Effect of Organic Manure and NPK Consortium on Growth, yield and qualityof Beetroot (*Beta vulgaris* L.) in Southern Rajasthan Condition

ABSTRACT

The present investigation entitled "Effect of Organic Manure and NPK Consortium on Growth, yield and quality of Beetroot (*Beta vulgaris* L.) in Southern Rajasthan Condition" was carried out at Horticulture Farm, Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur. The nine treatments for the beetroot crop were evaluated with three replications under randomized block design. Variety "Detroit dark red" of beetroot was used in this experiment. The results exhibit the significant effect of various treatments on growth, yield and quality of beetroot. The growth parameters *viz.*, Maximum germination percentage (72.23), maximum plant height at 25 DAS, 50 DAS and at harvesting (16.00, 31.77 and 32.30 cm), respectively, Number of leave per plant (6.58, 9.23 and 13.13), respectively,leaf area (195.47 cm),root length (16.30 cm), maximum root diameter (7.32 cm), Maximum root weight (147.90 g), Maximum yield per plot (7.10 kg) maximum TSS (8.59 ^{0}Brix), highest reducing sugar content (5.23 %), highest total sugar content (7.30%), highest betanine (1.96 mg/100g)

Keyword- NPK consortium, tss, betanine and total sugar,

1.INRTODUCTION

Beetroot (*Beta vulgaris* L.) is one of the winter vegetable crops of the Chenopodiaceous family and has the chromosome number of 2n=18. This crop is biennial grown as annual. This crop falls under the category of root crops and is identified by the presence of betanin pigments (betacyanins, which are reddish-violet, and beta-xanthins, which are yellow), the quantity of which in the roots is determined by the ratio of the two pigments.The bioactive substance found in Betanin pigment inhibits oxidation processes in several physiological contexts, including hematopoiesis and lipid peroxidase, whereas beetroot juice also possesses toxic effects on cancer cell development. (Alenzi and Manea, 2020).

Beetroot is a health-promoting food; 100 g of edible portion of its roots contain protein (1.7g), carbohydrates (88 mg), calcium (200 mg), phosphorus (55mg), and vitamin C (88 mg). Also, the leaves are a rich source of nutrients like, iron (3.1 mg), thiamine (110 µg), ascorbic acid (50 mg) per 100 g and vitamin A (2100 I.U) (Bhatt, 2007).

Organic manure and FYM are thought to be particularly significant for root crops.Because it enhances the physical, chemical, and biological conditions of the soil and ultimately promotes better root growth and supplies some essential plant nutrients (N, P and K) and other macronutrients and micronutrients (Sapkota *et al*., 2021)

Microorganisms connected to plants are crucial to agricultural productivity. It is becoming more and more clear that when two or more interacting microorganisms form a microbial consortium, additive or synergistic effects can be anticipated, despite the fact that numerous studies have demonstrated that single bacteria can have positive impacts on plants. (Santoyo *et al*., 2021)

2.MATERIALAND METHODS

The present study was conducted at the at Horticulture farm, College of Agriculture, MPUAT, Udaipur During final week of December to second week of april 2024 The experiment, was designed in a randomized complete block design with nine treatments and three replications. The total nine treatments consist of i.e., T_1-Control, T_2-RDF(100:50:70), T_3- FYM 20t/ha., T_4- Neem cake 2t/ha., T_5- NPK Consortium, T_6- FYM 10t/ha + Neem cake 1t/ha., T_7- FYM 10t/ha + NPK Consortium, T_8-Neem cake 1t/ha + NPK Consortium, T_9- FYM 5t/ha. + Neem cake 0.5t/ha. + NPK Consortium. Detroit dark red was the variety under investigation. Toensure spacing seeds were seeded at 40 cm × 10 cmand size of plot was kept 1.2 x 2.4 m^2.thinning was done 10 days following sowing. Urea, SSP, and MOP were used to provide nitrogen, phosphorus, and potassium in RDF respectively, As per treatment before planting. Organic manure such as FYM and neem cake was given before sowing and NPK consortium was given through seed treatment (5ml/kg seed).

