



Effect of Saline Irrigation Water on Growth and Yield of Chickpea (*Cicer arietinum*L.) Varieties

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Abstract: A pot experiment was conducted at College of Agriculture, Junagadh to assess the effect of saline irrigation water on growth and yield of chickpea varieties during winter season of 2016-17. There were four levels of salinity viz., <math><2.0, 4.0, 6.0</math> and 8.0 dS m⁻¹ and five varieties namely GG-1, GJG 3, GG 5, GJG 6 and Dahod Yellow. The highest plant height (33.56 cm), no. of branches plant⁻¹ (7.18), no. of pod plant⁻¹ (31.31) and no. of seed pods⁻¹ (1.47), root shoot ratio (0.57) and seed yield (12.28 g plant⁻¹) and stalk yield (20.55 g plant⁻¹) were observed with variety GJG 6. Application of saline irrigation water having EC <math><2.0</math> dS m⁻¹ was superior than other treatments for seed yield (15.29 g plant⁻¹), stalk yield (20.50 g plant⁻¹), plant height (39.04 cm), no. of branches plant⁻¹ (7.92), no. of pod plant⁻¹ (38.74) and no. of seed pod⁻¹ (1.52). Interaction effect of varieties and salinity levels had larger influence on plant height, no. of pod plant⁻¹, seed yield and stalk yield in variety GJG 6 irrigated with irrigation water having EC <math><2</math> dS m⁻¹ barring plant height.

Keywords: Saline water, growth, chickpea

Introduction

Chickpea (*Cicer arietinum*L.) is a member of family *Fabaceae*, and widely cultivated in India covering an area of 8.35 million hectare (2015-16) with a production 7.17 million tonnes and productivity of 859 kg ha⁻¹. Madhya Pradesh, Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Uttar Pradesh, Gujarat and Chhattisgarh are the major chickpea producing states contributing more than 95 per cent to the total chickpea production. In Gujarat, it was grown in area of 0.12 million hectare (2015-16) with a production 0.15 million tons and productivity 1330 kg ha⁻¹.

Extensive area (12.18 lakh ha) of Gujarat is affected by salinity due to different reasons. Coastal Junagadh is one of the salinity affected areas mainly due to sea-water intrusion from last two-three decades. Salinity stress delays the onset, reduces the rate and increases the dispersion of germination events, resulting

in reduced plant growth and crop yield. An excess of soluble salts in the soil leads to osmotic stress, which results in specific ion toxicity and ionic imbalances and the consequences of these can be plant demise (Rout and Shaw 2001). Through present study, an attempt has been made to screen some of the chickpea varieties for salt tolerance.

Material and Methods

The experiment soil was silty clay, alkaline (pH 8.0) with EC 0.58 dS m⁻¹, and had CaCO₃ 31.05 % and CEC 36.2 cmol (p⁺) kg⁻¹. The soil was medium in available nitrogen (242 kg ha⁻¹), phosphorus (34.20 kg ha⁻¹) and iron (6.25 mg kg⁻¹), and high in available potassium (298 kg ha⁻¹), sulphur (23.50 mg kg), manganese (15.20 mg kg⁻¹) and copper (1.25 mg kg⁻¹) and low in available zinc (0.45 mg kg⁻¹) content. There were twenty treatments comprising of four levels of salinity viz., S₁ - <math><2</math> dS m⁻¹, S₂ - 4 dS m⁻¹, S₃ - 6 dS m⁻¹, S₄ -

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8 dS m⁻¹ and five varieties viz., V₁- GG-1, V₂- GJG-3, V₃- GG-5, V₄- GJG-6, V₅- Dahod Yellow replicated thrice in FCRD. Basal dose of N @ 20 kg ha⁻¹ and P₂O₅ @ 40 kg ha⁻¹ was applied through urea and DAP, respectively. Seeds were sown as per treatments and a week after germination five plants per but pot were maintained. The pots were irrigated with saline water as per treatments throughout the growing season. At harvest, plant height, number of branches per plant, number of pods per plant, number of seeds per pod, root: shoot ratio, seed yield and straw yield were recorded.

Results and Discussion

Effect on growth parameters

The different varieties had significant influence on plant height and number of branches per plant. Significantly higher plant height (33.56 cm) and number

of branches per plant (7.18) was recorded with GJG-6 and it was statistically at par with variety GG-1 (Table 1). The lowest plant height (26.40 cm) and number of branches per plant (5.99) were observed in Dahod Yellow. The plant height, number of branches per plant and root: shoot ratio decreased with increasing salinity. The highest plant height (39.04 cm), branches per plant (7.92) and root: shoot ratio (0.63) were recorded with salinity level S₁ and lowest plant height (20.21 cm), branches per plant (4.92) and root shoot ratio (0.45) were recorded at salinity level S₄. The highest plant height (42.95 cm) was in V₁ at S₁, which was statistically at par to that of V₄ (GJG-6) x S₁. (Table 2) The lowest plant height (19.79 cm) was observed in V₅ at S₄. Mahmoodzadeh (2008) reported a decrease in number of branches with increased salinity. High salinity inhibits the photosynthetic activity of the plant and thus the growth of branch on the individual plant.

