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Performance of Plant Derivatives on Storability of Blackgram Seeds against *Callosobruchus chinensis*

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A B S T R A C T

Blackgram seeds are highly vulnerable to pulses beetle (*Callosobruchus chinensis*) due to its proteinases nature and rapidly affect its quality during storage. Pre-storage seed treatment with insecticides and plant derivatives can effectively utilized for management of this storage pest. In spite of effectiveness of several insecticides in seed storage, the indiscriminate uses of insecticides imparting more residual toxicity which in turn it affects the non-targeted animals including human being besides affecting quality of seeds. An integrated/ organic protection approach is highly warranted to develop resistance against pulse beetle and it's highly welcomed by the researcher/ organic lover. Hence, an attempt was made to ascertain effectiveness of bio-pesticides or plant derivatives for maintaining the storability of blackgram seeds. Hence, a laboratory experiment was laid out Completely Randomized Design (CRD) under ambient condition for 12 months storage period with plant derivatives viz., plant (neem, castor, mustard, mahua and olive) oil @ 5 ml/kg, plant powders @ 10 g/kg (turmeric rhizome powder, notchi leaf powder, soapnut seed powder, neem leaf powder, mehendhi leaf powder), wood ash powder (@ 5 g/kg) and neem seed kernel powder (5 g/kg) each separately. Seed quality parameters were observed periodically once at three months interval upto 12 months. The results revealed that blackgram seeds treated with neem oil @ 5 ml / kg of seed have retained better seed quality parameters of 76 percent germination with minimum bruchid infestation (20.6%) at twelve months of storage period.

Introduction

Pulses are the cheap and best sources of protein (25%) and rectifying the protein deficiency of human beings which occupies major area in Indian agriculture after cereals and oilseeds. Among the pulse crops, blackgram (*Vigno mumgo* L) is an important pulse crop grown throughout India. Maintaining seed quality is the pre-requisite for any seed production programme and it is also the biggest task in Indian seed industry particularly in pulse crop. The major attributes responsible for seed deterioration during storage are mainly depends on abiotic factors *viz.*, temperature, moisture and humidity and biotic factor *viz.*, insects and fungi. Among the biotic factors, pulse beetle

(*Callosobruchus chinensis*) rapidly destruct the quality and quantity of blackgram seeds upto 50-60 per cent during storage because of its proteinases nature (Higstrum *et al.,* 1990). In spite of use of several insecticides in seed storage, the indiscriminate uses of insecticides imparting more residual toxicity which in turn it affects the non-targeted animals including human being besides affecting quality of seeds. An integrated/ organic protection approach is highly warranted to develop resistance against pulse beetle and it's highly welcomed by the researcher as well as an organic lover.

Of late, use of plant derivatives has also been used against wide range of field and storage pest. At World level, nearly 2400 plant species have been identified for its pesticidal properties against wide range of pest (Grainge and Ahmed, 1988). India has a rich botanical biodiversity which contains numerous plant species having pesticidal properties to control storage pest. Nowadays, use of native plant derivatives gained much important in controlling storage pest due to its bio-efficacy properties. Pandey *et al.,* (1976) reported that the repellent property of *The vetinerifoli* drupe powder, *Acorus calamus* rhizome powder, garlic extract and neem oil against *Callosobruchus chinensis* in blackgram. Similarly, Yadav (1983) found that plant derivatives *viz.* neem, dhatura and *Callotropis* leaf powders, garlic powder and soapnut powder are effective against pulse beetle without affecting germination and vigour of cowpea seeds upto 5 months of storage period. Further, he has concluded that none of the treatments had adverse effect on germination of seeds. Rahman *et al.,* (1992) revealed that castor leaf powder gave 100 percent mortality of *Callosobruchus maculates* within seven days in cowpea at lab condition. Further, Sanon *et al.,* (2007) found that pulse bruchid (*Callosobruchus chinensis*) is a minor pest in the field and it lays eggs on seeds before harvest and subsequently becomes a serious pest in storage. According to Khatun *et al.,* (2010), the leaf powders of neem, *Ipmoeasepiara* and *Polygonumhy dropiper* had higher germination, vigour and dry weight over control upto three months of storage period in lentils. An integrated protection approaches with use of bio-pesticides and botanicals are presently being recommended with or without pesticides for seed storage. Since the bio-pesticides are more reliable, environmentally safe, no residual toxicity, cheaper and having no mammalian toxicity. Hence, plant derivatives are considered as best alternative methods over pesticides for control of storage pest. With this background, this study was undertaken with plant derivatives in blackgram seeds under storage.

