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Fertilizer Recommendations
Michigan State University Extension Service
Soil Science and Horticulture
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16 pages

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FERTILIZER RECOMMENDATIONS

Fertilizer Grades Authorized for Sale in Michigan

| | | | |
|-------------|-------------|-------------|------------|
| 0 - 12 - 12 | 0 - 14 - 7 | 2 - 12 - 6 | 4 - 16 - 4 |
| 0 - 14 - 14 | 0 - 20 - 10 | 3 - 9 - 18 | 4 - 16 - 8 |
| 0 - 20 - 20 | 0 - 9 - 27 | 3 - 12 - 12 | 6 - 12 - 6 |
| 0 - 10 - 20 | 2 - 16 - 8 | 4 - 12 - 8 | 10 - 6 - 4 |

Higher grades of the same ratios are also recommended.

Superphosphate—18% phosphoric acid or higher

Muriate of potash—50% potash or higher

Sulfate of potash—48% potash or higher

Ammonium nitrate—32-35% nitrogen

Sulfate of ammonia—20.5% nitrogen

Calcium cyanamid—20.6% nitrogen

Nitrate of soda—16% nitrogen

Some other materials carrying nitrogen, phosphoric acid, or potash may be sold.

8-8-8 for experimental purposes

Special garden and turf fertilizers

PREPARED BY

DEPARTMENTS OF SOIL SCIENCE AND HORTICULTURE

MICHIGAN STATE COLLEGE

COOPERATIVE EXTENSION SERVICE

EAST LANSING

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FERTILIZER FACTS

1. FERTILIZER SUPPLIES

The fertilizer industry is putting forth every effort to produce as much fertilizer as possible to supply customers' requirements. It is of interest to note that for the 5-year period preceding the war fertilizer production averaged only 7,350,000 tons, while in 1947 it was approximately 15,000,000 tons. The 16,000,000-ton mark is expected to be reached shortly, possibly in 1948. During the same period the use of fertilizer in Michigan has increased from 144,075 to approximately 390,000 tons. Certainly this is a rapid increase. New fertilizer factories have been and are being constructed. Supplies of raw materials have been the limiting factor in increased production. Present indications point to some increase in raw materials and a larger output of fertilizer. However, many more farmers are buying fertilizer than previously, especially in Wisconsin and Iowa, and hence it is doubtful if there will be an appreciably larger supply for Michigan farmers.

2. USE FERTILIZER WISELY

It is essential that farmers use fertilizers wisely to produce the maximum benefits with the supplies available this year. It is advisable to use the bulk of the fertilizer on crops which respond especially well to applications of plant food, such as alfalfa, potatoes, sugar beets, wheat, barley, oats, vegetables, fruits and essential oils. Farmers are urged to use the fertilizer on these crops rather than on crops which do not give consistent increases in yield as a result of fertilization.

3. ORDER FERTILIZER EARLY

Fertilizer manufacturers must keep their workers busy the year around if they are to hold their labor. Likewise the processing machinery must be kept running if fertilizer is to be produced economically and in large volume. Storage facilities are not adequate to hold this amount of fertilizer until near planting time and neither is there transportation to deliver so much fertilizer in a comparatively short

period. As a result forward-looking farmers are ordering their fertilizer many months in advance of the planting season and are taking it home and storing it in their own buildings.

4. STORE FERTILIZERS IN A DRY PLACE

Farmers should provide a dry, well ventilated place for the storage of the fertilizer from the time it is delivered to the farm until it is applied to the soil. The fertilizer should not be stacked too high, and there should be a good floor under it. Planks placed on two-by-fours or rails to raise them off the floor, allowing air circulation underneath make an excellent floor under the fertilizer. Fertilizer that remains in storage for a considerable time should be repiled, putting the bags on top that were on the bottom. This rehandling helps to break up any hardening that is taking place.

5. RECONDITIONING OLD FERTILIZER

Fertilizer which has been left over from last year, if it has been stored in a dry place, is just as good as newly mixed goods, except that it may become lumpy under unfavorable conditions. Screen through a gravel screen made with hardware cloth of about $\frac{3}{8}$ -inch mesh. Crush the lumps on a concrete or tight wooden floor with a tamp.

6. FERTILIZER ANALYSES

Since fertilizers are designed to supply one or more of the plant food elements, nitrogen, phosphoric acid, and potash, the Michigan fertilizer law requires that the percentage of each of these nutrients be printed on the container or on a tag attached to the container. It has become customary on the large containers to print the percentages with dashes separating the figures, as 2-16-8; 0-14-7; 3-12-12. This series of figures is popularly known as the analysis or grade of the fertilizer.

