Fertilizer Recommendations for 1930
Michigan State University Agricultural Experiment Station
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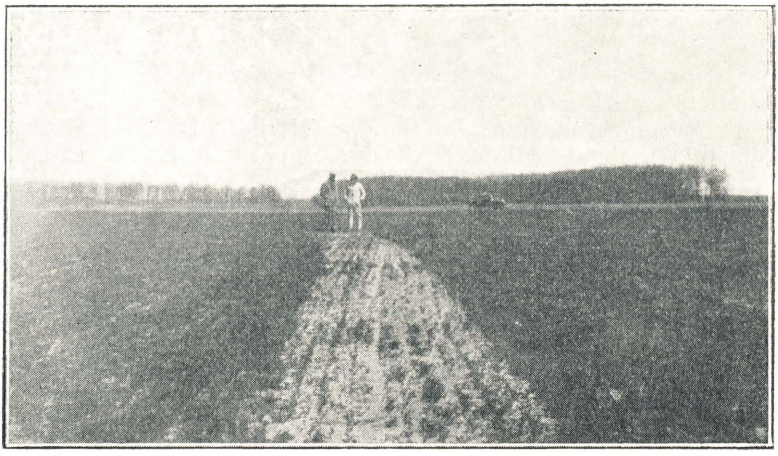

While preparing his field for alfalfa, this farmer left one drill width without fertilizer. Note the benefit resulting from fertilization in the better stand and greater growth of alfalfa.

AGRICULTURAL EXPERIMENT STATION

MICHIGAN STATE COLLEGE

Of Agriculture and Applied Science

SOILS SECTION

East Lansing, Mich.

TABLE OF CONTENTS

FERTILIZER RECOMMENDATIONS FOR 1930

M. M. McCool, G. M. Grantham, and P. M. Harmer

Profitable returns on an investment in commercial fertilizers would be derived by all Michigan farmers if the fertilizers were used properly. The use of high-analysis fertilizers, applied in the right amounts and by the latest approved methods, will result in maximum profits. Some Michigan farmers have not secured maximum returns on their investments because they have not made a careful study of the conditions on their farms.

Results of thirteen years' experiments in this state, and of those from several other northern states, show that the profits derived from one dollar invested in a suitable fertilizer, applied in the right amount and to the right crop, should range from one to three or more dollars in case of mineral soils and perhaps even more on muck soils. Fertilizer companies are now producing mixtures of high analyses, and these are gradually displacing those of lower analyses. It is good business to use these high-grade fertilizers because they are the cheapest carriers of plant food and, in addition, less energy is required to apply a given amount of plant food with high-grade fertilizers.

The soils of Michigan are notoriously variable. They may differ widely, not only texturally in adjoining areas, but also chemically, or in their composition and ability to grow crops. Such variations, coupled with differences in farm practices, make it difficult to offer recommendations that will fit all conditions. Investigations conducted by the Soils Department in the use of fertilizers in this state, however. have brought out certain principles which, if followed, will be of assistance to the farmer. It will be the policy of this department to present suggestions on the use of fertilizers each year in revisions of this Circular Bulletin No. 53, until it is no longer deemed necessary to follow this procedure. This policy will be followed because of changing conditions in the manufacture of commercial fertilizers, changes in the composition and cost of materials available for the farmer, and because of the acquisition of many new facts through field experimentation.

Selecting the Proper Fertilizer Formula

Many years of experimentation have demonstrated that at least three fertilizing constituents may be needed by crops growing on Michigan soils. While all three are important in increasing crop yields,

Note—Further information regarding fertilizers and soils can be secured by addressing the Soils Department, Michigan State College, East Lansing, and requesting any of the bulletins listed on the back cover of this circular.

other important benefits are also produced, if the soil is not naturally supplied with sufficient quantities of these constituents:

Nitrogen	1.	Increases top growth of crop.
	2.	Hastens early growth of crop.
Phosphate	1.	Hastens maturity of crop.
	2.	Improves quality and stimulates root development.
Potash	1.	Improves vigor of crop and makes it more resistant to disease.
	2.	Increases growth of root crops and is essential for production of starch, sugar, and other carbohydrates.

