Fertilizers for Fruit Crops
Michigan State University Cooperative Extension Service
F Folder Series
A.L. Kenworthy, R.P. Larsen, H.K. Bell, Horticulture
Issued June 1956
9 pages

EXTENSION FOLDER F-224

Fertilizers For Fruit Crops

By A. L. KENWORTHY, R. P. LARSEN, and
H. K. BELL
Department of Horticulture

MICHIGAN STATE UNIVERSITY
COOPERATIVE EXTENSION SERVICE
EAST LANSING

TABLE OF CONTENTS

FERTILIZERS FOR FRUIT CROPS

A. L. Kenworthy, R. P. Larsen, and H. K. Bell

Department of Horticulture

Applying fertilizers to your fruit planting will return more money for less cost than any other expenditure. With proper use of fertilizer, high production of excellent quality fruit will result. Certain fertilizers are needed in all fruit planting but should be used according to the needs of each planting.

Use of fertilizer on Michigan fruit plantings varies a lot, even for neighboring farms, because of: (1) the wide variation in Michigan soils due to their glacial origin; (2) the varied fertilizer and cultural treatments used during previous farming operations; and (3) the degree of pruning and other cultural practices.

NUTRIENTS NEEDED

NITROGEN

Nitrogen is needed in most Michigan fruit plantings and should be applied annually.

PHOSPHORUS

Phosphorus fertilizers often increase growth of strawberries and cover crops. Fruit trees have not shown a direct response to phosphorus fertilizers. However, annual applications of fertilizers containing phosphorus are suggested for all fruit plantings since such applications in orchards aid in maintaining good sod and cover crop growth. This, in turn, promotes soil conditioning, lessens erosion, and adds organic matter.

POTASSIUM

Adequate potassium promotes high yields and good quality fruit. Shortages are more common on grapes, peaches, and cherries than on other fruit crops; however, potassium should be applied to most fruit plantings in Michigan.

MAGNESIUM AND CALCIUM

Magnesium deficiency is widespread in Michigan fruit plantings. Calcium deficiencies are not common. Dolomitic or high magnesium lime is often used to supply calcium and magnesium and to adjust the pH.

MINOR ELEMENTS

Minor elements, such as iron, manganese, boron, copper, and zinc, are needed in small amounts. Although deficiency symptoms have been found for manganese, boron, zinc, and iron, they are rare in Michigan fruit plantings.

DETERMINING NUTRIENT NEEDS

LEAF ANALYSIS

Leaf analysis is the best way to determine the fertilizer needs of established fruit trees.

Leaf analysis is often used to confirm or diagnose a particular problem in an orchard after deficiency symptoms appear. More important, leaf analysis can be used to prevent symptoms from occurring by determining shortages or excesses of nutrients before visible symptoms appear. Leaf analysis may show the need for fertilizer not being used or that certain fertilizers being used are not needed.

A Leaf Analysis Service is now offered Michigan fruit growers by the Department of Horticulture, Michigan State University. Fruit crops now included in the service are: apples, pears, peaches, cherries, plums, and prunes. Grapes, blueberries, strawberries, and bramble fruits will be included soon in the program.

Take leaf samples for analysis between July 1 and August 15. Wash, dry, and send samples to the Department of Horticulture. You can get detailed instructions for collecting samples for analysis from the district horticultural agent, county agricultural agent, or by writing to the Department of Horticulture, Michigan State University, East Lansing, Michigan.

Leaves are analyzed for 10 essential nutrient elements. The analyses show how much of each nutrient is present. The results of leaf analysis will be returned to you on a Nutrient-element Balance Chart, accompanied by a letter giving specific fertilizer suggestions. A service charge is made to partly cover the cost of analysis.

SOIL TESTS

Soil tests are a good way to determine potassium, phosphorus and lime requirements for growing strawberry plants, cover crops in orchards, and for areas to be planted to new orchards.

When soil test values* approach 150 to 200 pounds of potassium per acre, 16 to 32 pounds of magnesium per acre, and 800 to 1,200 pounds of calcium per acre, fertilizer supplying these nutrients need not be added. A soil test of 48 to 72 pounds of phosphorus per acre is necessary for good growth of cover crops and shallow-rooted fruits.

