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Influence of seed hardening cum foliar spray treatments on biometric, physiological and yield parameters in black gram under dry land condition

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ABSRACT

The present study was attempted to find out the influence of various seed hardening cum foliar spray treatments on growth and yield parameters in black gram under dry land condition. The seeds of black gram cv VBN 3 were imposed with hardening treatment with prosopis leaf extract @ 1%, and then they were again given with foliar spray treatments. The above treated seeds along with control were evaluated for their growth, physiological and yield parameters under field condition. The study revealed that, 1%, *Prosopis* leaf extract hardened seeds along with foliar spray of salicylic acid @ 100 ppm recorded the higher seed yield and other parameters when compared to other treatments and control.

Key words: Black gram, *Prosopis,* Seed hardening, Salicylic acid.

INTRODUCTION

Pulses are the most important legume crops in India because of their high quality protein. Apart from being the cheaper and rich source of protein and essential amino acids, they share a major portion of the vegetarian diet besides enriching the soil fertility and health. Among the pulses, the urdbean or blackgram (*Vigna mungo* L. Hepper), used as seed and vegetable, is grown both as pure and mixed crop along with maize, cotton, sorghum and other millets. In India, it is cultivated both in *kharif* and *rabi* seasons in an area of 31.00 lakh hactares with a production of 14.00 lakh tonnes and productivity of 451.61 kg ha^{-1}. In Tamil Nadu, area under blackgram cultivation is 3.41 lakh hactares, production is 1.21 lakh tonnes and productivity is 354.84 kg ha^{-1} (FAO, 2011).

The low productivity in pulses is due to the reason that pulses are grown mostly in marginal and rainfed areas and the main constraint in raising the productivity of pulses in drylands are the inadequate soil moisture and poor fertility status of the soil. To overcome the adverse environmental conditions, seed hardening is given as a pre sowing treatment in dry land agriculture.

Seed hardening imparts drought tolerance, increases seed germination followed by better and quicker seedling emergence. Seed priming/hardening is a common practice followed to enhance seed performance with respect to rate and uniformity of germination (De Lespinay *et al.*, 2010). Hence, a study was undertaken in black gram cv VBN 4 with the objective to evaluate the influence of seed hardening cum foliar spray treatments on growth and yield under dry land condition.

METHODS AND MATERIALS

The present investigations were carried out at the Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University Annamalai Nagar (T.N.) to study the influence of various seed hardening cum foliar spray treatments on growth and yield parameters in black gram under drought condition.

Freshly harvested bulk seeds of black gram cv VBN 3 were utilized in this study. The seeds were first, pre-conditioned by keeping the seeds in between two layers of moist gunny bag for one hour. Then pre-conditioned seeds were soaked for one hour in water at 1/3 volume of seeds and quickly air dried in shade to their original moisture content. Pre-conditioned seeds were soaked for one hour in Prosopis (*Prosopis jouliflora*) leaf extract (1%) at 1/3 volume of seeds and quickly dried in shade to their original moisture content. Then the seeds were given with the following foliar spray (FS) treatments during 2012 by adopting randomised block design (RBD) with three replications under dry land condition. The plot size was 4×2.5 M^2. The crop was raised with the spacing of 30 × 15 cm. Apart from the regular recommended package of practices for black gram, the following foliar spray treatments were given during flower initiation period. The crop was irrigated once in 12 days

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instead of once in 8 days. Proper irrigation was done at critical stages of flowering and pod formation and observations growth, physiological and yield parameters were recorded.

T_0 - Control

T_1 - Seed hardening with prosopis leaf extract @ 1 % Succinic acid @ 20ppm (FS).

T_2 - Seed hardening with prosopis leaf extract @ 1 % + Ascorbic acid @ 20ppm (FS).

T_3 - Seed hardening with prosopis leaf extract @ 1 % + IBA @ 200ppm (FS).

T_4 - Seed hardening with prosopis leaf extract @ 1 % + Salicylic acid @ 100ppm(FS).

