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Seed invigoration in black gram by chemical hardening

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Abstract
An attempt was made to identify suitable and effective chemicals for seed hardening for improving seed germination and other quality parameters under drought conditions. The chemicals used for seed hardening were $FeSO_4$ @5%, $ZnSO_4$ @100 ppm, $CaCl_2$ @2%, $MnSO_4$ @100 ppm, KCl @2%, K_2SO_4 @ 100 ppm and control. Among the various chemicals, seed hardening with 2%, $CaCl_2$ improved the seed germination (98%) and other quality parameters, compared to control (88%).

Keywords: Seed hardening, chemicals, drought conditions

Introduction
India imports black gram mainly from Myanmar to meet the domestic demand supplementing the domestic production. These imports have been hovering around 2 lakh tonnes during the past few years although trends are being upwards since 2003. This situation warrants producing threefold increase as that of current pulse production. The low productivity is due to the fact that pulses are grown mostly in marginal and rain fed areas. The main constraint in raising the productivity levels of pulses in dry lands are the inadequacy of soil moisture and poor fertility status of the soil.

To overcome the adverse environmental conditions like rainfall and low soil moisture which prevent the germination and establishment of seedlings, seed hardening can be given as a pre sowing treatment which is a boon to dry land agriculture. This will give an initial boost for germinating seeds and growing seedlings. So the seedlings can put forth better root and shoot growth. This initial boost may be sustained throughout the plant growth and enhances the drought tolerance of the plants resulting in increased yield.

Seed hardening is to impart resistance to stress conditions has been recommended by Henckel (1967). Heydecker (1972) had advocated seed invigoration treatment for promoting vigour, viability and field performance. According to Salim and Todd (1968), the success of the seed treatment would depend largely upon the right kind of chemical and its concentration most suited for the kind of seed. The benevolent effects of the chemical seed hardening treatments convincingly demonstrated by several researchers in several kinds of crops were duly considered for test verifying the applicability of this ameliorative treatment with a few chemicals-and growth factors to the black gram cv. VBN 3 for improving the field performance of the treated seeds.

Materials and Methods
The certified seeds of black gram (*Vigna mungo* L.) cv. VBN 3 was obtained from the National Pulses Research Station, Vamban, Tamil Nadu formed the basic material for this study.

The seeds were cleaned and graded using BSS 7 x 7 sieves. The retained seeds alone were used for experimentation. The seeds were first preconditioned by keeping them in between two layers of moist gunny bags for an hour. The treatment details of hardening are as follows.

The seeds were soaked in the chemicals *viz.*, $FeSO_4$ 5%, $ZnSO_4$ 100 ppm, $CaCl_2$ 2%, $MnSO_4$ 100 ppm, KCl 2% and K_2SO_4 100 ppm for four hours and shade dried. The treated seeds were analyzed for seed quality parameters of rate of germination, germination per cent, root length, shoot length, dry matter production and vigour index.

A field experiment was carried out at experimental farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai university to perceive the effect of seed hardening on the yield, quality and storage potential of Black gram. A field trail was conducted during September – December, 2011 adopting randomized block design with seven treatments and three replications under dry land conditions. The plot size was 3 x 2 m and the crop was raised with a spacing of 30 x 10 cm. the recommended package of practices for black gram was followed uniformly for all the treatments. Five plants were selected randomly

irrespective of replication, labeled and the observations of characters *viz.* plant height, number of branches per plant, number of nodules per plant, chlorophyll content, days to first flowering, days to fifty per cent flowering, number of pods per plant, pod length, number of seeds per pod, pod yield per plant and seed yield per plant.

The data on various experiments were analyzed statistically adopting the procedure described by Panes and Sukhatme (1967).

Results

Seed quality parameters

High significant results were obtained at the evaluation of quality characters *viz.*, rate of germination, germination per cent, root length, shoot length, dry matter production, vigour index, when tested for variation among the seed hardening treatment.

Among the treatments, $CaCl_2$ hardened seeds recorded highest rate of germination (12.80), germination per cent (98%), root length (17.70cm), shoot length (27.14cm), dry matter production (30.23mg) and vigour index (4458.30) followed by $MnSO_4$ hardened seeds recorded rate of germination (12.40), germination per cent (96%), root length (16.60cm), shoot length (26.66cm), dry matter production (29.03mg) and vigour index (4274.00). Whereas control revealed the lowest for rate of germination (11.10), germination per cent (88%), root length (14.20cm), shoot length (23.40cm), dry matter production (26.50mg) and vigour index (3411.00).

