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SEED AND SEEDLING CHARACTERS IN RELATION TO STORABILITY IN SORGHUM (*SORGHUM BICOLOR* (L.) MOENCH)

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The analyses of means, variance and correlations were carried out on 16 germplasm accessions of sorghum after storing them for two years under ambient storage conditions. The study revealed the difference among accessions for their storability. Several seed and seedling characters were found to be correlated among themselves and with the viability of accessions after two years of storage.

Key words : Sorghum, seedling characters, storability, conservation

The extent and range of seed deterioration reflect the genotype differences and pre-storage history of seed lots (Delouche, 1968). The differential viability and vigour of genotypes having the same pre-storage history may be due to other factors like morphological, physiological and anatomical differences of the seed accessions (Rao *et al.* 1987; Barla-Szabo *et al.*, 1990). Agrawal *et al.* (1981) and Krishnaswamy (1986) reported genotype differences for seed longevity in Sorghum. The present study was aimed at examining the variation and interrelationships of a few seed and seedling characters associated with the storability of sorghum germplasm accessions as indicated by their differential viability and vigour after two years of storage under ambient conditions.

MATERIALS AND METHODS

The experimental material for the present study comprised 16 sorghum accessions selected at random from 150 accessions at the National Bureau of Plant Genetic Resources, Regional Station, Akola during *kharif*, 1989 but could not qualify the prescribed viability standard (85% and above), for long term conservation in the National Genebank at NBPGR. Seeds of these accessions were kept in cloth bags under ambient storage conditions at NBPGR Headquarters until September 1991. Seed moisture content of the sampled accessions was recorded using constant weight oven method (Cromarty *et al.*, 1982). The random samples of 500 seeds were drawn from each accession and their weight was recorded. The volume of water displaced by 500 seeds in a measuring cylinder was recorded as the seed volume while need density was found from ratio of seed weight and volume. The seed colour was recorded on visual scoring (1-5 scale). The score of 1 was assigned to very dull chalky seed colour and 5 to bright creamy seeds. The germination tests were carried out following the procedure prescribed by International Seed testing Association (ISTA, 1985a) for this crop, using 50 seeds replicated thrice. The germination was recorded after 7 days and number of normal abnormal seedlings and dead seeds were counted according to criterion in ISTA (1985 a, b). For recording seedling vigour, the shoot length, coeoptile length and root length were measured on 15 randomly selected seedlings in three replicates of 25 seeds each kept separately for germination on moist paper towels in a germinator.

Leachate analysis

Three replicates of 25 seeds each were prepared and soaked in 25 ml of distilled water for 16 hours at 25±°C. The leachate electrical conductivity was recorded in ml mho/cm^2 through an Elico cm 82 T conductivity bridge.

Statistical analysis

The data were analysed for means and variance. Phenotypic correlation coefficients were also computed using MSTAT between seed viability and other seed characteristics.

RESULT AND DISCUSSIONS

Analysis of variance for seed and seedling characters (Table 1) revealed highly significant differences between accessions for various viability and vigour parameters except for the frequency of abnormal seedlings which was significant only at 5 per cent level of significance. The coefficient of variation was 63.4 for this trait. The magnitude of variance due to difference between accessions was highest for the leachate electrical conductivity indicating the potential of this parameter in detecting genotypic differences for viability in sorghum. Mean data (Table 2) indicated IS-671, IS-1491, IS-2646 and IS-2872 retaining the viability of 82 per cent, 80 per cent, 80 per cent and 79 per cent respectively after two years of storage under ambient conditions. Whereas, the accessions IS 3982 and IS 18469 exhibited only 17 per cent viability after the same period of storage indicating very poor storability. The accessions showing relatively better storability as indicated by their better viability after 2 years of storage, were also found to be exhibiting bright seed colour and relatively high shoot and coleoptile lengths. The germplasm accessions which showed very high deterioration were also found to exhibit very high leachate electrical conductivity reflected through the correlation studies (Table 3).