T_5 - Seed hardening with prosopis leaf extract @ 1 % + Urea @ 2% (FS).

T_6 - Seed hardening with prosopis leaf extract @ 1 % + NAA @ 150ppm (FS).

T_7 - Seed hardening with prosopis leaf extract @ 1 % + Prosopis leaf extract @ 3% (FS).

Height of plant was measured from ground level to the tip of the main branch using a meter scale and the mean value was expressed in centimeter. Total number of branches plant^{-1} was counted and the mean number was recorded as whole number. The roots of 10 uprooted plants were washed carefully to free the adhering soil particles under a stream of tap water and the total number of nodules present in both the tap root and in lateral roots were counted and expressed as whole number (Sundaram, 1998). The Biomass production was recorded from ten seedlings selected at random which were uprooted with the intact root system and were washed to remove the soil particles, dried under shade for 24h and then in the hot air oven maintained at 100^{o}C for 24h. The dried plants were cooled in a desiccator for 30 minutes and the mean weight was recorded in grams. Number of days taken from sowing to 50 per cent flowering was recorded and the mean value is expressed as days to 50% flowering in whole number.

The total chlorophyll were calculated using the formula as suggested by Yoshida *et al.* (1971) and expressed as mg/g. Leaf photosynthetic rate, transpiration rate, stomatal conductance and intercellular CO_2 concentration were measured from two, uppermost fully expanded leaves on intact plants in the field using LICOR-6400×T portable photosynthetic system (Lioncoln, USA) between 10.00-11.00.A.M on the five replicates for each treatment.

At maturity, the pods obtained in each of the plants were measured for their length using scale. Excluding the stalk, the length was measured from the base to the tip of the pod and the mean pod length was expressed in centimetres. The number of pods plant^{-1} was counted and the mean number of pods plant^{-1} was arrived at and expressed as whole number. The pods used for recording pod length were split longitudinally and the number of seeds in each pod was counted. Mean number of seeds pod^{-1} was calculated and reported as whole number. The pods from ten tagged plants in each treatment were hand shelled. The seeds were cleaned and weighed in an electronic balance and the mean seed yield plant^{-1} was expressed in grams. The mean seed yield was expressed in kg ha^{-1}. Eight replicates of 100 seeds were drawn from each treatment randomly, weighed in an electronic balance and the mean weight was expressed as 100 seed weight in grams (ISTA, 1999). All the data were analysed statistically with appropriate tools and expressed as mean values.

RESULTS AND DISCUSSION

Biometric parameters: The experimental results revealed that the prosopis seeds hardened with foliar treatment of salicylic acid @ 100 ppm recorded higher values for the biometrical traits *viz.*, plant height, number of branches plant $^{-1}$, and number of nodules plant $^{-1}$ which were 12.4, 28.5, 43.2, percentages higher than the control with respect to the above mentioned characters (Table 1). The prosopis hardening supplies the bio active materials such as GA like substances

TABLE 1: Influence of seed hardening cum foliar spray treatments on growth characters in black gram cv. VBN 3 under dry land condition.

Treatment(T)	Plant height (cm)	Number of branches plant^{-1}	Number of nodules plant^{-1}	Biomass production plant^{-1} (g)	Days to 50% flowering
T_0	24.83	3.50	8.10	11.87	34.86
T_1	26.63	4.40	10.69	14.77	34.25
T_2	25.60	3.80	9.40	14.44	31.36
T_3	25.30	3.70	9.00	13.84	30.20
T_4	27.93	4.50	11.60	14.94	29.80
T_5	25.23	3.50	8.20	12.52	34.51
T_6	24.93	3.50	8.30	13.71	29.93
T_7	25.83	3.80	9.90	14.62	31.56
Mean	25.50	3.75	9.22	13.83	31.45
SEd	0.0605	0.0465	0.0930	0.027	0.0650
CD (P=05)	0.1302	0.1000	0.2000	0.0135	0.1397

to seed, which play an important role in enhancing the seed vigour and seed germination. It leads the rapid growth under drought condition (Saitoh *et al*., 1991). The prosopis leaf extract contains plant mineral nutrients like nitrogen (5.6%), phosphorus (P_2O_5- 0.9%), potassium (K_2O-3.11%) and calcium (CaO-1.0%) (Nadeem Binzia, 1992). The stimulatory effect on germination and the growth of seedlings of hardened seed 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).

