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Short Communication

Genetic analysis of peduncle length in durum wheat (*Triticum durum* Desf.) under diverse environments

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Recent breakthroughs in wheat production are attributed to the development of physiologically and morphologically efficient varieties, which can utilize light, nutrition and water more effectively to give better yield per unit area. Breeding on the basis of economic traits has received attention for a long time and this factor has been fully utilized in bread wheat. Presently the yield level has almost reached a plateau. Further breakthroughs in yield level may be obtained by exploiting the genetic information for important physiological traits related to yield. It appears that photosynthesis in the peduncle may also contribute to the dry matter of the grain of wheat [1] and therefore, the surface of the peduncle may have some relation to yield. The internodes remain usually very short as compared to the tall varieties, while the total number of leaves remain more or less equal. Therefore, due to shorter internodes, particularly the last internode (peduncle) and more number of leaves in a limited culm length, the sunlight does not properly penetrate throughout the plant. In this situation, longer peduncles will help the plant to receive more of sunlight and increase the total photosynthetic area and ultimately the end product. Studies on peduncle length would be extremely useful for the development of high yielding dwarf and semi dwarf durum wheat (*Triticum durum* Desf.) varieties having long peduncle length for both irrigated and unirrigated conditions. Limited work has been done on this trait particularly in durum wheat. In view of the above, this study was undertaken in twelve generations to estimate the nature and relative magnitude of various gene effects operative in the inheritance of peduncle length in three inter-varietal crosses of durum wheat grown under diverse environments by using generation means analysis for formulating effective selection procedures to improve this trait.

The experimental material was generated from six diverse parents, comprised three crosses: Cocorit 71 × A-9-30-1, HI 8062 × JNK-4W-128 and Raj 911 × DWL 5002. In each cross combination one of the parents (A-9-30-1, JNK-4W-128 and Raj 911) had higher peduncle length. Twelve basic generations, involved in these studies were two parents, F_1 and F_2, first backcross generations with both parents (BC_1 and BC_2), where BC_1 was the cross between F_1 × female parent and BC_2 was F_1 × male parent, their selfed progenies (BC_1 F_2, BC_2, F_2) and second backcross generations (BC_{11}, BC_{12}, BC_{21}, BC_{22}) *i.e.*, the BC_1 and BC_2 plants again crossed with both original parents (BC_1 × female parent; BC_1 × male parent and BC_2 × female parent; BC_2 × male parent). These twelve populations of each of the three crosses were evaluated in a randomized block design with three replications in two parallel experiments, one sown on 20th November (normal sown condition) and other sown on 20th December (late sown condition) in the same cropping season. Each replicate was divided into three compact blocks. The crosses, each consisting of twelve populations, were randomly allotted to the blocks. All twelve generations were then randomly allotted to twelve plots within a block. The plots of various generations contained different numbers of rows *i.e.*, parent and F_1 plots consisted of 2 rows, while each backcross generation comprised 4 rows and F_2 and the second cycle of backcrosses comprised 6 rows. Each row was 5m long accommodating 33 plants spaced 15 cm apart, row to row distance was 30 cm. The experiment was planted at the Research farm of Rajasthan Agricultural University, Agricultural Research Station, Durgapura, Jaipur, Rajasthan. The data were recorded on 15 random plants in each parent and F_1, 30 plants in each backcross generation and 60 plants in each F_2 and second backcross generations in each replication under both environments (normal and late sown conditions). The peduncle length was measured from the flag leaf sheath of the main tiller up to the base of spike in centimeters. Joint scaling test proposed by Cavalli [2] was used to estimate genetic parameters from the weighted least square estimates of components of generation mean. Components of heterosis in the presence of digenic interaction and trigenic interactions were calculated as suggested by Jinks and Jones [3] and Hill [4], respectively.

