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Effect of integrated nutrient management on economics of tomato

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Abstract
The present investigation titled "Impact of Integrated Nutrient Management on Economy of Tomato" was conducted at Horticultural Research cum Instructional Farm, IGKV, Raipur (C.G.) during Rabi season 2021-22 and 2022-23. The experiment was arranged in a randomized block with three replications and twelve treatments, i.e. T_1: control, T_2: 50% RDF, T_3: 75% RDF, T_4: 100% RDF, T_5: 50% RDF + 50% FYM, T_6: 50% RDF + 50% Vermicompost, T_7: 50% RDF + 50% FYM + PSB, T_8: 50% RDF + 50% Vermicompost + PSB, T_9: 75% RDF + 25% FYM, T_{10}: 75% RDF + 25% Vermicompost, T_{11}: 75% RDF + 25% FYM + PSB and T_{12}: 75% RDF + 25% Vermicompost + PSB. The result of this study showed that cost of cultivation (Rs. ha^{-1}) was recorded maximum in 50% RDF + 50% Vermicompost + PSB treatment, gross profit (Rs. ha^{-1}), net profit (Rs. ha^{-1}) and benefit ratio: cost was recorded maximum in the treatment of 75% RDF + 25% Vermicompost + PSB.

Keywords: Integrated nutrient management, economy, *Lycopersicon esculentum*

Introduction

Tomato (*Lycopersicon esculentum* Miller) is one of the most important vegetable crops grown worldwide under field and greenhouse conditions (Kaloo, 1986) [7]. It is also known as the poor apple. It is an herbaceous annual that reproduces sexually by seeds. It is grown in small home gardens and gardens for fresh consumption as well as for processing purposes. Tomatoes are used directly as a raw vegetable in sandwiches, sliced, in salads, etc. and several processed products such as paste, puree, soup, juices, ketchup, beverages, dried, whole peeled tomatoes, sauces and chutneys are prepared in large quantities scale.

The nutritional value of different cultivars varies depending on agro-climatic conditions. It is also rich in nutrients and calories. It is a good source of Fe and vitamins A, B and C. An edible portion of tomatoes per 100 g contains energy (18 kcal), proteins (0.95 g), fats (0.11 g), carbohydrates (4.01 g), total sugars (2.49 g), calcium (11 mg), iron (0.68 mg), magnesium (9 mg), phosphorus (28 mg), potassium (218 mg), sodium (11 mg), Zn (0, 14 mg), vitamin A (1100 I.U) vitamin C (22.8 mg), thiamin (0.036 mg), riboflavin (0.022 mg), vitamin B6 (0.079 mg), vitamin E (0.56 mg), lycopene (20 -50 mg), titratable acidity (7.5-10 mg /100 ml), total solids (4-7%), fiber (0.6 g), total saturated fatty acids (0.015 g) and total polyunsaturated fatty acids (0.044 g) (Anon., 2013) [2].

In India, tomatoes are grown in almost all parts of the country. Tomatoes rank first among processed vegetables. It is a very good source of income for small and marginal farmers. It is grown on an area of 86.5 million hectares, production 210.56 million tons with a productivity of 24.34 MT/ha. Major tomato producing states are Madhya Pradesh, Odisha Tamil Nadu, Karnataka, Andhra Pradesh, Chhattisgarh, Maharashtra, West Bengal, Bihar and Gujarat (Anon., 2021) [3]. In Chhattisgarh, it is grown in an area of 6.13 million hectares, production of 106.20 million tonnes with a productivity of 17.30 MT/ha. Major producing areas are Durg, Jashpur, Kondagaon, Raigarh, Bilaspur, Surguja, Raipur, Rajnandgaon, Bemetara and Balod (Anon., 2022) [4].

Today, different countries face different challenges in providing chemical-free food to growing populations. Due to the use of synthetic fertilizers, the yield of vegetables is decreasing day by day, the unwanted use of synthetic fertilizers reduces soil fertility, kills beneficial microorganisms and moreover these chemicals interfere with our ecosystem

(Diacono and Montemurro, 2010) [6]. Supply of balanced nutrients can increase yield, fruit quality, fruit size, shelf life, color and flavor of tomato (Shukla and Naik, 1993) [10].

The integrated use of chemical fertilizers, FYM and vermicompost and other organic matter holds great promise for ensuring high levels of crop productivity as well as protecting soil health from damage and pollution hazards. Continuous use of high levels of chemical fertilizers leads to a reduction in nutrient uptake by plants, resulting in either stagnation or reduced yield. The constant use of chemical fertilizers increases the concentration of heavy metals in the soil, impairs the health and quality of the soil, which cannot support plant growth in the long term.

