Muck Soil Management for Hay and Pasture Production
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Paul M. Harmer, Soil Science
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MUCK SOIL MANAGEMENT for HAY AND PASTURE PRODUCTION

By PAUL M. HARMER

MICHIGAN STATE COLLEGE
COOPERATIVE EXTENSION SERVICE
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SUMMARY

1. Properly fertilized muck soil, with its good moisture supply, is ideally suited for the production of hay or of pasture crops which generally remain green and succulent throughout the growing season.

2. Hay crops which do well on muck soil include reed canary grass for poorly drained muck soil and brome grass, timothy and alsike, and alfalfa for the better drained soils.

3. Pasture crops include reed canary grass for poorly drained soils —and a June grass, smooth brome, a brome-ladino clover or brome-alfalfa-ladino mixture, or ladino alone for the better drained soils.

4. Emergency hay and pasture crops for muck land include fall sown rye for pasture and oats, Sudan grass or a mixture of the two for hay or pasture, with rape included in the mixture for hog or sheep pasture.

5. Occasional very acid mucks may require an application of a liming material, while alkaline mucks may respond to a sulfur application to make them less alkaline. Neither material should be applied unless a soil test indicates definitely that it is needed.

6. Proper fertilization of hay and pasture crops should include a fertilizer mixture high in potash—and including such minor elements as the soil test, the nature of the crop, and the record of the past fertilization of the field indicate will be required. Nitrogen is likely to be needed in the mixture when the drainage is rather poor, the soil reaction extremely acid, the muck very shallow, or the growing season extremely wet.

7. In general, less fertilizer will be needed for pasture than for the same crop removed as hay. Rate of application for pasture will depend on the number of head of stock being pastured and the amount that the livestock are being fed in the barn during the pasture season.

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Muck Soil Management for Hay and Pasture Production

By PAUL M. HARMER[1]

A larger proportion of the muck land in Michigan[2] is being used for pasture and hay production than for all other crops combined. Most of this land is in wild pasture, with little or no attempt having been made either to increase the amount or to improve the quality of the grass consumed by the livestock grazing on it. Many times the drainage is poor and the growth is made up largely of marsh grass (sedges) of low feeding value, with a surface often so hummocky that the grazing stock gets more exercise than nourishment in its hunt for subsistence.

Studies carried on for the past 30 years on muck soil, in this and other states, have shown that the seeding of certain of the improved grasses and legumes, properly fertilized with a mixture high in potash and often containing some of the minor elements, will produce superior pastures that remain green and succulent throughout the grazing season. Likewise high-yielding meadows of high-quality hay, consisting of improved grasses and sometimes legumes, can replace the wild marsh grass growth. This bulletin is prepared for the purpose of outlining a program of permanent improvement of these exhausted and run-down muck pastures and meadows.

Choice of the best grass or legume, or mixtures of the two, for establishing a new seeding on muck land, will depend on the drainage conditions and on the use to which the seeding will be put. In the following paragraphs are presented the requirements of some of the grasses and legumes and the results which may be expected from them.

REED CANARY GRASS

This grass was first reported as adapted to organic soil by Minnesota Agricultural Experiment Station investigators who found it in 1919 in Blue Earth County of that state. It had been sown there several years previously by immigrants who had brought the seed from

[1]Extension Specialist (Professor) in Soil Science.

[2]Further information regarding types of muck soil, drainage, preparation of muck for cropping, fertilization, etc., may be found in Michigan Agricultural Experiment Station Special Bulletin 314, "The Muck Soils of Michigan, Their Management and Uses".

Germany. It has been grown successfully for hay and pasture by muck farmers in Minnesota, Oregon, Wisconsin, Michigan and other states. With ample moisture reed canary produces high yields of both hay and grass. With feeding value about equal to that of timothy, the hay has proven satisfactory for livestock. When used for cattle, it should be cut rather early and before heading, in order to improve the succulency of the hay. Since the crop has some decided advantages over other grasses, as well as some disadvantages, it is well to list them below:

Advantages—1. Reed canary can stand very poor drainage, with flooding for several weeks without injury to stand. It is the best of the grasses for muck areas which cannot be drained economically. It can be drowned out only with continuous flooding for an entire season and then it is likely to be replaced by some of the wild marsh grasses.

