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PERFORMANCE OF INTEGRATED NUTRIENT MANAGEMENT IN YIELD AND ECONOMIC TRAITS OF BOTTLE GOURD (*LAGENARIA SICERARIA* MOL. STANDL.) CV. PUSA NAVEEN

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ABSTRACT

This study investigates the effects of integrated nutrient management (INM) on the yield and economic attributes of bottle gourd. The experiment was conducted during the *Kharif* season of 2023-2024 at the Horticulture Experimental Field, Department of Horticulture, College of Agriculture, RVSKVV, Gwalior (M.P.). Our findings demonstrate that the treatment T_{13} - 75% RDF + Vermicompost (12 t/ha) + Azotobacter (5 kg/ha) + PSB (5 kg/ha) + KSB (5 lit/ha) - significantly enhanced bottle gourd yield, resulting in maximum fruit yield per plant (17.88 kg), fruit yield per hectare (298.3 q), and economic traits such as the highest gross returns of 4,47,000 Rs./ha, a net return of 3,37,100 Rs./ha and a cost-benefit ratio of 3.1, compared to other levels of fertilizers, organic manures and biofertilizers.

***Keywords*:** Biofertilizers, Economics, Integrated Nutrient Management, Yield.

Introduction

Bottle gourd (*Lagenaria siceraria* [Mol.] Standl.; 2n = 22), commonly referred to as long melon, white-flowered gourd or ghiya, holds significant importance among cucurbitaceous vegetable crops cultivated in tropical and subtropical regions worldwide. It is extensively grown in countries such as India, Sri Lanka, Indonesia, Malaysia, the Philippines, China, Hong Kong and Tropical Africa. Within India, the primary regions of cultivation include Bihar, Madhya Pradesh, West Bengal, Gujrat, Haryana, Uttar Pradesh, Punjab, Chhattisgarh, Orissa and Assam, contributing to an annual production of 2.86 million tonnes (Anonymous, 2024). The term bottle gourd is believed to derive from the traditional use of its mature fruits as containers or utensils. Nationally, bottle gourd covers an area of 223.84 million hectares with a total production of 3779.52 million tonnes. Specifically, in Madhya Pradesh, cultivation spans 30.30 thousand hectares with a production of 539.19 thousand metric tonnes (Anonymous, 2024). Nutritionally, bottle gourd is a rich source of energy (21 kcal), protein (0.5 g), fat (0.19 g), carbohydrates (5.2 g), fiber (0.6 g), phosphorus (34 mg) and iron (2.4 mg) (Mandloi *et al.*, 2022). Additionally, it provides essential fatty acids, antioxidants and vitamins, particularly vitamins E, A and C (Hassan *et al.*, 2008). The tender fruits are widely utilized in culinary preparations such as sweets, raita and pickles. Furthermore, the hardened shells of mature fruits serve various purposes including the fabrication of containers, water jugs, domestic utensils, musical instruments, fishing net floats and ornamental crafts.

In recent agricultural practices, the overuse of inorganic fertilizers to boost yield has led to the deterioration of soil quality, environmental degradation and potential health hazards. Present-day strategies emphasize reducing the dependence on chemical fertilizers to minimize production costs and mitigate environmental pollution. Integrating organic manures with lower doses of inorganic fertilizers has proven effective in enhancing soil health, crop growth and yield in bottle gourd cultivation. Organic inputs such as vermicompost, biofertilizers and farmyard manure have shown significant improvement in soil fertility and the quality of produce. Vermicompost, in particular, is a biologically active, peat-like organic amendment produced through the decomposition and humification of organic wastes by soil microbes and earthworms. It not only improves soil nutrient dynamics but also promotes superior plant growth and productivity (Leghari *et al*., 2014).

