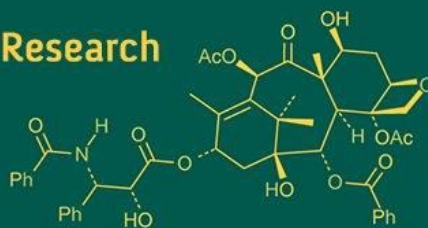


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Effect of integrated nutrient management on growth and fruit yield parameters in Chilli (*Capsicum annum* L.)

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Abstract

The present investigation was carried out with title “Effect of integrated nutrient management on growth and fruit yield parameters in Chilli (*Capsicum annum* L.)” was carried out during Kharif season of year 2024-25 at the Instructional farm Khudmudi, College of Horticulture and Research Station, Sankra, Patan, Durg (C.G.), India. The field experiment was laid out in Randomized block design with 10 treatments and 3 replications with different combination in integrated nutrient management. Under this experiment, overall, 10 treatments were taken including control. Comprised of Control, integrated nutrient management, Farmyard manure, Poultry Manure was given. The current study found that the use. T₂ showed the most favorable results in terms of plant height 30, 50 and 60 DAT (32.50 cm 75.80 cm and 79.20 cm), number of branches per plant 30, 50 and 60 DAT (9.20, 10.80 and 11.90), and minimum early flowering (34.80 days), number of flower per plant (77), number of fruit per plant (50.8), number of fruit set per plant (72.50), day to 1st harvest (66.80), average fruit weight (3.30 gm.), fruit yield per plant (167.64 g/plant), fruit yield per plot (1.59 kg) and the maximum fruit yield (31.80 q/ha).

Keywords: Integrated, RDF, fertilizers, growth, yield, Chilli. benefit cost ratio

Introduction

Vegetables are parts of plants that are consumed by humans or other animals as food. The original meaning is still commonly used and is applied to plants collectively to refer to all edible plant matter, including the flowers, fruits, stems, leaves, roots, and seeds. Chilli (Vernacular name: Mirchi), botanically known as (*Capsicum annum* L.) is one of the well-known plants belonging to Solanaceae. It is a diploid cross-pollinated dicot plant species with chromosome number $2n = 2x = 24$ (Manishbhai, B. N. 2019) [8].

Capsicum plants originated in modern day bolivia and have been a part of human diets since about 7,500 BC (Da Veiga Jr *et al.* 2022) [1] India is the second largest fruit and vegetable producer in the world, producing about 82.85 million tons of fruits and 166.18 million tons of vegetables in 2020, accounting for almost 14.0% of the world's vegetable production.%. He was one of the top 5 producers in the world, producing over 80% of agricultural products and with almost 25% of the production going to waste. (Kalpeshbhai, P. N. 2021) [5].

Lycopene, which is soluble in water, is responsible for the red colour of red chili peppers. Chili peppers offer numerous valuable benefits for the human body, including antioxidants, anti-inflammatory properties, protection against liver damage, and potential for preventing cancer (Nemzer, *et al.* 2023) [10].

Chili peppers are abundant across the country, with Germany and France being the primary cultivators, followed by other European nations in smaller quantities. According to FAOSTAT (2020), global production of red chili peppers in 2016-2017 reached 61.51 tons per hectare. Chili peppers are extensively cultivated in India, particularly in Andhra Pradesh, Telangana, Madhya Pradesh, Karnataka, West Bengal, and Himachal Pradesh. Capsaicin is the primary compound responsible for the spiciness of chili peppers. When capsaicin meets the receptors on our taste buds and sensory neurons, it triggers a sensation of heat and pain. This compound activates the transient receptor potential vanilloid 1 (TRPV1) channel, which plays a key role in our perception of heat and pain (Szallasi and Blumberg, 2007) [16].

