

## FERTILIZER PRACTICES

### AVOCADO ORCHARD FERTILIZATION

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The commercial production of avocados is in its infancy. Consequently knowledge regarding cultural operations in avocado production is quite limited. In order to accumulate knowledge and data relative to fertilization and other operations, it is necessary to have experience. The avocado is too new an industry as yet to show results from 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 and grows under climatic conditions similar to the citrus tree, we have been inclined to use the information on fertilization which has been accumulated relative to the growing of citrus fruits. A great deal of subject matter has been accumulated on citrus fertilization, and by using this material we can make suggestions on fertilizing the avocado orchard, recognizing certain differences in growth between the avocado and the citrus tree. Whether we are absolutely justified in so doing we shall later discover. We shall know more definitely how to fertilize the avocado orchard after commercial growers have had years of experience, and Experiment Station workers with the avocado have carried on experiments through a sufficient length of time.

It has been assumed that all the material going to make up the tissues of plants and trees come from the soil, but we must recognize that much of it, in fact the larger portion, is made up of carbon which is obtained from the atmosphere. The larger number of elements which go to make up plant food do come from the soil, but as already stated, the carbon of the atmosphere goes to make up the larger percentage of the tissues. The soil contains elements in the form of minerals which are taken up by the tree through the roots in solution. There are twelve or more such elements in the soil which are needed by a healthy, producing tree. Some of them are hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium, iron, sulphur, manganese, sodium, boron and other minor ones.

It is certain that these elements in small amounts are needed in the growth of an avocado tree if the tree remains healthy and productive. In practically all soils all of these elements are present, at least in Los<sup>1</sup> Angeles County, in sufficient quantity for the growth and development of the tree with the one exception of nitrogen. It is recognized, especially where large drafts are going to be made on the soil for nitrogen, that nitrogen-carrying fertilizers have to be applied in order to keep the soil fertile. Practically all of these elements 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 which will make the necessary elements available to the tree. It has been found in

practice that if organic matter is constantly added, certain compounds will form through the breaking down of the organic matter. Through this breaking down process the elements will become available and be taken up by the roots in solution in water. Since it is necessary to make the several elements available, and since nitrogen as an element is one of the limiting factors in the fertility of the soil which is being constantly cropped, the fertilizer program consists in applying organic matter regularly, supplementing the organic matter application with a nitrogen-carrying fertilizer.

In citrus fertilization it has been found that the application of organic fertilizers which adds organic matter, supplemented by a nitrogenous fertilizer, maintains fertility for the profitable production of crops of fruit. Organic matter added to the soil is broken down and decays through the action of certain bacteria which are present providing the soil is moist. Through the reaction which takes place certain mineral elements already referred to are made available, and the nitrogen which is usually in the form of organic matter is nitrified and made available for growth.

When organic matter is applied to the soil 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 phosphorus, potash and calcium, which elements are frequently purchased by growers as a supplemental application. It is recognized that with a sufficient application of organic matter all needed elements will be added in adequate quantity for the growth and development of the tree and fruit. There is no better complete fertilizer than bulky organics. If the same practice is followed with avocados as is usual with citrus, the equivalent of ten tons of dairy manure per acre will be recommended. This applies on the average about three tons of organic matter per acre.

Besides finding it necessary to apply organic matter in order to bring the several fixed elements into availability, it may be advisable to apply a certain amount of fertilizer containing nitrogen, thereby supplementing the nitrogen contained in the organic fertilizer. This is especially so if the quantity of organic fertilizer applied is not large. Professor Vaile in his survey of citrus orchards throughout Southern California found that where three hundred fifty pounds of nitrogen was applied per acre annually, in both commercial and organic fertilizers, maximum yields were obtained. He also found in analyzing results that three hundred fifty pounds was not an economical amount, but that two hundred fifty pounds per acre more nearly approximated the economical application of nitrogen. Also better results were obtained by using organics in sufficient quantity to supply about half the nitrogen, the other half being supplied by means of a supplemental nitrogenous fertilizer.

We have assumed that this program would probably apply to the avocado. In fact, it is the program that has been followed for a number of years by some of our avocado growers, with good results.

In applying the recommended amount of bulky, organic fertilizer approximately one-half of the needed nitrogen will be supplied. The balance can then be supplied through the use of a supplemental nitrogen carrier, bringing the total amount of nitrogen applied up to two hundred fifty pounds per acre per year. Whether this is sufficient or too much will have to be judged later by observations and on practical experience in the field, as well

as future experiments which will no doubt be carried out.

<i>Nitrogenous fertilizer</i>	<i>Average Nitrogen Content</i>	<i>Amount Required Per Acre</i>
Nitrate of Lime (calcium nitrate)	12 %	1000 Ibs.
Nitrate of Lime (calcium nitrate)	15½ %	800 Ibs.
Nitrate of Soda	15 %	800 Ibs
Calnitro	20½ %	600 Ibs.
Amo-Phos.	16 %	700 Ibs.
Dried Blood	12 %	1000 Ibs.
Fish Meal	10 %	1200 Ibs.
Cottonseed Meal	6 %	2000 Ibs.

