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Potassium Boosts Almond Yields Via Irrigation

Yield differences over control are significant in micro-sprinkler system but not in single- or double line drip systems.

***Summary:** Almond meat yields in 1997 were different between treatments under the micro-sprinkler system, but there were no significant differences between treatments in the single- or double-line drip irrigation systems. There was a consistent trend for all potassium treatments to give higher yields than control under the micro-sprinkler system. Yields did not show a consistent trend as rates of potassium were increased, particularly with injected potassium sulfate (K_2SO_4) and mono-potassium phosphate (MKP). Banded K_2SO_4 under the micro-sprinkler resulted in good yields compared to other sources and rates', whereas banded K_2SO_4 did not yield as well under single- or double-line drip systems.*

Declining leaf potassium (K) levels in high-yielding irrigated almond orchards on the West side of the Sacramento Valley and other areas of the state have given growers cause for concern on how best to apply K. Irrigation is accomplished with different systems that apply water to a limited soil volume or wetted area up to flooding the entire soil surface and wetting all of the soil.

Fertilizers generally are banded or broadcast before irrigation or winter rains, or applied through irrigation to help place nutrients in wetted soils, or move them into the soil where plant roots will contact the potassium. Good uptake by trees has been reported in low-volume irrigation systems or those with smaller wetted area systems, even though K does not readily move in the soil. Because some fertilizers are not dissolved easily or water quality prohibits trouble-free injection, growers are using soil applications as an alternative. However, the availability of several new liquid K formulations (e.g., sulfate, phosphate, and thiosulfate) makes it easier to inject into irrigation systems.

Given the above history, it seemed prudent to evaluate the relative efficiency of K uptake from several sources and methods of placement. The objectives of our experiments are to:

1) determine how different placement, sources, and rates of K applied through single-line, double-line, and micro-sprinkler irrigation systems affect almond yields, growth, and nutrient concentrations of leaves

2) assess the extent of K movement in soil under different placement, source, and rate of application through the three irrigation systems.

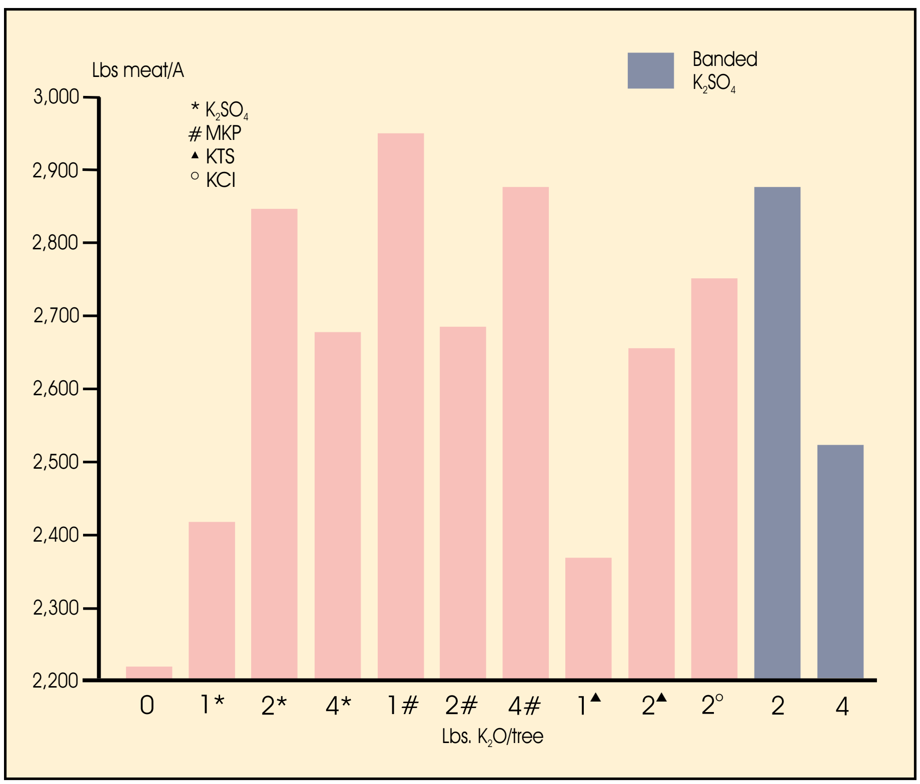

Figure 1. Almond meat yields from banded K_2SO_4 versus and rate of K injected through micro-sprinkler irrigation system at Nickels Soil Laboratory, Meyer, et al., 1997.