Field evaluation

Highly significant differences were recorded for the seed treatments, $CaCl_2$ @ 2% hardened seeds recorded maximum plant height (35.43), number of branches per plant (4.60), number of nodules per plant (20.33), chlorophyll a content (0.88), chlorophyll b content (0.39), total chlorophyll content (1.25), pod length (5.33cm), number of pods per plant (27.36), pod yield per plant (27.36), number of seeds per pod (6.73) and seed yield per plant (6.46), minimum for days to first flowering (20.33) and days to fifty per cent flowering (27.96). Whereas lowest was with control for plant height (29.30), number of branches per plant (3.70), number of nodules per plant (14.33), chlorophyll a content (0.61), chlorophyll b content (0.25), total chlorophyll content (0.85), pod length (3.80), number of pods per plant (21.36), pod yield per plant (21.36), number of pods per plant (5.30) and seed yield per plant (3.56). Days to first and fifty per cent flowering was maximum in control (29.33 and 36.0 respectively).

Discussion

The results of field and laboratory experiment on seed management practices for black gram is discussed. Establishment of seedling in the soil is an important and foremost need for better crop production. This depends largely on the germination and vigour potential of seeds used for sowing. To achieve the goal, holistic approach such as adaptation of sound and proven technology, scientific management practices on seed production and supply of good quality seeds are the essential criteria.

Black gram predominantly grown as rainfed crop in India suffers from severe at one or several stage of its growth, because of inadequate and uneven distribution of rainfall during the crop season. Low productivity is common in black gram cultivation which would be attributed broadly to use of poor quality seeds, soil drought, low and erratic rainfall and improper crop management. To overcome these blockades, new seed management technologies have been developed. One such technology is the seed hardening which provide degree of drought tolerance in the initial phase of seed germination. The effect of seed hardening treatment on seed quality parameters *viz.*, germination per cent, shoot length, root length, dry matter production and vigour index are discussed here under.

The germination per cent was more for seed hardened with $CaCl_2$ (98%) followed by $MnSO_4$ (96%). The untreated control recorded the lowest germination per cent. Similar findings were made earlier by Manjunath and Dhaanoji (2011) in green gram, Srimathi *et al.* (2007) and Verma *et al.* (2006) in mung bean. Better seedling characters like longer root length (17.70cm) and shoot length (27.14cm), higher dry matter production (30.23gm) and vigour index (4458.03) were also observed in black gram seeds hardened with $CaCl_2$. The improvement in germination as well as vigour might be due to chemical treatment which could have altered the membrane system as reported by Dharmalingam and Basu (1999) in sunflower.

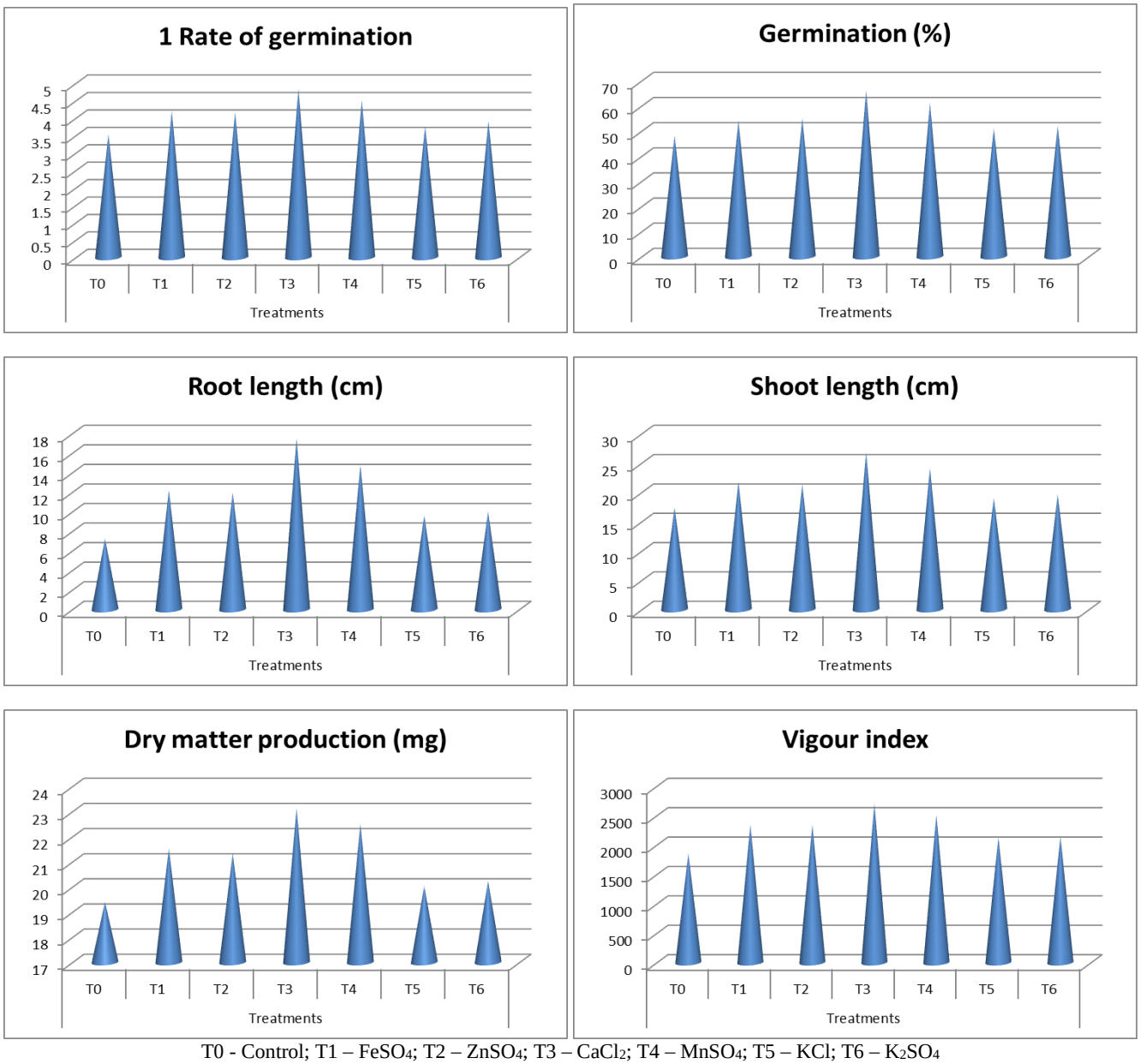
The maximum plant height (35.43cm) was observed in seeds treated with $CaCl_2$ followed by $MnSO_4$ (34.26cm) whereas the untreated seeds produced lowest plant height of 29.30cm. The seed hardening achieves a number of enzymes required for cell mitotic division and elongation (Kalarani *et al.* 2001 in ragi, Prakash and kandasamy 2004 in sunflower). Besides this, phytotonic effect of $CaCl_2$ treatment also cause increase in plant height. Similar findings were made by Angamutu, 1991.

