Effect of organic and inorganic fertilizer on growth, yield of beetroot (Beta vulgaris L.) cv. Detroit Dark Red

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"Effect of organic and inorganic fertilizer on growth, yield of beetroot (*Beta vulgaris* L.) cv. Detroit Dark Red"

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Abstract

Present investigation entitled, **"Effect of organic and inorganic fertilizer on growth, yield of beetroot (*Beta vulgaris* L.) cv. Detroit Dark Red"** was conducted at Agricultural Research Farm of Raja Balwant Singh College, Bichpuri, Agra during rabi season of the year 2022-23. The treatments involved in this study were 100% RDF (T_0), 75% RDF + 25% Vermicompost (T_1) , 75% RDF + 25% Poultry manure (T_2) , 75% RDF + 12.5% Vermicompost + 12.5% Poultry manure (T_3) , 50% RDF + 50% Vermicompost (T_4) , 50% RDF + 50% Poultry manure (T_5) , 50% RDF + 25% Vermicompost + 25% Poultry manure (T_6) , 25% RDF + 75% Vermicompost (T_7), 25% RDF + 75% Poultry manure (T_8), 25%RDF + 37.5% Vermicompost + 37.5% Poultry manure(T_9) and 50% Vermicompost + 50% Poultry manure (T_{10}). From the above treatment combinations T_1 proved to be best on all growth and yield parameters with maximum germination percentage and least no of days taken to germination, highest plant height (35.83 cm), number of leaves per plant (19.55), length of longest leaf (37.96cm) ,width of longest leaf (09.27 cm),diameter of root at shoulder point(04.87 cm) ,volume of roots (225.60 ml), fresh weight of leaves (189.10 g) ,Fresh weight of roots(271.77 g) ,average yield per plot(11.82 kg), average yield (394.00 quintals ha^{-1}),Dry weight of root (18.84 %), Dry weight of leaves (12.17 %) and benefit cost ratio (5.249) among all the treatments tested .On the basis of results obtained it was concluded that application of 75% RDF through inorganic fertilizer in combination with 25% of the RDF through vermicompost is best for beetroot cultivation.

Key words : vermicompost ,poultry manure,beetroot

Introduction

Beetroot, scientifically known as *Beta vulgaris* L., belongs to the Chenopodiaceae family and is recognized for it's vibrant crimson color. It goes by various names such as beet, chard, spinach beet, sea beet, garden beet, white beet, and 'Chukander' in Hindi. This versatile vegetable offers numerous medicinal properties that can positively impact human health. It is a widely cultivated root vegetable enjoyed globally, primarily in salads, though its leaves can also serve as a spinach substitute but gives slightly bitter taste.

As per Campbell, 1976, beetroot can be traced back to its parent plant, the wild sea beet (*Beta vulgaris* sub sp. maritima), which originally grew along the coastlines of Europe, Africa, and India. The earliest form of cultivated beet was primarily focused on its leaves, which were consumed as a food source, while the roots were primarily used for medicinal purposes.The Genus Beta is mainly distributed across Asia and Europe. The modern table beet, a common root vegetable, is one of the ancestors of the sugar-beet.

The growth, development, and yield of beetroot are strongly influenced by the quality of the soil it's planted in. Soil conditions can be improved by adding nitrogen (N), phosphorus (P), and potassium (K) through both organic and inorganic fertilizers, which play a crucial role in supporting beetroot crops(Deshika and karunarathna,2019).

Organic manure is particularly valuable for root crops like beetroot as it enhances the physical, chemical, and biological aspects of the soil, creating conditions favorable for robust root development(Subedi et. Al.,2018). Common sources of organic manure include farmyard manure, which supplies essential plant nutrients like N, P, and K, as well as other macronutrients and micronutrients. Poultry manure is another nutrient-rich organic option(Duncan,2005).However, relying solely on organic manure may not meet the crop's nutrient requirements, as it can be bulky and slow to decompose, making it challenging to apply during the growing season and potentially leading to reduced yields(Deshika and karunarathna,2019).

To address this, a combination of both organic and inorganic fertilizers has proven to be an effective approach for promoting healthy root growth and optimizing beetroot production (Ahmed et. al.,2014). Numerous studies have shown that appropriate fertilizer management strategies, whether involving inorganic or organic options, can yield significant economic benefits for growers(Escalante et. al.,2019).

Hence,Keeping the above mentioned facts in view a study entitled **"Effect of organic and inorganic fertilizers on growth and yield of beetroot (*Beta***

***vulgaris L.*) cv detroit dark red"** was carried out..In essence, this study aimed to understand how different fertilizers affect the growth and productivity of beetroot, determine the best combination of treatments, and evaluate the economic implications of these approaches.

