EFFECT OF PLANT OILS ON ADULT EGG LAYING, EMERGENCE, AND WEIGHT LOSS OF *COLLOSOBRUCHUS ANALIS* (FAB.) IN GREEN GRAM (*VIGNA RADIATA* L. ROXB).

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ABSTRACT: The experiment was carried out under laboratory conditions in which four plant oils i.e. Mustard (*Brassica compestris*) L, Coconut (*Cocus nucifera*) L, Sesame (*Sesamum indicum*) L, and Rocket seed (*Eurica sativa*)Mill, were tested against pulse beetle, *Callosobruchus analis*) Fab, in green gram. The standard quantity of each oil was 0.25 ml mixed with the 250 grams of green gram kept in plastic jars covered with Muslim cloth. Four pairs, one day old adults were released in each jar. The result indicated that the Rocket seed oil was the most effective followed by coconut oil, sesame oil and mustard oil which resulted in low egg laying and reduced adult emergence. The minimum eggs (4.20±0.57) were observed in rocket seed oil followed by mustard oil (8.31±0.78), sesame oil (9.46±0.74) and coconut oil (9.96±0.75), where as maximum eggs (12.16±1.18) were recorded in control treatment. Similarly, the minimum adult emergence (2.27±0.32) was observed in rocket seed followed by mustard (4.33±0.68) coconut (5.60±0.65) and sesame (6.65±0.66). The minimum weight loss (8.26%) was also observed in green gram with rocket seed oil followed by mustard oil (20.57%), sesame oil (25.63%) and coconut oil (36.13%). The maximum weight loss (56.14%) was recorded in control treatment.

Key words: Green gram, *Collosobruchus analis, Biology and effect of different oils.*

INTRODUCTION

Pulses belong to family Leguminosae and are excellent and an inexpensive source of plant protein. Pulses provide a balanced diet for millions of people when eaten in combination with cereals. Pulses are known as the poor man's meat in the developing world. While in the developed world they are perceived as 'health food'. As pulses are good source of proteins, they are good substitute for meat, fish and egg. Besides protein, pulses also contain vitamins and mineral and constitute an important article of daily diets for both poor and rich people (Malik, 1994). Pulses are major sources of dietary protein in vegetarian diet in our country. Besides being a rich source of protein, they maintain soil fertility through biological nitrogen fixation in soil and thus play a vital role in furthering sustainable agriculture (Kannaiyan, 1999; Lee, 2002). Mung bean, (green gram) Vigna *radiata* (L) is native to India –burma area of South Asia. It is a crop of tropical and sub tropicals areas (Khoso, 1998). Mung bean is an important pulse crop in many Asian countries including Pakistan, where the diet is mostly cereal based. It is grown mainly for its edible seeds, which are cooked, fermented, roasted, sprouted, or milled. In Pakistan, mung bean seeds, like other pulses, are split in a mill, separated from the husk, and then cooked as dal. It is used in making soups, noodles, bread, and sweets. The seeds roaste with spices are also very popular. Mung is high in protein, digestible, and does not cause the flatulence that many other legumes do. Seed protein content average 22-24%. The left over leaves, stalks and husks of the mung plants are used as fodder, and whole plant can be ploughed under as green manure for soil improvement purposes. (Nazir, 2005). The pulses are attacked by the pulse beetles in the storages i.e, *Callosobruchus chinesis* , *Callosobruchus maculate* and *Callosobruchus analis* (Lohar, 2001). Among these, *Callosobruchus analis* attack more on Mung. The pulse beetle, *Callosobruchus analis* (Fabricius) Coleoptera: Bruchidae) is the pest of mung (*Vigna radiata*), mash (*Phaseolus mungo*), moth (*Phaseolus aconitifolius*), peas, cowpeas and other pulses. (Lohar, 2001). Both the larvae and the adults cause damage. The larva is recognized by its creamy-white, oval, flabby body. The adult is an oval beetle, somewhat smaller than *C. chinensis*. The female is chocolate with a black trapezoidal area surrounding by white streaks on the three sides. This area is located in the centre of each elytra towards the outer margin. The exposed pygidium is black, having a central longitudinal white streak. The male is uniformly chocolate with a tinge of straw. The young larva on emergence bores into the grain and feeds entire contents. (Atwal, 1994).The insect's pests move within the grain mass at a rate that is determined by season and grain temperature. During summer and fall, infestations are common on the upper surface of grains. In winter the pests congregate at the center and lower portion may escape detection until high

pest populations (Shemais, 2000). Most favourable grain moisture range for storage insect pests is from 12 to 18 percent. It is important to control insect population size before grain is irrevocably damaged by boring, feeding and mold germination (Tunio, 2002).