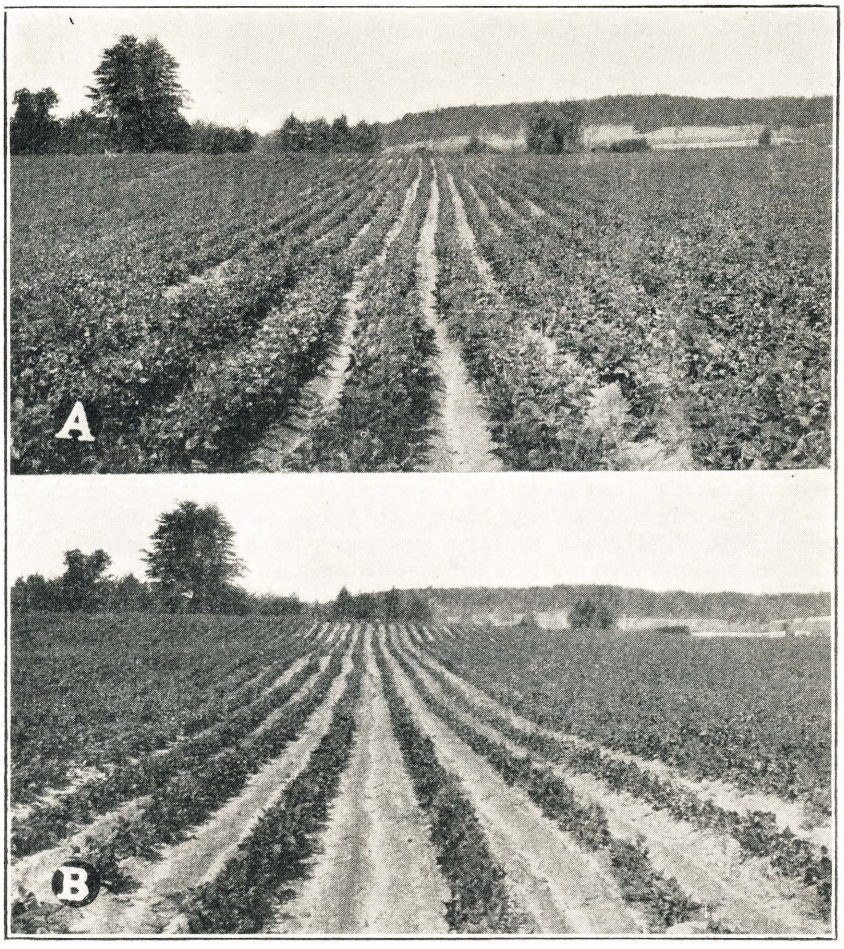

Fig. 1.—Beans respond to fertilization. Upper—250 pounds per acre of complete fertilizer. Lower—No treatment.

In making up a fertilizer mixture, it has been found convenient to express the content of these three constituents in the mixture by a formula in which the per cent of each constituent is given, the constituents being arranged in alphabetical order in the formula. Thus, a 2-12-6 fertilizer contains 2 per cent of nitrogen, 12 per cent of phosphate (calculated as P_2O_5), and 6 per cent of potash (calculated as K_2O).

Fig. 2.—The potatoes in the foreground received no fertilizer while those in the background received 1,000 pounds per acre of 4-16-8.

In the preparation of the tables which appear in this report, it was impracticable to include all of the mixtures now on the market that would be adapted to a given crop. Special attention has been given the higher-grade mixtures. Although these are recommended, other mixtures having the same, or very similar ratios between the nitrogen, phosphate and potash, may sometimes be secured when the higher-analysis mixtures are unobtainable. Thus we find on the market the 4-16-4 and the 3-12-4 mixtures with similar, but not identical ratios. Likewise the 0-20-20, the 0-14-14, the 0-12-12, and the 0-10-10 mixtures have the same ratio between the phosphate and potash. While the highest-analysis mixture is cheapest per unit of plant food, all four would be equally desirable from the standpoint of increasing crop yields, providing correspondingly heavier applications of the lower analyses are used.

Home Mixing of Fertilizer

The manufacturer should be able to mix fertilizer more cheaply and more efficiently than the farmer; however, conditions are sometimes such that one can economically mix them at home. The use of ready-mixed fertilizer is advisable if one can purchase a mixture which meets

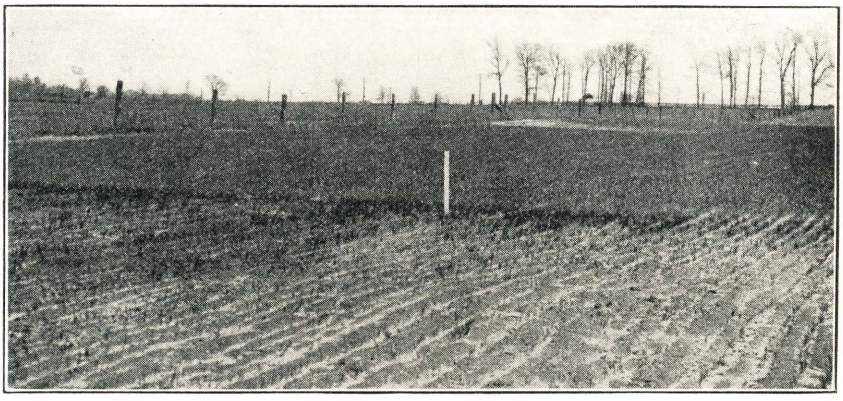

Fig. 3.—The unfertilized wheat in the foreground was almost entirely winter-killed, while the fertilized wheat in the background produced a good yield of grain.

his needs, at a cost not appreciably higher than the home mixture would cost when ready to apply to the soil. Certain mixtures which are not properly balanced for Michigan soils have recently been placed on the market at reasonable prices. Such mixtures may be improved by the addition of more phosphate, if they are to be used on mineral soils, and of more potash if intended for application on mucks.

