

Genetic Variability in Kharchia Wheat (*Triticum aestivum*) from Salt Affected Areas in Rajasthan

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Abstract Kharchia wheat (*Triticum aestivum*) collections revealed significant variation for all the eight attributes including grain yield and four indexes, both under normal and saline conditions. Salt stress had maximum effect on number of grains spikelet⁻¹ due to high abortion in central florets. Three distinct mechanisms of salt tolerance were identified. Collections with high yield potential could be grouped in types with high susceptibility for spikelet index and those having poor grains/spikelet index. Third group included entries with low yield potential but performance at par under salinity due to internal cancellation in component performance. Suggestions for their utility in salt stress breeding were made.

Key words Genetic variability, Kharchia wheat, Salinity

High temperature stress and widespread salinity in western Rajasthan put high yielding semidwarf varieties at a disadvantage. Consequently, in spite of high susceptibility to fungal diseases, indigenous wheats, locally known as Kharchia in salt affected areas and Mithwania under normal conditions are still predominant in this region. These red grained, awned, weak stem types with distinct light coloured leaves and long coleoptile are highly non synchronous in flowering and prone to lodging. Their main advantage had been high tolerance to stresses resulting in satisfactory grain yield under low management.

Looking to extremely location specific edaphic stresses, evolution of unique strategies for individual situations were expected in local types. An attempt was, therefore, made to collect and evaluate these types so as to quantify the variability under normal as well as salt stress conditions.

Materials and Methods

Out of 136 variable types collected from wheat growing areas of Jodhpur and Jalore districts, 24 types were selected for detailed investigation. These types along with semidwarf check variety

Table 1 Important characteristics of soil and water of experimental area

	Bilara		Mandore	
	Soil	Water	Soil	Water
pH	8.6	7.5	8.0	7.5
EC (dS m ⁻¹)	11.0	11.0	0.6	1.6
Ca + Mg [(C mol(p ⁺)L ⁻¹)]	20.0	22.5	3.9	8.4
Na + K [(C mol(p ⁺)L ⁻¹)]	90.0	84.3	2.3	7.3
CO ₃ + HCO ₃ [(C mol(p ⁺)L ⁻¹)]	2.2	4.5	3.1	6.2
Cl [(C mol(p ⁺)L ⁻¹)]	100.0	90.0	2.0	5.3
SO ₄ [(C mol(p ⁺)L ⁻¹)]	9.6	12.0	1.2	4.1
Texture	Sandy loam	—	Sandy loam	—

Kalyansona were planted in randomized block design with 4 replications both under saline and normal conditions. Chemical characteristics of surface soil and irrigation water used has been given in Table 1.

Experimental plots comprising of 5m long six rows spaced 23 cm apart were sown using commercial seed rate. Drill sowing was preferred to avoid confounding of inter/intra plant competition effects. Due care was taken to harvest 15 single competitive plants from inner rows of each plot for recording detailed observations. Four indexes used in the present study were as under:

$$\text{Tiller index} = \frac{\text{Number of spikes bearing tillers} \times 100}{\text{Total tillers plant}^{-1}}$$

$$\text{Spike index} = \frac{\text{Grain yield in main spike} \times 100}{\text{Grain yield plant}^{-1}}$$

$$\text{Spikelet index} = \frac{\text{Number of spikelets plant}^{-1} \times 100}{\text{Number of spikelets on main spike} \times \text{number of spikes plant}^{-1}}$$

Grain/spikelet-index

$$= \frac{\text{Average number of grains spikelet}^{-1} \text{ plant}^{-1} \times 100}{\text{Number of grain spikelet on main spike}}$$

Results and Discussion

Highly significant differences for all the eight attributes including grain yield and four indexes studied revealed wide variation amongst local wheat types both under normal as well as salt stress (Table 2). Maximum variation under normal conditions was recorded for number of grain spikelet⁻¹ (19.1 % GCV) followed by spike index (14.9%), grain spikelet index (13.5%) and grain yield (12.3%) (Table 3). Salt stress was most detrimental in expression of number of grains spikelet⁻¹ as evident from the genetic coefficient of variation (7.28 %). Abortion of central florets in saline environment was more pronounced in high potential types. Salt stress did effect mean performance for other attributes. However, nearly similar values for genetic coefficient of variation revealed varying susceptibility of local types for rest of the attributes. Secondly, least variability for plant height and spike length in both the environments indicated their limited contribution in stress management.

