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Influence of different sources of liming materials on organic carbon status of the soil for maize crop grown in acid soil of Odisha

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Abstract
A field experiment was conducted to study the “Influence of different sources of Liming materials on organic carbon status of the soil for Maize crop Grown in Acid soil of Odisha” in the village Bajpur in Khorda District of Odisha during Kharif, 2013.The soil was ameliorated with three different sources of liming materials (paper mill sludge @ 0.1LR, Stromatolyte @ 0.1 & 0.2 LR and Calcium Silicate @ 0.2 LR) added with soil test based dose with or without FYM. Results indicated the addition of FYM helped maintaining higher organic carbon content in the soil compared to the soil without its irrespective of the lime sources. The integrated application of stromatolyte @ 0.2 LR + STD with FYM gives the higher organic carbon status of the soil compare to the other treatments. The integrated application of liming materials with STD increases the organic carbon status of the soil initially (ST @0.1 LR- 0.55%, ST @ 0.2 LR – 0.53% & CS @ 0.2 LR – 0.53%) then decreases thereafter but the combine application of liming materials with STD & FYM increases the the organic carbon status of the soil up to the 21st after sowing (ST @0.1 LR- 0.55%, ST @ 0.2 LR – 0.52% & CS @ 0.2 LR – 0.54%) then decreases thereafter.

Keywords: *Acid Soil, Liming materials, Stromatolyte, PMS, Calcium silicate, O.C. etc.*

1. Introduction

Organic matter can serve as an alternative practice to mineral fertilizers (Naeem *et al.,* 2006) [6] by improving soil structure (Dauda *et al.,* 2008) [2] and microbial biomass (Suresh *et al.*, 2004) [11]. Although, compost is one source of OM and often viewed as a conspicuous measure to improve soil fertility by increasing soil organic carbon (OC), total N, sulfur (S), P, soil aggregation, plant available water and total porosity (Carine *et al*., 2006) [1], its sources such as cow dung and crop residues have been declined from time to time mainly due to their demand for domestic energy consumption and removal for animal feeding in the study area.

In addition, use of compost is also limited due to lack of awareness and technical know-how, its high labor demand for preparation, its requirement in large quantities due to low nutrient contents and slow release as well as its tediousness for transporting to crop fields in the study area. For instance, Jones (1971) found that annual applications of 7 - 8 ton per hectare (t ha-1) farm yard manure (FYM) are needed to maintain a 1% soil OM level in sandy top soils which indicated a need for bulk application of OM to soils.

Due to the continuous increase in the cost of inorganic fertilizers, application of inorganic fertilizers is becoming difficult to be afforded by small and marginal farmers (Jayathilake *et al.,* 2006) [5] including those of the study area as low soil fertility is one of the main constraints affecting the growth of food crops. Such high prices of inorganic fertilizers together with limited supply of organic inputs, therefore, call for a combined use of these two sources of plant nutrients because the sole application of either organic or inorganic fertilizers on nutrient depleted soils can hardly increase crop yields in the tropics (Wakene *et al*., 2007) [12].

To sustain high crop yields without deteriorating soil fertility, it is important to work out optimal combination of inorganic fertilizers and OM in cropping system (Rekhi *et al.*, 2000) [9] as the interaction of organic and inorganic fertilizers improves the absorption, distribution and function of another nutrient (Orkaido, 2004) [7]. Furthermore, the affordable, resilient, renewable and low cost sources of plant nutrients from OM supplement and complement chemical fertilizers (Jayathilake *et al.,* 2006) [5]. Roland *et al.* (1997) [10] ascribed that adequate soil fertility for sustained crop yields can be obtained with the combined use of organic and inorganic fertilizers.

Similarly, Heluf (2002) [4] reported that integrated use organic and inorganic fertilizers are pertinent enough to improve plant nutrients under the Ethiopian conditions.

Although an integrated nutrient management is an option to alleviate soil fertility problems (Wakene *et al.*, 2007) [12] and builds ecologically sound, socially acceptable and economically viable farming systems (Gruhn *et al.*, 2000) [3], its application has not been more practiced in nutrient depleted soils held by small scale farming systems. Moreover, low soil fertility concomitant with low use of organic and inorganic fertilizers could be the greatest constraints for increasing soil productivity in farming systems of the catchment.

The main objective of the present study was to determine the influence the different sources of the liming materials on organic carbon status of the soil for Maize crop Grown in Acid soil of Odisha.