Higher number of pods per plant was observed in the seeds of $CaCl_2$ (27.36) followed by $MnSO_4$ (26.23). This is a significant figure compared to control and hence has caused this by combinational effect. Higher pod yield per plant was obtained for the seeds treated with $CaCl_2$ (27.36) followed by $MnSO_4$ (26.23) while minimum pod yield per plant was recorded in control. Higher seed yield per plant (6.46g) was also recorded with the seed treatment with $CaCl_2$ followed by $MnSO_4$ (6.03g). While lowest weight of 3.56g per plant for seed yield was recorded in control. Similar findings were made by Verma *et al.* (2006) in black gram.

Table 1: Effect of seed hardening with chemicals on seed quality parameters and field performance of black gram

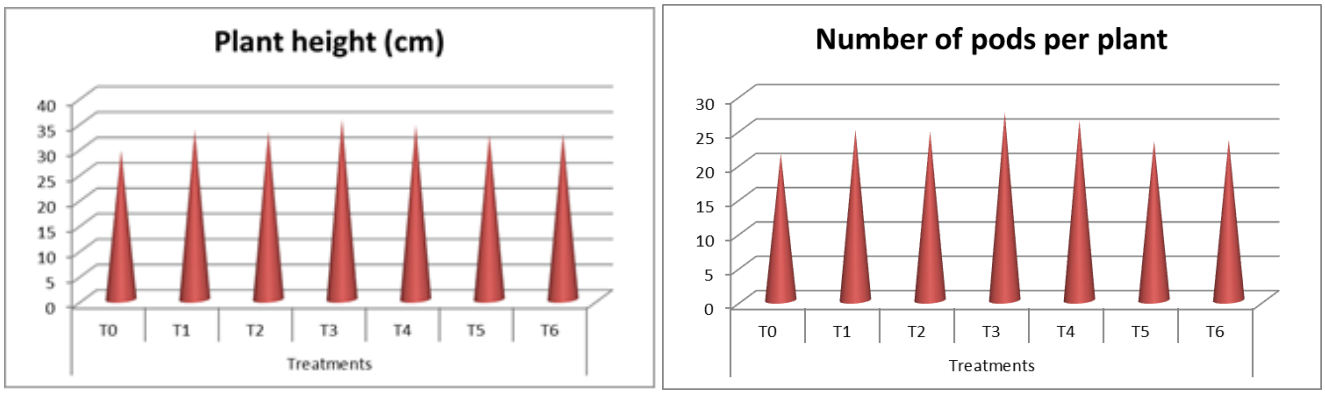
S.No.	Characters	Treatments							SEd	CD (0.05)
		T_0	T_1	T_2	T_3	T_4	T_5	T_6		
1.	Rate of germination	3.53	4.20	4.17	4.83	4.50	3.76	3.90	0.12	0.24
2.	Germination (%)	48	54	55	66	61	51	52	0.85	1.17
3.	Root length (cm)	7.23	12.20	11.96	17.50	14.76	9.60	10.00	0.18	0.37
4.	Shoot length (cm)	17.36	21.76	21.30	26.80	24.10	19.00	19.60	0.17	0.35
5.	Dry matter production (mg)	19.40	21.53	21.33	23.13	22.50	20.03	20.23	0.27	0.55
6.	Vigour index	1851.00	2341.33	2338.33	2708.00	2513.33	2128.00	2138.00	57.20	114.58
7.	Plant height (cm)	29.30	33.36	33.06	35.43	34.26	32.40	32.60	0.20	0.40
8.	Number of branches per plant	3.70	4.15	4.12	4.60	4.35	3.90	3.92	0.09	0.19
9.	Number of nodules per plant	14.33	17.26	17.26	20.33	18.46	16.46	16.53	0.19	0.38

