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RESEARCH ARTICLE

Genetic variability of greengram (*Vigna radiata* L.) in response to salinity on growth, yield and yield attributes in coastal saline belts of West Bengal

■ **SHYAM SUNDAR LAKSHMAN, ARUN KUMAR JANA AND B. MUKHERJEE**

SUMMARY

A field experiment was conducted during pre-*Kharif* season of 2010 at the Instructional farm of Ramkrishna Ashram Krishi Vigyan Kendra,Nimpith, 24-Parganas (South) to study the effect of salinity on growth and yield attributes of greengram. Present investigation was with an aim of finding the threshold salinity level for growing greengram successfully and profitably. The result revealed that soil salinity has significant influence on growth and yield attributes of greengram and the salinity of the soil severely reduced the seed yield beyond the EC level 2.06dS/m. In that situation the initial seed germination as well as early seedling growth and root development were severely affected with the increasing salinity of the soil which ultimately resulted to poor seed yield. The effect of interaction between salinity and variety on seed yield was found significant. Higher EC level hindered the growth and development of greengram irrespective of the genotypes, which confirms the importance of low to medium soil salinity for better growth and development of the plant. IPM 2000, PDM-139 and HUM-12 cultivars could grow successfully in limited irrigation source in the low to medium saline soil when electrical conductivity of the soil was below 2.06 dS/m.

Key Words : Salinity, Greengram, Seed yield, Sundarban

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Indian population is predominantly vegetarian. Protein requirement for the growth and development of the human being is mostly met with the pulse. Among the pulses, greengram (*Vigna radiata* L.) is one of the rich sources of protein (25%), carbohydrate, minerals, specially Ca (0.15%) and fat etc. Being a leguminous crop, it has the capacity to fix the atmospheric nitrogen and it also helps in preventing soil erosion. Being deep rooted crop, greengram is highly adaptive to rainfed areas. Due to shorter in duration, it fits well in cropping system and gives extra benefits to the farmers in a short period.

Mung bean is a self pollinated warm season crop. The total pulse production in the country was 13.38 million tones from 22.47 million ha area in the year 2004-2005. It is estimated that the country's population will reach nearly 1350 million by 2020 AD. The country needs 30.3 million of pulses to meet the demand. In west Bengal,production of pulses at about 158.02 thousand M.T. from an area of 200.943 thousand hectares. Among the pulses, mungbean produced16.048 thousand M.T. from an area of 34.99 thousand hectares in *Rabi*-summer season in the year 2008-2009. To meet the call of the future, the area under production and the productivity of greengram should be increased. In west Bengal mung is largely grown as a summer crop under rainfed condition and yield is influenced due to erratic monsoon. In the southern

MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
ARUN KUMAR JANA, Department of Agricultural Economics, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, NADIA (W.B.) INDIA

Address of the Co-authors:
SHYAM SUNDAR LAKSHMAN, AICRP on Sunflower, Ramkrishna Ashram Krishi Vigyan Kendra, NIMPITH (W.B.) INDIA

B. MUKHERJEE, Department of Agricultural Economics, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, NADIA (W.B.) INDIA

