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Effect of Fungicide Seed Treatment on Seed Quality Parameters in Storage of Soybean

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Abstract Seed deterioration is a serious problem in oil seeds, where seeds are stored in places usually without a proper control of humidity and temperature. The short shelf life of soybean seed is the result of its high lipid content. Seed quality and longevity is greatly influenced by storage condition, storage containers and seed treatment. Seed treatment with strobilurin group of fungicides not only controls the seed-borne diseases but also improves seed health in storage. These fungicides reduces mitochondrial respiration, metabolic activity, fungal infection and alters the status of phytohormones. Seed quality parameters like germination (88.94%), total seedling length (34.54 cm) and SVI (3564.80) was maximum in fungicide treated X_2 seeds compared to the control. With respect to packing materials vaccum packed bags showed higher germination (93.72%), seedling length (25.21 cm) and SVI (3041.56) compared to all other storage containers. Among the conditions cold storage showed maximum germination (90.86%), total seedling length (14.11 cm) and SVI (921.35) at 12th month of storage compared to ambient storage.

Keywords Germination, Opera, Seed quality parameters, Seedling vigor index, Xelora.

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Introduction

Seed is one of the basic needs in agriculture, characterized by high viability and vigor. Seed deterioration is a serious problem in oil seeds, where seeds are stored in places usually without a proper control of humidity and temperature. Oil seeds like soybean rich in lipids has limited longevity due to its specific chemical composition. In soybean which has non availability of high vigor seeds at the time of sowing are a major constraint. Soybean seed is usually not carried over to the next planting season because it deteriorates rapidly during storage and results in poor growth when planted and this rapid deterioration is a serious problem in seed production. The short shelf life of soybean seed is the result of its high lipid content and high levels of polyunsaturated linolenic and linoleic acids. At high temperature lipid undergoes peroxidation (lipids are abundant in seeds) and other biochemical processes, which leads to destruction of membranes. There is a relationship between changes in lipid peroxidation and enzyme activity affects the seed quality parameters in storage. Seed quality and longevity is greatly influenced by storage condition (temperature, relative humidity and oxygen), storage containers and seed treatment.

Seed treatment with fungicides not only controls the seed-borne diseases but also improves seed health in storage. Fungicide treatment is required for the seeds to be stored for several months and stability of fungicide effect without affecting the seed health adversely is to be assessed. Usually fungicide treatment is a curative measures against fungal dis-

eases but strobilurin group of fungicides helps to improve seed health. Whereas, advanced formulations like xelora 500 g l^{-1} FS (Thiophanate methyl 450 g l^{-1} + Pyraclostrobin 50 g l^{-1}) and opera (Pyraclostrobin + Epoxiconazole) are having broad spectrum fungicidal activity in positive way even in the absence of pathogen infection. These fungicides reduces mitochondrial respiration and blocks the transfer of electrons in the II complex (Cytochrom bc_1 complex). Pyraclostrobin altered the status of phytohormones like inhibition of ethylene biosynthesis by the reduction of the activity of ACC (1-aminocyclopropane–1–carboxylic acid) synthase and also stimulated the levels of ABA (abscisic acid) [1].

Materials and Methods

The present experiment contained three different factors like fungicide treatment, storage containers and storage condition. Soybean seeds (DSb–21) were subjected to three different fungicide treatments i). –No fungicide treatment to the seeds collected from absolute control plot (X_0) ii). No fungicide treatment to the seeds collected from xelora and opera treated plot (X_1) and iii). Seed treatment with xelora @ 2.5 ml kg^{-1} to the seeds collected from xelora and opera treated plot (X_2). These three different fungicide treated seeds were packed in four different packaging materials i). Cloth bags (C_1) ii). Polythene bags (C_2) iii). Vaccum packing bags (C_3) and iv). Gunny bags (C_4). After packing of all seeds in different containers 50% bags were stored in ambient condition (A_1) and 50% of bags stored in cold storage (A_2). For ambient storage, bags were stored at room temperature (25 ± 2°C) and for cold storage seeds were stored in cold storage unit. The temperature in the cold storage was around 5 ± 2°C and relative humidity was 85–90%.

