Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(5): 563-567
Received: 11-07-2020
Accepted: 09-08-2020

Kavitha S
Department of Plant Genetic Resources, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Srimathi P
Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Corresponding Author:
Kavitha S
Department of Plant Genetic Resources, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Influence of seed priming with micro-nutrients followed by *rhizobium* seed coating on seed vigour, crop growth and seed yield in redgram cv. VBN 3

Kavitha S and Srimathi P

DOI: https://doi.org/10.22271/phyto.2020.v9.i5h.12288

Abstract
Redgram is important pulses crop grown throughout the country, gives low seed yield mainly due to poor management. Development of suitable technology is essential to enhance productivity. Seed priming is one such effective technology to achieve high vigour, better stand establishment and yield. The current study aimed to study the micronutrient seed priming and *rhizobium* coating on crop growth and seed yield in redgram. Seeds were primed with 10 different micronutrient solutions, evaluated for its quality parameters to find out suitable seed priming technique. Seeds from two best performing priming treatments were coated with *rhizobium* and evaluated for its production potential. **S**eed priming with 0.5% $ZnSO_4$ recorded higher germination (86%) and vigour index (3621) than control under laboratory experiment. Field experiments revealed that seeds primed with 0.5% $ZnSO_4$ and coated with *rhizobium* @ 30 g per kg of seeds improved the seed yield by 18.8% over control.

Keywords: Redgram, priming, coating, seed quality, yield

Introduction

Red gram (*Cajanus cajan* L.) are the important pulses crop, grown throughout the country. The crops are resistant to adverse climatic conditions and improve soil fertility by fixing atmospheric nitrogen in the soil. It has been reported that the crop produces equivalent to 22.10 kg of N/ha., which has been estimated to be a supplement of 59 thousand tonnes of urea annually. The pulse 'Red gram' play an important role in the Indian diet, as it contains vegetable protein about 22% which is almost three times that of cereals and other minerals and vitamins. Red gram is the second important pulse crop in India covering an area of about 53.87 lakh ha with the production of 45.99 lakh tones and productivity of 854 kg/ha, respectively. In Tamil Nadu, red gram is grown in an area of 41,130 hectares with the production of 370 MT and productivity of 1,093 kg/ha, respectively.

Redgram gives low seed yield mainly due to poor management and low soil fertility. Nitrogen due to leaching and volatilization and phosphorous due to fixation may not be available adequately at flowering and pod formation stages of crop and result in shedding flowers and pods. The seed is one of the major inputs in agriculture and decides the future of crops. The rationale for pre-plant seed treatment is to mobilize the seeds to own resources and to augment them with external resources to maximum improvement in stand establishment and yield. Priming is the method used to improve stand establishment in several crops. Seed priming is a process in which seeds are imbibed either in water or in osmotic solution or nutrient solution, a combination of solid matrix carrier and water in specific proportion followed by drying before radical emergence. Seed priming is an effective technology to enhance rapid and uniform emergence and to achieve high vigor, leading to better stand establishment and yield (Harris *et al.*, 2007) [2]. Kulkarni and Chittapur (2003) [5] reported that pre-sowing seed treatment with water, mineral solution *viz.*, $CaCl_2$, $ZnSO_4$, Cobalt sulphate, K_2SO_4, $CuSO_4$, Sodium molybdate, Boric acid, and $MnSO_4$ or growth regulators *viz.*, ascorbic acid, kinetin, benzyl adenine, gibberellic acid and cycocel alone and in combination found to speed up the germination process, increased the germination rate, seedling vigor, improved the resistance for water and salinity stress and increased the crop yields. Seed coating with biofertilizer increased plant growth and yield in many crops. Vikas Gupta and Thomas Abraham (2003) [19] reported that *Rhizobium* inoculation coupled with 30 kg S/ha increased the dry matter accumulation, nodulation, and grain yield in soybean.

Renugadevi (2004) [13] reported that the pre-sowing seed management of seed pelleting with arappu leaf powder @ 200g kg^{-1} of seed or *Rhizobium* @ 50g kg^{-1} of seed increased the seed quality characters than DAP and *Acorus* pelleting in Clusterbean. Therefore, seed priming with micronutrients followed by coating with biofertilizer *rhizobium* is a beneficial technology to increase seed germination, seedling vigor, crop growth, and seed yield by improving the seed quality. Keeping these in view, this study was undertaken at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore both under laboratory and field condition to develop a suitable micronutrient seed priming and coating technology for enhancing the survival, establishment, growth, and yield in red gram.

