



## **Effect of Organic and Inorganic Fertilizers on Growth, Yield & Quality of Cucumber (*Cucumis sativus L.*) under Protected Cultivation**

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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**

The present investigation entitled "Effect of organic and inorganic fertilizer on growth, yield & quality of cucumber (*Cucumis Sativus L.*) Under protected cultivation" was carried out in the Polyhouse of Jacob Institute of Biotechnology and Bioengineering, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, during winter season from September to December 2021. The experiment was laid out in Randomized complete Block Design comprising of 10 treatments with three replications. The study revealed that the treatment T<sub>10</sub> (Recommended Dose of Fertilizer (RDF) 50% + Poultry manure 50%) performed best in terms of no. of leaves (107.62/plant), days to first flowering (36.94), days to harvest (62.33), fruit length (15.03 cm), fruit diameters (14.1 mm), number of fruits per plant (20.70), weight (162.40 g), yield per plot (3.26 Kg), yield per 200 sq.m (571.52 Kg) and Vitamin C (7.57 mg/100 g fresh fruit). However, treatment T<sub>7</sub> (25% RDF + 75% FYM) has maximum number days to fruit set (57.36) and treatment T<sup>4</sup> (RDF 50% + FYM 50%) had highest soluble solid (3.77°Brix). The significantly higher gross return (Rs 17,145.6/ha), Net Profit (Rs 13,415.21/ha) and B:C ratio (3.59:1) was also recorded under treatment T<sub>10</sub> ((RDF) 50% + Poultry manure 50%). Overall results revealed that T<sub>10</sub> (RDF) 50% + Poultry manure 50% was found to be the most suitable over all the other treatments in relation to growth and yield of Cucumber.

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## 1. INTRODUCTION

“The cucumber (*Cucumis sativus L.*) belongs to the cucurbitaceae family having a chromosome number  $2n=22$ . cucumber plants are monoecious – they produce both male and female flowers on the same plant. It contains 96.3 g water, 0.4g protein, 0.1g fat, 0.3 g minerals, 0.4 g fiber, 2.5g carbohydrate, 13 kcal energy, 10 mg calcium 25 mg Phosphorus mg iron 0.3 mg Thiamine 0.2 mg Niacin 7 mg Vitamin C per 100 g edible portion” [1]. Cucumber is considered as one of the major vegetable crops in the world and is considered as fourth most important crop after tomato, cabbage and onion. Protected cultivation of cucumber is gaining popularity in developing countries like India. Under Polyhouse, plants can be protected from pest, disease, rain and extreme temperature. Due to controlled system in the protected structure, climatic conditions *viz.* temperature, humidity and moisture can be controlled according to the plant’s requirement. Protected cultivation of cucumber emphasizes the need for proper density of plants in order to boost up the production per unit area by utilizing the available space and nutrients applied. Cucumber requires large quantities of both macro and micro nutrients for the yields of cucumber. Polyhouse production technology of cucumber emphasizes the need for proper density in order to boost up the production per unit area by utilizing the available space and nutrients applied. Cucumber requires large quantities of both macro and micro nutrients for required of economic yields of cucumber. Nitrogen, phosphate and potash nutrients are important and play a key role in the production of both quantity and quality level in cucumber. These nutrients are specific in function and must be supplied to the plant at the right time and in the right quantity. Indiscriminate use of inorganic fertilizers has resulted in decreased nutrient uptake, poor quality of vegetables and deterioration of soil health. “The use of organic and inorganic fertilizers has been recommended for sustenance of long term cropping in the tropics. Nitrogen, phosphate and potash nutrients are important and play a key role in the production of both quantity and quality level in cucumber. These nutrients are specific in function and must be supplied to the plant at the right time and in the right quantity” [2]. “Nutrients from mineral fertilizers enhance the establishment of crops while those from mineralization of organic manures promoted yield

when both fertilizers are combined” [3]. However, at what levels of organic and inorganic fertilizer combinations are suitable for cucumber’s growth and yield has not been studied. Thus, this study was conducted to find out the most suitable treatment of organic and inorganic fertilizers for higher growth yield and quality of cucumber. And it is also focused on the estimation of the economic analysis of various treatments.

