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Influence of non-edible oil on oviposition preference and hatchability of acarid mite, *Tyrophagus putrescentiae* Schrank on Groundnut

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ABSTRACT

The effect of non-edible oils on oviposition and hatching of acarid mite *Tyrophagus putrescentiae* were studied during the year 2017-18 and 2018-19 at Acarology Laboratory, Department of Entomology, N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat. All the five non-edible oils evaluated have a significant effect on the fecundity of mite, *T. putrescentiae*. Fecundity was markedly reduced when groundnut seeds infested with mite were mixed with *Neem*, eucalyptus, castor, karanj and alsi oil at the different level of concentrations of non-edible oils *i.e.* 0.50, 1.00 and 2.00 ml/kg. The alsi oil was least effective in reducing egg laying of mite. The discrimination quotient (DQ) was maximum 0.59 in *Neem* oil at 2.00 ml/kg concentration and was minimum (0.26) at 0.50 ml/kg in alsi oil treatment. Further, the per cent hatchability was maximum in the untreated groundnut seeds *i.e.* 96.67 per cent. In case of *Neem* oil at 2.00 ml/kg concentration only 64.50 per cent of eggs were hatched, while in case of alsi oil at 2.00 ml/kg concentration 89.33 per cent of eggs were hatched which were maximum as compared to all other non-edible oil treatments and less than that of untreated control.

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INTRODUCTION

Mites act as secondary invaders among storage pests as they cannot infest sound grain instead feed upon broken kernels, debris, high moisture seeds or damaged grain by primary insect pests. These invaders contribute directly to grain spoilage after establishment, just as primary pests do (Weaver and Petroff, 2009). Stored-grain mites damages usually go unnoticed until the grain is removed from the storage facility. Mites from family Acaridae are gaining importance as storage pests due to their increasing incidence and their association/ interaction with fungi and insects causing rapid qualitative and quantitative deterioration of grains (Weaver and

Petroff, 2009). Studies on acarid mites infesting stored products have been conducted in several regions throughout the world (Weaver and Petroff, 2009). Among the stored grain mite *Tyrophagus putrescentiae* Schrank (Schrank, 1781) is a ubiquitous, agriculturally, medically important mite species and is considered a severe pest of number of stored commodities with high fat and protein content throughout world. The mite, *T. putrescentiae* is a common and serious pest of stored grains due to its ability to tolerate low humidity and a wide range of temperatures (Hughes, 1976). It can cause problems for many foodstuffs ranging from weight reduction and degradation of stored foods to accumulation of harmful residues (fungi, dead mites, faeces, eggs and bits of food) through their activities (Hughes, 1976 and Zdarkova, 1971). This makes the infested grain storage unhygienic. World over, there is an increasing trend among grain buyers towards zero-tolerance to these contaminants. For effective and economical management of the mite, *T. putrescentiae* it is a felt need to use some plant products like oils. The present study therefore is an attempt to test the effect of various non-edible oils on oviposition preference and other life parameters of the mite, *T. putrescentiae*.

MATERIAL AND METHODS

Mite culture:

Acarid mite, *T. putrescentiae* was reared in plastic Petri dishes (5 cm diameter) with groundnut and yeast flour as food (4:1). These were placed in a dessicator containing super saturated solution of Potassium chloride to provide desired humidity which in turn was placed in BOD. Thus, stock culture of *T. putrescentiae* was maintained in laboratory at 27±10ºC and 80-85% RH. Copulating pairs were picked from the culture and were released in observation arenas.

Five non-edible oils were used against acarid mite, *T. putrescentiae* infesting stored groundnut seeds, 15 g of groundnut seeds were taken in a Petri dishes (11 cm x 2 cm) and 15 pairs of adult mite were released to it. Each non-edible oils treated at three specified concentrations (0.50 ml/kg, 1.0 ml/kg and 2.0 ml/kg) were mixed thoroughly by mechanical shaking with the groundnut seeds. Prior to application of the non-edible oil, the groundnut seeds were sterilized at 40^0 C for 24 hours in order to make them free from any other infestation. Observations were recorded daily in the observation arenas. The observations on fecundity *i.e.* number of eggs laid by a single mite as well as the observations were also recorded on the effects of various non-edible oil treatments on the ovipositional behavior and number of eggs laid.

