

Original Research Article

Combined effect of vermicompost and bonemeal on growth and yield of *Raphanussativus* var. Hill Queen

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ABSTRACT

The enquiry was done during rabi season of 2022 from 21 November, 2022 to 26 January, 2023 at the research station of Chandra Shekhar Azad University of Agriculture and Technology, Kalyanpur Kanpur, India. The cultivar was Hill Queen of radish (*Raphanussativus*) which is one of the important variety of North Indian Plain of Indian Subcontinent. The organic fertilizer vermicompost and bonemeal as a combined effect was recorded on different aspect of growth and yield of the respected variety. The experiment was conducted in Randomized Block Design on the total area of 150m². This area was divided in two halves, of which one half area was under Hill Queen variety with combined organic fertilizer application and the other half area was allotted with no fertilizer application. Considerable positive effect was recorded under the combined organic fertilizer on parameters like; Diameter of the green foliage, Length of the roots, Diameter of the roots, Number of leaves, Total mass of the plant and Number of root hair development which is crucial for the later period of seed production. All the major parameters included had shown considerable increase and they have shown in the percentage from the counterpart of the experiment.

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Keywords: Vermicompost, Bonemeal, radish, vegetative parameters, Foliage, test cultivar variety, Hill Queen, vermicompost.

1. INTRODUCTION

Organic farming is still in its infancy in India. As of March 2019, over 2.30 million hectares of cropland were under organic agriculture. This equates to 2% of the country's 140.1 million hectares net sown area. Because a large portion of organic farming is concentrated in a few states, which a few states have taken the lead in boosting coverage. Madhya Pradesh leads the list with 0.76 million hectares of organic farming area, accounting for more than 27% of India's total organic cultivation area.

Organic farming practices rely on the recycling of crop leftovers, animal manure, farm organic residues and wastes, and so on (Stockdale et al, 2001). Nitrogen (N) influences plant function at various levels, from metabolism to resource allocation, growth, and development (Crawford, 1995; Stitt and M, Krapp, 1999) A et al., and Crawford et al.,

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Radish (*Raphanussativus* L.) belongs Brassicaceae family, is an edible root vegetable that belongs to the "Cruciferae" family. It is a tropical and temperate area crop. It is a biennial or annual plant that grows quickly. The colour of its edible roots ranges from white to scarlet. Organic radish is a popular salad vegetable that is cultivated all over the world. Its green leaves are high in vitamin A and may be eaten as a green leaf vegetable.

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According to current research, several illnesses and livestock are reported as a result of the use of toxic pesticides during the standard farming method. Organic farming, which is derived from organic waste, has gained great importance in this area, adding more benefits and improving human immune systems. This organic gardening produced vegetables with 50%

more vitamins and minerals than previous approaches. It primarily protects the environment by retaining soil fertility and preventing soil erosion. As a result, it is in great demand in the market, and farmers prefer it as the best growing method over traditional farming methods. Vermicomposting is a technology that employs earthworms to convert any sort of organic waste into extremely valuable organic fertiliser (Singh [and Kumar, 2017](#); [et al. 2020](#); Yuvaraj et al., 2020; Yatoo et al., 2021). It is regarded commercially feasible, socially acceptable, and environmentally benign.

2. MATERIAL AND METHODS

Present experiment was conducted from the sowing on well prepared field on 21 November, 2022 and harvesting on 26 January, 2023 with the intermediate operation of 1st fertigation on same date of sowing of seeds on 21 November, weeding on 24th December, 2nd fertigation on 24 December, and final harvesting on 26th of January of 2023. The whole research was under Randomized Block Design with two replication at a spacing between plants of about 45x8cm. The area of block was 15m x 10m taken into consideration, with the number of plants equals to 4166 and half of block was under combined fertilizer effect of Vermicompost + Bonemeal and half area of about (75m²) was under no fertilizer supplement, and only weeding and normal irrigation was carried out in this area. Total four plots was undertaken and alternatively treatment was given to each plots, The per plot number of plants per plot was 1041.5.

On 21st of November 1st fertigation was conducted with vermicompost + bonemeal (in equal amount) total weighing 52.075 Kg mixed in required water was applied and on 22 December same mixer of 72.9Kg was applied in required amount of irrigation water, applied in Replication 1 and Replication 3. In Replication 2 and Replication 4, no fertigation was carried out. Each replication (Plot) was divided into 10 sub plots (SP) containing 104.15 plants and data were recorded on taking average choosing randomly 7 plants from each subplots.

