Research in Israel

Foliar Feeding of Potassium Nitrate in Cotton

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In high-yielding cotton varieties, more than three-fourths of the potassium (K) can be partitioned to fruiting structures (bolls). When K is limiting late in the season, foliar deficiency symptoms develop which are not typical. They occur on young leaves rather than older leaves. This study reinforces the contention that, under limiting soil conditions, foliar application of K during boll fill can supplement the K demand of the developing boll.

RECENT WORK in Arkansas has demonstrated the beneficial effect of foliar feeding of potassium nitrate (KNO_3) in cotton. California research has shown that cotton grown on vermiculitic soils exhibits K deficiency symptoms during periods of high demand for K transport to the developing boll.

The dominance of fruiting structures as a sink for K is well known. Plants of high-yielding varieties have been shown to partition as much as 78 percent of total plant K to fruiting structures. Acala varieties had only 60 to 65 percent of total plant K in fruiting structures at an equivalent stage of development.

Economic yields of cotton depend on optimal fiber growth. Potassium has a key role in fiber quality and is the most abundant mineral nutrient in fibers. With the cotton plant sensitivity to K shortages, several anomalies are associated with the occurrence of late season K deficiencies.

- Foliar symptoms are not typical of K deficiency and appear first on young, rather than old leaves.
- Soil test values do not always accurately reflect availability of soil K to cotton.
- Soil application of up to 700 lb/A K_2O does not eliminate foliar K deficiency symptoms in severely affected fields in California. Late-season K deficiencies have been estimated to limit lint yield on over 200,000 acres, about one-fifth of the cotton acreage in the San Joaquin Valley.

In irrigated, high-yield cotton, maximum K uptake rates range from about 3 to 5 lb of K/A per day. Potassium is a relatively immobile ion in soil. Its movement to plant roots depends mostly on diffusion. The rate of K uptake is dependent on root length, density, and total root surface area. Cotton is distinguished by its low density root system, further complicating K uptake.

Potassium Absorption by Cotton Foliage

The capability of cotton leaves to absorb foliar applied nutrients is limited because of the cuticle barrier. It is impossible, as trials have shown, to feed plants solely via the leaves and to bring them to full development and adequate fruit formation. However, foliar fertilization can be used to satisfy acute needs for supplemental nutrients.

Factors affecting foliar absorption of nutrients include: leaf age, relative position of "source leaf" to bolls, nutritional status of the plant, and certain environmental factors.

In these investigations of foliar absorption, a short-lived radioisotope ^{42}K (half

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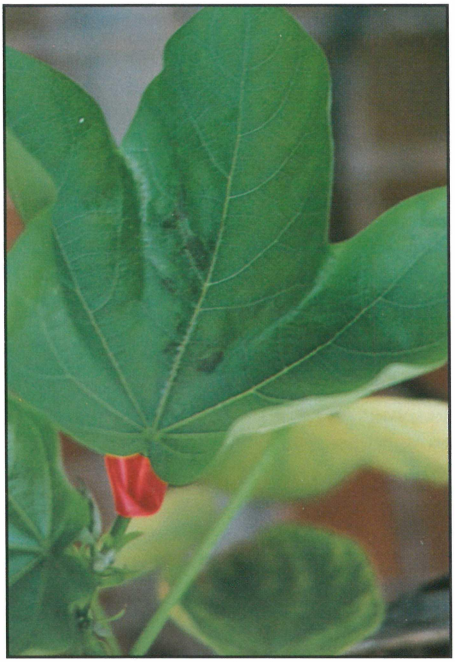

Figure 1. Radioactive $^{42}KNO_3$ was applied as a solution along the midrib of the cotton leaf.

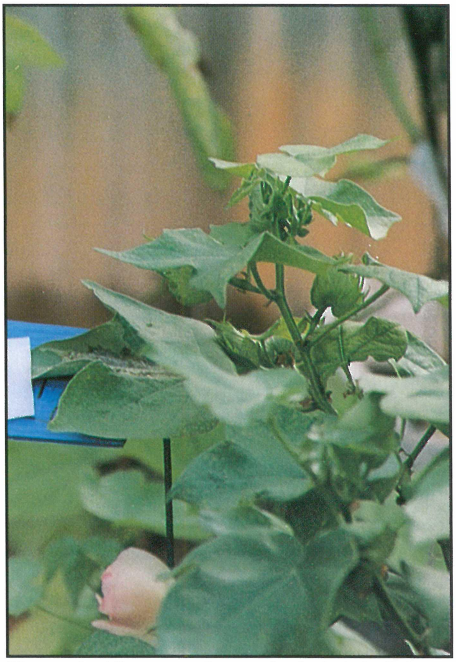

Figure 2. The experiment included boll-bearing plants (above) as well as young plants.

life of 12.4 hours) was utilized and its uptake and movement to the sinks of the developing boll and other plant parts followed. Radioactive $^{42}KNO_3$ was prepared by dissolving potassium carbonate ($^{42}K_2CO_3$) in dilute nitric acid (HNO_3) and applying the solution by micro pipette along the mid rib of the cotton leaf (**Figure 1**).

Twenty hours after foliar application, the treated leaf was removed to prevent high background activity. The radioactivity in other plant parts was recorded by a portable detector. The treatments were conducted on boll-bearing plants (**Figure 2**) as well as on young plants. The activity found in the plant parts demonstrated that ^{42}K is penetrating the leaf cuticle and is transported from the leaf to the young developing tissue.

The plant parts that demonstrated the highest activity are described in **Table 1**. High activity levels were found in the developing tip and developing bolls. The transport of K from the leaf to other organs was occurring within 20 hours of application, emphasizing that the developing organs are a strong sink for K from the leaf. These data reinforce the conclusion that when the soil K supply is limited, foliar spray of K during the boll-filling period can supplement the heavy demand of the developing boll. ■

Table 1. Radioactivity in plant parts 20 hours after ^{42}K applications to the young mature leaf.

Plant number	Boll	Leaf	Tip	Tip leaf
	(cpm)			
4	11,500	40,000	—	—
5	20,000	—	10,000	—
7	10,000	—	2,000	—
8	800,000	115,000	250,000	—
9	19,000	150,000	18,000	15,000