Soil tests are not reliable for determining fertilizer needs of established deep-rooted fruit plantings; however, they may show the amount of lime and/or potassium needed for desirable cover crop and sod growth.

DEFICIENCY SYMPTOMS

Visible deficiency symptoms indicate an acute shortage of a nutrient. Therefore, determine the need of plant nutrients before symptoms occur; keep the nutrient level high enough to prevent them from appearing. Trees which develop deficiency symptoms are weakened, and are more easily affected by winter injury, drought, diseases and insects.

Suspect nutrient deficiency when a characteristic pattern develops on the leaves. For most nutrients, the leaf pattern follows leaf veins or runs along the margin of leaves. Affected leaves

* The amounts listed would not apply to tests from other laboratories unless they are using the same method as used by Michigan State University. Mich. Agr. Expt. Sta. Tech. Bul. 132.

occur in a pattern on the shoots. Scattered trees usually show deficiency symptoms unless there is a general nutrient shortage at planting time. Girdling, winter injury and poor drainage also cause symptoms resembling nutrient deficiency.

Deficiency symptoms are more common in Michigan fruit plantings for nitrogen, potassium, and magnesium than for other elements.

Deficiency Symptoms Of Nitrogen

Nitrogen deficiency is usually characterized by light green to yellowish foliage which develops premature fall colors and poor shoot growth. The fruit is usually small, highly colored, and of poor quality.

Deficiency Symptoms Of Potassium

Potassium deficiency symptoms appear as yellow or scorched (necrotic) margins of leaves. Potassium-deficient leaves may be curled on sour cherry and peach trees.

Deficiency Symptoms Of Magnesium

Magnesium deficiency may be identified by yellowing or browning of the leaves between the veins or on the margins of the leaves. Leaves showing symptoms drop prematurely, progressing from the base of growing shoots toward the tip. Failure of apple shoots to produce spurs and branches often indicates the beginning of magnesium deficiency.

Deficiency Symptoms Of Minor Elements

Deficiencies of minor elements have varied symptoms. Some symptoms are found on leaves, some on fruit and some on twigs.

Manganese and zinc deficiency symptoms are much alike. In advanced stages, zinc deficiency differs from manganese by the occurrence of small, narrow, chlorotic (yellow between veins) leaves that are bunched together in a "rosette."

Boron deficiency results in dark, discolored areas (measles) in the bark of twigs, small cracks in the skin of apples and discoloration of fruit flesh. ("Measles" also develops as a result of manganese toxicity.)

Iron deficiency results in chlorotic leaves with only the veins remaining green. Copper deficiency results in a dying back of twigs and, on stone fruits, forming of gum on the twigs.

APPLYING COMMERCIAL FERTILIZERS

The type of fertilizer mixture to be used depends upon the needs of the specific plant to which the material is to be applied. These needs may be met by applying fertilizer in the right **form** at the proper **time** and in the right **amounts.** Many forms of commercial fertilizers are suitable for fruit crops grown in Michigan (see page 16).

Commercial fertilizers can be obtained dry in bags or bulk, or as a liquid.* Buy whichever form is the most economical in price, handling, storage and application.

TREE FRUITS

Forms To Use

Nitrogen

Nitrogen is available in the ammoniacal, nitrate or urea form. Ammonium nitrate, nitrate of soda, ammonium sulfate, urea, and several other dry or liquid types of nitrogen can be used. Urea sprays will supply a part of the nitrogen needs of apple trees. Urea sprays seldom help peach trees and have caused injury (yellowing of leaf margins) to sour cherry and grape. Do not use calcium cyanamid on stone fruits; if used on other fruits, apply it in the fall.

Phosphorus

Phosphorus is available as superphosphate, triple-superphosphate, ammonium phosphate, phosphoric acid, or other derivatives of rock phosphate. Fruit trees do not respond to soil applications of phosphorus. Recent experiments with dormant and foliar sprays of phosphorus materials have been encouraging, and further research in this field is underway.

---

* Liquid fertilizers having vapor pressures developing from ammonia should be chiseled into the soil.

