



Effect of Farmyard Manure and Biofertilizers on Productivity and Profitability of Cucumber (*Cucumis Sativus* L.) cv. Pant Kheera-1

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Biofertilizers are microbial inoculation of plant growth-promoting rhizobacteria (PGPRs) which act as important components of integrated nutrient management (INM) and have the ability to reduce the nutritional dependence of plants over chemical fertilizers. A field experiment was conducted to investigate the response of farmyard manure (FYM) and biofertilizers on the productivity and profitability of cucumber (*Cucumis sativus* L.) cv. Pant Kheera-1. The application of FYM was done by thoroughly mixing it in the soil one week prior to sowing and basal dose of vermicompost was incorporated in soil one week before sowing and treated with three biofertilizers such as Azotobacter, PSB and KSB as per the requirement of the treatment. The results indicated that

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farmyard manure and biofertilizers like Azotobacter and PSB with different RDF doses of fertilizers significantly influenced the different growth and yield attributes of cucumber. Application of 75% RDF + FYM + Azotobacter + PSB + KSB recorded significantly higher fruit setting percent (93.26%) and fruit yield. It was recorded that the maximum gross returns and net returns was recorded in with the application of 75% RDF + FYM + Azotobacter + PSB + KSB with B:C ratio of 4.7 while maximum B:C ratio (4.9) was recorded with a application of 100% RDF. Thus, integration of organic manure and biofertilizers with 75% of RDF improved the production potential of cucumber and enhanced the net return.

Keywords: Biofertilizers; cucumber; FYM; integrated nutrient management; economics; yield.

1. INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the early maturing most popular vine vegetable of Cucurbitaceae family (Sharma et al., 2016). Cucurbits are extremely cross-pollinated group of vegetable crops which is cultivated in tropics, subtropics and milder temperate zones of India. Cucumber responds well to various nutrients, including macronutrients and micronutrients. The vegetable crops grow and produce a good quality crop after application of calcium, magnesium, sulphur, zinc, copper and boron as these are important minerals for various metabolic activities in the plants [1,2,3,4,5]. Application of these nutrients through different sources is the primary need of crop production [6].

The use of expensive commercial fertilizers as per the requirement of the crop is not much affordable to the average farmers. The application of high input technologies such as chemical fertilizers, pesticides, herbicides improved the production but there is growing concern over the adverse effects of the use of chemicals on soil productivity and environment quality [5]. So, there is need of shifting towards integrated nutrient management (INM) approach which is a sustainable practice and aims at maintaining the soil fertility and plant nutrient supply by incorporating all the possible sources of nutrients like organic manures, inorganic fertilizer, and the biological components in an integrated and judicious manner to get higher crop yield without hampering the soil health and the environment [2,3,4,7].

Organic manures like panchagavya, neem cake, vermicompost or FYM or which is bulky in nature is a good source of nutrients and build up organic matter in soil as it has been formed by decomposing cattle dung, farm waste, cattle urine and plant waste [8]. Further, biological fertilizers like biofertilizers are the substances made up of the living cells of beneficial

microorganisms which have capability to convert unavailable form of nutrient into the available form in the soil [5] (Ramandeep et al., 2018). Biofertilizers are microbial inoculation of plant growth promoting rhizobacteria (PGPRs) which act as important component of integrated nutrient management (INM) and have ability to reduce the nutritional dependence of plants over chemical fertilizers. Amongst bio-fertilizers, *Azotobacter*, PSB, Rhizobium strains play an important role in harvesting the atmospheric nitrogen through its fixation in the roots [9,2,3,4]. It is given a primary importance in non-symbiotic and associative nitrogen fixation and was recognized to play a unique role in nitrogen economy of many crops. Several authors have worked on the economics of vegetable cultivation under different cropping model with integrated approach of nutrient management through organic sources as well as biofertilizers [10,11,12,2,3,4].

Providing nutrients through different sources and inclusion of drip irrigation practices have also been reported to enhance the nutrient use efficiency as drip irrigation makes the fertigation feasible which ensures proper availability of nutrients to plants [13], organic sources are responsible for ensuring slow and long-term release of nutrients, biofertilizers ensure the mobilization of nutrients from soil complex and availability of growth promoting factors; thus, ensure the improvement in soil and plant nutrient status for high productivity, quality and economical vegetable production. Considering all these aspects, a research study was carried out to study the effect of integrated application of FYM and biofertilizer with recommended dose of fertilizers on productivity and profitability of cucumber.

2. MATERIALS AND METHODOLOGY

A field experiment was conducted at the CRC Farm of the Division of Horticulture, ITM

University Gwalior (M.P.). The climate of this place is bestowed with hot and dry early summers followed by hot and humid monsoon season and cold and dry winters. The soil of the experimental field was sandy clay loam in texture, slightly alkaline (pH 7.73) in reaction, low in organic carbon (4.3 g/kg) and available nitrogen (196.6 kg/ha) but medium in available phosphorus (15.85 kg/ha) and potassium (229.6 kg/ha) with electrical conductivity in the safer range.

