

## Original Research Article

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

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#### **ABSTRACT**

The present investigation was carried out with title at Horticultural Research Farm (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<sub>1</sub> (Recommended dose of fertilizers (RDF)), T<sub>2</sub> (75% (RDF) +25% (FYM)), T<sub>3</sub> (75% (RDF) +25% (Vermicompost)), T<sub>4</sub> (75% (RDF) +25% (Poultry Manure)), T<sub>5</sub> (50% (RDF) + 50% (FYM)), T<sub>6</sub> (50% (RDF) +50% (Vermicompost)), T<sub>7</sub> (50% (RDF) +50% (Poultry Manure)), T<sub>8</sub> (25% (RDF) + 75% (FYM)), T<sub>9</sub> (25% (RDF) +75% (Vermicompost)), T<sub>10</sub> (25% (RDF) +75% (Poultry Manure)), T<sub>11</sub> (75% (RDF) + 12.5% (Poultry Manure) + 12.5% (Vermicompost)), T<sub>12</sub> (50% (RDF) +25% (FYM) +25% (Poultry Manure)) and T<sub>13</sub> (25% (RDF) + 50% (FYM) + 25% (Vermicompost)). From the above experimental finding it is concluded that the treatment T<sub>11</sub> (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.*

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#### **INTRODUCTION**

Beetroot botanically known as *Beta vulgaris* (L.) is one of the well-known plants belonging to the Amaranthaceae family. It includes approximately 1400 species divided into 105 genera. Also known as sugar beet, members 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 is a 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.

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

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 Prayagraj agro-climatic conditions of U.P.

## MATERIAL AND 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 at Horticultural Research Farm (HRF), Department of Horticulture, Naini Agricultural Institute SHUATS, Prayagraj, U.P., during the *Rabi* season of 2022. The different 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 <sub>1</sub>	Recommended dose of fertilizers (RDF)
T <sub>2</sub>	75% (RDF) +25% (FYM)
T <sub>3</sub>	75% (RDF) +25% (Vermicompost)
T <sub>4</sub>	75% (RDF) +25% (Poultry Manure)
T <sub>5</sub>	50% (RDF) + 50% (FYM)
T <sub>6</sub>	50% (RDF) +50% (Vermicompost)
T <sub>7</sub>	50% (RDF) +50% (Poultry Manure)
T <sub>8</sub>	25% (RDF) + 75% (FYM)
T <sub>9</sub>	25% (RDF) +75% (Vermicompost)
T <sub>10</sub>	25% (RDF) +75% (Poultry Manure)
T <sub>11</sub>	75% (RDF) + 12.5% (Poultry Manure) + 12.5% (Vermicompost)
T <sub>12</sub>	50% (RDF) +25% (FYM) +25% (Poultry Manure)
T <sub>13</sub>	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 <sub>1</sub>	RDF	2.47	5.13	49.51	61.34	21	11.17	2.71	136.34	102.97	138.55	3.54
T <sub>2</sub>	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 <sub>3</sub>	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 <sub>4</sub>	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 <sub>5</sub>	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 <sub>6</sub>	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 <sub>7</sub>	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 <sub>8</sub>	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 <sub>9</sub>	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 <sub>10</sub>	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 <sub>11</sub>	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 <sub>12</sub>	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 <sub>13</sub>	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
<b>‘F’ test</b>		<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
<b>S.E. (m) ±</b>		<b>0.13</b>	<b>0.06</b>	<b>0.01</b>	<b>0.61</b>	<b>0.26</b>	<b>0.01</b>	<b>0.01</b>	<b>0.35</b>	<b>0.02</b>	<b>0.03</b>	<b>0.21</b>
<b>C.D. at 5%</b>		<b>0.38</b>	<b>0.18</b>	<b>0.04</b>	<b>1.78</b>	<b>0.76</b>	<b>0.02</b>	<b>0.04</b>	<b>1.04</b>	<b>0.07</b>	<b>0.01</b>	<b>0.6</b>
<b>C.V.</b>		<b>7.61</b>	<b>1.98</b>	<b>0.05</b>	<b>1.83</b>	<b>2.07</b>	<b>0.08</b>	<b>0.07</b>	<b>0.4</b>	<b>0.03</b>	<b>0.04</b>	<b>8.82</b>

