



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
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NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(5): 956-960
Received: 02-02-2026
Accepted: 06-03-2026

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Effect of mulching and organic nutrient sources on growth, yield and quality of Brinjal (*Solanum melongena* L.)

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i5m.5643>

Abstract

Aims: The present investigation was conducted at the Agricultural Research Farm, Suresh Gyan Vihar University, Jaipur to study the effect of mulching and organic nutrient sources on growth, yield and quality of brinjal (*Solanum melongena* L.).

Place and Duration of Study: The experiment was conducted during Rabi season, 2025-26.

Methodology: The experiment was laid out in factorial randomized block design with two factors viz. first factor: mulching (4 levels, control, Black Plastic, Rice Straw and White Plastic) and second factor: Organic Nutrients (4 levels, control, Jeevamrit @ 3%, Panchgavya @ 5% and Jeevamrit @ 3% + Panchgavya @ 5% replicated thrice. The observed data was analyzed in OPSTAT.

Results: The results revealed significant differences among the factors and interactions. Among the treatment combination Superior growth, yield, quality parameters viz. maximum plant height (106.65 cm), plant spread [N-S] (92.79 cm), plant spread [E-W] (91.39 cm) Fresh weight of shoot (g) (402.04 g), Dry weight of shoot (g) (276.52 g), Root Length (cm) (446.23 cm), Fresh weight of root (g) (138.39 g), Dry weight of root (g) (95.69 g), Number of primary branches per plant (7.26), Number of leaves per plant (99.49), Chlorophyll content (mg/g) (46.86), Number of flowers per plant (39.39), Number of fruits per plant (25.51), Fruit length (cm) (9.43 cm), Fruit diameter (cm) (47.19 cm), Average fruit weight (g) (84.82 g), Total fruit yield per plant (kg/plant) (2.17 kg/plant), Total Yield (t/ha) (40.49 t/ha), total soluble solids (8.61°Brix) and ascorbic acid content (17.96 mg/100g) were observed in the treatment combination of Black Plastic X Jeevamrit @ 3% + Panchgavya @ 5% (M_2O_4) whereas the minimum was observed in control.

Conclusion: Although these results are only indicative and require further experimentation to arrive at more consistent and credible conclusion, the treatment Black Plastic X Jeevamrit @ 3% + Panchgavya @ 5% (M_2O_4) may be recommended for obtaining higher yield and superior quality of Brinjal.

Keywords: Brinjal, growth, mulching, black plastic, Jeevamrit, Panchgavya

1. Introduction

Brinjal (*Solanum melongena* L.) is one of the most important and widely cultivated vegetable crops belonging to the family Solanaceae. It is grown extensively in tropical and subtropical regions of the world due to its wide adaptability and high yield potential. India is considered the primary centre of origin and diversity of brinjal and ranks among the leading producers globally. The crop is grown for its edible fruits, which are rich in dietary fibre, vitamins, and minerals. Brinjal is valued for its year-round cultivation, diverse varieties, and high consumer demand. Owing to its economic importance, the crop plays a significant role in vegetable production systems and farmer livelihoods (Kumar *et al.*, 2023) ^[8]. Mulching is an important agricultural practice that involves covering the soil surface with organic or inorganic materials to improve soil conditions and enhance crop growth. Plastic mulches, particularly polyethylene films, are widely used in vegetable and horticultural crops to conserve soil moisture, regulate soil temperature, suppress weed growth, and reduce soil erosion. Mulching also improves fertilizer use efficiency, promotes early crop maturity, and increases yield and quality of produce. In modern agriculture, plastic mulch has gained popularity due to its ability to optimize water use,

