Original Research Article

Effect of organic manure and inorganic fertiliser on growth and root yield of beetroot (*Beta vulgaris* L.)

ABSTRACT

The present investigation was carried out with titleatHorticulturalResearchFarm (HRF), Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh during the *Rabi*-2022 with a view to identify the best treatment combination that performed in the Prayagraj region. The treatments comprised of T_1 (Recommended dose of fertilizers (RDF)), T_2 (75% (RDF) +25% (FYM)), T_3 (75% (RDF) +25% (Vermicompost)), T_4 (75% (RDF) +25% (Poultry Manure)), T_5 (50% (RDF) + 50% (FYM)), T_6 (50%(RDF) +50% (Vermicompost)), T_7 (50%(RDF) +50% (Poultry Manure)), T_8 (25% (RDF) + 75% (FYM)), T_9 (25% (RDF) +75% (Vermicompost)), T_{10} (25% (RDF) +75% (Poultry Manure)), T_{11} (75% (RDF) + 12.5% (Poultry Manure) + 12.5% (Vermicompost)), T_{12} (50% (RDF) +25% (FYM) +25 % (Poultry Manure)) and T_{13} (25% (RDF)+ 50% (FYM)+ 25% (Vermicompost)).From the above experimental finding it is concluded that the treatment T_{11}(75% (RDF) + 12.5% (Poultry Manure) + 12.5% (Vermicompost)) was found to be best in the terms of growth and yield among different treatment combinations of Beet root.

Keywords: *Farmyard Manure, Poultry manure, Vermicompost,Beet root.*

INTRODUCTION

Beetrootbotanically known as *Beta vulgaris* (L.) is one of the well-known plants belonging Amaranthaceae family includes approximately 1400 species divided into 105 genera. Also known as sugar beet aremembers of this family are dicotyledonous. It is an erect annual herb with tuberous root stocks. There are basically four varieties of Beetroot namely known as Detroit dark red, Crimson Globe, Crosby Egyptian and early Wonder. It ranks among the ten most potent vegetables with respect to antioxidant property. It is a diploid cross-pollinated dicot plant species with chromosome number 2n=2x=18 (Bennett and Smith, 1976).The beetroot is the taproot (bulb) portion of the beet plant. It is grown in temperate countries and biennial plant. The beetroot and its juice are freely consumed for its great taste, nutritional benefit, and flavor content. At present its productivity is 20-25 t/ha fruit per year

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in India (Anonymous, 2013).Beetroot grows plentiful throughout the country, but most widely in Germany and France, and in lesser amounts in other European countries. In 2016-2017, the total world production of red beets was found to be 61.51 ton per hectare (FAOSTAT, 2020). In India beetroot is grown in Uttar Pradesh, Haryana, Maharashtra, West Bengal, and Himachal Pradesh on large scale. The varieties of beetroot that are cultivated in India are Detroit dark red, crimson globe, early wonder, ooty-1.

They are rich in minerals, vitamins, essential amino acids, sugars, dietary fibres, and it has many other uses okra seed contain 24% of oil is used as salad oil and in the manufacture of oleic and linoleic acid.The technology of collecting and using animal, human and plant waste to improve crop productivity is as old as agriculture. Manures are organic materials derived from animal, human, and plant residues that contain phytonutrients in complex organic form. Natural or synthetic chemicals that contain nutrients for plants are called fertilizers. Though,Manures contains low nutrient per unit amount not only improve soil properties, but also have a longer residual effect than fertilizers with a high nutrient content. Farmyard manure is primarily made from cow dung, cow urine, straw, and other milk waste. It is very useful and some of its features are: FYM is rich in nutrients. On an average well decomposed farmyard manure contains 0.5 per cent Nitrogen (N), 0.2 per cent Phosphate(P_2O_5)and .0.5 per cent Potassium(K_2O). Vermicompost is the product of a decomposition process that uses various types of earthworms (usually red worms, white worms, and other earthworms) to create a decomposition mixture of vegetable or food waste, bedding materials, and vermicast.Vermicompost is rich in NKP (nitrogen 2-3%, potassium 1.85-2.25% and phosphorus 1.55-2.25%), micronutrients, beneficial soil microbes and contain 'plant growth hormones & enzymes'. The excreta of birds ferment very quickly. If left exposed, 50 percent of its nitrogen is lost within 30 days. Poultry manure contains higher nitrogen and phosphorus compared to other bulky organic manures. The average nutrient content is 3.03 per cent N; 2.63 per cent P_2O_5 and 1.4 per cent K_2O.Organics such as FYM, Poultry manure and Vermicompost not only promote increased yields and improved crop quality, but also maximize the genetic potential of plants and the presence of nutrients enhances root development, fruit set, affects the vitality and health of plants. Fertilizers may be distinct from liming materials or other non-nutrient soil amendments. Many sources of fertilizer exist, both natural and industrially produced. For most modern agricultural practices, fertilization focuses on three main macro nutrients: nitrogen (N), phosphorus (P), and potassium (K) with occasional addition of supplements like rock flour for micronutrients. This experiment was

