



# Fertilizing Agricultural Lands



## Nutrient Management...

What exactly is nutrient management? It is the process of managing every aspect of nutrients for crop production; from the amount, source, and type to where and when it is applied. The main objective of managing nutrients is to maximize the crop yield (and profits) while minimizing the amount of nutrients that leave the property (either through surface runoff or from leaching to the groundwater).

Nutrient management understands that the addition of nutrients to a crop is necessary to increase the crop's profitability, but that they are also potential pollutants for surface and ground water.

Correct nutrient management, at an agricultural operation, should maximize crop production, minimize nutrient losses to ground or surface water and reduce expenses by eliminating over-application of fertilizers.

One of the critical components of nutrient management is fertilizer. This brochure compares fertilization methods, discusses fertilizer best management practices and summarizes problems that can occur when too much or not enough fertilizer is used.



## Fertilizer Application Methods

Fertilizers are sold as either dry granules or powder, liquid or in gaseous form. No matter what form of fertilizer is used, all are equally effective or, if misapplied, ineffective, if the same amount of nutrients are applied. There are a variety of methods for applying fertilizers, which can be sorted into three categories; broadcast application, fertigation and injection.

### Broadcast Application

Fertilizers that are typically applied using broadcast application are in the dry, granular form.



This form of fertilizer can be applied using hand broadcasting, hand grinders, push wheel and mechanized applicators. As there are a wide range of applicators and techniques, it is very easy to misapply the fertilizer. The technique and applicator should be calibrated to ensure proper coverage and amount of fertilizer applied.

Traditionally, broadcast applications were applied once annually in large, heavy doses. This technique assumed that irrigation cycles would leach a portion of the fertilizer into the root zone. In actuality, the heavy doses did leach water into the root zone, but also lost excess fertilizer into the ...

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## Plant Nutrients and Their Effects

Excessive amounts of or not enough nutrients can be detrimental to crop yield. The following table\* outlines some of the symptoms of nutrient deficiency (too little) and toxicity (too much) for avocado and citrus trees.

	Deficiency or Toxicity (Avocado and/or Citrus)	Symptom
<b>Primary Plant Nutrients</b>		
Nitrogen	Deficiency (Avocado and Citrus)	<ul style="list-style-type: none"> <li>◆ Lack of vegetative growth</li> <li>◆ Low crop yield</li> <li>◆ Small pale or yellow-green leaves (chlorosis)</li> <li>◆ Premature defoliation</li> </ul>
Phosphorus	Deficiency (Citrus)	<ul style="list-style-type: none"> <li>◆ Pronounced reduction in bloom</li> <li>◆ Poor production of small fruit</li> </ul>
Potassium	Deficiency (Citrus)	<ul style="list-style-type: none"> <li>◆ Small fruit with thin peels</li> </ul>
Potassium	Toxicity (Citrus)	<ul style="list-style-type: none"> <li>◆ Coarse fruit with thick peels</li> </ul>
<b>Secondary Plant Nutrients</b>		
Magnesium	Deficiency (Citrus)	<ul style="list-style-type: none"> <li>◆ Tip and margin interveinal chlorosis</li> </ul>
Calcium	Deficiency (Citrus)	<ul style="list-style-type: none"> <li>◆ Decrease in root and canopy vigor</li> <li>◆ Interveinal chlorosis</li> </ul>
Sulfur	Deficiency (Not Common In Citrus)	<ul style="list-style-type: none"> <li>◆ Similar to nitrogen deficiency</li> </ul>
<b>Micronutrients</b>		
Manganese	Deficiency (Not Common In Citrus)	<ul style="list-style-type: none"> <li>◆ Yellow patches between veins on young leaves</li> </ul>
Copper	Deficiency (Not Common In Citrus)	<ul style="list-style-type: none"> <li>◆ Large leaves</li> <li>◆ Limb dieback</li> <li>◆ Gum pockets under bark of young trees</li> <li>◆ Brownish gumming of fruit, twigs and leaves</li> <li>◆ Multiple buds</li> </ul>
Copper	Toxicity (Citrus)	<ul style="list-style-type: none"> <li>◆ Small, dull green leaves</li> <li>◆ Stubby roots</li> <li>◆ Iron deficiency symptoms</li> <li>◆ Reduced crop yield</li> </ul>
Zinc	Deficiency (Avocado and Citrus)	<ul style="list-style-type: none"> <li>◆ Small leaves</li> <li>◆ Leaves occurring in rosettes</li> <li>◆ Interveinal chlorosis</li> </ul>
Iron	Deficiency (Avocado and Citrus)	<ul style="list-style-type: none"> <li>◆ Chlorosis with fine network of green veins to nearly white</li> </ul>

\*The information in the above table can be found in Mission Resource Conservation District's Eco-Lab's "BMPs for San Diego County Citrus and Avocado Growers" booklet.