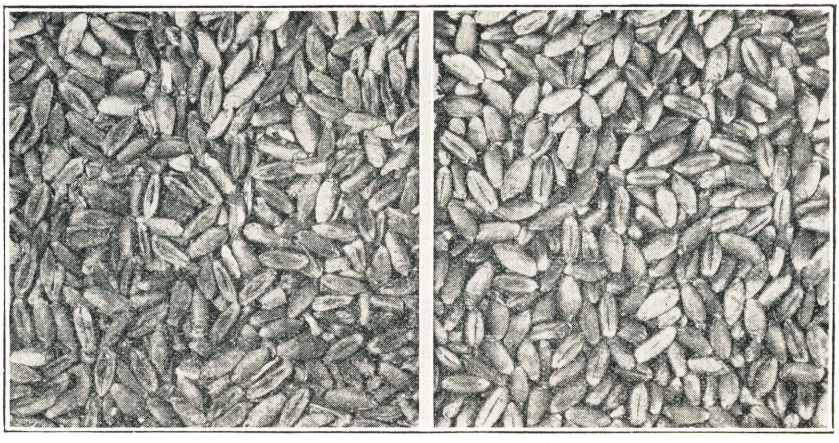

Fig. 4.—Fertilizer improves the quality of grain. Left, wheat from unfertilized area. Right, wheat from area which received complete fertilizer.

FERTILIZER NEEDS OF MINERAL SOILS

Relation of Soil Type and Method of Farming to Fertilizer Needs

The mineral soils (soils other than muck) include two main divisions: first, the sands and light sandy loams, and second, the heavy sandy loams, silt loams, and clay loams. The soils which belong to the sands and light sandy loams division usually respond profitably to complete fertilizers. If the soils in this division have been poorly managed, receiving no manure or leguminous green manure, they are most responsive to a mixture containing nitrogen, phosphate and potash, as

Fig. 5.—Fertilizer stimulates early growth of corn. Rows 1 and 2 received no fertilizer while rows 3 and 4 received in the hill 75 pounds per acre of complete fertilizer.

shown in Group 1 of Table I. Clovers and alfalfa on this group of soils respond more profitably to mixtures carrying only phosphate and potash. Where the soils have received better management, clovers or alfalfa having been grown, as in Group 2 of Table I, the proportion of nitrogen used in the mixture can be reduced for many crops. Where good management has been practiced for a number of years and manure applied within the last two years, as in Group 3 of Table I, the amounts of both nitrogen and potash can be reduced in comparison with those fertilizers used on less productive soils.

The heavy sandy loams, silt loams and clay loams, as a rule, require smaller proportions of nitrogen and potash in the fertilizer mixture for general crops than do the soils of the lighter-textured groups. If these soils have been poorly managed and without the use of manure, clovers, or alfalfa, as in Group 5 of Table II, a complete fertilizer is usually the most economical. The nitrogen can be omitted from the mixture when clovers or alfalfa are grown. Where a better system of management is practiced, using clovers or alfalfa in the rotation, as in Group 6 of Table II, the proportions of nitrogen and potash in the fertilizer mix-

ture can be reduced somewhat from that used in Group 5. If barnyard manure has been used within the last two years, in a system where good management has been practiced, phosphate should be given first consideration. For some crops on such soils, however, small amounts of nitrogen and potash should be included with the phosphate.

Fig. 6.—Potatoes respond to fertilization. Upper—Complete fertilizer. Lower—No fertilizer.

An efficient use of fertilizers can be obtained by fertilizing heavily the more valuable cash crops of a rotation and supplementing the residual fertilizer with smaller applications for the less valuable and less responsive crops which follow.

Method of Application of Fertilizer

On the mineral soils, the application of fertilizer in the row may be more effective than broadcasting and working it into the soil with the disc or spring-tooth harrow. Where row applications are made, it is better to keep the fertilizer away from the seed; for most crops, preferably at the side and deeper than the seed. The general tendency in fertilizer applications at the present time is to place the material deep in the soil. Good results have been secured with some crops by plowing the fertilizer under. Large fertilizer applications in the row, directly in contact with the seed should be avoided because of possible injury to germination.

