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EFFECT OF SEED PRIMING ON STORABILITY IN GREENGRAM CV. VBN-2

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Abstract:

Seed attains highest vigour during the physiological maturity stage and then successively declined depending upon the storage conditions and chemical composition of the seeds. Seed priming is used to some extent to alleviate the seed deterioration during storage. Priming is the process of controlled hydration of seeds which permits the initial process of germination, but preventing radicle development, modifying physiological and biochemical properties of the seed. In the present study, seeds were primed with various priming chemicals viz., mannitol 2%, $MnSO_4$ 100 ppm, $ZnSO_4$ 100 ppm and GA_3 100 pm and seeds were soaked for 12 hrs. The storage studies were conducted for 5 months after imposing the priming treatment. The results revealed that germination percentage, root length, shoot length, vigour index of primed seeds superior to untreated seeds. Seeds primed with mannitol @ 2% recorded highest germination percent, more root and shoot length, more vigour index and low electrical conductivity of seed leachates.

Key Words: Greengram, Seed Priming & Storability

Introduction:

Greengram (*Vigna radiate L.*) in the third important pulse crop of India and is a native of central Asia. It is originated from *Phaseolus sublobatus* a wild plant. It is extensively grown in West Indies, Japan and other tropical and subtropical countries. In India it is grown in Maharashtra, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh, Tamil Nadu and Bihar. It is highly nutritious containing 24-26% protein and rich in vitamin like A, B_1, B_3 and minerals like potassium, phosphorus, calcium and sodium.

In India, it is cultivated in an area of 2.9 m ha with total production of 1.24 mt. India is the major producer and consumer of pulses in world accounting for 33 and 22% of the world's area and production under pulses respectively (FAO, 2011).

Seed quality is influenced various biotic and abiotic factors and important characteristics of blckgram seed is it lose in viability very shortly. The natural ageing of seeds cannot be stopped completely during storage under ambient condition, but is can be controlled to a possible extent by adoption of suitable storage technique. Seed deteriorate during storage is due to lipid peroxidation causing disintegration of membrane integrity thereby reducing seed longevity (Sung and Chin, 1995) and oxidative modification of protein causing inactivation of antioxidant, hydrolytic and other types of enzymes. Due to the inactivation of enzymes, seeds lose their ability to stabilize reactive oxygen species thereby enhancing lipid peroxidation and denaturation of protein. Inactivation of hydrolytic enzymes causes low germination performance of seed (Job C Rajjou *et al.* 2005). During seed storage, reactive oxygen species are generated in seed by lipoxygenate enzyme and antioxidant enzymes such as superoxide dismutase, catalase decline during storage due to which lipid peroxidation increase (Sung and Chiu, 1995).

Seed deterioration during storage may be controlled through priming prior to storage (Georghiou *et al.,* 1987), because priming activates antioxidant enzymes in seed which scavenge reactive oxygen species and lower lipid peroxidation in seed (Braccini *et al.,* 2000). Seed priming with inorgnics is one such treatment to control deterioration process during seed storage. It contains antioxidant to be very effective in controlling

the deterioration process. Antioxidants are the substances that protect the cell membrane against the oxidative damage induced by oxidants (Temple, 2000).

Seed priming is basically pre-sowing seed treatment in which the seeds are hydrated and dehydrated which modifies physiological and biochemical properties of seed (Basu, 1976). The seed priming advances germination metabolism, enhances antioxidant activities and improves repair process. The efficacy of priming treatments in the maintenance of quality of seeds has been demonstrated by many workers in okra (Kapri *et al.,* 2003). Gu *et al.* (1993) suggested that hydration-dehydration treatments increased the activity of superoxide dismutase, catalase and peroxidase in germinating seeds of tomato and reduced melondialadehyde content and reduced membrane damage and maintained mitochondrial function. Hence, the present study was carried out to maintain the quality of nine months old greengram seeds during storage to prolong the shelf life of seeds.

