Madras Agric. J., 84(1): 15-19 January 1997
https://doi.org/10.29321/MAJ.10.A00831

EFFECT OF MUSHROOM SPENT RICE STRAW COMPOST ON SOIL PHYSICAL AND PHYSICO-CHEMICAL PROPERTIES OF ALLUVIAL AND LATERITE SOILS

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ABSTRACT

The absolute and apparent specific gravity values were appreciably influenced by the incorporation of mushroom spent rice straw compost whereas the water holding capacity, porosity and volume expansion on wetting were markedly improved by farmyard manure closely followed by composted coirpith and mushroom spent compost in an alluvial soil. However, in laterite soil, all the physical properties investigated were found to be influenced by the application of manures in the order of farmyard manure > mushroom spent compost > composted coir pith > NPK whereas the soil reaction and the total soluable salts of post harvest soil samples of both the soils were not influenced due to the application of organic manures in combination with NPK fertilizers.

KEY WORDS : Organic manures, alluvial soil, laterite soil, soil physical properties, soil reaction, total soluble salts

Organic manures have been profitably used by our forefathers from time immemorial for enhancing the soil fertility and crop productivity. Organic manures being a storehouse of nutrients and in possession of favourable physical characteristics have a bearing on the physical properties of soil. The overall influence of organic matter/manure had been the improvement of soil physical properties like bulk density, water holding capacity and porosity, most of which are related to soil productivity. The organic matter is an important factor in maintaining the desirable physical properties of the soils like water holding capacity, porosity, infiltration rate etc., In recent years, the mushroom spent compost (MSC) is available in large amounts as the byproduct of the commercial mushroom production centres. However, the use of MSC as an organic manure substitute and its effect on soil physical and physico-chemical properties have not been attempted on scientific grounds in India, though sporadic attempts have been made elsewhere. Keeping this in view, the present investigation was undertaken to study the effect of MSC on soil properties in comparison with other organic manures in combination with fertilizers in two different soils.

MATERIALS AND METHODS

A field experiment with IR 20 rice was conducted in an alluvial soil (Typic Haplustalf) during *kharif* 1989 at Wetlands, Coimbatore. The mainplot treatments consisted of the different organic manures *viz.*, mushroom spent rice straw compost - M2 (MSC), farmyard manure - M3 (FYM), composted coirpith -M4(CCP) and greenleaf manure - M5(GLM) applied @ 12.5 t ha^{-1} in combination with subplot treatments *viz.*, 75, 100 and 125 per cent soil test recommended NPK fertilizers (F1, F2 and F3 respectively). Another field experiment was conducted on laterite soil (Ultic Tropudalf) with potato var. Kufri Jothi as the test crop during the winter (1989-90) at Horticultural Research Station, Vijayanagaram, Ooty. The treatments tried were as the same in the previous case excepting the GLM. Here, the manures were applied @ 15 t ha^{-1} with 75, 100 and 125 per cent soil test recommended NPK fertilizers. Both the experiments were laid out in a split plot design with three replications. The post harvest soil samples from both the experiments were collected and physical properties were analysed (Piper, 1966). The soil reaction (soil:water ratio 1:2), the electrical conductivity, available N, available P, available K, available Ca and Mg and available micronutrients were analysed as per standard methods and statistically scrutinised.

RESULTS AND DISCUSSION

The initial characteristics of the soils and the organic manures used are given in Table 1 and 2 respectively. Appreciable changes in soil physical

Table 1. Initial analysis of the experimental soils

Properties	Alluvial soil	Laterite soil
Taxonomic Name	Typic Haplustalf	Ultic Tropudalf
Physical Properties		
Mechanical analysis		
Clay (%)	43.54	29.90
Silt (%)	16.13	15.29
Fine sand (%)	20.62	32.70
Coarse sand (%)	18.10	20.11
Texture	Clay	Sandy clay loam
Physical constants		
Apparent specific gravity	1.29	1.21
Absolute specific gravity	1.99	2.13
Maximum water holding capacity (%)	48.4	38.8
Volume expansion on wetting	35.3	24.7
Pore space (%)	50.6	48.7
Chemical Properties		
Organic carbon (%)	0.90	2.18
Soil pH	7.6	4.9
Electrical conductivity (dSm^{-1})	0.7	0.24
Available nitrogen ($Kg\ ha^{-1}$)	246(low)	476(high)
Available phosphorus ($Kg\ ha^{-1}$)	19.40(medium)	10.24(low)
Available potassium ($Kg\ ha^{-1}$)	554(high)	446(high)
Cation exchange capacity ($C\ mol\ Kg^{-1}$)	29.2	13.2
Available Ca ($C\ mol\ Kg^{-1}$)	17.0	5.56
Avilable Mg ($C\ mol\ Kg^{-1}$)	9.24	0.72
Avilable Mn (ppm)	38.0	33.2
Avilable Fe (ppm)	10.4	42.8
Avilable Zn (ppm)	3.6	7.4
Avilable Cu (ppm)	2.3	2.8

