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Evaluation of saline water irrigation and mulching on yield and nutrient uptake of maize (*Zea mays* L.) under drip irrigation

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Abstract
A field experiment was conducted on sandy loam soil during *rabi* 2024-25 at Agricultural College Farm, Bapatla to study the response of maize to saline water irrigation and mulching. The experiment was laid out in a split-plot design with four salinity levels (0.4, 2, 4, and 6 dS m^{-1}) as main plots treatments and three mulch treatments (no mulch, straw mulch, and plastic mulch) as sub-plots. The results indicated that irrigation with best available water (0.4dS m^{-1}) significantly enhanced kernel and stover yield and nutrient uptake (N, P, K) in both grain and stover respectively, which were at par with the main plot treatments 2 and 4 dS m^{-1}, while 6 dS m^{-1} registered significantly the lowest values. Among mulches, plastic mulch recorded significantly the highest yield and nutrient uptake, followed by straw mulch, and no mulch recorded the least. The interaction between salinity and mulch was found significant, with the combination of BAW and plastic mulch producing significantly the highest kernel yield (8.46 t ha^{-1}), stover yield (10.64 t ha^{-1}), and nutrient uptake. The findings suggest that saline water irrigation up to 4 dS m^{-1} can be used effectively for maize under drip irrigation if supplemented with mulching, particularly plastic mulch.

Keywords: Maize, saline water irrigation, mulching, kernel yield, nutrient uptake, stover yield

Introduction
Maize (*Zea mays* L.) is a globally important cereal crop, widely grown for its multiple uses in food, feed, and industrial applications. It is often referred to as the "Queen of Cereals" due to its high productivity. In India, maize occupies 11.24 million hectares, with a production of 37.67 million tons (2023-24) (DES, 2023-24). In Andhra Pradesh, maize is cultivated over 0.292 million hectares with an average productivity of 6225 kg ha^{-1}(des.ap.gov.in, 2023-24).
One of the emerging challenges in maize cultivation is the use of saline water for irrigation, especially in coastal regions like Andhra Pradesh. The use of saline water for irrigation, particularly in low-lying coastal regions of various countries, has been recognized as a notable constraint on crop productivity reported by Mrudhula *et al.* (2021) [19]. Resulted in salt accumulation in the root zone, leading to reduced soil matric potential and impaired water and nutrient absorption, photosynthesis, and enzyme activity—ultimately causing substantial yield losses.
Globally, salinity impacts approximately 20 per cent of cultivated land and has degraded nearly 45 million hectares of irrigated land. Forecasts indicate that up to 30 per cent of the world's agricultural land may be lost in the next 25 years, reaching as much as 50 per cent by 2050 if salinization continues unchecked. In India, coastal states like Andhra Pradesh face acute salinity problems due to seawater intrusion and inappropriate irrigation practices. These conditions place maize, a moderately salt-sensitive crop, at particular risk, necessitating innovative and adaptive management practices to sustain productivity in affected regions.
To combat these challenges, adaptive agronomic strategies have been developed, including the use of salt-tolerant cultivars, efficient irrigation systems, and soil management practices. Among these, drip irrigation and mulching are promising technologies that reduce the harmful impacts of salinity. Drip irrigation provides controlled and uniform water delivery, minimizing salt accumulation around the root zone (Kang, 1998) [13]. Mulching, both organic (e.g., straw) and

inorganic (e.g., black plastic), conserves soil moisture, suppresses weed growth, moderates soil temperature, and restricts salt migration to the upper soil layers (Lessa *et al.*, 2019; Barbosa *et al.*, 2021) [14, 4]. Plastic mulch, in particular, enhances nutrient availability and improves crop performance under saline water irrigation conditions. Considering the importance of maize (*Zea mays* L.) as a staple and industrial crop and its moderate sensitivity to salt, this study was undertaken to evaluate the effects of saline water irrigation and different mulching strategies on the yield and nutrient uptake of maize under drip irrigation in coastal conditions of Andhra Pradesh.

Materials and Methods

The field experiment was carried out during *rabi* 2024-25 at Agricultural College Farm, Bapatla (15°54' N, 80°30' E, 5.49 m MSL) under Krishna agro-climatic zone with 12 treatments. The experiment was laid out in a split-plot design with three replications. The main plot treatments comprised four salinity levels: M_1: Best Available Water (0.4 dS m⁻¹), M_2: 2 dS m⁻¹, M_3: 4 dS m⁻¹, and M_4: 6 dS m⁻¹. The subplot treatments included: S_1: No mulch, S_2: Straw mulch (applied at 3000 kg ha⁻¹ to a depth of 5 cm), and S_3: Plastic mulch (black polyethylene with 30 microns). The experimental site was sandy loam in texture, uniform in topography, homogeneously fertile, and neutral in pH (7.2) with EC 0.46 dS m⁻¹, low in organic carbon (0.35%), low in available nitrogen (165 kg ha⁻¹), high in phosphorus (28 kg ha⁻¹) and potassium (315 kg ha⁻¹). The hybrid maize PAC 751 was used for the study. Sowing was done on 23rd November 2024 with a spacing of 20/30 cm × 50 cm. Irrigation was provided through a drip irrigation system using 16 mm inline laterals fitted with 2.0 L h⁻¹ emitters at 50 cm intervals. Control valves were installed for plot-wise water application. A filtration unit with screen and disc filters was used to remove impurities, and pressure gauges ensured consistent emitter pressure. Saline water of EC 2, 4, and 6 dS m⁻¹ was prepared by diluting seawater (49 dS m⁻¹) with fresh water (0.4 dS m⁻¹) to achieve the required EC levels. These treatments were imposed from 20 DAS onward based on the calculated crop water requirement using the IW/CPE ratio. Meteorological observations during the crop period indicated a mean maximum temperature of 31.5°C, minimum temperature of 20.4°C, mean relative humidity of 67.5% to 87.0%, and a total rainfall of 20.3 mm over 3 rainy days. Nitrogen content(%) in the kernel and stover was estimated using the modified micro kjeldhal method(Piper *et al.*, 1966) [22].The plant samples were digested with a diacid mixture consisting of HNO3: HclO4(9:4) and the phosphorus content in the diacid digest was determined by the Vanado molybdo phosphoric acid yellow color method and the potassium content in the diacid digest was determined by using the flame photometer method (Jackson *et al.*, 1966) [12]. Nutrient uptakes were calculated using the following formula (Eqs.1and2) and expressed in kg ha-1(Godebo *et al.*, 2021) [8]