Materials and Methods

The experiment was carried out during 2011-13 at the laboratory of Soil and Water Management Research Institute (Tamil Nadu Agricultural University), Thanjavur, Tamil Nadu. The different plant derivatives were used for conducting storage experiment with blackgram (variety ADT 5) seeds. Seeds were collected from crops which were raised during Rabi, 2011 and stored in cloth bag with following plant derivatives.

Plant oil (@5 ml/kg of seed)

1. Neem (*Azadirachta indica*)
2. Castor (*Ricinus communis*)
3. Mustard (*Brassica nigra*)
4. Mahua (*Madhuca longifolia*)
5. Olive (*Olea europaea*)

Plant powders(@ 10 g per kg of seed)

6. Turmeric (*Curcuma longa*) rhizome powder,
7. Notchi (*Vitex negundo*) leaf powder

8. Soapnut (*Sapindus mukorossi*) seed powder
9. Neem (*Azadirachta indica*) leaf powder
10. Mehendhi (*Lawsonia inermis*) leaf powder
11. Wood ash powder (@ 5 g / kg)
12. Neem (*Azadirachta indica*) seed kernel powder (@ 5 g / kg).

The leaves/ rhizomes/ seeds of botanicals were dried under ambient room temperature (30-34^{o}C), ground separately, and then passed through a 60 mm mesh sieve to get fine powder forms which facilitate easy blending with seeds during storage. The clean and freshly harvested ADT 5 blackgram seeds were taken for this study and they were dried to maintain a 8.5 % moisture content. The dried seeds were divided into thirteen parts. One part without botanical treatment was considered as control and other parts are treated with above mentioned different plant derivatives. The treated seeds were stored in cloth bag (1kg) up to next planting season i-e 12 months from March, 2012- February, 2013.

The seed quality parameters *viz.*, percent hard seeds, seed germination, seedling length, seedling vigour and insect infestation and loss in seed weight due to pulse beetle were observed once at three months interval upto 12 months of storage. The seed quality parameters were tested as per ISTA Rules (Anonymous, 1999) and vigour index was determined according to Abdul-Baki and Anderson (1973).

The experiment was laid out in Completely Randomized Design(CRD) with two factorial concepts in three replications and the results were analyzed statistically as described by Sundararaj *et al.,* (1972) and Panse and Sukhatmae (1978).

Results and Discussion

The results revealed that marked and consistent variations in both seed quantitative and qualitative parameters were observed in the entire storage period of 12 months in irrespective of seed treatments (plant derivatives).

A progressive linear increasing trend was observed in percent seed infestation (zero) and loss in seed weight (zero) due to bruchid from initial period to the end of storage period (28.6 and 14.2%, respectively) in irrespective of seeds stored with plant derivatives. The plant derivatives had significant effect on insect infestation. Seeds treated with neem oil recorded lowest pulse beetle infestation of 9.1% which is followed by neem seed kernel powder (9.4%) whereas control registered 20.6 % at 12 months of storage period (Table 1).

The seed moisture content showed non-significant variation among the plant derivatives. It indicates plant derivatives did not change the seed moisture content. At the end of storage period, the highest moisture content of 9.9 percent was observed in blackgram seeds stored under control condition and the lowest moisture content was observed in seeds stored under plant oils (8.6%). Over period of storage, the seed moisture content was increased from 8.5 to 9.4 %. One interesting fact observed is plant oil treated seeds can arrest the transmission of atmospheric moisture into seeds. Similarly, no significant effect with respect to percent hard seeds was observed between plant derivatives. However, the hard seed percent showed decreasing trend from 24.3 to 0.5 from initial period to end of storage period. The factors responsible for hard seedness might be reduced and make it permeable seed coat during end of storage period (Table.2).

