GENETIC ANALYSIS OF LEAF ROLLING IN *Triticum aestivum* L.

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No information is available about the effect of leaf rolling on crop productivity. However, there appears an interest in the desirability of this character among wheat breeders.

It has been widely observed in Sahara desert grasses that their leaves are rolled and perhaps, this phenomenon reduces transpirational losses. Under dryland farming this character may appear of some importance, since rolled leaves will transpire less as compared to flat leaves and this will entail in moisture conservation. Another merit of this character is that rolled leaves allow more light to penetrate to lower leaves through foliage. However, sufficient studies are needed to establish the desirability of this trait.

With the increasing interest of breeders in this character it becomes necessary to understand the genetic architecture of this character. Genetic information on this aspect is very meagre. Hsieh (1962) observed certain narrow and rolled leaf mutants on irradiation in rice and reported that this character was recessive and monogenically controlled. Basak et al. (1971) inferred digenic complimentary gene action for this character in Jute.

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Material and Methods

A 5 x 5 diallel involving parents viz. Raj 829, WL 332, UP 245, HD 1976 and UP 240 was prepared. The trial consisted of parents, all possible F_1's (including reciprocals), F_2's (without reciprocals), BC_1's and BC_2's (without involvement of F_1 reciprocals). It was laid out in randomised block design with three replications during rabi 1972-73. Parents, F_1's and back cross generations were represented by single 3 meter row plots. For F_2's, there were four rows in a plot. Row to row and plant to plant spacing was 23 cm and 15 cm, respectively.

The fertilizers applied were 134 kg N, 67 kg P_2O_5 and 40 kg K_2O per hectare. Total number of irrigation was five and each was given at suitable interval.

In the present paper results obtained from parents and F_1's analysis are being discussed.

Ten competitive plants were selected in parents and F_1's for recording observations. Visual observations were recorded on '1 - 9' scale considering all the leaves of the plant just after earhead emergence. Score '1' represented flat leaves (normal) whereas '9' represented extremely rolled leaves. In between scores were assigned depending upon the intensity of rolling in leaves. Statistical analysis was carried out on plot mean basis.

Table 1. Mean squares from combining ability analysis for leaf rolling.

Source	Degree of Freedom	Mean Square
General combining ability	4	11.564**
Specific combining ability	10	0.427**
Reciprocal effects	10	0.177
Error	108	0.119

**Significant at 1% level.

The analysis of variance was carried out following the method by Fisher (1958) and supplemented by Snedecor (1961). Combining ability analysis was carried out in accordance with model I, method 1 of Griffing (1956 b). The genetic parameters were estimated according to the procedure outlined by Hayman (1954) and as used by Aksel and Johnson (1963) for group randomisation.

Results

Analysis of variance revealed highly significant differences among the treatments.

Combining ability analysis:

Highly significant general and specific combining ability variances were observed for leaf rolling (Table 1). Greater magnitude of general combining ability variance (27.08 times) revealed its major role in the expression of this character.

Mean score for leaf rolling and the combining ability effects of the parents are presented in Table 2. Parents Raj 829 and WL 332 showed highly significant negative g.c.a. effects along with low mean score for leaf rolling. Other parents HD 1976, UP 245 and UP 240 gave highly significant positive g.c.a. effects along with high mean score for leaf rolling. This indicated that these parents were good combiner for leaf rolling. The *per se* performance of the parents and their g.c.a. effects were in agreement with each other.

Table 2. General combining ability effects of the parents and their mean scores for leaf rolling.

Parents	Combining ability effect	Mean scores for leaf rolling
Raj 829	-1.007**	2.460
WL 332	-1.203**	1.852
UP 245	0.498**	6.516
HD 1976	1.329**	8.000
UP 240	0.384**	5.884
C.D. at 1% level ($g_i - g_j$)	0.404	-
C. D. at 1% level	-	1.277
C.V.	-	13.32%

