Brazil

Soybean Response to Potassium Is Similar for Various Sources

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THE PRINCIPLE SOURCE of potassium (K) fertilizer used on most crops in the State of São Paulo, Brazil, is potassium chloride (KCl). On the other hand, potassium sulfate (K_2SO_4) is used on crops such as potatoes, beetroot, pineapples, some deciduous fruits and vegetables. In the sugarcane growing area, vinasse is a K source for the sugarcane and soybeans grown in rotation. About 20 years ago, potassium-magnesium sulfate ($K_2SO_4 \cdot 2MgSO_4$) was introduced from the U.S.; it contains K, magnesium (Mg) and sulfur (S).

Experimental procedures

Experiments were initiated at four locations. The treatments utilized were:

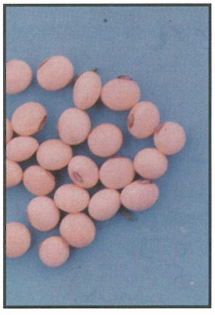
T_1 = Check
T_2 = KCl (60 percent K_2O and 45-48 percent Cl)
T_3 = K_2SO_4 (50 percent K_2O, 18 percent S)
T_4 = $K_2SO_4 \cdot 2MgSO_4$ (22 percent K_2O, 11 percent Mg and 22 percent S)
T_5 = Vinasse.

In treatments T_2 to T_4, K was applied at the rate of 150 kg/ha of K_2O, broadcast before planting. In the second and third year, residual effects were evaluated. For vinasse, 50,000 l/ha was annually applied before planting. The vinasse applied at Mococa and at Paraguaçu Paulista contained an average of 125 and 156 kg/ha of K_2O, respectively. Of the four locations, there was a positive response at only two.

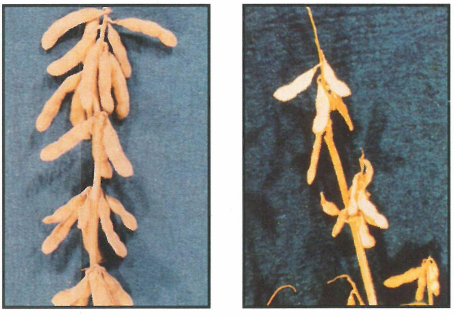
Results

At the Mococa Experimental Station, soybeans did not respond to any source of K in the first two years. Potassium levels in the soil were in adequate supply. In the third year, all K sources out-yielded the check. As shown in **Table 1,** leaf concentration of K decreased from the first to the third year.

At the Paraguaçu Paulista site, the soil is a very low fertility cerrado. There was no response the first year despite low levels of soil K, but there was response the second year as shown in **Table 2**. Appar-



VISUAL DIFFERENCES in the quality of soybean seeds with adequate (left) and inadequate (right) K nutrition.



VISUAL DIFFERENCES in the quality and number of pods on the stem of soybean plant due to adequate (left) and inadequate (right) K nutrition.

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Table 1. Effect of application of different sources of K on soybean yield and leaf K concentration at Mococa.

Treatments	Soybean yield, kg/ha 3rd yr.	K in the leaves, % 1st yr.	2nd yr.	3rd yr.
T_1	2,683	3.0	2.1	1.0
T_2	3,220	3.1	2.6	1.8
T_3	3,087	3.0	2.5	1.3
T_4	2,875	3.0	2.7	1.5
T_5	3,212	2.8	2.8	1.5

Table 2. Effect of application of different sources of K on soybean yield and leaf K concentration at Paraguaçu Paulista.

Treatments	Soybean yield, kg/ha 2nd yr.	K in the leaves, % 1st yr.	2nd yr.
T_1	1,050	2.1	0.74
T_2	1,758	2.8	1.53
T_3	1,722	2.2	1.50
T_4	1,697	2.9	1.50
T_5	1,622	2.2	1.65

ently, decomposition of remaining shrubs and grass released K which satisfied the needs of the soybeans. In the second year, there was a response.

All sources of K produced similar yields and surpassed the yield of the check. In the check plots, there were leaf symptoms of K deficiency. This K deficiency affected seed quality, as shown in the photo. There was a similar decrease in K concentration in the leaves from the first to the second year as observed at Mococa.

It is interesting to note that since vinasse was applied annually, one would expect a higher yield and higher concentration of K in the leaves when compared with other treatments. This did not occur. The results obtained by the research workers of the Pedology Department of IAC showed that due to heavy rains in the summer, more than 60 percent of K is usually leached out. Note in the photo the well developed pods nourished with K fertilization. In the absence of K, the raceme shows the lack of pods, malformation, pods without seeds and white color of young pods.

This study found that all four sources of K had similar effects on soybean response to fertilization. ■

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Conclusions

The major conclusions that can be drawn from these trial data are:

- Cane yield of unfertilized plots declined with older ratoons. The lower yields in the third crop cycle were largely due to lower rainfall.
- Mean yield responses from K fertilizer were significant and constant from crop cycle to crop cycle.
- Responses were obtained each year, with proportionally larger responses in fourth and fifth ratoons of the second and third crop cycles.
- Exchangeable K in soil gradually declined in fertilized plots, although the decline was greater in the unfertilized plots, particularly in the first crop cycle.
- NEAK levels in soil of the unfertilized plots are also declining, but at a modest rate considering the amount of K removed by each crop.
- Fertilized plots were less acid than the unfertilized plots in 1989.

Industry Significance

The significance of these results is that applications of K fertilizer are necessary to maximize yield, even on this soil type which has high reserves of K. There is little concern at this stage that exchangeable K levels are declining in the fertilized plots, for yield responses appear stable between crop cycles. Higher applications of K fertilizer do not appear to be warranted. ■