enhance resource efficiency, and provide higher economic returns, especially under intensive vegetable cultivation systems. Its adoption has been reported to significantly improve growth and productivity in crops like brinjal, tomato, and cucumber (Kader *et al.*, 2022) ^[5]. The term Jeevamrutha signifies life (jeeva) supporting holy liquid (amruth) (Dhanaji *et al.*, 2018) ^[2]. Jeevamrutha has helped in rapid enhancement of soil fertility through increased activity of soil micro flora and fauna (Sutar *et al.*, 2019) ^[15]. It can be applied as foliar spray or soil drenching, which helps to convert nutrients from non-available form to dissolved form in the soil (Kaur *et al.*, 2021) ^[7]. It contains vitamins, essential amino acids, macronutrients, micronutrients, and growth promoting hormones like IAA, GA. Apart from organic manure, Indian agriculture is directly benefited from cow in terms of milk production, urine, dung as well as milk products like curd, ghee and butter. Panchagavya is one of the cheaper eco-friendly traditional organic formulations in India. In Sanskrit literature, Panchagavya denotes the “blend of cow dung, cow urine, milk, curd and ghee”. Among these, cow dung, cow urine and milk are the direct components, and curd and ghee are the derived products. Each of these five products are known as ‘Gavya’ and together called as ‘Panchagavya’ (Amalraj *et al.*, 2015; Singh *et al.*, 2018) ^[1, 11]. Panchagavya is a plant growth stimulant that improves the biological efficiency of crops. It helps to activate soil and protect the plants from diseases as well as enhance the nutritional value of the crops (Rao *et al.*, 2015).

2. Materials and Methods

The present investigation was conducted at the Agricultural Research Farm, Suresh Gyan Vihar University, Jaipur, during Rabi season 2025-26. The experiment was laid out in factorial randomized block design with two factors viz. first factor: mulch, 4 levels viz. control (M₁), Black Plastic (M₂), Rice Straw (M₃) and White Plastic (M₄) and second factor: Organic Nutrients, 4 levels viz. control (O₁), Jeevamrit @ 3% (O₂), Panchagavya @ 5% (O₃) and Jeevamrit @ 3% + Panchagavya @ 5% (O₄) replicated thrice using brinjal variety Pusa Purple Round. The experimental data were statistically analyzed according to the method described by Fisher (1950). 30 days old brinjal seedlings were transplanted at a spacing of 60 cm x 60 cm (row to row and plant to plant) in raised beds having dimension of 3.6 m x 1.8 m = 6.48 m² accommodating 32 plants per plot. Recommended doses of fertilisers (NPK) was applied at the time of field preparation in all the treatments. Total soluble solids (TSS) were measured using a Hand Refractometer (Erma) with a pH range of 0 to 32°Brix. After being adjusted at 20°C, the data were presented as °Brix of the juice. To determine the ascorbic acid concentration, 5 grams of head was crushed using a mortar and pestle in the presence of 3 per cent metaphosphoric acid as a buffer. A 100 ml volume was prepared by filtering the isolated material. A small amount (5 ml) was tested for color by adding 2, 6-dichlorophenol indophenol dye solution until a pale pink hue was achieved. The findings were presented as milligrams of ascorbic acid for every hundred grams of head.

For normal ascorbic acid, the dye factor is half of the titratable value.

$$\text{Ascorbic acid (per cent)} = \frac{\text{Titrate value} \times \text{dye factor} \times \text{volume made up}}{\text{Aliquot taken for estimation} \times \text{Volume of sample taken}} \times 100$$

3. Results and Discussion

The results revealed significant differences among the factors and interactions. Among the treatment combinations, superior

