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Effect of different levels of Panchagavya and biocapsule on growth, yield and quality of radish (*Raphanus sativus*) in Prayagraj agroclimatic conditions

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Abstract

The experiment entitled “Effect of Different Levels of Panchagavya and Biocapsule on Growth, Yield and Quality of Radish (*Raphanus sativus*) in Prayagraj Agroclimatic Conditions” was carried out at Horticulture Research Farm in the Department of Horticulture, SHUATS, Prayagraj during *Kharif* season (2024). The experiment was laid out in Randomized Block Design consisting 9 treatments and are replicated thrice. The different treatments were allocated randomly in each replication. The treatment T₆ Biocapsule 500 ppm + Panchagavya 5 sprays @ 5% has produced significantly superior results in terms of growth, yield and quality of Radish (*Raphanus sativus*) viz., days to germination (4.40), plant height (28 cm), number of leaves per plant (16.66), length of leaf (24.20 cm), leaf area (2008.6 cm²), chlorophyll content (1.69 mg/g), root length (20.40), root diameter (3.80 cm), root weight per plant (328.78 g), root weight per plot (3.36 kg), root weight per hectare (149.41 q ha⁻¹), Total Soluble Solids (TSS) (6.19 °Brix) and Ascorbic acid (19.89 mg/100 g) the maximum benefit cost ratio was recorded in the same treatment with 3.14.

Keywords: Biocapsule, growth, panchagavya, radish, quality and yield

Introduction

Radish, scientifically known as (*Raphanus sativus*), is a popular root vegetable that belongs to the Brassicaceae family. Originating from Southeast Asia, it is now cultivated globally and appreciated for its crisp texture and peppery flavor. Radishes come in a variety of colors, including red, white, purple, and black, and they can be round, cylindrical, or elongated. This versatile vegetable is typically grown for its edible root, though the leaves, seeds, and pods can also be consumed.

Radishes are low in calories yet packed with vitamins and minerals, including vitamin C, potassium, and fiber. Their high-water content helps keep the body hydrated. Radishes are also known for their antioxidant properties, which help in fighting free radicals in the body. They can be eaten raw, pickled, or cooked, and are often used to add a crunchy, peppery punch to salads and dishes.

Radish cultivation requires well-drained, fertile soil with good organic matter. They prefer cool weather and can be planted in both spring and fall. The seeds are usually sown directly into the soil, and the plants thrive in full sunlight. They are relatively fast-growing, with some varieties ready to harvest in as little as 3-4 weeks. Regular watering and thinning of seedlings help ensure healthy growth and development.

Radishes are susceptible to pests like flea beetles, aphids, and root maggots. Diseases such as clubroot, downy mildew, and leaf spot can also affect radish crops. To manage these issues, integrated pest management practices, crop rotation, and the use of organic pesticides are recommended.

Panchagavya is an organic mixture used in traditional Indian agriculture to promote plant growth and improve soil fertility. The term "Panchagavya" derives from Sanskrit: "Pancha" meaning five and "Gavya" meaning cow-derived products. The five key ingredients of Panchagavya are

cow dung, cow urine, milk, curd, and ghee. These components are combined in specific proportions and allowed to ferment, resulting in a potent bio-enhancer.

Panchagavya contains nutrients viz., nitrogen (1000 ppm), phosphorus (175.40 ppm), potassium (194.10 ppm), magnesium (48 ppm), copper (0.38 ppm), zinc (1.37 ppm), calcium (152 ppm), manganese (1.84 ppm), iron (29.71 ppm) and Sulphur (485 ppm). It is a traditional organic formulation made from five key components derived from the cow, each contributing to its effectiveness. The primary ingredients are cow dung, cow urine, milk, curd, and ghee. These ingredients are rich in nutrients and beneficial microorganisms that support plant growth and soil health. To prepare Panchagavya, fresh cow dung and ghee are mixed thoroughly in a container and allowed to ferment for about three days. Then, cow urine is added, and the mixture is stirred daily for another 15 days. After that, cow milk, curd, and other optional ingredients like jaggery (for promoting microbial activity), tender coconut water (for growth stimulation), and banana (for enzyme enrichment) are added to the mixture. This blend is allowed to ferment for another week, after which it is ready for use. The entire process takes around 21 days, and regular stirring ensures proper fermentation. The final product is diluted in water before being applied to crops, either as a foliar spray or soil treatment, promoting healthy plant growth and pest resistance.

