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Phosphate Fertilizer Results in Minnesota

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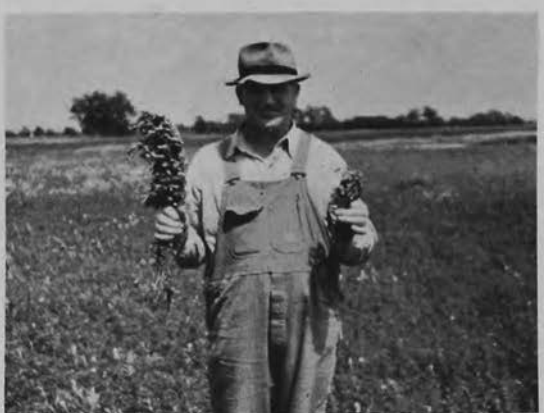
PHOSPHATE

Fertilizer Results

in Minnesota



Farm Demonstration Trials

Conducted by Extension Service
and AAA Cooperating

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Phosphate Increased Alfalfa Yields Over Ton Per Acre

ALFALFA yield increases from phosphate treatments were general in 26 counties where test demonstrations were conducted on 88 different farms in 1942 by the Agricultural Extension Service and the AAA. As shown in the table at the right, the average increase in yield for the first cutting was 0.59 tons per acre or 41.5 per cent, while on the second cutting the increase in yield was 0.48 tons per acre or 61.5 per cent. On the basis of the two cuttings harvested, the total yield on the unphosphated was 2.20 tons per acre compared with 3.27 tons on the phosphated, or an increased yield of 1.07 tons per acre in favor of phosphate fertilizer.

The effects of phosphate fertilizers on alfalfa, in addition to increases in yield per acre, were observed and reported on 114 different cuttings. Sixty-four per cent of the cuttings showed a definite increase in height. Of this group, 55.5 per cent had increases ranging from 2 to 5 inches, 32 per cent from 6 to 10 inches, and 12.5 per cent 10 inches or more. Leafiness of growth was increased on 47 per cent of the cuttings while a darker green was evident on 76 per cent of the cuttings.

Comparable responses may be expected from other phosphate-treated legume hay and pasture crops.

Minnesota Soils Losing Phosphorus

WHEN corn and grain crops are sold, the farm loses approximately three fourths of the phosphorus removed from the soil in the crops. The other one fourth remains in the crop residues.

When crops are fed to livestock and sold as livestock products the farm loses approximately one fourth of the phosphorus contained in the crops fed. The other three fourths is recovered in the manures. Unless care is taken in handling to preserve and return all manures to the soil, further serious loss of phosphorus may result.

It is very evident that no type of farming, no matter how good, will maintain the phosphorus supply of the soil, unless sufficient amounts of phosphorus-bearing material such as manure, feeds, or commercial phosphate fertilizer are brought to the farm from outside sources. From the standpoint of the farming community as a whole, the only recommended means of maintaining the phosphorus supply of the soil is through the use of commercial phosphate fertilizers. The transfer of manures or feeds from one farm to another brings phosphorus to one at the expense of another.

Alfalfa Yields from Phosphate—1942 Test Demonstrations

Conducted by Extension Service and AAA

County	No. of farms	Check (No phosphate) Yield in tons 1st Cut	2nd Cut	Total	Phosphate Yield in tons 1st Cut	2nd Cut	Total	Tons gain for phosphate 1st Cut	2nd Cut	Total	Per cent gain for phosphate 1st Cut	2nd Cut
Becker	4	.81	.32	1.13	1.62	1.02	2.64	.81	.70	1.51	100.0	218.7
Big Stone	1	.....	.60	.60	.....	1.21	1.21	.....	.61	.61	.....	101.6
Chippewa	3	1.50	.....	1.50	1.82	.....	1.82	.32	.....	.32	21.3	.....
Clay	2	.79	.54	1.33	1.56	.88	2.44	.77	.34	1.11	97.4	62.9
Douglas	3	1.56	1.41	2.97	2.02	1.82	3.84	.46	.41	.87	29.4	29.0
Kandiyohi	4	.95	.....	.95	2.06	.....	2.06	1.11	.....	1.11	116.8	.....
Lac qui Parle	4	1.39	.95	2.34	1.50	1.02	2.52	.11	.07	.18	7.8	7.3
Le Sueur	2	2.31	.....	2.31	3.15	.....	3.15	.84	.....	.84	36.3	.....
Lyon	1	1.36	.....	1.36	1.83	.....	1.83	.47	.....	.47	34.5	.....
Mahnomen	2	.44	.60	1.04	1.36	1.15	2.51	.92	.55	1.47	209.0	91.6
Marshall	2	.....	.43	.43	.....	1.28	1.28	.....	.85	.85	.....	197.6
Meeker	6	2.39	.87	3.26	2.77	1.29	4.06	.38	.42	.80	15.9	48.2
Norman	2	.....	.70	.70	.....	1.19	1.19	.....	.49	.49	.....	70.0
Olmsted	2	1.79	1.25	3.04	1.99	1.36	3.35	.20	.11	.31	11.1	8.8
East Otter Tail	2	.....	.65	.65	.....	1.27	1.27	.....	.62	.62	.....	95.3
West Otter Tail	8	1.89	.....	1.89	2.42	.....	2.42	.53	.....	.53	28.0	.....
Pope	1	1.16	.48	1.64	2.01	.68	2.69	.85	.20	1.05	73.2	41.6
Red Lake	3	.76	.....	.76	1.56	.....	1.56	.80	.....	.80	105.2	.....
Rice	3	1.65	.....	1.65	1.80	.....	1.80	.15	.....	.15	9.0	.....
Stevens	5	1.18	.54	1.72	1.89	1.00	2.89	.71	.46	1.17	60.1	85.1
Swift	6	.96	.81	1.77	1.69	1.23	2.92	.73	.42	1.15	76.0	51.8
Todd	1	1.21	.80	2.01	1.81	1.11	2.92	.60	.31	.91	49.5	38.7
Traverse	4	1.85	1.38	3.23	1.81	1.46	3.27	—.04	.08	.04	—2.1	5.7
Wilkin	7	1.48	.97	2.45	2.18	1.39	3.57	.70	.42	1.12	47.2	43.2
Winona	1	.83	.....	.83	.93	.....	.93	.10	.....	.10	12.0	.....
Yellow Medicine	9	1.13	.84	1.97	1.85	1.60	3.45	.72	.76	1.48	63.7	90.4
AVERAGE YIELD	88	1.42	.78	2.20	2.01	1.26	3.27	.59	.48	1.07	41.5	61.5