growth parameters viz. maximum plant height (106.65 cm), plant spread [N-S] (92.79 cm), plant spread [E-W] (91.39 cm) Fresh weight of shoot (g) (402.04 g), Dry weight of shoot (g) (276.52 g), Root Length (cm) (446.23 cm), Fresh weight of root (g) (138.39 g), Dry weight of root (g) (95.69 cm), Number of primary branches per plant (7.26), Number of leaves per plant (99.49), Chlorophyll content (mg/g) (46.86), (Table 1, 2, 3 and 4) were observed in the treatment combination of Black Plastic X Jeevamrit @ 3% + Panchagavya @ 5% (M₂O₄). Among different mulch treatments, Black Plastic Mulch showed superior performance for growth attributes. This may be due to its ability to reduce evaporation losses and maintain optimum soil moisture throughout the crop growth period. The favourable microclimatic conditions created under plastic mulch possibly enhanced cell division, photosynthetic activity and translocation of assimilates, thereby promoting vigorous vegetative growth. Reduced weed competition under mulched conditions might have further ensured greater availability of nutrients and moisture to the crop plants. Similar findings were also reported by Dogoreet *et al.* (2016) ^[3], Patel *et al.* (2019) ^[10], Kamble *et al.* (2020) ^[6], Vasava *et al.* (2023) ^[16] and Subedi and Adhikari (2024). Superior yield parameters viz. Number of flowers per plant (39.39), Number of fruits per plant (25.51), Fruit length (cm) (9.43 cm), Fruit diameter (cm) (47.19 cm), Average fruit weight (g) (84.82 g), Total fruit yield per plant (kg/plant) (2.17 kg/plant), Total Yield (t/ha) (40.49 t/ha), (Table 5 and 6) were observed in the treatment combinations consisting Black Plastic X Jeevamrit @ 3% + Panchagavya @ 5% (M₂O₄). Adequate soil moisture maintained under mulching possibly reduced flower drop and enhanced fruit retention, which ultimately increased marketable fruit yield. Improved hydrothermal conditions under mulch may have also promoted better enzymatic activity and nutrient utilization efficiency in plants. Similar findings were reported by Madhukar (2019) ^[9], Patel *et al.* (2019) ^[10], Kamble *et al.* (2020) ^[6], Vasava *et al.* (2023) ^[16], Singh *et al.* (2024) ^[12]. Superior quality parameters viz. total soluble solids (8.61 °Brix) and ascorbic acid content (17.96 mg/100g) (Table 7) were observed in the treatment combinations consisting Black Plastic X Jeevamrit @ 3% + Panchagavya @ 5% (M₂O₄). The enhancement in ascorbic acid content under mulching treatments may be due to increased metabolic activity and better synthesis of vitamins under favourable soil conditions. Improved nutrient availability, especially micronutrients, under mulched conditions might have stimulated enzymatic reactions responsible for synthesis of ascorbic acid and other quality constituents. Similar observations were also reported by Gajjala and Chatterjee (2019) ^[4], Patel *et al.* (2019) ^[10] and Singh *et al.* (2025) ^[13]. The economic analysis revealed that treatment combination of M₂O₄ (Black Plastic X Jeevamrit @ 3% + Panchagavya @ 5%) emerged as the most financially viable treatment combination, achieving the maximum gross return (₹598319.43/ha) and net return (₹499556.43/ha) and Benefit-Cost (B:C) ratio of 5.06 (Table 8), indicating the best return on investment. In contrast, control (M₁O₁) recorded the lowest performance across all economic parameters. The reason for higher net return in this treatment is apparently is the higher yield obtained under this treatment. Enhanced microbial activity and continuous nutrient availability under organic nutrient treatments may have further supported better crop growth and fruit development, ultimately resulting in increased economic returns. Better quality fruits produced under these treatments may also have improved market acceptability and consumer preference, thereby contributing to higher market value. Similar findings were also reported by Singh *et al.* (2024) ^[12] and Patel *et al.* (2024) ^[10].

