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MORPHO-PHYSIOLOGICAL EVALUATION OF COW PEA GENOTYPES UNDER SALT STRESS

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ABSTRACT

The present study was carried out to evaluate and Screen the cowpea genotype under salt stress. A field experiment was conducted with fourteen cowpea genotypes with two replication in controlled conditions under Salt stress. Morpho-physiological parameters were studied. Higher the salt stress Morpho-physiological, changes were observed net photosynthesis, transpiration, stomatal conductance, Chlorophyll (%) significantly decreased, Na^+,Cl^- and K^+ ion concentration increases up to maturity stage. Yield and yield contributing characters significantly decreased due to salt stress. The genotypes viz., *Phule Vithai, Phule Rukmini,* PCP-1123, PCP-1124, PCP-1122 early genotypes performed better due to salt exclusion mechanism and PCP-1112 , PCP-1131 performed poor under salt stress conditions.

Key words : Cowpea, salt, stress, PCP, physiology.

Cowpea (*Vigna unguiculata* L.) is a major food and oil crop in the most of the countries where salinity problems exist or might develop. Large areas of formerly arable land are being removed from crop production every year due to increasing soil salinity. Therefore, it is necessary to evaluate the physiological responses of crop plants to salt stress in order to develop appropriate strategies to sustain food production under adverse environmental conditions. Cowpea production is being threatened. Thus, it is very important to breed salt-tolerant cowpea cultivars (1). The number and quality of root nodules determine the nutritional status of the whole plant. The salt tolerance on Cowpea nodulation is thought to be mediated by solute signals in both the aerial part and roots (2). Cowpea is drought avoiding crop because of good root system for high water uptake, less water loss due to stomatal regulation and hypersensitive stomata for water movement. The whole-plant acclimation to salt stress is considered an integrated response of different organs, especially roots and leaves (3). Although the roots constitute the primary barrier to salt uptake, leaves have received more attention from researchers, because they are the sites of carbon assimilation and, therefore, more directly related to plant growth and development. Therefore, the objective of this paper was to explore the effects of salt stress of known intensity and duration on morpho-physiological changes in leaves of different ages, aiming for a better understanding of the acclimation process of the whole-plant.

Salt stress affects many physiological aspects of plant growth. Shoot growth and dry matter are reduced by salinity, root: shoot ratio is increased (4). The present study has been undertaken to compare the salinity stress adaptations in ten different Cowpea cultivars. In order to identify the Cowpea cultivars with a better performance even under saline conditions and providing a reference for breeding salt-tolerant In view of the above present investigation has undertaken to study "Morphological and physiological evaluation of cow pea genotypes for salt stress (*Vigna unguiculata* L.)" During Kharif-2018.

MATERIALS AND METHODS

The present experiment entitled "Morpho-physiological evaluation of cowpea genotypes for salt stress" was carried out under controlled conditions at Phytotron laboratory, Department of Agricultural Botany, Post Graduate Institute, Mahatma Phule KrishiVidyapeeth Rahuri during the kharif-2017-2018 with 10 genotype of cowpea, with design Factorial complete Randomized block design, with two replications with Salt stress treatments (control : 0 bar, -0.4 bar NaCl and -0.7 bar NaCl).

Hoagland solution and NaCl solutions were prepared by preparing. Stock A, Stock B, Stock C and Stock D solutions.

Sr. No	Chemicals Used		Mg/liter H_2O	Solution
1.	Calcium nitrate	$Ca(NO_3).4H_2O$	950	Stock A
2.	Potassium nitrate	KNO_3	610	
3.	Magnesium sulphate	$MgSO_4.7H_2O$	490	Stock B
4.	Monoammonium phosphate	$(NH_4).H_2PO_4$	120	Stock C
5.	Boric acid	H_3BO_3	0.6	Stock D
6.	Mangnase chlorite	$MnCl_2.4H_2O$	0.4	
7.	Zinc sulphate	$ZnSO_4.7H_2O$	0.09	
8.	Copper sulphate	$CuSO_4.5H_2O$		
9.	Ammonium molybdate	H_2MoO_4		
10.	Cobalt nitrate	$Co(NO_3)_26H_2O$	0.025	
11.	Ferrous sulphate	$FeSO_4.7H_2O$	24.8	
12.	Sodium hydroxide	NaOH	6.6	
13.	Disodium salt	E.D.T.A.	33.2	

After preparation of stock solutions Hoagland solution was prepared by mixing 10 ml of each stock solution in one liter of distilled water. Then required

Table-1 : Morpho-physiological and yield variation due to salt stress on cowpea.

