The Pharma Innovation Journal 2022; 11(1): 1587-1592

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(1): 1587-1592

www.thepharmajournal.com
Received: 02-10-2021
Accepted: 09-12-2021

Seema S Doddamani
Department of Seed Science and Technology, University of Agricultural Sciences, Dharwad, Karnataka, India

NK Biradarpatil
Department of Seed Science and Technology, University of Agricultural Sciences, Dharwad, Karnataka, India

JS Hilli
Department of Seed Science and Technology, University of Agricultural Sciences, Dharwad, Karnataka, India

Ramesh Bhat
Department of Biotechnology AC, Dharwad, Karnataka, India

GT Basavaraja
AICRP on Soybean, MARS Dharwad, Karnataka, India

Corresponding Author:
Seema S Doddamani
Department of Seed Science and Technology, University of Agricultural Sciences, Dharwad, Karnataka, India

A quick and simple way to screen soybean (*Glycine max* L. Merril) genotypes for longevity

Seema S Doddamani, NK Biradarpatil, JS Hilli, Ramesh Bhat and GT Basavaraja

Abstract
Longevity assessment of large number of genotypes takes longer time with traditional methods *viz.*, germination tests throughout seed storage and identification of genotypes with higher longevity is crucial in developing new varieties with long storage life. Even though soybean is very sensitive crop very limited work has been carried out on seed longevity related traits. By analyzing 120 soybean genotypes, here we propose accelerated aging as simple and quick method to screen large number of soybean genotypes for longevity based on percent reduction in germination and study indicated that it is strongly correlated to longevity of genotypes and negatively impacted by seed weight, *viz.*, bold seeds loose storability earlier than medium and small seeds. Seeds with grey hilum color has longer storability compared to others *viz.*, black, brown, variegated and grey, yellow and these can be used as visual marker for longevity assessment. Thus, these simple ways can be employed for quick estimation and screening of large number of genotypes for longevity.

Keywords: Soybean genotypes, seed quality, longevity, accelerated aging, percent reduction in germination, hilum colour

1. Introduction

Soybean (*Glycine max* L. merril) is an important oil seed crop and is an annual legume. It is originated in China and classified as an oilseed rather than a pulse by the UN Food and Agriculture Organization and is popularly known as ‘Meat of fields’ in china and also as “Miracle crop” due to its high protein (42-45%) and oil (19-20%) content. It is important oil seed crop accounts for 30 percent of the world edible oil production and its protein is composed of 10 properly balanced amino acids. It is also called as “Wonder crop” due to its multiplicity of uses in food and industrial areas. As it fixes atmospheric nitrogen in the soil to maintain the soil fertility and has beneficial effect on successive crops, it is called as “Golden bean” or “Gold of soil”.

Genetic variation among traits is important for breeding and in selecting desirable types. Knowledge of diversity patterns will allow breeders to understand better evolutionary relationships among accessions, to sample germplasm in a more systematic fashion and to develop strategies to incorporate useful diversity in their breeding programs. Introgression of new genetic diversity through hybridization with introduced germplasm is one way to increase genetic variation in breeding populations (Guedira *et al*., 2000) [5].

Seed longevity is defined as the ability of seed to remain alive during storage. Poor longevity negatively impacts on seedling establishment and consequently crop yield. This is particularly problematic for soybean as seeds have a short lifespan and looses viability below minimum seed certification standard before next growing season due to its inherent seed structure and composition (Tekrony 1984) [17].

The variation in speed of seed deterioration of soybean varieties is a genetic character. Soybean genotypes differ in their ability to maintain seed longevity (Wine and Kueneman, 1981) [22]. There are thousands of breeding lines and hundreds of elite cultivars developed yearly in the soybean hybridization programme over the world. Development of these breeding lines increased genetic uniformity in the frame of species. Therefore, the genetic basis of these released cultivars is rather narrow (Li *et al*. 2010) [11].

Seed longevity under conventional or optimal storage conditions would take years to complete. So accelerated ageing or controlled deterioration (CD) conditions are utilized to speed the loss of viability. The accelerated ageing test has been used to assess the vigour of seed lots and to predict their relative longevity by ageing seeds rapidly at elevated temperature and relative humidity (RH).

One of the major constraints in soybean cultivation is the non-availability of high vigorous and viable seeds at the time of sowing. Keeping this in view, here we propose accelerated aging as simple and quick method to screen large number of soybean genotypes for longevity based on percent reduction in germination.

