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# Quantification of Nutrient Release Pattern of Soil Enriched with Tank Silt and Organic Manures

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**To assess the nutrient release pattern of tank silt, an incubation experiment was conducted at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal with thirteen treatments, in which the soil was incubated with tank silt (TS) and organic manures *viz*., press mud (PM), sewage sludge (SS), water hyacinth compost (WHC), FYM and spent wash (SW) and tank silt blended with organic manures. The incubation was carried out for 120 days and soil samples were drawn at 0, 30, 60, 90 and 120 days of incubation. With the advancement of incubation period the pH and organic carbon declined sharply, whereas, the EC and soil available nutrients increased with duration of incubation. The simple linear regression had shown that the pH decreased at a rate ranging from 0.0047 units day$^{-1}$ (soil alone) to 0.0079 units day$^{-1}$ (soil+TS+FYM). The decrease in organic carbon content ranged from 8.0 g kg$^{-1}$ day$^{-1}$ in soil amended with tank silt to 19.6 g kg$^{-1}$ day$^{-1}$ in soil+TS+SW. The rate of release of $KMnO_4$-N, Olsen-P, $NH_4OAc$-K, $NH_4OAc$-Ca, $NH_4OAc$-Mg and $CaCl_2$-S ranged from 0.014 to 0.651, 0.028 to 0.102, 0.214 to 2.033, 0.195 to 0.803, 0.106 to 0.459 and 0.060 to 0.621 respectively. It was observed that the suitable blending of tank silt with organic manures could result in a complete organo mineral product which through increasing mineralization potential will definitely result in better release of nutrients.**

**Key words:** Tank silt, Organic manures, Nutrient release pattern, Available nutrients

Tank silt, a deposited suspended matter or eroded soil in tank, which comes along with surface runoff caused due to intensive rainfall, invariably contains higher nutritive value over their respective cultivated catchment soil. Therefore, it can be used preferably in the fields of respective catchment to build up their productivity. The clay content of the tank silt ranges from 60-80 per cent, whereas its application to the field reduces the bulk density of the soil and also improves the physicochemical properties of soil which results in good crop growth and higher yields (Kabir *et al*. 1991; Shankaranarayana, 2001). Removal of tank silt and its application on agricultural lands is a traditional practice done by the farmers to benefit the crops. In recent days, removal of silt from the tanks has been stopped, because of changes in cropping pattern and farmer's preference towards the application of fertilizers. Over years the non-removal of silt leads to heavy siltation. By this action the storage capacity of tank is getting reduced, which led to continuous decline in irrigable area and availability of water sources to the crop. Tanks thus serves as a good trap for eroded soil generating large quantities of accumulated sediments, invariably is free of cost to farmers, except the cost for its transport and also minimizes cost on the other external inputs such as manures, fertilizers *etc*.

However, not much scientific information is presently available in favour of or otherwise in the farming community or in development departments regarding the use of tank sediment and its beneficial effects on soil receiving it. The present study has been taken up in this context, to explore the potential of tank silt in improving soil properties by studying the release pattern of nutrients from the soil applied with tank silt. The nutrient content of silt is variable and it also depends on the source of silt. Therefore, to improve the nutrient contents of tank silt, attempts were made to blend /mix it with locally available organic manures which will improve the soil health by increasing the enzyme activity, thus buildup the organic matter content by increasing the biological load of soil.

## Materials and Methods

An incubation experiment was carried out for 120 days at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal in Sorakudy soil series (*Fluventic Haplustept*). The soil has not been cultivated for many years from which sample were drawn at 0-15 cm and the composite sample was prepared for conducting incubation experiment. Tank silt used for the experiment was collected from a community tank located at Nedungadu commune of Karaikal district. The soil and tank silt were air dried and sieved to < 2 mm. The initial characteristics of soil, tank silt and organic manures are shown in table 1. The treatments were imposed in 500 ml plastic cups containing 200 g of soil and thoroughly mixed. In one of the treatments 200g of tank silt alone was taken. After thorough mixing, distilled water was added to bring the gravimetric water content of the soil to field