Table.1 Influence of plant derivatives on seed infestation (%) and Loss in seed weight (g) in blackgram under storage

Treatments (T)	Seed infestation (%)						Loss in seed weight (g)					
	Storage period (Months) (P)						Storage period (Months) (P)					
	Initial	3	6	9	12	Mean	Initial	3	6	9	12	Mean
Control (Untreated)	0.0	4.8	24.8	31.5	41.8	**20.6**	0.0	3.6	12.6	19.3	28.7	**12.8**
Neem oil @ 5 ml/kg	0.0	0.0	10.5	14.4	20.6	**9.1**	0.0	0.3	4.7	7.1	7.5	**3.9**
Castor oil @ 5 ml/kg	0.0	0.0	13.5	15.5	19.8	**9.8**	0.0	0.5	4.3	6.4	8.1	**3.9**
Mustard oil @ 5 ml/kg	0.0	0.3	18.3	25.1	24.6	**13.7**	0.0	0.8	4.3	6.4	10.0	**4.3**
Mahua oil @ 5 ml/kg	0.0	1.0	17.0	20.6	25.6	**12.8**	0.0	0.4	4.0	6.9	9.4	**4.1**
Olive oil @ 5 ml/kg	0.0	0.2	13.3	28.0	25.0	**13.3**	0.0	0.3	3.9	5.5	9.0	**3.7**
Turmeric rhizome powder @10g/kg	0.0	0.2	10.9	18.0	29.0	**11.6**	0.0	1.5	6.0	7.9	10.7	**5.2**
Notchi leaf powder @ 10 g / kg	0.0	0.3	18.0	25.5	30.6	**14.9**	0.0	1.2	7.8	8.1	12.2	**5.9**
Soapnut seed powder @ 10 g / kg	0.0	0.4	19.9	25.0	36.1	**16.3**	0.0	2.2	10.3	11.9	16.6	**8.2**
Neem leaf powder @ 10 g / kg	0.0	0.4	20.6	28.0	42.0	**18.2**	0.0	1.7	12.2	14.1	21.1	**9.8**
Mehendi leaf powder @ 10 g / kg	0.0	0.3	18.5	26.6	40.0	**17.1**	0.0	1.3	11.1	13.3	24.5	**10.0**
Wood ash powder @ 5 g / kg	0.0	1.5	17.9	30.6	38.5	**17.7**	0.0	1.9	10.4	13.0	25.5	**10.2**
Neem seed kernel powder @ 5 %	0.0	0.3	12.2	16.6	18.0	**9.4**	0.0	2.0	9.7	12.0	14.2	**7.6**
Mean	**0.0**	**0.7**	**16.6**	**23.5**	**30.1**		**0.0**	**1.4**	**7.8**	**10.1**	**15.2**	
	T	**P**	**TP**				**T**	**P**	**TP**			
SED	0.10	0.29	0.48				0.01	0.02	0.04			
CD (0.05)	0.22	0.63	NS				NS	0.04	NS			

Table.2 Influence of plant derivatives on percentage of hard seeds (%) and seed moisture content (%) in blackgram under storage

Treatments (T)	Hard seeds (%)						Seed moisture content (%)					
	Storage period (Months) (P)						Storage period (Months) (P)					
	Initial	3	6	9	12	Mean	Initial	3	6	9	12	Mean
Control (Untreated)	24.2	22.1	12.7	4.5	0.8	**12.9**	8.5	8.9	9.0	9.2	9.9	**9.1**
Neem oil @ 5 ml/kg	24.6	19.0	11.6	4.2	0.5	**12.0**	8.5	8.5	8.6	8.7	9.0	**8.7**
Castor oil @ 5 ml/kg	24.2	19.0	11.4	3.9	0.6	**11.8**	8.5	8.5	8.7	8.9	9.1	**8.7**
Mustard oil @ 5 ml/kg	24.5	19.0	10.5	3.9	0.7	**11.7**	8.5	8.5	8.6	8.8	9.0	**8.7**
Mahua oil @ 5 ml/kg	24.1	19.3	10.5	3.9	0.6	**11.7**	8.5	8.5	8.6	8.9	9.0	**8.7**
Olive oil @ 5 ml/kg	24.0	19.9	10.7	3.8	0.5	**11.8**	8.5	8.5	8.6	8.8	9.0	**8.7**
Turmeric rhizome powder @10g/kg	24.8	21.1	10.0	3.0	0.5	**11.9**	8.5	8.7	8.8	9.2	9.5	**8.9**
Notchi leaf powder @ 10 g / kg	24.2	20.5	10.1	3.2	0.3	**11.7**	8.5	8.7	8.9	9.0	9.3	**8.9**
Soapnut seed powder @ 10 g / kg	24.0	20.1	10.0	2.8	0.4	**11.5**	8.5	8.6	8.9	9.1	9.6	**8.9**
Neem leaf powder @ 10 g / kg	24.7	20.5	9.9	2.9	0.3	**11.7**	8.5	8.7	8.9	9.1	9.6	**9.0**
Mehendi leaf powder @ 10 g / kg	24.1	21.5	9.6	2.8	0.4	**11.7**	8.5	8.6	8.8	9.0	9.7	**8.9**
Wood ash powder @ 5 g / kg	24.6	20.5	9.9	3.0	0.3	**11.7**	8.5	8.8	8.9	9.2	9.8	**9.0**
Neem seed kernel powder @ 5 %	24.4	20.6	10.0	2.8	0.4	**11.6**	8.5	8.8	8.9	9.1	9.6	**9.0**
Mean	**24.3**	**20.2**	**10.5**	**3.4**	**0.5**		**8.5**	**8.6**	**8.8**	**9.0**	**9.4**	
	T	**P**	**TP**				**T**	**P**	**TP**			
SED	0.10	0.29	0.48				0.001	0.002	0.004			
CD (0.05)	0.22	0.63	NS				NS	0.04	NS			