– The total number of eggs laid per mite was computed.

– Ovipositional preference was measured by

$$\text{Discrimination Quotient (DQ)} = \frac{\text{Number of eggs laid on control seeds} - \text{Number of eggs on treated seeds}}{\text{Total number of eggs}}$$

– Per cent hatching at each oil treatment was recorded.

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under the following heads:

Fecundity:

During the year 2017-18, the application of all non-edible oils namely *Neem* oil, eucalyptus oil, castor oil, karanj oil and alsi oil was successful in reducing the number of eggs laid by *T. putrescentiae*. The oils were effective at all the three level of concentrations *viz*., 0.5, 1.00 and 2.00 ml/kg as compared to control. The data presented in the Table 1 revealed that on an average 115.00 eggs were laid by the *T. putrescentiae* in control. When the *Neem* oil is applied at 0.50, 1.00 and 2.00 ml/kg concentrations 48.00, 41.00 and 31.00 eggs were observed, respectively. In eucalyptus oil treated seeds 54.00, 41.33 and 32.00 eggs were noticed at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. In castor oil treated seeds 65.00, 54.00 and 43.33 eggs were noticed at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. Further, in case of karanj oil treated seeds, 60.00, 50.33 and 42.67 eggs were recorded at the 0.50, 1.00 and 2.00 ml/kg, respectively. In case of the treatment of alsi oil at 0.50, 1.00 and 2.00 ml/kg concentrations 70.33, 61.00 and 50.33 eggs were recorded, respectively. The minimum number of eggs were laid by the female mite at 2.00 ml/kg concentration and were followed by the *Neem* oil, eucalyptus oil, karanj oil, castor oil and alsi oil 31.00, 32.00, 42.67, 43.33 and 50.33 eggs, respectively. This shows that *Neem* oil is more effective in reducing egg laying and alsi oil is least effective in reducing egg laying. The maximum number of eggs (70.33) were laid

on seeds treated with alsi oil at 0.50 ml/kg concentration. It is important to mention that egg laying was inversely proportional to the increase in level of concentrations of different oils namely *Neem* oil, eucalyptus oil, castor oil, karanj oil and alsi oil. The first year data indicated that maximum reduction in the egg laying of *T. putrescentiae* was at 2.00 ml/kg concentration of *Neem* oil (31.00). The Table 1 clearly indicate that as the concentrations of different non-edible oils increases, the number of eggs laid by the mite decreases in case of all non-edible oils. Further, during the year 2018-19, all the non-edible oils were found effective in reducing the fecundity of *T. putrescentiae*. The non-edible oils were effective at all the three concentrations *viz.*, 0.50, 1.00 and 2.00 ml/kg. *Neem* oil, eucalyptus oil, castor oil, karanj oil and alsi oil were found effective in decreasing egg laying of the female mite. The data presented in Table 1 revealed that when *Neem* oil was applied at 0.50, 1.00 and 2.00 ml/kg concentrations, 50.33, 39.67 and 29.00 eggs were laid by female, respectively. In eucalyptus oil 51.33, 42.33 and 30.33 eggs were recorded at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. In castor oil treated groundnut seeds 63.67, 52.33 and 41.67 eggs were noticed at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. Further, in case of karanj oil 58.33, 45.33 and 42.33 eggs were laid on groundnut seeds at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. Further, in alsi oil treated seeds 68.00, 59.67 and 52.00 eggs were recorded at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. The minimum numbers of eggs were laid by *T. putrescentiae* at 2.00 ml/kg treated groundnut seeds with *Neem* oil 29.00, followed by eucalyptus oil, castor oil, karanj oil and alsi oil, respectively. The maximum numbers of eggs (68.00 eggs) were laid on groundnut seeds treated with alsi oil at 0.50 ml/kg concentration. The two years pooled over data regarding the influence of various non-edible oils on fecundity of *T. putrescentiae* on groundnut revealed that the application of all non-edible oils were found effective in reducing the number of egg laid by *T. putrescentiae* on groundnut seeds. All the non-edible oils were found effective at all the three level of concentrations *viz.*, 0.50, 1.00 and 2.00 ml/kg as compared to control. The data presented in the Table 1 revealed that on an average 117.17 eggs were laid by *T. putrescentiae* in the control. When *Neem* oil was applied at 0.50, 1.00 and 2.00 ml/kg concentrations 49.17, 40.33 and 30.00 eggs were observed, respectively. In eucalyptus oil treated groundnut seed 52.67, 41.83 and 31.17 eggs were observed at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. In castor oil treated groundnut seeds 64.33, 53.17 and 42.50 eggs were recorded at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. In karanj oil treatment 59.17, 47.83, and 42.50 eggs were laid at all the three level of concentrations. Further, highest number of eggs *i.e.* 69.17, 60.33 and 50.17 were observed at 0.50, 1.00 and 2.00 ml/kg concentrations in alsi oil. However, it is less than the number of eggs laid in control.