Materials and Methods

The field experiment was conducted during the *kharif* season of 2023-24 at the Experimental Field of the Department of Horticulture, College of Agriculture, Gwalior, under the agro-climatic conditions of northern Madhya Pradesh. The experimental field is situated at the latitude 26^0 13' North and longitude of 76^0 14' East with an altitude of 211.52 m above mean sea level. The average annual precipitation in the gwalior region is 700 mm. The soil was slightly alkaline in nature (pH 7.6) with normal electrical conductivity (EC 0.32 dS m^{-1}). It contained a medium level of organic carbon (0.45 g kg^{-1}), low available nitrogen (197 kg ha^{-1}), medium phosphorus content (19 kg ha^{-1}) and low available potassium (241 kg ha^{-1}). The primary objective of the study was to assess the impact of different nutrient management strategies on the yield and economic parameters of bottle gourd (*Lagenaria siceraria*) cultivar 'Pusa Naveen.' The experiment was designed using a Randomized Block Design (RBD) comprising thirteen treatments, each replicated three times. The treatments were as follows: T_1- 100% RDF (Control), T_2- 75% RDF + Azotobacter (5 kg/ha) + PSB (5 kg/ha), T_3- 75% RDF + Azotobacter (5 kg/ha) + KSB (5 lit/ha), T_4- 75% RDF + PSB (5 kg/ha) + KSB (5 lit/ha), T_5- 75% RDF + Azotobacter (5 kg/ha) + PSB (5 kg/ha) + KSB (5 lit/ha), T_6- 75% RDF + FYM (25 t/ha) + Azotobacter (5 kg/ha) + PSB (5 kg/ha), T_7- 75% RDF + FYM (25 t/ha) + Azotobacter (5 kg/ha) + KSB (5 lit/ha), T_8- 75% RDF + FYM (25 t/ha) + PSB (5 kg/ha) + KSB (5 lit/ha), T_9- 75% RDF + FYM (25 t/ha) + Azotobacter (5 kg/ha) + PSB (5 kg/ha) + KSB (5 lit/ha), T_{10}- 75% RDF + Vermicompost (12 t/ha) + Azotobacter (5 kg/ha) + PSB (5 kg/ha), T_{11}- 75% RDF + Vermicompost (12 t/ha) + Azotobacter (5 kg/ha) + KSB (5 lit/ha), T_{12}- 75% RDF + Vermicompost (12 t/ha) + PSB (5 kg/ha) + KSB (5 lit/ha) and T_{13}- 75% RDF + Vermicompost (12 t/ha) + Azotobacter (5 kg/ha) + PSB (5 kg/ha) + KSB (5 lit/ha). Each experimental plot measured 3 × 2 m². Nutrient management treatments involved the application of organic manures [Farmyard manure (FYM) at 25 t/ha and vermicompost at 12 t/ha], biofertilizers [Azotobacter at 5 kg/ha, phosphate solubilizing bacteria (PSB) at 5 kg/ha and potassium solubilizing bacteria (KSB) at 5 liters/ha], along with different proportions of the recommended dose of fertilizers (100:60:80 NPK kg/ha). Prior to sowing, one-third of the nitrogen, along with the full recommended doses of phosphorus and potassium, were incorporated into the soil. The remaining nitrogen was top-dressed in two equal splits at 30 and 60 days after sowing. All fertilizers and organic inputs were uniformly mixed into the soil manually using a hand hoe according to the treatment specifications. For data collection, five plants were randomly selected from each plot to record observations related to yield attributes. Plot-wise yield was calculated, subsequently extrapolated to determine the overall yield, and yield converted in quintal per hectare with the using of following formula.

$$\text{Fruit yield}\left(\frac{q}{ha}\right) = \frac{\text{Yield per plot (kg)} \times 10000}{\text{Plot area } (m^2) \times 100}$$

Economic returns were estimated based on prevailing market prices of the produce and the costs of inputs utilized in the experiment.

$$\text{Net Monetary Returns}\left(\frac{Rs}{ha}\right) = \text{Gross return}\left(\frac{Rs}{ha}\right) - \text{Cultivation cost}\left(\frac{Rs}{ha}\right)$$

and

Benefit Cost Ratio = Gross return (Rs/ha) / Cost of cultivation (Rs./ha)

The collected data were subjected to statistical analysis using the Analysis of Variance (ANOVA) method as outlined by Panse and Sukhatme (1985). The significance of treatment differences was determined using the t-test at a 5% probability level (P = 0.05).

Results and Discussion

Yield-contributing parameters

Data pertaining to fruit yield per plant (kg) and per hectare (q) are presented in Table 1 and fig. 1. The highest fruit yield, both per plant (17.88 kg) and per hectare, was recorded under treatment T_{13} (75% RDF + Vermicompost @ 12 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha + KSB @ 5 lit/ha), while the lowest yield per plant (12.30 kg) and per hectare was observed under treatment T_1 (100% RDF). The superior yield performance under T_{13} may be attributed to enhanced vegetative growth, improved nutrient availability, and a better source-sink relationship, leading to greater assimilate partitioning towards the developing fruits. These results are consistent with the findings of Geethu *et al*. (2018), Ghayal *et al*. (2018), Mahale *et al*. (2018), Singh *et al*. (2018), Patel *et al*. (2019), Shah *et al*. (2020), Gaddam *et al*. (2022) and Niharika *et al*.