Table 1. Study protocol

	Fertigation	No fertigation	Fertigation	No fertigation
R1SP1	R2SP1	R3SP1	R4SP1	
R1SP2	R2SP2	R3SP2	R4SP1	
R1SP3	R2SP3	R3SP3	R4SP3	
R1SP4	R2SP4	R3SP4	R4SP4	
R1SP5	R2SP5	R3SP5	R4SP5	
R1SP6	R2SP6	R3SP6	R4SP6	
R1SP7	R2SP7	R3SP7	R4SP7	
R1SP8	R2SP8	R3SP8	R4SP8	
R1SP9	R2SP9	R3SP9	R4SP9	
R1SP10	R2SP10	R3SP10	R4SP10	

10 Meters

15 Meters

R Stands for Replication, SP stands for subplot.

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Study protocol used in the experiment to determine the effect of vermicompost + bonemeal applied on *Raphanussativus*

Vermicompost

Ancient civilizations such as Greece and Egypt recognised the importance of earthworms in soil. Cleopatra, the Egyptian Pharaoh, declared, "Earthworms are sacred." She recognised the worms' importance in fertilising the Nile Valley croplands following regular floods. Charles Darwin was fascinated with worms and spent 39 years studying them. "It may be questioned whether there are many other animals in the world that have played such an important part in the history of the world," Darwin stated of earthworms. The earthworm is a natural fertility and life resource. Earthworms are soil organisms that feed on decomposing organic matter. After digestion, the undigested food passes through the earthworm's

alimentary canal, where a small film of oil is formed on the castings. This layer erodes during a two-month period. So, while plant nutrients are readily available, they are gradually released in soil. The African earthworms (*Eudrilluseugenia*), red worms (*Eiseniafoetida*), and composting worms (*Perionyxexcavatus*) are promising vermicompost producers. For vermicompost production, all three worms can be blended together. The African worm (*Eudrilluseugenia*) is favoured over the other two speciesvarieties because it generates more vermicompost in a shorter amount of time and has more young ones during the composting process.

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Organic carbon	: 9.5 – 17.98%
Nitrogen	: 0.5 – 1.50%
Phosphorous	: 0.1 – 0.30%
Potassium	: 0.15 – 0.56%
Sodium	: 0.06 – 0.30%
Calcium and Magnesium	: 22.67 to 47.60 meq/100g
Copper	: 2 – 9.50 mg kg-1
Iron	: 2 – 9.30 mg kg-1
Zinc	: 5.70 – 11.50 mg kg-1
Sulphur	: 128 – 548 mg kg-1

Bonemeal

Steamed animal bones are crushed into a fine powder or granules for use on plants or crops to make bone meal fertiliser. Bones contain nutrients and minerals that assist your plants, making them healthier and stronger. Phosphorus is abundant in rock phosphate and bone meal, with 25.2 and 20%, respectively (Akande et al., 2006; Andrews et al., 2011; Imogie et al.,). Akande and colleagues.

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Bonemeal is a product made from the waste left behind after meat processors butcher animals, particularly beef cattle. It is a white powder that is prepared by crushing raw or heated animal bones. Plants receive phosphorus and calcium from bone meal, as well as a little quantity of nitrogen. The N-P-K rating of bone meal is normally 3-15-0. The NPK contained can range from 1-13-0 to 3-22-0 with a calcium concentration of roughly 12% (18% CaO equiv.), however this can range from 1-13-0 to 3-22-0 depending on the source.

Cultivar Hill Queen

Sowing season is from May through November. Root colour is pure white and smooth, with little hair on the root surface. Roots mature to be 12-15 inches long, tapering and semicircular at the bottom, and sweet in flavour. Maturity After 50-55 days.

3. RESULT AND DISCUSSION

In the following table significant increment in percentage of different parameters was recorded.

Table 2. Significant increment in percentage of different vegetative parameters of radish (*R. sativus*) cv. Hill Queen.

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SNo.	Parameters recorded (Average)	Fertigation	No fertigation	Increased %
1.	Diameter of the foliage	65.30 cm	50.60 cm	29.05 %
2.	Length of the root	26.92 cm	21.10 cm	27.58%
3.	Diameter of the root	4.92 cm	3.9 cm	26.15%
4.	Circumference of the root	15.49 cm	12.3 cm	25.93%
5.	Number of leaves at harvesting	15.5	13.5	14.81%
6.	Number of root hair	36.8	34.8	5.74%
7.	Length of leaves	31.75 cm	24.80 cm	28.02%
8.	Leaves broadness	12.44 cm	8.8 cm	41.36%

9.	Root mass	185 gram	115 gram	60.86%
10.	Green mass	135 gram	75 gram	80.00%
11.	Total mass	324 gram	185 gram	75.13%
12.	Ph	6	6	0%
13.	TSS (°Brix)	5.82	5.81	Very minute
14.	Acidity (mg/100gram)	0.09	0.09	0%
15.	Vitamin C (mg/100gram)	18.19	18.18	Very minute

Comment [AM6]: May be pH?