Keeping these points and importance of the pest under consideration, the present studies were carried out on the Effects of plant oils on the development stages of pulse beetle, *Callosobruchus analis* (Fab.) in green gram. This vital information will assist in devising the control procedures against this infamous pest of Mungbean as well as other pulses. Because of poor storage facilities, the use of synthetic insecticides or fumigants against this insect is not practicable due to undesirable residues in the environment and deleterious effects on non-target organisms. Hence, alternate methods for beetle control are needed, which involves the screening of available different hereditary collections and application of other non-chemical method.

MATERIALS AND METHODS

The present studies on effect of Plant oils on development stages of pulse beetle, *Callosobruchus analis* (Fab.) in green gram, were carried out under laboratory conditions in postgraduate laboratory, Entomology Department, Faculty of Crop Protection, Sindh Agriculture University, Tandojam. Experiment was conducted from August 06to November 16, 2008. The culture of *C. analis* was obtained from grain storage laboratory, Tropical Agriculture Research Institute, Karachi University.

Four plant oils i.e mustard (*Brassica compestris*), coconut (*Cocus nucifera*), sesame (*Sesamum indicum*) and rocket seed (*Eurica sativa*) which are commercially available in market were purchased and mixed with green gram grains. The standard concentration of each oil was 0.25 ml and which was mixed with the 250 grams of green gram. Weighted green gram grains were kept in plastic jars which were covered with muslin cloth and banded with rubber strips. The experiment was replicated four times including control (without treated grains) in Completely Randomized Design (CRD). Four pairs of adult beetles one day old were released in each jar.

The observations were taken at weekly intervals for observing the alive number of beetles emerged in each jar and fecundity was also recorded randomly on ten (10) grains in each jar. The mode of damage was recorded during the entire period of study. The percent weight loss was calculated by using the following formula.

$$\% \text{ weight loss} = \frac{(\text{Initial weight} - \text{weight of final weight of grain of gram})}{\text{Initial weight}} \times 100$$

The Percentage weight losses were calculated by subtracting the value of infested grains from the original weight. The data obtained was subjected to statistical analysis on computer programming.

RESULTS

Effects of different plant oils on pulse beetle, *C. analis.*

Effect of Sesame oil: The data (Table 1) revealed that significantly ($P<0.05$) less number of eggs was observed in sesame oil treated green gram as compared to the control. The maximum numbers of eggs (14.00) were observed in sesame oil treated green gram on 3rd week of September and minimum number of eggs (4.75) was recorded on 2nd week of August. In control treatment maximum eggs (19.00) were observed on 3rd week of September and minimum eggs (4.50) were recorded on 3rd week of November. The results indicated that there was highly significant ($P<0.05$) difference development of adult population between treated and untreated green gram grains. The treated green gram grains had less number of adults emerged as compared with the control. The maximum (9.25) adults emerged on 3rd week of September and minimum numbers (1.75) of adults were recorded on 2nd week of August. The maximum adult emergence (16.00) was observed on 3rd week of September and minimum was (3.50) on 2nd week of August in control.

Effect of Mustard oil: Mustard oil treated green gram grains had significantly ($P<0.05$) less number of eggs were observed as compared to the control. The maximum numbers of eggs (14.45) were observed on 3rd week of September in mustard oil treated green gram grains; where as minimum number of eggs (4.75) was recorded on 3rd week of August. Significantly ($P<0.05$) less number of adults emerged from mustard oil treated green gram grains as compared to the control. The maximum (10.25) adults emerged on 3rd week of September and minimum number (1.75) of adults emerged on 3rd week of August, 2008. The adult emergence increased gradually up to the month of September and than the population of pulse beetle drastically decreased up to November.

