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ORIGINAL ARTICLE

Efficacy of Application of four Vegetable Oils as Grain Protectant against the Growth and Development of *Callosobruchus maculatus* and on its Damage

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ABSTRACT

Four vegetable oils viz, Neem oil (Azadirachta indica), Eucalyptus (Eucalyptus globulus) , Sunflower oil (Helianthus annus) and Castor oil (Ricinus communis) each were applied @ 1 ml and 3 ml/ kg of pigeon pea against the pulse beetles (Callosobruchus maculatus fab.).Their effectiveness with both the dosages i.e. 1 ml and 3 ml/ kg seed in reducing the egg laying and adult emergence and normally delayed the developmental period .The infestation of beetle after 120 days of treatment with higher of eucalyptus oil, castor oil and neem oil dose i.e. 3ml/kg seed was recorded in terms of reduction in weight loss of the grain , which gave 100% control while 1ml/kg seed dose of these oils was also found effective (0.33, 0.46 and 0.55%).Results showed that the oils do effect the protoplasm of the egg and larval feeding , hence oils proved to be most effective and safest method to control the pulse beetle for stored pulses. Out of two dosages applied, 3ml/kg seed was found most effective in minimizing the pest incidence. Seed treatment with different oils @ 1ml and 3ml/kg seed has no significant adverse effect on seed germination after 120 days of treatment.

***Key words**: Callosobruchus maculatus (fab) , grain protectant Azadirachta indica (Linn), Helianthus annus (Linn) , Ricinus communis (Linn) , Eucalyptus globules (Labille).*

INTRODUCTION

Pulses (grain legumes) are the second most important group of crops world wide .Globally , 840 million people are undernourished mainly on account of inadequate intake of proteins, vitamins and minerals in their diets. Pulses are excellent sources of proteins (20-40 %), carbohydrates (50 - 60 %) and are fairly good sources of thiamin, niacin, calcium and iron. One of the major constraints in production of pulses are the insect pests which inflict severe losses both in the field and storage. In India over 200 species of insect have been recorded infesting various pulses [1]. Among these, pulse beetle, *C. maculatus* is a major pest that causes serious damage and is a cosmopolitan. The pulse seed suffer a great damage during storage due to insect attack [2]. Several bruchid species attack cereals and pulses in the store and causes a loss of 10- 15% with a germination loss ranging from 50- 92% [3]. Pulse beetle *Callosobruchus* species is serious one .this insect has been reported from the Phillipines , Japan , Indonesia , Srilanka , Burma and India. It is a notorious pest of chickpea , mung , peas, cowpeas, lentil and arhar [4]**.** Pulse beetle being internal feeder cannot be controlled with insecticides. It is also not advisable to mix insecticides with food grains. Fumigation being the most effective method cannot be practiced in our villages because the storage structures are not air tight and these are mostly built inside the residential areas. Plant materials which are being traditionally used by some farmers are quite safe and appear to be the most promising grain protectants [5-6]. Vegetables oils and plants products have been used for a long time for the protection of stored grains. But a very little work on the storage of pigeon pea seeds using vegetables oils has been carried out. Khaire et al. [7] reported the effectiveness of vegetables oils against *C. chinensis* on pigeon pea.. *C. maculatus* (F.) attacking vigna species was also tested against several oils . The use of some of vegetable oils (rubber seed oil, palm oil and palm kernel oil) was evaluated against cowpea weevil, *Callosobruchus maculatu**s*** in three cowpea varieties (Ife white, Ife brown and Kano white). There was no adverse effect of the oils on grains quality. Of the three plant oils used, rubber seed oil was the most effective [8]. Pierrard [9] used oils of groundnut , castor , coconut , palm kernel , corn cotton , babassu , mustard , olive , seasome , sunflower and rice , in their studies castor oil at 8 ml/kg provided complete control against *C. maculatus*.

In view of encouraging results obtained by the above workers , the effectiveness of these oils and other vegetable oils were estimated against *C . maculatus* (fab.) infesting pigeon pea seeds in respects of growth and development of the pest and the damage it caused .

MATERIALS AND METHODS

The seeds of susceptible pigeon pea variety T-21 were tested with different vegetable oils as grain protectants viz- Neem oil, Eucalyptus oil, Sunflower oil, Castor oil @ 1ml / kg and 3ml/ kg seed to determine their effect on fecundity, adult emergence , developmental period and grain damage.