Salicylic acid (SA) is an endogenous plant growth regulator. It is involved in various physiological processes of plant growth and development (Klessing and Malamy (1994), induction of flowering (Copeland and Ajmai, 1974) and root growth stimulation (Gutierrez-Coronado *et al.*, 1998). SA also plays a major role during the early stage of Rhizobium-Legume symbiosis (Ramussen, *et al.*, 1991). Salicylic acid is a signaling molecule, naturally occuring in plants and play a major role in regulating plant growth and development (Khodary, 2004). Seeds germinated in Salicylic acid supplemented media showed abundant levels of isocitrate lyase and malate synthase (key enzymes of glyoxylate cycle) (Eastmond and Graham, 2001). Seed imbibition with SA leads to an activation of germination and seedling growth (Shukirova *et al.*, 2003). SA is mediated in photosynthesis (Khan *et al.*, 2003) transpiration, stomatal regulation, nutrient uptake and transport (Gunes *et al.*, 2005).

Deotale *et al*. (1998) reported that when soybean seeds were treated with 0-150 ppm GA_3 the highest leaf area was obtained with 100 ppm. The *Prosopis* leaf extract hardening treatments might have improved the growth of plant during early stage of the crop with increased vigour and associated stronger root system which in turn might have favoured the derivation of available soil moisture and nutrients enabling better growth that resulted in higher yield (Jegathambal, 1996). Similar results were obtained by Basra *et al.* (2005), who reported that acetyl salicylic acid treatment on potato plants promoted plant growth, plant height and number of leaves per plant. Amira Hagazi and Amal El-Shraiy (2007) in common bean observed similar beneficial effect of salicylic acid spray.

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). 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. There were already reports about the benefits of seed hardening with *P*rosopis and pungam leaf extracts to overcome the adverse condition (Rathinavel and Dharmalingam, (2000) in uppam cotton; Khan Bahadar Marwat and Muhammed Azim khan, (2006) in wheat and Renugadevi *et al*., (2008) in cluster bean).

Physiological parameters: The physiological parameters such as total chlorophyll content, photosynthesis, transpiration, intercellular CO_2 concentration and stomatal conductance were also found higher in prosopis hardening cum foliar spray with salicylic acid @ 100 ppm treatment which were 9.7, 44.9, 19.9, 37.9 percentages higher than control respectively for the above mentioned characters (Table 2). Because of the invigorative effect of Prosopis hardening, the plants would have absorbed more nutrients from the soil and utilized for more chlorophyll production resulting in enhanced photosynthetic activity of hardened plants. Parwar and Kadam (1981) also reported that in wheat, seed hardening with $CaCl_2$ and NaCl improved the uptake of nitrogen and enhanced the metabolic activity (Karivaratharaju and Ramakrishnan, 1985) and thereby the plant height, dry matter production and yield in ragi.

TABLE 2: Effect of seed hardening cum foliar spray treatments on chlorophyll and gas exchange parameters in black gram cv.| VBN 3 under dry land condition.