Panchagavya acts as a natural fertilizer and bio-stimulant, encouraging faster seed germination, stronger root development, and improved flowering and fruiting. Additionally, it strengthens the plant's resistance to pests and diseases, reducing the need for chemical pesticides. Environmentally friendly, Panchagavya supports sustainable farming by decreasing reliance on synthetic inputs, contributing to healthier ecosystems. Its application is versatile, from foliar sprays and soil treatments to seed soaking, and it is used in a variety of crops, including vegetables, fruits, and cereals. Beyond farming, it also finds use in animal husbandry, where it enhances the health and productivity of livestock. Economical and easy to prepare from natural ingredients, Panchagavya serves as a holistic solution for both small-scale farmers and organic farming enthusiasts.

Bio capsules represent a modern advancement in agricultural biotechnology. These capsules contain essential nutrients, beneficial microorganisms, or bio-pesticides encapsulated in a biodegradable shell. They offer a controlled release of contents, ensuring a steady supply of nutrients and protection to the plants over time.

Bio capsules typically contain a variety of natural, bioactive substances that support health and well-being. These capsules are designed to deliver essential nutrients, probiotics, herbal extracts, or enzymes in a concentrated form to improve bodily functions. Common ingredients may include vitamins, minerals, amino acids, and fatty acids that support immune function, energy levels, and overall vitality. In addition to these, bio capsules often contain probiotics or prebiotics to promote gut health, as well as plant-based compounds like antioxidants, flavonoids, or herbal extracts such as turmeric, ashwagandha, or ginseng, which help manage inflammation, stress, and oxidative damage. Some bio capsules are formulated with enzymes to aid digestion or detoxification processes. These natural ingredients are often encapsulated in biodegradable, plant-based or gelatin shells, making them easy to digest and ensuring that the bioactive compounds are absorbed efficiently by the body. Overall, bio capsules provide a convenient and concentrated way

to enhance health through natural, holistic means.

Materials and Methods

The present experiment was carried out during the kharif season of the year 2024 at Horticulture Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Sciences, and Technology was the site of the field experiment. Uttar Pradesh's Allahabad. It is located at 25.870N latitude and 81.150E longitude, which is 78 meters above sea level. This area has a subtropical climate with frigid winters, intense summer heat waves, and moderate rainfall. The experiment was laid out in a Randomized Block Design with 3 replications, consisted of 9 treatments viz, T₀: control, T₁: Biocapsule (250 ppm), T₂: Biocapsule (500 ppm), T₃: Panchagavya 3 sprays @ 3%, T₄: Panchagavya 5 sprays @ 5%, T₅: Biocapsule 250 ppm + Panchagavya 3 sprays @ 3%, T₆: Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%, T₇: Biocapsule 500 ppm + Panchagavya 3 sprays @ 3% and T₈: Biocapsule 250 ppm + Panchagavya 5 sprays @ 5% to study the effect of organic nutrients on growth, yield, quality and economic parameters viz. Days to germination, Plant height (cm) at 15, 30 and 45 DAS, Number of leaves per plant at 15, 30 and 45 DAS, Length of leaf (cm), Leaf area (cm²), Chlorophyll content (mg/g), Root length (cm), Root diameter (cm), Fresh root weight per plant (g), Root weight per plot (kg), Root yield per hectare (q/ha), TSS (°Brix), Ascorbic acid (mg/100 g), Cost of cultivation, Net return (Rs. ha) and Gross return (Rs. ha).

The radish variety and the study was "F1 Hybrid" seeds were sown at spacing of 15 cm x 45 cm all recommended agronomic practices were followed to raise the good crop the treatments were sprayed on 15 DAS, 30 DAS and 45DAS. Five plants were selected randomly from each net plot. The data recorded on different parameters during the year of the investigation were statically analyzed as per the statical methods described by (Panse and Sukhatame, 1985) ^[6].

