Journal of Soil Salinity and Water Quality 17(2), 288-296, 2025
DOI: https://doi.org/10.56093/jsswq.v17i2.167449

Effect of Manure and Mulching under Drip Irrigation on Salinity and Yield of Brinjal in Coastal Saline Soils

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Abstract

Field experiments were carried out over four *rabi* seasons during 2019–20, 2020–2021, 2021–2022 and 2022–2023 at Khar Land Research Station, Panvel, Maharashtra, India on coastal saline soil to examine the impact of various manures [no manure, farmyard manure (FYM), vermicompost] and mulches (no mulch, plastic mulch, and paddy straw) on soil salinity and the yield of brinjal under drip irrigation. Findings indicated a notable decrease in salinity (2.57 and 1.08 dS m^{-1}) at 30 days of transplanting (DAT) and 60 days after transplanting of brinjal, respectively with the application of FYM @ 7.5 Mg ha^{-1} + vermicompost @ 2.5 Mg ha^{-1} under with plastic mulch over initial salinity (EC) of 6.13 dS m^{-1}. The information additionally indicated that the combination of paddy straw mulch with FYM at 7.5 Mg ha^{-1} + vermicompost at 2.5 Mg ha^{-1} resulted in a notably higher fruit yield of brinjal (33.71 Mg ha^{-1}) compared to the no manuring treatment (26.86 Mg ha^{-1}). The paddy straw mulch (32.78 Mg ha^{-1}) resulted in a significantly higher brinjal yield than no mulching (28.03 Mg ha^{-1}). Additionally, it was noted that the combination of FYM @ 7.5 Mg ha^{-1} + vermicompost @ 2.5 Mg ha^{-1} with paddy straw mulch produced the highest yield (37.25 Mg ha^{-1}), followed by the treatment receiving FYM @ 15 Mg ha^{-1} under paddy straw mulch (34.32 Mg ha^{-1}). According to the benefit-cost ratio, the combination of paddy straw mulch with FYM at 7.5 Mg ha^{-1} and vermicompost at 2.5 Mg ha^{-1} exhibited the highest ratio (1.38) in coastal saline soils of Kankan, Maharashtra.

Keywords: Salinity, Manures, Mulch, Brinjal, Fruit yield, Economics

Introduction

The saline coastal soils in Maharashtra extent 720 km across Palghar, Thane, Raigad, Ratnagiri, and Sindhudurg districts, containing 54 creeks and covering an estimated area of around 65,465 ha. In the coastal plains of Maharashtra, the accumulation of salinity in the root zone primarily results from irrigation with saline water and capillary rise from shallow saline groundwater (Dodake *et al.*, 2023; Patil *et al.*, 2016) when crops are cultivated on leftover moisture. Despite receiving an annual average rainfall of 3250 mm, water scarcity is a common occurrence in the post–monsoon period in the Konkan region of Maharashtra (Dodake *et al.*, 2022). In Maharashtra's coastal area, farmers mainly cultivate rice as a monocrop in the *kharif* season, leaving a significant portion of the land barren during the dry season, which impacts the farmers' economic condition and livelihood. The selection of crops in soils affected by presence and nature of salt. Nonetheless, employing salt–resistant crops and appropriate agricultural methods can enhance crop diversity in saline conditions to meet the essential needs of farming households. At times, farmers have excavated farm ponds to harvest rainwater. The saline groundwater along with the restricted fresh water in farm ponds could be efficiently utilized to cultivate salt–tolerant vegetables in the *rabi* and summer seasons. Additional factors that significantly lower yield include: elevated temperatures, excessive soil moisture, water scarcity, and competition from weeds.

