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ORIGINAL ARTICLES

Repellent Effects of Jatropha curcas, canola and Jojoba Seed oil, against *Callosobruchus maculates* (F.) and *Callosobruchus chinensis* (L.).

Sabbour, M.M. and M.A. Abd-El-Raheem

Pests and Plant Protection Department, National Research Centre, El-Behouth St., P.O. Box 12622, Dokki, Cairo, Egypt

ABSTRACT

The repellency test of the oils Jatropha curcas, canola and Jojoba Seed oil, were studied against *Callosobruchus maculates* (F.) and *Callosobruchus chinensis* (L.). Results, showed that Jatropha curcas oil acted not only as oviposition deterrents but also adversely influence fecundity. Beetles oviposited eggs on treated seeds with mustard oil but the numbers of eggs is always lower in treated seeds than in the control. The tested oils were significantly decreased the seeds infestations. The means number of eggs deposited/female were significantly decreased to 48.4±4.7, 36.5±3.5 and 34.3±4.3 egg/female after *C. maculatus* treated with Jojoba Seed oil at concentrations 5, 2 and 3%, respectively. Jatropha curcas oils were gave the higher mortality of *C. maculatus* when treated at the corresponding concentrations. Accumulative mortality (%) of *C. maculates and C. chinensis* beetles increased gradually by increasing the period of exposure in case of treated foam with different tested oils. After seven days of treatments, the Jojoba Seed oil, Jatropha curcas and canola oil the accumulative mortality of *C. chinensis* recorded 60.1, 63.4 and 48.6 , respectively as compared to 30.2.

Key words: *Callosobruchus maculatus* (F.) *Callosobruchus chinensis* (L.), Jatropha curcas, canola and Jojoba oil.

Introduction

The common bean (*Phaseolus vulgaris* L.) is one of the principal food and cash crop legume grown in the tropical world (Abate and Ampofo, 1996; Songa and Rono, 1998; Schmale *et al.*, 2002). Almost all the insect pests of stored grains have a remarkably high rate of multiplication and within one season, they may destroy 10-15% of the grains and contaminate the rest with undesirable odours and flavours (Baby, 1994). A wide range of seed beetles attack the grain of common bean varieties (Mulungu *et al.*, 2007). However, the predominant damaging pests of stored grain legumes mainly in the tropics are *Callosobruchus maculatus* (Fab.), *C. chinensis* (L.), *Caryedon serratus* (Oliver), *Zabrotes subfasciatus* (Boheman) and *Acanthoselids obtectus* (Say) (Nahdy and Agona, 1995; Nichimbi-Msolla and Misangu, 2002; Emana *et al.*, 2003).

Essential oils may have attractive or repellent effects and in some cases they showed an insecticidal action against insects. Essential oils isolated from plants and consisting of cyclic and monocyclic mono-terpenes are effective repellents against insects (Rodriguez. and Levin, 1975). Oil carriers can also distribute the inoculum over the thin intersegmental membranes, which are more readily penetrated by entomogenous fungi (Lisansky, 1989). Abdel-Gawad and Abdel-Aziz (2004) found that the fungus *B.bassiana* killed the insect pests through the cuticle and not needed to consumed by them, they also mentioned that they caused a protection to the cowpea. Essential oils have potential for use as insecticides and repellent against stored products insects (Shaaya *et al.*, 1991; Liu and Ho, 1999). During the past few decades, application of synthetic pesticides to control agricultural pests has been a standard practice. However, with growing evidence that many conventional pesticides can adversely affect the environmental requirements for safer means of pest management have become crucial (Rozman *et al.*, 2007). *Simmondasia chinensis* (Link) (jojoba) is a semiarid evergreen shrub. The plant is cultivated in some parts of the middle-east and Latin-American countries (Habashy *et al.*, 2005). Jojoba seeds are containing of some unique glucoside compounds that can cause foodintake inhibition and repellency effect for the stored products pests (Bellirou *et al.*, 2005).

The present work aimed to explore the protective potency of some botanical oils, broad bean beetle, *C. maculatus* and *C. chinensis* during storage.

