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Evaluation of plant oils against angoumois grain moth, *Sitotroga cerealella* (Olivier) infesting stored rice

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ABSTRACT: Angoumois grain moth, *Sitotroga cerealella* Olivier is one of the important insect pests during storages of ricee. Evaluation plant oils against the pest showed that all oils cause mortality over control. Among them neem oil @5ml/kg was found effective followed by pongamia oil as it causes mortality of *S. cerealella*, less weight loss and adult emergence.

KEY WORDS: Neem oil, pongamia oil, storage, mortality, weight loss, adult emergence

Rice, *Oryza sativa* L., is a staple food for a large part of the world's human population. In spite of its potential in providing food for humans and as industrial raw material, rice is not spared by various pests between harvest and storage. The most economically important insect pest of stored rice is the angoumois grain moth, *Sitotroga cerealella* (Olivier) (Ashamo and Khanna, 2006). Infestation by *S. cerealella* starts in the field and may reach serious levels in the store. In many developing countries, insect pests reduce the vigor and viability of infested seeds because they mostly feed preferentially on the germ of the grains (Ivbijaro *et al*., 1985), they cause weight loss and contamination of stored paddy (Ashamo and Odeyemi, 2001). In order to reduce infestation to the barest minimum, various methods such as the use of conventional insecticides, biological control, mechanical control, cultural control, and varietal resistance have been utilized, with chemical control being most effective though having adverse environmental, health, and economic hazards. These include pollution, poisonous residue accumulation in foods, development of resistance by target species, and high cost of insecticide application and reapplication. As alternatives to synthetic insecticides, plant oils have been used to reduce post-harvest losses of cereals including rice. Plant preparations found practical alternative to the increasing insect pest problems and agricultural pest resistance, problems of chemical residues, and environmental safety (Folake *et al*., 2023). However, not much work has been done on the control of *S. cerealella* using plant oils. Therefore, the present work investigated the efficacy of various oils against *S. cerealella* infesting rice in stored conditions.

Male and female adults of *S. cerealella* obtained from the godowns of farmers were used to raise a

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culture on rice, in jars (2litre) capped with a piece of muslin cloth which allowed ventilation but prevented entry or exit of moths, and other insects, as well as foreign materials. The jars were kept in insect cages and the culture was maintained by replacing the infested grains with fresh, uninfested grains. The environment for cultured insects and for experimentation was maintainedat28±2°C and 75±5 per cent relative humidity.

The experiment to evaluate the efficacy of plant oils against *S. cerealella* infesting rice was laid out in the Post Graduate Research Laboratory, Department of Entomology, N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat in a completely randomized design with ten oil-based treatments (Table 1), replicated thrice. Collected rice grains were sun-dried on the cemented floor for three consecutive days in the month of May. The rice grains were kept treatment wise in plastic jars maintaining one kilogram per jar. One kilogram sterilized rice grains were treated by mixing with different oils thoroughly at 5ml/kg dosages in such a way to get a uniform coating. 100 adults were released in each treatment. Observation on mortality was recorded at respective days i.e. 7, 14, 21 and 28 days after treatment,while after two months of infestation, and weightloss and adult emergence were also recorded.

Effect of different oil based treatments was

Table 1. Effect of plant oils on mortality, weight loss and adult emergence of rice grain moth during 2021-22

