

## Soil Physical Environment as Influenced by Different Organic Manures in Maize-Soybean Cropping System

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### ABSTRACT

In the present study different organic manures were evaluated for their contribution towards the improvement in soil physical environment in maize-soybean cropping system. The field experiments were conducted for two years during *kharif* and *rabi* seasons of 1994-95 and 1995-96, taking maize (DHM-105) in *Kharif* and soybean (Hardee) in *rabi* seasons. Application of organic manures significantly improved the soil physical properties like water stable aggregates >0.25mm (WSA), soil porosity (SP), water holding capacity (WHC), infiltration rate (IR), hydraulic conductivity (HC); however, bulk density (BD) decreased and there was no change in pH and EC of soil. The increase in WSA, SP, WHC, IR, and HC over control due to different organic manures application ranged between 29.65-35.51, 32.09-34.77, 48.84-54.87, 16.78-17.23, 51.70-53.17 per cent, respectively. The decreased BD over control due to different manures ranged between 0.08-0.09. The pH and EC values ranged between 7.7-7.8 and 0.10-0.12 dSm<sup>-1</sup>, respectively. The improvement in soil physical properties among different manure types was in the following order: VC> PM> BGS> FYM> RDN> Control.

### Introduction

Maintenance of good soil physical environment for sustaining crop productivity to meet current and future requirements of a growing population is the primary task of soil scientists. Application of selective nutrients alone through off farm inputs for increased production lead to the deterioration of soil health and environment. In order to avoid such problems it is necessary to adopt integrated soil building practices to improve soil physical environment and inturn to stabilize the productivity of our soils. Judicious use of different organic manures in combination with inorganic fertilizers help to regenerate and rejuvenate the degraded soil physical environment and ensure sustainability in crop production. Hence the present study was undertaken.

### Materials and Methods

Field experiments were conducted for two years during 1994-95 and 1995-96 in Alfisols at Hyderabad, A.P., India, taking maize (DHM-105) in *kharif* and soybean (Hardee) in *rabi* season. The experimental soil had the following characteristics: bulk density (BD) 1.55 Mg m<sup>-3</sup>, soil porosity (SP) 32.85%, water stable aggregates >0.25 mm 19.28%, water holding capacity (WHC) 23.84%, infiltration rate (IR) 4.23 cm h<sup>-1</sup>, hydraulic conductivity (HC) 2.25 cm h<sup>-1</sup>, pH 7.8, organic carbon (OC) 0.5% available N 202 kg ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 8.5 kg ha<sup>-1</sup>, K<sub>2</sub>O 296.5 kg ha<sup>-1</sup>, Fe 6.96 mg kg<sup>-1</sup>, Cu 0.58 mg kg<sup>-1</sup>, Mn 9.20 mg kg<sup>-1</sup> and Zn 0.91

mg kg<sup>-1</sup>. The experiment was laid out in a randomized block design with six treatments consisting of 100 per cent substitution of recommended dose of N (120 kg ha<sup>-1</sup>) through FYM, VC (Vermi compost), PM (poultry manure) and BGS along with recommended dose of N through fertilizer (RDN) and control. The treatments were imposed for maize crop only and the recommended dose of fertilizers (40:50:40 NPK kg ha<sup>-1</sup>) were applied to soybean crop. A uniform dose of P and K @ 60 kg ha<sup>-1</sup> each was applied to maize crop as basal dressing for all the treatments except control. The N was applied in the form of urea, P<sub>2</sub>O<sub>5</sub> as Single Super Phosphate and K<sub>2</sub>O as Muriate of Potash. Soil samples were collected just before start of the experiment and after two years and analyzed for different soil physical properties by following standard procedures.