Materials and Methods:

Nine months old seeds of greengram cv. VBN 2 were obtained from National Pulse Research Station, Vamban, Tamilnadu subjected to various seed priming treatments. The seed treatment was done by soaking the required quantity of seeds in water and various chemicals for 12 hours. Than the seeds were shade dried to bring back its original moisture content. The various priming treatments are:

T_1 – Control (Unprimed seeds)
T_2 – Hydropriming
T_3 – Priming with mannitol @ 2%
T_4 – Priming with $MnSO_4$ @ 100 ppm
T_5 – Priming with $ZnSO_4$ @ 100 ppm
T_6 – Priming with GA_3 @ 100 ppm

The primed seeds after drying back to its original moisture content were packed in HDPE (High Density Polyethylene) bag and kept at ambient storage condition for a period of 5 months. Unprimed seeds acted as control. The seeds samples were drawn at monthly intervals up to 5 months of storage period and evaluated for germination per cent, root length, shoot length, seeding dry weight, seedling vigour index, electrical conductivity and moisture content per cent.

Germination test was conducted in four replications of 100 seeds each by adopting between paper method as described by ISTA producers (Anonymous, 1999). Daily germination count was taken until to further germination occurred for seven consecutive days, the final and speed of germination were calculated. Ten normal seedlings were selected randomly in each treatment from all the replications on 7^{th} days to record root length, shoot length and dry weight of seedlings. The seedling vigour index was calculated by following the method as suggested by Abdul Baki and Anderson (1973). The electrical conductivity of leachate was measured in dSm^{-1} (Preseley, 1958). The data were statistically analyzed using analysis of variance appropriate completely randomized design.

Results and Discussion:

The results obtained from the present investigation and relevant discussion had been summarized below.

Significant difference was observed for speed of germination due to seed priming treatments on storability of greengram seeds. At the end of five month of storage period, seeds primed with GA_3 @ 100 ppm (T_6) recorded the highest speed of germination (21.22), followed by seeds primed with mannitol @ 2% (20.14), which are statistically on par with each other, while, the seeds primed with $MnSO_4$ @ 100 ppm (T_4) recorded

the lowest speed of germination (17.02). Higher speed of germination of GA_3 is attributed to its stimulation effect in the formation of enzymes, which are important in the early phases of germination, which helps for fat radicle protrusion and hence hypocotyls elongation. This result is in accordance with the findings of Kumar and Neelakandan, (1992) and Maske *et al.* (1997).

The results showed that germination percentage progressively declined with increase in storage period for all the treatments. Seeds primed with mannitol (T_3) recorded significantly higher germination (52.45%) followed by seed primed with GA_3 @ 100 ppm (T_6) 51.80%, which were significantly on par with each other, while (T_2) hydropriming recorded the lowest germination (49.25%) per cent (Table 1). High germination percentage in mannitol 2% seed treatment is due to increased activity of enzymes involved in carbohydrate metabolism (Kaur *et al.,* 2002b). This finding is in accordance with the findings of Night Sarwar *et al.* (2006) opined that seed priming with mannitol showed higher germination per cent in chickpea. The seeds primed with GA_3 @ 100 ppm also recorded higher germination may be attributed to the key role of gibberellins in germination. Beneficial effects of priming treatment may be through the improved physiological process for germination. The improved germination of primed seeds may be attributed to the concentration of free radicals and resynthesis of membrane - bound enzymes (Basu and Dasgupta, 1978).

Significant variation in root length and shoot length were observed due to seed priming treatment on storability of greengram seeds. At the end of 5 months of storage period, seeds primed with mannitol 2% (T_3) recorded highest root length and shoot length of 13.10 cm and 23.15 cm respectively, where as the seeds primed with $MnSO_4$ @ 100 ppm (T_6) recorded the lowest root length and shoot length of 11.34 cm and 20.95 cm respectively (Tables 2 & 3). More root length and shoot length may be attributed to increased activities of enzymes like amylase, invertase sucrose synthase and sucrose phosphate synthase in chickpea (Kaur *et al.,* 2002b).

