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# Effect of soil amendments on texture, porosity of soil and chlorophyll content in maize

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**Abstract**

A field experiment was conducted at college farm, college of agriculture, Rajendranagar with Maize variety 900-M-GOLD during *rabi*, 2014-15 in Randomised Block Design (RBD) with six treatments replicated four times. The soil was sandy loam in texture. Treatments consist of $T_1$-vermicompost @ 5 t ha$^{-1}$,$T_2$-FYM @ 10 t ha$^{-1}$, $T_3$-tanksilt @ 50 t ha$^{-1}$, $T_4$- biochar @10 t ha$^{-1}$,$T_5$- control (without any fertilizer) and $T_6$- RDF (NPK-200, 60, 50 kg ha$^{-1}$). RDF is commonly applied from treatment $T_1$ to $T_4$. With the application of FYM, vermicompost, tanksilt and biochar there is no change in the textural class, but clay content of soil increased by 2% with the application of tanksilt. The application of tanksilt, vermicompost and FYM significantly increased the porosity compared to the control. Application of amendments increased the SPAD reading in the order of tanksilt > vermicompost > biochar > FYM > RDF >control. The application of tanksilt, vermicompost, biochar, FYM and RDF significantly increased the SPAD meter reading compared to the control.

**Keywords:** Maize, Tanksilt, biochar, FYM and RDF

## Introduction

Among cereals, maize (*Zea mays* L.) is an important food and feed crop which ranks third after wheat and rice in the world. It is a multipurpose crop that provides food for humans, feed for animals (especially poultry and livestock) and raw material for the industries. This crop has much higher grain protein content than our staple food rice.

In AP, about 40 % of the total cultivated area is occupied by light textured red sandy loam and loamy sand type soils. The clay content in these soils is <15% and water holding capacity is around 5-10 cm m$^{-1}$ and are susceptible to leaching losses. Studies conducted at ANGRAU revealed that soil physical condition improved due to increase in clay content by mixing the locally available heavy textured soil (tanksilt) in surface 0-15 cm soil (Rao *et al.*, 1997) [8]. Romaniuk *et al*. (2011) [9] reported that clay, silt and sand percentages were not affected by the application of vermicompost at 10 and 20 Mg ha$^{-1}$. Baharvand *et al.* (2014) [2] reported that the highest chlorophyll content was observed in chemical and integrated treatments fallowed by application of vermicompost alone. It is due to Nitrogen being the major constituent of chlorophyll therefore increases in nitrogen availability leads to increase in chlorophyll content. In chemical treatments, nitrogen is supplied more quickly and chlorophyll synthesis proceeds rapidly. Organic amendments like FYM and PM improved salt tolerances of maize that were associated with increased yield components and chlorophyll content (Das *et al*., 2013) [5]. Chlorophyll content increased with application of pine woodchip biochar (PB) and maize stubble biochar (MB) compared to the Control in maize crop (Brennan *et al*., 2014) [4]. Biochar application reduce the soil bulk density because of their extremely high porosity which leads to increasing the pore volume (Atkinson *et al*., 2010) [1].

## Material and methods

Maize variety 900-M-GOLD was cultivated during *rabi* 2014-15 in Randamised Block Design (RBD) with 6 treatments replicated four times at the college farm, college of agriculture, Rajendranagar. The soil is sandy loam in texture, slightly alkaline, non saline and medium in organic carbon content. Treatments consist of $T_1$-vermicompost @ 5 t ha$^{-1}$,$T_2$-FYM @ 5 t ha$^{-1}$, $T_3$-tanksilt @ 50 t ha$^{-1}$, $T_4$- biochar @10 t ha$^{-1}$,$T_5$- control (without any fertilizer),$T_6$- RDF (NPK-200, 60, 50 kg ha$^{-1}$). Recommended Dose of Fertilizers was commonly applied from treatment $T_1$ to $T_4$. The particle size analysis was carried out by Bouyoucos hydrometer method (Piper, 1966) [7]. The textural class was determined on the basis the proportion of sand, silt and clay by using the textural triangle method. The chlorophyll content was measured by SPAD (Soil-Plant Analysis Development) meter at knee high, tasselling and harvest. Porosity of soil is calculated by using bulk density and particle density of soil.

Porosity = 100 X (particle density- bulk density)/ particle density.