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conducted to help in understanding the Effect of different organics and inorganics on plant growth and yield attributes of Beetroot crop. To see the effect this was done on the field practically.Therefore, present study of analysis in Beetroot crop was carried out to identify the best treatment combination with high yield, early maturing suited to Prayagrajagro-climatic conditions of U.P.

Comment [IGKA8]: ~~To see the effect this was done on the field practically~~

MATERIALAND METHODS

The present investigation was done to understand the effect of organic manures and inorganic fertilizer at different doses combination on growth, yield and quality of beetroot variety Golden Lalima.The experiment was carried out atHorticultural Research Farm (HRF), Department of Horticulture, Naini Agricultural Institute SHUATS, Prayagraj, U.P., during the *Rabi*season of 2022.Thedifferent combination doses of organic manures and inorganic fertilizers mentioned in table 1 and replicated thrice.Observations were recorded at different stages of growth periods. The data were statistically analysed by the method suggested by Fisher and Yates, 1963**.**

Table 1 details of different doses of organic manure and inorganic fertilizers.

Treatment Notation	Treatment Details
T_1	Recommended dose of fertilizers (RDF)
T_2	75% (RDF) +25% (FYM)
T_3	75% (RDF) +25% (Vermicompost)
T_4	75% (RDF) +25% (Poultry Manure)
T_5	50% (RDF) + 50% (FYM)
T_6	50%(RDF) +50% (Vermicompost)
T_7	50%(RDF) +50% (Poultry Manure)
T_8	25% (RDF) + 75% (FYM)
T_9	25% (RDF) +75% (Vermicompost)
T_{10}	25% (RDF) +75% (Poultry Manure)
T_{11}	75% (RDF) + 12.5% (Poultry Manure) + 12.5% (Vermicompost)
T_{12}	50% (RDF) +25% (FYM) +25 % (Poultry Manure)
T_{13}	25% (RDF)+ 50% (FYM)+ 25% (Vermicompost)

Table 2 Performance of different treatment combinations of organic manure and inorganic fertilizer on growth and yield parameters studied for beetroot.