Further, the minimum number of eggs were laid at 2.00 ml/kg concentration treated groundnut seeds, When mite infested groundnut seed were treated with the *Neem* oil 30.00 eggs were recorded, followed by eucalyptus oil, castor oil, karanj oil and alsi oil 31.17, 42.50, 42.50 and 51.17 eggs, respectively. This shows that *Neem* oil was more effective in reducing egg laying and alsi oil was least effective in reducing eggs lying (Table 1). The maximum numbers of eggs (69.17 eggs) were laid on seeds treated with alsi oil at 0.50 ml/kg, concentration. It is very important to mention that egg laying was inversely proportional to the increase in concentrations of different non- edible oils. The present findings clearly indicated that maximum reduction in egg laying of *T. putrescentiae* was at 2.00 ml/kg concentration in *Neem* oil (30.00 eggs). The Table 1 clearly indicated that as the level of concentrations of different non-edible oils increases the number of eggs laid by the mite decreased in case of all non-edible oils. The statistical analysis showed that number of eggs laid on various non-edible oil treatments was significantly different from each other (Table 1). All the five non-edible oils evaluated have a significant effect on the fecundity of mite, *T. putrescentiae*. Fecundity was markedly reduced when groundnut seeds infested with mites were mixed with *Neem*, eucalyptus, castor, karanj and alsi oil at different concentration of non-edible oils *i.e.* 0.50, 1.00 and 2.00 ml/kg. The maximum effect was assessed in *Neem* oil treated seeds at 2.00 ml/kg level of treatment because of the minimum eggs were laid on the groundnut seeds treated with this oil at this concentration, it was followed by eucalyptus oil and castor oil while the alsi oil was least effective in reducing egg laying of acarid mite. As the concentration of non-edible oil increased in stored groundnut seeds, a corresponding decrease in fecundity was observed. All the treatments were found markedly

superior over untreated control. In general, non-edible oils were found more effective in reducing egg laying at all concentrations of rest of non-edible oils. Similar results were also recorded by Verma and Pandey (1978), Khaire *et al*. (1992) who observed fecundity by safflower, karandi and maize oils on pigeonpea at 0.50, 0.75 and 1.00 per cent oil treatment upto 100 days of storage. Raheja and Singh (1998) reported that *Neem*, castor, mustard, groundnut and sesame oil at 0.25 ml/kg, 0.50 ml/kg and 0.75 ml/kg were effective to control stored mite, *Suidasia nesbitti* in stored pigeonpea. Eucalyptus, mint, turmeric and garlic products were reported to reduce the egg laying capacity of *T. putrescentiae* under laboratory conditions as reported by Gulati (1998) from Hisar in wheat. *Neem* oil at 0.25, 0.50 and 0.75 ml/kg showed sterilant activity of female mites. Further, Kim *et al.* (2003) tested acaricidal activity of 54 plant essential oils against *T. putrescentiae* and found *Neem* oil, karanj oil and castor oil as very effective in reducing the egg laying activity of female mites.

