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Characterization of Soybean Varieties for their Storage Potential by Using Accelerated Ageing

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ABSTRACT

Soybean being a potential oil and protein crop for narrowing the oil and nutrition gap, occupies an important place in agricultural economy of India. The seed of soybean varieties PS 1347, PS 1042, PK 472 and PK 262, obtained from Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar were used for this study. Electrical conductivity increases while germination percent, seedling length and seedling vigour index-I decreases with an increase in accelerated aging periods in all varieties. Increase in electrical conductivity was minimum in PS 1042 and followed by PS 1347. Decrease in germination percent, seedling length and seedling vigour index-I was less in PS 1042 followed by PS 1042. Varieties PK 472 and PK 262 were found same in all studied parameters. This indicate that PS 1042 show better membrane integrity followed by PS 1347 thus have better storability than rest of the varieties.

Keywords: Soybean, accelerated ageing, storage potential

Soybean being a potential oil and protein crop for narrowing the oil and nutrition gap, occupies an important place in agricultural economy of India. It is third important oilseed crop next to groundnut and mustard (Kakde and Chavan, 2012). Soybean is an important oil seed crop in world as well as in India. In Uttarakhand, it is grown over 12757 hectare having production of 15997 mt (Directorate of Agriculture, 2015). Under hot and humid storage conditions, oilseeds frequently become invaded by storage fungi (Nandi *et al.*, 1982). Soybean is an orthodox seed and has short storage life. In orthodox seeds (i.e. seeds which tolerate dehydration), accelerated aging can be artificially induced at high temperature and high relative humidity (RH) (Priestley, 1986). Seed aging had significant effects on electrical conductivity and seed germination traits (Mohammadi *et al.*, 2011). Soybean is classified as "poor storer" as it loses viability drastically under warm and humid conditions. Different varieties of soybean may show the different level of storability. This study was conducted to predict storage potential of soybean varieties.

MATERIALS AND METHODS

This study was conducted during the year 2013-14 in the Department of Plant Pathology, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. Seeds of soybean varieties PS 1347 (V_1), PS 1042 (V_2), PK 472 (V_3) and PK 262 (V_4) were obtained from Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar. Seeds of different soybean varieties were subjected to ageing treatments *viz.*, T_0 (0 days accelerated aging) (Control), T_1 (24 hours accelerated aging), T_2 (48 hours accelerated aging), T_3 (72 hours accelerated aging), T_4 (96 hours accelerated aging), T_5 (120 hours accelerated aging). Observations on different seed parameters *viz.*, Electrical conductivity, germination percent, seedling length and vigour index-I in 4 replications were recorded.

Electrical conductivity was recorded according to Bisht *et al.*, 2015. Observation on germination percent, seedling length and seedling vigour index-I were taken at 8th day of germination on randomly selected ten seedlings from each treatment in each

replication. Seedling vigour index-I was recorded according to Abdul-Baki and Anderson, 1973.

Vigour Index-I = Standard germination % × Seedling length (cm)

The statistical analysis of the data was done according to two factorial complete randomized design (CRD) and interpretation of results was based on "F-test" and critical difference (CD) at 5% level of significance (Rangaswamy, 2014).

RESULTS AND DISCUSSIONS

Electrical conductivity (mmhos/cm/5g)

Initially (T0), electrical conductivity of all varieties was found statistically same. After 24 hours of accelerated aging (T1), varieties V4 exhibited highest electrical conductivity (0.488mmhos/cm/5g) followed in variety V3 (0.486mmhos/cm/5g) and V1 (0.476mmhos/cm/5g). The lowest electrical conductivity was found at T1 in variety V2 (0.417mmhos/cm/5g). After 48 hours of accelerated aging (T2), variety V4 exhibited the highest electrical conductivity of 0.758mmhos/cm/5g which was significantly higher than electrical conductivity of V3 (0.735mmhos/cm/5g). The lowest electrical conductivity was found in variety V2 (0.638 mmhos/cm/5g) followed in V1 (0.696mmhos/cm/5g) (Table 1). These findings indicates that variety V2 and V1 show the better membrane integrity as compared to variety V3 and V4 and have the potential for safer storage for longer duration as compared to variety V3 and V4. These findings coincide with Bisht (2011), Mali *et al.* (2014) and Sripichitt (2001).