As regards mean values, local collections produced more tillers and spikes than the semi-dwarf check Kalyansona, more so under saline conditions (Table 3). Mean and range for tiller index

Table 2 ANOVA for grain yield and other attributes in *Kharchia* collections

Attributes	Mandore (Normal)		Bilara (Normal)	
	Tr.M.S.	EMS	Tr.M.S	EMS
Days to flower (Days)	250.51	25.23	257.84	28.53
Plant height (cm)	102.42	40.63	156.35	46.81
Spike length (cm)	1.18	0.34	1.62	0.34
Number of spike bearing tillers	0.30	0.03	0.30	0.05
Number of spikelets spike ⁻¹	8.08	1.93	7.01	2.28
Number of grains Spikelet ⁻¹	0.99	0.43	0.16	0.04
1000 grain weight (g)	82.54	3.17	97.67	2.53
Grain yield	0.69	0.06	0.45	0.05
Spike index	306.04	21.09	318.63	22.49
Tiller index	307.43	58.26	230.52	68.74
Spikelet index	116.14	39.69	165.51	67.48
Grain/spikelet index	664.32	45.94	835.18	65.26

Table 3 Mean, range and genetic coefficient of variation (GCV) in *Kharchia* wheat.

Attributes	Mandore (Normal)			Bilara (Saline)		
	Mean	Range	GCV	Mean	Range	GCV
Days to flower	89.74 ± 3.55	82.6 -93.2	8.36	92.08 ±3.78	84.7 -97.7	822
Plant height (cm)	109.94 ± 4.51	103.4 - 122.6	3.57	112.38 ±4.85	104.8 -125.3	4.66
Spike length (cm)	9.78 ± 0.41	8.9 -10.8	4.69	9.28 ±0.40	8.3 -11.0	5.78
Number of spike bearing tillers	2.38 ± 0.12	1.9 - 2.9	10.90	2.76 ±0.16	2.4 -3.1	9.03
Number of spikelets per spike ⁻¹	19.32 ± 0.98	15.6 - 21.5	6.42	19.35 ±1.06	16.9 21.4	4.18
Number of grains Spikelet ⁻¹	2.55 ± 0.16	2.13 - 2.79	19.08	2.35 ±0.14	2.09 2.58	7.28
1000 grain weight (g)	36.26 ± 1.26	29.08 - 46.12	12.28	35.46 ±1.33	28.42 -44.83	13.68
Grain yield plant ⁻¹ (g)	3.22 ± 0.18	2.66 - 3.99	12.29	2.63 0.15	2.01 -3.36	12.09
Tiller index	81.17 ± 5.39	70.8 - 90.2	9.72	80.58 ±5.86	69.8 -91.3	7.89
Spike index	56.75 ± 3.24	41.9 - 71.1	14.87	62.40 ±3.35	41.2 -79.3	13.79
Spikelet index	82.91 ± 4.45	70.7 - 91.3	6.78	73.36 ±5.81	62.2 -85.7	6.75
Grains spikelet ⁻¹ index	91.64 ± 4.79	79.4 -96.5	13.56	81.56 ±5.71	68.6 -95.6	17.04

depicted wasteful production of nearly 1/5th tillers in local types. In comparison, though Kalyansona, was shy tillering, its tiller index was 95.6 and 93.5% in normal and saline conditions. Rest of the indexes revealed non synchrony in spike development, later spikes usually having lesser spikelets spike⁻¹ that too with higher abortion rate leading to higher contribution of main spike. Secondly the said non synchrony was more pronounced under saline stress.

Under salt stress, seven local strains out yielded the check variety, though none was significantly superior than kalyansona in grain yield potential. The difference could be attributed to severe reduction in productivity of Kalyansona (34.6%) while mean decrease in local types was 18.3%, many being statistically at par in two environments. Kingsbury and Epstein (1984) also

reported high salt tolerance of two *Kharchia* accessions. Rana (1986 a,b) tested nearly 400 *Kharchia*-Rata collections under three levels of alkalinity and found many local collections with high level of salt tolerance. Outstanding collections gave nearly eight fold increase over the standard check HD 2009.

