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Short Communication

Selection criteria for drought tolerance in Indian mustard [*Brassica juncea* (L.) Czern & Coss]

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In India, rapeseed and mustard [*Brassica juncea* (L.) Czern & Coss] is grown as a rainfed crop on conserved moisture received from monsoon rains in 37 percent of the total area under the crop. Depending on planting time and winter rains, the crop is exposed to drought stress at one or more phonological stages [1]. This calls for screening and development of drought tolerant genotypes. Because yield and drought tolerance are controlled at separate loci [2&3], breeding for drought tolerance involves identification and transfer of morpho-physio- and biochemical traits that may impart drought tolerance to high-yielding cultivars. Available literature, however, suggest that only limited work has hitherto been done for identification and screening of such traits and genotypes, respectively for drought tolerance in Indian mustard. The present investigation was thus undertaken to generate information on drought tolerance in this crop.

The experimental material consisted of twenty-one genotypes of Indian mustard obtained from National Research Centre for Rapeseed and Mustard (NRCRM), Bharatpur. The same twenty-one genotypes were grown following randomized complete block design (RCBD) with three replications in contiguous fields under both normal and drought conditions at the Research Farm of SKN College of Agriculture, Jobner, during winter season of 2001-2002. The plot size for each treatment in each block was kept at 3.0×1.5 m^2 to accommodate five rows. Only basal fertilizer dose @ 30kg N and 20kg P_2O_5 per ha was applied in both the fields (with no K_2O). Pre-sowing irrigation was provided to both the fields. The trial treated as the control was irrigated three times additionally at the interval of 30 days after sowing. It is worth-mentioning that 10.0 mm rainfall occurred at the terminal grain-filling period (100 days after sowing or 20 days before harvest). Observations for days to flowering (50%), maturity period and reproductive period [(maturity period - days to flowering (50%)] were recorded on per plot basis. For the remaining eleven traits, data were taken on randomly selected five competitive plants and then were averaged. The relative drought tolerance of genotypes was quantified with respect to seed yield through drought susceptibility index (DSI) according to Fischer and Maurer [4].

The analysis of variance showed that the genotypes differed significantly for all the traits in both the environments (normal and drought conditions). Significant genotype - environment (irrigated / rainfed) inter-actions were also observed (data not presented). The overall average performance of genotypes under drought condition was higher for days to flowering (50%), primary branches/plant and protein content. Observed facts also suggest that stress tends to delay flowering; thus it increased days to flowering. It is an established fact that plant species tend to combat drought condition through increased protein synthesis. This led to increased mean protein content under drought condition compared to normal one. Ali and coworkers [5] also reported that drought stress had increased protein content in *Brassica* spp. Oil content of genotypes remained at par with that under normal condition. For all other traits such as maturity period, plant height, seeds/siliqua, siliquae/plant, siliqua length, seed yield/plant, reproductive period [(maturity period - days to flowering (50%)], harvest index, test weight and aphid infestation, the mean performance of genotypes was comparatively high under normal condition. Drought appeared to have reduced the overall mean performance of these traits by 9.4, 15.7, 11.5, 15.4, 7.1, 18.7, 17.6, 10.1, 13.0 and 39.2 per cents, respectively. It is interesting to note that aphid infestation under drought condition reduced substantially.

Drought susceptibility index (DSI) was calculated for each genotype as a criterion of its drought tolerance.

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Table 1. Drought susceptibility index (DSI) of genotypes of Indian mustard.

Genotype	Seed yield/ plant (g) [under drought condition]	Seed yield/ plant (g) [under normal condition]	DSI (ascending order)	Remarks	
				DSI value	Response
SEJ-2	8.00	6.73	–0.993		
SAL-2	7.27	6.47	–0.651		
EC 347852	7.73	7.33	–0.287	< 0.0	Drought tolerant
RH 819	8.73	8.40	–0.207		
RN 393	8.13	9.27	0.647		
DIR 673	8.27	9.47	0.666	0-1.0	Moderately tolerant
PSR 20	7.73	9.07	0.778		
RC 1446	6.87	8.33	0.923		
RC 53	7.13	8.87	1.033		
RH 781	7.13	8.93	1.060		
RC 5	7.33	9.20	1.069		
Rohini	6.60	8.67	1.238		
IS 1787	7.53	9.90	1.256		
CS 52	7.20	9.53	1.259	1.0-1.5	Moderately susceptible
PCR 7	7.93	10.67	1.286		
Varuna	8.07	11.07	1.352		
PRO 9702	6.93	9.80	1.426		
BE 3121	6.13	8.80	1.541		
Vaibhav	6.93	10.00	1.615	>1.5	Highly susceptible
JMMWR 941	7.07	10.33	1.661		
Pusa Jaikisan	7.07	11.33	1.978		
LSD5%	0.910	0.870	0.156		

The genotypes differed significantly for DSI. The lowest value indicated the highest level of drought tolerance and vice-versa. The numerical values of this parameter ranged from –0.993 (SEJ-2) to 1.978 (Pusa Jaikisan). The genotypes such as SEJ-2, SAL-2, EC-347852 and RH-819 that had lower DSI values (<0.00) were rated drought tolerant (Table 1). These genotypes performed better in drought condition because aphid infestation was exceptionally low. The five genotypes namely, PRO 9702, BE 3121, Vaibhav, JMMWR 941 and Pusa Jaikisan had higher DSI values (>1.5) and hence, were considered highly susceptible.

Clarke and coworkers [6] suggested that selecting for yield under dry condition should alone be more productive avenue for improvement of drought resistance until more rapid and effective screening procedures could be developed. As DSI is a ratio, a genotype could have lower value of this index even when its mean seed yield under drought condition is significantly lower than better performing genotype(s), Therefore, high mean seed yield along with lower DSI value was considered to identify and select the best genotype under drought condition. On this ground, the genotype, RH 819, was judged to be the most desirable. It is pertinent to note that the average performance of this genotype for all the traits was either higher than or at par with the mean performance of all the genotypes under drought condition. When ranking of genotypes was performed on the basis of DSI values (ascending order) and mean seed yield (descending order) under drought condition, there appeared a significant association (r_S = 0.494*) between these two criteria of ranking.

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