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Full Length Research Article

Influence of pre-sowing seed hardening treatment using botanical leaf extract on growth and yield parameters in Green gram

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Field experiment was conducted to study the effect of seed hardening using botanical leaf extract on growth and yield parameters of green gram. The seeds of green gram were given hardening treatments viz., hardening with 1 per cent various leaf extract and sown along with dry seeds (control) in a field experiment under Rice fallow condition. The results revealed that Prosopis leaf extract hardened seeds recorded higher plant height, number of branches, number of leaves, number of clusters, minimum days to 50% flowerings, number of pods per plant , seed number pod^{-1}, seed weight and seed yield compared to control. The seed yield ha^{-1} in the best treatment was 738 kg ha^{-1}, which was 19.8 per cent increase over the control.

Key words: Green gram; Leaf extract; Pre-sowing seed treatment::Prosopis; Seed hardening; Seed yield.

INTRODUCTION

Greengram (Vigna radiata L) is the one of the major pulse crop, grown all over India. Green gram is cultivated in India, Burma, Srilanka, China, Fiji and Africa. In India, the important states growing green gram are Maharashtra, Andhra Pradesh, Bihar, Karnataka, Rajasthan and Tamilnadu. It is a short duration legume crop belongs to the family Leguminosae, extensively grown in all types of soil ranging from sandy loam to heavy black cotton soil under varying climatic condition. Green gram seeds served as main resource in many food material prepared in South India. The sprouted seeds are rich in vitamins like Ascorbic acid, Niacin, Riboflavin and Thiamine and also rich in minerals like Ca, Fe and K. Green gram are rich in protein content (24%) and has higher digestability(79%) and biological value. Green gram does not cause flatulence that many legumes may cause. The net availability of total pulse is estimated to be 31.6 g/ day during 2010 was less when compared against 37.0 g/ day during 2009(Directorate of Economics and Statistics, Department of Agriculture and Co- operation). Green gram is mainly cultivated as rice fallow pulse, rain fed as well as irrigated crop. It cannot withstand water logging. In India about 70% of cultivated land is under rain fed condition. A well-drained soil with a pH ranging from 5.0 to 7.5 is ideal for seed production. This crop can also cultivate as green manure crop. The major constrain in green gram crop is its low productivity. It may be due to the fact that the crop is mainly cultivated in dry land areas and as well as a rice fallow pulse. The reason behind poor productivity under rice fallow pulse may be due to the soil moisture deficit, poor soil management and poor crop production practices. The yield potential of green gram in research plot is 1000 – 1200 kg per hectare whereas 800 – 900 kg per hectare in farmer's field. The national average yield may be still around 400 – 500 kg per hectare. This yield gap needs to be addressed by adopting improved and advanced seed production packages and supply of good quality seeds. The supply of certified/ quality seed is 1.76 lakh quintals during the year 2010 – 2011.

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One of the improved seed production packages to increase the production or covering this yield gap is adopting the proper pre sowing seed management practices. Various pre sowing seed treatments are available to increase the productivity of the crop. But, such methods are not practicable to the farmers due to the non – availability of chemicals and its high cost. To overcome the moisture problem prevailing in dry land agriculture, Henkel (1964) recommended the seed hardening techniques to alleviate the moisture stress condition. Hardening of seeds 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). Seed hardening has been reported to induce drought resistance capacity in plants and such seeds have the capacity to withstand moisture stress. Seed hardening induce the absorption of more water due to the development of stronger and efficient root system and increased dry matter production (Henckel, 1964). Seed hardening can be done by using organic and inorganic products. In our present study, to protect soil from pollution and to increase the microbial activity, plant based materials are used from various herbal and multi-purpose plants available around us for seed hardening. The present investigation will emphasizes on the influence of seed hardening using botanical leaf extract on seed establishment, growth performance and yield parameters of green gram.

MATERIALS AND METHODS

The present study was carried using genetically pure seeds of green gram obtained from the Tamilnadu Pulse Research Station, Vamban, Tamilnadu. The bulk seeds were manually cleaned to remove unwanted material from the lot and was graded using BSS 8 x 8 sieve for uniformity. Experiment was conducted at the University farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Tamilnadu. 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% leaf extract. The leaf extract was filtered by using muslin cloth to remove unwanted material and leaf debris.

Treatment details

T_0 - Control
T_1 - 1% Perungondraii (*Delonix elata*)
T_2 - 1% Bittergourd (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 (*Adutoda vasica*)
T_9 -1% Nochi (*Vitex nigundo*)
T_{10} -1% Kuppameni (*Acalypha indica*)
T_{11} -1% Umathai (*Datura metel*)
T_{12} -1% Keelanelli (Phyllanthus *niruri*)

Experiment was conducted to study the effect of presowing seed hardening using various leaf extract on seed yield and growth parameters in green gram. Observations on seed yield and growth parameters viz., plant height, number of branches, number of leaves, days to 50% flowering, number of clusters, number of pods per plant, pod length, number of seeds per pod, 100 seed weight, seed yield per plant and seed yield per hectare were recorded. The data were statistically analysed using ANOVA.

