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Rheological tools for predict alveographin relation to physicochemical attributes of Wheat flour Quality

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Abstract

The present assessment were conceded out on fifty genotype wheat flour to judge the relationship between viscoelastic parameters specific to the Alveograph method and flour analytical parameters (extensibility, baking strength and P/L ratio).The estimates of heritability were high for all the characters over all the environments, except protein content, sedimentation value, test weight and 1000-seed weight indicating relevance of phenotypic expression of these characters to the genotypes. The maximumassessments of genetic gain conveyed as percentage of mean were recorded for chapati score, extensibility, baking strength and P/L ratio over all the environments. They were medium for vegetative phase; while they were low for protein content, wet gluten and test weight over all the environments. A moderate estimate of genetic gain expressed as percentage of mean were observed for vegetative phase over all the environments. Four charactersviz; extensibility, baking strength, P/L ratio and chapati score evinced high value of heritability and high estimate of genetic advance as percentage of mean over all the environments. Thus, improvement in these traits can be effectively executed by selection.

Key Words: Extensibility, Baking strength, P/L ratio and Wheat

Introduction

Ever since the mankind transformed to civilized life, the contribution of wheat in thwarting hunger and malnutrition has been incredibly unparallel. It is grown over 17% of wholly crop acreage global and for 40% of basic food for the world's population [1].It has cleistogamous flowers of the family *poaceae*and is believed to have been originated in the

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golden crescent between Tigris and Euphrates in Middle East Asia. Wheat (*Triticum spp*.) is an incredible cereal by dint of having unique quality of protein, called gluten that assigns peculiar functional properties to its dough. India is unique as unlike other parts of the globe about 75 per cent of the ninety odd million metric tons annual production of wheat [2].

The uniqueness of wheat flour is that when it is mixed with water, it impregnates unique visco-elastic properties to the dough. This provides special functional properties to dough to make it amenable to processing in to variety of food products such as bread, chapati, biscuits and pasta. Each product demands unique physical and chemical requirements in wheat grain [3-4]. Therefore, wheat varieties have been classified in to different classes commercially in global wheat trade as per physical (hardness and bran colour) and chemical attributes (protein contents and quality). In India, no such commercial classes exist. However, it has been univocally reported that the both physical and chemical properties of wheat are inherently genotypic attributes, though they have been found varying over different zones of the country; South Zone and North Hill Zone being the richest and poorest for realizing protein content, respectively [5]. Similar regional differences exist for other quality traits too. It needs no over scoring that wheat grown in Central Zone is considered good quality wheat.

Wheat (*Triticum aestivum*L.) has been a foremost staple diet of overarching population throughout the recorded history. Unlike other parts of the world where wheat is consumed as bread for basic food, chapati prepared from whole wheat flour is the predominant staple diet in Indian sub-continent. It has been described as the 'king of cereals' because of the acreage occupied and production compared to every other grain crop [6]. It is a self-pollinated crop. It is a hexaploid wheat having 42 chromosomes with six groups of seven chromosomes each $2n=6x=42$. Glutenin assign extensibility while gliadin provides viscosity to dough [7].Protein quality (glutenin and gliadin) is the inherent characteristic of the genotype while protein content is the manifestation of genotype, environment and their interaction [8].

Materials and Method

The investigation was conducted entailing forty-five diverse genotypes and five checks of bread wheat. Seed material was acquired from the Wheat Research station, Vijapur. The complete set of 50 genotypes comprising 45 diverse genotypes and 5 checks were grown in a Randomized Block Design (RBD) with two replications during *rabi* 2013-14 and *rabi* 2014-2015

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at Sardarkrushinagar (Environment-1 and Environment-2). Each plot comprised of single row of 2.5m length spaced 22.5 cm apart with 10 cm within rows. Recommended practices were adopted for raising a good crop under irrigated conditions.The rheological properties of wheat flour dough were determined by the Alveograph device according to SR EN ISO 27971: 2008. Each Alveograph chart was analyzed for parameters.

Result and Discussion

The estimates of heritability in broad sense for different characters over different environments are presented in Table 4.1 to 4.2. P/L ratio (99.47%), baking strength (98.55%), extensibility (98.43%), grain yield per plot (90.87%), chapati score (90.35%), vegetative phase (85.47%), reproductive phase (84.47%), wet gluten (61.06%), dry gluten (73.34%) and grain hardness index (68.06%) evinced high estimates of heritability at Environment-1 (Table 4.1). The estimates of heritability were moderate for test weight (35.84%), sedimentation value (35.22%), protein content (32.12%), while it was low for 1000-seed weight (19.16%).

The estimates of heritability in broad sense for different characters under Environment-2 are presented in Table 4.1. Extensibility (99.93%), baking strength (99.87%), P/L ratio (99.75%), chapati score (92.40%), vegetative phase (87.09%), reproductive phase (86.00%), grain yield per plot (84.35%), grain hardness index (73.54%), 1000-seed weight (67.91%), dry gluten (65.15%), test weight (53.76%), protein content (47.54%) and wet gluten (43.51%) evinced high estimates of heritability. The moderate heritability was recorded for sedimentation value (27.88%).