	Phenological												Morphological								
	DAS to Flower initiation				DAS to 50 % Flowering				DAS to Physiological maturity				Plant height (At harvest) (cm)				Number of branches (At harvest)			
Salt Con. Cowpea Genotypes	0 ds/m	4 ds/m	7 ds/m	Mean	0 ds/m	4 ds/m	7 ds/m	Mean	0 ds/m	4 ds/m	7 ds/m	Mean	0 ds/m	4 ds/m	7 ds/m	Mean	0 ds/m	4 ds/m	7 ds/m	Mean
PCP 1104	36.11	43.75	45.55	41.80	41.39	49.03	50.00	46.81	73.66	58.45	65.78	65.96	52.06	35.19	32.85	40.03	11.45	8.40	6.25	8.70
PCP 1106	36.33	47.02	49.30	44.22	42.32	52.70	55.07	50.03	71.94	58.00	65.32	65.09	54.72	37.01	35.00	42.24	12.70	8.95	7.25	9.63
PCP 1112	41.66	45.00	46.71	44.46	46.50	51.33	52.70	50.17	82.55	66.71	75.06	74.77	67.44	43.08	37.35	49.29	14.35	10.15	7.50	10.67
PCP 1118	37.85	44.65	46.60	43.03	43.58	49.78	53.00	48.78	75.71	61.55	67.66	68.31	58.29	41.52	34.60	44.80	11.15	7.40	5.65	8.07
PCP 1122	36.28	41.90	43.99	40.72	41.70	46.85	48.72	45.76	72.22	57.00	64.37	64.53	63.01	44.95	39.05	49.00	11.85	7.70	5.70	8.42
PCP 1123	35.88	44.35	47.49	42.57	42.45	50.84	52.55	48.61	68.50	56.25	62.59	62.45	57.23	47.83	41.61	48.89	9.70	5.75	4.30	6.58
PCP 1124	40.65	44.66	46.26	43.85	45.80	50.28	52.65	49.58	67.49	55.50	60.58	61.19	53.34	38.21	34.16	41.90	10.30	6.10	5.05	7.15
PCP 1131	38.65	45.00	47.29	43.64	44.12	48.84	50.86	47.94	76.50	61.95	68.90	69.12	76.88	56.94	48.68	60.83	13.85	10.30	7.50	10.55
P. Vithai	42.78	49.45	52.10	48.11	47.96	54.16	56.80	52.97	83.33	69.00	75.56	75.96	98.27	76.93	62.28	79.16	15.46	12.65	9.95	12.69
P. Rukmini	42.05	49.54	52.50	48.03	47.05	52.03	54.55	51.21	79.61	65.03	72.95	72.53	97.26	60.84	52.30	70.13	14.35	10.45	8.65	11.15
Mean	38.82	45.53	47.78	44.04	44.28	50.58	52.69	49.18	75.15	60.94	67.88	67.99	67.85	48.25	41.79	52.63	12.52	8.79	6.78	9.36
Source	SE+	CD at 1%			SE+	CD at 1%			SE+		CD at 1%		SE+	CD at 1%			SE+	CD at 1%		
Treat (T)	0.14	0.56			0.11	0.45			0.20		0.79		0.25	0.97			0.073	0.29		
Genotype (G)	0.126	0.43			0.09	0.35			0.15		0.62		0.19	0.75			0.054	0.22		
T x G	0.45	1.76			0.36	1.41			0.64		2.51		0.79	3.06			0.232	0.90		

quantity of Hoagland solution was used for germination test and seedling test for screening cowpea genotypes for salt stress.

