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STABILITY PERFORMANCE OF TOSSA JUTE (*CORCHORUS OLITORIUS* L.) UNDER WATERLOGGED CONDITION

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ABSTRACT

Genotype x environment interaction for twenty genotypes of tossa jute were studied over four environments for seven different yield and quality attributing traits to identify genotypes with stable performance under waterlogged condition. Genotype x environment interactions were significant for fibre tenacity and fibre fineness indicating substantial variation among genotypes over the environment. High yielding OIN 955 (12.188 g/plant) showed high stability ($bi = 0.308$ and $\sigma^2 d_i = 0.388$) to waterlogged environment for the character along with average stability for basal diameter ($bi = 0.801$ and $\sigma^2 d_i = 0.023$). Relatively poor yielder OIN 941 (9.837 g/plant) also showed stability for yield ($bi = 0.646$ and $\sigma^2 d_i = 1.305$) along with average stability for quality parameters suggesting presence of resistance genes which could be harnessed to enhance genetic potentiality against inundated environment with simultaneous improvement in fibre quality. The genotypes OIN 955 can be recommended for cultivation under waterlogged condition or as donor parents to improve others commercially potent varieties

INTRODUCTION

Jute is a natural fibre with golden and silky shine and hence called "The Golden Fibre". It is the second most important source of vegetative fibre after cotton in terms of usage, productivity and availability. It is also regarded as the most important bast fibre crop of the world. Genotype environment interactions are of major importance to the plant breeder in developing improved varieties. This interaction is usually present whether the varieties are pure lines, single-cross or double-cross hybrids, top crosses or any other material with which the breeder may be working (Eberhart and Russell, 1966). The relative performance of different genotypes varies from one environment to another *i.e.* a genotype × environment (G × E) interaction always play important role. G × E interaction results in change of the relative ranking of the genotypes and also in altering the magnitude of differences in performance among genotypes (Kumar *et al.*, 2013). It is vital to study the performance of a crop in more than one environment to identify genotypes which give high productivity over a wide range of environments (Niharika *et al.*, 2014). The stable genotypes identified will play an important role in developing varieties for cultivation in adverse environment or may act as donor parents to improve commercially potent varieties.

Jute thrives best under a warm and humid climate with temperature ranging from 24 to 37°C and relative humidity from 70-80%.*C. capsularis* can withstand water logged condition and drought to some extent, whereas *C. olitorius* is more susceptible to waterlogged condition. Water management in jute includes application of need – based irrigation and drain out of stagnant or excess water from the field whenever necessary. In eastern India the crop is often encountered by water stagnation due to heavy rainfall or flash flood which greatly reduced yield potentiality of the crop. The present investigation, therefore, initiated to evaluate *C. olitorius* genotypes under waterlogged condition at their later stage of growth to assess the spectrum of genetic variability within the genotypes in respect to show resistance to waterlogging with stable yield.

MATERIALS AND METHODS

Twenty genotypes (OIN 915, OIN 921, OIN 937, OIN 941, OIN 955, OIN 976, OIN 981, OIJ 257, OIN 986, OIN 994, OIJ 213, OIJ 216, OIJ 246, OIJ 284, OIJ 299, OEX 008, OEX 019, OEX 024, JRO 524 and JRO 8432) were evaluated to identify stable genotypes under waterlogged condition by growing them under two environments *i.e.* waterlogged for two years. The experiment was carried out in Teaching Farm Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal. The experiment was laid out in Randomized Block Design with three replications. In each replication each genotype was grown in a plot of 5 rows of 3 meter length each with a spacing of 30 cm between rows. The size of each plot was 3 m X 1.5 m with inter plot distance of 0.5 m and sowing of the genotypes were done on 10th April, 2010 and 13th April, 2011. Recommended doses of major nutrient (N, P and K) were applied and normal cultural practices were followed. 90 days old plants were exposed to 30 cm standing water (Prodhan,

2001) and allowed to grow in standing water till they were 120 days old or died earlier. At 120 days after sowing, data were recorded for the yield attributing characters viz. plant height (cm), base diameter (cm), green weight (g), dry stick weight (g), fibre tenacity (tex/g), fineness (tex) and fibre weight (g) for five randomly selected plants per replication per genotype. Fibre tenacity and fibre fineness were measured by Fibre Bundle Strength Tester and Air Flow Fineness Tester respectively. Mean values of genotypes were computed and statistically analyzed to assess genotype × environment interaction and stability parameters for fibre yield and quality traits across the environments following the method of Eberhart and Russell (1966).

RESULTS AND DISCUSSION

Analysis of variance of g x e interaction (Table 1) revealed presence of significant variance for genotype with respect to fibre quality like fibre tenacity and fibre fineness only indicating substantial variation in mean performance among genotypes over the environment for these quality parameters. Roy *et al.* (2011) observed non-significant difference for different traits of tossa jute studied in different environments. The presence of significant environmental variance indicated that the two conditions, waterlogged and normal were well diverse and suitable for evaluating stability of genotypes. Highly significant mean sum of square due to g x e interactions for all the characters suggested differential performance of genotypes as a consequent effect on change in environmental conditions. The e+(gxe) mean sum of squares were highly significant for all the characters except dry stick weight indicating that these characters were highly influenced by environment resulting in higher gxe interaction. The higher magnitude of mean sum of square due to environment (linear) against (genotype x season) for all the characters indicated linear response of environment which accounted for major part of the variation among genotypes of these characters.