Applying organic materials to salt–affected soils can enhance surface soil fertility, improve soil structure and permeability, which in turn promotes salt leaching, decreases surface evaporation, and prevents salt buildup in the surface layers and boosts productivity (Raut *et al.*, 2021). Drip irrigation is deemed the most effective irrigation technique as it delivers water accurately to the root zone at regular intervals, allowing for minimal leaching fraction, which helps move salts toward the edges of the wetting zone. Consequently, plants might encounter less salinity stress in comparison to surface irrigation. Nonetheless, many studies have focused on crops like sesame (Singaravel *et al.*, 2019), okra, chili, bitter gourd, cucumber, and knol–khol (Mahanta *et al.*, 2019), garlic (Patel *et al.*, 2019), as well as barley and maize (Wang *et al.*, 2022) grown under drip irrigation in coastal saline soils, discovering that these crops exhibit greater resilience compared to others. Weed obstacles have been linked to annual crop losses ranging from 10 to 70% (Mani *et al.*, 1968), with a 45% loss noted in brinjal crops alone (Leela, 1982). Organic mulch such as straw, paper, dried leaves, sawdust, grass clippings, and compost is useful since these natural materials require replenishment as they decompose quickly. Inorganic mulching is commonly employed in perennial crops such as plastic mulch, synthetic mulch, and polyethylene film, among others (Memon *et al.*, 2017). Research has demonstrated a significant rise in yields for brinjal and tomato (Shivani *et al.*, 2019); brinjal (Kumar *et al.*, 2018); pumpkin, pointed gourd, cucumber, and bitter gourd (Sarangi *et al.*, 2024); chili, knol–khol, okra, bitter gourd, and cucumber (Mahanta *et al.*, 2019) when utilizing drip irrigation and plastic mulch. There is limited information regarding the application of manure and mulching with drip irrigation in the coastal saline soils of Maharashtra. In light of this, the current study was initiated to investigate the impacts of manure and mulch on salinity, growth, and yield of brinjal.

Material and Methods

A field experiment was carried out with brinjal (*Solanum melongena* L.) variety 'Mahyco MEBH 10' as the test crop over four continuous *Rabi* seasons from 2019–2020, 2020–2021, 2021–2022 and 2022–2023 at Khar Land Research Station (KRLS), Panvel (close to the Arabian Sea), Maharashtra, India. Geographically, KRLS Panvel is located at 18°99′24.36″ N and 73°6′6.12″ E, standing at an elevation of 5 m above the average sea level along the western coastal region of India. Rainfall is a crucial factor in agricultural planning since this area experiences significant annual precipitation of 2,500–4,000 mm, primarily due to the southwest monsoon from June to October. Nonetheless, there was no rainfall during the *rabi* seasons of the cropping years (2019–20 and 2022–23). It experiences a marine humid to per humid climate with minimal daily fluctuations. The average maximum and minimum temperatures during the growing season were 32.2 °C and 21 °C, respectively, while the mean relative humidity was 60 percent. The texture of the soil at the experimental site was silt clay loam and had saline characteristics, with a soil pH of 6.79, reflecting the dominance of high rainfall in the area under study. The initial soil sample was collected before transplanting of the brinjal crop (November). The first soil sampling was done in the months of December (30 days after transplanting of brinjal) and second in the month of January (60 days after transplanting of brinjal). The electrical conductivity of soil ($EC_{1:2.5}$) was 6.13 dS m^{-1}, along with organic carbon (5.1 g kg^{-1}), available nitrogen (174.36 kg ha^{-1}), available phosphorus (95.92 kg ha^{-1}), and available potassium (1275.25 kg ha^{-1}), respectively.

Design of experiment

The field experiment was conducted using a factorial randomized block design that included four levels of manure application: farmyard manure (FYM) at 15 Mg ha^{-1} (F_1), vermicompost at 5 Mg ha^{-1} (F_2), FYM at 7.5 Mg ha^{-1} combined with vermicompost at 2.5 Mg ha^{-1} (F_3), and a control with no manure (F_4). Additionally, there were three mulch types: plastic mulch (M_1), paddy straw mulch (M_2), and no mulch (M_3), with three replications across each of the 12 treatment combinations.