2. Its dense root system produces a heavy sod which permits pasturing when the land is so wet that livestock would mire in any other seeding.

3. With an ample moisture supply and proper fertilization, it produces a more abundant pasture for considerably more livestock than could be obtained with any other type of grass. Quality of the pasture is somewhat better with a high than with a low water level.

Disadvantages—1. It is generally necessary to confine livestock to the reed canary pasture in order to force them to eat it. The quality can be improved by proper fertilization, but the quality of fertilized brome grass is superior to that of fertilized reed canary where the drainage is sufficient for brome.

Fig. 1. Of the nine jars of reed canary grass shown above, the one at the left contained alkaline muck (pH 7.6) while the one at the right contained very acid muck (pH 3.6). The jars between contained, from left to right, decreasing amounts of the alkaline and increasing amounts of the very acid muck, mixed together. Five mixtures (4th to 8th jars from the left), with pH reading from 6.4 to 4.4, gave somewhat similar yields, indicating a fairly wide range of tolerance of acidity on the part of the reed canary.

2. If the reed canary grass is not grazed short, it is necessary to mow it off, as the livestock will not eat the old grass. Keeping sufficient livestock in the pasture to keep it down is essential if satisfactory results are to be obtained.

3. A considerable proportion of dairymen who have pastured reed canary report that cows do not produce as heavy a flow of milk on reed canary grass as when pasturing on other grasses. This appears to vary on different mucks and may be partly due to differences in fertilizer requirements and in amount of drainage.

4. Reed canary will not yield as well as brome grass on well drained, fertilized muck.

5. Reed canary grass has an underground root system (rhizomes) similar to quack grass and is somewhat difficult to kill out. It is advisable to break it deeply with a marsh breaking plow and to turn all sods well down, then to fallow very thoroughly all summer. If many roots are alive the following spring, the summer fallowing should be continued. If only occasional roots remain, the muck may be planted to a cultivated crop such as corn, preferably checked in to permit cross cultivation. Even then some hand hoeing may be required. It is important not to let up on the eradication until the reed canary is entirely eliminated.

JUNE GRASS

As soon as drainage is improved, most cleared muck land becomes covered with a volunteer growth of June grass (Kentucky Blue Grass). Where land has been cleared recently, it sometimes is advantageous to pasture it for a few years while stumps and roots are rotting. Where this situation prevails, fertilization of this June grass will considerably improve both yield and quality of the pasture and thus increase the returns obtained from the grazing livestock. It is well to remember that June grass is the natural habitat of the wireworm and, when the land is broken up for the production of other crops, steps should be taken to destroy the wireworms with chemical treatment before planting to most crops.

TIMOTHY

Timothy has long been grown for hay or pasture in drained muck land, usually in association with alsike clover. Generally the alsike does not persist when cropped for hay and the growth after the first

year is likely to be mostly timothy, with June grass creeping in. The yield is not as large as is obtained from brome grass under the same conditions.

SMOOTH BROME GRASS

This grass is one of the hardiest on muck land where drainage is not poor. It forms a good sod and will maintain a stand from year to year, with proper fertilization and continued fairly good drainage. If grown on muck land for hay, it is likely to crowd out, within a year or two at the most, other vegetation that may be seeded with it. If used for pasture, the associated vegetation is likely to hold its own with the brome grass for from two to four or more years. On drained muck it is likely to outyield any other grass.