Materials and Methods

The investigation entitled “Effect of Integrated Nutrient Management on Growth and Fruit Yield Parameters in Chilli (*Capsicum annum* L.)” was conducted during the Kharif season of 2024-25 at the Instructional Farm, Khudmudi, College of Horticulture & Research Station, Sankra, Patan, Durg (C.G.), India. The experimental site is located in the central part of the Chhattisgarh Plains, lying between 20°54' to 21°32' North latitude and 81°10' to 81°36' East longitude, at an altitude of 317 meters above mean sea level. The experiment was laid out in a Randomized Block Design (RBD) with ten treatments and three replications. The Chilli variety Pusa Jwala (*Capsicum annum* L.) was used for the study. The treatments comprised different combinations of inorganic fertilizers (Nitrogen, Phosphorus, and Potassium) and organic manures, namely Farmyard Manure (FYM), Vermicompost, and Poultry Manure. Growth and yield parameters were recorded at different stages of crop growth. The growth parameters included plant height (cm) at 30, 50, and 60 days after transplanting (DAT), number of branches per plant at 30, 50, and 60 days after transplanting (DAT), and days taken to first flowering, number of flowers per plant, number of fruits per plant and number of fruit set per plant and yield parameter included days to first harvesting, average fruit weight (g), fruit yield per plant (g/plant), fruit yield per plot (kg/plot), fruit yield per hectare (q/ha), cost of cultivation (Rs./ha), gross return (Rs./ha), net return (Rs./ha) and cost: benefit ratio.

The treatment details were as follows:

S. No.	Treatment Notation	Treatment combination
1.	T ₀	Control
2.	T ₁	100% RDF*Recommended Dose of Fertilizer (RDF) (NPK)
3.	T ₂	75% RDF + 25% Farm yard Manure
4.	T ₃	50% RDF + 50% Farm yard manure
5.	T ₄	75% RDF + 25% Vermicompost
6.	T ₅	50% RDF + 50% Vermicompost
7.	T ₆	50% RDF + 25% Farm yard manure + 25% Poultry Manure
8.	T ₇	40% RDF + 30% Farm yard Manure + 30% Poultry manure
9.	T ₈	50% RDF + 25%Vermicompost + 25% Poultry manure
10.	T ₉	100% Organic (Farm yard Manure + Vermicompost + Poultry Manure

Results and Discussion

A) Growth Parameter

1. Plant height

The results pertaining to the effect of integrated nutrient management on plant height of Chilli at 30, 50, 60 DAT are presented in table 1. The plant height significantly varied among different treatment combinations at 30 DAT. The maximum plant height at 30 DAT (32.50 cm) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 32.00 cm. Minimum plant height at 30 DAT (18.20 cm) was observed in T₀ Control. The plant height significantly varied among different treatment combinations at 50 DAT. The maximum plant height at 50 DAT (75.80 cm) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 75.00 cm. Minimum plant height at 50

DAT (44.10) was observed in T₀ control. The plant height significantly varied among different treatment combinations at 60 DAT. The maximum plant height at 60 DAT (79.20 cm) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 78.20 cm. Minimum plant height at 60 DAT (46.00 cm) was observed in T₀ Control.

The plant height significantly varied among different treatment combinations at first harvest. The maximum plant height at first harvest (79.20 cm) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 78.20 cm. Minimum plant height at first harvest (46.00 cm) was observed in T₀. These findings are in agreement with the results obtained by Deepika *et al.*, (2010) ^[2],

2. Number of branches per plant

The results related to Number of branches varied significantly among Effect of integrated nutrient management and is presented in table 1. The maximum number of branches at 30 DAT (9.20) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 9.00. Minimum Number of branches at 30 DAT (4.90) was observed in T₀ Control. The Number of branches significantly varied among different treatment combinations at 50 DAT. The maximum number of branches at 50 DAT (10.80) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 10.40 cm. Minimum number of branches at 50 DAT (5.70) was observed in T₀ control. The number of branches significantly varied among different treatment combinations at 60 DAT. The number of branches at 60 DAT (11.90) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 11.40. Minimum number of branches at 60 DAT (6.30) was observed in T₀ Control.

The number of branches significantly varied among different treatment combinations at first harvest. The maximum number of branches at first harvest (11.90) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 11.40. Minimum number of branches at first harvest (6.30) was observed in T₀. The present results corroborate the findings of Deepika *et al.*, (2010) ^[2], Ranjitha *et al.*, (2018) ^[13], Nchang *et al.*, (2018) ^[9], Gokul *et al.*, (2020) ^[3], Gokul *et al.*, (2020) ^[17].

