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Bio-efficacy of botaniclas as storage protectants in black gram seeds

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Abstract
Pre storage treatment plays a vital role in extending the storability of seeds to longer duration without appreciable loss in vigor and viability. Pulses are more sensitive to storage conditions than cereals. During storage heavy dosages of expensive pesticides are used in pulses but serious health hazards are in the long run. Therefore, it is essential to find a cost effective and non-toxic method for pest attack on stored crops. It is also considered that botanicals are safer alternatives to chemical insecticides due to secondary compounds in selected botanicals. Hence, with the objective of evolving eco-friendly seed treatment for black gram, present study was made to evolve plant products against seed quality deterioration with black gram. These black gram seeds were dressed by *Terminalia chebula (seed)*, *Terminalia bellirica (seed), Acorus calamus (rhizome), Andrographis paniculata*, *Curcuma longa* and *Carica papaya* leaves powder for 28 days. Moisture content, germination percentage, vigor index and protein content were observed after 30 days, 60 days and 90 days period. *Acorus calamus* rhizome powder @ 3g / kg was effective for black gram seeds during storage that recorded minimum seed deterioration. An eco-friendly and dual purpose for seed treatment was developed.

Keywords: *Acorus calamus*, *Andrographis paniculata*, Black gram, *Carica papaya,* protectants, *Terminalia chebula*, *Terminalia bellirica*

Introduction
Seed storage is an important post-harvest operation for next generation seeds. Storage and upkeep of pulses are very important in post harvest activity. High temperature, high relative humidity, high moisture content and storage period are affecting the keeping quality of black gram. Higher vigor and viability are two characters cannot be maintained in storage especially in pulses, since they deteriorate rapidly under ambient storage condition. Control of insects in stored grains is an increasing challenge with increase use of synthetic chemicals. Search for safe biological agent that used as insecticide is essential of today's world. Pulses absorb moisture on storage that leads to degradation of seed quality and death of seed. Hence, there is a need to develop environment friendly crop protective agents from botanicals. Use of plant products as insecticide is important to the management of stored grain pests. Botanical pesticides are being manufactured and exported to various countries. Numerous literatures indicate that plants could be source for new insecticides. Therefore, there is a great potential for a plant-derived insecticidal compounds.
Moisture content, temperature, relative humidity, duration of storage and storage devices used are the most important factors affects the stability of stored pulses. One of the most important advantages of botanical based pesticides is that they do not leave any residue on the plants. Turmeric, garlic, *Vitex negundo*, ginger, *Agave americana*, custard apple, *Datura, Calotropis, Ipomoea*, and coriander are some of the widely used botanicals to control and repel pests. An indigenous practice of using botanicals in storage of pulses to prevent storage losses and maintains the keeping quality of pulses. Botanicals in the form of leaf powders with varying concentrations have been proved to catalyze chemical reactions and are efficient in retaining keeping quality. In addition, leaves have their own growth hormones responsible for keeping pulses quality, maintenance of vigor and viability, insecticidal property and reducing the accumulation of free radical that is responsible for pulses senescence during aging. The objective of this research was to evaluate the efficacy of some botanicals as storage protectants in black gram seeds.

Materials and Methods
Plant materials such as *Terminalia chebula (seed)*, *Terminalia bellirica (seed), Acorus calamus (rhizome), Andrographis paniculata*, *Curcuma longa* and *Carica papaya* leaves were collected in Echangkottai village, Thanjavur. Leaves were cut into small pieces, air dried for

21-28 days and pulverised into fine powder using electric grinder. Black gram seeds of without any botanical treatment were considered as the control (T_1). The black gram seeds are dressed with *Terminalia chebula*, *Terminalia bellirica*, *Acorus calamus*, *Andrographis paniculata* and *Carica papaya* leave powder at doses of 3g/250 g of blackgram seeds. Before storage, the seeds were analyzed for germination percentage, moisture content, root length, shoot length, protein content and vigor index. The treated seeds were kept in cloth bag stored under ambient conditions for a period of three months and evaluated the seed quality parameters. To study the moisture content five gram of seeds in triplicate was taken separately in a pre weighed (M1) moisture estimation bottle and the sample weights along with the bottle were recorded (M2). 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 desiccators with calcium carbonate for 30 minutes. The weight of bottle along with dried seeds were recorded (M3) individually. The moisture content was calculated on wet weight basis adopting the following formula and expressed as percentage. 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 (ISTA, 1999) [6]. 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 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 cm. Seedlings used for growth measurement were dried in a hot air oven maintained at 85±2°C for 24 h and cooled in a desiccators for 30 min. and weighed in an electronic balance and the mean expressed as dry matter production per 10 seedlings in milligram. Vigour index was calculated by using the formula suggested by (Abdul-Baki and Anderson JD, 1973) [1] and the mean expressed in whole number.

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

Control and botanical treated blackgram seeds analyzed for protein content by Lowry method.

Statistical analysis

Data were expressed as mean ± SE. The significance of the differences between the means of the samples were established by the analysis of variance ($P< 0.05$)

Results and Discussion

All extracts had statistically significant ($P< 0.05$) control rate on black gram when compared with the control (table1&2). The results revealed that, seed treatments by the botanicals were found to be effective in maintaining the quality of seed. 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 control seed increased very slightly with advances in storage period and attained the maximum. The variation might be due to the extent of moisture transmission from seed to atmosphere. In addition, the seeds of blackgram 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. The botanical seed treatments maintained the moisture content at low level. Moisture content was reduced in *Terminalia bellirica, Terminalia chebula* and *Acorus calamus* treated seeds when compared to control. The lesser moisture content could have preserved the physiological seed quality parameters, like germination of seeds in soybean (Nakka *et al*. 1999) [7].