The first figure in the analysis gives the percentage of total nitrogen. The second figure in the analysis represents the percentage of available phosphoric acid (P_2O_5). The percentage of water-soluble potash (K_2O) is represented by the last figure in the analysis. Farmers are urged to study the results of experiments to determine the grade of fertilizer needed for different crops on the different soil types on their farms and to order fertilizer by analysis or grade.

7. MINOR ELEMENTS

Under specific soil conditions one or more of some five plant food elements not commonly added to fertilizers may be of benefit to certain crops. On the other hand, certain of these elements may be harmful to crops if too much is applied. These five elements, manganese, boron, copper, zinc, and sodium, are often referred to as "minor" elements because they are used in small quantities by plants.

Experiments indicate that on mineral or upland soils which are slightly acid none of these five elements are needed for commonly grown crops. In case the soil is alkaline, however, boron and manganese are needed by certain crops. This is one of the reasons for the caution against using lime on soils which do not need it. On the other hand, the large majority of the commonly grown field crops in Michigan yield better on soils which are slightly acid to neutral and hence we should lime medium to strongly acid soils as the first step in soil building.

In the case of certain crops growing on Muck soils, all five of these minor elements may be needed under specific conditions. **Definite recommendations for use of these elements for different crops are given in tables 1, 2, and 3.**

These minor elements are ordinarily applied in relatively cheap and available forms, already mixed in the fertilizer at the factory, and the amount added should be shown on an attached tag. The following percentages only can be so included: manganese sulfate, 5, 10 and 15%; borax, 2½, 5 and 10%; copper sulfate, 2½, 5 and 10%; and zinc sulfate, 1¼ and 2½%. Sodium ordinarily is applied separately in the form of common salt although the salt can be mixed with the fertilizer if the mixture is to be used in a short time.

8. BUY HIGH GRADE FERTILIZERS

Fertilizers containing reasonably high percentages of plant food are more economical to use than lower grades because they supply plant food at a lower cost per pound. During the war period materials were not available to make large tonnages of the higher grade fertilizers, and so a very large quantity of 2-12-6 was made. There is still a scarcity of some materials and as a result there will be considerable 2-12-6 this year, but this grade should disappear from the market very shortly because the plant food it supplies is too costly.

TABLE 1—FERTILIZER RECOMMENDATIONS FOR COMMON CROPS ON HEAVY LOAMS, SILT LOAMS, AND CLAY LOAMS such as the Brookston, Miami, Conover, Isabella, Kent, Nester, Bergland, Selkirk, Wisner and similar soils

| Crop | Manure applied within two years | Rates per acre, methods of application and other suggestions | Not manured recently |
|--------------------------------------|--|---|--------------------------------|
| | Grades recommended | | Grades recommended |
| Alfalfa, alfalfa-brome, sweet clover | Superphosphate 18-20% 0-20-10 0-14-7 | Drill 300 pounds or more when seeding and repeat after every second year. | 0-20-10 0-14-7 |
| Barley, oats | Superphosphate 18-20% 0-14-7 2-16-8 4-16-4 (1) | Drill 200-300 pounds per acre. If legume is seeded apply 300-400 pounds. | 2-16-8 2-12-6 4-16-4 (1) |
| Beans, soybeans(2) | 0-20-10 0-14-7 2-16-8 | Drill 200-400 pounds in bands 1 inch to the side and 1½ inches below the seed. Apply no fertilizer in contact with the seed. Borax is injurious to beans. | 2-16-8 4-16-8 2-12-6 |
| Corn | 2-16-8 0-20-10 Nitrogen fertilizers | Fertilizer applied with the planter for corn hastens early growth but usually does not increase yield of grain. Apply fertilizer liberally to small grain, legumes, and other crops preceding corn in the rotation. Side-dress with nitrogen fertilizer containing 40 pounds of nitrogen at last cultivation when plant symptoms and/or tests indicate a need. | 2-16-8 4-16-8 |
| Sugar beets, chicory, red beets | 4-16-8 2-16-8 2-12-6 | Drill 400-600 pounds in bands 1 to 2 inches to side and 1½ inches below seed. Not more than 200 pounds with the seed is safe. If a drill which places the fertilizer in a band separate from the seed is not available, drill deeply 500 pounds before planting. Use 5-10 pounds borax per acre for sugar beets, chicory, 20 pounds for red beets if applied in the fertilizer beside the seed or 40 pounds if applied broadcast. Use 20 pounds per acre manganese sulfate for sugar beets where pH of soil is above 6.9. | 4-16-8 2-16-8 2-12-6 |

(1) For use in the upper peninsula.

(2) If the pH of the soil is above 6.9, apply 30 pounds of manganese sulfate per acre. Mix the manganese sulfate with the fertilizer.