Field experiment

One-month-old brinjal seedlings were transplanted during the first fortnight of November each year, spaced 60 cm × 60 cm apart. The total plot dimensions were 4.20 m × 3.0 m. Prior to planting; 25 mm of irrigation water was applied to all treatments to raise the soil water content to the field capacity level in the 0–60 cm soil depth. The suggested set of practices (cultural and pest management techniques) was adhered to in order to cultivate a healthy brinjal crop. The 50–micron thick black polyethylene film and paddy straw at 3.0 Mg ha^{-1} were utilized for mulching. The mulch was applied by hand across the prepared field, and seedlings were transplanted by creating holes that measured 5 cm in diameter. The suggested fertilizer application rate (150:50:50 kg NPK ha^{-1}) was made using urea, single super phosphate (SSP), and muriate of potash (MOP). A complete dose of phosphorus and potassium was applied, along with 50% nitrogen as the basal dose, while the remaining nitrogen was side–dressed at 45 and 90 days after transplanting (DAT). Lateral drip lines with emitters spaced 50 cm apart were installed in every row across all treatments. The water needs for brinjal were met using collected rainwater stored in a farm pond at the KRLS Research farm in Panvel, Maharashtra. The quality of collected rainwater was normal from the irrigation perspective. The drip irrigation system was set to operate every alternet day. The overall fruit yield was documented by summing the yield from each picking and converting it to Mg per hectare for every experimental plot. Soil sampling occurred prior to the start of the experiment, 30 and 60 days after transplanting of brinjal. Soil samples (0–30 mm) were gathered to assess the soil pH and the electrical conductivity of the soil. Soil pH and electrical conductivity were determined in soil : de–ionized water :: 1: 2.5 ratio as outlined by Jackson (1973). The moisture levels of the respective samples were evaluated on a weight basis through the gravimetric method (Jackson, 1973).

Economic analysis

The economic assessment of brinjal farming under various treatments was conducted by evaluating fruit yield, gross income, and cultivation costs to ascertain net income and the benefit–cost ratio (BCR). The standard values concerning the cost component were sourced from the Cost of Cultivation Scheme, Department of Economics, Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli, Maharashtra.

Statistical analyses

Field data concerning soil pH, soil salinity, soil moisture, and fruit yield were statistically analysed employing conventional statistical techniques (Panse and Sukhatme, 1961). The Pearsons correlation between different variables was examined using the statistical approach detailed by Panse and Sukhatme (1961).

Results and Discussion

Effect on soil salinity

The lowest level of salinity was recorded with the application of FYM at 7.5 Mg ha^{-1} plus vermicompost at 2.5 Mg ha^{-1} measured at 30 (3.43 dS m^{-1}) and 60 (2.47 dS m^{-1}) days after transplanting of field experiment (Table 1). The decrease in soil EC may be associated with the formation of organic acids from the decomposition of added organic matter and the leaching of salts resulting from improved physical soil conditions. At the start of the season (November), the salinity of the soil in the root zone was below 6.13 dS m^{-1}. Subsequently, the soil salinity declined further to <2 dS m^{-1} in the surface layer (0–30 cm) due to irrigation with fresh water harvested in farm pond by drip irrigation. Similar observation also reported by Singaravel *et al*. (2019) and Dodake *et al*. (2022). Similarly, the plastic mulch decreased the average soil salinity accumulation during the growing season to 3.07 and 1.39 dS m^{-1} (Table 1) in comparison to the no mulch treatment (5.33 and 7.72 dS m^{-1}) after 30 and 60 days of brinjal transplanting, respectively. The salt levels in the mulched treatment rose initially and then fell throughout the entire growing period, whereas the salt levels in the non–mulched treatment displayed an upward trend and stayed steady. These findings align with those of Wang *et al*. (2022). In the interaction effect, the plastic mulch combined with FYM at 7.5 Mg ha^{-1} and vermicompost at 2.5 Mg ha^{-1} resulted in values of 2.57 dS m^{-1} at 30 days and 1.08 dS m^{-1} at 60 days after transplanting of brinjal. Nevertheless, greater levels of electrical conductivity were noted in relation to the plots without manure and mulching treatment compared to those that were treated. The

Table 1. Effect of manure and mulching on salinity ($EC_{1:2.5}$ dS m^{-1}) under brinjal crop (pooled data of four years)

Treatments	30 Days after transplanting					60 Days after transplanting				
	FYM @ 15 Mg ha^{-1} (F_1)	Vermi-compost @ 5 Mg ha^{-1} (F_2)	FYM @ 7.5 Mg ha^{-1} + vermi-compost @ 2.5 Mg ha^{-1} (F_3)	No manure (F_4)	Mean	FYM @ 15 Mg ha^{-1} (F_1)	Vermi-compost @ 5 Mg ha^{-1} (F_2)	FYM @ 7.5 Mg ha^{-1} + vermi-compost @ 2.5 Mg ha^{-1} (F_3)	No manure (F_4)	Mean
Plastic Mulch (M_1)	2.90	3.19	2.57	3.61	3.07	1.40	1.47	1.08	1.60	1.39
Paddy Straw Mulch (M_2)	3.71	3.81	3.50	4.06	3.77	1.91	2.23	1.70	2.41	2.06
No mulch (M_3)	4.22	4.25	4.20	4.31	4.25	4.56	4.39	4.62	4.35	4.48
Mean	3.61	3.75	3.43	3.99		3.49	3.88	3.25		
		SE± m	LSD (p≤0.05)				SE± m	LSD (p≤0.05)		
Mulch (M)		0.03	0.08				0.01	0.03		
Manure (F)		0.03	0.09				0.01	0.03		
Interaction (M × F)		0.06	0.16				0.02	0.06		