parts of south 24 Parganas district, *i.e.* parts of Sundarbans, the agriculture faces three way hindrances. These are i) soil salinity, ii) late release of land for *Rabi* crop due to poor drainage system along with low percolation rate of water and iii) poor irrigation facility as the ground water is saline and unfit for irrigation. So, the farmers of this region have a very less mobility in crop selection for the *Rabi* season after Aman paddy. In this crop selection process, one should keep in mind that the crop should bear the following characters, *i.e.* a) it is able to grow with minimum irrigation (drought condition) facilities and should survive water stress, b) can tolerate soil salinity to some extent and c) can protect the soil from direct sun by covering the soil surface, thus, minimizing soil salinization process. Mung bean is one this type of crop. Like other crops, mung bean also prefers low saline and highly nutritious soil having one or two light irrigation, which facilitates habbock production. However, the yield potential of this crop grown during summer can be realized to a greater extent by adopting suitable water and nutrient management practices. According to Ghassemi *et al.* (1995), soil salinity is one of the world's major environmental problems. About 7 per cent of the world's total land area is affected by salt. But, unlike other crops, mung bean can grow well in moderate type soil with at least one life saving irrigation facility as greengram is a somewhat drought tolerant crop. In Sundarban soil, mung bean has enough scope because Sundarban has its own peculiarity with respect to its salinity development. In any plant species sensitivity to salinity is known to vary between growth stages (Mass and Hoffman, 1977). It has been observed that, just after harvesting of paddy particularly in the month of December, there is very little or no salinity in the soil. But, gradually, when the upper surface of the soil starts drying, some of the plots become saline due to the upward movement of saline ground water. In this situation cultivation of mung bean immediately after harvesting of Aman paddy, can save both the soil and the crop as well. Mung bean is a good economic crop in this situation, as it gives the farmer to earn some money at a time when no other crop was possible due to lack of irrigation facility. Also it gives a good fodder during the drier months of March to May, when scarcity of green fodder is acute in this region. Thirdly, it improves soil health by minimizing soil salinity and by nitrogen fixation through symbiotic association with rhyzobium.

In Sundarban situation, mung bean has been tried for many years, particularly by the farmers who have low to marginal land as well as limited irrigation facilities. It has been noticed that in less saline plots, bumper seed yield has been recorded; where as in saline plots though the plant growth is good, but seed production is not satisfactory. In this condition, a systematic study was essential to find out the threshold level of salinity tolerance of this crop and identification of a suitable variety which can grow better in saline condition in coastal saline belts of west Bengal. Still now, no systematic study in this respect has been carried out to find out the optimum level of salinity which the crop can tolerate. In the present investigation, it was tried to find out the threshold level of tolerance of the crop to salinity and identification of a suitable variety which can grow better in saline condition.

MATERIALS AND METHODS

Present investigation was carried out during *Rabi* summer season at the Instructional farm of Ramkrishna Ashram Krishi Vigyan Kendra Nimpith. The experimental site was situated 22 ^{0}343"N latitude and 89 ^{0} 4"E longitude at an altitude of 5.0m above mean sea level. The soil of experimental plots was clay loam. The site was subtropical humid climate with annual average rainfall1350mm and 80 per cent of rainfall occurs during second week of June to middle of October. The experiment was arranged in Randomized Block Design with three replications. Ten different plots having ten different salinity levels were selected for conducting this experiment. All the ten plots had more or less similar nutritional and pH level. Each of the ten plots was again subdivided into three parts and each part was treated as one replication and each of the three plots was again subdivided into five parts and in each part one variety was grown .as one replication. Thus, in each treatment (salinity level) fifteen number of plot were developed and totally one hundred and fifty number of plot were prepared.

The different variety of green gram used in this experiment were PDM-139,IPM -2000,HUM-12, PDM-11and Pusa 9531. The varieties were collected from west Bengal Pulse and Oilseed Research Station, Baharampur.

Each subplot was of 3m in width and 5 m in length. Seeds were drilled 5-6 cm apart during first half of February and row to row spacing was given 60cm. At the time of land preparation FYM was applied 15ton/ha.Common dose of 25 kg N and 50 kg P_2O_5/ha and 40 kg K_2O /ha was applied in the form of urea, SSP and MOP as basal. Through SSP 40 kg sulphur /ha was

