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Pattern of Ammonia Volatilization Losses From Spent Mushroom Compost and Farm Yard Manure Amended Soil

SANJAY SWAMI[1]* AND KAPILA SHEKHAWAT

CCS Haryana Agricultural University, Hisar 125004, India
[1]Division of Soil Science & Agricultural Chemistry, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu
Chatha 180009, Jammu, India
E-mail : sanjayswamionline@yahoo.com
**Correspondence*

Abstract

A laboratory experiment was conducted to investigate the effect of spent mushroom compost (SMC) and FYM on ammonia volatilization losses in sandy loam soil. The treatments consisted of three types of organic amendments (WB-SMC, Dhingari-SMC and FYM) applied at the rate of 0.75% on soil weight basis. Then, urea at 100 mg N/kg soil was surface applied. A control treatment which received no organic amendment and no fertilizer was also run. NH_3 volatilization losses from applied urea in soil increased upto 3 days following urea application and then gradually decreased upto 7 days and thereafter, the per day losses were never more than 1% of the applied N at any time upto 28 days. More than 95% of the total NH_3 volatilization losses occurred during the first week following urea application. In the control, about 30% of the applied N was lost due to NH_3 volatilization in 28 days. The losses were significantly reduced with the addition of SMC and FYM in soil.

Key words : Ammonia volatilization, Spent mushroom compost, Applied urea, Farm.

Spent mushroom compost (SMC), a by-product of mushroom industry has recently been used as an organic amendment (1). Land application of SMC is viewed as a promising way of its disposal from an otherwise objectionable by-product of mushroom industry as it improves soil physical, chemical and biological properties and increase nutrient resources for crop production (2). The role of organic amendments in reducing the ammonia volatilization losses is welll known. However, a search of literature revealed that so far no work has been done to find out the pattern of ammonia volatilization losses of added urea from SMC amended soil. Therefore, the present experiment was conducted to investigate the pattern of ammonia volatilization losses in soil amended with SMCs and FYM.

Methods

The bulk surface soil sample (0—15 cm) of sandy loam (Typic camborthids) was collected from the experimental area of the Department of Soil Science, CCS Haryana Agricultural University, Hisar and was immediately air dried, crushed to pass through 2 mm sieve, thoroughly mixed and stored in a covered plastic container until the experiment was started. The physico-chemical properties of the soil are shown in Table 1. Organic amendments used in this study included white button spent mushroom compost (WB-SMC), Dhingari spent mushroom compost (Dhingari-SMC) and farm yard manure (FYM). WB-SMC refers to the compost previously used for cultivation of *Agaricus bisporus* and Dhingari-SMC refers to the compost previously used for cultivation of *Pleurotus* spp. The SMCs and FYM used in this study were collected from Mushroom Technology Laboratory and Live Stock Farm, CCS Haryana Agricultural University, Hisar, respectively. The SMCs and FYM were oven dried and ground to pass through 2 mm sieve and mixed throughly. The chemical analysis of the organic amendments used in this study is given in Table 2.

The required amounts of organic amendments at 0.75% were added in 500 g sandy loam soil. After thorough mixing, the soil was moistened with double distilled water to field capacity and subsequently

Table 1. Physico-chemical properties of soil used in the study.

Properties	Value	Properties	Value
Sand	64.3	pH (1:2)	7.7
Silt	17.3	EC, dS/m (1:2)	1.2
Clay	18.4	Organic carbon (%)	0.6
Textural class	Sandy loam	CEC [Cmole (P^+)/kg]	11.6
Taxonomy	Typic camborthids	Available-N (kg/ha)	116.00
Saturation (%)	39.0	Available-P (kg/ha)	15.50
Field capacity (%)	17.0	Available-K (kg/ha)	192.50

transferred to plexiglass columns (5.5 cm diameter and 35 cm length) fixed on plastic disc with the help of araldite. Then, urea at 100 mg N/kg soil was surface applied and mixed in top 2 cm soil. A control treatment which received no organic amendment and no fertilizer was also run. Each treatment was replicated thrice in a completely randomized design.

The method of measuring the ammonia volatilization losses consisted of a device similar to that used by Fenn and Kissel (3). Incoming air was passed through 2 liter of 1 N H_2SO_4 to remove ambient ammonia then through distilled water before entering the system. The humid air was subsequently passed over the soil kept in column with the help of air compressor. Compressed air flew through the system at 304 cm^3 air/cm^2 soil surface per min or 7 dm^3/min per column. The volatilized ammonia was absorbed in 50 ml of 2% boric acid containing mixed indicator (bromocresol green + methyl red). The boric acid was back titrated with 0.005 N H_2SO_4 every 24 hours for 7 days and later on at weekly interval up to 28 days to measure the amount of ammonia volatilized. The amount

Table 2. Chemical composition of organic amendments used.

