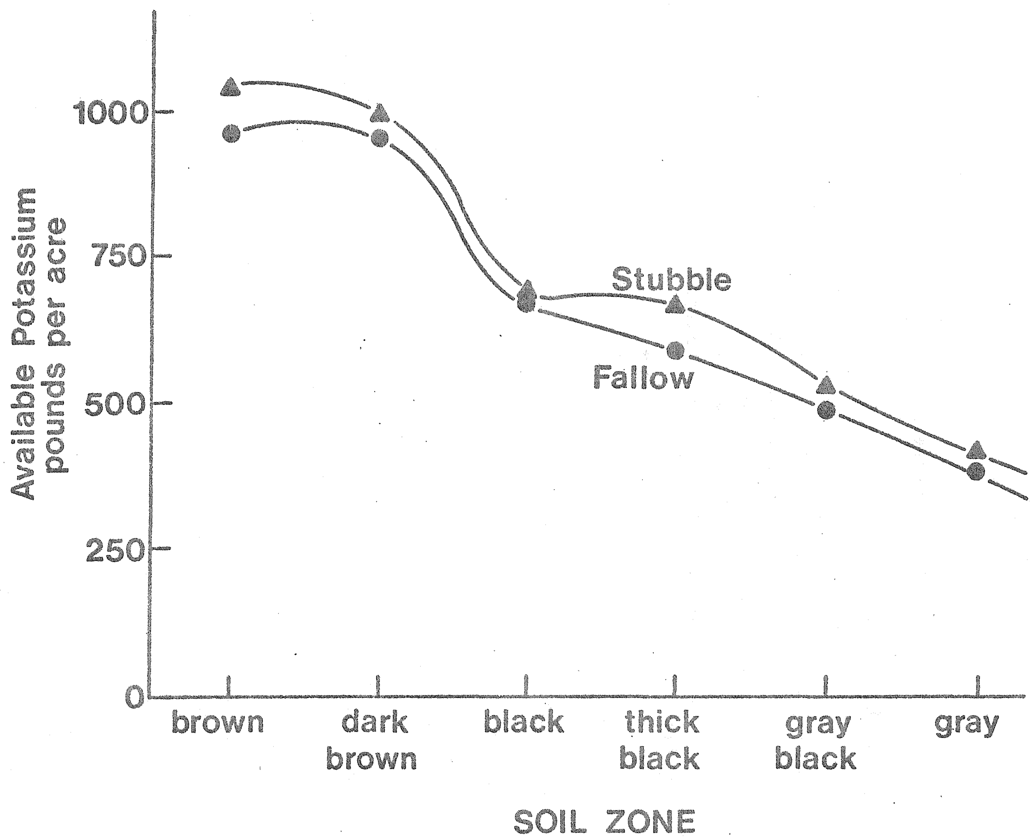


Fig. 1. Average soil test levels of potassium in Saskatchewan.

Table 1

Potash Requirement Guidelines for Saskatchewan, 1971-72

Soil Test	Dryland				Irrigated Crops	
$NaHCO_3K$ in 0-6" (lb/ac)	Wheat, Oats, Barley Buckwheat Rye, Mixed Grain, Sunflower and Native Grass	Flax, Rape, Mustard Field Peas Cultivated Grass (Established Stands)	Grass-legume Legume (Est. Stands)	Grass-legume Legume Pre-plant) Applications	Cereals Rape Mustard Flax	Potatoes and Corn
0-60 VL	30	60	90	120	60	100
61-120 L	15	30	60	90	30	80
121-180 M	0	0	30	60	15	60
181-240 H	0	0	0	30	0	40
241+ VH	0	0	0	0	0	0

Recommendation in lb/ac K_2O

Table 2

Summary of K reasearch conducted in north-east in the period 1967-72 by the Department of Soil Science