RESULT AND DISCUSSION

In the present study, seeds of green gram was hardened with leaf extract of various herbal and multi-purpose trees. Hardened seeds were used for sowing. Presowing seed hardening had a significantly positive influence on the seed yield and yield parameters of green gram crop. Pre sowing seed hardening is one of the seed management practices recommended for dry land agriculture to resist the seed against the adverse agro ecological condition prevailing in that area. Among the treatments, seed hardened with 1% prosopis leaf extract recorded a higher plant height (45.73 cm) which was 23.6 % increase over control. Increase in plant height might be due to the translocation of GA_3 to the aerial part of plants, and this perhaps occurs to an extent that is enough to increase hypocotyl size and the consequent increase in first node height hence sufficient to positively affect plant height. This increase in plant height was also due to the early availability of high energy compounds and vital bio molecules to the growing seedlings (Renugadevi and Vijayageetha, 2006). Increase in plant height may also due to the fertilizing effect of prosopis leaf effect on growing seedling as 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 Binzia, 1992) which favours plant growth and development when compared to other treatment and untreated seeds. The enhanced plant height may also be due to the improved and faster plant emergence in 1% prosopis leaf extract treated seeds which created cooperative competition among the plants for light and resulted in taller plants. The mean number of branches (2.60) and mean number of leaves (34.33) which were 44 % and 51.4 % increase over untreated seeds by seed hardening with 1% prosopis leaf extract. Increase in vegetative growth may be due to the presence of growth promoting substances like GA3 which causes increase in enzyme activity that leads to more availability of food reserves for plant growth and development in prosopis leaf extract hardened seeds (Rathinavel and Dharmalingam, 1999). The days to 50% flowering (37.33 days after sowing) were earlier in prosopis leaf extract hardened seeds. This could be because of their effect in the fast emergence of the seeds at the beginning as the correlation between the days to 50 % emergence and days to 50% flowering was significantly higher and positive. The initiation of flowering may also earlier in T4 treatment which influences earliness in days to 50% flowering. The reason may be due to the early seed germination by utilizing the available soil moisture and the stimulatory effect of hardened seeds on seed germination and on the growth of the seedling was by the fertilizing effect resulting from the nutrients released from the damaged or decayed tissues of prosopis hardened seeds (Orr *et al*., 2005). There are also other explanations for the stimulatory effect of prosopis hardened seeds on early flowering and development that it may be stimulatory effect of growth hormones like gibberellins that may stimulates early germinations by stimulating the synthesis of hydrolysing enzymes which degrades the food reserves for growing seedling which in turn leads to early emergence(Brady and McCourt, 2003) or a release of toxic substances that cause the breakdown of the seed coat which favours the early emergence (Cohn, 1996) in prosopis leaf extract hardened seeds. The water uptake by the hardened seeds is followed with denovo synthesis of hydrolytic enzymes (Bewley and Black, 1985). This facilitates a shift in metabolic activities by speeding up the solubilisation of stored food material. The growth regulator like gibberellins stimulates the translocation of photo-assimilates or effective partitioning of the accumulates from source to sink thereby helping in effective flower formation, fruit and seed development and ultimately enhance the seed productivity in the field crops (Solaimalai *et al*., 2001).

The mean number of clusters per plant (8.13), mean number of pods per plant (19.93), mean pod's length(6.53 cm), mean number of seeds per pod(10.02), 100 seed weight(2.89), mean seed yield per plant (5.65g) and mean seed yield per hectare (738.03 kg/ha) of prosopis leaf extract hardened seeds which were 32.6%, 53.66%, 25.4 %, 26.4%, 11.2%, 111 %, and 19.8% respectively higher than the untreated seeds. Such a positive effect on the yield parameters may be due to the bioactive chemiclas / allelopathic chemicals present in the prosopis leaf extract could have triggered the synthesis of gibberellins which increased the crop growth and development. Prosopis leaf extract hardening improved the yield attributes by triggered the biosynthesis of nucleic acid, proteins, hydrolytic enzymes and consequentially enhanced the cell division, cell enlargement, metabolic activity and increased the photosynthetic process of the plant resulting in increased uptake of more nutrients by efficient and stronger roots due to hardening which are associated with improved crop growth (Sabir ahamed,1999).T_4 hardened seeds have increased the nutrient status of the plant, helped in translocation of assimilates resulting in increased seed weight and single plant yield. Susheela (1996) reported increased number of seeds might may be due to increase pollen production which would have resulted in increased number of filled seeds and the seed yields. Increased seed yield per hectare may be due to the improved crop growth during early growth stages by utilizing the available soil moisture and prosopis was found to promote the growth of microbial group with specific physiological capabilities like degradation of cellulose, lipid, lignin and protein even at very low soil moisture which have beneficial

Table 1. Effect of Botanical leaf extract on plant morphological characters of Green gram

