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Combining Ability in Cotton Cultivars for Agronomic Traits

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ABSTRACT

Combining ability of six cotton cultivars for various traits was evaluated in a 6 × 6 partial diallel analysis. The results showed that Siokra324 was the best general combiner for yield, monopodial branches and plant height. GCA and SCA variances showed an important role of additive gene effects in the inheritance of monopodial branches. Both additive and non-additive components of genetic variances were important in the inheritance of yield, boll number, boll weight, plant height and stem diameter. However, non-additive gene effects were seen for earliness and sympodial branches. Hybrids Nazily84 x Siokra324, Tabladila x Mehr and Cukurova x Sahel were the best specific combinations for yield.

Key Words: *Gossypium hirsutum* L.; Combining ability; Gene action

INTRODUCTION

Characteristics such as yield, earliness etc. are inherited as quantitative traits. The knowledge of genetic structure and mode of inheritance of such complex traits help breeders to employ suitable breeding methodology for improvement of traits (Garg & Kalsy, 1988). Diallel analysis has been developed for this propose and can be used to help answer questions concerning the importance of specific combining ability and the predictability of hybrid performance using general combining ability or parental performance (Backer, 1978; Rauf *et al.*, 2004).

Several cotton cultivars have been introduced into Iran from different countries for direct cultivation after adaptation and yield tests or indirect utilization of them in hybridization breeding programs. Very little known about the genetic combining ability of these foreign varieties, then this study was designated to meet this objective.

MATERIALS AND METHODS

This study involved 6 cotton cultivars (*Gossypium hirsutum* L.) namely Cukurova, Nazily84, Tabladila, Siokra324, Mehr and Sahel. Sahel is the most successful cultivar, derived from Line 349/Coker100 Wilt at Varamin Research Station, Varamin, Iran. Cukurova and Nazily84 have been introduced from Turkey. Rest (Tabladila, Mehr & Siokra324) had been introduced from Spain, France and Australia into Iran, respectively.

In the first year crosses between parents, except reciprocals, were made (Pohlman, 1959) and in the second year 15 F_1 hybrids and their parents were grown in a randomized complete block design with three replications at Hashem Abad Research Station, Gorgan, Iran. Plots consisted of two rows of 20 plants each, with 80 cm spacing between rows and 20 cm between plants in a row. Data were recorded on five randomly selected plants. Normal cultural practices were followed during the experiments.

Data on plant height (cm), monopodial branches, sympodial branches, stem diameter (mm), boll number, boll weight (g), yield (kg) and earliness (%) were recorded. Data were analyzed by analysis of variance technique (Steel & Torrie, 1980) to determine genetic differences. Analysis of combining ability effects were performed by method II model I as described by Griffing (1956).

RESULTS AND DISCUSSION

Analysis of variance carried out for studied traits and there are significant differences between genotypes, hence later analysis for combining ability was possible. The total genetic variability was partitioned to general combining ability (GCA) and specific combining ability (SCA) as defined by Sprague and Tatum (1942). GCA variance was highly significant only for monopodial branches revealing important role of additive gene effects, while both additive and non-additive components of genetic variance were important in the inheritance of yield, boll number, boll weight, stem diameter and plant height (Table I), which are well supported by other works (Garg & Kalsy, 1988; Zia-ul-Islam *et al.*, 2001; Inam-ul Haq & Azhar, 2004; Rauf *et al.*, 2004). Therefore, these traits can be improved by recurrent selection method or by sib-mating followed by progeny testing. Non-additive genetic effects (dominance & epitasis) were seen for earliness and sympodial branches, so production of hybrid varieties for heterosis exploration can be suitable breeding strategy for these traits.

As regards estimates for GCA, Siokra324 appeared to be the best general combiner for yield, plant height and monopodial branches (Table II). Positive GCA effects for sympodial branches and earliness belonged to Mehr; whereas Sahel, most popularly grow variety in Iran, was the best general combiner only for boll weight and stem diameter. For boll number, no suitable parent was found.

Table I. Analysis of combining ability in 6x6 partial diallel cross

Sources of variation	D. F.	Plant Traits							
		Yield	Boll number	Boll weight	Sympodial branches	Monopodial branches	Plant height	Stem diameter	Earliness
GCA	5	0.307*	18.76*	89.16**	1.29	2.21**	183.99**	0.903**	0.007
SCA	15	0.326**	15.95*	62.96**	3.36**	0.25	234.08**	1.14**	0.014**
Error	40	0.093	7.084	21.253	1.118	0.201	36.418	0.178	0.005

* = Significant (0.05), ** = Highly Significant (0.01)

Table II. Estimates of GCA effects in 6x6 partial diallel cross

Varieties	Plant Traits							
	Yield	Boll number	Boll weight	Sympodial branches	Monopodial branches	Plant height	Stem diameter	Earliness
Sahel	-0.29**	-1.45	3.96*	-0.14	0.22	3.85	0.36*	-0.012
Cukurova	0.06	-1.13	1.14	-0.04	-0.29	1.44	0.26	-0.015
Nazily84	-0.04	1.55	-5.97**	-0.14	0.48**	0.56	0.24	-0.008
Tabladila	0.18	1.08	1.56	-0.48	-0.19	-5.99**	-0.47**	-0.002
Mehr	-0.14	-1.58	-0.80	0.73*	-0.80**	-5.49**	-0.27	0.060*
Siokra324	0.23*	1.52	0.11	0.08	0.58**	5.64**	-0.11	-0.024
SE (gi)	0.098	0.859	1.488	0.341	0.145	1.948	0.136	0.023

