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Phenology of Various Rice Genotypes as Affected by Different Transplanting Dates under Cold Climatic Region of Khyber Pakhtunkhwa-Pakistan

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Abstract
To study the effect of different transplanting dates on phenologyof various rice genotypes in cold climatic region, experimentwas conducted at Agriculture Research Institute (N) Mingora Swat, Pakistan, during summer 2013. The experiment was laid out randomized complete block design (RCBD) with split plot arrangement having four replications. Seven genotypes (PK 3445-3-2, DM5627, IR64, IR8225-9-3-2-3, LIBOGO, JAPONICA and FAKHR-E-MALAKAND) and 4 transplanting dates (D1= 25th May, D2= 9th June, D3= 24th June, D4= 9th July,) were used. The optimum 20x20 cm row to row and plant to plant distance was kept. All the genotypes were transplanted in six rows. Each row was consisting of 15 plants. Transplanting on either D2 (9th June)or D3 (24thJune) gave maximum tiller plant^{-1}(19), plant height (88.62cm), number of leaves seedling^{-1} and other yield and growth contributing parameters. Among the rice genotypes, Fakhr-e-Malakand produced highest tillers plant^{-1}(17), plant height (89.09cm), days to 50% flowering and days to physiological maturity while the other genotypes were at par valued in this order. On the basis of the above results, among the tested genotypes Fakhr-e-Malakand is recommended for transplanting on either June 9thor 24thin agro-ecological conditions of swat valley.

Keywords: Rice (Oryzasativa L.), genotypes, tillers, transplanting dates, physiological maturity

INTRODUCTION

Rice (*Oryzasativa L.*) is an important crop and rank at 2ndafter wheat crop in the world.Pakistan is the world's 4thlargest producer of rice, after China, India and Indonesia. Rice is normally grown as an annual plant, although in tropical areas it can survive as a perennial crop. Rice provides 20% of the world's dietary energy supply, while wheat supplies 19% and maize (corn) 5%. Rice grain contains Carbohydrates (80%), Sugars (0.12%), Dietary fiber (1.3 %), Fat (0.66 %), Protein (7.13 %),Water (11.61 %), Thiamine (vit. B1, 6%), Riboflavin (vit. B2, 1%), Niacin (vit. B3)(11%), Pantothenic acid (B5)(20%), Vitamin B6(13%), Calcium(3%), Iron(6%), Magnesium(7%), Manganese(52%), Phosphorus(16%), Potassium(2%) and Zinc(11%)(Anonymous, 2014).Rice cultivation is well-suited to countries and regions with low labour costs, high rainfalland requires ample water. However, rice can be grown practically anywhere, even on a steep hill or mountain area with the use of water-controlling terrace systems.In Pakistan, rice is the major source of foreign exchange earnings in recent years (GOP, 2011). In Khyber Pakhtunkhwa it is third most important crop after wheat and maize. However, yield of rice in Pakistan is low as compared to other countries regarding yield. Therefore, improvement in its yield while maintaining high quality is a long term goal in Pakistan. Choosing optimum date of plantation are important for high production become rice are sensitive to severe cold temperature which reduce the paddy yield and other yield contributing parameters. Sowing dates had been showed to provide differential growth conditions such as temperature, precipitation and growth periods. It is noted that rice is normally sown and transplanted in May and July (Bashir *et al*., 2010). Early date of sowing is the appropriate time for important properties such as maximum tillering, number of tillers per m^{-2}, plant height,1000 grain weight and grain yield (Khalifa, 2009). Thenumber of kernel per panicle show better response with early sowing, cause late sowing, shortened the growth period of the plant which reduced the leaf area, length of panicle and number of kernels per panicle than early sowing (Bashir *et al*., 2010). Although sowing dates effect paddy yield by providing various environmental conditions, yet temperature is the key factor to be affected by sowing dates in medium grain rice.They concluded that early sowing dates coincided with reproductive phase heat stress while late sowing helps to escape from heat stress. Therefore, early sowing is considered as the vector to reduce the growth and yield.

