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Performance of Herbal Hardened Seeds of Sesame to Accelerated Aging Test for the Prediction of Seed Storability

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ABSTRACT: *Accelerated aging test is a stress test. The seeds are stressed prior to the germination test. The seeds that had a high survival after accelerated aging stored well, while the seeds that were severely reduced in germination by accelerated aging declined rapidly in storage. Studies were carried out to predict the storability of various herbal extract hardened seeds of sesame through accelerated aging test. Accelerated aging was carried out at 40 ± 1°C and 98 ± 2 per cent RH for a period of 10 days. The results It revealed that irrespective of treatments, the germination period, seedling length, drymatter production, dehydrogenase enzyme activity were decreased with increased aging period. After 10th day after accelerated aging period, the 20 % chicory herbal leaf extract hardened seeds of sesame recorded more than 50% germination percentage but other herbal hardening treatments and control recorded only less than 50 percent of germination.*

Key words*: Sesame, germination, accelerated ageing.*

INTRODUCTION

Sesame (*Sesamum indicum L.*) is one of the most ancient oilseed crops, grown in India. It is the third main oilseed crop in India occupying an area of 243.7 lakh hectare with the production of 208.7l million tonnes and productivity level of 856 kg ha^{-1}. In Tamilnadu, it is grown in an area of 1.12 lakh hectare with annual production of 0.66 lakh tonnes and has a productivity level of 589 kg ha^{-1} (Prakash *et al.,* 2014).

Seed being a living entity, deterioration beyond physiological maturity is inevitable and will be pronounced when seeds are stored under hostile conditions. Rapid seed deterioration during storage is one of the important constraints encountered by sesame growing farmers. The performance capabilities of many seeds deteriorate during prolonged storage, but the rate of deterioration varies greatly among species (Robert, 1989). High temperature, ambient relative humidity, and seed moisture content are the main factors influencing seed storage capability (Abdul-Baki, 1980). The degree of cell membrane damage in response to ageing can be measured in terms of rate of seed electrolyte leakage (Khan *et al.,* 2003). Damage to the organization of cell membranes during seed ageing may constitute an important factor in explaining seed deterioration (Ferguson *et al.,* 1990).

Accelerated aging is considered as the prediction test for seed storability as this test brings changes in the seed at the cellular level as that of long term storage comparatively within a short period of time by exposing seeds to increased temperatures (40-45°C) and a higher (99 – 100 % RH) relative humidity for varying lengths of time, depending on the kinds of seeds, after which a germination test is made. The basis for this test is that higher vigor seeds tolerate the high temperature-high humidity treatment and thus retain their capability to produce normal seedlings in the germination test. The seeds that had a high survival after accelerated aging stored well, while the seeds that were severely reduced in germination by accelerated aging declined rapidly in storage (Delouche and Baskin, 1973). The accelerated aging test is rapid, inexpensive, simple and useful for many species; it can be used for individual seed evaluation and requires no additional training for correct evaluation. Solute leakage accompanies seed imbibition during the process of membrane organization following re-hydration. The rate of leakage depends on the degree of cell membrane

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damage in response to ageing (Simon, 1978). Damage to the organization of cell membranes during seed ageing may constitute an important factor in explaining seed deterioration (Khan *et al.,* 2003).

Medicinal plants are natures' wonderful gift and are used widely in traditional systems like Ayurveda, Siddha and Unani. Many medicinal plants have been found to possess principle compounds for treating diseases and serve as a source of raw materials for the manufacture of semisynthetic and synthetic products (Akerela, 1993). Many of the herbs possess antioxidant properties leading to their use in restorative medicine (Kapoor *et al.,* 2000). Herbs like Chicory, Aswagandha and Ocimum do have the ameliorative mechanism for oxidative stress reduction in human and animal system. While the usage of medicinal plants has been fully restricted to human and animal health care, no attempt has been made for exploitation in agriculture, particularly for seed treatment to maintain vigour, viability and productivity. Hence, identification of substances possessing all these advantageous properties from medicinal herbs will be a potential preposition. With these in background, studies were made to evaluate the performance of medicinal herbal hardened seeds under accelerated aging for evaluation of the storability of sesame seed under storage.