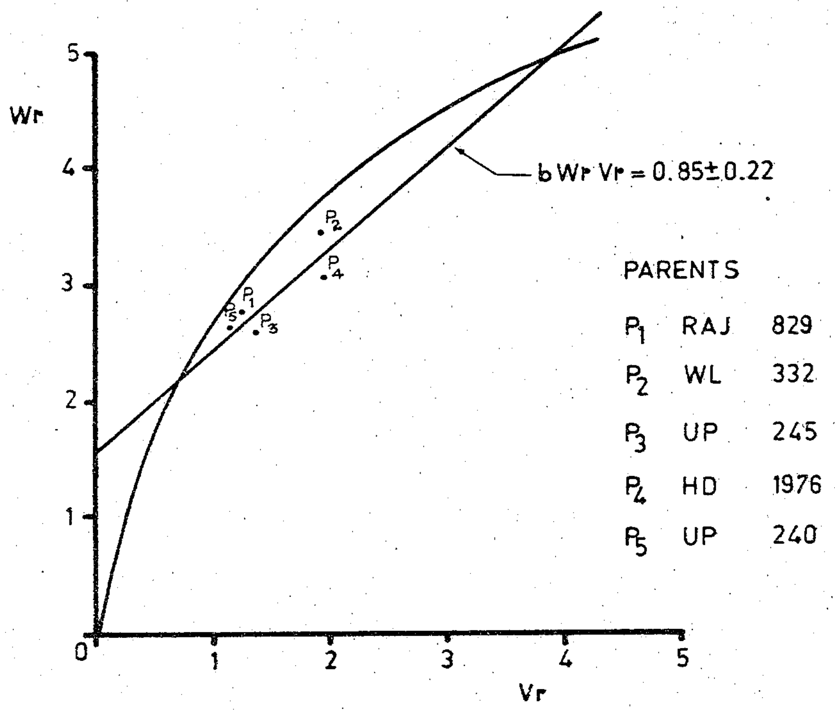

FIG. 1. F_1 Vr, Wr GRAPH

Cross UP 245 x HD 1976 gave highly significant (-0.661) and UP 245 x UP 240 significant negative (-0.430) s.c.a. effects. Cross WL 332 x HD 1976 had significant s.c.a. effect (0.455). Their mean score for leaf rolling were 5.780, 5.038 and 0.455, respectively. However, maximum intensity for leaf rolling among F_1 crosses was exhibited by HD 1976 x UP 240. This cross had non-significant negative s.c.a effect (-0.242).

Diallel analysis:

Validity of the assumptions of diallel analysis was shown by Wr - Vr analysis. Genetic analysis in terms of diallel cross parameters gave highly significant D estimate (Table 3). The $\hat{H}_1$ component was non-significant. In the absence of significance of H_1 and H_2, the significance of $\hat{h}^2$ does not carry any useful meaning. Highly significant and positive estimate of ; indicated the non-symmetrical distribution of dominant and recessive alleles of each gene and excess of dominant alleles among the parents.

Graphic analysis:

The Vr, Wr graph for leaf rolling is presented in Figure 1. The regression coefficient of Wr on Vr showed significant difference from zero and non-significant difference from unity. The proximity of regression line to the tangent of limiting parabola revealed that leaf rolling is inherited with little dominance.

Parents UP 240, Raj 829 and UP 245 fell relatively closer to the origin as compared to parents WL 332 and HD 1976. This showed the presence of relatively more number of dominant genes in the former group of parents.

Table 3. Components of genetic variation for leaf rolling.

Components	Leaf rolling
D	6.821** ±0.161
H_1	0.761 ±0.434
H_2	0.647 ±0.393
h^2	0.634* ±0.265
F	2.374** ±0.401
$(H_1/D)^{0.5}$	0.334
$(H_2/4H_1)$	0.213
(K_D/K_R)	3.176
(h^2/H_2)	0.980

Discussion

Combining ability analysis showed highly significant g.c.a. and s.c.a. for leaf rolling. However, the greater magnitude of g.c.a. indicated its major role in the expression of this character. Genetic analysis in terms of diallel cross parameters indicated that additive genetic variance was the sole component of genetic variation responsible for the determination of this character. Graphic analysis also pointed towards the operation of additive genetic variance. The highly significant specific combining ability observed in combining ability analysis may be the result of pooling together of non-significant dominance component of genetic variation and other non-significant non-allelic interactions ($\sigma^2 s.c.a. = \sigma^2 D + 1/2\, \sigma^2 AA + \sigma^2 AD + \sigma^2 DD$ + ---------). Validity of the assumptions of diallel analysis does not all together eliminate the possibility of non-allelic interactions. There could be some non-allelic interaction present though non-significant. Since wheat is a self pollinated crop, dominance variance and non-allelic interactions ($\sigma^2 AD$, $\sigma^2 DD$) can not be exploited to its advantage. Therefore, significance or magnitude of s.c.a. or s.c.a. effect is not of much importance unless hybrid wheat program becomes a success.

Parents HD 1976, UP 245 and UP 240 appeared to be good combiners for rolled leaves. These parents could be utilized in breeding plant types with rolled leaves. However, the value of rolled leaves in the yield improvement is still to be substantiated by experimental data. Once it is done efficient plant types with rolled leaves can easily be developed by exploiting additive genetic variance.

Parents UP 240, UP 245 and Raj 829 possessed relatively greater number of dominant genes controlling this character. Parents WL 332 and HD 1976 had relatively more number of recessive genes. Crosses HD 1976 x UP 245 and HD 1976 x UP 240 should give genotypes with highly rolled leaves in F_2 generation.

Summary

The genetic analysis of leaf rolling was carried out using Griffing (1956 b) and Hayman (1954) methodologies on 5 x 5 diallel. All the analyses pointed towards predominant role of additive genetic variance in the expression of this character. Combining ability analysis also indicated highly significant s.c.a., but its magnitude was low when compared with g.c.a. variance. Parents HD 1976, UP 245 and UP 240 were found good combiners for leaf rolling. However, there is need to experimentally substantiate the desirability of this character in wheat.

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