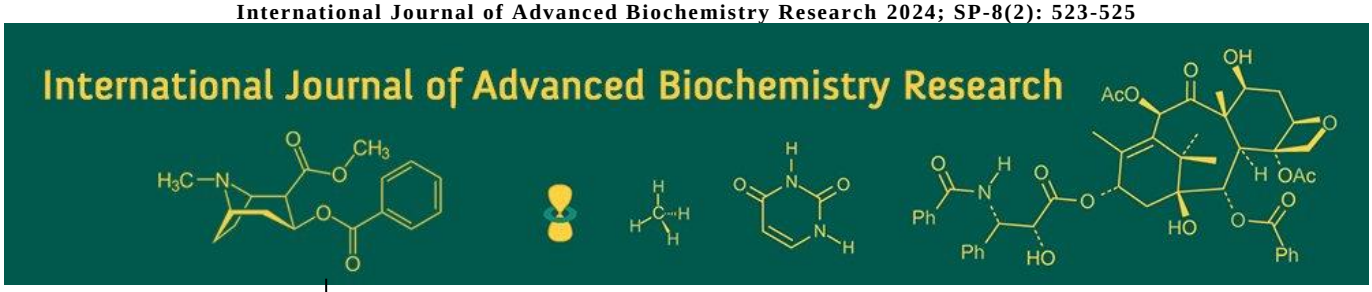

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Bhagwat Saran Asati
Department of Vegetable Science, RABL College of Agriculture and Research Station, Chhuikhadan Chhattisgarh, India

Manoj Kumar Chandraker
Department of Entomology Pt. SKS College of Agriculture and Research Station Rajnandgaon, Chhattisgarh, India

Corresponding Author:
Bhagwat Saran Asati
Department of Vegetable Science, RABL College of Agriculture and Research Station, Chhuikhadan Chhattisgarh, India

Study of growing containers on tomato yield, quality and economics

Bhagwat Saran Asati and Manoj Kumar Chandraker

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Abstract
An investigation was undertaken to assess the impact of different growing containers on the yield, quality and economics of tomato cultivation. Employing a Completely Randomized Design (CRD) with nine treatments replicated three times, the study revealed distinct variations among containers regarding yield and quality attributes. Treatment T_3 (White Polythene Bags), utilizing a specific type of container, consistently outperformed others in terms of plant growth, flowering, yield, quality, and economic viability. Regarding economics, white polythene bags yielded maximum gross returns and net profitability owing to lower cost of cultivation. They exhibited a very high benefit-cost ratio of 1.83, establishing white polythene bags as the most remunerative container for tomato cultivation. The study highlighted the significance of non-porous containers, particularly white polythene bags, in enhancing plant growth, quality parameters, and economic returns.

Keywords: tomato, containers, quality, economics

Introduction
Tomato (*Solanum lycopersicum* L.) is a self-pollinated and is one of the most important solanaceous vegetable crops grown widely all over the world. It is a very versatile vegetable for culinary purpose. Ripe tomato fruit is consumed fresh as salad, and consumed after cooking by utilizing in the preparation of a range of processed products such as puree, paste, powder, ketchup, sauce, soup and canned whole fruits. Unripe green fruits are used for preparation of pickles and chutney. Container gardening is a way to offer convenience and affordability of fresh and organic vegetables for family consumption. With the right growing containers many vegetables can be produced irrespective of the space. Container size has a huge effect on plant growth and it may affect root and shoot growth, biomass accumulation and partitioning, photosynthesis, leaf chlorophyll content, plant water relations, nutrient uptake, respiration and flowering (Al-Menaie *et al.,* 2012) [1]. Maximizing tomato yields and quality depends on providing optimal growing conditions. The use of appropriate growing containers is an important cultural practice for tomato production in urban areas.