The nutrient uptake in grain and stover was computed using the following formula:

$$\text{Nutrient uptake in Grain (kgha}^{-1}) = \frac{\text{Nutrient content (\%)} \times \text{Kernel yield (kg ha}^{-1})}{100}$$

$$\text{Nutrient up take in Stover (kg ha}^{-1}) = \frac{\text{Nutrient content (\%)} \times \text{Stover yield (kg ha}^{-1})}{100}$$

Soil available nitrogen was estimated using the alkaline potassium permanganate method (Subbaiah *et al.*, 1956) [28], while available phosphorus was analyzed using Olsen's method (Olsen *et al.*,1953) [20]. Available potassium was measured by extracting the soil with neutral normal ammonium acetate and analyzing it with a flame photometer (Jackson *et al.*, 1966) [12]. All values were expressed in kg ha⁻¹. The data collected for various parameters during the study were analyzed statistically using analysis of variance (ANOVA) through the CRAN package in R software. To compare treatment means, the Least Significant Difference (LSD) test was performed, which calculates a single LSD value at the 5% significance level. This value helps distinguish between significant and non-significant differences among treatment means.

Results and Discussion

Impact of saline water irrigation and mulching on kernel yield (kg ha⁻¹) of maize.

Salinity levels significantly influenced kernel yield (Table 1 & Fig. 1). Irrigation with best available water (M_1) recorded significantly the highest kernel yield (8.2 t ha⁻¹), which was statistically on par with 2 dS m⁻¹ (M_2) (7.7 t ha⁻¹) and 4 dS m⁻¹ (M_3) (7.2 t ha⁻¹), while significantly the lowest yield was recorded with 6 dS m⁻¹ (M_4) (5.2 t ha⁻¹). The decline in grain yield with increasing salinity levels can be attributed to the diversion of metabolic energy toward stress adaptation rather than growth and grain production. As soil salinity increases, plants expend more energy to maintain osmotic balance and ionic homeostasis, reducing the energy available for reproductive development and kernel filling (Morales-Garcia *et al.*, 2009; Lima *et al.*, 2020) [18, 15]. These physiological limitations ultimately result in yield reduction under salt stress.

Among the mulching treatments (subplot), plastic mulch (S_3) recorded significantly the highest kernel yield (7.6 t ha⁻¹), followed by straw mulch (S_2) (7.1 t ha⁻¹), with both treatments significantly superior to no mulch (S_1), which recorded the lowest yield (6.6 t ha⁻¹). Plastic mulch likely improved yield by maintaining better soil moisture, reducing temperature fluctuations, and preventing salt accumulation in the upper root zone. These results are in line with the findings of Absy*et al.* (2020) [1], who reported improved maize performance under mulched conditions.

The interaction between salinity level and mulching treatment was significant, with the highest kernel yield (8.8 t ha⁻¹) recorded under BAW + plastic mulch (M_1S_3), while significantly the lowest was recorded under 6 dS m⁻¹ + no mulch (M_4S_1) (4.9 t ha⁻¹).

Impact of saline water irrigation and mulching on stover yield (kg ha⁻¹) of maize

Salinity level had a significant effect on stover yield (Table.2 & Fig.2). Significantly the highest stover yield was observed with M_1 (9.3 t ha⁻¹), which was statistically on par with M_2 (8.8 t ha⁻¹) and M_3 (8.3 t ha⁻¹). Significantly the lowest yield was noted in M_4 (6.7 t ha⁻¹). Results of the data revealed that stover yield reduced significantly with increase in salinity levels. The lower stover yields noticed with saline water could be due to reduced leaf number and existence of high salt concentration near root zone in saline water irrigation treatment. The results were in line with the findings of Heidarpour*et al.* (2009) [10] and Amer (2010) [2] and Govada *et al.* (2024) [9].

In subplot treatments, S_3 (plastic mulch) significantly outperformed others (8.6 t ha⁻¹), followed by S_2 (8.3 t ha⁻¹), with significantly the lowest under S_1 (7.8 t ha^{-1}). It might be due to mulching practices enhance cumulative topsoil temperature and conserve soil moisture, which synchronizes greater leaf area index (LAI) and improved radiation interception with early vegetative growth and this resulted in accelerated plant development and increased dry matter accumulation. Similar findings was also reported by Liu *et al*. (2014) [16].

Interaction effects showed significant effect whereas M_1S_3 recorded significantly the maximum stover yield (9.9 t ha^{-1}), whereas M_4S_1 gave significantly the lowest (6.3 t ha^{-1}).

Impact of saline water irrigation and mulching on nitrogen uptake in kernel (kg ha^{-1}) of maize.

Nitrogen uptake in grain was significantly influenced by salinity levels. Significantly the highest N uptake was observed under best available water (M1) with 67.0 kg ha^{-1}, statistically on par with M_2 (61.0 kg ha^{-1}) and M_3 (53.9 kg ha^{-1}). M_4 registered significantly the lowest (38.0 kg ha^{-1}). Reduction in the N uptake by grain and stover at high salinity level could be attributed due to salinity induced reduction of synthesis of certain enzymes involved in the N metabolism such as nitrate reductase or reduced substrate in the root medium and nutritional imbalance. Excess salt in soil might have caused a decrease in total N uptake by plants. Similar results were reported by Singh and Sharma (2002) [27].

Among mulching treatments, plastic mulch (S_3) led to the highest N uptake (60.8 kg ha^{-1}), followed by S_2 (55.0 kg ha^{-1}) and S_1 (49.2 kg ha^{-1}). The improvement under mulched conditions could be attributed to higher soil moisture retention, improved nutrient availability, and favorable root zone conditions promoting nutrient uptake. The higher N uptake obtained in the irrigation schedules under high pan evaporation replenishment with plastic mulch was primarily due to higher grain and straw yields (Prasad and Prasad 1988) [23].