2. Material and Methods

The study was conducted on screening of soybean [*Glycine max* (L.) Merril.] genotypes for seed longevity, seed quality was analyzed in Post Graduate laboratory of the Department of Seed Science and Technology, College of Agriculture, Dharwad, University of Agricultural Sciences, Dharwad, Karnataka, India, during 2019-21. The details of the materials used and techniques adopted during the course of investigations are described below.

2.1 Source of seeds

The seeds of one hundred and twenty soybean genotypes consisting of indigenous and exotic collection, advanced breeding lines and released varieties were obtained from the National Seed Project, Seed Unit and All India Co-ordinated Research Project on Soybean, MARS, University of Agricultural Sciences, Dharwad.

2.2 Germination percentage

The standard germination test was conducted as per the ISTA Rules (*Anon*., 2011) [1] by adopting the rolled paper towel between paper method in four replications of randomly drawn 100 seeds. Rolled paper towel was kept at 25 + 1^{0}c and 95 + 1 per cent relative humidity (RH) in the seed germinator. On eighth day of germination test (final count), number of normal seedlings were counted and were expressed as germination percentage.

2.3 Per cent reduction in germination

$$\text{Per cent reduction in germination} = \frac{\text{Germination I (\%)} - \text{Germination after AA (\%)}}{\text{Germination I (\%)}} \times 100$$

Germination I (%) - Initial germination percentage prior to accelerated aging
Germination after AA (%) – Germination percentage after accelerated aging

2.4 100 seed weight (g)

100 seed weight was computed by weighing 100 filled seeds which were randomly chosen from a complete sample made by mixing the seeds of all the five plants in each replication and recorded in grams.

2.5 Accelerated ageing test

The seed material was subjected to accelerated ageing by controlled deterioration test as per ISTA procedure (*Anon*., 1996). First the chamber was sterilized with alcohol to prevent the fungal contamination to the seed material. Individual genotypes were taken in separate petriplate and placed on the wire mesh and incubated in temperature and relative humidity control chamber at 40 ºC temperature and 94 to 100 per cent RH for 72 hours continuously.

2.6 Statistical analysis

Experimental data were analyzed using analysis of variance (ANOVA) and critical differences were calculated at one per cent level. The data collected from the experiment was analyzed statistically for correlation using regression analysis. Values of $P<0.01$ were considered as significantly different ($\alpha=0.01$).

Table 2: Hilum Color, germination percentage prior and after accelerated aging, percent reduction in germination and 100 seed weight of soybean genotypes.

Sl. No	Genotype Name	Hilum Color	100 Seed weight(g)	Germination (%) initial	Germination (%) after accelerated aging	Reduction in germination(%) after AA
1	ADT-1	Brown	10.36	94.00	90.67	3.55
2	Ankur	Brown	16.06	92.67	85.00	8.27
3	Alankar	Brown	15.36	89.00	72.33	18.73
4	Bragg	Brown	19.45	85.00	64.00	24.71
5	Birsa Soya	Grey	17.25	94.67	89.67	5.28
6	Co-1	Brown	11.25	93.67	89.67	4.27
7	Co-2	Brown	17.33	87.67	69.00	21.29
8	Co-3	Black	10.47	96.00	91.00	5.21
9	DSb-1	Brown	13.42	95.00	89.00	6.32
10	DSb-21	Brown	13.57	93.00	88.00	5.38
11	DS-228	Brown	16.62	88.67	71.00	19.92
12	Davis	Brown	17.48	87.67	72.67	17.11
13	Durga	Black	14.25	92.67	76.33	17.63
14	Gaurav	Brown	15.59	95.00	70.67	25.61
15	Gujarat soya 1	Brown	14.90	92.67	76.67	17.27
16	Gujarat soya 2	Black	16.67	91.00	72.67	20.15
17	Hara soya	Black	16.22	87.33	69.67	20.23
18	Hardee	Brown	13.78	90.33	80.67	10.70
19	Indira soya	Black	14.41	89.33	70.33	21.27
20	Improved pelican	Brown	12.55	96.00	88.67	7.64
21	JS-2	Brown	16.90	85.00	70.33	17.25
22	JS-338	Brown	16.21	87.67	72.00	17.87
23	JS-20-29	Black	16.89	86.00	68.00	20.93
24	JS-20-34	Black	15.49	90.00	74.00	17.78
25	JS-20-69	Black	12.36	91.33	83.33	8.76

