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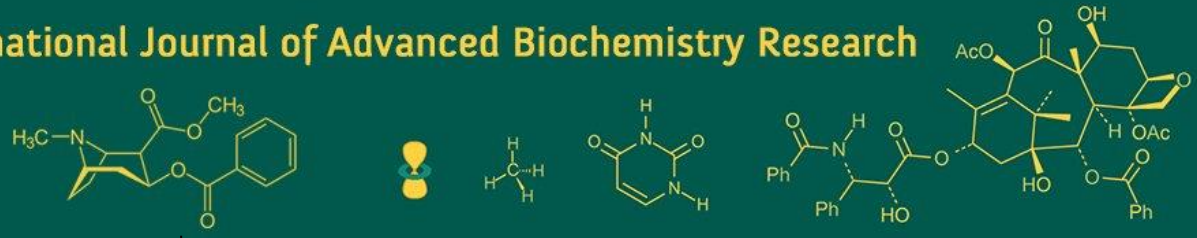

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Studies on seed quality parameters of soybean (*Glycine max* (L.) seed stored in gunny bags and HDPE bags

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Abstract
The experiment was conducted at Seed Technology Research Unit , Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during the year 2012-2013 to studies on seed quality parameters of soybean seed stored in gunny bags and High Density Polythene Bags (HDPE) bags. The experiment consisted of two soybean (MAUS-71 and JS-335) varieties was laid out in Factorial Completely Randomized Block Design with three replications. The character association revealed that the seed quality characters studied *viz*., germination%, speed of germination, seed vigour index, seed moisture content, seed mycoflora showed significantly maximum in the JS-335 variety for HDPE storage bag indicating the vital role of these characters towards corresponding seed storability of soybean variety. The JS-335 soybean variety showed high value of desirable seedling characters also good storer, this may be due to high germination and early vigour of JS-335 variety than the MAUS-71. Thus, more emphasis should be given on seed quality characters, as an early indicator of relative seed storability in the HDPE plastic bag it may be used as selection criteria for identification of good storable material for different field crops.

Keywords: Soybean, seed quality, storability, gunny bags, HDPE

Introduction
Soybean [*Glycine max* (L.) Merill] is an important legume crop belongs to the family *Leguminaceae*, sub-family *Papilionaceae* and genus *Glycine*. Soybean is believed to be South-East Asian origin and reported to be extensively cultivated in China from pre-historic time *i.e.* 2838 B.C. The soybean is generally considered as a crop best adaptable to temperate zones, but is also grown in many tropical regions of South-Eastern Asia, India and Africa. Soybean has become a wonder crop of the twentieth century and is often designated as a 'Golden bean'. Among the various pulses, soybean is recognized as an excellent source of high quality protein and oil. It contains 43.2 per cent protein and 19.5 per cent oil (Chowdhury *et al.,* 2015) [3]. Soybean occupies third position in the edible oil scenario of India. Madhya Pradesh state, which has the largest share in soybean production, is often referred as Soybean State. It was followed by Maharashtra, Rajasthan and Karnataka. Since 1985, there was steady increase in area, production and productivity in the state of Maharashtra. However, many farmers from Maharashtra state have harvested 35-40 qt/ha, suggesting the high potential yield that can be obtained. It is necessary to increase the productivity of crop by using improved production technology and using quality seed of improved varieties. Seed is a basic and crucial input in agriculture production.

Soybean suffer from poor seed longevity and least storable groups based on the 'Relative storability index' production of high quality seed which retains its seed viability throughout the storage (Justice and Basu 1978) [8]. Soybean seed is very susceptible to mechanical damage that occurs during handling and viability vigour storage. Polyethylene and aluminum foil materials were moderately effective in preventing moisture uptake and maintaining seed viability, while paper and cloth containers were found less effective (ISTA (1999) [6].

Soybean seeds may loose its viability or deteriorate even in three months if kept at 14% moisture content and 30ºC (Sadjad, 1980) [15]. Viability of soybean seeds decreased up to 57% after 6 months of storage if kept above 13% moisture content, 20ºC and relative humidity of 50%.