The interaction between subplots at main plots was found non-significant. However, the interaction of main plots at subplot level was significant different under salinity levels and mulching treatments. Interaction was significant, with M_1S_3 showing maximum uptake (73.1 kg ha^{-1}) and M_4S_1 shows significantly the minimum nitrogen uptake in kernel (32.3 kg ha^{-1}).

Impact of saline water irrigation and mulching on nitrogen uptake in stover (kg ha^{-1}) of maize

Main plot effect showed significantly the highest N uptake in stover with M_1 (45.6 kg ha^{-1}), statistically on par with M_2 (42.0 kg ha^{-1}) and M_3 (38.1 kg ha^{-1}), and significantly the lowest with M_4 (20.2 kg ha^{-1}). The probable reasons for this may be the concentrations of soluble salts through their high osmotic pressures affected the plant growth by restricting the uptake of water and nutrients by plant roots and there by affected the nitrogen content and uptake in grain. Also, the reduction in free amino acid content at higher salinity results in decreased nitrate reductase activity which plays an important role in conversion of nitrate to ammonium (El-Leboudi *et al*., 1997) [7] resulting into lesser N content and uptake in grain. Similar results were reported by Heidarpour *et al*. (2009) [10] and Yousfi *et al*. (2010) [32].

Among mulching treatments, plastic mulch (S_3) recorded higher nitrogen uptake in stover (40.3 kg ha^{-1}), followed by straw mulch (37.0 kg ha^{-1}) and no mulch (32.2 kg ha^{-1}). Singh (2002) [26] also reported that total nutrient uptake of nitrogen, phosphorus; potassium was significantly higher under mulch than no mulch treatment. The diffusion of nitrogen into the crop roots is more in mulched plot compared to unmulched plot. Another reason for increased nitrogen uptake was high soil moisture retention for longer time which mitigated the shrinkage of roots. Thus, facilitated high nutrient uptake by the plant.

The interaction between subplots at main plots was found non-significant. However, the interaction of main plots at subplot level was significant different under salinity levels and mulching treatments. M_1S_3 showed significantly the highest interaction effect (49.3 kg ha^{-1}), and M_4S_1 recorded the least (15.3 kg ha^{-1}).

Impact of saline water irrigation and mulching on phosphorus uptake in kernel (kg ha^{-1}) of maize.

Salinity had significant impact on phosphorus uptake. M_1 recorded significantly the highest uptake (23.2 kg ha^{-1}), statistically on par with M_2 (22.1 kg ha^{-1}) and M_3 (19.9 kg ha^{-1}), while M_4 registered the least (15.5 kg ha^{-1}). Bernstein *et al*. (1974) [5] reported that salinity caused more rapid depletion of solution phosphorous despite reduced growth. High calcium concentrations in the saline solutions probably caused phosphorous precipitation. A decrease in phosphorous solubility by high concentrations of calcium in saline environment combined with salinity induced decrease in root growth which may account for the reduced phosphorous content and uptake in high saline water treatments. Similar results were reported by Sharma (2003) [25]. S_3 recorded the highest uptake among mulches (21.5 kg ha^{-1}), followed by S_2 (20.3 kg ha^{-1}) and S_1 (18.6 kg ha^{-1}). The higher uptake under mulching might be due to improved soil microbial activity and phosphorus mineralization.

The interaction between subplots at main plots was found non-significant. However, the interaction of main plots at subplot level was significant different under salinity levels and mulching treatments. The combination of M_1S_3 showed significantly the highest P uptake (24.3 kg ha^{-1}), and M_4S_1 treatment shows significantly the lowest (14.0 kg ha^{-1}).

Impact of saline water irrigation and mulching on phosphorus uptake in stover (kg ha^{-1}) of maize.

Among salinity levels, M_1 registered significantly the highest (17.2 kg ha^{-1}), which was on par with M_2 (16.6 kg ha^{-1}) and M_3 (15.4 kg ha^{-1}) and these were significantly superior to M_4 (13.6 kg ha^{-1}). Decrease in the P uptake under saline water irrigation could be associated with the poor root development and drymatter accumulation by plants. Low uptake could also have been due to nutrient imbalance; that reduces the activity of phosphate or low solubility of phosphorous bearing salts. Soussi *et al*. (2001) [29] and Unno *et al*. (2002) [30] observed that crop plants lose their ability to absorb and transport the essential nutrient elements under salt stress conditions.

While mulching treatments, plastic mulch improved P uptake (16.2 kg ha^{-1}), followed by straw (15.5 kg ha^{-1}) and no mulch (14.4 kg ha^{-1}).

The interaction between subplots at main plots was found non-significant. However, the interaction of main plots at subplot level was significant different under salinity levels and mulching treatments. Interaction was found non-significant among salinity levels and mulching treatments.

Impact of saline water irrigation and mulching on potassium uptake in kernel (kg ha^{-1}) of maize

At salinity level significantly the maximum K uptake was observed in M_1 (24.5 kg ha^{-1}), followed by M_2 (23.2 kg ha^{-1}) and M_3 (21.3 kg ha^{-1}) these were significantly superior to M_4 which recorded significantly the lowest (14.3 kg ha^{-1}). Potassium uptake was influenced significantly by salinity levels.

Potassium uptake decreased substantially at high salinity level. Generally, K availability is impaired by the higher presence of Ca, Mg and Na cations in the rhizosphere. In plant nutrition K, Mg, and Ca all play the same role i.e., they act as a buffer system of plant cells, hence they can be substituted for one another. Similar results were reported by Anegundi (1997) [3] and Singh and Sharma (2002) [27].

Among mulching treatments plastic mulch enhanced K uptake (22.2 kg ha⁻¹) compared to straw (21.1 kg ha⁻¹) and no mulch (19.1 kg ha⁻¹). The higher potassium uptake under mulched plots may be due to presence of high moisture regime, regulation of temperature fluctuation and the preservation of an ideal level of soil temperature similar result were reported by Rakesh kumar (2015) [24], Iqbal *et al*. (2009) [11] and Mehmood *et al*. (2015) [17]

The interaction between subplots at main plots was found non-significant. However, the interaction of main plots at subplot level was significant different under salinity levels and mulching treatments levels were significantly the maximum uptake in M_1S_3 (25.7 kg ha^{-1}) and minimum in M_4S_1 (11.4 kg ha^{-1}).