Growth, yield and quality characteristics were recorded on five plants per treatment per plot in each. Germination% ,plant height, number of leaves per plant, leaf area, days require for harvesting, root length, root diameter, root yield per plant, root yield per plot, TSS, reducing sugar, total sugar and betanine content were all recorded. The data were statistically examined using analysis of variance (ANOVA) for RBD according to Panse and Sukhatme's standard approach

(1985).

2.1 Observations

Germination percentage was estimated on the base of number of seed germinated in per plot after one week from the date of sowing.

$$\text{Germination}(\%)=\frac{\text{No.of seed germinated per plot } \chi\ 100}{\text{Total no.of seed per pot}}$$

The plant's height was taken from its base, which is just above the soil's surface, to its head. The height was recorded at (i) 25 days days after sowing, (ii) 50 days after sowing, (iii) At harvest. The number of leaves of selected plants was counted and average was calculated out at (i) 25 days after sowing, (ii) 50 days after sowing, (iii) At harvest

Leaf area of leaves was counted at randomly selected five plant under each treatment at an 80 days after sowing using leaf area meter. Total number of days required for harvesting counted from date of sowing to harvesting.

The length of root was measured individually of five randomly selected plants from each plot and average length of root was calculated in cm. The diameter of root was measured individually of five randomly chosen plants from each plot and average diameter of root was calculated in centimetres. The weight of root was measured individually of five randomly chosen plants from each plot and average weight of root was computed in gram.

After harvesting the number of roots each net plot were weighted in a lot individually after harvesting. The crop was harvested replication wise and root yield was calculated in kilogram.

TSS of the root was determined by using a Pocket Refractometer of 0-53 ^{o}Brixrange.For reducing sugar determination, the method was given by Nelson Smogyi. In this method DNS reagent prepared by dissolving 1 g of di-nitrosalicyclic acid, 200 mg of crystalline phenol, and 50 mg of sodium sulphate in 100 ml of 1% NaOH was used immediately after preparation and absorbance was noted at 510 nm and accordingly graph plotted by standard glucose solution. Reducing sugar was calculated using the following formula (Ranganna, 1979).

$$\text{Reducing sugars (\%)} =\frac{\text{Factor value} \times \text{Dilution}}{\text{Titre value} \times \text{Weight of sample}} X100$$

The Dunois technique was used to calculate the total amount of sugar. In this procedure, analysis was performed using 96% conc. H_2SO_4 and 5% phenol. The sample's absorbance was measured at 490 nm, and graph results were plotted using the method below to determine the final total sugar value.

$$\text{Total sugar (\%)} = \frac{\text{Fehling's solution factor} \times 100 \times \text{Dilution}}{\text{Volume of sample used} \times 1000}$$

Betanine content of roots was determined at harvest with the procedure suggested by Singh *et al*. (2017) and was expressed in (mg 100 g^{-1}) sample.

3. RESULTS AND DISCUSSION

3.1 Effect of organic manure and NPK consortium on Germination percentageof beetroot.

Evaluation of data Table 1.shows that application of different treatments failed to show any significant effect on the germination percentage. Though maximum germination percentage at (72.23) was recorded with T_9(FYM 5t/ha. + Neem cake 0.5t/ha. + NPK Consortium)and minimum (68.60) was found with T_1(control). The similar result was found by Ingole *et al*. (2018) and Jagadeesh *et al*. (2015) in beetroot.