Among all sustainable crop production strategies, integrated nutrient management through minimization of chemical fertilizers and integration with organic manure without affecting soil quality and fertility plays an important role (Singh and Sinsinwar, 2006) [11]. The combined use of organic and inorganic fertilizers has reduced the cost and amount of fertilizer required by crops (Krupnik *et al*., 2004) [8]. It also produced the highest plant growth (Alam, 2006) [1].

The main principle of integrated nutrient management is to maximize the use of organic inputs while minimizing nutrient losses and the additional use of chemical fertilizers. Best practices for integrated nutrient management often include a combination of organic and inorganic nutrient sources. In addition to sustainable agricultural production, the main objective of INM is the comprehensive improvement of the physical, chemical and biological composition of soils (Chadha, 2002) [5]. Thus, keeping the above facts in mind, there is an urgent need to identify the most suitable combination of various nutrients and their effects to increase the yield, quality and also economics of tomato cultivation under Chhattisgarh conditions for higher production and for commercial use for farmers in this region. In view of the above-mentioned facts, a current investigation entitled the effect of integrated nutrient management on the tomato economy is proposed.

Materials and Methods

This experiment was conducted at Horticultural Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) during Rabi season 2021-22 and 2022-23 with tomato cultivar Pusa Ruby. The experiment consisted of 12 treatment combinations of the recommended rate of NPK fertilizers and integrated nutrient management practices with one control. Combinations of these treatments with their symbols are shown in Table 1. Schedules of various pre-sowing and post-sowing cultivation operations carried out in time during harvest. Economic analysis i.e. gross profit, net profit and b:c ratio was calculated.

Table 1: Treatments combination with their symbols.

S. No.	Symbols	Treatments
1.	T_1	Control
2.	T_2	50% RDF
3.	T_3	75% RDF
4.	T_4	100% RDF
5.	T_5	50% RDF + 50% FYM
6.	T_6	50% RDF +50% Vermicompost
7.	T_7	50% RDF + 50% FYM + PSB
8.	T_8	50% RDF + 50% Vermicompost + PSB
9.	T_9	75% RDF + 25% FYM
10.	T_{10}	75% RDF + 25% Vermicompost
11.	T_{11}	75% RDF + 25% FYM + PSB
12.	T_{12}	75% RDF + 25% Vermicompost + PSB

Results and Discussion

Data on costs of cultivation, gross yields, net yields and benefit ratios: costs affected by The Impact of Integrated Nutrient Management on Tomato Economics. The economics of tomato cultivation in this investigation were calculated using prevailing input costs and market rates of production during the respective years are shown in Table (2, 3 and 4) and Figure (1, 2 and 3).

1. Cost of cultivation (Rs ha^{-1})

The data showed that tomato cultivation cost is maximum in T_8 treatment (Rs 110246.00 and 111996.00 ha^{-1}) followed by T_6 (Rs 109996.00 and 111746.00) and T_{12} (Rs 100629.00 and 102329.00 ha^{-1} .00 and 202379.02 ha-20 20 Rs-200 Rs 23 and However, the cost of cultivation was recorded least in control treatment T_1 (69231.00 and 80981.00 ha^{-1} in 2021-22 and 2022-23).

2. Gross profit (Rs ha^{-1})

The data revealed that gross profit is highest in T_{12} treatment (Rs 385380.00 and Rs 395448.00 ha^{-1}) followed by T_{11} (Rs 381612.00 and Rs 386940.00 ha^{-1}) and T_{10} (Rs 378516.00 and 201,229,2500.00 201 Rs-100.00 -23 respectively However, the gross profit was recorded lowest under control treatment T_1 (Rs 241740.00 and 244380.00 ha^{-1}) in 2021-22 and 2022-23.

3. Net profit (Rs ha^{-1})

The data showed that the net profit is highest in treatment T_{11} (Rs 291233.00 and Rs 294811.00 ha^{-1}) followed by T_9 (Rs 284943.00 and Rs 293069.00 ha^{-1}) and T_{12} (Rs 284751.00 and 287551.00 and R287551.00 R2223.01) in 2001 -23, respectively. However, net profit was recorded lowest in T_1 control regime (Rs 172509.00 and Rs 163399.00 ha^{-1}) in 2021-22 and 2022-23.

4. Ratio of benefits: costs

The data showed that the benefit: Cost ratio is maximal with T_{11} treatment (3.22 and 3.20), followed by T_9 (3.16 and 3.13) and T_4 (2.99 and 2.95) in 2021 -22 and 2022-23. However, in 2021-22 and 2022-23, the least gross profit was recorded for the T_6 treatment (1.99 and 1.91). Similar results were obtained with Sharma el al. (2023) [9].