properties were brought about by the application of organic manures (Table 3,4).

Water holding capacity

Application of organic manures resulted in increased water holding capacities of both alluvial and laterite soils. In case of alluvial soil, the increase in water holding capacity ranged from 11.9 to 22.8 per cent. FYM treatment recorded the highest value (57.7%) followed by CCP, MSC and GLM. NPK alone registered the lowest water holding capacity. In laterite soil the increase in water holding capacity ranged from 19.3 to 27.4 per cent over and above the NPK alone. Application of FYM recorded the highest water holding capacity (46.4%) followed by MSC (44.1%) and CCP.

Table 2. Composition of organic manures

Nutrients	Mushroom spent compost	Farmyard manure	Composted coir pith	Green leaf manure
N (%)	1.84	1.08	1.06	2.38
P (%)	0.69	0.62	0.06	0.43
K (%)	1.19	0.80	1.20	1.36
Ca (%)	5.10	1.68	0.50	0.21
Mg (%)	0.38	0.62	0.48	0.14
Fe (ppm)	2200	3350	1800	1050
Zn (ppm)	225	262	125	75
Mn (ppm)	1260	1500	212	42
Organic C (%)	27.6	13.32	24.90	44.39

Porosity

A marked increase in porosity values were observed for the application of organic manures. The increase in porosity ranged form 10.4 to 14.8 per cent. FYM registered the highest increase over others which was followed by CCP, MSC and GLM in alluvial soil. In laterite soil, the porosity ranged from 48.8 to 56.6 per cent, the highest being recorded by MSC and the lowest by NPK.

Volume expansion on wetting

The influence of organic manures on the volume expansion on wetting followed a similar trend as in porosityin both the soils Investigated. The percentage increase over NPK treatment ranged from 16.8 to 24.6 in alluvial soil and 12.2 to

Table 3. Treatmental effect on soil physical and physico chemical properties of alluvial soil (post harvest sample)

Treatments	Apparent specific gravity	Absolute specific gravity	Water holding capacity (per cent)	Porosity (per cent)	Volume expansion on wetting (per cent)	pH	EC (dSm^{-1})
M_1F_1	1.28	1.99	47.0	50.8	35.4	7.7	0.86
M_1F_2	1.30	1.95	47.4	51.1	35.1	7.5	0.84
M_1F_3	1.29	1.97	46.6	50.3	36.2	7.5	0.83
M_2F_1	1.21	1.80	53.2	58.0	41.9	7.6	0.81
M_2F_2	1.22	1.78	52.1	57.2	41.1	7.5	0.85
M_2F_3	1.23	1.79	53.2	56.5	41.9	7.5	0.82
M_3F_1	1.22	1.92	57.1	57.8	44.4	7.5	0.79
M_3F_2	1.24	1.88	58.6	58.1	44.7	7.5	0.84
M_3F_3	1.23	1.90	57.4	58.9	43.9	7.5	0.85
M_4F_1	1.25	1.95	54.0	57.1	42.1	7.5	0.84
M_4F_2	1.26	1.97	53.2	58.0	43.0	7.5	0.80
M_4F_3	1.27	1.93	54.0	58.3	42.2	7.5	0.81
M_5F_1	1.25	1.90	52.1	56.1	43.0	7.5	0.70
M_5F_2	1.24	1.89	52.9	56.1	43.8	7.6	0.86
M_5F_3	1.23	1.88	52.6	55.9	42.9	7.5	0.82
CD (0.05)	0.02	0.05	1.8	1.3	1.2	NS	NS

M1 - No organic manure - NPK alone; M2 - Mushroom spent compost - MSC; M3 - Farm yard manure - FYM
M4 - Composted coirpith - CCP; M5 - Greenleaf manure - GLM; F1 - 75 percent of soil test recomended NPK
F2 - 100 percent of soil test recommended NPK; F3 - 125 percent of soil test recommended NPK

