High-yield Orange Orchards

management practices and soil conditions studied in 43 mature, high-performance orchards in California

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High-yielding orange orchards are being sampled throughout southern California to find clues as to management practices and soil conditions that will produce excellent citrus.

Forty-three mature orchards—20 years or older—were chosen which had production records for the past five years averaging better than 500 field boxes of fruit per acre. The orchards are located in San Diego, Orange, Riverside, San Bernardino, Los Angeles, Ventura, and Tulare counties, and were selected so a wide distribution geographically, pedologically, and climatically was obtained.

Management Practices

For each orchard, information was collected on cultural practices and tree appearance.

For the most part the trees are large, of good green color, with few, if any, foliage deficiency patterns.

Of the 43 orchards, 33 are cultivated but many are converting to noncultivation. Those that still cultivate average about three or four times a year and do so primarily for weed control.

The irrigation amount and frequency varies considerably with water source, soil type, and climate. Generally, the orchards on the most sandy soils in the interior are watered about every 15 days during the summer growing period; in the coastal districts every six to eight weeks; those depending on a mutual or common water source every 30 days. The amounts of water vary from 20 to 40 acre inches per year. As compared with average practices in any given district the high-yielding orchards are in general heavy users of water.

Most of the 43 orchards are on a stringent nitrogen and manure program generally consisting of an annual application of five tons per acre of steer or dairy manure, supplemented by commercial nitrogen sources to give an estimated annual nitrogen application of 250 to 300 pounds per acre. Very few orchards use mixed fertilizers, or soil amendments such as gypsum, lime or sulfur. In a few cases the program consists entirely of simple nitrogen and no manure.

Nutritional treatments consist primarily of zinc spray applications with 35 of the orchards reporting more or less regular usage.

About half the groves use oil spray regularly, and the other half, fumigation. Several orchards alternate oil with fumigation.

Very little pruning other than occasional removal of dead wood is the usual practice in these orchards. Only one of the orchards had ever been girdled.

Cover crops have little opportunity to grow in these mature groves, where the trees are large and much of the soil surface is shaded. In only a few cases is volunteer or seeded growth contributing any significant amount of organic matter.

Orchard Location

As to location two points are noteworthy: *1*, high-yielding orchards occur in nearly all the large citrus-producing regions of the state though they are strikingly less abundant in some areas than others; *2*, in certain localized districts no high-producing orchards could be found. Oranges can adapt to and produce heavily in areas such as Tulare County which is characterized by very hot dry summers, comparatively cool winters, and many bright sunshiny days; but also in areas such as San Juan Capistrano where the summer temperatures are cool, the winter mild, the humidity fairly high, and hours of sunlight more limited. It appears that so far as the macro features of climate are concerned, conditions are suitable for high production in all commercial orange districts of the state. However, two features of micro climate may restrict top performance: *1*, the degree of exposure to high velocity and desiccating winds which blow in from the desert to the east and north at periodic intervals during the fall and winter months; and *2*, frost. Protection against both these factors to some extent is possible but they are probably responsible for the scarcity or lack of top-performance orchards in some localities.

Orchard Age and Soil

Of the 43 mature orchards 35 are at least 30 years old, and 14 are 50 years or older. The oldest orchard is 70 years of age. It is evident from these data that the age of orange trees—at least up to 50 years—is in itself not a limiting factor in orange production.

The soil types on which the 43 orchards are located range in texture from adobe clay to loamy sands. Only three grow on loamy sands indicating that under the relatively arid conditions in the orange districts top production is not easily achieved on this and lighter textured types. Two of the orchards are on exceedingly heavy adobe-type soils demonstrating that with proper management, top production is possible even on these very heavy textured soils. It is doubtless significant, however, that save for these five orchards all others are on loams or sandy loams.

With reference to other soil characteristics, it is apparent that, while the majority of the orchards are located on deep, well-drained, friable soil types, such conditions are not absolutely indispensable to top performance. Two orchards on San Joaquin soil have hardpan throughout the grove at about 24″ depth.

The most acid soil found in the 43 orchards had a value of pH 4.3 in the surface, going to pH 6.5 in the 36–48″ layer. The most alkaline soil encountered showed pH 7.7 in the surface, going to pH 7.9 in the 36–48″ layer. This confirms the conclusions that within limits pH as such is not so important as the soil properties and conditions produced by or associated with it.

In a qualitative test for the presence of free lime in the soil, 16 of the 43 locations showed no evidence of lime carbonate in any of the soil depths, six showed traces, and the remaining 21 showed amounts ranging from a trace to high quantities. This indicates that top performance is not impossible in soils containing considerable amounts of free lime.

Salinity

Since salt accumulation is a perennial threat to citrus under conditions of irrigation agriculture, the salinity conditions in the orchards were determined. The average results for all 43 orchards showed conductance values well below the level where there is danger from salinity effects, and in general the average amount

Continued on page 14

QUARANTINE

Continued from page 3

sealing, and an entry system through an anteroom. The heating, cooling, air circulating, and sterilizing units are all self-contained within the quarantine wing. The laboratory equipment is assigned permanently to these quarters. The quarantine wing is kept locked at all times, and access to the wing is restricted.