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. The decline in germination percentage during storage could be attributed to the irreversible ageing characteristics of all living biological organism which causes deteriorative changes in physiological and biochemical characters of black gram seed. The untreated seeds expressed a drastic reduction in seed germination with advances in storage period. Among the treatments, *Acorus calamus* rhizome powder maintained the germination at higher level when compared to control (Table1). *Acorus calamus* rhizome powder contains active principle such as β-asarone which prevents bruchid infestation and maintained the viability of black gram seeds (Renugadevi *et al*., 2006) [12]. Seed treated with *Acorus calamus* rhizome powder excelled other botanicals in the seed quality maintenance (Anandi R, 2001; Parameswari, 2002) [3, 8].

The highest vigor index among the experimental seeds treated with *Acorus calamus* rhizome powder was recorded compared to control. Results reported by Baburatan *et al.* (1993) [4]; Agarwal and Dadlani M, 1995) [2] and Ponnuswamy *et al.* (1991) [9] were found to be close agreement with the present findings of this study. The vigour parameters of control stored black gram seeds, in terms of vigour index were also in decreasing order with increase in storage period which was in conformity with previous findings (Eevera T, 2000) [5] and (Raja K, 2000) [10]. Observation on the vigour parameter of seed also highlighted the beneficial effect of botanical treatment with *Acorus calamus* rhizome powder compared to control seeds. Irrespective of storage treatments, vigour index in line with germination percentage, reduced progressively with advance in storage periods which was evidenced in crops like pigeonpea (Parameswari K, 2006) [8]. The enhanced vigour parameters by seed treated with *Acorus calamus* rhizome powder was due to increase in the rate of imbibitions where the fine particle in the coating acts as a “wick” or moisture attracting material or perhaps to improve germination (Renugadevi *et al*., 2006) [11]. Therefore, seeds dressed with *Acorus calamus* rhizome powder could increase the vigour parameters and is might also be due to low moisture absorption and this rhizome powder promotes seed quality preservation. The decreased protein content of control seeds was enhanced in botanical treatments.

Among the treatments, untreated seeds were poorer in vigour, while seed treated with *Acorus calamus* rhizome powder performed better in maintenance of vigour parameters during storage. Increased root and shoot length and vigor index was also noted in *Andrographis paniculata* treatment next to *Acorus calamus*. The beneficial effect of sweet flag 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. Most of these practices are indigenous practices

enhances utilizations of locally available materials. This method protect the black gram seeds, do not cause health hazards apart from being eco-friendly, cheaper and locally available materials.

Table 1: Effect of botanicals on germination (%) and moisture content of black gram seeds

Treatment	Germination (%)				Moisture Content			
	Initial	30 D	60 D	90 D	Initial	30 D	60 D	90 D
T1	90	85	88	80	10.2	10.7	10.9	11.2
T2	89	85	81	79	10.5	9.8	9.5	9.4
T3	91	88	85	83	10.71	9.6	9.0	8.6
T4	89	91	90	90	10.6	9.54	9.34	8.9
T5	91	89	88	85	10.85	9.3	9.1	8.5
T6	89	88	89	87	10.4	9.25	9.2	8.7
mean	89.83	87.6	86.83	84	10.66	9.61	9.34	8.95
se	0.3664	0.87	1.23	1.56	0.07	0.13	0.12	0.16
CD:P=0.05	0.49	0.35	0.02	0.04	0.31	0.12	0.22	0.33

T1 - Control; T2 – *T.chebula* seed powder @ 3g kg-1 of seed; T3 – *T.bellirica* seed powder @ 3g kg-1 of seed; T4 - Vasambu rhizome powder @ 3g kg-1 of seed; T5 – *A. paniculata* leaf powder @ 3ml kg-1 of seed; T6 – *C.papaya* leaf powder @ 3g kg-1 of seed

Table 2: Effect of botanicals on vigor index and protein content (g/100g) of black gram

Treatment	Vigor Index				Protein Content (g/100g)			
	Initial	30 D	60 D	90 D	Initial	30 D	60 D	90 D
T1	3708	3538	3505	3444	24.9	24.3	23.8	20.0
T2	3420	3516	3256	3296	22.9	21.6	19.8	19.1
T3	3493	3454	3394	3301	22.2	21.5	20.5	19.2
T4	3778	3632	3576	3544	23.7	22.4	21.9	21.2
T5	3789	3520	3436	3347	24	22.9	21.9	20
T6	3720	3508	3220	3178	19.3	20.4	19.2	18.4
mean	3651.3	3528	3397.8	3351.6	21.3	20.7	21.1	19.65
se	58.0	21.7	51.7	47.5	22.6	0.65	0.54	0.36
CD:P=0.05	0.49	0.35	0.031	0.024	0.32	0.24	0.21	0.25

T1 - Control; T2 – *T.chebula* seed powder @ 3g kg-1 of seed; T3 – *T.bellirica* seed powder @ 3g kg-1 of seed; T4 - Vasambu rhizome powder @ 3g kg-1 of seed; T5 – *A. paniculata* leaf powder @ 3ml kg-1 of seed; T6 – *C.papaya* leaf powder @ 3g kg-1 of seed

Conclusion

The present study concluded that, *Acorus calamus* rhizome powder @ 3g/kg recorded minimum black gram seed deterioration without loss in vigor and viability of seeds. *Acorus calamus* serves as alternative to synthetic chemicals used in insect pest control. Replacement of chemical treatment of black gram seeds storage by botanical treatment and eco-friendly and farmer's friendly methods were evolved.

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