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Evaluation of eco-friendly seed protectants against *Callasobruchus chinensis* (L.) infestation in chick pea during storage

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Abstract
The study was conducted at seed Research and Technology Centre, PJTSAU during 2016 -17 to 2018-19 to know the effect eco-friendly seed treatment on seed storability of Chick pea. Seeds were treated with inorganic insecticides [Emamectin benzoate @ 2 ppm kg^{-1} and Delatmethrin @ 1 ppm kg^{-1}) and botanicals [*Azadirachtin* 10000 ppm @ 1.5 ml kg^{-1}, *Pongamia pinnata* oil @ 5 ml kg^{-1}, Citronella oil @ 5 ml kg^{-} and *Acorus calamus* @ 10 ml kg^{-1} seed. Among the different botanical seed treatments, the seed treatment with *Acorus calamus* has maintained minimum prescribed seed germination (88.11%) up to twelve months of storage, along with the highest seedling vigour index (1348) and lowest seed damage (0.34%). Whereas lower seed germination (61.78%), seedling vigour index (1121) and maximum seed damage (7.71%) was observed in untreated control. Therefore, *Acorus calamus* @ 10 ml kg^{-1} seed has found effective in maintaining the seed quality with minimum seed infestation up to twelve months of storage.

Keywords: Chick pea seeds, pulse beetle [*Callasobruchus chinensis* (L)], management, botanicals

1. Introduction
There is a growing demand for Chick pea due to its nutritional value. It is a good source of carbohydrates and protein. In India it occupies an area of 105 lakh hectares with annual production of 113 lakh tonnes and productivity of 1078 kg ha^{-1}. Telangana state accounts for 0.97 lakh hectares of area with production and productivity of 1.47 lakh tonnes and 1516 kg ha^{-1}, respectively (Indiastat.com, 2017-18) [3]. It is grown in Kamareddy, Sangareddy, Jogulamba Gadwal, Nizamabad and Adilabad districts of Telangana.
Chick pea is menaced by more than 200 species of insect pests under storage conditions in Indian context. Among these, the pulse beetles (*Callosobruchus chinensis* L.) are the major pests in stored pulse (Ahad, 2003 and Bhalla *et al*. 2008) [2]. Pulse beetles are most dominant causing severe losses. In case of heavy infestation by *Callosobruchus chinensis*, the seeds lose their germination capacity and become unfit for human consumption. Severe infestation leads to 100 percent damage thus leaving the seed coat. In addition to quantitative losses, the *Callosobruchus chinensis* also causes qualitative losses (Khare, B.P. and R.K. Johari, 1984) [11]. Post-harvest losses in Chick pea were reported to be 6.97 percent of production. In grub stage, the beetle lives inside the grain and fills the burrow with their excretion and dead bodies (Atwal, A.S, 1976) [5]. Currently, the control of stored product pests is primarily based on the use of synthetic pesticides, either as contact insecticides or as fumigants (Arthur, 1996) [4]. The extensive application of insecticides is directly related with the development of resistance of stored product insect species, raising serious concerns for human health as a result of food contamination with residues and possible environmental hazards (Boyer *et al*. 2012; Stadler *et al*. 2012) [7, 20]. These problems point out the necessity for research investigation towards the development of alternative methods for the protection of stored products.

2. Materials and Methods
A laboratory experiment was conducted at Seed Research and Technology Centre, Rajendranagar, Hyderabad during 2016-2018 by using the JG 11. Freshly harvested certified seed with high germination percentage (>99%) and low moisture content (<9%) was used. The study was carried out with seven treatments *viz.* Emamectin benzoate @ 2 ppm kg^{-1}, Deltamethrin @ 1 ppm kg^{-1}, Azadirachtin 10000 ppm @ 1.5 ml kg^{-1}, Karanj oil @ 5 ml kg^{-1},

Citronella oil @ 5 ml kg^{-1} and *Acorus calamus* @ 10 ml kg^{-1} and untreated control. The experiment was laid out in Completely Randomized Design with three replications. Required quantity of insecticides will be diluted in 5ml water to treat 1kg of seed for proper coating. Botanicals will be directly mixed with seed for coating. After drying in shade, seeds will be packed and kept in room under ambient temperature. Data were recorded on following parameters.

