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The Nitrogen Requirement of the Avocado Tree in California

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Horticultural experience and research have shown that the nitrogen requirements of fruit trees differ greatly, some being low, others high, and still others intermediate. Perhaps the best known members of these three groups are the apple, the citrus fruits and the peach, respectively. Thus the apple responds to nitrogen fertilization only on relatively poor soils or under conditions of sod culture where the available nitrogen supply is low. On the other hand, regardless of the initial fertility of the soil, it has been the universal experience that for the maintenance of satisfactory production citrus trees require, and make an economic response to, large applications of nitrogenous fertilizers.

For many kinds of fruit trees, among which is the avocado, the facts remain to be determined. During the past decade, however, considerable evidence has accumulated which strongly suggests that, contrary to the general supposition and current orchard practice, the nitrogen requirement of the avocado is materially lower than that of the citrus fruits. This evidence is provided by the contrasting behavior of avocado and citrus trees under similar conditions of soil moisture and nutrient supply. It is the purpose of this article to briefly review these responses, most of which can readily be observed in any of the important avocado orchard areas, and to urge growers to observe and review the field evidence for themselves.

YOUNG TREES

Growth and Bearing Behavior as Influenced By Soil Depth and Fertility

It has long been observed that young avocado trees on deep and fertile soils grow much more vigorously and are notoriously slower to come into bearing than on light, shallow or poor soils. Indeed it appears that the more favorable the soil conditions, the more rapid is the growth made and the slower are the trees to bear. Not uncommonly this slowness to bear is a cause for worry and complaint. The contrast in the behavior of young avocado trees as related to differences in soil conditions is certainly striking in comparison to that exhibited by young citrus trees, where depth and richness of soil are rarely reflected in prolonged growth and slowness to bear and merely postpone the time when the use of nitrogenous fertilizers become necessary.

Growth and Bearing Behavior as Influenced by Root Restriction, Competition of Sod Culture

Several instances have been noted where young avocado trees have come into bearing sooner than would be expected for the soil conditions in question, and in some cases earlier than other trees of the same variety and age on similar soils. Where this

unexpected behavior has been studied it has usually been shown to be associated with restriction of root development, or root competition. Thus far the former condition has been found only in regions of light rainfall and in orchards where the method of irrigation is such that only part, usually not more than 60 per cent, of the soil is irrigated. Under these conditions root distribution and activity are materially restricted during most of the year, and this seems to have slowed down the growth of the trees and caused them to come into bearing earlier than would otherwise be the case.

The majority of cases of root competition associated with earlier bearing have been related to orchard windbreaks or nearby trees of other kinds. In some instances the earlier bearing has been noted to occur on both sides of a nearby windbreak and in others to occur on the windbreak side, clearly suggesting that wind protection was not the factor involved in this response.

Numerous instances have been observed of vigorous young trees, not yet in bearing or just beginning to bear, which have materially increased in bearing following the initiation of sod culture, usually of Bermuda grass. Indeed in some cases the response has been most striking.

The responses of young citrus trees to these conditions differ materially from those described for the avocado. The time of coming into bearing seems usually to be little affected by root restriction and competition, though the amount of crop may be reduced somewhat. The latter is almost certain to occur following the initiation of sod culture unless the soil is of high fertility or supplemental fertilization is employed.

BEARING TREES

Growth, Bearing Behavior and Tree Health Under Permanent Sod Culture

Some of the best and most profitable avocado orchards in California have been in Bermuda sod for as long as 10 years yet the trees continue in good health and bearing. Most of them receive some fertilization, some considerable, yet under similar conditions few citrus orchards have continued to exhibit satisfactory health and production. In the vast majority of cases the citrus trees, even with heavy fertilization, have shown the leaf symptoms and poor fruit-set characteristic of nitrogen deficiency. As the consequence of this marked difference in response, permanent sod culture is now almost nonexistent in the California citrus industry whereas it is definitely on the increase in the avocado orchards of this state.