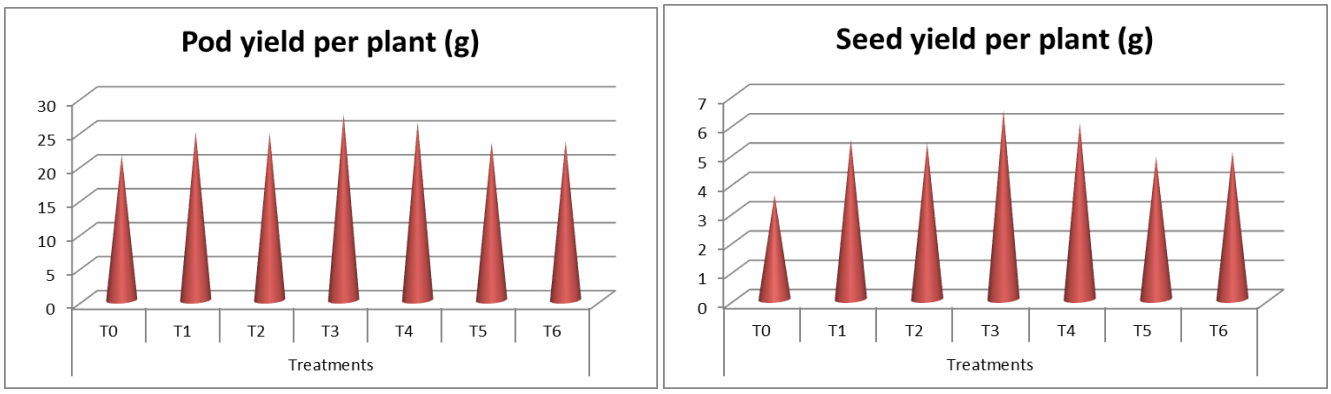
10.	Days to first flowering	29.33	23.00	23.00	20.33	21.66	27.80	27.33	0.54	1.09
11.	Days to fifty per cent flowering	36.03	31.66	31.63	27.96	30.03	34.33	33.66	1.13	2.27
12.	Chlorophyll content a	0.61	0.77	0.76	0.88	0.84	0.67	0.70	0.01	0.02
13.	Chlorophyll content b	0.25	0.35	0.34	0.39	0.37	0.29	0.30	0.09	0.19
14.	Total chlorophyll content	0.85	0.96	0.93	1.25	1.20	1.12	1.14	0.01	0.03
15.	Pod length (cm)	3.80	4.50	4.43	5.33	4.90	4.10	4.13	0.14	0.28
16.	Number of pods per plant	21.36	24.80	24.63	27.36	26.23	23.20	23.40	0.05	1.01
17.	Pod yield per plant (g)	21.36	24.80	24.63	27.36	26.23	23.20	23.40	0.05	1.01
18.	Number of seeds per pod	5.30	6.06	6.03	673	6.33	5.73	5.80	0.08	0.17
19.	Seed yield per plant (g)	3.56	5.46	5.33	6.46	6.03	4.86	5.03	0.13	0.26



T0 - Control; T1 – $FeSO_4$; T2 – $ZnSO_4$; T3 – $CaCl_2$; T4 – $MnSO_4$; T5 – KCl; T6 – K_2SO_4

Fig 1: Effect of seed hardening chemicals on seed quality parameters of black gram





T0 - Control; T1 – $FeSO_4$; T2 – $ZnSO_4$; T3 – $CaCl_2$; T4 – $MnSO_4$; T5 – KCl; T6 – K_2SO_4

Fig 2: Effect of seed hardening chemicals on field performance of black gram

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