reduction in soil EC may be associated with the production of organic acids from the decomposition of applied organic manure, as well as the leaching of salts enabled by the improved physical state of the soil (Singaravel *et al.*, 2019; Sarangi *et al.*, 2024). In the same way, mulching minimizes soil evaporation, aids in weed control, conserves moisture in the soil, regulates soil temperature, alleviates salinity issues, and creates a favorable environment for crop development (Rahul and Manikandan 2021). Alternatively, a drip system features regular irrigation and ensures ideal moisture levels in the soil, which keep soluble salts diluted, resulting in minimal soil salinity buildup (Seema *et al.*, 2023). Additionally, Wang *et al*. (2022) indicated that the combined application of farmyard manure and film mulch can not only prevent the rise of soil salt levels due to the use of organic fertilizer alone but also lower down salt and enhance soil fertility by minimizing soil evaporation. These mulching techniques not only boosted soil water retention but also aided in the leaching of salts, thereby reducing overall salt levels.

Effect on soil pH

Soil pH was affected by various manure treatments and mulching throughout the crop growth period (Table 2). The soil pH was affected by the application of FYM at 7.5 Mg ha^{-1} plus vermicompost at 2.5 Mg ha^{-1} (6.92 and 6.85) and by plastic mulch (7.20 and 7.07) at 30 and 60 days after transplanting of brinjal, respectively (Table 2). The rise in soil pH above initial levels without the use of mulching and manure treatments could be attributed to the neutral soil reaction and excessive leaching of salts occurs because of heavy rainfall. Whereas the introduction of salts *via*. capillary movement and irrigation transformed the soil from neutral to basic. These findings align with those from Dodake *et al*. (2022).

Regarding the interaction effect, the application of FYM at 7.5 Mg ha^{-1} combined with vermicompost at 2.5 Mg ha^{-1} and plastic mulch showed increased pH values (7.25 and 7.13) compared to other interactions at 30 and 60 days after transplanting of brinjal. It indicates that the soil pH was affected by the application of manure and mulch; however, in the absence of manure and mulch, soil pH negatively decreased, moving towards acidity. Additionally, it was noted that the soil pH started to rise from its initial value due to relatively intense evaporation, which led to salt accumulation. Following January, temperatures decline, leading to reduced soil evaporation and diminished root water uptake, while soil salinity hits its minimum in February of the subsequent year. Subsequently, temperatures increase, evaporation intensifies, and soil salinity starts to gradually increase. Comparable outcomes were likewise noted by Mbukwa *et al*. (2023).

Table 2. Effect of manure and mulching on soil $pH_{1:2.5}$ of saline under brinjal crop (pooled data of four years)

Treatments	30 Days after transplanting					60 Days after transplanting				
	FYM @ 15 Mg ha^{-1} (F_1)	Vermi-compost @ 5 Mg ha^{-1} (F_2)	FYM @ 7.5 Mg ha^{-1} + vermi-compost @ 2.5 Mg ha^{-1} (F_3)	No manure (F_4)	Mean	FYM @ 15 Mg ha^{-1} (F_1)	Vermi-compost @ 5 Mg ha^{-1} (F_2)	FYM @ 7.5 Mg ha^{-1} + vermi-compost @ 2.5 Mg ha^{-1} (F_3)	No manure (F_4)	Mean
Plastic Mulch (M_1)	7.22	7.19	7.25	7.15	7.20	7.08	7.05	7.13	6.99	7.07
Paddy Straw Mulch (M_2)	6.78	6.76	6.81	6.75	6.78	6.74	6.76	6.75	6.74	6.75
No mulch (M_3)	6.70	6.68	6.69	6.69	6.69	6.67	6.65	6.66	6.65	6.66
Mean	6.90	6.88	6.92			6.83	6.82	6.85		
		SE± m	LSD (p≤0.05)				SE± m	LSD (p≤0.05)		
Mulch (M)		0.003	0.010				0.002	0.006		
Manure (F)		0.004	0.011				0.002	0.007		
Interaction (M × F)		0.007	0.020				0.004	0.013		