Salinity induces water deficit even in well watered soils by decreasing the osmotic potential of soil solutes thus making it difficult for roots to extract water from their surrounding media (5). Frequently Na Cl is used to screen out the salt stress tolerant genotypes under laboratory conditions. NaCl salt solution is prepared at (-0.4 bar NaCl (5.31 g/l), -0.7 bar NaCl (9.29 g/l.)

Procedure :

(i) Healthy and equal sized seeds of genotypes were selected and sterilized with 1.0% sodium hypochlorite solution for 3min.

(ii) Ten seeds of each genotype were germinated in NaCl at 0, -0.4 and -0.7 bar osmotic potential.

(iii) Aqueous solutions of 0, -0.4 and -0.7 bar osmotic potential were obtained by dissolving 0, 5.31 and 9.2925 g of NaCl in 1 liter of nutrient solution, respectively.

(iv) Seeds are placed in two layers of What man No. 2 filter paper in 20 õ 40 mm glass petri dish and 25 ml of 0, -0.4 and -0.8 bar osmotic potential solutions were added.

(iv) Two replicates (Petri dishes) of each treatment were placed randomly in growth chamber for 2nd, 4th, 6th and 8th days at 25ºC ±2ºC temperature and 90% relative humidity.

(v) Recorded the germination when the radicle reached 3 mm in length. Physiological analysis for growth and yield variation :

Five hills with three seeds were sown in pots filled with clay + coco pit +coco bhusa (2:1:1) having zero nutrient value to study the effect of osmotic and salt stresses on morpho-physiological traits and yield variation. Pots were kept at natural condition upto initiation of floral buds. These pots were transferred in automated polyhouse after floral bud initiation and irrigated with nutrient solution (as control) NaCl solution with -0.4 bar (5.31 g/l) and -0.7 bar (9.29 g/l). These observations were recorded on time to time until physiological maturity.

Physiological analysis of growth and yield variation:

(A) Phenological :

(i) Days to flower initiation :

Table-1a : Morpho-physiological and yield variation due to salt stress on cowpea.

Salt Con. Cowpea Genotypes	Morphological: Number of leaves (At physiolo. maturity) 0 ds/m	4 ds/m	7 ds/m	Mean	Morphological: Leaf area (dm^2) 0 ds/m	4 ds/m	7 ds/m	Mean
PCP 1104	65.00	52.50	48.50	55.33	7.34	6.13	5.25	6.24
PCP 1106	61.00	50.00	46.50	52.50	6.62	6.00	4.95	5.86
PCP 1112	70.00	58.00	56.50	61.50	9.23	8.20	6.18	7.87
PCP 1118	63.50	53.00	45.00	53.83	9.04	7.75	6.30	7.70
PCP 1122	47.00	34.00	30.00	37.00	5.18	4.29	3.23	4.23
PCP 1123	36.50	25.00	19.00	26.83	4.37	3.22	2.49	3.36
PCP 1124	50.50	38.50	34.00	41.00	6.74	5.15	4.15	5.34
PCP 1131	74.00	62.00	57.00	64.33	10.27	9.22	8.29	9.26
P. Vithai	84.98	73.50	66.50	74.99	11.57	10.21	9.33	10.37
P. Rukmini	80.00	68.50	62.50	70.33	11.16	9.84	8.46	9.82
Mean	63.25	51.50	46.55	53.77	8.15	7.00	5.86	7.00
Source	SE+	CD at 1%			SE+	CD at 1%		
Treat (T)	0.14	0.56			0.11	0.45		
Genotype (G)	0.126	0.43			0.09	0.35		
T x G	0.45	1.76			0.36	1.41		