## 2. MATERIALS AND METHODS

The experiment was conducted in the Horticulture experimental field, Department of Horticulture, SHUATS, Prayagraj, Uttar Pradesh. Geographically Prayagraj is located at 25°45' North Latitude, 81°85' East Longitude and at an Altitude of 98m (322ft) above mean sea level. The experiment was conducted in winter season, September-December 2021, Uttar Pradesh prevails with both extremes of temperature during the crop season, *i.e.*, 11°C to 36°C. The average rainfall in this area is about 958 mm per annum.

The experiment was laid out in Randomized complete Block Design comprising of 10 treatments with three replications. Treatments were allocated randomly to each replication. T<sub>1</sub> - RDF(100%), T<sub>2</sub> -FYM(100%), T<sub>3</sub> -Vermicompost (100%), T<sub>4</sub>-Poultry manure(100%), T<sub>5</sub> -25% RDF + 75% Poultry manure, T<sub>6</sub> -25% RDF + 75% Vermicompost, T<sub>7</sub> -25% RDF + 75% FYM, T<sub>8</sub> - 50% RDF + 50% FYM, T<sub>9</sub> -50% RDF +50% Vermicompost, T<sub>10</sub> - 50% RDF + 50% Poultry manure. Basal dose of 10 tonnes/hectare of farm yard manure, 4 tonnes/hectare vermicompost and 6 tonnes/hectare poultry manure was applied before sowing of seeds. First dose of NPK fertilizers (@80:50:50Kg/ha) was applied in two split dose out of which half dose were applied after 15 days of germination. While the remaining dose was applied 30 days after the first dose. Seeds were sown at a distance of 50x50 cm in the plot of 1 sq. m. All cultural practices *i.e.*, irrigation, hoeing and weeding were carried out throughout the growing season as recommended. Observation were recorded on number of leaves/plants, days to first flowering, days to fruit set, days to first harvest, fruit length (cm), fruit diameter (cm), average fruit weight (g), number of fruits per plot, fruit yield per plot (kg), fruit yield (Kg/200m<sup>2</sup>), total Soluble Solid (TSS °Brix) and vitamin C content (mg/100 g).

Data were analysed by using ANOVA as per the standard procedure as of Panse and Sukhatame [4]. A Probability value of  $p < 0.05$  was considered as statistically significant. For statistical analysis of data and chart, Microsoft office Excel 2007 was employed.

### 3. RESULTS AND DISCUSSION

The maximum number of leaves per plant (107.62) was recorded in T<sub>10</sub> (RDF 50% + Poultry manure 50%). "This may be attributed to the prevailing favorable microclimate inside the greenhouse which helped the plants in better utilization of solar radiation, nutrients and water for the synthesis of photosynthates and also the prevailing higher temperature inside the greenhouse might have helped in faster multiplication of cells and cellular elongation resulting in better growth of roots and shoots, which helped better vegetative growth including number of leave" [5]. "The inorganic fertilizers applied in the form of RDF and organic manure have improved the soil physical and chemical properties and leading to the adequate supply of nutrients to the plants which have promoted the maximum vegetable growth". Similar findings have also been reported by Williams et al., [6].

The minimum number of day to first flowering (36.94) was found to be in T<sub>2</sub> (RDF 50% + Poultry manure 50%) The early flowering was initiated due to the high concentration of phosphorus and potassium present in poultry manure. [7] reported that macronutrients deficiency results in a delay in flowering. Similar findings have also been reported by Bindiya et al., [8].

The minimum number days to fruit set (49.73) was found to be in T<sub>1</sub> (100%RDF). Deficiency of major nutrients stunted the plant growth, resulting more time to fruit set. Fertilizers high in nitrogen can cause plants to produces more fruit set and increased level of NPK had decreased the days taken to fruit setting. Similar findings have also been reported by Jilani et al., [7].

"The maximum fruit length (15.03) was recorded in treatment T<sub>10</sub> (50%RDF + 25% Poultry Manure). The fruit length might be increased due to the optimum amount of macro and micro nutrients available in poultry manure. Auxin accelerates the physiological activities as the result it increase the fruits length with PM+NPK may be mainly due to reasons of more availability and release of nutrients by poultry

manure through the growing period of the cucumber plants". Similar findings have also been reported by Williams et al., [6] and Nweke et al., [9].

The maximum fruit diameters (5.67) was recorded in treatment T<sub>10</sub> (50%RDF + 25% Poultry Manure). Increase in NPK level increases the fruit weight also increases the diameter of the fruit gradually. Jilani et al., [7], this results are in agreement with the previous findings of Ahmed et al., [10] reported that fruit weight of cucumber increased linearly with an increase in Nitrogen fertilizer rate. Similar findings have also reported by Prathyusha and Singh [11].