BROME GRASS-LEGUME MIXTURES

It generally is not advisable to use legumes with brome grass on muck when the crop is being grown for hay production, since the brome grass will crowd out the legumes on fertilized muck soil so that the hay will be largely brome by the second year. If used for pasture alone, the legumes are likely to hold their own with the brome grass for a longer time. Recommended rate of seeding includes 2 to 3 pounds of brome grass, 5 to 8 pounds of alfalfa, and one-half to one pound of ladino clover. Because of difference in size of seed, *the brome should be sown separately from the legumes.*

If some spots in the field are a little too wet for the legumes, the brome grass is likely to persist, while the better drained parts will still supply a grass-legume pasture. If parts of the field prove to be too wet even for brome, reed canary can be sown in these spots. When part of the field is in reed canary grass, it generally is necessary to fence off the reed canary in order to insure its being kept grazed down.

ALFALFA

It has long been the popular conception that legumes, and alfalfa in particular, are not hardy on muck soil. Investigations made during the past 30 years have shown fairly definitely that this conclusion was the result of producing the crop without proper fertilization, especially with a mixture neither high in potash nor containing certain of the minor elements. With careful management, the stand can be maintained for hay production on properly drained muck for several years. If pastured, alfalfa should not be grazed too close, especially in hot dry weather. Precautions in raising the crop are as follows:

Fig. 2. The brome grass on the left of the stake and reed canary grass on the right were fertilized each year with 0-0-30 (straight muriate of potash) in the foreground and with 0-5-30 just beyond the first stakes. When first reclaimed the potash alone gave almost as much hay as did the 0-5-30 but, after five years of cropping, the natural phosphate in the muck in the foreground was exhausted and potash alone did not yield any better than the plot which had never received fertilizer while the yield with the 0-5-30 was practically six times as much.

1. Sow a hardy alfalfa variety, such as Grimm, Ladak, or Canadian Variegated, at not less than 10 pounds per acre.

2. Fertilize annually with a high-potash mixture containing copper and boron on acid muck, or manganese and boron on alkaline muck (see Table 1). The yield on acid muck sometimes may be doubled by including the copper.

3. Have seedbed firm and broadcast seed on surface or seed shallow. Roll or cultipack after seeding, being sure not to get seed too deep.

4. Do not leave much top growth to go into the winter, as it is likely to smother the crop. It is safer to make a last cutting, even as late as October in the latitude of Lansing, in order to allow the crop to winter over without excessive vegetative cover.

5. Alfalfa may show considerable winter-heaving in spring but the crowns generally are still alive and should be pressed back into the muck by use of weighted roller or cultipacker. Alfalfa is more likely to be killed out on muck by a heavy ice sheet in late winter or early spring, or by a severe frost in late spring that kills the top growth after it is several inches high.

6. Do not burn off any crop residue in spring, as the burning is likely to kill the crowns and destroy the stand. This is especially true if the crowns have been lifted slightly above the ground surface by heaving.

OTHER LEGUMES

Of the other legumes, medium red (June) clover has not proven as hardy on the muck as has alfalfa. Alsike clover generally shows slightly less damage from poor drainage than do the other legumes, although ladino can survive conditions nearly as wet. Ladino clover has a place in the pasture mixture on muck soil, but does not appear desirable for hay—either alone or in a mixture. Used alone, ladino serves very satisfactorily as a pasture for hogs. The precautions given above for alfalfa apply to the other legumes, ladino in particular—and especially the dangers of smothering by carrying too much growth over winter and of damage to the stand from burning over. None of the other legumes is as responsive to copper as is alfalfa.

THE MUCK SOIL REACTION

In its reaction, muck varies from soil that is intensely acid, on which the seed of both grasses and legumes may not even germinate unless limed, to soil which is so alkaline that both grasses and legumes may not do well. Presence of cranberries or a good growth of the high bush blueberry (commonly called huckleberry), or a barren area, is indication of intense acidity of the soil. A rather scant growth of

