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RESEARCH PAPER

Assessment of relative efficacy of different seed treatments in controlling bruchids (*Callosobruchus chinensis*) during storage in cowpea [*Vigna unguiculata* (L.) Walp]

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Abstract : An experiment was conducted in Completely Randomized Design (CRD) with seven treatments replicated three times to evaluate the relative efficacy of different seed treatments in controlling bruchids [*Callosobruchus chinensis* (L.)] and their effect on seed quality parameters during storage of cowpea variety KBC-2. In the storage study of six months, different seed treatments were used *viz.*, Malathion 5 per cent dust, pongamia oil, neem oil, neem leaf powder, sand and ash. Among the different seed treatments it was observed that sand layer of 2.5 cm thick above the seeds stored was found to be effective in maintaining minimum development of bruchid population (3.6 per 100 seeds), 10 per cent seed damage, 3.13 per cent weight loss of seeds, 67.3 per cent seed germination and 20.8 per cent protein content at the end of storage, followed by neem oil treatment.

Key Words : Cowpea, Malathion dust, Pongamia oil, Neem oil, Sand, Ash

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INTRODUCTION

Cowpea (*Vigna unguiculata*.L. Walp) is a most important food legume in the semi-arid tropics covering Asia, Africa, Southern Europe, Central America and Southern America. Its desirability reflects the fact that the leaves, immature pods, fresh seeds (southern peas or green pods) and dry grain can be eaten or marketed. The mature grain contain 23-25 per cent protein, 50-67 per cent starch, B vitamins such as folic acid which is important in preventing birth defects, and essential micronutrients such as iron, calcium, and zinc. Cowpea is equally important as nutritious fodder for the livestock. It tolerates low fertility soil due to its high rate of nitrogen fixation.

However, the main problem that farmers face is the conservation of the cowpea crop/seed, because 80 to 100 per cent of grains are destroyed by bruchid species namely [*Callosobruchus chinensis* (L.)] in a period of 2 to 3 months after storage causing both qualitative as well as quantitative losses (Khadim and Semben, 2010). Chemical control methods have proved to be very effective in the control of stored grain insect pests, but leave an array of problems behind. They are known to have residual effects and pose handling problems and health hazards and later insects also may develop resistance to them. More over these chemicals are not locally produced and hence represent additional input cost to the farming community. As a consequence, there has been a

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growing need for a safe and non toxic alternative seed protectant. Therefore use of natural (host plant) resistance exhibited by pulses varieties and locally available materials became the most important non chemical methods of integrated pest management.

MATERIALS AND METHODS

With this view an experiment was conducted during 2007-08 at University of Agricultural Sciences, GKVK, Bangalore in Completely Randomized Design (CRD) with seven treatments replicated three times to evaluate the relative efficacy of different seed treatments in controlling bruchids [*Callosobruchus chinensis* (L)] and their effect on seed quality parameters. The details of the treatments are furnished below:

Treatments :

T_1 - Malathion 5 per cent dust
T_2 - Pongamia oil
T_3 - Sand
T_4 - Neem oil
T_5 - Neem leaf power
T_6 - Ash
T_7 - Control

Five hundred grams of healthy cowpea seeds of KBC-2 variety with zero infestation were taken into transparent plastic jar of one kg capacity. Ten pairs of 0-24 hour's old bruchids (*Callosobruchus chinensis*) were released into each of the plastic jars and removed the dead insects after one week. Then these seeds were treated with different treatments and observations were recorded at monthly intervals by drawing 100 seeds randomly from the jar and manual counting was done for estimation of bruchids population and damaged seeds parameters.

