RESULTS AND DISCUSSION

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1. Biology Studies:

1.1. Effect of temperature on the biology of *S. cerealella*:

Some biological aspects of *S. cerealella* were studied at three constant temperatures of 30, 25 and 20°C and 70±5% relative humidity.

1.1.a. Effect on egg stage:

The effect of various temperatures (30, 25 and 20°C) on incubation period and hatching percent of the eggs of *S. cerealella* was presented in **Table (1).** These data indicated that eggs kept at 30°C showed the shortest incubation period 3.4 ± 0.5 (3 – 6 days) and those kept at 25°C showed 5.1±0.9 days, but the longest period (7.8±0.4) days with a minimum 7 and maximum 8 days, was recorded at 20°C.

Concerning, the effect of different temperatures on eggs hatching, data in the same Table revealed that the highest rate of hatching (85.6%) was recorded at 25°C, while lower values (69.8%) and 74.8% were obtained at 20 and 30°C, respectively. This results revealed that the optimum temperature for eggs hatching seems to be 25°C. The gradual drop below this temperature resulted in a pronounced reduction in hatching rates. The obtained results is in agreement with **Moustafa (1977)** who found that the incubation period of *S. cerealella* eggs was shortest at 30°C and longest at 20°C. While, **Willcocks (1925)** reported that the egg stage of this insect may last for a month in cold weather.

Table (1): Effect of various temperatures on incubation period and hatching percent of the eggs of *S. cerealella* at 70±5% RH.

Temperature	Incubation period (days)	% Hatching
30°C	3.4 ± 0.5 (3 – 6)	74.8 ± 9.0 (64 – 84)
25°C	5.1 ± 0.9 (4 – 6)	85.6 ± 3.9 (82 – 94)
20°C	7.8 ± 0.4 (7 – 8)	69.8 ± 4.8 (62 – 78)

1.1.b. Effect on adult stage:

-Pre-oviposition, oviposition and post-oviposition periods:

The effect of various temperatures on the pre-oviposition, oviposition, post-oviposition periods and adult longevity was given in **Table (2).** Results indicated that there are slight differences between the effect of different temperatures on the pre-oviposition, oviposition, post-oviposition periods of *S. cerealella* female.

At 20°C, females began laying eggs after 1.4±0.5 days from emergence, while at 30°C they started laying their eggs after 0.5±0.5 days from emergence, *i.e.* the longest pre-oviposition period was recorded at 20°C, while the shortest period was at 30°C.

As for, oviposition and post-oviposition periods, data revealed that these periods took the same trend as with pre-oviposition periods. Whereas these periods were 6.2±1.5, 2.0±1.4 and 4.7±1.2 & 1.3±0.9 at 20°C & 30°C for oviposition and post-oviposition, respectively. The oviposition period of female become shorter (4.7±1.2) at 30°C and this may be due to the fact that the female life was shorter at this temperature **(Table, 2).**

As for, post-oviposition period it is clear that this period was almost took the same trend as in case of pre-oviposition and oviposition at 20°C, 25°C and 30°C.

Table (2): Effect of various temperatures on the longevity and number of eggs laid per female of *S. cerealella* reared on wheat grains at 70±5% RH.

Temp.	Pre-oviposition period (day)	Oviposition period (day)	Post-oviposition period (day)	Female longevity (day)	No. of eggs laid/female
30°C	0.5 ± 0.5 (0 - 1)	4.7 ± 1.2 (3 - 7)	1.3 ± 0.9 (0 - 3)	6.7 ± 1.4 (4 - 9)	223 ± 47 (153-291)
25°C	0.6 ± 0.8 (0 - 3)	5.3 ± 1.6 (1 - 8)	1.6 ± 1.4 (0 - 5)	7.5 ± 1.2 (4 - 8)	176 ± 45 (100-254)
20°C	1.4 ± 0.5 (1 - 3)	6.2 ± 1.5 (3 - 9)	2.0 ± 1.4 (0 - 5)	9.6 ± 0.5 (9 - 10)	134 ± 30 (89-187)

Adult longevity:

Data of female longevity **(Table, 2)** clarified that as the temperature increased, the mean longevity of females decreased. Whereas, the shortest, 6.7±1.4 days of females longevity was detected at 30°C, but the longest (9.6±0.5 days), recorded at 20°C. These results are in general agreement with the finding of **Grewal and Atwal (1969)**, who concluded that *S. cerealella* female had the longest life (11.3 days) at 20°C.

