INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2000/02–1-2–77–79

Combining Ability Analyses of Physio-Morphological Traits in Wheat (*Triticum aestivum* L.)

ABDUS SALAM KHAN AND AHMAD RIZWAN
Department of Plant Breeding and Genetics University of Agriculture, Faisalabad–38040, Pakistan

ABSTRACT

Combining ability studies were under taken for five physio-morphological traits *viz*., flag leaf area, leaf venation, stomatal frequency, stomata size and plant height in a 5 x 5 diallel cross. The mean squares for general combining ability (GCA) were highly significant for leaf venation and plant height; whereas significant for stomatal frequency, flag leaf area and non-significant for stomata size. Highly significant mean squares for specific combining ability (SCA) were found for all the characters except stomata size which was non-significant. Non additive type of gene action was found to be of greater importance for all the characters except for plant height where additive gene action was more important. Variety KTDH-6 had high GCA effects for flag leaf area and stomata size. Cross 6500 x 4072 had high SCA effects for leaf venation and stomata size.

Key Words: Combining ability; Physio-morphological traits; *Triticum aestivum* L.

INTRODUCTION

The major objective of the most wheat breeding programmes is to increase grain yield on unit area basis. The physio-morphological characters play an important role in grain yield. Stomata plays an important role in regulating plant water stress, and stomatal frequency varies from one species to another, and is influenced by the environmental conditions under which a plant is grown (Ahmad, 1996; Munir, 1997; Subhani, 1997). Proper choice of the parents for hybridization is crucial in a wheat improvement programme. Combining ability studies are frequently used by the plant breeders to evaluate the nature of gene effects and classifying parental lines in terms of their hybrid performance. The present investigation was undertaken to derive information on the nature of combining ability operative in the inheritance of different physio-morphological traits.

MATERIALS AND METHODS

The here in reported combining ability studies were carried out in the experimental area of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. Five wheat genotypes *viz,* Inqalab 91, Pasban 90, 6500, KTDH-6 and 4072 were crossed in a 5 x 5 diallel fashion in 1997-98. F_1 seeds thus produced were used to raise the F_1 population during the crop season 1998-1999. The F_1's seeds along with their parents were sown in the field using triplicated randomized complete block design. Each replicate had parents and the F_1 seeds sown in lines each of 5 m in length. The plant to plant and row to row distance was 15 and 30 cm, respectively. Sowing was done with dibbler and two seeds per hole were sown which were thinned to single seedling per site before first irrigation to ensure good plant stand. Ten guarded plants were selected randomly one month before maturity to record the data on flag leaf area, leaf venation, stomata size and stomatal frequency whereas plant height was recorded at maturity. The leaf venation were counted per microscopic field (10x magnification) whereas stomatal frequency and stomata size at 40x magnification. The mean of the 10 plants for each character were subjected to analysis of variance technique, and the traits showing significant genotypic differences were further analysed for combining ability following Griffing (1956) method I, model I).

RESULTS AND DISCUSSION

Combining ability analyses revealed (Table I) that mean squares for GCA were highly significant for leaf venation and plant height significant for flag leaf area and stomatal frequency while non-significant for stomata size. The findings are supported by earlier breeders (Khan & Bajwa, 1991; Chaudhry *et al.,* 1994; Mohy-uddin & Shahzad, 1998). Mean squares for SCA were found highly significant for plant height and for the other all traits under study except for stomata size which was non-significant. Khan (1991), and Khan and Ali (1998) reported similar results regarding flag leaf area and plant height. Reciprocal effects were highly significant for leaf venation and stomata size, significant for stomatal frequency and non-significant for flag leaf area and plant height. The results corroborate the findings of Ali and Khan (1998) and Mohy-uddin and Shahzad (1998) for non-significance of flag leaf area and plant height, respectively.

