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Evaluate of plant products against *Corcyra cephalonica* (St.) in stored groundnut kernel

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Abstract
The present investigation was carried out on evaluate of plant products against *Corcyra cephalonica* (St.) in stored groundnut kernel under laboratory condition at Biocontrol laboratory, Department of Agril. Entomology, College of Agriculture, Dapoli. There were nine plant products evaluate against *C. cephalonica* at rate of 3 g and 6 g per 100 g of groundnut kernels. Effect of kernel plant products (as such) on fecundity revealed that no adult emergence were observed in the treatment with sweet flag rhizome each at 3 g and 6 g per 100 g of kernels, while very few (1 or 2) male moths were observed in the treatment with dry nutmeg each at 3 g and 6 g per 100 g of kernels. In treatment turmeric rhizome (57.79 days) at 6 g per 100 g of kernels found most promising in delaying the development of *C. cephalonica*.

Keywords: *C. cephalonica*, grain protectant, plant products, groundnut

Introduction
Groundnut, *Arachis hypogaea* L. an important oilseed crop, is the native of South America. It is called as the ‘king of oilseeds’, wonder nut and poor men’s cashew nut. Its famous Indian name is ‘*Mongphali*’. It is an important cash and food crop in many parts of the tropics, particularly in semi-arid areas. India is the second largest producer of groundnut after China. Groundnut kernel as a whole is highly nutritious as it is rich in edible oil and in proteins. It is poor man’s almond because it is very cheap as compared to almond and other nuts and at the same time, has comparative food value. It is an excellent combination of calories and essential amino acids in an average Indian diet.

More than 100 insect species are known to live and feed on stored groundnut, some of which are of economic importance (Ranga Rao *et al*., 2010) [11]. Stored insect-pests are serious problem throughout the world, because they reduce the quantity and quality of grain. Their damage to stored grains and grain products may amount 25 to 40 percent in the tropical zone (Shaaya *et al*., 1997) [13]. Among the major pests of stored groundnut, rice moth, *Corcyra cephalonica* (Stainton) is considered to be an important pest. It causes loss by feeding on stored groundnut. The adults do not feed. Females scatter their eggs among the produce. The larvae of *C. cephalonica* are capable of damaging intact kernels and feed both on the surface and within seeds. They spin a tough silken fiber, webbing together kernels, frass, and cast larval skins. Pupation takes place either within the food source, in sacking, or in crevices in storage structures (Dick, 1987) [3].

The search for safer insecticides and ecologically sound methods to manage insect pests is important. Locally available plants materials have been widely used in the past to protect stored produce against damage by insect infestation. The use of pesticides is hazardous to farmers and consumers due to their residual problem, while botanicals are ecofriendly, biodegradable, non-toxic, economic and easily available. Therefore, it is necessary to make more use of botanicals than pesticides for the management of stored grain pests. Hence keeping the view above facts, the present experiment was undertaken to study to evaluate of plant products against *C. cephalonica* (St.) in stored groundnut kernel under laboratory condition.

Materials and methods
A statistically designed laboratory experiment was laid out during year 2014-15 to study the efficacy of some kernel oil protectants against *C. cephalonica*. The details of experiment conducted are given below.

Location	:	Biocontrol Laboratory, Department of Agril. Entomology.
Design	:	Randomized Block Design
Variety of groundnut used	:	Konkan Tapora
Name of test insect	:	Rice moth, *Corcyra cephalonica* (Stainton)
No. of eggs released/treatment	:	100 eggs
Quantity of kernels/treatment	:	100 g
Number of replication	:	Three
No. of treatments	:	Nineteen

Treatment Details:		
T_1	:	Nirgudi leaves @ 3 g per 100g of kernels
T_2	:	Nirgudi leaves @ 6 g per 100g of kernels
T_3	:	Turmeric rhizome @ 3 g per 100g of kernels
T_4	:	Turmeric rhizome @ 6 g per 100g of kernels
T_5	:	Ginger rhizome @ 3 g per 100g of kernels
T_6	:	Ginger rhizome @ 6 g per 100g of kernels
T_7	:	Neem leaves @ 3 g per 100g of kernels
T_8	:	Neem leaves @ 6 g per 100g of kernels
T_9	:	Triphal seeds @ 3 g per 100g of kernels
T_{10}	:	Triphal seeds @ 6 g per 100g of kernels
T_{11}	:	Mango leaves @ 3 g per 100g of kernels
T_{12}	:	Mango leaves @ 6 g per 100g of kernels
T_{13}	:	Black pepper seeds @ 3 g per 100g of kernels
T_{14}	:	Black pepper seeds @ 6 g per 100g of kernels
T_{15}	:	Sweet flag rhizome @ 3 g per 100g of kernels
T_{16}	:	Sweet flag rhizome @ 6 g per 100g of kernels
T_{17}	:	Dry nutmeg @ 3 g per 100g of kernels
T_{18}	:	Dry nutmeg @ 6 g per 100g of kernels
T_{19}	:	Untreated Control