Potassium

Potassium is available as muriate of potash, sulfate of potash, sulfate of potash-magnesia, or potassium nitrate. Under certain conditions, plants respond better and absorb more potassium from sulfate than from muriate of potash.

Magnesium And Calcium

Magnesium and calcium can be most easily and economically supplied as dolomitic lime. It may take 3 years to correct magnesium deficiency with this material in sodded orchards. Trees in cultivated orchards respond to dolomitic lime more quickly. Finely ground or pulverized dolomitic lime will release magnesium and calcium more rapidly than the coarsely ground lime.

CAUTION: Unless the potassium reserve in the soil is adequate or high, applications of any type of lime can result in potassium deficiency. Where the potassium reserve is low apply potash fertilizers with the lime.

If symptoms of magnesium deficiency exist before lime applications, use foliar sprays of Epsom Salts (magnesium sulfate) or apply soluble magnesium fertilizers to the soil until magnesium from the lime becomes available.

Minor Elements

Minor elements are available in the form of chelated compounds, sulfate salts, or acids of the desired element. If needed, supply minor elements as follows:

IRON—use foliar sprays of ferrous citrate or ferrous sulfate. Apply iron chelates according to manufacturer's recommendations.

MANGANESE—use foliar sprays of manganese sulfate or soil applications of fertilizers containing manganese.

BORON—use soil applications or sprays of borax or other soluble borates.

ZINC—use foliar or delayed dormant sprays of zinc sulfate plus lime.

COPPER—use foliar sprays of copper sulfate plus lime.

When minor elements are supplied as sprays, do not mix with pesticide material because of possible reactions between materials.

Solutions At Planting

Fertilizer solutions applied at planting time can prevent nutrient deficiencies. Apply such solutions in the tree hole immediately after planting. If soil tests indicate low levels of potassium, use solutions containing potassium equivalent to 1 ounce of sulfate of potash per 3 gallons (2 pounds per 100 gallons). Use 1 to 3 gallons per tree immediately after planting.

Nitrogen solutions often help trees on light sandy soils. Such solutions should contain nitrate or urea nitrogen equal to 1 ounce per 3 gallons (2 pounds per 100 gallons) of sodium nitrate or potassium nitrate. Use 1 to 3 gallons per tree immediately after planting.

Solutions of hydrated dolomitic lime have been used successfully on soils low in calcium and magnesium. Solutions containing 1 pound of hydrated dolomitic lime per 10 gallons can be tried at a rate of 2 gallons per tree.

Commercial preparations of soluble fertilizers can be used as solutions at planting time. Use such materials according to manufacturer's recommendations.

Do not apply dry feritlizer near trees when planted; even small amounts can injure the limited root system of a newly planted tree. If the trees are on sandy soil, apply 1 to 2 ounces of ammonium nitrate or its equivalent about 1 month after planting. This can be banded around the trees, keeping the fertilizer about 1 foot from the trunks.

Time To Apply

Soil applications of nitrogen, phosphorus, potassium, and lime can be applied to fruit trees and grapes either in the spring or fall. Fall applications have certain advantages over spring applications: (1) labor is usually more available in the late fall after harvesting; (2) fertilizer applied in the fall will move into the deep-root zone

of trees and be available for growth in early spring. In orchards and vineyards located on light soil, however, it is better to apply at least part of the nitrogen in the spring since this nutrient leaches out of such soils quite easily.

Sprays containing nutrients are usually applied early in the season—in the pink, petal fall, and first or second cover periods. Zinc sprays can be applied to apple trees in the delayed dormant period or as a foliage spray. Boron can be applied to apple and pear trees as a post-harvest spray or in early cover sprays.

Amounts To Apply

Specific nutrient needs can be determined by leaf analysis, soil tests, and deficiency symptoms. Until leaf analysis or other information is available as a basis for fertilizer applications, use the following guide (a 25 to 30 percent increase in rate of application will be required for 2 or 3 years if fertilizer is broadcast rather than applied beneath trees):

Nitrogen, Phosphorus, and Potassium

APPLES AND PEARS—For established apple and pear trees, use a 1-1-1 or 2-1-2 ratio fertilizer. Apply enough to supply 2 to 3 ounces of nitrogen for each year of tree age up to 1 to 2 pounds of nitrogen per tree. For example—apply 12-12-12 or 12-6-12 fertilizer mix at a rate of 1 pound per year of tree age up to 10 to 15 pounds per tree. After the first application of fertilizer, use leaf analyses, soil tests and tree conditions as guides for future fertilizer programs.