Effect on soil moisture

A significantly highest soil moisture levels were observed with the application of FYM @ 7.5 Mg ha^{-1} + vermicompost @ 2.5 Mg ha^{-1} at 30 (34.95%) and 60 (28.49%) days after transplanting (Table 3). In alignment with this, the plastic mulch showed higher soil moisture levels (37.32 and 30.49%) than the no mulch treatment (27.26 and 23.09%) at 30 and 60 days after transplanting of brinjal, respectively (Table 3). The combination of manure (FYM at 7.5 Mg ha^{-1} + vermicompost at 2.5 Mg ha^{-1}) and plastic mulch showed the greatest soil moisture levels at 30 (39.4%) and 60 (32.3%) days following the transplanting of brinjal throughout the experimental duration. It was noted that the inclusion of organic fertilizer enhanced the soil moisture attributed to the improved water retention ability of the soil. Similar findings were noted in coastal saline soils of West Bengal (Raut *et al*. 2021). An effective retention of moisture with mulching could be attributed to the shading effect, which inhibited moisture evaporation from the soil surface and minimized vapor diffusion into the atmosphere.

Table 3. Effect of manure and mulching on soil moisture (%) in saline under brinjal crop (pooled data of four years)

Treatments	30 Days after transplanting					60 Days after transplanting				
	FYM @ 15 Mg ha^{-1} (F_1)	Vermi-compost @ 5 Mg ha^{-1} (F_2)	FYM @ 7.5 Mg ha^{-1} + vermi-compost @ 2.5 Mg ha^{-1} (F_3)	No manure (F_4)	Mean	FYM @ 15 Mg ha^{-1} (F_1)	Vermi-compost @ 5 Mg ha^{-1} (F_2)	FYM @ 7.5 Mg ha^{-1} + vermi-compost @ 2.5 Mg ha^{-1} (F_3)	No manure (F_4)	Mean
Plastic Mulch (M_1)	37.95	36.44	39.44	35.43	37.32	30.49	28.97	32.27	28.11	30.49
Paddy Straw Mulch (M_2)	33.98	32.32	36.65	30.99	33.49	27.62	25.77	29.09	24.66	27.62
No mulch (M_3)	27.81	26.69	28.77	25.79	27.26	23.09	20.52	24.11	19.62	23.09
Mean	33.24	31.82	34.95	30.74		27.07	25.09	28.49		
		SE± m	LSD (p≤0.05)				SE± m	LSD (p≤0.05)		
Mulch (M)		0.012	0.359				0.071	0.207		
Manure (F)		0.014	0.414				0.142	0.413		
Interaction (M × F)		0.024	0.718				0.083	0.236		

The process responsible for the maximum moisture retention in black plastic mulch is that the water, after evaporating, condenses on the underside of the polythene cover and subsequently drips back onto the soil surface, as reported by Kumar *et al*. (2018) and Mahanta *et al*. (2019).

Effect on production

The fruit yield of brinjal (Fig. 1) increased with the application of FYM at 7.5 Mg ha^{-1} plus vermicompost at 2.5 Mg ha^{-1} (33.71 Mg ha^{-1}). The highest fruit production of brinjal was noted with the treatment of farmyard manure combined with vermicompost. The inclusion of organic fertilizers aids in minimizing the negative impact of salinity because of the organic acids released during decomposition. Moreover, the organic acids generated during decomposition, along with humic acid, may have bound the micronutrient cations and enhanced nutrient availability to the plant, which ultimately aids in boosting production (Singaravel *et al*., 2019). Additionally, the paddy straw mulch demonstrated the highest and notable yield (27.5 Mg ha^{-1}) compared to other mulching methods. Paddy straw mulch notably influenced the fruit yield of brinjal in comparison to no mulching. The increased yield with paddy straw mulch may result from adequate soil moisture near the root zone and the maintenance of soil temperature during harsh winter days, which improved the soil environment around the roots, subsequently promoting plant growth, earlier harvest, and ultimately greater yield. Applying mulch to the soil surface positively effects on conserving soil moisture by reducing evaporation loss and aids in lowering soil salinity. Consequently, the prolonged retention, presence of moisture, and reduced salinity promote enhanced nutrient absorption, guarantee improved growth, and ultimately increase yield (Sarangi *et al*., 2024; Shivani *et al*., 2019).

