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Effect of panchagavya on growth, yield and quality of okra (*Abelmoschus esculentus* L. Moench)

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Abstract

The study took place at the Horticulture Research Farm of the Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj (UP) from February 2023 to June 2023. It aimed to assess the growth, yield, and quality of Okra. The experimental design employed was a Randomized Block Design (RBD) comprising nine treatments, each replicated three times. The findings indicated that T₄ (100% RDN + Sprayers of 5% Panchagavya) exhibited superior performance across various parameters: plant height (36.18 cm), number of branches per plant (6.33), days to 50% flowering (36.88), capsule length (13.65 cm), capsule width (7.06 mm), number of capsules per plant (14.77), fruit yield per plant (240.59 g), fruit yield per hectare (17.76 t/h), TSS content (4.91), and ascorbic acid (15.14 mg/100 g). Consequently, T₄ (100% RDN + Sprayers of 5% Panchagavya) emerged as the most effective treatment compared to others. Moreover, it yielded the highest benefit-cost ratio (5.35) in comparison to the other treatments.

Keywords: Ascorbic acid, benefit cost ratio growth, okra, panchagavya, quality, total soluble salt (TSS), yield

Introduction

Okra, scientifically known as *Abelmoschus esculentus* L. Moench, belongs to the Malvaceae family and has a chromosome number of $2n=72$. It is commonly referred to as "bhindi" in India, "Kajriab Khew" in Thailand, and has various other names such as okra plant, ochro, Okoro, quingombo, quingumbo, gombo, kopi arab, kacang bendi, and bhindi in Southeast Asia, as well as "lady's finger" in England. Okra is a versatile crop due to the multiple uses of its fresh leaves, buds, flowers, pods, stems, and seeds. The nutritional composition of okra pods per 100 g of edible portion (81% of the product, ends trimmed) includes: water 88.6 g, energy 144.00 KJ (36Kcal), protein 2.10 g, carbohydrates 8.20 g, fat 0.20 g, fiber 1.70 g, calcium (Ca) 84.00 mg, phosphorus (P) 90.00 mg, iron (Fe) 1.20 mg, β -carotene 185.00 mg, riboflavin 0.08 mg, thiamine 0.04 mg, niacin 0.60 mg, and ascorbic acid 47.00 mg. The nutritional composition of okra leaves per 100 g of edible portion includes water 81.50 g, energy 235.00KJ (56.00Kcal), protein 4.40 g, fat 0.60 g, carbohydrates 11.30 g, fiber 2.10 g, calcium (Ca) 532.00 mg, phosphorus (P) 70.00 mg, iron (Fe) 0.70 mg, ascorbic acid 59.00 mg, β -carotene 385.00 mg, thiamine 0.25 mg, and riboflavin 2.80 mg. Panchagavya holds a pivotal role in enhancing the quality of fruits and vegetables, commonly utilized as a foliar spray, soil application in conjunction with irrigation, and even as a seed treatment. Particularly in South India, farmers employ Panchagavya as a sustainable agricultural practice, steering away from chemical fertilizers and pesticides that contribute to environmental degradation. As an alternative to conventional chemicals, Panchagavya is sought after for its ability to improve crop establishment and health (Krishna Kumar *et al.*, 2020) ^[16] Functioning as a potent growth promoter and immunity booster for plants, Panchagavya is rich in beneficial microbial populations, serving as a natural fertilizer with remarkable effects on plant growth. It enhances the biological and metabolic efficiency of crops, containing growth hormones like Auxins and Gibberellins, which positively influence crop development. Furthermore, it acts as a tonic for soil enhancement, promoting both crop growth and yield, thereby instilling vigor in plants while ensuring quality production Panchagavya's significance extends to its role in conferring

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resistance against pests and diseases, consequently elevating overall yields. The primary objective of this experiment was to assess the impact of varying levels of Panchagavya on the growth, yield, and quality of okra.