FERTILIZER RECOMMENDATIONS FOR COMMON CROPS ON HEAVY LOAMS, SILT LOAMS, AND CLAY LOAMS—Continued

| Crop | Manure applied within two years | Rates per acre, methods of application and other suggestions | Not manured recently |
|-------------------------|---|---|---|
| | Grades recommended | | Grades recommended |
| Potatoes ⁽²⁾ | 4-16-8 4-16-4 2-16-8 | Drill 500 pounds in bands 2 inches to side of seed pieces. In cases where it is advantageous to use more, plow under 500 pounds additional. | 4-16-8 2-16-8 |
| Wheat, rye | Superphosphate 18-20% 0-20-10 0-14-7 2-16-8 4-16-8 | Drill 300-400 pounds per acre; if legume is seeded use 400-500 pounds. Application of manure to dark-colored soils may encourage lodging. Use the higher nitrogen mixture where straw is plowed under. | 2-16-8 4-16-8 6-12-6 |
| Peas | 0-20-10 0-14-7 2-16-8 | 300 pounds. Drill fertilizer in bands 1 to 1½ inches to side of seed, or drill approximately 4 inches deep before planting. Do not place in contact with the seed. | 2-16-8 2-12-6 |
| Sweet corn | 2-16-8 2-12-6 4-16-4 ⁽¹⁾ | Drill 200 to 300 pounds per acre, if possible in bands one to two inches to the side and slightly below the seed. Plow under 200 to 400 pounds. | 2-16-8 2-12-6 4-16-4 ⁽¹⁾ |
| Tomatoes | Superphosphate 18-20% 4-16-4 4-16-8 | Apply 300 to 500 pounds per acre in bands two to three inches to the side of the row and two to three inches below the soil surface at time of setting the plants or side-dress at first cultivation. Plow under 300 to 500 pounds. Use a starter solution. | 4-16-4 4-16-8 |
| Market gardens | 4-16-4 4-16-8 | Plow under 500-800 pounds per acre. Drill 200-300 pounds in bands ½ inch to side and 1½ inches below seed. | 4-16-4 4-16-8 |

⁽¹⁾For use in the upper peninsula.

⁽²⁾White-skinned varieties that are subject to severe scab injury are usually grown on strongly acid soils (pH 4.5-5.5) where they are freer of infection. Scab-resistant strains are grown successfully on high lime soils (pH 6.5-7.5).

FERTILIZER RECOMMENDATIONS FOR COMMON CROPS ON HEAVY LOAMS, SILT LOAMS, AND CLAY LOAMS—Concluded

| Crop | Manure applied within two years | Rates per acre, methods of application and other suggestions | Not manured recently |
|---|---------------------------------|---|----------------------|
| | Grades recommended | | Grades recommended |
| Spinach, cabbage, lettuce, leafy vegetables | 4-16-4 | Drill 500-600 pounds per acre in bands 1 to 2 inches to side and 2 inches below seed or broadcast after plowing and disk in the soil. Do not place fertilizer in contact with seed. | 4-16-4 |
| | 6-12-6 | | 6-12-6 |
| | 4-12-8 | | 4-12-8 |
| Pepper, eggplant | 4-16-8 | Sidedress cabbage, lettuce, spinach and similar crops and pickles with 100 pounds ammonium nitrate or 200 pounds nitrate of soda or 150 pounds of sulfate of ammonia in cool wet seasons. | 2-16-8 |
| Carrots, beets | | | |
| Pickles, melons, squash, etc. | Superphosphate 18-20% | If soil is alkaline, apply 10 pounds borax per acre, or 4 ounces per 1,000 sq. ft. to cabbage, spinach, lettuce, table beets, turnips, rutabagas, broccoli, cauliflower, brussels sprouts and similar crops. Beans are easily injured by even small amounts of borax. | 4-12-8 |
| | 4-16-4 | | 4-16-4 |
| Snap beans ⁽¹⁾ | 4-16-8 | | 2-16-8 |
| | 2-12-6 | | 2-12-6 |
| | 0-14-7 | | |
| Radish seed | 4-16-8 | | 4-16-8 |
| | 2-12-6 | 2-16-8 2-12-6 | |

⁽¹⁾If the pH of the soil is above 6.9, apply 100 pounds of manganese sulfate per acre.