In the interaction effect, the combination of FYM at 7.5 Mg ha^{-1} + vermicompost at 2.5 Mg ha^{-1} with paddy straw mulch showed a superior fruit yield of brinjal (37.25 Mg ha^{-1}) compared to the other interactions, as shown in Fig. 1. The incorporation of manure and mulching boosted the water and nutrient retention capabilities of these soils, thus improving soil fertility by enhancing the physical, chemical, and biological characteristics of the soil (Raut *et al*., 2021). Numerous researchers have reported the positive impacts of applying organic materials on the physical, chemical, and biological properties of soil (Patel *et al*., 2019; Appireddy and Mina, 2011). The use of organic fertilizers is noted to enhance salt–affected soils by improving their characteristics (Patel *et al*., 2019; Leogrande and Vitti, 2019). The inclusion of FYM and vermicompost may be linked to the direct supply

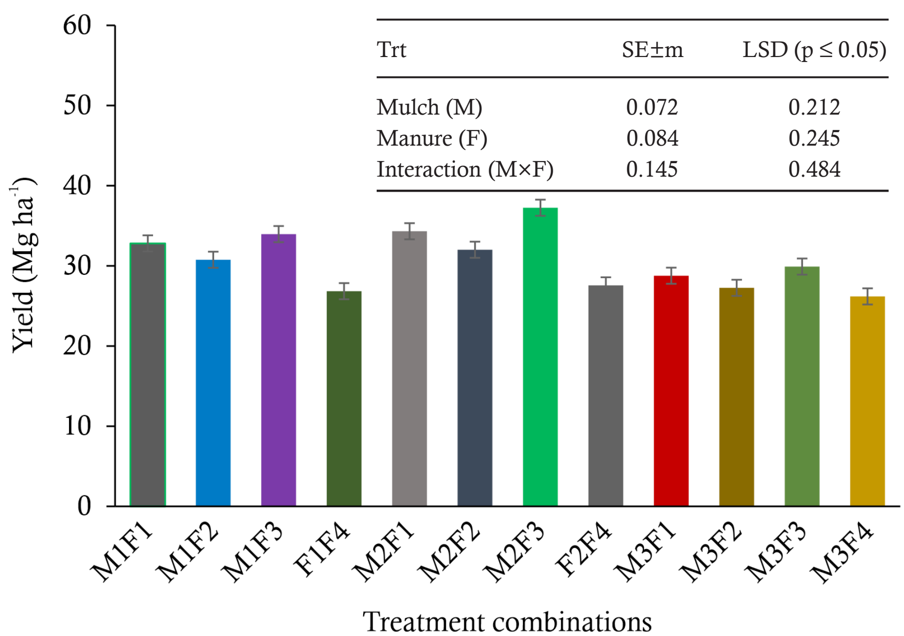

Fig. 1 Effect of different treatments on yield of brinjal (Mg ha^{-1}) (pooled data of four years)

of nitrogen, phosphorus, potassium, and other micronutrients, which also decreases the precipitation of phosphorus and potassium fixation, thus enhances nutrient availability. Further, paddy straw mulch decreased the amount of water loss *via*. evaporation from the soil surface. Paddy straw mulching reduces soil salinity and conserves soil moisture (Sarangi *et al.,* 2021). Thus, the relationship between soil, plants, and water improved leading to enhanced water productivity. Also, the drip irrigation delivers water accurately and directly to the root zone, enabling the crop to utilize water more effectively and maximize the irrigation capacity by enhancing the use of accessible irrigation water and boost the harvest. These results are corroborated with the findings of Shivani *et al*. (2019) and Singaravel *et al*. (2019).

