USE of UREA-FORMALDEHYDE FERTILIZERS WHEN SEEDING on SUBSOIL HIGHWAY SLOPES

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Many highway contracts are completed in the late autumn. In New York State one can seed after the growing season and usually get a stand of grass the following spring, especially if a mulch is employed. The resultant stand, however, is often weak. It appears to be due to a nitrogen deficiency caused by leaching, with the degree of leaching governed by soil type and openness of the winter.

Since urea-formaldehyde releases nitrogen only under favorable temperature conditions, reasoning suggested that by its use the leaching problem might be solved. Most of the nitrogen should then be available the following growing season when it is most needed.

Previous investigations on lawn areas (1,2) have established the superiority of urea-formaldehyde over other commercial chemical fertilizers in slowly releasing nitrogen over the entire growing season. This should also prove an advantage when seeding on subsoils.

In order to see how the two above mentioned characteristics worked on subsoil highway slopes, three commercial brands of urea-formaldehyde were compared with 10-10-10 or 10-20-10 commercial fertilizers and with superphosphate and/or 0-20-20 added to the urea-form to give comparable amounts of phosphorus and potash. All the comparisons were made at 100 lb of nitrogen per acre. (As a side observation, 100 lb of nitrogen per acre in a commercial fertilizer was compared with 60 lb of nitrogen per acre in a commercial fertilizer.)

Installations were made along highways on various soils and exposures in the spring, summer, early autumn, and in the late autumn after the growing season. A seed mixture consisting of red fescue, tall fescue, orchard grass, and perennial ryegrass was used throughout. All plots were mulched with straw at 2 to 3 tons per acre. The plots were evaluated at intervals as to percentage of cover, length of grass blades, and general color and vigor.

RESULTS

Installation Number 4

Installed November 14, it should have demonstrated the ability of urea-form to carry nitrogen through the winter. No growth occurred until the following spring. An observation made on June 7 showed the urea-formaldehyde plots were yellowish in color and the grass not nearly as long or vigorous as the commercial-fertilizer plot at 100 lb of nitrogen per acre (N/A).

By July 22 some of the yellow color had disappeared from the urea-form plots, and they approximated those where the 60-lb N/A commercial fertilizer had been used.

TABLE 1

INSTALLATION NO. 4

East Exposure; Unadilla Silt;
Nov. 14, 1956

1	2	3	4	5	6
60 lb N/A in 10-10-10	100 lb N/A in 10-10-10	100 lb N/A in urea-form + 0-20-20	100 lb N/A in 10-10-10	100 lb N/A in urea-form + 0-20-20	60 lb N/A in 10-10-10

The 100-lb N/A commercial-fertilizer plots were far superior to either of the others, and by Sept. 6 the grass on these averaged 10 in. in length and only 5 in. on the urea-form plots; the commercial-fertilizer areas at 100-lb N/A had twice the amount of effective cover (uniformity of stand plus volume of growth) than those receiving urea-form. At this time, the plots receiving 60 lb N/A were superior to those that had urea-form.

Installation Number 5

Installed Sept. 11, it produced a stand of grass before going into the winter. The following June all the plots had approximately the same percentage of cover, but the grass in the 100-lb N/A commercial-fertilizer plot was twice as tall as that receiving urea-form. The 60-lb N/A commercial-fertilizer plot was about equal to the urea-formaldehyde area.

TABLE 2

INSTALLATION NO. 5

West Exposure; Culvers Channery Silt;
Sept. 11, 1956

1	2
100 lb N/A in 10-10-10	100 lb N/A in urea-form + 0-20-20

By Sept. 6, the urea-form plot had grass 4 to 6 in. tall while in the 100-lb N/A commercial-fertilizer plot the grass was 6 to 18 in. tall (depending on species).

Installations Numbers 1 and 2

Installed in June, they had ideal growing conditions. The season was late and the weather cool with adequate precipitation. The sites were problem slopes (wet) which had received a run-of-bank gravel blanket approximately 1 ft thick to stop sloughing. Until they dried out in mid-August most of the plots had water percolating through the gravel, and excellent stands of grass resulted. Differences were not apparent as in installations 4 and 5, but the north and south exposures made some variations (the installations were opposite each other).

On Aug. 7, the 100-lb N/A commercial-fertilizer plots had a slight edge over the urea-formaldehyde areas.

By Oct. 10, the urea-form plots on the south-facing slope were slightly better than the 100-lb N/A commercial-fertilizer plots, but the opposite was true on the north-facing slopes where the 100-lb commercial-fertilizer plots had a slight edge. Apparently, the urea-form on the south slopes released more nitrogen because of a higher temperature.

