Using Soil Testing in Sod Production

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The effective manager of a sod farm will use all of the management tools available to him. One of these tools which can be a guide in efficient and productive use of fertilizers is soil testing. We have never really stressed the importance of soil testing for sod production in Michigan. This is apparent from data provided by Dr. Darryl Warncke, director of the M.S.U. Soil Testing Lab. In 1978, soil samples were received from only 39 sod fields in Michigan, 31 on mineral soils and only 8 on organic soils. Of course, there may have been soil testing done for sod growers by fertilizer companies and other agencies.

Soil testing has not proven dependable for making nitrogen recommendations for sod, and for most other crops for that matter. But soil test results are useful and necessary in making effective lime, P_2O_5 and K_2O recommendations. Based on thesis research done by Satari (1) several years ago on soil testing for sod production on organic soils and experience with general turf and other crops, we believe our recommendations based on soil tests for P_2O_5 and K_2O are reasonable.

The current P_2O_5 and K_2O recommendations based on soil testing techniques utilized at M.S.U. are given in Tables 1 through 4 for mineral and organic soils, respectively.

1978 M.S.U. Soil Testing Lab Survey

The soil test results and appropriate recommendations for the 39 soil samples for growers fields mentioned earlier can be summarized as follows:

None of 8 organic soils needed lime;
Only 5 of 26 mineral soils needed lime;
8 of 8 organic soils needed P_2O_5;
20 of 31 mineral soils needed P_2O_5;
8 of 8 organic soils needed K_2O;
31 of 31 mineral soils needed K_2O.

More specifically, of the 39 fields tested, 38% needed 85 pounds P_2O_5 per acre or higher and 43% needed little or no P_2O_5. On the other hand, 82% of the fields needed 85 pounds K_2O per acre or higher while 6% needed no K_2O. Thus, phosphate needs are less limiting than potash needs, especially on the mineral soils in Michigan. Still, soil testing is the only practical means of properly determining P_2O_5 and K_2O needs.

1978 Sod Growers Survey

To further evaluate the general evaluations from the Soil Testing Lab Survey, a more detailed soil sampling study was conducted on 14 different fields on 6 sod farms. Soil samples were obtained from each field in October or November, 1978. Samples were collected representing 3 different depths: a) 0-2 inches, b) a 2-inch deep sample taken from just above the bottom of the plow layer and c) a 2-inch deep sample taken just below the bottom of the plow layer. The soil tests from the 0-2 inch depth will reflect fertilizer placed at or near the surface. The sample taken from just above the bottom of the plow layer (or depth of other tillage equipment) will determine if some of the fertilizer has been incorporated into the soil below the 0-2 inch depth. The sample from below the plow layer should reflect soil test values in essentially unfertilized soil.

Table 1. Phosphate Recommendations in Pounds P_2O_5 per Acre for Sod Production on Mineral Soils Based on Michigan State University Soil Testing Lab Procedures.

Available Phosphorous soil test	P_2O_5 Recommended
lbs/A	lbs/A
<20	150
20-39	100
40-69	50
70-99	25
100+	0

Table 2. Potash Recommendations in Pounds K_2O per Acre for Sod Production on Mineral Soils Based on Michigan State University Soil Testing Lab Procedures.

Available Potassium soil test	K_2O Recommended
lbs/A	lbs/A
<100	250
100-174	200
175-249	150
250-324	100
325-399	50
400+	0

Table 3. Phosphate Recommendations in Pounds P_2O_5 per Acre for Sod Production on Organic Soils Based on Michigan State University Soil Testing Lab Procedures.

Available phosphorous soil test	P_2O_5 recommended
lbs/A	lbs/A
<20	250
20-39	200
40-69	150
70-99	100
100-149	50
150-199	25
200+	0

Table 4. Potash Recommendations in Pounds K_2O per Acre for Sod Production on Organic Soils Based on Michigan State University Soil Testing Lab Procedures.

Available potassium soil test	K_2O recommended
lbs/A	lbs/A
<100	250
100-174	200
175-249	150
250-324	100
325-399	50
400+	0

Table 5. Soil test results and recommendations from Michigan Sod fields, October, 1978.