3.2 Effect of organic manure and NPK consortium on growth attributes of beetroot.

The data showed in the table 1.showed that plant height at 25 DAS, 50 DAS and harvesting were found statistically significant. Application of T_9 (FYM 5t/ha. + Neem cake 0.5t/ha. + NPK consortium) registered maximum plant height(16.00, 31.77 and 32.30 cm) atDAS, 50 DAS and harvesting, respectively. However the minimum plant height (13.13, 16.77 and 27.40 cm) was observed with T_1 (control).Number of leaves at 25 DAS, 50 DAS and harvesting were found statistically significant. Application of T_9(FYM 5t/ha. + Neem cake 0.5t/ha. + NPK consortium) registered maximum number of leaves(6.58, 9.23 and 13.13) at DAS, 50 DAS and harvesting, respectively. However the minimum number of leaves (5.07, 7.18 and 11.33) was observed with T_1 (control).Average leaf area recorded at harvest is presented in Table 1. It showed that the effect of different treatments on average leaf area was found to be statistically significant. The treatment T_9 (FYM 5t/ha + Neem cake 0.5t/ha + NPK consortium) registered the maximum average leaf area (195.47 cm) followed by T_8 (187.30) indicating significantly superior overall other treatments whereas the lowest leaf area (150.13 cm^2) was observed with T_1 which was control. Application of different treatments failed to show any significant effect on the days required for harvesting. Though minimum days require for harvesting (86.77) was recorded with T_6 (FYM 10t/ha + Neem cake 1t/ha) and maximum days require (90.87) was found with T_1 which was control. The significant effect on theseparameters, as consequence of organic manures and NPK cnsortium attributed to the increased nutritional status of soil resulting into increased

growth of the crop. This may be attributed to favorable effect of organic sources on microbial activity and root proliferation in soil which caused solubilizing effect on native nitrogen, phosphorus, potassium and other nutrients and organic manures also decreases exploitation of micronutrients. Mounika *et al*. (2020), Baria*et al*. (2023) and Jagadeesh *et al*. (2015) in beetroot. Boroujerdnia and Ansari (2007), Baria *et al*. (2023) and Jagadeesh *et al*. (2015)in beetroot and Rana *et al*.(2022) in palak.

3.3 Effect of organic manure and NPK consortium on yield attributes of beetroot.

The data showed in the table 2showed that the highest root length (16.30 cm) was recorded with treatment T_9 (FYM 5t/ha + Neem cake 0.5t/ha + NPK consortium) followed by T_8 (15.80 cm). The treatment T_1(control) noted the lowest root length of 13.27 cm. The data pertaining root diameter to recorded at harvest is presented in Table 2. It showed that the effect of different treatments on average root diameter was found to be statistically significant. The treatment T_9 (FYM 5t/ha + Neem cake 0.5t/ha + NPK consortium) registered the maximum average root diameter (7.32 cm) followed by T_8 (6.72 cm) indicating significantly superior overall other treatments whereas the lowest average root diameter (5.50 cm^2) was observed with T_1 which is control. The result of data analysis is presented in Table 2 indicated that different treatments significantly increased the root weight. The maximum root weight (147.90 g) was recorded with T_9 (FYM 5t/ha + Neem cake 0.5t/ha + NPK consortium) followed by T_8 (140.50 g) and minimum (110.50 g) were found with T_1 (control). Root weight under T_9(FYM 5t/ha + Neem cake 0.5t/ha + NPK consortium) found significantly higher over all treatment. The data presented in Table 2. Showed that the effect of different treatments on root yield per plot (kg) were found to be significant. The highest yield (7.10 kg) was recorded in T_9 (FYM 5t/ha + Neem cake 0.5t/ha + NPK consortium) and it was at par with T_8 (7.00 g) and T_7 (6.90 g). The minimum (6.40 g) were found with T_1 which was control. This might be due to the reason that combine application of FYM, neem cake and NPK consortium increase the root diameter. Decrease in bulk density and increase in porosity and water holding capacity of the soil due to organic manures might have contributed in increasing the root diameter of the plants. The root diameter may be attributed to solubilization of plant nutrients by addition of FYM and neem cake leading to increase uptake of NPK Similaar close result was reported by Vaghela and Nadoda (2019) in onion, Mounika *et al* (2022), Jagadeesh *et al.* (2018), in beetroot and Shrivastava *et al* (2022) and Shahia*et al*. (2022), in radish.

