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Bio-efficacy of plant products against insect infestation in greengram

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Abstract
The present experiments were carried out in the Department of Seed Science and Technology, TNAU, Coimbatore during 2010-2011 to evaluate the efficacy of botanicals on seed deterioration in greengram cv. CO 6. The seeds were dry dressed with rhizome powders of turmeric (*Curcuma longa*) and vasambu (*Acorus calamus*) @ 3g kg^{-1} of seed and evaluated with Polymer @ 3ml kg^{-1} of seed, Polymer @ 3ml kg^{-1} of seed + Imidacloprid @ 2ml kg^{-1} of seed + Carbendazim @ 2g kg^{-1} of seed, Polymer @ 3ml kg^{-1} of seed + Halogen mixture @ 3g kg^{-1} of seed (chlorine based) ($CaCl_2$ + $CaCO_3$ in 1:1 ratio) along with control. The results revealed that vasambu rhizome powder @ 3g kg^{-1} of seed controlled both bruchid infestation and seed deterioration maintained seed quality characters up to nine months of storage in polythene bag container under ambient storage. Seed treated with vasambu rhizome powder @3g kg^{-1} of seed recorded highest germination percentage (82), dry matter production ((244 mg/10 seedlings), vigour index (3411) and nil percent of insect infestation compared to control seed after nine months of storage period in polythene bag without loss in vigour and viability of seeds.

Keywords: Greengram seed, Rhizome powder, Cloth bag and Polythene bag

Introduction
Seed storage is an important post-harvest operation that decides the success of seeds in next generation. Pulses have higher lipoprotein content which gain moisture on storage that undergo rapid lipid peroxidation [3] that leads to degradation of seed quality characters and finally ends with death of seed. Among them, the pulse beetle *Callosobruchus maculatus*, which is a field carry over storage pest, is considered as the most serious pest that hastens the deteriorating rate of seed during storage [14]. Higher vigour and viability are two characters cannot be maintained in storage especially in legumes, since they deteriorate rapidly under ambient storage condition [17]. Management techniques over the control of bruchids with synthetic insecticides from farm to storage and thereafter are widely recommended [8] but this treatment due to their toxic residues restrict the use of this economic crop as feed or food. Among the diversified factors, pre storage treatment [7] plays a vital role in extending the storability of seeds to longer duration without appreciable loss in vigour and viability. As an eco-friendly and dual purpose treatment, plant products are widely used for seed treatment. Hence, with the objective of evolving eco-friendly dual purpose seed treatment for green gram, studies were made to evolve plant products against the control of storage pest and seed quality deterioration with green gram cv. CO 6.

Material and Methods
Genetically pure, freshly harvested breeder seeds of greengram (*Vigna radiata* L.Wilczek) cv. CO 6 obtained from Agricultural Research Station, Bhavanisagar served as the base material for the study. The experiments were carried out in the Department of Seed Science and Technology, TNAU, Coimbatore during 2010-2011. The seeds were pre-cleaned and dried to eight percent moisture content and were imposed with various pre-storage seed treatments viz., Vasambu rhizome powder @ 3g kg^{-1} of seed, Turmeric rhizome powder @ 3g kg^{-1} of seed in comparision with Polymer @ 3ml kg^{-1} of seed, Polymer @ 3ml kg^{-1} of seed + Imidacloprid @ 2ml kg^{-1} of seed + Carbendazim @ 2g kg^{-1} of seed, Polymer @ 3ml kg^{-1} of seed + Halogen mixture @ 3g kg^{-1} of seed (chlorine based) ($CaCl_2$ + $CaCO_3$ in 1:1 ratio) along with control. The treated seeds were kept in cloth bag and polythene bag stored under ambient conditions for a period of nine months and evaluated the seed quality parameters and seed health.

Moisture content (%)

Five gram of seeds in triplicate were taken separately in a pre weighed (M_1) moisture estimation bottle and the sample weights along with the bottle were recorded (M_2). The bottles were kept in a hot air oven maintained at 105±2 ºC for 6 h. Then the bottles were taken out and cooled in a desiccator with calcium carbonate for 30 minutes. The weight of bottle along with dried seeds were recorded (M_3) individually. The moisture content was calculated on wet weight basis adopting the following formula and expressed as percentage [6].

$$\text{Moisture content (\%)} = \frac{M_2\text{-}M_3}{M_2\text{-}M_1} \times 100$$

Germination (%)

Germination test, in quadruplicate of 100 seeds, each with four sub replicates of 25 seeds were carried out in roll towel in a germination room maintained at temperature of 25 ± 1 ºC and RH of 96 ± 2% with diffused light. Final count based on normal seedlings was recorded on seventh day and the mean recorded as germination in percentage [6]

Root length (cm)

After the germination period of seven days, ten normal seedlings were selected at random in each of the replication, and were measured for root length, from the collar region to the tip of primary root using measuring scale. The mean expressed as root length in centimetre.

