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ENTOMOCIDAL STUDIES OF SOME PLANT MATERIALS AGAINST PULSE BEETLE, *CALLOSOBRUCHUS CHINENSIS* (BRUCHIDAE: COLEOPTERA) ON STORED CHICKPEA (*CICER ARIETINUM*)

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ABSTRACT

The studies were conducted in the laboratory of Entomology Department, Faculty of Agriculture, Gomal University, Dera Ismail Khan, Pakistan to investigate the entomocidal efficacy of four plant species including *Azadirachta indica, Euclyptus globules, Dalbergia* sisso and *Nicotiana tabacum* at three different concentrations *i.e.* 1, 2 and 3%, respectively against pulse beetle, *Callosobruchus chinensis*. The aqueous extracts of each plant material were applied to 20g of chickpea seeds placed in transparent plastic jars under constant conditions of 27± 1°C and 65 ± 5% R.H. The experiment was laid out following completely randomized design and repeated three times. Ten pairs of newly emerged adult pulse beetle were introduced in each jar following treatment of chickpea seeds with the evaluated plant aqueous extracts. Cumulative adult mortality of *C. chinensis* was recorded after 1, 2, 3, 6 and 9 days of treatment. The results showed that toxicity of the evaluated plant extracts increased by increasing the concentration and exposure period. Among the treatments, *N. tabacum* and *A. indica* aqueous extracts produced the maximum adult mortality (100%) of *C. chinensis* nine days after exposure period followed by *E. globules* (86%) whereas; minimum mortality of 25.66% was recorded in control where none of the plant extracts were applied. It can be concluded from the present results that *N. tabacum* and *A. indica* extracts can be used for the safer management of *C. chinensis* on stored chickpea seeds.

Keywords: Plant extracts, Mortality, *Callosobruchus chinensis*, Chickpea seeds

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the most important legume crop grown all over the world including Pakistan (Toker, 2009). It is considered as the best alternative to animal protein for poor masses of the country. It is a rich source of plant protein, minerals, carbohydrates, amino acids and vital source of vitamins (Sharma, 1984; Jukanti *et al*., 2012). The chickpea crop also maintains the fertility of the soils because of its nitrogen fixing ability with the help of nitrogen fixing bacteria (Kantar *et al*., 2007). India, Pakistan, Australia, Iran and Turkey are the top chickpea producing countries in the world (FAOSTAT, 2014). Chickpea is liable to both quantitative and qualitative losses under storage conditions. Quantitative damage leads to losses in seed weight and qualitative losses result in the reduction of aesthetic and nutritional values (Padin *et al*., 2002). The storage of chickpea is a matter of great concern as chickpea seeds are vulnerable to infestation by number of insect pests and suffer great damage during storage conditions due to insect pests and microorganisms (Hossain and Haque, 2010; Hossain *et al*., 2014).

The bruchids, *Callosobruchus annalis* (F.), *C. chinensis* and *C. masculatus* are of significant economic importance and major insect pests of leguminous grains (Rehman, 1989; Khandwe *et al*., 1997; Shafiq and Ahmad, 2002). The bruchids have been reported to cause heavy quantitative and qualitative losses to different stored grains (Sharma *et al*., 2007).

In storage, the control of *C. chinensis* is mainly relied on the use of synthetic insecticides which have many limitations and undesirable side effects on the environment and beneficial organisms. Chemical pesticides and fumigants have been the main tool for controlling insect pests (Erler *et al*., 2009). The indiscriminate and repeated application of synthetic insecticides to protect stored grains against insect pests have been the main source of concern due to serious health hazards, development of resistance problems, source of environmental pollutions, adverse effects on non-target beneficial organisms

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(Benhalmia, 2004; Golob, 2012; Muzemu, 2013).

These factors have led to look for some alternate control measures that are biodegradable, host specific in their mode of action and user friendly. In the current scenario, research is focused on the use of natural plant products for the control of stored grain insect pests because they have low toxicity to non-target organisms, readily degradable, and also prevent the development of bio types (Emana, 1999; Adedire *et al*., 2011).

The present studies were carried out to investigate the efficacy of Neem, Shisham, Euclyptus and tobacco extracts against pulse beetle*, C. chinensis* on stored gram seeds.

MATERIALS AND METHODS

The experiment was carried out during 2017 in the laboratory of the Department of Entomology, Faculty of Agriculture, Gomal University Dera Ismail Khan (Latitude: 31.8188°N, Longitude: 70.8971°E).

Plant Materials

The selected plant materials shown in Table 1 were collected from Dera Ismail Khan and its adjacent areas, dried under shade conditions and stored under controlled environmental conditions after due tagging for using in the experiments.

Preparation of plant extracts

Leaves of selected plants such as Neem, Euclyptus, Shishum and Tobacco were collected and brought to the laboratory. The leaves of selected plants were shade dried and were converted into powder form with the help of electric grinder and were sieved to get a 0.05 mm particle size.