PEACHES, CHERRIES, AND PLUMS—For established trees, apply a 1-1-1 or 2-1-2 ratio fertilizer. Use enough to supply 1 to 2 ounces of nitrogen for each year of tree age up to 8 to 16 ounces per tree. After the first application, use leaf analyses, soil tests and tree conditions as guides for future programs.

GRAPES—Apply nitrogen fertilizer or a 1-1-1 or a 2-1-2 ratio fertilizer in the spring in amounts to supply 40 to 50 pounds of nitrogen per acre. For normal healthy vineyards, apply in the fall a

0-1-3 ratio fertilizer to supply 30 to 40 pounds of phosphorus and 90 to 120 pounds of potassium per acre. If potassium deficiency is present, apply potash fertilizer in quantities to supply 150 to 200 pounds of potash per acre until the condition is corrected.

Magnesium And Calcium

Apply 1 to 2 tons of dolomitic lime where soil pH is below 5.5. If pH is above 6.0, use 1,000 pounds. Avoid applying larger quantities of dolomitic lime; this causes abrupt changes in soil pH and can induce deficiencies of minor elements.

If only magnesium is needed, use foliar sprays of Epsom Salts, 10 pounds per 100 gallons in the first three pesticide sprays, or use soluble magnesium fertilizers in amounts sufficient to supply 6 to 10 ounces of MgO (magnesium oxide) for each year of tree age until a maximum of 4 to 8 pounds are applied per tree. (For example, Epsom Salts may be applied at a rate of 2½ to 4 pounds per year of tree age until a maximum of 25 to 50 pounds is applied per tree.) Repeat applications annually until symptoms disappear.

Minor Elements

Apply according to the indicated need.

IRON—use ferrous sulfate (copperas) or ferrous citrate sprays in early foliar sprays at a rate of 5 pounds per 100 gallons. Use chelates according to manufacturer's recommendations.

MANGANESE—use two or three early foliar sprays of manganese sulfate at rates of 5 pounds per 100 gallons.

BORON—**Boron is extremely toxic when applied in excess.** Make soil applications of borax or other soluble borates at a rate of 1 to 4 ounces per tree, depending upon age of trees. Apply at rates of 2 or 3 pounds per 100 gallons in two early, or one after-harvest, sprays.

ZINC—use two or three early foliar sprays containing 3 pounds of zinc sulfate per 100 gallons. Use equal amounts of fresh hydrated lime to prevent leaf injury. On apple trees,

delayed dormant sprays (20 pounds of zinc sulfate per 100 gallons) can be used.

SMALL FRUITS

Base fertilizer applications upon known needs. Determine these needs by soil tests and local experimental results. Unless such information is available, use the following guide:

Strawberries

Where original fertility and organic matter are low, conduct a green manuring program for 1 or 2 years prior to planting. Such a program should include fertilizers and lime for the best growth of the green manure crops being used. (See Extension Bulletin 159, Fertilizer Recommendations for Michigan Crops).

If there was no previous soil building program before planting, work a 1-4-4 ratio fertilizer in amounts to supply 25 to 35 pounds of nitrogen per acre into the soil about 10 days before setting the plants in the spring. Make this application very early in the spring (before growth starts) on fields planted in the fall.

Apply starter solutions only to plants set very early in the season (before April 15 in southern Michigan; before May 1 in northern Michigan). A soluble fertilizer with a ratio of about 1-5-1 is best. Consult Extension Folder F-194, "Starter Solutions," for more information.

Apply a 1-1-1 ratio fertilizer about 2 weeks after setting the plants if growth is weak. Use enough to supply 30 to 35 pounds of nitrogen per acre. Repeat this application in 3 or 4 weeks if vigor still is low.

