SHORT NOTE Legume Research- An International Journal, Volume 48 Issue 8: 1415-1420 (August 2025)

Effect of Pre-storage Seed Treatments on the Storage Potential in Soybean Seed [*Glycine max* (L.) Merill]

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10.18805/LR-5061

ABSTRACT

Background: Oilseeds are very sensitive to the adverse environmental conditions. The oil inside the seeds will get oxidized easily and deteriorate the seed health during storage. Diverse environmental conditions such as temperature, pests and diseases, seed oil and moisture content, mechanical damages, storage time and relative humidity of store may affect the viability of seeds. Therefore, the present study aimed to study the effect of pre-storage seed treatments on the storage potential in soybean seed.

Methods: The study was carried out during *rabi* 2020-21 and onwards at the Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh. The seeds of two soybean varieties (V_1: GJS 3 and V_2: JS 335) with 7 per cent moisture content treated with different pre storage dry dressing seed treatments (S_1: Control (untreated seed), S_2: Boric acid powder @ 5 g/kg seed, S_3: Neem kernel powder @ 5 g/kg seed, S_4: Wood ash @ 5 g/kg seed and S_5: Calcium hypochlorite @ 5 g/kg seed) were stored after packing in three containers (C_1: Aluminium foil bag, C_2: Non-wooven cloth bag and C_3: Air tight plastic containers). The seeds were evaluated for seed quality parameters *viz*., seed moisture content (%), germination (%), seedling length (cm), seedling dry weight (mg), seedling vigour index - I and seedling vigour index - II up to eight month of storage at interval of two month after storage following completely randomized design (Factorial) repeated three times.

Result: Germination percentage, seedling length, seedling dry weight, seedling vigour index I and seedling vigour index II were decreased with increased in storage period, while seed moisture content was increased with increased in storage period, thus was concluded that the quality of seed degraded in storage condition after 8 months of storage. In the storage condition, seeds of JS 335 treated with wood ash @ 5 g/kg seed and packed in air tight plastic container recorded the maximum germination percentage and was statistically at par with seeds of JS 335 treated with wood ash @ 5 g/kg seed and packed in aluminium foil bag. Seeds of JS 335 treated with wood ash @ 5 g/kg seed and packed in aluminium foil bag recorded the maximum seedling length, seedling dry weight, seedling vigour index I and seedling vigour index II.

Key words: Pre-storage dry dressing seed treatments, Seed quality, Soybean, Storage potential.

INTRODUCTION

Soybean [(*Glycine max* (L.) Merill] is known as “Golden bean” and “Miracle crop”, of the 20th century, because of its multiple uses (Kumar *et al*., 2013) and often designated as “Wonder crop” and “Gold of soil”. Soybean belongs to the family *Fabaceae* and sub family *Papilionaceae* with chromosome number 2n=20. Soybean contains more protein (about 40-42%) than other pulses and a much higher content of edible oil (about 20%) (Gopalan *et al.,* 1989). Soybean protein is also rich in valuable amino acid “lysine” (5%), which is deficient in most of the cereals (Hammond *et al.,* 2005).

Oilseeds are very sensitive to the adverse environmental conditions. The oil inside the seeds will get oxidized easily and deteriorate the seed health during storage (Kausar *et al.,* 2009). The storage conditions of seeds influence the germination characteristics and vigour potential of seeds. Diverse environmental conditions such as temperature, pests and diseases, seed oil and moisture content, mechanical damages, storage time and relative humidity of store may affect the viability of seeds (Marshal and Levis, 2004). Seed deterioration leads to the reduction in the quality, viability and vigor either due to aging or effect of adverse environmental factors (Siadat *et al*., 2012). Decrease in seed vigor may be due to decrease in germination indexes and also can increase the susceptibility of seeds to environmental stress. Soybean seed losses its viability in very short period of storage. Soybean seeds treated with boric acid powder, neem kernel powder, wood ash and calcium hypochlorite maintained better seed quality for long time and storing the seeds in vapor proof container like aluminium foil bag and air tight plastic container, is found to be more useful in maintaining the desired quality of seeds for longer period (Donga, 2014).