Percent germination

Variety V2 (PS1042) had maximum percent germination in control (T0) followed by V1 (89.75%), V4 (89.50%) and V3 (88.00%). As the aging period increases, the percent germination decreases in all varieties. At 24hrs of aging (T1), higher percent germination was found in V4 (89.50%) which was found at par with V1 (89.25%) and V2 (89.00%) which was significantly higher than V3 (86.75%). At 48 hrs of aging (T2), higher percent germination was maintained in V1 (81.00%) which was at par with V2 (80.75%) but significantly higher than V3 (79.00%) & V4 (79.00%). At 72 hrs of aging (T3), variety V2 (PS1042) had significantly higher germination (above minimum seed certification standards) than other varieties. The lowest percent germination was found in T3V3 (59.00%). At treatment T4 (96 hrs) variety V2 was found to have higher percent germination (66.25%) than other varieties at T4. At 120 hrs of accelerated ageing, the maximum percent germination was maintained in V2 (36.75) although it was much below the minimum seed certification standards but was highest than the percent germination of different varieties at T5. However, at T1 and T2, the percent germination in all varieties remained above minimum seed certification standards but at T3 the percent germination decreased below certification standards in V1, V3 and V4 but was maintained in V2 indicating that V2 could withstand accelerated aging up to 72 hours as compared to other varieties (Table 2). Germination remain high during initial period of accelerated aging (up to 2 days) but decrease after 2 days (Sripichitt, 2001).

Table 1: Effect of accelerated aging on electrical conductivity of soybean varieties during 2012-2013

Treatments	Electrical conductivity (mmhos/cm/5g)				Mean
	V1 (PS1347)	V2 (PS1042)	V3 (PK 472)	V4 (PK262)	
T0 (Control)	0.363	0.354	0.339	0.358	0.353
T1 (24 Hrs)	0.476	0.417	0.486	0.488	0.467
T2 (48Hrs)	0.696	0.638	0.735	0.758	0.706
T3 (72 Hrs)	0.944	0.887	0.986	0.988	0.951
T4 (96 Hrs)	0.990	0.967	1.107	1.113	1.044
T5 (120 Hrs)	1.108	0.995	1.129	1.146	1.094
Mean	0.763	0.710	0.797	0.808	0.769
SEm±	Variety = 0.002	Treatment = 0.002		Variety × Treatment = 0.005	
CD5%	Variety = 0.006	Treatment = 0.007		Variety × Treatment = 0.015	

Ageing period was increased, percent germination, germination speed and seedling growth also decrease (Amjad and Anjum, 2002).

Seedling length (cm)

Maximum seedling length was found in variety V2 (37.42cm) followed by V1 (35.39cm), V4 (34.77cm) and V3 (34.65cm) in control (T0). After 24 hrs of aging (T1), significantly longer seedling length of 33.45cm was found in V2 followed by variety V4 (30.70cm), V1 (30.30cm) which were found at par with each other. After 48 hours of aging, variety V2 was found to have significantly longer seedling length (30.02cm) followed by V4 (26.74cm), V1 (26.01cm) and V3 (23.75cm). Longer seedling length was found in V2 (24.48cm) which was significantly higher than the seedling length of other varieties and followed by V1 (22.54cm), V4 (20.96cm) and V3 (19.17cm) after 72 hours of aging.

After 96 hours of aging, longer seedling length was maintained in V2 (20.66cm) followed by V1 (18.60cm), V4 (15.85cm) and V3 (14.11cm). After 120 hours of aging, longer seedling length was found in variety V2 (14.81cm) which was followed by V1 (11.99cm), V3 (10.51cm) and V4 (8.99cm) (Table 3). Variety V2 maintained maximum seedling length at all the accelerated aging periods followed in V1. At 120 hrs of accelerated aging, the minimum seedling length was found in variety V4 followed in V3.

