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Variability for seed longevity among advanced breeding lines of soybean (*Glycine max*)

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ABSTRACT The correlation between results of field emergence and accelerated aging test (0.664**) and the correlation between accelerated seed ageing and grain yield kg/ha (0.745**) were highly significant in the advanced soybean breeding lines tested. The genotypes showing more than 90% germination under accelerated aging test yielded more than 20 q/ha, whereas the genotypes which exhibited poor germination (<70%) under accelerated aging test yielded less than 15 q/ha. Since plant stand is determined by the seed longevity, its high correlation with grain yield is important. Thus, selection for better seed longevity will be of great help in indirect selection for higher yield. Apart from achieving higher yield, selection for good seed longevity will be beneficial to the farmers.

Key words: Accelerated aging test, seed longevity, field emergence, grain yield, soybean genotypes

Soybean, one among oilseed crop in India, is cultivated in more than 10 million ha with a production of more than 12 million tonnes [1]. Productivity of soybean in India has increased from 700 kg/ha in 1970 to more than 1200 kg/ha in 2010. However, soybean productivity in India is half of the average world productivity [2]. The low seed replacement rate of 9.5% is one of the major reasons for low productivity [3]. Poor quality seed results in poor plant stand and ultimately poor productivity per unit area. Soybean seed is known to have poor viability and field emergence. Breakability of testa and position of radical in soybean seed makes it vulnerable to injuries during harvesting, threshing, processing and storage [4]. Of the several factors which affect the seed longevity, genotypic component is one of the major factors [5]. Breeding for good seed longevity of the seed stored in conditions similar to that of the farmers in tropics is one of the major goals of the breeding programme at IARI, so as to resolve the problem of poor germination and plant stand in farmers' fields. With this objective, evaluation of the variation in advanced breeding lines of soybean for seed longevity was carried out.

MATERIALS AND METHODS

Plant stand in the field is one of the most important factors which affects seed yield. For establishing a good plant stand, good germination and field emergence are important. If field emergence can be predicted on the basis of seed vigour testing in the laboratory it will be of great help to the breeders as well as farmers. Therefore, the present study was undertaken to correlate the results of accelerated ageing test (AAT) with results of field emergence. The study material consisted of advanced breeding lines tested in station trial as well as AVT II trial of AICRP on soybean for north plain zone. A total of 16 genotypes (including checks) were evaluated in the station trial in a randomized block design with four replications. The data on field emergence, accelerated ageing test of the freshly harvested seeds, flower colour, days to 50% flowering, maturity, 100-seed weight

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and grain yield kg/ha were summarized (Tables 1&2). In advanced varietal trial a total number of eleven genotypes were evaluated in randomized block design with four replications. The seed longevity was tested by accelerated aging test [6].

RESULTS AND DISCUSSIONS

In station trial, field emergence was fairly good to very good [7]. The data on various characters namely, germination, days to 50% flowering, days to maturity, 100-seed wt. and seed yield were presented (Table 1). Entries differed with respect to 50 % flowering (42 to 56 days), days to maturity (114 to 129 days) and 100-seed wt. (7 to 12 g). Four entries namely, DS 2703, 2704, 2705 and 2707 were identified yielding *at par* or better than the best check SL 525 (1450 kg/ha). In AVT II trial, field emergence was fairly good to very good. The data on various characters namely, germination, days to 50% flowering, days to maturity, 100-seed wt. and seed yield were presented in table 2. Entries differed with respect to 50% flowering (45 to 57 days), days to maturity (117 to 131 days) and 100-seed wt. (9 to 13 g). Three entries namely, DS 12-13, DS 2614 and SL 794 were identified, yielding *at par* or better than the best check PS 1347 (1800 kg/ha).

The freshly harvested seeds of these 27 genotypes were tested for seed longevity using accelerated aging test. The germination value showed large variation among the genotypes tested (Tables 1&2). In the station trial the variation was marginally higher (52 to 94%) as against variation in AVT II genotypes (56-96%). The correlation between field emergence and accelerated aging test was high (0.664**) in station trial, whereas it was low (0.55) in case of AVT II entries. The correlation between accelerated seed ageing and grain yield kg/ha were highly significant (0.745**). All the genotypes showing more than 90 % germination under accelerated aging test yielded more than 20 q/ha, whereas the genotypes which exhibited poor germination (< 70%) yielded less than 15 q/ha in the station trial. Since plant stand is determined by the seed longevity; its high correlation with grain yield is important. However, the correlation between seed size and accelerated seed test (0.255); between AAT and oil content (0.069) were non-significant. Torres *et al.* [8] reported that the accelerated aging test provided an accurate estimate of the field emergence of soybean seedlings, however, as the seed bed conditions became less favourable, the ability of the accelerated aging test to estimate field performance significantly decreased. The poor correlation in the AVT II trial can be explained on the basis of the findings of the Torres *et al.* [8]. Thus selection for high seed longevity can help in indirect selection for higher yield.