Corresponding Author: Sabbour, M.M., Pests and Plant Protection Department, National Research Centre, El-Behouth St., P.O. Box 12622, Dokki, Cairo, Egypt
E-mail: sabbourm9@yahoo.com

Materials and Methods

The broad bean beetle (cowpea beetle), *Callosobruchus maculatus* (F.) and *C. chinensis* (L.) were reared on broad bean seeds *Vigna faba* (L.) at 28±2°C and 60±5% R.H. under laboratory conditions.

Extraction of Jatropha Seed Oil:

The seeds of Jatropha curcas were harvested from trees from Nobaryia rigion. They were dried in a shade for seven days, shelled and the batches ground into a fine powder, Five hundred and fifty grammes of the powder and 2.5 liters of petroleum ether (40^{o}C) were used in the extraction of the oil with a soxhlet's extractor for 48 hours. This yielded 250 ml of clean yellow oil and the ether was recovered through a rotary evaporator. The oil was kept in the dark at 4°C until it was needed. Toxicity of the Oil on *C. maculatus* and *C. chinensis*

The rapeseeds are first ground up coarsely and heated slightly to break down oil viscosity and preliminarily expel some excess moisture. It will also compromise the integrity of the cellular walls of the seed, which will make the next step of de-hulling much easier.

Extraction of canola oil begins with the rapeseed. The rapeseed comes from a yellow flowering plant from the Brassicaceae family (the same family of plant that produces mustard seeds). Rapeseed oil is the "crude oil" to canola oil's "gasoline." There is a refinement process used to create the finished product.

The essential oils jetropha, jojoba and canola were isolated by steam distillation of the dried plants (Guenther, 1961). Canola oil extracted according to Unger (1990). The tested oil emulsions were prepared as follows: 5 drops of "Triton X-100 as emulsifier was mixed thoroughly with 5ml of each tested oil, then water was added to obtain the desired concentrations (0.2, 0.5, 2 and 3 %) in percent of (v/w). The emulsifier was mixed at the corresponding concentrations and used as check.

Repellency test:

The experiments were conducted in an arena in choice test . Disc of filter paper (Whatman No. 1) was treated with the tested oil at 1 %conc. and placed in cell A. While filter paper treated with distilled water and emulsifier only as control was placed in the cell B . Twenty newly emerged beetles were introduced into each arena. After 1,2,3,4,5,6 and 7 days, the number of beetles present in the cells A and B was recorded. The percentages of repellency values were calculated using the equation: D= (1- T/c) x 100 (Lwande *et al.,* 1985) where T and C represent the mean number of beetles in cells A and B (Treated and untreated), respectively .

The insecticidal activity of tested oils:

Experiment was designed to test the initial as well as the persistent effect of the tested oils on beetles as cumulative mortality during successive intervals (0, 2, 4, and 7 days). Foam granules about 1cm in diameter were treated at time (zero time) with tested oils, dried and provided with heat sterilized bean seeds (100g/each) fastened each with a string. Then all treatments were used immediately as non-choice test. The foam granules treated with the tested oils were mixed with bean seeds (2g foam/100g seeds) according to Abd El-Aziz (2001).

Ovipostional deterrent effect of tested oils (no choice test):

To evaluate the oviposition deterrent of the tested oils, a pair of newly emerged beetles, was placed with treated or untreated broad seeds in glass jars (250 cc capacity) covered with muslin. The beetles were left to lay eggs, and then the deposited eggs were counted on the seeds in the treated and untreated jars. Each experiment was repeated five times, (Abd El-Aziz and Ismail, 2000). The number of deposited eggs was used as a criterion for the evaluation of reduction percentages.

$$\text{Reduction \%} = \left[100 - \frac{\textit{No. of deposited eggs in treatment}}{\textit{No. of deposited eggs in control}}\right] \times 100$$

The percent reduction is an index of effectiveness of the applied oils in reducing infestation and was calculated according to, Su (1989).