Materials and Methods

The study was conducted at the Horticulture Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (U.P.) from February to June 2023. Employing a Randomized Block Design, the experiment comprised nine treatments replicated thrice, namely: T₀ Control (Recommended dose of nutrients), T₁ (100% RDN+ Sprayers of 2% Panchagavya), T₂ (100% RDN+ Sprayers of 3% Panchagavya), T₃ (100% RDN+ Sprayers of 4% Panchagavya), T₄ (100% RDN+ Sprayers of 5% Panchagavya), T₅ (100% FYM + Sprayers of 2% Panchagavya), T₆ (100% FYM+ Sprayers of 3% Panchagavya), T₇ (100% FYM + Sprayers of 4% Panchagavya), T₈ (100% FYM + Sprayers of 5% Panchagavya) utilizing Okra hybrids COVI Plus. Crop spacing was set at 45 × 30 cm, with the application of FYM @ 25 tones + NPK 100:50:50 as basal dose, alongside Panchagavya spraying conducted at 21, 28, 35, and 42 days after emergence at the two true leaf stage. Each plot measured 1.5×1.5 m. Data collection encompassed parameters such as Plant Height (cm), number of branches, number of leaves, days to germination, appearance of first flowering, appearance of 50% flowering, number of fruits per plant, length of fruit (cm), average fruit weight (g), diameter of fruit (mm), average yield per plant (g), total yield (t/ha), TSS (o Brix), and ascorbic acid (mg/100 g). TSS was determined using a hand refractometer, while Vitamin C was quantified through the neutralization method

Treatments details

There are 9 treatments in this research which are shown in table 1.

Table 1: Details of Treatment Combination.

Treatments	Treatment combination
T ₀	Control (Recommended dose of nutrients)
T ₁	100% RDN + 2% Panchagavya
T ₂	100% RDN + 3% Panchagavya
T ₃	100% RDN + 4% Panchagavya
T ₄	100% RDN + 5% Panchagavya
T ₅	100% FYM + 2% Panchagavya
T ₆	100% FYM + 3% Panchagavya
T ₇	100% FYM + 4% Panchagavya
T ₈	100% FYM + 5% Panchagavya

Results and Discussion

The results of the investigation, regarding the Study on growth, earliness, yield, quality parameters in Okra.

Growth Parameters Plant Height (cm)

The highest plant height, reaching 12.83 cm at 20 days after sowing, was observed in T₄ (100% RDN + 5% Panchagavya), closely followed by T₈ (FYM + 5% Panchagavya) with a height of 12.46 cm. Conversely, the lowest plant height of 9.13 cm was noted in T₀ (Control - Recommended).

T₄ (100% RDN + 5% Panchagavya) exhibited the highest plant height of 26.14 cm at 40 days after sowing, followed closely by T₈ (FYM + 5% Panchagavya) with a height of 25.83 cm. Conversely, the lowest plant height of 23.27 cm was recorded in T₀ (Control - Recommended).

T₄ (100% RDN + 5% Panchagavya) displayed the highest plant height of 36.18 cm at 60 days after sowing, closely followed by T₈ (FYM + 5% Panchagavya) with a height of 35.91 cm. Conversely, the lowest plant height of 32.80 cm was recorded in T₀ (Control - Recommended).

The notable increase in plant height observed with the application of a 5% spray of Panchagavya can be attributed to the presence of auxin, which promotes apical dominance, and GA₃, which stimulates cell elongation and division. These components in Panchagavya likely contribute to the significant and enhanced plant height observed. Similar results were reported by Kameswari *et al* [4].

Number of Branches per Plant

The most significant number of primary branches per plant, reaching 2.66 at 20 days after sowing, was observed in T₄ (100% RDN + 5% Panchagavya), followed closely by T₈ (100% FYM + 5% Panchagavya) with 2.33 branches. In contrast, the lowest number of primary branches per plant, 0.77, was noted in the control group, T₀ (Recommended).

At 40 days after sowing, a significant maximum of 3.99 primary branches per plant was recorded in both T₄ (100% RDN + 5% Panchagavya) and T₈ (FYM + 5% Panchagavya). Conversely, the lowest count of 1.88 branches per plant was observed again in T₀ (Recommended). These results underscore the significance of the number of primary branches per plant at the 40-day mark.