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capacity. The soil samples with different treatments in triplicate were maintained separately. The moisture content was maintained throughout the experimental period by correcting the water loss periodically. The treatments are as follows. $T_1$: Soil alone (200 g), $T_2$: Tank silt alone (200 g), $T_3$: Soil + Tank silt @ 2 t $ha^{-1}$, $T_4$: Soil + Pressmud @ 2 t $ha^{-1}$, $T_5$: Soil + Sewage sludge @ 2 t $ha^{-1}$, $T_6$: Soil + Water hyacinth compost @ 2 t $ha^{-1}$, $T_7$: Soil + FYM @ 2 t $ha^{-1}$, $T_8$: Soil + Spent wash @ 2 t $ha^{-1}$, $T_9$: Soil + Tank silt @ 1 t $ha^{-1}$ + Pressmud @ 1 t $ha^{-1}$, $T_{10}$: Soil + Tank silt @1 t $ha^{-1}$ + Sewage sludge @ 1 t $ha^{-1}$, $T_{11}$: Soil + Tank silt @ 1 t $ha^{-1}$ + Water hyacinth compost @ 1 t $ha^{-1}$, $T_{12}$: Soil + Tank silt @ 1 t $ha^{-1}$ + FYM @ 1 t $ha^{-1}$, $T_{13}$: Soil + Tank silt @ 1 t $ha^{-1}$ + Spent wash @ 1 t $ha^{-1}$.

***Chemical analysis***

Soil samples were collected at $0^{th}$ day and at the end of 30, 60, 90 and 120 days, for which the experiments were maintained in 15 replications. At each stage 3 replications were discarded, shade dried and subjected to various analysis. The chemical properties of the soils were determined as follows: pH, EC (1:2.5 soil: water); organic carbon (Walkley and Black, 1934); available N by alkaline $KMnO_4$ method (Subbiah and Asija, 1956); available P by Olsen method (Olsen et al., 1954); available K by flame photometer using ammonium acetate (Stanford and English, 1949), available Ca and Mg by versernate titration using ammonium acetate extract (Jackson, 1973) and available S by turbidimetric method (Piper, 1996).

***Statistical analysis***

Statistical analysis of the experimental data was done by IRRISTAT software for the comparison of treatments and also simple regression analysis was carried out to quantify the release of nutrients in the soil amended with tank silt and organic manures.

## Results and Discussion

***Soil properties***

Decline in the pH values as the period of incubation increased was noticed. Among the treatments tried, tank silt alone had registered the lowest pH value at all the stages, whereas TS+WHC, TS+SS, TS+FYM registered higher pH values as compared to all other treatments (Table 2). While the lower values of pH in TS alone treatment could be attributed to the pH of eroded materials, the relatively higher values of pH in soils amended with organic manures could be attributed to various base cations that could have been released during the process of mineralization. Similar results were reported by Sarwar *et al.* (2008). Depending on source of organic manures and the amount of bases released by particular amendment could contribute the change in pH, which revealed that the drop in pH values were not the same in all treatments. It was further seen that the decline in pH with the advancement of incubation period in all the treatments, though the decrease was almost comparable at the last phase of incubation. It was noted that the maximum decline in pH value was in the soils which was treated with TS+FYM (0.0079 $day^{-1}$) followed by soil with FYM (0.0077 $day^{-1}$), which could be attributed to production of organic acids at much faster rate than other organic manures (Table 4).

The addition of tank silt and organic manures gradually increased the EC values of soils. The highest EC was recorded in TS alone treatment, whereas in the rest of the treatments the EC value ranged from 0.168 to 0.203 dS $m^{-1}$ which were not markedly significant among themselves (Table 2). The interaction effect had further confirmed the significance of tank silt in registering higher EC values at all stages. Simple regression analysis confirmed that there were significant variations in the EC values due to incubation period. The highest increase was 0.0034 dS $m^{-1}$ $day^{-1}$ in TS alone treatment and the least was in the soil amended with TS+SW (0.0011 dS $m^{-1}$ $day^{-1}$) (Table 4). As tank silt is an eroded substance, the soluble substances could also be transported and settled in the tanks, the mode of transportation is attributed to the cause for higher EC values in TS. The increase in EC values could also be attributed to liberation of organic acids, particularly soils treated with organic amendments, which might have resulted in the release of large amount of ions in the solution (Singh *et al.,* 1992).