## Results and discussion

### Texture

Data pertaining to the texture at harvest was presented in Table 1. Initial soil has the sand, silt and clay content 75.6, 8.00 and 16.40 % respectively and is sandy loam in texture. However, the application of tanksilt, vermicompost, biochar, FYM and RDF results in sand% ( 73.65, 74.40, 75.15, 74.95 and 75.25 %), silt% (9.00, 8.65, 8.65, 8.05 and 7.55 %) and clay % (18.2, 17.0, 15.9, 16.6 and 16.05 %) which was non significant compared to the control having sand, silt and clay % (75.3, 9.00 and 16.30 %).

The results indicate that application of different amendments *viz*., tanksilt, vermicompost, biochar and FYM was not shown any impact on textural class as that of RDF or control. However, an increase of around 2 % clay was observed with the addition of tanksilt.

Almost 2% increase in clay content was observed in tanksilt applied plots but it was not significant. However the textural class remained same *i.e.*, sandy loam in all the treatments which confirm that texture is almost a permanent property. Results are in line with Bhanavase *et al.*, 2011 [3] who reported that the tanksilt application improved the clay content from 31.5 to 40.9 % in the plough layer which had direct bearing on improving available water content and plant dry biomass.

**Table 1:** Soil amendments impact on texture of the soil at harvest of maize.

| Treatments | Texture | | | Textural class |
|---|---|---|---|---|
| | Sand (%) | Silt (%) | Clay (%) | |
| $T_1$: Vermicompost | 74.40 | 8.65 | 17.00 | Sandy loam |
| $T_2$ : FYM | 74.95 | 8.05 | 16.60 | Sandy loam |
| $T_3$ : Tanksilt | 73.65 | 9.00 | 18.20 | Sandy loam |
| $T_4$ : Biochar | 75.15 | 8.65 | 15.90 | Sandy loam |
| $T_5$ : Control | 75.30 | 9.00 | 16.30 | Sandy loam |
| $T_6$ : RDF | 75.25 | 7.55 | 16.05 | Sandy loam |
| Initial soil | 75.60 | 8.00 | 16.40 | Sandy loam |

### Porosity

Data pertaining to the porosity at harvest was presented in Table 2. The application of tanksilt, vermicompost and FYM significantly increased the porosity (48.73, 48.58, 48.60 % respectively) compared to the control (48.17%). The application of biochar and RDF results in porosity (48.24 and 48.18%) which was on par with the control (48.17%). The application of different amendments *viz*., tanksilt, vermicompost and FYM along with RDF significantly increased the porosity compared to the RDF alone but the application of biochar along with RDF was on par with application of RDF alone. The application of tanksilt significantly increased the porosity compared to biochar application but it was on par with vermicompost and FYM application. Ghosh *et al. (*2013) [6] reported that, the addition of finely divided peat like material 'vermicompost' increased the porosity of the soil. This increase in porosity of soil due to application of amendments also effects the bulk density, soil moisture content and other physical properties of soil. The reduced bulk density of agricultural soils is useful for crop production because it correlates to increased pore space (Schjønning *et al*., 2011) [10].

**Table 2:** Soil amendments impact on porosity (%) at harvest of maize.

| Treatments | Porosity (%) |
|---|---|
| $T_1$ : Vermicompost | 48.58 |
| $T_2$ : FYM | 48.60 |
| $T_3$ : Tanksilt | 48.73 |
| $T_4$ : Biochar | 48.24 |
| $T_5$ : Control | 48.17 |
| $T_6$ : RDF | 48.18 |
| CD (P = 0.05) | 0.574 |
| SEm± | 0.190 |

### SPAD meter reading

SPAD values were recorded at knee high, tasselling stage and at harvest and were presented in table 3 and Fig. 1. This SPAD values showed significant variation due to application of various amendments *viz.,* tanksilt, vermicompost, biochar and FYM over the control and RDF. This SPAD values increased from knee high stage to tasselling stage and then decreased towards the maturity of the crop. The SPAD values of maize at knee high stage varied from 34.45 to 53.18.

The perusal of data of the SPAD values at knee high stage indicates that highest SPAD reading was produced with the application of tanksilt @ 50 t $ha^{-1}$ (53.18) followed by vermicompost application (50.15) which was statistically on par with tanksilt applied plots. Application of all the amendments improved SPAD reading and was significantly more than that of control plots.

Application of amendments increased the SPAD reading in the order of tanksilt > vermicompost > biochar > FYM > RDF >control. Similar trend was observed in the tasselling and harvesting stage.