Discrimination quotient (DQ):

During the year 2017-18 it is evident from the Table 1 that DQ ranged from 0.24 to 0.58 for all non-edible oil treatments. All the non-edible oil treatments deterred the oviposition in *T. putrescentiae* infesting groundnut seeds. However, out of all the oils tested, the deterrence was maximum in *Neem* oil at all three concentrations, 0.50, 1.00 and 2.00 ml/kg indicated by DQ 0.41, 0.47 and 0.58, respectively. Likewise, in eucalyptus oil DQ values at 0.50, 1.00 and 2.00 ml/kg concentrations were 0.36, 0.47 and 0.56. When castor oil and karanj oil was applied at 0.50, 1.00 and 2.00 ml/kg concentrations 0.28, 0.36, 0.45 and 0.32, 0.39, 0.46 DQ was recorded, respectively. Moreover in alsi oil treated groundnut seeds, 0.24, 0.31 and 0.39 DQ was observed at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. Further, Table 1 showed that the effect was less intense in all other oils than that of *Neem* oil at the levels of treatments. All the five non-edible oils *i.e. Neem* oil, eucalyptus oil, castor oil, karanj oil and alsi oil at 0.50, 1.00 and 2.00 ml/kg concentrations indicated that the effect was not so strong as was at 2.00 ml/kg level. The highest DQ values were shown by *Neem* oil at all level of concentrations and lowest DQ values were shown by alsi oil at all the concentrations. These values ranged from 0.41 to 0.58 in case of *Neem* oil and 0.24 to 0.39 in case of alsi oil at 0.50, 1.00 and 2.00 ml/kg concentrations. During the year 2018-19 the DQ ranged from 0.27 to 0.61 for all non-edible oil treatments (Table 1). All the non-edible oil treatments deterred the oviposition in mite, *T. putrescentiae* infesting groundnut seeds. However, out of all the non-edible oils tested, the deterrence was maximum in *Neem* oil at three concentrations *i.e.* 0.50, 1.00 and 2.00 ml/kg indicated by DQ 0.41, 0.50 and 0.61, respectively. Moreover, in eucalyptus oil DQ values at 0.50, 1.00 and 2.00 ml/kg concentrations were 0.40, 0.48 and 0.59. When castor oil and karanj oil was applied at 0.50, 1.00 and 2.00 ml/kg concentrations, 0.30, 0.39, 0.48 and 0.34, 0.45, 0.48 DQ was recorded, respectively. In alsi oil treated groundnut seeds 0.27, 0.33 and 0.39 DQ was recorded at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. The effect was less intense in all other non-edible oils than that of *Neem* oil at all the concentrations. All the five non-edible oils *i.e. Neem* oil, eucalyptus oil, castor oil, karanj oil and alsi oil at 0.50, 1.00 and 2.00 ml/kg concentrations indicated that the effect was not so strong as was at 2.00 ml/kg concentration. The highest DQ values were shown by *Neem* oil at all the concentrations and lowest DQ values were shown by alsi oil at all concentrations. These values ranged from 0.41 to 0.61 in case of *Neem* oil and 0.27 to 0.39 in case of alsi oil at 0.50, 1.00 and 2.00 ml/kg concentrations. The two year pooled data on discrimination quotient (DQ) were presented in the Table 1. The DQ ranged from 0.26 to 0.59 for all non-edible oil treatments. All the non-edible oil treatments deterred the oviposition in mite, *T. putrescentiae* infesting groundnut seeds. Further, out of all the non-edible oils tested, the deterrence was maximum in *Neem* oil at all the three concentrations, 0.50, 1.00 and 2.00 ml/kg indicated by DQ 0.41, 0.49 and 0.59, respectively. Further, in eucalyptus oil DQ values at 0.50, 1.00 and 2.00 ml/kg concentrations was 0.38, 0.48 and 0.58. When castor and karanj oil was applied at 0.50, 1.00 and 2.00 ml/kg concentrations 0.29, 0.38 and 0.47 as well as 0.33, 0.42 and 0.47 DQ was noticed, respectively. In case of alsi oil treated groundnut seeds 0.26, 0.32 and 0.39 DQ was observed at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. The Table 1 showed that the effect was less intense in all other non-edible oils than that of *Neem* oil at all the concentrations. All the five non-edible oils at 0.50 and 1.00 ml/kg concentrations indicated that the effect was not so strong as was at 2.00 ml/kg concentration. However, the highest