Indicator crop	No. of Experiments	Range of years	Soil Associations included
Barley	24	1967-72	Carrot River (7), Glenbush (1), Waitville (2), Sylvannia (2)
Wheat	9	1967-69	Carrot River (3), Shellbrook (3), Sylvannia (1), Weirdale (1)
Rape	5	1968-72	Carrot River (5)
Oats	2	1969	LaCorne (1), Waitville (1)

applied in accordance with the phosphorus test. These trials were laid out in ½ mile strips. In 1968 to 1970 the experiments also consisted of ½ mile strips of N and P_2O_5 applied at recommended rates and N and P_2O_5 plus 60, 120 and 240 lb K_2O broadcast. In 1971 and 1972 the trials were rod-row plots with N and P_2O_5 controls and K_2O broadcast, seed placed and sidebanded.

The yield data was analyzed in two ways: (1) conversion to per cent yield for evaluation of current critical levels, and (2) conversion to yield increases to permit economic interpretation of the response surfaces in various $NaHCO_3$ availability categories. The relative effects and efficiencies of the three placement treatments were also examined.

Critical Levels and Relative Crop Response

The relationships between per cent yield and $NaHCO_3$-K for the various crops investigated (Fig. 2) indicates that barley is considerably more responsive to potassium fertilization than rapeseed, wheat or oats at the same soil-K levels. This would suggest that the current critical value of 120 lb $NaHCO_3$-K should be raised to perhaps 180 lb $NaHCO_3$ for barley. The fact that the yield percentages are generally less than 100 suggests that barley may require additional K at medium and high $NaHCO_3$-K levels on these soils. A similar observation has been made by Soper (1967) in Manitoba. The apparent lack of K-response by barley on some of the soils in the VL (0-60 lb K) category (Fig. 2), cast some doubt on the validity of the K-test. Other soil chemical factors such as $CaCO_3$ content may have to be considered to improve the test. Additional research is required.

These data also indicate that the current critical value of 120 lb $NaHCO_3$-K is adequate for wheat and oats. The data for rapeseed suggest that the critical value K should be reduced from 180 to 120 lb $NaHCO_3$-K for this crop.

K_2O Requirment guidelines

The yield data was converted to the yield increase form and partitioned into the $NaHCO_3$-K availability categories. Barley responses to K were substantial and strongly related to soil-K as illustrated in Fig. 3. Economic interpretation of the barley response surfaces resulted in observed optimum rates of 150, 105 and 90 lb K_2O/ac for the 0-60, 61-120, and 121-180 lb K categories respectively. These results indicate that an upward revision of the K_2O rates for barley is warranted, perhaps to 90, 60 and 30 lb K_2O/ac for the above