The per cent weight loss in seeds and seed infestation level were estimated as follows:

% Weight loss in seed due to infestation = (C x G) / B x 100

% Damaged seeds (infestation level) = (G/A) x 100

where,

A= sample size is 100 seeds
B = weight of the sample
C = loss in mass per grain due to infestation (D-E)
D = per seed weight of undamaged seed (H/F)
E = per seed weight of damaged seed (I/G)
F = number of undamaged seeds in the sample
G = number of damaged seeds
H = mass of undamaged seeds
I = mass of damaged seeds

RESULTS AND DISCUSSION

In sand and neem oil treated stored seeds, zero and lesser number of bruchid emergence was observed in six months of storage period which indicates the effective control of bruchids in these treatments. There was no significant increase in the number of adults emerged from one bruchid generation to next in case of ash treatment and neem leaf powder at first to six month after treatments. Though there was an infestation in first insect generation, the adults emerged subsequently had a hindrance for movement due to ash mixed with seeds. This may probably due to the deposition of fine particles of ash in the joints of insect body (Table 1). Lakshminarasimhaiah (1993); Parashiva murthy *et al.* (1994) and Lale *et al.* (2000); reported the effectiveness of malathion, neem oil and honge oil in controlling bruchids in pigeonpea and field bean.

With regard to per cent seed damage, seeds treated with sand, neem oil, pongamia oil and malathion were on par with each other *i.e.*, less infestation (Table 2). These findings are in accordance with reports made by Khare *et.al.* (1992) in neem oil and pongamia oil. The seed weight loss were also absolutely less in these treatments at the end of fifth and sixth monthly

Table 1: Effect of seed treatments on bruchid population in KBC-2 genotype of cowpea during storage

Treatments		1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	Mean
T_1	Malathion	4.0 (l.93)	10.6 (3.32)	9.6 (3.08)	18.0 (4.29)	20.6 (4.57)	30.0 (5.52)	15.27
T_2	Pongamia oil	2.33 (l.54)	13.0 (3.58)	17.6 (4.25)	20.6 (4.57)	25.0 (5.03)	23.3 (4.84)	17.0
T_3	Sand	0.0 (0.70)	0.0 (0.70)	l.0 (l.09)	l.0 (l.09)	3.0 (l.85)	3.6 (2.0)	l.44
T_4	Neem oil	3.33 (1.73)	4.6 (2.04)	8.3 (2.82)	6.6 (2.61)	7.3 (2.74)	9.3 (3.10)	6.61
T_5	NLP	6.0 (2.45)	15.3 (3.97)	20.3 (4.56)	23.3 (4.85)	28.0 (5.33)	30.3 (5.54)	20.83
T_6	Ash	8.33 (2.94)	14.66 (3.84)	21.66 (4.69)	28.0 (5.29)	30.33 (5.49)	30.66 (5.57)	22.27
T_7	Control	9.66 (3.17)	23.0 (4.83)	23.66 (4.9)	40.0 (6.35)	39.33 (6.30)	37.0 (6.11)	28.77
	Mean	4.8	11.6	14.6	19.6	22.3	23.12	
				S.E.±			C.D. at 5%	
MAS				0.13			0.39	
Treatments				0.14			0.42	
MAS x Treatments				0.36			1.03	

MAS - Months after storage , NLP - Neem leaf powder

observations (Table 3). Similar observations were made by Kumari *et al.* (1990) with neem oil in peas against bruchids. The protectant actions of oils such as ovicidal, larvicidal were reported by several workers but actual mode of action is not yet dealt in detail.

The per cent seed damage in sand layer treatment was only 10 per cent in sixth month after storage; as a result there was only 3.13 per cent seed weight loss. Bruchid population was only 3.6 per 100 seeds at sixth month after storage. These results clearly indicate that sand layers effectively prevent bruchid infestation in grains covered with sand layers. However, the sand layers are not effective in controlling the infestation already present (inoculated / hidden / field infestation) in the grain medium covered under a layer of sand. Also the smaller and thicker sized sand particles adds to the bruchid infestation to effectively prevent cross infestation of bruchid (Suresh, 1997; Subramanya, 1999; Choudhary and Pathak, 1989).

There was a steady increase in seed damage in case of ash treatment (21.66, 31.66, 49.66, 52.0, 96.33, 99.33 per cent) at first to six months after storage. Seed weight loss also increased from 7.54 per cent (first month after storage) to 29.94 per cent (sixth month after storage). The steady increase in per cent infestation and seed weight loss due to cumulative effect of each insect generation. The effectiveness of ash in reducing the infestation due to bruchids was also reported by Jane *et al.* (1991); George, *et al.* (2007) and Yusuf *et al.* (2011) in cowpea. Ash apparently acts as physical barrier hence the adults could not able to make and lay eggs as they were physically normal but functionally dead as per Jane *et al.* (1991).