Eggs laying activity:

Data in **Table (2)** revealed that the mean number of eggs laid per female at 20, 25 & 30°C was 134±30, 176±45 and 223±47 eggs, respectively. The highest number of eggs was recorded at 30°C, followed by 25°C. While, the lowest number was shown at 20°C.

From the above results it could be concluded that a decrease in the temperature below 30°C causes a high reduction in number of eggs laid per female. In this respect, **Joubert (1964)** found that, the number of eggs laid per *S. cerealella* female was limited to 80 eggs at 28°C and 60% R.H. Also, **Grewal and Atwal (1969)** estimated that *S. cerealella* female laid the greatest number of eggs (178) at 25°C.

1.2. Effect of temperature and kind of food on developmental period of *S. cerealella*:

The effect of various temperatures on the developmental periods of the different stages of *S. cerealella* reared on wheat and maize grains at 70±5% R.H. is presented in **Table (3).** Data in this table showed that the mean incubation periods was 3.4±0.5, 5.0±1.0 and 7.6±0.5 days at 30, 25 and 20°C, respectively on both the two diets. This means that the incubation period of eggs was affected by the degree of temperature, but didn't affect by kind of food, which offered to *S. cerealella*.

Concerning, the total larval period data in **Table (3),** indicated that the durations of *S. cerealella* larvae were 12.6±2.3, 20±1 and 26.6±3.0 days on wheat grains and 17±1.4, 25±1.2 and 33.2±1.6 days on maize grains at 30, 25 and 20°C, respectively.

From the above data, it could be concluded that the total larval period of *S. cerealella* at three different temperatures on maize grain was longer than on wheat grains. Also, results clarified that, the duration of the larval stage decreases with the increasing of temperature and this result is in line with the finding by **Hammad *et al.*, (1967)** who reported that the duration of the larval and pupal periods was longer on maize than on rice and slightly longer on the latter than on each of wheat and barley, also, the duration of the larval stage decreases with the increase of temperature and relative humidity.

As for, the developmental period of the pupal stage presented in **Table (3)** clear that these periods were 6.0±1.2 and 13.4±1.8 days on wheat grains at 30 and 20°C, but these periods were 7.6±1.8 and 15.0±1.6 days on maize grains at the same temperatures, respectively. The longest period was recorded at 20°C on both the two foods and the pupal duration lasted longer time on maize than on wheat at all three temperatures. Also, it noticed that the duration of the pupal stage was decreased markedly by the increasing of temperature.

The longevity of adult stage under different conditions of 30, 25 and 20°C was varied from 6.2±0.8 to 9.4±0.5 days on wheat grains, but these values were 7.6±1.8, 8.2±0.8 and 9.6±0.5 days on maize and there are slightly differences between the two grains at all tested temperatures. Also, *S. cerealella* adults had the shortest longevity at 30°C.

In this respect, **Grewal and Atwal (1969)** concluded that *S. cerealella* at high temperature become more active and restless, which resulted in rapid expenditure of their energy and accordingly shorter longevity.

The total developmental period was longer when *S. cerealella* reared on maize than on wheat grains at all temperatures, *i.e.* a higher survival from egg to adult estimated on maize than on wheat grains.

Table (3): Effect of various temperatures on the developmental periods of the different stages of *S. cerealella* reared on wheat and maize grains at 70±5% RH.

Temp.	Incubation period of egg (day)	Larval period (day)	Pupal period (day)	Total develop-mental period (day)	Adult longevity (day)	Total life cycle (day)
	Wheat grains					
30°C	3.4±0.5	12.6±2.3	6.0±1.2	22.0±1.4	6.2±0.8	28.2±1.3
	(3 – 4)	(11 – 16)	(4 – 7)	(21 –24)	(5 – 7)	(27 – 30)
25°C	5.0±1.0	20.0±1.0	6.4±1.1	31.4±0.9	6.2±1.5	37.6±1.7
	(4 – 6)	(19 – 21)	(5 – 8)	(31 –33)	(4 – 8)	(35 – 39)
20°C	7.6±0.5	26.6±3.0	13.4±1.8	47.6±4.7	9.4±0.5	57.0±4.2
	(7 – 8)	(24 – 30)	(11 – 15)	(42 –52)	(9 – 10)	(52 – 61)
	Maize grains					
30°C	3.4±0.5	17.0±1.4	7.6±1.8	28.0±1.4	7.6±1.1	35.6±2.2
	(3 – 4)	(16 – 19)	(5 – 10)	(27 –30)	(6 – 9)	(33 – 39)
25°C	5.0±1.0	25.0±1.2	12.0±1.6	41.4±0.9	8.2±0.8	50.2±0.8
	(4 – 6)	(24 – 27)	(10 – 14)	(40 –42)	(7 – 9)	(49 – 51)
20°C	7.6±0.5	33.2±1.6	15.0±1.6	55.8±2.1	9.6±0.5	65.4±1.8
	(7 – 8)	(31 – 35)	(13 – 16)	(53 –59)	(9 – 10)	(63 – 68)

There are a large numbers of literatures on *S. cerealella*, but most deals with cereals other than corn and temperatures different from that used in this work

(Simmons & Ellington, 1933, Crombie, 1944 and Cotton & Russel, 1970).