Effect of Coconut oil: The data showed that significantly ($P<0.05$) less eggs were observed on the coconut oil treated grains of green gram as compared to the control. The maximum numbers of eggs (13.25) were recorded on, 1st week of October and minimum numbers of eggs (3.25) were recorded on 2nd week of August. The application of coconut oil significantly ($P<0.05$) reduced emergence of adults in treated green gram grains compared with the control. The maximum adults (10.25) were emerged on 1st week of October and minimum number (1.75) of adults emerged on 2nd week of August, 2008. The population of pulse beetle increased gradually,

Table-1 Effect of different plant oils on the Eggs and %Survival of Pulse beetle, *C. analis on* green grams

Date of observation	Mustard		Cocount		Sesame		Rocket		Control			
	Eggs	Survival	Eggs	Survival (%)	Eggs	Survival (%)	Eggs	Survival (%)	Eggs	Survival (%)	Temp. oC	R.H %
August 10, 2007	6.00	3.25(54.17)	3.25	1.75(53.85)	5.00	2.00(40.00)	2.25	1.25(55.56)	4.25	3.50(77.78)	34.5	64.00
17	4.75	1.75(36.84)	5.25	2.25(42.86)	7.00	4.25(60.71)	2.50	1.50(60.00)	18.25	6.00(85.71)	34.00	65.00
24	5.50	2.25(40.91)	4.00	1.75(43.75)	8.00	3.75(46.88)	2.55	1.50(60.00)	5.25	4.25(47.22)	33.50	66.57
31	8.00	6.25(78.13)	5.75	3.00(52.17)	12.00	1.75(41.18)	2.56	1.25(55.56)	9.00	8.00(88.89)	36.58	66.59
September 07	9.00	5.25(58.33)	7.00	3.25(46.43)	9.00	4.00(44.44)	2.30	1.50(60.00)	11.25	10.25(91.11)	37.00	68.00
14	11.50	9.00(78.36)	6.75	2.00(29.63)	11.25	7.25(64.44)	2.00	2.00(66.67)	19.00	10.00(83.33)	37.56	70.00
21	14.45	6.25(64.10)	8.45	5.25(62.13)	14.00	3.00(41.38)	9.25	1.00(50.00)	9.25	7.25(78.38)	38.00	70.55
28	11.45	8.25(72.05)	10.25	6.00(58.54)	12.45	9.25(74.30)	4.25	2.25(52.94)	13.45	11.45(85.13)	38.70	77.88
October 05	12.00	8.00(66.67)	13.25	5.25(67.74)	10.00	6.00(60.00)	6.00	3.00(50.00)	15.00	12.00(80.00)	35.75	66.80
12	9.85	6.25(64.10)	11.23	7.00(62.33)	13.00	7.00(53.85)	3.25	1.25(38.46)	11.25	9.25(82.22)	36.0	64.65
19	12.75	9.25(72.55)	8.75	4.25(48.57)	9.25	5.25(56.76)	5.00	2.00(40.00)	16.25	14.25(87.69)	35.5	65.00
26.	10.45	7.45(71.29)	12.35	8.25(66.80)	11.25	9.25(82.22)	7.00	4.00(57.14)	17.00	15.00(88.24)	34.5	64.78
November 02	11.00	8.25(75.00)	11.00	7.75(70.46)	7.25	7.00(50.00)	4.25	2.25(52.94)	14.00	12.00(85.71)	33.0	60.00
9	13.00	8.00(61.54)	9.45	5.25(55.56)	8.25	5.25(63.64)	7.15	5.25 (56.76)	12.00	16.00(84.21)	30.0	66.56
16	9.75	10.25(70.93)	7.75	10.25(77.36)	4.25	9.00(75.00)	3.00	4.00(57.14)	7	15.25(83.56)	27.5	67.89
Mean ± S.E	9.95 ± 0.75	6.65 ± 5.60 (64.21 ± 3.22)	8.31 ± 0.74	4.33 ± 0.66 (55.87 ± 3.23)	9.46 ± 0.78	5.85 ± 0.68 (56.85 ± 3.44)	4.2 ± 0.57	2.26 ± 0.32 (54.21 ± 1.92)	12.18 ± 1.18	12.14 ± 1.02 (81.95 ± 2.67)		

and then it drastically decreased in the month of November.