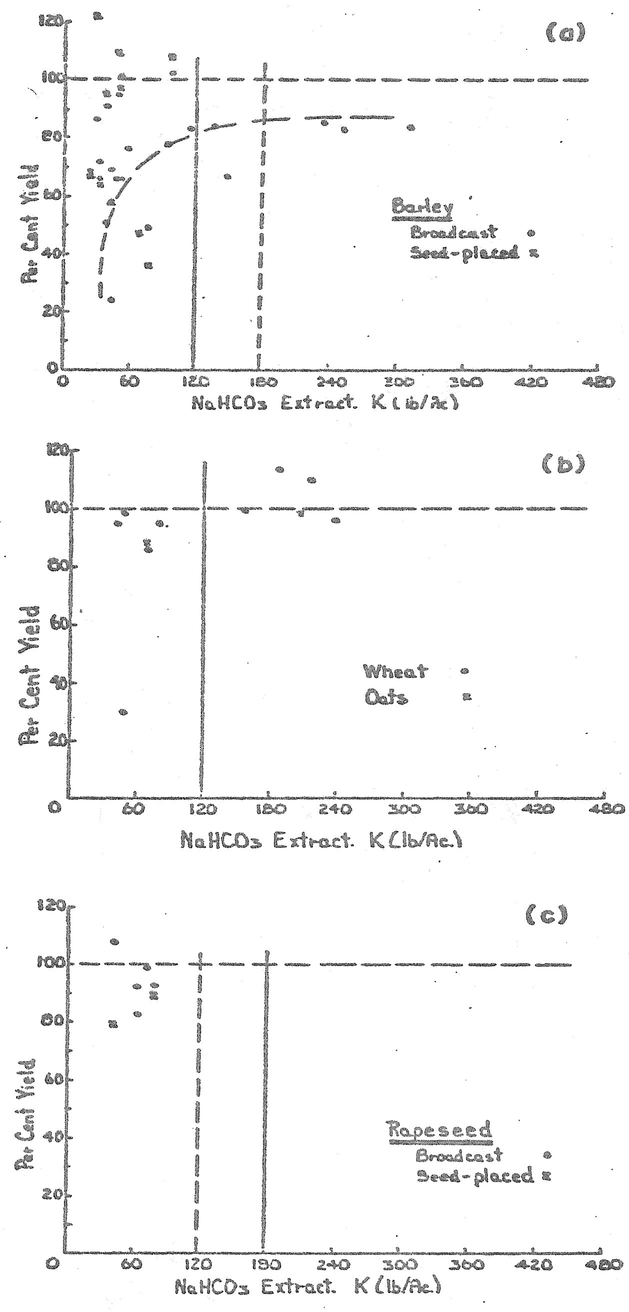
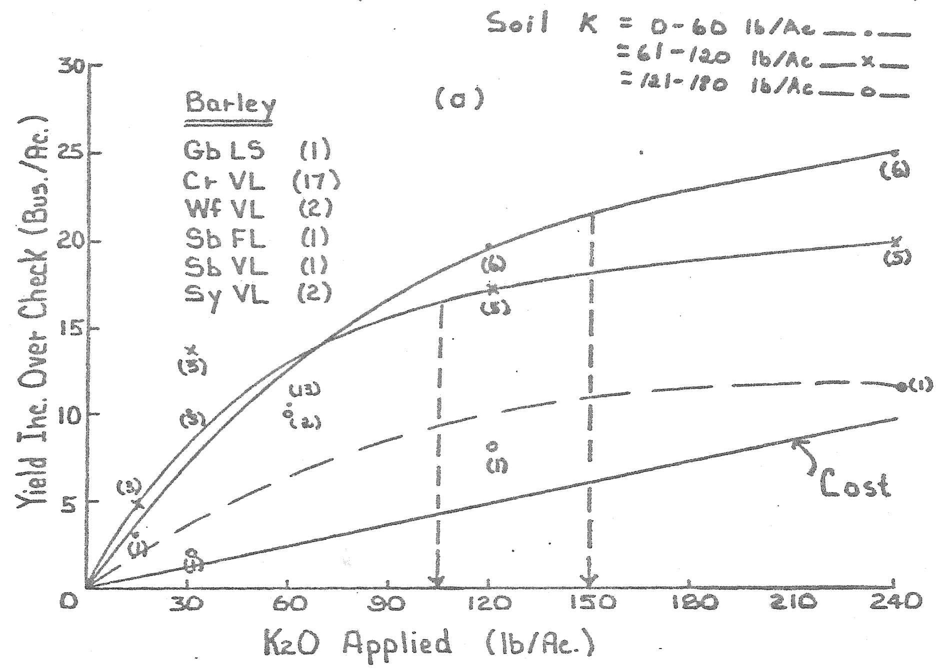


FIG. 2 Relationships Between Per Cent Yield and $NaHCO_3$-K for (a) Barley, (b) Wheat and Oats, (c) Rapeseed.