The duration of the whole life cycle was varied greatly according to the prevailing temperatures, **(Table, 3)**.

From all the above results it is clear that the incubation periods of *S. cerealella* eggs affected with the degree of temperature, but didn't affected by kind of food. But, the total larval period of this pest affected by both the degree of temperature and the type of grains, which reared on it. As for the pupal period and adult longevity some what similar at the two higher temperature under study on wheat grains but it was very longer at the last degree of 20°C temperature these periods were slight longer on maize than on wheat grains at the same temperatures.

Finally, the obtained results revealed that the degree of temperature and type of food had affected on the different stages of *S. cerealella*. Whereas, life cycle lasted from 28.2 - 57.0 days on wheat grains and 35.6 – 65.9 days on maize grains at 30 and 20°C, respectively and the whole life-cycle was shorter on wheat than on maize grains.

1.3. Effect of type and quantity of food on *S. cerealella*.

Results tabulated in **Tables, (4 & 5)** show the effect of wheat and maize grains on the number of emerging moths at 28±1°C and 70±5%RH.

As regards food consumption, the quantity of food consumed by *S. cerealella* larvae was higher on 40 g of grains than 20 g either with wheat or maize grains.

The loss of weight of wheat grains in the two wheat varieties, Sohag3 and Sids1, were 5.7±1.6 & 5.7±1.7 and 3.0±1.5 & 3.0±0.7 g for 40 and 20 g, respectively, (**Table, 4**). While, the loss of weight in maize varieties (Balady, three way cross 310 and three way cross Dahab) due to the feeding of the larvae were 1.3±0.6, 0.46±0.21 & 0.70±0.24 and 0.65±0.13, 0.60±0.34 & 0.43±0.20 for 40 and 20 g of maize grain, respectively (**Table, 5**).

Table (4): Effect of type and quantity of food on the number of emerged moths at 28±1°C and 70±5%RH.

Food	Variety	Initial food quantity (g)	No. of initial moths	Weight of grain after moth emerged	Weight loss (g)	%Weight loss	No. of emerged moths
Wheat grain	Sohag3		2 pairs				
		40		34.0±1.6 (33 – 36)	5.7±1.6 (4 – 7.5)	14.4±3.9 (10 – 19)	153.0±57.0 (104 – 222)
		20		17.0±1.5 (16 – 19)	3.0±1.5 (1 – 4.5)	15.0±8.0 (5 – 23)	59.0±28.0 (23 – 89)
	Sids1		2 pairs				
		40		34.0±1.7 (32 – 37)	5.7±1.7 (3.5 – 7.5)	14.3±4.3 (9 – 19)	154.0±41.0 (109 – 196)
		20		17.0±0.7 (16 – 17.6)	3.0±0.7 (2.4 – 4)	15.0±4.0 (12 – 20)	79.0±4.0 (76 – 85)

Also, data indicate that there aren't differences in grains loss between the two wheat varieties, Sohag3 and Sids1, in both 40 and 20g. But, the percentage of weight loss of maize grains were slight higher with Balady than the two other varieties.

Table (5): Effect of food and quantity of food on the number of emerged moths at 28±1°C and 70±5%RH.

Type of Food	Variety	initial quantity of food (g)	No. of initial moths	Weight of grain after moth emerged	Weight of consumed food (g)	%Weight loss	Average No. of emerged moths
Maize grains			2 pairs				
	Balady	40		38.7±0.6 (38 – 39)	1.30±0.6 (0.8 – 2)	3.3±1.4 (2 – 5)	70.0±1.9 (52 – 90)
		20		19.4±0.13 (19.2 – 19.5)	0.65±0.13 (0.5 – 0.8)	3.3±0.6 (2.5 – 4)	32±2.5 (29 – 35)
			2 pairs				
	Three way cross 310	40		39.3±0.2 (39 – 39.4)	0.46±0.21 (0.44 – 0.7)	1.2±0.5 (0.5 – 2.0)	32±3.1 (29 – 36)
		20		19.4±0.34 (19 – 19.8)	0.60±0.34 (0.2 – 1)	3.0±1.7 (1 – 5)	19.0±4.2 (13 – 23)
			2 pairs				
	Three way cross Dahab	40		39.4±0.2 (39.1 – 39.6)	0.70±0.24 (0.4 – 0.9)	2.0±0.6 (1 – 2.3)	36.0±3.2 (32 – 39)
		20		19.3±0.2 (19.1 – 19.5)	0.43±0.2 (0.3 – 0.5)	2.1±0.5 (2 – 3)	18.3±3.6 (13 – 21)