TABLE 3

INSTALLATION NO. 1

North Exposure; Gravel Blanket Approx. 1 Ft Thick Over Clay and Silt; June 28, 1956

1	2	3	4
60 lb N/A in 10-20-10	100 lb N/A in 10-20-10	Urea-form + 0-20-20 + Superphosphate	60 lb N/A in 10-20-10

TABLE 4

INSTALLATION NO. 2

South Exposure; Gravel Blanket Approx. 1 Ft Thick Over Clay and Silt; June 28, 1956

1	2	3	4	5	6	7
60 lb N/A in 10-20-10	100 lb N/A in Urea-form + 0-20-20 + Superphosphate	100 lb N/A in 10-20-10	60 lb N/A in 10-20-10	100 lb N/A in Urea-form + 0-20-20 + Superphosphate	100 lb N/A in 10-20-10	60 lb N/A in 10-20-10

One year later, Oct. 4, 1957, the urea-form plots and commercial-fertilzer plots at 100 lb N/A were almost identical on both the north and south exposures.

Installation Number 3

Installed July 18, this installation was to determine any differences in three commercial brands of urea-form.

By Oct. 10, Brand A plots were superior to the Brand B and C plots but not as good as the 100-lb N/A commercial-fertilizer areas.

Through an error in installation, one of the Brand A plots received 2 to $2\frac{1}{2}$ times the amount of material planned. In October, it was the most uniform plot of the series and had very good growth but was rated slightly below the adjacent 100-lb N/A commercial-fertilizer plot because of the length of the grass. The Brand A plots had more clover than any of the other plots. The clover was introduced by being in the mulch.

On May 17, 1957, the commercial-fertilizer plots at 100 lb N/A were far superior to Brand B and C plots. Where Brand A was applied at approximately 250 lb N/A it was superior to 100-lb N/A commercial-fertilizer plots, but where applied at 100-lb N/A rate, it was not as good as commercial fertilizer at 100 lb N/A. Clover in the Brand A plots was exceptionally heavy. Brand A seemed definitely to encourage growth of clover.

TABLE 5

INSTALLATION NO. 3

West Exposure; Wooster Gravelly Silt
July 18, 1956

1	2	3	4	5	6
100 lb N/A in 10-10-10	100 lb N/A in Urea-form (Brand A) + 0-20-20	100 lb N/A in 10-10-10	100 lb N/A in Urea-form (Brand A) + 0-20-20	100 lb N/A in Urea-form (Brand B) + 0-20-20	100 lb N/A in Urea-form (Brand C) + 0-20-20

By October 1957, the commercial-fertilizer plots at 100 lb N/A were superior to any of the urea-form plots. Brand A plots were superior to Brand B and C plots.

The Brand A plot that had received 250 lb of nitrogen per acre had a bright green color; the other plots were semidormant. The question arises whether this was due to the residue of nitrogen left by the clover or to certain qualities of urea-form. While this plot was greener than any of the other plots, the vigor and percentage of cover were equal (not superior) to the 100-lb N/A commercial-fertilizer plot.

OBSERVATIONS

Since previous investigations on lawn areas had shown the superiority of urea-form fertilizers by slowly releasing nitrogen over a long period, the question arises as to why they did not produce this result on subsoil slopes. Urea-form requires bacteria to break it down. These cuts were freshly made in subsoil and perhaps did not have the needed bacteria. Another explanation might lie in the fact that, by the time temperatures became favorable for the release of nitrogen, moisture became critical on the slopes, thus preventing the urea-form from producing. The rate of 60 to 80 lb N/A in a complete commercial fertilizer has been generally satisfactory for new seeding in New York State. By comparison, the 100 lb N/A was definitely superior.

CONCLUSIONS

In this series of trials urea-form fertilizers at the rate of 100 lb N/A plus phosphorus and potash did not produce results comparable to commercial chemical fertilizers at the same rate of nitrogen when applied on raw subsoil highway slopes.

Results were far superior when a complete commercial fertilizer was applied at the rate of 100 lb N/A as compared with a complete commercial fertilizer at the rate of 60 lb N/A.

REFERENCES

1. Musser, H. B., Watson, J. R., Jr., Stanford, J. P., and Harper, J. C., "Urea-Formaldehyde and Other Nitrogenous Fertilizers for Use on Turf." Bull. 542, Agr. Expt. Sta., State College, Pa.

2. Mruk, C. K., Wisniewski, A. J., and DeFrance, J. A., "A Comparison of Urea-Formaldehyde Materials for Turfgrass Fertilization." Agr. Expt. Sta., University of Rhode Island.

DISCUSSION

GARMHAUSEN: Was the fertilizer worked in and was the seed covered?

Answer: The fertilizer and seed were placed on top of freshly graded slopes and covered with mulch at the rate of approximately 3 tons per acre.

GARMHAUSEN: Were all results judged by observation of plants only, or were soil tests run to show if the soil had increased in fertility?

Answer: All results were judged by observation of plants only. Soil samples were taken at the time of installation with the intention of comparing them later with samples for pH and nitrogen. Unfortunately they were thrown out by mistake in a general housecleaning.