**Table 1. Initial characteristics of soil and tank silt**

| Properties | Soil | Tank silt |
|---|---|---|
| Clay (%) | 16.65 | 64.71 |
| Silt (%) | 8.00 | 11.26 |
| Fine sand (%) | 36.01 | 8.07 |
| Coarse sand (%) | 34.75 | 3.71 |
| Textural class | Sandy loam | Clay |
| Bulk Density (Mg $m^{-3}$) | 1.25 | 1.08 |
| Particle Density (Mg $m^{-3}$) | 2.24 | 2.13 |
| Pore space (%) | 44.31 | 48.94 |
| EC (dS $m^{-1}$) | 0.095 | 0.487 |
| pH | 7.29 | 6.65 |
| Organic carbon (g $kg^{-1}$) | 5.3 | 9.9 |
| CEC (cmol ($p^+$) $kg^{-1}$) | 20.7 | 47.15 |
| Total N (%) | 0.062 | 0.142 |
| Total P (%) | 0.187 | 0.140 |
| Total K (%) | 0.320 | 1.240 |
| Total Ca (%) | 1.800 | 2.556 |
| Total Mg (%) | 0.840 | 2.410 |
| Total S (%) | 0.680 | 4.053 |

The organic carbon content declined with the advancement of incubation. On comparison, the TS alone had recorded the highest organic carbon content (7.51 g $kg^{-1}$) than that of the soil alone (5.28 g $kg^{-1}$) (Table 2). The rate of decrease was maximum in TS alone treatment 24.7 mg $kg^{-1}$ $day^{-1}$ and the least was in soil alone treatment (9.9 mg $kg^{-1}$ $day^{-1}$) (Table 4). In the soils amended with tank silt has recorded a decrease of 8 mg $kg^{-1}$ $day^{-1}$. When the organic manures were applied with tank silt there was a sharp increase in the rate of decrease as compared to the respective organic manures when they were applied alone. The decrease could be attributed to the decomposition of organic manures or organic fraction of tank silt. It was clearly noticed that there was a significant change in the rate of decomposition of organic manures when they were applied along with tank silt which could be attributed to the increased biological activity in the organic manures when blended with tank silt, which are rich in nutrients.

***Available nutrients***

Though the incubation experiment was aimed to investigate the change in soil properties, it is of practical significance when nutrient releases were quantified rather than the change in pH, electrical conductivity and organic carbon. In that context, the soil nutrient availability gains significance. The $KMnO_4$-N content of the soil was found to increase with the advancement of the incubation period. It was noticed that the $KMnO_4$-N status of tank silt was the highest followed by various combinations