Various indigenous plant products like nirgudi leaves, turmeric rhizome, ginger rhizome, neem leaves, triphal seeds, mango leaves, black pepper seeds, sweet flag rhizome and dry nutmeg were used as such. Plant leaves *viz*., nirgudi, neem, mango were collected from the respective trees and then properly sun dried. The required quantity of dried chopped leaves, dried seeds and dried rhizomes (3 g and 6 g/100 g of kernels) were measured using high precision electronic balance and mixed thoroughly into the kernels of groundnut placed in desired glass bottles. Hundred freshly laid eggs were glued on a strip of paper and the strip with eggs was placed in each glass bottle including control. The open end of the bottle was covered with muslin cloth and secured firmly with rubber band and the bottle was kept undisturbed till the emergence of adult. Freshly emerged moths were removed daily to prevent fresh oviposition and the same bottles were observed further till no adult emergence was seen for a week. Such three sets were prepared for present experimentation. All the containers were labeled properly with respective treatments. The studies were conducted at room temperature and relative humidity (temperature 28 ± 2.33 ^{0}C and relative humidity 64 ± 6.30).

Method of recording observations

1. Effect of various treatments on fecundity

The total number of eggs laid by the female emerged from various treatments was counted. The mean number of eggs laid by a female moth was worked out on the basis of the total number of eggs laid by ten females. The data obtained were analysed statistically.

2. Effect of various treatments on oviposition period

Ten females emerged from different treatments were kept separately in plastic containers. First to last egg laid was counted to record the oviposition period. The data obtained were analysed statistically.

3. Effect on incubation period and hatching percentage

For observing incubation period, fifty eggs laid by the female moth emerged from each treatment were collected and kept in separate petriplates. Eggs were observed regularly till hatching. The period required from egg laying to hatching was considered as incubation period. The number of eggs hatched was counted to arrive at percent hatching. The data obtained were analysed statistically.

4. Effect on total development period

The period from egg laying to the emergence of adult was recorded in each treatment to calculate the total developmental period. The data obtained were analysed statistically.

5. Effect on percent adult emergence

Total number of adults emerged from each treatment were counted. The percent adult emergence was worked out for each treatment. The data obtained were analysed statistically.

$$\text{Percent adult emergence} = \frac{\text{Total no. of adults emerged from treated kernels}}{\text{Total no. of adults emerged from untreated control}} \times 100$$

6. Effect on adult longevity

Ten newly emerged adults from each treatment were separated for sexes and kept separately. With the help of thread, the cotton swab soaked with five percent sugar solution was kept in the jars in which adults were released. Ten adults of each sex were kept under the observation and period from adult emergence till its death was recorded. The data obtained were analysed statistically.

Results and Discussion

1. Effect of different plant products (as such) on fecundity

When plant products were tested as such, it was noticed that number of eggs laid per female was decreased. The mean numbers of eggs were observed to be deposited by female moth emerged from kernels treated with different plant products (as such) varied from 252.13 to 305.17 against 392.53 in untreated control. The data regarding effect of plant product (as such) on fecundity are presented in Table 1. No adult emergence were observed in the treatment with sweet flag rhizome each at 3 g and 6 g per 100 g of kernels, while very few (1 or 2) male moths were observed in the treatment with dry nutmeg each at 3 g and 6 g per 100 g of kernels. Hence no egg laying was observed in these treatments. Therefore, further observation on fecundity could not be recorded in respect of the treatments *viz*., sweet flag rhizome and dry nutmeg each at 3 g and 6 g per 100 g of kernels.