The correlation (Fig. 2) study indicated that the EC measured at both 30 and 60 days following transplanting of brinjal exhibits a strong negative correlation with soil moisture (r = –0.94 to –0.90) and pH (r = –0.90 to –0.80). This indicates that increased EC (which signifies higher soluble salts in the soil) is associated with reduced moisture levels and slightly acidic conditions. The correlation of soil pH values between 30 and 60 days after transplanting of brinjal is notably high (r = 0.99), reflecting strong temporal stability. Furthermore, pH is positively correlated with moisture (r = 0.84), suggesting that soils with higher moisture content tend to have slightly elevated pH levels. The moisture levels recorded at 30 and 60 days after transplanting of brinjal demonstrate an extremely strong positive relationship (r = 0.99), indicating that soil moisture patterns remain consistent over time. Both moisture parameters exhibit a positive correlation with yield (r = 0.69 and 0.71). Yield

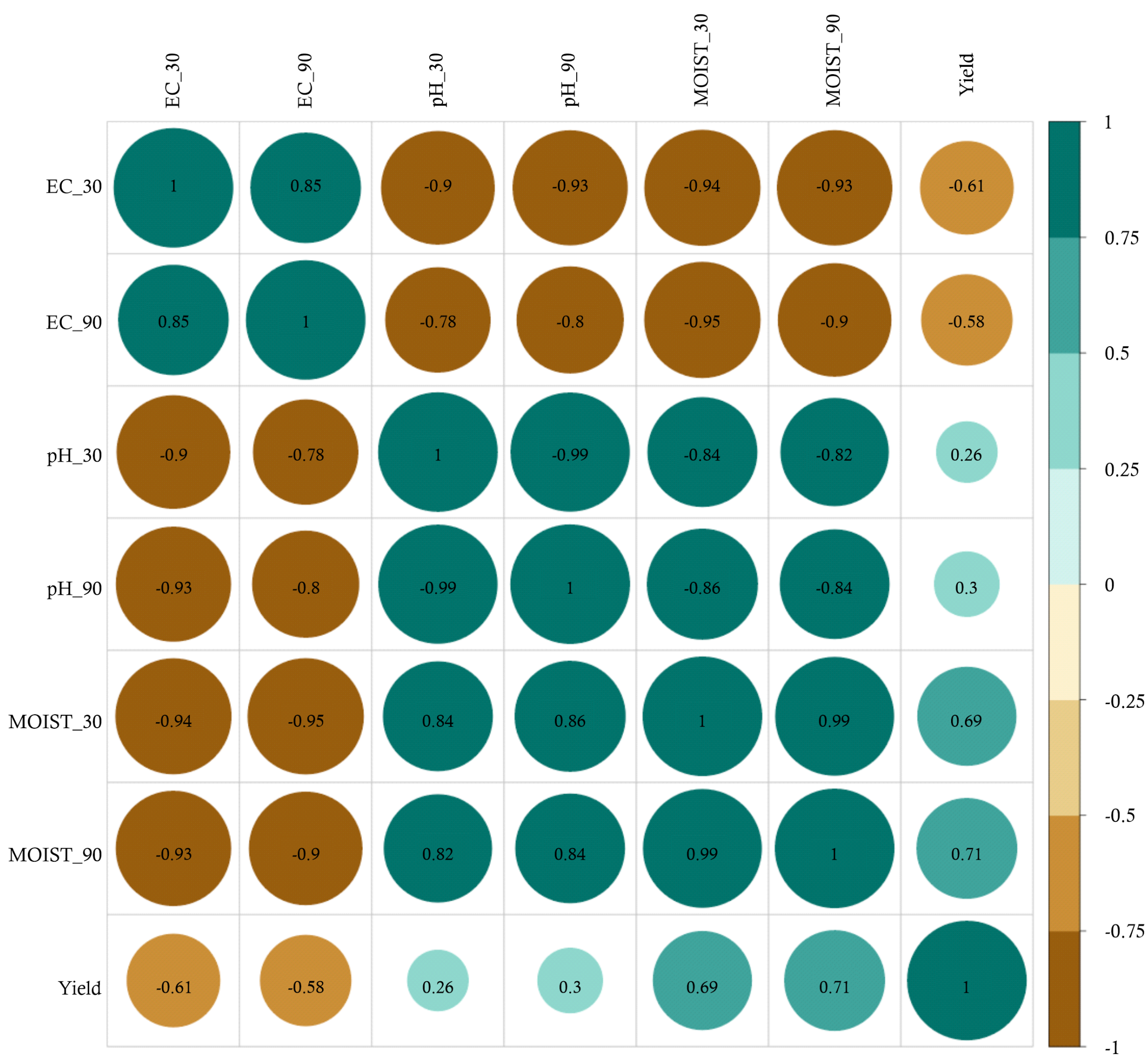

Fig. 2 Pearson's correlation among soil properties and yield of brinjal

Table 4. Net returns and benefit cost ratio of brinjal as influenced by manure and mulching under saline soil (pooled data of four years)

