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RESEARCH ARTICLE

Studies on seed quality characters in green gram cv. KM2

■ **A. Kamaraj and S. Padmavathi**

SUMMARY

Green gram is one of the major pulse crops, mainly cultivated as a rainfed crop under rice fallow condition. The low productivity under rainfed condition is due to soil moisture deficit, uneven rainfall, low soil fertility and poor crop management. To overcome this problem, seed hardening techniques is recommended to alleviate the moisture stress condition. The present study was emphasized on the effect of seed hardening using various leaf extract like *Prosopis, Pungam, Nochi, Neem,Umathai, Aduthoda, Nerium,* papaya, bittergourd etc. on seed and seedling characteristics like germination per cent, speed of germination, accumulated speed of germination, mean daily germination, root length, shoot length, seedling length, dry matter production, seedling vigour-I and seedling vigour-II of green gram KM2. The results revealed that green gram seeds hardened with 1 per cent *Prosopis* leaf extract for 3 hours @ 1/3 rd volume of solution enhanced the seed and seedling quality characteristics. under adverse environment conditions.

Key Words : Greengram, Leaf extract, Seed hardening, Seed quality, Prosopis, Pungam

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Green gram is the third important pulse crop cultivated throughout India, mainly as a rainfed crop under rice fallow condition as well as an irrigated crop. In India, green gram was cultivated over an area of 3 million hectare with annual grain production of one million tonnes. The six major green gram producing states are Maharashtra, Rajasthan, Bihar, Andhra Pradesh, Karnataka and Tamil Nadu. In Southern India, green gram was consumed as whole grain or broken cotyledon. Green gram is an important dietary protein food to humans. In addition to protein (23.86g), green gram supplies fibre (16.3g), fat (1.15g), vitamins like A, C, B, niacin, minerals like calcium, magnesium, potassium, phosphorus, sodium, sugars (6.6g) and carbohydrates (62.62g) per 100g of grain.

Green gram is grown on a variety of soil ranging from sandy loam to heavy black cotton soils. Green gram crop cannot withstand water logging during major growth stages. A well-drained soil with pH ranging from 5.0 to 7.5 is ideal for its seed production and cultivation. Problematic soils like saline, alkali and acidic are not suitable for seed production. The yield potential of green

MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
A. Kamaraj, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, **Chidambaram (T.N.) India**
Email : a.kamaraj@yahoo.co.in

Address of the Co-authors:
S. Padmavathi, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, **Chidambaram (T.N.) India**

gram in research plot is 10-12 quintals per hectare as against 8-9 quintals per hectare in farmer's field. The National average yield is still low at 4-5 quintals per hectare. This yield gap needs to be addressed by improving seed production packages and supply of good quality seeds to the farmers.

In India about 70 per cent of cultivated land is under rainfed condition. The low productivity under rainfed condition is due to soil moisture deficit, uneven rainfall, low soil fertility and poor crop management. One of the ways to improve the production or covering the yield gap to some extend is by adopting new or advanced seed invigoration techniques that may help to overcome the adverse soil environment during initial crop growth and development. Moisture stress is one of the abiotic stresses which affect the productivity by intensive flower dropping, poor pod formation, poor pod filling and low dry matter accumulation (Singh *et al*., 1991). The reason for low productivity of green gram may be due to inadequate pre-sowing seed treatment techniques to cope with moisture stress problem. To overcome this problem, the seed hardening techniques was recommended to alleviate the moisture stress condition. Seed hardening has been reported to induce drought resistance in plants and such seeds have the capacity to withstand dehydration and overheating. Other beneficial effects of hardening are inducing better root growth, higher rate of photosynthesis and dry matter accumulation (Henckel, 1964). Pre- sowing seed hardening is the method that results in modifying the physiological and biochemical processes of seed to mitigate the adverse environment and resulted in the absorption of more water due to increase in the elasticity of cell wall and development of a stronger and efficient root system (Krishnasamy and Srimathi, 2001). In the present study, leaf extract of some botanicals obtained from various herbal and multi – purpose plants available around us are used for seed hardening to investigate their effect on seed and seedling characteristics of green gram KM2.