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How to cite this article: Vaghasiya, K.P., Patel, J.B. and Sondarva, J.R. (2025). Effect of Pre-storage Seed Treatments on the Storage Potential in Soybean Seed [*Glycine max* (L.) Merill]. Legume Research. 48(8): 1415-1420. doi: 10.18805/LR-5061.

Submitted: 20-10-2022 **Accepted:** 29-06-2023 **Online:** 14-07-2023

MATERIALS AND METHODS

The experiment was carried out during *rabi* 2020-21 and onwards at the Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh. The seeds of two soybean varieties (V_1: GJS 3 and V_2: JS 335) treated with different pre storage dry dressing seed treatments (S_1: Control (untreated seed), S_2: Boric acid powder @ 5 g/kg seed, S_3: Neem kernel powder @ 5 g/kg seed, S_4: Wood ash @ 5 g/kg seed and S_5: Calcium hypochlorite @ 5 g/kg seed) were stored after packing in three containers (C_1: Aluminium foil bag, C_2: Non-wooven cloth bag and C_3: Air tight plastic containers). The seeds were evaluated for seed quality parameters *viz*., seed moisture content (%), germination (%), seedling length (cm), seedling dry weight (mg), seedling vigour index - I and seedling vigour index - II up to eight month of storage at interval of two month after storage following completely randomized design (Factorial) repeated three times as per the method suggested by Cochran and Cox (1957).

RESULTS AND DISCUSSION

Effect of varieties

Seed moisture content in the seeds increased gradually with increase in storage period, while germination, seedling length, seedling dry weight, seedling vigour index I and seedling vigour index II of seeds were decreased gradually with increase in storage period. After eight month of storage period, significantly the higher seed moisture content (11.44%) was recorded in variety V_1 (GJS 3) than variety V_2 (JS 335) (10.70%) (Table 1). The results are in accordance with the findings of Isaac *et al*. (2016) and Gadewar *et al.* (2020). After eight month of storage periods, significantly the higher germination (77.24%), seedling length (9.00 cm), seedling dry weight (10.71 mg), seedling vigour index I (702.86) and seedling vigour index II (839.29) was recorded in the variety V_2 (JS 335) in comparison to V_1 (GJS 3) (72.13%, 8.23 cm, 9.76 mg, 597.32 and 711.48, respectively) (Table 1). The results are in agreement with the findings of Singh and Dadlani (2003), Kandil *et al.* (2013), Donga (2014), Goswami (2016) and Isaac *et al.* (2016).

Effect of storage containers

After eight month of storage, seed moisture content, on an average, increased to 3-4 per cent and it was recorded significantly the maximum (11.76%) in non-wooven cloth bag (C_2) and minimum (10.67%) in air tight plastic containers (C_3), which remained at par with seeds packed in aluminum foil bags (C_1). The results are in accordance with the findings of Gadewar *et al.* (2020) (Table 1). After eight month of storage, significantly the maximum germination (83.43%), seedling length (9.29 cm), seedling dry weight (10.77 mg), seedling vigour index I (777.78) and seedling vigour index II (902.04) was recorded in seeds packed in air tight plastic containers (C_3) followed by seeds packed in aluminum foil bags (C_1) with germination of 79.50 per cent, seedling length of 8.50 cm, seedling dry weight of 10.77 mg, seedling vigour index I of 678.54 and seedling vigour index II of 862.29 in that order. Significantly the minimum germination (61.13%), seedling length (8.06 cm), seedling dry weight (9.16 mg), seedling vigour index I (493.95) and seedling vigour index II (561.84) was recorded in seeds packed in non-wooven cloth bag (C_2) (Table 1). The results are in accordance with the findings of Tatipata (2009), Monira *et al.* (2012), Akter *et al*. (2014), Verma and Verma (2014), Goswami *et al.* (2017) and Sonkamble *et al.* (2017).

