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Performance of Different Rice Genotypes in the Cold Climatic Region of Malakand Division

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Abstract
An experiment was conducted to evaluate the growth and yield performance of rice genotypes PK3445-3-2, OM5627, IR64, IR8225-9-3-2-3, CIBOGO, Japanese rice and Fakhre Malakand under agro-climatic conditions of Malakand division. The rice genotypes differed significantly with respect to days to 50% flowering, days to maturity, plant height, thousand grain weight and paddy yield (t ha^{-1}) except panicle length and number of tillers/hill. Japanese rice has smallest panicle length (21.23 cm) and OM5627 has longest panicle length (28.00 cm). In genotypes Fakhre Malakand showed higher paddy yield (9.58 t ha^{-1}) followed by PK3445-3-2 and IR64 produced paddy yield 8.66 and 8.51 t ha^{-1} respectively, while the minimum paddy yield (4.02 t ha^{-1}) was recorded in Japanese rice. Therefore the advanced rice genotype PK3445-3-2 should be further evaluated on farmers' field for approval as a commercial variety and to be best fit in the prevailing cropping pattern of the region.
Keywords: Rice, Genotypes, Cold tolerance.

INTRODUCTION
Rice is the most important cereal grown globally and the major staple food for about half of the world population, providing 23% of world calories intake. Around 600 million tons of rice is produce globally each year. Within the next 20 years, this production needs to increase by 20 to 30% to satisfy the demand of an expanding population in Asia, Africa and Latin America. Therefore rice is the worldwide major food staple and a mainstay for the rural population and their food security (IRRI KB, 2013).

Cereals especially wheat, maize and rice play a dominant role in the crop husbandry of Malakand division. In Malakand division, major cereals are grown on a total area of 378,000 hectare with a total production of 527,000 tons (Crop Statistics KPK 2010-11). Cereals alone generate an annual revenue of Rs. 13,187 million to cereals growers of Malakand division. There is big scope in cereal crops as the present production is far below than the average actual potential of the cereal crops and is trying hard to fill up the yield gap and increase the production as much as possible.

Cold stress is a common problem in rice cultivation and a crucial factor in global production (Zhou *et al.,* 2012). Rice is a cold-sensitive plant that originated from tropical or subtropical zones. When low temperature occurs during the reproductive stages, it can cause serious yield and yield components losses (Farrell *et al.,* 2006). The optimum temperature for rice cultivation is between 25°C and 35°C, and in temperate regions, rice growth is impressed by limited period that favors its growth (De Los Reyes *et al.,* 2003).

Exposure to cold temperature affects all phonological stages of rice and lower grain production and yield. Low temperature in vegetative stage can cause slow growth and reduce seedling vigor (Ali *et al.,* 2006) low number of seedlings, reduce tillering (shimono *et al.,* 2002) increase plant mortality (Farrell *et al.,* 2006, Baruah *et al.,* 2009, Fujino *et al.,* 2004) increase the growth period (Alvarado and Hernaiz 2007) and in reproductive stage, it can cause to produce panicle sterility and lower grain production and yield tillering (shimono *et al.,* 2002).

In the high altitude, cold and mountainous areas of Khyber Pakhtunkhwa 74% of the rice acreage lies where cold damage to rice crop has been a problem to growers (Crops Statistics Khyber Pakhtunkhwa 2010-11). The peculiar cooler climatic conditions encompass Malakand Division, Hazara Division, and high altitudes of attached tribal areas, having low air and water temperatures. Water temperature remains 18^{o}C during the main growing season (Soomro, and Mclean, 1972). Owing to this reason, the cultivation of high yielding coarse and fine basmati rice varieties has not been successful. Major impediments in higher rice yields are existing low temperatures and sub-optimal cultural practices. Leaf yellowing, stunting in seedling and early vegetative stage, delayed heading and sterility in the reproductive stage are common consequences of cold stress (IRRI, 1974; Kaneda and Beachell, 1972). These conditions dictate the development of cold tolerant rice's with appropriate production technologies for these cooler hilly areas.

Rice cultivation in the high altitude, cold and mountainous areas of Malakand division lies 34.5 to 36.0^{o}N and an elevation of 800 to 1800 m above sea level. The lowest minimum air temperature varies from 8.5^{o}C to 18.5.^{o}C during the rice growing season (May to October) with also large amount of precipitation in these months. Irrigation water is from the melting snow over the mountains in the river Swat. The temperature of water in the river is below 15^{o}C in the rice season and the temperature of irrigation water depends on the distance from the main channel which rarely increases 18°C in the rice field. The aim of this study was to evaluate the performance of different rice genotypes in cold region. The best performing genotypes will be selected for further evaluation and registration of variety.