Impact of saline water irrigation and mulching on potassium uptake in stover (kg ha^{-1}) of maize

Salinity significantly affected stover K uptake. M_1 recorded significantly the highest value (110.5 kg ha^{-1}), followed by M_2 (105.0 kg ha^{-1}) and M_3 (95.3 kg ha^{-1}), with M4 being lowest (83.7 kg ha^{-1}). Increased potassium uptake might be due to the increased availability of nutrients in the root zone coupled with increased metabolic activity at the cellular level probably might have increased the nutrient uptake and their accumulation in vegetative parts might be due to improved metabolism that led to higher translocation of these nutrients to reproductive structures of the crop. The present findings are in similarity with the earlier findings by Venkata Rao *et al*. (2016) [31].

In case of mulching treatments plastic mulch (S_3) promoted significantly the highest uptake (122.6 kg ha^{-1}), while S_2 and S_1 registered 118.2 and 114.1 kg ha^{-1}, respectively. The interaction between subplots at main plots was found non-significant. Pinjari (2007) [21] also reported that potassium uptake in the leaves, stem, cob sheath, cob axis, kernels were significantly higher under polythene mulch than no mulch.

However, the interaction of main plots at subplot level was significant different under salinity levels and mulching treatments levels (Table 4.35). Significantly the highest potassium uptake in stover (115.6 kg ha^{-1}) was recorded under BAW with plastic mulch, which was significantly superior to all other combinations. The lowest potassium uptake in stover (79.2 kg ha^{-1}) was observed under 6 dS m^{-1} with no mulch.

Table 1: Effect of saline water irrigation and mulching on kernel yield (kg ha^{-1}) of maize.

Salinity levels (dS m^{-1})	Mulch			Mean
	S_1: Without Mulch	**S_2: Straw Mulch**	**S_3: Plastic Mulch**	
M_1: BAW	7556	8198	8846	8200
M_2: 2 EC	7308	7792	8011	7704
M_3: 4 EC	6734	7244	7669	7216
M_4: 6 EC	4930	5103	5681	5238
Mean	6632	7084	7552	
	SEm (±)	**CD(0.05)**	**CV (%)**	
MAIN PLOT	289.9	1003	12.3	
SUB PLOT	162.6	487	9.9	
Interaction				
S at same level of M (S X M)	325.1	975		
M at same or different level of S (M X S)	393.1	1277		

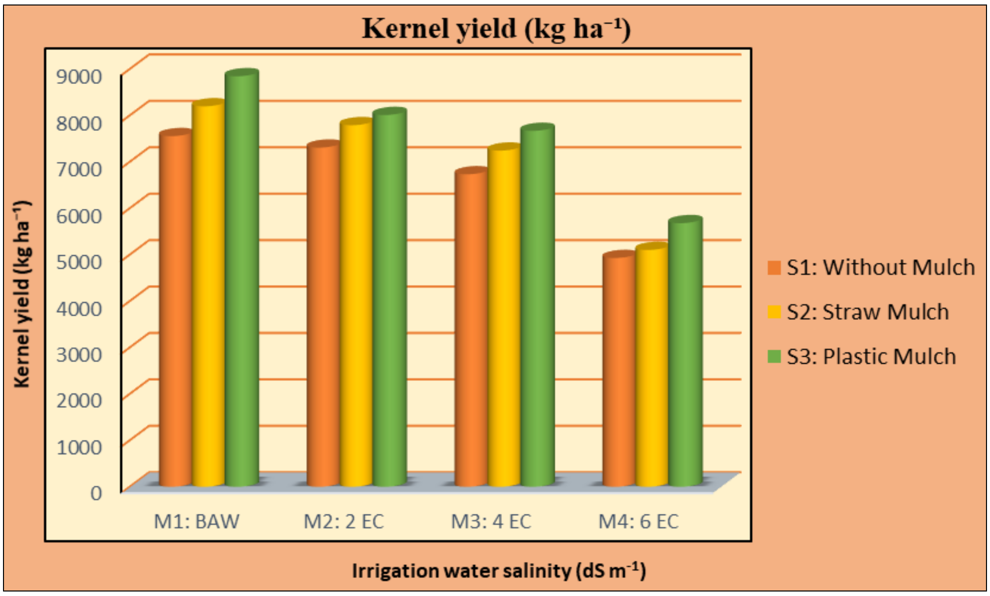

Fig 1: Effect of saline water irrigation and mulching on kernel yield (kg ha^{-1}) of maize.

Table 2: Effect of saline water irrigation and mulching on stover yield (kg ha^{-1}) of maize

Salinity levels (dS m^{-1})	Mulch			Mean
	S_1: Without Mulch	S_2: Straw Mulch	S_3: Plastic Mulch	
M_1: BAW	8471	9437	9939	9282
M_2: 2 EC	8389	8857	9135	8794
M_3: 4 EC	8167	8296	8403	8289
M_4: 6 EC	6316	6556	7105	6659
Mean	7836	8286	8646	
	SEm (+)	**CD (0.05)**	**CV (%)**	
MAIN PLOT	292.4	1012	10.6	
SUB PLOT	235.9	707	9.9	
Interaction				
S at same level of M (S X M)	471.8	1415		
M at same or different level of S (M X S)	483.7	1532		

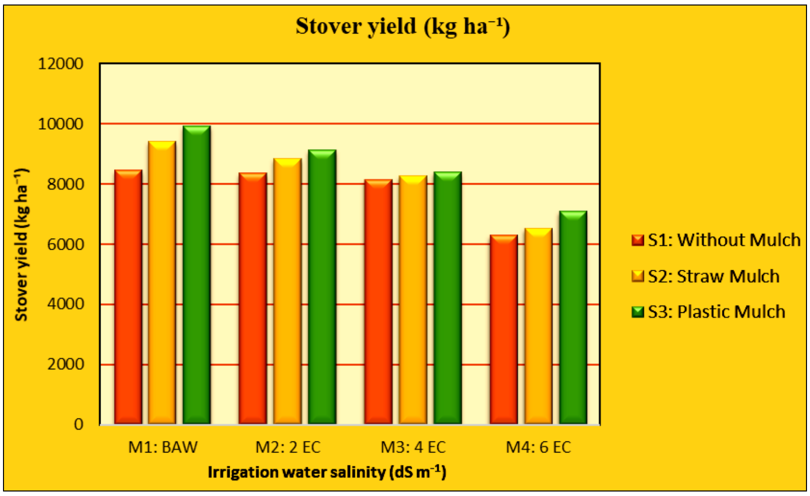

Fig 2: Effect of saline water irrigation and mulching on stover yield (kg ha^{-1}) of maize.