## Fertilizer Best Management Practices (BMPs)

Best management practices (BMPs) are processes and procedures that have been proven to be the most effective and reasonable methods to accomplish a goal (such as preventing pollution or minimizing over-application of fertilizer) while making the best use of the property's resources. BMPs for fertilizer use in agricultural operations include soil and water testing, determining nutrient needs, applying nutrients at the correct time, leaf tissue analysis, irrigation system management and record keeping.

### Nutrient Needs and Timing



Sixteen elements (including nitrogen, carbon, and magnesium) are needed by plants for growth and reproduction. Each crop (or plant type) has a crop nutrient requirement (CNR) for each element; that is, every crop type (avocado, citrus, etc.) needs specific amounts of each of the sixteen elements for optimal crop quality and yield. Knowing the CNR for the agricultural crop is critical when deciding what and how much fertilizer should be applied. The time of year when nutrients would have the greatest effect for crop yield should also be considered so that fertilizer is applied at the most opportune time.

### Soil and Water Testing

Nutrients are present in both the soil and irrigation water and testing of both is highly recommended to determine the amount of nutrients that are present and available for the agricultural crop. The quantity (and kind) of fertilizers can then be customized to complement the existing nutrients as well as the physical characteristics of the soil. Annual testing of the soil and well or reservoir water (if used) is recommended as nutrients in these mediums will fluctuate over time.



### Leaf tissue Analysis



Plant tissue analysis is highly recommended when determining needed fertilizing amounts and frequency. This test will help identify if there are any nutrient deficiencies before they can cause problems to crop yield. This is the most accurate way to determine plant nutrient levels. Annual testing of leaf tissue is recommended as nutrient levels will change over time.

### Irrigation System Management

Water management and fertilizers are closely tied as increasing the efficiency of the irrigation system may dramatically alter the management of fertilizing. The more uniformly an irrigation system applies water, the more accurately the amount of needed fertilizer can be calculated and applied.



### Record Keeping



Keeping records of the crop nutrient requirements, soil, water and plant tissue analysis results, fertilizer name and type as well as the fertilizer application amounts, rates and dates are very important. This BMP is often overlooked and easy to disregard, but can be an incredibly powerful tool when it comes to determining how to minimize fertilizer use and maximize crop quality and yield.



### Fertilizer Application Methods continued

groundwater as the crop was unable to assimilate the fertilizer quickly enough. The currently recommended technique for broadcast application is to use smaller doses throughout the year to supply the plant with the needed nutrients.



When using dry fertilizer, applications should be made based on the weight of the fertilizer and not the volume. As every fertilizer is made up of different materials, the densities (and weight per volume) will vary from fertilizer to fertilizer. An example of this is ammonium sulfate and urea. Based on their different densities (and nutrient amounts), a three pound coffee can would hold approximately seven pounds of ammonium sulfate and approximately five pounds of urea. As ammonium sulfate contains 21% nitrogen and urea contains 46%, the seven pounds of ammonium sulfate would hold 1.5 pounds of nitrogen and the five pounds of urea would hold 2.4 pounds of nitrogen.

### Fertigation

Fertigation is the application of liquid fertilizer in the water of an irrigation system. Irrigation systems are becoming more efficient (water is distributed more uniformly by the emitters). When combined with an efficient irrigation system, fertigation allows land managers to use their irrigation systems to their fullest potential. As fertilizer can be added to any irrigation cycle, the amount fertilizer can be rationed out throughout the crop's critical growth and reproductive seasons. If correct amounts of fertilizer are used, this technique greatly minimizes the potential of excessive nutrients from leaching through the soil and into the groundwater while meeting the crop nutrient requirements.



### Injection



Fertilizers also come in the form of a gas, such as anhydrous ammonia. These gas fertilizers are compressed into a liquid and then injected into the soil where they expand to gaseous form and combine with the soil's moisture. This technique requires specialized equipment as well as personnel who are trained in the proper handling of the fertilizer.

*For more information, Mission RCD's "Soil Fertility Facts" pamphlet explains exactly what is in a fertilizer bag and give directions on how to read a fertilizer bag accurately.*

### Resources

- ◆ For over 65 years **Mission Resource Conservation District** has been helping agricultural land owners and managers with resource concerns. In addition to its many educational brochures, MRCD offers free irrigation system evaluations for San Diego County growers. To contact MRCD, please call (760) 728-1332 or visit [www.missionrcd.org](http://www.missionrcd.org).
- ◆ The **UC Cooperative Extension's Farm and Home Advisor's Office** offers help to land owners and managers who have resource concerns. To contact UCCE, please call (858) 694-2845 or (760) 752-4724 or visit [www.cesandiego.ucdavis.edu](http://www.cesandiego.ucdavis.edu).
- ◆ The **Natural Resources Conservation Service** offers Nutrient Management Plans that are developed for each specific agricultural property and can be contacted at (760) 745-2061.



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