Treatment Notation	Treatment details	Days to germination	Days to 50% germination	Plant height (cm) (60 DAS)	Plant height with root (cm)	No of leaves/plant 60 DAS	Root length (cm)	Root diameter (cm)	Fresh plant weight (g)	Dry plant weight (g)	Biological yield (g)	Root yield per plot (Kg/plot)
T_1	RDF	2.47	5.13	49.51	61.34	21	11.17	2.71	136.34	102.97	138.55	3.54
T_2	75% (RDF) +25% (FYM)	2.8	5.07	50.15	60.47	21.07	11.32	3.69	148.72	113.97	151.05	3.74
T_3	75% (RDF) +25% (VC)	2.93	7.27	48.11	58.3	21.67	11.19	4.38	161.62	124.45	162.95	4.4
T_4	75% (RDF) +25% (PM)	3.8	6.13	47.43	57.4	22.2	10.97	3.17	143.72	108.69	145.05	4.17
T_5	50% (RDF) + 50% (FYM)	3.87	5.27	46.82	57.26	21.73	11.45	3.12	163.52	126.12	164.85	4.32
T_6	50%(RDF) +50% (VC)	2.53	5.53	46.72	57.14	22	11.08	3.11	167.22	129.37	168.55	4.31
T_7	50%(RDF) +50% (PM)	2.87	5.87	45.78	55.39	21.87	10.28	4.01	138.22	103.85	139.55	3.61
T_8	25% (RDF) + 75% (FYM)	2.87	5.2	43.45	54.13	22.2	11.35	3.21	131.72	98.13	133.05	3.61
T_9	25% (RDF) +75% (VC)	3.47	5.47	50.66	61.09	22.2	11.02	4.14	126.62	93.65	127.95	3.63
T_{10}	25% (RDF) +75% (PM)	3	7.2	49.39	60.6	21.53	11.57	4.2	168.72	130.69	170.05	4.29
T_{11}	75%(RDF)+12.5%+(PM)+12.5%(VC)	3.07	5.47	42.53	53.87	22.53	12	4.5	181.42	141.87	182.75	4.74
T_{12}	50%(RDF)+25%(FYM)+25%(PM)	2.47	5.2	43.14	53.54	21.87	11.24	4.33	157.12	120.49	158.45	4.29
T_{13}	25%(RDF)+50%(FYM)+25%(VC)	2.73	5.2	44.21	54.22	22.93	11.01	4.09	148.72	130.72	150.05	3.83
'F' test		**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S.E. (m) ±		**0.13**	**0.06**	**0.01**	**0.61**	**0.26**	**0.01**	**0.01**	**0.35**	**0.02**	**0.03**	**0.21**
C.D. at 5%		**0.38**	**0.18**	**0.04**	**1.78**	**0.76**	**0.02**	**0.04**	**1.04**	**0.07**	**0.01**	**0.6**
C.V.		**7.61**	**1.98**	**0.05**	**1.83**	**2.07**	**0.08**	**0.07**	**0.4**	**0.03**	**0.04**	**8.82**

Abbreviations used: **RDF**: Recommended doses of Fertilizers, **FYM**: Farmyard Manure, **VC**: Vermicompost, PM: Poultry Manure.

RESULTS AND DISCUSSION

Growth Parameters

Days to germination and Days to 50% germination

The maximum days to germination (3.87 days) was observed with T_5 ~~with 2.53 days~~. Minimum days to germination (2.47 days) was observed in T_1. The maximum days to 50% germination (7.27 days) was observed with T_3 followed by T_{10} with 7.20 days. Minimum days to 50% germination (5.07 days) was observed in T_2. The germination rate depends on factors like improved soil physical and chemical properties and leading to the adequate supply of nutrients to the seeds which might have promoted the germination rate. Similar results have also been reported by Kadalag*et al.,* (2007), Yepthoet *al.,* (2010), Singh *et al.,* (2014), Reddy *et al*., (2018) and Sapkotaet *al.,* (2020) in okra and Jagdish *et al.,* (2018) and Aarti *et al.,* (2021) in Beetroot.

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Comment [IGKA10]: Please interpretes the data. Find the possible factor that affect the growth rate. For example, T5 that was added 50% FYM germinated later than RDF. Meanwhile addition of only 25% FYM in T2 germination was found faster than T5. Indicating that FYM inhibit germination in beet plant, etc.

Plant height (cm)

The maximum plant height at 60 DAS (50.66 cm) was observed with T_9 followed T_2 with 50.13 cm. Minimum plant height at 60 DAS (42.53 cm) was observed T_{11}. The maximum plant height with roots (61.34 cm) was observed with T_1 followed T_9 with 61.09 cm. Minimum plant height with roots (53.54 cm) was observed T_{12}.Plant development depends on availability of proper nutrient and water to plants. The proper availability of water boosted the vegetative growth along with proper availability of nutrients from soil. Sunlight triggered the formation of photosynthates that also showed increase in height of the plant.Similar findingswere reported by Kadalag*et al.,* (2007), Yepthoet *al.,* (2010), Singh *et al.,* (2014), Reddy *et al*., (2018) and Sapkotaet *al.,* (2020) in okra and Jagdish *et al.,* (2018) and Aarti *et al.,* (2021) in Beetroot.