MATERIALS AND METHODS

The present study was carried using genetically pure seeds of sesame (*Sesamum indicum L*) cv. TMV 3 obtained from the Oilseed Research Station, Thindivanam, Tamilnadu. The experiments were conducted at the Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar (11°24'N latitude and 79°44'E longitude with an altitude of +5.79 mts above mean sea level). The bulk seeds were graded for uniformity using appropriate round perforated metal sieves of sizes of 5/64".

Preparation of Herbal Plant Leaf Extract

The fresh leaves of herbal plants i.e., chicory, aswagantha, ocimum and sarpagandha were collected separately and dried under shade. The shade dried leaves were powdered using mortar and pestle. Then twenty gram of leaf powder was exactly weighed using weighing balance and dissolved in 100 ml of distilled water which was measured already in the beaker to make 20% leaf extract. The herbal leaf extract was filtered by using muslin cloth to remove unwanted material and leaf debris. Then the seeds were soaked in the respective herbal leaf extract solutions at 1:1 (W/V) ratio of volume of seeds to herbal extract) along with water for four hours under aerated conditions at room temperature. Then the seeds were air dried under the shade for two days and maintained in drying chamber at 30 ± 0.5 °C for two days to bring back to their original moisture content.

Treatment Details

To - Control

T_1- Water Soaking

T_2 - 20% Chicory (*Cichorium intybus*) Leaf extract seed hardening

T_3- 20% Aswagantha (*Withania somnifera*) Leaf extract seed hardening

T_4- 20% Ocimum (*Ocimum gratissimum*) Leaf extract seed hardening

T_5- 20% Sarpagandha (*Rawolfia serpentina*) Leaf extract seed hardening

The treated seeds and control seeds were packed as 100g samples in a perforated paper bag and were placed in dessicators, maintaining 98 ± 2 percent RH and were kept in an oven maintained at 40 ± 1°C and subjected to aging for a period of 10 days (Delouche and Baskin, 1973). Seed packets were rearranged every day for uniform aging. At two days interval, the seeds were drawn upto 10 days and evaluated for its seed quality parameters (i.e.,) germination percentage (ISTA, 1999), speed of germination (Maguire, 1962), shoot length (ISTA, 1999), root length (ISTA, 1999), drymatter production (ISTA, 1999), electrical conductivity (Priestley and Leopold, 1983) and Dehydrogenase enzyme activity (Kittock and Law, 1968) under laboratory condition. The data were statistically analyzed as per the method of Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Accelerated ageing is proposed as a prediction test for seed storability (Agrawal, 1995) and gives the information on the extend of storability of seed as macro, micro and mesobiotic. Highly significant differences were observed among the aging period for the evaluated seedling quality characters. The interaction effect was also highly significant for all the characters.

The results revealed that the germination percentage decreased with increased aging period i.e., 90% to 40%. Between the seed treatment, 20% chicory hardened seeds recorded higher values (78%) of

germination than control (57%) seeds. The chicory hardened seeds recorded 58% germination after 10 days after accelerated aging, which was higher than other treatments and control. The other treatments and control recorded less than 50%. After 10 day after accelerated aging the aswagantha hardened seeds recorded higher speed of germination (3.3). But the untreated seeds recorded lower speed of germination (1.3) (tables 1 and 2). Evaluation of seedling vigour parameters such as shoot length, root length and drymatter production revealed that with increase in ageing periods, the vigour parameters such as shoot length, root length and drymatter production were decreased irrespective of treatments. The decrease was lesser in chicory hardened seeds when compared to other treatments and control. On 10th day, 20% chicory hardened seeds produced 5.1 cm shoot length, 6.4 cm root length and 1.32 mg of drymatter. But untreated seeds recorded only 3.1 cm shoot length, 4.0 cm root length and 0.74 mg of drymatter (tables 3, 4 and 5). The probable reason might be the leaf extract of chicory having various antioxidants i.e., tannins, saponins, flavonoids, terpenoids, which are having good free radical scavenging capacity and reducing power (Shad *et al.,* 2013). The oxidative stress caused by free radicals is delayed or even prevented by antioxidants. They participate in the antioxidant defence system against endogenous free radicals. These compounds possess hydrogen donating abilities and thus exert their antioxidant effect by breaking the free radical chain (Lobo *et al*., 2010). The above results are in conformity with the reports of Vanitha *et al.* (2008) in maize and Vanitha *et al.* (2009) in sunflower.