Concerning, the total numbers of adults emerged data in **Tables (4 & 5)**, revealed that the numbers were increased from 59 to 153 for Sohag variety and 79 to 154 moths for Sids variety when provided food increased from 20 to 40 g of grains.

In case of rearing *S. cerealella* on maize varieties, the adults emerged increased from 32 to 70; 19 to 32 and 18.3 to 36 moths for Balady, three way cross 310 and three way cross Dahab by increasing the quantity of food from 20 to 40 g.

In this respect, **Moustafa (1977)** found that the percentages of adult emergence varied considerably from generation to another in all diets.

From the above mentioned results it could be concluded that at 28±1°C and 70±5%RH, *S. cerealella* was affected by the type and quantity of food. Whereas, food consumption by its larvae and the number of emerged moths was higher on wheat grains than on maize grains, also, on 40 g than on 20g.

This is means that *S. cerealella* prefers wheat grains more than maize grains as insect food.

2- Antagonistic effect of some insecticides and plant extracts against S. cerealella:

2.1. Toxicity of Neemazal, Malathion and Actellic against *S. cerealella*:

Response of *S. cerealella* to neemazal, malathion and pirimiphos-methyl is demonstrated in **Tables (6, 7 and 8),** data clearly indicate that average numbers of emerged moths from the two treatments decrease by increasing the concentration of the insecticide under study. Whereas, the inhibition rates of moths emergence increased with increase of concentration, whereas values ranged from 8 – 70% & 15 – 83%, 15 – 88 & 28 – 82% and 28 – 87.3% & 32.5 – 88.9% for neemazal, pirimiphos-methyl and malathion, respectively.

Table (6): Response of *S. cerealella* (Oliv.) to the botanical insecticide neemazal 5%EC.

Conc. (ppm)	Average No. of emerged moth from egg treatment	Inhibition rates of moths emergence (mean ±SD)	Average No. of emerged moth from moth treatment	Inhibition rates of moths emergence (mean ±SD)
100	24.7	70 ± 4.2	63.3	83 ± 1.7
50	52.3	37 ± 2.6	185.3	51 ± 1.9
25	70.0	16 ± 6.7	233.7	38.9 ± 7.2
12.5	76.3	8 ± 4	325	15 ± 3
Control	83.0	--	382.7	--

Table (7): Response of *S. cerealella* (Oliv.) to Malathion.

Conc. (ppm)	Average No. of emerged moth from egg treatment	Inhibition rates of moths emergence (mean ±SD)	Average No. of emerged moth from moth treatment	Inhibition rates of moths emergence (mean ±SD)
8	10	87.3 ± 2.5	23.7	88.9 ± 1.9
4	20.3	75.0 ± 1.9	40.0	81.2 ± 3.1
2	27	66.7 ± 6.4	61.3	71.2 ± 3.2
1	33	49.0 ± 3.2	91.7	56.9 ± 3.6
0.5	58	28.4 ± 3.3	143.7	32.5 ± 11.5
Control	81	--	212.7	--

Table (8): Response of *S. cerealella* (Oliv.) to pirimiphos-methyl (Actellic).

Conc. (ppm)	Average No. of emerged moth from egg treatment	Inhibition rates of moths emergence (mean ±SD)	Average No. of emerged moth from moth treatment	Inhibition rates of moths emergence (mean ±SD)
1	8.0	88 ± 2.4	49	82 ± 2.4
0.5	14.7	82 ± 2.0	86	68 ± 1.7
0.25	28.3	67 ± 8.5	102	60 ± 2.1
0.13	66.0	23 ± 1.2	172.7	36 ± 3.2
0.06	73.3	15 ± 2.4	191.3	28 ± 3.0
Control	85.7	--	270.3	--

The lethal concentration values of Neemazal, Malathion and Actellic-pirimiphos-methyl are presented in **Table (9).** The results showed marked differences in the susceptibility of the insect species to the three insecticides tested.