**Table 2. Effect of tank silt and organic manures on soil properties at different days of incubation**

| Parameter | DAI | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ | $T_{10}$ | $T_{11}$ | $T_{12}$ | $T_{13}$ | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 7.55 | 6.87 | 7.49 | 7.55 | 7.62 | 7.48 | 7.61 | 7.51 | 7.49 | 7.54 | 7.68 | 7.71 | 7.40 | 7.50 |
| | 30 | 7.20 | 6.70 | 7.28 | 7.28 | 7.39 | 7.46 | 7.50 | 7.49 | 7.42 | 7.44 | 7.43 | 7.36 | 7.38 | 7.33 |
| | 60 | 7.15 | 6.48 | 7.14 | 7.13 | 7.12 | 7.00 | 7.12 | 7.06 | 7.11 | 7.12 | 7.10 | 7.19 | 7.17 | 7.07 |
| | 90 | 7.15 | 6.36 | 6.80 | 6.82 | 6.88 | 6.82 | 6.83 | 6.82 | 6.91 | 6.97 | 7.05 | 6.99 | 6.93 | 6.87 |
| pH | 120 | 6.87 | 6.22 | 6.80 | 6.85 | 6.77 | 6.77 | 6.78 | 6.77 | 6.81 | 6.90 | 6.90 | 6.71 | 6.78 | 6.76 |
| | Mean | 7.19 | 6.53 | 7.10 | 7.12 | 7.16 | 7.11 | 7.17 | 7.13 | 7.15 | 7.20 | 7.23 | 7.20 | 7.13 | |
| | | | T | D | TXD | | | | | | | | | | |
| | S. Ed | | 0.03 | 0.02 | 0.06 | | | | | | | | | | |
| | C.D (0.05) | | 0.06 | 0.04 | 0.13 | | | | | | | | | | |
| | 0 | 0.107 | 0.303 | 0.075 | 0.083 | 0.071 | 0.094 | 0.085 | 0.103 | 0.088 | 0.107 | 0.112 | 0.106 | 0.105 | 0.111 |
| | 30 | 0.15 | 0.521 | 0.155 | 0.169 | 0.135 | 0.191 | 0.118 | 0.147 | 0.147 | 0.175 | 0.119 | 0.186 | 0.141 | 0.181 |
| | 60 | 0.186 | 0.604 | 0.124 | 0.154 | 0.154 | 0.184 | 0.145 | 0.184 | 0.22 | 0.155 | 0.23 | 0.153 | 0.156 | 0.204 |
| | 90 | 0.196 | 0.739 | 0.212 | 0.182 | 0.178 | 0.218 | 0.244 | 0.22 | 0.251 | 0.22 | 0.271 | 0.146 | 0.191 | 0.251 |
| EC | 120 | 0.257 | 0.705 | 0.272 | 0.323 | 0.324 | 0.318 | 0.295 | 0.295 | 0.304 | 0.287 | 0.285 | 0.334 | 0.249 | 0.327 |
| | Mean | 0.179 | 0.574 | 0.168 | 0.182 | 0.172 | 0.201 | 0.178 | 0.19 | 0.202 | 0.189 | 0.203 | 0.185 | 0.168 | |
| | | | T | D | TXD | | | | | | | | | | |
| | S. Ed | | 0.009 | 0.006 | 0.020 | | | | | | | | | | |
| | C.D (0.05) | | 0.018 | 0.011 | 0.041 | | | | | | | | | | |
| | 0 | 5.79 | 9.73 | 5.95 | 6.27 | 6.03 | 6.43 | 6.35 | 6.91 | 6.59 | 6.40 | 6.83 | 6.27 | 6.43 | 6.61 |
| | 30 | 5.60 | 7.60 | 5.30 | 5.73 | 5.60 | 6.09 | 5.53 | 5.00 | 6.13 | 6.27 | 5.20 | 5.27 | 5.58 | 5.76 |
| | 60 | 5.33 | 7.10 | 5.36 | 5.43 | 5.23 | 5.03 | 5.31 | 4.72 | 5.40 | 5.53 | 5.13 | 5.00 | 5.60 | 5.40 |
| Organic | 90 | 5.16 | 6.53 | 5.13 | 4.71 | 5.16 | 4.76 | 5.10 | 4.69 | 4.62 | 5.20 | 4.71 | 4.76 | 4.82 | 5.03 |
| carbon | 120 | 4.52 | 6.56 | 4.84 | 4.65 | 4.24 | 4.30 | 4.61 | 4.34 | 4.46 | 4.38 | 4.18 | 3.62 | 3.87 | 4.51 |
| (g $kg^{-1}$) | Mean | 5.28 | 7.51 | 5.32 | 5.36 | 5.25 | 5.32 | 5.38 | 5.13 | 5.44 | 5.56 | 5.21 | 4.98 | 5.26 | |
| | | | T | D | TXD | | | | | | | | | | |
| | S. Ed | | 0.10 | 0.06 | 0.21 | | | | | | | | | | |
| | C.D (0.05) | | 0.19 | 0.12 | 0.43 | | | | | | | | | | |