The electrical conductivity increased with the increased ageing period irrespective of the treatments. But the dehydrogenase enzyme activity decreased with increased aging period irrespective of treatments. After 10th day of accelerated ageing, the chicory hardened seeds recorded lower EC (0.107 dsm^{-1}) and higher dehydrogenase enzyme activity (0.311). But the untreated seeds recorded higher EC (0.141 dsm^{-1}) and lower dehydrogenase enzyme activity (0.183) (tables 6 and 7). Damage to the organization of cell membranes during seed ageing may constitute an important factor in explaining seed deterioration (Ferguson *et al*., 1990). Tannins and Saponins which are present in the chicory leaf extract, are the high molecular weight polyphenolic compounds and they play a protective role in plants against micro-organisms, insects, unfavourable climatic conditions and damage by other organisms and prevent the seed coat damage and also their good phytochemical and antioxidant composition, would play an important role in antioxidant defence system against endogenous free radicals. (Rao and Sung,1995) The above results are in conformity with the reports of Vanitha *et al.* (2008) in maize and Vanitha *et al.* (2009) in sunflower.

Thus the study of prediction of seed storability through accelerated aging of sesame revealed that, 20% chicory herbal hardened seeds was the best treatment than the other treatments and control. After 10th day after accelerated aging period, the 20 % chicory herbal hardened seeds recorded more than 50 % germination percentage but other treatments and control recorded only less than 50 percent of germination.

Table 1
Effect of Different Medicinal Plant Leaf Extracts on Germination Percentage of Accelerated Aged Sesame cv TMV 3 Seeds

Treatments	*Accelerated ageing in days (A)*						*Mean*
	0	*2*	*4*	*6*	*8*	*10*	
T_0	85	74	64	52	41	28	57
	(68.21)	(60.34)	(53.03)	(45.32)	(39.83)	(25.16)	(48.65)
T_1	88	77	69	63	45	32	62
	(70.03)	(62.31)	(56.31)	(52.94)	(41.26)	(29.65)	(52.08)
T_2	95	89	81	76	69	58	78
	(77.21)	(70.62)	(64.31)	(60.06)	(57.46)	(51.36)	(63.50)
T_3	90	80	71	67	51	36	66
	(73.26)	(64.12)	(56.98)	(55.64)	(48.65)	(32.54)	(55.19)
T_4	93	83	79	68	60	47	72
	(75.26)	(65.15)	(62.33)	(56.14)	(51.26)	(43.56)	(58.95)
T_5	91	81	73	69	55	40	68
	(73.65)	(64.31)	(61.03)	(56.31)	(47.95)	(38.65)	(56.98)
Mean	90	81	73	66	54	40	67
	(72.93)	(64.47)	(58.99)	(54.40)	(47.73)	(36.82)	(55.89)

Figures in parenthesis are Arcsine Transformed value

CD	T	A	TXA
(P=0.05)	0.95	1.23	2.14

Table 2
Effect of Different Medicinal Plant Leaf Extracts on Speed of Germination of Accelerated Aged Sesame cv TMV 1 Seeds

Treatments	*Accelerated ageing in days (A)*						
	0	*2*	*4*	*6*	*8*	*10*	*Mean*
T_0	4.9	4.4	3.5	3.1	2.9	1.3	3.3
T_1	5.1	4.6	3.8	3.4	3.2	1.7	3.6
T_2	6.2	5.8	5.1	4.7	4.1	3.3	4.8
T_3	5.6	5.0	4.3	3.9	3.5	2.4	4.1
T_4	5.9	5.5	5.0	4.7	3.9	2.9	4.6
T_5	5.7	5.1	4.5	4.1	3.7	2.7	4.9
Mean	5.5	5.0	4.3	3.9	3.5	2.3	4.08
CD		T	A	TXA			
(P=0.05)		0.18	0.23	0.41			

Table 3
Effect of Different Medicinal Plant Leaf Extracts on Shoot Length (cm) of Accelerated Aged Sesame cv TMV 1 Seeds