Singh and Mayura, (1978) [18] reported that soybean seeds storied in gunny bags and HDPE bags under the ambient storage condition which was effects on seed quality parameters *viz.*, germination percentage, vigour index, moisture content, seed mycoflora, electrical conductivity, speed of germination and also biochemical activities *viz*., α-amylase enzymes and dehydrogenase enzymes.

Materials and Methods

This experiment was laid out at the Seed Technology Research Unit Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during the year 2012-13. Seeds of soybean [*Glycine max* (L.)] variety obtained from Seed Processing Unit, VNMKV, Parbhani. This experiment was arranged based on FCRD design with three replications. The experiment was evaluated of two soybean varieties including MAUS-71, JS-335. Gunny bag (GB) and high density polyethylene interwoven bag (HDPE) storage containers were used for this study. Each gunny had a capacity to hold 1 kg of seeds and each HDPE bag had a capacity to hold 100 gm of seeds. The separate storage material was used for each observation. In this experiment two varieties *viz.,* MAUS-71 and JS-335 are the main treatments while, storage conditions *ie.,* Gunny bag and HDPE bag considered as sub treatment. Soybean varieties including MAUS-71, JS-335 was stored in the 60 and 120 DAS and seed quality parameters *viz.,* seed germination%, speed of germination, seed vigour index, seed moisture content, electrical conductivity, seed mycoflora were recorded.

Seed vigour index

The data pertaining to effect of variety and container treatment exhibited statistically significant. However, the interaction of variety and storage containers was observed no-significant differences in the respect of seed vigour index (Table 4.1). The seed vigour index at the initial stage of storage period, variety MAUS-71 and JS-335 was recorded 1846.6 and 1764.6, respectively. The significant differences were observed in vigour index of both the varieties was noticed at 60 days of storage. The vigour index of MAUS-71 was observed 1762.2 and 1916.7 at 30 and 60 days of storage, respectively while, 1744.8 and 1700.5 vigour index were recorded at 30 and 60 days of storage for var. JS-335.

The significant differences were observed in vigour index due to containers storage of soybean seed. The seed vigour index of stored seed at 30 and 60 days in HDPE bags was observed 1745.5 and 1790.2, respectively, while in gunny bags seed vigour index 1761.5 and 1827.0 were recorded at 30 and 60 days, respectively. Similar results were also reported by Shanmugavel *et al.* (1995) [16], Malimath and Merwade (2007) [11] and Tekopony *et al.* (1993) [21]. They reported that vigour index decreased with increase in storage period. Arulnandhy and Senanayake (1988) [2] stated that soybean seeds storied in HDPE bag had significantly higher viability and vigour index as compare to other containers. Kalaviti *et al.* (1994) [9] also noticed similar findings in these regard.

Electrical conductivity

The data regarding to effect of variety and container on electrical conductivity of soybean seeds during storage exhibited significant differences while, no-significant interaction were observed in the variety and cultivars (Table 4.2). The initial electrical conductivity of variety and container in MAUS-71 and JS-335 was 0.15 and 0.19 (dsm^{-1}) simens, respectively. The electrical conductivity of a variety JS-335 was observed significantly higher than MAUS-71 higher at 30 and 60 days of storage period. At 30 days the electrical conductivity of JS-335 and MAUS-71 was 0.27 and 0.22 (dsm^{-1}) respectively whereas, at 60 days it was 0.49 and 0.40 (dsm^{-1}) for JS-335 and MAUS-71, respectively.

The significant differences observed in electrical conductivity due to containers used for storage a soybean seed. The electrical conductivity of seeds stored at 30 and 60 days in HDPE bags was observed 0.27 and 0.51(dsm^{-1}) respectively whereas, in gunny bags the electrical conductivity was 0.22 and 0.38 (dsm^{-1}) at 30 and 60 days respectively. Hampton *et al.* (1992) reported the electrical conductivity of soybean seed increased with increase in storage period, similar results were also reported by Shah and Sultan (2008) and Agrawal and Siddiqui (1973). Malimath and Merwade (2007) [11] reported that electrical [1] conductivity stored in HDPE bag was highest as compare to cloth bag. Similar results also reported by Prasad (2002) [14].

