Effect of Organic Nutrients and Bio Fertilizers on Soil Parameters and Nutritional Content of Amaranth

ABSTRACT

A field experiment was conducted to study the effect of organic nutrients and bio fertilizers on soil parameters and nutritional content of amaranth. Eleven treatments were taken in three replications and the experiment was conducted in a randomized block design (RBD).The treatments were T_1:RDF (60:30:20 kg NPK/ha), T_2:Vermicompost @ 2 t/ha, T_3:Vermicompost @ 5 t/ha, T_4:FYM 10 t/ha, T_5:FYM 20t/ha, T_6:Poultry manure 3t/ha, T_7:Poultry manure 5 t/ha, T_8:Vermicompost @ 2 t/ha+PSB+*Azospirillum*@ 5 kg/ha each, T_9 :FYM @ 10t/ha+ PSB+*Azospirillum*@ 5 kg/ha each, T_{10}:Poultry manure 3 t/ha+ PSB+*Azospirillum*@ 5 kg/ha each and T_{11}: Untreated control. The highest vitamin C (147.8 mg/100 gm) and crude fibre content (1.48%) was observed in the treatment T_8 and T_4, respectively.Maximum calcium (8.36%) and iron (0.21%) content was observed in the treatment T_8. The treatment T_{10} recorded the highest mean performance for P^H, organic carbon, available nitrogen and potash content in the soil analyzed after harvest of the crop.

Keywords: *Vermicompost, FYM, poultry manure and amaranth*

1.INTRODUCTION

Amaranth is an important leafy vegetable and a good source of protein, minerals, vitamin A and vitamin C. Depending on the colour of the leaves, green and red colouredvarieties are available. One of the most primary factors for increasing the production as well as the quality of amaranth leaves is the health of the soil. Soil should have ideal physical, chemical and biological conditions. Organic fertilizers positively influence the microbial population of the soil, which increases the soil's biomass, carbon, nitrogen content and dehydrogenase enzyme activity. Combining organic manure with bio-fertilizers increases crop yield and also helps to improve the physical health of the soil and serves as a reservoir for nutrients (Yadav *et al*., 2022). Organic fertilizers supply a variety of carbon compounds with diverse chemical compositions, ranging from readily degradable to stable, which can be utilized by soil microorganisms during mineralization to increase their growth rates and biomass (Lazcano *et al*., 2021). Therefore, organic fertilizers have strongsustainable effects on the soil micro organisms and are the foundation for improving soil health by rising microbial activity, microbial interactions and nutrient

cycling (Lazcano *et al*., 2013; Ling *et al*., 2016). The long-term application of chemical fertilizers increase soil acidity and organic fertilizers can increase the value of soil pH and soil organic carbon and reduce soil acidification (Wang *et al*., 2019; Liu *et al*., 2021).Due to risingcost of inorganic fertilizers the use of available local resources such as farmyard manure, vermicompost, poultry manure, etc. are very much essential to build up the scarcity. The use of organic manures not only increase crop production but also considerablyimproves the physical, chemical and biological qualities of soil as well as boosts the effectiveness of fertilizers. Vermicompost improves the physical properties by reducing the bulk density of soil and it also increases the water holding capacity of soil (Ravimycin, 2016). Well-decomposed FYM and vermicompost alone or in conjunction with bio-fertilizers aid in supplying the right amount of nutrients and preserve the health of the soil. It supplies necessary plant nutrients, which enhance the physical and chemical characteristics, increase water holding capacity and promote microbial activity in the soil. Poultry manures are very nutrient-rich organic manure and N, P, K content are 0.5-0.9, 0.4-0.5 and 1.2-1.7 percent, respectively (Adekiya, *et al*. 2019). Biofertilizers increase soil productivity by fixing atmospheric nitrogen or by solubilizing the soil phosphate and boost plant growth by providing growth-promoting substances. Considering the importance of organic nutrients, the investigation was carried out to study the impact of vermicompost, FYM, poultry manure and bio fertilizers on soil parameters and nutrient content of amaranth.