Table 3: Effect of saline water irrigation and mulching on nitrogen uptake (kg ha^{-1}) in maize kernel

Salinity levels (dS m^{-1})	Mulch			Mean
	S_1: Without Mulch	S_2: Straw Mulch	S_3: Plastic Mulch	
M_1: BAW	58.0	70.0	73.1	67.0
M_2: 2 EC	56.3	58.6	68.3	61.1
M_3: 4 EC	50.2	54.0	57.4	53.9
M_4: 6 EC	32.3	37.3	44.5	38.0
Mean	49.2	55.0	60.8	
	S.Em(+)	**CD (0.05)**	**CV (%)**	
MAIN PLOT	4.19	14.5	12.9	
SUB PLOT	3.13	9.4	9.7	
Interaction				
S at same level of M (S X M)	6.26	NS		
M at same or different level of S(M X S)	6.61	21.0		

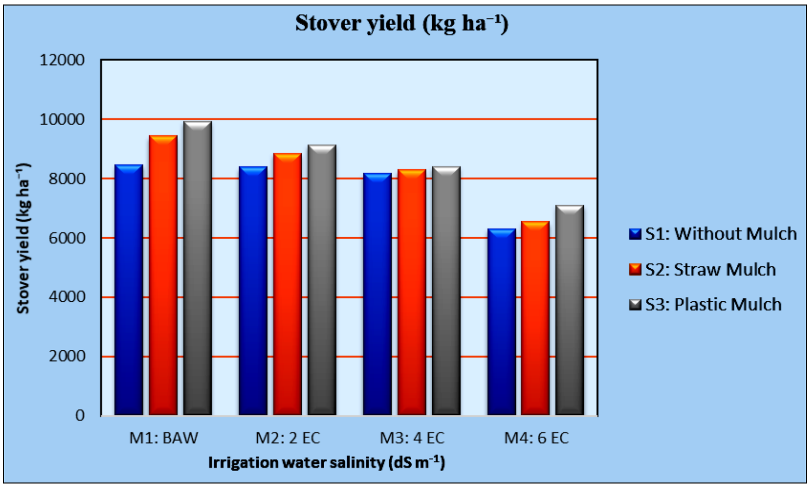

Fig 3. Effect of saline water irrigation and mulching on nitrogen uptake (kg ha^{-1}) in maize kernel.

Table 4: Effect of saline water irrigation and mulching on nitrogen uptake (kgha^{-1}) in maize stover.

Salinity levels (dS m^{-1})	Mulch			Mean
	S_1: Without Mulch	S_2: Straw Mulch	S_3: Plastic Mulch	
M_1: BAW	40.3	47.0	49.3	45.6
M_2: 2 EC	37.7	43.3	45.0	42.0
M_3: 4 EC	35.3	37.3	41.7	38.1
M_4: 6 EC	15.3	20.3	25.0	20.2
Mean	32.2	37.0	40.3	
	S.Em(+)	**CD (0.05)**	**CV (%)**	
MAIN PLOT	2.31	8.0	10.5	
SUB PLOT	2.04	6.1	9.7	
Interaction				
S at same level of M (S X M)	4.08	NS		
M at same or different level of S(M X S)	4.05	12.8		

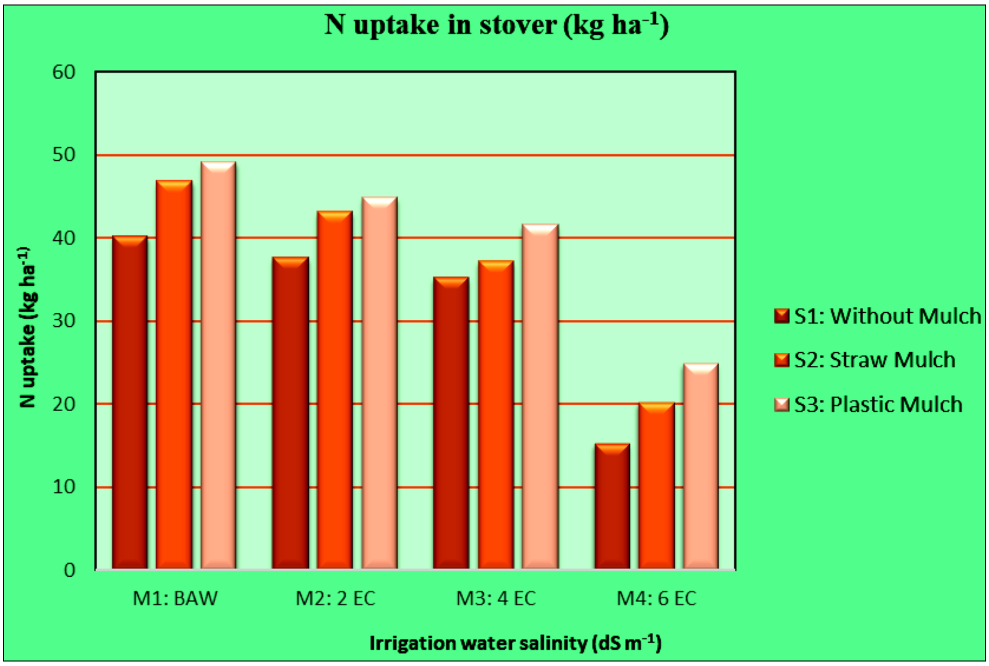

Fig 4. Effect of saline water irrigation and mulching on nitrogen uptake (kg ha^{-1}) in maize stover.