Effect of dry dressing seed treatments

After eight month of storage, significantly the maximum seed moisture content (11.25%) was recorded in control (S_1), while significantly the lowest seed moisture content (10.89%) was recorded in seeds treated with wood ash @ 5 g/kg seed (S_4), which remained at par with seeds treated with neem kernel powder @ 5 g/kg seed (S_3) and calcium hypochlorite @ 5 g/kg (S_5) with seed moisture content of 11.02 per cent and 11.05 per cent, respectively (Table 1). After eight month of storage, the maximum germination (80.11%), seedling length (9.17 cm), seedling dry weight (11.29 mg), seedling vigour index I (740.01) and seedling vigour index II (917.52) was recorded in seeds treated with wood ash @ 5 g/kg seed (S_4) followed by seeds treated with neem kernel powder @ 5 g/kg seed (S_3) with germination (78.61%), seedling length (8.77 cm), seedling dry weight (10.46 mg), seedling vigour index I (694.03) and seedling vigour index II (832.64). Significantly the lowest germination (70.22%), seedling length (8.22 cm), seedling vigourindex I (583.04) and seedling vigour index II (690.24) was recorded in control (S_1), while significantly the lowest seedling dry weight (9.63 mg) was recorded in seeds treated with calcium hypochlorite @ 5 g/kg seed (S_5) (Table 1). The results are in agreement with the findings of El-Mowafy (2017) and Patel *et al.* (2017).

Interaction effect of varieties and storage containers

Interaction effect of varieties and different storage containers was significant after eight month of storage for all the seed quality parameters studied. After eight month of storage period, significantly the maximum seed moisture content (12.22%) was recorded in V_1C_2 (seeds of GJS 3 packed in non-wooven cloth bag), while significantly the minimum seed moisture content (10.35%) was recorded in V_2C_1 (seeds of JS 335 packed in aluminum foil bags). The results are in accordance with the findings of Tatipata (2009) (Table 1). After eight month of storage period, significantly the maximum germination (87.67%), seedling length (9.75 cm), seedling vigour index I (855.62) and seedling vigour index II (974.85) was recorded in V_2C_3 (seeds of JS 335 packed in air tight plastic container), which was followed by V_2C_1 (seeds of JS 335 packed in aluminum foil bags) with germination (81.53%), seedling length (8.91 cm), seedling vigour index I (730.25) and seedling vigour index II (944.95). Significantly the maximum seedling dry weight (11.50 mg) was recorded in V_2C_1, which was followed by V_2C_3 (11.11 mg). Significantly

Table 1: Effect of varieties, containers and pre-storage seed treatments on seed moisture content (%), germination (%), seedling length (cm), seedling dry weight (mg), seedling vigour index I and seedling vigour index II in soybean seeds 8 month after storage.