Sample Depth inches	Texture	pH	Soil test, lbs/A P	Soil test, lbs/A K	Nutrient recommended, lbs/A P_2O_5	Nutrient recommended, lbs/A K_2O
FARM 1, FIELD 1: plow 10 inches; 600 lbs/A 6-24-24 mixed to 1 1/2 inches at planting time; 250 lbs/A 15-40-5 topdressed spring.						
0-2	loam	7.1	198	194	0	85
6-8	loam	7.2	68	126	45	130
13-15	silty clay loam	7.7	5	103	170	130
FARM 1, FIELD 2: Same treatment as FIELD 1.						
0-2	sandy loam	5.9*	441	446	0	0
6-8	sandy loam	6.0	160	114	0	130
13-15	loamy sand	6.7	20	69	130	170
FARM 2, FIELD 1: 500 lbs/A 0-24-24 mixed 2-3 inches at planting time, field crops (soybeans) included in the rotation.						
0-2	loam	7.2	99	240	0	85
4-6	loam	7.3	52	183	45	85
12-14	clay loam	7.5	2	160	170	130
FARM 2, FIELD 2: Same treatment as FIELD 1.						
0-2	loam	7.1	155	194	0	85
4-6	loam	7.2	80	171	0	130
12-14	clay loam	7.2	4	91	170	170
FARM 3, FIELD 1: Rototill 5"; 300 lbs/A 6-24-24 on surface at planting time; 150 lbs/A 12-12-12 following fall.						
0-2	muck	7.2	16	46	250	250
3-5	muck	7.1	8	34	250	250
10-12	muck	7.0	5	34	250	250
FARM 3, FIELD 2: 300 lbs/A 6-24-24 at planting time, Fall, 1978.						
0-2	sandy muck	6.8	55	91	150	250
3-5	sandy muck	7.0	42	46	150	250
10-12	sand	7.3	17	57	130	250
FARM 4, FIELD 1: 500 lbs/A 5-20-20 mixed 2-3 inches at planting time; 300 lbs/A 13-13-13 spring.						
0-2	muck	7.3	82	69	100	250
6-8	peaty muck	7.1	50	57	150	250
10-12	peat	6.8	10	34	250	250
FARM 4, FIELD 2: Same treatment as FIELD 1; field crops previous to 1977.						
0-2	muck	7.2	176	366	0	50
6-8	muck	7.2	125	274	50	100
10-12	muck	7.2	70	206	100	150

Table 5, continued.

Sample Depth	Texture	pH	Soil test, lbs/A		Nutrient recommended, lbs/A	
inches			P	K	P_2O_5	K_2O
FARM 4, FIELD 3: Same treatment as Field 1; newly cleared land with first seeding in Fall, 1978.						
0-2	peaty muck	6.4	53	126	150	200
6-8	mucky peat	6.3	8	23	250	250
10-12	mucky peat	6.2	4	23	250	250
FARM 5, FIELD 1: 500 lbs/A 6-24-24 on surface at planting time; 200 lbs/A on May 1 and June 15.						
0-2	muck	6.9	96	114	100	200
6-8	muck	6.9	35	14	200	250
12-14	muck	6.9	34	34	250	250
FARM 5, FIELD 2: 200 lbs/A 6-24-24 mixed to 1 inch at planting time; 200 lbs/A 6-24-24 on May 1 and June 15. Second crop on field.						
0-2	muck	7.9	70	183	100	150
6-8	muck	7.8	41	137	150	200
12-14	muck	7.5	18	80	250	250
FARM 6, FIELD 1: plow 9 inches. 500 lbs/A 8-32-16 mixed to 2 inches at planting time.						
0-2	mucky sand	6.2	192	183	0	150
4-6	mucky sand	6.3	107	57	0	170
10-12	sandy loam	5.2*	60	206	45	85
FARM 6, FIELD 2: Same treatment as in Field 1.						
0-2	muck	5.9	115	91	50	250
4-6	muck	5.7	112	23	50	250
10-12	peaty muck	5.8	42	23	150	250
FARM 6, FIELD 3: 425 lbs/A 8-32-16 after seeding, Fall, 1978.						
0-2	muck	6.3	121	274	50	100
4-6	muck	6.0	70	183	100	150
10-12	peaty muck	5.9	24	171	200	200

*lime recommended

The results of the soil tests are given in Table 5. Information was obtained from each field regarding depth of plowing or other tillage and rate and placement of fertilizers used.

Mineral Soils

Among the 4 fields representing mineral soils (Farms 1 and 2) only one needed lime, having a pH of 5.9 in the surface soil. The other 3 fields had pH values over 7.0. No P_2O_5 was recommended for any of the 4 surface samples, while 2 of 4 at the bottom of the plow layer and all 4 below the plow layer needed P_2O_5. Since phosphate normally does not move very much in the soil, it is not surprising that the subsoil is low in available P in spite of adequate levels in the surface soil.

Three out of 4 surface soils needed K_2O while all samples from the bottom of the plow layer and below the plow layer required K_2O. In fact, potash is recommended for all sampling depths except for the surface sample of Farm 1, Field 2, indicating not enough K_2O had been applied on these mineral soils.

Organic Soils

Farms 3 through 6 represent predominantly organic soils although Farm 3, Field 2 and Farm 6, Field 1 are shallow mucks and tend toward mineral soils. Results from Farm 3 indicate that relatively low rates of P_2O_5 and K_2O have been applied and/or that there has been significant removal of the nutrients with the sod. On this farm, the fields are rototilled but all the fertilizer has been applied at establishment time after any cultivation or on the established sod. The phosphorous and potassium levels in Field 1 (Farm 3) are considered especially low to maintain sod.