Table 2: Effect of integrated nutrient management on economics of tomato during 2021-22

Treatments		Total Cost (Rs ha^{-1})	Gross Return (Rs ha^{-1})	Net Return (Rs ha^{-1})	B:C Ratio
T_1	Control	69231.00	241740.00	172509.00	2.49
T_2	50% RDF	84996.00	280320.00	195324.00	2.30
T_3	75% RDF	87879.00	318336.00	230457.00	2.62
T_4	100% RDF	90761.00	362256.00	271495.00	2.99
T_5	50%RDF + 50%FYM	89496.00	317124.00	227628.00	2.54
T_6	50%RDF + 50%Vermicompost	109996.00	328368.00	218372.00	1.99
T_7	50% RDF + 50%FYM + PSB	89746.00	324072.00	234326.00	2.61
T_8	50% RDF + 50% Vermicompost + PSB	110246.00	333480.00	223234.00	2.02
T_9	75% RDF + 25% FYM	90129.00	375072.00	284943.00	3.16
T_{10}	75% RDF + 25% Vermicompost	100379.00	378516.00	278137.00	2.77
T_{11}	75% RDF + 25% FYM + PSB	90379.00	381612.00	291233.00	3.22
T_{12}	75% RDF + 25% Vermicompost + PSB	100629.00	385380.00	284751.00	2.83

Table 3: Effect of integrated nutrient management on economics of tomato during 2022-23

Treatments		Total Cost (Rs ha^{-1})	Gross Return (Rs ha^{-1})	Net Return (Rs ha^{-1})	B:C Ratio
T_1	Control	80981.00	244380.00	163399.00	2.02
T_2	50% RDF	86746.00	284520.00	197774.00	2.28
T_3	75% RDF	89629.00	316380.00	226751.00	2.53
T_4	100% RDF	92511.00	365736.00	273225.00	2.95
T_5	50% RDF + 50%FYM	91246.00	314316.00	223070.00	2.44
T_6	50% RDF + 50%Vermicompost	111746.00	325596.00	213850.00	1.91
T_7	50% RDF + 50%FYM + PSB	91496.00	328404.00	236908.00	2.59
T_8	50% RDF + 50% Vermicompost + PSB	111996.00	333840.00	221844.00	1.98
T_9	75% RDF + 25% FYM	91879.00	379452.00	287573.00	3.13
T_{10}	75% RDF + 25% Vermicompost	102129.00	379500.00	277371.00	2.72
T_{11}	75% RDF + 25% FYM + PSB	92129.00	386940.00	294811.00	3.20
T_{12}	75% RDF + 25% Vermicompost + PSB	102379.00	395448.00	293069.00	2.86

Table 4: Effect of integrated nutrient management on economics of tomato pooled basis

Treatments		Total Cost (Rs ha^{-1})	Gross Return (Rs ha^{-1})	Net Return (Rs ha^{-1})	B:C Ratio
T_1	Control	75106.00	243060.00	167954.00	2.25
T_2	50% RDF	85871.00	282420.00	196549.00	2.29
T_3	75% RDF	88754.00	317358.00	228604.00	2.58
T_4	100% RDF	91636.00	363996.00	272360.00	2.97
T_5	50% RDF + 50%FYM	90371.00	315720.00	225349.00	2.49
T_6	50% RDF + 50%Vermicompost	110871.00	326982.00	216111.00	1.95
T_7	50% RDF + 50%FYM + PSB	90621.00	326238.00	235617.00	2.60
T_8	50% RDF + 50% Vermicompost + PSB	111121.00	333660.00	222539.00	2.00
T_9	75% RDF + 25% FYM	91004.00	377262.00	286258.00	3.15
T_{10}	75% RDF + 25% Vermicompost	101254.00	379008.00	277754.00	2.74
T_{11}	75% RDF + 25% FYM + PSB	91254.00	384276.00	293022.00	3.21
T_{12}	75% RDF + 25% Vermicompost + PSB	101504.00	390414.00	288910.00	2.85

