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Reassessment of Potassium Critical Values

Project Leaders Patrick Brown and Steven Weinbaum

Cooperating Personnel Roger Duncan and Edwin Reidel

Objective 1:
To reassess leaf K critical values – that is, the leaf K concentration below which yields are affected adversely; also to determine the relative sensitivity of the various yield parameters to K insufficiency.

Progress
By differential fertilizer application rates we achieved a wide range of July leaf K concentrations (table 1). Individual tree values ranged from 0.5 – 2.1%. There was, however, no relationship between July leaf K concentration and yield this year, as compared to baseline (1998) values.

Table 1. Leaf K values as affected by potassium fertilizer treatments (n = 24 or 25).

Treatment (lbs K · acre^{-1})	Average Leaf K (%)	Significance*
800	1.68	a
500	1.58	b
200	1.33	c
0	0.74	d

* Means followed by a different letter are significantly different according to a separation of means by Duncan's Multiple Range Test ($p < 0.05$).

Despite the lack of a correlation between July leaf K concentration and yield this year, we anticipate a positive relationship between leaf K concentration and yield next year. Inadequate availability of nutrients may affect yield determinants in the current year (percentage fruit set and fruit size) or, more likely, in subsequent years (flower and fruit number).

We selected individual limbs on trees from the control and 800 pounds K per acre treatments to monitor the influence of potassium on yield components. Our observations revealed less growth and renewal of fruiting wood, in addition to premature leaf abscission on low K trees (table 2). Classic potassium deficiency symptoms at the tree tops accompanied the observations on fruiting spurs.

Table 2. Yield parameter observations from individual branches.

Observation	Minus K	High K	P
Percent Fruit Set – 1999	27	26	not significant
Percentage of Spurs in Decline	5	1	0.003
Nodes per Shoot	0.56	1.40	0.033

If spurs are impaired by K deficiency, the effects would be lower fruitfulness and more rapid mortality. Additionally, the observation of fewer nodes per shoot in fruiting areas of the canopy may lead to decreased fruit production on shoots and less spur renewal. Both observations point to lower yield in future growing seasons. We will monitor the return bloom on labeled branches for a relatively greater reduction in flower number. We will also monitor spurs tagged this year for signs of decreased productivity next year.

Objective 2:
To obtain seasonal patterns of leaf K concentration and establish early season critical values.

By sampling leaves and fruits frequently throughout the season, we can determine their patterns of accumulation/depletion of potassium (seasonal curves) on a concentration (%) and mass (weight in grams) basis. We will generate four curves based on the differential K+ application rates. We may then be able to predict July leaf K+ concentrations from early season samplings.

Progress
Until a relationship between leaf K concentration and yield emerges we cannot offer an early season value that would predict sufficiency or deficiency. Additionally, potassium-related yield decline will be correlated to values from previous years, rather than current-year test results

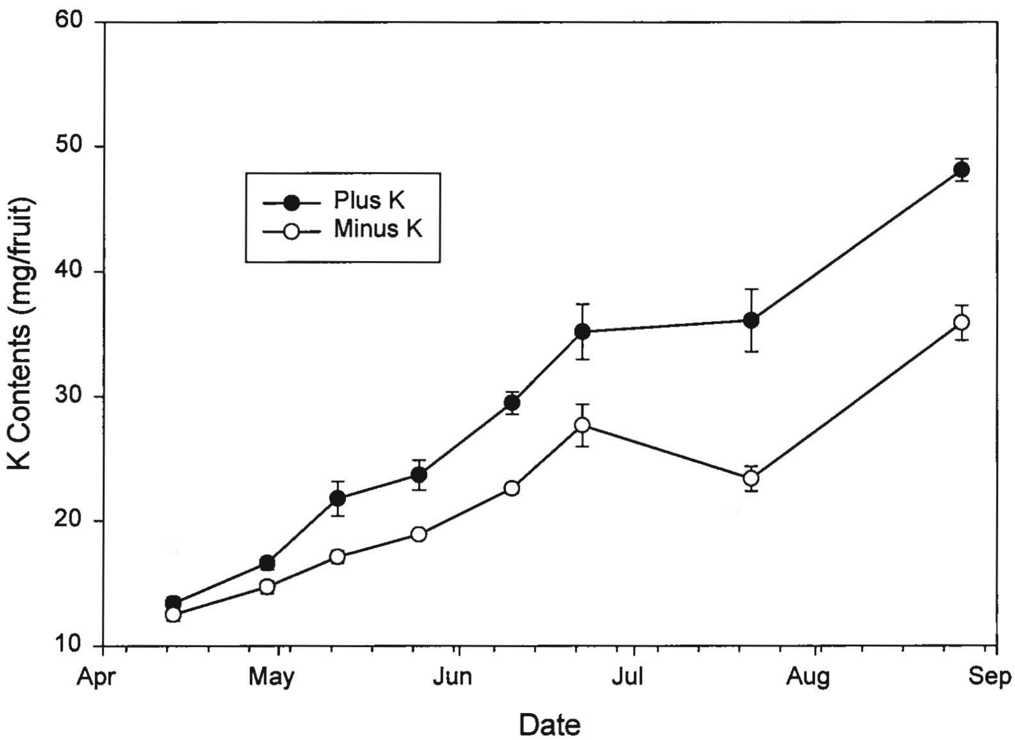
Objective 3:
To assess the impact of crop load on leaf K critical values.

Expanding leaves are potassium "sinks" in the spring, meaning they accumulate potassium. They are presumed to become potassium "sources" later in the season, because some of the potassium contained in leaves may be redistributed to developing fruit. It follows, then, that a heavy crop load (higher fruit:leaf ratio) may demand more leaf potassium than a light crop load (provided that soil uptake cannot satisfy the total fruit K+ demand). This difference in fruit K+ demand would be reflected in leaf K+ concentration, thus trees with heavy crops may have lower leaf potassium concentrations than trees with lighter crop loads.

Progress
In April of 1998, we chose 10 heavily-cropped 'Monterey' trees and removed (thinned) two-thirds of the fruit from five of them. In April of 1999, we performed the same treatment on 'Nonpareil' trees, removing approximately half of the fruit. Samples taken at the time of thinning, and monthly thereafter, revealed no differences in leaf K+ concentration. We propose that crop load, even under conditions of low potassium availability, has no effect on leaf K values.

Objective 4:
To determine the seasonal patterns of K accumulation and the magnitude of K demand by fruit, leaves, and perennial tree parts.
Progress
Frequent samplings of fruit from the treatment extremes confirmed and added detail to our previous findings that potassium uptake by fruit is substantial and continuous through the growing season (figure 1).

Figure 1. Accumulation of K in fruit during the 1999 growing season.



Although fruits from non-fertilized trees accumulated substantially less potassium than those receiving high fertilizer rates, there was no difference in kernel weight between the groups. The lower uptake rates and total accumulation are attributable mainly to lower potassium contents in the hulls of fruits from controls (table 3).

Table 3. Potassium contents of almond fruit sections near harvest (August 26, 1999).

	K Contents Of Fruit Fractions ($mg\ K \cdot fruit^{-1}$)		
Treatment	**Hull**	**Shell**	**Kernel**
No K	23	7.0	6.3
High K	33	8.2	6.7