Correcting potassium deficiency in prune trees is profitable

William H. Olson □ Kiyoto Uriu □ Robert M. Carlson
William H. Krueger □ James Pearson

Even a slight deficiency can be costly. A single application of potash fertilizer can correct the deficiency for three to four years.

Potassium deficiency, or "prune dieback," occurs in many Sacramento Valley prune orchards each year. Uncorrected deficiency could affect hundreds of acres in the valley, the center of California's prune-growing district.

Symptoms usually first appear in July as the fruit begins to color and become pronounced as prune harvest approaches in August. Visual symptoms in slight cases are characterized by leaf yellowing and marginal leaf burn. In severe cases, defoliation and limb dieback occur, resulting in reduced fruit quality.

The prune tree presents a unique potassium nutrition problem in that several factors operate to produce deficiency. Prunes are a strong sink for potassium, and a heavy fruit set therefore creates increased demand for the nutrient. The fruit we have analyzed has had about a 1 percent potassium concentration in the flesh. In addition, many of the fine-textured alluvial soils common in the Sacramento Valley are low in available potash. Problems also occur in cut areas caused by land grading or leveling; because levels of available potassium are usually greater in topsoil than in subsoil, cut areas generally have lower potash concentrations than do fill areas. Also, the ratio of other nutrients, such as calcium or magnesium, to potassium in the subsoil may in some cases have a negative influence on potassium availability.

Potassium deficiency in prune orchards can often be corrected by the addition of potassium-containing fertilizers to the soil. A single soil application of about 20 pounds of potash fertilizer per tree has corrected the deficiency for three or four years in most cases. The application of several potassium nitrate foliar sprays during each growing season also corrects deficiency symptoms.

These materials and their application, however, are costly to growers. Recommended rates of soil-applied potassium fertilizer can cost nearly $300 per acre. Four to five foliar sprays of potassium nitrate could cost as much as $70 to $90 per acre per season. These high costs often prevent growers from applying recommended rates of potassium fertilizers, leading to partial or no correction of deficiency symptoms.

We conducted a study to demonstrate the effects of good potassium nutrition of prune trees and to determine whether the expense of applying recommended rates

Leaf scorch is evident on a prune tree showing only a slight deficiency in potassium (left). The tree at right, rated severely deficient, suffers both leaf scorch and branch dieback. Growers sometimes ignore deficiency symptoms because of the high cost of correcting the condition, but these tests showed that treatment would be profitable.

of potassium fertilizer to prune trees could be recovered by increased production and fruit quality. The study investigated the relationships between visual potassium deficiency symptoms, leaf potassium levels, and fruit quality and evaluated the safety of using the less expensive, but more toxic potassium chloride instead of potassium sulfate for correction of potassium deficiency on prunes.

Field study

The 5-acre, soil-applied potassium fertilizer trial took place during 1980-83 in a northern Butte County prune orchard. The orchard was six years old when the trial began, and trees were uniform in size and appearance. Potassium chloride (KCl) at rates of 0, 6, 12, 18, and 24 pounds or potassium sulfate (K_2SO_4) at 0, 7, 14, 21, and 28 pounds per tree was drilled into the soil during the winter of 1981.

During evaluation of different rates of potassium chloride and potassium sulfate, the prune trees showed levels of potassium deficiency ranging from severe defoliation and limb dieback to no deficiency symptoms.

In July 1981, 1982, and 1983, we rated the trees visually for potassium deficiency symptoms using a numerical system. Since the effects of the potassium treatment appeared to be complete in 1983, that year's rating is used in this report. For clarity, we have converted the numerical rating system to four potassium symptom categories: no symptoms, slight, moderate, and severe. Within each category except "severe" are three subcategories: average, above average, and below average. The severe category had only two subcategories, since below average would be a dead tree. Using this rating, we selected five trees from each subcategory at random from the 5-acre trial to study the relationship between visual symptoms, leaf potassium levels, and various fruit quality characteristics.

Results

Potassium chloride at 18 pounds and potassium sulfate at 21 pounds corrected deficiency symptoms within the second growing season after applications were made. Higher rates of these materials resulted in quicker correction. In this trial location, no adverse effects were observed from the use of potassium chloride. However, under certain conditions such as low winter rainfall or insufficient irrigations, applications on poorly drained soil, or applications other than in the dormant period, these high rates of potassium chloride may result in phytotoxicity.

Visual symptoms of potassium deficiency corresponded well with analysis of leaves collected from the 55 trees in July. Trees with no visible symptoms had leaf potassium concentrations above 1.3 percent, while those in the above-average, slight-potassium-deficiency category had about 1 percent leaf potassium. These two concentrations correspond to the published midsummer potassium levels for prune trees: 1.3 percent is the minimum adequate supply, and 1 percent represents a deficiency. Leaves from trees showing moderate to severe leaf burn and defoliation had leaf potassium levels of 0.5 percent or less. Trees with no visible potassium deficiency symptoms had the largest fruit, highest soluble solids, lowest drying ratio, and greatest dry yield per tree (fig. 1).

