

RESPONSE TO SELECTION FOR WIDE ADAPTATION IN BREAD WHEAT

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CONFLICTING views have been expressed by various workers regarding the efficiency of selection under optimal and suboptimal conditions (Falconer,¹ 1960; Robertson *et al.*,⁴ 1960; James,³ 1961; Frey,² 1964). One of the drawbacks of selection under rainfed condition (low fertility) is the presence of high genotype-environment interactions preventing the identification of superior genotypes. Since germination and plant stands are poor under extreme moisture stress, maintenance of large segregating populations is a problem, while screening of genotypes is easy under favourable conditions for plant growth such as high fertility and optimum moisture.

Therefore, the efficiency and advance under selection in three diverse environments has been investigated in the present study to verify whether selection in favourable environments for some developmental features influencing yield will be useful in evolving lines with wide adaptation. The material consisted of the F₂'s of a set of 17 crosses of wheat in a partial diallel involving 14 Indian and three exotics, genetically diverse elite parents. The same F₂ populations were grown under three different environments, *viz.*, high fertility (120 lbs. N/acre + irrigation (Irrigated), moderate (60 lbs. N/acre + irrigation) and low (20 lbs. N/acre under rainfed condition) in 1965-66.

Among them, six crosses were chosen which were good for synchrony of tillering, vigour and population performance. Major emphasis was on synchronous tillering in all the three environments. Therefore, in respect of yield, norms were fixed for selection. The top 1.5% of the plants in each cross were chosen for carrying forward. In addition, an equal number of randomly chosen plants were also selected in each of the above six crosses. The progenies of these plants were grown during 1966-67 in the same three environments as mentioned earlier. These were tested in an additional environment also, i.e., low fertility + one protective irrigation. Out of the 84 single plants so chosen during 1965-66, 36 were from F_2 's grown in high fertility, 24 from moderate and 24 from low. Their performance in each of the environments during 1966-67 is given in Table I.

TABLE I
Performance of 48 F_2 families of wheat in 1966-67 test based on the environment of previous selection in 1965-66

Character	Environment (1966-67)	Number of best F_2 lines			Total
		Environment of F_2 selections			
		High (IRR)	Moderate (IRR)	Low (Rainfed)	
1. Seedling vigour	High (I)	18	8	8	34
	Moderate (I)	14	6	9	29
	Low (I)	13	9	9	31
	Low (R)	12	12	6	30
2. Synchronous tiller percentage	High (I)	8	6	3	17
	Moderate (I)	10	9	3	22
	Low (I)	8	8	2	18
	Low (R)	9	6	3	18
3. Survival at harvest	High (I)	12	5	6	23
	Moderate (I)	13	2	6	21
	Low (I)	8	5	10	23
	Low (R)	13	4	5	22
4. Yield	High (I)	13	5	4	22
	Moderate (I)	15	6	5	26
	Low (I)	11	5	7	23
	Low (R)	9	8	5	22

(I) = Irrigated (R) = Rainfed

It is interesting that 77% of the families yielding best under barani (rainfed) condition are the progenies selected under high and moderate fertility with irrigation, and 80% of the vigorous lines under barani originated from selections made under high and moderate fertility. Out of the 22 populations which maintained good stand even under adverse condition of moisture stress, 59% of these were originally selected under high fertility. Similar was the case for synchrony of tiller development (Synchronous tiller percentage) with the highest contribution

(83.3%) of superior lines coming from high and moderate fertility. Considering over-all performance at all the four levels of environments of 1966-67, the same fourteen families were found among the top ranking ones in respect of yield on population basis. Among them 8 (57.1%) originated from high fertility, 4 (28.6%) from moderate and 2 (14.3%) from low. The yield differences between the random selections and conscious selections were not significant.

The correlations between the proportion of synchronous tiller number, i.e., synchronous tiller percentage (X_1) with total ear-tillers per plant (X_2), days to heading (X_3) and yield per plant (X_4) were estimated (Table 2).

TABLE II
Correlation coefficients of 4 associated characters in wheat at 3 different soil fertility levels

Characters	r value		
	High (IRR)	Mod (IRR)	Low (Rainfed)
X_1X_2 Synchronous tiller percentage and total ear-tillers/plant	-0.7114*	NS	NS
X_1X_3 Synchronous tiller percentage and days to heading	-0.7797*	-0.6233*	-0.6684*
X_1X_4 Synchronous tiller percentage and yield/plant	0.5263*	0.5438*	0.5914*

NS.—Nonsignificant. * Significant at 1% level.

The value of X_1X_4 was significant and consistent at all the three environments indicating that synchrony in tillering is a major component of adaptation. Similar was the case for X_1X_3 . The values of $\gamma_{X_1X_2}$ were variable depending on the environment. Therefore, recombinants with higher ear and tiller number and synchronous development can be obtained.

The data, therefore, point to the possibility of evolving lines which will perform well both under drought as well as high fertility by selection for developmental traits rather than yield alone. Further studies are under way on the associated changes in other characters with selection on the above criteria. This procedure appears to be of promise as a convenient method of breeding for drought resistance as well as wide adaptation.

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