Use of Lime on Mineral Soils

Fertilizers are usually more effective on soils containing sufficient amounts of lime than on soils deficient in this material. Those soils

Fig. 7.—Wheat grown on light soils respond to top dressings of nitrogen. Right—No treatment. Left—100 pounds per acre of nitrate of soda.

included in Groups 1 and 4, in practically all cases, are in need of lime, and it is advisable to consider the application of this material as the first step in good soil management.

Fig. 8.—Fertilizers stimulate early growth of cabbage. Row 1 received no fertilizer. Rows 2 and 3 received 500 pounds per acre of 4-16-8.

TABLE I—SANDS AND LIGHT SANDY LOAMS

Fertilizers are usually more effective on soils containing sufficient amounts of lime than on soils deficient in lime.

Crop	Group 1 No manure or leguminous green manure used within the last two years.	Group 2 Clover or alfalfa grown within the last two years.	Group 3 Manured within the last two years.
With no seeding of clover or alfalfa	**2-12-6 or 4-16-8**	**2-16-2 or 2-12-6**	**2-16-2**
Wheat or Rye	Grain alone, 200 pounds or more. With alfalfa or clover seedings, 300 pounds or more at time of seeding the small grain. A spring top dressing of 75 to 150 pounds of nitrate of soda or its equivalent of some other nitrogen carrier is recommended.		
With seeding of clover or alfalfa	Legume seeding usually not recommended in this group.	**2-12-6 or 2-8-10**	**2-12-6**
With no seeding of clover or alfalfa	**2-16-2 or 4-16-4**	**2-16-2 or 2-12-6**	**2-16-2**
Oats or Barley	Grain alone, 200 pounds or more. With seedings of alfalfa or clover, 300 pounds or more. A top dressing of 50 to 75 pounds of nitrate of soda or its equivalent of some other nitrogen carrier is advisable when seasonal conditions necessitate a late planting.		
With seeding of clover or alfalfa	Legume seeding usually not recommended in this group.	**2-12-6 or 2-8-10**	**2-12-6**
Alfalfa, Sweet or other Clovers	**0-20-20**	**0-20-20**	**0-20-0**
	Broadcast, 300 pounds or more. Fertilizer should be drilled in or broadcast and worked into the soil before seeding.		
Corn or Sunflowers	**2-12-6 or 4-16-4**	**2-16-2 or 2-12-6**	**2-16-2**
	Broadcast, 250 pounds or more. In rows, 150 to 175 pounds. Broadcasting about 200 pounds of 0-20-0 previous to planting and, in addition, drilling 100 to 150 pounds of complete fertilizer in the row, is a good practice. Large applications in the row may prove injurious.		
Sweet Corn	**4-16-4 or 4-16-8**	**4-16-4 or 2-12-6**	**2-16-2 or 4-16-4**
	For early market, broadcast 400 pounds or more, or apply 150 to 175 pounds in the row. For canning, 300 pounds or more broadcast and worked into the soil before planting.		

Early Potatoes	4-10-6	4-10-6	4-10-6
	400 pounds or more. The nitrogen in the fertilizer should be very readily available as early growth is important.		
Late Potatoes	4-16-8 or 4-16-4	2-12-6 or 4-16-8	4-16-4 or 2-12-6
	400 pounds or more. Applications made beside the row and below the seed piece seem advisable.		
Beans	4-16-4	2-16-2 or 4-16-4	2-16-2 or 0-20-0
	200 pounds applied with grain drill (all holes running) at seeding time, or broadcast and dragged in before planting. When fertilizer is broadcast, an additional application of not to exceed 50 pounds may be drilled in bean row when seeding. Medium to large applications in the bean row should be avoided.		
Tomatoes	4-16-4 or 4-16-8	2-16-2 or 4-16-4	2-16-2 or 4-16-4
	For early market, 1,000 pounds or more. 300 to 400 pounds mixed with soil in hills and the remainder broadcast and worked into soil before setting. For canning, 400 pounds or more broadcast and worked into soil before setting.		
Cabbage	4-16-4 or 4-16-8	2-12-6 or 4-16-4	2-16-2 or 4-16-4
	For early market, 1,000 pounds or more. 300 to 400 pounds mixed with soil in hills and the remainder broadcast and worked into the soil before field setting. Late cabbage, 400 pounds or more broadcast and worked into the soil before setting.		
Cantaloupes and Cucumbers	4-10-6 or 4-16-4	2-16-2 or 4-16-4	2-16-2 or 4-16-4
	For early market, 400 pounds or more. 200 to 300 pounds mixed with the soil in the hills and the remainder broadcast and worked into the soil before planting. Cucumbers for pickling, 300 pounds or more broadcast before planting.		
Beets, Carrots, Turnips and Rutabagas	4-10-6 or 4-16-8	4-10-6 or 4-16-4	4-10-6 or 4-16-4
	400 pounds or more broadcast and worked into soil before planting.		