Systems compared

Yields. Average almond yields in response to K for the three irrigation systems were: 2,400 meat lbs/A for single-line drip, 2,445 meat lbs/A for double-line drip, and 2,619 meat lbs/A for micro-sprinkler.

Average yield for the NonPareil variety was 2,213 meat lbs/A, and for the Butte variety significantly higher at 2,763 meat lbs/A.

As seen in Figure 1, almond meat yields in 1997 were significantly different between treatments under the micro-sprinkler system. This was not the case in the single- or double-line drip irrigation systems shown in Figures 2 and 3. Note also that there was a consistent trend for all K treatments to give higher yields than control under the micro-sprinkler system. As K rates were increased, yields did not show a consistent trend, especially with injected K_2SO_4 and MKP. It is interesting to note that banded K_2SO_4 under micro-sprinkler produced good yields compared to other K sources and rates, but did not yield as well under the other two irrigation systems. This would be expected under the drip systems, since the irrigation water was not wetting the area where the K had been banded. Only winter rains would have wetted the soil and provided for some uptake of K early in the spring.

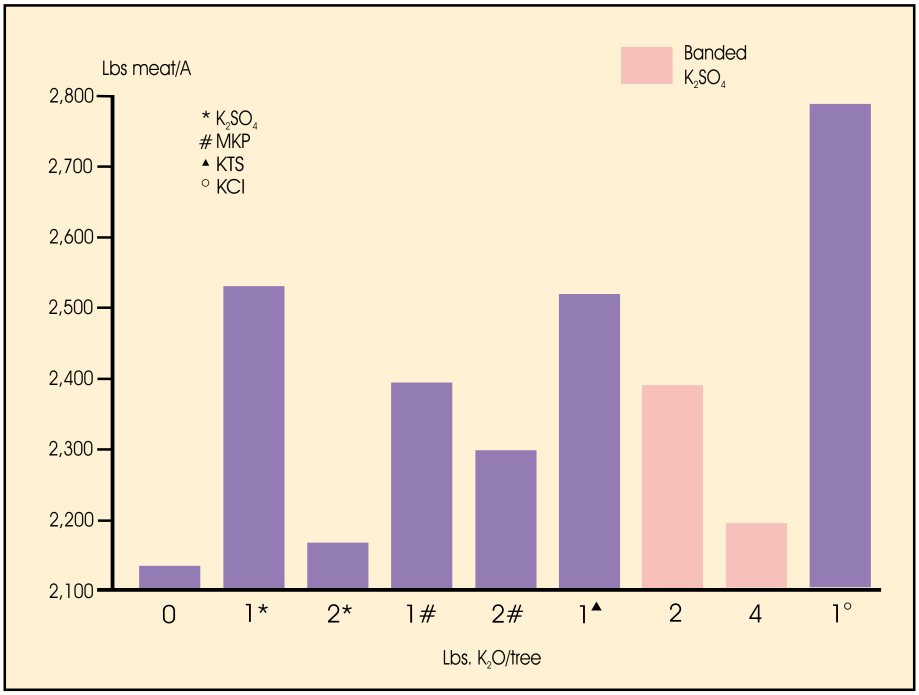

Figure 2. Almond meat yields from banded K_2SO_4 versus source and rate of K injected through single-line drip irrigation system at Nickels Soil Laboratory, Meyer, et al., 1997.