Salt Con. Cowpea Genotypes	Ionic content in leaves: K^+ content in leaves : (mmol/kg DW) 0 ds/m	4 ds/m	7 ds/m	Mean	Na^+ content in leaves : (mmol/kg DW) 0 ds/m	4 ds/m	7 ds/m	Mean	Cl^- content in leaves : (mmol/kg DW) 0 ds/m	4 ds/m	7 ds/m	Mean
PCP 1104	967.45	716.00	597.25	760.23	185.88	717.05	1085.35	662.76	117.84	2011.95	2394.30	1508.03
PCP 1106	1070.61	812.65	614.65	832.64	222.33	865.25	2135.31	1074.29	155.33	2245.68	2548.25	1649.75
PCP 1112	926.84	692.37	633.10	750.77	319.35	976.36	1758.62	1018.11	228.79	1943.43	2480.50	1550.90
PCP 1118	1018.05	818.36	587.35	807.92	326.06	778.41	1512.65	872.37	235.35	1791.55	2021.85	1349.58
PCP 1122	1182.60	818.48	736.74	912.61	316.53	818.48	1425.75	853.59	242.60	1886.85	2410.95	1513.47
PCP 1123	1195.75	893.83	583.58	891.05	327.48	893.83	1561.50	927.60	310.26	893.83	2519.40	1241.16
PCP 1124	943.79	717.49	666.70	775.99	326.35	816.75	1853.50	998.87	227.15	2356.85	2614.25	1732.75
PCP 1131	1286.76	786.00	712.36	928.37	298.32	616.39	1331.50	748.73	236.95	1526.50	1856.13	1206.53
P. Vithai	1188.07	755.80	547.96	830.61	214.10	538.30	959.75	570.72	224.65	814.05	1065.25	701.32
P. Rukmini	1128.75	838.66	566.41	844.60	216.15	494.60	818.05	509.60	214.25	865.15	1136.70	738.70
Mean	1090.87	784.96	624.61	833.48	275.25	751.54	1444.20	823.66	219.32	1633.58	2104.76	1319.22
Source	SE+		CD at 1%		SE+	CD at 1%			SE+	CD at 1%		
Treat (T)	0.20		0.79		0.25	0.97			0.073	0.29		
Genotype (G)	0.15		0.62		0.19	0.75			0.054	0.22		
T x G	0.64		2.51		0.79	3.06			0.232	0.90		

(ii) Days to 50% flowering

(iii) Days to physiological maturity

(B) Morphological :

(i) Plant height (At harvest) (cm)

(ii) Number of branches (At harvest)

(iii) Number of leaves (Before physiological maturity)

(iv) Leaf area

(C) Ionic content in leaves :

(i) K^+ (m moles/g DW)

(ii) Na^+ (m moles/g DW)

(iii) Cl^- (m moles/g DW)

(D) Stress tolerance indices :

(i) Relative Leaf Water Content (Kumar and Eltson-1992)

(ii) Chlorophyll Stability Index

(E) Physiological parameter :

(i) Rate of Photosynthesis

(ii) Rate of Transpiration

(iii) Stomatal conductance

(F) Dry matter studies :

(i) Study of dry matter and its distribution parts of plant at

(G) Yield contributing characters :

(i) No. of Pods/plant

(ii) No. of seeds/pod

(iii) No. of seeds

(iv) Harvest Index

Statistical analysis : The data were interpreted per the method suggested by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Cowpea (*Vigna unguiculata L.* Walp.) is well adapted on different environmental conditions and could be used as an alternative crop for salt affected soils (6). The mechanisms for salt tolerance are complex and depend upon anatomical and physiological changes occurring in the whole-plant rather than on a single cell.

Mechanism of Salinity Tolerance in Plants : Salt tolerance refers to the ability of plants to survive and maintain their growth under saline conditions

Table-1b : Morpho-physiological and yield variation due to salt stress on cowpea.