Shoot length (cm)

Seedlings used for measuring root length were also used for measuring shoot length. The length between the collar regions to tip of the primary leaf (Plumule) was measured and the mean expressed as shoot length in centimetre.

Dry matter production (mg/ 10 seedlings)

Seedlings used for growth measurement were dried in a hot air oven maintained at 85±2°C for 24 h and cooled in a desiccator for 30 min. and weighed in an electronic balance and the mean expressed as dry matter production per 10 seedlings in milligram.

Vigour index

Vigour index (VI) was calculated by using the formula suggested by [1] and the mean expressed in whole number.

VI = Germination (%) x [root length (cm) + shoot length (cm)].

Insect infestation (%)

To determine the insect infestation level in stored seeds, one hundred seeds in four replicates from each treatment and replication were taken randomly and observed for emergence hole on the seed. The percentage of infested seeds was calculated as per the following formula [2].

$$\text{Insect infestation (\%)} = \frac{\text{No. of seeds with emergence hole}}{\text{No. of seeds taken for counting}} \times 100$$

Statistical Analysis

The data obtained from different experiments were analysed for 'F' test of significance following the methods described by [11]. Wherever necessary and the percent values were transformed to angular (Arc-sine) values before analysis. The critical differences (CD) were calculated at 5 percent probability level. The data were tested for statistical significance (*). If F test is non-significant, it was indicated as NS.

Results and Discussion

The results revealed that, all the seed treatments were found to be effective in maintaining the quality of seed and in controlling the bruchid infestation. One of the factors that determine the viability of seeds in storage is the seed moisture content, which was monitored at regular intervals. In the present investigation, moisture content of seed increased very slightly with advances in storage period and attained the maximum of 8.8 percent. The variation might be due to the extent of moisture transmission from seed to atmosphere. In addition, the seeds of green gram stored in cloth bag might have be an exposed to increased frequency of moisture equilibration with atmosphere that resulted in the increased rate of absorption which accelerated the rate of deterioration. In polythene bag container, the increase in moisture content was less [9] due to their lesser amenability to variations in atmospheric moisture as reported by [16] in karpokkarasi. The botanical seed treatment maintained the moisture content at low level. The lesser moisture content could have preserved the physiological seed quality parameters, like germination of seeds, as revealed by [10] in soybean.

The germinability of seeds observed through the standard germination test indicated that the seed germination was in decreasing order from the initial period to nine months of storage periods (94 to 84 percent). The decline in germinability during storage could be attributed to the irreversible ageing characteristics of all living biological organism causing deteriorative changes in the physical, physiological and biochemical characters of seed. The untreated seeds which expressed a drastic reduction in seed germination with advances in storage period. Among the treatments, vasambu rhizome powder @ 10 g kg^{-1} maintained the germination at higher level (90 percent) when compared to control (82 percent) (Table 1). Vasambu rhizome powder is said to have an active principle β asarone, which prevented the bruchid infestation and maintained the viability of seeds [14]. Seed treated with vasambu rhizome powder excelled others in seed quality maintenance and was also supported by [4, 12].

The vigour parameters of the stored seeds, in terms of shoot length, root length, drymatter production and vigour index were also in decreasing order with increase in storage period which was in conformity with findings of [5] and [13] in blackgram and greengram respectively. Observation on the vigour parameter also highlighted the beneficial effect of botanical seed treatment with vasambu rhizome powder recording (244 mg/10 seedlings) higher dryweight compared to undressed seed (236 mg/10 seedlings). Among the treatments, untreated seeds were poorer in vigour (2960), while seed treated with vasambu rhizome powder (3411) performed better in maintenance of vigour parameters during storage (Table 2).

Table 1: Effect of seed treatments on germination (%) of Greengram cv.CO 6.

Treatments	Cloth bag (Storage period in months)					Polythene bag (Storage period in months)				
	Initial	3	6	9	Mean	Initial	3	6	9	Mean
T_1	92 (73.57)	85 (67.21)	79 (62.72)	65 (53.73)	80 (63.43)	92 (73.57)	88 (69.73)	83 (65.65)	76 (60.66)	85 (67.21)
T_2	96 (78.46)	93 (74.66)	86 (68.02)	80 (63.43)	89 (70.63)	96 (78.46)	94 (75.82)	90 (71.56)	85 (67.21)	91 (72.54)
T_3	95 (77.08)	90 (71.56)	84 (66.42)	78 (62.02)	87 (68.86)	95 (77.08)	93 (74.66)	88 (69.73)	83 (65.65)	90 (71.56)
T_4	92 (73.57)	87 (68.86)	80 (63.43)	69 (56.16)	82 (64.89)	92 (73.57)	91 (72.54)	85 (67.21)	78 (62.02)	87 (68.86)
T_5	93 (74.66)	88 (69.73)	81 (64.15)	72 (58.05)	84 (66.42)	93 (74.66)	91 (72.54)	86 (68.02)	80 (63.43)	88 (69.73)
T_6	95 (77.08)	89 (70.63)	83 (65.65)	75 (60.00)	86 (68.02)	95 (77.08)	92 (73.57)	87 (68.86)	81 (64.15)	89 (70.63)
Mean	94 (75.82)	89 (70.63)	82 (64.89)	73 (58.69)	84 (66.42)	94 (75.82)	92 (73.57)	87 (68.86)	81 (64.15)	88 (69.73)
SEd	P	C	T	PxC	CxT	PxT	PxCxT			
	(0.25)	(0.15)	(0.23)	(0.42)	(0.25)	(0.56)	(0.75)			
CD (P = 0.05)	(0.49)	(0.35)	(0.51)	(0.80)	(0.49)	(1.10)	(1.56)			