Table 5: Effect of saline water irrigation and mulching on phosphorous uptake (kg ha^{-1}) in maize kernel

Salinity levels (dS m^{-1})	Mulch			Mean
	S_1: Without Mulch	S_2: Straw Mulch	S_3: Plastic Mulch	
M_1: BAW	21.7	23.3	24.3	23.1
M_2: 2 EC	20.4	22.7	23.0	22.0
M_3: 4 EC	17.9	19.8	21.8	19.9
M_4: 6 EC	14.0	15.4	17.0	15.5
Mean	18.5	20.3	21.5	
	S.Em(+)	**CD (0.05)**	**CV (%)**	
MAIN PLOT	1.00	3.4	10.9	
SUB PLOT	0.91	2.7	7.7	
Interaction				
S at same level of M (S X M)	1.82	NS		
M at same or different level of S(M X S)	1.79	5.6		

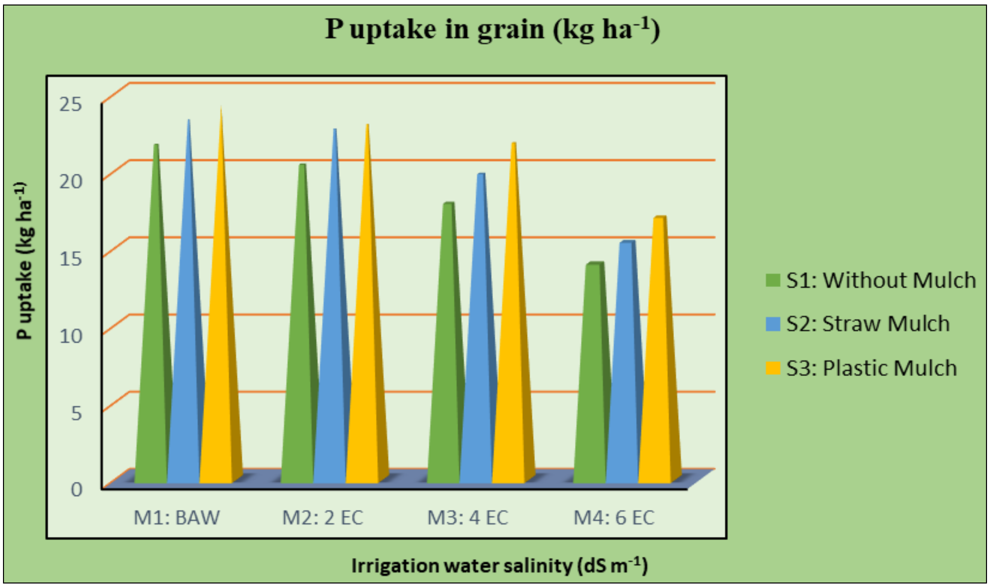

Fig 5: Effect of saline water irrigation and mulching on phosphorous uptake (kg ha^{-1}) in maize kernel

Table 6: Effect of saline water irrigation and mulching on phosphorous uptake (kg ha^{-1}) in maize stover

Salinity levels (dS m^{-1})	Mulch			Mean
	S_1: Without Mulch	S_2: Straw Mulch	S_3: Plastic Mulch	
M_1: BAW	16.4	17.5	17.8	17.2
M_2: 2 EC	15.7	16.9	17.1	16.6
M_3: 4 EC	14.5	15.3	16.3	15.4
M_4: 6 EC	11.2	12.3	13.5	12.3
Mean	14.4	15.5	16.2	
	SEm (±)	**CD (0.05)**	**CV (%)**	
MAIN PLOT	0.66	2.3	11.8	
SUB PLOT	0.52	1.6	10.7	
Interaction				
S at same level of M (S X M)	1.84	NS		
M at same or different level of S(M X S)	1.98	NS		

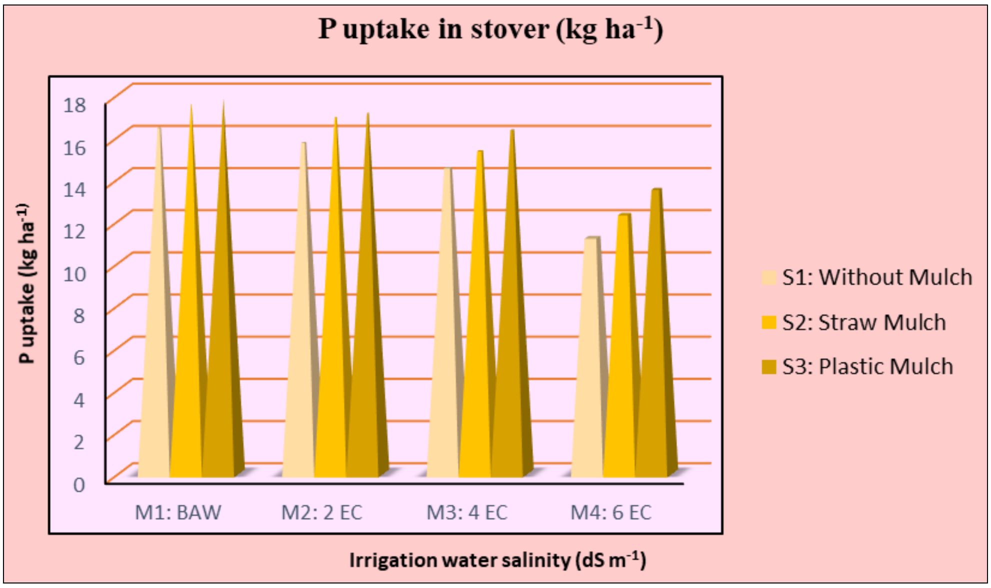

Fig 6 Effect of saline water irrigation and mulching on phosphorous uptake (kg ha^{-1}) in maize stover

Table 7: Effect of saline water irrigation and mulching on potassium uptake (kg ha^{-1}) in maize kernel.

