

EFFICACY OF EDIBLE AND NON-EDIBLE OILS AGAINST PULSE BEETLE *CALLOSOBRUCHUS CHINENSIS* L. IN STORED CHICKPEA

A.K. Sahoo*, H.K. Chandrakar and A.K. Ayam

Department of Entomology, College of Agriculture,
Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) 492012

*Email-aruns9285@gmail.com

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 replication. While testing the effectiveness of some edible and non-edible oils, minimum no. (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 is 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 (5.79 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 per cent) was found 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 treated with 0.25ml/ 100g seed and highest (16.34 and 35.14 %) was recorded on coconut oil treated with 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.

Keywords: Efficacy, fecundity, incubation, longevity, weight loss

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 a 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 chick pea, 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; Tapondjouet *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 (Ewete *et al.* 1996; Guedes *et al.* 1997, Talukdar and Howse, 2000; Elhag, 2000). This awareness has created worldwide interest in the development of alternative strategies 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 retard 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 oviposition rate and suppress adult emergence of bruchids and also reduced seed damage rate (Onu and Aliyu, 1995; Shaaya *et al.* 1997; Keita *et al.* 2001).

MATERIAL AND METHOD

The experiment was conducted at the laboratories of the Department of Agricultural Entomology, College of Agriculture, Indira Gandhi Agricultural University of Raipur, India. Raipur is situated in plains of Chhattisgarh at 21° 16' N latitude and 81° 16' E longitude with an altitude of 289.60 meter above mean sea level (MSL). 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°C, air temperature touches to 48°C and humidity drops up to 3 to 4 per cent during summer season and mercury level drops to as low as 60°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 (*Brassicacpp.*), Soybean oil (*Glycine max*) and

Sunflower (*Helianthus annuus*) were collected from the local market.

Preparation of seed Stored product

Chick pea seeds (variety –JG-74) were obtained from the local market. Healthy and fresh seeds were used to avoid any pre storage 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 $30 \pm 2^\circ\text{C}$ 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 100g of seed. Healthy and disease free with no egg of pulse beeton 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.

RESULT 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 was at par with nilgiri oil (12.21 eggs/100seeds) treated with 0.25ml/100gm 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 reported that maximum days of incubation period (8.13 days) was in neem oil which were treated with 0.25ml/100gm 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. Kachare *et al.* (1994) tested eight vegetable oils against *Callosobruchus chinensis* with three concentrations and revealed that 1% concentration is sufficient to reduce fecundity and hatching of the eggs.

Effect on larval pupal period: Maximum 27.25 days of larval-pupal period was recorded in karanj oil which were treated with 0.25ml/100gm 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, rape seed, coconut, mustard, mahua and palm against the eggs, grub, adults and on the egg laying. Neem, coconut, mustard, groundnut oil and sesamum oil infected 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 have 0.25ml/100gm 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). Khalequzzaman *et al.* (2007) reported that seven vegetable oils viz., sunflower, mustard, groundnut, sesame, soybean, olive and oil palm, each were applied at the rates of 5, 7.5 and 10 ml/kg, grain protectants against the pulse beetles (*Callosobruchus chinensis* L.). Effects on progeny emergence, loss in grain weight, and germination up to 66 days after treatment were measured. Adult emergence was completely prevented and the minimum grain loss was achieved by groundnut oil at 1% up to 66 days after treatment. 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 per cent was in karanj oil on chickpea, followed by neem oil (11.44 per cent) treated with 0.25ml/100gm 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 per cent). 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 per cent) in karanj oil, followed by neem oil (9.88 per cent). Per cent weight loss varied 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). Parsaiet 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 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/100gm 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/100gm 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 pigeon pea was studied. 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.

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 value

Table 2: Effect of different edible and non-edible oils on per cent seed damage by *C. chinensis* and on weight loss after 45 & 90 days 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 value

