Soybean Cultivar Responses to Potassium

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Soybeans in Ontario grow on more than 2 million acres of land. The crop produces a farm gate value averaging C$620 million (1998-2000), rivaling that of corn. Soybean harvest removes a lot of K, about 60 thousand tons of K_2O annually, in comparison to corn harvest (including silage), which removes about 49 thousand tons.

Soybeans remove large amounts of potassium (K) from soils. A 4-year study in southwestern Ontario shows that common fertilizer sources differ little in their effects on soybean yield and quality.

In typical Ontario crop rotations, soybeans often follow corn. Harvested for grain, corn usually leaves behind large amounts of K in stover. For this reason, many producers apply sufficient K to their corn to supply the following soybean crop. When soybeans follow crops other than corn, questions arise as to the appropriate way to meet K needs. Previous research in the southern U.S. indicated that some soybean cultivars were sensitive to chloride (Cl) in muriate of potash (KCl) fertilizers.

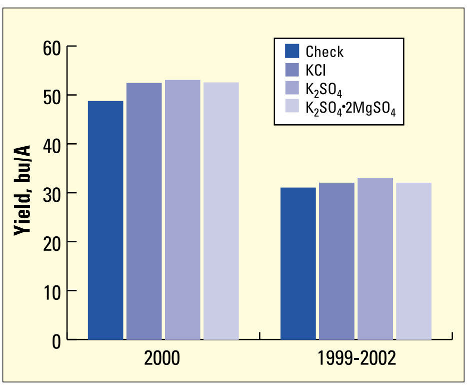

Figure 1. Soybean yield response to K was economic only in the year 2000. Mean of five cultivars.

The purpose of this study was to determine whether soybean cultivars in Ontario differed in responsiveness to K and in sensitivity to Cl. The treatments included a check, KCl, sulfate of potash (K_2SO_4), and sulfate of potash magnesia ($K_2SO_4 \cdot 2MgSO_4$, K-Mag). All sources provided K at 85 lb K_2O/A.

The soybeans were grown on a clay loam soil near Harrow in southwestern Ontario. They followed a rotation crop in 1999 and 2001. However, in 2000 and 2002, the treatments—cultivars and fertilizers—were applied in the same plots as the previous year. Thus, the 2000 and 2002 crops produced results from cumulative effects of two years of fertilizer application. They also followed soybeans, which is not recommended for optimum pest and disease control.

Soil test K ranged from 90 to 135 parts per million (ppm), rated medium to high. It was not depleted much where K was not applied within any 2-year period, indicating the soil had a high capacity to supply K.

Soybeans responded to K with only small yield gains over the 4-year period (**Figure 1**). While K increased both the 4-year average and the year 2000 yields statistically ($p = 0.0061$ and $p = 0.0000001$, respectively), the response was economic only in 2000. Averaged over cultivars and years, all three K sources produced similar effects.

The three K sources did not differ in their overall effect on quality. **Table 1** shows that K caused very slight changes in protein, oil, and sugar content. While the five cultivars differed substantially in these qualities, they did not respond differentially to K or to K sources.

The trials produced evidence of subtle yield interactions among cultivars and sources. Sulfate of potash magnesia slightly increased the yield of four of the cultivars, but it depressed the yield of S20-20 (**Figure 2**). The two cultivars OAC Arthur and AC756 showed a slight preference for sulfate as a K source, while Harovinton, RCAT Angora, and S20-20 showed preference for Cl (**Figure 3**).

These interactions, while significant statistically, should not be over-generalized. Particularly in the case of the interaction with Cl, there was evidence of an additional interaction with years as well. The existence of such complex interactions is interesting, but further understanding of the plant physiology and the relation to the growing environment will be necessary before making practical management recommendations. Potassium sources also interacted with cultivars and years with respect to incidence of several diseases.

The cultivar-source interactions are perplexing in that they were not consistent with cultivar types. Both RCAT Angora and S20-20 are full-season oilseed type cultivars—but they differed in their response to $K_2SO_4 \cdot 2MgSO_4$. Both Harovinton and AC756 are high-protein, food-grade cultivars—but they differed in their response to Cl. OAC Arthur has much shorter maturity (Group 00) than the other cultivars (Group 2)—but it did not distinguish itself in terms of any responses to K or K sources.

TABLE 1. Potassium slightly increased oil and sugar, but decreased protein content of soybeans. Mean of five cultivars over 4 years, 1999-2002.

Fertilizer treatment	Protein,	Oil, %	Sugar,
With K	41.9	21.6	11.0
Without K	42.3	21.4	10.9

Overall, these data show no particular advantage to any one K source for soybean production in general. It is possible, however, that specific cultivars may show preferences for one source over another depending on local growing conditions. BC

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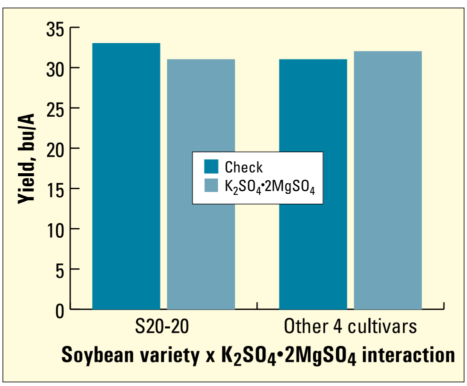

Figure 2. Variety S20-20 responded differently to $K_2SO_4 \cdot 2MgSO_4$ than the other four cultivars. Mean of 4 years, 1999-2002.

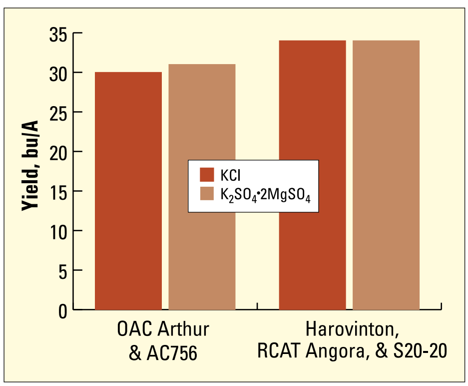

Figure 3. Cultivars showed slight differences in preference for Cl or sulfate sources. Mean of 4 years, 1999-2002.