Materials & Methods

The soil of the experimental site was loamy sand in texture with 76 per cent sand, 14 per cent silt and 10 per cent clay with 1.75 Mg m-3 of bulk density. The soil was strongly acidic in reaction (pHw 4.94). The organic carbon status was medium, i.e. 5.7 gkg-1 with lime requirement of 3.2 t CaCO3ha-1. The CEC of the experimental soil was 6.29 cmol (p+)kg-1 soil with 1.04, 0.60 and 0.44 cmol (p+)kg-1 soil of exchange acidity, acidity due to Al3+ and H+ respectively. The available nitrgen, phosphorous, potassium and sulphur in soil were 169 (low), 105 (high), 143 (medium) and 17 kgha-1 (low) respectively. The available Boron and Zinc content were very low, i.e 0.15 and 0.41 mgkg-1 soil respectively.

Three different types of liming materials were used in the experiment. These were Paper Mill Sludge (PMS), Stromatolyte (ST) and Calcium Silicate (CS). Liming materials were applied mixed with and without FYM in the field. Absolute control treatment was included without any addition of external source of nutrients. The test crop Maize (Hishell-hybrid) received 10 treatments. Each treatment was replicated three times and imposed over statistically laidout field with Radomised Block Design (RBD) in the field. Crop growth period.

The initial and post harvestsois were also collected. The samples Representative composite soil samples were collected at 7 days interval from all the treatments during were dried under shade, grind with wooden hammer and sieved through 2mm sieve. The samples were preserved in polythene bags with proper labels for analysis. The Organic carbon content of soil was determined by wet digestion procedure of Walkley and Black as outlined by Page *et al*, 1982 [8].

Result and Discussion

- **Change in Organic Carbon status in soil during crop growth period**

The data relating to change in organic carbon status under the influence of fertilizers, lime and manure application have been presented in Table-1 respectively.

Table 1: Change in Organic carbon status of the soil

Treatments	Days after sowing (DAS)										
	0day	7th	14th	21th	28th	35th	42th	49th	56th	63th	90th
Absolute Control	0.57	0.49	0.46	0.43	0.35	0.31	0.29	0.36	0.38	0.38	0.39
STD	0.57	0.38	0.4	0.45	0.37	0.34	0.31	0.25	0.24	0.23	0.23
STD + PMS @ 0.1 LR	0.57	0.35	0.36	0.41	0.21	0.35	0.31	0.34	0.36	0.32	0.38
STD + PMS @ 0.1 LR + FYM	0.57	0.51	0.46	0.48	0.42	0.42	0.38	0.38	0.4	0.38	0.4
STD + ST @ 0.1 LR	0.57	0.55	0.45	0.45	0.36	0.32	0.29	0.48	0.38	0.42	0.42
STD + ST @ 0.1 LR + FYM	0.57	0.53	0.54	0.55	0.45	0.46	0.41	0.5	0.55	0.52	0.44
STD + ST @ 0.2 LR	0.57	0.53	0.49	0.47	0.38	0.38	0.35	0.36	0.36	0.36	0.37
STD + ST @ 0.2 LR + FYM	0.57	0.56	0.54	0.52	0.5	0.41	0.39	0.4	0.4	0.42	0.4
STD + CS @ 0.2 LR	0.57	0.53	0.48	0.46	0.4	0.37	0.31	0.46	0.36	0.44	0.4
STD + CS @ 0.2 LR + FYM	0.57	0.54	0.54	0.54	0.46	0.39	0.38	0.46	0.47	0.45	0.44

The initial organic carbon in soil was medium in status. (5.7gkg^{-1} soil). Crop growth without addition of external source of nutrients exhibited depletion of organic carbon status in soil throughout the growing period. Crop growth with soil test based fertilizers application maintained still lower organic carbon status in soil compared to control treatment (Table-1).

Integration use of lime sources with STD of fertilizers for maize crop did not help in raising the organic carbon status in soil till the harvest of the crop. Combined use FYM with fertilizers and lime sources, though maintained higher level of organic carbon during crop growth period over other treatments which had not received FYM, continued to decrease till the harvest of crop (Table-1).

The integrated application of paper mill sludge @ 0.1 LR alone with STD increases the organic carbon status of the soil up to the 21st days after sowing then decreases thereafter and maintained 0.35 to 0.38 per cent. But the combine application of paper mill sludge @ 0.1 LR +STD with FYM increases the organic carbon status of the soil initially (0.51%) at 7th days after sowing then decreases thereafter (Table-1,Fig-1).

