SHORT COMMUNICATION

SCREENING OF CASTOR GERMPLASM ACCESSIONS FOR DROUGHT TOLERANCE

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An experiment was conducted to idendify germplasm lines for drought tolerance among one hundred extra early and early maturing lines sown during late *rabi*. Drought was imposed at 25 DAS and released at 85 DAS. After relieving stress, secondary and teriary branches production increased in stressed plants. Germplasm lines that maintained growth in terms of plant height, branches production and stem girth as that of control plants even under stress were RG 17, RG 18, RG 22, RG 25, RG 43, RG 52, RG 68, RG 72, and RG 90. The lines that showed less than 30% yield reduction due to stress and with low drought susceptibility index were RG 72 (11%), RG 17 (22%) and RG 52 (27%)

Key words: **Castor, drought susceptibility index, germplasm**

Drought is the most important and most intractable of the abiotic stresses. As the water crisis deepens, the yield reductions due to drought stress are already serious, and they will increase. Irrigation will cease to be a practical solution as water becomes scarcer. While growers have adopted management practices to gain improved yields under water-limited environments, breeders can assist in providing more drought tolerant cultivars. Traditional breeding has seen a steady increase in yields of dry land crops which suggest that targeted breeding programmes can help to provide cultivars with significantly improved drought tolerance. Variation in drought resistance among and within species has been reported in the literature. The black box approach, i.e., testing of performance of genotypes under stress situation is a very useful step in breeding programmes mainly because it allows a direct estimate of drought resistance or susceptibility of individual genotypes. In the last two decades, phenomenal progress has been made in assessing the stress responses of the plants (Mekersie and Lestem 1994). Yield under stress is often used as a preliminary criterion that can be applied to thousands of accessions, with more discriminating tests being applied subsequently to identify accessions with different mechanisms of tolerance.

Castor, a crop tolerant to water deficits is frequently grown in marginal and sub-marginal shallow soils under rainfed conditions with low inputs. Only in Gujarat and southern parts of Rajasthan, it is cultivated with irrigation. Due to erratic rainfall distribution there is wide variation in productivity between irrigated and rainfed crops. As it was considered drought tolerant, no attempts were made so far to identify genotypes that fare well under rainfed conditions. Developement of varieties and hybrids, which perform well under limited moisture conditions, is essential. Hence, an experiment was conducted with an objective to identify germplasm lines tolerant to drought.

One hundred extra early and early maturing germplasm line were sown during late rabi (November), 1999 for screening against drought. Water stress was imposed after the establishment of the crop i.e. 25 days after sowing (DAS) and continued for 60 days and then relieved at 85 DAS. Control plants were irrigated as and when required. Some of the lines died due to severe wilt infestation. Observations on plant height, number of nodes, stem girth, and number of branches were recorded before relieving stress and 20 days after relieving stress. Yield and yield components were recorded at maturity. Drought

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susceptibility index (DSI) values were calculated based on the formula given by Fisher and Maurer (1978).

Among the 100 extra early and early maturing germplasm lines studied, 24 lines survived during drought and maintained >70% population till harvest. These were RG 17, RG 18, RG 22, RG 25, RG 27, RG33, RG43, RG44, RG45, RG46, RG47, RG52, RG68, RG72, RG74, RG87, RG88, RG90, RG108, RG109, RG112, RG113, RG128 and RG152. Plant growth in terms of height, number of nodes, stem girth, branches production was more in control plants. Production of secondary and tertiary branches increased after relieving stress. The percent reduction in stress compared to control was not significant before and after relieving stress with regard to plant height, number of nodes and stem girth. But secondary and tertiary branch number increased after relieving stress (Table 1). Similar response in groundnut var. florigian was seen for lateral branches with supplementary moisture (Gorbet and Rhoads 1975). Germplasm lines that maintained growth at par with control during stress and/or after relieving stress were RG 17, RG 18, RG 22, RG 25, RG 43, RG 52, RG 68, RG 72, and RG 90 (Table 2). In these lines, secondary and tertiary branch number increased after relieving stress in both control and stress treatments.

Table 1. Growth of germplasm before and after relieving stress

S.No.	character	Before relieving stress			After relieving stress		
		control	stress	% reduction in stress	control	stress	% reduction in stress
1.	Plant height (cm)	45.6	29.8	35	66.5	34.3	48
2.	Number of nodes	10	9	10	11	11	9
3.	Stem girth (cm)	4.7	3.2	32	5.7	3.9	32
4.	Secondary Branches plant^{-1}	3	1	67	3	2	33
5.	Tertiary branches plant^{-1}	1	0	100	2	1	50

Table 2. Growth of germplasm lines similar to control during and after relieving stress