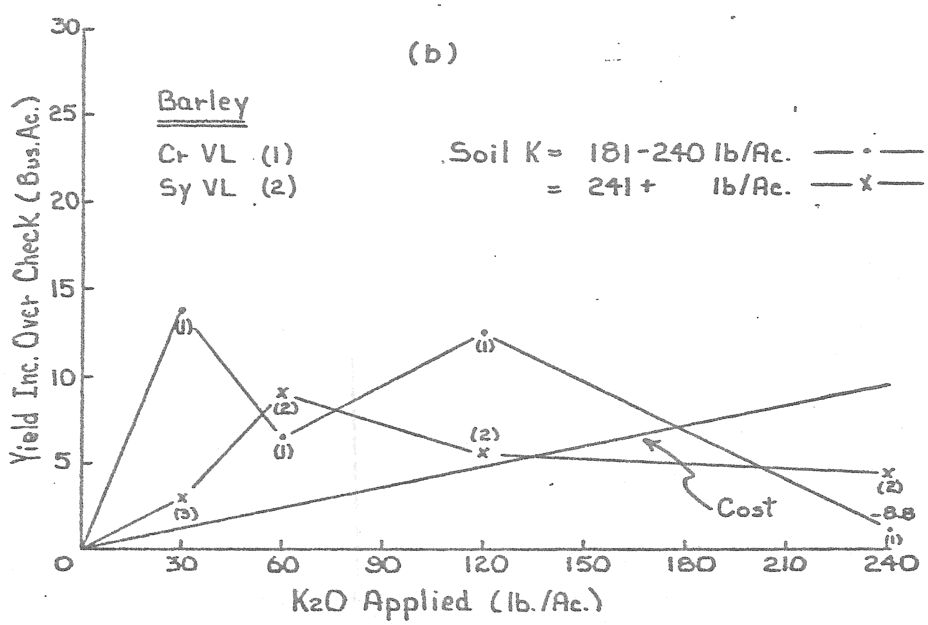


FIG. 3 Barley Response to Applied K_2O in soils containing (a) less than 180 lb $NaHCO_3$-K, and (b) more than 180 lb $NaHCO_3$-K per acre in 0-6" depth.

categories. Response data for wheat and oats on a soil test basis (Fig. 4 and 5) was insufficient to warrant any changes in the existing rate structure. Rape responses (Fig. 6) in the two categories investigated (0-60 and 61-120 lb $NaHCO_3$-K) were not economic.

Placement Studies

The relative efficiencies of seed placed, broadcast and sidebanded K at various rates is illustrated in Fig. 7. These data point out that placement of K with or beside the seed is substantially more efficient than broadcasting at the same rate. Rates as high as 120 lb K_2O seed placed and 240 lb K_2O sidebanded did not affect barley yields although germination was affected at the higher rates.

Conclusions and Future Research Requirements

The major results of this project can be summarized as follows:

1. The K_2O requirement guidelines for barley, rape and mustard should be revised as suggested in this paper. That is, barley should receive recommendations of 90, 60 and 30 lb K_2)/acre for soils testing VL, L and M respectively; and rape and mustard should receive 30 and 15 lb K_2O/acre when testing VL and L.
2. The general and soil test recommendations for K should specify that seed placement or sidebanding of K will result in more efficient plant utilization and therefore justify a reduction in our recommended rates.
3. Seed placement of K_2O was not detrimental to yields of barley and rape in the range of 15 to 120 lb K_2O, although germination was affected at higher rates. Therefore, the maximum rate for N plus K_2O (currently 30 lb/acre) should be revised upward.

Future field research efforts on K in Saskatchewan should be aimed at resolving some of the anomalous K-responses in the VL and L categories. Additional information on the K-requirements of barley at M, L and H soil-K levels is also required. More intensive and detailed research than was carried out in the past is implied.