* = Significant (0.05), ** = Highly Significant (0.01)

Table III. Estimates of SCA effects for various traits in 6x6 partial diallel cross

Combinations	Plant Traits							
	Yield	Boll number	Boll weight	Sympodial branches	Monopodial branches	Plant height	Stem diameter	earliness
Cukurova x Nazily84	-1.43**	9.57**	-8.57*	4.29**	-0.88*	45.24**	3.41**	-0.263**
Cukurova x Tabladila	0.21	2.37	4.70	1.10	-0.14	10.46*	0.45	-0.110*
Cukurova x Siokra324	0.15	-6.26**	13.71**	-0.80	-0.18	-8.78	-0.37	0.148**
Cukurova x Mehr	0.03	0.43	7.66*	1.95*	0.74*	4.88	-0.01	-0.033
Cukurova x Sahel	0.47*	-1.69	-0.93	-1.98*	0.12	-15.32**	-0.91**	0.130*
Nazily84 x Tabladila	0.32	-0.03	-0.99	-2.00*	0.29	-7.93	-0.32	0.063
Nazily84 x Siokra324	0.53*	3.47	5.90	0.36	0.58	3.97	-0.15	-0.027
Nazily84 x Mehr	0.36	-0.84	10.24**	-0.14	0.03	-7.70	-0.52	0.056
Nazily84 x Sahel	0.62**	-0.90	-1.08	-0.74	0.35	-7.57	-0.36	0.016
Tabladila x Siokra324	-0.11	-0.20	0.03	-0.96	-0.08	-7.88	0.43	0.046
Tabladila x Mehr	0.52*	-4.64*	-1.09	-1.80*	0.04	-4.88	0.05	0.093
Tabladila x Sahel	0.20	0.43	-0.01	1.40	-0.98**	9.78*	0.09	0.088
Siokra324 x Mehr	0.02	-2.27	2.89	0.36	-0.67*	-0.25	0.23	0.090
Siokra324 x Sahel	0.30	1.73	7.17*	1.96*	0.45	10.88*	0.66*	-0.016
Mehr x Sahel	-0.55*	3.02	-0.32	-0.08	0.03	4.07	0.15	-0.083
SE(Sij)	0.223	1.948	3.374	0.774	0.328	4.417	0.309	0.052

* = Significant (0.05), **=High Significant (0.01)

Based on the results of SCA effects (Table III) hybrid Siokra324 x Sahel with significant SCA effect was the best combination for boll weight, sympodial branches, plant height and stem diameter. Hybrid Cukurova x Siokra324 was the best specific combination for earliness and boll weight. Hybrid Cukurova x Nazily84 had significant SCA effects for all of the studied characters. Hybrids Nazily84 x Sahel, Nazily84 x Siokra324, Tabladila x Mehr and Cukurova x Sahel performed better for yield. Of these, only Cukurova x Sahel had short height and was early maturing. With the intention of developing cultivars for earliness in maturity and higher yield (Cheatham *et al.*, 2003), this hybrid seems to be desirable for this propose.

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REFERENCES

Backer, R.J., 1978. Issues in diallel analysis. *Crop Sci.*, 18: 533–6

Cheatham, C.L., J.N. Jenkins, J.C. McCarty, C.E. Watson and J. Wu, 2003. Genetic variances and combining ability of crosses of American cultivars, Australian cultivars and wild cottons. *J. Cotton Sci.*, 7: 16–22

Garg, H.R. and H.S. Kalsy, 1988. Inheritance and association of some quantitative traits in a diallel set of upland cotton. *Indian J. Agric. Sci.*, 58: 306–8

Griffing, B., 1956. Concept of general and specific combining ability in relation to diallel crossing system. *Australian J. Biol. Sci.*, 9: 463–93

Inam-ul Haq and F.M. Azhar, 2004. Genetic basis of varietal differences for seed cotton yield and its components in *Hirsutum* spp. *Int. J. Agric. Biol.*, 5: 904–7

Pohlman, J.M., 1959. *Breeding Field Crops*. Holt, Rinehart and winston Inc., New York, USA

Rauf, S., T.M. Khan and S. Nazir, 2005. Combining ability and heterosis in *Gossypium hirsutum* L. *Int. J. Agric. Biol.*, 7: 109–13

Sprague, G.F. and L.A. Tatum, 1942. General versus specific combining ability in single crosses of corn. *J. American Soc. Agron.*, 34: 923–52

Steel, R.G.D. and J.H. Torrie, 1980. *Principles and Procedures of Statistics: A Biometrical Approach*, 2nd ed. McGraw-Hill Inc., New York

Zia-ul Islam, H.A. Sadaqat and F.A. Khan, 2001. Evaluation of some cotton strains for their combining ability in important genetic traits. *Int. J. Agric. Biol.*, 3: 409–10

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