The characteristic habits of insects are taken into consideration. A trap light device is incorporated into the entry system. Utilizing the phototropic responses of insects, this device operates as an additional precaution to prevent the escape of any individual insect.

As all material in the laboratory is caged in some manner, it is unlikely that an insect would ever be free in the quarantine room. Even if it were, it would have no opportunity to escape to the outside.

The second requirement of a quarantine unit is that it be functional. The facilities at Albany are designed to speed up or retard the rate of development of the insects by individual temperature controls in each room. This is at times a factor in the handling of insects from the southern hemisphere which are conditioned to seasons just the opposite of those existing in California upon their arrival. Temperature controls for growth regulating are also useful in the breeding of insects with complex life histories.

Since the testing of weed insects is becoming increasingly important to California agriculture, the quarantine rooms are designed for this type of work, offering conditions favorable for plant growth.

When tests are completed, all the imported material that has not been proved to be completely beneficial is sterilized and destroyed within the quarantine unit. Sterilization is accomplished by autoclaving which not only disposes of insect material but plant diseases as well. A small stock of each beneficial species is retained for breeding and for ultimate release against pests in agricultural areas.

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BRUSH

Continued from page 5

of 30¢ per acre for burning and a total cost of $2.95 per acre where seed and seeding were necessary.

San Diego County Project

An extensive wildfire burned over many thousands of acres above El Capitan Reservoir in the late summer of 1950. A co-operative range improvement project was started in this area in the fall on a small ranch and adjacent Cleveland National Forest land in co-operation with the landowner, the Farm Advisor and the United States Forest Service.

Brush on the demonstration area was primarily chamise with lesser amounts of ceanothus and manzanita. Light sandy soils of granitic parent material prevail.

An area of about 400 acres was broadcast seeded in early December to a mixture of grasses and legumes. Half of the area was railed before seeding and the remainder railed following seeding. In general railing not only pulled out many chamise burls but also improved the seedbed for establishment of forage plants. Railing after seeding was much superior to railing before seeding.

The effect of seed coverage upon establishment of forage plants was investigated further by the Farm Advisor. Railing, disking and sheepfoot rolling were used to cover the seed following broadcast seeding. Observations indicate that on the sandy soils of this region and with the poorly distributed rainfall and drying winds of 1950–51 some type of seed coverage was usually necessary to produce a satisfactory stand of forage plants.

First year results indicate orchardgrass, Hardinggrass, smilo, rose clover and annual ryegrass to be among the most promising species. A small plot of veldtgrass looked good. Seed of this species is in limited supply and rather difficult to obtain.

Cattle were grazed in the demonstration seeding during the summer after the grasses became dry. Forage seed is being trampled into the soil and the cattle are browsing to some extent upon the chamise sprouts and brush seedlings.

New Demonstration Areas

In addition to the two demonstration areas started in 1950 in Shasta and San Diego counties four additional ones are to be started in the fall of 1951. These areas represent four brush types and climatic zones not thus far represented:

1. Southern Humboldt County, representing chaparral of tan-oak, madrone, huckleberry and associated species in a high rainfall region.

2. Ventura County, representing the coastal sage type.

3. Tulare County, representing dense chaparral consisting of ceanothus, live oak and blue oak.

4. Modoc County, representing the Great Basin sage brush type.

It will take four to six additional ranges to adequately represent the major brush types throughout the state.

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HIGH-YIELD

Continued from page 12

of salt—expressed on a pounds per acre basis—was very low. However, in the deeper regions of the Porterville clay adobe soil high salt concentration was indicated. It is probable that in this exceedingly heavy soil the roots are confined largely to the surface, and hence the salt in the lower layers is not affecting the vigor of the tree.

Relatively high amounts of water-soluble potassium were found in the surface layer—apparently the result of the past and continued use of manures. Sodium tended to increase with depth but seldom accounted for 50% of the total bases. The amount of chloride was very low in all the orchards to even the four-foot depth. The amount of nitrate was rather uniform throughout the soil profile, reflecting the generally heavy nitrogen applications in these orchards.

Soil Fungi and Nematodes

There was no significant difference in the fungal population of the soils of these top orchards as compared with old citrus soils generally. This implies that the mere presence of unfavorable organisms does not prevent excellent yields, though tree condition and yield might be better if fungi were absent.

No orchards were free of citrus root nematodes; substantial numbers were present in most cases.

The elements nitrogen, phosphorus, sulfur, chlorine, calcium, magnesium, potassium, and sodium were determined on leaf samples from these high performance orchards. The range of values found checked in most instances with the standards indicating ample but not excessive supplies.

From this preliminary report it is apparent that there is a low soil salinity condition in nearly all the high-yielding orchards, but a rather wide range of soil pH, free lime, texture, depth, and origin characteristics. Work is continuing on all phases of this project and will include an evaluation of the physical condition of the soil profiles. In addition, a comparison is being made with the soil conditions and management practices in a group of orchards where sizes and yields are poor. This study will in due course include lemon orchards.

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