26	JS-76-205	Grey	13.49	93.00	89.00	4.30
27	JS-7105	Black	14.24	90.33	73.67	18.45
28	JS-7546	Brown	14.94	91.00	75.33	17.22
29	JS 7981	Brown	14.23	91.33	76.00	16.79
30	JS-8021	Brown	15.37	91.67	72.67	20.73
31	JS-9041	Brown	16.01	86.33	72.00	16.60
32	JS-9305	Black	15.54	94.67	85.67	9.51
33	JS-9560	Brown	18.50	89.33	67.00	25.00
34	JS-9572	Black	10.43	95.00	90.00	5.26
35	Karuna	Brown	13.67	92.33	81.00	12.27
36	Kalitur	Grey	12.44	96.67	91.67	5.17
37	Khsb-2	Black	17.55	90.67	70.33	22.43
38	KB-79	Brown	16.32	90.67	73.33	19.12
39	Lee	Brown	14.97	89.33	75.00	16.04
40	LSb-1	Brown	15.71	91.00	76.00	16.48
41	Monetta	Brown	17.68	89.33	62.00	30.60
42	MAUS-1	Brown	13.26	92.33	84.33	8.66
43	MAUS-2	Black	13.68	91.33	83.00	9.12
44	MACS-13	Black	13.37	93.33	83.67	10.36
45	MAUS-32	Brown	16.69	87.67	72.00	17.87
46	MAUS-47	Brown	13.38	92.33	85.00	7.94
47	MACS-57	Brown	14.35	92.00	76.00	17.39
48	MACS-58	Brown	14.74	92.33	81.33	11.91
49	MAUS-61	Black	15.39	91.33	72.67	20.44
50	MAUS-71	Black	15.40	92.00	72.33	21.38
51	MAUS-81	Brown	16.45	89.33	70.33	21.27
52	MACS-124	Black	15.35	93.00	71.67	22.94
53	MAUS-158	Black	14.93	89.33	75.33	15.67
54	MAUS-162	Black	15.48	92.00	70.33	23.55
55	MAUS-450	Black	15.66	93.00	73.67	20.79
56	MAUS-1188	Black	14.24	93.00	77.33	16.85
57	MACS-124	Brown	14.44	90.67	75.33	16.91
58	MAUS-61-2	Brown	14.61	90.00	74.00	17.78
59	NRC-2	Grey	14.83	90.00	73.00	18.89
60	NRC-7	Black	14.29	93.00	76.67	17.56
61	NRC-12	Black	16.35	90.33	72.00	20.30
62	NRC-32	Brown	20.48	87.00	65.33	24.90
63	NRC-77	Brown	12.34	94.33	86.67	8.13
64	NRC-86	Brown	16.81	84.33	69.67	17.39
65	Pb-1	Brown	16.70	92.00	77.33	15.94
66	Palam Soya	Yellow	14.51	92.00	75.33	18.12
67	PK-262	Brown	13.47	90.67	84.33	6.99
68	PK-308	Brown	17.46	86.00	66.33	22.87
69	PK-327	Black	14.35	90.67	75.00	17.28
70	PK-416	Brown	17.08	86.67	67.33	22.31
71	PK-471	Grey	16.69	90.67	71.67	20.96
72	PK-472	Brown	17.74	86.00	64.33	25.19
73	PS-564	Black	15.23	90.00	73.67	18.15
74	PS-1024	Black	16.54	92.00	74.00	19.57
75	PS-1029	Black	18.21	90.00	65.33	27.41
76	PS-1042	Brown	16.80	88.00	71.00	19.32
77	PS-1092	Black	17.37	87.33	69.33	20.61
78	PS-1225	Brown	13.39	90.00	83.00	7.78
79	PS-1241	Brown	14.36	93.67	81.33	13.17
80	PS-1347	Brown	17.27	85.00	67.00	21.18
81	PS-1368	Black	17.29	90.00	70.00	22.22
82	PRS-1	Black	16.57	87.33	71.00	18.70
83	Pusa-12	Brown	14.66	90.33	74.00	18.08
84	Pusa-16	Variegted	14.31	92.67	75.67	18.35
85	Pusa-20	Black	12.80	93.00	89.00	4.30
86	Pusa-22	Black	15.51	91.33	72.33	20.80
87	Pusa-24	Black	15.23	90.67	72.00	20.59
88	Pusa-37	Brown	13.57	92.00	86.33	6.16
89	Pusa-40	Black	17.43	86.67	67.00	22.69
90	Pusa-9712	Black	18.44	88.33	64.67	26.79
91	Pusa-98-41	Black	17.76	84.00	61.67	26.59
92	RKS-18	Black	13.78	90.00	80.67	10.37