Apart from achieving higher seed yield, better seed longevity cut down the cost of the seed to the farmers. For planting one-hectare area, 80-100 kg seed of soybean is required. Assuming optimum plant population to be 4, 44,444 plants/ha, the number of viable seeds required is 4, 44,444. Suppose 100-seed weight of soybean is 13 g, we require (13/100 X 4, 44,444/1000) or 58 kg of seed to plant one hectare area. Assuming 70% seed germination standard, one need (58/70 x 100) or 83 kg seed. The recommended seed rate for planting one-hectare area is 80 to 100 kg. If we increase germination by 1% one will require (58/71 X 100) or 81.69 kg of seed. Thus, we can save 1.16 kg of seed/ha. For planting 10 million hectares one will save 11.6 million kg of seed. Thus, nation can save seeds worth Rs 348 million @ Rs 30/kg for every single per cent gain in seed longevity.

Genotype DS 12-13 registered 92% germination in AAT. Genotype DS 12-13 has shown higher and stable yields against all the three checks SL 688 (32.44%), PS 1347 (34.62%) and Bragg (42.69%) in the AVT II trial (Table 3). Soybean genotype DS 12-13 had shown higher and stable yields over the qualifying entry PS 1466 (8.59%) and SL 794 (10.86). DS 12-13 was identified for cultivation in North Plain Zone during 42 Annual Group Meeting of the AICRP on soybean. DS 12-13 had resistance against yellow mosaic virus, *Rhizoctonia* Arial Blight (RAB), Bacterial Pustule (BP) and it was moderately resistant to stem fly, and defoliators. DS 12-13 was a bold seeded variety having 100-seed weight of 10.53 g and good germination. It has high oil content (19.60%).

Table 1. Data on preliminary yield trial II (*Kharif* 2011) IARI, New Delhi

Genotype	Field emergence	% germination on AAT	Flower colour	Days to 50% flowering	Days to maturity	100-seed weight (g)	Yield (kg/ha)
DS 2801	FG	72	P	44	124	10	800
DS 2816	G	70	W	49	114	7	1000
DS 2822	FG	68	W	44	116	11	1417
DS 2825	FG	52	W	42	117	10	933
DS 2703	**VG**	**94**	**W**	**56**	**127**	**12**	**2217**
DS 2704	**VG**	**92**	**W**	**55**	**125**	**11**	**2017**
DS 2705	**VG**	**92**	**W**	**55**	**125**	**11**	**2517**
DS 2707	**VG**	**92**	**W**	**56**	**125**	**11**	**2217**
DS 2708	VG	76	P	56	129	8	583
DS 2709	FG	78	W	42	119	12	1100
DS 2716	G	66	W	49	125	11	1367
Bragg	G	80	W	46	122	9	983
Pusa 16	FG	84	W	43	121	10	1067
Pusa 9712	G	**84**	W	44	117	10	1350
Pusa 9814	FG	68	W	47	126	11	883
SL 525	FG	80	W	44	124	8	**1450**

CV = 12.98%; CD = 1.193 kg/plot; Correlation between accelerated aging test and yield = 0.7086**; Correlation between field emergence and accelerated aging test = 0.6446**; ** = Significant at 1%; Visual observation: FG = 70-79%; G = 80-89%; VG = 90% and above; AAT = Accelerated ageing test; P = Purple flower; W = White flower

Table 2. Data on advanced varietal trial II (*Kharif* 2011) IARI, New Delhi

Entry	Field emergence	% germination on AAT	Flower colour	Days to 50% flower	Days to maturity	100-seed wt. (g)	Yield (kg/ha)	Seed quality (NIR) (Sample size 250g seed)(%)		
								Protein	Moisture	Oil
DS 12-13	VG	92	W	57	131	9	2233	37.8	10.0	22.1
SL 794	G	64	W	46	117	10	1933	38.2	10.1	21.6
PS 1466	G	58	W	45	117	11	1528	35.3	10.5	23.3
SL 795	FG	56	W	46	118	12	1317	38.4	10.5	23.5
SL 799	FG	84	W	49	123	13	1578	37.9	10.8	21.9
DS 2614	VG	88	W	57	131	13	2067	36.4	10.1	24.7
Bragg (C)	G	74	W	46	122	11	1283	36.1	10.1	23.0
PS-1042 (C)	G	76	W	46	119	12	1778	37.9	10.6	22.7
SL525 (C)	FG	86	W	46	123	11	1544	33.7	10.0	25.7
SL 688 (C)	FG	74	P	47	119	13	1672	34.6	10.2	26.5
PS 1347 (C)	G	70	W	52	122	12	1800	37.4	10.1	24.1

CV= 17.86 %; CD = 1.045 kg/plot; Correlation between accelerated aging test and yield = 0.558NS; Correlation between field emergence and accelerated aging test = 0.358NS; Visual observation: FG = 70-79%; G = 80-89%; VG = 90% and above; AAT = Accelerated ageing test; P = Purple flower; W = White flower

Table 3. Data of coordinated varietal trials [Zonal Mean: Three years mean seed yield (kg/ha)]

Genotype	IVT	AVT I	AVT II	Mean	% increase	Rank
DS 12-13	2556(4)	1964(4)	2338(4)	2286(12)		I
PS 1466 (Qualifying variety)	2451(4)	1850(4)	2015(4)	2105(12)	8.59	II
SL 794 (Qualifying variety)	2496(4)	1599(4)	2090(4)	2062(12)	10.86	III
Bragg (check)	1735(4)	1505(4)	1567(4)	1602(12)	42.69	VI
PS 1347 (check)	1814(3)	1308(4)	1973(4)	1698(11)	34.62	V
SL 688 (check)	1866(3)	1272(4)	2041(4)	1726 11)	32.44	IV

*Figure in parenthesis indicate no. of testing locations

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