Table A : Soil nutrient status of eight treatments

Treatments	pH	Salinity (EC) (dS/m)	% O.C.	N_2 (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
T_1	6.65	1.28	0.85	625.2	91.6	478.6
T_2	6.82	1.45	0.89	595.6	88.2	456.8
T_3	7.04	1.63	0.86	563.6	89.7	443.5
T_4	6.86	1.85	0.78	542.9	79.6	451.6
T_5	6.98	2.06	0.81	556.1	83.4	411.8
T_6	6.82	2.26	0.80	510.7	80.5	403.2
T_7	6.88	2.37	0.84	537.4	78.8	436.2
T_8	7.01	2.49	0.80	513.5	81.3	468.8
T_9	6.92	2.58	0.76	532.2	78.2	423.6
T_{10}	7.02	2.70	0.85	560.6	85.9	431.7

applied as basal. The crop was grown as rainfed and one irrigation at the time of 50 per cent flowering was applied. There was very little rain during the crop period. The meteorological data are given in Table B. Observations were recorded from ten representative plants selected randomly from each replication on the following set of characters *viz.*, germination per cent, final plant height (cm.), number of branches/plant, leaf area (cm^2) per plant, days to 50 per cent flowering , number of pods per plant, pod leangth at maturity, number of seeds per pod, seed yield per plant(g),), seed yield (kg/ha),leaf area was calculated by multiplying number of leaf in the plant and average individual leaf size.

Table B: Weather data during the investigation period (2009-2010)

Months	Temperature (^{0}C)		Rainfall (mm)	Relative humidity (%)	
	Maximum	Minimum		Maximum	Minimum
Dec., 2009	228.8	10.0	-	94.5	29.5
Jan., 2010	27.5	10.2	-	93	26
Feb., 2010	32.5	11.9	-	98	26
Mar., 2010	38.5	21.5	-	98	23
Apr., 2010	39.5	22.6	4.0	99	30
May, 2010	38.6	23.0	180.5	99	31
June, 2010 (1st week)	37.4	22.7	96.4	99	51

RESULTS AND DISCUSSION

The findings of the present study well as relevant discussions have been presented under following heads:

Effect on germination :

From the experiment it is clearly observed that the germination of seed of greengram had been highly influenced by salinity status of the soil. Higher EC level hindered germination of seeds. The germination of the greengram decreased significantly with the consequent increase in EC level of the soil .In the present experiment minimum germination per cent of seed was recorded in Pusa 9531 (18.84) where EC level was highest (2.70 dS/m) and the maximum (86.25) being with lowest EC level(1.63 dS/m). Present findings confirm that irrespective of the variety the seed germination was highly influenced by soil salinity (Table 1). Form the experiment it may clearly be stated that soil salinity plays a key role for germination of seeds. The experimental findings confirmed the importance of low to medium soil salinity for better seed germination and early seedling development of greengram.

Effect on final plant height and leaf area :

The final plant height of greengram was significantly influenced by the salinity level(EC)of the soil. The plant height of the greengram decreased significantly with the consequent increase in EC level of the soil. In the present experiment in higher salinity level (EC 2.70 dS/m) the minimum plant height was recorded (15.8cm) in cv. PUSA- 9531 and maximum plant height was recorded in CV. IPM-2000. In lower salinity level the better plant height was observed when EC level was lowest (EC 1.28 dS/m), In the lower salinity level the maximum (47.4cm) being recorded in cv. IPM 2000 and minimum was recorded in cv. PUSA- 9531 (Table 1).

Leaf area significantly reduced with the increasing EC level from 1.28 to 2.70dS/m and the lowest leaf area was observed at highest soil salinity level in treatment no. 10 (EC 2.70dS/m) followed by treatment 9 (EC 2.58dS/m) and treatment 8 (EC 2.49dS/m) . Both final plant height and leaf area/plant showed similar type of response to consequent increase in soil salinity level. In highest salinity level the maximum leaf area was recorded in cv IPM2000 and the lowest leaf area was

Table 1: Effect of different salinity levels on germination and final plant height