Material and Methods

The seeds of redgram cv. VBN 3 were obtained from the National Pulses Research Centre, Vamban, and the seeds were first preconditioned by keeping the seeds in between two layers of moist gunny bags for one hour. Then, the preconditioned seeds were soaked in different micronutrient solutions at 1/3rd seed to solution ratio for 3 hours and air-dried in shade to bring its original moisture content and evaluated for its quality parameters *viz.*, germination percentage, root length, shoot length, dry matter production and vigor index under laboratory condition to find out the best micronutrients seed priming treatment by adopting Factorial Completely Randomized Design in three replications.

Treatment details

Treatment details	Concentration		
	C_1	C_2	C_3
T_1 - Control	-	-	-
T_2 - Water	-	-	-
T_3 - Zinc sulphate (Crop Production Guide recommendation)	100 ppm		
T_4 - Ferrous sulphate	0.5 %	0.75 %	1.0 %
T_5 - Zinc sulphate	0.5 %	0.75 %	1.0 %
T_6 - Borax	0.5 %	0.75 %	1.0 %
T_7 - Ammonium molybdate	0.5 %	0.75 %	1.0 %
T_8 - Manganese sulphate	0.5 %	0.75 %	1.0 %
T_9 - Magnesium sulphate	0.5 %	0.75 %	1.0 %
T_{10} - Potassium chloride	0.5 %	0.75 %	1.0 %
T_{11} - Potassium dihydrogen phosphate	0.5 %	0.75 %	1.0 %
T_{12} - Ammonium chloride	0.5 %	0.75 %	1.0 %
T_{13} - Ammonium sulphate	0.5 %	0.75 %	1.0 %

From the results and findings obtained, the best performing two priming treatments (priming with 0.5 % $ZnSO_4$ and 0.5 % $MnSO_4$) were selected and forwarded to field trials along with control and combination of *Rhizobium* seed coating @ 30 g per kg of seeds using 10 % maida solution (adhesive) in such a way to have a uniform coating for evaluating their effect on crop growth and yield. The treatment details were as follows.

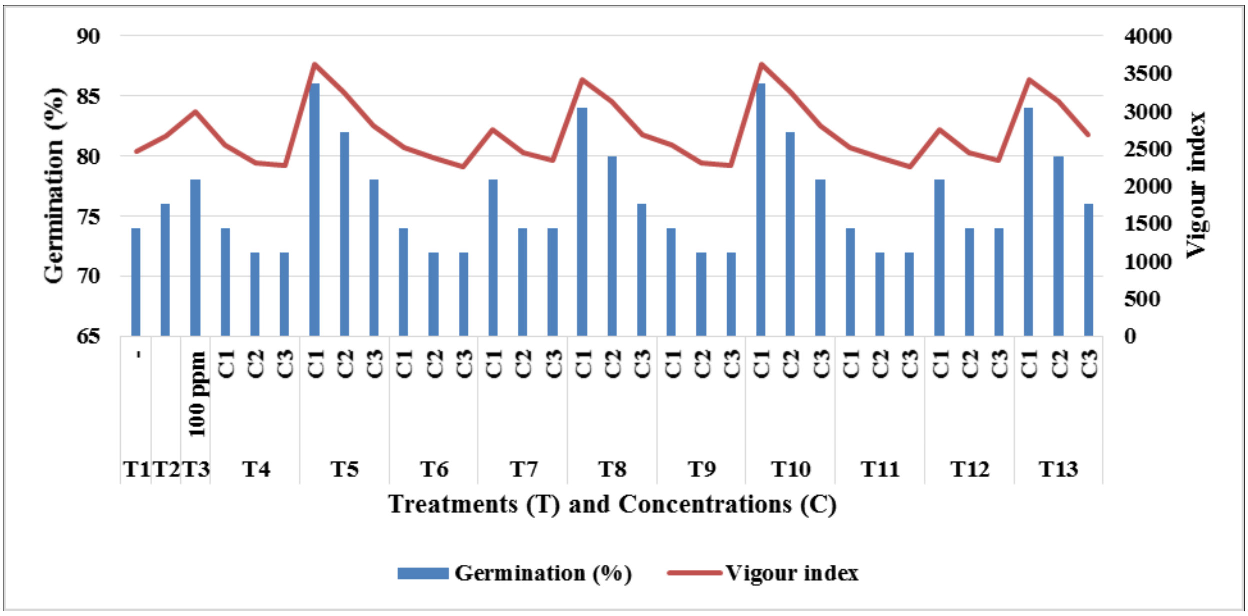
Treatments details

T_1 - Control
T_2 - Seed priming with 0.5 % $ZnSO_4$
T_3 - Seed priming with 0.5 % $MnSO_4$
T_4 - T_1 + *Rhizobium* coating @ 30 g / kg of seeds
T_5 - T_2 + *Rhizobium* coating @ 30 g / kg of seeds
T_6 - T_3+ *Rhizobium* coating @ 30 g / kg of seeds

