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Assessing groundnut (*Arachis hypogea* L.) yield and attributes under variable salinity levels in irrigation with diluted seawater in coastal area

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Abstract
A pot experiment to investigate the effect of irrigation water with different levels of salinity prepared by diluting the sea water (44 dS/m) from Bay of Bengal on groundnut in the groundnut growing coastal areas was conducted at State Horticulture Farm, Pushpavanam, Nagapattinam during summer, 2023. The treatments were arranged in Completely Randomised Block Design with three replications and seven levels of irrigation water. The different levels of saline water used for irrigation are T_1 - actual ground water (0.8 dS/m), T_2 – 1 dS/m, T_3 – 2 dS/m, T_4 – 3 dS/m, T_5 – 4 dS/m, T_6 – 5 dS/m, T_7 – 6 dS/m. The soil used for the study was very deep, excessively drained sandy soil. Observations on the number of days for seedling emergence, days to 50% flowering, plant height at harvest, number of branches/plant at harvest, number of pods/plant, number of kernels/pod, pod yield/plant, kernel yield/plant, shelling percentage and haulm yield/plant were recorded. Results revealed that seedling emergence was significantly hindered by higher salinity levels, leading to delayed germination. Plant height at harvest stage exhibited a marked decline with increased salinity, attributed to possible chlorophyll reduction and hindered nutrient uptake. Days to 50% flowering were prolonged under elevated salinity conditions, potentially due to reduced nutrient availability and delayed root development. The number of branches per plant, number of pods per plant, and number of seeds per pod all showed consistent decreases as irrigation water salinity increased. Similarly, both pod and kernel yields per plant were adversely affected by higher salinity, primarily due to reductions in pod number and seed weight. Shelling percentage also decreased with increasing salinity, likely due to decreased kernel weight. Haulm yield per plant exhibited a significant decrease, attributed to reduced growth characteristics influenced by salinity-induced stress. These findings identify the impact of different levels of irrigation salinity on groundnut in the coastal areas.

Keywords: Groundnut, peanut, *Arachis hypogea,* irrigation salinity, electrical conductivity, yield, yield attributes, sea water, coastal area

1. Introduction

Being an annual legume, groundnut (*Arachis hypogea* L.) belongs to the third-largest family among the flowering plants which is the Leguminaceae family. In the global level, groundnut ranks the fourth among the important oilseeds and third as the source of the vegetable proteins. Although groundnut is primarily produced for human consumption, there are additional applications for the seed, such as the production of oil, butter and other goods. Due to the crop's high edible oil yield, nutritious kernels for human consumption, and haulm for rich cow feed, the crop has its unique significance. In addition to vitamins and minerals, groundnut seeds also include 48.52% oil, 20% carbohydrates and 25 to 30% protein. It is utilised widely as a source of cooking oil, digestible protein, minerals, and vitamins in several nations, and it makes a substantial contribution to ensuring food security and reducing poverty.

The top producing nations of groundnuts are India, Nigeria, Brazil, Argentina, China, Indonesia, Senegal, and the United States (FAO, 2003) [3]. China is followed upon by India as the largest producer. In India, there were 5.7 million hectares under cultivation, yielding a total of 10.13 million tonnes with a productivity of 1777 kg ha-1 in 2021–22. Gujarat, Andhra Pradesh, Tamil Nadu, Odisha, Maharashtra, Rajasthan, MP, UP, and West Bengal are India's top groundnut-producing states. Tamil Nadu stands third in the total production of groundnut during 2021-22 only after Gujarat and Rajasthan and second only after Pondicherry in terms of productivity. A total of 0.37 million hectares of Tamil Nadu were planted with groundnut in 2021-22, and the state produced 1.04 million tonnes with a productivity of 2812 kg ha-1. (Indiastat, 2021) [6].