Treatments	Germination %					Final plant height (cm)				
Variety	IPM-2000	PDM-139	HUM-12	PDM-11	Pusa-9531	IPM-2000	PDM-139	HUM-12	PDM-11	Pusa-9531
T_1	86.25	85.36	84.25	85.65	85.15	47.4	45.9	45.1	43.9	42.7
T_2	83.66	82.86	83.25	83.26	83.26	45.6	44.8	43.2	42.8	41.9
T_3	81.25	80.35	80.25	81.45	78.55	43.9	42.4	42.3	41.3	41.2
T_4	76.28	76.28	74.28	73.28	72.28	40.4	39.3	37.9	37.2	36.7
T_5	68.36	67.26	64.36	63.36	61.36	35.1	33.6	31.6	30.7	28.5
T_6	55.25	53.65	51.25	50.25	49.55	30.6	29.7	28.7	28.2	26.9
T_7	45.84	43.24	40.84	40.21	39.84	26.7	25.9	25.5	25.1	24.9
T_8	39.25	37.85	33.25	31.85	30.25	24.9	23.6	22.1	21.9	20.8
T_9	34.34	32.14	28.34	27.84	25.34	21.6	20.8	19.1	18.8	17.7
T_{10}	25.84	22.54	20.84	19.64	18.84	20.1	18.6	17.8	16.7	15.8
S.E.(±)	4.84	4.75	4.94	4.68	4.55	0.59	0.58	0.61	0.56	0.51
LSD (P=0.05)	12.66	13.65	14.74	14.31	13.75	1.74	1.68	1.83	1.5	1.55
S.E.(±))		GXE: 1.4						GXE : 0.72		
LSD (P=0.05)		GXE : 4.1						GXE : 2.18		

recrded in cv Pusa 9531(Table 2).The G X E interaction was also significant which indicate that there is a genetic divergence among the varieties in response to salinity. The cv. IPM 2000 was recorded the highest leaf area which was at per with cv PDM 139 and the lowest leaf area was recorded in cv. PUSA 9531. From the experiment it is clearly observed that the growth of plant, number of leaf per plant as well as individual leaf size of greengram were highly influenced by salinity status of the soil. Higher EC level hinders the growth and development of greengram irrespective of the genotypes, which confirms the importance of low to medium soil salinity for better growth and development of the plant. Here pH, organic carbon, available nitrogen, phosphate and potash had insignificant variation in different treatment levels (Table A). Therefore, it can be concluded that, only the electrical conductivity (salinity) of the soil was the limiting factor on the growth of greengram.

Effect on number of branches per plant and days to 50 per cent flowering :

The no. of branches varied significantly in variety to variety. The GXE interaction was highly significant. From the Table 2 it may be inferred that numbers of branches per plant were significantly influenced by the level of salinity of the soil. In the present experiment, minimum no. of branches per plant was recorded (3.1) in cv. PUSA 9531 where EC level of soil was highest (2.70 dS/m), and the maximum was recorded in cv IPM 2000(10.48) being with lowest EC level (1.28 dS/m). From the above experimental findings it may inferred that the no. of branches per plant were significantly influenced by soil salinity levels.

The Days to 50 per cent flowering varied significantly in variety to variety. For the said character the GXE interaction was highly significant. The experimental results clearly indicate that the days to 50 per cent flowering was significantly influenced by the EC status of the soil. With increase of EC level, the plants took less time to flower. From experimental findings it may be inferred that due to high salinity the plants were came to flower earlier than the plots where salinity was low (Table 3). Kelm *et al.* (1999) reported that root development and water use efficiency of green gram was affected by the availability of nitrogen, potash and phosphate and other micronutrients to the plants. From the results it may be concluded that in high salinity level (EC> 2.4 dS/m)due to low availability of nutrients to the plants they came to flower earlier than the fields where salinity was found low (EC< 2.0 dS/m). Therefore, it may be concluded that, high soil salinity influences such type of physiological development of the plants causing early flowering in greengram.

Effect on no. of pods per plant, pod length and number of seeds per pod :

Number of pods per plant varied significantly from variety to variety. For the trait the GXE interaction was highly significant. Number of pods per plant showed typical response to soil salinity. The highest no. of pods per plant was observed in cv IPM 2000 which was at par with PDM 139 (Table 3). In both the high and low salinity levels cv Pusa 9531 produced lowest no. of pods. With the increasing soil salinity, the no. of pods per plant and the no. of seeds per pod decreased sharply irrespective of the variety (Table 3 and 4). It may be due to a physiological pressure which is imparted upon the plant due to high salinity, which induces the plant to decrease number of pods and no. of seeds per pod.