Table 1 : ANOVA for seed and seedlings traits in sorghum

Source	D.F.	Mean Sums of Squares						
		Shoot length	Coleoptile length	Root length	Normal seedlings	Abnormal seedling	Dead seeds	leachate electrical condu-ctivity
Replication	2	6.97	4.20	16.47	3.58	1.69	0.25	814.4
Accessions	15	18.45**	16.98**	18.21**	109.22**	3.08*	100.17**	8151.9**
Error	30	5.17	2.24	3.64	10.18	1.71	8.47	272.9
C.V.%		18.11	14.48	18.11	20.9	63.4	38.2	12.5
S.E.(Mean)		1.31	0.86	1.10	1.84	0.75	1.68	11.68

**Significant at $p = 0.01$, *Significant at $p = 0.05$

The seed moisture content which is a well known factor determining the storage life of the orthodox seeds (Roberts 1986, 1991) was found to be significantly negatively correlated with number of dead seeds and leachate electrical conductivity. Seed weight was found to be significantly positively correlated with seed volume and leachate electrical conductivity and significantly negatively correlated to seed colour and seedling shoot length. The correlation of seed colour was significant and positive with shoot and negative with leachate electrical conductivity. This indicated that bright creamy seeds produced vigorous seedlings and released less water soluble nutrients with low electrical conductivity of the leachate. As expected, seedling vigour as inferred from shoot length was found to be positively significantly correlated with coleptile length and frequency of normal seedlings and was negatively correlated with frequencies of abnormal seedlings, dead seeds and leachate electrical conductivity. Similar correlation coefficients were observed for coleoptile length. These results revealed that shoot length and coleoptile length of seedlings are good indices of vigour in sorghum. The frequency of dead seeds showed highly significant positive correlation with leachate electrical conductivity. therefore, leachate electrical conductivity in sorghum can be considered as the good indicator of seed viability.

Table 2 : Mean of sorghum germplasm for some seed and seedling characters

S. No.	Accession	Initial germination %	Germination after 2 years of storage %	Seed density	Seed colour (1-5) score	Shoot length (cm)	Coleoptile length (cm)	Root length (cm)	Abnormal seedlings %	Dead seeds %	Leachate Electrical conductivity ml mho/cm^2
1.	IS-671	84	82	1.11	4	18.2	14.9	7.8	9	9	95.7
2.	IS-825	65	59	0.90	4	10.9	10.4	9.8	13	28	163.0
3.	IS-1035	80	77	1.08	3	15.5	11.7	15.6	5	18	194.0
4.	IS-1491	84	80	1.07	3	14.2	10.4	12.2	8	12	174.7
5.	IS-2235	45	22	1.13	2	10.5	7.4	9.8	14	64	416.7
6.	IS-2646	84	80	1.04	3	14.6	14.2	7.0	10	10	103.7
7.	IS-2872	83	79	1.20	1	11.6	9.9	11.5	5	16	159.6
8.	IS-3982	40	17	1.24	2	10.3	10.0	9.2	7	76	326.0
9.	IS-4342	78	75	1.07	5	14.1	9.3	8.8	8	17	84.0
10.	IS-10295	75	68	1.03	4	13.2	10.4	11.6	2	26	284.0
11.	IS-10934	73	68	1.15	2	13.8	13.4	10.2	4	28	224.0
12.	IS-18469	35	17	1.03	2	11.1	8.2	13.3	6	77	526.0
13.	IS-19071	62	57	0.99	4	13.5	12.1	12.7	9	34	304.0
14.	IS-19363	68	63	1.16	3	10.0	8.6	7.7	13	24	294.0
15.	IS-20502	80	74	1.12	4	10.4	7.2	13.3	12	14	264.0
16.	IS-21726	60	45	1.13	2	8.8	7.9	7.9	14	41	424.0
SE (d)		NR	2.60	NR	NR	1.86	1.22	1.55	1.06	2.37	13.5
CD AT 5%		NR	5.31	NR	NR	3.87	2.45	3.06	2.25	4.90	27.6