**Table 3. Effect of tank silt and organic manures on soil available nutrients at different days of incubation**

| Parameter | DAI | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ | $T_{10}$ | $T_{11}$ | $T_{12}$ | $T_{13}$ | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 101.8 | 153.0 | 105.9 | 107.5 | 105.1 | 114.8 | 103.7 | 97.5 | 96.5 | 98.7 | 106.4 | 98.9 | 101.6 | 107.0 |
| | 30 | 106.3 | 166.0 | 112.2 | 118.1 | 111.7 | 113.8 | 114.6 | 116.2 | 113.2 | 117.7 | 103.3 | 109.5 | 116.7 | 116.9 |
| | 60 | 111.3 | 172.3 | 109.8 | 119.1 | 120.5 | 112.4 | 117.0 | 107.9 | 120.9 | 123.5 | 114.4 | 111.4 | 114.3 | 119.6 |
| | 90 | 108.3 | 216.7 | 116.5 | 122.1 | 121.4 | 115.7 | 118.1 | 116.5 | 125.6 | 120.5 | 115.3 | 111.0 | 122.8 | 125.4 |
| $KMnO_4$-N (mg $kg^{-1}$) | 120 | 103.0 | 225.3 | 124.9 | 123.9 | 125.2 | 122.4 | 122.5 | 114.8 | 128.2 | 126.8 | 123.4 | 123.0 | 122.2 | 129.7 |
| | Mean | 106.2 | 186.7 | 113.9 | 118.1 | 116.8 | 115.9 | 115.2 | 110.6 | 116.9 | 117.4 | 112.6 | 110.8 | 115.5 | |
| | | | T | D | TXD | | | | | | | | | | |
| | S. Ed | | 2.39 | 1.48 | 5.33 | | | | | | | | | | |
| | C.D (0.05) | | 4.72 | 2.93 | 10.55 | | | | | | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Olsen P (mg kg$^{-1}$) | 0 | 14.91 | 11.04 | 14.02 | 21.99 | 13.43 | 15.94 | 13.65 | 17.47 | 18.85 | 17.02 | 18.23 | 20.78 | 17.18 | 16.50 |
| | 30 | 18.36 | 11.48 | 18.51 | 20.73 | 18.03 | 17.12 | 17.71 | 16.93 | 20.11 | 18.11 | 21.33 | 19.82 | 19.79 | 18.31 |
| | 60 | 17.30 | 15.20 | 19.72 | 20.68 | 22.31 | 19.11 | 21.74 | 18.35 | 23.93 | 20.57 | 21.33 | 19.22 | 23.57 | 20.23 |
| | 90 | 22.69 | 17.05 | 25.24 | 24.78 | 23.70 | 19.99 | 20.56 | 25.63 | 22.88 | 21.22 | 20.29 | 20.32 | 24.90 | 22.25 |
| | 120 | 25.38 | 19.61 | 25.98 | 32.12 | 25.25 | 20.42 | 25.71 | 25.81 | 29.61 | 22.03 | 22.97 | 29.94 | 27.94 | 25.46 |
| | Mean | 19.37 | 14.88 | 20.69 | 24.06 | 20.54 | 18.52 | 19.87 | 20.84 | 23.08 | 19.79 | 20.83 | 22.02 | 22.67 | |
| | | | T | D | TXD | | | | | | | | | | |
| | S. Ed | | 0.87 | 0.54 | 1.94 | | | | | | | | | | |
| | C.D (0.05) | | 1.72 | 1.07 | 3.85 | | | | | | | | | | |
| $NH_4OAc$-K (mg kg$^{-1}$) | 0 | 92.6 | 528.1 | 98.6 | 121.3 | 99.2 | 103.4 | 102.9 | 102.7 | 108.2 | 104.0 | 104.4 | 105.1 | 101.7 | 136.3 |
| | 30 | 97.0 | 541.0 | 114.1 | 135.3 | 102.5 | 109.3 | 125.2 | 116.5 | 112.4 | 98.2 | 106.1 | 112.2 | 112.2 | 144.8 |
| | 60 | 99.6 | 652.7 | 132.5 | 178.2 | 134.3 | 149.7 | 124.6 | 149.2 | 154.3 | 142.1 | 151.0 | 143.9 | 140.0 | 181.0 |
| | 90 | 117.2 | 714.7 | 133.9 | 173.0 | 148.8 | 162.8 | 131.3 | 161.8 | 168.3 | 143.0 | 153.8 | 153.6 | 146.6 | 193.0 |
| | 120 | 114.6 | 746.1 | 148.5 | 179.1 | 153.4 | 161.1 | 135.7 | 160.7 | 171.0 | 151.0 | 164.0 | 155.6 | 145.2 | 198.9 |
| | Mean | 104.2 | 636.5 | 125.5 | 157.4 | 127.7 | 137.3 | 124.0 | 138.2 | 142.8 | 127.7 | 135.8 | 134.1 | 129.1 | |