2.1 Percentage seed damage

Percentage seed damage was calculated by taking a random sample of 400 seeds and counting the number of seeds with bored holes of pulse beetle and converted into percentage.

$$\text{Percentage seed damage} = \frac{\text{Number of damaged seeds}}{\text{Total number of seeds}} \times 100$$

2.2 Adult emergence

Number of live and dead insects emerged out from 500 gram sample seed of each replication of the treatment was counted.

2.2 Percent seed germination

Germination of the seeds was tested by paper towel method by maintaining three replications of each treatment. 100 paddy seeds were kept in moist paper towel and allowed to germinate in walk in germinator for 8 days and the percentage of germination was calculated by using the formula

$$\text{Percentage of seed germination} = \frac{\text{Number of germinated seeds}}{\text{Total number of seeds}} \times 100$$

2.3 Seedling vigour index

For determination of the seedling vigour index, eight days old 10 healthy germinated seedlings were selected from each replication of the treatment and shoot and root length of each of the 10 seedlings were measured in centimeter and average length of the seedlings was calculated

Seedling length = Shoot length + Root length

Seedling vigour index was calculated by multiplying germination percentage with seedling length as suggested by Abdul Baki and Anderson (1973) [1].

Seedling vigour index (SVI) = Percent seed germination x seedling length

2.4 Seed moisture content

Moisture content of the seed was taken by using Dickyjohn moisture meter.

2.5 Statistical analysis

The data were analyzed by adopting Completely Randomized Design (CRD) as suggested by Snedecor and Cochran (1967) [19].

3. Results and Discussion

The efficacy of botanicals along with chemical check against *Callasobruchus chinensis* were evaluated against pulse beetle and impact on seed quality was studied and results are presented in Tables 1 and 2.

3.1 Effect of insecticidal and botanical seed treatments on adult emergence by *Callasobruchus chinensis*

The data on mean number of adults emerged from the seeds treated with different insecticides and botanicals are presented in Table 1. The data on adult emergence of *Callasobruchus chinensis* recorded at three months of storage revealed that all the seed treatments were lethal to test insect and resulted in complete mortality and did not recorded any mean adult emergence except Citronella oil @ 5ml kg^{-1} (6.33) and untreated control (8.33).

At six months of storage lowest mean number of adult emergence (6.33) was observed in *Acorus calamus* @ 10 ml kg-1 treated seeds and was on par with Emamectin benzoate @2 ppm kg^{-1} seed (8.00) followed by *Pongamia pinnata* @ 5 ml kg^{-1} seed resulted 14 mean number of adult emergence and was on par with Delatamethrin @1 ppm kg $^{-1}$ (14.67) seed treatment. In the rest of treatments mean number of adult emergence ranged from 24.53-35.67, while highest number of adult emergence (37.33) was observed in untreated control. At nine and twelve months of storage the least mean number of adult emergence (7.33 and 8.33) were recorded in *Acorus calamus* @ 10 ml kg^{-1}, respectively.

The results obtained from adult emergence studies clearly revealed superior performance of *Acorus calamus* @10 ml kg^{-1} seed in protecting Chick pea seed and was on par with emamectin benzoate @ 40 mg kg^{-1} seed. The few eggs laid on *Acorus calamus* @10 ml kg^{-1}seed, could not complete their development resulting in no adult emergence up to three months. The reduction in adult emergence observed in the present study could also be due to low hatchability of eggs.

Shukla *et al*. (2002) [18] determined the dose at which rhizome powder of *Acorus calamus* proved fatal, causing 100 percent mortality of *C. chinensis* in Chick pea and completely inhibiting F_1 emergence by ovicidal activity as 5 mg g^{-1} (0.5% w/w).

3.2 Effect of insecticidal and botanical seed treatments on seed damage caused by *Callasobruchus chinensis*

The efficacy of insecticidal and botanical seed treatment on seed damage by *C. chinensis* indicated all the treatments gave complete protection up to three months of storage except Citronella oil @ 5 ml kg^{-1} seed and untreated control which resulted in 1.33 and 2.13 percent seed damage, respectively. At six months of storage, among the botanicals lowest percent seed damage was observed in *Acorus calamus* @10 ml kg^{-1} seed was on par with Emamectin benzoate @ 2 ppm kg^{-1} seed. At nine and twelve months of storage among botanicals *Acorus calamus* maintained its supremacy followed by *Pongamia pinnata* oil @ 5 ml kg^{-1} seed.