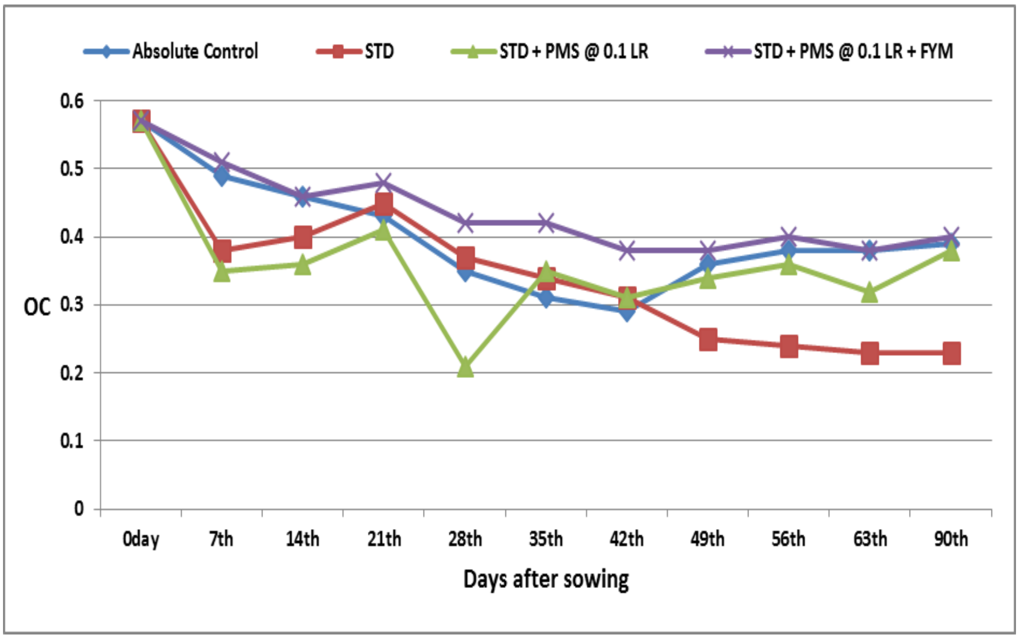

Fig 1: Change in organic carbon status of the soil by the application of paper mill sludge @ 0.1 LR

The integrated application of stromatolyte @ 0.1 LR alone with STD increases the organic carbon status of the soil initially (0.55%) at 7th days after sowing then decreases thereafter. But the combine application of stromatolyte @ 0.1 LR + STD with FYM increases the organic carbon status of the soil up to the 21st days after sowing then decreases thereafter (Table-1,Fig-2).

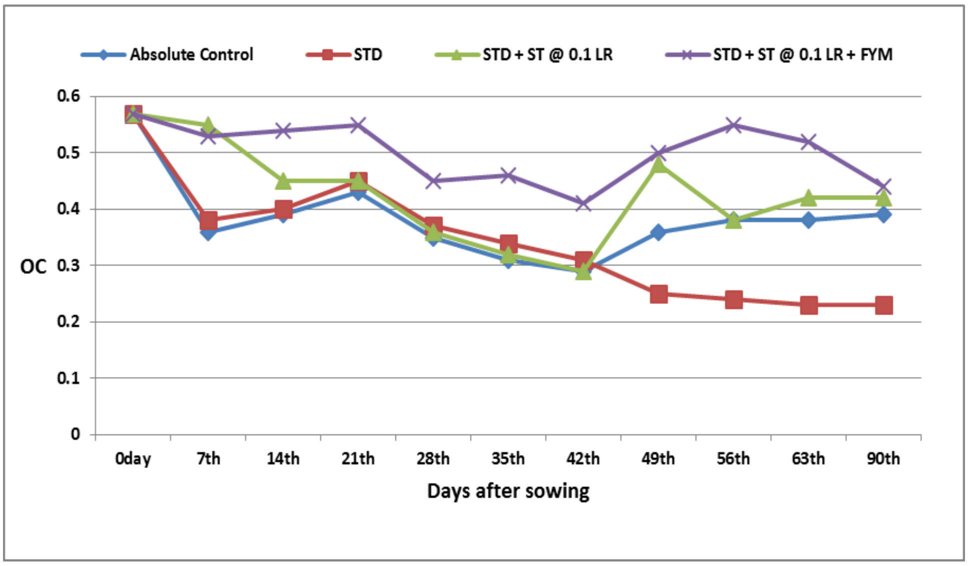

Fig 2: Change in organic carbon status of the soil by the application of stromatolyte @ 0.1 LR

The integrated application of stromatolyte @ 0.2 LR alone with STD increases the organic carbon status of the soil initially (0.53%) at 7th days after sowing then decreases thereafter. But the combine application of stromatolyte @ 0.1 LR + STD with FYM increases the organic carbon status of the soil initially (0.56%) at 7th days after sowing then decreases thereafter (Table-1, Fig-3).