Mass culture of *Callosobruchus maculatus* was maintained. The oils were thoroughly mixed with required quantity of seed and kept in 3 kg capacity of glass jar by manual operation . For above each experiment was replicated thrice having 25 g seed in separate glass vials measuring 10×3 cm. In individual treatment of each replication, 5 pairs of matured adults were released into each vial obtained from the pure culture. All vials were kept under the room temperature of 27 ± 2˚ and 75 ± 5 percent relative humidity. The mouth of each vial was covered with muslin cloth and tied with rubber bands. For taking the observations on fecundity, emergence, developmental period and grain damage , three sets of experiments were managed separately for each study. Later on progeny adults were recorded daily when their emergence started. Damaged seeds were obtained after 90 days , while the germination of the treated grains were recorded after 120 days treatment.

RESULTS AND DISCUSSION

Effect on the growth and development of *Callosobruchus maculatus*:

The vegetable oils namely : Neem oil, Eucalyptus oil , Sunflower oil , Castor oil were tested on the growth and development of *C. maculatus* and data presented in Table 1.

Effect on fecundity

The eggs laid by female on the pigeon pea grains were significantly less in comparison to untreated check. The minimum number of eggs were laid on the seeds treated with eucalyptus (10.63) oil which did not differ from seeds treated with neem (14.52) , sunflower (14.67) , Castor (15.37) but these were significantly different from control.

In case of treatment @ 3 ml/kg seed gave almost similar trends as in 1ml/kg dose. The minimum number of eggs (6.35) were observed on eucalyptus treated seeds which was at par with neem (7.56) and sunflower (8.38), but these were significantly superior from castor being (10.61) . Thus, the eggs laid by female on the grains treated with different grain protectants were significantly less in comparison to untreated check. Jagjeet *et al* [10], Raghvan and Kapadia [11] also observed retarded oviposition over the seeds treated with different oils. Mbailao et al [12] reported the effects of 6 common plants extracts including neem and some others which have been never tested on the longevity of adults, the number of eggs laid and adult emergence of *Callosobruchus maculatus* .Lolestani and Shayesteh [13] observed the insecticidal and ovicidal effects of essential oil extracted from *Ziziphora clinopodioides* (Boiss.) (Lamiaceae) were tested on adults and eggs of *Callosobruchus maculatus* (Fab.). Abulude *et al* [14] also found that there was no sign of oviposition during the storage except in the control.

Effect on the emergence

The emergence of adult beetles of *C. maculatus* , recorded from the pigeon pea seeds treated with different oils @ 1ml / kg seed showed that the emergence of adult beetles was less in case of seed treated with eucalyptus oil (1.01) , which was at par with neem oil (1.15) and castor oil (1.37). The treatment of eucalyptus oil , neem oil , castor oil are significantly superior to sunflower oil being 4.36% .The seed treated with different oils @ 3ml / kg gave significantly better results in comparison with untreated check to reduce the beetle emergence from the seed treated with the eucalyptus oil , neem oil and castor oil . The maximum number of adult emergence (3.54 %) were observed on sunflower treated seeds . Verma et al [15], Swella and Mushobozy [16] observed that the use of different oils prevented the emergence of adult beetles. Haghtalab *et* al [17] observed complete suppression in progeny production was achieved on cowpea treated with Castor oil at 9 mL kg^{-1} but in the all case, the percentage of reduced progeny [18].The powders of the leaves of *Hyptis suaveolens*, *Azadirachta indica* and *Ocimum gratissimum* were evaluated for comparative effectiveness in controlling *Sitophilus zeamais* Mots infesting stored maize grain (*Zea mays*) and *Callosobruchus maculatus* Fab infesting stored cowpea seeds (*Vigna unguiculata*).

Effect on the developmental period

Observations recorded on the efficacy of different oils @ 1 ml & 3 ml / kg seed on the developmental period of *C. maculatus* indicated that longer developmental period was observed on the seeds treated with the eucalyptus oil (42.50) which did not differ significantly from neem

oil (41.33) and castor oil (41.66). The minimum developmental period was observed on the seeds treated with the sunflower oil (37.35). The seed treated with different oils @ 3ml / kg gave significantly better results in comparison with untreated check to reduce the development of *C. maculatus* to 0.00 %. The sunflower treated seed showed the maximum development (38.00). Schoonhoven [19] and Don Pedro [20] observed the efficacy of different vegetable oils and under study the oils appeared to be promising as delaying the developmental period of *Callosobruchus* species. Epidi and Udo [21] used ethanolic extract of dried leaves of *Dracaena arborea* (Willd.) Link (Dragon tree; Dracaenaceae) dissolved in distilled water and observed that progeny production and development of eggs within grains were inhibited.

