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Influence on different sources of liming materials on root characteristics of Maize 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 root characteristics of maize grown in acid soil of Odisha" in the village Bajpur of Khorda district during kharif, 2013. The soil was ameliorated with three different sources of liming materials i.e paper mill sludge, stromatolyte & calcium silicate added with soil test based recommended dose with or without FYM. The application of liming sources alone increases the root length, dry weight, volume and density up to 53 cm, 9.80 g, 50 cc and 0.20 g/cc respectively but the application of liming materials with organic manure increases the root length, dry weight, volume and density more as compare to the lone sources of liming materials i.e 62 cm, 16.56 g, 100 cc and 0.22 g/cc respectively. The application of PMS @ 0.1 LR with STD & FYM increases the root dry weight and root volume more as compare to all other treatments but the application of ST @ 0.2 LR with STD & FYM increases the root length and root density more as compare to all other treatments. The double dose of stromatolyte @ 0.2 LR gives better result and increases the root length, dry weight, volume and density more compare to the single dose @ 0.1 LR. The absolute control gives the very less in root length, dry weight, volume and density among all the treatments. The soil test based recommended dose alone gives the higher result over absolute control.

Keywords: Acid soil, paper mill sludge, stromatolyte, calcium silicate, root length, dry weight, volume and density etc.

Introduction
Soil acidity and soil strength are major constraints to root growth yet there is limited understanding of the potential interaction of these stresses, which often occur together. Soil acidity affects over half of the world's productive agricultural land. In acid soils, aluminium (Al) toxicity constrains root elongation and hence plant growth. Incorporating lime and/or use of acid-soil resistant genotypes are integral to the management of acid soils (Scott, Fisher & Cullis 2001) [9] but soil physical conditions may still constrain root growth. Soils with a penetrometer resistance greater than 1 MPa inhibit root elongation (Passioura 2002) [7], and are widespread because of both natural (e.g. high bulk density, drying soil; Bengough 1997) [1] and anthropogenic processes (e.g. compaction by machinery; Passioura 2002) [7]. Soil strength slows root growth by reducing production and elongation of cells (Bengough *et al*. 2006) [2]. The potential benefit of genotypes with acid-soil resistance are unclear in acid soils that also have high penetrometer resistance (Foy *et al*. 1999) [3] and it has been suggested that genotypes with roots that are resistant to multiple soil stresses may be required in high strength, acid soils (Foy *et al*. 1999; Gilker *et al*. 2002) [3, 4].

Vigorous root growth is important for nutrient and water uptake and consequently for plant productivity and persistence. This is particularly the case in moisture-limiting environments where perennial plants rely for survival on establishment of a deep root system to access subsoil moisture. Pores and cracks provide a path of lower resistance and potentially aid root penetration through high-strength soils and improve access to subsoil moisture. This is consistent with observations in the field that roots are increasingly found growing in pores at depth (Wang, Hesketh & Woolley 1986; White & Kirkegaard 2010) [10, 11]. In these pores, factors including decomposing plant residues, activity of soil macrofauna and preferential water flow may alter chemical, physical and biological properties relative to the bulk soil (Pierret, Moran & Pankhurst 1999; Jegou *et al*. 2001; Pankhurst *et al*. 2002) [8, 5, 6] and affect root growth.

This paper examines the root growth and morphological responses of perennial pasture grasses to acidity and soil strength. A comparison of root growth of acid-soil resistant genotypes (weeping grass, cocksfoot and an acid-soil resistant cultivar of phalaris) with acid-soil sensitive genotypes (tall wheatgrass and phalaris cv Sirosa) was used to assess whether acid-soil resistance is beneficial to root growth in high-strength, acid soils. The present study aimed to investigate the Influence of different sources of liming materials on cob characteristics of maize grown in acid soil of Odisha.

Materials & Methods

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. The maize root samples were collected from all the treatment plots after harvesting. These samples were dried. Then the root length, dry weight, volume and density calculated treatment wise. The root length was calculated by the measuring scale. The volume of the root was calculated by the putting the root sample in the water filled measuring cylinder. Then initial and final reading was calculated which gives the root volume. The root density was calculated by the diving the weight of the root by volume.

