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Studies on stability of seedling characteristics in rice

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Abstract

Fifteen genetically diverse and promising varieties of rice were studied for their seedling characteristics viz.,coleoptile length, root length, soot length, seedling vigour index, root volume and seed yield under four agro –eco systems in order to identify their suitability under direct seeding. Genotype x environment interaction and it's both linear and non-linear components were found significant for all seedling characteristics and seed yield under studied. Among the genotypes especially developed for upland condition, the Shushksmrat, Baranideep and Vasumathi showed good yield along with higher positive intercept 'a' value indicating their stability over environments though the highest yielder was MTU 7029 followed by Swarna Sub 1. Besides, varieties which showed the highest 'a' values for component characters of effective root system viz., root volume (NDR 359) should prominently be involved in crossing with good characteristics varieties which expressed consistency over environments. Further, the varieties viz., NDR 97, NDR 359 and NDR 2064 showed high seed yield and positive intercept 'a' value could successfully be exploited for direct seeding by using drum seeder in rice.

Key words: Seedling characteristics, seed yield, direct seeding, drum seeder, rice

I. INTRODUCTION

Rice, being staple food crop, is backbone of our national food security. However, shortages of labours or high labour wages and looming nature of rainfall/ availability of water have made rice cultivation extremely difficult to rice growers/producers. In order to provide an alternative option to traditional transplanting, direct seeding by integrating a fibre bodied multi rows drum seeders is worth prime owing to its potentials for proving several benefits to farmers (higher economic return, less labour and water consumption, conducive to mechanization, early crop maturity by 7-10 days) and the environments (comparatively less methane emission) over conventional transplanting. Direct seeded rice requires specially bred cultivars having good mechanical strength in the coleoptile to facilitate early emergence of the seedlings, early seedling vigour for weed competiveness, and an efficient root system for anchorage and to tap soil moisture from lower layers in peak evaporation demands and yield stability over a range of plantings. Keeping in view, 15 varieties developed for diverse rice ecosystems were studied under transplanting and direct seeding using drum seeder systems in split plot design with 3 replications during *kharif* 2013 and 2014.

II. MATERIALS AND METHODS

Fifteen genetically diverse and promising genotypes of rice (Table 2) were grown in four agro-eco systems viz., Dry seeding-dibbling seed into fine seed bed at a depth of 2-3 cm, Wet/ pre-germinated seeding-puddled field, puddled field left for 48 hrs and germinated

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seeds sown after 48 hrs using drum seeder. The experiment was conducted in split plot design by keeping methods of raising in main plot and varieties in sub-plot with 3 replications during *kharif* 2013 and 2014. Recommended package of practices were followed time to time in order to raise an ideal crop. Twenty random seedlings were subjected for observations on coleoptile length, root length and shoot length as per ISTA rules [1].The root volume was determined at active tillering stage of each variety. Seed yield was obtained on plot basis. Stability parameters were analysed according to Eberhart and Russell [2] and Blum [3].

III. RESULTS AND DISCUSSION

The analysis of variance for seedling characteristics and seed yield revealed significant differences among the genotypes and the environments. Highly significant mean square due to genotype x environment (G X E) interaction for all the characters under studied indicated that the genotypes interacted considerably with environmental conditions which emulated. Partitioning of mean squares due to G X E interaction revealed that both linear and non-linear components were found significant for the traits under studied, indicating the importance of both these components in determining the stability of seedling characteristics and seed yield in rice. These findings are in accordance to earlier reports of Yadav [4].

An efficient root system is a major factor for the anchorage and also to tap soil moisture from deeper soli profiles during peak evaporation and ultimately stabilize the yield. The coleoptile facilitates the early emergence. Early seedling vigour accelerate growth and development leading to weed competiveness, healthy stands and boost up the yield. A variety possessing these characteristics is demand driven in current scenario of climate change in totality. Thus, identification of a variety with good yield and stable seedling characteristics over environments is of immense value. Different investigators have been utilized different techniques for identification of stable varieties. According to Eberthart and Russell [2], a stable variety is one which shows a high mean yield, regression coefficient (b) around unity and mean square deviation from regression (S^2d) nearly zero. However, Blum [3] emphasized the important of intercept (a) another stability parameter besides b and S^2d while assessing the stability performance of a genotype under major agro-ecosystems. Accordingly, in the present study, the genotypes were assessed on the basis of four stability parameters $\bar{X}$, b, S^2d and a) for seed yield and important seedling characteristics (Tables 2 & 3). Considering the four parameters in view, out of 15 varieties only two varieties viz., Shushksmrat and Baranideep showed good yield along with higher positive intercept ‘a’ value indicating their stability over environments though the highest yielder was MTU 7029 followed by Swarna Sub 1. Besides, varieties which showed the highest ’a’ values for component characters of efficient root system viz., root volume (NDR 359)should prominently be involved in crossing with good characteristics one which expressed consistency over environments. Further, the varieties showed high seed yield and positive intercept ‘a’ value were NDR 97, NDR 359 and NDR 2064 could be used for direct seeding

Table 1. Analysis of variance for seedling characteristics and seed yield in rice.