Factor	Seed moisture content (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (mg)	Seedling vigour index I	Seedling vigour index II
V_1	11.44	72.13	8.23	9.76	597.32	711.48
V_2	10.70	77.24	9.00	10.71	702.86	839.29
S.Em±	0.03	0.25	0.04	0.07	3.92	5.64
C.D. at 5%	0.10	0.72	0.12	0.19	11.10	15.96
C_1	10.78	79.50	8.50	10.77	678.54	862.29
C_2	11.76	61.13	8.06	9.16	493.95	561.84
C_3	10.67	83.43	9.29	10.77	777.78	902.04
S.Em±	0.04	0.31	0.05	0.08	4.81	6.91
C.D. at 5%	0.12	0.88	0.15	0.23	13.59	19.54
S_1	11.25	70.22	8.22	9.74	583.04	690.24
S_2	11.14	72.89	8.55	10.05	628.45	738.44
S_3	11.02	78.61	8.77	10.46	694.03	832.64
S_4	10.89	80.11	9.17	11.29	740.01	917.52
S_5	11.05	71.61	8.37	9.63	604.93	698.09
S.Em±	0.06	0.40	0.07	0.10	6.20	8.92
C.D. at 5%	0.16	1.14	0.19	0.29	17.55	25.23
V × C						
V_1C_1	11.20	77.47	8.09	10.05	626.83	779.63
V_1C_2	12.22	59.73	7.78	8.79	465.19	525.60
V_1C_3	10.90	79.20	8.83	10.43	699.95	829.22
V_2C_1	10.35	81.53	8.91	11.50	730.25	944.95
V_2C_2	11.31	62.53	8.34	9.53	522.72	598.08
V_2C_3	10.44	87.67	9.75	11.11	855.62	974.85
S.Em±	0.06	0.44	0.07	0.11	6.80	9.77
C.D. at 5%	0.17	1.25	0.21	0.32	19.22	27.64
V × S						
V_1S_1	11.59	69.00	7.91	9.32	549.57	648.20
V_1S_2	11.55	69.22	8.22	9.78	571.24	680.07
V_1S_3	11.42	76.33	8.43	9.96	646.53	767.71
V_1S_4	11.18	77.11	8.59	10.41	663.81	812.93
V_1S_5	11.45	69.00	8.00	9.32	555.46	648.50
V_2S_1	10.91	71.44	8.53	10.17	616.51	732.28
V_2S_2	10.73	76.56	8.88	10.32	685.66	796.82
V_2S_3	10.62	80.89	9.11	10.97	741.53	897.58
V_2S_4	10.60	83.11	9.74	12.17	816.21	1022.11
V_2S_5	10.64	74.22	8.73	9.94	654.41	747.68
S.Em±	0.08	0.57	0.10	0.15	8.77	12.61
C.D. at 5%	NS	1.61	0.27	0.41	24.82	35.68
C × S						
C_1S_1	11.00	73.50	8.08	10.13	594.02	744.30
C_1S_2	10.68	75.33	8.40	10.40	633.70	784.50
C_1S_3	10.78	86.00	8.52	10.88	733.58	937.43
C_1S_4	10.66	86.67	9.25	12.42	805.20	1082.03
C_1S_5	10.78	76.00	8.23	10.03	626.22	763.17
C_2S_1	11.90	58.17	7.53	8.82	438.00	512.55
C_2S_2	11.73	61.67	8.02	9.22	494.67	568.47
C_2S_3	11.72	62.17	8.37	9.35	520.75	581.43

Table 1: Continue.....