### Results and Discussion

Substitution of 100 per cent of recommended dose of N with organic manures significantly improved the soil physical properties viz., soil porosity, water stable aggregates >0.25 mm, water holding capacity, infiltration rate, hydraulic conductivity while the bulk density decreased and there was no significant change in pH and EC of soil (Table 1). The vermicompost treated plots which were on par with poultry manure treated plots recorded the highest soil porosity, water stable aggregates, water holding capacity, infiltration rate and hydraulic conductivity while bulk density was lowest in comparison with other treatments applied

Table 1. Soil physical parameters as influenced by the different organic manures in maize-soybean cropping system

| Treatments | SP (%)           | WSA (%)          | WHC (%)          | IR (cmh <sup>-1</sup> ) | HC (cmh <sup>-1</sup> ) | BD (Mgm <sup>-3</sup> ) | pH (dSm <sup>-1</sup> ) | EC   |
|------------|------------------|------------------|------------------|-------------------------|-------------------------|-------------------------|-------------------------|------|
| Control    | 31.72            | 18.78            | 21.25            | 4.17                    | 2.05                    | 1.57                    | 7.8                     | 0.12 |
| RDN33.23   | 19.85<br>(4.76)  | 22.72<br>(5.69)  | 4.28<br>(6.91)   | 2.23<br>(2.63)          | 1.55<br>(8.78)          | 7.7<br>(-0.07)          | 0.12                    |      |
| 100FYM     | 41.90<br>(32.09) | 24.35<br>(29.65) | 31.63<br>(48.84) | 4.87<br>(16.78)         | 3.11<br>(51.70)         | 1.45<br>(-0.08)         | 7.7                     | 0.10 |
| 100VC      | 42.75<br>(34.77) | 25.45<br>(35.51) | 32.91<br>(54.87) | 4.89<br>(17.23)         | 3.14<br>(53.17)         | 1.43<br>(-0.09)         | 7.8                     | 0.10 |
| 100PM      | 42.59<br>(34.26) | 25.16<br>(33.97) | 32.50<br>(52.94) | 4.88<br>(17.02)         | 3.12<br>(52.19)         | 1.44<br>(-0.08)         | 7.7                     | 0.10 |
| 100BGS     | 41.92<br>(32.15) | 24.83<br>(32.21) | 31.99<br>(50.54) | 4.87<br>(16.78)         | 3.11<br>(51.70)         | 1.45<br>(-0.08)         | 7.7                     | 0.10 |
| C.D.(0.05) | 0.50             | 0.50             | 0.58             | 0.02                    | 0.02                    | 0.12                    | NS                      | NS   |

Note: Values in parentheses indicate the percentage increase over the control treatment. SP=soil porosity; WSA=Water Stable Aggregates; WHC=Water Holding Capacity; IR=infiltration Rate; HC=Hydraulic Conductivity; BD=Bulk Density; EC=Electrical Conductivity.

with BGS, FYM, RDN and Control. The lowest bulk density attained may be attributed to the better degree of aggregation and porosity in VC and PM applied treatments as compared to other manures, RDN and Control. Similar decrease in bulk density on addition of PM was reported by Obi and Ebo (1995). The highest soil porosity maintained by VC applied treatments may be due to stimulative action of manures on earthworms, which might have resulted in build up of worm population leading to increase in the soil macropores through burrowing action. The improvement in water stable aggregates >0.25 mm in treatments applied with manures may be due to binding action of organic matter that is added to the soil through manure, while the dispersive action of inorganic fertilizers in RDN on soil structure resulted in lower aggregation. Similar results were observed by Biswas et al. (1971). Increase in water holding capacity due to application of organic manures was reported in case of PM (Obi and Ebo, 1995), FYM (Nambiar and Abrol, 1989) due to increase in both soil porosity and fraction of porosity involved in soil water storage. The variation in infiltration rate and hydraulic conductivity due to the type of manure may be attributed to their inherent ability to add organic matter to soil. Similar results were observed by Obi and Ebo (1995) with PM application.

There was increase in values of soil physical properties under manure treated plots over control plot values. The increase in WSA, SP, WHC, IR, and HC over control due to different organic manures application ranged between 29.65-35.51, 32.09-34.77, 48.84-54.87, 16.78-17.23 and 51.70-53.17 per cent, respectively. The decreased BD over control due to different manures ranged between 0.08-0.09. The pH and EC values ranged between 7.7-7.8 and 0.10-0.12 dSm<sup>-1</sup>, respectively at the end of the experiment. The improvement in soil physical properties among different manure types was in the following order: VC>PM>BGS>FYM> RDN>Control.

## References

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