In case of neem leaf powder, the per cent seed damage ranged from 22.33 to 93.3 per cent at first to six months after storage, respectively. While the seed weight loss recorded were 1.6, 6.09, 11.91, 12.51, 32.93 and 24.43 per cent from first to six months after storage, respectively.

Table 2: Effect of seed treatments on per cent seed damage in KBC-2 genotype of cowpea during storage

Treatments		1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	Mean
T_1	Malathion	7.6(13.21)	30.3(32.77)	43.3(40.78)	50.6(45.4)	75.3(60.33)	79.0(62.93)	47.61
T_2	Pongamia oil	7.0(11.32)	24.6(29.17)	32.3(34.08)	42.3(40.55)	47.0(43.27)	58.6(50.03)	35.33
T_3	Sand	0.0(0.0)	1.6(6.03)	1.6(5.75)	5.6(13.31)	10.3(18.68)	10.3(18.72)	4.94
T_4	Neem oil	0.6(2.71)	2.0(4.72)	9.0(16.38)	6.6(12.27)	13.3(21.37)	17.3(24.51)	8.16
T_5	NLP	22.3(28.05)	39.0(38.56)	57.3(49.2)	69.0(56.18)	89.3(71.42)	93.3(75.2)	64.94
T_6	Ash	21.66(26.45)	3l.66(33.34)	49.66(44.4)	52.0(46.23)	96.33(8l.27)	99.33(86.90)	58.44
T_7	Control	32.66(34.51)	39 . .33(38.51)	64.66(53.76)	81.0(64.62)	97.0(81. 98)	100.0(89.42)	69.10
	Mean	13.11	24.07	36.83	43.87	61.21	65.40	
				S.E.±			C.D. at 5%	
MAS				l.79			5.05	
Treatments				l.793			5.45	
MAS x Treatments				4.75			13.36	

MAS - Months after storage , NLP - Neem Leaf Powder

Table 3: Effect of seed treatments on per cent weight loss of KBC-2 seeds of cowpea during storage

Treatments		1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	Mean
T_1	Malathion	0.91(5.47)	l.69(7.46)	10.18(18.60)	14.70(22.54)	14.84(22.58)	6.19(13.93)	8.08
T_2	Pongamia oil	l.57(7.20)	l.74(7.57)	3.71(1l.10)	12.12(20.36)	7.25(15.52)	8.18(16.60)	5.76
T_3	Sand	0.0(0.0)	0.22(2.68)	0.25(2.80)	0.95(5.58)	2.21(8.54)	3.13(10.18)	l.12
T_4	Neem oil	0.30(3.15)	0.13(2.06)	0.23(2.75)	0.83(4.91)	3.26(10.09)	3.77(10.45)	1.42
T_5	NLP	1.60(7.27)	6.09(14.28)	11. 91 (20.19)	12.51(20.69)	32.93(35.01)	24.43(29.62)	14.91
T_6	Ash	7.54(15.93)	5.09(13.04)	17.50(24.58)	23.91(29.02)	50.75(45.43)	29.94(33.17)	31.92
T_7	Control	8.04(16.47)	13.50(2l.55)	19.28(26.03)	23.87(29.10)	72.95(58.66)	64.52(53.44)	24.23
	Mean	7.93	9.81	15.15	18.89	27.97	23.91	
				S.E.±			C.D. at 5%	
MAS				0.59			1.69	
Treatments				0.64			1.82	
MAS x Treatments				1.56			4.47	

MAS - Months after storage, NLP - Neem leaf powder

This showed that the neem leaf powder was effective only in the first month of storage due to presence of active principle 'azadirectin' which acts as antifedant. Since the experiment was carried out in aerated conditions where boxes covered with muslin cloth, the effectiveness of azadirectin might have lost in the subsequent insect generation. Similar results were also reported by Yadava and Bhatnagar (1987) in cowpea and Araya Gselase *et al*.(2009), in haricot beans.