Methods and materials

The research trial was conducted during the rabi season of 2022-2023 at the Agricultural Research Farm of R.B.S. College, Bichpuri, Agra(27°2' N and 77°9' E and 163.4 m amsl) to investigate how both organic and inorganic fertilizers impact the growth, yield, and quality of beetroot (*Beta vulgaris* L.) cv. Detroit Dark Red.The soil of experimental field was Gangetic alluvial with calcareous layer at the depth of about 1.5 m to 2.0 meter. It was slightly alkaline in reaction (pH 7.9) and was well drained. To ensure the purity in variety seeds of Detroit Dark Red variety of Beetroot were procured from National seed Corporation,Agra for the experimental trial.The seeds were sown in plots of 2.00 m x 1.50m with spacing 15cm x 40.0 cm .The treatments involved in this study have been given in Table-1.

Number of seeds germinated in each plot was taken on daily basis from 22nd November to 4th December and growth parameters i.e plant height (cm), number of leaves plant, length(cm),width of longest leaf (cm) , Diameter of root at shoulder point (cm) were recorded on every 30 days from sowing with last data recorded on 13thMar'23 which included study of yield attributes and yield too.

The roots of tag plants were dipped in a beaker full of water and the the amount of water replaced was measured to get the volume of the root.At final observation 100 g sample each of leaves and root was taken from each tag plant and dried in open sun for few days and then in the electric oven at 60 C- 80°C and 100 °C till their weight became constant. Then it was weighed on electrical weighing machine and the weight so obtained was converted in percentage.

The data obtained from different observation on growth, yield, gross income and net income were subjected to statistical analysis as per "Randomize Block Design" by standard method suggested by *Fisher and Yates* (1957). The significant of treatments effect were tested with the help of F-test and significant f difference of treatments mean was tested by C.D. All these calculations were carried out with the degree of freedom (d.f.). The SE difference between two treatments mean was calculated with the following formulae:

Standard error of deviation for factor V: *SE* (d)

Standard error of mean (SEm ±) = $\sqrt{\frac{VE}{r}}$

Critical difference (C.D.) = 't' value at 5% level of significance.

Results and Discussion

Growth and development was highly affected by various treatments(Table -2).An application of 75°% RDF through inorganic fertilizers in combination with 25% of the nutrient requirement through vermicompost(T_1) resulted in increased germination count and least number of days taken to germination followed by application of 75% RDF through inorganic fertilizers in combination with 25% of the nutrient requirement through poultry manure (T_2) over all other treatment combinations. Plant height was found to be influenced by different treatments under study at all the stages of crop growth, in particular with total requirement fulfilled, 75% through inorganic fertilizers and rest 25% through Vermicompost i.e Plant height was found to be best with treatment T_1 (75% RDF + 25% VC).Number of leaves,length and width of longest leaf and diameter of root at shoulder point in T_1 (75% RDF + 25% VC) was found to be higher followed by treatment T_2 at all stages of crop growth.

This may be attributed to proper utilization of supplied nutrients in balanced form through inorganic fertilizers and organic manure in the form of poultry manure and vermicompost. The favourable effect of 75 per cent RDF of NPK ,poultry manure and vermicompost on plant growth and development might be due to the fact that the integrated use of organic and inorganic fertilizers is more effective through correction of deficiencies of primary, secondary and micronutrients. The present findings are supported with findings of (Vijaya kumari et al. (2012) and Khede, et al.(2019)) in Radish and(Kumar et al. (2014)) in Carrot who have recommended application of inorganic fertilizers in combination with vermicompost for better results.

As the yield and yield contributory characters of beet root are concerned,in the present study,significantly higher values of volume of roots (225.60 ml), fresh weight of leaves (189.10 g) ,Fresh weight of roots(271.77 g) ,average yield per plot(11.82 kg), average yield (394.00 quintals ha^{-1}),Dry weight of root(18.84 %), Dry weight of leaves (12.17 %) and benefit cost ratio (5.249) were obtained (Table -3) with the application of 75 per cent RDF through inorganic fertilizers and rest 25% through vermicompost. Beet root yields often face the lack of nitrogen supply instead of deficiencies of other essential nutrients. This is because beet root has a high nitrogen

requirement and depletion of nitrogen supplied can occur during the growing season by leaching, de-nitrification or other Processes.Nitrogen forms a major source for cell division and cell enlargement as nitrogen is the main component of chlorophyll, proteins and nucleic acid. Hence, adequate amount of it can stimulate the growth of stems and leaves.

