

QUESTIONS AND ANSWERS ABOUT

Fertilizing Orchards

How? When? Why?



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CIRCULAR 333
MAY, 1963

COOPERATIVE EXTENSION SERVICE
NEW MEXICO STATE UNIVERSITY
UNIVERSITY PARK, NEW MEXICO



Iron deficiency, shown by the yellowing of these leaves, is a common condition of New Mexico soils.



These peach trees grew well after recommended amounts of mineral nutrients were added to the soil.

This circular has been published and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914, by the Cooperative Extension Service of New Mexico State University, Philip J. Leyendecker, director, and the United States Department of Agriculture, cooperating.

Fertilizing Orchards

How? When? Why?

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Nutritional deficiencies are common in New Mexico orchards and vineyards. In general, these deficiencies can be remedied by the application of proper fertilizers. Sometimes, however, deficiency symptoms remain even after fertilizers have been applied. This circular answers some of the questions that growers ask about orchard fertilization and fruit tree nutrition.

What is tree nutrition?

This is the process by which a plant takes in the food it needs for normal growth and fruiting. Its food is in the form of nutrient elements.

Where are nutrient elements found?

Fruit trees obtain most of their nutrient elements from the soil. Besides providing nutrient elements and moisture, the soil acts as a natural support.

What nutrient elements are needed by fruit trees?

Chemical analyses have shown that 40 to 60 mineral elements are present in fruit trees. However, most of these are not essential for growth and fruit production.

When is an element essential?

An element is considered essential if the tree cannot grow or reproduce normally without its presence. The element may be a structural component of the tissue (protoplasm), or it may act as a stabilizer or take direct part in plant metabolism.

What are the essential elements?

Fifteen mineral elements are essential. Three of these — oxygen, hydrogen, and carbon — are obtained from water and air. The remaining 12 are divided into two groups. The major essential elements are nitrogen, phosphorus, calcium, magnesium, sulfur, and potassium. The

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minor essential, or trace, elements are boron, manganese, iron, zinc, copper, and molybdenum. These two groups of elements are found in the soil and are equally essential. The only difference is that trees need much more of the major elements.

It is not enough for these elements to be present in the soil, they must also be in a usable form. Some factors that affect their availability are pH (acidity or alkalinity) of the soil, balance between elements, soil organisms, soil aeration, soil moisture, soil management and cultural practices, and organic matter content.

What soils are best suited for different fruits?

Apples: A heavy to medium, deep soil rich in organic matter and nutrients. The soil must have good water holding capacity and good drainage.

Blackberry, Raspberry, and Dewberry: Well drained, acid soil having good water holding capacity.

All the trees in this orchard are the same age, but the small ones are growing on shallow soil.

Grapes: Loam or silt loam, deep, mellow and well drained.

Peaches: Medium to light soil, two feet or more deep, good organic matter content (up to 2 percent).

Pears: Heavy soil, not too high in nitrogen.

Plums and Sweet Cherry: Medium to light soil, two or more feet deep, good organic matter content (up to 2 percent).

Sour Cherry: Medium depth soil having good drainage.

What is the condition of New Mexico orchard soils?

Symptoms of nitrogen and iron deficiencies are widespread among New Mexico orchards. Zinc deficiency symptoms are appearing in an increasing number of apple orchards. Phosphorus deficiency symptoms are not yet apparent although leaf and soil analysis has shown that the phosphorus content in most trees is low.

Nitrogen deficiency symptoms, well known to growers, are small yellow leaves and stunted growth.

Iron deficiency causes a severe chlorosis of fruit trees, with the young leaves usually showing the symptoms first. The leaf chlorosis is interveinal and may cause bleaching of all areas except those immediately adjacent to the veins.

Zinc deficiency is usually called rosette because of its most characteristic symptom—a dense cluster of small narrow leaves that terminates a branch, which is usually without leaves for a space below the rosette. The most obvious rosette is produced





This peach tree shows iron deficiency symptoms on one side.

during the first growth in the spring. Leaves on the affected branches may or may not be chlorotic.

Phosphorus deficiency symptoms appear on the shoots, petioles, and leaves. The shoot growth appears slender, petioles of the leaves are somewhat upright, the leaves may be smaller than normal and they tend to be dark green with reddish or purplish tinting of the midrib and larger veins.

Will soil test show fertilizer needs of trees?

In New Mexico, many factors affect the availability of elements in the soil—pH and calcium content, for example. A soil test alone, though a good indicator, may not show the needs of the trees. It is advisable to have a tissue test of the tree leaves along with the soil test. These tests

show the condition both in the soil and in the trees.

Can nutrient elements be depleted if originally present in sufficient quantities in the soil?

All nutrient elements may be depleted after extensive cropping, if the supply is not replaced. The rate of depletion depends on the original supply and the depth of the soil. The lower the supply and the shallower the soil, the faster the depletion.