TABLE II—HEAVY SANDY LOAMS, SILT LOAMS AND CLAY LOAMS

Fertilizers are usually more effective on soils containing sufficient amounts of lime than on soils deficient in lime.

Crop	Group 4 No manure or leguminous green manure used within the last two years.	Group 5 Clover or alfalfa grown within the last two years.	Group 6 Manured within the last two years.
With no seeding of clover or alfalfa	2-16-2 or 4-16-4	2-16-2	0-20-0
Wheat or Rye	Grain alone, 200 pounds or more. With alfalfa or clover seedings, 300 pounds or more at time of seeding the small grain. In groups 4 and 5, a spring top dressing of 75 to 150 pounds of nitrate of soda or its equivalent of some other nitrogen carrier is recommended.		
With seeding of clover or alfalfa	2-12-6 or 4-16-8	2-12-6 or 2-16-2	0-20-0
With no seeding of clover or alfalfa	2-16-2 or 4-16-4	2-16-2	0-20-0
Oats and Barley	Grain alone, 200 pounds or more. With seedings of alfalfa and clover 300 pounds or more. In group 4, a spring top dressing of 50 to 75 pounds of nitrate of soda or its equivalent of some other nitrogen carrier is recommended when seasonal conditions necessitate a late planting.		
With seeding of clover or alfalfa	2-12-6 or 4-16-8	2-12-6 or 2-16-2	0-20-0
Alfalfa, Sweet or other Clovers	0-20-20	0-20-20	0-20-0
	Broadcast, 300 pounds or more. Fertilizer should be drilled in or broadcast and worked into the soil before seeding.		
Corn or Sunflowe	2-16-2 or 2-12-6	0-20-0 or 2-16-2	0-20-0
	Broadcast, 250 pounds or more. In rows, 150 to 175 pounds. Broadcasting about 200 pounds of 0-20-0 previous to planting and in addition 100 to 150 pounds in the row is a good practice. Large applications in the row may prove injurious.		
Sweet Corn	4-16-4 or 4-16-8	2-16-2 or 4-16-4	2-16-2 or 4-16-4
	For early market, broadcast 400 pounds or more or apply 150 to 175 pounds in the row. For canning, 300 pounds or more broadcast and worked into the soil before planting.		

Sugar Beets	4-16-4 or 4-16-8	4-16-4 or 0-20-0	4-16-4 or 0-20-0
	In row, 200 to 250 pounds. A good practice is to broadcast 200 pounds or more before or after plowing and, in addition, apply 100 to 200 pounds in the row. Large applications in the row may prove injurious.		
Early Potatoes	4-10-6	4-10-6	4-10-6
	400 pounds or more. The nitrogen in the fertilizer should be very readily available as early growth is important.		
Late Potatoes	4-16-4 or 4-16-8	2-12-6 or 4-16-4	2-12-6 or 4-16-4
	400 pounds or more. Applications beside the row and below the seed piece seem advisable.		
Beans	2-16-2 or 4-16-4	2-16-2 or 0-20-0	0-20-0
	200 pounds applied with grain drill (all holes running) at seeding time, or broadcast and dragged in before planting. When fertilizer is broadcast an additional application of not to exceed 50 pounds may be drilled in the row when seeding. Medium to large applications in the bean row should be avoided.		
Tomatoes	4-16-4 or 4-16-8	2-12-6 or 4-16-4	2-16-2 or 0-20-0
	For early market, 1000 pounds or more. 300 to 400 pounds mixed with the soil in the hill and the remainder broadcast and worked into the soil before field setting. For canning, 500 pounds broadcast and worked into the soil before setting.		
Cabbage	4-16-4 or 4-16-8	4-16-4 or 2-12-6	4-16-4 or 2-12-6
	For early market, 1000 pounds or more. 300 to 400 pounds mixed with soil in hills and the remainder broadcast and worked into the soil before field setting. Late cabbage, 400 pounds or more broadcast and worked into the soil before setting.		
Cantaloupes and Cucumbers	4-16-4 or 4-16-8	4-16-4 or 2-12-6	2-16-2 or 0-20-0
	For early market, 400 pounds or more. 200 to 300 pounds mixed with the soil in the hills and the remainder broadcast and worked into the soil before planting. Cucumbers for pickling, 300 pounds or more broadcast before planting.		
Beets, Carrots, Turnips and Rutabagas	4-16-4 or 4-16-8	2-16-2 or 4-16-4	2-16-2 or 0-20-0
	400 pounds or more broadcast and worked into the soil before planting.		