Table 1: Effect of Mulching and Organic Nutrient Sources on plant height (cm), plant spread (cm) of Brinjal

Factors	Plant Height (cm)					Plant Spread (cm) [N-S]					Plant Spread (cm) [E-W]				
	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean
O ₁	63.62	96.06	93.82	75.70	82.30	53.21	81.65	73.12	60.51	67.12	56.75	78.92	76.02	64.82	69.13
O ₂	71.45	99.89	97.87	89.17	89.60	61.08	85.19	84.85	67.04	74.54	64.68	83.75	81.90	70.54	75.22
O ₃	74.78	101.98	100.54	91.39	92.17	65.00	88.05	88.05	69.95	77.76	66.70	86.05	82.87	72.88	77.13
O ₄	76.23	106.65	102.21	93.46	94.64	66.08	92.79	90.79	73.26	80.73	67.88	91.39	86.85	74.96	80.27
Mean	71.52	101.15	98.61	87.43		61.34	86.92	84.20	67.69		64.00	85.03	81.91	70.80	
Factors	C.D.			SE(m)	CV (%)	C.D.		SE(m)		CV (%)	C.D.		SE(m)		CV (%)
Factor (O)	2.57			0.89	6.45	4.08		1.41		6.43	3.24		1.12		6.16
Factor (M)	2.57			0.89		4.08		1.41			3.24		1.12		
Factor (O X M)	5.14			1.78		6.67		2.83			6.48		2.25		

Table 2: Effect of Mulching and Organic Nutrient Sources on Fresh weight of shoot (g), Dry weight of Shoot (g) and Root Length (cm) of Brinjal

Factors	Fresh weight of shoot (g)					Dry weight of shoot (g)					Root Length (cm)				
	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean
O ₁	265.33	325.31	339.97	309.65	310.07	193.23	257.63	246.04	210.28	226.80	34.73	41.41	40.71	39.13	39.00
O ₂	293.06	368.47	354.15	320.93	334.15	205.56	264.46	262.54	224.78	239.34	38.56	41.52	40.82	39.46	40.09
O ₃	307.24	379.75	365.43	332.51	346.23	213.89	268.79	266.87	234.32	245.97	40.89	43.63	42.93	41.79	42.31
O ₄	313.37	402.04	373.16	343.14	357.93	216.12	276.52	272.20	236.65	250.37	40.92	46.23	42.98	41.82	42.99
Mean	294.75	368.89	358.18	326.56		207.20	266.85	261.91	226.51		38.78	43.20	41.86	40.55	
Factors	C.D.			SE(m)	CV (%)	C.D.		SE(m)		CV (%)	C.D.		SE(m)		CV (%)
Factor (O)	12.18			4.22	6.34	4.97		1.72		7.49	1.59		0.55		6.64
Factor (M)	12.18			4.22		4.97		1.72			1.59		0.55		
Factor (O X M)	24.37			8.44		9.94		3.44			3.19		1.10		

Table 3: Effect of Mulching and Organic Nutrient Sources on Fresh weight of root (g), Dry weight of root (g) and Number of primary branches per plant of Brinjal

Factors	Fresh weight of root (g)					Dry weight of root (g)					Number of primary branches per plant				
	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean
O ₁	79.19	110.50	113.68	94.53	99.47	51.13	78.84	78.82	66.56	68.84	3.12	5.58	5.98	3.56	4.56
O ₂	90.02	122.11	118.20	101.24	107.89	60.46	83.28	79.64	68.89	73.07	4.45	6.39	6.28	4.36	5.37
O ₃	97.40	130.17	127.09	110.71	116.34	67.79	90.39	87.32	76.97	80.62	4.78	6.73	6.39	4.32	5.56
O ₄	100.93	138.39	128.70	114.60	120.66	70.23	95.69	88.43	79.65	83.50	4.23	7.26	6.47	4.95	5.73
Mean	91.88	125.29	121.92	105.27		62.40	87.05	83.55	73.02		4.15	6.49	6.28	4.30	
Factors	C.D.			SE(m)	CV (%)	C.D.		SE(m)		CV (%)	C.D.		SE(m)		CV (%)
Factor (O)	5.06			1.75	6.53	3.94		1.36		6.23	0.29		0.10		6.51
Factor (M)	5.06			1.75		3.94		1.36			0.29		0.10		
Factor (O X M)	10.11			3.50		7.88		2.73			0.57		0.20		