The assessments of genetic advance expressed as per cent of mean for different characters over different environments are given in Table 4.10 to 4.12. The estimates of genetic advance expressed as per cent of mean was high for P/L ratio (44.62%), grain yield per plot (30.22%), extensibility (27.25%), baking strength (23.40%) and chapati score (20.91%) at Environment-1 (Table 4.10). They were moderate for dry gluten (16.27%) and vegetative phase (10.88%). Low estimates of genetic advance expressed as per cent of mean were observed for reproductive phase (5.83%), protein content (3.38%), wet gluten (4.46%), sedimentation value (6.03%), 1000-seed weight (2.93%), grain hardness index (7.98%) and test weight (2.33%).

The estimates of genetic advance expressed as per cent of mean for different characters over Environment-2 are given in Table 4.10. The estimates of genetic advance were high for P/L

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ratio (44.98%), extensibility (27.89%), grain yield per plot (25.50%), chapati score (25.25%) and baking strength (23.58%). They were moderate for grain hardness index (15.74%), 1000-seed weight (14.18%) and vegetative phase (12.14%). Low estimates of genetic advance expressed as per cent of mean were observed for dry gluten (8.42%), reproductive phase (6.41%), protein content (5.47%), wet gluten (3.30%), sedimentation value (4.53%) and test weight (2.13%).

A combination of maximum heritability and high genetic advance as percentage of mean is the ideal condition for a breeder to execute precise and effective selection for a particular trait. Four characters*viz;* extensibility, baking strength, P/L ratio and chapati score evinced high value of heritability and high estimate of genetic advance as percentage of mean over all the environments. Thus, improvement in these traits can be effectively executed by selection. Other traits exhibited variable combinations of heritability and genetic advance as percentage of mean over different environments. These verdicts are in agreement to the findings of [9-17].

Conclusion

The estimates of heritability were high for all the characters over all the environments, except protein content, sedimentation value, test weight and 1000-seed weight indicating relevance of phenotypic expression of these characters to the genotypes. The high estimates of genetic gain expressed as percentage of mean were recorded for chapati score, extensibility, baking strength and P/L ratio over all the environments. They were medium for vegetative phase; while they were low for protein content, wet gluten and test weight over all the environments. A moderate estimate of genetic gain expressed as percentage of mean was observed for vegetative phase over all the environments. Four characters*viz;* extensibility, baking strength, P/L ratio and chapati score evinced high value of heritability and high estimate of genetic advance as percentage of mean over all the environments. Thus, improvement in these traits can be effectively executed by selection.

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Table 4.10 Genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV),heritability (h^2_{bs}),genetic advance (GA) genetic advance as per cent of mean (GA_{pm}) for different characters in bread wheat under Environment-1 and Environmednt-2

Characters	GCV (%)	PCV (%)	h^2_{bs}	GA	GA_{pm}	GCV (%)	PCV (%)	h^2_{bs}	GA	GA_{pm}
	Environmednt-1					Environmednt-2				
Chapati score	10.10	10.15	90.35	1.68	20.91	12.22	12.26	92.10	1.96	25.25
Protein content (%)	2.89	5.11	32.12	0.44	3.38	3.85	5.59	47.54	0.78	5.47
Wet gluten (%)	2.77	3.55	61.06	1.35	4.46	2.43	3.68	43.51	10.05	3.30
Dry gluten (%)	9.22	10.77	73.34	1.67	16.27	5.06	6.28	65.15	0.83	8.42
Sedimentation value (ml)	4.93	8.31	35.22	2.63	6.03	2.51	8.44	27.88	2.12	4.53
Extensibility (mm)	13.15	13.22	98.43	16.23	27.25	13.51	13.54	99.93	16.14	27.89
Baking strength (10^{-4}J)	11.28	11.36	98.55	42.75	23.40	11.42	11.46	99.87	42.70	23.58
P/L ratio (mm)	21.70	21.77	99.47	69.33	44.62	21.86	21.89	99.75	69.11	44.98
Grain hardness index	4.69	5.69	68.06	6.54	7.98	8.91	10.39	73.54	10.56	15.74
Test weight (kg/hl)	1.89	3.15	35.84	1.81	2.33	1.41	1.92	53.76	1.69	2.13
1000-seed weight (g)	3.25	7.43	19.16	1.31	2.93	8.35	10.14	67.91	6.47	14.18
Vegetative phase (days)	5.71	6.18	85.47	6.43	10.88	6.31	6.77	87.09	6.97	12.14
Reproductive phase (days)	3.08	3.35	84.47	6.26	5.83	3.35	3.62	86.00	6.78	6.41
Grain yield per plot (g)	15.39	16.14	90.87	41.53	30.22	12.46	13.78	84.75	46.22	25.50