MATERIALS AND METHODS

An experiment entitled "Performance of different rice genotypes in the cold climatic region of Malakand division" was conducted during kharif 2013 at Agricultural Research Institute, Mingora, Swat. The experiment was laid out in randomized complete block design (RCB) having seven different rice genotypes in three replications. Nursery was sown in the 2nd week of May and transplanted in the age of thirty days. Before transplanting, the field was thoroughly prepared in watered condition. Then water was applied to the field, for puddling. The well puddled field was supplied with the basal doze of NPK, 120, 60, 40, kg ha^{-1}. Before transplanting half of the nitrogen and all phosphorus and potash were applied. The remaining half of the nitrogen was applied one month after transplantation. Row to row and plant to plant distance of 20 cm was maintained in a plot size of 4.2 m^2 with six rows. The recorded data was subjected to statistical analysis and treatment means were compared using critical value for comparison, through statistical software, Statistics-8.1 package.

RESULTS AND DISCUSSION

Days to 50% flowering

The data regarding days to 50% flowering showed significant differences. Maximum days to 50% flowering (69 days) were recorded in genotype CIBOGO, followed by PK3445-3-2 and IR64 (68 days) respectively, while the minimum days to 50% flowering (49 days) was recorded in Japanese rice. This type of variability might be due to the genetic makeup of the exotic lines under specific environmental conditions.

Days to maturity

Data recorded on days to maturity showed significant differences. The maturity period ranged from 84 to 121 days. Maximum maturity days (121) were recorded in genotypes Fakhre Malakand, PK3445-3-2 and CIBOGO. While minimum maturity days (84) was recorded in Japanese rice. Sabouri *et al.,* (2008) have also reported variations in days to maturity in different genotypes of rice. Cold regions are characterized by short growing season and the genotypes taking maximum days are either fail to mature or having grain sterility. Early maturing varieties escape the cold damage.

Number of Tillers/hill

The analysed data on the number of tillers/hill showed non-significant differences. All the genotypes produced number of tillers/hill in the range of 14-17 tillers/hill. This sowed the relative stability of this character and that it is less prone to varying environmental conditions (Tahir *et al*., 2004).

Plant height (cm)

Analysis of variance for plant height showed significant differences. Maximum plant height (105, 104 and 103 cm) were recorded in genotypes PK3445-3-2, Fakhre Malakand and IR8225-9-3-2-3 respectively. The minimum plant height (90 cm) was recorded in Japanese rice. Zahid *et al*., (2005) reported that plant height has a negative correlation with yield. He also observed that plant height has a positive relationship with grain quality.

Panicle length (cm)

Analysis of variance data on panicle length showed non-significant differences among the genotypes. The data recorded on panicle length in the range of 21.23 to 28.00 cm. Maximum panicle length (28.00 cm) was recorded in Fakhre Malakand and OM5627, while the minimum panicle length (21.23 cm) was recorded in Japanese rice. Number of grains/panicle is closely related with yield but not the panicle length, as some genotypes have longer panicles but less number of grains/panicle.

1000 grain weight (gm)

Statistically analysed data on 1000 grain weight showed significant differences among the tested genotypes. Maximum 1000 grain weight (28.63, 28.00, 27.90, 27.07, 27.00 and 26.60 gm) were recorded in genotypes OM5627, Fakhre Malakand, IR8225-9-3-2-3, IR64, Japanese rice and CIBOGO respectively. The minimum 1000 grain weight (21.40 gm) was recorded in PK3445-3-2. Environmental factors such as temperature, season and time and soil fertility have also an effect on grain size and weight.

Paddy yield (t ha^{-1})

The data recorded on paddy yield showed significant differences. Maximum paddy yield (9.58 t ha^{-1}) was recorded in Fakhre Malakand followed by PK3445-3-2 (8.66 t ha^{-1}) and IR64 (8.51 t $ha^{-1)}$ respectively. The minimum paddy yield (4.02 t ha-1) was recorded in Japanese rice tested in the rice genotypes. Biswass *et al.,* (1998) reported that higher number of effective tillers per hill and higher number of grains per panicle showed higher yield in rice. Tahir *et al.,* (2002) reported that the environmental coefficient of variation (ECV) was the highest for grain yield/plant and grains/panicle showing these characters were sensitive to environment.