These results are in conformity with the findings of Sunil Kumar (2003) [21] who reported that, sweet flag rhizome powder and custard apple seed powder recorded significantly minimum damage to seeds with 17.20 and 20.00 percent, respectively against *S. oryzae* in sorghum at 180 days after storage. Similar work was done by Jadhav (2006) [10] who reported that no seed damage was reported at 180 days after treatment when treated with *A. calamus* rhizome powder @ 1 percent, while custard apple seed powder, neem seed powder @ 5 percent and malathion 5D @ 5 percent recorded significantly less percentage of damaged seeds. Kudachi (2008) [13] who reported that, seeds treated with *A. calamus* rhizome powder @ 1 percent was significantly superior with no damage to seeds. While, significantly maximum damage to seeds was noticed in untreated check (82.00 percent).

3.3 Effect of insecticidal and botanical seed treatments on germination of chick pea seeds

The results obtained on effect of insecticidal and botanical seed treatments on germination of maize seed were presented

in the Table 2.

Highest germination percentage (98.88) was observed in deltamethrin 2.8 EC @ 1ppm kg $^{-1}$ seed (98.81%) which, was on par with all other botanical seed treatments. There was no significant difference among treatments at three months of storage.

At six months of storage, highest germination percentage (97.67) was recorded in Emamaectin benzoate 5 SG 2 @ 2 ppm kg seed and was on par with *Acorus calamus* @ 10 g kg^{-1} seed (97.44). The germination percentage in the rest of the treatments ranged from 94.22-94.67 percent. While, germination percentage recorded was 93.67 percent in untreated control.

At nine and twelve months of storage highest seed germination was recorded in *Acorus calamus* 88.89 and 88.11 percent, respectively.

The perusal of the data obtained on the effect of seed protectants on germination of Chick pea seeds suggested that there was no negative effect of insecticidal and botanical seed treatments on the germination of Chick pea seeds.

These findings are in accordance with the results of the earlier workers. Sandeep *et al*. (2013) [17] reported that seeds treated with sweet flag rhizomes powder @ 10 g kg^{-1} seed had recorded higher germination (87.3), vigour index (2864) and less infestation (3.6 percent) at the end of 10 months of storage of sweet corn seed.

Rajesh *et al*. (2017) [15] observed sorghum seeds treated with sweet flag powder (2.5 percent) and custard apple seed powder 2.5 percent showed significantly higher 100 seed weight, germination percentage, seedling vigour, field emergence percentage and adult mortality as compared to other seed treatments and control during storage.

Seeds treated with different botanicals did not affect the germination of seeds when compared with control. Overall results indicated that botanicals used in the present investigation had no adverse effect on seed germination of Chick pea seeds and can be safely used for treating the seed.

3.4 Effect of botanical seed treatments on seedling vigour index of maize seeds

After three months of seed treatment, the highest seedling vigour index was observed in emamectin benzoate 5 SG @ 40 mg kg^{-1} seed (3654). However, it was on par with all other treatments. Among the botanical seed treatments highest seedling vigour index was observed in *Acorus calamus* @ 10 ml kg^{-1} seed (1592, 1452 and 1348) at six, nine and twelve months respectively.

Rajesh *et al*. (2017) [15] observed that sorghum seeds treated with sweet flag powder rhizome (2.5 percent) and custard apple seed powder 2.5 percent showed significantly higher 100 seed weight, germination percentage, seedling vigour, field emergence percentage and adult mortality as compared to other seed treatment and control during storage.

Seeds treated with different botanicals did not affect the viability of seeds when compared with control. Overall, results indicated that viability was found to be decreased with increase in storage period due to natural aging and due seed damage caused by *Callasobruchus chinensis.*

3.5 Effect of insecticidal and botanical seed treatments on moisture content of chick pea seeds

The observations recorded at three months after treatment imposition revealed that lowest moisture content was recorded in *Pongamia pinnata* oil @ 5 ml kg^{-1} seed (12.97 percent), which was on par with rest of the treatments. There was no significant difference among the treatments at six month of storage.