Treatments	Per cent corrected Mortality - DAT				Weight loss	Adult emerged-%
	7	14	21	28		
Mustard (5ml/kg)	39.22 (39.99)	39.42 (40.39)	43.48 (47.35)	48.19 (55.56)	26.14 (19.41)	55.67
Sesame (5ml/kg)	32.93 (29.57)	44.53 (49.19)	(51.01) 45.58	50.82 (60.08)	27.18 (20.86)	52.67
Soybean (5ml/kg)	36.66 (35.72)	36.61 (35.64)	38.46 (38.75)	44.64 (49.37)	27.95 (21.97)	57.00
Coconut (5ml/kg)	37.19 (36.55)	34.52 (32.12)	(22.84) 28.53	26.93 (20.60)	25.66 (18.75)	61.67
Groundnut (5ml/kg)	36.24 (34.98)	42.26 (45.22)	42.07 (44.91)	42.49 (45.65)	27.00 (20.62)	60.00
Castor (5ml/kg)	40.56 (42.28)	46.09 (51.90)	(59.99) 50.77	53.26 (64.17)	27.69 (21.59)	64.00
Neem (5ml/kg)	48.75 (56.52)	55.45 (67.83)	59.53 (74.28)	60.48 (75.70)	18.41 (9.98)	33.33
Mahua (5ml/kg)	41.45 (43.82)	36.68 (35.70)	(30.20) 33.33	45.58 (51.01)	24.82 (17.62)	58.00
Pongamia (5ml/kg)	45.42 (50.73)	50.72 (59.90)	53.42 (64.49)	55.78 (68.34)	24.81 (17.61)	46.00
Control	0.81 (0.00)	0.81 (0.00)	0.81 (0.00)	0.81 (0.00)	37.48 (37.04)	91.67
S. Em+	1.07	1.27	1.01	1.09	0.56	0.91
CD at 5 %	3.15	3.76	2.97	3.23	1.65	2.67
CV (%)	5.14	5.70	4.40	4.42	3.77	2.71

Figures in parentheses are retransformed values, those outside are angular transformed values

Table 2. Effect of plant oils on mortality, weight loss and adult emergence of rice grain moth during 2022-23

Treatments/ dose	Per cent corrected Mortality - DAT				Weight loss	Adult emerged-%
	7thDay	14th Day	21st Day	28th day		
Mustard (5ml/kg)	28.32 (22.59)	42.33 (45.45)	43.40 (47.30)	47.57 (54.46)	26.76 (20.28)	56.67
Sesame (5ml/kg)	21.78 (13.79)	39.62 (40.88)	42.21 (45.31)	42.43 (45.54)	27.42 (21.20)	55.00
Soybean (5ml/kg)	20.73 (12.57)	34.79 (32.59)	28.99 (38.66)	38.02 (38.04)	28.12 (22.21)	57.67
Coconut (5ml/kg)	24.78 (17.58)	39.17 (39.90)	42.41 (45.49)	37.43 (37.08)	25.86 (19.03)	62.67
Groundnut (5ml/kg)	23.90 (16.42)	41.68 (44.23)	43.40 (47.21)	41.24 (43.46)	27.20 (20.91)	61.67
Castor (5ml/kg)	26.55 (20.58)	43.63 (47.62)	49.58 (57.96)	38.48 (38.83)	28.10 (22.19)	65.33
Neem (5ml/kg)	48.38 (55.89)	59.24 (73.84)	67.96 (85.79)	71.10 (89.47)	27.20 (20.89)	36.33
Mahua (5ml/kg)	35.83 (34.27)	37.62 (37.30)	42.14 (45.02)	46.33 (52.31)	18.37 (9.94)	59.00
Pongamia (5ml/kg)	43.99 (48.24)	55.44 (67.81)	62.72 (78.96)	64.18 (81.02)	23.81 (16.31)	47.00
Control	0.81(0.00)	0.81 (0.00)	0.81 (0.00)	0.81 (0.00)	43.59 (47.55)	91.33
S. Em+	1.48	1.97	2.31	1.79	0.61	0.88
CD at 5 %	4.36	5.81	6.80	5.28	1.80	2.60
CV (%)	9.31	8.64	9.22	7.25	3.85	2.58