Among the remaining treatments, the minimum number of eggs were observed to be deposited by the female moth emerged from the treatment with turmeric rhizome (252.13 eggs), followed by mango leaves (252.57 eggs), triphal seeds (253.97 eggs), neem leaves (259.73 eggs), black pepper seeds (265.73 eggs) each at 6 g per 100 g of kernels and turmeric rhizome (267.37 eggs), mango leaves (268.87 eggs), neem leaves (279.70 eggs) and triphal seeds (289.10 eggs) each at 3 g per 100 g of kernels, respectively and were at par with each other.

Most of the observations corroborate with the observations recorded by Patkar (1990) [9] who reported that least number of eggs was laid by *S. cerealella* on sweet flag treated seeds (40.67) at 6 percent w/w, followed by triphal (47.67). Chakraborti and Chatterjee (1996) [1] observed that *Azadirachtin* interfered with ecdysteroid (moulting hormone) titres and produced morphogenetic effects. It also adversely affected the reproductive potential of the initial generation. Sawant (2001) [12] revealed that no egg laying was observed by *C. cephalonica* in the treatments like black pepper powder, sweet flag powder used at 3 g, 4 g and 5 g per 100 g of seed concentrations. Narangoda and Karunaratne (2009) [7] observed that maximum oviposition deterrence was observed with *P. nigrum* followed by *A. indica* and, *A. squamosa.* Raktade (2013) [10] reported that the minimum number of eggs laid by *S. cerealella* on sweet flag (42.50), followed by triphal seeds (45.50), turmeric rhizome (48.00) and mango leaves (48.00) each at 6 g per 100 g of seeds, respectively. Jadhav (2013) [4] reported that minimum egg laid by pulse beetle was observed in treatment like sweet flag.

2. Effect of different plant products (as such) on oviposition period, incubation period and hatching percentage of *C. cephalonica*

The data regarding effect of different plant products (as such) on oviposition period, incubation period and hatching percentage are presented in Table 1. When different plant products (as such) were tested, no adult emergence were observed in the treatment with sweet flag rhizome each at 3 g and 6 g per 100 g of kernels, while very few (1 or 2) male moths were observed in the treatment with dry nutmeg each at 3 g and 6 g per 100 g of kernels. Therefore, oviposition period could not be recorded in these treatments, while in remaining treatments, oviposition period ranged from 3.17 to 4.03 days as against 4.27 days in untreated control. Minimum oviposition period were observed in case of eggs which were observed to be deposited by the female moth emerged from the treatment with turmeric rhizome (3.13 days), followed by black pepper seeds (3.17 days), triphal seeds (3.20 days), neem leaves (3.23 days), ginger rhizome (3.30 days) and mango leaves (3.33 days) each at 6 g per 100 g of kernels.

It was revealed that the incubation period in the treatments with different plant products (as such) ranged from 4.18 to 5.07 days as against 4.12 days in untreated control. No adult emergence was observed in the treatment with sweet flag rhizome at 3 g and 6 g per 100 g of kernels, while very few (1 or 2) male moths were observed in the treatment with dry nutmeg each at 3 g and 6 g per 100 g of kernels. Therefore, further observation on incubation period could not be recorded.

Among the remaining treatments, maximum incubation period of 5.07 days was observed in case of the eggs laid by the female moth emerged from the treatment with turmeric rhizome followed by black pepper seeds (4.85 days) each at 6 g per 100 g of kernels and those were at par with each other. The next best treatments were neem leaves (4.78 days) and triphal seeds (4.58 days) each at 6 g per 100 g of kernels and those were at par. Prolongation of incubation period might be due to some action of plant products causing unsuitable conditions. Effectiveness of sweet flag and turmeric might be due to active principle ‘Osarone’ and ‘Curcumin’, respectively. The results of present study are in agreement with those of Sawant (2001) [12] who noticed that there was no egg laying in treatments like black pepper powder and sweet flag powder so no incubation period was recorded. The maximum incubation period was of 6 days recorded in the treatments like citrus rind powder, neem leaves and triphal powder used at 4 g and 5 g of seed in both mixture and layer application.

The observations recorded on effect of different plant products (as such) on percent hatching ranged from 87.73 to 96.53 as against 99.73 in untreated control. No adult emergence were observed in the treatment with sweet flag rhizome at 3 g and 6 g per 100 g of kernels, while very few (1 or 2) male moths were observed in the treatment with dry nutmeg at 3 g and 6 g per 100 g of kernels. Therefore, observations on hatching percentage could not be recorded in case of these treatments.