Applications of fertilizer seldom are needed during the spring of the first fruiting year. Excessive nitrogen at this time can result in soft berries which decay rapidly. If plants lacked vigor during the previous fall, use nitrogen fertilizers in amounts not over 10 pounds of actual nitrogen per acre. This can be applied through irrigation or as urea sprays. On beds of very low vigor, make two such applications at about 10-day intervals.

Apply a complete fertilizer after harvest when fields are to be fruited for another year. Immediately after harvest use a 1-1-1 ratio fertilizer to supply 60 to 100 pounds of nitrogen per acre. As the fruiting season approaches, use the applications suggested for first fruiting season.

Blueberries

Blueberries are sensitive to nitrate nitrogen and to chlorides contained in certain fertilizers. Therefore, blueberry fertilizers should contain only ammonium salts as a source of nitrogen and sulfate of potash as a source of potassium. Also, blueberries grow best on soils having a low pH (4.0 to 5.5), and lime should not be used unless the pH is 3.5 or lower.

Apply fertilizer to newly set fields with caution. Use one ounce of a 1-1-1 blueberry fertilizer per plant if soil fertility is low. The fertilizer may be applied as a band 6 inches or more away from the plants.

On established blueberry fields, apply blueberry fertilizer in sufficient amounts to apply 60 to 100 pounds of nitrogen per acre. Use a 1-1-1 ratio fertilizer on mineral soils and a 1-2-3 ratio fertilizer on organic soils. Make two applications of equal amounts, the first as early as possible in the spring, the second in early June. Broadcast fertilizer or apply it with a drill between the rows.

On mineral soils low in organic matter, use ammonium sulfate to supplement the applications of 1-1-1 fertilizer. If plants lack vigor, use ammonium sulfate at a rate of 60 to 70 pounds per acre (1 ounce per plant) during the first and second years. Increase the amount 30 to 35 pounds per acre annually until a maximum of 240 to 280 pounds per acre are being applied. Apply supplemental ammonium sulfate in late June.

Other Small Fruits

Apply complete fertilizer to brambles, gooseberries and currants before growth starts in the spring. Use 2 ounces of a 1-1-1 ratio fertilizer around newly set plants. In the second year use enough 1-1-1 ratio fertilizer to supply 25 to 30 pounds of nitrogen per acre. In succeeding years use enough 1-1-1 ratio fertilizer to supply 50 to 60 pounds of nitrogen per acre.

If leaf scorch (potassium deficiency) appears, apply enough potash fertilizer to furnish 150 to 200 pounds of potash per acre. Repeat annually until leaf scorch disappears. Gooseberries and currants need sulfate of potash to avoid possible chloride injury.

COVER CROPS AND SODS

Cover crops and sods in orchards require separate fertilizer applications. When cover crops are used, apply fertilizers at seeding time. Soil conditions determine the kind and amount of fertilizer to be applied.

Use the following general guide (Table 1), based upon soil tests, for grass sods and for cover crops of rye, wheat, oats and sudan grass:

TABLE 1—Fertilizer recommendations for cover crops and sods, based on soil test results.

Soil test result		Fertilizer ratio
Phosphorus	Potassium	
Low	Low	1-3-3
Medium	Medium	1-2-2
High	High	1-1-1
Very high	Very high	1-0-0

(Fertilizer ratios should be varied according to soil tests. For example: if phosphorus is high and potassium is low, a ratio of 1-1-3 should be used. If phosphorus is low and potassium high, a ratio of 1-3-1 should be used).

Fertilizer applications should provide 25 pounds of nitrogen per acre on loamy soils and 35 pounds of nitrogen per acre on sandy soils. Regulate the amount of nitrogen to provide the amount and rate of growth desired. Growth of grass sods should be enough to prevent thatching (the accumulation of undecomposed organic matter on the soil surface) which often results in the sod dying out because seeds are unable to grow through the mat of organic material.

If legumes are used, reduce the nitrogen level or omit it from the fertilizer. If the cover is 50 percent legumes, reduce the nitrogen rate 50 percent. Additional nitrogen (approximately 20 pounds per acre) may be needed if the cover crop is beyond bloom stage when disced down.