The field experiments were conducted by adopting Randomized Block Design (RBD) with three replications and evaluated for field emergence, root and shoot length, dry matter production, plant height, seed yield and yield attributing characters *viz.*, no. of pods/plant, No. of seeds/pod, pod and seed yield/plant/ha and resultant seed quality parameters *viz.*, 100 seed weight (g) and germination (%) under laboratory condition. The results were subjected to analysis of variance and tested for significance according to Panse and Sukhatme (1999) [10]. Percentage values were transformed into arcsine values before analysis.

Results and Discussion

Standardization of seed priming with different micro-nutrients revealed that seed priming with 0.5 % $ZnSO_4$ at 1/3rd seed to solution ratio for 3 hours recorded higher germination (86 %) and vigor index (3621) than control which recorded 74 % seed germination and 2464 of vigor index. Seed priming with 0.5 % $MnSO_4$ was the next best treatment. It recorded higher germination of 13.5 % and vigor index of 38.4 % in redgram, respectively over control (T_1) (Fig 1). The probable reason for higher germination in 0.5 % $ZnSO_4$ primed seeds could be due to greater hydration of colloids, higher viscosity and elasticity of protoplasm, increase inbound water content, lower water deficit, more efficient root system and increased metabolic activity (Joseph and Nair, 1989) [3]. The increased seedling growth and vigor index observed in this treatment might be due to greater early vigor and a higher percentage of germination of the seeds that had reached the autotropic stage well in advance than others. Patangundi *et al.* (1997) highlighted that $ZnSO_4$, as a constituent of dehydrogenase enzyme, an activator of other enzymes, and a constituent for the biosynthesis of IAA and amino acid that favored the synthesis of protein. Sulphur in $ZnSO_4$ also increased the levels of vitamins, biotins, and thiamin and its coenzymes in seeds and enhanced the growth rate of seedlings. Likewise, due to the active participation in seed physiology, $ZnSO_4$ might have enhanced the seedling growth, dry matter production, and vigor index. The use of chemicals and botanicals as hardening substances to enhance the growth and yield of crop varieties has been employed by several workers (Vanangamudi and Kulandaivelu, 1989 [17]; Maitra *et al.*, 1997 [2]).



T_1 – Control; T_2 - Water; T_3 - Zinc sulphate; T_4 - Ferrous sulphate; T_5 - Zinc sulphate; T_6 - Borax; T_7 - Ammonium molybdate; T_8 - Manganese sulphate; T_9 - Magnesium sulphate; T_{10} - Potassium chloride; T_{11} - Potassium dihydrogen phosphate; T_{12} - Ammonium chloride; T_{13} - Ammonium sulphate; C_1 - 0.50 %; C_2 - 0.75 %; C_3 - 1.0 %

Fig 1: Effect of seed priming with micro-nutrients on seed germination (%) and vigour index in redgram under laboratory condition.

The results of the field experiment on "Evaluation of the production potential of the best performing micronutrient seed priming treatment in combination with *rhizobium* coating in redgram" revealed that seeds primed with 0.5 % $ZnSO_4$ and coated with *rhizobium* @ 30 g per kg of seeds (T_5) recorded higher field emergence (88 %), root length (11.4 cm), shoot length (22.0 cm) and dry matter production (7.92 g/plant) at vegetative stage than control (T_1) which recorded lower field emergence (82%), root length (9.6 cm), shoot length (17.8 cm) and dry matter production (6.01 g/plant) (Table 1.). In pulses, the micronutrients play an important role in plant growth and yield. Moreover, in the present investigation, the above said treatment contains Zn which is constituent of an enzyme essential for the synthesis of plant hormone indole acetic acid, which is presumed to be capable of stimulating emergence. The root growth was increased due to the biofertilizer (*Rhizobium*) treatment. The increase in plant growth attributes might be due to increased uptake of nutrients by microorganisms associated with plants and their synergistic effect. The microorganisms that are used as biofertilizers stimulate plant growth by providing necessary nutrients by their colonization at the rhizosphere or by their symbiotic association. The association may also regulate the physiological processes in the ecosystems by involving in the decomposition of organic matter, fixation of atmospheric nitrogen, secretion of growth-promoting substances, increasing the availability of mineral nutrients, and protecting the plants from the pathogen. Thus, the rhizosphere effect through microbial activity modifies the plant itself by providing the plant growth substances and increasing the availability of elements to the root zone (Newman *et al.*, 1992) [9].

