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Avocado Fertilization in Los Angeles County

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In considering recommendations on avocado orchard fertilization, it must be borne in mind that the information which is used has been obtained largely through experience and practice with citrus fertilization. However,, there are some variations in the light of new information secured from studies made on the growth and development of avocado trees, as well as the results of analyses made on the leaves and fruit.

The suggested program is to apply ten tons of dairy or barnyard manure per acre per year in the summer or early fall, which should be broadcast over the surface of the cultivated area underneath and outside the tree. A three and a half ton application of straw or hay may be used instead of a ten ton application of manure. In fertilizing bearing avocado orchards, a further application of nitrogenous fertilizer is suggested in order to supplement the amount of nitrogen contained in the bulky organic. For the supplemental application, the following is advised: Fifty pounds of nitrogen per acre in October, fifty pounds of nitrogen per acre in January, fifty pounds of nitrogen per acre about March 15, and fifty pounds of nitrogen per acre about June 1. In adding fifty pounds of nitrogen, make an application of 250 pounds of a nitrogeneous fertilizer per acre containing 20% nitrogen or 500 pounds nitrogeneous fertilizer containing 10% nitrogen. If the grower wishes to fertilize on a per tree basis and is using a 20% nitrogen fertilizer, apply 3 1-3 pounds per tree in order to add fifty pounds nitrogen per acre. In using other kinds of fertilizer, apply them in proportion to the amount of nitrogen contained in them. In following this program, the grower will have to take into consideration the age of the trees, the volume of fruit produced, soil type, and manner of applying irrigation water.

The avocado grower should also consider the whole soil management program in relation to the fertilizer practice. To get the best results, irrigation should be carried on in a manner that will prevent leaching of the soil. Leaching frequently accounts for the loss of available nitrates,, especially in the surface twelve to eighteen inches, where a large proportion of the roots are located. The surface of the soil should be cultivated as little as possible in order to prevent plow sole and thus provide a better distribution and penetration of water.

All plants require certain elements which are taken from the air or soil and used in the process of manufacturing plant foods. As a matter of fact, most of the material which goes to make up the tissues of plants originates in the air surrounding the plants. Avocado trees are no exception to this fundamental rule. Carbon dioxide is taken from the air into the leaf tissues, where it is manufactured into foods for the use of all portions of the tree. Elements which come up from the soil in solution are used in combination with those elements taken from the air.

SUPPLYING ELEMENTS:

Avocado trees require ten or more elements for their growth the same as other plants. Each element taken up by the tree and used in the manufacture of foods has its function to perform. Some of the elements which are taken from the soil in comparatively large amounts are: calcium, potassium, magnesium, nitrogen, phosphorous, and sulphur. In order to maintain soil fertility in which the above-named elements will be made available, it is necessary to apply organic matter. All elements must be in water soluble form in the soil to be taken up by the tree. In our fertile Southern California soils, it has been apparent from experiments carried on with citrus fertilization over a period of twenty-five years that probably all the above-mentioned elements are in the soil in sufficient quantity for the needs of the tree, with the exception of nitrogen. Many soils may have sufficient nitrogen for a certain period of time. Soils become depleted through leaching, however, because nitrogen is finally oxidized and becomes a soluble nitrate of some basic element. Other elements are not leached from the soil so readily as nitrogen in the form of nitrates.

RELATION OF CITRUS TO AVOCADO FERTILIZATION:

The avocado industry is too new as yet to show results from the practical experience of growers. Practically no experiments have been carried on where it has been possible to obtain worthwhile data. Since the avocado tree is a subtropical evergreen and grows under climatic conditions similar to the citrus tree, we have been inclined to use the information accumulated on citrus fertilization. By using this material, we can make suggestions on fertilizing the avocado orchard, recognizing, of course, certain differences in growth between the avocado and the citrus tree. We shall know more definitely how to fertilize the avocado orchard after commercial growers have had years of experience and after research workers have carried on experiments with the avocado for a sufficient length of time.

WHAT ELEMENTS MUST BE SUPPLIED:

Is it necessary to supply all elements in a fertilizer program? The fertilizer program in avocado orchards in Southern California consists of a frequent application of organic materials such as manures, straw, or hay. Organic materials containing all the necessary elements for plant growth may be considered complete fertilizers. However, they may not contain all the necessary nitrogen because of the great losses which occur with materials containing that element.

It has been proved necessary to apply organic matter to the soil in order to maintain fertility. Since the avocado is a subtropical and an evergreen, with a comparatively shallow root system, it has been assumed that the information previously referred to also applies to avocado fertilization. Organic matter thus applied provides food for beneficial bacteria, the bacteria in turn causing a decay of the organic material.

