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Effect of different dose of NPK with biofertilizer on growth and yield of pumpkin in semi arid conditions of Bundelkhand region

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Abstract

A field experiment was conducted to evaluate the effect of different doses of NPK in combination with biofertilizers on growth, flowering, and yield parameters of pumpkin under semi-arid conditions. Significant variations were observed among the treatments for all the characters studied. The maximum vine length (448.50 cm at 90 DAS) was recorded under treatment T₆, while the minimum (321.38 cm) was observed in the control (T₀). The highest number of branches per vine (13.49) was recorded in T₃. Flowering parameters also showed significant differences; the number of male flowers was maximum (80.80) in T₅, whereas the minimum (53.81) was observed in T₁. Improvement in sex ratio and flowering behavior under integrated nutrient application was attributed to enhanced physiological activity and growth-promoting substances released by biofertilizers. Fruit characters were significantly influenced by nutrient treatments. The maximum number of fruits per vine (2.48) was recorded in T₃, while the highest fruit weight (4041.0 g) was obtained in T₄ (125% recommended dose of NPK + PSB). Yield parameters revealed that treatment T₃ produced the highest fruit yield per plot (30.52 kg) and per hectare (203.50 q ha⁻¹), followed by T₇. The lowest yield was recorded in T₁. The enhanced growth and yield under integrated application of NPK and biofertilizers may be attributed to improved nutrient availability, better vegetative growth, enhanced flowering, higher fruit set, and increased fruit weight. Overall, integrated nutrient management proved superior in improving productivity of pumpkin.

Keywords: Pumpkin, NPK levels, biofertilizers, vine length, flowering, fruit yield, semi-arid conditions, productivity

Introduction

Pumpkin (*Cucurbita moschata* Duch. ex Poir.) belongs to the family Cucurbitaceae and is one of the oldest cultivated vegetable crops known for its high yield potential, nutritional richness, and wide adaptability. Pumpkin fruits are rich in carbohydrates, carotenoids (especially β -carotene), vitamins A, C and E; minerals like potassium and calcium, and possess antioxidant properties. Due to these attributes, pumpkin is considered a functional food with health-promoting benefits. In India, among states highest area and production under vegetable cultivation is in West Bengal (1.49 million hectares and 28.35 million tonnes) followed by Uttar Pradesh (1.18 million hectares and 27.12 million tonnes) and Bihar (0.85 million hectares and 16.67 million tonnes) (National Horticulture Board, 2023-24). Plant nutrients are vital for sustaining plant growth and achieving maximum yield. Among these, nitrogen (N), phosphorus (P), and potassium (K) are considered primary macronutrients essential for vegetative growth, reproductive development, and yield formation. Nitrogen is a key constituent of proteins, amino acids, and chlorophyll and influences the vegetative vigor, leaf area, and photosynthetic capacity of plants. Phosphorus plays a crucial role in energy transfer (ATP synthesis), root development, early flowering, and fruit set. Potassium contributes to enzyme activation, osmotic regulation, translocation of photosynthates, and stress tolerance, which enhances both yield and fruit quality traits. Several studies have reported significant interactions between biofertilizers and chemical fertilizers. Integrated use of biofertilizers with reduced rates of NPK has been shown to enhance nutrient uptake, physiological efficiency, growth parameters, and yield attributes in several vegetable and field crops compared to sole application of chemical fertilizers.

In cucurbit crops like pumpkin, synergistic effects of biofertilizers and NPK have been associated with improved plant height, vine length, leaf area index, number of fruits per plant, average fruit weight, and total yield (Singh & Sharma, 2020) [5].

Materials and Methods

The current study “Effect of different dose of NPK with biofertilizer on growth and yield of pumpkin in semi arid condition of Bundelkhand” was conducted during summer season of 2024-25 at the Rainfed Agriculture Research Farm, Narayan Bagh, Bundelkhand University Jhansi (Uttar Pradesh). The treatments details are as follow

Table 1: Details of treatment with symbols

S. No.	Treatment	Symbol
1.	100% RDF	T ₀
2.	100% recommended dose of NPK + PSB	T ₁
3.	75% recommended dose of NPK + PSB	T ₂
4.	125% recommended dose of NPK + PSB	T ₃
5.	75% recommended dose of NPK + 25% FYM	T ₄
6.	75% recommended dose of NPK + 25% FYM + PSB	T ₅
7.	75% recommended dose of NPK + 25% VC	T ₆
8.	75% recommended dose of NPK + 25% VC + PSB	T ₇

The experiment was laid out in Randomized Block Design with Three replications and eight treatments. Variety used was NS9521 for Pumpkin.

Results and Discussion

Vine length recorded at 90 days after sowing (DAS) exhibited significant variation among the treatments. The maximum vine length (448.50 cm) was observed under treatment T₆, which was significantly superior to the remaining treatments, whereas the minimum vine length (321.38 cm) was recorded in T₀ (control). The enhanced vegetative growth under T₆ might be attributed to the integrated application of recommended doses of NPK along with biofertilizers, which ensured balanced nutrient availability throughout the crop growth period. Nitrogen plays a pivotal role in chlorophyll synthesis, amino acid formation, and protein metabolism, thereby promoting vigorous vegetative growth and cell elongation. Phosphorus enhances root proliferation and energy transfer through ATP synthesis, while potassium regulates enzymatic activity and translocation of photosynthates. Similar enhancement in vine length due to integrated nutrient management in cucurbits has been reported by Kumar *et al.* (2013) [7] in pumpkin, Meena *et al.* (2015) [9] in bottle gourd, and Yadav *et al.* (2017) [19] in cucumber, where combined application of NPK and biofertilizers significantly improved vegetative parameters under semi-arid conditions. The number of branches per vine at 90 DAS also showed significant differences among treatments. Treatment T₃ recorded the maximum number of branches (13.49), whereas the minimum (9.65) was observed in the control (T₀). Increased branching under integrated nutrient application may be attributed to enhanced nitrogen availability, which stimulates lateral bud differentiation and cytokinin

