

APPLICATION OF ONION SLUDGE AS A FERTILIZER SUPPLEMENT

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Summary

Onion sludge resulting from onion oil extraction was applied to fields of Virtue silt loam in Skyline Farms, Ontario, Oregon. The application of 58 tons of sludge per acre added substantial nutrients to the land; 135.7 lb N/ac, 30.7 lb P/ac, and 152.0 lb K/ac. The nitrogen was mostly in the forms of ammonium-N (17.5 percent) and organic N (82.5 percent). Based on average nitrate-N and ammonium-N in the fall in farm fields, approximately 32 percent of the organic N mineralized during the first summer after application. Replicated and controlled field plots would be necessary for more accurate N mineralization estimates. Onion sludge should be valuable for use as a crop fertilizer.

Procedures

Onion sludge resulting from onion oil extraction was applied to four fields of Virtue silt loam at the rate of 58 tons per acre between November 16, 1995 and March 1996 and was disked into the soil. Part of each field was left untreated.

The sludge contained an average 2.34 lb of N per ton, of which 0.41 lb was available as ammonium at the time of application (Table 1). The average application of 58 t/ac resulted in 135.7 lb N/ac being added to the land.

In the spring (March 29 through April 2) and again in the fall (November 16 through 20) of 1996 soil samples were taken on both the treated and untreated fields. The soil was analyzed for nitrate-N, ammonium-N, phosphorous, potassium, pH, electrical conductivity, percent N, cation exchange capacity, and percent organic matter. The pounds of nitrate-N and ammonium-N were calculated by assuming a soil bulk density of 1.2 in the top foot of soil and 1.3 in the second and third foot of soil.

All operations and samplings were conducted by Northwest Essential Oil of Ontario, Oregon.

Results and Discussion

Soil analyses revealed no change in soil organic matter or percent nitrogen due to the addition of 58 tons per acre of sludge. In the spring of 1996, available nitrogen remained low in all fields averaging 8.4 lbs per acre more in the treated areas than in the untreated areas (Table 2).

In November, 1996 available-N as nitrate and ammonium averaged 44.0 lb N/ac higher in the treated than in the untreated fields. The increase in available-N is consistent with mineralization of 35.6 lb N/ac of the organic matter (111.9 lb N/ac as organic N in the onion sludge) or 32 percent mineralization. The high variability of the mineralization calculations was consistent with field scale operations. Further N mineralization studies are warranted with carefully controlled rates of application and replicated sampling.

Table 1. Onion sludge content by wet weight. Ontario, Oregon, 1995-1996.

| Nutrient | Nutrient application | | |
|------------------|----------------------|--------|------------|
| | g/Mg | lb/ton | lb/58 tons |
| Ammonium-N | 205 | 0.41 | 23.8 |
| Nitrate-N | <6.2 | ns | ns |
| Nitrate | ns | ns | ns |
| Total Kjeldahl N | 1,170 | 2.34 | 135.7 |
| K | 1,310 | 2.62 | 152.0 |
| P | 265 | 0.53 | 30.7 |
| Na | 220 | 0.44 | 25.5 |
| Heavy metals | ns | ns | ns |

Table 2. Comparison of available nitrogen forms in fields receiving and not receiving onion sludge by the spring of 1996, Ontario, Oregon.

