Indian J. Genet., **65**(2): 115-116 (2005)

Short Communication

Gene effects for quality parameters in *Triticum durum*

Paramjit Singh, Navreet Kaur and G. S. Mahal

Department of Plant Breeding, Genetics & Biotechnology, Punjab Agricultural University, Ludhiana 141 004

(Received: May 2004; Revised: April 2005; Revised: April 2005)

Grains from six basic generations (P_1, P_2, F_1, F_2, BC_1 and BC_2) of three crosses of *Triticum durum* namely CMH74540 × PDW245 (C_1), CMH74540 × PDW274 (C_2) and CMH 74540 × PDW 277 (C_3) were analyzed for various quality parameters such as protein content, sedimentation value, dry gluten content, β-carotene, hectoliter weight and yellow berry incidence. Protein content was estimated following Macro-kjeldahl method [1], sedimenation value was calculated according to Dick and Quick [2], Gluten content was determined according to AACC approved method [3]. The recorded data were subjected to scaling test for testing the adequacy of additive dominance model [4]. In the event of inadequacy of additive dominance model weighted analysis of Cavalli [5] was used for estimating the various components of generation means.

The investigations have revealed that simple additive-dominance model is inadequate in the inheritance of various quality parameters. For certain traits in some crosses additive and dominance gene effects along with all the three types of non-allelic interactions (additive × additive, additive × dominance and dominance × dominance) were important while in other crosses one or two type of non allelic interactions were important.

Additive gene effects alongwith additive × dominance type of interaction influenced the inheritance of protein content in C_1. For cross C_2 only additive × dominance interaction controlled the inheritance of protein. However, in C_3, it was dominance gene effects along with additive × additive and additive × dominance gene effects which governed the inheritance of protein content (Table 1). Dhillon *et al.*, [6] reported the importance of additive, dominance and non-allelic interactions while Aruna and Raghaviah [7] reported the role of dominance and epistatic gene effects in the inheritance of protein content.

For the inheritance of sedimentation value only additive gene effects were found to be important in case of cross C_2 whereas for crosses C_1 and C_3 in addition to additive and dominance gene effects in all the three types of digenic non-allelic interactions were found to be important (Table 1). Zhang and Zhang [8] have also reported the importance of additive as well as non-additive gene effects in the inheritance of sedimentation value.

Additive gene effects along with dominance × dominance type of interactions was found to be important in the inheritance of dry gluten content in case of cross C_1 whereas for cross C_2 and C_3 additive and dominance gene effects alongwith, additive × additive and dominance × dominance type of non-allelic interactions played an important role in the inheritance of dry gluten content (Table 1). Yadav *et al.*, [9] also reported importance of epistatic gene effects in the genetic control of gluten content in wheat.

Only additive gene effects were found to control the inheritance of β-carotene content in case of cross C_3 while for cross C_1 in addition to additive and dominance gene effects, additive × additive and dominance × dominance type of non-allelic interactions controlled the inheritance of β-carotene. In cross C_2 all the three types of non-allelic interactions along with additive and dominance gene effects controlled the inheritance of this trait. Dhillon [6] and Lee [10] have also reported the importance of additive and dominance gene effects along with all the three types of non-allelic interactions in the inheritance of β-carotene content.

All the six parameters of a digenic model were found to be significant in cross C_1 and C_3 suggesting the importance of additive, dominance as well as non-allelic interactions in the inheritance of hectolitre weight (Table 1). For cross C_2 additive gene effects alongwith dominance × dominance type of interactions were found to be important. However, Singh [11] has reported the adequacy of simple additive dominance model in the inheritance of this trait.

The inheritance for yellow berry incidence in cross C_1 was found to be governed by additive and dominance