NR - Non-replicated

Table 3 : Phenotypic correlation coeficients for sorghum germplasm accessions

Character	Seed Weight	Seed volume	Seed density	Seed colour	Shoot length	Coleoptile length	Root length	Normal seedling	Abnormal Seedling	Dead seeds	leachate Elect-conductivity
Seed moisture	0.24	0.26	0.20	0.003	–0.05	0.05	0.18	–0.67**	–0.02	0.71**	0.53**
Seed weight	-	0.95**	0.36	–0.55*	–0.53*	–0.34	0.14	–0.35	0.32	0.32	0.59*
Seed volume	-	-	0.12	–0.41	–0.41	–0.25	0.28	–0.26	0.23	0.24	0.58
Seed density	-	-	-	–0.52*	–0.19	–0.22	–0.23	–0.26	–0.03	0.26	0.23
Seed colour	-	-	-	-	0.53*	0.42	–0.21	0.28	–0.03	–0.30	–0.61**
Shoot length	-	-	-	-	-	0.84**	0.08	0.61**	–0.51*	–0.55*	–0.70**
Coleoptile length	-	-	-	-	-	-	–0.16	0.55*	–0.44	–0.50*	–0.64**
Root length	-	-	-	-	-	-	-	0.02	–0.39	0.36	0.24
Normal seedling	-	-	-	-	-	-	-	-	–0.36	–0.98**	–0.75**
Abnormal seedling	-	-	-	-	-	-	-	-	-	0.19	0.20
Dead seeds	-	-	-	-	-	-	-	-	-	-	0.76**

**Significant at p= 0.01, * Significant at p = 0.05

Selvaraj and Ramaswamy (1984) studied the storability of Sorghum and observed that maternal influence is involved in governing the loss of viability in this crop. Agrawal *et al* (1981) observed the influence of better storer parents in influencing the loss of viability of sorghum hybrids. They also noted that if the initial viability of a genotype is low, such genotypes lose seed viability faster during storage. The results obtained in the present study are in conformity to those of Agrawal *et al* (1981).

Although several physiological and biochemical tests have been developed for evaluating seed vigour and viability in different crops (Hall and Wiesner, 1990), these relationships have not been extensively studied in sorghum. Ching and Schoolcraft (1968) observed that electrical conductivity of the seed leachate correlates well with germination of "Dixie" Crimson clover (*Trifolium incarnatum* L.). In the present study also the leachate electrical conductivity appeared to be a good indicator of the degree of deterioration of sorghum seeds. This character showed meaningful correlations with 8 of the 11 characters studied.

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REFERENCES

Agrawal, P.K., R.B. Patil, M. Dadlani and D. Singh. 1981. Effect of relative humidity and temperature on the seeds of two F1 sorghum hybrids and their parents during storage. *Journal of Seed Technology* **6**: 31-37.

Barla-Szabo, G. J. Bocsi, B. Dolinka and M. Odiemah. 1990. Diallele analysis of seed vigour in maize. *Seed Sci. & Technol.* **18**: 721-729.

Ching, T.M. and I. Schoolcraft. 1968. Physiological and chemical differences in aged seeds. *Crop Sci.* **8**: 407-409.

Cromarty, A.S., R.H. Ellis and E.H. Roberts. 1982. The design of seed storage facilities for Genetic conservation. IBPGR Secretariat, Rome.

Delouche, J.C. 1968. Physiology of seed storage. Proc. Corn. Sorghum Res. Conf. ASTA, **23**: 83-90.

Hall, R.D. and L.E. Wiesner. 1990. Relationship between seed vigour tests and field performance of 'Reger' Meadow bromegrass. *Crop Sci.* **30**: 967-970.

ISTA. 1985a. International rules for seed testing. *Seed Sci & Technol.* **13**: 307-355.

ISTA. 1985b. International rules for seed testing. Annexes 1985. *Seed Sci. & Technol.* 13: 356-513.

Krishnasamy, V. 1986. Study of seed quality factors among sorghum (*Sorghum bicolor* L. Moench.) genotypes. *Seed Sci.& Technol.* **14**: 577-583.

Rao, N.K., E.H. Roberts and R.H. Ellis 1987. Loss of viability in letuce seeds and the accumulation of chromosome damage under different storage conditions. *Annals of Botany* 60: 85-96.

Roberts, E.H. 1986. Ouantifying seed deterioration. *In* : M.B. Donald and C.J. Nelson (Eds), Physiology of seed deterioration: 101-123. Madison. Crop Science Society of America.

Roberts, E.H. 1991 Genetic conservation in seed banks. *Biological Journal of the Linnean Society* **43**: 23-29.

Selvaraj, S. and K.R. Ramaswamy. 1984. Parental influence on seed storability in sorghum hybrids. Precongress scientific meeting on genetic and improvement of heterotic systems T.N.A.U., Coimbatore, India.