Seedling Vigour Index-I

Table 4 indicates that after 24 hours of accelerated aging, maximum seedling vigour Index-I was found in Variety V2 (2977.36) which was significantly higher than the other interactions of accelerated aging and varieties. After 48 hours of aging seedling vigour index-I ranged between 1876.86-2424.12, maximum (2424.12) being in V2 followed

Table 2: Effect of accelerated aging on percent germination of soybean varieties during 2012-2013

Treatments	Percent germination				Mean
	V1 (PS1347)	V2 (PS1042)	V3 (PK472)	V4 (PK 262)	
T0 (control)	89.75	90.25	88.00	89.50	89.37
T1 (24 Hrs)	89.25	89.00	86.75	89.50	88.62
T2 (48Hrs)	81.00	80.75	79.00	79.00	79.93
T3 (72 Hrs)	69.00	75.75	59.00	68.00	68.06
T4 (96 Hrs)	54.75	66.25	44.25	40.75	51.50
T5 (120 Hrs)	26.75	36.75	20.25	15.50	24.81
Mean	68.50	73.12	62.87	63.70	67.05
SEm±	Variety = 0.19	Treatment = 0.23		Variety × Treatment = 0.47	
CD5%	Variety = 0.54	Treatment = 0.66		Variety × Treatment = 1.32	

Table 3: Effect of accelerated aging on shoot length (cm) of soybean varieties during 2012-2013

Treatments	Seedling length (cm)				Mean
	V1 (PS1347)	V2 (PS1042)	V3 (PK472)	V4 (PK 262)	
T0 (Control)	35.39	37.42	34.65	34.77	35.55
T1 (24 Hrs)	30.30	33.45	29.85	30.70	31.07
T2 (48Hrs)	26.01	30.02	23.75	26.74	26.63
T3 (72 Hrs)	22.54	24.48	19.17	20.96	21.79
T4 (96 Hrs)	18.60	20.66	14.11	15.85	17.30
T5 (120 Hrs)	11.99	14.81	10.51	8.99	11.57
Mean	24.14	26.80	22.00	23.00	23.99
SEm±	Variety = 0.07	Treatment = 0.36		Variety × Treatment = 0.19	
CD5%	Variety = 0.22	Treatment = 0.27		Variety × Treatment = 0.55	

Table 4: Effect of accelerated aging on seedling vigour index-I of soybean varieties during 2012-2013

Treatments	Seedling vigour index-I				Mean
	V1 (PS1347)	V2 (PS1042)	V3 (PK472)	V4 (PK 262)	
T0 (control)	3176.36	3377.39	3049.32	3111.96	3167.45
T1 (24 Hrs)	2704.40	2977.36	2590.00	2748.42	2793.31
T2 (48Hrs)	2106.95	2424.12	1876.86	2112.97	2130.22
T3 (72 Hrs)	1555.25	1854.38	1131.24	1425.78	1494.48
T4 (96 Hrs)	1018.35	1368.76	624.17	646.10	914.34
T5 (120 Hrs)	320.85	544.71	212.78	139.27	304.40
Mean	1813.69	2091.12	1580.73	1697.41	1800.70
SEm±	Variety = 8.33	Treatment = 10.20	Variety × Treatment = 20.41		
CD5%	Variety = 23.49	Treatment = 28.77	Variety × Treatment = 57.54		

by V4 (2112.97), V1 (2106.95) and V3 (1876.86). The seedling vigour index-I was statistically at par in varieties V1 and V4. After 72 hours of aging, variety V2 was found to have maximum seedling vigour index-I (1854.38). After 96 hours of aging, maximum seedling vigour index-I was maintained in variety V2 (1368.76) followed by V1 (1018.35), V4 (646.10) and V3 (624.17). After 120 hours of aging, significantly maximum vigour index-I was found in V2 (544.71) than other interactions (Table 4). However, at T0, there has been maximum vigour index-I in all the varieties. Indicating that with the increase in accelerated aging the vigour index decreased in all the varieties. Soybean varieties showed differential response of towards different aging period and mentioned that vigour index decreases as storage period increases (Bisht, 2015).

Conclusion

All vigour related characters were affected by accelerated ageing in all varieties. Characters are less affected by ageing in variety PS 1042 followed by PS 1347 while maximum in PK 472 and PK 262. This indicate that variety PS 1042 can tolerate the ageing conditrions, thus may have better storer, PS 1347 as medium storer and PK 472 and PK 262 as poor storer.

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