There has been a constant growth in the area under groundnut cultivation in Andhra Pradesh and Tamil Nadu, the two states that are the major producers of the crop. However, this is not the case in states like Gujarat and Maharashtra. In these places where the groundnut is preferred by farmers for its use as oilseed, fodder crop and food, the salinity is an arising issue. Salinity is increasing alarmingly fast in these locations. Around 7.1 million ha of India are affected by salinity, of which 3.5 million ha are in high-salinity hazard areas and 3.5 million ha are in medium-salinity areas. (Yadav *et al*., 1979) [24]. Among the major states in India that cultivate groundnut the soil salinity is spread around 2.0 m ha of the saline and coastal areas which are affecting the productivity of groundnut (Chhabra and Kamra, 2000) [2].

Salinity poses a widespread issue within coastal groundwater across various regions of India, including Tamil Nadu. Inland, elevated salinity levels in groundwater are particularly common in the arid and semi-arid zones of states like Rajasthan, Haryana, Gujarat, Punjab, Uttar Pradesh, Delhi, Andhra Pradesh, Karnataka, Maharashtra, and Tamil Nadu. The primary reasons for increased salinity along the coastal plains may arise from individual or combined influences, including inherent geological salinity, tidal effects, irrigation with brackish water, and the intrusion of seawater due to extensive groundwater extraction.

In most instances, the detrimental impacts of salinity have been linked to the rise in Na^+ and Cl^- ions within various plants, thereby creating unfavourable conditions for vital plant processes. Both Na^+ and Cl^- ions play pivotal roles in inducing numerous physiological disorders in plants, with Cl^- being particularly hazardous (Tavakkoli *et al*., 2010) [23]. Elevated levels of sodium ions (Na^+) can disrupt the absorption and utilization of other essential cations, leading to the disruption of chloroplasts and a subsequent decline in photosynthesis (Seeman and Critchley, 1985) [20]. These consequences can give rise to membrane impairment, nutrient imbalances, fluctuations in growth regulators, inhibition of enzymes, and metabolic dysfunction, including disruptions to photosynthesis, culminating in the eventual demise of the plant. The irrigation of saline water can also contribute to the accumulation of salts in the soil, resulting in diminished crop yields and the deterioration of soil quality. Studies have demonstrated that salinity may prompt an uptake of Na^+ while simultaneously hindering the uptake of Ca^{++} and K^+ (Neel *et al*., 2002) [16].

Salinity lowers the water potential of the substrate, which limits plant water and nutrient absorption. In spite of that, certain plant species persist and yield more than others in such environments by effectively altering their metabolism. At germination and seedling stages groundnut (*Arachis hypogea* L.) is sensitive despite being rated as moderately drought and salt tolerant. Both the vegetative and reproductive phases of plants are impacted by salinity. It results in slower growth during the vegetative phase, and the primary problem will be a decrease in yield during the reproductive phase.

2. Materials and methods

Experiment was conducted to evaluate the performance of groundnut (*Arachis hypogea*) under diluted seawater irrigation in the groundnut growing coastal area of Tamil Nadu under open air pot culture experiment.

2.1 Site description

A polybag based pot culture experiment was conducted at the Tamil Nadu Government State Horticulture Farm, Pushpavanam to study the effect of irrigation with diluted sea water on the growth and development of the groundnut in the groundnut growing coastal area during summer, 2023. The site is situated at the Vedaranyam block of Nagapattinam district, Tamil Nadu located at 10º47’ N latitude,79º85’ E longitude and an altitude of 3.83 m above mean sea level.

2.2 Plant and growth conditions

Groundnut variety GG7 (Parentage: S 206 x FESR 8-1-9-B-B) which is a promising variety in this coastal area was chosen as the test variety for the experiment. The variety is preferred and widely cultivated by the farmers in this region. For the conduct of the experiment UV treated HDPE polybags with a dimension of 16” x 12” height and diameter were used. The polybags were filled with soil up to a height of 13” leaving some room for irrigation. The coastal soil was collected and processed from the State Horticulture Farm, Pushpavanam field (0-20 cm). The soil used for the study was very deep, excessively drained sandy soil. The chemical properties of the soil are given in the Table 1. The soil was low in organic matter, available nitrogen, available phosphorus and available potassium. The soil was mixed with FYM and the basal dose of fertilizers were applied before sowing. All the polybags were irrigated with same quantum of water irrespective of the treatments. Irrigation was done with rose can to wet the entire diameter of the polybag uniformly.