Materials and Methods
The present investigation was carried out in the Department of Vegetable Science, RABL College of Agriculture and Research Station, Chhuikhadan, Chhattisgarh during the year 2022-23. A completely randomized design (CRD) was used with nine treatments repeated three times. The nine treatments (T_1 Green Grow Bags, T_2 Plastic Pots, T_3 White Polythene Bags, T_4 Black Polythene Bags, T_5 Tin Pots, T_6 Cloth Bags, T_7 Cement Pots, T_8 Clay Pots and T_9 Jute Bags) were allocated in each replication under study. The size of grow bag or container for each treatment was same i.e. 18 x 18 inch. Growing media was combination of soil: FYM: sand (1:1:1) filled in different treatment growing bags. Thirty days old seedlings were transplanted in the evening hours and immediately followed by irrigation for proper establishment of the seedlings. All the other recommended package of practices was followed to raise a healthy crop. The data collected for different characters were analyzed by the method of analysis of variance as derived by Panse and Sukhatme (1978) [3].

Results and Discussion

Remarkably the highest plant height (88.08 cm), number of leaves per plant (72.43), number of primary branches per plant (5.54), root surface area (192.18 cm^2), stem base diameter (1.47 cm), number of fruits per plant (33.39), fruit weight (70.63 grams) and yield per plant (2.36 kg) was observed in treatment T_3 (White Polythene Bags) as compared to other treatment under study (Table 1). The variations in different growing characters can be attributed to differences in properties of the growing containers like availability of nutrients, water retention capacity, aeration, etc. which influences plant growth and productivity. The results obtained in the present study is in accordance with the results of Pramanik *et al.* (2007) [4], Kumar *et al.* (2019) [2] and Sharma *et al.* (2021) [5]. On other hand, remarkably minimum days to 50% flowering (47.36 days) was noted with the treatment T_3 (White Polythene Bags) (Table 1). Similar result was also reported by Soumya (2015) [6].

Table 1: Evaluation of growing traits under different containers.

Tr. No.	Treatment details	Plant height (cm)	Number of leaves per plant	Number of primary branches per plant	Roots surface area (cm^2)	Days to 50% flowering	Stem base diameter (cm)	Number of fruits per plant	Fruit weight (g)	Yield per plant (kg)
T_1	Green Grow Bags	87.35	70.39	5.35	190.19	47.47	1.44	32.58	69.57	2.27
T_2	Plastic Pots	86.42	65.40	5.32	180.34	47.86	1.38	30.83	68.39	2.08
T_3	White Polythene Bags	88.08	72.43	5.54	192.18	47.36	1.47	33.39	70.63	2.36
T_4	Black Polythene Bag	85.40	68.58	5.21	177.37	48.08	1.42	31.54	67.47	2.15
T_5	Tin Pots	84.33	63.42	5.06	155.61	48.30	1.34	29.40	66.73	1.96
T_6	Cloth Bags	81.20	55.32	4.11	145.14	51.14	1.25	25.52	62.51	1.59
T_7	Cement Pots	83.40	61.38	4.85	150.99	48.53	1.30	28.82	65.85	1.90
T_8	Clay Pots	82.22	59.60	4.55	148.15	48.53	1.25	27.49	64.31	1.76
T_9	Jute Bags	81.12	57.39	4.36	146.51	48.89	1.20	26.88	63.48	1.71
S.Em (±)		0.57	1.31	0.20	0.43		0.68	0.04	1.56	0.50
CD (at 0.05%)		1.69	3.90	0.59	1.27		2.03	0.12	4.63	1.48

The data pertaining pH, TSS (°Brix) and Vitamin C (mg) influenced by various treatment has been given in Table 2. The tomato fruits grown in white polythene bags (T_3) showed the significantly highest pH (4.89), TSS (5.03 °Brix) and vitamin C content (25.33 mg). The significantly lowest pH (4.65), TSS (3.10.°Brix) and vitamin C (19.25 mg) were recorded in tomato grown in cloth bags (T_6). The study showed non-porous containers like polythene bags enhance tomato quality over porous types. Appropriate container selection can boost quality parameters by up to 30% over suboptimal types.