In recent years, it has become evident that different species and sub species groups have developed polymorphism for adaptation to saline and other problem soils (Christiansen & Lewis 1982, San 1982, Staples 1984, Shannon 1985). However mechanisms imparting resistances to salinity and other soil stresses are yet to be properly understood and reliable markers need to be made available (Rana 1986a). Assuming that yield performance of a genotype under salinity is a reflection of both, its response to stress and poten-

Table 4 Comparative performance of selected *Kharchia* collections under normal and saline condition

Cultures	Grain yield plant ⁻¹ (g)		Per cent increase (+) decrease (-) under saline stress over normal					
	Normal	Saline	Grain yield	Number of spikes	Number of grains spikelet ⁻¹	Spikelet index	Grain Spikelet ⁻¹ index	Spike index
S203	3.93	3.36	-14.5	+26.1	-19.9	+19.9	+0.1	-0.6
S186	3.87	2.91	-24.8	0.0	-14.9	-14.2	-10.5	+17.6
S175	3.89	2.66	-31.6	+6.9	-8.0	-17.4	-18.5	+36.6
S157	3.11	3.02	-2.9	+7.4	-4.8	-3.4	-12.1	+10.9
S187	3.26	3.00	-8.0	+16.0	-6.1	-5.2	-14.5	+18.6
S183	3.16	2.17	-31.3	+4.2	-8.7	-7.8	-14.4	+19.1
S215	2.89	3.10	+7.3	+14.0	-0.8	-0.4	+3.7	-15.3
S210	2.73	2.86	+4.8	+25.0	-3.0	-4.4	-7.8	-6.2
Kalyansona	3.79	2.48	-34.6	0.0	-15.4	-6.4	-12.3	+20.8
Grand Mean	3.22	2.63	-18.3	+16.0	-7.8	-11.5	-10.8	+10.1

tial yield level, high yielding local collections were examined for identification of salinity adaptive traits predictive of salt response. First group included collections S 203, S 186 and S 175 where grain yield reduction under salt stress was due to high reduction in spikelet index (14.2-19.9%) and high abortion in central florets of main spike (8.0-14.4%). Within group variation could be explained on the basis of grains spikelet⁻¹ index (Table 4). In second group (S 157, S 187 and S 183) reduction in grains spikelet⁻¹ was predominant (12.1-14.5%) while other two indexes explained within group variation. Third group of entries (S 210 and S 215) had low yield potential but no reduction in grain yield under stress. Limited variation in component indexes appeared counter balanced by increased spike number.

Multiple cross approach using group crosses between promising local types as well as donors for lodging and disease resistance followed by weighted selection for indexes under varying levels of stress could perhaps be considered quite effective for identification of elite materials. Unavoidable heterogeneity for salt stress under field conditions makes it necessary to screen germplasm

as well as segregating material at different stress levels for combining high yield potential and plasticity in stress tolerance.

References

- Christiansen MN & Lewis CF 1982 *Breeding Plants For Less Favourable Environments*. John Wiley, New York.
- Kingsbury RW & Epstein E 1984 Selection for salt resistant spring wheat. *Crop Science* **24** 310-315
- Rana RS 1986a Breeding crop varieties for salt affected soil. (In *Breeding For Stress Resistance in Crop Plants*. Ed VL Chopra) Oxford and IBH, New Delhi 24-55
- Rana RS 1986b Evaluation and utilization of traditionally grown cereal cultivars of salt affected areas in India. *Indian Journal of Genetics* **46** 121-135
- San Pietro A 1982 *Bio Saline Research: A Look To The Future*. Plenum Press, New York
- Shannon MC 1985 Principles and strategies in breeding for higher salt tolerance. *Plant and Soil* **89** 227-241
- Staples RC & Toenniessen GH 1984 *Salinity Tolerance In Plants. Strategies For Crop Improvement*. John Wiley, New York