DQ values were noticed in case of *Neem* oil at all concentrations and lowest value were recorded in alsi oil at all concwentrations. These values ranged from 0.41 to 0.59 in case of *Neem* oil and 0.26 to 0.39 in case of alsi oil at 0.50, 1.00 and 2.00 ml/kg concentrations. All the five non-edible oils deterred the oviposition of *T. putrescentiae* infesting groundnut seeds at different concentrations. The discrimination quotient (DQ) was maximum 0.59 in *Neem* oil at 2.00 ml/kg and was minimum (0.26) at 0.50 ml/kg in alsi oil treatment. Agarwal *et al.* (1988) reviewed that coconut oil at 0.1 per cent, sesame oil at 0.2 per cent and castor oil at 0.3

Table 1 : Influence of different non-edible oil on ovipositional preference and percentage hatchability of *T. putrescentiae* on groundnut

Treatments	Conc. ml/kg	Fecundity						Percentage hatchability		
		Number of eggs laid per female			Discrimination Quotient (DQ)					
		2017-18	2018-19	Pooled	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
Neem oil	0.5 ml	6.92 (48.00)	7.09 (50.33)	7.01 (49.17)	0.41	0.41	0.41	61.98 (77.67)	62.16 (78.00)	62.07 (77.83)
	1.0 ml	6.40 (41.00)	6.29 (39.67)	6.35 (40.33)	0.47	0.50	0.49	56.59 (69.67)	57.00 (70.33)	56.80 (70.00)
	2.0 ml	5.56 (31.00)	5.38 (29.00)	5.47 (30.00)	0.58	0.61	0.59	53.93 (65.00)	53.25 (64.00)	53.59 (64.50)
Eukalyptus oil	0.5 ml	7.35 (54.00)	7.16 (51.33)	7.25 (52.67)	0.36	0.40	0.38	63.68 (80.33)	64.42 (81.33)	64.05 (80.83)
	1.0 ml	6.43 (41.33)	6.51 (42.33)	6.47 (41.83)	0.47	0.48	0.48	57.86 (71.67)	58.71 (73.00)	58.29 (72.33)
	2.0 ml	5.65 (32.00)	5.51 (30.33)	5.58 (31.17)	0.56	0.59	0.58	55.56 (68.00)	56.18 (69.00)	55.87 (68.50)
Castor oil	0.5 ml	8.06 (65.00)	7.98 (63.67)	8.02 (64.33)	0.28	0.30	0.29	67.33 (85.00)	67.06 (84.67)	67.20 (84.83)
	1.0 ml	7.35 (54.00)	7.23 (52.33)	7.29 (53.17)	0.36	0.39	0.38	62.97 (79.33)	62.75 (79.00)	62.86 (79.17)
	2.0 ml	6.58 (43.33)	6.45 (41.67)	6.52 (42.50)	0.45	0.48	0.47	59.39 (74.00)	59.20 (73.67)	59.29 (73.83)
Karanj oil	0.5 ml	7.74 (60.00)	7.64 (58.33)	7.69 (59.17)	0.32	0.34	0.33	65.72 (83.00)	64.96 (82.00)	65.34 (82.50)
	1.0 ml	7.09 (50.33)	6.73 (45.33)	6.91 (47.83)	0.39	0.45	0.42	60.91 (76.33)	60.46 (75.67)	60.68 (76.00)
	2.0 ml	6.53 (42.67)	6.51 (42.33)	6.52 (42.50)	0.46	0.48	0.47	57.24 (70.67)	57.47 (71.00)	57.36 (70.83)
Alsi oil	0.5 ml	8.39 (70.33)	8.24 (68.00)	8.32 (69.17)	0.24	0.27	0.26	70.94 (89.33)	70.97 (89.33)	70.96 (89.33)
	1.0 ml	7.81 (61.00)	7.72 (59.67)	7.77 (60.33)	0.31	0.33	0.32	68.90 (87.00)	68.94 (87.00)	68.92 (87.00)
	2.0 ml	7.09 (50.33)	7.21 (52.00)	7.15 (51.17)	0.39	0.39	0.39	68.31 (86.33)	68.32 (86.33)	68.32 (86.33)
Control	-	10.72 (115.00)	10.92 (119.33)	10.82 (117.17)			0.41	79.14 (96.33)	80.12 (97.00)	79.63 (96.67)
	S. E. ±	0.114	0.105	-				1.673	1.577	-
	Treatment (T)			0.078				-	-	1.150
	(Y × T)			0.110				-	-	1.63
	C. D. (P=0.05)	0.328	0.304	-				4.820	4.542	-
	Treatment (T)			0.219						3.248
	(Y × T)			NS						NS
	C.V. (%)	2.73	2.55	2.64				4.59	4.32	4.46