MATERIAL AND METHODS

Genetically and physically pure seeds of greengram cv. KM2 obtained from the Tamil Nadu Rice Research Institute, Aduthurai, Tamil Nadu served as a basic material for the study. Laboratory analysis was conducted in the seed testing laboratory, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Tamil Nadu. The bulk seeds were manually cleaned to remove unwanted material from the lot and was graded using BSS 8 x 8 sieve for uniformity.

Pre-conditioning:

After cleaning and grading, seeds were preconditioned by keeping the seeds in between the layers of moistened gunny bags to avoid soaking injury for one hour. After preconditioning, the conditioned seeds were soaked in the respective leaf extract solution at 1/ 3rd volume of seeds for three hours. Then the seeds were air dried under the shade to bring back to their original moisture content and used for sowing.

Preparation of plant leaf extract:

The fresh leaves of the concerned plants were collected separately and dried under shade. The shade dried leaves were powdered using mortar and pestle. Then exactly weigh one gram of leaf powder using weighing balance and dissolved in 100 ml of distilled water which was measured already in the beaker to make 1 per cent leaf extract. The leaf extract was filtered by using muslin cloth to remove unwanted material and leaf debris. The following were the details of the treatment such as T_0– Control (untreated seed): T_1-1% Perungondraii (*Delonix elata*): T_2-1% Bitter gourd (*Momordica charantia*): T_3- 1% Papaya (*Carica papaya*) : T_4 - 1% Prosopis (*Prosopis juliflora*) : T_5 - 1% Pungam (*Pongamia pinnata*) : T_6 -1% *Neem* (*Azadirachta indica*): T_7-1% Nerium (*Nerium oleander*): T_8 -1%, Aduthoda ilai (*Aduthoda vasica*): T_9-1% Nochi (*Vitex nigundo*) : T_{10}-1% Kuppameni (*Acalypha indica*) : T_{11} -1% Umathai (*Datura metel*) and T_{12} -1% Keelanelli (*Phyllanthus niruri*).

Germination test was conducted in a Completely Randomised Block Design with three replications. From each treatment, randomly selected 50 seeds per replication were put for germination in a sterilized sand media. Daily count on the number of germinated seeds was recorded separately for each treatment and replications till the final count (8th day). The trays were incubated at normal light at room temperature. The above treated seeds along with control were observed for the following seed quality parameters such as speed of germination (Maguire, 1962), germination per cent (ISTA Rules, 2013), accumulated speed of germination (Wardle *et al.*,1991), mean daily germination (Scott *et al.,* 1984), germination value (Djavanshir and Pourbeik, 1976), mean time to hermination [(day^{-1}), Ellis and Roberts, 1981],

Emergence index (Scott *et al*., 1984), root length (cm), shoot length (cm), dry matter production (mg/10 seedlings), vigour index I (Abdul-Baki and Anderson, 1973) and vigour index II (Abdul-Baki and Anderson, 1973). The datawere statistically analysed using ANOVA by adopting the procedure described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Presowing seed hardening techniques had a significantly positive effect on different aspects of seed and seedling quality characteristics under laboratory and field condition. In the present study, germination per cent ranged from 94 per cent to 80 per cent which were significantly different over the various seed hardening treatment. The highest germination was observed in T_4 (94%) followed by T_5 (93%) whereas the lowest per cent was recorded by T_0 (untreated seeds) (Table 1). Seed hardening techniques had increased the germination per cent of hardened seed over non-hardened seeds. The increment in germination per cent of T_4 may be due to the modification of physiological and biochemical nature of seed embryo and its associated structures, *i.e.* pre-enlargement of the embryo (Austin *et al*.,1969) and also due to the biochemical changes like enzyme activation and gibberellins like substances (Lee and Kim, 2000 and Basra *et al*., 2005) were released during the II phase of germination which triggers the synthesis of hydrolytic enzymes that causes the early availability of high energy compounds and vital biomolecules to the germinating seedling (Renugadevi and Vijayageetha, 2006).

