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Stability of breeding characters related with bread wheat quality in Southern Spain

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SUMMARY – In 1998 CIMMYT and Agrovegetal SA signed an agreement aimed at developing new wheat varieties adapted to agroclimatic conditions of Southern Spain. To select bread wheat cultivars appropriate for Andalusian market is important to meet high protein and bread making quality requirements. The stability of several characters related with bread quality of a set of five new varieties ('Escacena', 'Ecija', 'Olvera', 'Jerezano' and 'Vejer'), and three checks ('Yecora', 'Cartaya' and 'Pinzon') has been tested in samples collected from trials in quadrate lattice with three replicates in five locations of Andalusia during the 2000-2001 and 2001-2002 crop seasons. The quality testing and statistical analysis of the data were conducted at the Genetics Department of the University of Cordoba, showing that in these typical Mediterranean conditions the main part of quality parameters were highly influenced by the environment. The distribution of phenotypic variance showed that the three quality traits in which the genotype was the main factor of variation in the two-year analysis were SDS-sedimentation, falling number, and alveograph-W. For the rest of traits the environment or the genotype x environment interaction explained, in at least one year, more than 50% of the observed variance.

Introduction

Bread wheat (*Triticum aestivum* ssp. a*estivum* L. em. Thell), is the third small grain cereal cultivated in the south of Spain, right after durum wheat and barley. The area cultivated to bread wheat has been increasing quickly in the last few years from around 50,000 hectares to more than 100,000 hectares.

The soil and climatic conditions of southern Spain are adequate to produce high quality flours for the bread wheat industry and new cultivars suited for this purpose are being developed by the CIMMYT-Agrovegetal agreement. In a breeding program aiming to select new cultivars with high flour quality and good stability for the most important characters, it is very important to know which of them show a good stability among years and localities and which are the most influenced by the environment.

Materials and methods

The new cultivars 'Escacena', 'Ecija', 'Olvera', 'Jerezano' and 'Vejer', together with the three checks 'Yecora', 'Cartaya' and 'Pinzon', were grown in quadrate lattice with three replicates and plot size of 6 m^2 in five localities of Andalusia (Spain) during 2000-2001 and 2001-2002: Ecija (Sevilla), Escacena del Campo (Huelva), Jerez de la Frontera, Olvera and Conil (Cádiz). The agronomic practices were according to the standards in each locality. These new cultivars were obtained by the agreement between CIMMYT and Agrovegetal SA.

Yield was measured as kg/ha. The quality traits analysed were test weight and thousand kernel weight, grain and flour moisture content, flour extraction rate, protein concentration, SDS-lactic sedimentation (SDSs) volume measured in ml according to micromethod of Dick and Quick (1983) modified by Peña *et al.* (1990), the gluten index measured in percentage of wet gluten according to Cubbada *et al.* (1992), and the Chopin Alveograph (Tripette & Renaud) parameters (P, L, G, P/L and W), measured according to manufacturer's instructions.

Data were statistically analysed for each locality and all the localities by an analysis of variance (ANOVA). The distribution of phenotypic variance of yield and quality characters in samples collected in five places in 2001and 2002 were determined and compared.

Results and discussion

The distribution of the phenotypic variance (Table 1) showed that the main factor (observed variation above 50%) affecting during the two years the quality traits SDS-sedimentation, falling number and alveograph-W was the cultivar.

Table 1.Distribution of phenotypic variance of yield and quality characters in 2001 and 2002