Result & Discussion

The influence of different sources of liming materials on root length, dry weight, volume and density were presented in the Table-1.

Table 1: Influence of different sources of liming materials on root length, dry weight, volume and density

Treatments	Root length (cm)	Root dry wt (g)	Root volume (cc)	Root density (g/cc)
Absolute Control	15	0.83	10	0.08
STD	26	4.76	30	0.14
STD + PMS @ 0.1 LR	33	7.45	50	0.15
STD + PMS @ 0.1 LR + FYM	45	16.56	100	0.17
STD + ST @ 0.1 LR	30	9.80	50	0.19
STD + ST @ 0.1 LR + FYM	34	11.99	60	0.20
STD + ST @ 0.2 LR	53	8.29	40	0.20
STD + ST @ 0.2 LR + FYM	62	10.99	50	0.22
STD + CS @ 0.2 LR	31	6.07	35	0.18
STD + CS @ 0.2 LR + FYM	38	7.83	40	0.20
CD (P=0.05)	2.8	1.8	3.8	0.098

The length of the root was influenced by different sources of liming materials which was varied between 15.0 cm and 62.0 cm. The lowest root length was seen in absolute control (15.0 cm) where was highest was seen in soil test based recommended dose mixed with ST @ 0.2 LR and FYM (62.0 cm). The application of PMS @ 0.1 LR alone increases the root length up to 33.0 cm but integrated use of PMS @ 0.1 LR with organic manure increases the root length up to 45.0 cm. The application of ST @ 0.1 LR alone increases the root length up to 30.0 cm but the integrated use of ST @ 0.1 LR with organic manure increases the root length up to 34.0 cm. The double dose of ST @ 0.2 LR alone increases the root length up to 53.0 cm but the integrated application of ST @ 0.2 LR with organic manure increases the root length up to 62.0 cm. The application of CS @ 0.2 LR alone increases the root length up to 31.0 cm but the integrated application of CS @ 0.2 LR with organic manure increases the root length up to 38.0 cm. (Table-1, Figure-1)

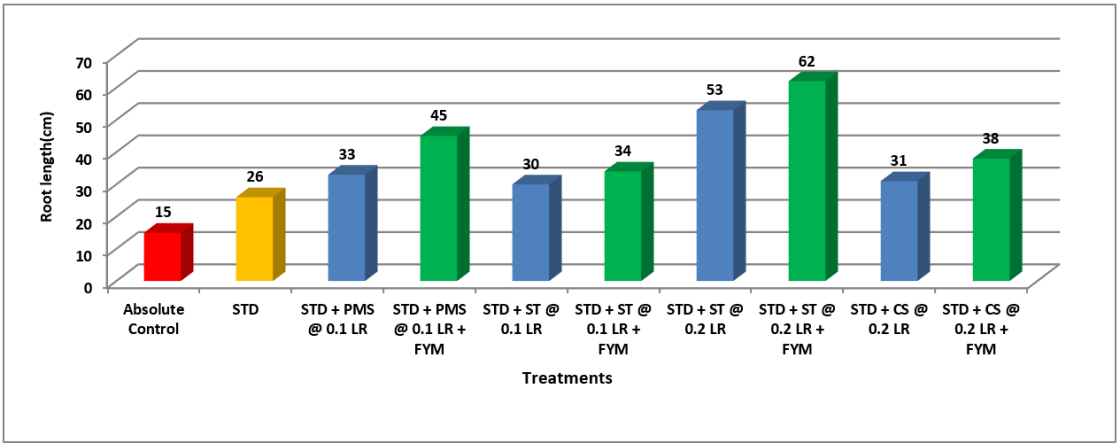

Fig 1: Influence of different sources of liming materials on root length

The dry weight of the root was influenced by different sources of liming materials which was varied between 0.83 g and 16.56 g. The lowest dry weight of the root was seen in absolute control (0.83 g) where was highest was seen in soil test based recommended dose mixed with PMS @ 0.1 LR and FYM (16.56 g). The application of PMS @ 0.1 LR alone increases the dry weight of the root up to 7.45 g but integrated use of PMS @ 0.1 LR with organic manure increases the dry weight of the root up to 16.56 g. The application of ST @ 0.1 LR alone increases the dry weight of the root up to 9.80 g but the integrated use of ST @ 0.1 LR with organic manure increases the dry weight of the root up to 11.99 g. The double