Table 1: Influence of micronutrients seed priming and *rhizobium* coating on field emergence (%), root length (cm), shoot length (cm) and drymatter production (g/plant) at vegetative stage in redgram under field experiment

Treatments	Field emergence (%)	Vegetative stage		
		Root length (cm)	Shoot length (cm)	Drymatter production (g/plant)
T_1	82.0 (64.92)	9.6	17.8	6.01
T_2	87.0(68.88)	11.0	20.9	7.83
T_3	85.0 (67.22)	9.9	19.8	6.43
T_4	84.0 (66.42)	9.7	18.5	6.15
T_5	88.0 (69.78)	11.4	22.0	7.92
T_6	86.0 (68.06)	10.8	20.7	7.70
Mean	85.0 (67.22)	10.4	19.95	7.01
SEd	0.10	0.47	0.75	0.22
CD (P=0.05)	NS	0.98**	1.49**	0.44**

(Figures in parentheses are arc sine transformed values)
T_1 – Control; T_2 - Seed priming with 0.5 % $ZnSO_4$; T_3 - Seed priming with 0.5 % $MnSO_4$; T_4 - T_1 + *Rhizobium* coating @ 30 g / kg of seeds; T_5 - T_2 + *Rhizobium* coating @ 30 g / kg of seeds, T_6 - T_3+ *Rhizobium* coating @ 30 g / kg of seeds; **Significant at P = 0.05; NS - Non Significant

The treatment T_5 *i.e.*, seeds primed with 0.5 % $ZnSO_4$ and coated with *rhizobium* recorded higher plant height of 150.2 cm and more number of nodules/plant of 26.6 which is 10.9 % and 41.5 % increased, respectively over control (T_1) which recorded 135.4 cm plant height and 18.8 number of nodules/plant. The next best treatment was seed priming with 0.5 % $ZnSO_4$ (T_2) which registered 149.0 cm plant height and 24.2 number of nodules/plant (Table 2). Similar results have been reported by Kavitha (2002) [4]. The increased plant height could be attributed to the presence of ammoniacal nitrogen, phosphorus, and other essential micronutrients in the film coating combination. Certain seed coating materials improve seedling vigor at changing soil moisture especially in the sub-optimal range.

Inoculation of seeds with *Rhizobium* recorded more number of nodules at all the growth stages. The increased nodule number plant^{-1} due to the *Rhizobium* inoculation was reported by many scientists in pulses such as redgram (Prabakaran and Srinivasan, 1995) [12], lablab (Prabakaran and Rangarajan, 1992) [11], and chickpea (Namdeo *et al.*, 1989) [8]. According to Vaishya and Gajendragadkar (1984) [18], the treatments *Rhizobium, Rhizobium* + *Azospirillum* and *Rhizobium* + *phosphobacterium* produced significantly more nodules than the control in redgram. Normally, a high population of rhizobia on the pulse before sowing is required to ensure the survival of an optimum number of rhizobia on seed and in the soil to bring about effective nodulation, because pulse productivity mainly depends upon optimum nodulation (Kurundkar *et al.*, 1991) [6]. The increase in plant height and dry matter production might be due to an increased supply of nitrogen due to more nodulation by the *Rhizobium* inoculation (Saraswathi *et al.*, 1988) [15].