TABLE 2—FERTILIZER RECOMMENDATIONS FOR COMMON CROPS ON LOAMS, SANDY LOAMS, AND SANDY SOILS such as Fox, Hillsdale, Plainfield, Berrien, Arenac, Emmet, Onaway, Montcalm, Kalkaska and similar soils

| Crop | Loams and heavy sandy loams | Rates per acre, methods of application and other suggestions | Sandy loams and sandy soils |
|--------------------------------------|--|--|---|
| | Grades recommended | | Grades recommended |
| Alfalfa, alfalfa-brome, sweet clover | 0-12-12 0-20-20 | 250-350 pounds. Apply fertilizer when seeding and every two years. | 0-10-20 0-12-12 |
| Barley, oats | 3-12-12 2-16-8 4-16-4 (1) | 200-300 pounds. If legume is seeded apply 400 pounds 0-12-12. | Barley not recommended. 3-12-12 4-16-4 (1) |
| Beans, soybeans | 0-12-12 0-14-7 | 200 pounds. Apply 1 inch to the side and 1½ inches below seed. None with seed. | Crop not recommended. |
| Corn | 2-12-6 3-12-12 | Fertilizer hastens early growth, but usually does not greatly increase yield of grain. See Table 1 for further discussion. | 3-12-12 |
| Sugar beets, chicory, red beets | Sugar beets and chicory recommended on better soils only. 3-12-12 | Quantities of fertilizer to use and method of application are given in Table 1, page 5. | Sugar beets and chicory not recommended. 3-12-12 |
| Potatoes: Early Late | 4-12-8 3-12-12 4-16-8 3-12-12 | 500-600 pounds. Apply in bands at side of seed piece. In special cases, especially under irrigation, 1000 pounds or more may be used. | 3-9-18 3-12-12 |
| Wheat, rye | 3-12-12 2-16-8 2-12-6 4-16-8 | 300 pounds drilled at seeding. Topdress in winter with manure, using about 6 loads per acre. Use the higher nitrogen fertilizer where straw is plowed under. | 3-12-12 6-12-6 |
| Peas | 0-12-12 3-12-12 | 300 pounds per acre. Directions for method of application are given in Table 1, page 6. | Crop not recommended. |
| Sweet corn | 2-16-8 3-12-12 4-12-8 | 200 to 300 pounds. Drill fertilizer in bands one to two inches to the side and slightly below seed level. Plow under 200 to 400 pounds. | 3-12-12 4-12-8 |

(1) For use in the upper peninsula.

FERTILIZER RECOMMENDATIONS FOR COMMON CROPS ON LOAMS, SANDY LOAMS, AND SANDY SOILS—Concluded

| Crop | Loams and heavy sandy loams | Rates per acre, methods of application and other suggestions | Sandy loams and sandy soils |
|---|---|---|--|
| | Grades recommended | | Grades recommended |
| Tomatoes | 3-12-12 2-16-8 4-12-8 | 800 to 1200 pounds. Apply 300 to 500 pounds per acre in bands two to three inches to the side of the row and two to three inches below the soil surface at time of setting the plants or side-dress at first cultivation. Plow under 300 to 500 pounds. Use a starter solution. | 3-12-12 3- 9-18 |
| Market gardens | 3-12-12 4-12-8 2-16-8 6-12-6 | 800 to 1500 pounds. Drill 300 to 500 pounds one to two inches to the side and below the seed, plow under 500 to 700 pounds per acre. Side-dress with 300 to 500 pounds of a fertilizer of high nitrogen content if conditions warrant. | 3-12-12 6-12-6 |
| Cabbage, spinach, lettuce, leafy vegetables | 4-12-8 6-12-6 4-16-4 | Drill 300-500 pounds per acre in bands 1 to 2 inches to side of and 2 inches below seed. Plow under 400 to 600 pounds on soils of low fertility. Do not place fertilizer in contact with seed. Side-dressing with nitrogen fertilizer during growth is desirable. If soil is alkaline apply 10 pounds of borax per acre for cabbage, spinach and lettuce. | 6-12-6 |
| Peppers, eggplant | 2-16-8 | | 3-12-12 |
| Carrots and other roots | 3-12-12 | 500 pounds. Apply beside seed or broadcast before planting. | |
| Pickles, melons, squash, etc. | 4-16-4 3-18-9 3-12-12 If manured, use super-phosphate 18-20% | 500 to 800 pounds. Apply 500 pounds broadcast and 300 pounds in bands two inches to the side of the row either at planting or at first cultivation. | 3-12-12 |
| Snap beans, radish seed | 3-12-12 2-16-8 4-12-8 | 300-500 pounds. Apply 1 inch to the side and 1½ inches below seed. None with seed. If soil is alkaline, apply 100 pounds manganese sulfate per acre. Use 4-12-8 for early plantings of snap beans. | 3-12-12 |
| Asparagus | 0-10-20 Ammonium nitrate, nitrate of soda | Broadcast 700-1000 pounds per acre of 0-10-20 before cutting begins. Apply 150 pounds ammonium nitrate or nitrate of soda before cutting begins and 150 pounds at the end of the cutting season. Use half portions on young beds. | 0-10-20 Ammonium nitrate, nitrate of soda |

