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Multivariate Analysis of Physico-Chemical, Grain Shape and Cooking Quality Parameters of Some Advance Indica Rice (Oryza Sativa l) Lines under Irrigated Condition

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Abstract:

Rice quality is considered as the 2nd most important trait in rice breeding programs after yield, whereas in some cases as the most important where rice quality is the most valuable trait. Better quality rice gives better returns to the farmer therefore rice lines with better yield as well as supreme quality is very important while breeding for rice crop. In the present study, sixty (60) promising high quality rice lines were evaluated for their grain shape quality traits, cooked grain and physico-chemical traits were studied. Results depicts significantly different behavior of rice genotypes for all the studied quality traits. All the traits showed more than 60% heritability emphasizing the significant heritable behavior of the genes involved in these traits as well as polygenic behavior of the traits. Average grain length (AGL) showed significantly negative genotypic correlation with average grain length (-0.4158*) and elongation ratio (-0.3153*) whereas positive significant genotypic correlation (0.4143*) with cooked grain lemgth. Average grain thickness had highly significant and positive genotypic correlation (0.8689**) with average grain width while elongation ration had highly significant and positive genotypic correlation (0.7118**) with cooked grain length

Keywords: Grain Quality Traits, Physico-Chemical Traits, Rice, Genotypic, Phenotypic Correlation, Multivariate Analysis

Introduction:

Rice (Oryza sativa L) is most eatable food across the world. World's round 2/5th (2.4 billion) population uses Rice as staple food. As per IRRI 2009, Rice is leading cereal crop after wheat and feed half of the world. Rice consumers prefers aromatic rice due to its aroma and palatability. Grain quality is very important trait and comes after yield and it is very complex trait and comprises of many important traits such as milling quality, grain size, shape, appearance and other cooking characteristics (Huang et al. 1998; Wan et al. 2004).

Among cereal crops only rice is consumed as whole grain, quality concerns are very important (Hossain et al., 2009). Cooked Grain Length (CGL) is one of the significant cooking quality attributes. Elongation Ratio (E/R) of rice grain after cooking is desirable feature in high quality like Basmati rice. Because of its linear expansion it fetches premium price. To determine approval of a rice variety kernel shape and visual appearance of rice before and after cooking is very important. Prime rice eating nations have the preference towards varieties that elongate considerably after cooking Khatun et al. (2003).

For high yielding variety approval, rice breeder along with yield give attention to quality parameters which enhance the economic importance of rice. Cooking and processing quality, which can be measured in terms of grain elongation during cooking, amylose content, milling and processing systems also contribute to the economic value of rice. Later, high extent of variability in a population provides the opportunity for selection of varieties having desirable characters. Previous outcomes during the past studies conclude that cooking quality is directly related to the physical and chemical characteristics of the starch present in the endosperm; i.e.; alkali spreading value (ASV) amylose content (AC), gel consistency (GC), (Little et al., 1958., Webb, 1980., Juliano, 1980., Unnevehr et al., 1992., and Tan et al., 1999).

In rice main factor responsible for the grain appearance are grain shape and chalkiness ratio (i.e. the ratio between opaque and translucent grains).Chalky grains process low density of starch granules in contrast to the translucent ones (Del Rosario et al. 1968). Since chalky grains are more likely to break during milling because they are not as hard as the translucent ones (Septiningsih et al. 2003). Head rice is an essential traits for milled rice and main aspect in determining rice market value. (Aluko et al. 2004).

Material and Methods:

Sixty advance lines were grown in Rice Research Institute Kala Shah Kaku, Pakistan during 2016. Ten randomly selected whole kernel of rice in three sets were taken and length of each grain was measured by placing on a micro scale. Breadth of each grain was measured using a vernier caliper. The average of 10 such observation was taken for final reading of breadth of rice kernels in millimeter (mm). The L/B ratio was calculated by dividing the Average length by the average breadth of rice kernel. Based on the L/B ratio, grains were classified into long slender (LS), short slender (SS), medium slender (MS), long bold (LB) and short bold (SB) (Dela Cruz et al., 2000). The length of 10 whole rice kernel after cooking was measured by using the micro scale, and then average length of cooked kernel by the average length of the raw (uncooked) rice (Juliano 1971). Kernal elongation ratio was calculated by dividing the average length of cooked kernel by the average kernel length determined.

Ten cooked rice kernels were selected (intact at both ends) and length of the kernels measured using graph paper for computing the kernel length after cooking (KLAC). ER were calculated (Anonymous, 2004). Select 100 healthy grains. Place in petri dish and soak for 34-40min in excess water. Then add these grain for boiling water (100 ^{o}C) for 6 min. then drain water and add cold water.