The number of pods plant^{-1}, number of seeds pod^{-1}, pod and seed yield plant$^{-1,}$ and ha^{-1} were significantly influenced by seed priming with micronutrients and coated with *rhizobium* culture. Seeds primed with 0.5 % $ZnSO_4$ and pelleted with *rhizobium* (T_5) registered more number of pods plant^{-1} (258.6), the number of seeds pod^{-1} (4.9), pod yield plant^{-1} (44.36 g), seed yield plant^{-1}(28.17 g), pod yield ha^{-1} (1554.20 kg), and seed yield ha^{-1} (990.64) which is 11.5, 32.8, 19.5, 25.9, 4.7, 47.2, 13.7 and 18.8 %, respectively increased over untreated control (T_1). Control (T_1) recorded 194.7 number of pods/plant, 4.1 number of seeds/pod, 35.24 g pod yield /plant, 19.13 g seed yield/plant, 1366.82 kg pod yield/ha, and 833.79 kg seed yield/ha. The second best treatment was seeds primed with 0.5 % $ZnSO_4$ (T_2) whereas the number of pods/plant is 248.2, the number of seeds/pod is 4.7, pod and seed yield/plant is 43.12 g and 26.06 g and pod and seed yield /ha is 1496.24 kg and 928.30 kg, respectively. The same treatment (T_5) recorded a higher 100 seed weight (10.01 g) and germination (96 %) in the resultant seeds whereas it was 9.16 g and 92 %, respectively in control (T_1) (Table 2). Such a positive effect on pod yield attributes was reported by Sabir-Ahamed (1999) [14] in black gram. The increased pod yield also due to unaborted reproductive structures could have resulted due to higher photosynthetic activity and adequate vegetative structure to produce more number of reproductive sinks. All these reasons could have attributed to increased pod yield in 0.5 % $ZnSO_4$ seed priming and pelleted with *rhizobium* culture.

Table 2: Influence of micronutrients seed priming and *rhizobium* coating on seed yield and yield attributing characters in redgram under field experiment.

Treatments	Harvesting stage								Resultant seed	
	Plant height (cm)	No. of nodules/ plant	No. of pods / plant	No. of seeds / pod	Pod yield / plant	Seed yield /plant	Pod yield (kg/ha)	Seed yield (kg/ha)	100 seed weight (g)	Germination (%)
T_1	135.4	18.8	194.7	4.1	35.24	19.13	1366.82	833.79	9.16	92.0 (73.59)
T_2	149.0	24.2	248.2	4.7	43.12	26.06	1496.24	928.30	9.83	94.0 (75.86)
T_3	147.3	21.2	230.3	4.6	39.42	22.28	1403.56	840.72	9.48	94.0 (74.30)
T_4	142.0	19.6	210.5	4.3	37.10	21.08	1390.50	835.10	9.32	93.0 (78.33)
T_5	150.2	26.6	258.6	4.9	44.36	28.17	1554.20	990.64	10.01	96.0 (80.11)
T_6	148.0	24.0	242.1	4.6	40.51	24.39	1442.90	846.90	9.60	94.0 (78.33)
Mean	145.32	22.40	230.73	4.53	39.96	23.52	1442.37	879.24	9.57	94.0 (78.33)
SEd	10.93	0.66	5.66	0.01	0.33	0.41	6.68	6.16	0.31	0.12
CD (P=0.05)	21.87**	1.32**	11.30**	0.02**	0.67**	0.83**	13.34**	12.29**	0.63**	NS

(Figures in parentheses are arc sine transformed values)

T_1 – Control; T_2 - Seed priming with 0.5 % $ZnSO_4$; T_3 - Seed priming with 0.5 % $MnSO_4$; T_4 - T_1 + *Rhizobium* coating @ 30 g / kg of seeds; T_5 - T_2 + *Rhizobium* coating @ 30 g / kg of seeds, T_6 - T_3+ *Rhizobium* coating @ 30 g / kg of seeds; **Significant at P = 0.05; NS - Non Significant

The seed yield/ha in treatment T_5 is 18.8 percent higher over control (T_1) (Table 2). Similarly increased yield due to *rhizobium* pelleting was reported by Srimathi and Malarkodi (2000) [16] in soybean. Rapid, uniformity, and percentage of seedling emergence of the direct-seeded crop have a major impact on final yield and quality. The seeds primed with 0.5 % $ZnSO_4$ and pelleted with *rhizobium* in the present study enabled quick emergence and established well in the field with a higher population that accounted for a higher yield per unit area. Similar results were reported by Dharmalingam and Basu (1989) [1] in mungbean. As far as the increase in the seed yield per plant is concerned, the physio-chemical treatments could have triggered the biosynthesis of nucleic acids, proteins, and the consequential enhancement of cell division besides, the enhanced metabolic activity of the plants resulting on the increased uptake of nutrients. This could have possibly accounted for the improvement in crop performance.