2.3 Irrigation water

The experiment consisted of seven levels of irrigation water salinity. The different levels of saline waters for irrigation were prepared by diluting the sea water (44 dS/m) collected from the Bay of Bengal Sea nearby with the shallow groundwater (0.8 dS/m). The groundwater was collected from the skimming wells (depth of 10 ft x 4 nos).

Table 1: Initial properties of soil used for the experiment

Properties	Values
pH	7.89
EC	0.01 dS/m
Organic matter	0.12%
Available nitrogen	84 kg/ha
Available phosphorus	4.3 kg/ha
Available potassium	34 kg/ha

2.4 Experimental Design

The treatments were assigned in a Completely Randomised Block Design (CRD) with three replications and seven levels of irrigation water salinity. The different levels of saline water used for irrigation are T_1 - actual ground water (0.8 dS/m), T_2 - 1 dS/m, T_3 - 2 dS/m, T_4 - 3 dS/m, T_5 - 4 dS/m, T_6 - 5 ds/ and T_7 - 6 dS/m.

2.5 Observations

The following observations were recorded on the plants: number of days for seedling emergence, days to 50% flowering, plant height at harvest, number of branches/plant at harvest, number of pods/plant, number of kernels/pod, pod yield/plant, kernel yield/plant, shelling percentage and haulm yield/plant. The kernels and pods were dried to a moisture of 7% and 16% respectively under the sun as recommended before taking the observations.

2.6 Statistical analysis
The recorded observations were tabulated and statistically analysed by Analysis of Variance (ANOVA) for variance using the software AGRES version 3.01. The significant differences were computed among the treatments at $P < 0.05$. Since the treatment T_7 recorded nil seedling emergence, it was not included in the statistical analysis.

3. Results and Discussion
3.1 Effect of irrigation salinity on seedling emergence
The effect of irrigation salinity on seedling emergence were observed from the next day of sowing up to 15 DAS in all the treatments and presented in Table 2, expressed as number of days. The results clearly indicate that the seedling emergence is highly affected by the salinity of the irrigation water. Higher EC of the irrigation water affected the germination of the groundnut. With a corresponding increase in the EC of the irrigation water the seedling emergence was delayed. The seeds did not emerge at the highest EC (T_7 - dS/m). In the T_1 (actual groundwater) the seeds germinated earlier (5 days). The seeds took the maximum number of days (7.58) to germinate in T_6 (EC – 5dS/m). From this we can conclude that the lower EC of the irrigation water is essential for a faster seedling emergence. Similar observation was made by Yasmine *et al.* (2019) [25], Meena *et al.* (2017) [14] and Mensah *et al*. (2006) [15] on groundnut where the effect of salinity was more significant on the number of days required for the seeds to germinate. The delay in germination at higher salinity was observed by Francois *et al*. (1984) [4] in sorghum and Francois (1985) [5] in squash.

Table 2: Effect of different levels of irrigation salinity on the yield attributing and yield factors of Groundnut (*Arachis hypogea*)

Treatments	Days to seedling emergence	Final plant height (cm)	Days to 50% flowering	No. of branches per plant	No. of pods per plant
T_1	5.00	52.60	21.33	7.93	23.58
T_2	5.31	51.00	22.67	7.72	21.25
T_3	6.40	48.56	24.00	7.33	18.12
T_4	6.74	44.76	25.33	6.82	14.84
T_5	7.00	39.86	27.00	6.13	10.96
T_6	7.58	33.87	29.33	5.27	6.37
T_7^*	0.00	0.00	0.00	0.00	0
S.E(±)	0.2520	1.1587	0.5431	0.1468	0.3600
CD (P=0.05)	0.5492	2.5247	1.1834	0.3199	0.7844