Table-1: Comparative Study of different Rice Genotypes for Growth and Yield Characters

Genotypes	50% flowering (days)	Maturity (days)	tillers/hill	Plant height (cm)	Panicle length (cm)	1000 grain weight (gm)	Paddy yield (t ha^{-1})
PK3445-3-2	68 AB	121 A	14	105 A	25.27	21.40 BC	8.66 AB
OM5627	66 C	116 B	14	98 B	28.00	28.63 A	7.32 AB
IR 64	68 AB	116 B	16	93 CD	25.20	27.07 AB	8.51 AB
IR 8225-9-3-2-3	67 BC	121 A	16	103 A	26.93	27.90 AB	7.28 B
CIBOGO	69A	116 B	17	94 BC	24.50	26.60 AB	7.28 B
Japanese rice	49 E	84 C	14	90 D	21.23	27.00 AB	4.02 C
Fakhre Malakand	62 D	121 A	16	104 A	27.90	28.00 AB	9.58 A
Critical value for comparison	**1.99**	**1.03**	**5.27**	**40.45**	**6.97**	**6.60**	**14.58**
CV %	**1.75**	**0.51**	**19.63**	**2.55**	**9.54**	**8.68**	**1.96**

LITERATURE CITED

Ali, M. G., R. E. L. Naylor, and S. Matthews. 2006. Distinguishing the effects of genotype and seed physiological age on low temperature tolerance of rice (Oryza sativa L.). Experimental Agriculture, vol. 42, no. 3, pp. 337–349.

Alvarado, R and S. Hernaiz. 2007. Antecedentesgeneralessobre el arroz en Chile, in Arroz Manejo Tecnológico, R. Alvarado, Ed., vol. 162 of Boletín INIA, p. 179, Instituto de InvestigacionesAgropecuarias INIA, Centro Regional de Investigación Quilamapu, Chillán, Chile.

Baruah, A. R., N. Ishigo-Oka, M. Adachi. 2009. Cold tolerance at the early growth stage in wild and cultivated rice. Euphytica, vol. 165, no. 3, pp. 459–470.

Biswas, J. K., M. A. Hossain, B. C. Sarker, M. Hassan and M. Z. Haque, 1998. Yield performance of several rice varieties seeded directly as late aman crops. *Bangladesh J. Life Sci*., 10: 47-52.

Crops Statistics. Government of Khyber Pakhtunkhwa, 2010-11. Crop reporting services Agriculture Livestock and Cooperative Department.

De Los Reyes, B. G., S. J. Myers, and J. M. McGrath. 2003. Differential induction of glyoxylate cycle enzymes by stress as a marker for seedling vigor in sugar beet (Beta vulgaris). Molecular Genetics and Genomics, vol. 269, no. 5, pp. 692–698.

Farrell, T. C., K. M. Fox, R. L. Williams, S. Fukai, and L. G. Lewin. 2006. Minimising cold damage during reproductive development among temperate rice genotypes. II. Genotypic variation and flowering traits related to cold tolerance screening. Australian Journal of Agricultural Research, vol. 57, no. 1, pp. 89–100.

Fujino, K., H. Sekiguchi, T. Sato. 2004. Mapping of quantitative trait loci controlling low-temperature germinability in rice (Oryza sativa L.). Theoretical and Applied Genetics, vol. 108, no. 5, pp. 794–799.

IRRI rice knowledge bank, 2013, Knowledgebank.irri.org.

IRRI.1974. Annual Report for 1973. Int. Rice Res. Instt., Los Banos, Philippines.

Kaneda, C. and H.M. Beachell. 1974. Response of indica Japonica rice hybrids to low temperatures. SABRAO J. 6:17:32.

Sabouri, H., B. Rabiei and M. Fazalalipour. 2008. Use of selection indices based on multivariate analysis for improving grain yield in rice. Rice Sci. 15 (4): 303-310.

Shimono, H., T. Hasegawa, and K. Iwama. 2002. Response of growth and grain yield in paddy rice to cool water at different growth stages. Field Crops Research, vol. 73, no. 2-3, pp. 67–79.

Soomro, R.A and G.W. Mclean. 1972 Rice Breeding. Int. Rice Res. Instt. Los Banos. Laguna,Philippines.

Tahir, M., A. Zada and A. Said. 2004. Performance of rice genotypes grown under varying seedling ages. Sarhad J. Agric. 20 (3) 385-389.

Tahir M., D. Wadan and A. Zada. 2002. Genetic variability of Different Plant and Yield Characters in Rice. *Sarhad J. Agric*. 18 (2). 207-210.

Zahid A. M., M. Akhtar, M. Sabar, M. Anwar and M. Ahmad. 2005 a. Interrelationship among Yield and Economic Traits in Fine Grain Rice. Proceedings of the International Seminar on Rice Crop. October 2-3. Rice Research Institute, Kala Shah Kaku, Pakistan. 21-24.

Zahid A. M., M. Akhtar, M. Anwar and A. Jamal. 2005 b. Genotypic and Phenotypic. Correlation and Path Analysis in Coarse Grain Rice. Proceedings of the International Seminar on Rice Crop. October 2-3. Rice Research Institute, Kala Shah Kaku, Pakistan.

Zhou, L., Y. Zeng, G. Hu. 2012. Characterization and identification of cold tolerant near-isogenic lines in rice. Breeding Science, vol. 62, pp. 196–201.