Use of Manure and Green Manures

On the mineral soils, organic matter added in the form of manures or green manures greatly increases the efficiency of fertilizers. Where barnyard manure is applied, it not only increases the soil's organic

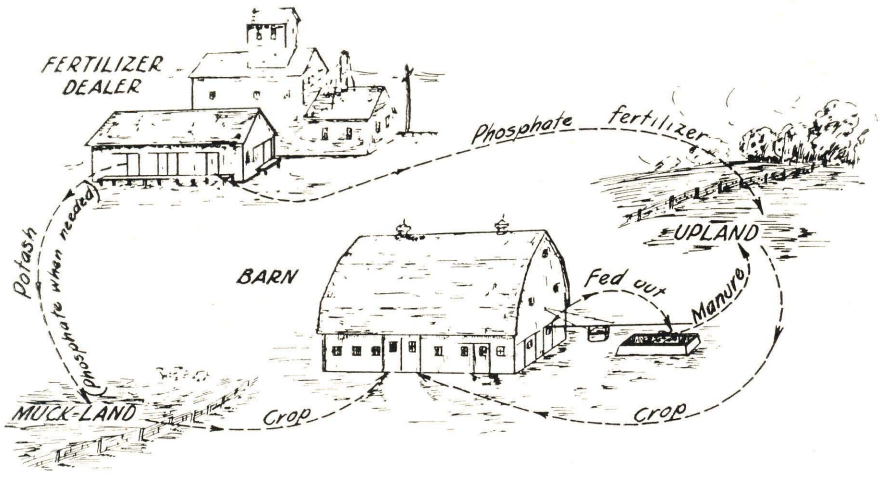

Fig. 9.—Showing proper maintenance of fertility of the soil on the farm which is composed of both mineral soil and muck. The nitrogen and organic matter content of the mineral soil is increased by applying all of the manure on it and the fertility of the muck is improved by the use of commercial fertilizer.

content, but also adds to the essential elements in the soil. If manure is not obtainable, green manures furnish an excellent source of supply of organic matter. On those soils which have a low content of organic matter, as in Groups 1 and 4, it is advisable to lime, if necessary, and to grow a sweet clover crop to be plowed down before the general crops are grown. Probably no more economical use of fertilizer could be made than by applying an 0-20-20 to a sweet clover crop grown for green manuring purposes.

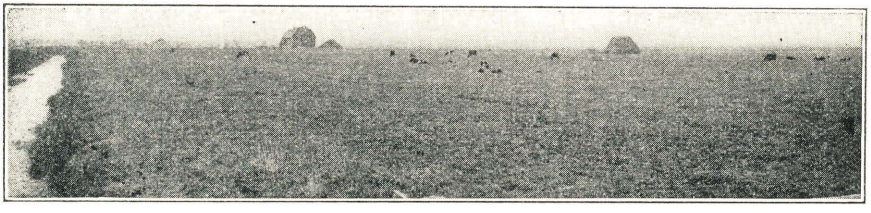

Fig. 10.—Muck pasture, when properly drained and properly fertilized, produces a high yield of grass, which remains green and succulent when upland pasture may be dry and brown.

FERTILIZER NEEDS OF MUCK SOILS

Relation of Type of Muck and Method of Farming to Fertilizer Needs

Muck soils may be roughly divided into three main groups, insofar as their fertilizer needs are concerned: first, those which are low in lime content, as indicated by their very strongly acid reaction; second, those which have sufficient lime for the production of most crops(not acid to strongly acid in reaction); and third, those which contain an excess of water-soluble and alkaline salts and which are alkaline in reaction. The last group is comparatively a very small one and has resulted from the burning-off of a layer of the muck at some time in the past or from the presence of marl within a short distance of the surface. Because of the variation in the response to fertilization of this last-named "alkali" group, farmers having burned-over muck are advised to present their particular problems to the College.

While the low-lime mucks are likely to be in immediate need of a complete fertilizer after they have been properly limed, some of those which contain sufficient lime may not show any fertilizer requirements for one or more years after reclamation. All of the latter will develop a marked potash hunger within a very few years and, most of them, a need of both potash and phosphate. Some mucks show this fertilizer need immediately after they are broken up, especially if several crops of wild hay have been removed before breaking, or if the soil is cropped at once to certain special crops, such as celery or onions.

Whether or not a certain muck field is in need of a fertilizer containing potash alone, or both potash and phosphate, generally can be determined only by a field trial. If the field has been under cultivation for a long period of years without having been well fertilized, it is certain that both potash and phosphate will be needed for the production of any crop. If it has been reclaimed for only a few years, the field may require only potash for such crops as pasture, hay, and grain, but is more likely to need both fertilizing constituents for special crops such as onions and celery. Since a majority of our mucks give paying returns when both potash and phosphate are applied in the fertilizer mixture, it is advisable to apply a mixture containing both on any muck, unless it is definitely known that only potash is needed.