(Figures in parentheses indicate arc sine transformed values)

T_1 - Control;T_2 - Vasambu rhizome powder @ 3g kg^{-1} of seed;T_3 - Turmeric rhizome powder @ 3g kg^{-1} of seed; T_4 - Polymer @ 3ml kg^{-1} of seed ;T_5 - Polymer @ 3ml kg^{-1} of seed + Imidacloprid @ 2ml kg^{-1} of seed + Carbendazim @ 2g kg^{-1} of seed;T_6 - Polymer @ 3ml kg^{-1} of seed + Halogen mixture @ 3g kg^{-1} of seed (chlorine based) ($CaCl_2$ + $CaCO_3$ in 1:1 ratio).

Table 2: Effect of seed treatments on vigour index of Greengram cv.CO 6.

Treatments	Cloth bag (Storage period in months)					Polythene bag (Storage period in months)				
	Initial	3	6	9	Mean	Initial	3	6	9	Mean
T_1	3643	3111	2662	2028	2831	3643	3318	2938	2516	3089
T_2	3869	3590	3130	2872	3355	3869	3685	3348	3001	3468
T_3	3800	3429	3016	2753	3238	3800	3599	3230	2888	3370
T_4	3625	3228	2728	2312	2954	3625	3449	3026	2613	3166
T_5	3701	3282	2803	2455	3044	3701	3467	3096	2720	3235
T_6	3772	3355	2930	2603	3151	3772	3533	3158	2786	3302
Mean	3735	3331	2876	2496	3093	3735	3508	3131	2752	3270
SEd	P	C	T	PxC	CxT	PxT	PxCxT			
CD (P = 0.05)	10.93	5.18	10.25	18.69	15.25	32.56	45.8			
	22.04	11.02	19.96	35.25	31.47	65.28	NS			

T_1 - Control;T_2 - Vasambu rhizome powder @ 3g kg^{-1} of seed;T_3 - Turmeric rhizome powder @ 3g kg^{-1} of seed; T_4 - Polymer @ 3ml kg^{-1} of seed ;T_5 - Polymer @ 3ml kg^{-1} of seed + Imidacloprid @ 2ml kg^{-1} of seed + Carbendazim @ 2g kg^{-1} of seed;T_6 - Polymer @ 3ml kg^{-1} of seed + Halogen mixture @ 3g kg^{-1} of seed (chlorine based) ($CaCl_2$ + $CaCO_3$ in 1:1 ratio).

Irrespective of storage treatments, the evaluated physiological vigour parameters viz., drymatter content and vigour index in line with germination percentage, reduced progressively with advance in storage periods which was evidenced in crops like pigeonpea [12]. The enhanced vigour parameters by seed treated with vasambu rhizome powder was due to increase in the rate of imbibition where the fine particle in the coating acts as a "wick" or moisture attracting material or perhaps to improve germination [14]. Therefore, seeds dressed with vasambu rhizome powder could increase the vigour parameters. Better seedling length in this treatment might also be due to low moisture absorption and this rhizome powder promotes seed quality preservation [14]. For insect infestation, vasambu rhizome powder preventing the bruchid infestation to totality (percent) in polythene bag, where as in cloth bag 50 percent infestation in control seeds at nine months of storage. This may due to their insecticidal and antioxidant property which might have reduced the insect infestation and seed deterioration during storage [15]. Vasambu also said to have sterilizing effect on the insect, as well as toxic towards the deposited eggs. It induce sickness or weakness, inhibit growth, reduce the reproductive efficiency and bring about premature death of insects [16]. The beneficial effect of vasambu rhizome powder on maintenance of seed quality was focused to the presence of active principle, keta osarone, which prevent the bruchid infestation and preserved the genetic storage potential of seed

Conclusion

The present study concluded that, greengram seeds treated with vasambu rhizome powder @ 3 g / kg recorded minimum seed deterioration when stored in polythene bag upto nine months without loss in vigour and viability of seeds. Moreover vasambu rhizomes are available locally at lower cost and also found to be eco-friendly.

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