Table 2: Effect of different salinity levels on no. of branches /plant and avg. leaf area (cm^2) /plant

Treatments	Variety No. of branches per plant					Variety Avg. leaf area (cm^2) /plant				
	IPM-2000	PDM-139	HUM-12	PDM-11	Pusa-9531	IPM-2000	PDM-139	HUM-12	PDM-11	Pusa-9531
T_1	10.48	10.10	10.12	9.95	9.61	2543	2531	2507	2437	2382
T_2	10.36	10.25	9.95	9.65	8.77	2465	2425	2371	2329	2256
T_3	10.07	9.85	9.35	8.87	8.52	2347	2319	2245	2187	2147
T_4	9.18	9.35	8.47	8.12	7.61	2265	2207	2159	2065	2016
T_5	7.42	7.10	6.92	6.81	5.62	2137	2113	2047	1937	1837
T_6	6.18	5.81	5.81	5.62	4.65	1968	1903	1848	1768	1668
T_7	5.45	4.86	4.72	4.45	4.07	1842	1789	1642	1572	1542
T_8	4.67	4.22	4.37	4.17	3.67	1456	1386	1306	1256	1156
T_9	4.10	3.45	3.41	3.67	3.51	1236	1189	1136	1036	936
T_{10}	3.45	3.28	3.21	3.18	3.10	1081	1038	988	948	817
S.E. (±)	0.13	0.12	0.14	0.13	0.14	42.2	43.7	45.2	38.2	43.2
LSD (P=0.05)	0.40	0.36	0.42	0.39	0.42	128.7	121.3	138.1	116.6	131.2
S.E. (±)			GXE: 0.21					GXE : 73.8		
LSD (P=0.05)			GXE : 0.62					GXE : 218.5		

Table 3 : Effect of different salinity levels on days to 50 % flowering and no. of pods per plant

Treatments	Variety					Variety				
	Days to 50 % flowering					No. of pods per plant				
	IPM-2000	PDM-139	HUM-12	PDM-11	Pusa-9531	IPM-2000	PDM-139	HUM-12	PDM-11	Pusa-9531
T_1	32.6	35.6	37.6	39.6	42.6	52.6	48.6	46.5	44.6	43.5
T_2	31.5	34.5	36.9	38.5	41.5	51.5	46.5	44.6	42.5	42.3
T_3	32.6	33.7	36.3	37.2	39.6	48.6	44.6	42.5	41.7	40.6
T_4	31.5	32.4	35.7	35.3	37.5	45.5	42.5	40.5	39.6	38.3
T_5	29.6	30.6	34.6	34.1	35.6	41.6	39.8	38.6	36.7	36.1
T_6	28.5	29.5	32.5	31.5	33.5	38.5	35.6	32.7	32.1	32.8
T_7	27.8	28.8	30.9	30.2	31.8	34.8	31.7	29.1	28.8	29.5
T_8	25.6	26.6	28.6	28.1	29.6	30.6	26.1	25.6	25.6	27.6
T_9	24.7	25.7	26.7	26.0	27.3	24.7	24.7	24.7	23.7	21.2
T_{10}	24.1	24.9	25.3	24.5	25.1	20.1	22.4	20.1	18.1	16.6
S.E. (±)	0.83	1.08	1.13	1.09	0.91	2.6	2.9	2.6	2.3	1.9
LSD (P=0.05)	2.69	3.18	3.21	3.28	2.85	7.8	8.5	8.2	7.5	5.8
S.E. (±)			GXE :0.62					GXE :0.83		
LSD (P=0.05)			GXE : 1.84					GXE :2.28		

Table 4 : Effect of different salinity levels on number of seeds per pod and pod length (cm)