Table.3 Influence of plant derivatives on seed germination (%) and seedling length (cm) in blackgram under storage

Treatments (T)	Seed germination (%)						Seedling length (cm)					
	Storage period (Months) (P)						Storage period (Months) (P)					
	Initial	3	6	9	12	Mean	Initial	3	6	9	12	Mean
Control (Untreated)	92	86	81	74	62	**79**	29.7	26.0	22.3	18.0	16.8	**22.6**
Neem oil @ 5 ml/kg	92	91	84	80	76	**85**	29.7	28.0	26.1	23.6	22.3	**25.9**
Castor oil @ 5 ml/kg	92	90	84	82	73	**84**	29.7	28.4	25.5	22.5	21.9	**25.6**
Mustard oil @ 5 ml/kg	92	88	84	80	70	**83**	29.7	28.0	24.9	21.5	21.3	**25.1**
Mahua oil @ 5 ml/kg	92	86	84	80	72	**83**	29.7	27.7	24.4	21.5	21.0	**24.9**
Olive oil @ 5 ml/kg	92	90	89	81	72	**85**	29.7	27.4	25.1	22.9	21.7	**25.4**
Turmeric rhizome powder @10g/kg	92	86	88	80	70	**83**	29.7	28.0	22.8	20.4	18.8	**23.9**
Notchi leaf powder @ 10 g / kg	92	90	88	80	69	**84**	29.7	28.0	24.0	20.6	19.5	**24.4**
Soapnut seed powder @ 10 g / kg	92	88	82	78	65	**81**	29.7	27.7	24.0	19.0	18.3	**23.7**
Neem leaf powder @ 10 g / kg	92	88	84	76	69	**82**	29.7	27.5	23.6	19.5	18.0	**23.7**
Mehendi leaf powder @ 10 g / kg	92	87	82	76	70	**81**	29.7	27.0	22.4	18.8	18.1	**23.2**
Wood ash powder @ 5 g / kg	92	87	83	77	72	**82**	29.7	27.0	23.0	18.5	17.8	**23.2**
Neem seed kernel powder @ 5 %	92	86	84	75	70	**81**	29.7	27.7	23.4	18.3	17.5	**23.3**
Mean	**92**	**88**	**84**	**78**	**70**		**29.7**	**27.6**	**24.0**	**20.4**	**19.5**	
	T	**P**	**TP**				**T**	**P**	**TP**			
SED	0.01	0.02	0.004				0.01	0.03	0.04			
CD (0.05)	0.02	0.04	NS				0.02	0.06	NS			

Table.4 Influence of plant derivatives on seed vigour index and electrical conductivity (dSm^{-1}) in blackgram under storage