The observations recorded at nine months after treatment imposition revealed that lowest moisture content (8.82) was recorded in Emamectin benzoate 5 SG @ 2 ppm kg^{-1} seed and was on par with Deltamethrin 1 ppm kg^{-1}, *Azadiractina indica* @ 5 ml kg^{-1} seed and *Acorus calamus*. While moisture content in untreated control was 9.11 percent. At twelve months of storage all the treatments were on par with each other.

Among botanicals, *Acorus calamus* @10 g kg^{-1} seed was found to be effective botanical seed treatments up to nine months of treatment (Plate 4.4).

The insecticidal activity of *A. calamus* against *C. chinensis* and other stored coleopterans has been reported previously (El-Nahal *et al*. 1989; Risha *et al*. 1990; Kim *et al*. 2003; Nandi, 2007) [8, 12, 14, 16].

The present study recommends the use of *Acorus calamus* for the control of pulse beetle. Products derived from *A. calamus* are used as pharmaceuticals worldwide and could therefore be considered less harmful to humans than most conventional insecticides.

Table 1: Efficacy of insecticides and botanicals on pulse beetle adult emergence seed damage percent in Bengalgram

S. No.	Treatments	Mean adult emergence				Seed damage (%)			
		3 M	6 M	9 M	12 M	3 M	6 M	9 M	12 M
T1	Emamectin benzoate (Proclaim 5 SG) @ 2 ppm (40.0 mg/kg seed)	0.00	8.00	11.67	9.00	0.00	0.34	0.11	0.09
T2	Deltamethrin 2.8 EC @ 1.0 ppm (0.04 ml/kg seed)	0.00	14.67	17.67	23.00	0.00	0.42	0.07	0.00
T3	Neem Azal 10000 ppm @ 1.5 ml/ kg seed	0.00	24.33	25.67	57.33	0.00	2.60	1.51	1.46
T4	Karanj (pongamiapinnata) oil @ 5ml/kg seed	0.00	14.00	22.00	12.00	0.00	0.39	1.06	0.43
T5	Citronella oil @ 5ml/kg seed	6.33	35.67	26.67	26.00	1.33	2.64	2.18	1.74
T6	Acoruscalamus @ 10 ml/kg seed	0.00	6.33	7.33	8.33	0.00	0.19	0.25	0.34
T7	Untreated control	8.33	37.33	53.00	139.33	2.13	5.72	7.92	7.71
	CD at 5%	0.55	2.18	3.11	4.87	0.50	0.74	0.16	0.252

Table 2: Efficacy of insecticides and botanicals against storage insects of seeds and their influence on seed viability during storage under ambient condition in Bengalgram

S. No.	Treatments	Germination percentage				Seedling vigour index				Moisture content (%)			
		3 M	6 M	9 M	12 M	3 M	6 M	9 M	12 M	3 M	6 M	9 M	12 M
T1	Emamectin benzoate @ 2 ppm (40.0 mg/kg seed)	97.44	97.67	92.44	89.56	2274	1804	1629	1560	13.18	11.21	8.82	8.34
T2	Deltamethrin 2.8 EC @ 1.0 ppm (0.04 ml/kg seed)	98.89	95.44	91.00	88.56	2384	1596	1615	1426	13.28	11.46	8.83	8.40
T3	Neem Azal 10000 ppm @ 1.5 ml/kg seed	97.44	94.56	88.89	82.78	2269	1569	1367	1259	13.02	11.46	8.89	8.52
T4	Karanj (pongamiapinnata) oil @ 5 ml/kg seed	97.56	94.67	85.78	83.44	2307	1467	1366	1129	12.97	11.43	9.02	8.66

T5	Citronella oil @ 5ml/kg seed	97.67	94.22	87.44	84.67	2256	1427	1237	1144	13.26	11.64	8.90	8.62
T6	Acoruscalamus @ 10 ml/kg seed	97.00	97.44	88.67	88.11	2248	1592	1452	1348	13.03	11.26	9.02	8.68
T7	Untreated control	97.78	93.67	75.22	61.78	2179	1455	1250	1121	13.14	11.44	9.11	8.56
	CD at 5%	N.S.	2.15	1.65	5.057	N.S.	61.608	76.31	68.621	N.S.	N.S.	0.13	N.S.

4. Conclusion

The findings of the present investigation were based on laboratory trials and can therefore be recommended for the use in pest management strategies, especially by small-scale farmers who store small amounts of pulses for consumption and planting. This plant may be further investigated to determine the exact mode of action of active ingredients and their effect on non-target organisms.