Figures in parentheses are retransformed values, those outside are angular transformed values

evaluated against *S.cerealella* during the year 2021-22 and 2022-23. During the year 2021-22, neem oil recorded the highest mortality of *S.cerealella* i.e., 56.52,67.83,74.28 and 75.70 per cent after 7,14, 21, and 28 days, respectively and was significantly superior over rest of the treatments. The treatment pongamia oil found second best against *S.cerealella* as it recorded 50.73, 59.90, 64.49 and 68.34 percent mortality after 7, 14, 21 and 28 days, respectively and it was at par with the treatment of castor oil. In case of weight loss, the treatment neem oil recorded the lowest weight loss (9.98%), and was followed by the pongamia oil (17.61%). Maximum weight loss was observed in control (37.04%). Adult emergence was maximum (91.67%) in control, whereas in neem oil lowest adult emergence (33.33 nos) was noticed (Table 1). During the year 2022-23, all the treatments effectively reduced the damage of *S. cerealella* in rice over control. The treatment neem oil recorded highest mortality *i.e.*, 55.89, 73.84, 85.79 and 89.47 after 7, 14, 21 and 28 days, respectively but it was at par with pongamia oil after 14 and 21 days. The treatment of pongamia oil found second best treatment against *S.cerealella* as it recorded 48.24, 67.81, 78.96 and 81.02 per cent mortality after 7, 14, 21 and 28 days, respectively and significantly superior over rest of the treatments. Regarding weight loss, neem oil (9.94 %) was most effective and was followed by the pongamia oil (16.31%). The maximum weight loss was recorded in the control (47.55 %). More number of adult emergence (91.33) was noticed in control (Table 2). The two years of pooled over data showed that all oil used as seed protectants was found effective over control. Neem oil was found most effective as it causes 56.20, 70.84, 84.04 and 82.58 per cent mortality after 7, 14, 21 and 28 days, respectively and it was at par with pongamia oil. The minimum weight loss was noticed in neem oil (9.96%) and was followed by pongamia oil (16.96%). The maximum weight loss was observed in the control (42.30 %). In the case of adult emergence, the maximum number of adult emergence was observed in control (91.50 adults) and the minimum in neem oil (34.83 adults) (Table3).

Table 3. Effect of plant oils on mortality, weight loss and adult emergence of rice grain moth (Pooled 2021-22 and 22-23)

Treatments	Per cent corrected Mortality				Weight loss	Adult emerged-%
	7thDay	14th Day	21st Day	28th day		
Mustard (5ml/kg)	33.77 (31.29)	33.87 (42.92)	43.44 (47.32)	47.88 (55.01)	26.45 (19.84)	56.17
Sesame (5ml/kg)	27.35 (21.68)	33.16 (45.04)	43.90 (48.16)	46.63 (52.81)	27.30 (21.03)	53.83
Soybean (5ml/kg)	28.70 (24.15)	28.67 (34.12)	38.40 (38.70)	41.33 (43.70)	28.04 (22.09)	57.33
Coconut (5ml/kg)	30.98 (27.07)	29.65 (36.01)	35.47 (34.17)	32.18 (28.84)	25.76 (18.89)	62.17
Groundnut (5ml/kg)	30.07 (25.70)	33.08 (44.72)	42.74 (46.06)	41.87 (44.56)	27.10 (20.77)	60.83
Castor (5ml/kg)	33.55(31.43)	36.32 (49.76)	50.18 (58.98)	45.87 (51.50)	27.90 (21.89)	64.67
Neem (5ml/kg)	48.57(56.20)	51.92 (70.84)	63.75 (80.04)	65.79 (82.58)	18.39 (9.96)	34.83
Mahua (5ml/kg)	38.64(39.05)	36.25 (36.50)	37.73 (37.61)	45.95 (51.66)	24.82 (17.62)	58.50
Pongamia@5ml/kg	44.71(49.49)	47.35 (63.86)	58.07 (71.72)	59.98 (68.44)	24.31 (16.96)	46.50
Control	0.81 (0.00)	0.81 (0.00)	0.81 (0.00)	0.81(0.00)	40.54 (42.30)	91.50
S. Em+	3.00	3.90	2.91	4.18	0.98	0.63
CD at 5 %	9.61	9.20	9.31	9.40	3.12	2.64
CV (%)	7.04	7.22	7.43	6.00	3.12	2.64

Figures in parentheses are retransformed values, those outside are angular transformed values