Table I. Combining ability analysis for some metric characters in a 5 x 5 diallel cross of wheat

SOV	df	Flag leaf area	Leaf venation	Stomatal frequency	Stomata size	Plant height
GCA	4	16.70*	0.646**	0.397*	2982.40 N.S	679.36**
SCA	10	14.17**	0.703**	0.226**	2796.75 N.S	16.48**
Reciprocals	10	5.95 N.S	0.374**	0.217*	6059.25**	4.07 N.S
Error	48	4.37	0.069	0.082	1773.44	4.63

* Significant (P = 0.05), ** Significant (P = 0.01), NS = non-significant

It is obvious from the Table II that variety KTDH-6 had high positive GCA effects for flag leaf area where lowest effect was shown by genotype 6500. Positive GCA effects were shown by all genotypes for leaf venation except KTDH-6, which possessed negative value. For stomata size, variety KTDH-6 was a good general combiner. Genotype KTDH-6 exhibited high positive GCA effect for plant height, while genotype 6500 showed maximum negative GCA effect, so considered to be the best source of height reduction. So KTDH-6 considered as best general combiner for flag leaf area and stomata size.

Table II. Estimates of GCA effects for some metric characters in a 5 x 5 diallel cross of wheat

Varieties	Flag leaf area	Leaf venation	Stomatal frequency	Stomata size	Plant height
Inqalab 91	0.29	0.08	-0.20	0.94	-2.40
Pasban 90	-0.23	0.09	0.06	-16.75	-4.30
6500	-0.67	0.23	-0.02	-18.11	-5.63
KTDH-6	2.02	-0.43	-0.14	18.94	14.52
4072	1.41	0.01	0.30	14.97	-2.17

Maximum positive SCA effect (Table III) was shown by the cross Inqalab 91 x 6500, and minimum effect was shown by the cross Pasban 90 x 6500 for flag leaf area. The top scorer for specific combining ability effect was the cross 6500 x 4072 for leaf venation, the lowest value was exhibited by the cross combination Pasban 90 x 6500. The highest specific combining ability effect was found in the cross 6500 x KTDH-6 and the cross KTDH-6 X 4072 proved to be a poor specific combiner for stomatal frequency. Regarding stomata size Pasban 90 x 4072 showed the highest positive SCA effect whereas cross KTDH-6 x 4072 was the poorest specific combiner. For plant height the cross combination Pasban 90 x 6500 showed the lowest SCA effect whereas high positive SCA effect was shown by the cross Pasban 90 x KTDH-6.

Table III. Estimates of SCA effects for some metric characters in a 5 x 5 diallel cross of wheat

Varieties	Flag leaf area	Leaf venation	Stomatal frequency	Stomata size	Plant height
Inqalab 91 x Pasban 90	2.16	0.28	-0.17	13.32	-0.31
Inqalab 91 x 6500	2.63	0.47	-0.34	-23.10	-0.45
Inqalab 91 x KTDH-6	-0.55	-0.68	-0.28	-3.25	2.93
Inqalab 91 x 4072	1.24	0.19	0.12	-5.44	-0.31
Pasban 90 x 6500	-3.82	-0.86	-0.15	-19.78	-2.77
Pasban 90 x KTDH-6	-2.26	0.30	-0.002	-31.61	4.92
Pasban 90 x 4072	0.25	-0.10	-0.10	38.88	0.18
6500 x KTDH-6	2.10	0.33	0.41	14.02	-0.16
6500 x 4072	0.07	0.68	-0.05	34.74	0.48
KTDH-6 x 4072	-2.38	-0.78	-0.49	-68.74	0.01

Table IV. Estimates of reciprocal effects for some metric characters in a 5 x 5 diallel cross of wheat

Varieties	Flag leaf area	Leaf venation	Stomatal frequency	Stomata size	Plant height
Inqalab 91 x Pasban 90	0.37	-0.16	0.51	12.94	-1.52
Inqalab 91 x 6500	-2.85	-0.16	0.20	19.31	3.26
Inqalab 91 x KTDH-6	2.91	0.00	-0.21	-7.73	-1.05
Inqalab 91 x 4072	0.96	-0.33	0.26	9.50	-0.60
Pasban 90 x 6500	-0.31	0.50	0.45	-0.30	-0.99
Pasban 90 x KTDH-6	1.32	1.00	0.15	4.03	1.20
Pasban 90 x 4072	1.77	0.63	-0.36	-88.88	-0.86
6500 x KTDH-6	2.26	-0.16	-0.08	54.81	-1.08
6500 x 4072	1.33	-0.03	0.36	0.71	-1.2
KTDH-6 x 4072	-0.45	-0.16	0.40	45.89	0.34

Table V. Components of variance for GCA (Vg), SCA (Vs) and reciprocal effects (Vr) for some metric characters in a 5 x 5 diallel cross of wheat

