



Phosphorus and Potassium Maintenance Fertilizer Recommendations

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The removal of nutrients by crops has often been used to make maintenance fertilizer recommendations. (Maintenance fertilizer is the fertilizer required to replace that removed by the crop.) There are some fallacies of using only a maintenance fertilizer program, however, because maintenance recommendations do not take into account the ability of the soil to supply nutrients. Thus one may be over fertilizing or under fertilizing, depending upon the soil test level. A maintenance fertilizer program has merit if you have a medium soil test and would like to maintain the soil test level at that position, but it may be costly if soil tests are either low or high.

The primary difference between a maintenance recommendation and a recommendation based on a soil test is the desire to get the soil into the most advantageous range for a particular crop. Some crops require a higher level of fertility than others. For instance, potatoes require a higher level of fertility for optimum production than corn.

Michigan State University fertilizer recommendations based on soil tests usually include both a maintenance and a buildup amount of fertilizer when soil tests are low. When soil tests are high, the fertilizer recommendation may be less than the maintenance amount. In this situation, it is no longer necessary or practical to maintain such a high level of fertility and it would be better to draw upon the soil and let the soil test decrease to a lower level where (1) luxury consumption of nutrients (in excess of normal requirement) does not readily occur and (2) where downward movement (leaching) of nutrients is minimized.

To determine what portion of the MSU recommendation resulting from a soil test analysis is the maintenance recommendation, subtract the amount of nutrients removed by the crop from the amount of fertilizer (N, P₂O₅, K₂O) recommended on the soil test report. If the amount of removal exceeds the recommendation on that report, it is our judgment that the soil will have an adequate amount to make up any difference. If the recommended amount exceeds the amount of nutrients removed, the difference is considered necessary for soil buildup.

Example 1.

Soil test phosphorus = 10 lb P/A

Corn yield goal = 100 bu/A

MSU phosphorus recommendation (found in Bulletin E-550) = 100 lbs P₂O₅

From Table 1 each bushel of corn contains 0.35 lbs P₂O₅. Therefore 100 bu × 0.35 lbs = 35 lbs P₂O₅ removal.

MSU Phosphorus recommendation = 100 lb P₂O₅

Minus the maintenance

recommendations = 35 lb P₂O₅

Thus the buildup

recommendation = 65 lb P₂O₅

Table 1. Nutrient Removal by Several Michigan Field Crops¹

Nutrient Removal			lbs/acre			lbs/unit yield		
Crop	Yields		N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
	Corn	(Grain)	150 bu	135	53	40	.9	.35
(Stover)		4.5 tons	100	37	145	22.2	8.2	32.2
(Silage)		25 tons	235	90	195	9.4	3.6	7.8
Soybeans*	(Grain)	40 bu	150	35	55	3.8	.9	1.4
Wheat	(Grain)	40 bu	50	25	15	.12	.62	.38
	(Straw)	1.5 tons	20	5	35	13.3	3.3	23.3
Oats	(Grain)	80 bu	50	20	15	.62	.25	.19
	(Straw)	2 tons	25	15	80	12.5	7.5	40.0
Rye	(Grain)	30 bu	35	10	10	1.17	.33	.33
	(Straw)	1.5 tons	15	8	25	10.0	5.3	16.7
Sorghum	(Grain)	60 bu	50	25	15	.83	.42	.25
	(Stover)	3 tons	65	20	95	21.7	6.7	31.7
Sugar Beets	(Roots)	15 tons	60	20	50	4.0	1.3	3.3
Potatoes	(Tubers)	500 cwt	167	67	316	.33	.13	.63
Field Beans*	(Seed)	18 cwt	75	25	25	2.5	.83	.83
Alfalfa*	(Hay)	5 tons	225	50	225	45.0	10.0	45.0
Bromegrass	(Hay)	3 tons	90	18	140	30.0	6.0	47.0

*Legumes get most of their Nitrogen from air.

¹Source: USDA Miscellaneous Publication No. 369 and "Feeds and Feeding" by Morrison. 22nd Edition.

The buildup recommendation for Example 1 is 65 lb P_2O_5 and should be applied to raise the soil test level. The amount of P_2O_5 to raise the soil test one pound may range from 4-30 lbs P_2O_5 , depending on the phosphorus fixing capacity of the soil. On an average, approximately 9 lbs of P_2O_5 is required to raise the soil test approximately one pound. Therefore, 65 lbs P_2O_5 would raise the soil test 7 lbs ($65/9 = 7.2$). Only periodic sampling of the field will reveal how quickly the soil test level is increasing.

Example 2.

Soil test potassium = 200 lbs K/A
 Alfalfa yield goal = 5 tons/A
 MSU potassium recommendation

on a sandy soil = 100 lbs K_2O
 From Table 1, each ton of alfalfa contains 45 lbs K_2O . Therefore, 5 tons $\times 45 = 225$ lbs K_2O
 Maintenance recommendation = 225 lbs K_2O
 MSU potassium recommendation = 100 lbs K_2O (found in Bulletin E-550)
 Thus net removal from soil = 125 lbs K_2O

Since an average of approximately 4 lbs K_2O is required to raise the soil test one pound, the same loss through removal would lower the soil test one pound. In this example the K soil test might be expected to drop 31 pounds

($125/4 = 31.2$) after 5 tons of alfalfa were removed. You may consider such a drop in soil test too great and would prefer to apply the full maintenance amount. If this is done, however, you might see luxury consumption by alfalfa, resulting in greater K removal than normal and a small drop in the soil test. Periodic soil sampling is recommended to observe the actual changes in soil test due to crop removal or fertilizer additions. This procedure for recommending K fertilizer for alfalfa can be argued from many points of view, and many states differ on potassium fertilizer recommendations for the hay crops where K removal is great.

Related Publications

Additional information on fertilizer recommendations, soil testing and soil test changes can be found in the following MSU publications:

- Bulletin E-486. Secondary and Micronutrients for Vegetable and Field Crops.
- Bulletin E-550. Fertilizer Recommendations for Vegetable and Field Crops.
- Bulletin E-802. Effect of Nitrogen Fertilizer on Corn Yield.
- Bulletin E-937. Understanding the MSU Soil Test Report.
- Bulletin E-1067. Fertilization of Wheat.
- Research Report No. 127. Phosphorus and Potassium Fertilizers Affect Soil Test Levels.
- Research Report No. 197. Levels and Changes in Soil Tests in Lower Michigan 1962-71.