Table 1. Effect of varieties and salinity on growth, yield and yield attributes

Treatments	Plant height (cm)	No. of branches plant ⁻¹	No. of pods plant ⁻¹	No. of seeds pod ⁻¹	Root : Shoot	Seed yield (g plant ⁻¹)	Stalk yield (g plant ⁻¹)
Variety (V)							
V ₁ :GG-1	33.04	6.21	28.55	1.44	0.53	11.88	17.67
V ₂ :GJG-3	28.88	6.25	25.75	1.45	0.54	11.42	15.03
V ₃ : GG-5	31.16	6.19	26.45	1.44	0.55	11.06	15.11
V ₄ : GJG-6	33.56	7.18	31.31	1.47	0.57	12.28	20.55
V ₅ : Dahod Yellow	26.40	5.99	22.30	1.41	0.54	9.31	13.99
S.Em. ±	0.62	0.15	0.73	0.01	0.01	0.24	0.39
C.D. (P=0.05)	1.77	0.42	2.09	NS	NS	0.69	1.11
Salinity (S)							
S ₁ : < 2.0 dS m ⁻¹	39.04	7.92	38.74	1.52	0.63	15.29	20.50
S ₂ : 4.0 dS m ⁻¹	34.98	6.82	30.61	1.48	0.59	12.99	18.54
S ₃ : 6.0 dS m ⁻¹	28.21	5.80	23.85	1.42	0.51	9.85	14.74
S ₄ : 8.0 dS m ⁻¹	20.21	4.92	14.29	1.35	0.45	6.63	12.10
S.Em. ±	0.55	0.13	0.65	0.01	0.01	0.21	0.35
C.D. (P=0.05)	1.59	0.37	1.87	0.04	0.02	0.61	1.00
V x S Interaction							
S.Em. ±	1.24	0.29	1.46	0.03	0.02	0.48	0.78
C.D. (P=0.05)	3.54	NS	4.18	NS	NS	1.37	2.23
C.V.%	7.02	7.98	9.43	3.46	6.09	7.44	8.20

Table 2. Interaction effect of varieties and salinity on plant height of chickpea

Treatments	Plant height (cm)				Mean
	S ₁ : < 2.0 dS m ⁻¹	S ₂ : 4.0 dS m ⁻¹	S ₃ : 6.0 dS m ⁻¹	S ₄ : 8.0 dS m ⁻¹	
V ₁ :GG-1	42.95	38.74	29.97	20.50	33.04
V ₂ :GJG-3	37.25	33.16	25.06	20.06	28.88
V ₃ : GG-5	38.30	36.41	29.85	20.10	31.16
V ₄ : GJG-6	41.54	38.64	33.44	20.60	33.56
V ₅ : Dahod Yellow	35.14	27.92	22.74	19.79	26.40
Mean	39.04	34.98	28.21	20.21	
S.Em. ±	1.24		C.D. (P=0.05)	3.54	

Effect on yield attributes

Number of pods per plant was affected by different varieties of chickpea but it was significant for number of seed per pod (Table 3). The significantly higher number of pods per plant (31.31) was recorded with variety V₄ and lower value (22.30) was associated with V₅. Application of saline water significantly influenced the number of pod per plant and number of seed per pod. The higher number of pods per plant (38.74) and number of seed per pod (1.52) was observed

with the application of irrigation water having EC <2.0 dS m⁻¹ (S₁), whereas the lowest number of seed per pod (14.29) and seed per pod (1.35) was recorded at 8.0 dS m⁻¹. The interaction effect of varieties and salinity levels was found significant for number of pods per plant. The highest number of pods per plant (45.49) was observed in variety V₄ at <2.0 dS m⁻¹. The lowest number of pods per plant (11.50) was recorded in V₅ at 8.0 dS m⁻¹. Reduction in crop yield as a result of salt stress has been also been reported by Sohrabi *et al.* (2008) in chickpea.