In the maintenance of fertility of muck soils, the fertilizer should be applied each year, rather than once in a rotation, in order to prevent extensive loss by leaching. While the fertilizer to be applied should be high in potash content, the proportions of phosphate and potash, and the rate of application, depend to considerable extent on the crop which will be grown. If a crop which received a heavy application of fertilizer is followed by one which requires a comparatively light application, a good yield of the latter can generally be secured with a relatively light fertilization the second year, especially if the growing season of the first year was droughty.

Method of Application of Fertilizer

Experiments on muck soils have shown that, with cultivated crops, row applications of fertilizers may prove more economical than broadcast applications. Mucks which are well supplied with moisture generally give the best results with the row application. The row application is more likely to injure the seed on soils if they have been heavily

Fig. 11.—Sugar beets on muck land. The beets in the upper picture received phosphate only while those in the lower picture received phosphate and potash. Yields: Phosphate only, 3.8 tons; phosphate and potash, 10.6 tons per acre.

fertilized in preceding years than if little or no fertilizer has been applied in the past. Some seeds, of which beans and cabbage are examples, are much more susceptible to fertilizer injury than are others. Because of possible injury in droughty seasons, the fertilizer should be at least two inches from, and preferably, below the seed. If a heavy application of fertilizer is being made, a considerable proportion of it should be applied broadcast and disked well into the soil previous to planting.

If the fertilizer is one of the higher-analysis mixtures, less should be applied in the row than if a lower-analysis fertilizer is used.

Use of Lime on Muck Land

Lime should never be applied on muck land unless the muck is low in lime content, as indicated by a very strongly acid reaction. Lime, applied to high-lime muck (not acid to medium acid in reaction) may decrease the benefit to be secured from fertilization. Low-lime muck will require from two to 12 tons per acre of ground limestone or marl, the amount depending on the degree of acidity and on the crops being grown. Application of sufficient lime to completely correct the acid condition of the soil is unnecessary and, in fact, undesirable.

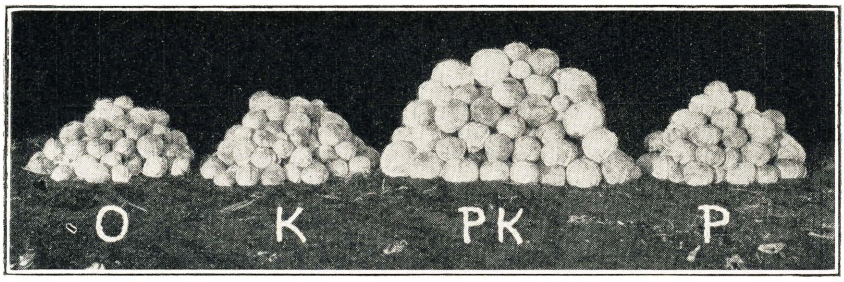

Fig. 12.—Cabbage on muck land. From left to right, O—unfertilized, K—potash only, PK—phosphate and potash, and P—phosphate only.

Following liming, the fertilization of this low-lime muck should include, for a few years, more nitrogen in the mixture than is needed on high-lime muck soils. After the soil has become more decomposed, the same fertilizer mixtures should be applied as are recommended for the high-lime mucks.

Use of Manure and Green Manure

Muck soils are relatively high in nitrogen content and consequently do not require a nitrogenous fertilizer, except for a very few special crops. The nitrogen content of manure, on the other hand, is its most valuable constituent. It is, therefore, not a balanced fertilizer, when used alone on muck soil, and tends to produce excessive top growth, resulting in increased lodging of grain and in an increased proportion of scallions in onions. If there are mineral soils on the farm, it is desirable to use the manure on those fields and to maintain the fertility of the muck with commercial fertilizers and green manures.

The growing of green manure crops on muck land, which would otherwise lie fallow, is a highly desirable practice. The green manure tends to retain the residual potash, which would, to considerable extent, be leached away if the muck laid fallow. It also prevents the blowing away of the surface muck, while the fibrous organic matter of roots and tops, incorporated in the soil, gives a more granular structure, so that the soil does not blow as easily as does the finely divided muck. Still further, it tends to keep down the weeds which otherwise are likely to flourish on well fertilized muck soil.