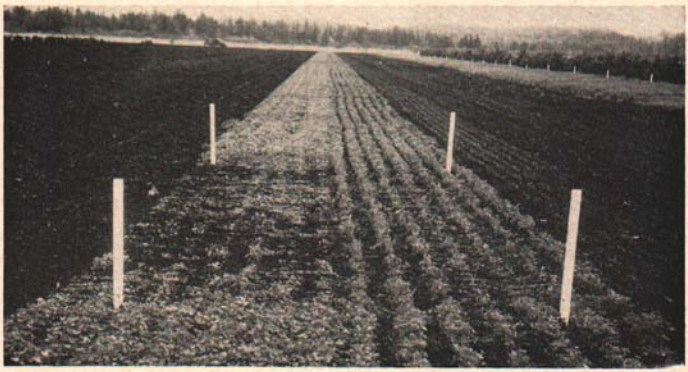

Fig. 3. The ladino on the left and alfalfa on the right on a deep muck soil (pH 6.0) were sown in the spring of 1946 and photographed in the spring of 1947. No fertilizer had been applied in the foreground, while 500 pounds per acre 0-20-0 was applied annually from 1942 to 1947 inclusive on the plot between the stakes, and 500 pounds annually of 0-20-10 just beyond the further stakes. Note that the straight phosphate, without potash, appeared to be toxic to the crop. Farther up the field a 0-10-30 gave the best yield.

June grass or alfalfa may be caused by a highly alkaline condition of the surface soil, generally due to previous burning of the soil. Fortunately a large proportion of the muck soils of the state have a satisfactory reaction; nevertheless, it is advisable to have your soil tested before starting the improvement of your muck.[3]

If the muck soil is extremely acid (pH 4.5 or less), an application of from 4 to 8 tons per acre of ground limestone (preferably dolomitic limestone) or of 6 to 10 yards of well pulverized marl, is advisable. If the land has been broken up for some years or is barren, it should be leveled, half the liming treatment applied and thoroughly disked in, then the muck plowed deeply and the other half applied and thoroughly disked in. If the land has been recently broken, and cannot be replowed immediately, about two-thirds of the lime should be applied and disked in thoroughly before seeding, and the remainder applied and disked in later, following the next plowing and leveling.

If the surface layer of an unbroken muck has an alkaline reaction, deep breaking often will bring to the surface underlying slightly acid muck which will correct the condition sufficiently for grass crops. If the soil is decidedly alkaline, legumes and sometimes the grasses may be benefited by an application of from 250 to 500 pounds per acre of agricultural sulfur, made after breaking and leveling, then thoroughly disked in. Manganese is likely to be needed in the fertilizer mixture, and more sulfur may be required following the next breaking.

DRAINAGE

Although extremely poor drainage may result in poor growth, or even in the dying out of all of the cultivated grasses, and the return of the muck to marsh grass and its associates, excessive drainage likewise will result in low yields of hay and pasture and sometimes the dying out of legumes. Most pasture grasses do best with a water level about 24 to 30 inches below the surface, although reed canary grass prefers a level 6 to 10 inches nearer the surface. Where hay is to be produced, a water level 24 to 30 inches below the surface is likely to be advisable, especially if legumes are being grown, while reed canary again will yield better with a level about 6 to 10 inches higher. Most desirable with most hay and pasture crops is a controlled water level,[4] so that there will be little or no flooding and no period of drought.

[3]Directions for taking muck samples for testing may be obtained from the Soil Science Department, Michigan State College.

[4]For further information on water control, see M.S.C. Extension Bulletin 307, "Conservation of Michigan's Muck Soil".

PREPARATION OF SEEDBED

If a seeding is to be made on newly reclaimed muck, it generally is advisable to break the land to a depth of 12 to 16 inches in the early summer of the year preceding the seeding and preferably to summer-fallow for the remainder of the growing season in order to kill out the wild growth. If necessary, muck broken in early spring can be seeded in August or fall-broken muck can be seeded the following spring. In preparation for seeding reed canary grass on poorly drained land, some fields do not become dry enough to permit breaking until well along in July. In such a case a crawler tractor is almost a necessity in hurriedly breaking and fitting the land, so that it can be seeded in August or early September before the water level may again be too high for working. If the muck is covered with high hummocks, it is necessary to reduce their height with sharp disk harrow or to cut them off before breaking.