Treatments	*Accelerated ageing in days (A)*						
	0	*2*	*4*	*6*	*8*	*10*	*Mean*
T_0	7.6	7.2	6.5	6.1	5.0	3.1	5.91
T_1	8.0	7.5	6.9	6.4	5.7	3.7	6.36
T_2	8.9	8.3	7.8	7.1	6.7	5.1	7.31
T_3	8.3	7.9	7.2	6.6	6.0	4.2	6.70
T_4	8.5	8.1	7.4	6.8	6.4	4.6	6.96
T_5	8.4	8.0	7.5	6.6	6.2	4.4	6.85
Mean	8.28	7.83	7.21	6.60	6.0	4.18	6.68
CD		T	A	TXA			
(P=0.05)		0.058	0.075	0.131			

Table 4
Effect of Different Medicinal Plant Leaf Extracts on Root Length (cm) of Accelerated Aged Sesame cv TMV 1 Seeds

Treatments	*Accelerated ageing in days (A)*						
	0	*2*	*4*	*6*	*8*	*10*	*Mean*
T_0	9.2	8.8	8.0	6.9	5.5	4.0	7.06
T_1	9.9	9.6	8.4	7.3	6.2	4.7	7.68
T_2	11.2	10.8	9.7	8.9	7.4	6.4	9.06
T_3	10.4	10.0	8.6	7.8	6.6	5.1	8.08
T_4	10.7	10.4	9.1	8.2	7.1	6.1	8.60
T_5	10.4	10.1	8.8	8.0	6.9	5.8	8.33
Mean	10.33	9.95	8.76	7.85	6.61	5.35	8.14
CD		T	A	TXA			
(P=0.05)		0.048	0.062	0.10			

Table 5
Effect of Different Medicinal Plant Leaf Extracts on Drymatter Production (mg. 10. Seedlings^{-1}) of Accelerated Aged Sesame cv TMV 1 Seeds

Treatments	*Accelerated ageing in days (A)*						
	0	*2*	*4*	*6*	*8*	*10*	*Mean*
T_0	2.54	2.28	1.68	1.12	0.94	0.74	1.55
T_1	2.65	2.35	1.84	1.29	1.05	0.89	1.67
T_2	3.07	2.91	2.64	2.11	1.71	1.32	2.29
T_3	2.82	2.41	2.07	1.57	1.29	1.01	1.86
T_4	2.96	2.67	2.23	1.96	1.57	1.20	2.09
T_5	2.91	2.53	2.11	1.83	1.41	1.09	1.98
Mean	2.82	2.52	2.09	1.64	1.32	1.04	1.90
CD		T	A	TXA			
(P=0.05)		0.075	0.09	0.169			

Table 6
Effect of Different Medicinal Plant Leaf Extracts on Electrical Conductivity (dsm^{-1}) of Accelerated Aged Sesame cv TMV 1 Seeds

Treatments	*Accelerated ageing in days (A)*						
	0	*2*	*4*	*6*	*8*	*10*	*Mean*
T_0	0.077	0.089	0.121	0.132	0.140	0.141	0.116
T_1	0.080	0.098	0.109	0.121	0.131	0.147	0.114
T_2	0.069	0.078	0.084	0.091	0.097	0.107	0.087
T_3	0.077	0.089	0.098	0.106	0.124	0.134	0.104
T_4	0.072	0.086	0.097	0.103	0.108	0.119	0.097
T_5	0.076	0.091	0.102	0.110	0.117	0.126	0.103
Mean	0.075	0.089	0.101	0.110	0.119	0.12	0.103
	CD	T	A	TXA			
	(P=0.05)	NS	0.07	NS			

Table 7
Effect of Different Medicinal Plant Leaf Extracts on Dehydrogenase Enzyme Activity (OD) of Accelerated Aged Sesame cv TMV 1 Seeds

Treatments	*Accelerated ageing in days (A)*						
	0	*2*	*4*	*6*	*8*	*10*	*Mean*
T_0	0.371	0.312	0.282	0.234	0.203	0.183	0.264
T_1	0.382	0.364	0.309	0.285	0.231	0.197	0.294
T_2	0.473	0.451	0.412	0.391	0.371	0.311	0.401
T_3	0.451	0.411	0.372	0.346	0.322	0.246	0.358
T_4	0.463	0.426	0.381	0.361	0.343	0.296	0.378
T_5	0.457	0.414	0.392	0.352	0.331	0.274	0.370
Mean	0.432	0.396	0.358	0.328	0.300	0.251	0.344
	CD	T	A	TXA			
	(P=0.05)	0.018	0.021	NS			

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