By the 60-day milestone, the highest number of primary branches per plant, 6.33, was documented in T₄ (100% RDN + 5% Panchagavya), closely trailed by T₈ (100% FYM + 5% Panchagavya) with 5.99 branches. Once more, the control group, T₀ (Recommended), exhibited the fewest branches per plant, numbering 3.66.

The application of a 5% spray of Panchagavya resulted in a significant and highest number of branches per plant. This effect is likely due to the presence of auxin and increased chlorophyll concentration in Panchagavya, stimulating enhanced photosynthetic activity that promotes apical dominance. Additionally, GA₃ in Panchagavya facilitates cell elongation and division, contributing to an increased number of branches. These findings align with previous studies conducted by Ram *et al*. and Mishra *et al* [6].

Number of Leaves per Plant

The most significant number of leaves per plant, reaching 10.88 at 20 days after sowing, was observed in T₄ (100% RDN + 5% Panchagavya), closely followed by T₈ (100% FYM + 5% Panchagavya) with 10.44 leaves. Conversely, the lowest number of leaves per plant, 7.44, was recorded in the control group, T₀ (Recommended).

At 40 days after sowing, a significant maximum of 20.99 leaves per plant was recorded in both T₄ (100% RDN + 5% Panchagavya) and T₈ (FYM + 5% Panchagavya). Conversely, the lowest count of 15.21 leaves per plant was observed again in T₀ (Recommended). These results underscore the significance of the number of leaves per plant at the 40-day mark.

By the 60-day milestone, the highest number of leaves per plant, 41.33, was documented in T₄ (100% RDN + 5% Panchagavya), closely trailed by T₈ (100% FYM + 5% Panchagavya) with 40.11 leaves. Once more, the control group, T₀ (Recommended), exhibited the fewest leaves per plant, numbering 32.10.

The application of a 5% spray of Panchagavya resulted in a significant and highest number of leaves per plant. This effect is likely due to the increased chlorophyll concentration in Panchagavya, stimulating enhanced photosynthetic activity.

Additionally, GA3 in Panchagavya facilitates cell elongation and division, contributing to an increased number of leaves. These findings align with similar results reported by Mishra *et al* [6].

Days to Germination

Significantly maximum number of days taken to germination of plants with the treatment T₁ (100% RDN+ Sprayers of 2% Panchagavya) was 6.80 days and the minimum number of days to germination was found the treatment (control).

Days to First Flowering & Days to 50% Flowering of Okra

T₄ (100% RDN + Sprayers of 5% Panchagavya) exhibited significantly shorter durations for both Day to 1st flowering and Days to 50% flowering of Okra, recorded at 31.39 and 37.77 days respectively. Conversely, T₀ (100% Recommended dose of nutrients) displayed the longest durations for both parameters, with 35.30 days for Day to 1st flowering and 41.99 days for Days to 50% flowering.

The significant and early initiation of 1st flowering observed with the application of a 5% spray of Panchagavya is likely attributed to the presence of GA3 and NPK in Panchagavya. Similar findings were reported by Patle *et al*.

Similarly, the significant and early occurrence of 50% flowering associated with the application of a 5% spray of Panchagavya may be influenced positively by Panchagavya, attributed to the cell differentiation and flower bud formation activity of cytokinin present in Panchagavya. Patle *et al*. also reported similar results.

Fruit Length

Significantly maximum fruit length of 13.65 after sowing was recorded at T₄ (100% RDN+ Sprayers of 5% Panchagavya) followed by T₈ (100% FYM+ Sprayers of 5% Panchagavya) of 12.94 whereas minimum fruit length of 7.02 was recorded in T₀ Control (Recommended).

The significant and maximum length of fruit was recorded with the application of 5% spray of Panchagavya which might be due to growth hormones and macronutrients that have affected treated plants along with increase photosynthesis causing the cell elongation and division. Similar results were reported by Sangeeta *et al* [10].