SLACK: The subsoils of New York are foreign to me, but in dealing with Louisiana's subsoils I can state that they fail to produce good stands of grass at the outset. I have always thought that this was due to the lack of bacteria. By topsoiling we have gotten fair results. Furthermore, complete fertilizers on our subsoils (and some of the topsoils) produce better results at the outset than nitrogen alone. Thus the recorded results in this paper are quite interesting.

Answer: We wish to make it quite clear that phosphorus and potash were added to the urea-form in all cases to produce a complete fertilizer that was equal in composition to the commercial fertilizer with which the urea-form was compared.

GRAU: Could you identify the materials used in the tests by name of product? Were they urea-forms or were they urea-formaldehyde products? Is there information as to the A. I. value of the products used?

By way of explanation, the ASDA definition of urea-form is "the product of combining urea and formaldehyde so that the resultant product has a good agricultural (fertilizer) value and exhibits an A. I. value equal to or greater than 40." The term A. I. stands for Activity Index and is a measure of quality somewhat analogous to the term pH. A. I. value is determined by dissolving the insoluble portion of the urea-form in buffered hot phosphate solution. There are urea-formaldehyde products which have no fertilizer value.

When rates of application are less than 4 lb of nitrogen to 1,000 sq ft, it is best to use inorganic sources of nitrogen. At 4 lb or more, urea-form fertilizers can be used advantageously. It is not valid to compare directly inorganic nitrogen and urea-form nitrogen. The slow release of urea-form always shows to disadvantage during the first few weeks compared with quickly available sources of nitrogen. Urea-form is made to release nitrogen gradually over a 15- to 20-week period. Inorganic sources of nitrogen yield their nitrogen completely within a few weeks.

One hundered pounds of nitrogen to the acre in an inorganic 10-10-10 will yield about 20 lb of nitrogen per acre per week. One hundred pounds of nitrogen from urea-form, which releases nitrogen gradually for 20 weeks, cannot possibly yield more than 5 lb per acre per week. This explains the apparent lack of response from urea-form.

Answer: The materials used in the trials were DuPont Uramite; Borden's 38, a product of the Borden Co.; and Nitro-form, made by Allied Chemical & Dye Corp. The A. I. values of all three materials are available from the manufacturer.

The rates used were within the range recommended by two of the manufacturers but slightly below the rate recommended by the third:

Material	Mfr. Recommended Rate	Actual Application
Uramite	5-10 lb/1,000 sq ft	6.05 lb/1,000 sq ft
Borden's 38	8-10 lb/1,000 sq ft	6.05 lb/1,000 sq ft
Nitro-form	3.45-4.59 lb/1,000 sq ft	6.05 lb/1,000 sq ft

The rates suggested by Dr. Grau undoubtedly would give good results but would cost several times what it costs to get good results with inorganic sources of nitrogen.

Observations were made over a period of at least one year following application of the fertilizers. Under the conditions of these plantings, the advantages of slow release of nitrogen were not apparent.

BRANT: We have used urea-formaldehyde fertilizer on a field trial basis instead of carefully controlled experiments. It was used as topdressing on established cover on both sandy and clay soils. On sandy soil, the urea-formaldehyde plots had an even growth and color that was very decidedly better than other topdressers used, apparently as indication of resistance to leaching. On the clay soil, the difference was much less noticeable but good color was maintained longer on the urea-formaldehyde plots.

HAGEMEISTER: In May 1956, approximately 1,400 lb of 5-10-5 fertilizer and 600 lb of Blue Chip 38 percent Nitro-form were mixed. About 140 tons of this mixture was used on about 280 acres of New Jersey Turnpike median strip. This gave a fertilizer formula of about 16 percent nitrogen.

It was the contention that 700 lb of 5-10-5 per acre would give a light but effective application of a complete fertilizer and that the addition of 300 lb per acre of urea-form (38 percent nitrogen) would give effective feeding over a long period.

The results of this application were excellent. Where check plots were run by laying a sign on the grass, the spots that had been missed could be seen very easily.

The slightly higher cost of the material was offset by the saving in the cost of sending vehicles ahead of the spreading equipment to protect workers and equipment from traffic. For every $30,000 spent for fertilizer, approximately $6,000 is for such protection. By saving one application of fertilizer through the use of longer-lasting Nitro-form, there is a surplus in the budget. Better results were secured than with conventional fertilizers, because the grass stayed green longer through the drought and had a better appearance than at any previous time.

The minimum rate of application of a fertilizer of this kind should yield 4 lb of nitrogen to 1,000 sq ft; otherwise, the full value of the slow-acting nitrogen cannot be realized. Experience has been that the nitrogen lasts over an entire season. This makes it an economical purchase where cost of application is very high, as it is on the New Jersey Turnpike.