	Stress tolerance								Stress physiology											
	Relative leaf water content in leaves				Chlorophyll stability index				Rate of photosynthesis (mol of CO_2 m^{-2} s^{-1})				Rate of transpiration (mmol of H_2O m^{-2} s^{-1})				Stomatal conductance (mol H_2O m^{-2} s^{-1})			
Salt Con. Cowpea Genotypes	0 ds/m	4 ds/m	7 ds/m	Mean	0 ds/m	4 ds/m	7 ds/m	Mean	0 ds/m	4 ds/m	7 ds/m	Mean	0 ds/m	4 ds/m	7 ds/m	Mean	0 ds/m	4 ds/m	7 ds/m	Mean
PCP 1104	90.41	79.01	73.75	81.06	34.65	28.05	25.65	29.45	55.27	48.30	44.95	49.51	1.66	1.41	1.10	1.39	0.16	0.04	0.01	0.07
PCP 1106	91.52	81.93	76.85	83.43	33.10	26.30	21.65	27.02	58.91	49.57	46.75	51.74	1.65	1.21	0.97	1.28	0.14	0.04	0.01	0.06
PCP 1112	92.80	82.50	77.65	84.32	35.73	29.00	26.90	30.54	56.82	50.17	45.03	50.67	2.06	1.60	1.04	1.57	0.21	0.03	0.01	0.08
PCP 1118	90.32	80.00	75.12	81.81	32.95	26.60	22.67	27.41	49.99	44.69	42.85	45.84	1.84	1.32	0.84	1.33	0.08	0.04	0.01	0.04
PCP 1122	91.35	82.60	77.05	83.67	33.40	26.95	24.65	28.33	55.08	53.33	49.17	52.53	1.24	0.90	0.42	0.85	0.13	0.04	0.02	0.06
PCP 1123	89.80	78.25	69.39	79.15	32.90	25.80	22.35	27.02	57.06	52.89	48.90	52.95	1.17	0.82	0.35	0.78	0.09	0.05	0.03	0.06
PCP 1124	87.00	80.15	70.75	79.30	30.20	24.40	19.70	24.77	51.38	47.24	40.74	46.45	1.27	1.04	0.75	1.02	0.12	0.03	0.01	0.05
PCP 1131	93.15	83.40	79.60	85.38	35.70	29.36	24.95	30.00	47.27	45.12	42.00	44.80	2.20	1.70	1.23	1.71	0.15	0.03	0.01	0.06
P. Vithai	96.71	89.25	86.45	90.80	36.95	31.65	29.25	32.75	59.84	56.05	51.30	55.73	2.47	1.73	1.34	1.85	0.24	0.09	0.05	0.12
P.Rukmini	95.07	86.25	83.30	88.21	37.70	28.35	27.85	31.30	60.51	55.50	46.50	54.17	2.57	1.55	1.21	1.78	0.22	0.08	0.05	0.12
Mean	91.81	82.33	76.99	83.71	34.33	27.65	24.60	28.86	55.21	50.28	45.82	50.44	1.81	1.33	0.92	1.35	0.15	0.04	0.02	0.07
Source	SE+		CD at 1%		SE+		CD at 1%		SE+		CD at 1%		SE+		CD at 1%		SE+		CD at 1%	
Treat (T)	0.298		1.161		0.130		0.505		0.333		1.295		0.013		0.052		0.001		0.004	
Genotype (G)	0.222		0.906		0.096		0.394		0.248		1.010		0.010		0.041		0.0008		0.003	
T x G	0.944		3.674		0.411		1.599		1.053		4.097		0.043		0.167		0.003		0.014	

(7). It is a complex, quantitative, genetic character controlled by many genes. There is a continuous spectrum of plant tolerance to saline conditions ranging from glycophytes that are sensitive to salt, to halophytes which survive in very high concentrations of salt. In order to identify the salinity tolerance of plants, the most commonly used characters are yield, survival, vigour, leaf damage, plant height and biomass. Hence, the growth and yield are measured as determinants of salt stress.

Plants use several mechanisms to tolerate salinity; salt avoidance (Salt exclusion), tissue tolerance or ion accumulation, osmotic adjustment (8). In glycophytes such as beans salt tolerance is associated with Na^+ exclusion. However, in some salt-sensitive genotypes, salt tolerance is not always associated with Na+ exclusion. For example, while Na+ exclusion was a general characteristic of a number of salt-tolerant wheat lines, a salt sensitive line had much lower shoot Na+concentration than the more tolerant lines (9). Thus, tolerance to take up substantially high concentrations of ions as an adaptation to saline environments (10); however, some can sequester toxic ions not only in vacuoles but also in specialized organs such as salt glands and bladders (10).