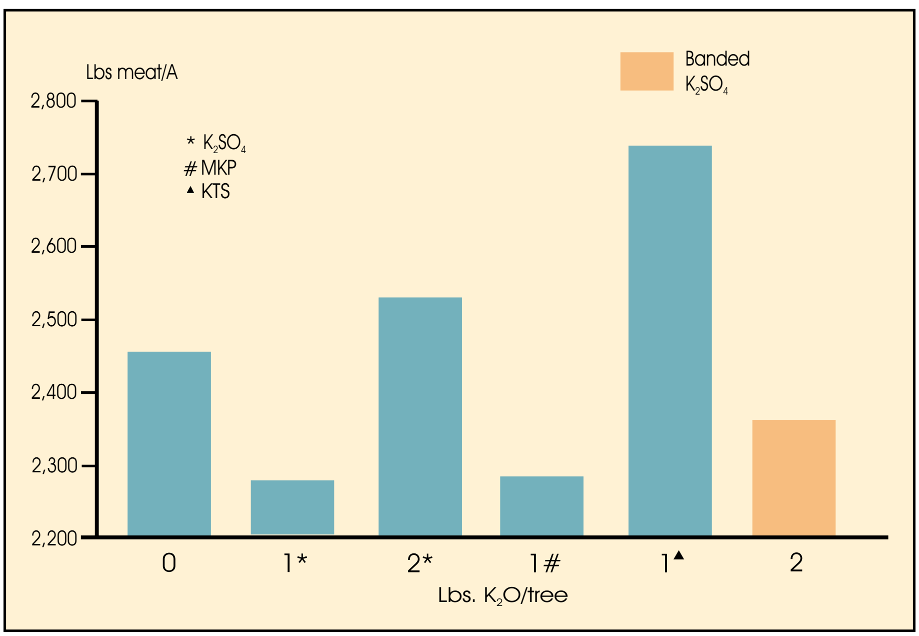

Figure 3. Almond meat yields from banded K_2SO_4 versus source and rate of K injected through double-line drip irrigation system at Nickels Soil Laboratory, Meyer, et al., 1997.

Leaf concentration. Highest leaf K concentrations of more than 2.0 percent were recorded in April and October samples under the micro-sprinkler system. In general, leaf K concentrations were higher in April and October than in July, except for the double-line system where July and October concentrations were more similar. Leaf K concentrations reflect the K availability of fall banded fertilizer as April leaf levels were fairly high for all banded treatments. These levels dropped somewhat in the July leaf samples, and increased to some extent in the October leaf samples for all irrigation systems, but particularly in the micro-sprinkler treatments.

There was a fairly consistent trend of leaf K concentrations to increase over control for all injected treatments under the single-line drip system. Banded treatments had somewhat higher K concentrations than control in April, but not in the July or October leaf samples. Leaf K concentrations were not significantly different in the April and October samples under the double-line drip system, but indicated some increases over control, particularly the injected K_2SO_4 treatments in the July samples.

Under the micro-sprinkler system on all three sample dates, there was a consistent trend for all K treatments to result in higher leaf K concentrations versus control. Under this system, leaf K concentrations on any of the three sample dates did not show a consistent trend as rates of K were increased, especially with injected K_2SO_4 and MKP.

As might be expected, KCI increased K concentrations in leaves. Chloride levels also increased, although not to concentrations high enough to affect tree production.

Design and treatments

Fertilizers. Liquid K_2SO_4 was applied as 1-0-8, potassium thiosulfate (KTS) as a liquid (0-0-25), and MKP as a dry granular added to water. KCl was dissolved in water and applied as a liquid. Although KCl is the most economical source of K, the addition of chloride represented a potential detrimental effect. A preliminary experiment with 9 rates of KCl indicated no toxicity. Therefore, when the product was included in our large study, it was applied at one-quarter the highest rate used in the earlier study. Dry granular potassium sulfate (0-0-50) was fall applied on soil's surface in a band approximately 3 to 4 inches wide, approximately 4 feet from tree on both sides of tree row.

Timing. To improve uniformity of application, the two main irrigation systems—one for drip (both single-and double-line) and one for micro-sprinkler—were turned on approximately 3 hours before any fertilizer was injected. Liquid materials were split injected during May and June in two to four applications. Treatments for the three systems were randomly assigned.

Injectors. Liquid injection systems were designed, built, and installed to inject fertilizer for each 5-tree plot. Injection cylinders were 6 inches in diameter and constructed at various lengths to accommodate different volumes of liquid fertilizer having a range in K concentration.

Replications. Since there was an uneven number of plots for the three irrigation systems, the trial was initiated with the following replications: single-line drip, 4; double-line drip, 2; micro-sprinkler. 2.

Plots. Each plot size was 5 trees with a 15-foot in-row spacing and 20 feet between rows. There were 72 plots.

Varieties. NonPareil and Butte varieties were used in our K experiments on almonds.

Soil was an Arbuckle gravelly loam (Fine-loamy, mixed, thermic Typic Haploxeralf) having a pH just below neutral (6.7).

Location. Experiments were conducted at the Marine Avenue location at Nickels Soil Laboratory, Arbuckle, California.

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