Indian J. Genet., **48**(2): 167–170 (1988)

DIALLEL ANALYSIS IN WHEAT

T. DASGUPTA* AND A. B. MONDAL

All India Coordinated Wheat Improvement Project, Bidhan Chandra Krishi Viswavidyalaya, North Bengal Campus, Coochbehar, West Bengal 736101

(Received: May 13, 1986; accepted: October 20, 1987)

ABSTRACT

Combining ability studies on seed yield per plant and its three components from an 8 × 8 half-diallel cross of wheat over two years indicated that both gca and sca variances were important for controlling the traits. Nonadditive gene effect was of greater importance in the genetic control of seed yield and number of productive tillers per plant, while preponderance of additive gene effect was noted for ear length and spikelets/spike. sca × year interaction exhibited greater importance as compared to gca × year interaction. UP 262 was a good general combiner for all the characters. The choice of cross for selection of desirable segregants in segregating generations has been suggested.

Key words: Combining ability, wheat, gene effects, yield components.

Diallel analysis in wheat has been reported by many workers [1–4]. But information on diallel analysis of wheat over environment is scanty. Moreover, it is known that quantitative characters are influenced by the environment. In view of this, the present study has been undertaken to analyse an 8 × 8 diallel cross over two environments (years) for yield and its components for estimating combining ability, components of variance, and combining ability × year interaction.

MATERIALS AND METHODS

Eight varieties of breadwheat (*Triticum aestivum* (L.) Thell), namely, K7903, Sonalika, HP 1102, HUW 187, UP 262, BR 2104, HD 2233, and BR 2053, were crossed in all possible combinations excluding reciprocals. The 28 F_1 and 8 parents were grown in randomized block design with four replications at Bidhan Chandra Krishi Viswavidyalaya Farm during 1984 and 1985. Each plot consisted of single 5 m long row with the spacing of 23 cm between rows and 10 cm between plants. Recommended cultural practices were followed for raising the crop. Ten competitive plants were selected randomly for recording observations on seed yield/plant (g), no. of productive tillers/plant, grains/ear, spikelets/spike, and ear length (cm). The progeny means were used for statistical analyses. The combining ability analysis was done according to Singh [5, 6], using Method 2, Model 1 of Griffing [7].

RESULTS AND DISCUSSION

The analysis of variance for combining ability for the data pooled over years showed that mean squares due to gca and sca were highly significant for yield and

*Present address: Genetics and Plant Breeding Department, Bidhan Chandra Krishi Viswavidyalaya, P.O. Krishividyalaya, West Bengal 741252.

its four components (Table 1). The relative importance of gca and sca is usually judged from the ratio $2\sigma_g^2/2\sigma_g^2+\sigma_s^2$, as suggested by Baker [8]. If the ratio is close to 1, additive gene action is of greater importance. In the present study nonadditive gene action, i.e., sca played a preponderant role in the genetic control of productive tillers and seed yield/plant (Table 1), as the ratio is low. Many workers [1, 3, 4, 9] reported similar finding for seed yield/plant, and some of them [3, 10] reported predominant nonadditive genetic effect for productive tillers/plant. Additive and nonadditive gene effects seemed to be equally important for grains per ear. On the contrary, a preponderant role of additive gene effect was observed for ear length and spikelets/spike (Table 1). This finding is in agreement with those of Yadav and Murty [11] for spikelets/spike and Sharma and Singh [12], Gill et al. [13] and Kumar et al. [14] for ear length.

Table 1. Analysis of variance (mean squares) for combining ability over environments (years)

Source	d.f.	Productive tillers/plant	Ear length	Spikelets/ per spike	Grains/ear	Seed yield/ per plant
gca	7	0.26**	10.36**	24.19**	87.95**	1.53**
sca	28	0.13**	0.22**	0.91**	24.65**	0.58**
gca × environment	7	0.23**	0.23**	1.41**	18.34**	0.18
sca × environment	28	0.12**	0.22**	0.58**	22.28**	0.16*
Error	210	0.03	0.05	0.16	5.98	0.09
$\frac{2\sigma_g^2}{2\sigma_g^2+\sigma_g^2}$		0.33	0.92'	0.85	0.47	0.37

*, ** Significant at 5% and 1% levels, respectively.

Both gca and sca exhibited significant interaction with year (Table 1), except gca in the case of seed yield/plant, indicating the role of environment in influencing the variances. Similar finding was also reported by Paroda and Joshi [1]. The ratio $\sigma_{se}^2/\sigma_{ge}^2$ was greater than unity for all the traits, suggesting that sca variance exhibited greater interaction than gca variance. The ratios σ_g^2/σ_{ge}^2 showed that interaction variances of all the traits were less than the respective main effects for both gca and sca (Table 1).