*- not included in statistical analysis

3.2 Effect of irrigation salinity on plant height at harvest stage
The effect of irrigation salinity on plant height at harvest stage were observed in all the treatments and presented in Table 2 and expressed in cm. Salinity affected the plant height as observed at the harvest stage. The maximum plant height of 52.60 cm was observed with the T_1 (actual groundwater) and minimum plant height of 33.87 cm was observed in T_6 (EC – 5 dS/m). When the salinity in the irrigation water increases, the growth and development of the plant is affected. The reduction in chlorophyll due to the accumulation of salts in the plants irrigated with higher EC might be the reason for the decrease in plant height. It can be concluded that the EC of the irrigation water is a limiting factor for the plant growth and it was also affected by irrigation water of higher salinity. Similar observations were made by Machekposhti *et al.* (2017) [12] on the plant height of sunflower irrigated with diluted sea water.

3.3 Effect of irrigation salinity on days to 50% flowering
The effect of irrigation salinity on days to 50% flowering were observed in all the treatments and expressed in number of days. When the salinity of the irrigation water increased, a delay in flowering was observed. Plants irrigated with actual ground water (T_1) flowered first (21.33 days) followed by the corresponding treatments with the highest days (29.33 days) required by T_6 (EC – 5 dS/m). The days to 50% flowering was influenced by the different levels of salinity of the irrigation water as depicted in the Table 2. Kelm *et al.* (2000) [10] had reported an influence on root development in sweet potato by the nitrogen availability. Since the plants irrigated with higher EC of water had delayed in germination and had less plant height and reduced growth the plant nutrient uptake would be less. Due to the lack of nutrients the flowering might be delayed. Thus, it can be concluded that an increase in EC of the irrigation water increased the number of days required by the plants to flower. Similar delay in the flowering was observed by Meena *et al.* (2017) [14] in groundnut. Thus, the flowering of the groundnut plants was delayed by an increase in the salinity of the irrigation water.

3.4 Effect of irrigation salinity on number of branches per plant at harvest
The effect of irrigation salinity on number of branches per plant at harvest stage were observed in all the treatments and presented in Table 2 and expressed in numbers. It can be inferred that the number of branches per plant decreased when the EC of the irrigation water increased. The lowest number of branches per plant (5.27) was recorded at the highest EC of 5 dS/m (T_6). The highest number of branches per plant (7.93) was recorded with the use of actual ground water (T_1). The plants irrigated with irrigation water of higher salinity had less plant height due to lesser growth. Also, the salinity inhibits the branching of the plants. Due to this the number of branches per plant also decreases. Thus, it can be concluded that the number of branches per plant decreased with the increase in the salinity of the irrigation water. Similar observations were made by Meena *et al.* (2017) [14] and Kekere (2014a) [8] in groundnut where a decrease in the number of branches per plant was noticed.

3.5 Effect of irrigation salinity on number of pods per plant

The effect of irrigation salinity on number of pods per plant were observed in all the treatments and expressed in numbers. The highest number of pods per plant (23.58) was observed in the T_1 (actual ground water). The lowest number of pods per plant (6.37) was observed in the T_6 (EC of 5 dS/m) as shown in Table 2. At higher salinity the flowering of the plants was delayed. The number of flowers decreases due to salinity as reported by Singla and Garg (2005) [22] in chickpea. Due to less number of flowers the number of pods formed is also affected and decreases. Thus, it can be observed that the number of pods per plant decreased with an increase in the salinity of the irrigation water. Similar results were obtained by Yasmine *et al*. (2019) [25] and Kekere (2014b) [9] with a decrease in the number of pods per plant due to an increase in the salinity.