Gelatinization Temperature (GT):

This was indexed by alkali spreading test [11]. The degree of spreading of individual milled rice kernel in a weak alkali solution (1.7% KOH) at room temperature (32±2^{0} C was evaluated on a 7-point numerical scale [12]. Each test was conducted three times, each time, 10 intact milled grains were placed on a petri dish to which 15 ml of 1.7% KOH was added. The grains were carefully separated from each other and incubated at 27-30oC temperature for 23 hours to allow spreading of the grains. Grains swollen to the extent of a cottony center and a cloudy collar were given an alkali spread value (ASV) score 4 and used as check for scoring the rest of the samples in the population. Grains that were un-affected were given ASV of 1 and grains that were dispersed and disappeared completely were given a score of 7. A low ASV correspond to a high gelatinization temperature; con-versely, a high ASV indicates a low GT.

Statistical analysis:

All the experiment was carried out using three replications. The data was analyzed by using a staitistical software Statistix v1.8 and PB Tools (IRRI).

Results And Discussion:

Rice consumers' quality criteria is based on appearance, size and shape of the grain. Breeders give more attention to the size of the grain and shape in developing the new rice varieties (Adair et al., 1966). For quality the rice grain can classified into long grain, medium grain and short grain (Adu-kwarteng et al., 2003). The Basmati lines are categorized into long slender grains with grain length more than 6mm, L/ B ratio is 3mm and high kernel elongation ratio after cooking (Singh et al., 2000). It ranged from 8.74 to 6.86. Maximum grain length was recorded for G37 (8.74 mm) followed by Line G 60 (8.73 mm), Line-G49 (8.58 mm). Minimum grain length was recorded for G-54 (6.86 mm), (Table 5). It ranged from 1.67 to 1.32. Maximum grain width was recorded for G31 (1.67 mm) followed by G23 (1.66 mm), G24 (1.60 mm). Minimum grain width was recorded for G52 (1.32 mm), (Table 5). Grain thickness ranged from 1.2mm to 1.5133mm. Maximum grain thickness is recrded for G54 (1.5133mm) followed by G23 (1.5mm), G25 and G31 (1.47 mm) and minimum grain thickness was recorded in G49 (1.2mm) followed byG3 (1.25mm) and G2 (1.2733mm), (Tabel 1)

Quality trait	Mean (±St. Dev.)	Max.	Min.	Mean Sq.	F value	Pr (>F)	h^2
AGL	7.81 (±0.69)	8.96	6.78	0.807	2.680	0.0000	0.63
AGW	1.525 (±0.104)	1.78	1.20	0.019	3.080	0.0000	0.67
AGT	1.386 (±0.084)	1.55	1.10	0.013	3.622	0.0000	0.72
CGL	14.528 (±1.255)	17.5	11.8	3.806	7.652	0.0000	0.87
BP	4.197 (±3.494)	24.3	0	23.762	3.373	0.0000	0.70
ER	1.856 (±0.159)	2.509	1.201	0.059	5.841	0.0000	0.83
ASV	5.759 (±1.117)	7	3	3.300	10.822	0.0000	0.91