Salinity levels (dS m^{-1})	Mulch			Mean
	S_1: Without Mulch	**S_2: Straw Mulch**	**S_3: Plastic Mulch**	
M_1: BAW	23.0	24.8	25.7	24.5
M_2: 2 EC	21.9	23.4	24.4	23.2
M_3: 4 EC	20.3	21.3	22.3	21.3
M_4: 6 EC	11.4	14.9	16.6	14.3
Mean	19.1	21.1	22.2	
	S.Em(+)	**CD (0.05)**	**CV (%)**	
MAIN PLOT	0.94	3.3	13.6	
SUB PLOT	0.81	2.4	12.5	
Interaction				
S at same level of M (S X M)	1.62	NS		
M at same or different level of S(M X S)	1.62	5.1		

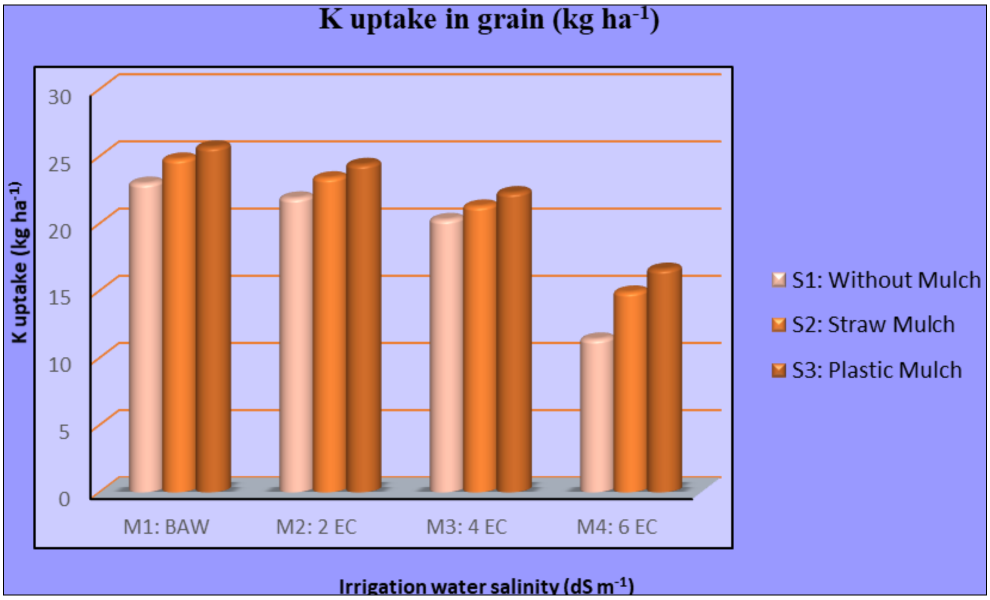

Fig 7: Effect of saline water irrigation and mulching on potassium uptake (kg ha^{-1}) in maize kernel

Table 8: Effect of saline water irrigation and mulching on potassium uptake (kg ha^{-1}) in maize stover

Salinity levels (dS m^{-1})	Mulch			Mean
	S_1: Without Mulch	**S_2: Straw Mulch**	**S_3: Plastic Mulch**	
M_1: BAW	104.7	111.2	115.6	110.5
M_2: 2 EC	99.5	106.1	109.3	105.0
M_3: 4 EC	87.2	96.2	102.5	95.3
M_4: 6 EC	79.2	83.4	88.5	83.7
Mean	92.7	99.2	104.0	
	S.Em(+)	**CD (0.05)**	**CV (%)**	
MAIN PLOT	4.41	15.3	12.8	
SUB PLOT	3.78	11.3	11.7	
Interaction				
S at same level of M (S X M)	7.57	NS		
M at same or different level of S (M X S)	7.59	23.9		

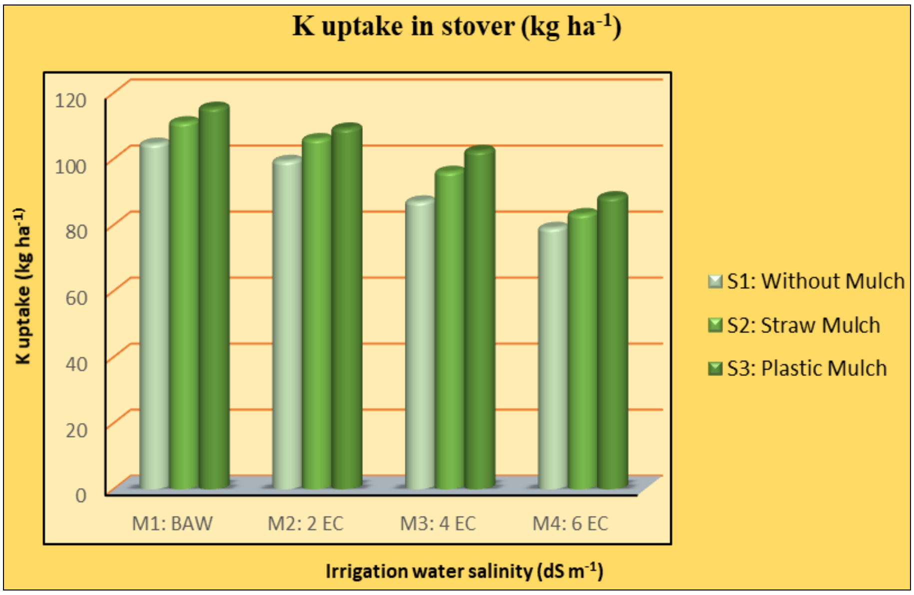

Fig 8. Effect of saline water irrigation and mulching on potassium uptake (kg ha^{-1}) in maize stover.

Conclusion

The findings of the present study clearly demonstrate that saline irrigation had a negative impact on kernel yield, stover yield, and the uptake of nitrogen, phosphorus, and potassium in maize. Increasing salinity levels, particularly 6 dS m^{-1}, significantly reduced both yield and nutrient uptake, which may be attributed to osmotic stress, ionic toxicity, and nutrient imbalance. Conversely, the best available water (0.4 dS m^{-1}) consistently resulted in higher yields and improved uptake of N, P, and K in both grain and stover.

Among mulching treatments, plastic mulch was the most effective in improving crop performance by enhancing soil moisture retention, moderating soil temperature, and minimizing salt accumulation in the root zone. This led to significantly higher yields and nutrient uptake compared to straw mulch and no mulch treatments.

The combination of best available water with plastic mulch emerged as the most efficient treatment in terms of both productivity and nutrient use. Moreover, treatments involving 6 dS m^{-1} + without mulch significantly reduced of both productivity and nutrient use.