* Figures in parentheses are original value while those outside are square root transformed values for fecundity while arc sine transformed value for percentage hatchability
NS=Non-significant

per cent inhibited oviposition of *C. chinensis* on green gram during storage. Oils have been reported to reduce fecundity due to the blockage of oogenesis and egg retention in the lateral oviducts. Further, Rani (2000) from Hisar, Haryana also reported maximum DQ when pigeonpea grains were treated with anola oil against stored mite, *S. nesbitti*. All these earlier work more or less support the present findings.

Per cent hatchability:

In the year 2017-18 all the non-edible oils used as protectants significantly reduced the percentage of eggs hatched with the increase in concentration of the non-edible oils. The per cent hatchability observed in the *Neem* oil treatments were 77.67, 69.67 and 65.00 at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. In eucalyptus oil per cent hatchability observed was 80.33, 71.67 and 68.00 at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. The per cent hatchability observed in castor oil at 0.50, 1.00 and 2.00 ml/kg concentration were 85.00, 79.33 and 74.00 per cent, respectively. The per cent hatchability observed in case of karanj oil and alsi oil was 83.00, 76.33, 70.67 and 89.33, 87.00, 86.33 per cent at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. The per cent hatchability was highest in the untreated groundnut seed, it was 96.33 per cent. The present finding indicated that all the non-edible oils at all the concentrations showed lesser per cent hatchability as compared to untreated groundnut seeds. All the non-edible oils proved to be most effective at 2.00 ml/kg concentration where only 65.00, 68.00, 74.00, 70.67 and 86.33 per cent hatchability was observed in case of *Neem* oil, eucalyptus oil, castor oil, karanj oil and alsi oil treatments, respectively. At 2.00 ml/kg concentration 77.67, 80.33, 85.00, 83.00 and 89.33 per cent hatchability was recorded in case of *Neem* oil, eucalyptus oil, castor oil, karanj oil and alsi oil treatment, respectively at 0.50 ml/kg concentration. *Neem* oil proved most effective whereas alsi oil was found least effective. In *Neem* oil at 2.00 ml/kg concentration only 65.00 per cent of eggs were hatched, whereas in alsi oil at 2.00 ml/kg concentration 86.33 per cent eggs were hatched which was more than all other non-edible oils but less than that of control. In the year 2018-19, the data revealed that all the non-edible oils used as protectants significantly reduced the percentage of eggs hatched with the increase in concentration of the non-edible oils. The per cent hatchability observed in the *Neem* oil treatments were 78.00, 70.33 and 64.00 at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. In Eucalyptus oil the per cent hatchability observed was 81.33, 73.00 and 69.00 at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. The per cent hatchability observed in castor oil at 0.50, 1.00 and 2.00 ml/kg concentrations were 84.67, 79.00 and 73.67 per