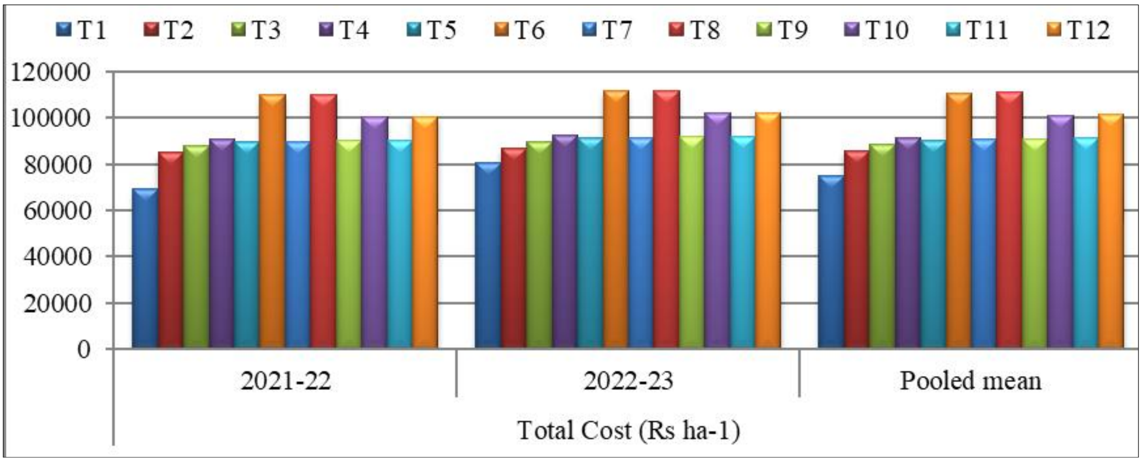

Fig 1: Effect of integrated nutrient management on total cost (Rs ha^{-1}) of tomato during 2021-22 and 2022-23

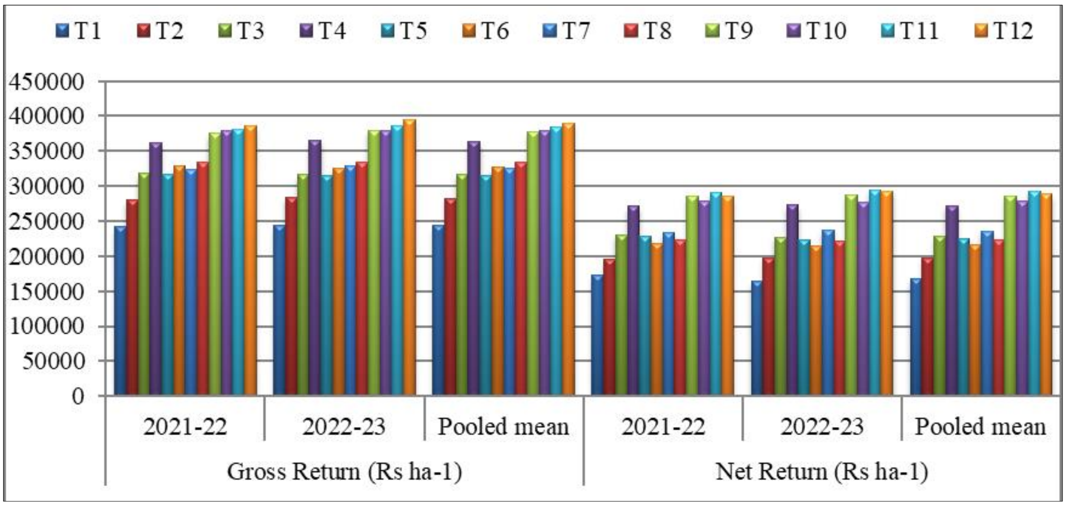

Fig 2: Effect of integrated nutrient management on gross return (Rs ha^{-1}) and net return (Rs ha^{-1}) of tomato during 2021-22 and 2022-23

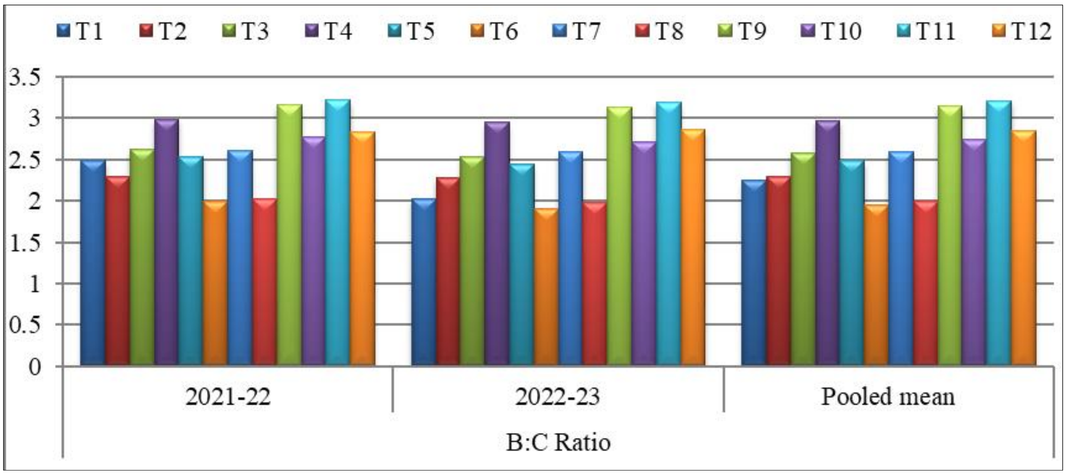

Fig 3: Effect of integrated nutrient management on B:C Ratio of tomato during 2021-22 and 2022-23

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