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, 1956, 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.

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
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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