Results and Discussion

Growth Parameters

Days to germination

It is evident from the data that, significantly maximum days to germination (4.40) of Radish was recorded with the treatment of T₆ Biocapsule 500 ppm + Panchagavya 5 sprays @ 5% however it was at par with Biocapsule 500 ppm + Panchagavya 3 sprays @ 3%, Biocapsule 250 ppm + Panchagavya 5 sprays @ 5% and Biocapsule 250 ppm + Panchagavya 3 sprays @ 3% treatment combinations. Where as the minimum days to germination (6.56) was recorded with the foliar application of T₀ Control.

Plant height (cm)

It is evident from the data that, significantly maximum plant height (24.60 cm) of Radish was recorded with the treatment of T₆ Biocapsule 500 ppm + Panchagavya 5 sprays @ 5% however it was at par with Biocapsule 500 ppm + Panchagavya 3 sprays @ 3% treatment combinations. Where as the minimum plant height (18.46 cm) was recorded with the foliar application of T₀ Control.

Number of leaves

It is evident from the data that, significantly maximum number of leaves per plant (16.66) of Radish was recorded with the treatment of T₆ Biocapsule 500 ppm + Panchagavya 5 sprays @ 5% however it was at par with Biocapsule 500 ppm +

Panchagavya 3 sprays @ 3% treatment combinations. Where as the minimum number of leaves per plant (8.20) was recorded with the foliar application of T₀ Control.

Length of leaf (cm)

It is evident from the data that, significantly maximum length of leaf (cm) (24.20) of Radish was recorded with the treatment of T₆ Biocapsule 500 ppm + Panchagavya 5 sprays @ 5% however it was at par with Biocapsule 500 ppm + Panchagavya 3 sprays @ 3% treatment combinations. Where as the minimum length of leaf (cm) (17.80) was recorded with the foliar application of T₀ Control.

Area of leaf (cm²)

The foliar application of Panchagavya and Biocapsule at the rate of (500ppm and 5%) recorded the highest leaf area (cm²) (208.86) and was significantly superior to T₀ Control, and it was followed by treatment Biocapsule 500 ppm + Panchagavya 3 sprays @ 3%, Biocapsule 250 ppm + Panchagavya 5 sprays @ 5% and Biocapsule 250 ppm + Panchagavya 3 sprays @ 3%. Where as the minimum leaf area (cm²) (134.11) was recorded with the foliar application of T₀ Control.

Chlorophyll content (mg/g)

The chlorophyll content was significantly influenced by foliar application of Panchagavya and Biocapsule. The highest chlorophyll content (mg/g) (1.69) was recorded when Panchagavya and Biocapsule was foliar application applied at the rate of Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%, however it was at par with Biocapsule 500 ppm + Panchagavya 3 sprays @ 3% treatment combinations. Where as the minimum chlorophyll content (mg/g) (0.71) was recorded with the foliar application of T₀ Control.

Yield Parameters

Root length (cm)

The root length (cm) of Radish was significantly influenced by foliar application of Panchagavya and Biocapsule. The highest root length (cm) (20.40) was recorded when Panchagavya and Biocapsule was foliar application applied at the rate of Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%, however it was at par with Biocapsule 500 ppm + Panchagavya 3 sprays @ 3% treatment combinations. Where as the minimum root length (cm) (12.06) was recorded with the foliar application of T₀ Control.

Root diameter (cm)

The root diameter of Radish was significantly influenced by foliar application of Panchagavya and Biocapsule. The highest root diameter (cm) (3.80) was recorded when Panchagavya and Biocapsule was foliar application applied at the rate of Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%, however it was at par with Biocapsule 500 ppm + Panchagavya 3 sprays @ 3% treatment combinations. Where as the minimum root diameter (cm) (3.13) was recorded with the foliar application of T₀ Control.

Root weight (g)

The root yield was significantly influenced by foliar application of Panchagavya and Biocapsule. The highest root weight per plant (g) (112.06) was recorded when Panchagavya and Biocapsule was foliar application applied at the rate of Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%, however it was at par with Biocapsule 500 ppm + Panchagavya 3 sprays @ 3% treatment combinations. Where as the minimum root weight per plant (g) (54.20) was recorded with the foliar application of T₀ Control.