Should additional elements be applied to soils already adequately supplied?

This depends on the nutrient element in question and on the condition of the soil. When excesses are not known to exist, a good practice is to add the major essential elements in proportion to the amounts

being removed by the trees. This will maintain an adequate level of these elements.

Trace elements are needed in very small quantities. Excess amounts may severely injure the trees. It is best to know that these elements are needed before applying them. The grower should check his trees for deficiency symptoms if no chemical analyses have been made.

Is too much fertilizer harmful?

Yes. An excess of any trace element is toxic to trees. An excess of any major essential element can also be harmful. Too much nitrogen, for example, delays maturity, causes poor fruit color, and prevents the fruit from keeping well. In young trees, too much nitrogen often promotes excessive vegetative growth and delays fruiting. Nitrogen should be applied in quantities sufficient for maximum yields and yet light enough to insure good color and good keeping quality.

In what form should fertilizer be applied?

Most major essential elements are applied to the soil in the form of granules or powder. Nitrogen can also be sprayed on the foliage for quicker results. However, some fruit foliages do not respond to the spray treatment. Apple trees usually respond satisfactorily. Foliage sprays must be used with caution because they can severely injure the leaves.

Trace elements may be applied to the soil, but they are usually sprayed on the foliage when deficiency symptoms appear. Again, caution

should be practiced to prevent foliage injury.

When should fertilizer be applied?

For most fruits, soil application of fertilizer, especially nitrogen, should be made in the late fall or early spring. For grapes and peaches, nitrogen may be applied later in the spring or early summer.

Foliage applications, especially of nitrogen to apples, should be made no later than June. It is best to spray trees with zinc during the dormant season. Iron sprays may be applied later in the summer if needed.

Does soil pH affect fertilizer practices?

Yes. Soil acidity or alkalinity strongly affects the availability of nutrient elements. Some elements are more available at a certain pH than others.

Soils with a pH value of 6.0-6.5 are said to be neutral. Before a pH of 6.0, soils are considered acid, while those above 6.5 are alkaline. Most orchard crops do best when the pH of the soil is 5.5 to 6.5. In New Mexico, however most soils

Soil pH for maximum availability of essential elements	
Essential Elements	pH
Nitrogen	6 to 8
Phosphorus	6.5 to 7.5
Potassium	6 to 9
Sulfur	6 to 9
Calcium	7 to 9
Magnesium	6.5 to 9
Iron	below 5 to 6
Manganese	5 to 6.5
Copper and Zinc	5 to 7

have a pH of 7.5 and higher. The table shows the pH at which essential elements are at their maximum availability.

Do we need organic matter in our soils?

Yes. Soil organic matter consists of a wide range of materials varying from freshly added plant and animal remains to the rather uniform-appearing slow-decomposing group of complex compounds known as humus. Organic matter, a transitory part of the soil, is continually decomposing and must be regularly replaced.

Organic matter improves soils for plant growth. It stores plant nutrients and, more important, it improves the physical properties of the soil. It increases the water-holding capacity of the soil, decreases water run-off losses, and improves both aeration and soil structure. Without organic matter, clay soils become compacted, which reduces water intake and aeration, and sandy soils lack body and capacity to hold water and nutrients.

Organic matter can be applied as barnyard manure or as a green manure. One ton of barnyard manure usually averages about 500 pounds of dry matter, and the dry matter contains 10 pounds nitrogen, 5 pounds phosphorus, and 10 pounds potassium.

Green manure may be legumes, which are nitrogen fixers, or non-legumes. When a non-legume is plowed under as a green manure crop, 30 pounds of nitrogen should be applied for each ton of material.

What effect does drainage water used in irrigation have on orchard soils?

Drainage water usually contains salts, some of which are detrimental to soil structure and plant growth. When salts build up in a soil, certain minerals become less available. Excess salts may produce symptoms in plants resembling those of mineral deficiencies. Water of poor quality may be used for irrigation where soil is open and well drained, providing sufficient water is applied each time to cause at least some leaching of accumulated salts. Soil structure becomes poor when brackish water, containing too much of sodium or magnesium, is used on clay soils or on soils having an underlying hardpan.

What effect do cultural practices have on a fertilizer program?

Growers use at least three systems of orchard cultural—clean culture, sod, and mulch. Some growers use an intercropping system or a combination of two or more of the three main systems. When a crop or sod is grown between the trees, the fertilizer must provide adequate nutrients for both trees and plants. Sod and intercropping increase color in apples but may reduce yields below those produced under clean cultivation or mulch. The increase in color is probably due to the reduction of nitrogen in the soil, as it is used by the intercrop.

Legumes, used as an intercrop, provide nitrogen for the trees. However, nitrogen fixed by the legumes late in the summer and fall may delay maturity and reduce color in apples.

Growers use different systems of orchard culture—top, clean culture; middle, sod; bottom, intercropping. The system affects the fertilizer needs of the orchard.



