



# NUTRIENT MANAGEMENT

CALIFORNIA ALMOND **SUSTAINABILITY PROGRAM**

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## INTRODUCTION - SUSTAINABILITY AND NUTRIENT MANAGEMENT

California Almond growers have a wide array of soil fertility tools at their fingertips today—more than ever before. Given that fertilizer costs have increased significantly and nutrients are increasingly found as contaminants in water resources, it only makes sense to use available tools to maximize nutrient use efficiency.

The International Plant Nutrition Institute, a fertilizer trade organization, promotes the efficient use of fertilizer through the concept of right source, right amount, right timing and right place. The practices within this module have been grouped according to this concept.

*The right source* will deliver the precise balance of nutrients your trees need for optimum yields without excess, and the best chemistry to do so at the right price without negative effects on plant health or soil quality.

*The right amount* takes into account the actual nutrient load the crop needs for optimum yields based not only on a realistic assessment of yield potential but also the nutrients present in the soil or being delivered via some other route such as organic matter or nitrate-laden irrigation water. Any less, and your yield might be suboptimum; any more, and you likely will waste money and possibly contaminate water resources. Some almond growers are experimenting with nutrient sampling methods which identify variable needs throughout the orchard and precision application methods which deliver different rates at different orchard locations—matching the nutrient rate for each location to its need. While still somewhat experimental for almonds (though increasingly common in field crops), the potential for increasing nutrient use efficiency by precision application is attractive.

*The right timing* ensures that applications of nutrients coincide with key periods of uptake, growth, and nut development in the tree.

*The right place* refers to the delivery of nutrients to precise areas of the root zone to optimize utilization and minimize loss. When used properly, today's fertigation technologies can deliver nutrients right into the root zone. But the same technologies can just as easily flush nutrients below the root zone if used improperly.

The combination of the best type and amount of fertilizer for your soil and trees, right timing in the season, and the right placement in the root zone will maximize yield response and cause the least waste—and also the least negative environmental impact.

# Nutrient Management

1	How many pounds of nitrogen (N) were applied per acre for this orchard in the season being assessed?	lbs/acre
2	How many pounds of phosphorus (P) were applied per acre for this orchard in the season being assessed? (NOTE: Please use actual P instead of P <sub>2</sub> O <sub>5</sub> *)	lbs/acre
3	How many pounds of potassium (K) were applied per acre for this orchard in the season being assessed? (NOTE: Please use actual K instead of K <sub>2</sub> O*)	lbs/acre
4	What is the percent soil organic matter for this orchard, as measured in the past 5 years**? IF YOU HAVEN'T TESTED FOR THIS, CHECK HERE <input type="checkbox"/>	%

For my orchard, I am using the following practices and/or technologies for maximizing nutrient management efficiency:

Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
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## SOURCE

5	The following sources of nitrogen were utilized in this orchard in the past year. (Select all that apply):	a. commercial in-organic nitrogen fertilizer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		b. manure (not recommended for food safety reasons) <input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		c. compost <input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		d. nitrogen-fixing cover crops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	If compost, manure, or nitrogen-fixing cover crops were used, their nitrogen contribution to the crop was estimated and used in calculating the total nitrogen applied.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	Irrigation well water (if used) has been analyzed for its nitrogen content at least once during the past 3 years.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	a. If the test indicates the water has nitrogen, the amount of nitrogen applied via irrigation over the season is calculated and used in calculating the total nitrogen applied.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

This practice may also have food safety implications. Consult ABC GAP recommendations for more information.

\*Fertilizer labels generally list P and K content as P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O instead of actual P and K. That is, a bag of fertilizer labeled 10-10-10 does not contain 10 lbs of N, 10 lbs of P and 10 lbs of K; the label designation means 10 lbs of N, 10 lbs of P<sub>2</sub>O<sub>5</sub>, and 10 lbs of K<sub>2</sub>O. If you know how many lbs P<sub>2</sub>O<sub>5</sub> were applied and want to convert to actual P applied, multiply by 0.44 (e.g., 10 lbs P<sub>2</sub>O<sub>5</sub> x 0.44 = 4.4 lbs P). **Note that most soils in the Central Valley seldom require P applications.** To convert lbs K<sub>2</sub>O applied to lbs K, multiply by 0.83 (e.g., 10 lbs K<sub>2</sub>O x 0.83 = 8.3 lbs K).