Some of the nitrogenous fertilizers used for supplying supplemental nitrogen are tabulated below with the percentage of nitrogen and the amount of each to make an application of approximately 125 pounds per acre.

Many other nitrogenous fertilizers are being used by growers and are found satisfactory. Adjustments can be made by the grower with regard to the amount of material to use by considering the total amount of nitrogen contained in the material. Approximately 125 pounds of nitrogen for the spring application should be used. However, this will vary according to circumstances and is not a set rule.

The time of applying these different kinds of fertilizer will vary according to weather and soil type. In general, we recommend the application of the bulky organics such as manure and straws during the period from June until November, that is, this material should be turned under during that time in order to mix it with the surface soil. That period of the year when the tree requires the greatest amount of nitrogen, when naturally the drain on the soil is greatest, is during the spring and early summer. Because of the great demand for nitrogen in that growing period of the year, the supplemental application or extra nitrogen is applied during winter or early spring. The nitrogenous fertilizer should, therefore, be applied during February and March. We suggest that if six hundred pounds of nitrogenous fertilizer is to be applied during that period that only half be applied the first of February, and the balance, or second half, March 15. Since the rainy season is not yet over at this season, the materials applied, if soluble chemicals, will be dissolved and taken down into the soil where they will be nitrified and become available to the tree in the form of nitrates.

It is necessary to vary the applications according to soil type, cultural practices and root growth. If the soil is a very sandy or shallow one, the above recommendation on the application of nitrogenous fertilizer might not be desirable, since the nitrates in the shallow or light soil may be leached out by the constant application of irrigation water or a heavy rainfall. In this case instead of putting all the nitrogenous fertilizer on in February or March, it would be more desirable to make three or four applications at least, perhaps adding no more of the material but less at each application. Also, if the root growth is shallow a greater number of applications may be desirable. In applying the materials they should be broadcast both underneath the trees and in the rows outside, or in other words, wherever the water is applied to the soil. If the material is

applied during the irrigation season where the furrow method is the practice, it should be put only in that area where the furrows are made. If overhead irrigation is used, the application should be made both underneath and outside the drip of the tree.

In the case of the use of organic, nitrogenous fertilizers, such as blood, tankage, cottonseed meal and fish meal, it is necessary to mix it with the surface soil in some way by means of a disc, plow, or cultivator. Otherwise there will be some loss and the material will not be decomposed and nitrified until mixed with the moist soil.

Where avocado orchards are planted on terraces we frequently find, especially with furrow irrigation, that part of the terraces are not moistened, consequently the most efficient use of the soil is not obtained. Whether overhead or furrow irrigation is used, the application of nitrogenous fertilizer should be made to all the surface of the soil. In the case of furrow irrigation, an effort should be made to get the material on before the rains are over. This is done for the purpose of making certain that some of the nitrogenous fertilizer gets into that portion of the soil which remains dry during the irrigation season.

When trees show signs of yellowness and appear not to be as thrifty as they might, in spite of the fact that apparently sufficient fertilizer has been applied, it is always desirable to make an application of a soluble and quickly available nitrogenous fertilizer. This can be done at any time of the year, depending upon conditions and how serious the situation is as to the amount to apply.

In summarizing our recommendations, I would suggest that at least a ten-ton application of dairy or barnyard manure of some kind be applied in the summer or fall and incorporated into the soil at that time. About February and March apply sufficient nitrogenous fertilizer to provide about one hundred twenty-five pounds of nitrogen per acre, putting on half about February 1, and the other half the middle of March. This general suggestion is a program that is being followed by citrus growers throughout the county. It has been adopted by many avocado growers and found to be a desirable practice. It may be discovered that a smaller amount of both manure and nitrogenous fertilizer can be used but until such time as we are definitely certain of this fact it will probably be advisable to keep on with this program.

A three and a half ton application is advised if bean straw or strawy materials of any kind, including alfalfa hay, are used in order to supply the equivalent amount of organic matter contained in a ten-ton application of manure. Our advice, however, is to not apply any of this material during the late winter, especially if it is to be incorporated into the soil at that time. It has been suggested by some who have had experience in the fertilization of avocado trees that it is inadvisable to mix manures, or in fact much of any fertilizer, with the soil which is placed around the young trees when planted.

We would not advise the using of large amounts of fertilizer in applications to young orchards. One grower who has fertilized young trees has used a little sulphate of ammonia during the year, put on in four or five applications, usually several teaspoonfuls to a basin around a tree at each application. The estimated amount used per tree per year of sulphate of ammonia in this case is one pound.

The avocado grower should consider his whole soil management program when

studying the fertilizer program and irrigate in a way that would not leach out the nitrates through heavy applications. This frequently accounts for a loss of available nitrates in the surface soil. The soil should not be cultivated too much because of the danger of creating a plow sole which will prevent proper distribution and penetration of water. In conclusion, let us state again that the fertilizer program must be carried on in conjunction with the whole soil management program.

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