What can be done about the iron deficiency in soils?

When iron deficiency symptoms appear on a tree, it is advisable to apply iron. It may be added to the soil or sprayed on the foliage in either of two forms — iron sulfate or iron chelate.

Trees respond to iron sulfate very erratically. In some cases, a tree responds to either soil or spray applications of iron sulfate (copperas), and at other times no response is apparent. In alkaline soils, iron sulfate often becomes fixed in an unavailable form and cannot be taken up by the roots. The same condition may occur when iron sulfate is applied as a spray to foliage covered with a film of dust. If the dust is alkaline, the iron may become unavailable for foliage absorption.

Iron chelates are more expensive than iron sulfate, but they are usually more effective and may be applied in much smaller quantities. There are two types of chelates—one for alkaline soils (basic) and one for acid soils. Since most New Mexico soils are basic, the chelates developed for basic soils are best in this state. Iron chelate developed for acid soils must be applied in larger quantities to obtain the same results.

Chelate iron may be applied to the soil or sprayed on the foliage. Soil applications usually help overcome iron deficiency for more than one season, but tree response is slower. Spray applications usually give more immediate but more temporary results.



Young trees must have enough nutrients in proper balance to grow and mature wood and buds. The tree above shows signs of iron deficiency and defoliation. The one below is healthy.



How much fertilizer should be applied?

This depends on the type of soil, condition and age of the trees, kind of fertilizer, and the cultural practices used in the orchard.

Enough fertilizer should be applied to replace the elements removed by the trees so that the soil does not reach a point of depletion, which results in nutrient starvation of the trees. Recent studies have shown that approximately four-fifths of the apple trees in New Mexico are deficient in one or more nutrient elements.

The fruit grower must decide for himself how much fertilizer his trees need. The amounts mentioned here are only guides. If trees are vigorous and the soil is rich, less fertilizer probably will be needed than the rates mentioned. Where trees are weak and the soil is poor, the amounts of fertilizers should be increased.

Apples: Barnyard or green manure may need supplementing with commercial nitrogen fertilizer. About 400 pounds of barnyard manure usually supply the necessary nitrogen for a large apple tree. It is not always possible or profitable to supply that much manure each year, so additional nitrogen from some other source should be provided.

A mature apple tree removes approximately 1.5 pounds of pure nitrogen from the soil every year. Since a tree does not retrieve every ounce of nutrients applied to the soil, more should be applied than is actually taken up. Nitrogen fertilizers should be applied annually at the rate of 0.05 pound of pure nitrogen for each year of tree age. To calculate the amount of fertilizer

to apply, use the following equation:

$$\frac{\text{Age of tree (Years)} \times 5}{\text{Percentage of N in fertilizer}}$$

Example: If 30-year-old trees are to be fertilized with ammonium sulfate, which is 20 percent N., $30 \times 5 = 150 \div 20 = 7.5$ pounds per tree.

20

Mature trees which have not grown at the normal rate or have begun to decline because of old age may not be able to utilize 7.5 pounds of ammonium sulfate per tree. In this case, reduce the rate of application by 10 to 25 percent.

A 25-year-old tree removes about 0.5 pound of phosphorus per year from the soil. In New Mexico, where soil conditions help induce phosphorus fixation, it is advisable to add 2 to 3 pounds of 45 percent superphosphate per tree annually.

The mature apple tree removes 1.6 pounds of potassium per year from the soil. When a soil becomes low in potassium, 0.12 pound of potassium sulfate per year of tree age should be added, not to exceed 2.5 pounds per tree.

Sandy soils require more frequent applications of potassium. The recommended time for the application is once every three years. Since heavier soils in New Mexico usually have an adequate supply of potassium, no application should be made unless a soil test shows a definite need for it.

Apricots, Plums, and Cherries: Bearing trees need nitrogen at the rate of 0.05 pound of pure N per year of tree age as do apples, but the application should not exceed 0.75 pound pure nitrogen per tree.

Peaches: These need nitrogen at the rate of 0.05 pound of pure N per year of tree age, but should not receive more than 1 pound pure N per tree.

Pears: Nitrogen must be applied very carefully to pear trees. Too much tends to increase their susceptibility to fire blight. Nitrogen should be applied at one-half the rate prescribed for apples. No tree should receive more than 1 pound of actual N in any given year.

Brambles: Brambles need generous amounts of organic matter. Twenty tons of barnyard manure plus 300 pounds of superphosphate (45 percent) per acre should be applied annually. Potassium, when needed, should be applied at the rate of 300 to 400 pounds per acre. Annual applications of potassium are seldom needed.

Grapes: Grapes thrive in soils relatively high in organic matter, but they produce quite well on sandy loams which may be low in organic matter. Nitrogen should be applied at the rate of 40 to 80 pounds of actual nitrogen per acre. Fertilizers for grapes and brambles are usually broadcast between the rows.

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