dose of ST @ 0.2 LR alone increases the dry weight of the root up to 8.29 g but the integrated application of ST @ 0.2 LR with organic manure increases the dry weight of the root up to 10.99 g. The application of CS @ 0.2 LR alone increases the dry weight of the root up to 6.07 g but the integrated application of CS @ 0.2 LR with organic manure increases the dry weight of the root up to 7.83 g. (Table-1, Figure-2).

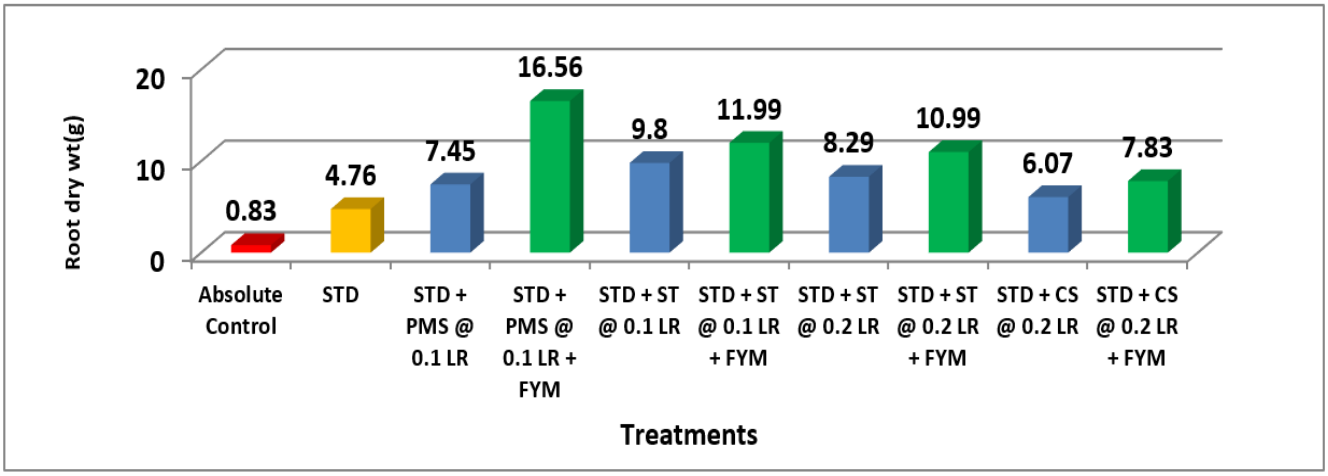

Fig 2: Influence of different sources of liming materials on dry weight of the root

The volume of the root was influenced by different sources of liming materials which was varied between 10.0 cc and 100 cc. The lowest volume of root was seen in absolute control (10.0 cc) where was highest was seen in soil test based recommended dose mixed with PMS @ 0.1 LR and FYM (100.0 cc). The application of PMS @ 0.1 LR alone increases the root volume up to 50.0 cc but integrated use of PMS @ 0.1 LR with organic manure increases the root volume up to 100.0 cc. The application of ST @ 0.1 LR alone increases the root volume up to 50.0 cc but the integrated use of ST @ 0.1 LR with organic manure increases the root volume up to 60.0 cc. The double dose of ST @ 0.2 LR alone increases the root volume up to 40.0 cc but the integrated application of ST @ 0.2 LR with organic manure increases the root volume up to 50.0 cc. The application of CS @ 0.2 LR alone increases the root volume up to 35.0 cc but the integrated application of CS @ 0.2 LR with organic manure increases the root volume up to 40.0 cc. (Table-1, Figure-3)