| | | | T | D | TXD | | | | | | | | | | |
| | S. Ed | | 2.28 | 1.41 | 5.10 | | | | | | | | | | |
| | C.D (0.05) | | 4.51 | 2.80 | 10.09 | | | | | | | | | | |
| $NH_4OAc$-Ca (mg kg$^{-1}$) | 0 | 21.32 | 77.29 | 13.12 | 23.56 | 19.13 | 20.77 | 21.87 | 19.13 | 20.77 | 23.54 | 21.87 | 21.87 | 19.68 | 24.92 |
| | 30 | 26.79 | 101.2 | 24.05 | 27.33 | 27.33 | 24.60 | 25.15 | 25.49 | 22.96 | 25.15 | 26.79 | 25.69 | 30.61 | 31.79 |
| | 60 | 32.25 | 144.0 | 38.24 | 41.00 | 36.63 | 36.39 | 36.63 | 32.25 | 37.17 | 34.99 | 38.27 | 37.72 | 37.17 | 44.83 |
| | 90 | 40.45 | 146.9 | 40.63 | 41.00 | 43.19 | 40.45 | 42.64 | 42.64 | 42.64 | 39.91 | 44.83 | 43.73 | 43.19 | 50.17 |
| | 120 | 47.03 | 174.9 | 44.75 | 45.92 | 54.55 | 48.51 | 55.03 | 44.08 | 46.29 | 48.96 | 49.59 | 45.19 | 44.59 | 57.65 |
| | Mean | 33.57 | 128.8 | 32.16 | 35.76 | 36.17 | 34.15 | 36.26 | 32.72 | 33.97 | 34.51 | 36.27 | 34.84 | 35.05 | |
| | | | T | D | TXD | | | | | | | | | | |
| | S. Ed | | 1.06 | 0.66 | 2.38 | | | | | | | | | | |
| | C.D (0.05) | | 2.11 | 1.31 | 4.71 | | | | | | | | | | |
| $NH_4OAc$-Mg (mg kg$^{-1}$) | 0 | 13.45 | 66.17 | 17.68 | 16.07 | 15.69 | 17.96 | 17.65 | 19.59 | 16.01 | 16.97 | 17.00 | 16.33 | 16.90 | 20.57 |
| | 30 | 22.30 | 68.15 | 20.34 | 21.65 | 22.63 | 21.98 | 22.31 | 26.90 | 23.94 | 17.71 | 18.04 | 20.34 | 19.35 | 25.05 |
| | 60 | 23.29 | 72.72 | 20.66 | 25.58 | 24.93 | 23.73 | 21.65 | 21.65 | 20.99 | 24.27 | 22.31 | 22.96 | 23.29 | 26.77 |
| | 90 | 23.34 | 100.8 | 25.91 | 26.24 | 30.18 | 29.19 | 28.21 | 31.49 | 26.90 | 33.46 | 30.18 | 36.08 | 33.78 | 35.06 |
| | 120 | 30.50 | 118.7 | 38.70 | 30.83 | 29.52 | 33.46 | 34.44 | 33.13 | 33.46 | 29.19 | 33.46 | 34.11 | 29.90 | 39.19 |
| | Mean | 22.58 | 85.32 | 24.66 | 24.07 | 24.59 | 25.26 | 24.85 | 26.55 | 24.26 | 24.32 | 24.20 | 25.96 | 24.64 | |
| | | | T | D | TXD | | | | | | | | | | |
| | S. Ed | | 1.07 | 0.67 | 2.40 | | | | | | | | | | |
| | C.D (0.05) | | 2.13 | 1.32 | 4.75 | | | | | | | | | | |
| $CaCl_2$-S (mg kg$^{-1}$) | 0 | 42.89 | 109.8 | 47.58 | 34.37 | 41.42 | 37.72 | 29.77 | 33.61 | 31.97 | 30.81 | 25.31 | 35.99 | 31.68 | 41.00 |
| | 30 | 52.21 | 115.0 | 56.09 | 38.09 | 42.52 | 40.20 | 30.36 | 49.83 | 33.33 | 34.56 | 33.63 | 44.26 | 31.28 | 46.30 |
| | 60 | 54.54 | 147.8 | 54.17 | 45.62 | 53.39 | 57.37 | 36.01 | 55.19 | 40.05 | 46.99 | 42.17 | 52.45 | 43.43 | 56.09 |
| | 90 | 53.07 | 167.8 | 60.96 | 36.25 | 57.36 | 59.36 | 44.71 | 60.55 | 42.16 | 56.44 | 40.88 | 50.40 | 49.73 | 59.98 |
| | 120 | 51.50 | 176.6 | 64.45 | 39.10 | 68.51 | 65.47 | 54.54 | 65.91 | 43.63 | 54.04 | 60.42 | 55.99 | 63.71 | 66.45 |
| | Mean | 50.84 | 143.4 | 56.65 | 38.77 | 52.64 | 52.02 | 39.08 | 53.02 | 38.23 | 44.57 | 40.48 | 47.82 | 43.97 | |
| | | | T | D | TXD | | | | | | | | | | |
| | S. Ed | | 2.00 | 1.24 | 4.46 | | | | | | | | | | |
| | C.D (0.05) | | 3.95 | 2.45 | 8.83 | | | | | | | | | | |

