Degluming, Storage and Testing Periods Influence Seed Germination of Wild Sorghum Germplasm

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Introduction

Freshly harvested and viable seeds sometimes fail to germinate because of dormancy. Glumes may prevent or delay the germination of viable seeds in several ways. This problem needs considerable attention in genebanks as it seriously interferes with germination test results, besides reducing germination during germplasm regeneration, resulting in preferential selection for less dormant types. Grain sorghum seeds [*Sorghum bicolor* (L.) Moench] show dormancy at harvest (Wilson 1973; Gaber et al. 1974) when tested for germination. However, seeds of other sorghum species (*S. almum*, *S. intrans, S. halepense, S. stipodium* and *S. verticilliflorum*) show considerably more dormancy than cultivated species. The sorghum germplasm collection (36,774 accessions) at ICRISAT's genebank, Patancheru, India includes 417 accessions of 22 related wild species. Following International Genebank Standards, accessions with 85% or more viability were eligible for long-term storage (LTS). Hence, an attempt was made to find out the extent of factors affecting seed germination while processing sorghum germplasm for long-term storage.

Materials and Methods

A set of 105 accessions of 16 wild sorghum species regenerated at ICRISAT during the postrainy season of 2004 and dried in muslin cloth bags at 15°C and 15% RH (FAO-IPGRI 1994) were used for testing initial germination. Two replications of 50 seeds each were tested for germination in an incubator for 10 days following standard procedures (ISTA 1993). Based on available literature for improving germination in dormant seed (Wilson 1973; Gaber et al. 1974; Sastry et al. 1995), the seed samples were stored in muslin cloth bags for three months under ambient conditions (25°C and 50% RH). From among these accessions tested for initial germination, a set of 20 accessions representing seven species and having a wide range of germination (0–92%) was selected for further study. Germination tests following the procedures mentioned earlier were carried out on two sets of seed: one set with glumes and the other deglumed with a fine-quality sand paper (Fig. 1). Considering delays in germination, the germination test was extended to 40 days under hygienic conditions to prevent fungal infection. Data on germination were subjected to analysis of variance, and the significance of differences between treatments was tested by the F-test while the paired 't' test was used for comparing mean values.

Results and Discussion

The results of germination tests on freshly regenerated accessions are presented in Table 1. After 10 days of testing, germination ranged from 0% to 93% with a mean of 60.4%. The proportion of nongerminating seeds was much larger in *S. verticilliflorum* (19 accessions) followed by *S. drummondii* (41 accessions) compared to *S. lanceolatum* (2 accessions) and *S. virgatum* (4 accessions).

The results of germination tests on 20 selected accessions (Table 2) showed large variations in germination within and among species. The initial germination of freshly harvested accessions tested with glumes after 10 days ranged from 0% to 90% with a mean germination of 45.9%. After storing the seed lots for three months under ambient conditions, the germination (with glumes) increased to 57.6% at 10 days, indicating loss of dormancy to some extent during storage. Extending the germination test to 40 days resulted in further improvement to 65.3%. In comparison, deglumed seeds had a higher mean germination of 85.8% after 10 days (Fig. 2) and 93.5% after 40 days.

Among the different species, germination in two accessions of *S. drummondii* (IS 21687 and IS 21895) was as low as 2% and 4% respectively even after three months of storage and 40 days of testing with glumes

Figure 1. Sorghum seed with glumes (left) and glumes removed (right).

while it increased to 97% and 72%, respectively, when glumes were removed and tested for 20 days. Both these accessions had zero germination when fresh seeds (with glumes) were tested. On the other hand, there was a significant improvement in germination for seeds of *S. arundinaceum* (IS 21368) when tested with glumes (0–55%) and glumes removed (0–100%) and test duration extended to 40 days.

Table 1. Number of accessions tested and seed germination percentage of freshly harvested seed of 16 wild sorghum accessions, ICRISAT-Patancheru, India, 2005.

