# Mineralization of Nutrients During Biological Degradation of Wheat Straw

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*Mineralizing activities of different inoculated microorganisms during degradation of straw were studied. The inoculated microorganisms showed an increased release of ammonical and nitrate nirogen during degradation. Inoculation has proved its special role in mineralization of phosphorus.* **Penicillium sp.** *was found to be most active in releasing available phosphorus. The amount of potash declined as the degradation progressed.*

During composting process complex organic substances are converted into simpler inorganic forms so that plants can absorb them. Faller and Neilsen (1957) showed that greater amounts of phosphorus are used by plants from composted than from non-composted wheat straw. Bhandari, *et al;* (1972) reported that unhumified dung depressed nitrogen mineralization in soil and increased mineralization after 105 days. It was considered worth while to study the rate of mineralization of nutrients during composting wheat straw when inoculated with specific microbial cultures.

## MATERIALS AND METHODS

An experiment consisting of 17 treatments including an uninoculated control each replicated twice was laid out as given below. Micropits of size 3'x3'x3' were dug and filled with 100 Kg. of finely chopped wheat straw (5-8 cms long) in layers. Enough urea and supper phosphate added so as to bring the C:N ration to 36:1 and to enrich the compost with phosphorus. Hundred ml culture suspension ($10^4$ cells/spores per ml) of different microorganisms (previouslv screened) was also sprinkled on all layers before compaction and the final moisture content adjusted to 55-60 W. H. C. Each pit was then covered with a Polythene sheet and soil.

Samples collected while turning at 30, 60, and 120 days were analysed for ammonia nitrogen ($NH_4N$): nitrate nitrogen ($NO_3N$), available phosphorus and potash contained in a water extract of 20.09 of compost (wet weight basis) in 100 ml distilled water. Samples were decolorized with activated charcoal and filtered through Whatman No. 1 filter paper. Ammonia and nitrate nitrogen were determined as per method of Bremner (1965).Available phosphorus and potash were estimated as per method given by Black, *et al;* (1965).

## RESULTS

Analysis of wheat straw showed that it contained 90.0% dry matter composed of 36 percent total carbon, 0.45 percent total nitrogen, giving a C:N ratio of 90:1. The total Phosphorus content was 0.25 pereent while total potash was 0.3 percent. Water holding capacity was found to be 480 ml per 100 g. Results of chemical analysis carried out at 30, 60 and 120 days of wheat straw compositing are presented in Table No. 1.

This paper forms part of M. Sc. (Agril.) thesis of Senior author accepted by Mahatma Phule Krishi Vidyapeeth, Agricultural University, Rahuri (Maharashtra).

**Table-1. Effect of inoculation with different cultures on ammoniacal, and nitrate and available phosphorus Wheat Straw compost ( Mg@/100 g Wheat Straw )**

| Sr. No. | Treatments | Days 30 | | | 60 | | | 120 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $NH_4N$@ | $NO_3N$@ | Avail. P@ | $NH_4N$@ | $NO_3N$@ | Avail. P@ | $NH_4N$@ | $NO_3N$@ | Avail .P@ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1. | *Serratia kiliensis* ( I-1 ) | 10.81 | 12.07 | 2.20 | 19.24 | 7.23 | 4.69 | 37.83 | 10.56 | 7.14 |
| 2. | *Bacillus subtilis* ( I-2 ) | 30.65 | 10.44 | 2.50 | 40.40 | 3.94 | 5.69 | 94.53 | 16.55 | 11.24 |
| 3. | *B. firmus* ( I-3 ) | 16.63 | 18.24 | 3.20 | 29.29 | 24.78 | 6.82 | 97.95 | 19.61 | 12.93 |
| 4. | *B. macerans*( I-4 ) | 28.39 | 11.76 | 2.75 | 32.18 | 4.85 | 5.50 | 93.80 | 24.80 | 10.95 |
| 5. | *Cytophaga rubra* ( I-5 ) | 10.96 | 8.97 | 2.67 | 18.87 | 5.34 | 5.37 | 63.45 | 13.24 | 10.90 |
| 6. | *C. rubra* ( I-7 ) | 13.11 | 8.73 | 3.15 | 25.79 | 4.71 | 6.15 | 102.07 | 25.94 | 11.79 |
| 7. | *B. meacerans*( I-8 ) | 14.87 | 14.17 | 1.90 | 25.35 | 7.76 | 3.90 | 74.25 | 10.73 | 7.45 |
| 8. | *C. rubra* ( I-10 ) | 26.13 | 13.17 | 1.75 | 33.23 | 5.31 | 3.32 | 74.33 | 15.10 | 6.43 |
| 9. | *B. macerans* ( I-11 ) | 22.70 | 13.30 | 2.02 | 13.88 | 6.48 | 3.99 | 86.08 | 23.98 | 7.83 |
| 10. | *C. rubra* ( I-12 ) | 9.86 | 10.18 | 1.80 | 29.03 | 13.23 | 3.25 | 71.34 | 17.76 | 6.40 |
| 11. | *Cellulomonas uda* ( I-13 ) | 9.24 | 6.91 | 1.17 | 11.44 | 4.28 | 3.05 | 74.23 | 41.54 | 6.41 |
| 12. | *Penicillium* spp. ( J-16 ) | 10.41 | 10.91 | 3.27 | 14,34 | 3.14 | 7.32 | 70.38 | 15.07 | 13.33 |
| 13. | *Aspergillus* spp. ( I-17 ) | 15.55 | 23.32 | 1.27 | 13.12 | 11.67 | 2.71 | 87.48 | 12.50 | 5.64 |
| 14. | Aspergillus spp. ( I-18 ) | 10.08 | 10.80 | 2.37 | 34.79 | 18.94 | 4.99 | 108.79 | 25.91 | 9.78 |
| 15. | Aspergillus spp.( 119 ) | 17.53 | 12.70 | 1.90 | 25.00 | 4.76 | 4.28 | 80.01 | 14.46 | 7.99 |
| 16. | Mixture of all isolates | 8.20 | 6.72 | 0.92 | 9.63 | 4.96 | 2.10 | 55.51 | 7.37 | 4.36 |
| 17. | Control | 9.00 | 5.41 | 0.67 | 6.29 | 5.76 | 1.24 | 25.46 | 16.37 | 2.28 |
| | 'F' Value | 22.78** | 1.99 (N.S.) | 4.58** | 5.30** | 4.21** | 4.63** | 4.42** | 2.20 (N.S.) | 5.02** |
| | C. D. at 5 % level | 4.88 | — | 1.06 | 13.03 | 8.44 | 2.32 | 31.53 | — | 415 |