Line no	Sec br		Tert br		Plant ht (cm)		Node no		Stem girth (Cm)	
	BRS*	ARS	BRS	ARS	BRS	ARS	BRS	ARS	BRS	ARS
RG17C*	2	3	-	3	18.3	24.0	7	8	3.7	5.7
S	2	3	-	2	28.0	29.0	6	8	3.7	3.7
RG18 C	1	3	-	2	22.7	25.0	7	8	3.7	4.0
S	2	2	1	2	27.2	28.3	3	5	3.0	3.0
RG22 C	2	3	1	2	16.7	23.7	5	5	3.3	6.0
S	2	2	-	-	22.7	23.3	8	8	3.0	3.7
RG25 C	2	2	2	3	15.0	19.7	6	8	3.7	4.0
S	1	3	-	1	17.3	17.7	7	7	2.7	3.0
RG43 C	3	3	2	3	22.0	22.3	7	7	4.0	6.0
S	2	2	1	2	20.3	20.7	6	7	3.7	4.0
RG52 C	-	2	-	1	97.7	99.3	17	18	5.7	6.3
S	-	1	-	-	26.3	43.6	12	18	3.7	4.0
RG68 C	2	2	1	1	40.0	42.3	10	12	4.7	5.7
S	-	2	-	1	23.7	28.0	9	9	3.0	3.7
RG72 C*	2	3	1	2	27.3	30.7	8	12	4.7	5.7
S	2	2	-	-	27.0	30.3	7	9	3.0	3.7
RG90 C	2	2	2	3	36.7	42.0	8	8	4.7	4.7
S	2	3	-	3	26.7	34.7	7	7	2.7	4.7

*C- control, S-stress *BRS- before relieving stress, ARS-after relieving stress

Yield and yield components of differnet spike order were more in control plants (Table 3). Growth of primary spike was affected due to stress. Spike length, capsule number, capsule weight, and seed weight showed 40 to 54 per cent reduction with stress. But after relieving stress, growth was recovered and secondary spikes compensated for severe yield loss in primary spike, which is shown by less per cent reduction in spike characters in stress treatment (21 to 30%). On the whole, there was 42.3 per cent yield reduction due to stress though the plants survived stress. Ravishanker *et al.* (1991) also reported reduced seed yield and TDM with early stress from 41-71 days in sunflower. Lines with <30 per cent reduction under stress are RG17, RG43, RG52, RG72 & RG113 (Table 4). Among these RG17, RG52 and RG72 also showed low DSI. The genotypes with low/moderate DSI (<0.7) were considered least drought susceptible in wheat also (Chaowdhury *et al.*, 1988). Lines RG 27 and RG 45 are highly susceptible to drought which showed >70 per cent decrease under stress.

Thus, the lines surviving drought maintained >70 per cent population, produced more number of branches. The lines that were highly tolerant to stress with <30 per cent yield reduction and with low DSI are RG17, RG52 and RG72.

Table 3. Yield and yield components

S.No.	character	control	stress	% reduction in stress
	Primary spike			
1	Spike length (cm)	25.4	14.8	45.4
2	Capsule number plant^{-1}	22	13	40.9
3	Capsule weight (g. plant^{-1})	20.1	10.7	46.8
4	Seed weight (g. plant^{-1})	12.7	5.9	53.5
	Secondary spike			
1	Spike length (cm)	17.4	13.6	21.8
2	Capsule number plant^{-1}	15.6	11.9	23.7
3	Capsule weight (g. plant^{-1})	30.3	21.6	28.7
4	Seed weight (g. plant^{-1})	20.4	14.2	30.4
	Total seed weight (g. plant^{-1})	35.7	20.6	42.3

Table 4. Seed yield of lines surviving drought

S.No.	Germplasm line	Total seed yield (g plant^{-1}) control	stress	% decrease in yield in stress	Drought susceptibility index (DSI)
1	RG17	14.2	12.5	13.6	0.286
2	RG18	8.7	5.5	58.2	0.878
3	RG22	19.8	9.2	53.5	1.277
4	RG25	15.4	9.3	39.6	0.945
5	RG27	47.5	13.8	70.9	1.692
6	RG33	47.7	22.7	52.4	1.251
7	RG43	19.2	13.6	29.2	0.697
8	RG44	24.2	14.1	41.7	0.995
9	RG45	31.0	8.0	74.2	1.771
10	RG46	34.5	20.2	41.4	0.988
11	RG47	48.8	20.5	58.0	1.384
12	RG52	18.5	14.9	19.5	0.465
13	RG68	50.6	26.9	46.8	0.117
14	RG72	30.2	26.0	13.9	0.332
15	RG74	51.7	36.2	30.0	0.716
16	RG87	67.7	42.5	37.2	0.888
17	RG88	42.5	20.4	52.0	1.241
18	RG90	38.0	21.1	44.5	1.062
19	RG108	49.0	30.3	38.2	0.912
20	RG109	40.3	25.2	37.5	0.895
21	RG112	31.0	14.7	52.6	1.255
22	RG113	29.7	23.1	22.2	0.530
23	RG128	39.7	27.4	31.0	0.740
24	RG152	55.0	37.0	32.7	0.780

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