30.6 in laterite soil. In both the soils, the maximum volume expansion on wetting was registered by FYM. As expected, the water holding capacity, porosity and volume expansion on wetting in Alfisol were improved by the addition of organic manures. The trend of influence being FYM > CCP MSC > GLM > NPK. The reason for the increase of above parameters may be because of the supply of organic matter which sets apart a balance in the rearrangement of soil particles resulting in more macropores (Durai, 1982). Moreover, the high carbonaceous material present in these organic manures have been proved to contribute for enhancing the water holding capacity/power of the soils which could even reduce the number of irrigations owing to its higher moisture retention capacity.

As in alluvial soil, the positive role of organic manures on various soil physical properties of laterite soil was evident confirming their favourable influence on the conducive soil physical environment needed for the higher crop productivity. The water holding capacity which reflects mostly the influence of clay quality and quantity along with the proportion of the organic molecules had experienced an appreciable increase due to the application of the organic manures (19 to 27%). The trend of their influence being FYM MSC CCP NPK. This could be attributed to the higher water retention capacity of the organic molecules which are incorporated properties during organic manuring. The porosity and volume expansion on wetting was favourably inflenced by the manures which also followed the earlier trend. This would provide proper aeration and better aggregation because of the carbonanceous material incorporated into the soil (Mayalagu, 1983).

Apparent specific gravity

There was a marginal decrease in apparent specific gravity due to the application of organic manures to alluvial soil but a substantial decrease was observed in laterite soil. The lowest bulk density was recorded by MSC (1.22) followed by FYM, GLM and CCP. NPK recorded the highest (1.29) in alluvial soil. The decrease in bulk density ranged from 16.5 to 27.9 per cent in laterite soil. The highest decrease was observed in FYM applied plot followed by MSC and CCP. which were comparable.

Absolute specific gravity

The trend of decrease in absolute specific gravity was similar to apparent specific gravity in the case of alluvial soil and the values ranged from 1.79 to 1.97, the lowest being registered for MSC application whereas in laterite soil, the absolute

Table 4. Treatmental effect on soil physical and physico chemical properties of laterite soil (post harvest sample)

Treatments	Apparent specific gravity	Absolute specific gravity	Water holding capacity (per cent)	Porosity (per cent)	Volume expansion on wetting (per cent)	pH	EC (dSm^{-1})
M_1F_1	1.24	1.96	36.1	49.0	25.1	4.6	0.11
M_1F_2	1.21	1.93	35.8	48.2	23.9	4.5	0.17
M_1F_3	1.21	1.93	37.1	49.0	25.1	4.5	0.19
M_2F_1	1.02	1.82	45.2	56.0	28.8	4.6	0.18
M_2F_2	1.06	1.78	44.0	54.9	29.7	4.8	0.24
M_2F_3	0.98	1.77	43.0	55.7	28.8	5.1	0.20
M_3F_1	0.89	1.70	46.1	52.8	32.4	4.7	0.18
M_3F_2	0.88	1.69	47.3	53.9	31.9	4.7	0.25
M_3F_3	0.87	1.68	45.6	54.8	32.5	4.9	0.22
M_4F_1	1.00	1.88	42.8	56.5	28.1	4.6	0.19
M_4F_2	1.00	1.90	43.2	56.1	27.5	4.6	0.23
M_4F_3	1.02	1.89	44.1	57.0	27.6	4.7	0.24
CD (0.05)	0.06	0.03	1.7	1.9	0.9	NS	NS

NS - Not Significant; M1 - No organic manure - NPK alone; M2 - Mushroom spent compost; M3 - Farmyard manure - FYM
M4 - Composted coirpith - CCP; F1 - 75 percent of soil test recommended NPK; F2 - 100 percent of soil test recommended NPK
F3 - 125 percent of soil test recommended NPK

specific gravity was the lowest in FYM (1.69) followed by MSC and CCP over NPK alone (1.94). The apparent and absolute specific gravity values of the alluvial soil decreased under all the organic manurial treatments. The extent of decrease being more for the apparent specific gravity than absolute specific gravity. This derease in apparent specific gravity is possibly due to increase in aeration, porosity, friability and promotion of better aggregation by the carbonaceous matter present in the organic manures. The organic matter would have also helped to increase the microbial activity leading to better aggregation (Mayalagu, 1983). The MSC has marked in its effect in decreasing the above parameters.