of tank silt and organic manures among which there were only marginal differences. The highest $KMnO_4$-N content was registered in TS alone treatment that might be also due to reason that the estimation was done in whole tank silt, whereas in all other treatments it was done in the soil treated with amendment. The range of $KMnO_4$-N in soil amended with organic manures and tank silt was 110.61 to 118.12 mg kg$^{-1}$ which were not markedly different (Table 3). In soils which were amended with only organic manures, the maximum release was recorded in the sewage sludge treated soils followed by TS (0.167 mg kg$^{-1}$ day$^{-1}$ and

0.141 mg kg$^{-1}$ day$^{-1}$). While comparing the role of tank silt with that of organic manures, it was noticed that the rate of release of 0.141 mg kg$^{-1}$ day$^{-1}$ in the tank silt amended soil was enhanced to 0.252 mg kg$^{-1}$ day$^{-1}$ when tank silt was applied along with pressmud (Table 4). The higher $KMnO_4$-N content in tank silt could be attributed to the higher quantities of organic fractions in which N forms an integral component. Increased availability of nutrients through tank silt application was reported by Shankaranarayana (2001) and Binitha (2006). It was also opined by Padmaja *et al.* (2003) that the tank silt being rich in organic carbon had resulted in C mineralization and higher nutrient availability. Increase in $KMnO_4$-N due to addition of organic manure was also reported by Sharma and Singh (1970). It was also noticed that blending organic manure with tank silt had enhanced the release of $KMnO_4$-N.

The Olsen-P content of the soil increased with the advancement of the incubation. The least was recorded in tank silt alone treatment, whereas higher value was recorded in soils amended with PM, TS+PM and TS+SW which were comparable (Table 3). It could be attributed to the higher P content in pressmud (2.57 %) and the lower pH of spent wash which could have provided the protons for the solubility of mineral P from tank silt. On the contrary to $KMnO_4$-N, the release in different organic manures and tank silt amended soils was only marginal, ranging from 0.028 mg kg$^{-1}$ day$^{-1}$ in soils amended with TS+WHC to 0.102 mg kg$^{-1}$ day$^{-1}$ in soil amended with tank silt (Table 4). The increased release in tank silt applied soil could only be attributed to the dissolution of mineral phosphorus during the period of incubation. It was also worth mentioning that the rate of release was higher when tank silt or any one of the organic manure was applied separately than when they were applied together.

The data on $NH_4OAc$-K indicated that higher content was registered in the tank silt alone treatment which could be attributed to higher total potassium content in the tank silt (1.240 %) (Table 1). The eroded soil which gets settled in the tanks are dominated by clay mineral illite and vermiculite which contains higher amounts of K. The X-ray diffraction analysis carried out in the tank silts of Karnataka by Binitha (2006) supports the above inference. The least was soil alone treatment. When soil was applied with amendments, the highest $NH_4OAc$-K was registered in the soil amended with PM followed by TS+PM which could be ascribed to the higher total potassium content of pressmud (3.18 %). The rate of release was as high as 2.033 mg kg$^{-1}$ day$^{-1}$ in the tank silt alone samples and least in soil alone (Table 4). Furthermore, it was observed that the release was higher when tank silt was applied along with the organic manures like pressmud and FYM.