Rice is high valued cash crop and also a major export item. Present rice is grown on an area of 2.71 million hectares and is the country's largest crop in term of area. It accounts for 5.7 per cent of the total value added in agriculture and 1.3 per cent of GDP. Traditionally rice cultivation has been concerned in Khyber Pakhtunkhwa, the central Punjab, north Western districts of Sindh and Baluchistan. Rice is the third most important food grain crop of our province after wheat and maize. It is grown on an area of about 61686 hectares with a total production of 128293 tons annually (NWFP, Agriculture statistics 2007-2008). In Khyber Pakhtunkhwa rice cultivation is mainly concerned in Malakand Division, Hazara Division, D.I. Khan, Tribal areas and some parts of Peshawar valley. In high altitude colder regions, coarse varieties; FakhreMalakand JP-5 are cultivated which are resistant to cold stress prevailing in the regions while in the aims and comparatively hot climates usually fine grain Basmati type varieties like Basmati-385 and or other varieties are grown. The average rice yield in Pakistan and particularly in our Province is very low. It may be attributed to many reasons in which unawareness and non-adoption of improved production technology are the major causes. One of the fundamental feature of improved production technology of rice is optimum dates for nursery rising and optimum dates for transplanting of nursery. Optimum dates for transplanting of rice is contribute in the establishment of good crop stand, high and good quality yield.

MATERIALS AND METHODS

The experiment entitled "effect of different planting dates on phenology of various rice genotypes" was conducted at Agricultural Research Institute(north) Mingora Swat during *kharif*season 2013.The site is located at 34^0 and 36^0 North latitude and 72^o and 73^0 East longitudes and at an altitude of 1075 m above sea level. The site is located in temperate region where the average annual precipitation is ranges from 100 to 1200 mm.The experiment was laid out in Randomized Complete Block RCBD with split plot arrangement having four replications with a plot size of 3m x 9 m. Each sub plot was 3 m long, having 6 rows with 20 cm R-RandP-P distance. Four transplanting dates (25 May, 9 June, 24 June and 9 July) and seven genotypes (PK 3445-3-2, DM 5627, IR 64, IR 8225-9-3-2-3, LIBOGO, Japonica and FakhreMalakand) were used in the experiment.FertilizersN, P, and K were applied at the rate of 120, 60 and 40 kg ha^{-1}.Practices were carried out uniformly for all the experimental units throughout the growing season.Data was recorded on Seedling height (cm), Number of leaves $seedling^{-1}$, Days to 50 % flowering, Days to physiological maturity, Number of tillers $hill^{-1}$and plant height.Seedling height was recorded before transplanting with the help of meter rod from the crown to the top of the seedling.Leaves were recorded by counting the number of leave present in one seedling. Days to 50 % flowering were counted from the date of transplanting to 50% flowering in each sub plot.Days to physiological maturitywere recorded by counting number of days from the day of transplanting till plants panicle mature in each sub plot.Number of tillers $hill^{-1}$ data was recorded by counting the number of tillers $hill^{-1}$ of three randomly selected plants and then averaged. Plant height (cm) was recorded at the physiological maturity through a meter rod from the ground to the top of panicle of each tiller plant.
Data collected were analysed statistically according to the procedure relevant to RCB design. Upon significant F-Test, least significance difference (LSD) test was used for mean comparison to identify the significant components of the treatment means (Jan *et al*., 2009).

RESULTS AND DISCUSSION

Seedling height (cm)

Data concerning seedling height are presented in table 1. Analysis showed that sowing dates and rice genotypes significantly affected seedling height. Interaction between sowing dates and rice genotypes (D x G) was also significant. Maximum seedling height (22.58 cm) was recorded at sowing date D4followed by sowing on D1 (20.62cm) while smaller seedling height (17.6 cm) wasattained by sowing of nursery on date D3followed by (18.54 cm) sowingon date D2. This might be due to optimum time for nursery rising, suitable temperature for growth and development and might be due genetic makeup.In case of genotypes maximum seedling height (21.53 cm) was produced by genotype Japonica, while minimum seedling height (18.48 cm) was produced bygenotypeFakhr-e-Malakand.This might be due to good root system, adaptation to the environment, genetic makeup as well as environmental affect. These findings of the results are supported bySafdar*et al*., (2013),who reported that seedling height significantly affected by different sowing dates.

