# Potassium for Soybeans

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**Development of new land and improvements to traditionally-farmed areas are responsible for the unprecedented growth of Brazil's soybean production sector. The region's climate is favorable, but the intense weathering of its soils has resulted in low cation retention and exchange. The role of potassium (K) and its management, particularly in terms of adequate application, is critical for success in soybean cropping.**

After nitrogen (N), K is the nutrient absorbed in the next largest quantity by soybean plants. A large portion of plant K is partitioned to the seed, hence substantial quantities are exported from the field each year in harvest. About 20 kg of $K_2O$ is contained in 1,000 kg of soybean seeds. By 1986/87, most soybean farms in São Paulo State were affected by soil K deficiency.

This situation was primarily a reflection of a 20-year reliance on indiscriminate use of low analysis fertilizers. Farmers typically applied 300 kg/ha of either 0-20-10 in the northeast or 4-30-10 in the southwest, thus supplying only 30 kg $K_2O$/ha, or enough to resupply the amount of K removed in 1.5 tonnes (t). Average yields in the mid 1980s were about 1.8 t/ha. Now that yields are much higher (2.6 t/ha), simple nutrient K input/output balance rules must be considered.

Photo 1. Symptoms of K deficiency on the leaves of soybean plants at flowering.

Local field research has since provided guidance on best K management practices…including the recommendation for 30 kg $K_2O$/ha as a basal application and an additional 30 or 40 kg applied as a side-dressing 35 days after planting. This practice has been especially relevant for sandy soils prone to leaching. These problems are also being addressed by the popular movement towards no-tillage farming practices.

Photo 2. Symptoms of K deficiency at maturity. Soybean plants have mature pods, but green stems would delay harvesting.

Low soil K concentrations expose symptoms of K deficiency in soybean leaves. Acute shortages can, at maturity, cause green stems, foliar retention, and formation of parthenocarpic (seedless) fruits (**photos 1, 2, 3 and 4**).

Because K influences nodule formation (and thereby biological N fixation) as well as various fungal diseases, insufficient nutrition compromises plant health. Several diseases can cause problems. *Phomopsis* causes premature drying of pods and stems (**photo 5**). *Cercospora kikuchii* is responsible for leaf blight and purple stain in seeds (**photo 6**). *Diaporthe phaseolorum f.* sp *meridonalis* is responsible for stem canker disease (**photo 7**).

Stem canker is better controlled in early maturing soybean cultivars as compared to medium or late maturing cultivars since their short duration maturity (110 and 120 days) reduces the likelihood of exposure to infection during the most susceptible R3 and R4 stages.

Inadequate soil K supply can be avoided by maintaining both a proper supply and balance among soil nutrient cations...calcium (Ca), magnesium (Mg), and K...competing for plant uptake. The equation commonly used to

**Table 1.** Soil analysis of areas cultivated to soybeans in southwest São Paulo State, Brazil, 1986/87.

| Location | pH in $CaCl_2$ | Organic matter, g/dm³ | P mg/dm³ | K | Ca | Mg | Base saturation, % | Ca + Mg / K Index |
|---|---|---|---|---|---|---|---|---|
| | | | | ------- mmol$_c$/dm³ ------- | | | | |
| 1. Florínea[1] | 5.8 | 34 | 22 | 4.2 | 153.2 | 38.8 | 86 | 46 |
| 2. Cruzália[2] | 5.2 | 20 | 89 | 3.0 | 35.2 | 19.0 | 61 | 18 |
| 3. Cruzália[2] | 5.2 | 32 | 100 | 3.8 | 35.6 | 19.4 | 63 | 14 |
| 4. Cruzália[2] | 5.2 | 18 | 78 | 2.2 | 39.3 | 18.2 | 63 | 26 |

[1] Dark Red Latosol
[2] Ortho Dark Red Latosol

**Photo 3.** Symptoms of K deficiency in soybean plants showing foliar retention and green stems which would delay harvesting.

**Photo 4.** Symptoms of K deficiency in soybean plants at maturity; pods with few seeds and parthenocarpic fruits.

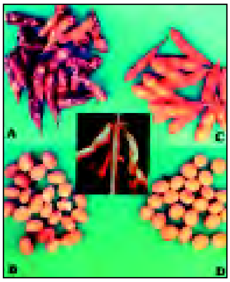

**Photo 5.** Incidence of *Phomopsis* sp. in soybeans pods (A) and loss of seed quality (B). Control of disease with K fertilization with healthy pods (C) and seeds (D). Center image shows stem with pycnidia and dry, empty pods.

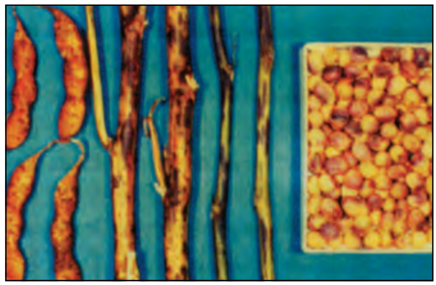

**Photo 6.** Symptoms of *Cercospora kikuchii* in seeds (purple seed stain), stems and pods of soybean plants.

describe this balance is:

$$\text{Index} = \frac{Ca+Mg}{K}$$

Repeated analysis of the relationship between Ca, Mg, and K suggests the optimum range of index falls between 23 and 28. Farmers can expect varying degrees of K deficiency once this range is exceeded.

**Table 1** presents example soil analyses data from four soybean fields in the counties of Florínea and Cruzália, located in the southwest region of São Paulo. The soil at Florínea tested high in available K, Ca, and Mg, but produced an index value of 46, enough evidence to generate a recommendation for K along with phosphorus (P), which tested in the medium range. Sites 2 and 3 at Cruzália produced similarly narrow indexes of 18 and 14, respectively.

Given the soil test levels, the recommended strategy for these two locations would be to monitor the effect of K removal and its impact on the index. The index value of 26 for the fourth site at Cruzália provides an example of this proper cationic balance. BC

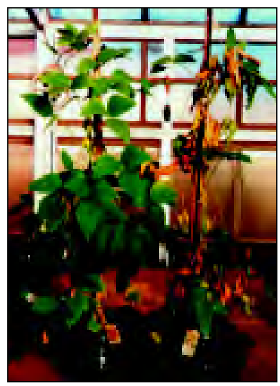

**Photo 7.** On the left are soybean plants inoculated with *Diaporthe phaseolorum*, showing tolerance to stem canker with 60 kg $K_2O$/ha (base saturation index of 40%). At right, severe symptoms of stem canker are shown in inoculated control plants.

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## Reference:

For more on this topic, visit the Scientia Agricola website **>www.scielo.br/sa<.** Look for the paper titled "Calcário e Potássio para Cultural de Soja" ("Lime and Potassium for the Soybean Crop"), Vol. 57, No. 3, p. 445-449.