The significant mean sum of square due to (genotype x environment) linear component against pooled deviation for fibre tenacity and fibre fineness suggested that the genotypes were diverse for these quality features of fibre which changes with environment on account of regression response. Alam (1987) and Subbalakshmi *et al.*(1992) reported the same for basal diameter only. Highly significant mean sum of square due to pooled deviation was observed for all the characters except fibre tenacity suggesting that performance of different genotypes fluctuated significantly from their respective linear path of response to environment. Nargis *et al.* (2010) reported the same for fibre yield and its attributes except basal diameter. Thus it may be concluded that predictable components for fibre tenacity and predictable as well as non-predictable component for other yield related characters and fibre fineness were mainly involved towards differential response for stability of the genotypes for the respective characters.

The genotypes with good performance like OIJ 216 (fibre yield 13.198 g/plant) and JRO 524 (fibre yield 13.587 g/plant) with regression coefficient more than one and significant deviation from regression (ó^2 d$_i$) was highly unstable and can be cultivated under good cultural environment (Table 2).

Table 1: Analysis of variance for interaction between genotype and environment

Source	d.f	Plant height(cm)	Base diameter (cm)	Green weight (g)	Dry stick weight (g)	Tenacity (g/tex)	Fineness (tex)	Dry fibre weight (g)
Genotype(g)	19	585.811	0.019	1,647.379	15.365	4.930**	0.126**	4.951
Environment(e)	3	6249.746**	0.213**	45400.237**	75.672**	737.956**	0.628**	117.595**
g x e	57	431.721**	0.012**	1460.460**	15.550**	1.284**	0.053**	4.151**
e+(g x e)	60	722.622**	0.022**	3657.449**	18.556	38.118**	0.081**	9.824**
e (linear)	1	18749.237**	0.639**	136200.712**	227.016**	2213.868**	1.885**	352.785**
g x e (linear)	19	407.407	0.017	1612.428	18.267	3.793**	0.127**	2.053
Pooled Deviation	40	421.684**	0.009**	1315.252**	13.482**	0.028	0.015**	4.941**
Pooled Error	152	59.935	0.001	18.026	0.219	0.175	0.003	0.074

*Significant at 5% level ** Significant at 1% level

Table 2: Stability parameters for different yield attributing traits

Genotypes	Plant height (cm)			Base diameter (cm)			Green weight (g)			Dry stick weight (g)		
	Mean	b_i	$\sigma^2 d_i$	Mean	b_i	$\sigma^2 d_i$	Mean	b_i	$\sigma^2 d_i$	Mean	b_i	$\sigma^2 d_i$
OIJ 216	279.450	1.223	135.731**	1.435	0.762	0.000	206.250	1.166	47.198*	24.928	1.513	3.988
OIJ 213	278.863	2.208	44.839**	1.334	0.280	0.012	190.250	0.791	1294.754**	23.103	2.501	1.270
OIN 981	292.904	1.610	207.047**	1.306	-0.162	0.004	184.333	0.388	2516.219**	21.939	1.718	0.609
OIJ 257	291.371	1.584	361.317**	1.372	0.050	0.008	216.500	1.391	612.804**	24.780	3.096	28.454**
OEX 019	294.617	1.709	490.420**	1.445	0.059	0.008	219.792	1.518	5582.400**	25.377	2.525	27.478**
OIN 941	284.708	0.972	137.942**	1.319	1.496	0.004	182.083	1.021	494.179**	22.494	0.736	0.965
OIN 921	281.983	1.609	56.210**	1.405	0.589	0.001	183.250	0.752	627.745**	23.263	2.734	2.920
OEX 008	302.950	1.066	-4.790	1.500	1.438	0.005	222.417	1.311	171.302**	27.446	1.300	4.418*
OIN 955	312.325	0.668	191.110**	1.479	0.801	0.023	215.417	0.421	374.316**	28.903	1.417	40.851**
OIN 976	305.913	0.847	37.148**	1.523	1.523	0.012	223.417	1.370	1140.602**	27.673	0.630	2.402
OIJ 284	305.508	0.927	84.105**	1.451	0.069	0.000	222.167	0.396	1075.200**	26.448	1.413	8.248**
OIJ 246	303.367	0.455	61.408**	1.414	1.744	0.004	199.500	1.173	543.085**	25.411	-0.183	20.728**
OIN 986	302.825	-0.194	255.291**	1.405	1.357	0.003	200.083	0.618	68.945**	23.445	1.454	0.136
OIN 937	289.746	0.651	1.592	1.382	1.105	0.008	194.834	0.456	126.549**	25.456	1.371	7.041**
OIN 994	294.325	0.570	137.312**	1.492	1.773	0.006	211.500	1.282	1728.581**	22.637	0.439	1.298
OIN 915	296.163	-0.621	3225.940**	1.402	1.059	0.003	192.250	1.318	410.080**	25.388	0.766	3.827
OEX 024	286.288	1.205	1454.834**	1.506	2.233	0.032	242.500	2.253	7453.134**	25.668	-0.993	9.237**
OIJ 299	265.162	1.344	-16.894	1.384	1.839	0.008	193.083	1.223	1202.930**	23.248	-1.268	26.610**
JRO 8432	274.000	1.388	56.422**	1.415	0.178	0.017	191.167	0.517	706.655**	25.521	0.098	5.432*
JRO 524	285.867	0.778	1117.125**	1.560	1.805	0.007	257.917	0.636	8.183	27.791	-1.267	72.261**