Number of Leaves $seedling^{-1}$

Data regarding number of leaves $seedling^{-1}$ are presented in table 1. Analysis showed that transplanting dates and rice genotypes significantly affected leaves $seedling^{-1}$. Interaction between sowing dates and rice genotypes (D x G) had non-significant effect. Nursery raising dates showed that more number of leaves $seedling^{-1}$ (6.81) was recorded at D1 followed by D2 having 5.52 leaves $seedling^{-1}$. While less number of leaves $seedling^{-1}$ (3.86) wasattained when nursery was raised on D3. This might be due to optimum temperature for nursery rising. These results are supported by Safdar*et al*., (2013), who reported that number of leaves affected by sowing dates. These findings are with conformity with those of Kumar and Reddy, (2003) they concluded that leaf area and leaves quantity are varied with different sowing dates.In case of genotypes more number of leaves $seedling^{-1}$ (6.0) was recorded in genotype IR 8225-9-3-2-3 while less number of leaves $seedling^{-1}$(4.83) in genotype Japonica, followed bygenotype DM 5627(5.08).Kumar and Reddy, (2003), reported that number of leaves is significantly affected by different sowing dates.

Days to 50 % flowering

The analysis showed that transplanting dates and rice genotypes significantly affected days to 50 % flowering.

Interaction between transplanting dates and rice genotypes (D x G) was also significant. More number of days were takento 50% flowering (81.10) at transplanting date D1 followed by D3 taken 78.10 days to 50% flowering. Less number of days were takento 50% flowering (72.43) was recorded on transplanting date D4 followed by D2 having statistically at par value. This might be due to optimum time of transplanting.In case of genotypes more number of days to 50% flowering (82.92) were recorded in genotype LIBOGO while less number of days to 50% flowering (64.42) in genotype Japonica.Interaction between transplanting dates and genotypes (D x G) was also highly significant. Maximum days taken to 50% flowering (81.10) were recorded atplanting date (25 May). Minimum days taken to 50% flowering (74.62) were recorded at planting date (9July). Obviously rice, a photoperiod sensitive plant had to shift form vegetative into reproductive growth phase when entered into specific day length. Therefore late transplanting reduces their growth duration. Maximumdays to 50 % flowering (82.92) were recorded ingenotype LIBOGO and Minimum (64.42) ingenotype Japonica.Soomro*et al*., (2001) reported that different planting dates effect days to flowering.

Days to Physiological maturity

The analysis showed that transplanting dates and rice genotypes significantly effected days to physiological maturity. Interaction between planting dates and rice genotypes (D x G) was also significant. More number of days taken to physiological maturity (123) was recorded on D3 (24-June) followed by D1 (25-May) having statistically at par with each other (122.33). Less number of days taken physiological maturity (112) was recorded at transplanting date D2 (9-July). The reason could be that too early and too late transplanting effect the photoperiod, assimilation of photosynthats and dry matter portioning which delay physiological maturity. Soomro*et al*., (2001) are in line with these findings. They reported that physiological maturity influenced by different transplanting dates.In case of genotypes more number of days to physiological maturity (126.33) was recorded in genotype PK 3445-3-2while less number of days to physiological maturity (96.5) was observed in genotype Japonica. This might be due to genetic variation as well as environmental factor.Safdar*et al*., (2013), and Soomro*et al*., (2001) also reported that effect of different planting dates on rice were significant effect on days to physiological maturity.