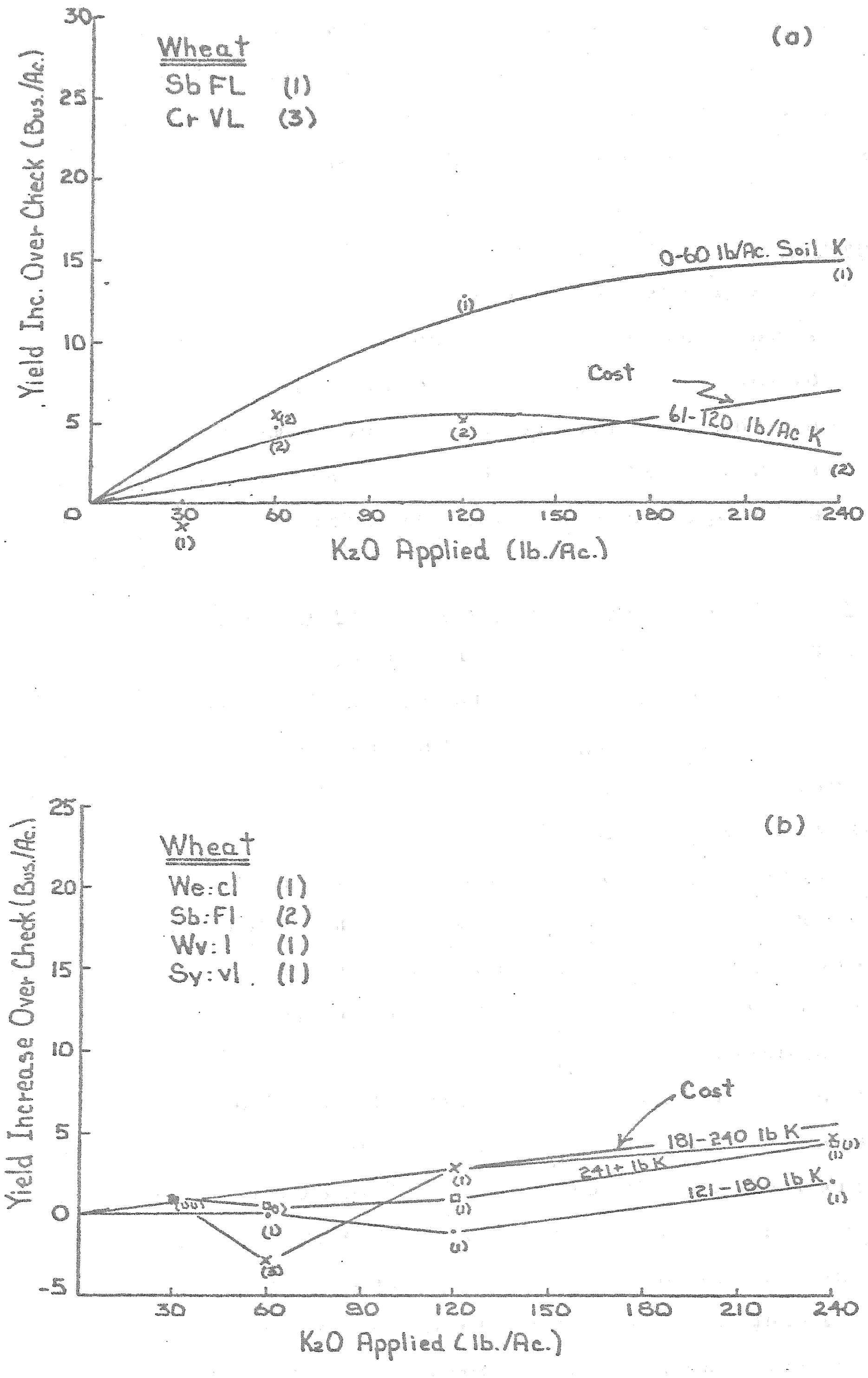


FIG. 4 Wheat Response to Applied K_2O on Soils Containing: (a) less than 120 lb $NaHCO_3$-K and, (b) more than 120 lb $NaHCO_3$-K per acre.