| Field ID | Nitrate -N | Ammonium -N | Nitrate plus ammonium-N | | |
|---------------------------|--------------|-------------|-------------------------|--------------|-------------------------|
| | | | | | Difference when treated |
| | ppm | ppm | ppm | lb N/ac | lb N/ac |
| 02-check | | | | | |
| 1' | 8.46 | 3.7 | 12.16 | 39.7 | |
| 2' | 9.06 | 3.42 | 12.48 | 44.1 | |
| 3' | 11.1 | 4.18 | 15.28 | 54 | |
| | Total | | | 137.8 | |
| 02-treated | | | | | |
| 1' | 8.46 | 3.38 | 11.84 | 38.6 | |
| 2' | 8.76 | 3.22 | 11.98 | 42.4 | |
| 3' | 8.88 | 3.28 | 12.16 | 43 | |
| | Total | | | 124.0 | -13.8 |
| 05-check | | | | | |
| 1' | 5.7 | 3.28 | 8.98 | 29.3 | |
| 2' | 7.68 | 3 | 10.68 | 37.8 | |
| 3' | 9.48 | 2.84 | 12.42 | 43.9 | |
| | Total | | | 111.0 | |
| 05- treated | | | | | |
| 1' | 9.18 | 2.94 | 12.12 | 39.6 | |
| 2' | 12.06 | 3.52 | 15.58 | 55.1 | |
| 3' | 10.8 | 3.2 | 14 | 48.5 | |
| | Total | | | 144.2 | 33.2 |
| 06-check | | | | | |
| 1' | 8.22 | 3.54 | 11.76 | 38.4 | |
| 2' | 8.40 | 3.28 | 11.68 | 41.3 | |
| 3' | 10.62 | 3.30 | 13.92 | 49.2 | |
| | Total | | | 128.9 | |
| 06 treated | | | | | |
| 1' | 8.28 | 4.18 | 12.46 | 40.7 | |
| 2' | 8.34 | 3.68 | 12.02 | 42.5 | |
| 3' | 8.82 | 3.38 | 12.20 | 43.1 | |
| | Total | | | 126.3 | -2.6 |
| 07-check | | | | | |
| 1' | 7.02 | 3.06 | 10.08 | 32.9 | |
| 2' | 5.82 | 3.22 | 9.04 | 32.0 | |
| 3' | 5.40 | 2.68 | 8.08 | 28.6 | |
| | Total | | | 93.5 | |
| 07-treated | | | | | |
| 1' | 6.60 | 2.80 | 9.40 | 30.7 | |
| 2' | 6.18 | 3.06 | 9.24 | 32.7 | |
| 3' | 9.72 | 3.54 | 13.26 | 46.9 | + 16.8 |
| | Total | | | 110.3 | |
| Average difference | | | | | + 8.4 |

Table 3. Comparison of available nitrogen forms in fields receiving and not receiving onion sludge by the fall of 1996, Ontario, Oregon .

| Field ID | Nitrate -N | Ammonium -N | Nitrate plus ammonium-N | | |
|---------------------------|--------------|-------------|-------------------------|--------------|-------------------------|
| | | | | | Difference when treated |
| | ppm | ppm | ppm | lb N/ac | lb N/ac |
| 02-check | | | | | |
| 1' | 8.05 | 4.18 | 12.23 | 39.9 | |
| 2' | 3.43 | 3.98 | 7.41 | 26.2 | |
| 3' | 7.91 | 4.56 | 12.47 | 44.1 | |
| | Total | | | 110.2 | |
| 02-treated | | | | | |
| 1' | 6.51 | 5.06 | 11.57 | 37.8 | |
| 2' | 6.58 | 4.58 | 11.16 | 39.5 | |
| 3' | 6.58 | 4.30 | 10.88 | 38.5 | |
| | Total | | | 115.8 | + 5.6 |
| 05-check | | | | | |
| 1' | 7.56 | 5.22 | 12.78 | 41.7 | |
| 2' | 4.55 | 4.92 | 9.47 | 33.5 | |
| 3' | 2.87 | 4.54 | 7.41 | 26.2 | |
| | Total | | | 101.4 | |
| 05- treated | | | | | |
| 1' | 19.67 | 4.50 | 24.17 | 78.9 | |
| 2' | 6.37 | 4.78 | 11.15 | 39.4 | |
| 3' | 10.71 | 4.42 | 15.13 | 53.5 | |
| | Total | | | 171.8 | + 70.4 |
| 06-check | | | | | |
| 1' | 3.64 | 4.16 | 7.80 | 25.5 | |
| 2' | 5.32 | 4.44 | 9.76 | 34.5 | |
| 3' | 4.69 | 3.96 | 8.65 | 30.6 | |
| | Total | | | 90.6 | |
| 06 treated | | | | | |
| 1' | 5.67 | 4.76 | 10.43 | 34.0 | |
| 2' | 2.10 | 5.58 | 7.68 | 27.2 | |
| 3' | 4.76 | 5.14 | 9.87 | 34.9 | |
| | Total | | | 96.1 | + 5.5 |
| 07-check | | | | | |
| 1' | 7.35 | 5.62 | 12.97 | 42.3 | |
| 2' | 5.39 | 5.12 | 10.51 | 37.2 | |
| 3' | 5.11 | 4.56 | 9.67 | 34.2 | |
| | Total | | | 113.7 | |
| 07-treated | | | | | |
| 1' | 25.22 | 4.66 | 30.21 | 98.6 | |
| 2' | 8.54 | 4.54 | 13.08 | 46.3 | |
| 3' | 13.37 | 4.54 | 17.91 | 63.3 | |
| | Total | | | 208.2 | + 94.5 |
| Average difference | | | | | + 44.0 |