Treatment (T)	Total chlorophyll content(mg g^{-1})	Pn (mg CO_2 $m^{-1}S^{-1}$)	Tr(mg H_2O CO_2 $m^{-1}S^{-1}$)	Ci(mol/mol^{-1})	CS(mol/mol $^{-1}S^{-1}$)
T_0	1.71	23.60	7.37	228.65	0.58
T_1	2.08	25.86	10.50	270.27	0.77
T_2	1.87	25.86	10.31	268.23	0.67
T_3	1.79	25.85	9.91	251.25	0.65
T_4	2.16	25.91	10.68	274.31	0.80
T_5	1.7	24.84	8.97	237.12	0.61
T_6	1.73	24.98	9.50	243.15	0.59
T_7	1.9	25.62	10.20	270.27	0.73
Mean	1.86	25.31	9.68	255.40	0.67
SEd	0.0232	0.007	0.009	0.0145	0.0075
CD (P=05)	0.0499S	0.014	0.018	0.029	0.015

TABLE 3: Influence of seed hardening cum foliar spray treatments on yield attributes in blackgram cv. VBN 3 under dry land condition.

Treatment (T)	Pod length (cm)	Number of pods plant^{-1}	Pod yield plant^{-1} (g)	Number of seeds pod^{-1}	Seed yield plant^{-1} (g)	Seed yield ha^{-1} (kg)	Hundred seed weight (g)
T_0	5.13	22.43	7.07	6.81	4.43	773.81	4.10
T_1	6.40	25.99	7.79	7.14	5.02	793.0	4.28
T_2	5.96	23.73	7.32	6.97	4.82	789.0	3.87
T_3	5.63	23.3	7.23	6.90	4.67	783.98	3.86
T_4	6.60	26.33	8.18	7.27	5.26	797.86	5.88
T_5	5.23	22.73	7.25	6.77	4.49	778.58	4.30
T_6	5.43	22.86	7.14	6.86	4.6	780.49	3.84
T_7	6.10	24.06	7.55	7.06	4.91	791.66	3.88
Mean	5.81	23.52	7.44	6.97	4.77	751.90	4.12
SEd	0.0557	0.1118	0.0650	0.0278	0.0465	0.9460	0.0022
CD (P=05)	0.1198	0.2404	0.1397	0.597	0.1000	2.0339	0.0048

Similar observations of increased gas exchange parameters *viz.,* leaf photosynthetic rate, transpiration, stomatal conductance and intercellular CO_2 concentration with flyash treatment was reported by Anbarasan (2011) in cowpea. Kalpana kumar and Dubey (2003) attributed increase in chlorophyll content to the enhancement in the photosynthetic efficiency in terms of carbohydrate content with the application of flyash.

Yield parameters: Drought stress at flowering stage may reduce the efficiency of redistribution of storage accumulation. Salicylic acid acts as a priming agent and foliar application at the beginning of flowering may lead to tillering and increased photo synthetic efficiency. It leads to the highest redistribution of stored material, redistribution efficiency and partitioning (Deotale *et al.*,1998). The above treatment also recorded higher yield attributes such as pod length, number of pods plant^{-1}, pod yield plant^{-1}, number of seeds pod^{-1} and seed yield plant-^{1} which were also 28.6, 17.3, 15.7, 6.7, 18.7 percentages higher than control respectively for the above mentioned characters (Table 3).

Similar results were reported by Sathiya Narayanan *et al.* (2013) and Srimathi *et al.* (2007) in green gram. Muhammad Farooq (2009) reported that osmohardening with KCl performed better and it was followed by osmohardening with $CaCl_2$ and ascorbate priming in improving growth, yield and quality of transplanted rice. Osmohardening with $CaCl_2$ recorded the best yield followed by hardening and osmohardening with KCl (Muhammad Farooq *et al.*, 2006). More than one pre-sowing treatment causing an increase in seed weight and it was reported by Vijaya (1996) in cowpea and blackgram, Maheshwari(1996) in soyabean and Jayaseelan(1997) in redgram and greengram.

Thus, the influence of seed hardening cum foliar treatments on seed production in black gram under for drought condition revealed that seed hardening treatment @ 1% prosopis leaf extract coupled with foliar spray treatment with salicylic acid @ 100 ppm recorded the higher seed yield when compared to other treatments.

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