3.6 Effect of irrigation salinity on number of seeds per pod

The effect of irrigation salinity on number of seeds per pod were observed in all the treatments and expressed in numbers. The number of seeds per pod responded significantly to the saline irrigation water. The highest number of seeds per pod (1.74) was observed when the groundnut was irrigated with actual ground water (T_1). Similarly, the lowest number of seeds per pod (1.41) was observed with the T_6 (EC of 5 dS/m) as depicted in Table 3. Thus, it can be concluded that the total number of seeds per pod decreased with an increase in the salinity of the irrigation water. Similar trend was noticed by Mensah *et al*. (2006) [15] and Lakshmanan *et al*. (2011) [11] in groundnut. Also, Machekposhti *et al*. (2017) [12] observed a similar decrease in the number of seeds per head in sunflower and seeds per pod in pigeon pea by Tayyab *et al.* (2016) [26] with an increase in the salinity of the irrigated water.

3.7 Effect of irrigation salinity on pod yield per plant

The effect of irrigation salinity on pod yield per plant was observed in all the treatments and presented in Table 3 and expressed in grams. The T_1 (actual ground water) recorded the highest pod yield per plant of 12.49 g. The T_6 (EC of 5 dS/m) recorded the least pod yield per plant of 1.96 g. The yield components like the number of pods per plant and number of seeds per pod decreases with an increase in salinity. Due to this the pod yield per plant is highly influenced and thus reduces with increase in salinity. Thus, the pod yield per plant decreases with increase in salinity of the irrigation water. Similar results of reduction in pod yield with increase in salinity were obtained by Nithila *et al.* (2013) [17] with groundnut. Mensah *et al*. (2006) [15] and Lakshmanan *et al*. (2011) [11] observed a similar decrease in the pod yield of groundnut with increase in salinity. Silberbush and Lips (1998) [26] also observed similar results of decrease in pod weight with increase in salinity.

Table 3: Effect of different levels of irrigation salinity on the yield attributing, yield and quality factors of Groundnut (*Arachis hypogea*)

Treatments	No. of seeds per pod	Pod yield per plant (g)	Kernel yield per plant (g)	Shelling percentage (%)	Haulm yield per plant (g)
T_1	1.74	12.49	8.49	67.98	73.15
T_2	1.69	11.75	7.76	66.01	67.31
T_3	1.64	10.38	6.69	64.42	58.34
T_4	1.60	8.41	5.35	63.65	45.94
T_5	1.49	5.84	3.69	63.22	31.92
T_6	1.41	1.96	1.22	62.08	14.73
T_7^*	0.00	0.00	0.00	0.00	0.00
S.E. (±)	0.0348	0.1883	0.1267	0.0760	0.2338
CD (P=0.05)	0.0758	0.4104	0.2760	0.1656	0.5093

*- not included in statistical analysis

3.8 Effect of irrigation salinity on kernel yield per plant

The effect of irrigation salinity on kernel yield per plant was observed in all the treatments and expressed in grams. It was observed that the kernel yield of individual plants was influenced by the salinity of the irrigation water. The maximum kernel yield per plant (8.49 g) was recorded in T_1 (actual ground water). The least kernel yield per plant (1.22 g) was recorded in T_6 (EC of 5 dS/m) as shown in Table 3. Since the pod yield per plant decreases with salinity, the kernel yield per plant also decreases. Thus, the kernel yield per plant decreases when the salinity of the irrigation water increases. Similar decrease in the seed yield was observed by Salama (2011) [19] in groundnut and Bahrami *et al.* (2016) [1] in sesame with an increase in the salinity.

3.9 Effect of irrigation salinity on shelling percentage

The effect of irrigation salinity on shelling percentage was observed in all the treatments and presented in Table 3 and expressed in percentage. The shelling percentage of groundnut was significantly influenced by the salinity of the irrigation water. The maximum shelling percentage (67.98%) was obtained with the irrigation of actual ground water (T_1). The T_6 (EC of 5 dS/m) recorded the lowest shelling percentage (62.08%). The 100 seed weight of the seeds decreases due to salinity as reported by Lakshmanan *et al*. (2011) [11] in groundnut. Since the kernel weight decreases the shelling percentage decreases correspondingly. It can be inferred that the shelling percentage decreases significantly with increasing levels of irrigation water salinity. Pandya and Subbaiah (2017) [18] and Meena *et al*. (2017) [14] observed a similar decrease in the shelling percentage with increasing salinity.