"The maximum average weight (162.40) was recorded in treatment T<sub>10</sub> (50%RDF + 25% Poultry Manure. High poultry manure level which are rich source of nitrogen, phosphorous, magnesium and calcium increased fertility of soil lead to increase in the fruit weight" Dauda et al. [12]. Similar findings have also reported by Mohan et al. [13].

"The minimum number day to first harvest (62.33) was found to be in T<sub>10</sub> (RDF 50% + Poultry manure 50%). The earliness to harvesting might be due to the better translocation of nutrients to the aerial parts". Similar findings have also reported by Bindiya et al., [8].

"The maximum number of fruits per plant (20.70) was recorded in treatment T<sub>10</sub> (50%RDF + 50% Poultry Manure). Poultry manure improved the availability of nutrients to plants, bulk density and the water holding capacity of the soil. This, in turn, increases the vegetative growth, accelerate the division of meristematic tissue and metabolic reactions and the plants take more food as a result of which increase in the number of fruits/plant. Poultry manure as a rich source of nutrients improved the soil texture and encouraged the nutrients uptake by the plants which enabled the plants to become healthy and produce more fruit". Similar Dauda et al., [12]. Similar findings have also reported by Singh et al., [14].

The maximum number of fruits per plot (3.26) was recorded in treatment T<sub>10</sub> (50%RDF + 50% Poultry Manure). The highest yield per plant was corresponding to more number of fruits per plants and average fruits weight with application of required amount of fertilizers.

**Table 1. Effect of organic and inorganic fertilizer on number of leaves, days to first flowering, days to fruit set, fruit length, fruit diameter, average fruit weight and days to first harvest as affected by different organic and inorganic fertilizer combination**

Treatments combinations	Number of Leaves	Days to first flowering	Days to fruit set	Fruit length (cm)	Fruit diameter (cm)	Average Fruit weight (g)	Days to First Harvest
T <sub>1</sub> -100% RDF	94.97	38.17	49.73	13.55	5.22	150.51	66.67
T <sub>2</sub> -100% FYM	91.03	41.33	54.30	13.08	3.99	138.96	71.67
T <sub>3</sub> -100% Vermicompost	102.34	38.5	54.26	13.45	4.21	155.84	64.67
T <sub>4</sub> -100% Poultry	93.71	37.51	55.33	13.33	4.91	148.26	68.67
T <sub>5</sub> - 25%RDF+75%Poultry manure	101.41	39.25	51.97	13.26	5.47	161.41	64
T <sub>6</sub> - 25%RDF+75% vermicompost	92.40	38.04	55.96	13.37	4.72	159.51	67.33
T <sub>7</sub> - 25% RDF + 75% FYM	95	38.19	57.36	13.51	4.29	157.58	70.67
T <sub>8</sub> -50% RDF + 50% FYM	98.95	38.59	53.74	13.3	5.46	154.72	64.33
T <sub>9</sub> -50%RDF+50% Vermicompost	94.97	38.69	55.04	14.15	4.95	139.43	66.33
T <sub>10</sub> -50%RDF+50%Poultry manure	107.62	36.94	51.44	15.03	5.67	162.40	62.33
F-Test	S	S	S	S	S	S	S
S.Ed.(±)	4.59	1.04	8.18	0.21	0.05	6.74	2.59
C.D at 5%	9.63	2.19	17.18	0.44	0.11	14.15	5.44
C.V	5.78	3.31	3.75	1.87		5.4	4.76

**Table 2. Effect of organic and inorganic fertilizer on number of fruit per plot, plant Weight, yield per plot, fruit Yield, total Soluble Solid and vitamin C content as affected by different organic and inorganic fertilizer combination**