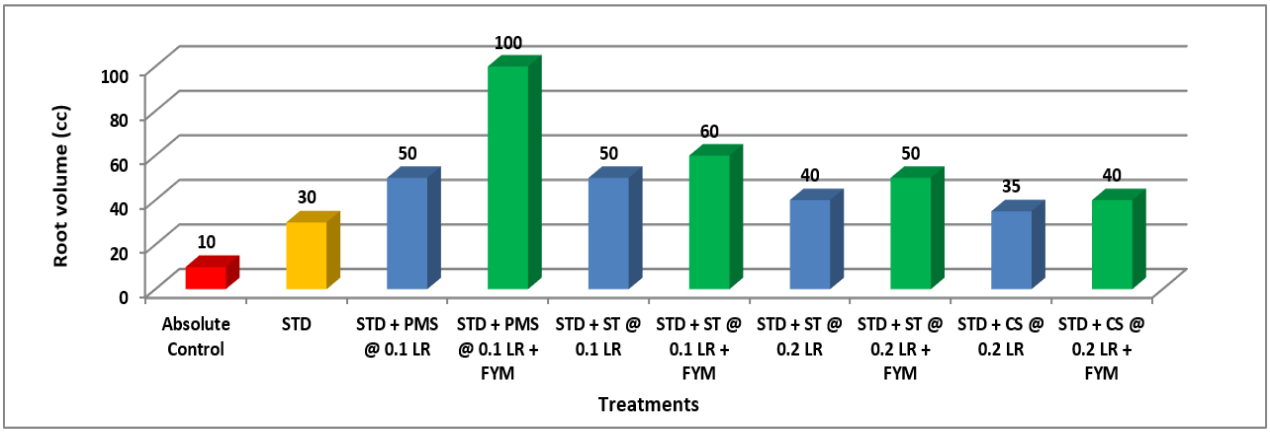

Fig 3: Influence of different sources of liming materials on root volume

The density of the root was influenced by different sources of liming materials which was varied between 0.08 g/cc and 0.22 g/cc. The lowest density of root was seen in absolute control (0.08 g/cc) where was highest was seen in soil test based recommended dose mixed with ST @ 0.2 LR and FYM (0.22 g/cc). The application of PMS @ 0.1 LR alone increases the root density up to 0.15 g/cc but integrated use of PMS @ 0.1 LR with organic manure increases the root density up to 0.17 g/cc. The application of ST @ 0.1 LR alone increases the root density up to 0.19 g/cc but the integrated use of ST @ 0.1 LR with organic manure increases the root density up to 0.20 g/cc. The double dose of ST @ 0.2 LR alone increases the root density up to 0.20 g/cc but the integrated application of ST @ 0.2 LR with organic manure increases the root density up to 0.22 g/cc. The application of CS @ 0.2 LR alone increases the root density up to 0.18g/cc but the integrated application of CS @ 0.2 LR with organic manure increases the root density up to 0.20 g/cc. (Table-1, Figure-4)