Based on LC_{95} *S. cerealella* was high susceptible to pirimiphos-methyl (Actellic), followed by malathion and Neemazal.

This result indicates that pirimiphos-methyl was the most effective against *S. cerealella* **(Table, 9).**

In this respect, **Halawa (1998)** found that pirimiphos-methyl was more toxic to *Callosobrachus maculatus*-adults than malathion.

From these data it could be concluded that *S. cerealella* is very sensitive to pirimiphos-methyl as compared with the two other insecticides.

The findings of **Bitran *et al.* (1983); Mohammed and Al-Jabrey (1988); Suchila *et al.* (1989)** and **Halawa (1998)** indicated that pirimiphos-methyl was more toxic to other stored product insects.

Table (9): Lethal concentrations of some insecticides against *S. cerealella*.

Insecticides	Treatment stage	Lethal concentrations (ppm) and their 95% confidence limits			Slope±SD	R
		LC_{50}	LC_{90}	LC_{95}		
Neemazal	egg	64 (44 – 94)	254 (104 – 616)	374 (130 – 1077)	2.143±0.05	0.988
	moth	39 (28 – 54)	160 (76 – 338)	239 (96 – 594)	2.093±0.06	0.985
Malathion	egg	1.2 (0.98 – 1.5)	4.9 (3.7 – 6.4)	7.3 (5.2 – 10.1)	2.096±1.14	0.927
	moth	1.0 (0.81 – 1.27)	4.4 (3.3 – 5.8)	6.7 (4.6 – 9.4)	2.011±1.01	0.929
Actellic	egg	0.21 (0.17 – 0.27)	0.92 (0.6 – 1.4)	1.4 (0.84 –)	1.999±0.25	0.968
	moth	0.19 (0.14 – 0.28)	2.02 (0.86 – 4.7)	3.94 (1.34 – 11.7)	1.258±0.04	0.987

R = Correlation coefficient of regression line.

SD = Standard deviation of the regression line.

2.2. Antagonistic activity of some plant extracts against *S. cerealella*:

The effectiveness of petroleum ether and acetone extracts of dill-, black pepper, -cumin and lupine seeds as well as and clerodendron leaves against *S. cerealella* is presented in **Tables (10, 11, 12, 13, & 14)**. The results of dill seed extracts given in **Table (10)** showed that the average number of emerged adults from egg and moth treatments was reduced with the increase of concentration. The recorded numbers were 56, 29.3, 13.2 and 4.7 emerged adults from the eggs treatments and 176.3, 94.3, 35.7 and 8.7 emerged adults from the moths treatments at 0.003, 0.006, 0.012 and 0.03 concentrations of petroleum ether extract of dill seeds, respectively. The corresponding values for the acetone extract were 57.3, 31.3, 19.3 & 3.7 emerged adults from egg treatments and 172, 103.3, 37.3 & 2 emerged adults from moth treatment at the previously mentioned concentrations, respectively. The obtained results revealed no significant differences in the efficacy of the two extracts against *S. cerealella* infestation to treated grains with dill seeds extracts. Also, the effect was somewhat similar in the two treatments of the eggs and moths. In this respect, **El-Lakwah *et al.*, (1996)** indicated that mortalities of acetone and petroleum ether extracts of were somewhat higher at the highest concentration of 10%. Whereas, the petroleum ether extract was more effective on mortalities and reduction in F_1 progeny than acetone extract to some stored product insects.

Response of *S. cerealella* to petroleum ether and acetone extracts of black pepper seeds is given in **Table (11).** The results indicated that inhibition rates of moths resulted from eggs and moths treatments are concentration dependent. The highest inhibition rates of moths emergence were 94±2 and 97±2 to eggs and moths treatments at the highest used concentration (0.2%) of petroleum ether extract of black pepper seeds for treated eggs and moths, respectively. While the lowest reduction rates of moth emergence (34±10 and 46±5.4) were recorded at the lowest concentration (0.0125%w/v).

Table (10): Response of *S. cerealella* to petroleum ether and acetone extracts of dill seeds.