\*\*To test for soil organic matter, it is recommended you use a lab that uses a combustion method rather than the Walkley-Black method.

For my orchard, I am using the following practices and/or technologies for maximizing nutrient management efficiency:

Not familiar with this  
I haven't tried it  
I have tried it  
My current practice  
Not applicable

AMOUNT

8	Fertilization amounts are calculated based on yield estimates, taking into account historical yields, tree age, tree growth, and replacing nutrients removed in nuts, shells, and hulls.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9	Plant tissue tests have been taken prior to the application of nutrients (also select any of the following that apply)...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	a. in the past year.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b. following recommended sampling procedures (including time of year).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c. taking into account variations within the orchard such as soil characteristics, tree growth, and other factors.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	d. and the analysis includes expert recommendations/UC critical levels.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	e. and the test results actually guide the amount of nutrients applied in the orchard.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	f. and the tissue testing results have been mapped to show variations within the orchard.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	g. and maps of the testing results are used to guide precision fertilizer applications (variable rate technology).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	h. and results are kept from year to year with the cumulative trends used for decision making.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	Soil analysis has been used to identify potential management zones or problems (also select any of the following that apply)...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	a. following recommended sampling procedures.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b. with the sampling procedure taking into account soil textures and other orchard variations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c. and results are mapped to show variations within the orchard.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	Soil pH has been measured at least once in the past 3 years.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	a. Based on this measurement, soil amendments or other inputs (e.g., irrigation acid injection) for adjusting pH have been applied as needed to benefit nutrient availability.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

For my orchard, I am using the following practices and/or technologies for maximizing nutrient management efficiency:

Not familiar with this  
I haven't tried it  
I have tried it  
My current practice  
Not applicable

TIMING



12	Do you broadcast nitrogen? <input type="checkbox"/> Yes <input type="checkbox"/> No					
13	Do you fertigate nitrogen? <input type="checkbox"/> Yes <input type="checkbox"/> No					
14	Nutrient applications are timed primarily to spring growth and crop demand.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
15	Nitrogen is applied to the orchard...					<input type="checkbox"/>
	a. <input type="checkbox"/> once a year.					
	b. <input type="checkbox"/> twice a year.					
	c. <input type="checkbox"/> three or more times a year.					

PLACEMENT

16	Variable rate applications are made to account for variations in orchard productivity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17	To reduce the likelihood of nitrogen leaching or runoff, I...					
	a. time fertilizer applications with irrigation and rainfall (where possible) so water moves the nitrogen into the root zone without running off or leaching beyond the root zone.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b. use organic matter, filter strips, or cover crops.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c. monitor the depth of irrigation water in the soil to place nutrients in the root zone and not beyond.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

NUTRIENT MANAGEMENT BUDGET

18	In addition to the above practices, I have written a comprehensive nutrient management plan and budget for this orchard which guides my annual nutrient management.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
19	Other: _____				<input type="checkbox"/>	



# Fertigation

For my orchard, I am using the following practices and/or technologies for optimizing fertigation performance:		Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
20	I have determined the injection time for my fertilizers to place them properly in the root zone and prevent leaching. (Prior to initiating injection, the system is at the proper pressure.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21	I have determined the injection time for my system cleaning solutions to provide effective cleaning and proper rinsing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22	Before mixing new materials for injection (for cleaning or fertilization), I have performed a jar test* to check their compatibility; OR I avoid mixing materials and assure fertilizer storage tanks are thoroughly rinsed and irrigation systems are completely flushed between changes in fertilizer formulations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23	At least one back flow prevention device is installed between the water source and the injection site. (County regulations vary—some require more than one device.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24	Other: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

\*Jar test—Using water from the source of your irrigation, mix fertilizers or other injection materials in the concentrations and order which you plan to use them. If the resulting mixture is clear, they are likely compatible. If the mixture is cloudy, they may or may not be compatible—further information is required.

## References & more information

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