Comment [IGKA11]: Please provide interpretation. Compare the height of plants after addition of VC, FYM or other addition. It is very important to make a multiple comparation, whether the different height is significant among the treatments

Number of leaves per plant

The maximum number of leaves per plant at 60 DAS (22.93) was observed with T_{13} followed by T_{11} with 22.33. Minimum number of leaves per plant at 60 DAS (21.00) was observed in T_1.Similar findingswere reported by Kadalag*et al.,* (2007), Yepthoet *al.,* (2010), Singh *et al.,* (2014), Reddy *et al*., (2018) and Sapkotaet *al.,* (2020) in okra and Jagdish *et al.,* (2018) and Aarti *et al.,* (2021) in Beetroot.

Comment [IGKA12]: Interpretation ???

Yield Parameter

Root length (cm) and Root diameter (cm)

The maximum root length 12.00 cm were recorded in treatment $T_{11,}$ and the lowest root length (10.28 cm) were observed in T_7. The maximum root diameter 4.50 cm were recorded in treatment $T_{11,}$ and the lowest root diameter (2.71 cm) were observed in T_1.Uniform root length is essentiality for marketing of root and yield of roots too. Results were in accordance with the findings ofKadalag*et al.,* (2007), Yepthoet *al.,* (2010), Singh *et al.,* (2014), Reddy *et al.,* (2018) and Sapkotaet *al.,* (2020) in okra and Jagdish *et al.,* (2018) and Aarti *et al.,* (2021) in Beetroot.

Fresh plant weight (g)Dry plant weight (g) and biological yield (g)

The maximum fresh plant weight 181.42 g were recorded in treatment $T_{11,}$ and the lowest fresh plant weight (126.62 g) were observed in T_9. The maximum dry plant weight 159.50 g were recorded in treatment $T_{11,}$ and the lowest dry plant weight (111.28 g) were observed in T_9. The maximum biological yield 182.75 g were recorded in treatment and the lowest biological yield (127.95 g) were observed in T_9.Plant weight directly contributes to yield per plants. Weight of root directly depends on higher photosynthates produced that is stored in roots too. The more photosynthates production is directly correlated to higher leaves number per plant and availability of nutrients and sunshine. Nutrition play an important role in improving productivity and quality of root. Increased vigour of plants, assimilating area, size of fruit, thereby resulting into higher weight of fruit. These results are in close conformity with the findings ofKadalag*et al.,* (2007), Yepthoet *al.,* (2010), Singh *et al.,* (2014), Reddy *et al.,* (2018) and Sapkotaet *al.,* (2020) in okra and Jagdish *et al.,* (2018) and Aarti *et al.,* (2021) in Beetroot.

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Comment [IGKA14]: Please see data on the leaf number. The highest leaf number is shown by T13, but the highest plant dry weight is shown by T11. Indicating that the plants dry weight do not directly related to the number of leaves.

Root yield per plot (Kg/plot)

The maximum root yield per plot 4.74 kg/plot were recorded in treatment T_{11} and the lowest root yield per plot (3.54 kg/plot) were observed in T_1. Yield is a complex character that depends directly on root weight, length, diameter, and numbers per plot. It depends directly or even indirectly on earliness of plant along with plant height and number of leaves per plant too. It was seen in experimentation yield had direct positive correlation with These results are in close conformity with the findings ofKadalag*et al.,* (2007), Yepthoet *al.,* (2010), Singh *et*

al., (2014), Reddy *et al.,* (2018) and Sapkota*et al.,* (2020) in okra and Jagdish *et al.,* (2018) and Aarti *et al.,* (2021) in Beetroot.

Summary and Conclusion

From the above experimental finding it ~~may be~~ concluded that the treatment T_{11}(75%(RDF)+12.5%+(PM)+12.5%(VC)) was found to be best in the terms of growth and yield among different treatment combinations of Beet root.

References

Comment [IGKA15]: References must be listed and numbered in the order that they appear in the text. Every reference referred in the text must also present in the reference list and vice versa

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