Observations recorded

The required quantity of seeds was drawn at bimonthly interval from each treatment under both ambient as well as cold storage for determination the effect of fungicide on seed quality parameters like germination per cent, root length, shoot length, total seedling length and seedling vigor index. Observations on the following parameters were recorded for 12 months.

Germination test was conducted as per the ISTA procedure using between paper method in three replication. Germination test was conducted in incubator and germination count was taken at the end of 10^{th} day and expressed in per cent. At the time of germination count, 5 normal seedlings were selected at random from each replication and used for measuring the total seedling length. Vigor index value were computed using the formula: Seedling vigor index (SVI) = Germination (%) × Seedling length (cm).

Results and Discussion

It was observed from Table 1 among the fungicide treatment the higher germination per cent was observed in X_2 seeds (88.94%) and lower germination per cent in control seeds (81.54%) after two months of storage. The germination per cent was decreased with increased storage period. In X_2 seeds the germination per cent was decreased from 88.94% to 42.62% at 12^{th} months of storage. In control the germination per cent was decreased from 81.54% to 12.97% at 12^{th} months of storage. A mong the containers the vacuum packed bags (C_3) had higher germination per cent (93.72%) and lower germination per cent was observed in cloth bags (C_1) (84.88%) at 2^{nd} month of seed storage. The germination per cent was decreased to 51.20% and 23.75% in vacuum packed and cloth bags respectively after 12 months of seed storage. The higher germination per cent was observed in the cold storage in all the storage months (2, 4, 6, 8, 10 and 12 months) compared to the ambient storage. In 2^{nd} month of storage the cold storage had higher germination per cent (90.86%) and ambient condition had lowest germination per cent (86.77%).

The seedling length of the soybean seed was presented in Table 2. Among the fungicide treatment the maximum seedling length was observed in xelora seed treatment to the seeds collected from xelora and opera treated plot (X_2) (34.54 cm) at 4^{th} month of storage and lower seedling length was observed in control seedling (X_0) (26.76 cm). The seedling length was decreased with increased storage period (months). In X_2 the seedling length was decreased

Table 1. Influence of xelora fungicide seed treatment, different packing and storage conditions on germination (%) in soybean seeds at different period of storage. X_0–No fungicide treatment to the seeds collected from control plot (Absolute control), X_1–No fungicide treatment to the seeds collected from xelora and opera treated plot, X_2–Seed treatment with xelora @ 2.5 ml/kg to the seeds collected from xelora and opera treated plot, Means followed by the same latter (s) in the column does not differ significantly by DMRT (p = 0.01).

Treatments	2nd month	4th month	6th month	8th month	10th month	12th month
			Xelora fungicide treatments			
X_0	81.54[b] (64.63)	70.89[b] (57.96)	61.49[c] (48.82)	44.32[b] (36.30)	25.17[c] (22.28)	12.97[b] (12.99)
X_1	88.87[a] (70.84)	77.90[b] (62.80)	77.69[b] (62.50)	57.17[ab] (46.26)	36.83[b] (32.98)	39.62[a] (34.42)
X_3	88.94[a] (72.03)	84.42[a] (63.78)	86.00[a] (69.01)	64.41[a] (54.48)	42.26[a] (38.24)	42.62[a] (37.50)
SEm±	0.44	0.73	0.59	1.18	0.32	0.34
LSD (0.01)	1.70	2.75	2.24	4.48	1.22	1.27
			Storage containers			
Cloth bag (C_1)	84.88[b] (67.43)	74.21[c] (60.02)	72.75[b] (58.61)	47.78[b] (39.31)	26.92[c] (21.55)	23.75[b] (19.34)
Polythene bag (C_2)	88.29[b] (70.44)	85.62[ab] (65.07)	74.17[b] (59.38)	65.60[a] (51.77)	34.12[b] (32.86)	28.17[b] (23.12)
Vaccum packing (C_3)	93.72[a] (76.11)	89.18[a] (66.17)	85.83[a] (68.43)	65.99[a] (54.60)	49.84[a] (44.83)	51.20[a] (45.12)
Gunny bag (C_4)	88.38[b] (70.28)	75.62[bc] (61.57)	75.69[b] (60.56)	48.35[b] (42.09)	31.88[b] (28.79)	26.93[b] (28.44)
SEm±	0.51	0.84	0.68	1.36	0.37	0.39
LSD (0.01)	1.94	3.18	2.59	5.17	1.40	1.47
			Storage conditions			
Room temperature (A_1)	86.77 (69.15)	68.78 (56.16)	66.37 (53.40)	25.58 (24.12)	20.83 (9.83)	16.19 (16.43)
Cold storage (A_2)	90.86 (72.99)	87.54 (70.26)	87.85 (70.09)	87.17 (69.77)	66.55 (54.18)	48.83 (41.58)
SEm±	0.36	0.59	0.50	0.96	0.26	0.27
LSD (0.01)	1.37	2.25	1.91	3.66	0.99	1.04