3.10 Effect of irrigation salinity on haulm yield per plant

The effect of irrigation salinity on haulm yield per plant was observed in all the treatments and expressed in grams. A significant effect on the haulm yield per plant was observed. The T_1 (actual ground water) recorded the maximum haulm yield per plant (73.15 g). The T_6 (EC of 5 dS/m) recorded the minimum haulm yield per plant (14.73 g) as depicted in the Table 3. Since the growth characteristics like the plant height, number of branches and leaves reduces due to salinity the dry matter of the plant also reduces. Thus, it can be concluded that the haulm yield per plant decreases with the increase in the salinity of the irrigation water. Similar results of decrease in haulm yield were obtained by Janila *et al*. (1999) [7] and Meena and Yadav (2018) [13] in groundnut.

4. Conclusion

The groundwater salinity is mostly influenced by the sea in the coastal area by ways like sea water intrusion or tidal inundation. This research had used the diluted sea water for irrigation of groundnut. Hence effect of irrigation with groundwater with different EC on groundnut had been simulated resembling the natural conditions. The growth, yield and shelling percentage of groundnut are influenced by irrigation water salinity. The days to seedling emergence, days to 50% flowering were longer for T_6 (EC – 5 dS/m) and earlier for T_1 (actual ground water). They were found to be delayed with increasing salinity of the irrigation water. The final plant height, number of branches per plant at harvest, number of pods per plant, number of seeds per pod, pod yield per plant, kernel yield per plant, shelling percentage and haulm yield per plant recorded highest values for T_1 (actual ground water) and lowest values for T_6 (EC of 5 dS/m). They were found to decrease with increasing salinity of the irrigation water. T_7 (EC of 6 dS/m) recorded nil germination. From the results it can be concluded that the groundnut can be grown in coastal areas in sandy soil which is low in organic carbon, available soil nitrogen, phosphate and potash under irrigated condition after testing the feasibility of the irrigation water.