Next to MSC, it was the FYM which decreased the apparent specific gravity appreciably. This is in agreement with the established inferences of numerous researchers (Biswas *et al.*, 1967). The impact of coir pith on soil apparent specific gravity has been attributed to an increase in porosity through secondary aggregation (Durai, 1982). In the present investigation, the influence of GLM on the soil physical properties was comparatively the least. This could be due to the succulent nature of this organic manure with lower proportions of lignin and hemicellulose.

The apparent and absolute specific gravity values were appreciably reduced by FYM followed by MSC and CCP due to the incorporation of organic components in laterite soil. The soil loosening is very favourable for tuber initiation and development. The role of MSC on apparent specific gravity was very marked with a decrease of about 16.0 per cent from the initial value. Thus, the present investigation confirms the positive role of organic manuring of even laterite soils more specifically with MSC which could influence the soil physical properties favourably towards increasing the soil productivity.

Soil reaction (pH)

Both in alluvial and laterite soils, the pH of the post harvest soil samples did not vary much due to the application of the organic manures in combination with fertilizers, the range being 7.5 to 7.7 in case of alluvial soil and 4.5 to 5.1 in laterite soil.

Total soluble salts (EC)

The total soluble salts of post harvest soil samples of both the experimental soils, did not have any marked change due to the application of various organic manures in combination with fertilizers. The EC of alluvial soil ranged from 0.66 to 0.86 dSm^{-1} whereas it was still narrower (0.11 to 0.25 dSm^{-1}) in the case of laterite soil. The soil reaction was not influenced by the application of various organic manures in combination with fertilizers in alluvial soil. It tended to be towards neutrality. This is understandable, because under water logged situations due to the buffering capacities of the clay present in the soil as well as the added organic matter through the manures. The

total soluble salt content of the post harvest soil samples though registered a slight increase over its initial value, was not substantial. There was a slight increase in the EC value as the levels of fertilizers progressively increased. This is understandable, as the increasing dose of fertilizers contributed to increasing soluble salt content. The organic manurial treatments did not increase the total soluble salt content appreciably in alluvial soil. The influence of manures in combination with fertilizers and soil reaction was not marked though a slight increase due to MSC, CCP and FYM was evident in laterite soil. The organic manures which release organic acids initially could have been neutralised by the ions like Ca and Mg released during the mineralisation process. MSC with its higher Ca content (5.1%) has a slight edge over the other manures. The laterite soils which are generally depleted of total soluble salts due to intensive leaching showed a very slight increase due to the application of manures and fertilizers during the period of study, due to the possible build up of the soluble nutrient elements drawn from fertilizers and amnures on mineralisation.

In conclusion, the improvement in the above physical properties of the soil by the the application of different organic manures resulted in an substantial increase in moisture retention capacity, improvement in macropore which will favour better permeability of the soil and better proliferation of plant roots and hence higher crop productivity.

ACKNOWLEDGEMENT

The senior author is very much obliged to M/s. Ponds (India) Limited, Ketti, Ooty for having provided the financial assistance by way of awarding the Junior Research Fellowship.

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(Received : December 1995 Revised : July 1996)

Madras Agric. J., 84(1): 19-22 January 1997

TRACING THE SEED DEVELOPMENT AND MATURATION IN KASSOD TREE

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ABSTRACT

To assess the physiological maturity for harvesting the seed with high germination and vigour, studies were made in *Cassia siamea* Lamk. Sufficient number of flowers were tagged at the time of anthesis. The developing pods were collected at weekly interval and the pod and seed development were studied in each collection. The pod and seed weight increased with increase in the stage of collection and reached the maximum at 133 days after anthesis (DAA). In this stage, pod colour turned from green to brown. The seed extracted at this stage resulted in maximum seed weight, germination and vigour potential. Since the germination potential and vigour of a species started declining beyond this stage (133 DAA), the physiological maturity stage for *C.siamea* could be fixed as 133 days after anthesis.

KEY WORDS : *Cassia siamea* seeds, maturation, germination, vigour

Cassia siamea Lamk. a perennial multipurpose tree is widely distributed all over the country. It grows well in all kinds of soils with minimum rainfall of 750 mm. It is useful for dry zone afforestation. All parts of the tree are useful *viz.* and fuel and fibre; leaves as manure; flowers as