3.4 Effect of organic manure and NPK consortium on quality attributes of beetroot.

The result of data analysis is presented in Table 3 indicated that different treatments significantly increased the total soluble solid. The maximum total soluble solid (8.59 ^{0}Brix) was recorded with T_6(FYM 10t/ha + Neem cake 1t/ha) and it was at par with T_4 (8.38 ^{0}Brix) and minimum were found with T_1 (6.41 ^{0}Brix) which is control. Under T_6(FYM 10t/ha + Neem cake 1t/ha) was found significantly higher over all treatments.The total sugars content of beetroot roots was significantly affected due to application of different treatments. The results are presented in Table 2. The highest reducing sugar content (5.23 %) was recorded in T_6 (FYM 10t/ha + Neem cake 1t/ha.) followed by T_4 (Neem cake 2t/ha) by noting 4.90% reducing sugar. Whereas the lowest reducing sugars content (4.37 %) was recorded with control (T_1). Under T_4(Neem cake 2t/ha) was found significantly higher over all treatments.

The total sugars content of beetroot roots was significantly affected by the application of different organic manure and NPK consortium. The results are presented in Table 2 The highest total sugar content (7.30 %) was recorded in T_6 with the application of FYM 10t/ha + Neem cake 1t/ha which was at par with T_9 (7.10 %) with FYM 5t/ha. + Neem cake 0.5t/ha. + NPK Consortium and were significantly superior to all other treatments. The lowest total sugars content (6.30) was recorded in T_1 which was control. The Betanine content of beetroot roots was significantly affected by the different treatments applied to the experiment. The results are presented in Table 2. The highest betanine (1.96 mg) was recorded in T_6 with the application of FYM 10t/ha + Neem cake 1t/ha followed by T_9 (1.90 %) with FYM 5t/ha. + Neem cake 0.5t/ha. + NPK Consortium which were significantly superior to all other treatments. The lowest betanine content (1.49 %) was recorded in T_1 which was control. This may be because of better availability and uptake of nitrogen and other nutrients with the application of FYM and neem cake in combination which might have lead to balanced C/N ratio and increased activity of plant metabolism. Similar findings were made bykiran*et al.* (2016) and Emura and Hosoya (1979) in carrot, Jagdeesh *et al.* (2016) in beetroot and Shankar *et al.* (2009) in onion.

3.5 Effect of organic manure and NPK consortium onEconomics of treatments of beetroot.

Data pertains to economics of beetroot for per hectare area under various treatments are shown in table 2. Treatment T_9(FYM 5t/ha + Neem cake 0.5t/ha. + NPK Consortium) and T_8 (Neem cake 1/ha + NPK Consortium) gave maximum net return Rs. 249161 and 232871. Minimum net return of Rs. 139300 was recorded with T_1 (Control). However, maximum B:C (2.93) was recorded with T_7- (FYM 10t/ha + NPK consortium) and minimum B:C (1.29) with

T_4(Neem 2t/ha.).Maximum net return might be due to the more yield of beetroot fruit and resulted in higher net return while high benefit cost ratio may be due to lower cost of cultivation for that particular treatment application. Sharma *et al.*(2003) in carrot and Patel *et al*. (2021) in fenugreek.