3. Days taken to first flowering

The results related to days to first flowering varied significantly among Effect of integrated nutrient management and is presented in table 1. The minimum days to first flowering at harvest (34.80 days) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 35.20 days. Maximum days to first flowering at harvest (48.50 days) was observed in T₀ Control. A similar trend was also reported by Deepika *et al.*, (2010) ^[2], Singh *et al.*, (2010) ^[15], Shabir *et al.*, (2017) ^[14]

4. Number of Flower per Plants

The results related to days to first flowering varied significantly among Effect of integrated nutrient management and is presented in table 1. The maximum number of flower per plants at (77/plant) was observed with treatment T₂ (75% RDF + 25%FYM) followed by T₃ (50%

RDF + 50% FYM) with 72/plant. Minimum number of flower per plants (60/plant) was observed in T₀ Control. These findings are in agreement with the results obtained by Deepika *et al.*, (2010)^[2], Singh *et al.*, (2010)^[15], Shabir *et al.*, (2017)^[14].

5. Number of fruits per plant

The results related to number of fruits per plant varied significantly among different treatments and is presented in table 1. The maximum number of fruits per plant of fruit at harvest (50.8 fruits) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 44.2 fruits. Minimum number of fruits per plant of fruit at harvest (31.5 fruits) was observed in T₀ Control. The present results corroborate the findings of Deepika *et al.*, (2010)^[2], Singh *et al.*, (2010)^[15], Shabir *et al.*, (2017)^[14].

6. Number of fruit set per plant

The results related to number of fruit set per plant varied significantly among different treatments and is presented in table 1. The maximum number of fruit set per plant of fruit at harvest (72.50) was observe with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 71.20. Minimum number of fruit set per plant of fruit at harvest (52.50) was observed in T₀ Control. These results are supported by the work of Deepika *et al.*, (2010)^[2], Ranjitha *et al.*, (2018)^[13] Nchang *et al.*, (2018)^[9] Pradhiapan *et al.*, (2018)^[12], Gokul *et al.*, (2020)^[3], Kumari *et al.*, 2020^[7], Khatik *et al.*, (2025)^[6] Prasad *et al.*, (2025)^[11].

B) Yield Parameter

1. Days to first harvesting (DAT)

The results related to days to first harvest varied significantly among different treatments and is shown that presented in table 2. The minimum days to first harvest of fruit at harvest (66.80 days) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 67.80 days. Maximum days to first harvest of fruit at harvest (80.50 days) were observed in T₀ Control. These findings are in agreement with the results obtained by Deepika *et al.*, (2010)^[2], Singh *et al.*, (2010)^[15], Shabir *et al.*, (2017)^[14].

2. Average fruit weight (g/fruit)

Weight of Chilli fruit under different treatment combination is shown that presented in table 2. The average fruit weight of fruit significantly varied among different treatment combinations at harvest. The maximum average fruit weight of fruit at harvest (3.30 g) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 3.25 g. Minimum average fruit weight of fruit at harvest (2.20 g) was observed in T₀ Control. Comparable observations were recorded by Deepika *et al.*, (2010)^[2], Shabir *et al.*, (2017)^[14], Ranjitha *et al.*, (2018)^[13].

3. Fruit Yield per plant (g/plant)

Yield of Chilli fruit per plant under different treatment combination is shown that presented in table 2. The fruit yield per plant of fruit significantly varied among different treatment combinations at harvest. The maximum fruit yield per plant of fruit at harvest (167.64 g/plant) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃

(50% RDF + 50% FYM) with 143.65 g/plant. Minimum fruit yield per plant of fruit at harvest (69.30 g/plant) was observed in T₀ Control. A similar trend was also reported by Deepika *et al.*, (2010)^[2], Shabir *et al.*, (2017)^[14], Ranjitha *et al.*, (2018)^[13], Nchang *et al.*, (2018)^[9], Pradhiapan *et al.*, (2018)^[12] and Gokul *et al.*, (2020)^[3].

4. Fruit Yield per plot (kg/Plot)

Yield of Chilli fruit per plot (kg/plot) under different treatment combination is shown that presented in Table 2. The fruit yield per plot (kg/plot) of fruit significantly varied among different treatment combinations at harvest. The maximum fruit yield per plot (kg/plot) of fruit at harvest (1.59 kg/plant) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 1.29 kg/plot. Minimum fruit yield per plot (kg/plot) of fruit at harvest (0.62 kg/plant) was observed in T₀ Control. The present results corroborate the findings of Gokul *et al.*, (2020)^[7], Khatik *et al.*, (2025)^[6] Prasad *et al.*, (2025)^[11].

