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Rice Seedling Characteristics of Various Genotypes Influenced by Different Sowing Dates in Swat-Pakistan

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Abstract
To study the effect of different sowing dates on rice nursery rising and to evaluate their effect on yield and yield components of rice genotypes, an experiment was conducted at Agriculture Research Institute (N) Mingora Swat, Pakistan, during summer 2011. The experiment was laid out in randomized complete block design with four replications. Seven genotypes (PARC 403, OM5627,IR64,IR8225-9-3-2-3, CIBOGO,GA-5015, and FakhreMalakand) and 5 sowing dates (D1= 25th April, D2= 10th May, D3= 25th May, D4= 9th June, and D5= 24th June) were used. Each genotype was sown in six rows in dry bed nursery. The germination percentage was above 90%. The nursery reached its optimum size up to 30 days and was ready for transplantation.Sowing on either D5 (24th June) or D4(9th June)gave maximum leaf area(9.6 and 9.1 cm^2) followed by D3 (7.2 cm^2), maximum leaves seedling^{-1} produced by D3 (5.3) followed by D2 (5.0). Maximum seedling height was gave by sowing on D5 (23.5 cm) followed by D4 (19.9 cm), maximum biomass gave by sowing on D4 (15.3 gm) and D5 (13.8 gm) followed by D2 and D3 (12.8 and 12.2 gm), highest root number gave by D4 (13.0) followed by D2 and D3 (11.3 and 11.5) and highest root length gave by D1 and D2 (10.7 and 10.7 cm) followed by D3 (9.6 cm). Among the rice genotypes FakhreMalakand produced highest seedling height (21.9 cm), highest biomass (14.0 gm), highest root length (12.9 cm) followed by GA-5015 while maximum leaf area gave by genotype PARC 403 (9.8 cm^2) and number of leaves (4.9) followed by FakhreMalakand (8.3 cm^2 and 4.6) respectively. Later data showed that highest paddy yield (6.49 t ha^{-1}) was produced by FakhreMalakand sown on either D2 or D3 while the other genotypes were at par valued in this order. On the basis of the above results, it is recommended that rice nursery rising should be either D2 or D3May10th or 25th in the agro-ecological conditions of swat valley.
Keywords: Rice (Oryza sativa L.), genotypes, sowing dates, biomass, seedling

Introduction

Rice (*Oryza sativa* L*)* is an important*kharif* crop of Pakistan ranking second to wheat as a staple food. Rice has gradually moved to occupy a predominant position in the agricultural economy of Pakistan. In Asia, it is the main item of the diet of 3.5 billion people. Therefore, increase in population will require 70 percent more rice in 2025 than is consumed today (Kim and Krishnan, 2002). Seedling vigour is an important contributor to subsequent tillering quality and yield of rice (TeKrony and Egli, 1991). It is found to be associated with plant viability, height, thickness of stems and uniformity (Matsuo and Hoshikawa, 1993).

The establishment of transplanted rice seedlings and their subsequent growth depends not only on the above-ground morphological characteristics that define seedling vigour, but also on the growth of new roots (Hoshikawa and Ishi, 1974) and the amount of irreparable damage incurred by the roots during transplanting (Ros*et al.*, 2003). These above and below-ground characteristics of rice plants, before and after transplanting, vary with seedling age (Himeda, 1994), growing environment (Kordon, 1974) and seeding rate (Sasaki, 2004). Due to increasing scarcity of water at field level, many alternative technologies are now being evaluated. In particular, the System of Rice Intensification (SRI) hasattracted much interest among rice-growers around the world. It recommends growing seedlings with a healthy root system to obtain healthy plants under limited water supply by applying four management practices. These include rapid and shallow transplanting of very young seedlings at 2–3 leaf stage after growth in a dry seed bed, transplanting one or two seedlings with wider spacing, maintaining non-flooded soil conditions during the vegetative stage and very shallow irrigation after flowering, and applying compost as fertilizer (Stoop *et al.*, 2002). To raise healthy seedlings with healthy root systems, SRI recommends maintaining well-drained soil conditions, low seeding rates and application of organic manure to the seedbed. Following long-standing cultural practices in Asia, farmers generally use wet seedbeds for raising seedlings, and organic manure is applied to flooded and puddle seedbeds. The average age of seedlings used for transplanting is 30–45 d, and they are transplanted into continuously flooded soils.

This study was therefore designed to characterize the morphological features of rice seedlings at early and later rising when grown on different dates and to evaluate their effect on yield and yield attributes on rice genotypes.

