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Iron and Mn accumulation in sugarcane crop as influenced by resource based organic farming

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Abstract

A field trial was conducted at Organic Farm, Navsari Agricultural University, Navsari during the years 2019-20 and 2020-21. The objectives of study were (i) To find out the effect of available organic resource-based treatments on growth, yield and quality of sugarcane, (ii) To study the effect of available organic resource-based treatments on soil properties and (iii) To work out the economics. The experiment was conducted using the RBD (factorial concept) with three replications. Two factors were tested in which one factor was spacing (S_1 : 90 cm and S_2 : 60 - 120 -

60 cm paired row with dhaincha green manuring) and another factor was compost levels (M_1 : NADEP compost @ 100 % RDN, M_2 : NADEP compost @ 75 % RDN, M_3 : NADEP compost @ 50 % RDN and M_4 : NADEP compost @ 25 % RDN + sugarcane trash @10 t/ha + jeevamrut @ 2000 l/ha.). Among the Fe, Mn, content of cane and trash, Fe in trash were affected significantly by the compost treatments in pooled analysis. Significantly higher content of these nutrients was observed in treatment M_1 as compared to remaining treatments.

Keywords: Sugarcane Crop, Organic Farming, NADEP Compost

Introduction

Organic farming perceptions are quite divergent but there is a strong consensus on its eco-friendly nature and inherent ability to protect human health. Also, many studies have revealed that organic agriculture is productive and sustainable. However, organic food production costs are higher as compared to conventional counterparts due to higher input cost and labor intensive in nature. Efforts have been made by the government of India on an overall basis to encourage organic farming. Even different organizations have been set up for the marketing of the produce of organic farming. The increasing demand for the organic food products in the developed countries as well as the policies adopted by the government of India to encourage the exports of the organic agri-products are the driving factors responsible for the uprising of the Indian organic food industries which have the potential to strengthen the Indian economy as well as the health standards of the Indian masses (Roychowdhury *et al.*, 2013) [6].

In India, post-independence agriculture has witnessed several undesirable consequences in the want to produce more and more to feed hungry population. Often these are called as ill-effects of green revolution. Few examples of these are, indiscriminate use of natural resources, imbalanced fertilization with no or little emphasis on organics, over emphasis on use of synthetic chemicals *etc.* The continuous application of chemical fertilizers deteriorates the physical, chemical and biological property of soil in turn resulting low yield of sugarcane. The frequent and excessive use of chemical fertilizers has created various problems like widespread deficiency of secondary and micronutrients, decline in crop productivity and increasing environmental pollution. In due course, these became parts of conventional practice of farming (Horrihan *et al.*, 2002) [1], reduction in bio-diversity (Lupwayi *et al.*, 2001; Oehl *et al.*, 2004) [3, 4] and soil erosion (Reganold *et al.*, 1987) [5] are some of the most important negative impacts of conventional farming, which are paid much attention these days due to environmental and public health concerns (Horrihan *et al.*, 2002) [1]. The long-term sustainability of conventional crop production practices has become questionable due to these negative impacts. Thus, to sustain the production system in long run "devoid of

unsustainable components of conventional farming” scope of integrated farming in general and organic farming in particular has received utter attention.

Materials and methods

The experiment was conducted using the RBD (factorial concept) with three replications. Two factors were tested in which one factor was spacing (S_1 : 90 cm and S_2 : 60 - 120 - 60 cm paired row with dhaincha green manuring) and another factor was compost levels (M_1 : NADEP compost @ 100 % RDN, M_2 : NADEP compost @ 75 % RDN, M_3 : NADEP compost @ 50 % RDN and M_4 : NADEP compost @ 25 % RDN + sugarcane trash @ 10 t/ha + jeevamrut @ 2000 l/ha.).

Table 1: Plant analysis methods

Parameters	Methods/Formula	References
N	Micro Kjeldahl	Jackson (1973) ^[2]
P	Spectrophotometer	Jackson (1973) ^[2]
K	Flame photometer	Jackson (1973) ^[2]
Fe, Mn, Zn and Cu	Atomic Absorption Spectrophotometer	Jackson (1973) ^[2]

Results and discussion:

Iron content of cane and trash (mg/kg)

Result pertaining to Fe content (mg/kg) in cane and trash of sugarcane at harvest as influenced by different treatments is presented in Table 2. Content of Fe was not affected significantly by the spacing treatments during individual years and in pooled data analysis. However, the treatment S_2 (60 - 120 - 60 cm paired row with green manuring) recorded higher Fe content in cane (145.3, 148.7, 147.0 mg/kg) and trash (284.4, 356.4 and 320.4 mg/kg) and spacing treatment S_1 (90 cm) recorded lower Fe content in cane (143.8, 147.0 and 145.4 mg/kg) and trash (282.0, 346.6 and 314.3 mg/kg) during the year 2019-20, 2021-21 and in pooled analysis, respectively.

Content of Fe in cane during the years 2019-20, 2020-21 and in pooled analysis and content of Fe in trash during the year 2019-20 were not affected significantly by the treatment of compost (Table 2). However, content of Fe in trash during the year 2020-21 and in pooled analysis was affected significantly by the treatment of compost. During the year 2020-21, significantly higher Fe content in trash (365.1 mg/kg) was recorded in treatment M_1 (application of NADEP compost @ 100 % RDN) but it was remained at par with treatment M_2 (NADEP compost @ 75 % RDN) and recorded Fe content 354.3 mg/kg in trash. In pooled analysis, significantly highest Fe content in trash (328.3 mg/kg) was observed in treatment M_1 . In all the individual years as well as in pooled analysis, treatment M_4 (NADEP compost @ 25 % RDN + sugarcane trash @ 10 t/ha + jeevamrut @ 2000 l/ha) recorded lowest Fe content in cane and trash.