Table 3. Interaction effect of varieties and salinity on no. of pods per plant

Treatments	No. of pod plant ⁻¹				Mean
	S ₁ : < 2.0 dS m ⁻¹	S ₂ : 4.0 dS m ⁻¹	S ₃ : 6.0 dS m ⁻¹	S ₄ : 8.0 dS m ⁻¹	
V ₁ :GG-1	41.01	29.20	27.45	16.53	28.55
V ₂ :GJG-3	34.93	29.54	23.55	15.00	25.75
V ₃ : GG-5	37.45	31.35	22.59	14.40	26.45
V ₄ : GJG-6	45.49	37.64	28.09	14.04	31.31
V ₅ : Dahod Yellow	34.81	25.35	17.55	11.50	22.30
Mean	38.74	30.61	23.85	14.29	
S.Em. ±	1.46		C.D. (P=0.05)		

Table 4. Interaction effect of varieties and salinity on seed yield

Treatments	Seed yield (g plant ⁻¹)				Mean
	S ₁ : < 2.0 dS m ⁻¹	S ₂ : 4.0 dS m ⁻¹	S ₃ : 6.0 dS m ⁻¹	S ₄ : 8.0 dS m ⁻¹	
V ₁ :GG-1	15.75	13.35	10.70	7.74	11.88
V ₂ :GJG-3	15.43	13.10	10.48	6.68	11.42
V ₃ : GG-5	15.15	12.64	9.92	6.52	11.06
V ₄ : GJG-6	15.91	13.58	11.41	8.23	12.28
V ₅ : Dahod Yellow	14.23	12.29	6.74	3.97	9.31
Mean	15.29	12.99	9.85	6.63	
S.Em. ±	0.48		C.D. (P=0.05)	1.37	

Effect on seed and straw yield

Significantly higher value of seed (12.28 g plant⁻¹) and stalk (20.55 g plant⁻¹) yields were registered with variety V₄ (GJG 6), and it was statistically at par with variety GG-1 of (11.88 g plant⁻¹) for seed yield. The seed and stalk yields decreased with increase in salinity. Significantly higher seed (15.29 g plant⁻¹) and stalk (20.50 g plant⁻¹) yield was recorded at <2.0 dS m⁻¹ while lowest seed yield was recorded at S₄ salinity level. The

highest seed (15.91 g plant⁻¹) and stalk (23.72 g plant⁻¹) yield was observed in variety V₄ at S₁ (<2.0 dS m⁻¹) and it was at par with variety V₁, V₂, V₃ at S₁ (<2.0 dS m⁻¹) for seed yield. (Table 4 & 5) The lowest seed (3.97 g plant⁻¹) and stalk (8.62 g plant⁻¹) yields were observed in V₅ at 8.0 dS m⁻¹ might be due to accumulation of salts in root zone causing water deficit and the disruption of ion homeostasis (Munns 2002).

Table 5. Interaction effect of varieties and salinity on and straw yield

Treatments	Straw yield (g plant ⁻¹)				Mean
	S ₁ : < 2.0 dS m ⁻¹	S ₂ : 4.0 dS m ⁻¹	S ₃ : 6.0 dS m ⁻¹	S ₄ : 8.0 dS m ⁻¹	
V ₁ :GG-1	21.86	19.87	16.53	12.43	17.67
V ₂ :GJG-3	19.02	16.20	12.84	12.07	15.03
V ₃ : GG-5	18.68	16.63	14.60	10.53	15.11
V ₄ : GJG-6	23.72	22.14	19.49	16.84	20.55
V ₅ : Dahod Yellow	19.21	17.89	10.25	8.62	13.99
Mean	20.50	18.54	14.74	12.10	
S.Em. ±		0.78			C.D. (P=0.05)

Conclusion

It may be concluded that the chickpea variety GJG-6 produced significantly higher yield (seed and straw), growth parameters (plant height and number of branches per plant) yield attributing characters (no. of pod per plant and number of seeds per pod) at salinity levels <2 dS m⁻¹ showing tolerance to salinity. Tolerance sequence of chickpea varieties were GJG 6 > GG 1 > GJG 3 > GG 5 > Dahod yellow against salinity.

References

- Mahmoodzadeh, H. (2008). Comparative study of tolerant and sensitive cultivars of *Brassica napus* L. in response to salt conditions. *Asian Journal Plant Science* **39**, 1-5.
- Munns, R. (2002). Comparative physiology of salt and water stress. *Plant, Cell and Environment* **25**, 239–250.
- Rout, N.P., and Shaw, B.P. (2001). Salt tolerance in aquatic macrophytes: Ionic relation and interaction. *Biologiaplantatum* **44**, 95-99.
- Sohrabi, Y., Heidari, G., and Esmailpoor, B. (2008). Effect of salinity on growth and yield of deshi and kabuli chick pea cultivars. *Pakistan Journal of Biological* **11**, 664-667