Number of Fruits per Plant

T₄ (100% RDN + Sprayers of 5% Panchagavya) exhibited the significantly highest number of fruits per plant, recording 14.77 fruits after sowing, closely followed by T₈ (100% FYM + Sprayers of 5% Panchagavya) with 14.44 fruits. In contrast, the minimum number of fruits per plant, 11.77, was recorded in the control group, T₀ (Recommended).

The significant increase in the number of fruits per plant observed with the application of a 5% spray of Panchagavya may be attributed to the presence of auxin and kinetin in Panchagavya. These components, upon application via foliar spray, likely favor the plants in producing a greater number of fruits per plant. Similar findings were reported by Nileema *et al* [7].

Average Fresh Fruit Weight (g)

T₄ (100% RDN + 5% Panchagavya) exhibited the significantly highest average fresh fruit weight of 17.77 g after sowing, closely followed by T₈ (100% FYM + Sprayers of 5% Panchagavya) with 16.94 g. Conversely, the minimum individual fruit weight, 12.37 g, was recorded in the control

group, T₀ (Recommended).

The significant increase in fruit weight observed with the application of a 5% spray of Panchagavya may be attributed to the metabolic activity stimulated by Panchagavya, leading to active translocation of a greater amount of carbohydrates to developing fruits. Additionally, the utilization of NPK present in Panchagavya likely contributes to the heavier fruits.

Fruit Diameter (mm)

T₄ (100% RDN + Sprayers of 5% Panchagavya) exhibited the significantly maximum fruit diameter of 7.08 mm after sowing, closely followed by T₈ (100% FYM + Sprayers of 5% Panchagavya) with 6.85 mm. Conversely, the minimum fruit diameter, 5.50 mm, was recorded in the control group, T₀ (Recommended).

The significant increase in fruit diameter observed with the application of a 5% spray of Panchagavya may be attributed to the presence of NPK, along with a combination of cytokinin, which enhances the efficiency of chlorophyll pigment and promotes greater photosynthate production. This results in increased allocation of resources to the economic part of the plant, leading to a higher fruit diameter. Similar findings were reported by Shafeek *et al* [12].

Average fruit yield per plant (g)

T₄ (100% RDN + Sprayers of 5% Panchagavya) exhibited the significantly maximum average fruit yield per plant of 240.59 g after sowing, closely followed by T₈ (100% FYM + Sprayers of 5% Panchagavya) with 211.86 g. Conversely, the minimum average fruit yield per plant, 136.53 g, was recorded in the control group, T₀ (Recommended).

The significant increase in fruit yield observed with the application of a 5% spray of Panchagavya may be attributed to the presence of microbes in Panchagavya that produce growth hormones. These hormones likely contribute to an increase in fruit weight, the number of fruits per plant, cell division, and cell elongation. This process is facilitated by the translocation of a greater amount of carbohydrates to the developing fruits. Similar findings were reported by Sanjiv *et al* [11].

Total Yield (t/ha)

T₄ (100% RDN + Sprayers of 5% Panchagavya) exhibited the significantly maximum total yield of 17.76 t/ha after sowing, closely followed by T₈ (100% FYM + Sprayers of 5% Panchagavya) with 15.61 t/ha. Conversely, the minimum total yield of 9.64 t/ha was recorded in the control group, T₀ (Recommended).

TSS (°Brix)

T₄ (100% RDN + Sprayers of 5% Panchagavya) exhibited the significantly maximum TSS (°Brix) of 4.91 after sowing, closely followed by T₈ (100% FYM + Sprayers of 5% Panchagavya) with 4.45. Conversely, the minimum TSS of 3.87 (°Brix) was recorded in the control group, T₀ (Recommended).

The significant increase in TSS observed with the application of a 5% spray of Panchagavya may be attributed to the rapid metabolic transformation of starch and pectin into soluble compounds. Additionally, there may be rapid translocation of sugars from leaves to developing fruits, contributing to the higher TSS levels. Similar findings were reported by Kameswari *et al* [4].