Table 1. Gene effects for quality attributes in *durum* wheat

Character	Cro-sses	Components of mean						Type of epistasis
		[m]	[d]	[h]	[i]	[j]	[l]	
Protein content (%)	C_1	11.95**±0.06	0.47**±0.08	ns	ns	−1.93**±0.48	ns	
	C_2	12.04**±0.06	ns	ns	ns	1.74**±0.35	ns	
	C_3	12.77**±0.34	ns	−1.66*±0.49	−1.06**±0.35	−0.61*±0.27	ns	
Sedimentation value (mm)	C_1	34.85**±1.66	1.35**±0.21	−18.65**±3.64	−8.39**±1.64	−2.40**±0.74	10.79**±2.16	Duplicate
	C_2	26.14**±0.18	0.92**±0.17	ns	ns	ns	ns	
	C_3	16.99**±1.96	2.49**±0.19	15.90**±4.17	6.40**±1.95	1.40*±0.71	−9.00**±2.29	Duplicate
Dry gluten (%)	C_1	10.99**±0.10	1.19**±0.12	ns	ns	ns	−0.99**±0.2C	
	C_2	13.92**±0.89	0.83**±0.12	−6.38**±2.06	−2.84**±0.88	ns	3.44*±1.23	Duplicate
	C_3	13.83**±0.86	0.87**±0.12	−6.44**±2.00	−2.76**±0.86	ns	3.47*±1.23	Duplicate
β-Carotene (ppm)	C_1	7.64**±0.68	0.77**±0.09	−5.16**±1.53	−1.48*±0.68	ns	3.20**±0.88	Duplicate
	C_2	7.87**±0.70	0.83**±0.11	−6.71**±1.63	−2.09**±0.69	−1.0/8*±0.41	4.75**±0.98	Duplicate
	C_3	5.42**±0.09	1.09**±0.08	ns	ns	ns	ns	
Hectolitre weight (kg/hl)	C_1	83.44**±2.07	3.29**±0.16	−22.80**±4.38	−7.77**±2.06	3.42**±0.68	15.36**±2.38	Duplicate
	C_2	77.09**±0.14	5.70**±0.15	ns	ns	ns	−1.67**±0.36	
	C_3	81.75**±1.73	5.07**±0.18	−10.08*±3.68	−6.46**±1.72	1.29*±0.64	−4.42**±2.01	Duplicate
Yellow berry incidence (%)	C_1	9.78**±0.90	1.13**±0.17	−13.89**±1.98	−4.81**±0.88	−1.69**±0.46	8.65**±1.21	Duplicate
	C_2	4.02**±0.11	2.32**±0.11	−3.25**±0.48	ns	−1.02*±0.42	2.16**±0.44	Duplicate
	C_3	4.03**±0.06	1.78**±0.11	ns	ns	−2.51**±0.41	ns	

*,**Significant at 5% and 1%, respectively; ns: non-significant

gene effects along with all the three types of non-allelic digenic interactions. In cross C_2 also the pattern of inheritance was similar to that of C_1 except that the additive × additive type of interaction was non-significant. In cross C_3 only additive gene effects and additive × dominance type of interaction played an important role in the inheritance of yellow berry incidence. Singh [11] and Dhillon [6] had also reported importance of additive and dominance gene effects in the genetic control of yellow berry incidence.

A perusal of the above results suggests that digenic interaction model was adequate for protein content and dry gluten content. For sedimentation value and hectrolitre weight there was an indication for presence of trigenic or linked digenic interactions as all the six parameters were found to be significant for these two traits in crosses C_1 and C_3. The presence of trigenic or linked digenic interactions can not be ruled out in cross C_1 for yellow berry incidence and in cross C_2 for β-carolene content. It was also noticed that nature and magnitude of gene effects varied with different crosses for different characters, therefore, different strategy has to be adopted for a particular cross to bring improvement with regard to quality attributes. The study suggests that homozygous pure lines can be developed by following selection scheme like pedigree method of selection. Diallel selective mating or bi-parental mating in early segregating generations can prove to be an effective approach.

References

1. **McKenzie H. A. and Wallace H. S.** 1954. Kjeldahl determination of nitrogen. A critical study of digestion conditions, temperature, catalyst oxidising agent. Aust. J. Chem., **7**: 55-70.
2. **Dick J. W. and Quick J. S.** 1983. A modified screening test for rapid estimation of gluten strength in early generation durum wheat breeding lines. Cereal Chem., **60**: 315-318.
3. **American Association of Cereal Chemists.** 1976. Approved methods of the AACC. Method 38-10. Association: St. Paul, MN.
4. **Mather K.** 1949. Biometrical Genetics. (1st. Ed.). Methuen, London.
5. **Cavalli L. L.** 1952. An analysis of linkage in quantitative inheritance. *In*: Quantitative Inheritance (eds. E.C. Reeve and C.H. Waddington) HMSO, London: 135-144.
6. **Dhillon O. P., Yunus M. and Waldia R. S.** 2002. Inheritance of yield and quality components in durum wheat (*Triticum durum* Desf.). Indian J. Genet., **62**: 155-156.
7. **Aruna C. and Raghaviah P.** 1995. Generation mean analysis for yield and quality parameters in *Triticum aestivum* L. Crop Res. Hisar, **10**: 307-317.
8. **Zhang C. Y. and Zhang C. Ying.** 1996. A study on the combining ability of processing quality characters in wheat germplasm resources. J. Hebei. Agric. Univ., **19**: 7-11.
9. **Yadav B., Yunus M. and Madan S.** 1997. Genetic architecture of yield, yield components arid quality traits in bread wheat. Indian J. Agric. Res., **31**: 28-32.
10. **Lee J., Kaltsikes P. J. and Bushuk W.** 1976. The inheritance of Lip oxidase activity and pigment content in durum wheat. Theor. Appl. Genet., **47**: 243-250.
11. **Singh M.** 1995. Genetic analysis of some quality traits in durum wheat (*Triticum durum* Desf.). Ph.D dissertation, Punjab Agricultural University, Ludhiana, India.