HOME GARDENS

| | | |
|----------------------------|--|-----------------------------|
| Heavy loams and clay loams | Broadcast 2 pounds per 100 square feet before plowing or spading. Place 2 to 3 pounds per 100 feet of row in shallow trenches 2 inches to side and 2 inches below the seed. For tomatoes, place $\frac{1}{2}$ pound in a circular trench around the plant approximately 2 to 3 inches from the root cluster and 4 to 5 inches deep in addition to the application broadcast before plowing or spading. Use fertilizer with higher nitrogen content for root and leafy crops and fertilizer of lower nitrogen content on fruit crops. If the home garden soil is alkaline, apply 3 to 4 ounces manganese sulfate per 100 square feet of garden area. | Light loams and sandy soils |
| 4-16-4 | | 3-12-12 |
| 2-16-8 | | |
| 6-12-6 | | 6-12-6 |

TREE FRUITS, GRAPES, BUSH FRUITS AND BRAMBLES

(See notes below)

| | | |
|----------------------------|--|---|
| Apples | Ammonium nitrate, nitrate of soda, or sulfate of ammonia | Use no fertilizer when trees are planted except on light soils and no fertilizer during first year. Use $\frac{1}{4}$ to $\frac{1}{2}$ pound of ammonium nitrate, or its equivalent, per tree for each year of orchard age until 5-7 pounds are being applied per tree. |
| Peaches | Same as above | Use 1 to 2 ounces the first year that trees are planted. Use $\frac{1}{3}$ to $\frac{1}{2}$ pound of ammonium nitrate, or its equivalent, per tree for each year of orchard age until 2-3 $\frac{1}{2}$ pounds are being used per tree. |
| Cherries Pears Plums | Same as above | Use 1 to 2 ounces the first year that trees are planted. Use $\frac{1}{4}$ to $\frac{1}{2}$ pound of ammonium nitrate, or its equivalent, per tree per year of orchard age until 1 $\frac{1}{2}$ -3 pounds are being applied per tree. |
| Grapes | Same as above | Use 1 to 2 ounces the first year planted. Use $\frac{1}{4}$ to $\frac{1}{2}$ pound of ammonium nitrate per vine according to cane vigor. |
| Currants Gooseberries | Same as above | Use 2 to 4 ounces per bush or 150-250 pounds per acre of ammonium nitrate or its equivalent. |
| Raspberries | Same as above | Use 5-10 pounds per 100 feet of row or 150-300 pounds per acre of ammonium nitrate or its equivalent. |

1. Consult your local county agricultural agent or district horticultural agent concerning the use of lime, phosphorus, potassium, and minor elements. Their use may be needed only for cover crop or sod growth.

2. Mulching of trees growing on soils subject to drought or in sod will be markedly beneficial. Nitrogen rates should be increased in orchards planted in sod or mulched with sawdust. A 50 to 100% increase is frequently used. However, excessive amounts of nitrogen predisposes a tree to winter injury.

3. Amount of fertilizer must be regulated according to growth and production. On over-vigorous plants reduce the amount applied. On poor growing plants increase the amount of fertilizer, degree of pruning, and mulch plants.

4. Apply fertilizer in spring or fall. Spring applications usually preferred for nitrogen; and fall applications preferred for phosphorus, potassium and lime. Fall nitrogen applications are more successful on apples than on other fruits and more successful on heavy than on light soils.

5. Fertilize cover crops in orchards, vineyards and small fruits as suggested for small grain or pasture crops.

6. Use no fertilizer in tree holes at planting time.

STRAWBERRIES

| | | |
|--------------------------------------|----------------------------------|---|
| Strawberries (See notes below) | Super- phosphate or 4-16-4 | 500-1000 pounds per acre applied in spring when preparing soil for planting. |
| | Sulfate of ammonia | Side-dress with 200 pounds per acre two weeks after planting. Repeat first of August. Side-dress weak beds in spring of fruiting year with 100 pounds per acre. CAUTION —spring applications on vigorous beds have caused serious loss of fruit. |
| | 10-6-4 or 4-16-4 | 500 to 1000 pounds per acre soon after harvest for second and third crop. |

1. Care should be used when making summer applications to prevent excess burning of leaves.
2. Soils well supplied with organic matter and high in fertility may not need any commercial fertilizers.
3. Soils vary considerably. Consult local county agricultural agent or district horticultural agent about the use of lime, phosphorus, potash and minor elements.

BLUEBERRIES**on Strongly Acid, Muck and Sandy Soils**

| | | |
|-------------|-----------|--|
| Blueberries | 8-8-8 (1) | On sandy soil, 2 ounces in the spring of the second year in the field, and increased 1 ounce each year until a total of 7 ounces per plant is being used. |
| | 3-9-18 | On muck soil, use fertilizer containing 5 percent copper sulfate. Two to three ounces fertilizer per plant the first year, increasing $\frac{1}{2}$ ounce per year to a maximum of 8 ounces annually. Slightly acid muck soil can be made suitable for blueberries by the use of sulfur. |

(1)Should be made up with sulfate of potash.