from 34.54 cm 23.95 cm and in X_0 the seedling length was decreased from 26.76 cm to 10.34 cm at 12 months of storage. The storage of soybean seeds in different containers for twelve months, the seedling length data were non significant between the containers upto eight months. After eight months the data showed significant difference. Among the containers the vacuum packed bags (C_3) showed maximum seedling length (25.21 cm) and lower seedling length was observed in seeds stored in cloth bags (C_1) (14.11 cm) at 10th month of seed storage. Among the storage conditions the higher seedling length was observed in the cold storage (A_2) throughout the storage period compared to the ambient storage (A_1). In 12th month of storage the cold storage seedlings had seedling length of 28.47 cm and seeds stored in ambient condition had seedling length of 12.98 cm.

The data pertaining to seedling vigor index (SVI) presented in Table 3 showed significant differences between the different treatments. Among the fungicide treatment the higher SVI was noticed in X_2 (3564.8) at 2nd month of storage and lower SVI was observed in X_0 (2137.05). The SVI was decreased with increased storage period (months. In X_2 the SVI was decreased from 3564.81 to 810.97 after 12 months of soybean storage. In X_0 the SVI was decreased from 2137.05 to 227.30 after 12 months of storage. Among the con-

Table 2. Influence of fungicides (xelora and opera), different packing and storage conditions on seedling length (cm) of soybean seeds at different period of storage. X_0–No fungicide treatment to the seeds collected from control plot (Absolute control), X_1–No fungicide treatment to the seeds collected from xelora and opera treated plot, X_2–Seed treatment with xelora @ 2.5 ml/kg to the seeds collected from xelora and opera treated plot, Means followed by the same latter (s) in the column does not differ significantly by DMRT (p = 0.01).

Treatments	2nd month	4th month	6th month	8th month	10th month	12th month
			Xelora fungicide treatments			
X_0	27.15	26.76[b]	24.59[b]	15.50[b]	14.04b	10.34[b]
X_1	31.47	33.15[a]	28.30[a]	26.39[ab]	22.28a	19.76[a]
X_3	33.00	34.54[a]	28.56[a]	28.71[a]	21.78[a]	23.95[a]
SEm±	0.87	0.43	0.54	1.09	0.50	0.43
LSD (0.01)	NS	1.63	2.06	4.13	1.89	1.63
			Storage containers			
Cloth bag (C_1)	30.36	29.08	24.87	20.56	14.11[b]	15.27[b]
Polythene bag (C_2)	32.91[b]	31.88	28.59	27.71	20.57[a]	18.28[b]
Vaccum packing (C_3)	34.28	33.50	29.72	28.94	25.21[a]	21.65[a]
Gunny bag (C_4)	29.78	31.05	28.38	25.48	20.31[a]	17.79[b]
SEm±	0.50	1.01	0.63	1.26	0.58	0.50
LSD (0.01)	NS	NS	NS	NS	2.19	1.89
			Storage conditions			
Room temperature (A_1)	27.99	25.64	25.53	15.54	13.53	12.98
Cold storage (A_2)	37.11	36.68	30.25	30.15	28.82	28.47
SEm±	0.71	0.35	0.44	0.89	0.41	0.35
LSD (0.01)	2.70	1.33	1.68	3.37	1.55	1.33

tainers the vacuum packed bags (C_3) showed maximum SVI (3041.56) in 2nd month of storage and lower SVI was observed in seeds stored in cloth bags (C_1) (2466.41). The SVI was decreased from 2nd month to 12th month and maximum SVI maintained in vacuum packed bags. When compared to the SVI in seedling of cold storage (A_2) and ambient storage (A_1). The maximum SVI was observed in the cold storage throughout the storage period compared to the ambient storage. In 12th month of storage the cold storage had SVI of 921.35 and seeds stored in ambient condition had SVI of 161.37.