**Table 4. Effect of tank silt and organic manures on release of available nutrients in soil**

| Treatments | Change per day | | | Nutrient release (mg kg$^{-1}$ day$^{-1}$) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | pH | EC (dS m$^{-1}$) | Organic carbon (g kg$^{-1}$) | $KMnO_4$- N | Olsen-P | $NH_4OAc$-K | $NH_4OAc$-Ca | $NH_4OAc$-Mg | $CaCl_2$-S |
| Soil alone | -0.0047 | 0.0012 | -9.9 | 0.014 | 0.0722 | 0.214 | 0.217 | 0.117 | 0.060 |
| TS alone | -0.0055 | 0.0034 | -24.7 | 0.651 | 0.0757 | 2.033 | 0.803 | 0.459 | 0.621 |
| Soil+TS | -0.0062 | 0.0015 | -8.0 | 0.141 | 0.102 | 0.399 | 0.266 | 0.158 | 0.129 |
| Soil+PM | -0.0062 | 0.0016 | -14.2 | 0.122 | 0.081 | 0.511 | 0.195 | 0.114 | 0.024 |
| Soil+SS | -0.0074 | 0.0018 | -13.4 | 0.167 | 0.098 | 0.516 | 0.289 | 0.117 | 0.230 |
| Soil+WHC | -0.0069 | 0.0016 | -18.6 | 0.057 | 0.039 | 0.563 | 0.238 | 0.127 | 0.249 |
| Soil+FYM | -0.0077 | 0.0018 | -13.0 | 0.137 | 0.090 | 0.239 | 0.279 | 0.132 | 0.213 |
| Soil+SW | -0.0071 | 0.0015 | -18.2 | 0.116 | 0.085 | 0.538 | 0.223 | 0.106 | 0.251 |
| Soil+TS+PM | -0.0063 | 0.0018 | -19.2 | 0.252 | 0.081 | 0.605 | 0.236 | 0.126 | 0.107 |
| Soil+TS+SS | -0.0058 | 0.0014 | -17.0 | 0.197 | 0.044 | 0.462 | 0.218 | 0.134 | 0.228 |
| Soil+TS+WHC | -0.0065 | 0.0017 | -19.3 | 0.153 | 0.028 | 0.556 | 0.245 | 0.150 | 0.258 |
| Soil+TS+FYM | -0.0079 | 0.0014 | -19.4 | 0.165 | 0.063 | 0.474 | 0.216 | 0.171 | 0.154 |
| Soil+TS+SW | -0.0057 | 0.0011 | -19.6 | 0.158 | 0.089 | 0.405 | 0.208 | 0.135 | 0.275 |

$NH_4OAc$ extractable Ca was found to be more in tank silt alone treatment and the least was in soil + TS and soil amended with spent wash which were comparable. The release in the $NH_4OAc$-Ca was higher in tank silt alone treatment, whereas among the different manures maximum release was in sewage sludge treated soils (0.289 mg kg$^{-1}$ day$^{-1}$) and the least was in pressmud amended soils (Table 4). Also the rate of release was higher when tank silt or the organic manures were applied alone than when they were applied together. The higher release of calcium from tank silt could be attributed to its predominant quantity of clay fraction (64.71 %) which might have contributed for such a significantly higher release from tank silt (Table 1).

Similar trend of results as that of Ca was also found in the case of $NH_4OAc$ extractable Mg.

However, the rate of release was different as revealed by the simple regression analysis. The release was higher in tank silt alone treatment, obviously due to the reasons quoted above with respect to calcium. In all other treatments it ranged from 0.106 mg $kg^{-1}$ $day^{-1}$ in soils amended with spent wash to 0.158 mg $kg^{-1}$ $day^{-1}$ in soils amended with tank silt (Table 4). Addition of spent wash had enhanced the $NH_4OAc$-Mg possibly due to its role on the exchangeable sites. Similar results were obtained by Baskar *et al*. (2003).

The available S extracted using $CaCl_2$ increased from 41.00 mg $kg^{-1}$ to 66.45 mg $kg^{-1}$ after 120 DAI (Table 3). On an average the highest was recorded in tank silt, whereas the least was in soil amended with TS+PM, PM alone, FYM alone and TS+WHC which were all comparable. The higher sulphur content of the tank silt sample could be attributed to the organic fractions of tank silt (9.90 g $kg^{-1}$) as well as total sulphur content (4.053 %) (Table 1). The rate of release of $CaCl_2$-S was significantly predicted in the tank silt with a rate of release of 0.621 mg $kg^{-1}$ $day^{-1}$ (Table 4).

From the present study, it is concluded that the amendments used in this investigation viz., tank silt and organic manures which included pressmud, sewage sludge, water hyacinth compost, FYM and spent wash were proved to be good source of nutrients, the tank silt being rich in mineral elements like K, Ca and Mg and that of the organic manures in N, P, S and trace elements. Therefore, it was postulated that the suitable blending of these two amendments could result in a complete organo mineral product which could be utilized not only as a source of nutrients (wherein increasing mineralization potential will definitely result in better release of nutrients), but also as an amendment to maintain soil health. In that way, the present investigation had proved beyond doubt that combining these two amendments could be a useful proposition, though no single organic manure is capable of improving all properties.

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