Effect of Rocket seed oil: The data in showed that significantly (P<0.05) less number of eggs was recorded on the concentration of Rocket seed oil treated green gram grains as compared to the control. Where as maximum number of eggs (9.25) was recorded on 4th week of September and the minimum number of eggs (2.00) was recorded on 2nd week of September. The Rocket seed oil was significantly (P<0.05) more effective in reducing the adult emergence of pulse beetle when compared with the control and other plant oils. Where the maximum (5.25) adults of pulse beetle emerged was recorded on 1st week of September and the minimum number of adults (1.0) emerged on 2nd week of November.

Overall mean effects of different oils: The over all minimum eggs (4.20 ± 0.57) was recorded in Rocket seed oil followed by mustard oil (8.31±0.74), sesame oil (9.46 ± 0.75) and in coconut oil (9.96 ± 0.78) respectively. Whereas the maximum eggs (12.18 ± 1.18) was observed in control treatment. The result of effect of plant oils on eggs laid was significantly (F = 12.5; DF = 4, 74; (P < 0.001). The minimum adult emergences (2.26 ± 0.32) of pulse beetle was recorded in Rocket seed oil followed by in mustard oil (4.33 ± 0.66), Coconut oil (5.85 ± 0.68) and sesame oil (6.65 ± 5.60) in respectively. Whereas, the maximum adult emergence (12.14 ± 1.02) was observed in control treatment. Result of adult population development on different plant oils applied green gram grains was significant (F = 17.0; DF = 4, 74; P<0.001). The effect of plant oils on green gram grains weight loss by pulse beetle showed that all the plant oils at their application rate significantly(F = 749.0; DF = 1,9; P<0.001) reduced the weight loss by pulse beetle. The minimum weight loss (8.26%) was seen in Rocket seed oil and the maximum weight loss (56.14%) was recorded in the control. However, mustard oil was the least effective in protecting grains (20.57%) and followed by sesame oil (25.63%) (Fig.1).