Table 4: Effect of Mulching and Organic Nutrient Sources on Number of leaves per plant, Chlorophyll content (mg/g) and Number of flowers per plant of Brinjal

Factors	Number of leaves per plant					Chlorophyll content (mg/g)					Number of flowers per plant				
	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean
O ₁	62.56	87.51	86.23	68.46	76.19	23.25	33.46	31.31	28.89	29.22	17.79	33.87	29.99	24.23	26.47
O ₂	72.56	91.36	87.82	80.79	83.13	30.11	37.12	34.97	33.55	33.94	24.45	34.17	32.54	28.22	29.85
O ₃	79.89	96.13	92.36	88.89	89.32	34.12	41.13	38.98	35.66	37.47	27.78	36.28	36.54	31.98	33.15
O ₄	80.13	99.49	94.17	92.89	91.67	23.78	46.86	41.31	38.99	37.74	28.23	39.39	37.56	32.65	34.46
Mean	73.79	93.62	90.15	82.76		27.82	39.64	36.64	34.27		24.56	35.93	34.16	29.27	
Factors	C.D.			SE(m)	CV (%)	C.D.		SE(m)		CV (%)	C.D.		SE(m)		CV (%)
Factor (O)	3.93			1.36	6.57	1.17		3.39		7.27	1.94		0.67		7.63
Factor (M)	3.93			1.36		1.17		3.39			1.94		0.67		
Factor (O X M)	7.85			2.72		2.34		6.77			3.88		1.34		

Table 5: Effect of Mulching and Organic Nutrient Sources on Number of fruits per plant, Fruit length (cm) and Fruit diameter (cm) of Brinjal

Factors	Number of fruits per plant					Fruit length (cm)					Fruit diameter (cm)				
	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean
O ₁	13.05	21.66	22.11	18.00	18.71	3.02	6.41	6.62	5.23	5.32	27.12	38.98	38.98	31.23	34.08
O ₂	15.55	21.07	21.23	19.22	19.27	4.15	7.52	6.91	5.56	6.04	31.45	40.31	39.87	35.89	36.88
O ₃	16.44	23.62	22.67	22.20	21.23	5.08	8.15	7.55	5.89	6.67	32.78	43.97	40.54	36.32	38.40
O ₄	16.78	25.51	23.91	20.76	21.74	5.21	9.43	7.88	5.91	7.11	33.23	47.19	41.21	37.65	39.82
Mean	15.46	22.97	22.48	20.05		4.37	7.88	7.24	5.65		31.15	42.61	40.15	35.27	
Factors	C.D.			SE(m)	CV (%)	C.D.		SE(m)		CV (%)	C.D.		SE(m)		CV (%)
Factor (O)	1.09			0.38	6.46	0.48		0.17		9.39	2.88		1.00		9.19
Factor (M)	1.09			0.38		0.48		0.17			2.88		1.00		
Factor (O X M)	2.18			0.75		0.96		0.34			3.62		2.00		

Table 6: Effect of Mulching and Organic Nutrient Sources on Average fruit weight (g), Total fruit yield per plant (kg/plant) and Total Yield (t/ha) of Brinjal