Results and Discussions

The effect of tested plant oil vapors on the reproduction of the *C. maculatus* and *C. chinensis* beetles were studied using the no-choice test (Table 1). The reproduction of beetles was reduced by the treatments with

Jojoba Seed oil and canola oil vapors, but not inhibited completely. Jatropha curcas oil acted not only as oviposition deterrents but also adversely influence fecundity. Beetles oviposited eggs on treated seeds with mustard oil but the numbers of eggs is always lower in treated seeds than in the control. Data in table (1) show that the tested oils were significantly decreased the seeds infestations. The means number of eggs deposited / female were significantly decreased to 48.4±4.7, 36.5±3.5 and 34.3±4.3 egg/female after *C. maculatus* treated with Jojoba Seed oil at concentrations of 0.5, 2 and 3%, respectively. Jatropha curcas oils were gave the higher mortality of *C. maculatus* when treated at the corresponding concentrations. Shaaya *et al.* (1991& 1997) reported that edible oils are potential control agents against *C. maculatus* and can play an important role in stored-grain protection. Abd El-Aziz (2001) mentioned that clove and eucalyptus oil vapors impaired the fecundity of the bruchid beetles, *Callosobruchus maculatus*. Data proved promising oviposition detergence, toxicity and suppressing egg deposition and adult emergence.

Table 1: Ovipostion deterrent effect of tested oils against *C. maculatus* beetles.

Type of oils	Mean number of eggs/female ±S.E.		
	0.5%	2%	3%
Jojoba Seed oil	48.4±4.7 (62.46)	36.5±3.5 (72.50)	34.3±4.3 (78.61)
Jatropha curcas oil	32.4±4.4 (73.63)	24.5±3.3 (84.66)	20.4±4.7 (90.57)
canola oil	58.4±4.5 (51.65)	64.4±5.7 (55.31)	69.1±3.7 (48.40)
Control	89.3±5.4		
F value LSD	24.5 10.92	22.9 10.11	26.56 11.18

When *C. chinensis* treated with Jatropha curcas at concentrations, 0.5, 2 and 3% the eggs laid per female showed a significant decreased reached to 30.4±1.4, 19±3.3, and 17.4±4.4 eggs/female as compared to 82.1±3.5 in the control (Table 2). The same results obtained by Boateng and KusiIn (2008),who reported that the adults of *C. maculatus* and *D. basalis* had the same susceptibility to Jatropha oil and The oil was also repellent to *C. maculatus* but its persistency declined from 15 to 60 days in storage seed oil. In this respect , Deshpande *et al.* (1974) reported that oleic and linoleic acid as insecticidal components from *Nigella sativa* which were found to be toxic to the pulse beetle , *C. chinensis* . the same results obtained by (Adebowale and Adeire 2006 and Adabie *et al.*, 2006). In a choice test, filter paper strips treated with *Acorus calamus* oil at 200, 400 or 800 µg/cm² repelled *Tribolium castaneum* adults during the first 2 weeks, there after repellency decreased more rapidly, than neem oil (Jilani *et al.*, 1988). Abd El-Aziz and Ismail (2000) mentioned that Nigella oil gave 45.5 and 40.2% repellency during the first and second days, respectively. Nigella oil became attractive to *Bruchidius incarnatus* beetles and had little persistent. Pumpkin oil at 1% concentration, had strong repellent activity (88%) during the first day of observation and then decreased gradually to reach (0.0%) repellency during the last day of experiment. Frankincense oil indicated the more persistent. White Mustard oil was found to protect storage insects infesting stored pulses, especially the black gram and the green gram (Prakash, 1982). Black mustard seeds contain sinigrin and myrosin and yield after maceration with water 0.7–1.3% of volatile oil. The latter contains over 90% of allylisothiocyanate (Olivier *et al.*, 1999). The main chemical components of clove oil are eugenol, eugenol acetate, iso-eugenol and caryophyllene (Olivier *et al.*, 1999).

Table 2: Ovipostion deterrent effect of tested oils against *C. chinensis* beetles.