Among remaining treatments, minimum percent hatching was observed in case of eggs which were deposited by the female moth emerged from the treatment with turmeric rhizome (87.73%) followed by neem leaves (88.47%) and black pepper seeds (88.67%) each at 6 g per 100 g of kernels.

The observations are more or less similar with those of Patkar (1990) [9] who noticed that minimum number of eggs were hatched on sweet flag at 6 percent level followed by soapnut shell and black pepper at 6 percent level w/w. Sawant (2001) [12] revealed that minimum hatching was observed in neem leaf powder used at 5 g, 4 g and 3 g per 100 g of seed (49.38, 56.25 and 63.75%) followed by neem leaves, citrus rind powder used at 5 g per 100 g of seed (72.5%) in mixture application. Jadhav (2013) [4] reported that the treatment of sweet flag powder observed more effective in which only 50 percent egg were hatched followed.

3. Effect of different plant products (as such) on percent adult emergence of *C. cephalonica*

The data on effect of different plant products (as such) on percent adult emergence are presented in Table 2. When different plant products (as such) were tested, it was observed that the percent adult emergence ranged from 1.05 to 77.70 as against 95.67 in untreated control. No adult emergence was observed in the treatment with sweet flag rhizome each at 3 g and 6 g per 100 g of kernels.

Therefore, further observations on percent adult emergence could not be recorded in respect of the treatments with sweet flag rhizome each at 3 g and 6 g per 100 g of kernels. In the treatment with turmeric rhizome, nirgudi leaves, mango leaves, neem leaves, triphal seeds and ginger rhizome each at 3 g and 6 g per 100 g of kernels abnormal adults were observed.

Among the remaining treatments minimum (1.74 and 2.09) percent adult emergence was recorded in the treatment with dry nutmeg at both the doses (6 g and 3 g per 100 g of kernels). The possible reason could be that the active components of spices might have affected the physiology of the pest. The next best treatment in reducing the percent adult emergence was turmeric rhizome (34.84%) at 6 g per 100 g of kernels, followed by turmeric rhizome (51.57%) at 3 g per 100 g of kernels. Further the treatment with neem leaves (56.79%) followed by mango leaves (59.23%) each at 6 g per 100 g of kernels were found to be effective treatments in reducing percent adult emergence, and were at par with each other. The slight action of plant products in reducing adult population might be due to their repellent action.

Present studies are in conformity with those of Patkar (1990) [9] minimum number of adults were recorded on sweet flag (1.33) at 4 percent concentration. Chander *et al.* (2000) [2] observed that the lower insect count in most of the effective treatments were probably due to their repellent action. Sawant (2001) [12] observed that at higher concentrations like 3 g, 4 g and 5 g per 100 g of seeds, plant products like black pepper powder and sweet flag powder, there was no adult emergence in both mixture and layer application. In these treatments, there was no egg laying and hence, there was no adult emergence. Shah Hussain Ahmad Mahadi and Md. KhaladurRahman (2008) [14] observed that the clove and black pepper treated black gram produced lower number of adults. Morya *et al*. (2010) [6] observed that in the treatments with *L. camara* and *C. inerme* the silken cocoons produced for pupation by the treated larvae were less rigid and were absent in some. More than 50 percent of such pupae produced abnormal adults with distorted wings. Pathak and Tiwari (2010) [8] revealed that the azadirachtin, the main constituent of the neem, as well as its other chemical constituents function as antifeedent, growth inhibitor and stomach poison, they inhibit the release of prothoracicotropic and allotropic hormones also and consequently they may affect metamorphosis. Raktade (2013) [10] found that found that the treatments with sweet flag rhizome at both concentration (6 g and 3 g per 100 g of seeds) was found comparatively more effective in reducing adult emergence. Jadhav (2013) [4] reported that minimum adult emergence was observed in vekhand powder which was at par with black pepper powder.

4. Effect of different plant products (as such) on total developmental period *C. cephalonica*

The effect of different plant products (as such) on total development period are presented in Table 2. The data revealed that the total development period ranged from 40.67 to 57.79 days. No adult emergence was observed in the treatment with sweet flag rhizome at 3 g and 6 g per 100g of kernels. Therefore, further observations on total development period could not be recorded in respect of the treatments with sweet flag rhizome each at 3 g and 6 g per 100 g of kernels. In the treatments with dry nutmeg each at 3 g and 6 g per 100 g of kernels very few (1 or 2) adult moths were found to be emerged, further the mean total development period was found to be minimum in these treatments as compared to the remaining treatments.