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<sub>5</sub> with 2.53 days. Minimum days to germination (2.47 days) was observed T<sub>1</sub> and T<sub>12</sub>. The maximum days to 50% germination (7.27 days) was observed with T<sub>3</sub> followed T<sub>10</sub> with 7.20 days. Minimum days to 50% germination (5.07 days) was observed T<sub>2</sub>. 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 Kadalaget *et al.*, (2007), Yepthoet *et al.*, (2010), Singh *et al.*, (2014), Reddy *et al.*, (2018) and Sapkotaet *et al.*, (2020) in okra and Jagdishet *et al.*, (2018) and Aartiet *et al.*, (2021) in Beetroot.

#### Plant height (cm)

The maximum plant height at 60 DAS (50.66 cm) was observed with T<sub>9</sub> followed T<sub>2</sub> with 50.13 cm. Minimum plant height at 60 DAS (42.53 cm) was observed T<sub>11</sub>. The maximum plant height with roots (61.34 cm) was observed with T<sub>1</sub> followed T<sub>9</sub> with 61.09 cm. Minimum plant height with roots (53.54 cm) was observed T<sub>12</sub>. 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 findings were reported by Kadalaget *et al.*, (2007), Yepthoet *et al.*, (2010), Singh *et al.*, (2014), Reddy *et al.*, (2018) and Sapkotaet *et al.*, (2020) in okra and Jagdishet *et al.*, (2018) and Aartiet *et al.*, (2021) in Beetroot.

#### Number of leaves per plant

The maximum number of leaves per plant at 60 DAS (22.93) was observed with T<sub>13</sub> followed T<sub>11</sub> with 22.33. Minimum number of leaves per plant at 60 DAS (21.00) was observed T<sub>1</sub>. Similar findings were reported by Kadalaget *et al.*, (2007), Yepthoet *et al.*, (2010), Singh *et al.*, (2014), Reddy *et al.*, (2018) and Sapkotaet *et al.*, (2020) in okra and Jagdishet *et al.*, (2018) and Aartiet *et al.*, (2021) in Beetroot.

## **Yield Parameter**

### **Root length (cm) and Root diameter (cm)**

The maximum root length 12.00 cm were recorded in treatment T<sub>11</sub>, and the lowest root length (10.28 cm) were observed in T<sub>7</sub>. The maximum root diameter 4.50 cm were recorded in treatment T<sub>11</sub>, and the lowest root diameter (2.71 cm) were observed in T<sub>1</sub>. Uniform root length is essentiality for marketing of root and yield of roots too. Results were in accordance with the findings of Kadalaget *et al.*, (2007), Yepthoet *et al.*, (2010), Singh *et al.*, (2014), Reddy *et al.*, (2018) and Sapkota *et al.*, (2020) in okra and Jagdishet *et al.*, (2018) and Aartiet *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<sub>11</sub>, and the lowest fresh plant weight (126.62 g) were observed in T<sub>9</sub>. The maximum dry plant weight 159.50 g were recorded in treatment T<sub>11</sub>, and the lowest dry plant weight (111.28 g) were observed in T<sub>9</sub>. The maximum biological yield 182.75 g were recorded in treatment and the lowest biological yield (127.95 g) were observed in T<sub>9</sub>. 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 of Kadalaget *et al.*, (2007), Yepthoet *et al.*, (2010), Singh *et al.*, (2014), Reddy *et al.*, (2018) and Sapkota *et al.*, (2020) in okra and Jagdishet *et al.*, (2018) and Aartiet *et al.*, (2021) in Beetroot.

### **Root yield per plot (Kg/plot)**

The maximum root yield per plot 4.74 kg/plot were recorded in treatment T<sub>11</sub> and the lowest root yield per plot (3.54 kg/plot) were observed in T<sub>1</sub>. 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 of Kadalaget *et al.*, (2007), Yepthoet *et 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<sub>11</sub>(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.

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