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RESEARCH ARTICLE

# Efficacy of edible and non-edible oils against pulse beetle *Callosobruchus chinensis* L. in stored chickpea

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ABSTRACT

The experiment was conducted at laboratory in the Department of Entomology, College of Agriculture, IGKV, Raipur during 2009- 2010 with eight treatments and four replications. While testing the effectiveness of some edible and non-edible oils, minimum number 10.70 (eggs) of fecundity was recorded on 0.25 ml/100g neem oil treated seeds. In 0.25ml/100g karanj oil treated seed larval-pupal period was longer than control. Higher incubation period (8.13 days) was recorded in neem oil with lower incubation period of 5.39 days, in sunflower oil treated with 0.25 ml/ 100g seed. Adult longevity (5.75 days) was shortest on neem oil at 0.25ml/ 100g seed and longest (7.94 days) on nilgiri oil at 0.25ml/ 100g seed. Seed damage in coconut oil treated seeds at 0.25 ml/ 100g seed was found highest (20.50 and 43.79 per cent) while lowest (9.25 and 30.39 %) in karanj oil treated seeds 0.25ml/100g seeds after 45 days and 90 days, respectively. Lowest (8.06 and 23.73) weight loss was recorded on karanj oils treatedwith 0.25ml/ 100g seed and highest (16.34 and 35.14 %) was recorded on coconut oil treatedwith 0.25 ml/ 100g seed after 45 days and 90 days. Control of pulse beetle in chickpea with insecticide grain protectants can be dangerous due to its residual effect. Application of edible and non-edible oils to chickpea seeds for storage of the chickpea especially in months of infestation can be an effective alternate.

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## INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a highly nutritious pulse cultivated throughout the world and is placed third in the importance list of the food legumes. India is the largest producer of this pulse contributing to around 63% of the world's total production (ICRISAT, 2007). It contains 38-59% carbohydrates and 25.3-28.9% protein, which is the maximum, provided by any pulse (Hulse, 1991) and does not contain any specific major anti-nutritional factor. The pulse beetle, (Coleoptera;bruchidae), is a major pest of economically important leguminous grains, such as chickpea cowpea, lentil, green gram and black gram (Talukdar and Howse, 1994; Mulatu and Gebremedhin, 2000; Park *et al*., 2003). The larvae bore into the pulse grains which become unsuitable for human consumption and for the production of sprouts. They are important pests of pulse crop in India under storage conditions (Raja *et al*., 2000; Ajayi and Lale, 2001; Tapondjou *et al.,* 2002).

Serious problems of genetic resistance by insect species, pest resurgence, residual toxicity, photo toxicity, vertebrate toxicity, widespread environmental hazards and increasing cost of application of the presently used synthetic pesticide have directed the need for effective biodegradable pesticide (Talukdar and Howse, 1994).This awareness has created worldwide interest in the development of alternative strategic including the re-examination of using plant derivative material is more readily biodegradable. Some are less toxic to mammals, may be more selective in action and may retire the development of resistance. Their main advantage is that they may be easily and cheaply produced by farmers and small-scale industries as crude or partially purified extracts. In the last two decades,

considerable efforts have been directed at screening plants in order to develop new botanical insecticides as alternative to the existing insecticide. It has been reported that when mixed with some stored grains, leaf, bark, seed, powder or oil extracts of plants reduce ovipostion rate and suppress adult emergence of bruchids and also reduced seed damage rate (Shaaya *et al*., 1997, Keita *et al*., 2001).

## MATERIAL AND METHODS

The experiment was conducted at the laboratories of the Department of Agricultural Entomology, College of Agriculture, Indira Gandhi Agricultural University of Raipur, India. Raipur comes under sub humid region, receiving an average rainfall of 1200-1400 mm out of which about 85 per cent during winter season (October-February). The place experiences a short mild winter, January being the coolest and dry hot summer, May being the hottest month. Soil surface temperature of this region crosses $60^0$C, air temperature touches to $48^0$C and humidity drops up to 3 to 4 per cent during summer season and mercury level drops to as $60^0$C during December and January.

**Plant oils** :

Commercially available Neem oil (*Azadirachta indica*), Karanj oil (*Pongamia pinnata*), Mahua oil (*Madhuca indica*), nilgiri oil (*Eucalyptus citriodora*), coconut oil (*Cocos nucifera*), mustard oil *(Brassica* spp.), soybean oil (*Glycine max*) and sunflower (*Helianthus annuus*) were collected from the local market.

**Preparation of seed** :

Chickpea seeds (variety –JG-74) were obtained from the local market. Healthy and fresh seeds were used to avoid any prestorage infestation or egg laying of bruchids.

**Rearing of the test insects :**

Insect rearing was carried out in Department of Agricultural Entomology, College of Agriculture, Indira Gandhi Agricultural University of Raipur, India under the prevailing environmental conditions of 30 ± 2°C and 70 ± 5 RH. To obtain newly emerged pulse beetles of same generation, 25 insects were released in a plastic container having 250 g of chickpea seeds covered by a muslin cloth. After 24 hours all the adults were removed and egg laid seeds were maintained at required temperature and humidity. The insects emerged after four weeks were used in the entire investigation. Insect eggs were counted by using hand lens.