On Farm 4, Fields 1 and 3 have low P and K tests, especially in the subsoil, while Field 2 has obviously been treated differently in the past. Note the extremely low tests in the 6-8 and 10-12 inch depths of Field 3 which had recently been cleared.

Farm 5 had medium to low P soil levels while K was low. It appears that the surface application of 6-24-24 is largely being removed with the sod. The pH of 7.8 to 7.9 in the plow layer of Field 2 is very high for a muck soil. This soil would likely have deficiency of manganese for many field crops. Although I have not observed any responses of sod to applied manganese in Michigan, it would be on such a soil that a response to manganese on sod would be most likely to occur.

The phosphorous soil tests on Farm 6 tend to be higher than on other farms even in the subsoil. These higher tests may result from higher annual phosphate applications, the fertilizer being mixed deeper into the soil, heavy phosphate fertilization of other crops previous to the sod crop, or a soil which is natively higher in phosphorous. The potassium tests vary with Field 2 being very low while Field 3 is high in K. The more acid pH in the mineral subsoil of Field 1 points out the fact that different soil layers can vary greatly in chemical properties and should be tested on occasion. This should be done especially when there are clear differences in the soil layers.

Conclusions

Several conclusions can be drawn from these data that should be helpful to the sod grower.

1. Soil tests vary from farm to farm (and even field to field) depending not only on the fertilizer and the rate of application, but also with the placement and means of incorporation of the fertilizer. Clearly when P_2O_5 and K_2O fertilizers are applied on the soil at establishment

time with little or no incorporation or when topdressed on the sod at any time after seeding, most of this P_2O_5 and K_2O will be removed with the subsequently harvested sod.

This practice of surface application of fertilizer may provide some "insurance" in that some P_2O_5 and K_2O are sent with the sod to the new site. This could be helpful in cases where no P_2O_5 and K_2O are used at sodding time by the landscaper or homeowner. Still, the grower should realize that most of the P_2O_5 and K_2O he has applied has been shipped away. Incorporation of the P_2O_5 and K_2O to more than 2 inches would be more efficient in terms of long term fertilizer costs.

Some growers feel that high P_2O_5 is needed in the surface for ready uptake by the new seedling. But the results of Satari's (1) research would suggest this is not necessary on organic soils at least.

2. The subsoils in most fields are very low in both P and K. It is necessary to keep applying adequate amounts of P_2O_5 and K_2O to raise the amount of available nutrients in this "newly cultivated" soil as it is being fertilized for the first time. Our recommendations based on soil tests for P_2O_5 and K_2O should be adequate to raise these soil test levels. It is necessary that the soil sample be taken to the depth of soil mixing (plowing, etc.) to include this "unfertilized" new soil layer. More research may be necessary on this matter.

Of further concern is the potential change in soil pH as deeper soil layers are being incorporated with the plow layer. On mineral soils, the pH of the subsoil will often be higher than the topsoil (except on some sands) while in organic soils some lower layers may be quite acid. Soil testing is the best way to evaluate the pH of different soil layers.

3. On mineral soils, the relatively high soil P tests in the surface soils indicates that more P_2O_5 is being applied than is needed. The recommendations for K_2O were somewhat higher. This, too, points out the need for soil testing. Many growers are using 1-4-2 or 1-4-4 ratio fertilizers when it would appear that a ratio of 1-2-4 would be more appropriate on many sod fields grown on mineral soils.

4. On the organic soils, the K_2O recommendations were generally higher than for P_2O_5 although both were needed at higher rates than on the mineral soils. These differences may be due to sampling error as there were only 4 mineral fields tested. The figures from the soil testing lab survey are similar to those of the growers fields survey, however.

From these results, it would seem wise for the sod grower to apply the P_2O_5 and K_2O fertilizers before tillage so these nutrients can be mixed into the soil. This would allow for more efficient utilization of the fertilizer dollar. For those growers who only occasionally till their fields while some or all of the reestablishment occurs from regrowth from rhizomes, it is expecially important to use higher P_2O_5 and K_2O rates in those years when the soil is tilled deeper. Otherwise, the surface applied fertilizer will essentially all be removed with the sod.

Soil testing is only one of the management tools available to the sod grower, but it is one that should be utilized more effectively in the future.

Literature Cited

1. Satari, Achmad M. 1967. Effects of various rates and conbinations of nitrogen, phosphorus, potassium and cutting heights on the development of rhizome, root, total available carbohydrate and foliage composition on *Poa pratensis* L. Merion grown on Houghton muck. Ph.D. Thesis. Michigan State University.