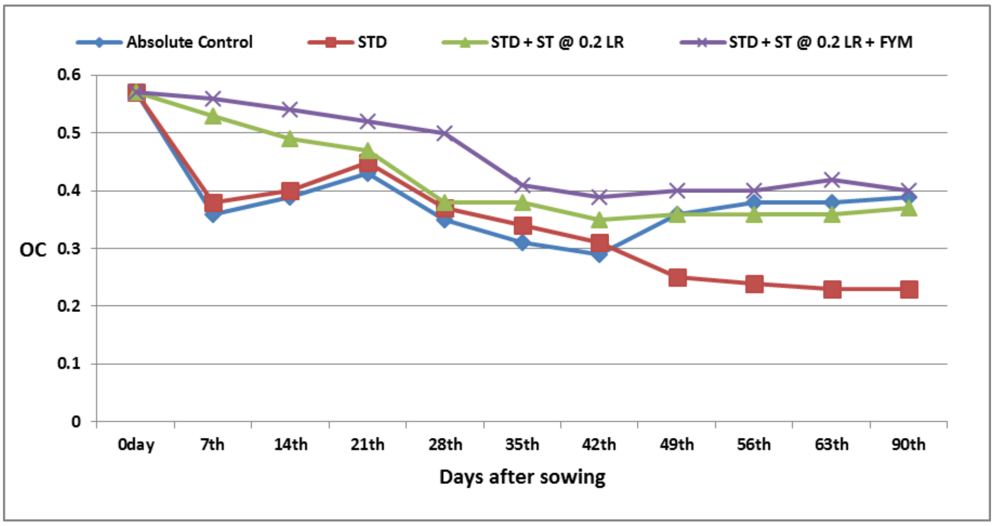

Fig 3: Change in organic carbon status of the soil by the application of stromatolyte @ 0.2 LR

The integrated application of calcium silicate @ 0.2 LR alone with STD increases the organic carbon status of the soil initially (0.53%) at 7th days after sowing then decreases thereafter. But the combine application of stromatolyte @ 0.1 LR + STD with FYM increases the organic carbon status of the soil up to the 21st days after sowing (0.54%) then decreases thereafter (Table-1, Fig-4).

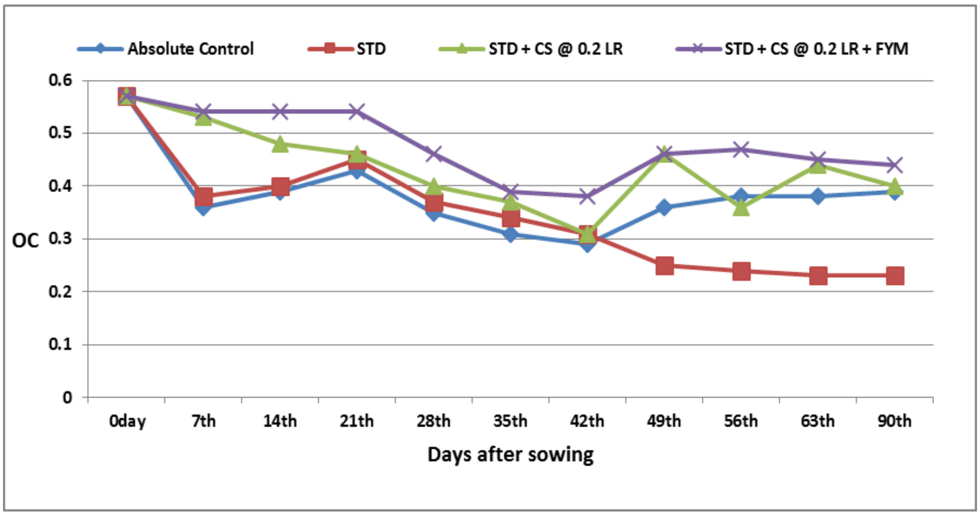

Fig 4: Change in organic carbon status of the soil by the application of calcium silicate @ 0.2 LR

Conclusion

Addition of FYM helped maintaining higher organic carbon content in the soil compared to the soil without its irrespective of the lime sources. The integrated application of stromatolyte @ 0.2 LR + STD with FYM gives the higher organic carbon status of the soil compare to the other treatments. The integrated application of liming materials with STD increases the organic carbon status of the soil initially (ST @0.1 LR- 0.55%, ST @ 0.2 LR – 0.53% & CS @ 0.2 LR – 0.53%) then decreases thereafter but the combine application of liming materials with STD & FYM increases the the organic carbon status of the soil up to the 21st after sowing (ST @0.1 LR- 0.55%, ST @ 0.2 LR – 0.52% & CS @ 0.2 LR – 0.54%) then decreases thereafter.

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