Ascorbic Acid (mg/100 g)

T₄ (100% RDN + Sprayers of 5% Panchagavya) exhibited the

significantly maximum ascorbic acid content of 15.14 mg/100 g after sowing, closely followed by T₈ (100% FYM + Sprayers of 5% Panchagavya) with 14.21 mg/100 g. Conversely, the minimum ascorbic acid content of 12.84 mg/100 g was recorded in the control group, T₀ (Recommended).

The significant increase in Vitamin C content observed with the

application of a 5% spray of Panchagavya may be attributed to the rapid metabolic transformation of starch and pectin into soluble compounds. Additionally, there may be rapid translocation of sugars from leaves to developing fruits, contributing to the higher Vitamin C levels. Similar findings were reported by Meenakshi *et al* [5].

Table 2: Data regarding Growth parameters

Treatment	Plant Height at 20 days (cm)	Plant Height at 40 days (cm)	Plant Height at 60 days (cm)	No. of Branches at 20 days	No. of Branches at 40 days	No. of Branches at 60 days	No. of Leaves at 20 days	No. of Leaves at 40 days	No. of Leaves at 60 days
T ₀	9.13	23.27	32.8	0.77	1.88	3.66	7.44	15.21	32.1
T ₁	10.42	24.11	33.56	1.11	2.44	4.33	8.1	16.44	33.99
T ₂	10.92	24.8	34.43	1.55	2.99	4.99	8.99	17.99	35.99
T ₃	12.07	25.52	35.22	2.1	3.66	5.66	10.1	19.99	38.22
T ₄	12.83	26.14	36.18	2.66	3.99	6.33	10.88	20.99	41.33
T ₅	9.56	23.68	33.23	0.88	2.1	3.99	7.77	16.11	33.66
T ₆	10.68	24.24	33.83	1.22	2.66	4.66	8.55	16.88	34.88
T ₇	11.36	25.09	34.99	1.88	3.33	5.33	9.66	19.77	37.66
T ₈	12.46	25.83	35.91	2.33	3.99	5.99	10.44	20.55	40.11
CD at 5%	0.39	0.32	0.65	0.22	0.37	0.01	0.20	0.81	2.25
S.Ed(±)	0.19	0.15	0.31	0.10	0.17	0.00	0.10	0.38	1.06

Table 3: Data regarding Earliness, Yield and Quality Parameters

Treatment	Days to Germination	Days to first flowering	Days of 50% flowering	Fruit Length	No. of fruits per plant	Average fruit weight (g)	Average fruit yield per plant (g)	Total yield (t/ha)	Fruit diameter (mm)	TSS (°Brix)	Ascorbic Acid (mg/100 g)
T ₀	6.00	35.3	41.99	7.02	11.77	12.37	136.53	9.64	5.5	3.87	12.84
T ₁	6.80	35.29	40.66	11.32	12.55	14.24	146.47	10.8	5.99	4.07	13.16
T ₂	6.40	33.99	39.77	11.94	13.22	15.32	178.43	13.17	6.5	4.146	13.60
T ₃	6.67	32.88	38.44	12.66	14.1	16.15	194.86	14.35	6.73	4.43	14.21
T ₄	6.47	31.39	37.77	13.65	14.77	17.77	240.59	17.76	7.08	4.91	15.14
T ₅	6.13	36.62	41.21	10.73	12.22	12.99	139.37	11.28	5.95	4.66	14.14
T ₆	6.00	34.29	40.33	11.78	12.88	14.8	158.88	11.69	6.3	4.35	14.21
T ₇	6.67	33.02	39.10	12.18	13.55	15.55	186.1	13.76	6.64	4.38	13.72
T ₈	6.53	30.73	36.88	12.94	14.44	16.94	211.86	15.61	6.85	4.45	13.82
CD at 5%	1.09	2.84	0.71	0.50	0.38	1.90	18.94	1.14	0.31	0.46	0.84
S.Ed(±)	0.51	1.34	0.34	0.24	0.18	0.90	8.93	0.54	0.15	0.22	0.40

Conclusion

From the present investigation it is concluded that the effect of Panchagavya has a significant effect on growth, yield and Quality of Okra. Among all the treatments the treatment T₄ was found to be best in terms of growth, yield and quality of Okra.

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