Nutrients	WB-SMC	Dhingari-SMC	FYM
OC (%)	32.00	38.00	22.00
N (%)	1.84	0.78	1.20
P (%)	0.90	0.19	0.88
K (%)	2.19	1.24	1.92
Ca (%)	5.10	1.21	1.48
Mg (%)	2.38	1.26	1.48
Zn (mg/kg)	215.00	108.00	203.00
Cu (mg/kg)	179.00	118.00	153.00
Fe (mg/kg)	2200.00	1508.00	1800.00
Mn (mg/kg)	1439.00	1153.00	1226.00

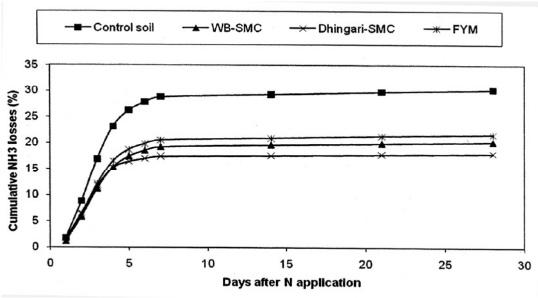

Figure 1. Effect of SMCs and FYM on NH_3 volatilization losses (%) from applied urea in sandy loam soil.

of added-N volatilized was calculated by subtracting the amount of ammonia volatilized in organic amendments treated soil from that of organic amendments + urea-N treated soil.

Results and Discussion

The ammonia volatilization losses from applied urea increased upto 3 days under control soil (8.1%/day), WB-SMC (5.4%/day), Dhingari-SMC (5.2%/day) and FYM (5.8%/day) and then gradually decreased from 3 to 7 days. After that, per day losses were never reached more than 1% of the applied N in any treatment and at any time upto 28 days of incubation (Table 3).

The ammonia volatilization losses of applied N were lower during the first day which might be attributed to delay in the urea hydrolysis. The maximum losses in all the treatments were observed during the first week and amounted to 28.8, 19.2, 17.4 and 20.5% of the applied urea N in control soil, WB-SMC, Dhingari-SMC and FYM treatments, respectively. These losses under various treatments represented about 95.4% of their total loss occurred during this period. During subsequent weeks, the losses decreased gradually and amounted to a maximum of 0.5, 0.4, 0.2 and 0.4% of the applied N in control soil. WB-SMC, Dhingari-SMC and FYM treatments, respectively. These results are in agreement with those of Whitehead and Raistrick (4), Kumar and Menon (5) and Sangwan et al. (6) who found that more than 85% of the total losses occurred during the first week of the fertilizer N application.

In the organic matter un-amended soil (control), about 30% of the applied N was lost due to NH_3 vola-

Table 3. Effect of organic amendments on NH_3 volatilization losses (%) from applied urea in sandy loam soil.

Days after N-application	Control soil	Organic amendments WB-SMC	Dhingari-SMC	FYM
0—1	1.8	1.2	1.7	1.3
1—2	7.0	4.6	4.8	5.0
2—3	8.1	5.4	5.2	5.8
3—4	6.2	4.1	3.5	4.4
4—5	3.1	2.1	1.2	2.2
5—6	1.6	1.1	0.6	1.1
6—7	1.0	0.7	0.4	0.7
7—14	0.5	0.4	0.2	0.4
14—21	0.5	0.3	0.2	0.4
21—28	0.4	0.3	0.2	0.3
Cumulative	30.2	20.2	18.0	21.6

tilization in 28 days. These losses were, however, significantly reduced to 20.2, 18.0 and 21.6% with the addition of WB-SMC, Dhingari-SMC and FYM in the soil, respectively (Fig. 1). These results indicated that application of different organic amendments were helpful in reducing the ammonia volatilization losses. The probable reason for decreased ammonia volatilization losses of N in the presence of organic matter may be due to absorption of NH_4^+ ions on organic matter surface, which resulted in reduction of aqueous NH_4^+ concentration in soil solution. These results are comparable to those of Yaduvanshi (7), Benerjee et al. (8) and Tao et al. (9) who also reported decrease in NH_3 volatilization losses from applied urea in soils due to FYM/cattle slurry application.

The cumulative losses after 28 days of N-application from the WB-SMC and FYM treated samples were statistically at par but significantly higher than that observed under Dhingari-SMC treatment. The phenomenon of lower loss under Dhingari-SMC treatment might be due to immobilization of ammonium ions. The addition of wheat straw to soils has been found to reduce N losses through the increased immobilization of inorganic N (10). From these results, it is clear that losses of N through NH_3 volatilization from applied urea may be significantly reduced by application of organic amendments, which may significantly contribute in enhancing the N use efficiency.

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