Phosphate Fertilizer Treatments

THE treatments summarized in the above table included one fertilized strip or plot and one unfertilized area or check plot. The size of the fertilized areas ranged from 1/20 acre plots to field demonstrations. The fertilizer used in most cases was superphosphate, mainly 0-20-0, and a small amount of 0-43-0 held over from the year before. Most of the demonstrations were established in 1942 except a few which were well set up the year before.

The phosphate treatments were generally applied broadcast on soil-conserving crops such as alfalfa, red clover, and sweet clover, or on mixtures of legumes and grasses according to AAA regulations. The rates of application on most of the demonstrations ranged from 100 to 150 pounds per acre for the 43 per cent superphosphate and 200 to 250 pounds for the 20 per cent. As the greatest number of demonstrations were uniformly established on alfalfa, the data presented here are confined to the results on that crop.

The yields were obtained by harvesting six square yards from each treatment on representative soil conditions on the plot or field. Green weights were taken at the time of harvest and samples hung in a shed on the farm for drying. The yield calculations were then based on the air-dried hay. Small samples of the air-dried hay were taken from each soil treatment and sent to the Division of Soils, University Farm, St. Paul, Minnesota, for phosphorus and protein analysis. The results of these determinations will be reported at a later time. At the time of harvesting each cutting of hay, an observation report was prepared indicating if there were any observable difference between the fertilized and unfertilized areas as to height, leafiness, maturity, color, stand, and any other visible differences.

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The use of phosphates or other commercial fertilizers such as phosphate-potash combinations will not alone maintain soil fertility. Other principles of the Minnesota Soil Fertility and Management program must be given attention such as good crop rotations, inoculating legumes, conserving and using farm manure, returning legume and crop residues to maintain organic matter, and adopting certain supplementary erosion control practices where practical.

Phosphate Recommendations

RESULTS of the test demonstrations indicate that it may be quite profitable to make phosphate fertilizer applications on soil-conserving crops such as alfalfa, red clover, and legume and grass mixtures. The results agree with the findings of experiments carried on for many years by the University Farm Division of Soils. Because the test demonstration results are for *only one* season with favorable moisture and weather conditions, it should be expected that the responses may vary from year to year, due to different seasonal conditions and the management of the hay crop. However, the one season's results are released so that farmers having questions regarding phosphate fertilizer for alfalfa and other soil-conserving crops may have such data as are available. Phosphate fertilizer recommendations made from these results or from any other experimental work should take into account the soil type conditions, the cropping history, and the soil management program now being used on the land.

Inclusion of Potash

All crops remove potash as well as phosphate from the soil and legumes remove more than small grains and corn. The acreage of legumes, especially alfalfa, has been increasing, thus increasing the demand on the available potash of the soil. Recent experiments have shown that in many cases yields of corn, grain, and alfalfa can be further increased if potash as well as phosphate is included in the fertilizer. These responses have been especially prominent in western Minnesota on level fields of heavy black clay loam on which drainage is or has been imperfect. Phosphate-potash is very effective on alkali rims that occur on these soils. The AAA is distributing an 0-14-14 grade of phosphate-potash.