Treatments	Variety					Variety				
	Number of seeds per pod					Pod length (cm)				
	IPM-2000	PDM-139	HUM-12	PDM-11	Pusa-9531	IPM-2000	PDM-139	HUM-12	PDM-11	Pusa-9531
T_1	10.6	10.2	10.1	9.6	9.2	7.5	7.8	7.4	6.8	6.7
T_2	10.2	10.1	9.6	9.2	8.7	7.4	7.7	7.3	6.7	6.6
T_3	10.0	9.5	9.2	8.7	8.3	7.3	7.6	7.2	6.7	6.6
T_4	9.5	9.1	8.7	8.3	7.9	7.0	7.2	7.0	6.4	6.2
T_5	9.1	8.7	8.0	7.7	7.2	6.6	6.4	6.2	6.1	5.9
T_6	8.2	7.9	7.4	6.9	6.6	5.8	5.7	5.4	5.4	5.6
T_7	7.6	7.1	6.6	6.2	5.6	5.3	5.1	5.1	5.0	5.1
T_8	6.7	5.8	5.4	5.2	4.8	4.8	4.6	4.6	4.6	4.5
T_9	5.8	5.2	4.9	4.8	4.1	4.4	4.1	4.2	4.0	4.1
T_{10}	5.1	4.9	4.3	4.1	3.6	4.1	3.8	4.1	3.7	3.5
S.E. (±)	0.13	0.14	0.11	0.16	0.14	0.31	0.25	0.21	0.27	0.33
LSD (P=0.05)	0.38	0.44	0.33	0.48	0.42	0.89	0.75	0.64	083	1.03
S.E. (±)			GXE : 0.24					GXE : 0.09		
LSD (P=0.05)			GXE : 0.71					GXE :0.27		

Pod length significantly varied from variety to variety. Among the varieties, the highest pod length was observed in PDM 139(7.8 cm) followed by IPM 2000.In both case the higher pod length was observed in lowest salinity level (1.28dS/m). For the trait the GXE interaction was highly significant. In all the varieties, the lowest pod length was observed in highest salinity level (EC 2.70dS/m). In higher salinity level (EC >2.0dS/m) the variety PDM 139 and IPM 2000 performed significantly better than rest of the varieties.

From the Table 3 and 4 it may clearly be observed that all the treatments varied insignificantly except EC level of the soil and variety. In the different salinity level the availability of different macro and micronutrients not varied significantly. Singh *et al.* (1989) reported that the reduction in production level of mungbean cultivars reached upto 50 per cent under salt stress conditions.

Radha *et al.* (1988) reported the deficiency of phosphorus reduced shoot length, root length, shoot and root weight and ultimately reduced the total leaf yield of the plant like mulberry. Therefore, uptake of phosphorus may hamper in high saline soil which ultimately cause poor growth and development of pods in green gram. Luxuriant plant growth had been found in soil where EC level vary from 1.26-2.0 dS/m and in consequent higher EC level, the high soil salinity cause hindrance for the growth and development of green gram which confirms the importance of low to medium soil salinity for better growth and pod development of the plant. Sankar (1997) reported positive effects of phosphorus on stimulating root growth, increasing resistance to drought and many quality parameters and increasing foliage production in greengram.

In his findings he was reported that the no. of pods per plant and no of seeds /pod have significantly influenced by K_2O application in the soil. The experimental plots in present investigation varied insignificantly in respect of K_2O availability. Therefore, from the result it may inferred that the soil salinity plays a major role in the uptake of potassium by the plants and in high salinity level (EC> 2.0 dS/m) the uptake of potassium may reduce significantly which ultimately leads to the lower no. of seeds/ pod or low seed yield per plant. From our experimental findings it may be pointed out that uptake of potassium is hampered in high salinity level which ultimately leads to the lower no of pods per plant as well as lower no. of seeds (Kernel) per pod at high salinity level.