Table 2: Performance of tomato under different containers on quality traits

Tr. No.	Treatment details	pH	TSS (°Brix)	Vitamin C (mg)
T_1	Green Grow Bags	4.85	4.59	23.83
T_2	Plastic Pots	4.82	4.48	22.67
T_3	White Polythene Bags	4.89	5.03	25.33
T_4	Black Polythene Bag	4.78	4.12	21.77
T_5	Tin Pots	4.75	4.29	21.11
T_6	Cloth Bags	4.65	3.65	19.25
T_7	Cement Pots	4.74	3.80	20.47
T_8	Clay Pots	4.73	3.51	20.03
T_9	Jute Bags	4.72	3.10	19.66
	S.Em (±)	0.04	0.14	1.09
	CD (0.05)	0.11	0.43	3.22

The data presented in Table 3 shows the economics of tomato cultivation as influenced by different growing containers per plant. The cost of cultivation per plant was highest in Plastic Pots (T_2) obtained in (₹20.90) per plant followed by Cement Pots (T_7) (₹18.90) per plant. The lowest cost of cultivation of ₹11.90 per plant was recorded in cloth bags (T_6). However, the data shows that the highest gross returns of ₹47.20 per plant was obtained with white polythene bags (T_3) followed by ₹45.40 per plant with green grow bags (T_1). The data shows that the highest net returns of ₹34.30 per plant was obtained with white polythene bags (T3) followed by green grow bags (T_1) with ₹32.00 per plant. The highest benefit: cost ratio was the treatment (T_3) White Polythene Bags (2.66) followed by the treatment (T_1) Green Grow Bags (2.39). The lowest benefit: cost ratio of (0.99) was recorded in Plastic Pots (T_2). This indicates that white polythene bags and green grow bags were the most economically viable options for tomato cultivation among the different containers tested.

The study compared the costs and returns of cultivating tomatoes in different containers and found that the cost of cultivation was highest in plastic pots and cement pots at Rs. 20.90 and Rs. 18.90 per plant respectively, compared to Rs. 11.90-13.90 per plant for polythene bags, jute bags and cloth bags (Table 3). While plastic and cement pots yielded moderately high gross returns, the higher costs resulted in lower net profits. Polythene bags, specifically white polythene bags, produced the highest gross and net returns of Rs. 36.50 and Rs. 23.60 per plant respectively, due to their lower cost of cultivation and ability to provide favorable growing conditions for roots and plant health. The benefit-cost ratio was also highest for white polythene bags at 1.83, making them the most economically viable option for tomato cultivation according to the study. The results obtained in the present study are supported by the works of Soumya (2015) [6].

Table 3: Economics of tomato as influenced by different growing containers per plant.

Tr. No.	Treatment Details	Economics of Tomato per plant			
		Cost of Cultivation (₹ plant^{-1})	Gross returns (₹ plant^{-1})	Net returns (₹ plant^{-1})	Benefit: cost ratio
T_1	Green Grow Bags	13.40	45.40	32.00	2.39
T_2	Plastic Pots	20.90	41.60	20.70	0.99
T_3	White Polythene Bags	12.90	47.20	34.30	2.66
T_4	Black Polythene Bag	12.90	43.00	30.10	2.33
T_5	Tin Pots	16.90	39.20	22.30	1.32
T_6	Cloth Bags	11.90	31.80	19.90	1.67
T_7	Cement Pots	18.90	38.00	19.10	1.01
T_8	Clay Pots	13.90	35.20	21.30	1.53
T_9	Jute Bags	11.90	34.20	22.30	1.87

*Tomato market price ₹20 per kg

Conclusion

The results indicated that container type had a significant influence on various yield and quality parameters of tomato. Regarding economics, white polythene bags yielded maximum gross returns and net profitability owing to lower cost of cultivation. They exhibited a very high benefit-cost ratio of 1.83, establishing white polythene bags as the most remunerative container for tomato cultivation. Of all the containers, white polythene bags (T_3) consistently produced the highest values for most parameters such as plant height, number of leaves, branches and roots, early flowering, fruit yield as well as quality attributes. Appropriate selection of growing container plays a critical role in optimizing growth, yield and quality of tomato. In conclusion, white polythene bags emerged as the best performing container for cultivation of tomato in Chhattisgarh plains.

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