Leaf Potassium Critical Values and Potassium Sensitive Yield Determinants in Almond

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Summary

The currently-accepted potassium (K) critical value in almond appears to be based primarily on leaf symptomology and orchard surveys rather than experimentally-determined values which associate inadequate K availability with yield reduction. Our objectives, therefore, were to reassess the validity of the critical value and determine how K deficiency impacts yield as well as the time frame over which that impact occurs. Work conducted in 1999 and 2000 indicated that percentage fruit set and weight per nut were not reduced by K deficiency. Thus, during the onset year of K deficiency, yield is not likely to be impacted. We also reported that survival of fruiting spurs was much lower than that of non-fruiting spurs and was further reduced by K deficiency. Processes sensitive to K deficiency which may impact yield in the subsequent year include reduced axillary flowering and fruiting e.g., in 2001 on shoots which grew the previous year (2000) and on spurs. Shoot growth was reduced in 2001 as was the number of new spurs on shoots produced in 2000. In reassessing the K critical value over the last few years, we have observed no yield advantage when leaf K concentrations averaged as high as 1.7% K. Therefore, we propose no change in the currently- accepted leaf K critical value of 1.4%.

Results

Table 1 indicates the leaf K concentrations and yields recorded since the experiment was initiated. As a result of the differential rates of the K application initiated in 1998, and the relatively low tree K status at that time, K deficiency occurred in 1999. There was a time lag of one year between the onset of K deficiency in 1999 (as indicated by leaf K conc. < 1.0%) and a significant yield reduction among non- fertilized trees which occurred in 2000. Some parameters, such as percentage fruit set and nut weight, are not affected by K deficiency (see last year's proceedings). Others parameters may impact yield after one or more years. If K deficiency continues unchecked, the severity of yield reduction is likely to increase annually as more and more yield-dependent parameters are influenced. Thus, flowering and fruiting on shoots which grew the previous year and spurs more than one-year-old were reduced one year after the onset of deficiency. Longer term consequences may follow the reduction in shoot growth. The onset of K deficiency occurred in 1999, a significant reduction in shoot elongation presumably occurred (but was not measured) in 2000, and we measured a 40% reduction in spur renewal per tree on those shoots in 2001 (Table 2). Shoot growth per tree declined by about 20% in 2001 (Table 2). We would anticipate a significant reduction in spur renewal, i.e., the number of new spurs on those shoots in 2002 and reduced fruiting of those spurs in 2003.

Yield is primarily a function of nut number per acre and is influenced primarily by the number of fruiting spurs. That number is influenced by the dynamics of spur death and spur renewal (i.e. new spur formation) as well as the ratio of fruiting to vegetative spurs among the current spur population. The lack of an apparent impact of K deficiency on yield in 2001 (Table 1), may result from the natural alternate bearing rhythm. The yield of low K trees may have received a boost in 2001 as a result of the fruiting of many spurs which had been vegetative in 2000.

Three plots of leaf K concentrations in 1999 and 2000 against yields in 2000 and 2001 do not indicate any apparent advantage to increasing the critical value above 1.4%.

Conclusions

1) There was no apparent yield advantage associated with leaf K concentrations above 1.4%. Therefore, we propose no change to the existing leaf K critical value.

2) K deficiency does not affect production during the year of onset because flower number is determined the previous year and percentage fruit set and weight per nut are unaffected by K deficiency.

3) Flower number and yield will decline in subsequent years as a result of K deficiency. Yield is reduced as a result of the combined effects of reduced flowering and fruiting on shoots and spurs, reduced survival of fruiting spurs*, reduced shoot growth and reduced spur renewal. The reduction of shoot growth in 2001will likely impact yield in 2002 as a result of a reduction in flowering on those shoots. Spur renewal on those shoots will also be reduced in 2002, and the reduced flowering of those new spurs will likely limit yield in 2003.

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*We reported last year that leaf K concentrations below 0.7% K were associated with a reduction in leaf photosynthetic capacity and premature leaf fall on fruiting spurs. We suggested that these factors were likely contributors to the reduced survival of fruiting spurs on low K trees. Furthermore, the leaf K concentration of fruiting spurs is often 0.2 % to 0.3% lower than the leaf K concentrations of non-fruiting spurs on the same tree. Thus, a leaf K concentration of 1% in non-fruiting spurs is likely to equate to 0.7% K in fruiting spurs.

Table 1. Summary of treatments, July leaf K concentrations from non-fruiting spurs and yields during the course of this experiment.