Type of oils	Mean number of eggs/female ±S.E.		
	0.5%	2%	3%
Jojoba Seed oil	40.4±4.8 (67.56)	34.5±4.5 (73.51)	30.3±5.3 (78.61)
Jatropha curcas oil	30.4±1.4 (73.63)	19±3.3 (85.66)	17.4±4.4 (95.50)
canola oil	68.4±4.4 (50.55)	74.4±5.7 (55.41)	79.1±3.6 (49.70)
Control	82.1±3.5		
F value LSD	15.1 10.13	25.8 11.11	28.54 10.10

Data in Table (3) indicate that accumulative mortality (%) of *C. maculates and C. chinensis* beetles increased gradually by increasing the period of exposure in case of treated foam with different tested oils. After seven days of treatments, the Jojoba Seed oil, Jatropha curcas and canola oil the accumulative mortality of *C. chinensis* recorded 60.1, 63.4 and 48.6%, respectively as compared to 30.2% in control. In this respect, Chander and Ahmed (1986) applied different doses of the essential oil of *Acorus calamus* to seeds of green gram *Vigna radiata* (Wilcz) to protect them against *Callosobruchus chinensis* and found that 1ml/Kg offered a high degree of protection up to a period of 135 days. Prolonged protection of the seeds was mainly due to a high adult mortality besides reduced oviposition and low hatching. Foam sprayed with clove oil (5%) and placed between sacks caused the highest mortality (66.6%) of *C. maculatus* as compared with treated sacks or foam inside sacks (63.3% and 42%, respectively) after 6 days of storage (Abd El-Aziz, 2001). Araya and Emana (2009), found that More than 90% mortality of adult *Z. subfasciatus* was also observed for bean seeds treated with *J. curcas*, *D. stramonium* and *P. dodecondra* 96 hour after treatment at the rate of 15g/ 150g of grain application. The same results were obtained by Chander and Ahmed (1986); Saxena *et al.*(1976); Surabaya *et al.* (1994) Kheradmand,et al (2010) and Maheshwari *et al.* (1998).

Table 3: Accumulative mortality of *C. maculatus and C. chinensis* adults during the first week of broad bean seeds exposed to treated foam with different oils.

Treated oils	Time(days)	Accumulative mortality	
		C. maculatus	*C. chinensis*
Jojoba Seed oil	0	19.3	22.3
	2	32.6	35.5
	4	41.7	44.3
	7	59.7	60.1
Jatropha curcas	0	25.7	27.5
	2	47.8	48.9
	4	61.4	63.4
	7	66.9	73.1
Canola oil	0	23.3	26.4
	2	34. 6	38.4
	4	38. 9	40.3
	7	43.7	48.6
Untreated (control)	0	15.3	16.6
	2	23.5	24.8
	4	26.8	27.7
	7	29.9	30.2

References

Abate, T. and J.K.O. Ampofo, 1996. Insect pests of common bean in Africa: Their ecology and management. Annu. Rev. Entomol., 41: 45-75.

Abbott, W.S., 1925. A method of computing the effectiveness of insecticides. J. Econ. Entomol., 18: 265-267.

Abd El-Aziz, E. Shadia and I.A. Ismail, 2000. The effectiveness of certain plant oils as protections of broad bean against the infestation by *Bruchus incaratus* Schm. (Coleoptera-Bruchidae) during storage. Annals Agric. Sci., Ain Shams Univ., Cairo, 45(2): 717-725.

Abd El-Aziz, Shadia, E., 2001. Persistence of some plant oils against the bruchid beetle, *Callosobruchus maculates* (F.)(Coleoptera: Bruchidae) during storage. Arab. Univ. J. Agric. Sci., Ain Shams Univ. Cairo, 9(1): 423-432.

Abdel-Gawad, H. and A. Abdel-Aziz, 2004. Evaluation of different integrated pest management concept for controlling the legumes beetles *Calosobruchus maculates* (F.) and *Calosobruchus chinensis* (L.) on faba bean and cowpea seeds. Bull. Egypt. Ent. Econ., 30: 105-122.