Following the breaking, the double-disk harrow should be used to maintain a clean fallow until time for seeding. On many virgin marshes, the use of a leveler (see Special Bulletin 314) to fill depressions and put the land in good condition for mowing, is advisable. Just before seeding and following fertilization, the muck should be made firm by weighted farm roller or cultipacker.

Fig. 4. Deep breaking with marsh breaker, to a depth of 14 to 16 inches, to bury completely the native growth, followed by thorough disking to smother the marsh grasses, results in a seedbed free from wild sods and weed seed which can be fertilized, compacted by heavy rolling and seeded with a minimum of effort.

SEEDING AND CARE

Generally, newly reclaimed muck is fairly free from weeds, under which conditions seedings can be made in early May (latitude of Lansing). With weed-free soil, the seeding can be made without a nurse crop but, if there will be some weeds, a nurse crop of Henry spring wheat (4 to 5 pecks) is advisable. Otherwise the muck can be fall-seeded to Yorkwin winter wheat and the grass or legume sown in the spring. If the land is very weedy, it is by all means preferable to summer fallow until mid-August, and to seed then without a nurse crop.

Shallow seeding of all grasses and legumes on muck soil generally will result in a better stand than deep seeding. With a well prepared, firm seedbed, good results can be secured by seeding very shallow. Generally it is advisable to sow the seed on the surface, and then cover it slightly by use of a roller or cultipacker without weights. When sown with a nurse crop, it is best to drill the grain in the muck, with grass and legume seed applied on top and cultipacked or rolled with farm roller. When brome grass is being sown, it can be mixed with bran or sawdust, or with the nurse crop, when used, and likewise sown shallow. Where desired for increasing volume of legume seed, thoroughly dried muck passed through ordinary house screen generally proves very satisfactory.

When the seeding is made in the spring, care should be taken to control weeds. Generally, this can be done by mowing two or three times during early growth. Sown without a nurse crop and without too much weed competition, a properly fertilized seeding is likely to be ready for pasturing in sixty days, or for cutting for hay in 80 to 100 days.

FERTILIZATION

Proper fertilization of muck soil is essential for the production of good yields and high quality of hay crops and pasture, and for the maintenance of good stands of both grasses and legumes. Not only should the initial application of fertilizer be made before seeding (Table 1) but it is also important that the seeding be fertilized broadcast each spring. This generally can be done satisfactorily by the use of an endgate distributor. In case the land was heavily fertilized the preceding year for such crops as celery or onions, the initial application for the seeding may not be required but the seeding generally should be fertilized the year following the sowing. If the grazing livestock

is being fed at the barn at the same time that they are using the pasture, the fertilizer requirement may be slightly reduced, owing to the added fertility in the droppings. On well drained muck inclusion of nitrogen in the fertilizer mixture is not likely to be necessary for any pasture or hay crop unless the growing season has been exceptionally wet. On poorly drained muck, where the tame grass must be limited to reed canary, nitrogen generally is beneficial. Where drainage is very poor and quality of reed canary hay or pasture inferior, a 10-10-10

TABLE 1—Recommended fertilizer analyses and rates of application, with percentages of minor elements needed in the mixtures for broadcast applications on muck land meadows and pastures