The maximum speed of germination was recorded in T_4 (16.02) followed by T_5 (15.94) while the minimum speed of germination was recorded in control T_0 (12.46). The greater accumulated speed of germination was recorded in T_4 (56.99) followed by T_5 (56.71) while the poor accumulated speed of germination was recorded in control T_0 (46.11). The beneficial influence on higher emergence index (2.94) and germination value (1883.13) in T_4 which indicates their earliness in germination which could be due to cell wall elasticity that paved the way for easy radicle emergence out of seed coat and the mobilization of food reserves to the growing seedlings and may be due to the presence of growth promoting substance present in 1 per cent Prosopis leaf extract migrates into the seed, might have brought this positive effect on seed germination and other germination indices. This increase in germination value may be due to the cumulative increase in germination and speed of germination by T_4 over T_0.

The mean daily germination was significantly more in T_4 (11.75) followed by T_5 (11.63) and the lowest mean daily germination was observed in control (9.75) which

Table 1 : Effect of pre-sowing seed hardening treatment using leaf extract on speed of germination,germination (%), accumulated speed of germination, mean daily germination, emergence index and germination value in green gram cv KM2

Treatments	Speed of germination	Germination (%)	Accumulated speed of germination	Mean Daily Germination (day^{-1})	Emergence index	Germination value
T_0	12.46	80.00 (63.43)	46.11	9.75	2.66	1246.56
T_1	13.90	83.50 (66.04)	49.41	10.31	2.68	1450.94
T_2	14.01	84.50 (66.87)	49.79	10.56	2.72	1480.72
T_3	12.93	82.00 (64.92)	47.98	10.25	2.67	1325.35
T_4	16.02	94.00 (76.02)	56.99	11.75	2.94	1883.13
T_5	15.94	93.00 (74.70)	56.71	11.63	2.89	1852.63
T_6	14.38	87.00 (68.90)	51.12	10.88	2.79	1573.75
T_7	14.19	85.50 (67.65)	50.39	10.69	2.84	1525.75
T_8	14.23	87.00 (68.88)	50.58	10.88	2.77	1529.75
T_9	15.34	90.00 (71.65)	54.47	11.25	2.88	1726.03
T_{10}	14.47	87.50 (69.31)	51.37	10.94	2.83	1582.96
T_{11}	14.75	89.00 (70.69)	52.45	11.13	2.86	1641.88
T_{12}	13.11	83.00 (65.66)	48.21	10.38	2.72	1359.80
Mean	14.29	86.62 (68.82)	51.20	10.80	2.79	1552.25
S.E.±	0.1506	0.8945 (0.8255)	0.5290	0.1176	0.0353	32.2119
C.D. (P=0.05)	0.2983	1.7712 (1.6344)	1.0474	0.2329	0.0698	63.7797

indicates the poor daily germination. The highest value of mean daily germination in T_4 may due to the hardening process which causes earlier emergence of radicle and availability of various nutrients when compared to control. Early and quicker germination/ emergence of seedlings indicated by other germination indices may be due to the greater hydration of colloids and higher viscosity of protoplasm and cell membrane that allows the early entrance of moisture that activates the early hydrolysis of reserve food materials in the seed when compared to untreated seeds. Prosopis leaf extract contains plant mineral nutrient like nitrogen (5.6%), phosphorus (P_2O_5-0.9%), potassium (K_2O – 3.11%) and calcium (CaO – 1.0%) (Nadeem, 1992). The higher germination might be due to the role of calcium as an enzyme cofactor in germination process by increasing protein synthesis as reported by Christansen and Foy (1979).

The presence of saponin, tannins, flavonoids glycosides and phenolic compounds in prosopis and pungam leaf extracts (Satish *et al*., 2007) and anti-oxidant activity/ free radical quenching property of prosopis leaf extract (Napar *et al*., 2012), would have counteracts the free radicals and reduce the damage effect by autoxidation, utilize the available nutrients thereby improves the germination. The increases in germination rate by T_4 and T_5 have been interpreted as the repair of accumulated damage that occurs during hydration cycle of seed hardening process (Burgass and Powell, 1984). The seedlings from untreated seeds failed to mobilize the reserves from the seeds during germination in the initial period may be the reason for poor germination but the hardened seeds made up the loss by using the improved synthesis of secondary metabolites and synthesizing the biomass through other physiological processes.