cent, respectively. Furthermore, the per cent hatchability observed in karanj oil and alsi oil was 82.00, 75.67, 71.00 and 89.33, 87.00, 86.33 per cent at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. Meanwhile, the per cent hatchability was highest in the untreated groundnut seeds, which was 97.00 per cent. Further, it was found that all the non-edible oils at all the concentrations lesser per cent hatchability as compared to untreated groundnut seeds. In the present study, all the non-edible oils proved to be most effective at 2.00 ml/kg concentration where only 64.00, 69.00, 73.67, 71.00 and 86.33 per cent hatchability was observed in case of *Neem*, eucalyptus, castor, karanj and alsi oils, respectively. At 2.00 ml/kg concentration in comparison to 78.00, 81.33, 84.67, 82.00 and 89.33 per cent hatchability observed in case of *Neem* oil, eucalyptus oil, castor oil, karanj oil and alsi oil treatment, respectively at 0.50 ml/kg concentration. *Neem* oil at all the concentrations proved best most effective as compared to other non-edible oils.

The two years pooled over data on per cent hatchability of the eggs of mite, *T. putrescentiae* on groundnut seeds treated with different concentrations of non-edible oils were presented in the Table 1. All the non-edible oils used as protectants significantly reduced the percentage of egg hatched with the increase in concentration of the non-edible oils. The per cent hatchability noticed in *Neem* oil treatments were 77.83, 70.00 and 64.50 at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. In case of eucalyptus oil treated groundnut seeds, the per cent hatchability observed at 0.50, 1.00 and 2.00 ml/kg concentrations were 80.83, 72.33 and 68.50 per cent, respectively. Further, the per cent hatchability was observed in castor oil and karanj oil was 84.83, 79.17, 73.83 and 82.50, 76.00, 70.83 per cent at 0.50, 1.00 and 2.00 ml/kg concentrations, respectively. The per cent hatchability was 89.33, 87.00 and 86.33 per cent in case of alsi oil treated groundnut seeds. However, the per cent hatchability was maximum in the untreated groundnut

seeds *i.e*. 96.67 per cent. In the present investigation, all the non-edible oils at all concentrations showed lesser per cent hatchability as compare to control. All the non-edible oils proved to be most effective at 2.00 ml/kg concentration where only 64.50, 68.50, 73.83 and 86.33 per cent hatchability was recorded in case of *Neem* oil, eucalyptus oil, castor oil, karanj oil and alsi oil treatment, respectively in comparison to 77.83, 80.83, 84.83, 82.50 and 89.33 per cent hatchability observed in case of *Neem* oil, eucalyptus oil, castor oil, karanj oil and alsi oil treatments, respectively at 0.50 ml/kg concentration. *Neem* oil proved most effective followed by eucalyptus oil, castor oil, karanj oil and alsi oil. In case of *Neem* oil at 2.00 ml/kg concentration only 64.50 per cent of eggs were hatched, while in case of alsi oil at 2.00 ml/kg concentration 89.33 per cent of eggs were hatched, which were more than all other non-edible oils but less than that of control.