Effect of salinity on seed yield per plant and seed yield in kg/ha :

The result of experiment has clearly highlighted the feature that salinity plays a key role on seed yield of greengram. From the experiment it is clearly observed that seed yield per plant as well as seed yield in kg/ha was significantly influenced by the salinity status of the soil (Table 5). With increase in EC level of the soil, the seed yield per plant reduced sharply and the similar response was observed in all the varieties. According to Nauiliyal *et al.* (1989 and 1994) growth and initiation of secondary roots affected adversely due to salinity. Seed yield per plant was significantly reduced with the increasing EC level of soil from 1.28 to 2.70dS/m. The result also indicated that seed yield of greengram directly correlated with the no. of pods per plant, total leaf area per plant, and no. of filled grain and all the traits are yield attributing and also influenced by soil salinity. Therefore, the yield which is a complex trait in any of the crop species is indirectly influenced by soil salinity. This finding is in close proximity with the findings of Greig and Smith (1962). Mishra and Bhattacharya (1983) reported that the reduction of grain yield of greengram ranged from 23.1-82.7 per cent due to soil salinity and the performance of the varieties differed significantly within themselves.

The available nutrients (nitrogen, phosphate and potash) including organic carbon of all experimental plots showed no significant variations; therefore, it can be concluded that in high saline soil the nutrients become unavailable to the plants which were reflected in the individual pod and seed development and ultimately on the seed yield per plant. In the salinity level EC beyond 2.06dS/m, the seed yield per plant reduced drastically, which confirms that this level of soil salinity may be the threshold limit for growing the crop profitably in the coastal saline belts of west Bengal. Our experimental findings shows close proximity reported by Hassam *et al.,* (1970) who reported that soil salinity have great influence on production, uptake and distribution of nutrients in barley [*Hordium vulgere* (L.)]. Our findings also shows close proximity reported by Girdhar *et al.* (2005) who reported that performance of groundnut (*Arachis hypogea* L.) as influenced by soil salinity and saline water irrigation in black clay soil. Therefore, from the above studies it may be inferred that soil salinity has significant influence on uptake of nitrogen, phosphate, potash and other macro and micro

Table 5: Effect of different salinity levels on seed yield per plant and seed yield (kg/ha)

Treatments	Variety					Variety				
	Seed yield per plant					Seed yield (kg/ha)				
	IPM-2000	PDM-139	HUM-12	PDM-11	Pusa-9531	IPM-2000	PDM-139	HUM-12	PDM-11	Pusa-9531
T_1	69.2	65.9	64.2	61.2	56.8	686.7	689.7	675.3	616.8	586.6
T_2	67.1	62.8	63.4	59.8	55.4	674.3	678.2	647.1	598.1	572.1
T_3	65.6	61.6	59.6	57.4	54.2	652.9	665.9	639.2	577.3	565.9
T_4	61.6	57.1	55.5	54.9	52.5	639.3	631.7	621.7	549.1	542.1
T_5	54.2	52.3	49.4	47.8	44.3	547.6	551.6	539.5	481.7	456.2
T_6	48.2	46.4	45.6	43.6	41.2	512.9	509.2	494.1	416.9	391.6
T_7	42.4	39.4	37.8	35.9	32.4	447.1	441.1	432.3	358.5	326.6
T_8	37.4	34.7	32.4	30.8	29.6	406.2	385.7	365.7	321.6	285.6
T_9	34.1	31.6	29.6	27.8	27.1	315.5	301.6	285.3	263.2	245.8
T_{10}	31.2	30.5	27.8	25.2	22.4	261.6	251.3	237.9	212.2	188.7
S.E. (±)	0.7	0.8	0.7	0.8	0.6	54.50	38.30	32.60	36.60	31.30
LSD (P=0.05)	2.1	2.5	2.0	2.4	1.78	164.50	116.30	67.60	110.60	93.80
S.E. (±)			GXE :2.6					GXE :28.2		
LSD (P=0.05)			GXE : 7.7					GXE :84.5		

nutrients to the plant, thus, in spite of presence good amount of nutrients and organic carbon in the soil, high EC level reduced the total leaf area which is the responsible part of the plants for photosynthetic activity and indirectly influenced the storage of photosynthates in seed kernel and by that way it may influenced the no. of seeds per pod. The salinity of the soil significantly influences macro and micro nutrient uptake and transportation and by that way it may control the photosynthesis, source – shrink transportation, photosynthates accumulation in different storage organs (seed kernel) and other physiological activities which are directly related to the seed yield of the plants. The result of the experiment also indicates that the greengram can be grown profitably in coastal and saline belts of Sundarbans as a rain fed crop with minimum irrigation facilities (One irrigation at pick flowering stage) where the EC level of the soil not exceeds 2.06 dS/m and availability of soil nitrogen, phosphate, potash and organic carbon is medium to high.