NEED FOR ORGANIC MATTER:

It is acknowledged, especially where large drafts are to be made on the soil for nitrogen, that nitrogen-carrying fertilizers must be applied in order to keep the soil fertile. Because of the great loss of nitrogen, owing to the process of decomposition, it will probably be necessary to supplement the application of organic matter with a nitrogenous fertilizer. It is assumed that forty to sixty per cent of the nitrogen contained in bulky organic fertilizers such as manure, straw, or hay, is made available to the tree. Practically all of the elements needed are contained in the soil in compounds which are not soluble in water; therefore it is necessary to bring about certain conditions within the soil that will make them available.

Since it is necessary to make certain elements available and since nitrogen may be lost, the fertilizer program consists in applying organic matter regularly, supplementing with a nitrogen-carrying fertilizer.

APPLICATION OF BULKY ORGANIC FERTILIZERS:

When organic matter is applied in the form of bulky, organic fertilizers, various elements are added to that soil, including nitrogen. Some of the elements which are added to the soil in that manner are phosphorous, potash, and calcium, which elements are frequently purchased by growers as a supplemental application. Organic matter in sufficient quantities supplies all needed elements for the growth and development of the tree and fruit. Following is the analysis of a typical sample of dairy manure: Nitrogen .66%, phosphoric acid .56%, potash 1.84%, organic matter 27.62%.

There is no better fertilizer than bulky organics. Ten tons of dairy manure per acre or its equivalent of three and a half tons of hay or straw is recommended if the same practice is followed in the avocado fertilizer program as with citrus. Bulky organic fertilizers such as manure, straws, hay, etc. should be applied during the summer and early fall if used in large quantities. If bulky organics containing large amounts of the carbonaceous materials are applied early in the year, the locking up of nitrogen may be so great that the tree would not have an available supply of nitrates. This situation is very liable to occur during the spring months because of the greater need for nitrogen by the tree during that time of the year. In order to accomplish the greatest benefit by the use of bulky organics, they should be broadcast over the surface of the land, both outside and underneath the tree.

The following table furnishes a list of bulky organic fertilizers, with the approximate percentage of dry organic matter and nitrogen, including the amount to apply per acre per year.

	Per cent Nitrogen	Per cent Organic	Apply annually per acre
Dairy manure	¾%	30%	10 tons
Bean straw	1¼%	85%	3½ tons
Poultry manure No. 1	2½%	60%	5 tons
Poultry manure No. 2	1½%	65%	5 tons
Alfalfa hay	2¼%	80%	3½ tons
Alfalfa straw	1¼%	85%	3½ tons

NEED FOR NITROGENOUS FERTILIZERS:

There is considerable feeling, in the light of more recent investigations, that a greater amount of available nitrogen per acre should be applied to the avocado than has been the case with citrus, although many successful avocado growers have been following the citrus fertilizer program. Investigators believe that the need for available nitrogen is especially great during the early spring months because setting and vigorous growth occur during that period of the year. The time of making applications of nitrogenous fertilizer or the amount to apply has not yet been worked out. As a suggested program, apply a sufficient amount of nitrogenous fertilizer to furnish approximately fifty pounds of nitrogen per acre in October, fifty pounds during January, fifty pounds about March 15, and another fifty pounds about June 1. Soil type, age of tree, and other factors would, of course, change the recommendation as far as the amount of material and time to be applied is concerned. These factors could not be discussed here as they depend entirely upon the individual orchard.

APPLICATION OF NITROGENOUS FERTILIZERS:

The manner of applying the several nitrogenous fertilizers depends upon the material itself. In using soluble chemical nitrogenous fertilizers, such as nitrate of soda, nitrate of lime, or sulphate of ammonia, they should be applied to the surface of the soil during the rainy season, both underneath and outside the tree. After the rainy season, soluble fertilizers should be applied wherever the irrigation water will dissolve and take them into the surface soil. To get the quickest results, these fertilizers should be applied prior to an irrigaton. If furrows are used, they should be applied in the bottom of the furrows, or they may be dissolved in the irrigating water. Materials such as dried blood, fish meal, and cottonseed meal should be applied to the surface of the land, both underneath and outside the tree, intermixed with the surface soil with a disc, plow, or cultivator during the rainy season. After the rainy season or during the irrigating season, the organic materials mentioned above should be applied to the portion of the land to be irrigated.