TABLE 3—MUCK SOIL

Fertilizer analysis and rate of application* for crops on muck soil, together with initial percentage of minor element plant foods which should be included in the fertilizer mixture.

| Salt (pounds per acre) | For Acid Muck Soils (pH 6.5 or less) | | | | For Alkaline and Faintly Acid Muck (pH 6.6 or more) | | | | |
|------------------------------|--|------------------------|------------------------|-----------------------|--|-----------------------|---------------------------|-------|---------------------------------|
| | Fertilizer analysis for mucks of good and poor drainage. Per- centage minor plant foods in fertilizer mixture | | | | Fertilizer analysis for mucks of good and poor drainage. Per- centage minor plant foods in fertilizer mixture | | | | |
| | Percent in fertilizer*** | | Fertilizer analysis | | Percent in fertilizer*** | | Fertilizer analysis | | |
| | Borax | Copper sul- fate | Poor drain- age | Good drain- age | Good drain- age | Poor drain- age | Manga- nese sulfate | Borax | Salt (pounds per acre) |
| 0 | 0 | 0 | 0 | 0-9-27 | 0-9-27 | | 15 | 0 | 0 |
| 0 | 0 | 0 | 0-12-12 | 0-10-20 | 0-10-20 | 3-12-12 | 15 | 0 | 0 |
| 0 | 0-5 | 2.5-5 | 3-9-18 | 0-9-27 | 0-10-20 | 3-12-12 | 15 | 5 | 0 |
| 100 | 0-5 | 5 | 3-9-18 | 0-9-27 | 0-10-20 | 3-9-18 | 5 | 5 | 100 |
| 0 | 0 | 5 | 0-9-27 | 0-9-27 | 0-9-27 | 3-9-18 | 15 | 0 | 0 |
| 0 | 2.5 | 2.5 | 3-9-18 | 0-9-27 | 0-10-20 | 3-9-18 | 5 | 2.5 | 0 |
| 500-1000 | 2.5 | 0 | 3-12-12 3-9-18 | 0-10-20 0-9-27 | 0-10-20 0-9-27 | 3-12-12 3-9-18 | 5 | 5 | 500 |
| 0 | 0 | 2.5 | 3-9-18 | 0-9-27 | 0-10-20 | 3-9-18 | 10 | 0 | 0 |
| 100-200 | 0 | 2.5 | 3-9-18 | 0-9-27 | 600-800 | 3-9-18 | 0 | 0 | 100-200 |
| 0 | 5 | 10 | 3-12-12 | 0-10-20 | 500-1000 | 3-12-12 | 15 | 5 | 0 |

Crop and Rate of Fertilization

(If row crops are fertilized in row, not more than $\frac{1}{2}$ to $\frac{3}{4}$ the amounts recommended below should be used, preferably 2 to 3 inches below seed.)