Conclusion

The results of the present study on Influence of seed priming with micronutrients followed by *rhizobium* seed coating on crop growth and seed yield in redgram revealed that seed priming with 0.5 % $ZnSO_4$ at 1/3rd seed to solution ratio for 3 hours increased seed germination and seedling vigor under laboratory experiment. Seed priming with 0.5 % $ZnSO_4$ and coated with *rhizobium* @ 30 g per kg of seeds improved crop growth, seed yield, and resultant seed quality under filed experiment. So, the present study concluded that red gram seeds can be primed with 0.5 % $ZnSO_4$ and coated with *rhizobium* @ 30 g per kg of seeds to enhance seed germination, seedling vigor, crop growth, and seed yield.

References

1. Dharmalingam C, Basu RN. Invigoration treatment for increased production in carried-over seeds of mungbean. Seeds & Farms. 1989; XV(5):34-36.
2. Harris D, Rashid A, Miraj G, Arif M, Shah H. 'On-farm' seed priming with zinc sulphate solution-A cost-effective way to increase the maize yields of resource poor farmers. Field Crops Res. 2007; 102:119-127.
3. Joseph K, Nair NR. Effect of seed hardening on germination and seedling vigour in paddy. Seed Res. 1989; 17(2):188-190.
4. Kavitha S. Seed hardening and pelleting for maximizing the productivity of black gram (*Vigna mungo* L.) Hepper) cv. Vamban 3 under rainfed conditions. M.Sc. (Ag.)

Thesis, Tamil Nadu Agricultural University, Coimbatore, 2002.
5. Kulkarni SS, Chittapur BM. Seed treatment technology in crop production - a review. Agric. Rev. 2003; 24(4):308-312.
6. Kurundkar BP, Thombre PA, Kawale BR. Effect of different inoculum levels of *Bradyrhizobium japonicum* on soybean. Legume Res. 1991; 14(4):201-204.
7. Maitra S, Sounda G, Ghosh DC, Jana PK. Effect of seed treatment on finger millet (*Eleusine coracana*) varieties in rainfed upland. Indian J Agric. Sci. 1997; 67(10):478-480.
8. Namdeo SL, Gupta SC, Bangar KS. Effect of rhizobial strains on symbiotic traits and yield of chick pea genotypes under rainfed conditions. Indian J Pulses Res. 1989; 2(1):64-67.
9. Newman EL, Eason WR, Eissenstat DM, Ramos MIRF. Interaction between plants: The role of mycorrhiza. Mycorrhiza. 1992; 1:47-53.
10. Panse VG, Sukhatme PV. In: Statistical methods for agricultural workers. ICAR Publication, New Delhi, 1999, 327-340.
11. Prabakaran J, Rangarajan M. Effect of Rhizobial inoculation on the nodulation, nitrogen fixation and yield of lablab (*Phaseolus vulgaris* L.). Madras agric. J. 1992; 79(3):172-174.
12. Prabakaran J, Srinivasan K. Effect of *Rhizobium* inoculation and coir dust on growth, nodulation and yield of pigeon pea (*Cajanus cajan*). Indian J Agron. 1995; 40(3):518-519.
13. Renugadevi J. Investigations on seed management, production, processing and storage of clusterbean (C*yamopsis tetragonoloba* (L.) Taub.). M.Sc.(Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, 2004.
14. Sabir-Ahamed A. Field performance of hardened green gram seeds. Legume Res. 1999; 22(3):207-208.
15. Saraswathi S, AGR Reddy, Singh BG. Effect of seed treatment with fungicides and *Rhizobium* on seed germination, nodulation, growth, dry matter, nitrogen content and yield in greegram. J Res., APAU. 1988; 16(1):14-22.
16. Srimathi P, Malarkodi K. Influence of nutrient pelleting on seed yield of soybean cv. CO 1. Indian Agriculturist. 2000; 44(1/2):79-82.
17. Vanangamudi K, Kulandaivelu R. Pre-sowing seed treatment for dryland farming. Seeds and farms. 1989; 15(9-10):33-34.
18. Vaishya JK, Gajendragadkar GR. Response of pigeon pea to biofertilizers. Int. Pigeon pea Newsl. 1984; 2:49-50.
19. Vikas Gupta, Thomas Abraham. Effect of different levels of sulphur and *rhizobium* inoculation on soybean (*Glycine max* L. Merril) cv. JS 75-46. In inceptisols. Madras Agric. J. 2003; 90(7-9):406-410.