Number of tillers hill^{-1}

Data regarding number of tiller hill^{-1}are presented in table 1. The analysis showed that transplanting dates and rice genotypes significantly affected number of tiller hill^{-1}. Interaction between transplanting dates and rice genotypes was non-significant. Transplanting dates showed significant difference in number of tillers plant^{-1}. Maximum number of tillers (19) were recorded On D2 followed by at par value D1 and D3 (14 tillers) having no statistical differences among them. Minimum numbers of tillers was noted on D4 having 12 tillers plant^{-1}.The reason could be optimum temperature for growth and development, optimum light interception and good root systems of the plant which leads the plant to vigorous growth. The findings of these results are against with those ofRafi *et al*., (2013), they divulge that tillers were not affected with transplanting dates.In case of genotypes quantitative tillers (17) was produced by genotype Fakhr-e-Malakand while less number of tillers (11) was produced by genotype Japonica.The variation in tillers might be due to genetic superiority. Rafi *et al*., (2013), reported that effect of transplanting dates on rice varieties were non-significantly number of tiller hill^{-1}.

Plant height (cm)

The analysisshowed that transplanting dates and rice genotypes significantly affected plant height. Interaction between transplanting dates and rice genotypes (D x G) had non-significant effect. Maximum plant height (88.62 cm) was recorded at transplanting date D2 (9-June) followed by transplanting on D3 and D1 having statistically at par with each other.Minimum plant height (71.38 cm) was recorded at transplanting date D4 (9-July).In case of genotypes tallest plant (89.09 cm) was recorded in genotype Fakhr-e-Malakand while smallest plant height (76.51 cm) was observed in genotype LIBOGO followed by genotype Japonica (78.09 cm) and genotype IR 64 (78.62 cm).This might be due to early transplanting of seedlings which faced to heat stress and at late transplanting the crop produce flowering earlier due to shorter in day length. Basher *et al*., (2010), reported that plant height was significantly affected by different planting dates.

Table 1. *Seedling height (cm), number of leaves seedling^{-1}, days to 50% flowering, days to physiological maturity, number of tiller plant^{-1}, Plant height (cm)ofRice genotypes as affected by transplanting date*

Transplanting dates (D)	Seedling height (cm)	No of Leaves seedling^{-1}	Days to 50% flowering	Days to physiological maturity	Tillers plant^{-1}	Plant height (cm)
D1 25th May	20.62b	6.81a	81.10a	122.33a	14b	84.70a
D2 9th June	18.54c	5.52b	74.62c	112.00c	19a	88.62a
D3 24th June	17.60c	3.86d	78.10b	123.0a	14b	85.09a
D4 9th July	22.50a	4.38c	72.43c	120.29b	12c	71.78b
LSD $_{(0.05)}$	1.84	0.58	2.24	1.48	1.12	6.56
Genotypes						
G1PK 3445-3-2	19.43bc	5.33b	80.67ab	126.33a	15b	88.89a
G2 DM 5627	19.69bc	5.08bc	74.25c	119.42c	13d	83.39b
G3 IR 64	20.65ab	5.33b	80.08b	123.33b	14bc	78.62c
G4 IR 8225-9-3-2-3	20.27ab	6.08a	75.42c	122.42b	15bc	82.56b
G5 LIBOGO	18.53cd	4.67c	82.92a	123.17b	14bcd	76.51c
G6 Japonica	21.53a	4.83bc	64.42d	96.50d	11e	78.09c
G7 Fakhr-e-Malakand	18.48d	4.77bc	78.17b	124.17b	17a	89.09a
LSD $_{(0.05)}$	1.46	0.58	2.60	1.98	1.26	3.75
Interaction (DxG)	*	ns	*	*	ns	ns

CONCLUSION AND RECOMMENDATIONS

It was concluded from the present research that among the rice genotypes FakhreMalakand gave significantly higher tiller plant^{-1}, plant height, number of leaves and other yield contributing parameters as compared to other genotypes. Similarlymaximum tillers plant^{-1}, Plant height and other yield and growth contributing parameters were produced when transplanting was carried out on either 9th or 24th June as compared with 25th May and 9th July. Therefore, on the basis of above results genotypes FakhreMalakand is recommended for transplanting on either June9thor24thin the agro-ecological zone of swat valley.

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