Treatment (lbs K/acre)	Leaf K Concn. (% dry wt)				Yield (meat lbs/acre)			
	Year 1998	Year 1999	Year 2000	Year 2001	Year 1998	Year 1999	Year 2000	Year 2001
0	1.1	0.7	0.7	0.6	800	3900	2300	2900
200	1.3	1.3	1.2	1.2	900	3800	2600	3000
500	1.3	1.6	1.4	1.6	800	4400	2700	3000
800	1.3	1.7	1.7	1.9	1100	4000	2600	2800

Table 2. Effect of tree K status in 2000 on yield, nut weight, % axillary fruiting, total shoot growth per tree and total spur renewal per tree in 2001.[z]

Parameter	High K trees	Low K trees	% reduction in low K trees
Yield (meat lbs/acre)	2777	2483	10.4%
Nut size (wt/shelled nut) (g)	1.01	0.99	not affected
Axillary [y] fruit (% of total crop)	12.1	9.5	21.5%
Shoot growth (ft) per tree	336	227	17.6%
New spurs [x] per tree	2464	1466	40.7%

[z] Data based on three high K (avg. leaf K conc. 1.5%) and three low K (0.72% K) trees.
[y] The percentage of crop produced on shoots which grew in 2000.
[x] New spurs produced on shoots which grew in 2000.

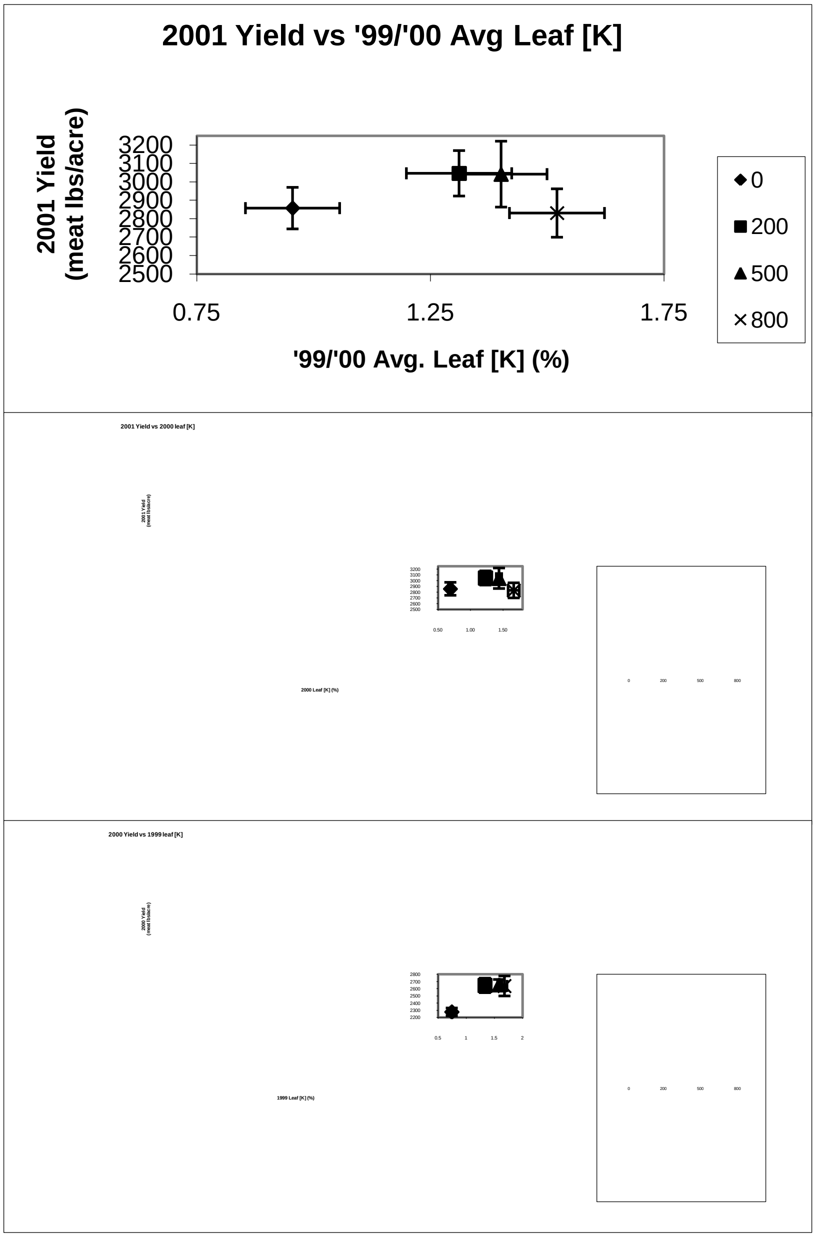

Figure 1. Relationship between tree K status (July leaf K concn. of non-fruiting spurs) and yield (meat lbs/acre) in subsequent year(s).