2. MATERIALS AND METHOD

The experiment was conducted in a randomized block design (RBD) comprising of eleven treatments in three replications. The treatments used in the experiment were T_1: RDF (60:30:20 Kg NPK/ha),T_2:Vermicompost @ 2 t/ha, T_3:Vermicompost @ 5 t/ha, T_4:FYM 10 t/ha, T_5:FYM 20 t/ha, T_6:Poultry manure 3 t/ha, T_7:Poultry manure 5 t/ha, T_8:Vermicompost @ 2 t/ha+ PSB+ *Azospirillum*@ 5 kg/ha each, T_9:FYM @ 10 t/ha+ PSB+*Azospirillum*@ 5 kg/ha each, T_{10}:Poultry manure 3 t/ha+ PSB+*Azospirillum*@ 5 kg/ha each and T_{11}: Untreated control. The experimental area was ploughed, leveled and harrowed to a fine tilth. The plot was divided into equal plots, each having a size of 4sqm and each plot was separated by 50 cm. The recommended dose of inorganic fertilizers for amaranth is 60:30:20 kg NPK/ha.

After proper land preparation, biofertilizers were applied to the individual plots according to the treatments three days before sowing of seeds. According to the treatment plan, vermicompost, FYM and poultry manure were also applied to the plots. The organic manures and biofertilizers were carefully mixed into the soil. Seeds were sown in well-prepared plot. At the time of sowing, seeds were mixed with fine sand for even distribution of the seeds as the seed size is very small. The seeds were sown at 1cm depth and covered evenly with thin layer of fine soil. Extra seedlings were thinned off after the seedlings were well-established to maintain a proper spacing of 10cm between plants. The quality parameters viz.,vitamin C, crude fibre, calcium, iron and soil parameters were analyzed after harvesting of crop.

3. RESULTS AND DISCUSSION

The treatment T_8 exhibited significantly the highest (147.8mg) mean performance for vitamin C content of leaves whereas, the treatment T_{11} (Control) showed the lowest (75.3mg) value for vitamin C (Table1). The ability of *Azospirillum* to fix atmospheric nitrogen and the production of hormones that promote plant development by both vermicompost and *Azospirillum* might be responsible for the rise in vitamin C content. These hormones assisted to speed up the process of carbohydrate synthesis. Because vitamin C is a sugar acid, its synthesis is encouraged by the application of organic fertilizers (Vlahora*et al*., 2013). Inoculation with phosphate solubilizing biofertilizer helpful in assimilation of carbohydrates and which in turn increased the synthesis of ascorbic acid (Upadhyay *et al*., 2012).The treatment T_4 (FYM 10 t/ha) recorded the highest (1.48%) value for crude fibre content while the lowest (1.10%) was exhibited by the treatment T_{11} (Control). The mean value (1.47%) of treatment T_5 (FYM 20 t/ha) was at par with T_4. This might be due to lesser amount of nitrogen in FYM as compared to vermicompost because decreased in nitrogen content enhance the fiber content of leaves. The percentage of crude fiber content is reduced with enhancement of phosphorus.

The treatment T_8 recorded significantly the highest mean performance for calcium content with a value of 8.36% and it was at par with the treatment T_{10} (8.28).The increased calcium content of amaranth leaves might be due to increased absorption of micro and macro nutrients by the

crop.Shankar *et al* (2013) reported that more microorganisms are present in organically managed soil and these microbes create a variety of chemicals that encourage plants to take up more micronutrients from the soil. Organic acids present in vermicompost had great role in releasing of calcium from exchange sites and thereby increased the availability of calcium. According to Kumar (2017), the organic acids in vermicompost have a significant role in releasing calcium from exchange sites, increasing calcium availability.