The nine treatments were carried out to find out the effect of edible and non-edible oils against pulse beetle. Among the eight treatments, four edible and another four non-edible oils were selected with one untreated control (free from oils). Treatments with dose *viz.*, 0.25ml concentration was thoroughly mixed with 100 g of seed. Healthy and disease free with no egg of pulse beetle chickpea seeds were selected and taken into consideration for the study. Moisture of chickpea seeds was 12% before the treatment of various oils. The 100g of dried and clean seeds were taken into a plastic container (capacity 250g). The quantity of oil for all the treatments was measured with the help of micro-pipette and discharged on the seeds. Afterward, seeds treated with oil were mixed thoroughly to cover a thin film around the seeds in a plastic container. All the treatments were replicated four times, completely randomized block design for statistical analysis.

## RESULTS AND DISCUSSION

The effect of edible and non- edible oils on fecundity, larval pupal period (days) and longevity of pulse beetle on chickpea has been presented in Table 1.

**Effect on fecundity:**

It was observed that minimum number of eggs (10.70 eggs/100 seeds) were laid out by a single female in neem oil on chickpea, followed by karanj oil (12.05 eggs/100 seeds) which were at par with nilgiri oil (12.21 eggs/100seeds) treated with 0.25ml/100g of chickpea seeds. Oviposition varied from 10.70 to 20.26 eggs/100 seeds on all the treated seeds of chickpea. All the treatments were significantly superior over untreated control (25.66 eggs/100 seeds).Biswas and Biswas (2005) reported that citronella and neem oil at 0.25 and 5.0 ml/kg of seed effectively controlled *C. chinensis* population by reducing oviposition rate.

**Effect of incubation period (days) :**

It was observed that maximum days of incubation period (8.13 days) was in neem oil which were treated with 0.25ml/100g seed on chickpea, followed by karanj oil (7.13 days) which was at par with nilgiri oil (7.08 days). Incubation period varied from 5.39 to 8.13 days on all the treated seeds of chickpea. All the treatments were significantly superior over untreated control (4.50 days). Incubation period was significantly at par on mustard (6.06 days), mahua (6.13 days), coconut (6.38 days) and soybean (6.13 days) oils, respectively. It concludes that the neem oil can be used to reduce the pulse beetle infestation significantly in storage.

**Effect on larval pupal period :**

Maximum 27.25 days of larval-pupal period was recorded in karanj oil which were treated with 0.25ml/100g seed on chickpea, followed by neem oil (26.25 days) which was at par with mustard oil (26.13 days). Larval-pupal period varied from 23.25 to 27.25 days on all the treated seeds of chickpea. All the treatments were significantly superior over untreated control (20.19 days). Ali *et al.*, (1983) studied efficacy of different oils

*viz.*, neem, rapeseed, coconut, mustard, mahua and palm against the eggs, grub, adults and on the egg laying. Neem, coconut, mustard, groundnut oil and sesamum oil exhibited 100% egg mortality at 0.1 ml per 100g of seeds. Neem and coconut oils each recorded 100% grub mortality at 0.1 ml/ 100g of seeds.

**Effect on adult longevity:**

The treatment (0.25ml/100g) seeds treated noticed that minimum adult longevity was 5.75 days in neem oil which was at par with karanj oil (5.94 days). Adult longevity varied from 5.75 to 7.94 days among all the treated seeds. All the treatments were significantly superior over untreated control (9.40 days).

The effect of edible and non-edible oils on per cent seed damage and weight loss after 45 and 90 days of pulse beetle on chickpea has been presented in Table 2.

**Per cent seed damage after 45 days :**

It was noticed that minimum seed damage (9.25 %) was in karanj oil on chickpea, followed by neem oil (11.44 %) treated with 0.25ml/100g seed.Per cent seed damage varied from 9.25 to 20.50 per cent among all the treated seeds. All the treatments were significantly superior over untreated control (28.35 %). Singal and Singh (1990) reported that the oils of groundnut, coconut, mustard, sesame, soybean and rapeseed used as surface protectants at 1, 3 and 5 ml/kg of seed to test their efficacy against *Callosobruchus chinensis* on a variety of chickpea seeds showed only 0.5% damage when treated with mustard oil @ 5 and 3 ml/kg, and rapeseed at 5 ml/kg.