The maximum shoot length (21.47cm) and maximum seedling length (38.05 cm) was recorded in treatment T_4 followed by T_5 (21.22 cm and 37.07 cm, respectively). The small seedling (31.04 cm) with short shoot (17.49 cm) was observed in T_0 (Table 2). The stimulatory effect on germination and the growth of seedlings of hardened seed (T_4) could be due to the fertilizing effect resulting from the nutrient release from damaged or decayed tissue of storage organ by hydrolysis (Orr *et al*., 2005). The increased seedling growth and dry weight observed in T_4 treatment might be due to greater early vigour and higher percentage of germination because of which the seedling had reached autotrophic stage well in advance than control. The increase in dry weight was claimed to be due to enhanced lipid utilization and enzyme activity due to the presence of bioactive substances like auxin in prosopis leaf extract (Rathinavel and Dharmalingam, 1999) and development of seedling to reach autotrophic stage and enabling them to produce relatively more

Table 2: Effect of pre-sowing seed hardening treatment using leaf extract on mean time germination, root length (cm), shoot length (cm), dry matter production (g / 10 seedlings), vigour index I and vigour index II ingreen gram cv KM2

Treatments	Mean time germination (day^{-1})	Root length (cm)	Shoot length (cm)	Dry matter production (g / 10 seedlings)	Vigour index I	Vigour index II
T_0	3.32	13.55	17.49	0.1896	2482.97	15.17
T_1	3.22	14.27	18.08	0.2061	2700.85	17.18
T_2	3.20	15.05	18.59	0.2165	2841.46	18.32
T_3	3.26	13.86	17.81	0.1938	2597.44	15.89
T_4	3.14	16.58	21.47	0.2666	3576.54	25.19
T_5	3.15	15.85	21.22	0.2590	3447.23	24.16
T_6	3.24	14.98	18.44	0.2319	2907.48	20.13
T_7	3.25	15.17	19.23	0.2278	2941.46	19.56
T_8	3.22	15.65	19.47	0.2372	3054.81	20.70
T_9	3.17	16.27	19.98	0.2550	3261.38	22.82
T_{10}	3.23	15.57	19.31	0.2332	2975.22	20.50
T_{11}	3.21	15.64	19.50	0.2486	3110.49	22.18
T_{12}	3.28	14.07	18.50	0.1987	2702.85	16.54
Mean	3.2146	15.12	19.16	0.2280	2969.24	19.87
S.E.±	0.0169	0.1314	0.1394	0.0018	31.8132	0.2541
C.D. (P=0.05)	0.0335	0.2603	0.2759	0.0035	62.9901	0.5031

quantity of dry matter which discerning the cause for the hike in vigour index by hardening treatment.

The maximum seedling vigour I was recorded in T_4 (3576.54) followed by T_5 (3447.23) and T_9 (3261.38) while the minimum seedling vigour I was recorded in control T_0 (2482.97). The highest seedling vigour II (25.19) and more biomass production (0.2666g/10 seedlings) were recorded in T_4 followed by T_5 whereas low value was recorded in T_0. This may be due to the beneficial effect of prosopis leaf extract seed hardening which activates the growth promoting substances and translocations of secondary metabolites to the growing seedling. Physiologically active substances might have activated the embryo and other associated structures which resulted in the absorption of more water due to cell wall elasticity and development of stronger and efficient root system and that would have ultimately resulted in higher vigour index (Rangaswamy *et al*., 1993). Many researchers also reported the benefits of seed hardening with prosopis and pungam leaf extract to overcome the adverse condition [Marwat and Khan (2006) in wheat and Renugadevi *et al*. (2008) in cluster bean].

Thus, from the present study, it could be concluded that green gram seeds should be hardened with 1 per cent prosopis leaf extract for 3 hours @ 1/3 rd volume of solution to enhance the seed and seedling quality characteristics under adverse environment conditions. In addition, green gram seeds may also be hardened with 1 per cent pungam leaf extract to get the similar results.

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