Seedling dry weight is one of the major components of seed quality in greengram. Most of the priming treatments recorded more seedling dry weight than T_4. Seedling dry weight is presented in table 4. At the end of 5 months of storage period, seed treated with mannitol @ 2% (T_3) recorded highest seedling dry weight (82.42 mg), while the seeds primed with $MnSO_4$ @ 100 ppm (T_6) recorded lowest seedling dry weight (57.42 mg). Significant difference was recorded for seedling vigour index for seed priming treatments on storability of greengram seeds. The seeds primed with mannitol @ 2% (T_3) recorded higher seedling vigour index (1924.50) whereas, the seeds primed with $MnSO_4$ @ 100 ppm (T_4) recorded the lowest seedling vigour index (1485.43) (Table 5). Electrical conductivity showed significant different due to seed priming treatments on seed storage. At the end of 5 months of storage period, seeds primed with mannitol @ 2% (T_3) recorded the lowest electrical conductivity of 1.750 dSm^{-1}, where as the seeds primed with $MnSO_4$ @ 100 ppm (T_4) recorded highest electrical conductivity of seed leachate (2.257 dSm^{-1}) (Table 6). This suggests that repair mechanism is taking place during priming or minimizing disruption of the membrane (Burgars and Powel, 1984). Electrical conductivity increased for each priming agent and unprimed seeds after 5 months of storage, but it was statistically lower for primed seeds as compared to control. Osmoprimed seeds significantly controlled increase in electrical conductivity during storage as compared to unprimed seeds. Khan *et al.* (1977) reported that priming activates antioxidant enzymes which reduces peroxidation of lipid in seed during storage there by results low solute leakage from seed cells due to which increase in electrical conductivity comes under control.

Significant different was recorded for moisture content of seeds for various priming treatments on seed storage. At the end of five months of seed storage, the seeds primed with $ZnSO_4$ @ 100 ppm (T_5) recorded the lowest moisture content (7.42%) where as the unprimed seeds (T_1) recorded the highest moisture of 7.65 per cent. Significant different in seed quality parameters were observed in the entire five months of storage period due to seed priming treatments. Speed of germination, root length, shoot length, seedling dry weight, seedling vigor index were significantly maximum 28.30, 84.38, 18.45 cm, 28.42 cm, 115.50 mg, 3860 respectively at the initial period, but declined gradually to minimum value 17.10, 50.32%, 10.17 cm, 20.05 cm, 57.42 mg and 1486, respectively at the end of 5 months of storage period. The initial electrical conductivity value 0.525 dSm^{-1} increased to 2.257 dSm^{-1}.

The greengram seeds primed with mannitol @ 2% (T_3) recorded highest germination per cent, root length, seedling dry weight and electrical conductivity from initial to end of storage period. The minimal reduction in deterioration of primed seeds in terms of germination and seedling vigor might be attributed to the induction of repair mechanism of seed deterioration (Ellis and Butcher, 1988) due to priming. Mannitol @ 2% proved to be most effective priming agent due to enhancing of reducing and total sugars and total sugar and □-amylase activity is primed seeds. Mannitol reduces peroxidation of unsaturated acids, which controls deterioration during storage (Rahman *et al.,* 2013). The seeds primed with GA_3 @ 100 ppm showed significantly higher speed of germination.

Conclusion:

The results demonstrated that priming in greengram has an ameliorating effect on storage. This enhancement is due to priming stimulated repair and reconfiguration of the membrane, increased activity of scavenging enzymes and improved metabolism of reserves.

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Table 1: Effect of seed priming treatments on seed germination (%) in greengram

Priming treatment (T)	**Storage Period (Months)**					
	Initial	**1**	**2**	**3**	**4**	**5**
T_1	80.42 (62.50)	74.40 (58.32)	68.43 (54.32)	61.38 (50.43)	54.33 (44.35)	50.32 (40.33)
T_2	81.50 (64.55)	77.33 (61.85)	72.33 (56.42)	62.80 (51.42)	57.45 (49.45)	50.25 (44.38)
T_3	84.38 (67.55)	79.85 (63.32)	69.70 (59.38)	63.45 (54.35)	59.30 (51.75)	52.45 (46.85)
T_4	78.80 (61.43)	73.30 (58.35)	68.45 (54.60)	62.40 (50.35)	55.50 (46.70)	50.35 (44.63)
T_5	82.40 (65.45)	77.60 (61.75)	70.35 (58.35)	63.35 (51.70)	60.40 (48.45)	52.47 (44.37)
T_6	83.40 (66.43)	78.70 (61.80)	72.45 (58.75)	68.30 (53.42)	60.75 (50.80)	51.80 (44.70)
SEd	0.96	1.32	0.80	0.63	1.00	0.53
CD at 5%	2.00	2.74	1.67	1.30	2.08	1.10