A perusal of gca estimates revealed the transcendency of the parents UP 262 and HUW 187 for seed yield/plant; UP 262, HUW 187 and BR 2104 for grains/ear; BR 2104 and UP 262 and BR 2053 for spikelets/spike; BR 2053, BR 2104 and UP 262 for ear length; and Sonalika, BR 2053 and UP 262 for productive tillers/plant as good general combiners. The parent UP 262 was found to be a good general combiner for all the traits and its per se performance was also high. So, it will be an efficient selection if UP 262 is included as a parent in any hybridization programme.

Specific combining estimates revealed that seven crosses for seed yield/plant, four crosses for grains/ear, and five crosses for productive tillers/plant, ear length and spikelets/spike exhibited significant positive effects. When good crosses with at least more than two common characters were compared (Table 2), it was found that cross HUW 187×UP 262 would be the best choice to get transgressive segregants as this cross exhibited significant positive sca effect for yield and its three major components coupled with high pe se performance. While cross K 7903 × UP 262 also appeared to be good for seed yield/plant, No. of productive tillers, and grains/ear (Table 2). It needs to be mentioned that in a self-pollinated crop like wheat conventional breeding methods could exploit only that portion of genetic variability which is due to additive or additive × additive interaction. The gca estimates showed that UP 262 was a good general combiner for all the traits. So its cross with HUW 187 or K7903 would be the best choice for obtaining segregants with improved yield in segregating generations.

Table 2. Good crosses that show desirable means and combining ability effects for more than 2 characters

Cross	Seed yield/plant			Grains/ear			Spikelets/spike			Ear length			Productive tillers/plant		
	m	gca	sca	m	gca	sca	m	gca	sca	m	gca	sca	m	gca	sca
HUW 187 × UP 262	H	H×H	H	H	H×H	H	H	L×H	H				H	M×H	H
K 7903 × UP 262	H	L×H	H	H	L×H	H							H	M×H	H
K 7903 × HUW 187	H	L×H	H	H	L×H	H									
UP 262 × BR 2104	H	H×M	M	H	H×H	M	H	H×H	L	H	H×H	M			

m—mean value, H—high; M—medium; L—low.

REFERENCES

1. R. S. Paroda and A. B. Joshi. 1970. Combining ability in wheat. Indian J. Genet., **30**(3): 630–637.
2. S. C. Mani and M. V. Rao. 1977. Combining ability and heterosis in wheat (*Triticum aestivum* L.). *In:* Genetics and Wheat Improvement. Oxford and IBH Publication, Delhi: 23–30.
3. J. C. Sharma, Z. Ahmed and A. N. Khanna. 1978. Combining abilities in relation to wheat breeding. Indian J. Genet., **38**(1): 77–85.
4. S. K. Sharma and R. K. Singh. 1983. Combining ability for harvest index and its components in wheat. Indian J. Genet., **43**(2): 229–231.
5. Daljit Singh. 1973. Diallel analysis for combining ability over several environments. 11. Indian J. Genet., **33**: 469–481.
6. Daljit Singh. 1979. Diallel analysis for combining ability over environments. Indian J. Genet., **39**: 383–386.
7. B. Griffing. 1956. Concept of general and specific combining ability in relation to diallel crossing systems. Aust. J. Biol., **9**: 463–493.

8. R. J. Baker. 1978. Issues in diallel analysis. Crop Sci., **18:** 533–536.

9. D. S. Jatasra and R. S. Paroda. 1978. Use of F_2 generations for combining ability in wheat. Cereal Res. Commun., **6:** 265–271.

10. G. S. Nanda, P. S. Virk and K. S. Gill. 1983. Diallel analysis over environments in wheat—yield and its components. Indian J. Genet., **43**(1): 229–231.

11. S. P. Yadav and B. R. Murty. 1976. Heterosis and combining ability in crosses of different height categories in breadwheat. Indian J. Genet., **36**(2): 184–196.

12. G. S. Sharma and R. B. Singh. 1976. Inheritance of plant height and spike length in dwarf spring wheat. Indian J. Genet., **36**(2): 173–183.

13. K. S. Gill, G. S. Nanda and G. Singh. 1977. Inheritance of plant height, tiller number, ear length and number of spikelets in two winter × spring crosses of wheat. Genet. Agrar., **31:** 227–237.

14. H. Kumar, G. S. Sharma and R. B. Singh. 1983. Genotype × environment interaction in relation to combining ability in spring wheat. Indian J. Genet., **43**(2): 232–238.