Conclusion :

The G x E (salinity x variety) interaction is highly significant in major yield attributing characters under studies. Therefore, it concluded that the salinity of the soil has significant influence growth and on yield attributes of greengram and the greengram is a crop which can tolerate low to medium soil salinity (EC<2.0dS/M). The result also revealed that the salinity of the soil severely reduce the seed yield beyond the EC level 2.06dS/m. In that situation the initial seed germination as well as early seedling growth and root development are severely affected with the increasing salinity of the soil which ultimately resulted to poor seed yield. Higher EC level hinders the growth and development of greengram irrespective of the genotypes, which confirms the importance of low to medium soil salinity for better growth and development of the plant.

From the experimental findings, it may be concluded that the cultivar like IPM 2000, PDM-139 and HUM-12 may advice to grow successfully in limited irrigation source in the low to medium saline soil when electrical conductivity of the soil was below 2.06 dS/m. the salinity of the soil significantly influences macro and micro nutrient uptake and transportation and by that way it may control the photosynthesis, source–shrink transportation, photosynthates accumulation in different storage organs (seed kernel) and other physiological activities which are directly related to the seed yield of the plants. The result of the experiment also indicates that the greengram can be grown profitably in coastal and saline belts of Sundarbans as a rain fed crop with minimum irrigation facilities (One irrigation at pick flowering stage)where the EC level of the soil not exceeds 2.0 dS/m and availability of soil nitrogen, phosphate, potash and organic carbon is medium to high.

REFERENCES

Ashraf, M. (1989). The effect of Nacl on uptake relations, chlorophyll, protein and praline content of two cultivars of greengram. *Plant & Soil,* **119**:205-210.

Asarf, M. and Rasul, E. Salt tolerance of mung bean cultivars (*Vigna radiata* (L.) Wilczek) at two growth stages. *Plant & Soil*, **110**(1): 63-67.

Epestein, A.K. (1985). Performance of mung bean cultivars affected by moisture stress and soil salinity. *Plant & Soil*, **58**(1): 163-170.

Ghassemi, F., Jackman A.J. and Nix, H.A. (1995). Salinization of land and water resources : Human causes, extent, management and case studies. UNSW PRESS, SYDNEY, AUSTRALIA.

Greig, J.K. and Smith, F.W. (1962). Salinity effects on greengram growth. *Agron. J.*,**42**(2):145-150 .

Jain, R.K., Jain, S., Nainuwalse and Choudhury, J.B. (1990). Salt tolerance in greengram [*Vigna radiata* (L.) Wilczek]; *in vitro* selection for agronomic evaluation and genetic stability. *Euphytica*, **48**:141 -152.

Mass, N.J. and Haffman, S.J.(1977). Effect of soil salinity on various pulse crop in rainfed condition. *Plant & Soil,* **41**:225-232.

Mishra, J.N. and Trivedi, U.N.(2004). Genotypic differences in salinity tolerance of greengram [*Vigna radiata* (L.) Wilczek] cultivars. *Plant Sci* . **66**: 1135-1142.

More, S.S. and Gourishankar, C.P. (1982). Salt tolerance studies on greengram [*Vigna radiata* (L.) Wilczek] cultivars. *J. Maharastra Agric .Univ.,* **7**: 245-252.

Singh, Harbir, Malik, B.P. and Sharma, H.C.(1989) Relative performance of mung bean cultivars [*Vigna radiata* (L.) Wilczek] under various level of soil salinity. *Harryana J. Agron.*, **5**(2): 171- 173.

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