Table 2: Effect of seed priming treatments on root length in greengram

Priming treatment (T)	**Storage Period (Months)**					
	Initial	**1**	**2**	**3**	**4**	**5**
T_1	15.30	14.52	13.10	12.85	12.05	11.34
T_2	16.20	15.85	13.74	13.10	13.00	11.05
T_3	18.45	17.10	15.45	15.10	14.75	13.10
T_4	14.10	13.80	13.10	12.85	12.05	10.17
T_5	16.50	15.90	14.10	13.74	13.10	12.67
T_6	16.10	16.03	14.72	14.10	13.05	12.95
SEd	0.21	0.20	0.28	0.21	0.31	0.13
CD at 5%	0.45	0.42	0.58	0.44	0.65	0.28

Table 3: Effect of seed priming treatments on shoot length in greengram

Priming treatment (T)	**Storage Period (Months)**					
	Initial	**1**	**2**	**3**	**4**	**5**
T_1	26.05	25.10	23.60	24.73	22.85	21.68
T_2	26.75	25.35	24.74	23.10	23.80	21.68

T_3	28.42	27.55	27.78	25.60	24.92	23.15
T_4	24.50	23.80	22.95	21.40	20.80	20.05
T_5	26.30	24.43	23.33	23.05	22.85	21.95
T_6	26.35	25.70	25.05	24.80	23.10	22.08
SEd	0.59	0.30	0.42	0.56	0.27	0.30
CD at 5%	1.23	0.63	0.87	1.17	0.56	0.63

Table 4: Effect of seed priming treatments on seedling dry weight (mg) in greengram

Priming treatment (T)	**Storage period (months)**					
	Initial	**1**	**2**	**3**	**4**	**5**
T_1	87.74	85.25	83.52	74.45	70.22	66.65
T_2	102.25	98.67	91.42	81.74	77.15	67.74
T_3	115.50	105.26	103.50	98.50	92.42	82.42
T_4	82.48	80.50	63.95	70.10	65.50	57.42
T_5	98.50	99.50	94.15	86.68	79.38	71.64
T_6	105.15	100.50	98.14	93.15	86.34	76.10
SEd	1.52	1.63	7.44	1.23	1.10	0.93
CD at 5%	3.15	3.37	15.41	2.55	2.28	1.93

Table 5: Effect of seed priming treatments on vigour index in greengram

Priming treatment (T)	**Storage period (months)**					
	Initial	**1**	**2**	**3**	**4**	**5**
T_1	3215.35	2885.15	2491.75	2242.80	1895.85	1490.50
T_2	3390.65	3075.90	2645.20	2280.35	2060.25	1622.50
T_3	3860.40	3545.55	3090.15	2660.50	2345.90	1924.50
T_4	3005.60	2760.50	3410.42	2060.42	1785.21	1485.43
T_5	3415.32	3030.15	2620.52	2340.15	2070.42	1655.17
T_6	3570.30	3253.42	2867.17	2535.42	2230.64	1775.82
SEd	80.00	61.89	43.21	49.36	43.18	26.94
CD at 5%	165.61	128.12	89.45	102.18	89.40	55.76

Table 6: Effect of seed priming treatments on electrical conductivity (dSm^{-1}) in greengram

Priming treatment (T)	**Storage period (months)**					
	Initial	**1**	**2**	**3**	**4**	**5**
T_1	0.815	0.953	1.103	1.445	1.625	2.078
T_2	0.767	0.855	1.005	1.222	1.505	1.203
T_3	0.525	0.625	0.810	1.015	1.275	1.750
T_4	0.940	1.022	1.199	1.425	1.722	2.257
T_5	0.667	0.782	0.935	1.157	1.440	1.857
T_6	0.562	0.862	0.825	1.053	1.330	1.777
SEd	0.009	0.008	0.010	0.019	0.021	0.068
CD at 5%	0.019	0.018	0.021	0.039	0.045	0.142