Treatments combinations	Number of fruit per plot	Fruits Yield/plot (Kg)	Fruit Yield (Kg/200m <sup>2</sup> )	Total Soluble Solid (°Brix)	Vitamin C content (mg/100g)
T <sub>1</sub> -100% RDF	18.03	2.71	474.89	3.29	5.42
T <sub>2</sub> -100% FYM	14.88	2.06	361.29	3.27	5.23
T <sub>3</sub> -100% Vermicompost	16.43	2.56	448.08	3.3	5.69
T <sub>4</sub> -100% Poultry	16.98	2.51	439.97	3.47	5.79
T <sub>5</sub> - 25%RDF+75%Poultry manure	17.71	2.85	499.93	3.61	7.17
T <sub>6</sub> - 25%RDF+75% vermicompost	18.32	2.92	511.38	3.43	6.22
T <sub>7</sub> - 25% RDF + 75% FYM	19.09	2.94	515.97	3.33	5.91
T <sub>8</sub> -50% RDF + 50% FYM	19.43	2.88	505.19	3.77	6.14
T <sub>9</sub> -50%RDF+50% Vermicompost	18.90	2.64	462.62	3.49	6.2
T <sub>10</sub> -50%RDF+50%Poultry manure	20.70	3.26	571.52	3.73	7.57
F-Test	S	S	S	S	S
S.Ed.(±)	1.14	0.11	19.90	0.10	0.37
C.D at 5%	2.40	0.24	41.80	0.22	0.78
C.V	7.75	7.82	5.09	3.69	7.40

**Table 3. Effect of organic and inorganic fertilizer on economics of different Treatment and Cost Benefit Ratio**

Treatment	Total cost of cultivation/ha.	Yield kg/200m <sup>2</sup>	Gross return @Rs. 30/kg (Rs./200m <sup>2</sup> .)	Net return (Rs/ha)	Cost Benefit ratio
T <sub>1</sub>	3,585.86	474.89	14,246.7	10,660.84	2.97:1
T <sub>2</sub>	4,016	361.29	10,838.7	6,822.9	1.69:1
T <sub>3</sub>	3,916	448.08	13,442.4	9,526.4	2.43:1
T <sub>4</sub>	3,876	439.97	13,199.1	9,323.1	2.40:1
T <sub>5</sub>	3803.46	499.93	14,997.9	11,194.4	2.94:1
T <sub>6</sub>	3,893.46	511.38	15,341.4	11,447.94	2.94:1
T <sub>7</sub>	3,908.46	515.97	15,479.1	11,571.1	2.96:1
T <sub>8</sub>	4,800.93	505.19	15,155.7	10,353.77	2.15:1
T <sub>9</sub>	3,750.39	462.62	13,878.6	10,128.21	2.70:1
T <sub>10</sub>	3,730.39	571.52	17,145.6	13,415.21	3.59:1

The maximum fruits yield (571.52) was recorded in treatment T<sub>10</sub> (50% RDF + 50% Poultry Manure). Due to the increased yield per plot which increased total yield per 200m<sup>2</sup>.

“The maximum total soluble solid (3.77) was recorded in treatment T<sub>8</sub> (50% RDF + 50% FYM). Inadequate supply of organic and inorganic fertilizer deteriorates the quality of fruits and lower the amount of TSS”. Similar findings have also reported by Singh et al., [14].

“The maximum Vitamin C (7.57) was recorded in treatment T<sub>10</sub> (50% RDF + 25% Poultry Manure). Increased Vitamin C content can be attributed to low foliage that hindered composition and intensity of light reaching plant tissue which reduced Vitamin C content in the plant due to shade” [15]. Similar findings have also reported by Singh et al., [14].

Economics also plays a crucial role to evolve the best among the different treatments and to promote it. The economics of different treatments viz. cost of cultivation, gross return, net return and cost: benefit ratio. Maximum gross return was recorded in T<sub>10</sub> (50% RDF + 50% Poultry Manure) (Rs. 17,145.6/200m<sup>2</sup>) and the minimum (Rs. 10,838.7/200m<sup>2</sup>) was recorded in T<sub>2</sub> (FYM). Maximum net return was recorded in T<sub>10</sub> (50% RDF + 50% Poultry Manure) (Rs. 13,415.21/200m<sup>2</sup>) and the minimum (Rs. 6,822.9/200m<sup>2</sup>) was recorded in T<sub>2</sub> (FYM). Maximum cost: benefit ratio was recorded in T<sub>10</sub> (50% RDF + 50% Poultry Manure) (1:3.59) and the minimum (1:1.69) was recorded in T<sub>2</sub> (FYM).

#### 4. CONCLUSION

On the basis of present investigation, it is concluded that the treatment T<sub>10</sub> (50% RDF + 50% Poultry Manure) was found to be the most

suitable over all the other treatments in relation to growth and yield of Cucumber. Similarly, the treatment T<sub>10</sub> (50% RDF + 50% Poultry Manure) recorded maximum gross return, net return and highest benefit cost ratio (3.59).

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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