TABLE III—MUCK SOILS

Crop (In those columns in which two fertilizer recommendations are given, the first formula is generally preferred)	Range in annual broadcast application	TYPE OF MUCK			
		High-Lime Muck			Low-Lime Muck
	Pounds per acre. If only muriate of potash is needed, one-half to two-thirds these recommendations should be applied.	Deep and Medium Muck		Shallow Muck	Very strongly acid in reaction. Limestone or marl should be applied preceding fertilization.
		Mucks requiring both potash and phosphate.	Mucks showing little or no benefit from phosphate in mixture.	Manure or green manure recommended in rotation.	
Oats, Barley, Rye	250-400	0-8-24 or 0-8-32	Muriate of Potash	0-20-20 or 0-8-24	2-8-16 or 3-9-18
With or without seeding.	To secure satisfactory results from fertilizers, grow varieties adapted to muck land, such as Gopher oats, Peatland barley and Rosen rye.				
Timothy and Alsike, Sweet clover, Hungarian millet	200-350	0-8-32 or 0-8-24	Muriate of Potash	0-8-24	0-8-24 or 3-9-18
	Seeding without nurse crop often advisable. Early seeding necessary to beat weed growth.				
Permanent Pasture	100-200	0-8-32	Muriate of Potash	0-8-24	0-8-24 or 3-9-18
	Apply broadcast in spring. Growth increased and palatability and nutritive value of grass much improved by proper fertilization.				
Field Corn, Sweet Corn, Sunflowers	250-500	0-8-24 or 0-8-32	0-8-32 or Muriate of Potash	0-8-24	0-8-24
	If row application is made, do not use more than 200 pounds, preferably below and 2 inches from seed. Broadcast remainder and disc in.				
Sugar Beets	400-600	0-8-32 or 0-8-24	Muriate of Potash	0-8-24	Crop not adapted
	Row application advisable but not more than 150 pounds with seed or not more than 300 pounds if 2 inches from seed. If more is to be applied, broadcast it and disc in before planting.				

Potatoes	400-800	0-8-24 or 0-8-32	0-8-32 or Muriate of Potash	0-8-24	0-8-24
	Row application advisable but not more than 400 pounds should be applied, preferably in furrow 2 inches below seed. If mixed with muck in row application with machine planter, 600 pounds can be safely applied. Plant close to avoid hollow heart and to minimize frost danger.				
Cabbage	500-800	3-9-18 or 2-8-16	4-8-28 or 0-8-24	2-8-10 or 3-9-18	3-9-18 or 2-8-16
	Application of 400-500 pounds advisable, in row 4 inches deep if plants are transplanted to field. Application of 200-300 pounds in row 2 inches below seed if crop is sown in field. Broadcast remainder and disc in.				
Celery, Late	1200-2000	4-8-28 or 0-8-24	4-8-28 or 0-8-32	3-9-18 or 2-8-10	4-8-28 or 3-9-18
	If no manure has been applied, application of available nitrogen fertilizer is often beneficial in cold or wet periods during growth. If manure has also been applied, no nitrogen is needed in the fertilizer mixture.				
Early	1200-1800	3-9-18 or 2-8-10	3-9-18 or 2-8-16	3-9-18 or 2-8-10	3-9-18 or 2-8-16
Mint	250-500	3-9-18 or 2-8-16	4-8-28 or 0-8-24	3-9-18 or 2-8-10	Crop not adapted
	Fertilizer needed to maintain stand as well as to increase oil content. Apply broadcast fairly early in spring.				
Onions	800-1200	3-9-18 or 2-8-16	4-8-28 or 3-9-18	2-8-10 or 3-9-18	2-8-10 or 3-9-18
	Row application of 400-500 pounds 2 inches below seed advisable. Broadcast remainder before seeding and disc in. Seed early if possible. Protect from wind to save crop and fertilizer. For further information see Special Bulletin 168.				
Turnips, Carrots, Rutabagas	250-600	0-8-32 or 0-8-24	Muriate of Potash	0-8-24	0-8-24 or 3-9-18
	Broadcast and disc in fertilizer before seeding.				
Beans, Cucumbers, Melons, Tomatoes	600-1000	0-20-20 or 0-8-24	0-8-24	0-20-20	0-20-20
	These crops easily killed by frost, therefore generally not safe on muck soil.				

AVAILABLE SOILS AND FERTILIZER BULLETINS

Further information regarding fertilizers and soils and any of the following bulletins on the subjects may be secured without charge by addressing the Soils Department, Michigan State College, East Lansing.

Special Bulletin No. 133 (Revised). Fertilizers, What They Are and How to Use Them.

Special Bulletin No. 91 (Revised). Some General Information on Lime and Its Uses and Functions in Soils.

Special Bulletin No. 180. Grayling Sands.

Circular Bulletin No. 90. Cucumber Culture.

Special Bulletin No. 136. The Muck Soils of Michigan, Their Management for the Production of General Crops.

Special Bulletin No. 168. The Management of Michigan Muck Soils for the Production of Onions.

Circular Bulletin No. 103 (Revised). The Prevention of Wind Injury to Crops on Muck Land.