Species name	Number of accessions tested	Germination (%)	
		Range	Mean
Sorghum aethiopicuum	6	63–88.0	75.3
S. almum	5	58–80.0	66.8
S. arundinaceum	7	0–88	69.4
S. controversum	3	33–85.0	62.7
S. deccanense	3	8–84.0	58.3
S. dimidiatum	1	73.0	73.0
S. drummondii	41	0–90	61.2
S. halepense	8	52–87.0	58.8
S. intrans	1	29.0	29.0
S. lanceolatum	2	89–90.0	89.5
S. laxiflorum	1	79.0	79.0
S. sorghastrum	2	0–43	21.5
S. usumbarense	1	69.0	69.0
S. versicolor	1	8.0	8.0
S. verticilliflorum	19	0–92.0	59.2
S. virgatum	4	81–93.0	86.0
Total	105	0–93.0	60.4

The improvement in germination of stored seeds in a majority of the accessions at 10 days of testing could be attributed to after-ripening, a common feature in graminae seeds (Ujiihra 1982; Sastry et al. 1995). The mean germination at 10 days was higher (85.8%) for deglumed seed compared with seeds tested with glumes (57.6%). There was significant improvement in germination (72–97%) when glumes were removed for accessions showing poor initial germination (2–25%). This contributed in a large measure to the higher mean germination (93.5%) for deglumed accessions. Mean germination increased from 57.6% at 10 days to 65.3% at 40 days when seeds were tested with glumes and from 85.8% to 93.5% for deglumed seeds. Deglumed accessions reached higher levels of germination by 20 days of testing while there was some advantage in extending the germination test up to 40 days for seeds with glumes. Further storage and extending the test improved seed germination in all the accessions (2–99%). In two accessions of *S. drummondii* (IS 21687 and IS 21895) there was a slight improvement in germination (2% and 4%) when tested with glumes while degluming seeds substantially improved the germination to 97% and 72%, respectively.

Conclusions

Breaking seed dormancy before initial viability testing and further monitoring is essential for assessing the full germination potential. After-ripening improves germination in a majority of the wild species of sorghum. Careful degluming significantly improves seed germination while extending the germination test has a positive effect too. The results of this study could be useful for other species of sorghum or other crops with such limiting factors.

Table 2. Seed germination (%) of sorghum wild accessions with and without glumes under different durations of testing, ICRISAT-Patancheru, India, 2005.

			Stored seeds					
			With glumes			Deglumed		
Accession	Species name	Fresh seeds with glumes (10 days)	10 days	20 days	Total (40 days)	10 days	20 days	Total (40 days)
IS 18822	*S. aethiopicuum*	67	77	2	80	79	11	90
IS 21368	*S. arundinaceum*	0	55	0	55	84	16	100
IS 18855	*S. controversum*	70	79	2	81	88	4	92
IS 21687	*S. drummondii*	0	2	0	2	83	14	97
IS 21895	*S. drummondii*	0	3	0	4	60	12	72
IS 33534	*S. drummondii*	0	21	33	93	79	12	92
IS 23117	*S. drummondii*	22	30	0	30	89	5	95
IS 21175	*S. drummondii*	41	48	0	48	96	3	99
IS 10988	*S. drummondii*	44	52	27	99	99	1	100
IS 14220	*S. drummondii*	67	85	1	87	83	11	94
IS 23166	*S. drummondii*	68	70	0	70	89	6	95
IS 10995	*S. drummondii*	79	85	10	98	91	6	97
IS 31554	*S. drummondii*	85	96	0	96	98	2	100
IS 33540	*S. drummondii*	85	85	10	95	92	0	92
IS 11009	*S. drummondii*	90	96	0	96	98	0	98
IS 18843	*S. halepense*	55	85	1	87	84	7	91
IS 18856	*S. lanceolatum*	89	96	0	96	96	4	100
IS 30966	*S. verticilliflorum*	0	13	0	13	83	13	96
IS 30894	*S. verticilliflorum*	14	25	0	25	74	15	91
IS 14583	*S. verticilliflorum*	42	48	1	50	71	8	79
Range		0–90	2–96	0–33	2–99	60–99	0–16	72–100
Mean		45.9	57.6	4.4	65.3	85.8	7.5	93.5
SEm ±		7.6	7.2	2.9	7.6	2.2	1.1	1.6

Figure 2. Germination of sorghum seed with glumes (left) and glumes removed (right).

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