The above data expressed in Table 2, is shown in the graphical representation (Fig. 1), below with the black bar showing significant increment in the major parameters in series 1 and series 2 representing fertilizer application and non-fertilizer applied values, respectively. The highest increase observed was of 80.00% in the green mass of the fertigated plants more than non-fertigated plants (Table 2), and increase in the total mass of plant (root plus green foliage) part which was in fertigated plant 75.13% more than non-fertigated plant. Root part and the green part weight was taken separately after finely chopping off the head. Mass of the separate root part was recorded of each R1 and R3 subplots on average 60.86% increase was recorded as this was the most important economical part, which is the main edible portion of the whole plant. Green foliage is more like byproduct for the cattle feed.

Green foliage canopy increased significantly after the use of the fertilizer combination particularly leaves length and broadness escalated by 28.02% and 41.36%, respectively. Most important edible part having economical value is radish roots. Scientist, breeder and researcher predominantly focus on the roots length, width, colour, pungency, etc. As the combined effect of vermicompost and bonemeal had shown more than a quarter increment in the respective parameters of the root. Increase in the length of the root by 27.58%, width (Diameter) of the root by 26.15% as the resultant increase in circumference by 25.93%.

Green canopy area (diameter of the foliage) was increased by 29.05 % as the leaves length and broadness increased but the number of the leaves and the number of root hairs didn't show that much rise as 14.81% and 5.74% only was observed.

The main contribution of the combined positive effect of the both organic fertilizer was predominantly on the physiological growth but not observed in pronounced way on the chemical content of the crop. Very minute or fractional change was recorded of Ph, Acidity, TSS(°Brix) and Vitamin C concentration of both fertigated and non-fertigated plants. The organic manures had statistically significant variation ($p < 0.05$) in all the growth and yield parameters including vitamin-C in quality parameter but no significant difference was found in TSS content (B. Gyewali, B. Maharjan, G. Rana, R. Pandey et al., YEAR)

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Fig. 1. Fertigated and non-fertigated effect on radish cv. Hill Queen

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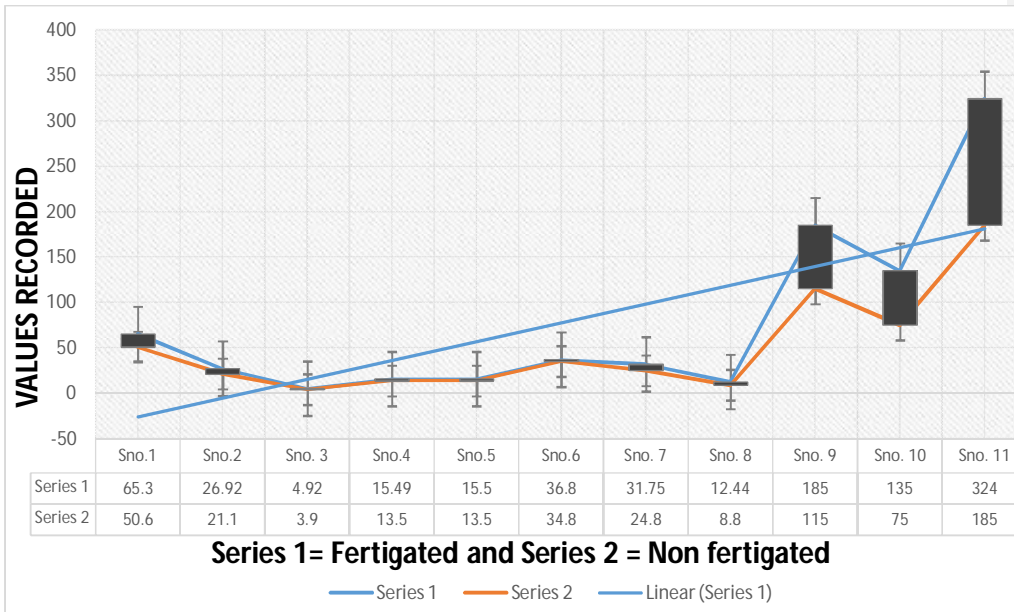


Fig. 2. PHOTOS OF THE CONTROL (NON FERTIGATED) PLANT

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Fig. 3. PHOTOS OF FERTIGATED (VERMICOMPOST+ BONEMEAL) PLANT.

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CONCLUSION

The current study found that combination of fertilizers had a substantial impact on the growth, production, and quality features of radish in the Kalyanpur region of North Indian plain, Kanpur, Uttar Pradesh. Potassium and phosphorus are important nutrients for the root crop and our organic fertilizer combination showed significant impact.

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