

Improving Fruit Set and Yield of the 'Hass' Avocado with Potassium Phosphate or Potassium Phosphite Applied During Bloom

Continuing Project; Year 4 of 4

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Benefit to the Industry

At the end of this research, we will be able to tell avocado growers the optimal potassium and phosphorus fertilizer formulation(s), best application technique (soil vs. foliar), and a time of application based on the phenology of the tree to use to increase fruit size, cumulative yield and reduce alternate bearing.

Objectives

The main objective of this project is to improve yield in the 'Hass' avocado by supplying nutrients that might be limiting during fruit set due to competition between individual setting fruit and between setting fruit and developing vegetative shoots at the time they are most needed but are not adequately supplied by the roots or from reserves in the leaves or branches.

In this project we are compare the efficacy of applying potassium phosphate versus potassium phosphite to the canopy of 'Hass' avocado trees during bloom to increase yield and net return to the grower in comparison to trees receiving potassium phosphate or potassium phosphite to the soil via irrigation.

Experimental Plan and Design

The research orchard is located in Somis, California. The trees are 11-yr-old 'Hass' avocado on Duke 7 rootstock. The experimental design is randomized complete block with 20 individual tree replicates per treatment. All treatments are being applied at the cauliflower stage of inflorescence development. This stage of inflorescence development was determined by Salazar-Garcia et al. (1998) to be the time of gametogenesis, i.e., pollen, ovule, and egg formation and confirmed through field research to be the optimal time to apply foliar nutrients (Jaganath and Lovatt, 1995) to improve fruit set.

Treatments are the following: (1) control; (2) phosphorous acid based fertilizer, 0-28-26, at 2.86 quarts/acre to the soil; (3) phosphoric acid based fertilizer, 3-18-18, at a rate of 4.44 quarts/acre to the soil; (4) foliar-applied phosphorous acid based fertilizer, 0-28-26, at a rate of 2.86

quarts/acre; and (5) foliar-applied phosphoric acid, 3-18-18, at a rate of 4.44 quarts/acre. All treatments are applied at rates that provide the same amount of P and K per treatment (1.6 lbs P₂O₅ and 1.6 lbs K₂O per acre). We also tested soil and foliar applications of potassium phosphite, 4-30-8, keeping the N and P levels similar to the potassium phosphate, 3-18-18. Foliar applications are made with a "Herbie" sprayer to simulate helicopter application.

Forty spring flush leaves from non-fruiting terminals are collected at chest height around each data tree in September for nutrient analysis. The leaves are immediately stored on ice, taken to UCR, washed thoroughly, oven-dried, ground and sent to Fruit Growers' Laboratories for analysis of potassium, phosphate and/or phosphite, and all other nutrients, to make sure no other essential nutrients are limiting.

Harvest data include total kg fruit/tree and the weight of 100 randomly selected individual fruit/tree, which are used to fruit size to calculate packout per tree, evaluation of internal fruit quality, and a cost/benefit analysis of each treatment.

All data will analyzed for significance at $P \leq 0.05$ by analysis of variance and repeated measure analysis using SAS.

Summary

We have leaf analyses and yield and fruit quality data for three harvests. In all years of the study, the treatments had no significant effect at the 5% level on leaf nutrient status, fruit quality, fruit size or yield. In year 1, total lb. fruit per tree and total number of fruit per tree were both numerically higher for trees receiving foliar applied potassium phosphate (3-18-18) or foliar applied potassium phosphite (4-30-8) than the control trees or other treatments (Table 1). The yields of the trees receiving soil-applied fertilizers were lower. In addition, trees receiving foliar potassium phosphate (3-18-18) or potassium phosphite (4-30-8) tended to yield more large size fruit (packing carton sizes 60, 48 and 40). In year two, the best treatment was foliar-applied potassium phosphite (4-30-8) (Table 2). The two-year cumulative yield data is presented in Table 3. In year 2 the orchard was analyzed for *Phytophthora*. In the 60 samples analyzed, no *Phytophthora* was detected.

The year three yield was devastated by the freeze. More than half of the data trees in the experiment had no fruit. Foliar potassium phosphite (0-28-26) was the best treatment (data not shown).

Table 1. Effect of three foliar and two soil K and P fertilizer treatments on yield and fruit size of the 'Hass' avocado after one year.

Treatment^z	Lbs. fruit/tree	Fruit of sizes 64+48+40		no./tree
		No. fruit/tree	lbs/tree	
Control 71	132	66	122	
Foliar-applied				
Potassium phosphate (3-18-18)	79	152	73	137
Potassium phosphite (4-30-8)	79	145	73	132
(0-28-26)	73	133	68	123
Soil-applied				
Potassium phosphate (3-18-18)	57	104	53	97
Potassium phosphite (0-28-26)	64	118	60	110
<i>P</i> ≤0.05	NS	NS	NS	NS

^zAll treatments were standardized to provide 1.6 lbs. P₂O₅/acre.

Table 2. Effect of three foliar and two soil K and P fertilizer treatments on yield and fruit size of the 'Hass' avocado after two years.

Treatment^z	Lbs. fruit/tree	Fruit of sizes 64+48+40		no./tree
		No. fruit/tree	lbs/tree	
Control 59	134	45	90	
Foliar-applied				
Potassium phosphate (3-18-18)	51	107	38	75
Potassium phosphite (4-30-8)	68	155	50	101
(0-28-26)	57	126	44	89
Soil-applied				
Potassium phosphate (3-18-18)	62	139	46	92
Potassium phosphite (0-28-26)	61	137	46	92
<i>P</i> ≤0.05	NS	NS	NS	NS

^zFoliar treatments were standardized to provide 1.6 lbs P₂O₅/acre. Soil treatments were standardized to provide 22.5 lbs. P₂O₅/acre

Table 3. Effect of soil- or foliar-applied potassium phosphate and potassium phosphite fertilizer formulations with and without nitrogen on yield of 'Hass' avocado. Treatments were applied at the cauliflower stage of inflorescence development.^z

Treatment	Cumulative lbs. fruit/tree/2 years	Cumulative fruit no./tree/2 years
Control	130	264
Soil-applied		
3-18-18 as PO ₄	121	241
0-28-26 as PO ₃	126	253
Foliar-applied		
3-18-18 as PO ₄	132	276
0-28-26 as PO ₃	128	264
4-30-8 as PO ₃	148	303
<i>P</i> ≤0.05	NS	NS

^zSoil treatments applied to provide 22.5 lbs. P₂O₅/acre and foliar treatments applied to provide 1.6 lbs. P₂O₅/acre.