The protectants significantly reduced the hatching of eggs in comparison to the untreated groundnut seeds. In each non-edible oil treatment the percentage hatching gradually decreased with the increase in the non-edible oil concentration. *Neem* oil was found most effective in reducing the hatching at higher level concentrations *i.e.* 2.00 ml/kg followed by eucalyptus oil, castor oil, karanj oil and alsi oils. The reduction in hatching of the eggs treated with non-edible oils may be due to the fact that oil entered in the eggs through its micropyle and stopped the protoplasmic movement of freshly laid eggs. Somewhat similar observations were recorded by Singh *et al*. (1994) in case of *C. chinensis*. Rani (2000) also reported *Neem* oil as one of the most effective treatment in reducing hatchability of stored mite, *S. nesbitti* on stored pigeonpea. Rim and Jee (2006) from Korea in a study found that essential oils from various plants like pennyroyal, ylangylang, citronella, lemmon grass, tea tree, *Neem* and rosemerry were very effective in reducing egg hatching against mite, *Dermatophagoides farinae* and *D. pteronyssinus*. All these reports were more or less in accordance with the present findings.

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REFERENCES

Agarwal, A., Lal, S. and Gupta, K.C. (1988). Natural products as protectants of pulses against pulse beetles. *Bull. Grain Tech.*, **126**(2): 154-164.

Gulati, R. (1998). Inhibitory action of *Neem* products on *Tyrophagus putrescentiae* Schrank (Acarina: Acaridae) in wheat during storage. *Ann. Agri. Biol. Res.*, 227-230.

Hughes, A.M. (1976). The Mites of Stored Food and Houses, Vol. 9. 2nd Edition. Technical Bulletin of the Ministry of Agriculture, Fisheries and Food, 400.

Khaire, V.M., Kachare, B.V. and Mote, U.N. (1992). Efficacy of different vegetable oils as grain protectants against pulse beetle,*Callosobruchus chinensis* L. in increasing storability of pigeonpea. *J. Stored Prod. Res.*, **28**(3):153-156.

Kim, E., Kim, H., Don, H.C. and Ahn, Y.J. (2003). Acaricidal activity of clove bud oil compounds against *Tyrophagus putrescentiae* (Acari: Acaridae). *Appl. Entomol. Zool.*, **38**(2): 261–266.

Raheja, A. and Singh, M. (1998). Effect of different oils on the oviposition and fecundity of an Acarid mite, *Suidasia nesbitti* (Hughes). *Ann. Agri-Bio. Res.*, **3**(1):49-53.

Rani, Suman (2000). Evaluation of oils ass grain protectants against an acarid mite, *Suidasia nesbitti* in stored pigeonpea. M. Sc. Thesis, CCSHAU, Hisar. pp.107.

Rim, I. and Jee, C. (2006). Acaricidal effects of herb essential oils against *Dermatophagoides farinae* and *D. pteronyssinus* (Acari: Pyroglyphidae) and qualitative analysis of a herb *Mentha pulegium* (pennyroyal). *Korean J. Parasitol*, **44**(2): 133-138.

Schrank, F.V.P. (1781). Enumeratio insectorum Austriae indigenorum. vid, Eberhardi Klett et Frank., Augustae Vindelicorum.

Singh, V.N., Pandey, N.D. and Singh, Y.P. (1994). Effectiveness of vegetable oils on the development of *Callosobruchus chinensis* L. infesting stored gram. *Indian J. Ent.*, **56**(3):216-219.

Verma, B.K. and Pandey, G.P. (1978). Treatments of stored green gram seed with edible oils for protections from *Callosobruchus maculatus*. *Indian J. Agric. Sci.*, **48**(2):72-75.

Weaver, D.K. and Petroff, A.R. (2009). Pest Management for Grain Storage and Fumigation. Department of Entomology, Montana State University, 333 Leon Johnson Hall, Bozeman, MT.

Zdarkova, E. (1971). Orientation of *Tyrophagus putrescentiae* (Schrank) towards olfactory stimuli. *In*: *Proc. 3rd Intl. Congr. Acarol*, Prague, 241-246.