Table:-1 Effect of organic manure and NPK consortium on germination %, number of leaves per plant, plant height (cm), leaf area (cm), days require for harvesting,

Treatment	Germination %	Number of leaves per plant			Plant height			Leaf area	Days require for harvsting
		25DAS	50DAS	Harvest	25 DAS	50DAS	Harvest		
T_1	68.60	5.07	7.18	10.53	13.13	26.87	27.40	150.1	90.30
T_2	70.17	5.44	7.41	10.83	14.00	27.33	28.53	155.2	88.53
T_3	71.17	5.61	7.30	11.37	14.03	27.87	28.90	156.3	87.80
T_4	71.07	5.82	7.20	11.41	14.13	28.67	29.73	160.5	87.20
T_5	71.56	5.24	7.20	10.41	13.27	26.93	27.33	152.7	88.87
T_6	72.11	5.97	8.10	12.19	14.53	29.17	30.53	173.7	86.77
T_7	70.60	5.85	8.42	12.87	15.60	29.87	30.50	180.5	87.60
T_8	71.30	6.15	9.14	12.60	15.93	30.87	31.07	187.3	91.67
T_9	72.23	6.58	9.23	13.13	16.00	31.77	32.30	195.5	90.77
SE(m)±	0.75	0.20	0.11	0.21	0.22	0.41	0.52	2.64	1.20
CD at 5%	NS	0.61	0.34	0.63	0.66	1.22	1.57	7.60	NS

Table:-2 Effect of organic manure and NPK consortium Root leingh (cm), Root diameter (cm), Root weight(g), Yield pe plot(kg), Net returns, B:C Ratio

Treatment	Root leingh	Root diameter	Root weight	Yield per plot	Net returns (Rs/ha)	B:C Ratio
T_1	13.27	5.50	110.5	7.7	139300	2.00
T_2	14.77	6.06	125.7	8.3	153160	2.02
T_3	14.40	6.31	127.3	8.5	144640	1.61
T_4	14.98	5.77	130.9	8.7	141310	1.29
T_5	13.10	5.66	124.5	8.0	141271	2.03
T_6	15.37	6.73	135.1	8.8	183590	1.70
T_7	15.60	7.04	138.9	9.0	231431	2.90
T_8	15.80	6.72	140.5	9.2	232871	2.38
T_9	16.30	7.32	147.9	9.5	249161	2.80
SE(m)±	0.33	0.08	2.18	0.13		
CD at 5%	0.99	0.25	6.53	0.39		

Table:-3 Effect of organic manure and NPK consortium on reducing sugar (%) total sugar(%), betanine content (mg/1000g) and TSS(^{o}Brix)

Treatment	Reducing sugar	Total sugar	Betanine	TSS
T_1	4.37	6.30	1.5	6.41
T_2	4.40	6.43	1.6	6.86
T_3	4.50	6.57	1.7	7.53
T_4	4.90	6.93	1.8	8.38
T_5	4.83	6.53	1.7	7.65
T_6	5.23	7.57	2.0	8.59
T_7	4.60	6.87	1.7	7.83
T_8	4.80	7.00	1.7	8.29
T_9	4.80	7.10	1.9	8.33
SE(m)±	0.08	0.09	0.02	0.11
CD at 5%	0.25	0.27	0.05	0.33

4.CONCLUSION

On the basis of present investigation entitled "Effect of Organic Manure and NPK Consortium on Growth, Yield and Quality of Beetroot (*Beta vulgaris* L.) In Southern Rajasthan Condition". It may be concluded that among the various treatments T_9 (FYM 5t/ha. + Neem cake 0.5t/ha. + NPK Consortium) as found superior in different growth and yield attributes *viz.,* germination percentage plant height at 25, 50 DAS and at harvesting, number of leaves per plant at 25, 50 DAS and harvesting, leaf area (cm), days require for harvesting, root length (cm), root diameter (cm), root yield per plant (g), and root yield per plot (kg).The quality parameter *viz.* TSS (^{0}brix), reducing sugar (%), total sugar (%), and betanineconent (mg/100) found significantly higher in treatment T_6 (FYM 10t/ha + Neem cake 1t/ha). Maximum B:C (2.93) was recorded with T_7 (FYM 10t/ha + NPK Consortium) and minimum B:C (1.29) with T_4 (Neem cake 2t/ha.). Whereas, highest net return was found in T_9- (FYM 5t/ha.+ Neem cake 0.5t/ha. + NPK Consortium) Rs. 249161.

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