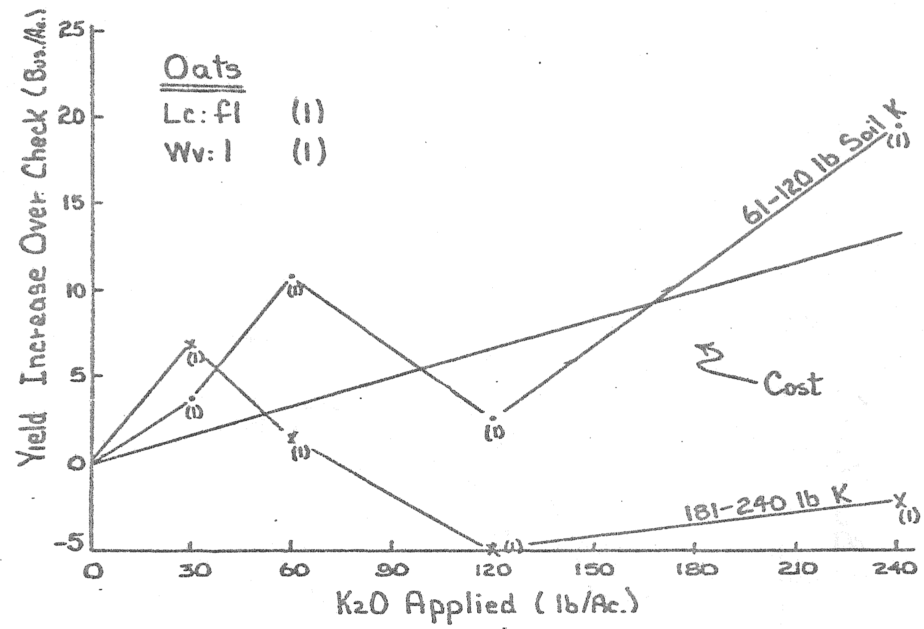


FIG. 5 Response to Oats to Applied K_2O.

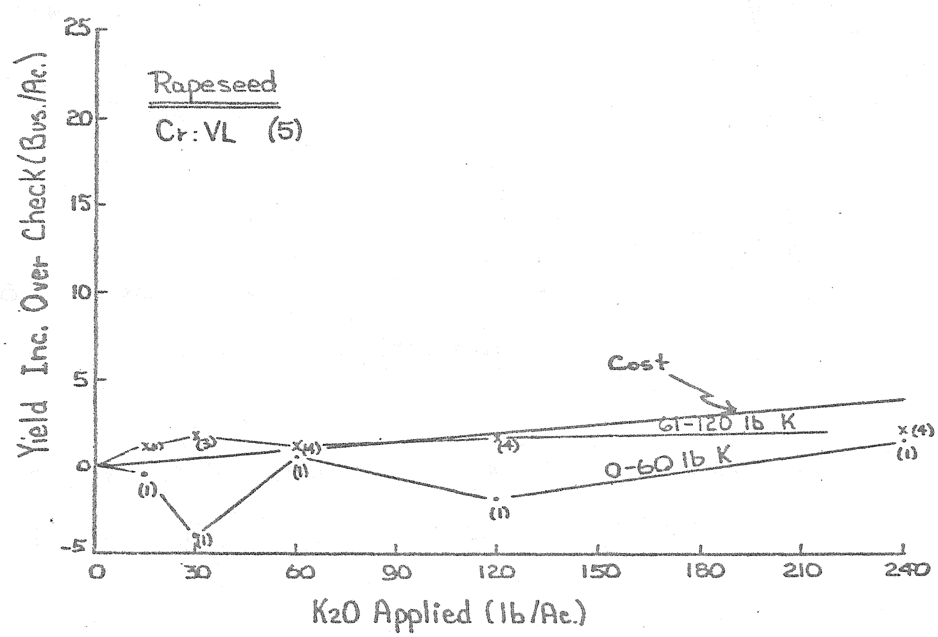


FIG. 6 Response of Rapeseed to Applied K_2O.

