E. F. SERR

Walnut orchards on volcanic soils

Deficient in Phosphorus

During a period of abnormally high temperatures in 1954, severe leaf burning occurred in hillside plantings of walnuts in Lake County. Browning and drying of irregular areas in the walnut leaflets were followed by progressive dropping of entire leaflets, starting with the basal pair. The leaf analyses suggested phosphorus deficiency.

The orchards are growing mainly on Hesse and Glenview gravelly clay loams, volcanic soils derived from obsidian rock.

Trees of a young and a mature orchard of Franquettes in the most seriously affected areas were graded for tree condition, and leaf samples were taken from individual trees. The leaf symptoms and poor general tree condition were found to be closely associated with abnormally

Normal walnut trees usually contain low phosphorus content.

0.10% to 0.20% phosphorus. In the affected trees in the Lake County orchards, phosphorus content in the dry matter of the leaves was only 0.065% to 0.09%. Trees in the severely affected areas of the young orchard were growing abnormally slowly. Trees in the affected part of the mature orchard were also below normal size for the variety.

Soil applications of triple superphosphate—0-45-0—were made in November, 1954, at the rate of 25 and 50 pounds per tree on young trees, and 50 and 100 pounds per tree on old trees. An adjoining group of young trees was treated in the winter of 1956–57. Trees were examined and leaf samples were taken again during the summers of 1955, 1958, and 1959. Field data during the years 1956 and 1957 were not available.

Trees were graded in late July, August, or early September on the following basis: Grade *1* — apparently normal; Grade *2*—slight leaf burn; Grade *3*—considerable leaf burn, dropping of leaflets, and weak growth; Grade *4*—severe leaf burn, many leaflets shed, very weak growth; Grade *5*—very severe leaf burn, many leaflets shed, extremely weak growth, some dieback in top of tree.

Hillside walnut orchard on volcanic soil deficient in phosphorus. Alternate trees down row given 25 pounds triple superphosphate in trenches, Novembeor 1954. Picture taken October, 1956

Adjacent young walnut trees in phosphorus-deficient area in young walnut orchard on volcanic soil. *Left tree* received 25 pounds triple superphosphate, November 1954. *Right tree* untreated. Pictures taken October 19, 1956.

Comparison of phosphorus content of leaves and tree grade for the same tree during the same year showed a highly significant correlation in both the young and the old orchard. Leaf burning, leaflet dropping, and weak growth were consistently associated with low phosphorus content in the leaves. Poor trees given large applications of phosphorus showed consistent improvement.

Most of the applications of triple superphosphate were made in trenches 6″ deep and about 2′ out from the trunks of young trees, and 5′ out from the trunks of mature trees. This was to avoid the fixation of phosphorus in the soil before it could reach the feeder roots. When surface applications were made, the material was placed in a narrow ring around the trees at the same distance from the trunk as the trenches. Fifty pounds placed in a ring on the surface for young trees, and 100 pounds for mature trees, gave results similar to 25 and 50 pounds placed in trenches.

In the fall of 1959 measurements were made of the total length growth of all shoots that grew during the preceding season on phosphorus-treated and check trees in the young orchard. Data for trees paired on a basis of similar tree grades

***Left*—Leaves from phosphorus-deficient young walnut tree. Phosphorus content 0.075%, 1959. *Right*—Leaves from adjoining tree receiving 25 pounds triple superphosphate in November, 1954. Phosphorus content 0.115%, 1959. Both trees graded the same before treatment. Pictures taken August 21, 1959.**

before treatments were given, and also on similar tree size in 1958, show that treated trees made significantly greater length growth per unit size than similar untreated, phosphorus-deficient trees.

Yield of trees in the mature orchard was obtained in 1959. Trees were paired on the basis of comparable tree condition before treatments were made, and comparable tree size. Yields were significantly larger on trees that had received phosphorus than on untreated trees. All Franquette yields were abnormally low in 1959. Additional plots for further study have been established in other bearing orchards in the vicinity.

A limited survey, made in 1959, of walnut orchards on Hesse series soils and on the closely related Glenview and Aiken series, all of volcanic origin, indicated that some orchards on all of these soil series may be seriously deficient in phosphorus. However, there is no indication of a general deficiency of phosphorus in walnut orchards of California. Only a limited acreage of orchards on volcanic soils seems to be involved.

Further trials are needed to determine the most economical methods of supplying phosphorus to orchards. Broadcast surface applications are not effective because of the high fixing power of the soil for phosphorus. This has been demonstrated in two orchards in the affected district where broadcast surface applications have been made for several years and the trees are still showing severe deficiency symptoms.

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The above progress report is based on Research Project No. 1385.

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Early stocking affects

Forest Stands

in quality and value

Stand density or stocking during early stages of stand development has an important effect on quality and value of the timber because it influences size and distribution of knots. Openly stocked stands tend to develop large, persistent limbs which remain in the logs as knots. Large and numerous knots result in downgrading of logs, thereby lowering their value.

The forester can control stocking of seedlings on pole stands through regulation of planting densities and early thinning. In this way he may also, in large measure, control the quality and value of logs produced. However, he must have guides to aid in regulating early stocking to meet quality production goals. To provide such guides, studies were made of young Douglas-fir stands in Humboldt County and of ponderosa pine stands in the Sierra Nevada. Results with Douglas-fir to be grown to rotation ages of 80 years or less were as follows:

1. Average stocking of less than 170 trees per acre during the first 20 years of stand development results in butt logs with knots larger than 1½″ in diameter. These logs are disqualified for use as peeler logs in the manufacture of plywood. Furthermore, 70% of the butt logs will have knots larger than 2½″ in diameter, and will be graded No. 3 sawlogs.

2. With average stocking of less than 135 trees per acre during the first 20 years, none of the butt logs will grade higher than No. 3 sawlogs.

3. To minimize the degrading effect of knots on log quality, stands should be grown at densities greater than 170 trees per acre during the first 20 years, or should be artificially pruned.

Results from similar studies on ponderosa pine cannot be so definitely shown because of basic differences in log grading rules, but so far they indicate:

1. Average limb age and knot size increase with fewer trees per acre.

2. Average limb age on pine stands grown during the first 20 years at 170 trees or more per acre is nine years, while that of Douglas-fir may be 15 or 20, indicating that natural pruning may occur earlier on open-grown pine than on open-grown Douglas-fir.

3. Limbs live longer and reach larger average diameters on south and west than on north and east faces of the trees.

The combined studies indicate so far that early stocking is probably a more important determinant of quality and value in Douglas-fir than in ponderosa pine stands.

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