93	RKS-24	Black	13.55	93.33	86.33	7.50
94	RKS-45	Brown	13.02	94.33	85.33	9.54
95	RVS-2001-4	Black	14.38	90.33	74.00	18.08
96	RAUS-5	Brown	12.71	92.00	85.00	7.61
97	Shivalik	Black	13.48	93.00	73.67	20.79
98	Shilajeet	Black	12.48	95.00	86.33	9.12
99	Swarna Vasundhara	Brown	36.78	92.00	59.67	35.14
100	SL-96	Black	13.37	92.00	85.00	7.61
101	SL-295	Black	18.54	87.00	66.33	23.75
102	SL-525	Black	17.58	88.00	65.67	25.38
103	SL-688	Black	17.57	88.00	67.67	23.11
104	SL-744	Black	16.30	90.00	72.67	19.26
105	SL-958	Brown	14.64	91.00	75.33	17.22
106	TAMS-38	Brown	15.28	90.00	70.33	21.85
107	TAMS-98-21	Brown	14.77	90.00	74.67	17.04
108	Type-49	Brown	11.36	93.00	87.00	6.45
109	VLS-1	Grey	19.78	91.00	76.00	16.48
110	VLS-2	Brown	21.56	89.33	61.33	31.34
111	VLS-21	Brown	18.82	85.33	64.00	25.00
112	VLS-47	Black	11.40	94.33	86.67	8.13
113	VLS-59	Black	12.64	92.67	86.33	6.83
114	VLS-63	Black	13.40	90.67	85.33	5.88
115	VLS-65	Brown	15.62	93.00	71.00	23.66
116	DSb-23	Grey	9.71	94.67	92.00	2.82
117	DSb-31	Brown	14.40	90.67	79.00	12.87
118	DSb-32	Black	15.19	93.33	75.67	18.93
119	LBS	Grey	9.25	97.00	94.67	2.41
120	JS-335	Brown	12.72	95.00	88.33	7.02
		Mean	15.31	90.84	76.20	
		S.Em	0.14	0.91	0.87	
		CD@0.01	0.51	3.33	3.18	
		CV%	1.56	1.73	1.97	

Table 2: Relation between percent reduction in germination and 100 seed weight by regression analysis

Regression Statistics		
Multiple R		0.755008
R Square		0.570037
Adjusted R Square		0.566393
Standard Error		4.665977
Observations		120
	Coefficients	Standard Error
Intercept	-11.3616	2.248526
100 Seed weight	1.803614	0.144201

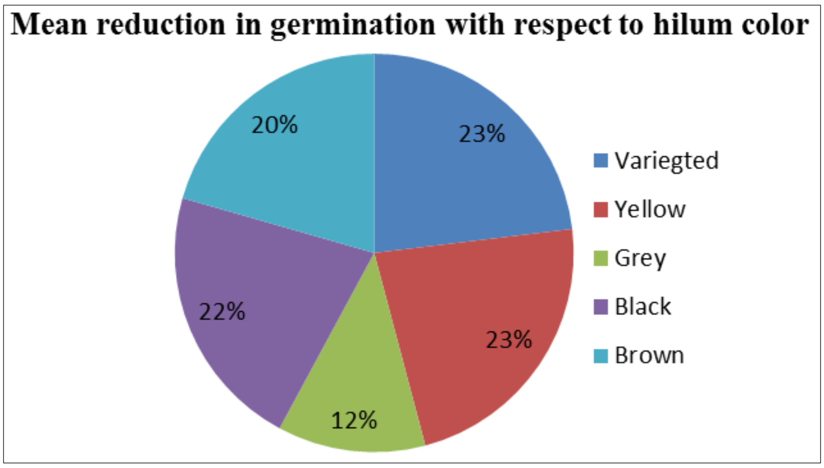

Fig 1: Relationship between percent reduction in germination and hilum color of soybean genotypes

3. Results

Soybean genotypes had Yellow, Grey, Brown, Black and Variegated hilum color. Palam soy had shown yellow hilum and variegated was observed in Pusa-16 where as 8 genotypes indicated Grey color *viz*., NRC 2, PK 471 and VLS-1 etc., and 50 genotypes had black as in PS 1029, KHSb 2, RKS-24 and

Shilajeet. As described in Table 1 other 60 genotypes recorded brown hilum color *viz*., NRC 37, PK 416 and DS-228, Davis etc.