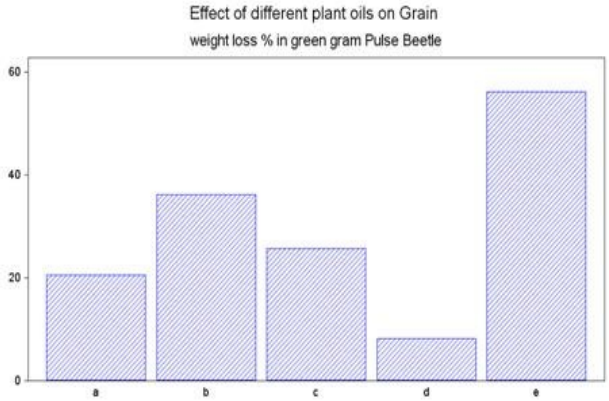

FIG.1. (a) Mustard (b) Coconut (c) Sesame (d) Rocket seed (e) Control

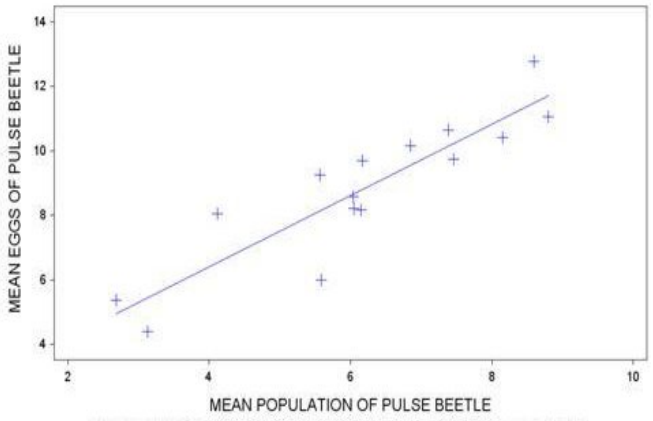

FIG.2.RELATIONSHIP BETWEEN MEAN EGGS & MEAN POPULATION OF PULSE BEETLE

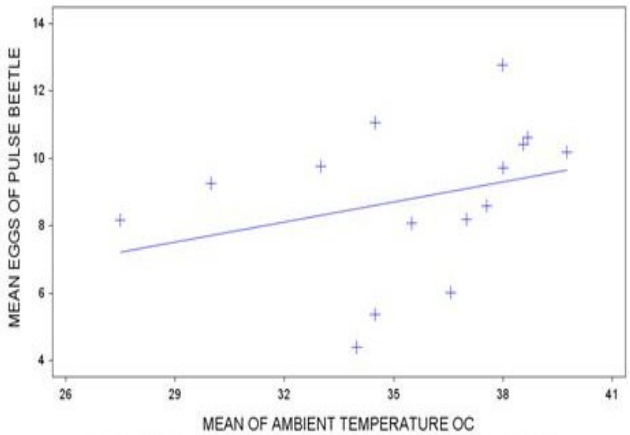

FIG.3.RELATIONSHIP BETWEEN MEAN EGGSPULSE BEETL & AMBIENT TEMPERATURE

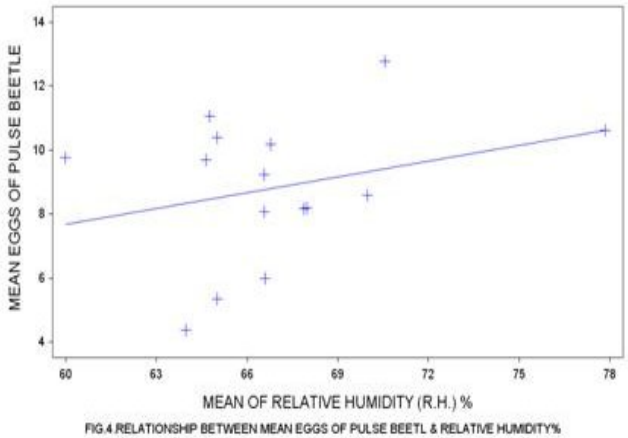

FIG.4 RELATIONSHIP BETWEEN MEAN EGGS OF PULSE BEETL & RELATIVE HUMIDITY%

A highly positive correlation (r^2 = 0.80) value (Fig.2) was observed between mean eggs of pest and pest population. A positive correlation (r^2 = 0.09) value (Fig.3) and (r^2 = 0.08) value (Fig.4) was observed between temperature and eggs laid and relative humidity respectively. Similarly positive correlation between temperature and relative humidity with pest population (r^2 = 0.07) value and (r^2 = 0.04), respectively (Fig.5-6).