Treatments	Gross return (₹ ha^{-1})				Total cost (₹ ha^{-1})				Net returns on input cost (₹ ha^{-1})				B:C Ratio (Input cost)				B:C Ratio (Total cost)			
	F_1	F_2	F_3	F_4	F_1	F_2	F_3	F_4	F_1	F_2	F_3	F_4	F_1	F_2	F_3	F_4	F_1	F_2	F_3	F_4
M_1	554320	519895	573856	453748	537387	617387	577387	507387	16933	-97492	-3530	-53639	1.63	1.24	1.51	1.46	1.03	0.84	0.99	0.89
M_2	580008	541070	629542	465950	421387	501387	461387	391387	158621	39684	168155	74563	2.59	1.78	2.38	2.40	1.38	1.08	1.36	1.19
M_3	486213	460762	505428	442696	412387	492387	452387	382387	73826	-31625	53041	60309	2.26	1.56	1.98	2.39	1.18	0.94	1.12	1.16
SD	-				-				-				0.46				0.17			
SE± m	-				-				-				0.13				0.05			
LSD (0.05)	-				-				-				0.29				0.11			

Treatments (Manure)-FYM @ 15 Mg ha^{-1} (F_1); Vermicompost @ 5 Mg ha^{-1} (F_2); FYM @ 7.5 Mg ha^{-1} + vermicompost @ 2.5 Mg ha^{-1} (F_3); No manure (F_4); Mulch- Plastic Mulch (M_1); Paddy Straw Mulch (M_2) and No mulch (M_3)

(Fig. 2) shows a positive correlation with soil moisture (r = 0.70) but a negative correlation with EC (r = –0.60). This suggests that elevated salinity (EC) adversely affects yield, whereas well–moistened soils enhance yield. Soil pH presents a weak positive correlation (r = 0.26–0.30), indicating a minimal direct impact on yield within this range. The findings suggest that yield performance is primarily reliant on sustaining high soil moisture and low electrical conductivity, while pH plays a modest supportive role.

Economics

The expenses associated with brinjal cultivation (Table 4) using farmyard manure (FYM) at 7.5 Mg ha^{-1} combined with vermicompost at 2.5 Mg ha^{-1} and plastic mulch (F_3M_1) were elevated because of the increased costs of plastic mulch and vermicompost compared to F_4M_4 and F_4M_2. The highest net return of brinjal was noted with FYM at 7.5 Mg ha^{-1} + vermicompost @ 2.5 Mg ha^{-1} under paddy straw mulch at 3.0 Mg ha^{-1} (F_3M_2), amounting to INR 168155, followed by FYM at 15 Mg ha^{-1} with paddy straw mulch (INR 158621) over all treatments. Analysing the economics (Table 4) by evaluating all investments and returns revealed that a superior B:C ratio of 1.38 was noted for FYM at 15 Mg ha^{-1} with paddy straw mulch at 3.0 Mg ha^{-1} (F_1M_2) followed by 1.36 in F_3M_2 treatment in comparison to all other treatments. The advantage arose largely from improved crop yield and quality, along with enhanced water and nutrient access, while reducing the impact of salinity.

Conclusions

Plastic mulch (M_1) and paddy straw mulch (M_2) retained greater moisture levels and decrease in weed competition than the un–mulched control (M_0) in the semi-arid coastal area of Maharashtra. The use of paddy straw mulch with drip irrigation proved to be the most effective method for lowering salinity and achieving high yields. According to the benefit cost ratio, the application of rice straw mulch proved to be the most cost-effective, complemented by farmyard manure at 7.5 Mg ha^{-1} and vermicompost at 2.5 Mg ha^{-1}, which was closely succeeded by farmyard manure at 15 Mg ha^{-1}.

Acknowledgements

The authors express their gratitude to ICAR, New Delhi, and the ICAR-Central Soil Salinity Research Institute in Karnal for their financial and technical assistance in carrying out this research under the AICRP on Managing Salt-Affected Soils and Utilizing Saline Water in Agriculture at the Khar Land Research Station in Panvel, Maharashtra.

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Received: June 2, 2025; Accepted: October 24, 2025