Speed of germination

The data pertaining to effect of variety and container on speed of germination of soybean seeds showed significant differences while, no-significant interaction were found in respect of speed of germination duet to variety and containers. The initial speed of germination was observed in the soybean variety MAUS-71 and JS-335 was 66.45 and 68.45 unit respectively. The speed of germination in a variety MAUS-71 was observed 63.38 and 60.43 at 30 and 60 days of storage respectively, whereas, in case of variety JS-335 the speed of germination was 66.42 and 63.54 at 30 and 60 days respectively (Table 4.2).

At beginning, the speed of germination soybean seed sorted in gunny bag was 68.53. However, it was 66.37 when stored in HDPE bags. The speed of germination in gunny bags was observed 66.38 and 63.40 at 30 and 60 days of storage respectively, whereas in case of HDPE bag the speed of germination was 63.42 and 60.56 at 30 and 60 days, respectively. The speed of germination was decreased with increase in storage period. The seed stored in gunny bag showed maximum speed of germination as compare with the seed stored in HDPE bag. The speed of germination was to be found reduce at 30 and 60 days of storage period irrespective the containers (Gontia and Awasthi 1999) [5].

Seed moisture

The data on effect of variety and container on moisture content of soybean seeds during storage exhibited significant differences. Interaction effects were found no-significant for moisture content due to variety and containers (Table 4.3). The initial moisture content in the varieties MAUS-71 and JS-335 was observed 13.6 and 10.1%, respectively. The moisture content in the seed of a variety JS-335 was significant lower *viz.*, 9.8 and 9.5% at 30 and 60 days of storage, respectively, than the variety, MAUS-71. The moisture content in JS-335 and MAUS-71 was not much decreased at 60 days of storage. The moisture content of soybean seeds was decrease with advancement of storage period irrespective of variety.

The moisture content in seed stored in gunny bag and HDPE bags was observed 12.0 and 11.7% respectively. The moisture content of seed at 30 and 60 days stored in gunny bag was observed 11.9% whereas; the seed stored in HDPE

bag showed moisture 11.3 and 10.6% at 30 and 60 days of storage, respectively. Similar results observed that Sripichitt *et al.* (1989) [20] and Egli *et al.* (1979) [4] in soybean. The moisture content in the seed stored in HDPE bag was found to be lower as compared with gunny bag. There was 1% decrease in moisture content at 60 days of storage in both the containers. Sharma *et al.* (1998) [17] reported that moisture content of soybean seed stored in HDPE bag was lower than in gunny bag. Jawale *et al.* (2001) [7] and Munde (2005) [12] were also reported similar findings.

Seed microflora

The data on effect of variety and containers on presence seed mycoflora on seed during the storage showed significant differences (Table 4). Initially seed mycoflora population on var. MAUS-71 was noticed as Aspergillus flavus (8.33%), A. niger (13.8%), Fusarium spp. (4.41%), Alternaria spp. (1.66%) and Rhizopus spp. (8.75%). This incidence was observed on JS-335 as Aspergillus flavus (8.75%), A. niger (7.21%), Fusarium spp. (5.16%), Alternaria spp. (2.33%) and Rhizopus spp. (6.91%). At 30 days of storage period, the seed mycoflora population on the variety MAUS-71 was observed Aspergillus flavus (10.4%), A. niger (13.8%), Fusarium spp. (8.33%), Alternaria spp. (2.91%) and Rhizopus spp. (12.5%). As regard, JS-335 the incidence was observed as Aspergillus flavus (9.12%), A. niger (11.7%), Fusarium spp. (6.10%), Alternaria spp. (3.71%) and Rhizopus spp. (7.21%). At 60 days of storage period the seed mycoflora population observed on the variety MAUS-71 was Aspergillus flavus (13.1%), A. niger (16.1 per cent), Fusarium spp. (11.2%), Alternaria spp. (5.91%) and Rhizopus spp. (16.0%). As regard, JS-335 the incidence was observed as Aspergillus flavus (11.4%), A. niger (12.0 per cent), Fusarium spp. (8.30%), Alternaria spp. (4.98%) and Rhizopus spp. (7.65%). When the soybean seed stored in gunny bag the initial seed mycoflora population was observed as Aspergillus flavus (8.54%), A. niger (10.5%), Fusarium spp. (5.70%), Alternaria spp. (3.93%) and Rhizopus spp. (6.6%). Where as in HDPE bags the micoflora population of Aspergillus flavous (6.96%), (5.87%), Alternaria spp. and Rhizopus spp. (5.54%) was observed.

