

Agronomic and Economic Responses of Mature Kerman Pistachio (*Pistacia vera* L.) Trees to Potassium Applications in California

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Executive Summary

This study was designed to examine the potassium (K) nutritional characteristics of pistachio and to determine the effects of K fertilization in pistachio production. This study also serves to provide California pistachio growers with the K fertilization and diagnostic guidelines to improve K fertility of orchard soils.

Results demonstrate that soil K applications are essential for optimal pistachio production and that levels of K application and currently accepted tissue diagnostic criteria are inadequate.

This study indicates that optimal productivity in high yielding orchards requires an annual K fertilization of 100-200 lbs K/acre and that leaf K values of 1.6% should be present in July/August leaf samplings. These values are substantially higher than previously recommended.

Results

Response of soil K availability to K application in pistachio

K application significantly increased soil K availability, with total soil NH_4OAc -extractable K nearly doubling or tripling after three years of K fertilization at the rate of 200 lbs K/acre. Due to differences in mineralogy, the magnitude of soil K increase was highest in Madera soil, lowest in Orland soil, and moderate in Yolo soil. The dominant minerals are montmorillonite and vermiculite in Orland and Yolo soils, and are kaolinite in Madera soil. Due to greater K-fixing capacity in Orland and Yolo soils, a greater quantity of potash is required to bring the soil extractable K to an optimum level in Orland and Yolo soils than in Madera soil.

Responses of nut yield and quality to K application in pistachio

Regardless of rate, source and application method, potassium fertilization significantly increased nut yield over the control trees. The

magnitude of nut yield response to K varied with K application rate, K source, K application method and soil type.

There was a significant yield increase as the K application rate increased from 0 to 200 lbs K/acre, but a further increase to 300 lbs K/acre tended to decrease nut yield. The reduced nut yield at high K dose may be associated with reduced Ca_{2+} and Mg_{2+} levels in the tree, both of which are below the optimal ranges. High K+ may inhibit the uptake of Ca_{2+} and Mg_{2+} by the plant.

There was no significant difference in nut yield between using K_2SO_4 , KCl and KNO_3 in Yolo and Madera orchards, whereas in the Orland orchard, the yield was significantly higher in trees receiving KCl. Nut yield was significantly higher in trees fertilized with K fertilizers via microsprinklers compared to banding on soil surface. Fertilizers applied to soil via a microirrigation system distribute more uniformly and can be utilized by plants more efficiently than via soil banding. KCl appears to be an economical and safe K source. After two years of K fertilization, leaf Cl-concentrations were only slightly higher in trees receiving KCl as the K source than those receiving K_2SO_4 or KNO_3 . However, the difference in leaf Cl among K_2SO_4 , KCl, and KNO_3 was not significant, with all values falling within the optimal Cl-range (0.1-0.3%). With no significant increase in leaf Cl-level after KCl fertilization, Cl-accumulation in pistachio trees may be minimal when KCl is applied. Leaf Cl should be monitored if KCl is used.

K application, regardless of rate, improved pistachio nut quality with a significantly higher percent split nuts and 100-nut weight and lower percent blank or stained nuts. Increased nut weight and percent split nuts are suggestive of enhanced nut fill, probably due to enhanced photosynthesis and photoassimilate transport to developing nuts.

The diagnostic criteria for K nutrition in pistachio trees

Plant analysis is a valuable tool to evaluate the nutritional status and enable the growers to better manage fertilizer programs. It is suggested that the fully expanded leaves from non-fruiting branches be sampled in late July through August. In development of diagnostic criteria,

attention should be directed to levels associated with optimal growth, fruit yield and quality. There was a significant, positive correlation between leaf K levels from July to August and nut yield. To obtain a nut yield of about 3500 lbs/acre, a leaf K level greater than 1.6% is essential and higher nut yield and quality requires higher leaf K level (1.5 to 2.0%).

Conclusions and Practical Application

1. Agronomically, K application is beneficial to pistachio trees, with significantly increased soil K availability, leaf K levels, nut yield and quality. K application appears to be economically justified.

2. Based on both agronomic and economic responses of pistachio trees to K applications, it is recommended that K fertilizers be applied at the rate of 100 to 200 lbs K/acre, using either K_2SO_4 or KCl, in California pistachio orchards.

3. There was a significant, positive correlation between leaf K level and nut yield. To obtain a nut yield of about 3500 lbs/acre, leaf K concentration greater than 1.6% is required.