The range of 100 seed weight was as low as 9.25 in LBS to as high as 36.78 in Swarna Vasundhara. Based on DUS guidelines of PPV and FR, among the 120 genotypes two fall in the group of Small (≤ 10.0 g) and sixteen genotypes to Medium (10.1 -13.0 g) *viz*., JS 335 (12.72), NRC- 77 (12.33) and 102 to Large (> 13.0 g) like RKS-18(13.78), JS 7981(14.23), LSb-1 (15.71), Ankur (16.06) and VLS-21 (18.82), Bragg (19.45). The mean value was 15.31 as indicated in Table 1. The bold seeds undergo cracks, breaks and abrasions, bruises while threshing and processing which obviously result in abnormal seedlings of questionable planting value. These results are in conformity with the findings of Kausal *et al* (2006) [9]. Vanangamudi (1988) [19].

As most soybean varieties are bold seeded, they are highly vulnerable to mechanical damage. The small, spherical seeds usually elude from injury while harvesting, threshing and handling, processing and lean to undergo lower mechanical damage, whereas elongated or larger and irregularly shaped seeds prone to get extensive damage. The wide cotyledon and site of embryo axis, constitute a structure that won't tolerate higher damage (Roberts 1972, Paulsen *et al.* 1981) [16, 14].

The significantly highest germination prior to accelerated aging was observed in LBS (97) followed by Kalitur (96.67), Improved pelican (96) was on par with Co-3, JS-335 (95) and the lowest was in Pusa 98-41 (84), NRC-86 (84.33), Bragg (85) was on par with JS-2, PS-1347. Mean was 90.84. The maximum germination after aging (94.67) was maintained by LBS followed by DSb-23 (92), Kalitur (91.67) and Co-3 (91). Whereas Swarna vasundhara recorded lower germination 59.66 after aging and it was followed by VLS-2 (61.33), Pusa-98-4 (61.66). (Table 1)

The reduction in germination of soybean genotypes after accelerated aging ranged from 2.5 to 35 percentage. Minimum reduction was observed in LBS (2.41), DSb-23 (2.82), ADT-1 (3.55) but Swarna vasundara (35.14), VLS-2 (31.34), Monetta (30.60) recorded higher reduction in germination. (Table 1)

Percent reduction in germination were varying among the genotypes. This indicates that storability of genotypes depend on its genetic character and applied agronomic principles. It implies that genotypes with maximum reduction in germination are poor storer where as genotypes with minimum reduction in germination are high or long storer (Table 1). (McDonald *et al*., 1999, Rastegar *et al*., 2012, Balesevic *et al*., 2011) [12, 15, 3]. Changes linked with the seed deterioration were reduction in food reserve, enhanced enzyme activity, membrane permeability and fat acidity. As the catabolic activity go along with aging, the potentiality of seed to germinate was reduced (Justice and Bass, 1979). Soybean seed exposed to weathering before harvest and to mechanical damage while threshing and processing wont store well even though they had passably higher initial germination as in Swarna Vasundhara (Gupta, 1976) [6].

Hilum color had impact on mean percentage of reduction in germination and was minimum in seeds with grey color (12%) followed by brown (20%), black (22%) and variegated (23%), yellow color were on par with each other. Maximum germination reduction was observed in seeds having variegated (23%), yellow hilum color (32%). (Fig 1). This may be due to impermeability of grey color hilum to water and pathogens and also due to the presence of positively correlated components of seed longevity viz., higher vita-E, calcium, lignin content and reduced lipid peroxidation rate. Thus this can be used as visual marker in longevity assessment (Tiwari *et al.*, 1995, Vijay *et al*., 2003 and Dellagostin *et al.*, 2011 P. V Pawar *et al*., 2019) [18, 21, 4, 13].

Regression analysis indicates that correlation between 100 seed weight and percent reduction in germination is 75 percentage. Contribution of independent factor (100 seed weight) on dependent (percent reduction in germination) is 57 percentage, with negative intercept value of 11.36 and regression coefficient 1.80. There is negative correlation between seed weight and longevity, as bold seeds looses longevity much earlier than small and medium seeds due to exposure of seeds surface to several damages during harvesting to processing that lead to seed coat rupture and water imbibition, ultimately reduction in germination due to stress. Our results are in agreement with Verma *et al*., 1992 [20], Husain *et al.*, 1998 [7], Vanangamudi, K., 1988 [19] and Kuchlan *et al.* 2010 [10], Amit *et al*., 2018 [2].