At 30 days of storage in gunny bags storage container the population of the Aspergillus flavus (9.77%), A. niger (10.6%), Fusarium spp. (7.83%), Alternaria spp. (4.94%) and Rhizopus spp. (9.17%) was observed. In case of HDPE bags the incidence of Aspergillus flavus (8.25%), A. niger (9.46%), Fusarium spp. (6.64%), Alternaria spp. (5.62%) and Rhizopus spp. (5.46%) was observed. Whereas, at 60 days of storage in gunny bags the Aspergillus flavus (12.3%), A. niger (12.8%), Fusarium spp. (10.3%), Alternaria spp. (6.73%) and Rhizopus spp. (12.0%). As regard, HDPE bags the mycoflora population of Aspergillus flavus (9.75%), A. niger (10.3%), Fusarium spp. (6.64%), Alternaria spp. (6.85%) and Rhizopus spp. (7.91%) was noticed. Similar results are also reported by Tripathi and Singh (1991) [22]. Raj *et al.* (2002) also reported that seed stored in gunny bag were found minimum incidence *Aspergillus flavus*, *A. niger*, *Fusarium* spp, *Alternaria* spp and *Rhizopus* spp as compare to HDPE bag. The seed stored in both containers were noticed increase in *Aspergillus flavus*, *A. niger*, *Alternaria* spp, *Fussarium* spp and *Rhizopus* spp, *Fussarium* spp and *Rhizopus* spp mycoflora incidence of 60 days of storage. Naryanaswamy *et al.* (2000) [13] reviled, that the percentage of mycofloral infection was highest in soybean seeds stored in gunny bag and lowest in seed stored in plastic gunny bag (Table 4).

Table 1: Seed germination percent and seed vigour index as influenced by variety and container during the storage.

Treatments	Seed germination%			Seed Vigour index		
	Storage period (days)			Storage period (days)		
	Initial (0)	30	60	Initial (0)	30	60
A. Variety						
MAUS-71	83.33 (56.65)	82.25 (55.34)	80.50 (53.61)	1846.6	1762.20	1916.7
JS-335	86.75 (60.18)	85.66 (58.97)	84.58 (57.80)	1764.6	1744.8	1700.5
SE±	-	0.38	0.38	-	53.58	47.09
CD at 5%	-	1.14	1.14	-	157.82	138.7
B. Container						
Gunny bag	85.25 (58.55)	84.25 (57.45)	83.33 (56.52)	1779.4	1761.5	1827.0
HDPE bag	84.83 (58.09)	83.66 (56.86)	81.75 (54.89)	1831.8	1745.50	1790.2
SE±	-	0.38	0.38	-	53.58	47.09
CD at 5%	-	1.14	1.14	-	157.8	138.7
Interaction	-	NS	NS	-	NS	NS

NS = No- significant

Table 2: Electrical Conductivity and speed of germination as influenced by variety and container during the storage.