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C_2S_4	11.68	64.33	8.68	9.95	559.27	643.02
C_2S_5	11.79	59.33	7.70	8.48	457.08	503.73
C_3S_1	10.86	79.00	9.05	10.28	717.10	813.87
C_3S_2	11.03	81.67	9.23	10.53	756.98	862.37
C_3S_3	10.56	87.67	9.43	11.15	827.77	979.07
C_3S_4	10.34	89.33	9.57	11.50	855.57	1027.52
C_3S_5	10.57	79.50	9.17	10.38	731.50	827.37
S.Em±	0.10	0.70	0.12	0.18	10.74	15.45
C.D. at 5%	0.27	1.97	0.33	0.51	30.40	43.70
V × C × S						
$V_1C_1S_1$	11.33	74.33	7.97	9.67	592.20	718.47
$V_1C_1S_2$	11.09	72.33	8.10	10.07	585.97	728.13
$V_1C_1S_3$	11.23	83.00	8.17	10.33	677.87	857.53
$V_1C_1S_4$	11.17	83.33	8.20	10.63	683.33	885.93
$V_1C_1S_5$	11.18	74.33	8.00	9.53	594.80	708.07
$V_1C_2S_1$	12.27	58.67	7.17	8.33	420.40	488.77
$V_1C_2S_2$	12.33	60.33	7.80	9.07	470.57	547.03
$V_1C_2S_3$	12.21	60.33	8.13	9.00	490.83	542.73
$V_1C_2S_4$	12.05	61.00	8.47	9.20	516.43	561.07
$V_1C_2S_5$	12.25	58.33	7.33	8.37	427.70	488.40
$V_1C_3S_1$	11.18	74.00	8.60	9.97	636.10	737.37
$V_1C_3S_2$	11.25	75.00	8.77	10.20	657.20	765.03
$V_1C_3S_3$	10.82	85.67	9.00	10.53	770.90	902.87
$V_1C_3S_4$	10.33	87.00	9.10	11.40	791.67	991.80
$V_1C_3S_5$	10.91	74.33	8.67	10.07	643.87	749.03
$V_2C_1S_1$	10.66	72.67	8.20	10.60	595.83	770.13
$V_2C_1S_2$	10.27	78.33	8.70	10.73	681.43	840.87
$V_2C_1S_3$	10.32	89.00	8.87	11.43	789.30	1017.33
$V_2C_1S_4$	10.15	90.00	10.30	14.20	927.07	1278.13
$V_2C_1S_5$	10.37	77.67	8.47	10.53	657.63	818.27
$V_2C_2S_1$	11.54	57.67	7.90	9.30	455.60	536.33
$V_2C_2S_2$	11.13	63.00	8.23	9.37	518.77	589.90
$V_2C_2S_3$	11.23	64.00	8.60	9.70	550.67	620.13
$V_2C_2S_4$	11.32	67.67	8.90	10.70	602.10	724.97
$V_2C_2S_5$	11.32	60.33	8.07	8.60	486.47	519.07
$V_2C_3S_1$	10.54	84.00	9.50	10.60	798.10	890.37
$V_2C_3S_2$	10.81	88.33	9.70	10.87	856.77	959.70
$V_2C_3S_3$	10.30	89.67	9.87	11.77	884.63	1055.27
$V_2C_3S_4$	10.34	91.67	10.03	11.60	919.47	1063.23
$V_2C_3S_5$	10.23	84.67	9.67	10.70	819.13	905.70
S.Em±	0.13	0.99	0.17	0.25	15.20	21.85
C.D. at 5%	NS	2.79	0.47	0.72	42.99	61.80
CV %	2.11	2.29	3.32	4.29	4.05	4.88

the minimum germination (59.73%), seedling length (7.78 cm), seedling dry weight (8.79 mg), seedling vigour index I (465.19) and seedling vigour index II (525.60) was observed in V_1C_2 (seeds of GJS 3 packed in non-wooven cloth bag) (Table 1). The results are in accordance with the findings of Tatipata (2009); Monira *et al.* (2012); Akter *et al.* (2014); Verma and Verma (2014); Goswami *et al.* (2017) and Sonkamble *et al.* (2017).

Interaction effect of varieties and dry dressing seed treatments

Interaction effect between varieties and different dry dressing seed treatments was significant after eight month of storage for all the seed quality parameters studied. After eight month of storage period, significantly the maximum germination (83.11%), seedling length (9.74 cm), seedling dry weight (12.17 mg), seedling vigour index I (816.21) and

seedling vigour index II (1022.11) was recorded in V_2S_4 (seeds of JS 335 treated with wood ash @ 5 g/kg seed) and it was followed by V_2S_3 (seeds of JS 335 treated with neem kernel powder @ 5 g/kg seed) with germination (80.89%), seedling length (9.11 cm), seedling dry weight (10.97 mg), seedling vigour index I (741.53) and seedling vigour index II (897.58), while significantly the minimum germination (69.00%), seedling length (7.91 cm), seedling dry weight (9.32 mg), seedling vigour index I (549.57) and seedling vigour index II (648.20) was observed in V_1S_1 (untreated seeds of GJS 3) (Table 1). The results are in agreement with the findings of El-Mowafy (2017) and Patel *et al.* (2017).