4. Conclusion

This study indicates that percent reduction in germination is strongly correlated to longevity of genotypes and is negatively impacted by seed weight. Seeds with grey color hilum has longer storability or longevity compared to other hilum color which can be used as visual marker. Thus, these simple ways can be employed for quick estimation of longevity of large number of genotypes.

5. References

1. Anonymous. International rules for seed testing. Seed Sci. Technol. 2011;29(3):1-348.
2. Amit Adsul T, Vivek P, Chimote, Milind Deshmukh P. Inheritance of Seed Longevity and its association with other seed related traits in soybean (*Glycine max*), Agric. Res. 2018;7:105-111.
3. Balesevic-Tubic S, Tatic M, Orevic V, Nikolic Z. Changes in soybean seeds as affected by accelerated and natural ageing. Romanian Biotechnological Letters. 2011;16(6):6740-6747.
4. Dellagostin G, Marisa S. Soybean genetic dissimilarity in a segregant population with variability in seed morphological traits. Rev. Bras. Sementes [online]. 2011;33(4):689-698.
5. Guedira GL, Thompson JA, Nelson RL, Warbureton ML. Evaluation of genetic diversity of soybean introductions and North American ancestors using RAPD and SSR markers. Crop Sci. 2000;40:815-823.
6. Gupta PC. Viability of stored soybean seeds in India. Seed Res. 1976;4(1):32-39.
7. Husain SM, Bhatnagar PS, Karmakar PG. Radiation induced variability for seed longevity in soybean variety NRC-7. Soybean Genet. Newslett. 1998;25:83.
8. Justice OL, Bass LN. Principals and Practises of Seed Storage (book). Castle House Publication Ltd. London, 1979, 22-25.
9. Kausal RT, Jagtap AP, Patil BN, Pavitrakar NR, Rathod TH. Management of mechanical damage to soybean seeds during threshing. Annals Pl. Physiol. 2006;20(1):74-77.
10. Kuchlan P, Husain SM, Chauhan GS. Evaluation of soybean genotypes for seed longevity. Indian J Agric. Sci. 2010;80(2):141-145

11. Li Y, Guan R, Liu Z, Ma Y, Wang L, Li L, *et al*. Genetic structure and diversity of cultivated soybean (*Glycine max*) Theor. Appl. Genet. 2010;117:857-871.
12. McDonald MB. Seed deterioration: physiology, repair and assessment. Seed Sci. Tech. 1999;27:177-237.
13. Pawar PV, Naik RM, Deshmukh MP, Satbhai RD, Mohite SG. Biochemical and molecuar marker based screening of seed longevity in soybean [*Glycine max* (L.) Merill], Legume Res. 2019;5:0571-0976. DOI: 10.18805/LR-3915
14. Paulsen MR, Nave WR, Mounts TL, Gray LE. Storability of harvest damaged soybeans. Transaction of the ASAE. 1981;24(6):1583-1587
15. Rastegar Z, Sedghi M, Khomari S. Effects of Accelerated Ageing on Soybean Seed Germination Indexes at Laboratory Conditions. Not Sci. Biol. 2011;3(3):126-129.
16. Roberts EH. Viability of seeds. illus. London, 1972, pp. 448.
17. Tekrony DM, Egli DB, Rucker M, Vieira RD. Electrical conductivity of soybean seeds after storage in several environments. Seed Sci. Technol. 2001;29:599-608.
18. Tiwari SP, Bhatia VS. Association of seed anatomical characters with seed longevity in soybean. Seed Res. 1995;23(1):38-39.
19. Vanangamudi. Storability of soybean seeds as influenced by the variety, seed size and storage container. Seed Res. 1988;16(1):81-87.
20. Verma RS, Gupta PC. Storage behavior of soybean varieties vastly differing in seed size. Seed Res. 1992;3(1):39-44.
21. Vijay D, Dadlani M. Seed longevity and water absorption pattern in maize, soybean and safflower. Indian J Plant Physiol. (Special Issue) 2003, 244-248.
22. Wine HC, Kueneman EA. Soybean seed deterioration in the tropics, varietal differences and techniques for screening in field. Crop Res. 1981;4(2):123-132.