* Figure in parentheses are arcsine transformed value

REFERENCES

- Ali, S.I., Singh, O.P. and Mishra, U.S. (1983). Effectiveness of plant oils against pulse beetle, *Callosobruchus chinensis* Linn. *Indian J. Ent.*, 45(1): 6-9.
- Ajayi FA, Lale NES. Seed coat texture, host species and time of application affect the efficacy of essential oils applied for the control of *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) in stored pulses. *International Journal of Pest Management* 2001; 47(3):161-166.
- Biswas, N.P. and Biswas, A.K. (2005). Effect of some non-edible oils against pulse beetle, *Callosobruchus chinensis* in stored gram. *Journal of Interacademia*. 9(3): 448-450.
- Hulse, J. H. (1991). Nature, composition and utilisation of grain legumes, In: Uses of tropical Legumes: Proceedings of a Consultant Meetings, 27-30 March 1989, ICRISAT Centre, Patancheru, A.P. 502324, India.
- ICRISAT (2007). Chickpea (Internet). International Crop Research Institute for the Semi-Arid Tropics. Available from www.icrisat.org, Accessed 2007 Feb. 17
- Khalequzzaman, M., Keita SM, Vincent C, Schmit JP, Arnason JT, Belanger A. Efficacy of essential oil of *Ocimum basilicum* L. and *O. gratissimum* L. applied as an insecticidal fumigant

and powder to control *Callosobruchus maculatus* (Fab.) (Coleoptera: Bruchidae). *Journal of Stored Products Research* 2001; 37(4):339-349.

Mahdi, S.H.A. and Goni, S.O. (2007). Efficacy of edible oils in the control of pulse beetle, *Callosobruchus chinensis* L. in stored pigeonpea. *Univ. J. Zool. Rajshahi Univ. Vol.* 26, pp. 89-92.

Mulatu B, Gebremedhin T. Oviposition-deterrent and toxic effects of various botanicals on the Adzuki bean beetle, *Callosobruchus chinensis* L. *Insect Science and its Application* 2000; 20(1):33-38.

Ogunwolu O, Idowu O. Potential of powdered *Zanthoxylum zanthoxyloides* (Rutaceae) root bark and *Azadirachta indica* (Meliaceae) seed for control of the cowpea seed bruchid, *Callosobruchus maculatus* (Bruchidae) in Nigeria. *Journal of African Zoology* 1994; 108(8):521-528.

Okonkwo EU, Okoye WI. The efficacy of four seed powders and the essential oils as protectants of cowpea and maize grains against infestation by *Callosobruchus maculatus* (Fabricius) (Coleoptera: Bruchidae) and *Sitophilus zeamais* (Motschulsky) (Coleoptera: Curculionidae) in Nigeria. *International Journal of Pest Management* 1996; 42(3):143-146.

Parsai, S.K., Shaw, S.S., Deshpande, R.R., Verma, R.S., Badaya, A.K. and Mandloy, K.C. (1990). Studies on fecundity longevity of *C. chinensis* and

caused grain weight loss and efficacy Ofedible oils against *Callosobruchus chinensis* L. on mungbean. *Indian J. pulse Res.* 3(1): 61-65.

Park C, Kim SI, Ahn YJ. Insecticidal activity of asarones identified in *Acorusgramineus* rhizome against three coleopteran stored-product insects. *Journal of StoredProducts Research* 2003; 39(3):333–342

Raja N, Albert S, Babu A, Ignacimuthu S, Dorn S. Role of botanical protectants and larval parasitoid *Dinarmusvagabundus* (Timberlake) (Hymenoptera: Pteromalidae) against *Callosobruchusmaculatus* Fab. (Coleoptera: Bruchidae) infesting cowpea seeds. *Malaysian Applied Biology* 2000; 29(1-2):55–60.

Shaaya E, Kostjukovski M, Eilberg J, Sukprakarn C. Plant oils as fumigants and contact insecticides for the control of stored-product insects. *Journal of Stored ProductsResearch* 1997; 33(1):7–15.

Srinivasan, G. (2008). Efficacy of certain plant oils as seed protectant against pulse beetle, *Callosobruchus chinensis* Linn, on pigeonpea. *Pesticide Research Journal.* 20(1): 13-15.

Singal, S.K. and Singh, Z. (1990). Studies of plant oils as surface protectants against pulse beetle, *Callosobruchus chinensis* (L.) in chickpea, *Cicerarietinum* (L.) in India. *Tropical Pest Management.* 36(3): 314-316.

Tapondjou LA, Adler C, Bouda H, Fontem DA. Efficacy of powder and essential oil from *Chenopodiumambrosioides* leaves as post-harvest grain protectants against six-stored product beetles. *Journal of Stored Products Research*2002; 38(4):395–402.

Talukder FA, Howse PE. Repellent, toxic and food protectant effects of pithraj, *Aphanamixis polystachya*extracts against the pulse beetle, *Callosobruchus chinensis* in storage. *Journal of Chemical Ecology* 1994; 20(4).