Fertilizer and minor elements for hay and pasture		Legumes, most grasses and grass legume mixtures (Good to fair drainage)		Reed canary grass (Poor drainage)	
		Acid muck (pH 6.9 or less)‡	Alkaline muck* (pH 7.0 or higher)	Acid muck (pH 6.9 or less)	Alkaline muck* (pH 7.0 or higher)
Treatment	Analysis	0–10–30	0–10–20	3–9–18 or 10–10–10†	3–12–12 or 10–10–10†
Fertilization Rate—lb. per acre	Hay: Initial application	300–400	400–500	400–600	500–800
	Annual later applications	250–350	300–400	300–500	400–600
	Pasture: Initial application	250–300	300–400	250–400	400–600
	Annual later applications	200–250	200–300	200–300	300–500
Minor elements	Copper sulfate (Copper)	5–10% (1.25–2.5)	none	5–10% (1.2–2.5)	none
Percent in fertilizer mixture	Manganese sulfate* (manganese)	none	10% annually (2.5)	none	10% annually (2.5)
	Borax (for legumes)* (Boron)	2½% for 2 to 4 years (0.3)	5% annually (0.6)	none	none

*Minor elements generally can be omitted from mixture on alkaline muck when sulfur has been applied as discussed on page 9.
†Under exceptionally wet conditions, 10-10-10 is sometimes preferable to 3-9-18 for reed canary grass.
‡On decidedly acid muck (pH 4.5 or less), recently limed, the 3-9-18 or 10-10-10 mixture is likely to prove best for all grasses and legumes.

Fig. 5. On this very acid muck (original pH 4.0) which was given an 8-ton application of ground limestone, a very uniform stand of alfalfa was obtained on all plots with a uniform application of 3-9-18 from a seeding made in the spring of 1949. Without an application of copper sulfate, however, the alfalfa on this side of the white stakes was almost entirely heaved out during the winter of 1949-50, while with copper sulfate (alfalfa beyond the stakes) the vigorous root development prevented heaving and a good stand still remained in 1951, when the trial was completed.

mixture rather than the 3-9-18 may increase growth and protein content. On the better drained mucks the need for a greater amount of potash in proportion to the phosphate is likely to exist. Table 1 presents fertilizer and minor element recommendations for several grass and legume crops. In parentheses in this table are also included the percentages of minor elements on the elemental basis, in case the grower wishes to use a different carrier than the sulfate of copper or manganese, or a different strength of borax.

Most grasses show considerable benefit from copper, applied on acid muck soil. Alfalfa may also show from 40 to 75 percent increase in yield from the copper but other legumes give less response to it. Application of copper for alfalfa on acid muck, where none has been applied previously, will greatly reduce the amount of heaving, and consequent winter killing of the crop. This apparently is due to a

much more vigorous root development which occurs when copper is present. Where no copper has been applied to acid muck previously, either in the fertilizer or in dusts or sprays, an initial application of 25 to 50 pounds of copper sulfate or its equivalent per acre should be applied. Where considerable copper has been applied previously, as in the production of special crops, no more will be needed for hay or pasture. If no copper has been applied previously on the land, an application should be made for the wheat at the time of seeding.

On decidedly alkaline muck soil, the grasses and alfalfa are likely to respond to manganese in the fertilizer, unless sulfur has been applied as previously described. On highly alkaline muck it is sometimes necessary to apply both. Because of increased root development, resulting from manganese in the fertilizer on alkaline soil, its use is likely to insure the wintering over of the legumes.

Boron deficiency in alfalfa may occur on new muck or on muck which has not been fertilized to any appreciable extent in past years. It may continue to be deficient on alkaline muck for several years, even when boron has been applied in previous years. When alfalfa is being grown, it is therefore good insurance to include boron in the fertilizer mixture for from two to four years from seeding on acid muck and longer on alkaline muck, in order to make certain of a good growth and a continued good stand.

TEMPORARY HAY PASTURE CROP

Dairymen and livestock producers are sometimes confronted with a need for an emergency hay crop or a temporary pasture to carry over until the more permanent pasture is ready for grazing. Properly fertilized muck will produce good yields of practically any crop. Fall sown rye is used more than any other crop on muck for temporary spring pasture. Sudan grass or oats or a mixture of the two can be used for either hay or pasture. Rape is sometimes included for pasture, especially if hogs or sheep are to do the grazing. For the fertilization of the muck for these crops, a 0-10-30, with minor elements as recommended in Table 1, generally will give satisfactory yields.

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