Factors	Average fruit weight (g)					Total fruit yield per plant (kg/plant)					Total Yield (t/ha)				
	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean
O ₁	49.23	67.31	65.75	62.00	61.07	0.67	1.58	1.56	1.34	1.28	7.34	22.52	22.16	17.71	17.43
O ₂	63.46	75.54	72.31	67.89	69.80	1.01	1.81	1.63	1.35	1.45	14.26	33.22	29.68	24.03	25.30
O ₃	69.79	81.87	77.64	74.32	75.91	1.11	1.85	1.77	1.44	1.54	16.24	34.07	32.31	25.82	27.11
O ₄	70.23	84.82	78.97	75.65	77.42	1.15	2.17	1.90	1.51	1.68	16.92	40.49	35.01	27.17	29.90
Mean	63.18	77.39	73.67	69.96		0.98	1.85	1.71	1.41		13.69	32.57	29.79	23.68	
Factors	C.D.			SE(m)	CV (%)	C.D.			SE(m)	CV (%)	C.D.			SE(m)	CV (%)
Factor (O)	4.20			1.45	7.09	0.17			0.06	8.49	3.34			1.16	9.49
Factor (M)	4.20			1.45		0.17			0.06		3.34			1.16	
Factor (O X M)	8.40			2.90		0.34			0.12		6.68			2.32	

Table 7: Effect of Mulching and Organic Nutrient Sources on total soluble solids (⁰Brix) and ascorbic acid (mg/100g pulp) of Brinjal

Factors	Total soluble solids (⁰ Brix)					Ascorbic acid (mg/100g pulp)				
	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean
O ₁	3.23	7.21	6.88	5.12	5.61	9.86	15.12	14.59	10.87	12.61
O ₂	4.53	7.41	7.18	5.42	6.14	11.94	15.25	14.83	12.85	13.72
O ₃	4.89	7.87	7.48	5.78	6.51	12.47	15.78	15.36	13.13	14.19
O ₄	4.98	8.61	7.54	5.82	6.74	12.71	17.96	15.69	13.46	14.96
Mean	4.41	7.78	7.27	5.54		11.75	16.03	15.12	12.58	
Factors	C.D.			SE(m)	CV (%)	C.D.			SE(m)	CV (%)
Factor (O)	0.49			0.17	4.53	1.10			0.38	4.50
Factor (M)	0.49			0.17		1.10			0.38	
Factor (O X M)	0.98			0.34		2.20			0.76	

Table 8: Effect of Mulching and Organic Nutrient Sources on economics of cultivation

Treatment combinations	Total Cost (₹/ha)	Gross Return (₹/ha)	Net Return (₹/ha)	B:C Ratio
M ₁ × O ₁	90763	302055.21	211292.21	2.33
M ₁ × O ₂	91763	303866.16	212103.16	2.31
M ₁ × O ₃	91763	333671.75	241908.75	2.64
M ₁ × O ₄	92763	343753.47	250990.47	2.71
M ₂ × O ₁	96763	472769.18	376006.18	3.89
M ₂ × O ₂	97763	543347.24	445584.24	4.56
M ₂ × O ₃	97763	556054.57	458291.57	4.69
M ₂ × O ₄	98763	598319.43	499556.43	5.06
M ₃ × O ₁	92763	449367.92	356604.92	3.84
M ₃ × O ₂	93763	472272.97	378509.97	4.04
M ₃ × O ₃	93763	511645.63	417882.63	4.46
M ₃ × O ₄	94763	552190.87	457427.87	4.83
M ₄ × O ₁	95763	400710.91	304947.91	3.18
M ₄ × O ₂	96763	405397.82	308634.82	3.19
M ₄ × O ₃	96763	432316.08	335553.08	3.47
M ₄ × O ₄	97763	452613.85	354850.85	3.63

4. Conclusion

From the present study it can be concluded that treatment combination of Black Plastic X Jeevamrit @ 3% + Panchagavya @ 5%(M₂O₄) enhanced not only the vegetative performance of brinjal but also their yield, quality traits and benefit cost ratio.

Acknowledgements

Authors acknowledged School of Agriculture, Suresh Gyan Vihar University, Jagatpura, Jaipur, Rajasthan.

Competing Interests

Authors declare no competing interest.

Authors' Contributions

First author: Conducted the study, data analysis, manuscript preparation; Second author: investigation, data analysis, supervision, manuscript writing; Third author: data correction;

fourth author: supervision, data curation; fifth author: data curation; sixth author: data curation; seventh author: data curation, statistical analysis

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