*Significant at 5% level ** Significant at 1% level

Table 2: Cont....................................

Genotypes	Tenacity (g/tex)			Fineness (tex)			Dry fibre weight (g)		
	Mean	b_i	$\sigma^2 d_i$	Mean	b_i	$\sigma^2 d_i$	Mean	b_i	$\sigma^2 d_i$
OIJ 216	17.716	0.903	-0.007	2.463	0.975	0.098	13.198	1.854	11.102**
OIJ 213	18.752	0.689	-0.046	2.481	-1.470	0.026	11.169	1.505	1.436
OIN 981	17.772	1.219	-0.036	2.136	2.121	0.000	9.655	1.199	4.965**
OIJ 257	16.663	1.078	-0.058	2.189	2.043	-0.000	10.425	0.835	14.323**
OEX 019	16.433	1.150	0.019	2.207	0.025	0.011	10.168	0.940	15.723**
OIN 941	18.275	0.995	-0.008	2.484	-0.103	-0.001	9.837	0.646	1.305
OIN 921	16.481	1.033	-0.055	2.689	-0.123	0.040	10.148	0.833	5.568**
OEX 008	18.527	0.909	-0.041	2.476	1.126	-0.001	12.108	1.038	0.582
OIN 955	15.474	1.485	-0.009	2.261	2.389	-0.001	12.188	0.308	0.388
OIN 976	16.273	0.796	-0.057	2.133	1.340	-0.001	10.964	1.029	1.631
OIJ 284	17.974	1.038	-0.050	2.178	1.687	-0.001	12.811	0.895	1.665
OIJ 246	18.800	0.895	-0.057	2.484	0.298	0.020	12.352	0.799	0.835
OIN 986	19.158	0.787	-0.057	2.598	0.352	0.037	11.151	1.497	6.873**
OIN 937	16.423	1.083	-0.057	2.378	0.875	0.000	11.349	0.729	0.272
OIN 994	15.606	1.086	0.016	2.388	-0.541	0.001	10.975	1.045	0.502
OIN 915	16.720	1.113	0.017	2.277	2.178	0.005	10.861	1.014	1.238
OEX 024	16.231	0.844	-0.030	2.175	1.550	0.005	10.750	0.866	2.890*
OIJ 299	16.754	0.752	-0.033	2.344	0.045	0.002	10.371	1.281	11.198**
JRO 8432	18.022	1.048	-0.002	2.005	2.767	0.034	11.458	0.805	0.205
JRO 524	17.688	1.095	-0.046	2.225	2.466	-0.001	13.587	0.884	15.621**

*Significant at 5% level ** Significant at 1% level

Khandakar *et al.* (1990) earlier reported that yield and stability were inversely related in both the species of jute. The genotypes OIJ 284 and OIJ 246 with relatively high *per se* performance for fibre yield (12.811 g/plant and 12.352 g/plant respectively) had shown average stability for the character (bi= 0.895 and 0.799 respectively with non-significant least deviation from regression), fibre tenacity in OIJ 246 (bi=0.895 and non-significant least deviation from regression) and basal diameter in OIJ 284 (bi=0.069 and ó^2 d$_i$=0.000). Another relatively high fibre yielding genotype OIN 955 (fibre yield= 12.188 g/plant, bi=0.308 and ó^2 d$_i$=0.388) showed high stability to waterlogged environment for the character along with average stability for basal diameter (bi=0.801 and ó^2 d$_i$=0.023). The genotype OIN 941 having relatively poor performance for fibre yield (9.837 g/plant) showed high stability for the character (bi=0.646 and ó^2 d$_i$= 1.305) along with average stability and mean value more than average population mean for quality parameters i.e. fibre tenacity (bi=0.995 and ó^2 d$_i$= -0.008) and fibre fineness (bi= -0.103 and ó^2 d$_i$= -0.001). It can be suggested that resistance genes against such adverse environment are also present in OIN 941 hence it can be used to enhance genetic potentiality against inundated environment with simultaneous improvement in fibre quality. The genotypes OIN 955 can be recommended for cultivation under waterlogged condition or as donor parents to improve others commercially potent varieties.

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