Table: 1:- Effect of different vegetable oils on growth and development of *C.maculatus*

Treatment	Effect on fecundity		Effect on adult emergence		Effect on development	
	1 ml/kg seed (%)	3 ml/kg seed(%)	1 ml/kg seed(%)	3ml/kg seed(%)	1ml/kg seed(%)	3ml/kg seed(%)
Neem	14.52	7.56	1.15	0.00	41.33	0.00
Castor	15.37	10.61	1.37	0.00	41.66	0.00
Eucalyptus	10.63	6.35	1.01	0.00	42.50	0.00
Sunflower	14.67	8.38	4.36	3.54	37.35	38.00
Unchecked	42.12	40.45	61.11	61.30	29.66	29.33
S.Em±	5.725034	6.482402	11.84369	12.10243	2.381833	8.359375
CD at 5%	0.657772	0.988077	1.91908	2.086818	0.138336	1.388098

Effect on damage

The effect of different vegetable oils on damage was recorded by assessing the grain infestation and loss in weight of pigeon pea grains Table 2. The grains treated with the eucalyptus oil @ 1ml / kg seed were reduced the grain infestation to a minimum level of 0.91 percent which did not differ to neem and castor oil treated grain 1.10 and 1.38 percent grain infestation respectively. The sunflower treated seed showed the maximum infestation in 3ml/kg seed dose of the oils treatment. It is evident from the Table that least damage (0.33%) was occurred in the grains treated with oil of eucalyptus 1ml / kg. The grains treated with neem , castor also do not differ with the eucalyptus oil providing 0.55 and 0.46 percent grain damage.

The sunflower oil treated seeds showed the maximum damage of 1.25 percent. The 3 ml / kg dose of these oils was effective in checking the weight loss in eucalyptus (0.00%) , neem (0.00%) and castor (0.00%) oil treated seeds . The weight loss in sunflower oil (0.56%) treated seed was also significantly superior to untreated check (49.60%).

Both the dosages (1 ml / kg and 3 ml / kg seed) were quite effective in reducing the grain damage. Kieta et al [22-23] , Tripathi et al [24] **,** Singh and Yadav [25] also reported that various oils as seed treatment against the pest were effective in reducing the damage. K.E. Law-Ogbomo , [26] used rubber seed oil, palm oil and palm kernel oil in reducing post harvest loss caused by *Callosobruchus maculatus* (F.) in three cowpea varieties and found that these oils gave appreciable percentage reduction in percentage weight loss (0.1-1.7%) when compared with the untreated control (48.2%).

Effect of oil treatment on the seed germination

The seeds treated with different vegetable oils @ 1 ml / kg and 3 ml / kg seed , the germination percentage in neem oil , eucalyptus oil , castor oil and sunflower (1ml/kg seed) were 84.72%, 82.20% , 81.01% , 81.09 % and in 3 ml / kg seed were 82.96 % , 80.47 % , 78.23 % and 77.10 % respectively in comparison to untreated seeds 90.06% (1ml/kg seed) and 89.36 % (3ml/kg seed) but the differences were not significant. Here Raghvani and Kapadia [11] and Sangwan , Chhillar and Kashyap [10] who reported that germination of the seeds treated with different vegetable oils was not affected. K.E. Law-Ogbomo and R.K.A. Egharevba [26] observed that there was no adverse

effect of the oils on grains quality on the use of some of vegetable oils (rubber seed oil, palm oil and palm kernel oil) was evaluated against cowpea weevil, *Callosobruchus maculatus* in three cowpea varieties. Seed viability in the test done by F.O. Abulude *et al*, [14] was high compared to the control which did not show any sign of viability i.e., seed viability was not affected by the oil treatment.

TABLE : 2:- Effect of different vegetable oils on the grain damage by *C.maculatus* and on germination of pigeon pea seeds

Treatment	grain infestation		loss in weight		seed germination	
	1 ml/kg seed(%)	3 ml/kg seed(%)	1 ml/kg seed(%)	3ml/kg seed(%)	1ml/kg seed(%)	3ml/kg seed(%)
Neem	1.10	0.00	0.55	0.00	84.72	82.96
Castor	1.38	0.00	0.46	0.00	81.01	78.23
Eucalyptus	0.91	0.00	0.33	0.00	82.20	80.47
Sunflower	3.60	1.70	1.25	0.56	81.09	77.10
Unchecked	67.83	70.94	51.70	49 .60	90.06	89.36
S.Em±	13.22536	14.10684	10.21174	0.14	1.698837	2.178854
CD at 5%	1.976264	2.171246	2.10298	2	0.045322	0.059689

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