2. Materials and Methods

To study the effect of different sowing dates on rice nursery rising, an experiment was conducted at the

Agriculture Research Institute, (N) Mingora (Swat) Pakistan during *kharif* season 2011. The design of the experiment was Randomized Complete Block (RCBD) with four replications. There were seven 7 Genotypes (PARC 403, OM5627,IR64,IR8225-9-3-2-3, CIBOGO,GA-5015, And FakhreMalakand) and 5 sowing dates (D1= 25th April, D2= 10th May, D3= 25th May, D4= 9th June, and D5= 24th June) were used. The first date of sowing of all these genotypes was 25th April 2011. Dry bed method was used for nursery rising. Each genotype was sown in six rows in dry bed nursery. The germination percentage was above 90%. The nursery reached its optimum size up to 30 days and was ready for transplantation. These genotypes were tested to find out the optimum date for rice nursery rising.First transplantation was done on 25th May 2011. The following data was recorded before transplantation. Germination %, Leaf area, number of leaves seedling^{-1}, seedling height, number of tillers seedling^{-1}, seedling biomass, number of roots seedling^{-1}, root length, and seedling age. All the recommended agronomic practices were followed. Seedling age was maintained 30 days in each transplanting having 90 % germination viability and one seedling tiller in each sowing date.

Data collected were analyzed 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).

3. Results and Discussion

3.1 Leaf area (cm^2)

Data regarding leaf area are presented in Table1. The analysis of the data showed that genotypes, sowing dates and their interaction (G x D) significantly affected leaf area. Mean value of the data indicated that maximum leaf area was recorded in genotype PARC 403 (9.8 cm^2) followed by FakhreMalakand and GA-5015 (8.3 and 8.2 cm^2) whereas minimum at par valued leaf area was noted in genotypes OM5627,IR64 andIR8225-9-3-2-3(6.3, 6.1and 5.6 cm) respectively. Among sowing dates maximum leaf area produced by seedling sown on D4 and D5 (9.1 and 9.6 cm^2)followed by D3 (7.2 cm^2) whereas minimum leaf area produced by sowing dates on D1 and D2 (5.3 and 5.6 cm^2). Similarlyinteraction showed that genotype CIBOGO produced minimum leaf area sown on D1 (3.6 cm^2) and maximum leaf area was produced on D5 (11.6 cm^2) while genotype PARC 403 produced maximum leaf area on D4 and D5 (12.2 and 12.0 cm^2) and minimum leaf area was recorded on D1 (7.9 cm^2) respectively. These findings are in line with those of mishra and salokhe (2008) who reported that seedling characteristics are influenced by early and late sowing of rice.

3.2 Number of leaves seedling^{-1}

Data regarding number of leaves seedling^{-1} are presented in Table 1. The analysis of the data showed that genotypes and sowing dates significantly affected number of leaves seedling^{-1} while interaction of G x D was non significant. Mean value of the data indicated that maximum number of leaves produced by genotype PARC 403 (4.9) followed by genotypes OM-5627, IR-8225-9-3-2-3 and FakhreMalakand (4.6, 4.6, and 4.6)whereas minimum leaves was recorded in genotype CIBOGO (3.8) respectively. It might be due to genetic superiority and well adoptive features of the genotype. Similarly maximum leaves seedling^{-1} was recorded on D3 (5.3) followed by D2 (5.0) and minimum leaves produced on D5 (2.7). The possible result could be that too early sowing of rice nursery leads to cold environment which greatly influenced the seedling characteristics. The results are closely associated with Jha*et al*. (1990) who reported that reduction in growth characteristics was due to different dates of sowing.

3.3 Seedling Height (cm)

Data regarding seedling height are presentd in Table 1.The analysis revealed that genotypes, sowing dates and interaction of GxD significantly affected seedling height. Mean value of the data revealed that maximum seedling height was attained by genotype FakhreMalakand (21.9 cm) followed by GA-5015 (20.5 cm) whereas minimum seedling height was attained by genotype IR-8225-9-3-2-3. This might be due to dense root system of the genotype and more nutrients absorption. These findings are closely associated with those of Ros et al. (2003) who reported that growth and root shoot elongation promote by nutrients absorption.Among sowing dates maximum seedling height was recorded on D5 (23.5 cm) followed by D4 (19.9 cm) whereas minimum seedling height was observed on D1 (17.2 cm) respectively. Interaction of genotype IR-8225-9-3-2-3with D1 attained minimum (15.2 cm) seedling height. Maximum seedling height was attained by genotype FakhreMalakand on D5 (31.9 cm). This might be due to optimum temperature for growth and development and having dense root system and more nutrients up take by the genotype. These results are with conformity of with those of Venkateswalu (1989).

3.4 Seedling Biomass (gm seedling^{-1})

Data regarding seedling biomass are presented in Table 1. The analysis of the data divulged that genotypes and sowing dates significantly affected seedling biomass while interaction of GxD was not significantly affected

seedling biomass. Maximum biomass was recorded in genotype FakhreMalakand (14.0 gm) followed PARC 403 (13.2 gm) while minimum biomass was noted of genotype CIBOGO (12.3 gm). This might be due to dense root system of the genotype and more nutrients absorption. Similarly maximum biomass produced by seedling on D4 (15.3 gm) followed by D5 (13.8 gm) and minimum biomass was recorded on D1 (12.1 gm) respectively. This might be due to optimum temperature for growth and development and having dense root system and more nutrients up take by the genotype. The findings of the result are in line with those of Venkateswalu (1989). Who reported that biomass reduction was observed when sowing was delayed.