Liming is often essential for the establishment and maintenance of cover crops and sods. Use dolomitic lime when needed to provide sufficient calcium and magnesium and to make suitable adjustments in soil pH.

Additional information on fertilizer recommendations may be obtained from Michigan Cooperative Extension Service Bulletin 159, Fertilizer Recommendations for Michigan Crops.

MULCHES AND MANURE

Mulches or organic material of low nitrogen content (shade tree leaves, sawdust and shavings) require additional nitrogen. With such materials, the nitrogen applications (see page 10) may need to be increased as much as 50 percent for 2 or 3 years. Mulches of fresh straw may require an increase of 25 percent in the nitrogen application to prevent any competition for nitrogen between the trees and fresh straw. Straw or hay that has partly decayed should not increase nitrogen needs. Legume hay or residues may lower the nitrogen requirements by as much as 25 to 50 percent.

All mulch materials release nutrients upon decomposition and usually make soil nutrients more available by equalizing the soil moisture supply.

The actual amount of mineral nutrients contained in manure is usually quite low; however, it is a valuable source of organic matter. If an economical source of manure is available, manure applications should be made, especially on light sandy soils. Additional fertilizer will be needed if the manure contains a large proportion of bedding or litter. Such manures can be used as a mulch.

Cooperative extension work in agriculture and home economics. Michigan State University and the U. S. Department of Agriculture cooperating. Paul A. Miller, Director, Cooperative Extension Service, Michigan State University, East Lansing. Printed and distributed under Acts of Congress, May 8 and June 30, 1914.

6:56—20M

ANALYSIS OF COMMONLY AVAILABLE FERTILIZERS

Kind of fertilizer	Analysis	Nutrient
Nitrate of soda—$NaNO_3$	16.0% N	Nitrogen
Sulfate of ammonia—$(NH_4)_2SO_4$	20.0% N	Nitrogen
Calcium nitrate—$Ca(NO_3)_2$	15.5% N 28.0% CaO	Nitrogen Calcium
Ammonium nitrate—NH_4NO_3	33.0% N	Nitrogen
Ammonia, anhydrous—NH_3	82.2% N	Nitrogen
Urea—$CO(NH_2)_2$	45.0% N	Nitrogen
Calcium cyanamid—(CaNCN)	30.5% N*	Nitrogen
Mono-ammonium phosphate—$NH_4H_2PO_4$	11.0% N 48.0% P_2O_5	Nitrogen Phosphorus
Di-ammonium phosphate—$(NH_4)_2HPO_4$	21.2% N 53.8% P_2O_5	Nitrogen Phosphorus
Superphosphate—$(CaH_4(PO_4)_2 + CaSO_4)$	20.0% P_2O_5	Phosphorus
Double or triple superphosphate—$(CaH_4(PO_4)_2)$ (concentrated superphosphate)	45.0% P_2O_5	Phosphorus
Ortho phosphoric acid—H_3PO_4	71.0% P_2O_5	Phosphorus
Muriate of potash—KCl	60.0% K_2O	Potassium
Sulfate of potash—K_2SO_4	50.0% K_2O	Potassium
Sulfate of potash—magnesia—$K_2SO_4 \cdot MgSO_4$	21.0% K_2O 18.0% MgO	Potassium Magnesium
Magnesium sulfate		
Epsom salts—$MgSO_4 \cdot 7H_2O$	16.3% MgO	Magnesium
Anhydrous—$MgSO_4$	33.0% MgO	Magnesium
Keiserite (Emjeo)—$MgSO_4 \cdot H_2O$	27.0% MgO	Magnesium
Dolomitic lime**—$MgCO_3 \cdot CaCO_3$	22.0% MgO 30.0% CaO	Magnesium Calcium
Dolomitic lime** hydrated—$Mg(OH)_2 \cdot Ca(OH)_2$	30.0% MgO 45.0% CaO	Magnesium Calcium

Mixed Fertilizers—see analysis on bags. Ratios refer to nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O) percentages in the mixed goods. Ask dealer about source of nutrients.

---

* Commercial preparations contain 20 percent nitrogen.

** Dolomitic lime varies considerably in MgO content. Consult dealer for magnesium analysis.