In pooled analysis, year effect was significant on Fe content in trash only. Significantly higher Fe content in trash was observed in the year 2020-21 as compared to the year 2019-20 (Table 2).

Interaction effect of S x M, Y x S, Y x M, Y x S x M did not exert any significant effect on Fe content in cane and trash of sugarcane at harvest during individual years and in pooled data analysis (Table 2).

Manganese content of cane and trash (mg/kg)

As far as Mn content in cane and trash of sugarcane is concerned, among the different treatments and their interactions, only compost treatment affects the Mn content in cane significantly during the year 2020-21 (Table 3). In this year, treatment M_1 (NADEP compost @ 100 % RDN) recorded significantly highest Mn content of cane (38.6 mg/kg) followed by M_3 (34.8 mg/kg) and M_2 (33.4 mg/kg). While significantly lowest Mn content in cane (33.0 mg/kg) was recorded in treatment M_4 (application of NADEP compost @ 25 % RDN + Sugarcane trash @ 10 t/ha + jeevamrut @ 2000 l/ha).

Table 2: Effect of different treatments on Fe content in cane and trash

Treatments	Fe content (mg/kg)					
	Cane			Trash		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor I: Spacing						
S_1 -(90 cm)	143.8	147.0	145.4	282.0	346.6	314.3
S_2 -(60-120-60 cm with GM)	145.3	148.7	147.0	284.4	356.4	320.4
S Em±	1.4	1.2	1.1	2.4	3.3	2.3
CD at 5 %	NS	NS	NS	NS	NS	NS
Factor II: Compost levels						
M_1 -Com. @ 100 % RDN	149.2	150.6	149.9	291.5	365.1	328.3
M_2 -Com. @ 75 % RDN	144.4	148.3	146.4	282.5	354.3	318.4
M_3 -Com. @ 50 % RDN	142.4	146.5	144.4	281.3	347.0	314.1
M_4 -Com. @ 25 % RDN + ST @ 10 t/ha + JM @ 2000 l/ha	142.0	146.0	144.0	277.6	339.6	308.6
S Em±	2.0	1.7	1.6	3.4	4.7	3.25
CD at 5 %	NS	NS	NS	NS	14.4	9.5
CV (%)	3.4	2.9	3.9	3.0	3.3	3.5
Year mean	--	--	--	283.2	351.5	317.4
S x M						
S Em±	2.9	2.5	2.3	4.9	6.7	4.6
CD at 5 %	NS	NS	NS	NS	NS	NS
Pooled	S Em±		CD at 5 %	S Em±		CD at 5 %
Y	1.1		NS	2.3		6.7
Y x S	1.6		NS	3.2		NS
Y x M	2.3		NS	4.6		NS
Y x S x M	3.3		NS	6.5		NS

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 3: Effect of different treatments on Mn content in cane and trash

Treatments	Mn content (mg/kg)					
	Cane			Trash		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor I: Spacing						
S ₁ -(90 cm)	33.5	35.1	34.3	54.0	55.0	54.5
S ₂ -(60-120-60 cm with GM)	33.0	34.8	33.9	51.8	54.1	53.0
S Em±	0.8	0.8	0.6	1.1	1.0	0.8
CD at 5 %	NS	NS	NS	NS	NS	NS
Factor II: Compost levels						
M ₁ -Com. @ 100 % RDN	34.1	38.6	36.4	55.9	56.5	56.2
M ₂ -Com. @ 75 % RDN	33.7	33.4	33.5	52.8	55.4	54.1
M ₃ -Com. @ 50 % RDN	33.0	34.8	33.9	52.4	53.5	52.9
M ₄ -Com. @ 25 % RDN + ST @ 10 t/ha + JM @ 2000 l/ha)	32.3	33.0	32.7	50.7	52.8	51.7
S Em±	1.1	1.2	0.9	1.6	1.5	1.2
CD at 5 %	NS	3.6	NS	NS	NS	NS
CV (%)	8.3	8.4	9.7	7.5	6.8	8.0
S x M						
S Em±	1.6	1.7	1.3	2.3	2.1	1.7
CD at 5 %	NS	NS	NS	NS	NS	NS
Pooled	S Em±		CD at 5 %	S Em±		CD at 5 %
Y	0.6		NS	0.8		NS
Y x S	0.9		NS	1.2		NS
Y x M	1.3		NS	1.7		NS
Y x S x M	1.9		NS	2.5		NS

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Conclusion

- Treatment effect of spacing on Fe and Mn content of cane and trash was non-significant in pooled analysis.
- However, content Fe in trash were affected significantly by the compost treatments in pooled analysis. treatment effect of compost. Significantly higher content of these nutrients was observed in treatment M₁ as compared to remaining treatments.
- Year effect was significant Fe in trash and significantly higher content was observed during the year 2020-21 as compared that observed during the year 2019-20.
- Interaction effect of S x M, Y x S, Y x M, Y x S x M did not exert any significant effect on content of any nutrients in cane and trash at harvest during individual years and in pooled analysis.

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