**Note** : @ = Average of two replications
** = Significant at 1% level.
N.S. = Non significant
I-1 to I-19 = Isolates 1 to 19

**Ammoniacal nitrogen :**

Ammonia nitrogen results indicate an increasing trend from 30 days up to 120 days in all treatments. The increase was significant in treatments nos. 2, 3, 4, 7, 8 & 15. Maximum increase in $NH_4N$ was observed at 120 days in treatments 14 & 16.

**Nitrate nitrogen :**

At 60 days a significant increase in $NO_3N$ was observed in treatment No. 3. The greater decrease in $NO_3N$ at 60 days than at 30 days was noted in all treatments except treatment Nos. 3, 10, 14 and control. An increase in $NO_3N$ from 60 days onwards was recorded in all treatments except No.3 Maximum $NO_3N$ at final stage was observed in case of *Cellulomonas uda* (Treat No. 11 ). Nitrate nitrogen less than that of control was observed at final stage in treatment Nos. 1, 5, 7, 8, 12, 15, and 16.

Available phosphorus showed increased trend from 30-120 days in all the treatments. The highest rate of mineralization was observed in treatment No. 12. with *Penicillium* and the lowest rate in the control.

Available potash declined from 30 days to 120 days in all treatments except in No. 12. This treatment showed more available potash at 60 days than that at 30 days. Maximum available potash (80 mg/100g) was observed in treatment 5 and minimum in treatment No. 10 (25. 01 mg/100 g)

## DISCUSSION :

The results in Table-1 indicate that ability to mineralize nitrogen differs with the microbial species. During microbial degradation of plant residues the organic nitrogen is released as ammoniacal nitrogen which in turn is utilized by the vegetation or is oxidized to nitrate. Similar results regarding increased release of ammoniacal nitrogen were also noted by Alexander (1961), Chandra *et al;* (1962) and Debnath and Hajra (1972). Similarly the $NO_3N$ content varied with different cultures. The increased amount of $NO_3N$ in all the inoculated treatments as against control shows that microorganisms play a role in nitrification. The lower $NO_3N$ content at 60 days than 30 days could be due to loss of $NO_3N$ through leaching as there were continuous rains, denitrification or microbial utilizationo These results confirm the findings of Guar, *et al;* (1971) but differ from those of Chandra, *et al* (1962) who noted continuous decline in $NO_3N$.

Different cultures have proved their positive role in the mineralization of Phosphorus. Maximum amount of available phosphorus was observed with *Penicillium* spp. (Treat No. 12) indicating there by that it is an active phosphate solubilizer, Similar results were observed by Gaur. *et al;* (1971). A constant decline in available potash was observed which might be due to loss of K through leaching & or microbial utilization.

The authors are thankful to Prof. B.B. More, Head, Department of Plant Pathology and Agricultural Microbiology, MPKV, Rahuri for his encouragement during the course of investigation.

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