The organic manure in the form of poultry manure improved nutrient uptake and could have explained the improvement of plant growth and yields of beet root in this study. The mechanism of this beneficial effect could be due to the fact that poultry manure is a suitable carrier for bio-organism. Such combination provides the plant with more balanced nutrition. It also improves the absorption of NPK as well as other mineral nutrients that are essential for beet root plants to grow and achieve optimum yield. It was also concluded by (Subedi,et al.(2018) and Kiran et. al.(2019)),(Sapkota,et al. (2021)) and (Singh,et. al. (2022)).that Application of inorganic fertilizer in combination with poultry manure is best and beneficial in Radish, Beetroot and Turnip respectively.

Conclusion

From the results obtained from this investigation it may be concluded that application of 75% RDF through inorganic fertilizer in combination with 25% of the RDF through Poultry manure is best for beetroot cultivation in respect of yield. However, due to it was only one year experimentation results are indicative and require further research to arrive on a more consistent result.

Conflict of Interest

There have been no conflict of interest.

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Table -1 Details of treatments tested

Treatment		**Notation**
100% RDF	:	T_0
75% RDF + 25% VC	:	T_1
75% RDF + 25% PM	:	T_2
75% RDF + 12.5% VC + 12.5% PM	:	T_3
50% RDF + 50% VC	:	T_4
50% RDF + 50% PM	:	T_5
50% RDF + 25% VC + 25% PM	:	T_6
25% RDF + 75% VC	:	T_7

25% RDF + 75% PM	:	T_8
25% RDF + 37.5% VC + 37.5% PM	:	T_9
50% VC + 50% PM	:	T_{10}

Table-2 :Growth characters as influenced by different treatments.

Treatment	Germination Count (%)	Days taken to germination	Plant Height (cm)	No. of leaves	Length of longest leaf(cm)	Width of longest leaf(cm)	Diameter of root at shoulder point(cm)
T_0	81.33	03.86	27.82	11.99	28.64	05.63	02.82
T_1	88.96	02.47	35.83	19.55	37.96	09.27	04.87
T_2	87.40	02.53	35.52	18.66	36.69	09.14	04.39
T_3	86.77	02.80	35.25	18.55	36.09	08.81	04.35
T_4	85.29	02.87	35.14	18.11	35.39	08.34	04.28
T_5	84.63	02.87	35.06	17.33	34.52	07.59	04.11
T_6	83.33	02.93	33.95	16.33	33.79	07.17	04.06
T_7	83.33	03.00	33.31	15.44	33.18	06.89	03.83
T_8	83.00	03.07	32.43	14.99	31.03	06.77	03.76
T_9	82.67	03.47	30.72	14.11	29.63	06.73	03.36
T_{10}	81.67	03.80	28.89	12.89	29.20	06.05	03.10
SEm±	1.071	0.214	1.030	0.486	0.825	0.696	0.397
CD at 5%	3.159	0.632	3.040	1.433	2.435	2.055	1.173

Treatment	Fresh Weight of Root(g)	Fresh Weight of Leaves(g)	Yield Plot^{-1} (kg.)	Yield Plot^{-1} (q./ha^{-1})	Volume of Root (ml)	Dry Weight of Leaves (%)	Dry Weight of Root (%)	Benefit cost ratio(for hectares)
T_0	128.66	69.773	05.06	168.666	096.11	6.93	9.34	1.722
T_1	271.77	189.10	11.82	394.00	225.60	12.17	18.84	5.249
T_2	260.10	167.99	10.21	340.33	224.44	10.13	17.15	4.221
T_3	251.11	158.44	09.19	306.33	207.22	9.65	16.78	3.778
T_4	240.22	157.99	08.72	290.66	146.66	9.43	15.48	3.531
T_5	222.89	132.77	08.50	283.33	137.77	8.89	14.84	3.140
T_6	211.11	130.44	07.89	263.00	136.55	8.62	14.67	2.968
T_7	204.89	106.88	05.16	172.00	128.88	8.59	14.39	1.638
T_8	167.33	89.776	06.29	209.67	125.55	7.85	14.15	1.928
T_9	140.93	79.776	05.47	182.33	109.99	7.81	14.13	1.665
T_{10}	133.33	73.773	06.13	204.00	103.33	7.23	13.82	3.336
SEm±	40.061	19.899	0.499	-	24.333	0.639	0.902	1.722
CD at 5%	118.18	58.704	1.472	-	71.783	1.886	2.661	5.249

Table-3 Yield and yield attributes

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