In the past, essential oils from four plant species including *T. vulgaris, S. hortensis, P. roseum*, and *S. aromaticum* showed vapor toxicity during 24 h against female adults of the Angoumois grain moth, *S. cerealella* and found that oils in the volatile concentration caused 25% adults mortality (Ghoorchian *et al*., 2023). Volatile extracts of *P. angolensis* and *P. quadrifolia* was used as alternatives to synthetic chemicals in paddy for the protection against *S. cerealella* and had the insecticidal and repellent effects on *S. cerealella* (Elvis *et al*., 2015). Oil extracted from all the parts of the *Newbouldia laevis* had significant effect on the mortality of the *S. cerealella* moth but the root bark oil extract had the most effective and caused 100% insect mortality within 72h of application at 4% concentration (Ashamo *et al*. 2018). Cooking oils had an insecticidal activity tested against Angoumois grain moth, *S. cereallela,* and found that cooking oils (*Gossypium hirsutum* @ 0.5 ml and *Brassica carinata* @ 0.5 ml per 250 g of maize grains were potent bio-insecticides against *S. cereallela* (Fekadu *et al*., 2013). Bulb extracts of *Allium chinense* G. had significant effect on the developmental period of *S. cerealella* and also showed adverse effect on moth emergence (Rhetso *et. al*. 2020). Garlic essential oil and its active substances viz., diallyl trisulfide (DATS) inhibit oviposition in moths of *S. cerealella* and further the proportion of viable eggs significantly decreased when the moths of *S. cerealella* were treated with diallyl trisulfide (DATS) (Chang *et al*., 2020). Oil of *Cinnamomum camphora* (L.) J. Presl, was found highly effective at 0.05 percent concentration (v/w) against *S. cerealella* and showed that essential oil of *C.camphora* had completely suppressed the development of *S. cerealella* (Geetanjly and Tiwari, 2015). The findings of the above workers, supports thre present findings. The neem oil at 1.0 per cent as the most effective grain protectant against different stored grain pests (Pereira and Wohlgemuth, 1982). The oils and cakes of neem, castor, and mustard as effective to reduce the fecundity, hatching, and adult emergence in *S. cerealella* (Verma *et al*.1983). Neem and karanji oils at 0.25, 0.5, and 1.0 ml/kg as

most effective in reducing the fecundity of pulse beetle on green gram seed during storage. Various oils like castor, mustard, groundnut, sesamum, coconut, and sunflower at 1.0 per cent were found effective against pulse beetle in stored cowpea (Babu *et al.,* 1989). Castor oil at 1.0 per cent was most effective against pulse beetle based on reduced oviposition, egg viability, and adult emergence followed by mustard and groundnut oils (Bhargava and Meena, 2002). Plant products like neem, karanji, clove and lemongrass oils at 1.0 per cent was were found the most effective due to reduced fecundity, adult emergence, longevity, grain damage, weight loss, and prolonged developmental period against *Sitophilus oryzae* L in stored wheat (Yadav *et al.,* 2008). The neem, eucalyptus, sunflower, and castor oil at 0.1 and 0.3 per cent as safest and most effective to minimize the incidence of *C. maculatus* on pigeon pea based on its reduced fecundity, adult emergence and delayed development (Lal and Raj, 2012). Neem oil at 0.20 per cent as highly effective based on the lowest adult emergence of lesser grain borer, *Rhyzopertha dominica* (Fabricius) in stored wheat (Singh *et al.,*2016).

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REFERENCES

Ashamo M.N. and Khanna S.C. (2006) Resistance to Angoumois grain moth, *Sitotroga cerealella* (Oliver), in paddy varieties. Annals of Plant Protection Sciences 14(2): 368–373.

Ashamo M.O. and Odeyemi O.O. (2001) Protection of maize against *Sitophilus zeamais* Motsch. using seed extracts from some indigeneous plants. *Journal of Plant Diseases and Protection* 108(3): 321–326

Ashamo M.O., Ogungbite O.C. and Adetogo T.A. (2018) Insecticidal potency of *Newbouldia laevis* oil extracts against *Sitrotoga cerealella*, an important pest of paddy rice, International Journal of Horticulture 8(9): 98–105. doi: 10.5376/ijh.2018.08.0009.