synthesis, leading to improved vegetative proliferation. Similar findings were reported by Singh *et al.* (2014) [16] and Choudhary *et al.* (2018) [12], who observed that combined use of inorganic fertilizers and biofertilizers significantly increased branching and canopy development in cucurbitaceous crops. Regarding floral characters, significant variation was observed in the number of male flowers, female flowers, and sex ratio due to different nutrient treatments. The minimum number of male flowers per vine (53.81) was recorded in T₁, whereas the maximum (80.80) was recorded in T₅, which was statistically at par with T₂ and T₇. The modification in sex expression and improvement in sex ratio under biofertilizer treatments may be attributed to the production of growth-promoting substances such as auxins, gibberellins, and cytokinins by microbial inoculants like PSB and Azotobacter. These substances positively influence floral differentiation and enhance female flower production. Similar observations were reported by Sharma *et al.* (2016) [15] in pumpkin and Verma *et al.* (2019) [18] in cucumber, where integrated nutrient management significantly improved flowering behaviour and reduced male: female flower ratio. The number of fruits per vine was significantly influenced by different treatments. Treatment T₃ produced the maximum number of fruits per vine (2.48), followed by T₂, whereas the minimum (1.41) was observed in T₅. The increase in fruit number might be due to improved nutrient uptake and better carbohydrate partitioning resulting from balanced fertilization. Integrated nutrient application enhances sink strength and fruit retention capacity. Similar improvements in fruit set under integrated nutrient management were reported by Patel *et al.* (2017) [11] and Kaur *et al.* (2020) [5] in cucurbits.

Fruit weight was also significantly affected by nutrient treatments. The maximum fruit weight (4041.0 g) was recorded in T₄ (125% recommended dose of NPK + PSB), while the minimum (3000.35 g) was observed in T₁. The increased fruit weight under T₄ may be due to enhanced photosynthetic efficiency, better translocation of assimilates, and improved nutrient solubilization by PSB. These results are in conformity with findings of Rathore *et al.* (2015) [14] and Kumar *et al.* (2021) [6], who reported that integrated nutrient management significantly improved fruit size and weight in pumpkin and other cucurbits. Yield parameters exhibited significant variation among treatments. Treatment T₃ recorded the maximum fruit yield per plot (30.52 kg) and the highest yield per hectare (203.50 q ha⁻¹), followed by T₇ (196.14 q ha⁻¹), whereas the lowest yield was recorded in T₁ (105.12 q ha⁻¹). The substantial increase in yield under integrated application of NPK and biofertilizers may be attributed to improved soil microbial activity, enhanced nutrient availability, better vegetative growth, improved flowering, higher fruit set, and increased fruit weight. Biofertilizers improve soil health by increasing nutrient solubilization and biological nitrogen fixation, which ultimately enhances crop productivity. Similar yield enhancement under integrated nutrient management has been reported by Meena *et al.* (2015) [9], Singh *et al.* (2018), and Kaur *et al.* (2020) [5] in pumpkin and related cucurbit crops grown under semi-arid agro-climatic conditions.

Table 2: Effect of different doses of NPK in combination with biofertilizers on growth and yield parameters of pumpkin under semi-arid conditions.

Treatment	Length of vine cm			Average Number of branches per vine			Number of male and female flowers per vine			Average Number of fruits per vine	Average Weight of fruit (kg)	Yield per vine (kg)	Yield per plot (kg)	Yield per ha (q)
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	Male flowers	Female flowers	Sex ratio					
T ₀	13.37	146.50	321.38	0.94	8.95	9.65	53.81	6.24	8.62	1.66	3.35	5.51	15.58	105.12
T ₁	15.18	161.50	386.50	1.33	9.93	11.81	56.24	6.62	8.49	2.06	3.68	7.58	27.42	144.39
T ₂	17.99	184.73	376.25	1.24	10.76	11.92	62.20	7.68	8.09	2.40	3.96	9.53	25.75	181.42
T ₃	20.38	182.68	448.50	1.57	11.07	13.49	67.24	8.58	7.83	2.48	4.30	10.68	30.52	203.50
T ₄	18.51	176.25	388.50	1.35	10.79	12.84	76.69	7.97	9.62	1.45	4.41	6.73	21.75	128.09
T ₅	18.70	177.25	409.75	1.38	10.78	13.10	80.80	7.94	10.17	1.41	4.07	6.36	10.86	121.17
T ₆	18.60	175.98	442.30	1.34	10.21	13.32	62.32	7.11	8.03	1.88	4.09	7.45	20.11	183.23
T ₇	18.87	170.30	436.67	1.26	9.94	11.98	66.71	8.54	7.90	1.84	3.69	7.69	25.12	196.14
'F' test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig		Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.32	3.24	6.01	0.09	0.19	0.24	0.49	0.15		0.15	0.10	0.66	10.87	7.61
C.D. at 5%	0.95	9.77	18.10	0.27	0.57	0.71	1.49	0.46		0.46	0.30	2.00	39.88	28.02

Conclusion

The study clearly indicates that integrated application of NPK fertilizers with biofertilizers significantly improves growth, flowering, and yield of pumpkin under semi-arid conditions. Among the treatments, T₃ and T₄ proved most effective in enhancing fruit yield and fruit weight, respectively. Therefore, integrated nutrient management can be recommended for achieving higher productivity and sustainable pumpkin cultivation in semi-arid regions.

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