Root weight per plot (kg)

The leaf yield was significantly influenced by foliar application of Panchagavya and Biocapsule. The highest root yield (kg plot⁻¹) (3.362) was recorded when Panchagavya and Biocapsule was foliar application applied at the rate of Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%, however it was at par with Biocapsule 500 ppm + Panchagavya 3 sprays @ 3% and Biocapsule 250 ppm + Panchagavya 5 sprays @ 5% treatment combinations. Where as the minimum root yield (kg plot⁻¹) (1.62) was recorded with the foliar application of T₀ Control.

Root yield per hectare (q/ha)

The root yield was significantly influenced by foliar application of Panchagavya and Biocapsule. The highest leaf yield (q ha⁻¹) (149.41) was recorded when Panchagavya and Biocapsule was foliar application applied at the rate of Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%, it was followed by treatment Biocapsule 500 ppm + Panchagavya 3 sprays @ 3% and Biocapsule 250 ppm + Panchagavya 5 sprays @ 5%. Where as the minimum root yield (q ha⁻¹) (72.28) was recorded with the foliar application of T₀ Control.

Quality parameter

TSS (Total Soluble Solids) (o Brix)

The root yield was significantly influenced by foliar application of Panchagavya and Biocapsule. The highest Total Soluble Solid (TSS) (6.19) was recorded when Panchagavya and Biocapsule was foliar application applied at the rate of Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%, however it was at par with Biocapsule 500 ppm + Panchagavya 3 sprays @ 3%, Biocapsule 250 ppm + Panchagavya 5 sprays @ 5% and Biocapsule 250 ppm + Panchagavya 3 sprays @ 3% treatment combinations. Where as the minimum Total Soluble Solid (TSS) (3.95) was recorded with the foliar application of T₀ Control.

Ascorbic acid (mg/100g)

The root yield was significantly influenced by foliar application of Panchagavya and Biocapsule. The highest Ascorbic acid (mg/100g) (19.89) was recorded when Panchagavya and Biocapsule was applied at the rate of T₆ 500 ppm + Panchagavya 5 sprays @ 5%, however it was at par with Biocapsule 500 ppm + Panchagavya 3 sprays @ 3% treatment combinations. Where as the minimum Ascorbic acid (mg/100g) (16.33) was recorded with the foliar application of T₀ Control.

Table 1: Growth parameters of Radish

Notation	Treatment combinations	Days to germination	Plant height			Number of leaves			Leaf length (cm)	Leaf area (cm ²)	Chlorophyll content (mg/g)
			15DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS			
T ₀	Control	6.56	13.66	16.00	18.46	4.20	6.26	8.20	17.80	1099.67	0.71
T ₁	Biocapsule (250 ppm)	5.56	10.60	18.46	22.26	5.60	7.73	11.53	20.00	1780.21	1.00
T ₂	Biocapsule (500 ppm)	5.23	12.13	19.20	23.46	5.96	8.33	12.26	21.13	1939.72	1.02
T ₃	Panchagavya 3 sprays @ 3%	6.10	12.60	17.26	19.40	4.80	6.80	9.40	18.33	1314.33	0.82
T ₄	Panchagavya 5 sprays @ 5%	5.86	11.13	17.86	20.60	5.20	7.26	10.60	19.26	1568.98	0.88
T ₅	Biocapsule 250 ppm + Panchagavya 3 sprays @ 3%	5.00	11.53	20.20	24.60	6.26	9.00	13.06	22.00	2050.95	1.09
T ₆	Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%	4.40	13.00	22.40	28.00	7.53	11.06	16.66	24.20	3480.20	1.69
T ₇	Biocapsule 500 ppm + Panchagavya 3 sprays @ 3%	4.66	15.40	21.80	26.13	7.06	10.60	15.33	23.26	3049.20	1.59
T ₈	Biocapsule 250 ppm + Panchagavya 5 sprays @ 5%	4.83	14.26	21.20	25.53	6.73	9.80	14.40	22.60	2498.44	1.26
	F-Test	S	S	S	S	S	S	S	S	S	S
	S.Ed. (+)	0.18	0.18	0.11	0.21	0.12	0.10	0.20	0.18	52.65	0.02
	C.D. at 0.5%	0.39	0.39	0.25	0.44	0.26	0.22	0.42	0.39	111.63	0.04
	CV	4.25	1.80	0.74	1.17	2.62	1.52	1.99	1.07	3.09	2.18