5. References

1. Helale B, di Jafari AO, Razmjoo J. Effect of salinity levels (NaCl) on yield, yield components and quality content of sesame (*Sesamum indicum* L.) cultivars. Environmental Management and Sustainable Development. 2016;5(2):104.
2. Chhabra R, Kamra SK. Management of salt affected soils. In Extended Summaries, International Conference on Managing Natural Resources for Sustainable Agricultural Production in the 21st Century; c2000. p. 47-49.
3. FAO. FAO Production Year Book 2003.2003. Rome Italy.
4. Francois LE. Salinity effects on germination, growth, and yield of two squash cultivars. Hort Science. 1985;20(6):1102-1104.
5. Francois LE, Donovan T, Maas EV. Salinity Effects on Seed Yield, Growth, and Germination of Grain Sorghum 1. Agronomy Journal. 1984;76(5):741-744.
6. Indiastat. Indiastat Data Base; c2021. https://www.indiastat.com/
7. Janila P, Rao TN, Kumar AA. Germination and early seedling growth of groundnut (*Arachis hypogaea* L.) varieties under salt stress. Annals of Agricultural Research. 1999;20(2):180-182.
8. Otitoloju Kekere. Growth, yield and seed nutritional composition of groundnut (*Arachis hypogaea* LINN) under elevated level of soil salinity. Molecular Soil Biology. 2014, 5(5).
9. Kekere, Otitoloju. Sustainable Production of Groundnut (*Arachis hypogaea* L.) Through Screening and Selection of Soil Salinity-Tolerant Genotypes. American Journal of Experimental Agriculture. 2014;4(12):1842.
10. Kelm M, Brück H, Hermann M, Sattelmacher B. Plant productivity and water use efficiency of sweet potato (*Ipomoea batatas*) as affected by nitrogen supply. CIP Program Report; c2000. p. 273-279.
11. Lakshman SS, Rahaman S, Jana AK. Effect of salinity on growth, yield and yield attributes of summer groundnut (*Araches hypogaea* L.) in coastal saline belts of West Bengal, Adv. Res. J Crop Improv. 2011;2(2):178-184.
12. Machekposhti, Farhadi M, Shahnazari A, Ahmadi MZ, Aghajani G, Ritzema H. Effect of irrigation with sea water on soil salinity and yield of oleic sunflower. Agricultural Water Management. 2017;188:69-78.
13. Meena HN, Yadav RS. Effects of Reusing Peanut Seeds Grown in Saline Irrigation Water on Yield Attributes and Quality Traits. Journal of Irrigation and Drainage Engineering. 2018;144(3):04018002.
14. Meena HN, Bhaduri RSD, Yadav NK, Jain, Meena MD. Agronomic performance and nutrient accumulation behaviour in groundnut-cluster bean cropping system as influenced by irrigation water salinity. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences. 2017;87:31-37.
15. Mensah JK, Akomeah PA, Ikhajiagbe B, Ekpekurede EO. Effects of salinity on germination, growth and yield of five groundnut genotypes. African Journal of Biotechnology, 2006, 5(20).
16. Neel JPS, Alloush GA, Belesky DP, Clapham WM. Influence of rhizosphere ionic strength on mineral composition, dry matter yield and nutritive value of forage chicory. Journal of Agronomy and Crop Science. 2002;188(6):398-407.
17. Nithila S, Devi DD, Velu G, Amutha R, Rangaraju G. Physiological evaluation of groundnut (*Arachis hypogaea* L.) varieties for salt tolerance and amelioration for salt stress. Research Journal of Agriculture and Forestry Sciences. c2013. p. 6063.
18. Pandya SM, Subbaiah R. Groundnut (*Arachis hypogaea* L.) influenced by poor (saline) irrigation water for coastal region. International Journal of Agriculture Sciences. 2017;9(47):4733-4736.
19. Salama MAAA. Estimating water consumptive use for some crops under stress conditions using neutron scattering method; c2011.
20. Seemann, Jeffrey R, Christa Critchley. Effects of salt stress on the growth, ion content, stomatal behaviour and photosynthetic capacity of a salt-sensitive species, *Phaseolus vulgaris* L. Planta. 1985;164:151-162.
21. Pawitar S, Choudhary OP, Singh P. Performance of some wheat cultivars under saline irrigation water in field conditions. Communications in soil science and plant Analysis. 2018;49(3):334-343.
22. Singla, Ranju, Garg N. Influence of salinity on growth and yield attributes in chickpea cultivars. Turkish journal of agriculture and forestry. 2005;29(4):231-235.
23. Ehsan T, Rengasamy P, McDonald GK. High concentrations of Na+ and Cl–ions in soil solution have simultaneous detrimental effects on growth of faba bean under salinity stress. Journal of experimental botany. 2010;61(15):4449-4459.
24. Yadav JSP, Bandyopadhyay AK, Sinha TS, Biswas CR. Coastal saline soils of India. In Bulletin No.5. Central Soil Salinity Research Institute: Karnal, India; c1979. p. 1-10.
25. Yasmine F, Rahman MA, Hasan MM, Md Amirul Alam,

Haque MS, Ismail MR, *et al*. Morphophysiological and yield attributes of groundnut varieties under different salinity stress conditions. Legume Research-An International Journal. 2019;42(5):684-687.
26. Bortolotti A, Wong YH, Korsholm SS, Bahring NH, Bobone S, Tayyab S, *et al*. On the purported "backbone fluorescence" in protein three-dimensional fluorescence spectra. Rsc Advances. 2016;6(114):112870-112876.