Proceedings of the Iowa Academy of Science

Volume 38 | Annual Issue Article 109

1931

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SOME EFFECTS OF NITROGENOUS FERTILIZERS ON THE NITRIFYING POWER OF CARRINGTON LOAM

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The World War stimulated research on the production of synthetic nitrogenous compounds and after the war, this activity was transferred to the production of synthetic nitrogenous fertilizers. Today these fertilizers are rapidly coming into practical use and a knowledge of their effects on soil conditions is essential to a proper determination of their agricultural value and economic significance.

Nitrates are among the most important of the plant food compounds coming from the soil, and the ability of a soil to produce these nitrates by the oxidation of nitrogenous compounds or nitrification may be considered one of the most important factors affecting its crop producing power. To determine whether or not these synthetic nitrogenous fertilizers have any effect on the nitrifying power of a soil, the following experiment was planned.

EXPERIMENTAL

Four-gallon pots were filled with virgin Carrington loam and cyanamid, Ammo-Phos "A," sodium nitrate, ammonium sulfate and superphosphate were applied in two amounts equivalent to 21 and 63 pounds of nitrogen per acre, superphosphate in amounts sufficient to supply an equivalent amount of phosphorus to that added in the Ammo-Phos, or 89.7 and 269.3 pounds of P_2O_5 respectively. The A and B treatments shown in the tables represent the two applications of the fertilizers. Each treatment was made in duplicate, and the data recorded in the tables are the averages of the results secured from the duplicate pots. The treatments were made November 10 and the pots were incubated in the greenhouse, optimum moisture content being maintained by additions of distilled water.

The soils were sampled at four week intervals. Portions equivalent to 100 grams of air dry soil were weighed into tumblers and 30 milligrams of nitrogen as ammonium sulfate added. After 4 weeks incubation the nitrates were determined colorimetrically by the phenoldisulphonic acid method.

The results obtained are given in table I. Table II shows the numbers of bacteria present two weeks before the time of sampling, as determined by growth on plates using the usual plating technique and albumen agar as a medium.

Table I — Nitrification — Mgms. Nitrate Nitrogen Produced per 100 gms. Soil from 30 mgms. Nitrogen as $(NH_4)_2\ SO_4$.

Treatment	Date of Sampling		
	December 16	January 17	February 18
Check	6.20	8.99	4.94
Cyanamid A	5.73	8.67	4.70
Cyanamid B	5.82	8.12	5.63
Ammo Phos "A" A	5.49	8.39	4.72
Ammo Phos "A" B	6.01	8.78	4.42
Sodium Nitrate A	6.18	9.61	5.84
Sodium Nitrate B	5.36	9.66	5.52
Ammonium Sulphate A	6.73	10.30	5.30
Ammonium Sulphate B	6.96	11.83	5.50
Superphosphate A	8.21	11.87	6.38
Superphosphate B	7.43	9.27	5.70

Table II — Numbers of Bacteria per gram of Soil (in thousands)

Treatment	Date of Sampling		
	November 29	December 31	February 5
Check	1,950	900	800
Cyanamid A	1,800	1,050	400
Cyanamid B	1,550	1,500	1,200
Ammo Phos "A" A	1,800	1,000	450
Ammo Phos "A" B	2,100	1,200	800
Sodium Nitrate A	1,950	650	500
Sodium Nitrate B	2,600	600	300
Ammonium Sulphate A	2,200	850	500
Ammonium Sulphate B	2,150	850	400
Superphosphate A	1,900	1,200	700
Superphosphate B	1,950	950	500

The results in table I show that the nitrifying power of all the soils increased until about January 17 and then decreased about fifty per cent in the following four weeks, the rise and fall being quite uniform throughout the series. The nitrifying power seemed to follow the same general trend as the total numbers of organisms except that the latter decreased more quickly than the former.

There was a direct correlation between the numbers of organisms and the nitrifying power in the case of the soils receiving the superphosphate and cyanamid treatments, but no correlation appeared between the numbers and the nitrifying power of the soils under the other treatments. In all cases, only a small part, one-fifth to one-third, of the nitrogen added was nitrified and there were no large differences between the effects of the various treatments on the amounts of nitrogen nitrified. In all cases except one (Cyanamid, 63# N, February 18), the Cyanamid and the Ammo Phos treated soils produced slightly less nitrate than the check soil while an average of the three samplings shows that sodium nitrate and superphosphate (B treatment) exerted a slightly stimulating effect. Ammonium sulphate and superphosphate (A treatment) showed the most marked stimulating effect. However, the greatest increase over the check in any case was only 2.88 milligrams.

From the data at hand no entirely adequate explanation can be offered for the striking decrease in nitrifying power after January 17. The results indicate that Cyanamid when applied in amounts equivalent to 63 pounds of nitrogen per acre may have a delayed stimulating effect on the nitrifying bacteria. Cyanamid is about 17 per cent calcium hydroxide. While this amount of basic material has no apparent effect on the pH of the soil as a whole, it may raise the pH in close proximity to the particles of Cyanamid and thus provide areas where nitrifying organisms may function to better advantage than in the entire mass of the soil.

Comparing the results secured with Ammo Phos, ammonium sulphate and superphosphate (amount A), it appears that some factor other than the form of the nitrogen or the presence of the phosphate may be responsible for the stimulative effect of the superphosphate. It is possible that under the conditions of this experiment the sulphate radical may be responsible for the stimulation.

As a whole the results of this experiment indicate that Cyanamid, Ammo Phos "A," sodium nitrate, ammonium sulphate and superphosphate have little effect in increasing or decreasing the nitrifying power of Carrington loam.

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