Conc. (%w/w)	Average No. of emerged moth from egg treatment	Inhibition rates of moths emergence (mean ±SD)	Average No. of emerged moth	Inhibition rates of moths emergence (mean ±SD)
	Petroleum ether extract			
0.03	4.7	94.3 ± 1.8	8.7	96.0 ± 0.6
0.012	12.3	85.0 ± 3.9	35.7	86.4 ± 2.2
0.006	29.3	64.2 ± 4.9	94.3	65.0 ± 2.2
0.003	56	48.3 ± 1.9	176.3	34.5 ± 6.0
Control	82	--	269.3	--
	Acetone extract			
0.03	3.7	95.0 ± 1.9	2	99.3 ± 0.4
0.012	19.3	75.9 ± 6.4	37.3	86.0 ± 0.9
0.006	31.3	60.9 ± 4.0	103.3	62.9 ± 3.0
0.003	57.3	28.4 ± 3.2	172.0	38.0 ± 2.7
Control	80.0	--	278.3	--

In case of black pepper acetone extract, the highest concentration (0.2%) caused the highest reduction rate, (92±3 and 96±2%) for eggs and moths treatments, respectively. While, the lowest reduction rates of moth emergence was observed at the lowest tested concentrations.

Table (11): Response of *S. cerealella* to petroleum ether and acetone extracts of black pepper seeds.

Conc. (%w/w)	Average No. of emerged moth from egg treatment	Inhibition rates of moths emergence (mean ±SD)	Average No. of emerged moth	Inhibition rates of moths emergence (mean ±SD)
	Petroleum ether extract			
0.2	3.2	94.0 ± 2.0	7	97.0 ± 2.0
0.1	10	80.0 ± 3.4	37.7	82.0 ± 6.0
0.05	37	48.0 ± 6.0	59.3	60.0 ± 5.4
0.025	51.3	34.0 ± 10	70.7	46.0 ± 5.4
Control	77.3	--	169.3	--
	Acetone extract			
0.2	4.7	92 ± 3	4.3	96 ± 2
0.1	15.0	80 ± 2	32.7	81 ± 3
0.05	37.3	44 ± 8	71.3	55 ± 4
0.025	45.7	28 ± 12	101.3	34 ± 6
Control	80.0	--	171.0	--

Results of the response of *S. cerealella* to petroleum ether and acetone extracts of cumin seeds (*Cumminum cyminum* L.) are given in **Table (12)**. Data showed the same phenomenon as mentioned with the extracts of black pepper seeds.

The number of emerged moths was gradually reduced with increasing the concentration at all treatments when compared with the control. Consequently, the inhibition rates of moth emergence increased with increasing the concentration at all treatments, reaching between 22.5 – 90.2% and 28.6 – 97.7% in egg and moth treatments for petroleum ether extract of cumin seeds, while this rates were 27 – 86.8% and 27.1 – 89.6% egg and moth treatments for the acetone extract of Cumin seeds.

Table (12): Response of *S. cerealella* to petroleum ether and acetone extracts of cumin seeds.

Conc. (%w/w)	Average No. of emerged moth from egg treatment	Inhibition rates of moths emergence (mean ±SD)	Average No. of emerged moth	Inhibition rates of moths emergence (mean ±SD)
	Petroleum ether extract			
0.2	8.3	90.2 ± 2.9	5.7	97.7 ± 0.6
0.1	19.7	76.8 ± 0.7	49.7	80.2 ± 2.2
0.05	24.7	70.9 ± 5.3	91.7	63.5 ± 4.1
0.03	40.0	52.8 ± 10.5	122.7	51.1 ± 2.3
0.012	65.7	22.5 ± 6.1	179.3	28.6 ± 2.9
Control	84.7	--	251.0	--
	Acetone extract			
0.2	11.3	86.8 ± 4.1	30.0	89.6 ± 1.7
0.1	21.3	75.1 ± 3.8	66.0	77.1 ± 1.2
0.05	31.3	63.4 ± 3.7	109.7	61.9 ± 3.6
0.03	48.0	44.0 ± 5.3	155.3	46.1 ± 4.7
0.012	62.7	27.0 ± 0.7	210.0	27.1 ± 6.3
Control	85.7	--	288.0	--

From **Table (13)** it is clear that the inhibition rates of moth emergence from moths treatment with petroleum ether extract of lupine seeds ranged from 37 – 94.2% and were slightly higher than figures resulted from eggs treatment (23.9 – 87.1%).

On the other hand, the efficacy of lupine seed petroleum ether extracts against eggs and moths of *S. cerealella* was somewhat similar to the effectiveness of the acetone extract.

Table (13): Response of *S. cerealella* to petroleum ether and acetone extracts of lupine seeds.