Variance Components	Flag leaf area	Leaf venation	Stomatal frequency	Stomata size	Plant height
Vg	1.2489	0.0576	0.0315	120.8957	67.4723
	(7.70)	(6.30)	(9.69)	(2.38)	(80.63)
Vs	9.7945	0.6336	0.1437	1023.311	11.8431
	(60.42)	(69.36)	(44.24)	(20.22)	(14.15)
Vr	0.7865	0.1525	0.0673	2142.908	0.2819
	(4.85)	(16.69)	(20.72)	(42.34)	(0.33)
Ve	4.3798	0.0679	0.0823	1773.443	4.6390
	(27.03)	(7.65)	(25.35)	(35.06)	(5.55)
Total	16.2097	0.9134	0.3248	5060.55	84.236
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

NB: (Values showed in parenthesis showed percentage)

Reciprocal effect presented in (Table IV) showed that, for flag leaf area the cross Inqalab 91 x KTDH-6 was at the top with the highest positive value whereas the lowest effect was observed in the cross combination Inqalab 91 x 6500. With regard to leaf venation, the cross Pasban 90 x KTDH-6 possessed the highest reciprocal effect, the lowest effect was recorded in Inqalab 91 x 4072. For stomatal frequency, the lowest negative value was achieved by the cross Pasban 90 x 4072. Pertaining to stomata size, KTDH-6 x 4072 exhibited the high positive reciprocal effect and the lowest by Pasban 90 x 4072. For plant height most of the crosses showed negative reciprocal effects. A high positive value was shown by the cross Inqalab 91 x 6500.

The components of variance and their relative proportion for GCA, SCA and reciprocal effects (Table V) revealed that variances due to SCA effect were higher than variances due to GCA effects in all the characters under study except for plant height where variance due to GCA effect was of more importance. The highest value for GCA variance was observed in plant height (80.63%) and the lowest value was indicated by stomata size (2.38%). The highest value of SCA variance component was observed in leaf venation (69.36%), while the lowest value was shown by plant height (14.15%). The variance due to reciprocal effects was highest in stomata size (35.06%) and lowest value was found in plant height (0.33). Genotypes KTDH-6 and 4072 were good general combiners for flag leaf area, stomatal frequency and stomata size. They can be used intensively to get better hybrid comminations for increased wheat production.

REFERENCES

Ahmad, S., 1996. General and specific combining ability of some pysio-morphological characters in bread wheat. M.Sc. (Hons.) Agri. Thesis, Deptt. Pl. Br. Genet., Univ. Agric., Faisalabad, Pakistan.

Ali, Z. and A.S. Khan, 1998. Combining ability studies of some morpho-physiolgical traits in bread wheat. *Pakistan J. Agri. Sci.,* 35: 1–3.

Chaudhry, M.H., G.M. Subhani, F.A. Khan, M.A. Ali, N. Khan and A. Sattar, 1994. Combining ability analysis of some physiological and agronomic traits of wheat. *J. Agric. Res.,* 32: 227–38.

Griffing, B., 1956. Concept of general and specific combining ability in relation to diallel crossing system. *Australian J. Biol. Sci.*, 9: 363–93.

Khan, A.S. and Z. Ali, 1998. General and specific combining ability estimates for plant height and some yield components in wheat. *Pakistan J. Agri. Sci.*, 35: 3–4.

Khan, N., 1991. Implication of combining ability analysis in wheat breeding. *J. Agric. Res.,* 29: 1–6.

Khan, N. and M.A. Bajwa, 1991. Wheat breeding based on genetic information. *J. Agric. Res.,* 29: 417–23.

Mohy-uddin, Z. and K. Shahzad, 1998. Combining ability for some physiological and yield contributing traits in spring wheat. *J. Agri. Res.,* 36: 1–5.

Munir, F., 1997. Genetic control of some metric traits determining grain yield in bread wheat. M.Sc. (Hons.) Agri, Thesis. Deptt. Pl. Br. Genet., Univ., Agric., Faisalabad, Pakistan.

Subhani, G.M., 1997. Genetic architecture of some morpho-physiological traits in hexaploid wheat under stress and normal conditions. Ph.D. Thesis. Dept. Pl. Br. Genet. Univ., Agric., Faisalabad, Pakistan.

(Received 15 September 1999; Accepted 08 December 1999)