By weighing the yield from each tree, categorizing the dry fruit by size, and using the Prune Bargaining Assocation's Schedule of Prices for 1983, we calculated the crop values on trees with differing degrees of potassium deficiency. These values are expressed as dollars per acre for the 55 test trees with different degrees of potassium deficiency (fig. 2). Prune crops from trees with no deficiency ranged in value from $1,000 to $2,500 per acre, while crops from trees severely affected with potassium deficiency were worth less than $250 an acre. A difference of at least $750 per acre was apparent between severely potassium-deficient and nondeficient trees.

Conclusions

If potassium deficiency symptoms are difficult to recognize in an orchard, analysis of leaf samples collected in midsummer will confirm the trees' potassium status. In this trial, fruit size, soluble solids, drying ratio, and dry yield per tree were all reduced by low potassium levels in the tree. These fruit quality measurements were adversely affected, even when trees showed only slight potassium deficiency symptoms.

Value per acre from prune trees with only slight potassium deficiency symptoms averaged about $1,070. Values from those trees showing no symptoms averaged about $1,775 per acre, or an average difference of $705 per acre between trees with no potassium deficiency symptoms and those with only slight deficiency symptoms.

Soil-applied potassium fertilizers cost less than $300 per acre and correct potassium deficiency for three to four years. Maintaining prune trees free of potassium deficiency therefore is not only desirable but also highly profitable.

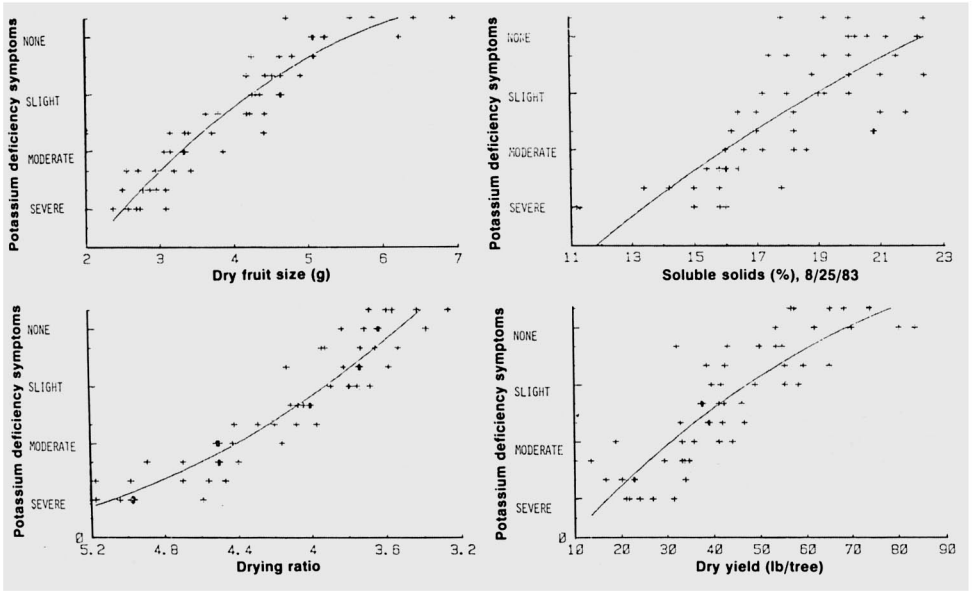

Fig. 1 (above). Prune trees with no potassium deficiency produced the largest fruit, highest soluble solids, lowest drying ratio, and highest dry yield.

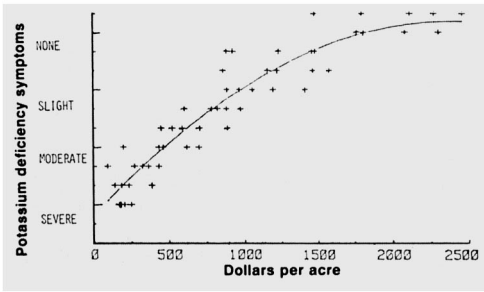

Fig. 2 (right). Prune trees with no potassium deficiency produced higher gross income than did deficient trees.

Willaim H. Olson is Farm Advisor, University of California Cooperative Extension, Butte County; Kiyoto Uriu is Professor and Robert M. Carlson is Pomologist, Department of Pomology, UC Davis; William H. Krueger is Farm Advisor, Glenn County; and James Pearson is Staff Research Associate, Department of Pomology, UC Davis. *The authors thank McGowan Orchards for cooperating in this study.*