The perusal of data of the SPAD values at tasselling stage indicates that highest SPAD reading was produced with the application of tanksilt @ 50 t $ha^{-1}$ (58.99) followed by vermicompost application (56.15) which was statistically on par with tanksilt applied plots. Application of all the amendments improved SPAD reading and was significantly more than that of control plots. The application of tanksilt, vermicompost, biochar, FYM and RDF significantly increased the SPAD meter reading (58.99, 56.15, 53.81, 52.27 and 50.98) respectively compared to the control (31.7). Nitrogen being the major constituent of chlorophyll therefore increased in nitrogen availability leads to increase in chlorophyll content (Baharvand *et al.*, 2014) [2].

The perusal of data of the SPAD reading at harvest indicates that highest SPAD reading was produced with the application of tanksilt @ 50 t $ha^{-1}$ (20.69) followed by vermicompost application (19.50) which was statistically on par with tanksilt applied plots. Application of all the amendments improved SPAD reading and was significantly more than that of control plots. The application of tanksilt, vermicompost, biochar, FYM and RDF significantly increased the SPAD meter reading (20.69, 19.50, 15.79, 15 and 11.53) respectively compared to the control (9.73).

Significant increase in SPAD values may be attributed to higher chlorophyll content because of more leaf nitrogen content as availablility of nitrogen was increased due to application of amendments *viz*., FYM, tanksilt, biochar and vermicompost.

**Table 3:** Soil amendments impact on SPAD at knee high stage, tasselling stage and at harvest of maize.

| Treatments | SPAD | | |
|---|---|---|---|
| | **Knee high stage** | **Tassselling stage** | **Harvest** |
| $T_1$ : Vermicompost | 50.15 | 56.16 | 19.51 |
| $T_2$ : FYM | 47.33 | 52.28 | 15.01 |
| $T_3$ : Tanksilt | 53.18 | 58.99 | 20.70 |
| $T_4$ : Biochar | 49.13 | 53.82 | 15.80 |
| $T_5$ : Control | 34.45 | 31.70 | 9.73 |
| $T_6$ : RDF | 45.88 | 50.99 | 11.54 |
| CD (P = 0.05) | 4.42 | 4.88 | 1.63 |
| SEm± | 1.46 | 1.62 | 0.54 |

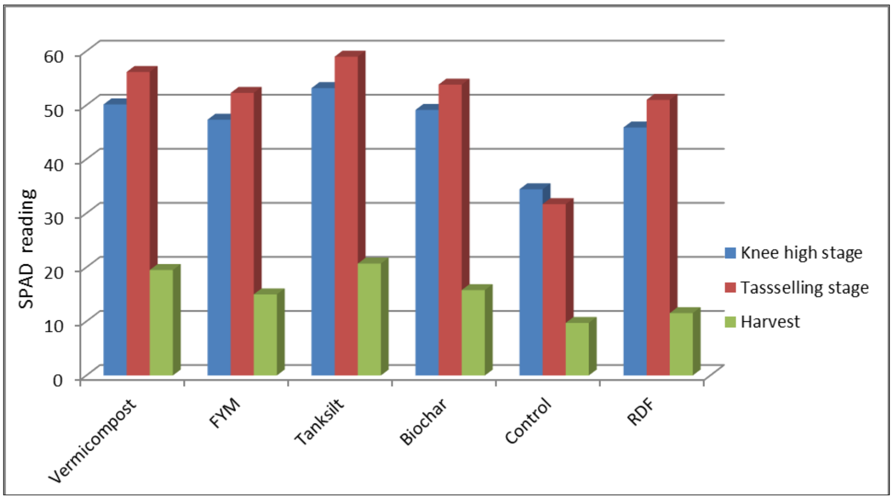


**Fig 1:** Soil amendments impact on SPAD at knee high stage, tasselling stage and at harvest of maize.

## Conclusion

Tanksilt, vermicompost, biochar and FYM addition did not shown any impact on textural class as that of RDF or control. However, an increase of around 2 % clay was observed with the addition of tanksilt @ 50 t $ha^{-1}$. The application of tanksilt significantly increased the porosity compared to biochar application but it was on par with vermicompost and FYM application. The application of tanksilt, vermicompost, biochar, FYM and RDF significantly increased the SPAD meter reading compared to the control. Significant increase in SPAD values may be attributed to higher chlorophyll content because of more plant nitrogen content as availability of nitrogen was more due to these amendments which was reflected in N content and uptake.

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