5. References

1. Abdul Baki AA, Anderson AA. Vigour determination in soybean seed by multiple criteria. Crop science 1973;13:630-633.
2. Ahad MA. Pest management in graminacious crops (in Bangla). Bangla Academy, Dhaka, Bangladesh 2003.
3. Area, Production and Productivity of Chick pea 2017-18. https://www.indiastat.com.
4. Arthur FH. Grain protectants: current status and prospects for the future. Journal of Stored Products Research 1996;32(4):293-30.
5. Atwal AS. Agricultural pests of India and South-East Asia. Agricultural pests of an India and South-East Asia Kalyani Publisher. Delhi, India 1976, 159.
6. Bhalla SK, Gupta Lal B, Kapur ML, Khetarpal RK. Efficacy of various non-chemical methods against pulse beetle, *Callosobruchus maculatus* Fab. Int. Conf. Diver. crop protection; La Grande-Motte, France - Oral presentations 2008.
7. Boyer S, Zhang H, Lemperiori G. A review of control methods and resistance mechanisms in stored-product insects. Bulletin of entomological research 2012;102(2):213-229.
8. El-Nahl AKM, Schmidt GH, Risha EM. Vapours of *Acorus calamus* oil. A space treatment for stored product. Journal of Stored Products Research 1989;25:211-216.
9. ISTA (International Seed Testing Association). International rules for seed testing 1999. Supplement to Seed Science and Technology 1999;27:27-32.
10. Jadhav K. Biology and management of Rice weevil, *Sitophilus oryzae* (L.) in pop sorghum. M.Sc. (Agri.) Thesis, Univ. Agric. Sci. Dharwad 2006.
11. Khare BP, Johari RK. Influence of phenotypic characters of Chick pea (*Cicer arietinum* L.) cultivars on their susceptibility to *Callosobruchus chinensis* L. Legume Research 1984;7(1):54-56.
12. Kim SI, Park C, Ohh MH, Cho HC, Ahn YJ. Contact and fumigant activities of aromatic plant extracts and essential oils against *Lasioderma serricorne* (Coleoptera: Anobiidae). Journal of Stored Product. Research 2003;39:11-19.
13. Kudachi DC. Management of lesser grain borer, *Rhizopertha dominica* Fab. and rice weevil, *Sitophilus oryzae* Linn. in stored sorghum. M.Sc. (Agri.) Thesis, Univ. Agric. Sci. Dharwad 2008.
14. Nandi KC, Biswas AK, Acharya HN. Density-of-states determination in hydrogenated amorphous silicon obtained from rice husk. Materials Letters 1991;12(3):171-174.
15. Rajesh G, Vipin B, Prachi Ashish L, Ramesh P, Sanjiv C. The influence of some botanicals against rice weevil during storage in rabi sorghum. International Journal Of Researches In Biosciences, Agriculture And Technology 2017;5(1):28-30.
16. Risha EM, El-Nahal AKM, Schmidt GH. Toxicity of vapours of *Acorus calamus* L. oil to the immature stages of some stored-product coleoptera. Journal of Stored Products Research 1999;36:133-137.
17. Sandeep RS. Biology and management of groundnut pod borer *Caryedon serratus* (Oliver) in groundnut pods. M. Sc. (Ag.) Thesis. Acharya N.G. Ranga Agricultural University, Hyderabad 2005.
18. Shukla S, Tiwari SK. Toxicity of Dryopteris filix-mas powder against the ontogeny of rice-moth, *Corcyra cephalonica* (Staint.) (Lepidoptera: pyralidae). Asian Journal Experimental Science 2002;25(2):17-24.
19. Snedecor ME, Cochran TS. Statistical methods. Calcutta: Oxford and IBH 1967, 296.
20. Stadler T, Buteler M, Weaver DK, Sofie S. Comparative toxicity of nanostructured alumina and a commercial inert dust for *Sitophilus oryzae* (L.) and *Rhyzopertha dominica* (F.) at varying ambient humidity levels. Journal of stored products research 2012;48:81-90.
21. Sunil Kumar. Survey of indigenous technologies and evaluation of botanicals against major storage pests. M.Sc. (Agri.) Thesis, University of Agricultural. Science, Dharwad (India) 2003, 124.