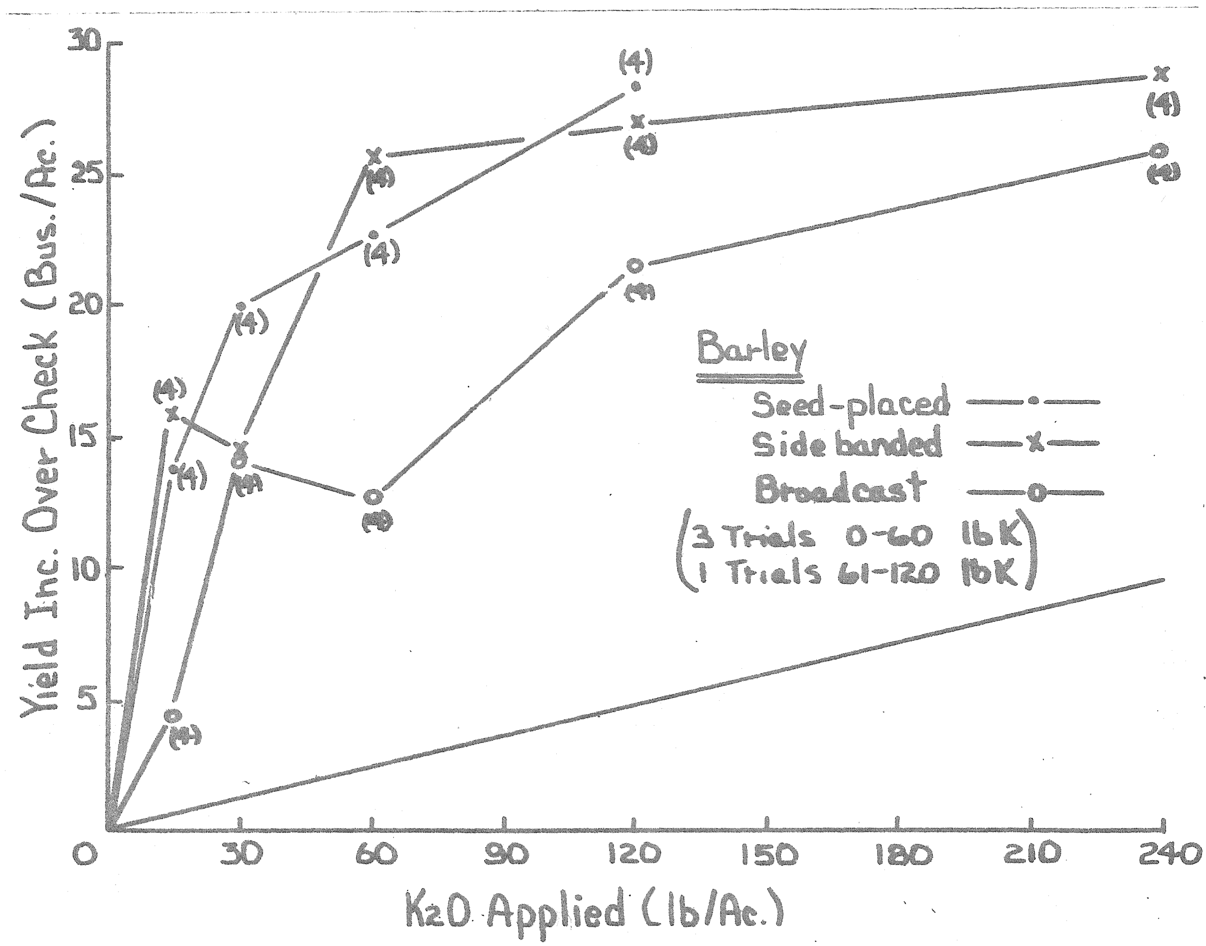


FIG. 7 Relative Efficiency of Broadcast, Sidebanded and Seed Placed K_2O as Indicated by Barley Response on Four K-deficient Soils.

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