S. No.	Treatment	Plant Height(cm)	Number of Branches per plant	Number of Leaves per plant	Days to 50% flowering	Number of clusters per plant	Number of pods per plant
1	T_0	37.00	1.80	22.67	40.67	6.13	12.97
2	T_1	38.33	2.00	27.00	39.33	6.46	13.70
3	T_2	39.13	1.96	25.33	38.67	6.80	14.30
4	T_3	37.90	1.90	24.67	40.67	6.33	13.30
5	T_4	45.73	2.60	34.33	37.33	8.13	19.93
6	T_5	44.70	2.53	33.33	37.67	7.83	18.80
7	T_6	39.83	2.20	30.00	38.33	6.60	16.47
8	T_7	42.43	2.13	28.33	37.67	6.83	16.80
9	T_8	40.60	2.36	29.33	36.67	6.86	17.23
10	T_9	43.83	2.36	32.67	36.00	7.33	18.20
11	T_{10}	40.16	2.20	30.33	38.67	6.60	16.80
12	T_{11}	44.26	2.33	31.67	38.00	7.16	17.63
13	T_{12}	37.60	2.00	25.33	38.67	6.50	13.77
14	Mean	40.88	2.18	28.84	38.33	6.89	16.14
15	CD(P=0.05)	1.3034	0.2090	2.4750	0.9335	0.8439	0.7840
16	SED	0.6485	0.1040	1.2314	0.4644	0.4199	0.3900

Table 2.. Effect of Botanical leaf extract on yield parameters of Green gram

S. No.	Treatment	Pod length (cm)	Number of seeds per pod	100 seed weight (g)	Seed yield per plant(g)	Seed yield per plot(kg)	Seed yield per hectare(kg)
1	T_0	5.20	7.93	2.60	2.67	1.23	616.33
2	T_1	5.47	9.47	2.69	3.48	1.27	636.22
3	T_2	5.55	9.27	2.70	3.58	1.29	643.10
4	T_3	5.30	8.33	2.61	2.89	1.25	623.17
5	T_4	6.52	10.02	2.89	5.65	1.48	738.03
6	T_5	6.35	9.97	2.79	5.22	1.46	727.73
7	T_6	5.52	9.53	2.68	4.21	1.36	680.30
8	T_7	5.76	10.06	2.65	4.48	1.39	695.77
9	T_8	5.64	9.43	2.66	4.32	1.37	686.83
10	T_9	6.10	10.30	2.77	5.18	1.44	717.62
11	T_{10}	5.63	9.70	2.70	4.40	1.41	704.23
12	T_{11}	5.91	10.20	2.73	4.90	1.42	711.13
13	T_{12}	5.42	9.23	2.65	3.36	1.26	629.02
14	Mean	5.72	9.51	2.70	4.18	1.36	677.64
15	CD(P=0.05)	0.1774	1.0908	0.0482	0.1847	0.0216	5.0334
16	SED	0.0883	0.5427	0.0240	0.0919	0.0105	2.5042

effect on early seedling establishment (Sundarmoorthy *et al*., 2010) and make use of available nutrients as prosopis is also a nitrogen fixing(Orr *et al*., 2005). Evidently, because of enhancement in all the basic photosynthetic attributes, these hardened plants could more efficiently harvest the available light energy and subsequently fix it into valuable photo assimilates. This also strengthened the sink potential of the developing pods and through enhancement of the duration rate of assimilate translocation to these reproductive structures (Davies, 1995), caused the observed increases in seed yield and pod number per plant at harvest. It can be observed that action of hormones triggered by T4 treatment could have sustained itself till the plants were well into the vegetative stage. And it is during this critical growth phase that the basic infrastructure of the plant functioning is laid down, the effective dividends of which are reaped when the crop reaches harvest (Shah *et al*., 2006). Pre- sowing hardening might have triggered enhanced protein synthesis, which in turn could have contributed to the amino acid rescue and protein turnover during active metabolism, later in plant life. Increase in yield parameters in case of leaf extract hardened seed may be due to the presence of auxin like substances in leaf extract which regulates the growth and initial establishment (Krishnasamy, 2005) and also due to hardening effect of seed over unhardened seeds (Control). Seed yield in prosopis leaf extract hardened seeds may be due to the increase in the activity of dehydrogenase enzymes, amylase and peroxidase enzymes by the presence of growth regulators like GA_3. This also leads to the development of unaborted reproductive structures that could have resulted due to the higher photo-assimilatory areas (more number of leaves) and higher photosynthetic activity in prosopis leaf extract hardened seeds. The unaborted reproductive structures in turn exerted a profound influence on seed filling resulting high percent of filled seeds. The hike in the performance of T_4 may due to the carryover effect of hardening treatment of the seeds in the early phase of crop growth (seedling establishment with efficient root system and recover from wilting quickly compared to untreated seeds) and the quality like antioxidant potential (Manisathiya and Muthuchelian, 2010) and antibacterial, antifungal and antioxidant effect (Napar *et al*., 2012) of prosopis leaf extract which leads to increased productivity than untreated seeds. Hence it is recommended that for the production of quality seeds and improved productivity of green gram, seeds could be hardened with 1% prosopis leaf extract under rice fallow condition.

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