Interaction effect of storage containers and dry dressing seed treatments

Interaction effect between storage containers and dry dressing seed treatments was significant after eight month of storage for all the seed quality parameters studied. After eight month of storage, significantly the maximum seed moisture content (11.90%) was recorded in C_2S_1 (untreated seed packed in non-wooven cloth bag), while significantly the minimum seed moisture content (10.34%) was recorded in C_3S_4 (seeds treated with wood ash @ 5 g/kg seed and packed in air tight plastic container) (Table 1). After eight month of storage, significantly the maximum germination (89.33%), seedling length (9.57 cm), seedling vigour index I (855.57) and seedling vigour index II (1027.52) was recorded in C_3S_4 (seeds treated with wood ash @ 5 g/kg seed and packed in air tight plastic container). Significantly the maximum seedling dry weight (12.42 mg) was recorded in C_1S_4 (seeds treated with wood ash @ 5 g/ kg seed and packed in aluminum foil bags). Significantly the lowest germination (58.17%), seedling length (7.53 cm) and seedling vigour index I (438.00) was recorded in C_2S_1 (untreated seed packed in non-wooven cloth bag), while significantly the lowest seedling dry weight (8.48 mg) and seedling vigour index II (503.73) was recorded in C_2S_5 (seeds treated with calcium hypochlorite @ 5 g/kg seed and packed in non-wooven cloth bag) (Table 1). The results are in agreement with the findings of El-Mowafy (2017) and Patel *et al.* (2017).

Interaction effect of varieties, storage containers and dry dressing seed treatments

Interaction effect between varieties, storage containers and dry dressing seed treatments was significant after eight month of storage for all the seed quality parameters studied. After eight month of storage period, significantly the maximum germination (91.67%) was recorded in $V_2C_3S_4$ (seeds of JS 335 treated with wood ash @ 5 g/kg seed and packed in air tight plastic container) and it was remained statistically at par with $V_2C_1S_4$ (seeds of JS 335 treated with wood ash @ 5 g/kg seed and packed in aluminium foil bag), $V_2C_3S_3$ (seeds of JS 335 treated with neem kernel powder @ 5 g/kg seed and packed in air tight plastic container) and $V_2C_1S_3$ (seeds of JS 335 treated with neem kernel powder @ 5 g/kg seed and packed in aluminium foil bag) with germination of 90.00 per cent, 89.67 per cent and 89.00 per cent in that order. Significantly the lowest germination (58.33%) was noted in $V_1C_2S_5$ (seeds of GJS 3 treated with calcium hypochlorite @ 5 g/kg seed and packed in non-wooven cloth bag) (Table 1). After eight month of storage period, significantly the maximum seedling length (10.30 cm), seedling dry weight (14.20 mg), seedling vigour index I (927.07) and seedling vigour index II (1278.13) was recorded in $V_2C_1S_4$ (seeds of JS 335 treated with wood ash @ 5 g/kg seed and packed in aluminium foil bag), while significantly the lowest seedling length (7.17 cm), seedling dry weight (8.33 mg), seedling vigour index I (420.40) was noted in $V_1C_2S_1$ (Untreated seeds of GJS 3 packed in non-wooven cloth bag) and seedling vigour index II (488.40) in $V_1C_2S_5$ (seeds of GJS 3 treated with calcium hypochlorite @ 5 g/kg seed and packed in non-wooven cloth bag) (Table 1).

Wood ash is the cheap, easily available and affordable material and because of its hygroscopic nature, it maintained low seed moisture content of seed during storage and prolong the shelf life of seed (Ashok and Gowda, 2017).

CONCLUSION

From the results, it was seen that, germination percentage, seedling length, seedling dry weight, seedling vigour index I and seedling vigour index II were decreased with increased in storage period, while seed moisture content was increased with increased in storage period, thus, was concluded that the quality of seed degraded in storage condition. However, it is suggested that, seeds of soybean could be stored for a period of eight months (up to next season sowing) with optimum germination and good vigour with seed treatment of wood ash @ 5 g/kg seed in air tight plastic container or aluminium foil bag packaging material.

Conflict of interest

All authors declared that there is no conflict of interest.

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