3.5 Number of roots seedling^{-1}

Data regarding number of roots seedling^{-1} are presented in Table 1. The analysis of the data showed that genotypes and sowing dates significantly affected number of roots seedling^{-1} while interaction of G x D was non significant. Mean value indicated that maximum roots seedling^{-1} was observed in genotype FakhreMalakand (12.9) followed by at par valued of genotype GA-5015. Minimum roots seedling^{-1} was observed by at par valued of the other rest genotypes. The reason could be that of genetic character of the genotype. Among sowing datesmaximum roots seedling^{-1} was counted on D4 (13.0) while the other sowing dates were at par having no statistical difference among number of roots seedling^{-1}. The reason could be that of genetic superiority and optimum temperature for growth and development and more nutrients absorption and soft seed bed for absorption of nutrients. The results are closely related to with those of Veeramani (2010) who reported that roots number increased with soil fertility and frequent nutrient supply.

3.6 Root length (cm)

Data regarding root length are presented in Table 1. Analysis of the data revealed that sowing dates significantly affected root length while genotypes and interaction of G x D was non significant. Mean value of the data showed that maximum root length was observed on D1 and D2 produced 10.7 cm and 10.7 cm elongated root followed by D5 having at par value with D1 and D2 and also with D3 and D4 (10.2 cm). Minimum root length was recorded on D3 which was at par with D4 and D5 (9.6 cm). The might be due optimum time of sowing and best agronomic practices like manual weeds control which loosen the soil and root penetration occurred rapidly. The results are related with those of Veeramani (2010) who reported that roots length and roots number increased with soil fertility, soil structure and frequent nutrient supply.

Table I. Leaf area (cm^2), number of leaves seedling^{-1}, seedling height (cm), seedling biomass(gm), root number and root length(cm) of rice seedling as affected by different sowing dates.

Treatment	Leaf area (cm^2)	No. of leaves	Seedling height (cm)	Seedling biomass (gm)	Root number	Root length (cm)
Genotypes						
PARC 403	9.86a	4.93a	20.20bc	13.20b	10.86b	ns
OM 5627	6.36fd	4.60b	19.56bcd	12.78bcd	10.93b	ns
IR 64	6.12d	4.26c	18.56d	12.33cd	11.60b	ns
IR-8225-9-3-2-3	5.64d	4.66ab	17.20e	12.63bcd	11.26b	ns
CIBOGO	7.28c	3.86d	19.42cd	12.30d	11.00b	ns
GA-5015	8.22b	4.40bc	20.57b	13.05bc	12.06ab	ns
FAKHRE MALAKAND	8.37b	4.60b	21.96a	14.09a	12.93a	ns
LSD (0.05)	0.73	0.32	1.08	0.73	1.20	ns
Sowing dates						
D1	5.30c	4.71c	17.22d	12.11c	10.85b	**10.74a**
D2	5.67c	5.09b	18.60c	12.83b	11.23b	10.76a
D3	7.22b	5.38a	18.94c	12.22bc	11.52b	9.61b
D4	9.16a	4.47c	19.91b	15.31a	13.00a	9.96b
D5	9.69a	2.71d	23.51a	13.89b	11.00b	10.22ab
LSD (0.05)	0.62	0.27	0.92	0.62	1.02	0.72
Interaction						
S x C	*	ns	*	ns	Ns	ns

Means in the same category followed by different letters are significantly different at P ≤0.05 levels. ns = non-significant

Conclusion and Recommendations

It was concluded from the present research that among the rice genotypes Fakhre Malakand gave

significantly highest seedling height, biomass and root number followed by genotype GA-5015 and PARC 403 where as highest leaf area and number of leaves gave by genotype PARC 403 followed by Fakhre Malakand. Similarly highest leaf area and number of leaves gave by D2 and D3 respectively and highest seedling height, root number and biomass gave by D4 and D5 followed by D2 and D3 respectively. Similarly maximum paddy yield were produced when sowing was carried out on either D2 or D3 as compared with D1, D4 and D5. Therefore, on the basis of best seedling characteristics which leads later to highest paddy yield, genotypes Fakhre Malakand is recommended for sowing of rice nursery rising on either D2 or D3 in the agro-ecological zone of swat valley. Otherwise genotype GA-5015 and PARC 403 are also suitable for sowing on D2 and D3 for best seedling characteristics to attained maximum paddy yield in the agro-ecological condition of swat valley.

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