References

1. Absy R, Hassan AM, Abdel-Lattif HM, Abuarab ME. Effect of plastic mulching and deficit irrigation on yield, water productivity, soil temperature and characteristics of maize. Plant Arch. 2020;20(2):2263-2271.
2. Amer KH. Corn crop response under managing different irrigation and salinity levels. Agric Water Manag. 2010;97:1553-1563.
3. Anegundi KM. Effect of conjunctive use of canal and groundwater on soil properties and yield of wheat in vertisols of Ghataprabha command. Dharwad: University of Agricultural Sciences; 1997.
4. Barbosa IJ, Sousa HC, Schneider F, Sousa GG, Lessa CIN, Sano L. Mulch with sugarcane bagasse and bamboo straw attenuates salt stress in cowpea cultivation. Rev Bras Eng Agric Ambient. 2021;25:485-491.
5. Bernstein L, Francois LE, Clark RA. Interactive effects of salinity and fertility on yields of grains and vegetables. Agron J. 1974;66:412-421.
6. Department of Economics and Statistics. 2023-24. https://des.ap.gov.in.
7. El-Leboudi AE, Gawish SM, Abd-El-Aziz SM, Ahmed MRM. Some metabolic aspects in wheat plants subjected to salinity. Ann Agric Sci. 1997;42(2):585-597.
8. Godebo T, Laekemariam F, Loha G. Nutrient uptake, use efficiency and productivity of bread wheat (*Triticum aestivum* L.) as affected by nitrogen and potassium fertilizer in Keddida Gamela Woreda, Southern Ethiopia. Environ Syst Res. 2021;10:1-6.
9. Govada DS, Mrudhula KA, Kumar MS, Ramesh G, Babu GK, Naik BS. Evaluation of saline water effects on use efficiency and soil nutrient availability of maize under drip irrigation. Plant Sci Today. 2024;11:485-495.
10. Heidarpour M, Mostafazadeh-Fard B, Arzani A, Aghakhani A, Feizi M. Effects of irrigation water salinity and leaching fraction on yield and evapotranspiration in spring wheat. J Commun Soil Sci Plant Anal. 2009;40:2521-2535.
11. Iqbal Q, Amjad M, Asi MR, Ali MA, Ahmad R. Vegetative and reproductive evaluation of hot peppers under different plastic mulches in poly/plastic tunnel. Pak J Agric Sci. 2009;46(2):113-118.
12. Jackson MC. Soil chemical analysis. Prentice Hall of India Private Limited; 1973. p. 498.
13. Kang YH. Microirrigation for the development of sustainable agriculture. Trans. CASE. 1998;14:251-255.
14. Lessa CIN, Oliveira ACN, Magalhães CL, Sousa JTM, Sousa GG. *Estresse salino*, cobertura morta e turno de rega na cultura do sorgo. Revista Brasileira de Agricultura Irrigada. 2019;13:3637-3645.
15. Lima GS, Lacerda CN, Soares LA, Gheyi HR, Araujo RHCR. Production characteristics of sesame genotypes under different strategies of saline water application. Rev Caatinga. 2020;33:490-499.
16. Liu XE, Li XG, Hai L, Wang YP, Fu TT, Turner NC, *et al*. Film-mulched ridge-furrow management increases maize productivity and sustains soil organic carbon in a dryland cropping system. Soil Sci Soc Am J. 2014;78(4):1434-1441.
17. Mehmood S, Rasool T, Iqbal M, Iqbal M, Haq I, Sohail M. Effect of plastic mulch and different irrigation practices on soil properties, nutrient contents and their availability in maize. J Environ Agric Sci. 2015;3:35-41.
18. Morales-Garcia D, Stewart KA, Seguin P, Madramootoo C.

Saline drip irrigation and polyethylene mulch on yield and water use efficiency of bell peppers. Int J Veg Sci. 2009;16(1):3-14.
19. Mrudhula KA, Subbaiah GV, Sambaiah A, Sunil Kumar M. Performance of flower and medicinal plants with saline irrigation water through drip system. Pharma Innov J. 2021;10(8):14-19.
20. Olsen SR, Cole CL, Wetanabe PS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. United States Department of Agriculture; 1953. p. 939.
21. Pinjari SS. Effect of integrated nutrient management and polythene mulch on the performance of sweet corn under larerate soils of Konkan [Ph.D. (Ag.) Thesis]. Dapoli: Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth; 2007.
22. Piper CS. Soil and plant analysis. Hans Publishers; 1966. p. 197-201.
23. Prasad TN, Prasad UK. Effect of irrigation, crop- geometry and intercrops on yield and nutrient uptake of winter maize. Indian Journal of Agronomy. 1988;33(3):238-241.
24. Kumar R. Productivity, profitability and nutrient uptake of maize (Zea mays L.) as influenced by management practices in North-East India. Indian Journal of Agronomy. 2015;60(2):273-278.
25. Sharma R. Effect of salinity and nitrogen levels on yield and nutrient uptake of wheat cultivars [M.Sc. (Ag) Thesis]. Haryana: Chaudhary Charan Singh Haryana Agricultural University; 2003.
26. Singh A. Soil salinity: A global threat to sustainable development. Soil Use and Management. 2022;38(1):39-6.
27. Singh KN, Sharma DP. Effect of irrigation with surface water and saline water on crop yield and soil properties. Annual Report, Central Soil Salinity Research Institute, Karnal. 2002;36-37.
28. Subbaiah BV, Asija GL. A rapid procedure of estimation of available nitrogen in soils. Current Science. 1956;5:477-80.
29. Soussi M, Santamaria M, Ocana A, Lluch C. Effects of salinity on protein and lipopolysaccharide pattern in a salt-tolerant strain of *Mesorhizobium ciceri*. J Appl Microbiol. 2001;90:476-481.
30. Unno H, Maeda Y, Yamamoto S, Okamoto M, Takenaga H. Relationships between salt tolerance and Ca^{2+} retention among plant species. Jpn J Soil Sci Plant Nutr. 2002;73:715-718.
31. Venkata Rao P, Subbaiah G, Veeraraghavaiah R. Productivity and nutrient uptake of rice fallow maize (*Zea mays* L.) as influenced by plant density and fertilizer N under no-till conditions. Int J Curr Microbiol Appl Sci. 2016;5(6):826-836.
32. Yousfi S, Serret MD, Voltas J, Araus JL. Effect of salinity and water stress during the reproductive stage on growth, ion concentrations, 13C, and 15N of durum wheat and related amphiploids. J Exp Bot. 2010;61(13):3529-3542.