Babu T.R., ReddyV.S. and Hussain S.H. (1989) Effect of edible and non-edible oils on the development of the pulse beetle (*Callosobruchus chinensis* Linnaeus) and viability and yield of mung bean, *Vigna radiate* (Linnaeus) Wilczek. Tropical Science 29(3): 215–220.

Bhargava M.C. and Meena B.L. (2002) Efficacy of some vegetable oils against pulse beetle, *Callosobruchus chinensis* (Linnaeus) on cowpea, *Vigna unguiculata* (Linnaeus). International Journal of Plant Protection 30: 46–50.

Chang M.M., Shah S., Wu M.Y., Zhang S.S., Wu G. and Yang F.L. (2020) Effect of Diallyl Trisulfide on the Reproductive Behavior of the Grain Moth, *Sitotroga cerealella* (Lepidoptera: Gelechiidae). Insects 11: 21.

Elvis A., Philippe S., Théophile O., Gilles F., Dansou K., Félicien A., Chantal M. and Dominique S. (2015) Chemical Composition and Insecticidal and Repellent Effect of Essential Oils of Two Premna Species against *Sitotroga cerealella*. Journal of Insects. ID 319045, 6. doi:10.1155/2015/319045

Fekadu G., Waktole S. and Santiago D.R. (2013) Efficacy of botanical powders and cooking oils against Angoumois grain moth, *Sitotroga cereallela* O. (Lepidoptera: Gelechiidae) in stored maize. African Journal of Biotechnology 12(16): 1978–1986.

Folake A.O., Matthew O., Adewale A.O. and Ibrahim M.G. (2023) Insecticidal activity of botanicals and their effectiveness in insects and pests control. South Asian Journal of Agricultural Sciences 3(2): 88–96. doi: 10.22271/27889289.2023.v3.i2b.95.

Geetanjly and Tiwari S.N. (2015) Evaluation of Four Essential Oils against Angoumois Grain Moth, *Sitotroga Cerealella* (Olivier). Journal of Plant Science Research 2(2): 127.

Ghoorchian M., Rahmani S. and Weisany W. (2023) Toxicity effects of Lamiaceae, Geraniaceae, and Myrtaceae essential oils on Angoumois Grain Moth (*Sitotroga cerealella*) Female Adults. doi:10.21203/rs.3.rs-2957459/v1.

Ivbijaro M.F., Ligan C. and Youdeowei A. (1985) Control of rice weevil, *Sitophilus oryzae* L., in stored maize with vegetable oil. Agriculture, Ecosystem and Environment 14 (3-4): 237–242.

Lal D. and Raj D.V. (2012) Efficacy of application of four vegetable oils as grain protectant against the growth and development of *Callosobruchus maculatus* and on its damage. Advances in Bioresources 3: 55–59.

Pereira J. and Wohlgemuth R. (1982) Neem, *Azadirachta indica* (Adrien-Henri de Jussieu) of West African origin as a protectant of stored maize. Journal of Applied Entomology 94: 208–214.

Rhetso T., Roopa M., Verghese A., Ramnath, Shubharani and Venkataramegowda S. (2020) Efficacy of different extracts of *Allium chinense* bulb against *Sitotroga cerealella* infestation in stored paddy, *Oryza sativa*. Environmental and Experimental Biology 18: 283–289. doi: 10.22364/eeb.18.27.

Singh S., Sharma D.K. and Gill R.S. (2016) Evaluation of three plant oils for the control of lesser grain borer, *Rhyzopertha dominica* (Fabricius) in stored wheat. Journal of Insect Science 29: 162–169.

Verma S.P., Singh B. and Singh Y.P. (1983) Studies on the comparative efficacy of certain grain protectants against *Sitotroga cerealella* (Olivier). Bulletin of Grain Technology 21: 37–42.

Yadav J.P., Bhargava M.C. and Yadav S.R. (2008) Effect of various plant oils on rice weevil, *Sitophilus oryzae* (Linnaeus) in wheat. Indian Journal of Plant Protection, 36: 35–39.

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