Conc. (%w/w)	Average No. of emerged moth from egg treatment	Inhibition rates of moths emergence (mean ±SD)	Average No. of emerged moth from treated moth	Inhibition rates of moths emergence (mean ±SD)
	Petroleum ether extract			
0.2	11.0	87.1 ± 8.8	13.3	94.2 ± 1.8
0.1	28.7	66.3 ± 2.7	46.0	80.0 ± 3.7
0.05	36.0	57.6 ± 5.1	59.0	74.4 ± 5.9
0.03	50.0	41.2 ± 2.0	91.7	60.0 ± 3.3
0.012	64.7	23.9 ± 8.8	149.0	37.0 ± 6.6
Control	85.0	--	230.0	--
	Acetone extract			
0.2	13.7	83.8 ± 3.5	16.3	93.6 ± 1.5
0.1	25.0	70.9 ± 3.1	50.0	78.4 ± 3.7
0.05	32.7	62.0 ± 4.4	94.3	59.2 ± 3.2
0.03	53.0	41.9 ± 9.2	125.3	46.8 ± 6.4
0.012	60.0	30.2 ± 4.0	173.7	25.0 ± 2.3
Control	86.0	--	231.3	--

Results in **Table (14)** indicated also, that the toxic effect of *Clerodendron inermi*, leaves extract in acetone were slight high than petroleum ether extract of the tested material on *S. cerealella* at high concentrations (0.2, 0.1 and 0.05%), whereas the emergence rates of moths from eggs treatments ranged from 37.7 to 18.3 individuals with petroleum extract and 30.7 – 14.3 individuals with acetone extract. While, in case of moths treatment with the same concentrations, these rates ranged 176.3 – 43.3 and 98.3 – 52.3 emerged individuals for petroleum ether and acetone extract, respectively. Also, the inhibition rates of moth emergence increased with increasing the concentration.

The obtained results are in complete harmony with that obtained by **El-Lakwah and Mohamed (1999)** who studied the toxicity of four plant extracts, namely black pepper (*Piper nigrum*), dill (*Anethum graveolens* L.) flea bane (*Inula conyza* L.) and cumin (*Cumminum cyminum* L.) on the mortality and oviposition of *C. maculatus*. They reported that, mortality increased with increasing the concentrations and time of exposure at all treatments, reaching between 34.4 to 100% after 7 days. Black pepper extract was the most effective. Also, the treatment of cowpea seeds with 10% acetone extract inhibited the oviposition of the insect.

Generally, it is clear that, wheat grains treated with the highest used concentrations of each plant extract reduced significantly the F_1 progeny of *S. cerealella*.

Table (14): Response of *S. cerealella* to petroleum ether and acetone extracts of *Clerodendron inerme* leaves.

Conc. (%w/w)	Average No. of emerged moth from egg treatment	Inhibition rates of moths emergence (mean ±SD)	Average No. of emerged moth from treated moth	Inhibition rates of moths emergence (mean ±SD)
	Petroleum ether extract			
0.2	18.3	76.9 ± 5	43.3	87 ± 2.6
0.1	36.3	54.2 ± 12	91.0	67 ± 2.2
0.05	37.7	40.7 ± 10	153.3	44 ± 2.5
0.025	55.0	30.6 ± 7	176.3	36 ± 10.7
0.012	60.7	16.8 ± 7	214.0	22 ± 4.3
Control	79.2	--	276.3	--
	Acetone extract			
0.2	14.3	78 ± 4.8	52.3	80.4 ± 2.1
0.1	21.3	64 ± 3.9	72.7	72.7 ± 1.3
0.05	30.7	53 ± 6.3	98.3	63.2 ± 1.5
0.025	52.3	37 ± 2.2	141.0	47.1 ± 5.1
0.012	64.3	23 ± 5.4	191.3	28.0 ± 3.9
Control	85.3	--	266.7	--

The lethal concentrations of petroleum ether and acetone extracts of the seeds and leaves for tested plants on *S. cerealella* are summarized in **Tables (15 & 16)**.

The results showed that the lethal concentration values to eggs (LC_{90} & LC_{95}) were slightly greater than those obtained to moths for various plant extracts. This result indicates that the tested plant extracts were slightly more effective in moths treatment than eggs treatment and showed promising results at the highest used concentrations of the different tested materials. Thus, these plant seeds and leaves extracts could be used as grain protectants against this insect species in frame of an integrated pest management program.

Table (15): Lethal concentrations of petroleum ether extracts of certain plant seeds and leaves against *S. cerealella*.