Left: Phosphate-treated alfalfa—Right: Untreated

Benefits from Phosphate

ON soils needing phosphate treatment, as indicated by increased yields shown in table, the application of phosphate fertilizers can be of benefit to different crops in one or more of the following ways:

1. **Greater leaf and stem development**
2. **Better stands of legumes**
3. **Increased root growth**
4. **Higher feeding value in phosphorus content**
5. **Earlier maturity**
6. **Better quality of crops**
7. **Higher yield of grain, seed, or hay**

Where to Apply in the Rotation

Under the AAA Conservation Materials program, phosphate or phosphate-potash combinations can be applied only to soil-conserving crops, at the time of seeding or as top-dressing on old established stands. Satisfactory results have been obtained from top-dressing established stands but the most satisfactory place in the rotation to apply phosphate or phosphate-potash fertilizer is immediately before seeding of the biennial or perennial legumes, either when seeded alone or with a small-grain companion crop. If fertilizer is to be most effective in seeding and growing the crop, it should be thoroughly worked into the soil at the time the seedbed is prepared. Top-dressing phosphate fertilizers on old seedings of alfalfa and clovers is not generally recommended in Minnesota.

Residual effects of the phosphate treatments may be expected on the succeeding crops for several years. Experiments being conducted by the Division of Soils and the Extension Service are showing that yields of corn following a phosphate-treated legume crop are significantly increased on the phosphated area over the untreated area three years after the application.

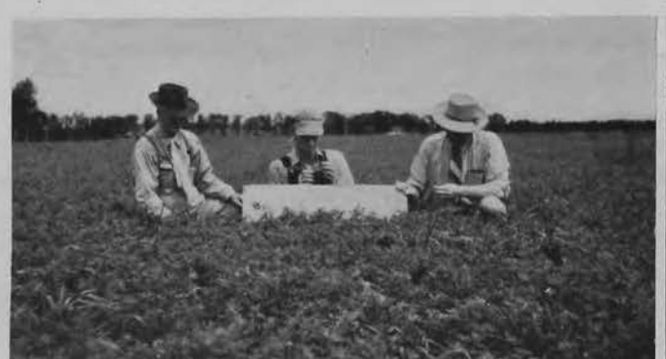
Rates of Application

The amount of fertilizer to use on various soil-conserving crops will depend on the type of soil, the present level of fertility resulting from the past management practices, and the length of time the crop will remain on the land.

In the following recommendations the smaller amounts are for the soils of higher fertility levels and the larger amounts are for soils of lower fertility levels.

For alfalfa, clover, and legume and grass mixtures to remain seeded for at least a three-year period, with or without a small-grain companion crop, and for reseeded, renovated permanent pastures, apply 250 to 300 pounds of 0-20-0 superphosphate or 125 to 150 pounds of 0-43-0 treblesuperphosphate per acre. The 0-14-14 mixture would be applied at 350 to 400 pounds per acre if this mixture is used.

For biennial legumes such as sweet clover, red clover, alsike clovers with timothy, or other grass mixtures seeded alone or with a small-grain companion crop, apply 150 to 200 pounds of 0-20-0 superphosphate or 100 pounds of 0-43-0 treblesuperphosphate per acre. If the 0-14-14 mixture is used, apply at 225 to 275 pounds per acre.



Phosphate-treated alfalfa

Untreated alfalfa

Methods of Application

The most satisfactory method of applying fertilizer to small-grain, legume, and grass seedings is by means of a combination fertilizer and grain drill. It distributes the fertilizer evenly and uniformly into the proper place in the soil. An endgate or trailer-type lime spreader or the "low-down" fertilizer and lime sower are satisfactory. Endgate, broadcast seeders, or grasshopper bait spreaders may be used in addition to the above broadcasting machines.

If no other means of spreading is available, phosphate may be spread over each load of manure, the amount per load being determined by dividing the rate per acre of phosphate by the number of loads of manure per acre.

When the broadcast method is used, care should always be taken to work or disk the phosphate thoroughly into the soil.

Care must be used with all types of distributing machines to keep them properly oiled and adjusted. They should be thoroughly cleaned after use to prevent rusting and breakage. An old tire pump or a good, stiff brush is very useful in cleaning a machine. After all fertilizer has been thoroughly removed from the machine, it is advisable to paint all moving parts with kerosene or old crankcase oil or distillate to prevent rusting.

HOW THESE TRIALS BEGAN

WHAT results are being obtained in Minnesota from phosphate fertilizer made available through the AAA Conservation Materials program? This question was raised during a state meeting of AAA fieldmen and representatives of the Soil Conservation Service and Extension Service in February, 1942. The outcome was a cooperative phosphate test-demonstration project, with the Extension Service responsible for conducting the program on the state basis through the county extension agents. The state AAA committee, through its county committees, secured AAA participation in the counties. County extension agents and county AAA committees, together with the Extension-AAA blockmen, organized and set up the county programs. Yield samples from the phosphated and unphosphated areas of the fields in soil-conserving crops, especially alfalfa, were taken in each county by a person selected by the two agencies. Yield samples and weights were sent to University Farm, St. Paul, where the Extension Service and the Division of Soils were responsible for summarizing, interpreting, and reporting the project results.

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