**Per cent weight loss after 45 days :**

It was observed the treatment having 0.25ml/100gm seeds showed minimum weight loss (8.06 %) in karanj oil, followed by neem oil (9.88 %). Per cent weight loss varied

**Table 1: Effect of different edible and non-edible oils on growth and development of *C. chinensis* at 0.25ml/100g chickpea seeds**

| Treatments | Effect of fecundity | Effect of incubation period (days) | Effect on larval pupal period (days) | Effect on adult longevity (days) |
|---|---|---|---|---|
| Neem | 10.70 (3.35) | 8.13 (2.94) | 26.25 (5.17) | 5.75 (2.50) |
| Karanj | 12.05 (3.54) | 7.13 (2.76) | 27.25 (5.27) | 5.94 (2.54) |
| Mahua | 15.38 (3.98) | 6.13 (2.57) | 25.25 (5.07) | 7.13 (2.76) |
| Nilgiri | 12.21 (3.57) | 7.08 (2.75) | 23.75 (4.92) | 7.94 (2.91) |
| Coconut | 18.53 (4.36) | 6.38 (2.62) | 23.25 (4.87) | 7.00 (2.74) |
| Mustard | 14.39 (3.86) | 6.06 (2.56) | 26.13 (5.16) | 6.94 (2.73) |
| Soybean | 15.50 (4.00) | 6.13 (2.57) | 25.13 (5.06) | 7.06 (2.75) |
| Sunflower | 20.26 (4.56) | 5.39 (2.43) | 24.31 (4.98) | 7.06 (2.75) |
| Control | 25.66 (5.11) | 4.50 (2.24) | 20.19 (4.55) | 9.40 (3.15) |
| SEM± | 0.06 | 0.05 | 0.03 | 0.04 |
| C.D. at 5% | 0.18 | 0.16 | 0.07 | 0.13 |

Figure in parentheses are square root transformed values

**Table 2 : Effect of different edible and non-edible oils on per cent seed damage by *C. chinensis* and on weight loss after 45 & 90days of 0.25ml/100g chickpea seeds**

| Treatments | Per cent seed damage | | Weight loss | |
|---|---|---|---|---|
| | After 45 days | After 90 days* | After 45 days | After 90 days* |
| Neem | 11.44 (3.46) | 33.19 (35.17) | 9.88 (3.22) | 25.95 (30.62) |
| Karanj | 9.25 (3.12) | 30.39 (33.45) | 8.06 (2.93) | 23.73 (29.15) |
| Mahua | 14.38 (3.86) | 38.66 (38.44) | 12.06 (3.54) | 31.91 (34.39) |
| Nilgiri | 12.85 (3.65) | 36.44 (37.13) | 11.19 (3.42) | 28.91 (32.52) |
| Coconut | 20.50 (4.58) | 43.79 (41.43) | 16.34 (4.10) | 35.14 (36.95) |
| Mustard | 13.38 (3.73) | 35.35 (36.48) | 11.56 (3.47) | 28.91 (32.52) |
| Soybean | 16.81 (4.16) | 38.03 (38.07) | 14.94 (3.93) | 31.31 (34.02) |
| Sunflower | 18.00 (4.30) | 37.56 (37.79) | 12.91 (3.66) | 31.06 (32.81) |
| Control | 28.35 (5.32) | 65.71 (54.15) | 23.81 (4.93) | 45.26 (42.28) |
| SEM± | 0.05 | 0.34 | 0.05 | 0.32 |
| C.D. at 5% | 0.16 | 1.00 | 0.15 | 0.92 |

Figure in parentheses are square root transformed values
* Figure in parentheses are arcsine transformed values

from 8.06 to 16.34 per cent on all the treated chickpea seeds. All the treatments were significantly superior over untreated control (23.81 per cent). Parsai *et al.* (1990) had observed effect of groundnut oil, mustard oil @ 0.3 per cent concentration on the fecundity, longevity of *C. chinensis* and caused grain weight loss. They observed that the number of eggs, adult emergence and grain weight loss decreased with increase in oil concentration**.**

**Per cent seed damage after 90 days :**

It was observed that minimum seed damage (30.39 per cent) was in karanj oil treated with 0.25ml/100g seed on chickpea, followed by neem oil (33.19 per cent). Per cent seed damage varied from 30.39 to 43.79 per cent on all the treated chickpea seeds. All the treatments were significantly superior over untreated control (65.71 per cent). Mustard (35.35 per cent), nilgiri (36.44 per cent), mahua (38.66 per cent), sunflower (37.56 per cent), soybean (38.03 per cent) and coconut (43.79 per cent) oils showed significantly lower per cent seed damage as compared to untreated control.

**Per cent weight loss after 90 days :**

It was noticed that minimum weight loss (23.73 per cent) was in karanj oil on chickpea, followed by neem oil (25.95 per cent). Per cent weight loss varied from 23.73 to 35.14 per cent on all the treated 0.25ml/100g chickpea seeds. All the treatments were significantly superior over untreated control (45.26 per cent). Srinivasan (2008) reported the efficacy of some indigenous plant oils, *viz.*, castor, eucalyptus, sunflower and neem oil at 5 and 10 ml/kg of seeds against pulse beetle (*Callosobruchus chinensis*) on pigeonpea. The findings after 9 months of treatment also revealed that neem oil at 10 and 5 ml/kg of seeds was highly effective against *C. chinensis* registering the minimum seed damage of 9.2 and 15.0% as against 96.0% in untreated check. The loss in seed weight was also less in neem oil (10.6 and 14.5% in 10 and 5 ml, respectively) followed by 10 ml castor oil (22.8%) when compared to 49.9% in the control.

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