Among the remaining treatments, the maximum (57.79 days) total development period was observed in case of the adult moths emerged from the kernels treated with turmeric rhizome followed by neem leaves (55.92 days), black pepper seeds (55.38 days), triphal seeds (55.03 days) and nirgudi leaves (54.97 days), respectively each at 6 g per 100 g of kernels and were at par with each other.

Present findings are in conformity with those of Tewari and Singh (1978) [15] who observed that many plants like *Annona squamosa* L., *Lantana camara* L., *Clerodendrum inerme* L., *Cassian fistula* L., *Azadirachta indica*, *A. Juss* and *Calotropis cera* Ait. was proved to be lethal to various stored grain pests and delay the developmental stages by interfering with their apolysis and moulting processes. Raktade (2013) [10] reported that maximum development period of *S. cerealella* was observed in seeds treated with sweet flag rhizome (33.50 days), followed by turmeric rhizome (32.52 days) and triphal seeds (32.00 days) each at 6 g per 100 g of seeds as against control (24.00 days). Jadhav (2013) [4] reported that the development period of pulse beetle was maximum on black pepper powder followed by sweet flag powder, turmeric powder, ash and tisal powder.

5. Effect of different plant products (as such) on adult longevity

The data regarding effect of different plant products (as such) treatments on adult longevity are presented in Table 3.

When plant products were tested, longevity of male and female moths ranged from 7.33 to 9.07 days as against 10.07 days in untreated control and 4.87 to 6.67 days as against 8.33 days in untreated control. No adult emergence was observed in the treatment with sweet flag rhizome each at 3 g and 6 g per 100 g of kernels, while very few (1 or 2) male moths were observed in the treatment with dry nutmeg each at 3 g and 6 g per 100 g of kernels. Therefore, further observations on female longevity could not be recorded in respect of the treatment with dry nutmeg each at 3 g and 6 g per 100 g of kernels.

The minimum (7.33 and 7.50 days) longevity of male moth was recorded in case of male adults emerged from the treatment with dry nutmeg at 6 g and 3 g per 100 g of kernels and both the treatments were at par with each other. The next best treatments were turmeric rhizome (8.03 days) followed by black pepper seeds (8.10 days), triphal seeds (8.37 days), neem leaves (8.43 days) and mango leaves (8.47 days) each at 6 g per 100 g of kernels, respectively and those were at par with each other, while minimum (4.83 days) female longevity was recorded in the case of the female moths emerged from the treatment with turmeric rhizome followed by black pepper seeds (4.87 days) and triphal seeds (5.07 days) each at 6 g per 100 g of kernels and were at par with each other.

Present results when viewed in the light of existing works find support from Patkar (1990) [9] who observed that neem products contains ‘azadirachtin’ as chemical compound which may have some insecticidal properties in reducing adult longevity of *S. cerealella*. Karthikeyan *et al*. (2009) [5] who reported that the strong odour emitted from sweet flag acted as a repellent against all the storage pests. Raktade (2013) [10] found that seeds treated with sweet flag and turmeric showed minimum longevity of male and female moth of *S. cerealella* might be due to the active principle of ‘Osarone’ and ‘Curcumin’, respectively. Jadhav (2013) [4] reported that minimum adult longevity was observed in the treatment with black pepper powder, followed by sweet flag.

Table 1: Effect of different plant products (as such) on fecundity, mean oviposition period, mean incubation period and hatching percentage of *C. Cephalonica*

Treatment	Dose (g/100 g of kernels)	Fecundity	Mean oviposition period (Days)	Mean incubation period (Days)	Mean hatching percentage
Nirgudi leaves	3	305.17 (17.48)*	4.03	4.22	96.53 (79.73)**
	6	298.03 (17.28)	3.53	4.40	94.53 (76.52)
Turmeric rhizome	3	267.37 (16.36)	3.63	4.38	94.87 (77.07)
	6	252.13 (15.89)	3.13	5.07	87.73 (69.50)
Ginger rhizome	3	299.13 (17.27)	3.77	4.22	95.07 (77.25)
	6	294.67 (17.18)	3.30	4.42	93.07 (74.80)
Neem leaves	3	279.70 (16.73)	3.63	4.38	92.33 (73.97)
	6	259.73 (16.12)	3.23	4.78	88.47 (70.21)
Triphal seeds	3	289.10 (16.97)	3.67	4.23	93.47 (75.28)
	6	253.97 (15.91)	3.20	4.58	91.80 (73.39)