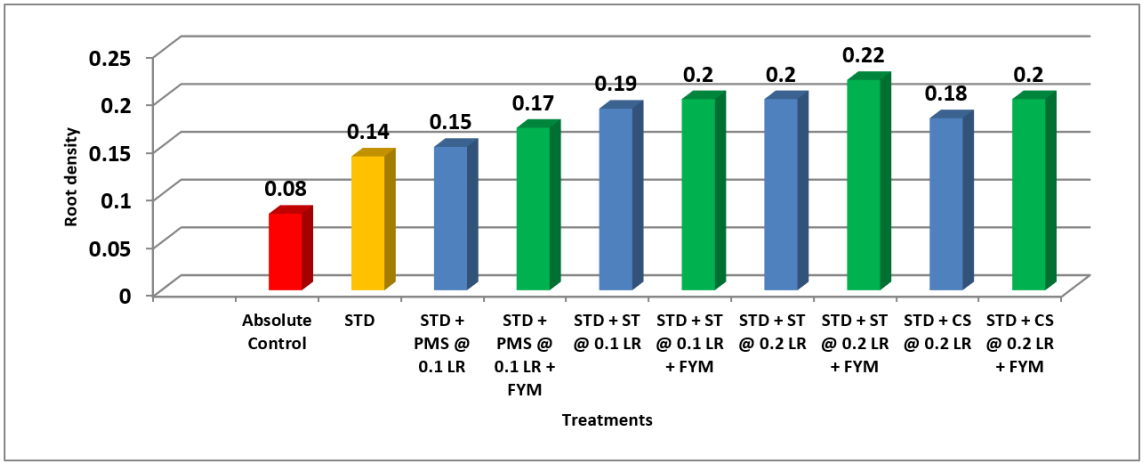

Fig 4: Influence of different sources of liming materials on root density

Conclusion

The application of liming sources alone increases the root length, dry weight, volume and density up to 53 cm, 9.80 g, 50 cc and 0.20 g/cc respectively but the application of liming materials with organic manure increases the root length, dry weight, volume and density more as compare to the lone sources of liming materials i.e 62 cm, 16.56 g, 100 cc and 0.22 g/cc respectively. The application of PMS @ 0.1 LR with STD & FYM increases the root dry weight and root volume more as compare to all other treatments but the application of ST @ 0.2 LR with STD & FYM increases the root length and root density more as compare to all other treatments. The double dose of stromatolyte @ 0.2 LR gives better result and increases the root length, dry weight, volume and density more compare to the single dose @ 0.1 LR. The absolute control gives the very less in root length, dry weight, volume and density among all the treatments. The soil test based recommended dose alone gives the higher result over absolute control.

References

1. Bengough AG. Modelling rooting depth and soil strength in a drying soil profile. Journal of Theoretical Biology. 1997; 186:327-338.
2. Bengough AG, Bransby MF, Hans J, McKenna SJ, Roberts TJ, Valentine TA. Root responses to soil physical conditions; growth dynamics from field to cell. Journal of Experimental Botany. 2006; 57:437-447.
3. Foy CD, Sadeghi AM, Ritchie JC, Krizek DT, Davis JR, Kemper WD. Aluminum toxicity and high bulk density: role in limiting shoot and root growth of selected aluminum indicator plants and eastern gamagrass in an acid soil. Journal of Plant Nutrition. 1999; 22:1551-1566.
4. Gilker RE, Weil RR, Krizek DT, Momen B. Eastern gamagrass root penetration in adverse subsoil conditions. Soil Science Society of America Journal. 2002; 66:931-938.
5. Jegou D, Schrader S, Diestel H, Cluzeau D. Morphological, physical and biochemical characteristics of burrow walls formed by earthworms. Applied Soil Ecology. 2001; 17:165-174.
6. Pankhurst CE, Pierret A, Hawke BG, Kirby JM. Microbiological and chemical properties of soil associated with macropores at different depths in a red-duplex soil in NSW Australia. Plant and Soil, 2002; 238:11-20.
7. Passioura JB. Soil conditions and plant growth.Plant, Cell & Environment 2002; 25:311-318.
8. Pierret A, Moran CJ, Pankhurst CE. Differentiation of soil properties related to the spatial association of wheat roots and soil macropores. Plant and Soil. 1999; 211:51-58.
9. Scott BJ, Fisher JA, Cullis BR. Aluminium tolerance and lime increase wheat yield on the acidic soils of central and southern New South Wales. Australian Journal of Experimental Agriculture 2001; 41:523-532.
10. Wang J, Hesketh JD, Woolley JT. Pre-existing channels and soybean rooting patterns. Soil Science. 1986; 141:432-437.
11. White RG, Kirkegaard JA. The distribution and abundance of wheat roots in a dense, structured subsoil – implications for water uptake. Plant, Cell & Environment 2010; 33:133-148.