Some of the nitrogenous fertilizers used for supplying supplemental nitrogen are tabulated below, showing the percentage of nitrogen they contain and the amount to apply per tree to add fifty pounds of nitrogen per acre:

Nitrogenous Fertilizer	Average Nitrogen Content	*Amt. per tree to apply 50 lbs. Nitrogen per Ac.
Sulphate of ammonia	20 %	3-1/3 lbs.
Nitrate of lime (calcium nitrate)	15½%	4-1/3 lbs.
Nitrate of soda	15 %	4-1/2 lbs.
Calnitro	20½%	3-1/4 lbs.
Ammo-Phos	16 %	4-1/2 lbs.
Dried Blood	12 %	5-1/2 lbs.
Fishmeal	10 %	6-2/3 lbs.
Cottonseed meal	6 %	11 lbs.

** (Assuming there are 75 trees per acre. in the case of terraced orchards, the trees are 24 feet apart.)*

Many other nitrogenous fertilizers are being used satisfactorily by growers. Adjustments can be made by the grower as to the amount of material to use by calculation, considering the total amount of nitrogen contained in the material.

VARIATION IN PRACTICE:

The fertilizer practice has to be varied according to soil type. Soil which has a high moisture capacity, such as one with a high wilting point, will retain the fertilizing elements in solution more tenaciously than a light soil. Because of the dissolving effect of water, soluble plant food will be leached more readily from light soils. The loss of fertility is therefore greater in light soils and the necessity for making frequent but small applications of nitrogenous fertilizer more necessary.

If a sandy or light soil contains an adequate amount of available nitrogen in the form of nitrates, over irrigation or heavy rainfall may leach it from the root zone and it will not be obtained by the tree. In medium soils—sandy loam types—usually the root system of the tree is comparatively deep. In this type of soil, the maintenance of fertility is not so difficult, particularly if the irrigation practice is carried on in an ideal manner. In shallow soils, where the root system of the tree would naturally be confined to a shallow zone, namely, one and a half feet of the surface soil, the application of nitrogenous fertilizers should be made with considerable thought and care.

USE OF SOIL AMENDMENTS:

Soil amendments such as lime, sulphur,, gypsum, and preparations containing these materials have frequently been recommended as necessary for certain soils. Usually the elements supplied in these materials are calcium, sulphur, and sometimes phosphorus. The use of lime under certain conditions, especially in heavy and adobe soils, might be advantageous, but from the standpoint of furnishing elements needed by the avocado tree there is no information which leads us to believe that they are necessary in Southern California soils.

CALCULATING THE COST OF MATERIAL:

In purchasing fertilizing material, the price is usually based on the unit value of the plant nutrient. In order to determine the comparative cost according to the sources of the several elements, divide the price per ton by the percentage of that element contained in the fertilizer. As an example, if the price of cottonseed meal is $18.00 per ton, eighteen should be divided by six, which is the percentage of nitrogen contained in cottonseed meal. This will indicate that the price of the nitrogen contained in this material is $3.00 per unit. One per cent of a ton or 20 pounds is the so-called unit for evaluating the various elements or other materials contained in the fertilizer.

CALCULATING THE AMOUNT OF FERTILIZER TO USE

In determining the amount of fertilizer to use, the following plan is suggested. If fifty

pounds of nitrogen per acre is to be applied, divide the number of pounds per acre by the percentage of nitrogen contained in the fertilizer to be used, then multiply by one hundred. As an example, assuming that cottonseed meal is to be used, if fifty pounds of nitrogen per acre is to be applied, divide fifty by six, which is 8.33. This figure multiplied by one hundred is 833, or the number of pounds necessary to apply per acre to obtain fifty pounds of nitrogen. To determine how much to apply per tree after obtaining this figure, divide the number of pounds of cottonseed meal, which is 833, by 75—assuming that there are seventy-five trees per acre. This will be 11.1 pounds per tree to be applied.

COMPARING COSTS OF ORGANIC FERTILIZERS:

If the comparative cost of two materials is to be determined, take the following as an example: If dairy manure is worth $3.00 per ton delivered and spread in the orchard, how much per ton will another organic material be worth, considering the same price?

Using the per unit price of $2.00 for nitrogen, if the dairy manure contains three-fourths of one per cent, then the nitrogen contained in one ton of dairy manure would be $1.50. The organic matter would be worth the difference between $1.50 and $3.00, namely, $1.50. If dairy manure contains 30% organic matter, $1.50 is divided by the thirty units which would then be worth five cents per unit.

As an example for comparison, take an organic material with 1 1/2% nitrogen and 85% organic matter. The nitrogen is worth $3.00, and 85% or 85 units of organic matter at five cents per unit is worth $4.25,—total $7.25. However, if it costs $1.25 per ton to spread the organic material, then $1.25 should be subtracted from the $7.25, leaving $6.00, which is the value per ton of the organic material being compared with manure.