The treatment T_8 showed significantly the highest mean performance for iron content with a value of 0.21%. The high iron content in the leaves of amaranthus might be due to vermicompost which increased the micronutrients in soil and it also acted as a chelating agent. It plays important role to make available the other metallic micronutrients to the plants. The abundance of microorganisms due to addition of vermicompost increases siderophores production and enhances the availability of Fe to plants. This is essential for iron in particular since many soils have substantial iron content but in inaccessible form. Similar observations were also reported by Shankar *et al.* (2013). Vermicompost is chemically as well as biologically enriched compound as compared to compost and the pH of the vermicompost exerts a strong influence on the availability of micronutrients like iron (Wright *et al*., 2007)

The treatment T_{10} (Poultry manure 3 t/ha + PSB +*Azospirillum*@ 5kg/ha each) recorded the highest mean performance for P^H (5.34), organic carbon (1.24%)), available nitrogen (237kg) and potash (141.23kg)in the present investigation (Table 2). Combining bio-fertilizers with organic nutrients had a positive impact on soil health by enhancing the soil structure, texture, ability to retain water, capacity as a buffer, nutritional status and microbial population. The present study showed that organic nutrients alone and in conjunction with bio-fertilizers boost soil fertility and nutritional status. According to experimental findings, the addition of *Azospirillum* and PSB to organic nutrients greatly improved the availability of nitrogen, phosphorus and potassium as compared to the treatments without bio-fertilizers. The increase in nitrogen availability might be attributable to increased percentage of nitrogen in vermicompost and

Azospirillum population, which may have fixed atmospheric nitrogen non-symbiotically and increased nitrogen solubilization in soil.

The increase in the amount of phosphorus that is readily available in soil following the addition of vermicompost and biofertilizer may be attributable to the more effective and efficient mineralization and solubilization of phosphorus. Phosphorus present in soil is unavailable to plants and it is made available by the action of bacteria that produce phosphatase and other phosphorus-solubilizing acids and enzymes. Similar findings were also reported by Han *et al.* (2006), Narayanamma *et al*. (2005) and Parthasarathi *et al*. (2008).

Table 1.Effect of organic nutrients and bio fertilizers on nutritional content of amaranth leaves

Treatments	Vitamin C (mg/100g)	Crude fibre (%)	Calcium (%)	Iron (%)
T_1	76.2	1.23	7.46	0.17
T_2	102.1	1.29	6.25	0.18
T_3	103.1	1.29	6.71	0.19
T_4	82.2	1.48	6.22	0.17
T_5	84.2	1.47	6.25	0.19
T_6	92.2	1.30	5.32	0.18
T_7	94.1	1.32	6.34	0.19
T_8	147.8	1.14	8.36	0.21
T_9	141.9	1.23	8.28	0.20
T_{10}	145.9	1.27	7.39	0.20
T_{11}	75.3	1.10	5.27	0.15
SEd (±)	0.4	0.03	0.21	0.01
CD (0.05)	0.9	0.06	0.45	0.02

Table 2.Effect of organic nutrients and bio fertilizers on soil parameters after harvest

Treatments	pH	Organic carbon (%)	Available nitrogen (kg/ha)	Available phosphorus (kg/ha)	Available potash (kg/ha)
T_1	4.91	0.71	228.00	38.98	125.22
T_2	5.16	0.91	215.33	45.76	134.15
T_3	5.26	0.95	229.00	47.25	139.51
T_4	4.96	0.75	206.00	41.12	128.06
T_5	5.16	0.82	212.67	45.12	132.55
T_6	5.19	0.77	215.00	46.56	135.15
T_7	5.23	0.85	226.00	49.41	137.76
T_8	5.28	1.19	235.00	51.15	141.15
T_9	5.22	1.11	221.00	49.15	136.77
T_{10}	5.34	1.24	237.00	52.23	141.23
T_{11}	4.86	0.69	202.00	36.12	118.60
SEd (±)	0.03	0.01	1.34	0.15	0.06
CD (0.05)	0.05	0.03	2.81	0.32	0.13

4. CONCLUSION

Based on the result obtained from the investigations it can be concluded that different treatments exhibited significant differences in nutritional content of amaranth leaves. The highest vitamin C, crude fibre, calcium and iron content were observed in the treatment T_8.The highest values for P^H, organic carbon, available nitrogen and potash content in the soil were exhibited by the treatment T_{10}.

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