Crop**

Pounds
per
acre

600-1000

400-600

500-1000

600-1000

800-1200

800-1600

1200-2500

1200-2500

500-1000

600-800

500-1000

Asparagus

Beans

Broccoli

Cabbage

Carrots

Cauliflower

Celery {
Early
Late

Cucumbers

Kohlrabi and kale

Lettuce, Head and Leaf

| | | | | | | | | | | | |
|----------|-------|-----|-------------------|------------------------------|---------------------------------|----------|------------------------------|-------------------|-------|----|----------|
| 0 | 0 | 5 | 3-12-12 3-18-9 | 0-10-20 0-12-12 | Mint | 400-1000 | 0-10-20 0-12-12 | 3-12-12 3-18-9 | 0 | 0 | 0 |
| 0 | 0 | 5 | 3-12-12 3-18-9 | 0-10-20 3-9-18 0-12-12 | Onions† | 800-1800 | 0-12-12 3-9-18 0-20-20 | 3-12-12 3-18-9 | 5-15 | 0 | 0 |
| 0 | 5 | 2.5 | 3-9-18 | 0-9-27 | Parsnips | 800-1200 | 0-9-27 | 3-9-18 | 5-10 | 5 | 0 |
| 0 | 0 | 2.5 | 3-9-18 | 0-9-27 | Potatoes | 800-1200 | 0-9-27 | 3-9-18 | 10-15 | 0 | 0 |
| 0 | 0 | 2.5 | 0-12-12 | 0-9-27 | Pumpkins, squash | 300-600 | 0-9-27 | 3-9-18 | 15 | 0 | 0 |
| 100-200 | 2.5 | 2.5 | 3-9-18 | 0-9-27 | Radishes | 400-800 | 0-9-27 | 3-9-18 | 15 | 5 | 100-200 |
| 0 | 5 | 10 | 3-9-18 | 0-9-27 | Spinach | 600-1200 | 0-10-20 | 3-9-18 | 10-15 | 5 | 0 |
| 0 | 5 | 0 | 3-12-12 | 0-10-20 | Sweet corn | 600-1000 | 0-10-20 | 3-12-12 | 10 | 5 | 0 |
| 500-1000 | 2.5-5 | 5 | 3-9-18 | 0-9-27 | Table beets, Swiss chard | 600-1000 | 0-9-27 0-10-20 | 3-9-18 | 5-15 | 10 | 500 |
| 0 | 0 | 5 | 3-12-12 | 0-9-27 | Tomatoes | 800-1000 | 0-10-20 | 3-12-12 | 5-10 | 0 | 0 |
| 500 | 2.5-5 | 5 | 0-10-20 | 0-9-27 | Turnips, rutabagas | 300-500 | 0-9-27 | 0-10-20 | 10-15 | 5 | 500 |
| 0 | 5 | 0 | 3-9-18 | 0-9-27 | Corn, field | 400-800 | 0-9-27 | 3-9-18 | 15 | 5 | 0 |
| 0 | 0 | 5 | 0-10-10 | 0-9-27 | Grain | 250-400 | 0-9-27 | | 15 | 0 | 0 |
| 500-1000 | 2.5 | 5 | 3-9-18 | 0-9-27 | Sugar beets, mangels | 400-700 | 0-9-27 | 3-9-18 | 0 | 5 | 500-1000 |
| 0 | 0 | 5 | 0-9-27 | 0-9-27 | Permanent pasture | 125-175 | 0-9-27 | 0-9-27 | 0 | 0 | 0 |
| 0 | 0 | 2.5 | 3-9-18 | 0-9-27 | Timothy and alsike, brome grass | 200-350 | 0-9-27 | 3-9-18 | 15 | 0 | 0 |
| 0 | 0 | 2.5 | 3-9-18 | 0-9-27 | Reed canary grass | 300-400 | 0-9-27 | 3-9-18 | 15 | 0 | 0 |
| 0 | 0 | 5 | 0-10-20 | 0-9-27 | Soybeans, sweet clover | 250-350 | 0-9-27 | 0-10-20 | 15 | 0 | 0 |

TABLE 3—MUCK SOIL—Continued.

| Salt (pounds per acre) | For Acid Muck Soils (pH 6.5 or less) | | | For Alkaline and Faintly Acid Muck (pH 6.6 or more) | | |
|------------------------------|--|------------------------|-----------------------|--|-----------------------------|-----------------------|
| | Fertilizer analysis for mucks of good and poor drainage. Per- centage minor plant foods in fertilizer mixture | | | Fertilizer analysis for mucks of good and poor drainage. Per- centage minor plant foods in fertilizer mixture | | |
| | Percent in fertilizer*** | Fertilizer analysis | | Fertilizer analysis | Percent in fertilizer*** | |
| | Borax | Poor drain- age | Good drain- age | Good drain- age | Poor drain- age | Borax |
| 0 | 0 | 3-9-18 | 0-9-27 | 0-9-27 | 3-9-18 | 15 |
| 0 | 0 | 3-9-18 | 0-9-27 | 0-9-27 | 3-9-18 | 15 |
| 0 | 0 | 0-12-12 | 0-12-12 | 0-12-12 | 0-12-12 | 0 |
| | Crop and Rate of Fertilization | | | Crop and Rate of Fertilization | | |
| | (If row crops are fertilized in row, not more than 1/2 to 3/4 the amounts recommended below should be used, preferably 2 to 3 inches below seed.) | | | (If row crops are fertilized in row, not more than 1/2 to 3/4 the amounts recommended below should be used, preferably 2 to 3 inches below seed.) | | |
| | Crop** | | Pounds per acre | Crop** | | Pounds per acre |
| | Sudan grass, Hungarian millet | | 200-300 | Sudan grass, Hungarian millet | | 200-300 |
| | Raspberries | | 500-800 | Raspberries | | 500-800 |
| | Strawberries | | 200-400 | Strawberries | | 200-400 |

*Where two crops are produced on the same field in one growing season, the maximum fertilization for the year should be not more than the maximum recommended for the first crop plus two-thirds of the maximum recommended for the second crop. Where a crop requiring light fertilization, such as mint, follows a crop which received heavy fertilization, such as celery or onions, the rate of fertilization for the crop of the second year can be considerably reduced below that recommended above.

**Sidedressings of ammonium nitrate may be required during growth on the following crops: Broccoli, cabbage, cauliflower, 100 to 150 pounds per acre. Celery, 150 to 400 pounds. Topdressings of available nitrogen following exceptionally wet weather may be required on the following crops: Lettuce, mint, onions, radishes, spinach, table beets, Swiss chard, 100 to 200 pounds per acre. Double the application if nitrate of soda is used.