Source	d.f.	Mean Square							
		Coleoptile length (cm)	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Root volume (cc)	Emergence index	Seedling vigour index	Seed yield (q/ha)
Genotypes (G)	14	7.23**	23.53**	12.25**	25.56**	9.45**	14.74**	1475.45**	6.43**
Environments (E)	7	2.18*	5.68**	3.16**	6.58**	2.95**	4.02**	1547.74**	8.62**

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G X E	98	1.59*	11.42**	6.41*	16.45**	5.31**	8.45**	265.65**	7.13**
Environment (Linear)	1	6.67*+	14.37**++	6.16*+	23.34**++	7.43**++	11.65**++	1667.32**++	10.56**++
G X E (Linear)	14	0.82*	2.03**	1.04*	3.68**	0.94**	1.42**	134.76**	0.32**
Pooled deviation	90	0.81*	1.21**	0.94*	1.87**	1.03**	1.18**	114.17**	0.37**
Pooled error	224	0.03	0.14	0.21	0.32	0.26	0.35	6.76	0.03

*, ** Significant at 5% and 1% level, respectively (pooled error)
+, ++ Significant at 5% and 1% level, respectively (pooled deviation)

Table 2. Stability parameters of some seedling characteristics in rice.

Genotype	Coleoptile length (cm)				Root length (cm)				Shoot length (cm)			
	$\bar{X}$	b	S^2d	a	$\bar{X}$	b	S^2d	a	$\bar{X}$	b	S^2d	a
Aditya	2.9	0.89	0.56	1.21	17.34	0.76	0.65	1.54	6.70	0.86	0.45	3.45
Baranideep	3.2	0.95	0.23	2.56	18.07	0.97	0.14	3.78	7.34	0.89	0.09	3.71
Jaya	3.0	1.23	1.27	-5.20	15.56	1.45	1.39	-1.23	5.98	1.29	1.32	-3.76
Krishna Hamsa	3.2	0.85	0.45	2.12	16.98	0.89	0.34	1.86	6.90	0.79	0.23	2.43
BPT 5204	3.1	1.36	1.05	-4.32	16.05	1.32	1.09	-3.67	7.21	1.28	1.06	-2.56
MTU 7029	2.9	1.12	1.54	-3.54	15.50	0.87	1.63	-4.12	6.13	1.43	1.65	-4.51
NDR 97	3.0	0.94	0.43	1.37	17.23	0.90	0.54	2,76	6.76	0.97	0.32	1.23
NDR359	3.1	1.14	1.26	-3.76	16.21	1.34	1.16	-3.33	6.25	1.21	1.43	-4.32
NDR 2064	3.1	1.05	0.98	1.42	17.40	1.11	0.89	-1.35	6.87	0.97	0.94	-1.04
Sarjoo 52	3.2	1.21	0.63	-2.95	15.53	1.17	0.87	-2.15	6.65	1.41	0.67	-1.43
Swarna Sub 1	3.0	0.97	1.48	-4.21	15.78	0.96	1.59	-1.23	6.15	0.87	1.29	-1.12
Shushksmrat	3.3	0.95	0.09	3.13	18.12	0.95	0.15	4.27	7.50	0.91	0.11	3.76
Rasi	3.2	0.92	0.16	2.56	16.23	0.86	0.26	2.54	7.34	0.84	0.24	2.48
Tulsi	2.8	0.76	0.18	1.97	16.05	0.84	0.29	1.98	7.21	0.82	0.17	3.22
Vasumathi	2.9	0.82	0.24	1,56	17.23	0.82	0.25	1.37	7.41	0.79	0.28	2.63

Table 3. Stability parameters of some seedling characteristics and seed yield in rice.

Genotype	Root volume (cc)				Seedling vigour index				Seed yield (q/ha)			
	$\bar{X}$	b	S^2d	a	$\bar{X}$	b	S^2d	a	$\bar{X}$	b	S^2d	a
Aditya	49.34	1.45	0.45	-1.76	1703	0.78	0.32	2.31	32.43	0.89	0.31	2.87
Baranideep	48.14	0.94	0.23	3.32	1718	0.89	0.07	3.47	35.86	0.97	0.07	3.56
Jaya	80.78	1.30	0.78	-4.32	1675	1.56	1.05	-4.32	47.45	1.34	0.68	-4.81
Krishna Hamsa	39.43	1.32	0.87	-1.45	1681	0.76	0.87	1.89	30.56	0.87	0.43	2.05
BPT 5204	73.41	1.05	0.31	-0.67	1713	1.43	1.24	-3.21	49.65	1.48	1.31	-4.51
MTU 7029	74.34	1.43	0.25	3.41	1628	1.21	1.56	-3.74	51.04	1.87	1.64	-5.67
NDR 97	48.20	0.89	0.06	3.74	1672	1.05	0.43	2.34	37.81	1.05	0.12	2.82
NDR359	84.72	1.09	0.45	5.45	1711	1.50	1.07	-4.32	46.87	1.54	1.25	2.12
NDR 2064	47.48	1.12	0.32	2.31	1632	1.20	0.58	2.10	40.06	1.02	1.01	3.21
Sarjoo 52	56.42	0.98	0.21	3.62	1654	1.21	0.65	-1.29	47.83	1.26	1.30	-3.65
Swarna Sub 1	52.42	1.23	0.36	2.56	1729	1.40	0.86	-1.43	50.78	1.34	1.37	-2.82
Shushksmrat	48.47	0.87	0.08	3.23	1745	0.87	0.08	3.45	38.64	0.87	0.09	4.69
Rasi	45.76	0.79	0.20	1.32	1607	0.79	0.12	3.21	31.43	0.76	0.12	3.52
Tulsi	37.56	1.24	0.24	-0.63	1559	0.68	0.22	2.78	32.80	0.79	0.23	2.74
Vasumathi	35.71	1.12	0.21	0.95	1583	0.74	0.43	1.12	33.65	0.85	0.31	2.31

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