The experiment was laid out in the Randomized Block Design with ten 100 % RDF, FYM, 75 % RDF + FYM + *Azotobacter* + PSB, 75 % RDF + FYM + *Azotobacter* + KSB, 75 % RDF + FYM + PSB+ KSB, 75 % RDF + FYM + *Azotobacter* + PSB + KSB, 50 % RDF + FYM + *Azotobacter* + PSB, 50 % RDF + FYM + *Azotobacter* + KSB, 50 % RDF + FYM + PSB+ KSB and 50 % RDF + FYM + *Azotobacter* + PSB + KSB) which were replicated thrice. FYM was applied by thoroughly mixing it in the soil one week prior to sowing and basal dose of vermicompost was incorporated in soil one week before sowing and treated with three biofertilizers such as *Azotobacter*, PSB and KSB as per requirement of the treatment.

The observation on yield and related attributes like fruit length (cm), fruit girth (cm), average fruit weight (g), number of fruits per vine, fruit yield per plant (g), fruit yield per hectare (q) were recorded at harvest and economic analysis was carried out and analysis of variance was performed to determine the effect of FYM and biofertilizers on growth and productivity of cucumber. The data were analyzed following the method described by Gomez and Gomez (1984). Significant difference of sources of variation was

tested at the probability level of 0.05. The standard error of the mean (SEM \pm) and the CD value were indicated in the tables to compare the difference between the mean values.

3. RESULTS AND DISCUSSION

3.1 Yield and Related Attributes

The data with respect to fruit length and girth revealed that maximum fruit length and girth was observed with the application of 75 % RDF + FYM + *Azotobacter* + PSB + KSB (Table 1). It may be due to the easy accessibility of nutrients to plants through inorganic fertilizers along with better solubilization of organic manures with the action of *Azotobacter* and PSB. Integration of biological components like *Azotobacter* with inorganic fertilizers and organic manures has proven to enhance the process of nitrogen fixation in the soil. It has further resulted in the production of amino acids which are the building blocks of protein capable of hastening the multiplication of cells manifesting maximum fruit length, girth and weight of cucumber.

This could be accountable to maximum average fruit weight and number of fruits per vine, maximum fruit yield per plant and per hectare. Increase in average weight of fruit, due to application of organic manures and biofertilizers, might be associated with favourable action of the microorganisms and positive effect of the manures which might have enhanced the micronutrient availability in the soil. The similar findings were reported by Bairwa et al. [14], Mohan et al. [15], Thriveni et al. [16], Dash et al. [17], Eifediyi and Remison [18] and Sahu et al. [19].

Table 1. Yield and related attributes of cucumber after application of FYM and biofertilizers

Treatments	Fruit length (cm)	Fruit girth (cm)	Average fruit weight (g)	Number of fruits per vine	Fruit yield per plant (g)	Fruit yield per hectare (q)
T ₁	14.33	10.94	235.26	17.00	3999.37	444.33
T ₂	12.14	9.11	200.10	12.19	2439.26	271.00
T ₃	13.86	10.43	225.89	15.08	3407.23	378.54
T ₄	13.30	9.96	212.57	14.12	3000.87	333.40
T ₅	12.85	9.65	205.89	13.29	2735.72	303.94
T ₆	14.47	11.09	240.26	17.72	4258.06	473.07
T ₇	13.60	10.20	216.92	14.66	3180.29	353.33
T ₈	13.05	9.76	208.32	13.67	2848.36	316.45
T ₉	12.55	9.34	202.54	12.88	2608.82	289.84
T ₁₀	14.10	10.73	230.47	16.59	3823.56	424.80
Sem (\pm)	0.060	0.052	1.099	0.103	34.628	3.847
CD at 5%	0.177	0.156	3.265	0.305	102.889	11.431

Table 2. Economics of cucumber cultivation after application of FYM and biofertilizers

Treatments	Cost of cultivation (₹ ha ⁻¹)	Gross returns (₹ ha ⁻¹)	Net returns (₹ ha ⁻¹)	B:C ratio
T ₁	63600	311031	247431	4.89
T ₂	80000	189701	109701	2.37
T ₃	68900	264980	196080	3.85
T ₄	69100	233378	164278	3.38
T ₅	69300	212757	143457	3.07
T ₆	69900	331149	261249	4.74
T ₇	73200	247331	174131	3.38
T ₈	73400	221517	148117	3.02
T ₉	73600	202888	129288	2.76
T ₁₀	74200	297358	223158	4.01

3.2 Economics

The economic analysis of cucumber cultivation after application of various treatments confirms that the maximum gross returns (₹ 331149 ha⁻¹) and net returns (₹ 261249 ha⁻¹) was estimated with the application of 75 % RDF + FYM + *Azotobacter* + PSB + KSB) with B:C ratio of 4.7 while the maximum B:C ratio (4.9) was recorded with the application of 100% RDF) (Table 2). However, the minimum gross returns (₹ 189701 ha⁻¹) and net returns (₹ 109704 ha⁻¹) and B:C ratio (2.4) was recorded with the application of FYM) which could be due to less yield and high cost of FYM. These results are supported by the findings of Prabhu et al. [20], Kumar et al. [21], Sharma et al. [22], Navya et al. [23] and Kumar et al. [9].

4. CONCLUSION

The application of the farmyard manure and biofertilizers like *Azotobacter* and PSB with different RDF doses of fertilizers significantly influenced the yield parameters in cucumber. The application of 75 % RDF in combination with FYM, *Azotobacter*, PSB and KSB recorded significantly higher fruit yield and good economic benefits in terms of gross and net return in cucumber.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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