(2023), who also reported that the integrated use of organic manures, biofertilizers and reduced levels of chemical fertilizers significantly enhanced yield parameters in bottle gourd.

Economic Analysis

The economic parameters recorded are summarized in Table 1 and fig. 2. The highest cost of cultivation (1,09,900 Rs./ha), gross returns (44,7000 Rs./ha), net returns (33,7100 Rs./ha) and benefit-cost ratio (3.1) were recorded under treatment T_{13} (75% RDF + Vermicompost @ 12 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha + KSB @5 lit/ha). Conversely, the lowest values for these economic indicators were observed under treatment T_1 (100% RDF). The enhanced economic returns under T_{13} can be attributed to the superior yield performance, which offset the relatively higher cultivation costs, thereby resulting in greater profitability and a favourable benefit-cost ratio. These findings are in close agreement with those reported by Nayak *et al.* (2016), Patle *et al.* (2018), Shah *et al.* (2020) and Mandloi *et al.* (2022), who also emphasized the economic advantages of integrated nutrient management practices in vegetable crops.

Table 1 : Effect of Integrated Nutrient Management on Yield and Economic Parameters of Bottle gourd

Treatments	Fruit yield per plant (kg)	Fruit yield (q/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	Benefit cost ratio
T_1- 100% RDF (Control)	12.30	205.6	89400	307500	218100	2.4
T_2- 75% RDF + AB (5 kg/ha) + PSB (5 kg/ha)	12.78	213.4	89900	319500	229600	2.6
T_3- 75% RDF + AB (5 kg/ha) + KSB (5 lit/ha)	12.90	215.6	90400	322500	232100	2.6
T_4- 75% RDF + PSB (5 kg/ha) + KSB (5 lit/ha)	13.20	220.1	90900	330000	239100	2.6
T_5- 75% RDF + AB (5 kg/ha) + PSB (5 kg/ha) + KSB (5 lit/ha)	13.62	227.4	92400	340500	248100	2.7
T_6- 75% RDF + FYM (25 t/ha) + AB(5 kg/ha) + PSB (5 kg/ha)	14.58	243.0	94900	364500	269600	2.8
T_7- 75% RDF + FYM (25 t/ha) + AB (5 kg/ha) + KSB (5 lit/ha)	13.80	230.7	97900	345000	247100	2.5
T_8- 75% RDF + FYM (25 t/ha) + PSB (5 kg/ha) + KSB (5 lit/ha)	13.86	231.8	98400	346500	248100	2.5
T_9- 75% RDF + FYM (25 t/ha) + AB (5 kg/ha) + PSB (5 kg/ha) + KSB (5 lit/ha)	15.62	262.1	100900	393000	292100	2.9
T_{10}- 75% RDF + VC (12 t/ha) + AB (5 kg/ha) + PSB (5 kg/ha)	17.16	286.3	107400	429000	321600	3.0
T_{11}- 75% RDF + VC (12 t/ha) + AB (5 kg/ha) + KSB (5 lit/ha)	16.44	274.2	107900	411000	303100	2.8
T_{12}- 75% RDF + VC (12 t/ha) + PSB (5 kg/ha) + KSB (5 lit/ha)	15.66	261.0	108400	391500	283100	2.6
T_{13}- 75% RDF + VC (12 t/ha) + AB (5 kg/ha) + PSB (5 kg/ha) + KSB (5 lit/ha)	17.88	298.3	109900	447000	337100	3.1
SEm (±)	0.860	10.353	-	-	-	-
CD 5%	2.581	30.217	-	-	-	-

*RDF= Recommended dose of fertilizer, VC= Vermicompost, AB= *Azotobacter*, PSB= Phosphorus Solubilizing bacteria, KSB= Potassium Solubilizing Bacteria
SEm= Standard Error of Mean CD= Critical Difference