Adabie–Gomez, D.A., K.G. Monford, A. Agyir-Yawson, A. Owusu-Biney and M. Osae, 2006. Evaluation of four local plant species for insecticidal activity against *Sitophilus zeamais* Mots ch. (Coleopte ra :Curculion idae) and Callosobruchus maculatus (F) (*Coleoptera:Bruchidae*). Ghana J. Agric. Sci., 39: 147-154.

Adebowale, K.O. and C.O. Adedire, 2006. Chemical composition and insecticidal properties of the underutilized *Jatropha curcas* seed oil. Afr. J. Biotechnol., 5(10): 901-906.

Araya G/selase and Emana Getu2. 2009. Evaluation of botanical plants powders against *Zabrotes subfasciatus* (Boheman) (*Coleoptera: Bruchidae*) in stored haricot beans under laboratory condition. African Journal of Agricultural Research, 4(10): 1073-1079.

Baby, J.K., 1994. Repellent and phagodeterrent activity of *Sphaeranthus indicus* extract against *Callosobruchus chinensis*. Proceeding of the 6th International Working Conf. On Stored-Product protection, 12: 17-23.

Bellirou, A., B. Bouali, N. Bouammali, B.N. Boukhatem, A. Elmtili and M. Hamal, 2005. Extraction of simmondsin and oil in one step from jojoba seeds. Industrial Crop Production, 21: 229-233.

Boateng, B.A. and F. Kusi, 2008. Toxicity of Jatropha Seed Oil to *Callosobruchus maculatus* (*Coleoptera:Bruchidae*) and its Parasitoid, Dinarmus basalis (Hymenoptera: Pteromalidae). Journal of Applied Sciences Research, 4(8): 945-951.

Chander, H. and S.M. Ahmed, 1986. Efficacy of oils from medicinal plants as protectants of green gram against the plus beetle. *Callosobruchus chinensis*. Entomol., 11: 21-28.

Deshpande, R.S., P.S. Adhikary and N.P. Tipris, 1974. Stored grain pest control agents from *Nigella sativa* and Pogostemon heyneamus. Bull. Grain tech., 12: 232-234.

Emana, Getu, Ahmed Ibrahim and Fridissa Iticha, 2003. Review of lowland pulse insect pest research in Ethiopia. Proceedings of grain legume workshop, 22-27 September, 2003, Addis Ababa, Ethiopia.

Guenther, G., 1961. The Essential Oils VIII. Robert E. D. Nastrand Company Inc., Toronto.

Habashy, A.B., A. Abdelnaim, E. Khalifa and M.M. Al-Azizi, 2005. Anti-inflammatory effects of jojoba liquid wax in experimental models. Pharmacology Research, 51: 95-105.

Jilani, G., R.C. Saxena and B.P. Rueda, 1988. Repellent and growth inhibitory effects of turmeric oil, sweet flag oil, neem oil and “Margosan–O“ on red flour beetle (Coleoptera: Tenebrionidae). J. Econ. Entomol., 81(4): 1226-1230.

Kheradmand, K., S.A. Sadat Noori and Gh. Sabahi, 2010. Repellent Effects of Essential Oil from *Simmondasia chinensis* (Link) against *Oryzaephilus surinamensis* Linnaeus and *Callosobruchus maculates* (Fabricius). R. J. of Agri. Scie, 1(2): 66-68.

Lisansky, S., 1989. Biopesticides fall short of market projections. Performance Chem., 16: 387-396.

Liu, Z.L. and H.L. Ho, 1999. Bioactivity of essential oils extracted from Evodia rutaecarpa Hook f. et Thomas against the grain storage insects, *Sitophilus zeamias* Motsch. and *Tribolium castaneum* (Herbst). Journal of Stored Products Research, 35: 317-328.

Lwande W., A. Hassanalli, P.W. Njorage, M.D. Bentley, F. Delle Monache, J.I. Jondiks, 1985. A new 6a-hydroxy petrocarpan with insect antifeedant and antifungal properties from the root of *Tephrosia hildebrandtu*. Vatle. Insect Sci. Appl., 6: 537-541.