Table 2: Yield parameters of Radish

Notation	Treatment combinations	Root length (cm)	Root diameter (cm)	weight per plant (g)	Root weight per plot (kg)	Root yield per hectare (q/ha)
T ₀	Control	12.06	3.13	54.20	1.62	72.283
T ₁	Biocapsule (250 ppm)	14.20	3.20	69.73	2.036	90.487
T ₂	Biocapsule (500 ppm)	15.40	3.30	73.06	2.192	97.417
T ₃	Panchagavya 3 sprays @ 3%	12.73	3.13	58.86	1.766	78.487
T ₄	Panchagavya 5 sprays @ 5%	13.06	3.20	65.06	1.943	86.350
T ₅	Biocapsule 250 ppm + Panchagavya 3 sprays @ 3%	16.26	3.40	84.06	2.522	114.360
T ₆	Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%	20.40	3.80	112.06	3.362	149.417
T ₇	Biocapsule 500 ppm + Panchagavya 3 sprays @ 3%	19.13	3.60	103.80	3.120	137.997
T ₈	Biocapsule 250 ppm + Panchagavya 5 sprays @ 5%	18.26	3.46	93.26	2.798	125.153
	F-Test	S	S	S	S	S
	S.Ed. (±)	0.16	0.03	1.34	0.04	1.81
	C.D. at 0.5%	0.34	0.08	2.85	0.08	3.85
	CV	1.25	1.38	2.07	2.06	2.10

Table 3: Quality parameters of Radish

Notation	Treatment combinations	Total Soluble Solid (TSS)	Ascorbic acid (mg/100g)
T ₀	Control	3.95	16.33
T ₁	Biocapsule (250 ppm)	4.75	18.32
T ₂	Biocapsule (500 ppm)	5.30	18.52
T ₃	Panchagavya 3 sprays @ 3%	4.27	17.48
T ₄	Panchagavya 5 sprays @ 5%	4.38	17.94
T ₅	Biocapsule 250 ppm + Panchagavya 3 sprays @ 3%	5.48	18.91
T ₆	Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%	6.19	19.89
T ₇	Biocapsule 500 ppm + Panchagavya 3 sprays @ 3%	6.14	19.47
T ₈	Biocapsule 250 ppm + Panchagavya 5 sprays @ 5%	6.04	19.16
	F-Test	S	S
	S.Ed. (±)	0.06	0.10
	C.D. at 0.5%	0.13	0.21
	CV	1.50	0.68

Table 4: Economics of Radish

Notation	Treatment combinations	Total cost of cultivation	Root yield (q ha ⁻¹)	Selling price (Rs. Kg)	Gross return (Rs. ha ⁻¹)	Net return (Rs. ha ⁻¹)	Benefit cost ratio
T ₀	Control	167888.5	72.283	40	457020.5	289132	1.72
T ₁	Biocapsule (250 ppm)	171325.8	90.487	40	533273.8	361948	2.11
T ₂	Biocapsule (500 ppm)	171614.3	97.417	40	561282.3	389668	2.27
T ₃	Panchagavya 3 sprays @ 3%	182063.5	78.487	40	496011.5	313948	1.72
T ₄	Panchagavya 5 sprays @ 5%	189413.5	86.350	40	534813.5	345400	1.82
T ₅	Biocapsule 250 ppm + Panchagavya 3 sprays @ 3%	182350.8	114.417	40	640018.8	457668	2.50
T ₆	Biocapsule 500 ppm + Panchagavya 5 sprays @ 5%	189989.3	149.417	40	787657.3	597668	3.14
T ₇	Biocapsule 500 ppm + Panchagavya 3 sprays @ 3%	189989.3	137.017	40	738057.3	548068	2.88
T ₈	Biocapsule 250 ppm + Panchagavya 5 sprays @ 5%	182350.8	125.353	40	683762.8	501412	2.74

Conclusion

From the present investigation, it is concluded that treatment, T₆ (Bio capsule 500 ppm + Panchagavya 5 sprays @ 5%) performed best in terms of growth (plant height (28.00 cm), number of leaves (16.00), chlorophyll content (1.69 mg/g), yield (root yield per hectare (149.41) q/ha and quality (ascorbic acid (19.89 mg/100 g), TSS (6.19 °Brix), The height B:C ratio was also found in the same treatment with 3.14.

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