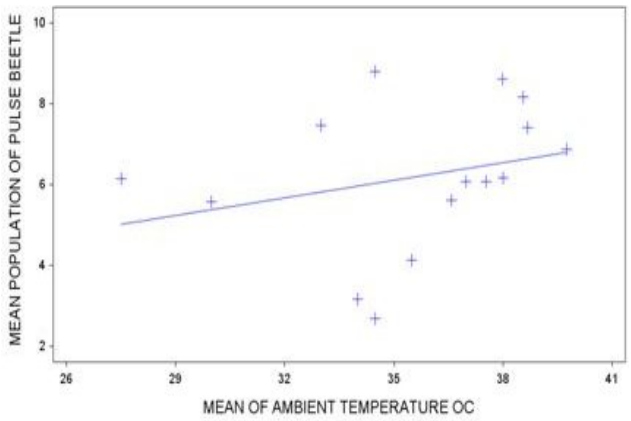

FIG.5.RELATIONSHIP B/W MEAN POPULATION OF PULSE BEETLE & AMBIENT TEMPERATURE

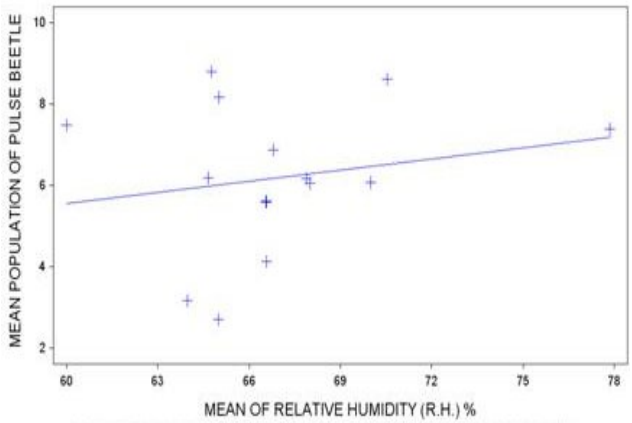

FIG.6.RELATIONSHIP B/W MEAN POPULATION OF PULSE BEETLE & RELATIVE HUMIDITY %

DISCUSSIONS

During present studies it was observed effectiveness that plant oils were in reducing the egg laying and development of adult population of pulse beetle. Vegetables oils also reduced pest damage and resultant weight loss of green gram grains. All the oils gave better results but among all these plant oils, Rocket seed oil gave statistically better results compared with all other oils. The minimum adult emergence and eggs lying were recorded on Rocket seed oil. Considering the effectiveness of plant oils on the basis of various criteria, all the oils under study appeared to be promising as grain protectants. These results are in conformity with Miah *et al*. (1993) who tested the different plant materials tested against *C. chinensis* on chickpea seeds, remained effective in reducing adults emergence. However, maximum number of adults emerged in control treatments. The plants materials are traditionally used by farmers, are quite safe and appear to be the most promising grain protectants (Al- Lawat *et al.*, 2002a, b). The essential oil and their constituents have been shown to be a potent source of botanical pesticides. The toxicity of a large number of essentials oils and their constituents have been evaluated against a number of bruchid pests (Keita, *et al.*, 2000, 2001, Tripathi *et al.*, 2002.Some indigenous plant materials have been known for their effectiveness to reduce oviposition, egg hatchability and adult emergence of pulse beetle. Chinwada and Giga (1993) reported that commercial vegetable oil and neem oil were very effective against pulse beetles till sixteen weeks in reducing oviposition, percent eggs, hatching, progeny emergence and seed damage. They also reported that mortality of these pulse beetles was more than 90%.

There are many reports on effect of application of vegetables oils on pulse beetle. Haque *et al.*, (2002) reported that no harmful effect was found on oviposition due to oil treatment. However, the percentage of adult emergence was greatly reduced and completely inhibited by the application of oils on the seeds. There was also no adverse effect on the viability of seeds due to different treatments. Lakhanpal *et al.*, (1995) evaluated nine edible oils (sesame, cotton seed, mustard, rapeseed, groundnut, coconut, linseed, soybean and sunflower) as grain protectant against *Callosobruchus analis* infesting black gram (*Vigna mungo*) seeds when applied at 1, 2 and 4 ml/kg. Cotton seed oil was the most effective, followed by sesame, groundnut and coconut oil, which resulted in low fecundity and prevented adult emergence for up to 150 days. Reddy *et al.*, (1999) reported that the application of four plant oils, neem oil (*Azadirachta indica*), karanja oil (*Pongamia glabra*) mohua oil (*Madhuca latifolia*) [Madhuca longifolia] and palmolein oil (*Elaeis guineensis*) at dosages of 0.5 and 1.0% level, effectively protected green gram from pulse beetle, *Callosobruchus chinensis*. These oils caused a significant reduction in oviposition and adult emergence. Neem oil at one per cent level gave the best protection, followed by palmolein, karanja and mohua oils. Insect populations correlated positively with quantitative and qualitative losses such as protein and amino acids in green gram. These oils also exhibited contact toxicity, and no adults could survive in neem-treated green gram at 5% concentration. In other treatments insect mortality ranged from 25 to 50%. Maheshwari *et al.* (1998) tested Repelin, (a mixture of 5 vegetable oils), as a surface protectant against *C. chinensis* on cowpeas (*Vigna unguiculata*) at 1, 3 and 5 ml/kg seed. Oviposition and adult emergence were reduced, in comparison with the control. Least oviposition (53 eggs) and adult emergence (0.79%) occurred on seeds treated with 5 ml/kg Repelin. Weight loss of seeds was 0.55% at 5 ml/kg Repelin, compared to 33.55% in the control. *C. chinensis* had a prolonged developmental period in the presence of Repelin. Seeds experienced 0.78% damage when treated with Repelin. Kiran and Singh (2002) determined the efficacy of six types of vegetable oils (mustard, linseed, groundnut, till (*Sesamum indicum*), neem and mahua (*Bassia latifolia*) oils against the pulse beetle, *C. chinensis* infesting pea grains under laboratory conditions. All the vegetable oils

controlled the pulse beetle compared to the control. Mahua oil treatment resulted in the lowest number of eggs/100 grains, number of adults and percentage of damaged grains.

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