Germination percent is the most widely used indicator of viability while seedling length is the index of the seedling vigor. In this study, using seed quality parameters determined the seed viability and vigor with respect to different treatments.

Results of present study revealed that there was gradual decrease in seed quality parameters like germination, total seedling length and seedling vigor index during entire storage period. There was gradual decline in seed quality parameters upto six months of storage and after six months there was drastic reduction in ambient storage compared to the cold storage. This is because in cold storage the rate of respiration and metabolic activities were very slow compared to the ambient storage and pathogens activities also very slow. So seed in cold storage conserves the resources for longer period. The results are in agreement with findings earlier [2—5].

The higher germination, higher seedling growth and higher seedling vigor index indicate good quality seeds and seeds with higher viability and vigor. Similar results obtained from seeds treated with fungicide like xelora after harvest (X_2) and seeds collected from the field where fungicide (opera) treated in the form of foliar application along with seed treatment (X_1) compared to the control seeds (X_0). These fungicide treatments prevent the fungal diseases in

Table 3. Influence of fungicides (xelora and opera), different packing and storage conditions on seedling vigor index (SVI) in soybean seeds at different period of storage. X_0–No fungicide treatment to the seeds collected from control plot (Absolute control), X_1–No fungicide treatment to the seeds collected from xelora and opera treated plot, X_2–Seed treatment with xelora @ 2.5 ml/kg to the seeds collected from xelora and opera treated plot, Means followed by the same latter (s) in the column does not differ significantly by DMRT (p = 0.01).

Treatments	2nd month	4th month	6th month	8th month	10th month	12th month
			Xelora fungicide treatments			
X_0	2137.05[b]	2056.26[b]	2031.35[b]	1284.72[b]	489.64[b]	227.30[b]
X_1	2555.74[b]	2514.97[ab]	2265.20[b]	1864.78[a]	1362.97[a]	542.53[a]
X_3	3564.81[a]	2871.78[a]	2740.87[a]	2018.18[a]	1088.55[a]	810.97[a]
SEm±	58.51	47.26	48.80	43.73	27.77	25.91
LSD (0.01)	221.95	179.28	185.11	165.86	105.34	98.29
			Storage containers			
Cloth bag (C_1)	2466.41[b]	2260.29[b]	2215.60[b]	1359.19[b]	777.076[b]	316.75[b]
Polythene bag (C_2)	2718.42[ab]	2600.10[ab]	2653.13[ab]	1937.21[a]	1018.05[ab]	648.52[a]
Vaccum packing (C_3)	3041.56[a]	2902.97[a]	2865.92[a]	2312.30[a]	1220.75[a]	718.53[a]
Gunny bag (C_4)	2631.61[ab]	2456.22[b]	2360.80[b]	1881.69[a]	993.34[ab]	481.61ab
SEm±	67.56	54.57	56.34	50.48	32.06	29.92
LSD (0.01)	256.29	207.01	213.74	191.51	121.63	113.50
			Storage conditions			
Room temperature (A_1)	2240.01	2174.30	2060.43	253.52	96.62	161.37
Cold storage (A_2)	3491.68	3222.06	3038.47	2851.27	1908.00	921.35
SEm±	47.78	38.59	39.84	35.70	22.67	21.16
LSD (0.01)	181.22	146.38	151.14	135.42	86.01	80.25

the storage and reduces rate of seed respiration in storage and helps to increase the longevity of the seeds under storage. Similar results have been reported by Mbofung [6] and Raikar et al. [7].

With respect to packing materials, the good quality seeds with higher vigor and viability (as mentioned above) was seen in seeds stored in vacuum packaging method irrespective of storage conditions throughout the storage period, followed by polythene bags, gunny bags and cloth bags because of the less moisture content, absence of oxygen and lesser rate of respiration of the seeds. Least germination, seedling growth and higher seedling vigor index was observed in cloth bag under both ambient and cold storage followed by gunny bag. These cloth bags and gunny bags are moisture permeable containers due to high moisture content in cold storage seeds lost their quality in cold storage but compared to the ambient storage cloth bag and gunny bags also showed better performance in cold storage. Similar results have been reported earlier [8—10].

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