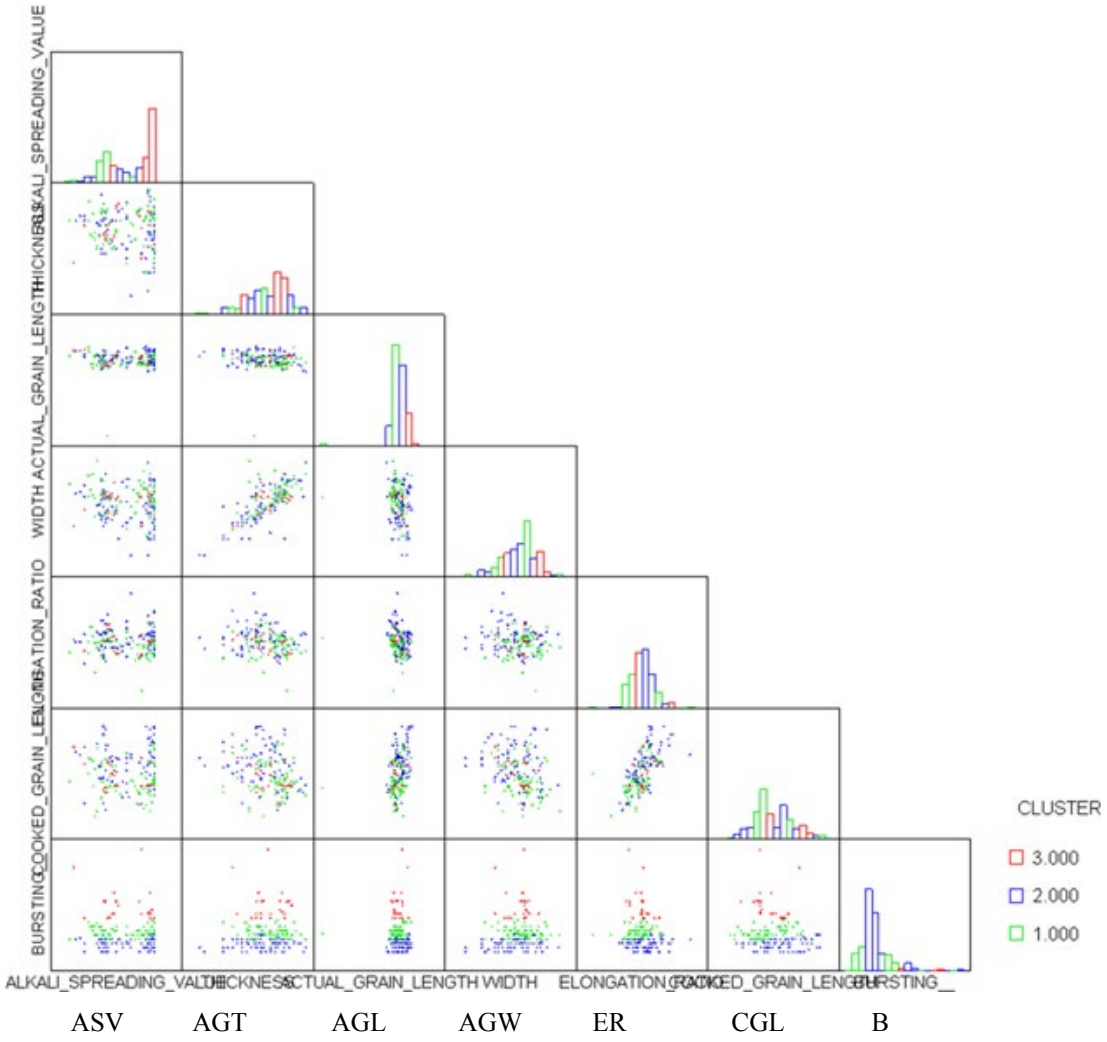
Table 1: results of ANOVA for all the studied traits

Results depicts significantly different behavior of rice genotypes for all the studied quality traits. All the traits showed more than 60% heritability emphasizing the significant heritable behavior of the genes involved in these traits as well as polygenic behavior of the traits. Average grain length (AGL) showed significantly negative genotypic correlation with average grain length (-0.4158*) and elongation ratio (-0.3153*) whereas positive significant genotypic correlation (0.4143*) with cooked grain length. Average grain thickness had highly significant and positive genotypic correlation (0.8689**) with average grain width while elongation ration had highly significant and positive genotypic correlation (0.7118**) with cooked grain length.

		Avg. Grain Length	Avg. Grain Width	Avg. Grain Thickness	Cooked Grain Length	Bursting Percentage	Elongation Ratio
Avg. Grain Width	G	-0.4158*					
	P	-0.2812					
Avg. Grain Thickness	G	-0.2135	0.8689**				
	P	0.1596	0.7932**				
Cooked Grain Length	G	0.4143*	-0.1948	-0.1254			
	P	0.3667	-0.2158	-0.1660			
Bursting Percentage	G	0.0219	0.1176	0.2096	-0.1932		
	P	-0.0026	0.1123	0.1354	-0.1644		
Elongation Ratio	G	-0.3153*	-0.0402	-0.0012	0.7119**	-0.1410	
	P	-0.2462	-0.0776	-0.0655	0.6869**	-0.1229	
Alkali Spreading Value	G	-0.0251	0.0280	0.0286	0.0261	-0.1345	-0.0232
	P	0.0002	-0.0228	0.0172	0.0293	-0.1202	-0.0078

Table 2: Genotypic and phenotypic correlation coefficients among rice grain quality traits

Cluster SPLOM



Conclusion:

Rice quality is considered as the 2nd most important trait in rice breeding programs after yield, whereas in some cases as the most important where rice quality is the most valuable trait. Better quality rice gives better returns to the farmer therefore rice lines with better yield as well as supreme quality is very important while breeding for rice crop. In the present study, sixty (60) promising high quality rice lines were evaluated for their grain shape quality traits, cooked grain and physico-chemical traits were studied. Results depicts significantly different behavior of rice genotypes for all the studied quality traits. All the traits showed more than 60% heritability emphasizing the significant heritable behavior of the genes involved in these traits as well as polygenic behavior of the traits. Average grain length (AGL) showed significantly negative genotypic correlation with average grain length (-0.4158*) and elongation ratio (-0.3153*) whereas positive significant genotypic correlation (0.4143*) with cooked grain lemgth. Average grain thickness had highly significant and positive genotypic correlation (0.8689**) with average grain width while elongation ration had highly significant and positive genotypic correlation (0.7118**) with cooked grain length.

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