5. Fruit Yield per hectare (q/ha)

Yield of Chilli fruit per hectare under different treatment combination is shown that presented in Table 2. The fruit yield per hectare of fruit significantly varied among different treatment combinations at harvest. The maximum fruit yield per hectare of fruit at harvest (31.8 q/ha) was observed with treatment T₂ (75% RDF + 25% FYM) followed by T₃ (50% RDF + 50% FYM) with 25.8 q/ha. Minimum fruit yield per hectare of fruit at harvest (12.4 q/ha) was observed in T₀ Control. These results are supported by the work of Deepika *et al.*, (2010)^[2], Shabir *et al.*, (2017)^[14], Ranjitha *et al.*, (2018)^[13], Nchang *et al.*, (2018)^[9] Pradhiapan *et al.*, (2018)^[12] and Gokul *et al.*, (2020)^[3].

C. Economics of Different Treatments

Economics of all treatments were calculated according to the expenditure occurred from then nursery raising till harvesting of fruits viz. Cost of cultivation, gross return, net return, and benefit: cost ratio has been worked out and presented in table 3.

1. Maximum gross returns were recorded in treatment T₂ (75% RDF + 25% Farmyard Manure) with (₹ 190800 ha⁻¹) and the minimum (₹ 74400 ha⁻¹) was recorded in treatment T₀ Control.
2. Maximum net returns were recorded in treatment T₂ (75% RDF + 25% Farmyard Manure) with (₹ 123000 ha⁻¹) and the minimum (₹ 3900 ha⁻¹) was recorded in treatment T₀ Control.
3. Maximum benefit: cost ratio was recorded in T₂ (75% RDF + 25% Farmyard Manure) with 2.81 and the minimum 1.08 was recorded in treatment T₀ Control (No bio-stimulant application).

Maximum gross returns, net returns, and benefit: cost ratio was observed in the treatment T₂ (75% RDF + 25% Farmyard Manure) and recorded the best treatment among all the other treatments.

As the economics is the need of the farmers while taking decision regarding the adoption of the techniques and scientific knowledge hence, T₂ (75% RDF + 25% Farmyard Manure) gave the highest gross return, net return, and cost benefit is due to higher productivity and higher quality of fruits, which increase the market value of the fruits. These

findings are in agreement with the results obtained by Deepika *et al.*, (2010) ^[2], Shabir *et al.*, (2017) ^[14], Ranjitha *et al.*, (2018) ^[13] Nchang *et al.*, (2018) ^[9] Pradhiepan *et al.*,

(2018) ^[12] Gokul *et al.*, (2020) ^[3], Gokul *et al.*, (2020) ^[7], Khatik *et al.*, (2025) ^[6], Prasad *et al.*, (2025) ^[11].

Table 1: Effect of integrated nutrient management on growth parameter of Chilli

Treatment Notation	Treatment details	Plant height (cm.)			Number of branches per plant			Days taken to first flowering	Number of Flower per Plants	Number of fruits per plant	Number of fruit set per plant
		30 DAT	50 DAT	60 DAT	30 DAT	50 DAT	60 DAT				
T ₀	Control	18.20	44.10	46.00	4.90	5.70	6.30	48.50	60	31.5	52.50
T ₁	100% RDF*Recommended Dose of Fertilizer (RDF) (NPK)	30.80	71.20	74.50	8.40	9.70	10.50	37.20	62	40.2	64.83
T ₂	75% RDF + 25% Farm yard Manure	32.50	75.80	79.20	9.20	10.80	11.90	34.80	77	50.8	72.50
T ₃	50% RDF + 50% Farm yard manure	32.00	75.00	78.20	9.00	10.40	11.40	35.20	72	44.2	71.20
T ₄	75% RDF + 25% Vermicompost	26.20	63.50	66.10	7.20	8.30	9.10	41.80	63	38.7	61.42
T ₅	50% RDF + 50% Vermicompost	25.80	62.80	65.40	7.10	8.20	9.00	42.90	65	39.3	60.46
T ₆	50% RDF + 25% Farm yard manure + 25% Poultry Manure	31.80	74.20	77.60	8.90	10.20	11.10	35.90	70	42.4	69.10
T ₇	40% RDF + 30% Farm yard Manure + 30% Poultry manure	31.20	73.10	76.40	8.60	9.90	10.80	38.10	65	43.0	66.15
T ₈	50% RDF + 25% Vermicompost + 25% Poultry manure	22.40	55.60	58.30	6.20	7.30	8.10	46.20	63	36.3	58.54
T ₉	100% Organic (Farm yard Manure + Vermicompost + Poultry Manure)	23.60	57.40	60.10	6.50	7.60	8.40	44.10	62	43.4	57.80
SEm (±)		0.95	1.85	2.05	0.35	0.48	0.55	1.25	1.85	1.7	1.63
CD		2.85	5.50	6.10	1.05	1.42	1.63	3.70	5.50	5.44	5.21
CV (%)		6.45	6.90	6.75	6.80	7.10	7.35	6.45	6.90	8.18	12.6