Treatments	Electrical Conductivity (dsm^{-1})			Speed of germination		
	Storage period (days)			Storage period (days)		
	Initial (0)	30	60	Initial (0)	30	60
A. Variety						
MAUS-71	0.15	0.22	0.40	66.45	63.38	60.43
JS-335	0.19	0.27	0.49	68.45	66.42	63.54
SE±	-	0.009	0.001	--	1.38	1.51
CD at 5%	-	0.027	0.044	--	4.06	4.46
B. Container						
Gunny bag	0.16	0.22	0.38	68.53	66.38	63.40
HDPE bag	0.18	0.27	0.51	66.37	63.42	60.56
SE±	-	0.009	0.001	--	1.38	1.51
CD at 5%	-	0.027	0.044	--	4.06	4.46
Interaction	-	**NS**	**NS**	--	**NS**	**NS**

NS = No-significant

Table 3: Seed moisture percent as influenced by variety and container during the storage.

Seed moisture%			
Treatments	**Storage period (days)**		
	Initial (0)	**30**	**60**
A. Variety			
MAUS-71	13.6	13.4	13.3
JS-335	10.1	9.8	9.5
SE±	--	0.17	0.23
CD at 5%	--	0.52	0.70
B. Container			
Gunny bag	12.0	11.9	11.9
HDPE bag	11.7	11.3	10.6
SE±	--	0.17	0.23
CD at 5%	--	0.52	0.70
Interaction	--	NS	NS

NS = No- significant

Table 4: Seed microflora incidence as influenced by variety and container during the storage.

Seed mycoflora Treatments	Per cent incidence																			
	Aspergillus flavus				Aspergillus niger				Fusarium spp.				Alternaria spp.				Rhizopus spp.			
	Stored period				Stored period				Stored period				Stored period				Stored period			
	0	30	60	Mean	0	30	60	Mean	0	30	60	Mean	0	30	60	Mean	0	30	60	Mean
A. Variety																				
MAUS-71	8.33	10.4	13.1	10.6	13.8	13.8	16.1	14.5	4.41	8.33	11.2	7.98	1.66	2.91	5.91	3.49	8.75	12.5	16.0	12.4
JS-335	8.75	9.12	11.4	9.76	7.21	11.7	12.0	10.3	5.16	6.10	8.30	6.52	2.33	3.71	4.98	3.67	6.91	7.21	7.65	6.82
SE ±		0.77	0.84	0.80		0.56	0.63	0.59		0.52	0.61	0.56		0.35	0.47	0.41		0.37	0.52	0.44
CD at 5%		2.28	2.48	3.38		1.66	1.86	1.76		1.54	1.81	1.67		1.04	1.39	1.21		1.10	1.54	1.32
B. Container																				
Gunny bag	8.54	9.77	12.3	10.2	10.5	10.6	12.8	11.3	5.70	7.83	10.3	7.94	3.93	4.94	6.73	5.13	6.6	9.17	12.0	9.27
HDPE bag	6.96	8.25	9.75	8.32	8.68	9.46	10.3	9.48	5.87	6.64	6.64	7.05	4.05	5.62	6.85	5.50	5.54	5.46	7.91	6.30
SE ±		0.77	0.84	0.80		0.56	0.63	0.59		0.52	0.61	0.56		0.35	0.47	0.41		0.37	0.52	0.44
CD at 5%		2.28	2.48	2.38		1.66	1.86	1.76		1.54	1.81	1.67		1.04	1.39	1.21		1.10	1.54	1.32
Interaction		NS	S	NS		NS	NS	NS		NS	NS	NS		NS	NS	NS		NS	NS	NS

S = Significant

NS = No- significant

Conclusion

Seed storage is the main problem in seed production of soybean, since storage of seed after harvest leads to seed deterioration and reduction in seed quality due to biochemical activities. In the present study concluded that the soybean variety JS-335 was found better in respect of seed quality at 30 and 60 days of storage period. The moisture content is also found at safe level during storage period. The microbial activity *viz.*, *Aspergillus flavus*, *A. niger*, *Fusarium* spp, *Alternaria* spp and *Rhizopus* spp was minimum in case of var. JS-335 than the var. MAUS-71 during storage period.

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