Osmotic adjustment is regarded as an important adaptation of plants to salinity because it helps to maintain turgor and cell volume. Plants are able to tolerate salinity by reducing the cellular osmotic potential as a consequence of a net increase in inorganic and solute accumulation (11). Thus, a better salinity is not necessarily related with ability to exclude toxic ions.

Restriction of ions into roots or shoots is one of the most frequently reported differences between salt- tolerant and -sensitive varieties. It is well known that halophytes understanding of these mechanisms and processes would enhance our efforts to improve the salinity tolerance of crop genotypes.

The present study has been undertaken to compare the salinity stress adaptations in ten different Cowpea cultivars. In order to identify the Cowpea cultivars with a better performance even under saline conditions and providing a reference for breeding salt-tolerant Cowpea cultivars.Also to find out the effect of bio regulator and anti transparent growth and yield of these genotypes.

Table-1c : Morpho-physiological and yield variation due to salt stress on cowpea.

Salt Con. Cowpea Genotypes	Dry matter: Total dry matter (g) 0 ds/m	4 ds/m	7 ds/m	Mean	Yield contributing characters: No. of pods per plant 0 ds/m	4 ds/m	7 ds/m	Mean	No. of seeds per pod 0 ds/m	4 ds/m	7 ds/m	Mean	No. of seeds / plant 0 ds/m	4 ds/m	7 ds/m	Mean	Number of Seeds per plant 0 ds/m	4 ds/m	7 ds/m	Mean
PCP 1104	20.95	16.30	14.20	17.15	12.70	8.58	6.88	9.39	12.64	9.55	8.75	10.31	201.81	137.18	130.76	156.58	201.81	137.18	130.76	156.58
PCP 1106	22.60	17.50	14.70	18.27	12.23	7.39	6.35	8.65	15.18	11.85	9.67	12.23	215.56	143.63	135.25	164.81	215.56	143.63	135.25	164.81
PCP 1112	29.05	24.65	20.70	24.80	14.12	9.45	8.08	10.55	14.12	9.45	8.08	10.55	226.15	150.45	141.91	172.84	226.15	150.45	141.91	172.84
PCP 1118	25.15	19.00	14.25	19.47	14.46	8.81	7.00	10.09	16.26	11.37	9.64	12.42	196.82	123.25	111.50	143.86	196.82	123.25	111.50	143.86
PCP 1122	18.75	14.50	11.75	15.00	8.41	5.48	3.56	5.82	12.77	7.92	7.46	9.38	180.45	129.55	117.05	142.35	180.45	129.55	117.05	142.35
PCP 1123	19.30	14.40	11.45	15.05	6.46	4.54	2.00	4.33	16.81	12.27	10.65	13.24	109.84	77.46	68.65	85.32	109.84	77.46	68.65	85.32
PCP 1124	23.27	16.75	14.30	18.11	13.29	8.74	7.38	9.80	16.21	10.25	7.38	11.28	146.82	87.53	73.92	102.76	146.82	87.53	73.92	102.76
PCP 1131	29.95	22.80	17.90	23.55	15.13	10.40	8.29	11.27	14.23	10.40	8.29	10.97	178.29	105.67	96.00	126.65	178.29	105.67	96.00	126.65
P. Vithai	35.60	31.15	26.65	31.13	20.33	14.41	9.33	14.69	11.30	7.14	5.63	8.02	245.51	163.60	151.70	186.94	245.51	163.60	151.70	186.94
P. Rukmini	33.04	29.95	23.85	28.95	18.16	13.55	8.46	13.39	11.84	8.47	6.24	8.85	238.53	138.85	127.58	168.32	238.53	138.85	127.58	168.32
Mean	25.77	20.70	16.98	21.15	13.53	9.13	6.73	9.80	14.13	9.87	8.18	10.73	193.98	125.72	115.43	145.04	193.98	125.72	115.43	145.04
Source	SE+	CD at 1%			SE+	CD at 1%			SE+	CD at 1%			SE+	CD at 1%			SE+	CD at 1%		
Treat (T)	0.120	0.467			0.057	0.222			0.061	0.239			0.760	2.958			0.760	2.958		
Genotype(G)	0.089	0.364			0.042	0.173			0.045	0.187			0.566	2.307			0.566	2.307		
T x G	0.380	1.477			0.181	0.703			0.194	0.758			2.405	9.35			2.405	9.35		