Character	Variation factor								Total	
	Location (L)		Cultivar (C)		Interact. (L x C)		Error			
	σ^2	%	σ^2	%	σ^2	%	σ^2	%	σ^2	%
Yield 2001	1.64E6	69.0†	2.92E5	12.3	5.2E5	2.2	3.9E5	16.5	2.3E6	100
Yield 2002	140E+3	21.7	172E+3	26.8†	112E+3	17.5	218E+3	34.0†	642E+3	100
Test weight 2001	2.31	53.8†	0.67	15.6	0.66	15.3	0.66	15.3	4.29	100
Test weight 2002	3.96	46.6†	2.27	26.7	1.00	11.8	1.27	15.0	8.51	100
1000 kernel weight 2001	24.31	67.7†	3.01	8.4	499.04	11.3	4.53	12.6	35.89	100
1000 kernel weight 2002	9.04	48.6†	4.85	26.0	2.32	12.5	2.40	12.9	18.61	100
Grain moisture % 2001	0.34	89.0†	0.00	0.0	0.00	0.8	0.04	10.2	0.38	100
Grain moisture % 2002	1.31	94.6†	0.02	1.7	0.01	0.8	0.04	2.9	1.38	100
Flour moisture % 2001	0.00	4.8	0.00	0.0	0.00	0.0	0.08	95.2†	0.09	100
Flour moisture %2002	0.04	24.8	2E-3	1.0	0.02	13.7	9E-3	60.6†	0.16	100
Flour extraction % 2001	6.59	50.1†	1.87	14.2	0.00	0.0	4.70	35.7	13.16	100
Flour extraction % 2002	3.95	26.0	7.17	47.1†	1.93	12.7	2.17	14.2	15.22	100
Protein content % 2001	0.10	6.2	0.50	31.6†	0.41	26.0†	0.57	36.1†	1.57	100
Protein content % 2002	0.49	32.4†	0.40	26.1	0.16	10.7	0.47	30.9	1.52	100
SDS 2001	0.99	11.0	5.78	64.4†	0.07	0.8	2.14	23.8	8.98	100
SDS 2002	1.16	22.6	3.08	61.1†	0.09	1.8	0.71	14.1	5.04	100
Falling number 2001	1.21E4	10.1	8358.34	69.6†	1.4E3	12.1	975.63	8.1	1.2E5	100
Falling number 2002	857.30	13.9	3152.90	51.0†	1172.40	19.1	969.00	15.8	6151.60	100
Wet gluten % 2001	2.47	23.2	1.40	13.2	2.30	21.6	4.48	42.0†	10.65	100
Wet gluten % 2002	2.40	26.8	1.10	13.1	1.40	16.6	3.81	43.4†	8.80	100
Dry gluten % 2001	0.28	17.6	0.22	14.1	0.36	22.4	0.73	45.9†	1.59	100
Dry gluten % 2002	0.40	31.7	0.15	12.2	0.16	12.8	0.54	43.2†	1.25	100
Gluten index 2001	4.82	16.3	8.30	28.0	2.65	8.9	13.85	46.8†	29.61	100
Gluten index 2002	3.60	11.4	9.70	31.3	3.40	11.0	14.40	46.3†	31.00	100
P 2001	14.33	5.4	178.67	66.9†	39.71	14.9	34.40	12.9	267.12	100
P 2002	23.96	12.8	93.00	49.7†	49.25	26.3	20.84	11.1	187.06	100
L 2001	306.33	29.6†	323.81	32.2†	187.25	18.1	218.90	21.1	1036.2	100
L 2002	313.61	26.6†	298.35	25.3†	300.30	25.5†	267.44	22.8†	1179.71	100
G 2001	3.62	31.0†	3.65	31.3†	1.83	15.6	2.58	22.1	11.67	100
G 2002	2.70	26.0†	2.80	26.8†	2.60	25.2†	2.30	22.0†	10.40	100
W 2001	720.07	12.4	3232.16	55.7†	960.88	16.6	891.38	15.4	5804.4	100
W 2002	1945.41	27.1	3861.84	53.7†	395.93	5.5	983.83	16.7	7187.01	100
P/L 2001	0.05	27.8†	0.06	34.3†	0.02	13.1	0.04	24.8	0.17	100
P/L 2002	8E-3	17.3	0.01	22.7	0.019	39.0†	0.01	21.1	0.05	100

†Most important component/s of phenotypic variance for each character.

The influence of location, cultivar and their interaction on all other quality parameters varied with year of testing. For SDS-sedimentation, falling number and alveograph-W, which showed high stability in southern Spain, samples from only two or three trial locations are considered enough for determining the suitability of each new cultivars for industrial purposes. Otherwise for other important traits such as specific weight, protein content, and extensibility (L and P/L), we need samples from at least four or more locations due the low stability of these characters.

The data showed the low screening value of measuring some characters to compare the industrial quality of new cultivars due to the huge influence of locations (specific weight, thousand kernel weight and grain moisture) and errors (flour moisture, wet and dry gluten % and gluten index).

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