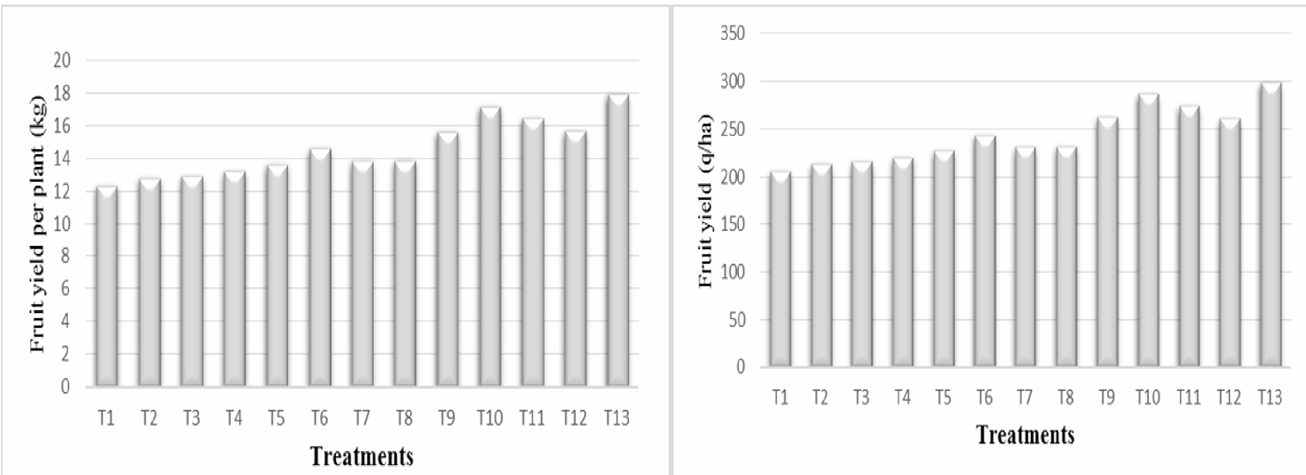

Fig. 1 : Effect of Integrated Nutrient Management on Fruit Yield per Plant (kg) and Fruit Yield (q/ha) of Bottle gourd

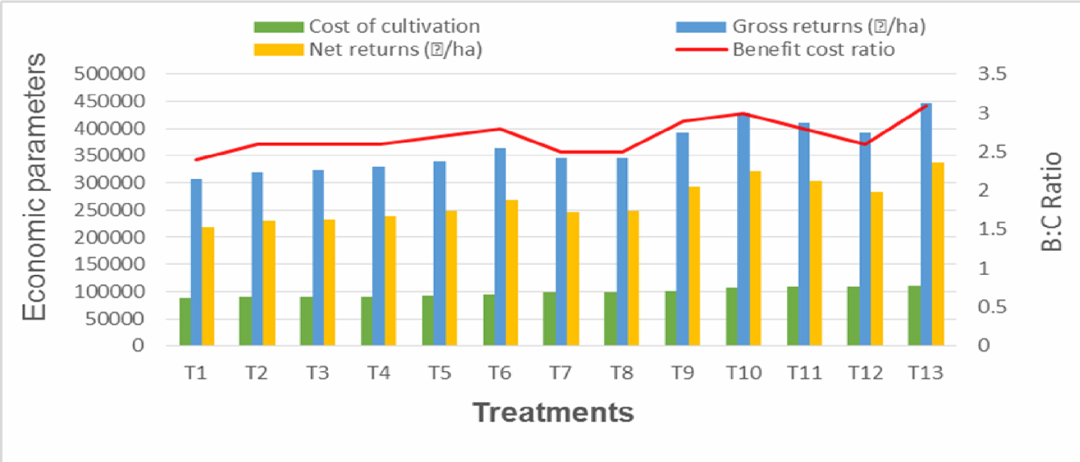

Fig. 2 : Effect of Integrated Nutrient Management on Economic Parameters of Bottle gourd

Conclusion

The study revealed that integrated nutrient management significantly enhanced the yield and profitability of bottle gourd (cv. Pusa Naveen). Treatment T_{13} (75% RDF + Vermicompost @ 12 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha + KSB @ 5 lit/ha) recorded the highest fruit yield, gross and net returns and benefit-cost ratio. Improved growth and nutrient availability likely contributed to these results. Thus, integrated use of organic and inorganic sources is recommended for sustainable and profitable bottle gourd cultivation.

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