The results indicated that among different models, a 10-parameter model was adequate in all three crosses under both environments to account for the variability

Table 1. Results of joint scaling test and gene effects for peduncle length in durum wheat under normal and late sown conditions

Effects	Cocorit-71 × A-9-30-1		HI-8062 × JNK-4W-128		Raj 911 × DWL 5002	
	Normal	Late	Normal	Late	Normal	Late
m	43.00**	36.95**	26.65**	27.29**	32.32**	29.28**
	±1.36	±0.74	±0.79	±1.38	±1.05	±14.18
(d)	−2.72*	−1.08*	−5.39**	−4.31**	1.69*	−1.33*
	±1.18	±0.46	±0.68	±1.25	±0.85	±0.62
(h)	−5.37*	−1.63	8.98**	4.92	−2.84	−1.95
	±2.39	±1.12	±1.34	±2.51	±1.71	±1.25
(i)	−21.47**	−3.93**	−1.40	3.43	4.37	6.88
	±3.13	±1.13	±2.20	±2.44	±2.56	±5.12
(j)	−13.25*	0.48	2.43	−51.00**	−2.21	12.22**
	±5.57	±1.42	±3.50	±5.18	±3.63	±2.81
(l)	−25.61	5.40**	−28.66**	−36.71**	9.74	18.47
	±13.62	±2.41	±7.19	±12.54	±10.01	±16.15
(w)	1.70		4.13	−4.95	−7.28*	−5.02*
	±5.18		±2.43	±5.06	±3.34	±2.38
(x)	−65.67**		−31.24**	−21.46	10.11	24.57
	±14.85		±8.73	±14.31	±12.08	±21.01
(y)	−34.15*		−7.69	22.24*	14.95*	−2.21
	±16.34		±8.14	±8.79	±5.65	±5.16
(z)	79.35**		43.06**	37.49	1.76	−2.18
	±23.29		±32.72	±19.59	±13.67	±21.93
χ^2 values for adequate model	4.31(2)	6.78(6)	6.67(2)	43.50(2)	0.75(2)	8.35(2)

*,**Significant at 5% and 1% levels, respectively. Note: Degree of freedom for χ^2 is given in parentheses

of generation means of this trait, except in the crosses Cocorit 71 × A-9-30-1 and HI 8062 × JNK-4W-128, under late sowing. A six-parameter model in the former cross was adequate, however, in the latter cross, even a 10-parameter model did not adequately fit the data, revealing involvement of more complex interactions or linkage in the inheritance of this character. Additive (d) gene effect was significant in all of the crosses whereas dominance (h) was not as frequently significant under either sowing date. Among non-allelic interactions, both digenic and trigenic interactions were significant role in controlling the inheritance of this trait in all cases in both normal and late sown environments, however, trigenic interactions had a greater role (Table 1). Non-fixable gene effects were higher than fixable in all the cases, which indicated greater role of non-additive gene effects. Sharma *et al.*, [5] and Menon and Sharma [6] also reported the important role of non-additive gene effects in controlling the inheritance of this trait. Significant and positive heterosis was observed in some cases. Similarly, significant inbreeding depression was observed in a few cases. Epistatic interactions (digenic and trigenic) caused significant and positive heterosis. Epistatic effects involving dominance in the F_2 generation caused significant inbreeding depression.

Biparental mating and/or diallel selective mating could be helpful to improve the peduncle length in durum wheat. These breeding approaches could be helpful in developing durum wheat populations, which upon selection will result an efficient high yielding dwarf/semi-dwarf durum wheat varieties with longer peduncle length, which could give respectable yield even under rainfed condition through a new plant type. Longer peduncle will help the plant to utilize more sunlight. It also increases the total photosynthetic area and ultimately the end product. Photo-synthetically more efficient semi-dwarf durum plant types could stand better under high production management conditions to get maximum yield. Furthermore, as the duplicate type of epistasis was observed in the cross HI 8062 × JNK-4W-128 under normal sown environment, so the selection intensity should be mild in the earlier, and more intense in the later generations, to achieve the desirable improvement in this trait in durum wheat. It is suggested that the peduncle length an appropriate choice of the environment should be made in such a way that character show relatively simple inheritance for further improvement of grain yield in durum wheat.

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