Growth, Bearing Behavior and Tree Health Under Conditions of Known Low Nitrogen Supply

Both avocado and citrus orchards and trees may be found where it is virtually certain that the nitrogen supply is low, sometimes to the point of probable deficiency. Such include young orchards where fertilization has temporarily been discontinued, nurseries where trees have been kept well beyond the marketable stage and dooryard trees which have been watered but not fertilized. Where it is possible to compare both kinds of trees under the same or similar conditions it will be observed that the avocado trees

exhibit much less evidence of deficiency in nitrogen supply. Indeed, not uncommonly they will show no visible effects whatever whereas the citrus trees will provide unmistakable evidence of nitrogen starvation.

EXPERIMENTAL EVIDENCE

Limited experimental results, incidental to other studies, have shown this contrast in response. Several years ago an experiment was conducted to ascertain the relationship, if any, between nitrogen supply and the alternate bearing tendency in the Fuerte avocado. Plots which provided low, medium, and high nitrogen supply respectively were established in several localities and conducted for a period of four years. The high nitrogen treatment consisted of 10 pounds of nitrogen per tree (50 pounds of ammonium sulfate, etc.) which is three to four times the usual application to citrus trees. The low nitrogen treatment consisted in the spading in under the spread of the tree, of 200 pounds of cereal straw. Six months after the first application, laboratory tests showed the soil nitrate supply reduced to little more than a trace to a six-foot depth. At no time during this experiment were any differences detected in the trees or crops and at the end of the third year, when 30 pounds of nitrogen had been applied per tree (150 pounds of ammonium sulfate, etc.), analyses for nitrogen content of the leaves, shoots and fruits failed to show differences between the three treatments.*

More recently a somewhat similar experiment was established on Valencia orange trees in which the amount of nitrogen applied was about half that employed in the avocado experiment. Within a few months pronounced differences in foliage color were observable between the high and low "nitrogen treatments. In the former the color was slightly darker than on untreated trees and in the latter it was distinctly paler. While the samples still await analysis, similar studies by other workers* make it reasonably certain that significant differences in nitrogen content will be found.

DISCUSSION AND APPLICATION

The contrasting behavior of avocado and citrus trees under the same or similar conditions of soil moisture and nutrient supply, above described, strongly suggests a difference in nitrogen requirement between the two. Extensive field observations and limited experimental evidence support the conclusion that avocado trees have a lower nitrogen requirement and respond satisfactorily to conditions of lower nitrogen supply than is the case with citrus trees. The contrasting behavior of the two under permanent sod culture may be considered to afford the most convincing evidence on this point for extensive studies of sod culture in apple orchards have shown that its principal effect on nutrient conditions is to markedly reduce the available nitrogen supply.

The evidence now available is insufficient to warrant a definite appraisal of the nitrogen requirement of the avocado tree. There is abundant observational evidence, however, to indicate that the application of nitrogenous fertilizers, under certain conditions at least, is both beneficial and economic. In the present state of our knowledge, therefore, the only justifiable practical application of the observations and conclusions here presented is that avocado orchard fertilization programs based on what might be termed

standard practice for citrus orchards in many cases may safely be materially reduced with respect to the total amount of nitrogen applied. For those growers who may wish to experiment for themselves, it is suggested that a program be followed which provides a moderate amount of decayable organic matter and that supplementary nitrogen applications be made only when tree growth, foliage color and bearing indicate the need for additional nitrogen.

* Cameron, S. H. and J. Bialoglowski. Effect of fertilization, ringing, blossoming and fruiting on the nitrogen content of avocado leaves. Yearbook California Avocado Assn. 1937: 142-148. 1&37.

*1. Hilgeman, R. H., Smith, J. G., and G. E. Draper. A preliminary note on nitrogen assimilation by citrus trees. Proc. Amer. Soc. Hort. Sci. 37: 58-61. 1940.

2. Hilgeman, R. H. Nitrogen uptake by grapefruit trees in the Salt River Valley. Proc. Amer. Soc. Hort. Sci. 39: 119-124. 1941.