Maheshwari, H.K., M.K. Sharma and S.C. Dwivedi, 1998. Effectiveness of repelin as surface protectant against plus beetle, *Callosobruchus chinensis* infesting cowpea. Int. J.Trop. Agric., 16: 229-232.

Mulungu, L.S., E.L. Luwondo, S.O.W.M. Reuben and R.N. Misangu, 2007. Effectiveness of local botanicals as protectants of stored beans (*Phaseolus vulgaris* L.) against bean bruchid (*Zabrotes subfasciatus* Boh.). J. Entomol., 4: 210-217.

Nahdy, M.S. and A. Agona, 1995. Studies on the control of bean bruchids Acanthoscerlides obtectus (Say) and *Zabrotes subfasciatus* (Boheman) (Coleoptera: Bruchidae) in the east Africa region. In: Habtu Assefa (ed.). Proceedings of the 25th Anniversary of Nazareth Research Center: 25 years of experience in lowland crops research, 20-33, September, 1995. Nazareth agriculture research center, pp: 181-194.

Nichimbi-Msolla, S. and R.N. Misangu, 2002. Seasonal distribution of common bean bruchid species in selected areas in Tanzania. Proceedings of the Bean Seed Workshop, Arusha, Tanzania, 12–14 January, 2001. Bean/Cowpea Collaborative Research Support Program–East Africa. pp. 5.

Olivier, C., S. Vaughn, E. Mizubuti and R. Loria, 1999. Variation in allyl isothiocyanate production within Brassica species and correlation with fungicidal activity. J. Chem. Ecol., 25: 2687-2701.

Prakash, A., 1982. Studies on insect pests of pulses and oil seeds and their management. Ann. Tech. Report of All India Scheme of Harvest and Post–Harvest Technology, Central Rice Res. Inst., Cuttack, India, 1982 p 46.

Rodriguez, E. and D.H. Levin, 1975. Biochemical Parallelism of Repellents and Attractants in Higher Plants and Arthropods. In: Recent advances in phytochemistry biochemical interaction between plants and insects, pp: 215-270.

Rozman, V., I. Kalinovic and Z. Korunic, 2007. Toxicity of naturally occurring compounds of Limiaceae and Lauraceae to three stored- product insects. Journal of Stored Products Research, 43: 349-355.

Saxena, B.P., O. Koul and K. Tikku, 1976. Non-toxic protectant against the stored grain insect pests. Bull. Ger. Tech., 14: 190-193.

Schmale, I., F.L. Wackers, C. Cardona and S. Dorn, 2002. Field Infestation of Phaseolus vulgaris by Acanthoscelides obtectus (Coleoptera: Bruchidae), Parasitoid Abundance and Consequences for Storage Pest Control. Environ. Entomol., 31: 859-863.

Shaaya, E., U. Ravid, N. Paster, B. Juven and U. Zisman, 1991. Fumigant toxicity of essential oils against four major stored-product insects. Journal of Chemical Ecology, 17: 499-504.

Shaaya, E., M. Kostjukovski, J. Eilberg and C. Sukprakarn, 1997: Plant oils as fumigants and contact insecticides for the control of stored-product insects. J. Stored Prod Res., 33: 7-15.

Songa, J.M. and W. Rono, 1998. Indigenous methods for bruchid beetle (Coleoptera: Bruchidae) control in stored beans (Phaseolus vulgaris L.). Inter. J. Pest Mgt., 44: 1-4.

Surabaya, S., C.K. Babu, C. Krishnappa and K.C.K. Murty, 1994. Use of locally available plant products against *Callosobruchus chinensis* in red gram. Mysore, j. of Agric. Sci., 28: 325-345.

Su, H.C.F., 1989. Laboratory evaluation of dill seed extract in reducing infestation of rice weevil in stored wheat. J. Entomol. Sci., 24: 317-320.

Unger, E.H., 1990. Canola and Rapeseed; Production, Chemistry, Nutrition, and Processing. Technology, F. Shahidi, ed., van Nostrand Reinhold, New York, pp: 235-249.