Plant extract	Treated stage	Lethal concentrations (%w/w) and their 95% confidence limits			Slope ± SD	R
		LC_{50}	LC_{90}	LC_{95}		
Dill seeds	egg	0.004 (0.002–0.006)	0.018 (0.009–0.034)	0.030 (0.01–0.07)	1.847±0.01	0.996
	moth	0.004 (0.003–0.007)	0.016 (0.01–0.025)	0.022 (0.012–0.022)	2.420±0.00	0.999
Black pepper seeds	egg	0.04 (0.03 – 0.06)	0.16 (0.09 – 0.28)	0.23 (0.12 – 0.46)	2.257±0.06	0.988
	moth	0.03 (0.02 – 0.05)	0.13 (0.07 – 0.2)	0.18 (0.09 – 0.37)	2.195±0.09	0.979
Cumin seeds	egg	0.03 (0.02 – 0.04)	0.18 (0.12 – 0.31)	0.31 (0.16 – 0.61)	1.604±0.09	0.981
	moth	0.03 (0.02 – 0.04)	0.13 (0.08 – 0.19)	0.19 (0.12 – 0.34)	1.908±0.15	0.978
Lupine seeds	egg	0.04 (0.03 – 0.05)	0.31 (0.15 – 0.62)	0.55 (0.23 – 1.33)	1.430±0.05	0.988
	moth	0.02 (0.01 – 0.03)	0.15 (0.08 – 0.26)	0.27 (0.13 – 0.56)	1.449±0.06	0.985
Clerodendron inerme leaves	egg	0.07 (0.05 – 0.09)	0.63 (0.25 – 1.61)	1.18 (0.37 – 3.8)	1.322±0.04	0.987
	moth	0.05 (0.03 – 0.06)	0.32 (0.16 – 0.62)	0.55 (0.24 – 1.3)	1.526±0.028	0.981

R = Correlation coefficient of regression line.

SD = Standard deviation of the mortality regression line.

Based on the LC_{90} & LC_{95} results revealed that seed extracts of Dill were the most effective followed by Black pepper and Cumin, while the extracts of Lupine seeds and Clerodendron leaves were the least effective against *S. cerealella* infestation. The antagonistic effect of these plants extracts may be due to the fact that these plants contain some compounds (terpenoids or similars) which possess antifeedant or toxic activity or lead to a moulting disturbance which is often lethal to insects. **(Champagne *et al.*, 1989).**

Also, the obtained results coincide with the findings of these investigators **(Klein, 1930; Matsobara and Tanimura, 1966; Hammad *et al.*, 1967; El-Lakwah *et al.*, 1996; Halawa, 1998)**.

Table (16): Lethal concentrations of acetone extracts of some plants against *S. cerealella*.

Insecticides	Treated stage	Lethal concentrations (mg/kg) and their 95% confidence limits			Slope ± SD	R
		LC_{50}	LC_{90}	LC_{95}		
Dill seeds	egg	0.006 (0.004–0.008)	0.02 (0.01–0.03)	0.03 (0.01 – 0.05)	2.3949±0.046	0.9909
	moth	0.005 (0.003–0.006)	0.013 (0.008–0.019)	0.017 (0.01 – 0.03)	2.9209±0.104	0.9864
Black pepper seeds	egg	0.05 (0.04 – 0.7)	0.17 (0.1 – 0.3)	0.25 (0.13 – 0.49)	2.3106±0.05	0.9892
	moth	0.04 (0.03 – 0.07)	0.14 (0.08 – 0.23)	0.20 (0.1 – 0.4)	2.3936±0.03	0.9934
Cumin seeds	egg	0.03 (0.02 – 0.05)	0.27 (0.14 – 0.53)	0.49 (0.20 – 1.15)	1.3987±0.007	0.9982
	moth	0.03 (0.02 – 0.04)	0.22 (0.12 – 0.41)	0.39 (0.18 – 0.83)	1.5005±0.028	0.9993
Lupine seeds	egg	0.03 (0.02 – 0.05)	0.34 (0.15 – 0.78)	0.67 (0.24 – 1.9)	1.2591±0.012	0.9960
	moth	0.03 (0.02 – 0.04)	0.18 (0.12 – 0.29)	0.29 (0.15 – 0.54)	1.7183±0.037	0.9932
Clerodendron inerme leaves	egg	0.05 (0.03 – 0.07)	0.52 (0.20 – 1.3)	1.03 (0.32 – 3.3)	1.2326±0.004	0.9983
	moth	0.03 (0.02 – 0.05)	0.39 (0.16 – 0.94)	0.78 (0.25 – 2.4)	1.1886±0.027	0.9896

R = Correlation coefficient of regression line.

SD = Standard deviation of the mortality regression line.