Table 2: Effect of integrated nutrient management on yield parameter of Chilli

Treatment Notation	Treatment details	Days to first fruit harvest (DAT)	Average fruit weight (g/fruit)	Fruit yield per plant (g/plant)	Fruit yield per plot (kg/plot)	Fruit yield per hectare (q/ha)
T ₀	Control	80.50	2.20	69.30	0.62	12.4
T ₁	100% RDF*Recommended Dose of Fertilizer (RDF) (NPK)	70.20	3.10	124.62	1.12	22.4
T ₂	75% RDF + 25% Farm yard Manure	66.80	3.30	167.64	1.59	31.8
T ₃	50% RDF + 50% Farm yard manure	67.80	3.25	143.65	1.29	25.8
T ₄	75% RDF + 25% Vermicompost	74.20	2.75	106.42	0.96	19.2
T ₅	50% RDF + 50% Vermicompost	75.10	2.70	106.11	0.94	18.8
T ₆	50% RDF + 25% Farm yard manure + 25% Poultry Manure	68.90	3.20	135.68	1.22	24.4
T ₇	40% RDF + 30% Farm yard Manure + 30% Poultry manure	71.50	3.00	129.00	1.16	23.2
T ₈	50% RDF + 25% Vermicompost + 25% Poultry manure	76.80	2.60	94.38	0.85	17.0
T ₉	100% Organic (Farm yard Manure + Vermicompost + Poultry Manure)	78.20	2.55	110.67	0.99	19.8
SEm (±)		1.15	0.08	2.73	0.90	1.69
CD		3.40	0.24	4.91	0.26	5.4
CV (%)		6.50	6.80	9.24	7.80	8.81

Table 3: Effect of integrated nutrient management on cost of cultivation parameter of Chilli

Treatment Notation	Treatment details	Fruit Yield (q/ha)	Cost of cultivation (in Rs)	Gross Return (in Rs)	Net return (in Rs)	B:C Ratio
T ₀	Control	12.4	68500	74400	3900	1.08
T ₁	100% RDF*Recommended Dose of Fertilizer (RDF) (NPK)	22.4	65200	134400	69200	2.06
T ₂	75% RDF + 25% Farm yard Manure	31.8	67800	190800	123000	2.81
T ₃	50% RDF + 50% Farm yard manure	25.8	69000	154800	85800	2.24
T ₄	75% RDF + 25% Vermicompost	19.2	70550	115200	44650	1.63
T ₅	50% RDF + 50% Vermicompost	18.8	66000	112800	46800	1.70
T ₆	50% RDF + 25% Farm yard manure + 25% Poultry Manure	24.4	65800	146400	80600	2.22
T ₇	40% RDF + 30% Farm yard Manure + 30% Poultry manure	23.2	66200	139200	73000	2.10
T ₈	50% RDF + 25% Vermicompost + 25% Poultry manure	17.0	72000	102000	30000	1.41
T ₉	100% Organic (Farm yard Manure + Vermicompost + Poultry Manure)	19.8	70163	118800	48637	1.69
Selling Price of Chilli @ Rs 60/Kg						

Conclusion

The current study found that the use of integrated nutrient management had a significant positive impact on the growth, and development of Chilli. Among the treatments tested, T₂ showed the most favorable results in term of plant height, number of branches, and early flowering and maturing. T₂ also demonstrated superior performance in terms of fruit weight, number of fruits per plant, and yield per plant. Additionally, T₂ had the highest benefit cost ratio of 2.81. T₂ was composed of 75% RDF + 25% Farmyard Manure.

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