In view of the above present investigation has undertaken to study "Morphological and physiological evaluation of cow pea genotypes under salt stress

The results were observed under study with interaction were statistically significant. Effect of salt stress on Phonology (Table-1) it was observed that there was delayed in days to flowering initiation (8-9 days) and 50% flowering (8-41 days) than normal but there was reduction in days to physiological maturity matures earlier due to stress (7-27 days). The genotypes *viz., Phule Vithai* (48.11 days) and *Phule Rukhmini* (48.03 days) required for flower initiation under stress condition similar results were reported by (12).

Effect of salt stress on Morphology (Table-1 and 1a) it was observed that there was reduction in plant height (26.06 cm), Number of branches per plant (5.74), Leaves per plant (16.7), and Lead area (2.29 dm^2) than normal The genotypes *viz., Phule Vithai* and *Phule Rukhmini* required were found promising under stress condition similar results were reported by (13).

Effect of salt stress on Ionic content in leaves (Table-1a) it was observed that there was a higher ion content K^+, Na^+ CL on roots of susceptible genotypes and lesser in promising genotypes Phule Vithai and Phule Rukhmini similar results were reported by (12).

Effect of salt stress on Physiology of plant the tolerant genotypes maintain higher relative water content under salt stress Phule Vithai (90.70%) and Phule Rukhmini (88.21%) the rate of photosynthesis, rate of transpiration, and stomatal conductance were decreases as salt stress increases (Table-1b) similar results were reported by (14).

Effect of salt stress on yield and yield contributing characters (Table-1c and d) it was observed that there was reduction in dry matter and its partitioning in different parts of plants, number pod branches, pods per plant, seed per pod and yield per plant (g) under normal than salt stress conditions similar results were reported by (15).

CONCLUSION

The present investigation observed that effect of salt stress concentrations on Morphophysiology, yield and yield contributing characters. The reduction Morphological and Physiological, yield and yield

Table-1d : Morpho-physiological and yield variation due to salt stress on cowpea.

	Yield contributing characters							
	Yield / plant (gms)				Harvest index (%)			
Salt Con. Cowpea Genotypes	0 ds/m	4 ds/m	7 ds/m	Mean	0 ds/m	4 ds/m	7 ds/m	Mean
PCP 1104	18.49	16.04	12.65	15.73	49.84	43.75	38.89	44.16
PCP 1106	19.64	16.60	12.75	16.33	51.35	49.35	44.09	48.26
PCP 1112	25.70	23.85	20.45	23.33	55.95	52.05	45.54	51.18
PCP 1118	18.68	15.64	14.35	16.22	37.85	35.50	30.49	34.61
PCP 1122	16.24	13.65	11.45	13.78	50.88	45.00	38.65	44.84
PCP 1123	9.54	7.31	5.30	7.38	36.06	33.50	27.50	32.35
PCP 1124	14.25	11.25	9.45	11.65	49.12	44.75	38.05	43.97
PCP 1131	23.36	21.00	18.65	21.00	55.59	53.71	46.03	51.77
P. Vithai	27.25	24.80	21.85	24.63	44.41	42.15	34.45	40.34
P. Rukmini	25.75	22.22	19.24	22.40	40.89	35.04	30.30	35.41
Mean	19.89	17.24	14.61	17.25	47.19	43.48	37.40	42.69
Source	SE+	CD at 1%			SE+	CD at 1%		
Treat (T)	0.081	0.315			0.204	0.793		
Genotype (G)	0.060	0.246			0.152	0.618		
T x G	0.256	0.999			0.645	2.508		

contribution characters were observed. The Cowpea genotypes Phule vithai and Phule rukhmini PCP-1123, PCP-1124, PCP-1122 were found promising due to salt exclusion mechanism. Suitable for Salt stress conditions.

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