Treatments (T)	Seed vigour index						Electrical conductivity (dSm^{-1})					
	Storage period (Months) (P)						Storage period (Months) (P)					
	Initial	3	6	9	12	Mean	Initial	3	6	9	12	Mean
Control (Untreated)	2732	2236	1806	1332	1042	**1830**	0.311	0.356	0.358	0.689	0.690	**0.481**
Neem oil @ 5 ml/kg	2732	2548	2192	1888	1695	**2211**	0.311	0.331	0.333	0.452	0.566	**0.399**
Castor oil @ 5 ml/kg	2732	2556	2142	1845	1599	**2175**	0.311	0.351	0.353	0.452	0.565	**0.406**
Mustard oil @ 5 ml/kg	2732	2464	2092	1720	1491	**2100**	0.311	0.362	0.366	0.661	0.675	**0.475**
Mahua oil @ 5 ml/kg	2732	2382	2050	1720	1512	**2079**	0.311	0.347	0.349	0.481	0.677	**0.433**
Olive oil @ 5 ml/kg	2732	2466	2234	1855	1562	**2170**	0.311	0.333	0.336	0.444	0.565	**0.398**
Turmeric rhizome powder @10g/kg	2732	2408	2006	1632	1316	**2019**	0.311	0.356	0.363	0.428	0.578	**0.407**
Notchi leaf powder @ 10 g / kg	2732	2520	2112	1648	1346	**2072**	0.311	0.381	0.385	0.448	0.528	**0.411**
Soapnut seed powder @ 10 g / kg	2732	2438	1968	1482	1190	**1962**	0.311	0.356	0.366	0.444	0.559	**0.407**
Neem leaf powder @ 10 g / kg	2732	2420	1982	1482	1242	**1972**	0.311	0.356	0.360	0.421	0.620	**0.414**
Mehendi leaf powder @ 10 g / kg	2732	2349	1837	1429	1267	**1923**	0.311	0.372	0.376	0.386	0.624	**0.414**
Wood ash powder @ 5 g / kg	2732	2349	1909	1425	1282	**1939**	0.311	0.352	0.355	0.421	0.586	**0.405**
Neem seed kernel powder @ 5 %	2732	2382	1966	1373	1225	**1936**	0.311	0.362	0.368	0.381	0.601	**0.405**
Mean	**2732**	**2424**	**2023**	**1602**	**1367**		**0.311**	**0.355**	**0.359**	**0.470**	**0.603**	
	T	**P**	**TP**				T	**P**	**TP**			
SED	15.3	35.1	55.6				0.0001	0.0002	0.0004			
CD (0.05)	32.0	70.4	NS				0.0002	0.0004	NS			

With respect to seed quantitative parameters *viz.* Germination, seedling length and vigour, a progressive linear decreasing trend was observed over storage period which were 92 to 70 %, 29.7 to 19.5 cm and 2732 to 1367, respectively. Among the plant derivatives, neem oil recorded significantly highest seed quality parameters (85%, 25.9cm and 2211, respectively). On the contrary, the electrical conductivity were significantly the highest (2732) in the initial period but declined drastically to minimum value (14248) at the end of twelve months period, whereas the initial EC value of 0.311 dSm^{-1} increased sharply to 0.588 dSm^{-1} at 12 months period (Table 3& 4).It clearly indicated that the negative correlation of electrical conductivity with seed quality.

In the present study, the lower percentage of seed infestation might be attributed to their ovicidal, oviposition inhibitory and unpleasant odourous repellent properties apart from interfering respiratory mechanism of storage insect pest causing greater mortality of pulse bruchid, during 12 months storage period (Yadav 1983). Further, a significant reduction in seed germination and other quality parameters during the entire 12 months period might be due marked hike in seed quantitative losses was mainly due to rise in the population of pulse beetle Apart from this, seed moisture content also showed fluctuating variations in the entire storage period due to variation in ambient storage condition which might have caused greater metabolic wastages such as uric acid produced by bruchids when they were metabolically very active during storage (Yadav1983) and also by increased dead insect debris, high bran and its fecal matters in damaged seeds.

About 75 per cent minimum germination (inclusive of hard seeds) prescribed as per Minimum Seed Certification Standards (MSCS) (Anonymous, 1999) was maintained in neem oil treated seeds upto 12 months period whereas, it was upto six months in the control. The present study shows the better seed quality parameters noticed in neem oil @ 5 ml per kg of seeds may be due to the reduced bruchid infestation and it was further related to their unpleasant repellent, odourous and ovicidal properties in the entire storage period.

In conclusion the outcome of this study is blackgram seeds treated with neem oil @ 5 ml per kg of seeds have retained better seed quality parameters with minimum bruchid infestation and seed quantitative losses upto twelve months of storage period. Hence, it is highly advisable for storing the blackgram seeds which are maintained by the seed producers/farmers/seed growers.

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