The results on germination percentage at different monthly intervals showed that sand treatment has no adverse effect on seed germination and it is found to maintain germination percentage of 67.3 per cent as compared to untreated control at the end of sixth month after storage. There was a gradual decrease in germination per cent as the treatments and storage period increased. Relatively reduction of germination percentage in pongamia oil treated seeds was observed and it was due to some inhibitory effects in oils. No effect of oil treatments on germination were also reported in green gram with neem oil, pigeonpea with neem oil and pongamia oil (Khare *et al.* (1992) and field bean with neem oil and Malathion (Parashiva murthy *et al.,* 1994) which agrees with present findings. There was drastic reduction in the germination per cent from treated seeds with neem leaf powder, ash and untreated control. There was no adverse effect of neem leaf powder on germination percentage as reported by Subramanya *et al.* (1999) However, the reduction in germination per cent in present study may be due to seed damage by bruchid infestation, since the study started with artificial infestation.

Higher seed protein content (20.8 %) was noticed in seeds treated with sand layer at the end of storage period. The higher loss in protein content in untreated seeds may be due to higher kernel damage and loss of food reserves as a result of higher infestation of bruchid while, it was less in treated seeds due to protection offered to seeds against insect infestation. Similarly protein content was also estimated by Arati Patil (2000) in cowpea seeds treated and stored.

The severities of bruchid emergence, seed damage, seed

Table 4: Effect of seed treatments on seed germination per cent during storage of KBC-2 genotype

Treatments		1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	Mean
T_1	Malathion	83.66 (66.2)	71.0(57.4)	58.0(49.6)	41.3(39.9)	22.0(27.8)	13.3(21.3)	48.21
T_2	Pongamia oil	75.66(60.4)	72.3(58.2)	62.0(51.9)	42.0(40.3)	34.6(36.0)	17.6(24.7)	50.69
T_3	Sand	89.66(71.2)	79.1(71.2)	78.5(63.6)	75.3(60.3)	70.3 (57.0)	67.3(55.3)	76.69
T_4	Neem oil	82.66(66.1)	76.3(60.8)	64.3(53.3)	59.6(50.5)	53.6(47.1)	46.3(42.8)	63.79
T_5	NLP	78.33(61.6)	65.0(53.7)	48.6(44.2)	35.0(36.2)	13.6(17.9)	4.0(6.7)	40.75
T_6	Ash	75.0(59.3)	58.3(49.8)	32.6(34.6)	13.6(21.5)	3.6(6.45)	2.0(4.7)	30.85
T_7	Control	76.33(60.8)	58.3(49.7)	33.6(35.3)	17.3(24.4)	0.0(0.0)	0.0(0.0)	30.92
	Mean	80.19	68.61	53.94	40.58	28.1	21.5	
				S.E.±			C.D. at 5%	
MAS				1.09			3.06	
Treatments				1.17			3.31	
MAS x Treatments				2.88			8.12	

MAS - Months after storage, NLP - Neem leaf powder
Figures in the parenthesis indicates Arc sine transformed values for which statistical analysis was done.

Table 5: Effect of seed treatments on protein content (%) of KBC-2 genotype during storage

Treatments		Initial	6 MAS
T_1	Malathion	22.1	20.3
T_2	Pongamia oil	21.6	19.1
T_3	Sand	22.1	20.8
T_4	Neem oil	21.7	19.6
T_5	NLP	22.3	18.7
T_6	Ash	22.0	18.1
T_7	Control	22.2	18.0
	Mean	22.0	19.22
	S.E.±	0.22	0.22
	C.D.@ 5%	0.67	0.68

MAS - Months after storage , NLP - Neem leaf powder

weight loss were significantly lower in case of sand treatment followed by neem oil. The germination percentage was highest in sand followed by neem oil where as protein percentage was highest in sand followed by malathion dust. This may be fact that sand particles may trigger a physical reaction on skin of insects and the resulting physical disturbance may help cause their death and oils have ovicidal effect and in case of malathion dust it may be due to contact toxicity and also odour which suppress the growth of bruchids.

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