Mango leaves	3	268.87 (16.40)	3.80	4.18	94.80 (76.87)
	6	252.57 (15.90)	3.33	4.40	92.13 (73.98)
Black pepper seed	3	292.73 (17.07)	3.73	4.27	92.47 (74.18)
	6	265.73 (16.31)	3.17	4.85	88.67 (70.38)
Sweet flag rhizome	3	0.00 (1.00)	0.00	0.00	0.00 (0.18)
	6	0.00 (0.71)	0.00	0.00	0.00 (0.18)
Dry nutmeg	3	0.00 (0.71)	0.00	0.00	0.00 (0.18)
	6	0.00 (0.71)	0.00	0.00	0.00 (0.18)
Untreated control	-	392.53 (19.82)	4.27	4.12	99.73 (87.08)
S.E.(m±)		0.42	0.13	0.08	1.13
C.D. at 5%		1.16	0.35	0.22	3.13

* Figures in parentheses are √n+0.5 values ** Figures in parentheses are arcsine values.

Table 2: Effect of different plant products (as such) on percent adult emergence and total development period of *C. Cephalonica*

Treatment	Dose (g/100 g of kernels)	Percent adult emergence	Total development period (Days)
Nirgudi leaves	3	67.25 (55.09)*	50.65
	6	63.41 (52.79)	54.97
Turmeric rhizome	3	51.57 (45.90)	53.98
	6	34.84 (36.17)	57.79
Ginger rhizome	3	75.26 (60.17)	51.35
	6	68.99 (56.17)	54.41
Neem leaves	3	62.37 (52.19)	53.62
	6	56.79 (48.91)	55.92
Triphal seeds	3	67.59 (55.31)	49.57
	6	62.02 (51.96)	55.03
Mango leaves	3	66.20 (54.45)	50.62
	6	59.23 (50.34)	54.65
Black pepper seed	3	69.33 (56.38)	51.79
	6	63.76 (53.03)	55.38
Sweet flag rhizome	3	0.00 (0.18)	0.00
	6	0.00 (0.18)	0.00
Dry nutmeg	3	2.09 (8.13)	40.67
	6	1.74 (7.50)	42.00
Untreated control	-	95.67 (78.00)	47.18
S.E.(m±)		1.03	1.06
C.D. at 5%		2.85	2.93

*Figures in parentheses are arcsine values.

Table 3: Effect of different plant products (as such) on adult longevity (Days)

Treatment	Dose (g/100 g of kernels)	Adult longevity (Days)	
		Male	Female
Nirgudi leaves	3	9.07	6.17
	6	8.57	5.53
Turmeric rhizome	3	8.67	5.63
	6	8.03	4.83
Ginger rhizome	3	8.70	6.47
	6	8.53	5.47
Neem leaves	3	8.83	6.67
	6	8.43	5.53
Triphal seeds	3	8.57	5.63
	6	8.37	5.07
Mango leaves	3	8.93	6.43
	6	8.47	5.23
Black pepper seed	3	8.57	5.47
	6	8.10	4.87
Sweet flag rhizome	3	0.00	0.00
	6	0.00	0.00
Dry nutmeg	3	7.50	0.00
	6	7.33	0.00
Untreated control	-	10.07	8.27
S.E.(m±)		0.18	0.12
C.D. at 5%		0.49	0.32

Conclusion

From the present study, it can be concluded that different plant product (as such) use as grain protectant by farmer to avoid infestation of pests during storage condition. In here sweet flag rhizome at the rate 3 g and 6 g per 100 g of kernel found to be best groundnut kernel protectants against *C. cephalonica*. There was no fecundity and adult emergence of *C. cephalonica* occurs. It is safe and effective method for reducing the infestation of *C. cephalonica* in stored grain products. While turmeric rhizome at 6 g per g per 100 g of kernel treatment delaying the development *C. cephalonica*.

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