***Where a range in percentage of minor plant food elements is given, the percentage which should be used depends on the rate of application of fertilizer and on the degree of acidity or alkalinity of the soil. Zinc sulfate or borax generally not advisable in row fertilization.

†For onions 2 1/2% zinc sulfate is recommended in the fertilizer mixture on new muck for the first three years of cropping. Need greater in wet seasons. See further notes on page 15.

NOTES REGARDING MUCK LAND FERTILIZATION AND CROPPING

| Crop | Remarks | Crop | Remarks |
|--|---|--|--|
| Broccoli Cabbage Cauliflower Spinach Swiss chard Head lettuce | Apply fertilizer in 7" drills before seeding or transplanting. For cabbage and cauliflower transplanted to wet muck, 400 to 500 pounds per acre can be applied in row 4" deep. With head lettuce, heavy fertilization increases tip burn. Use little fertilizer if well fertilized previous years. Raise Imperial 456, Great Lakes or Imperial 44. These six crops responsive to manure, supplemented with 0-9-27 fertilizer. | Field corn Sweet corn | Generally advisable to fertilize broadcast in 7" drills 4" deep before planting. |
| Celery Radishes Table beets | Nitrogen advisable in fertilizer mixture for early crops. Celery responsive to manure, supplemented with commercial fertilizer. In absence of manure, side-dress celery with available nitrogen fertilizer. | Grain | Apply fertilizer in 7" drills 4" deep. Grow varieties adapted to muck, as Peatland barley, Vicland oats, Rosen rye, Yorkwin (Fall) and Henry (Spring) wheat. |
| Onions | Row application 400 to 800 pounds 2 inches below seed advisable on moist muck, with 400-800 pounds per acre previously drilled over field if soil is low in fertility. Try 3-12-12 or 3-18-9 if crop is generally slow in maturing. | Permanent pasture | Apply fertilizer annually broadcast in spring. Growth increased, and palatability and nutritive value much improved by proper fertilization. |
| Mint | Fertilizer needed to maintain stand, as well as to increase oil content. Try 0-12-12 on well drained, and 3-18-9 on poorly drained muck if mint is late in blossoming. Heavy fertilization advisable where wilt is prevalent. | Meadows | Seeding without nurse crop often advisable. Early seeding necessary to beat weed growth. |
| Carrots Parsnips | Fertilize in 7" drills 3 to 4 inches deep. Sow parsnips early for good yields on muck. | Soybeans | Sow around May 20 in vicinity of Lansing if weather is favorable. Use early variety if grain is desired. |
| Potatoes | Fertilize in 7" drills or, on moist muck, put 400-600 pounds in row, preferably 4" below seed. Plant close to avoid hollow heart and frost injury and fairly early for good yields. Plant 4 to 5" deep and keep soil firm to reduce scab. | Sugar beets | Apply fertilizer and salt in 7" drills, 4" deep, or apply not more than 200 pounds fertilizer in row, preferably 2" below seed. Apply remainder in 7" drills. |
| | | Beans Cucumbers Squash Tomatoes | These crops easily killed by frost; therefore, generally not safe on muck soil. Keep soil compact and well supplied with moisture to help prevent frost injury. Early tomato varieties preferable. |
| | | Strawberries | For berry production on strawberries, fertilize lightly —100 to 300 pounds 0-12-12. For plant production apply 500 to 600 pounds 0-9-27. Use everbearing varieties if muck is frosty. |

PLANTS SHOW STARVATION SYMPTOMS

Crop plants are normally green. When another color develops it is very likely caused by a deficiency of some plant nutrient. Most deficiencies result in yellowing of leaves. The pattern of yellowing varies with different nutrients and with different species of plants. For many years these deficiency symptoms have been studied under controlled conditions. The time has arrived when in many cases one can tell from the appearance of a starved plant just what nutrient shortage was chiefly responsible for its unhealthy condition. Growers may very easily become familiar with these symptoms and decide for themselves when their plants are suffering for lack of plant food.

A bulletin on the subject has been prepared by the Soil Science Section of the Michigan Agricultural Experiment Station. It contains both black-and-white and colored pictures, illustrating nutrient deficiency symptoms on field crops, vegetables and flowering plants. Descriptions of the symptoms and the soil conditions under which they most commonly occur are included. The use of soil and plant tissue tests, as a means of verifying symptoms, is also discussed. The bulletin is designed to be used in the field if desired.

Because of the expense involved in publishing so many colored pictures it is necessary to make a charge for the bulletin, sufficient to cover part of the cost of publication. The bulletin may be purchased from the Bulletin Office, Department of Public Relations, Michigan State College, East Lansing, Michigan. Information as to price may be obtained from the same source.