The plant powders of selected plant materials were used to get aqueous extracts. The experiment was carried out by following completely randomized design having 3 replicates at 27 ± 3°C and 65 ± 5% R.H. with 12:12 h (L: D). Three concentrations viz. 1, 2 and 3% were used for the investigations. The required concentrations of plant materials were prepared by adding 0.1gm/100 ml, 0.2gm/100 and 0.3gm/100 ml of water. In each treatment, twenty grams of sterilized chickpea seeds were placed in plastic jars and the above-mentioned concentrations were applied thoroughly on gram seeds in each jar and were shaken well for complete mixing of selected plant materials before release of newly emerged adult pulse beetle. Ten newly emerged adult pulse beetles were introduced in the test arena. The adults were starved for an hour prior to release in the tested arena.

Parameters studied

The mortality data were recorded after one, two, three, six and nine days of treatment of plant materials. Data were analyzed using Statistical Software Statistix 8.1 and means were compared using Least Significant Difference (LSD) Test at 5%.

RESULTS AND DISCUSSION

Mortality of pulse beetle after one day

Data collected after 24 hours on the percent mortality of pulse beetle as influenced by various natural products are presented in Table 2. It was observed that none of the plant products could perform against *C. chinensis* at all the tested concentrations after 24 hours. However, it was noted that *N. tabacum* was the most effective treatment showing 29.33% mortality of the test insect at 3% concentration followed by *A. indica* causing 23.25% mortality of the tested insect. Among the treatments, *D. sisso* was found least effective treatment in controlling pulse beetle on stored gram. Similar findings were also documented by reported by Neupane *et al.,* (2016). They concluded that among botanicals tested, camphor and tobacco dust @ 2 g/kg can be used as alternative to synthetic insecticides for the management of *C. chinensis* on stored mungbean. Similar findings were also reported by Hossain and Haque (2010). They investigated the efficacy of some local plant parts extracts against *C. chinensis* on chickpea seeds and found that the lowest infestation of the pest on chickpea seeds treated with neem seed extract (20.05%) followed by (25.20%) on tobacco leaf extract. However, the result of Zia *et al.*, (2011) was contradiction to the present findings.

Data recorded after two days on the mortality of pulse beetle as affected by natural products are presented in Table 3. It was found that among the selected plant materials the extracts of *N. tabacum* were found most effective against the tested insect on stored chickpea. The treatment of gram seeds with aqueous extracts of *N. tabacum* resulted into 41.11% mortality of the tested insect at 3% concentration. Among the tested plant extracts, the extracts of *D. sisso* were found least effective after two days exposure period compared to other treatments. The results of Kausar *et al*., (2017) also support present findings.

Mortality of pulse beetle after three days

Data recorded after three days on the mortality of pulse beetle affected by different plant products is presented in Table 4. The plant products significantly ($P<0.05$) affected the mortality of the test insects. Among the treatments, the extracts of *N. tabacum* were found most effective compared to other treatments. The mortality of the tested insects increased with the increase in the concentration of the plant products. The maximum mortality of 65.56% of the test insect was recorded with the maximum concentration (3%) of the *N. tabacum* extracts. The minimum mortality of 32.33% was recorded with the 1% concentration of *D. sisso* extracts. Overall, minimum mortality of 10% was recorded in control treatment. The results of Kausar *et al.* (2017) and Zia *et al.* (2011) are in conformity with present observations.

Mortality of pulse beetle after 6 days

The aqueous extracts of *N. tabacum* were found most effective against *C. chinensis* causing 100% adult mortality of

the test insects at 3% concentration after 6 days. The *A. indica* aqueous extracts were also found more toxic registering 97% mortality of adult pulse beetles. Among the treatments, minimum mortality of 58% of the test insects were recorded on chickpea seeds treated with *D. sisso* extracts at 1% concentration. Overall an increase in the efficacy of the extracts was observed by increasing the concentration of the tested extracts after 6 days exposure period. The minimum mortality of 15.66% was recorded when the test insects were reared on untreated chickpea seeds. Similar results were reported by Obembe and Ogungbite (2016). They documented that the use of Pet-ether, n-hexane and aqueous extracts of *N. tabacum* produced 100% mortality of *C. maculatus within* 96 h of exposure period on stored cowpea. The results of Kavillieratos *et al*., (2007) are in conformity with the present findings. They found mortality of *Tribolium confusum* and *Sitophilus oryzae* on wheat and maize grains grains treated with azadirachtin based insecticides.

Mortality of pulse beetle after 9 days

The cumulative mortality of *C. chinensis* recorded after 9 days subsequent to the application of plant aqueous extracts was found statistically different at ($P<0.05$) (Table 6). The *A. indica* and *N. tabacum* plant aqueous extracts produced maximum cumulative adult mortality of 100% followed by *E. globules* (86%) at maximum concentration of 3% and minimum mortality of 21.66% was observed when pulse beetles were cultured on untreated grains. An increase in the efficacy of the selected plant aqueous extracts was observed by increasing the exposure time to the plant extracts. The efficacy of the treatments was in the array of *N. tabacum* > *A. indica* >*E. globules* > *D. sisso* compared with control. The results of Kausar *et al.,* (2017) and Zia *et al.,* (2011) are in conformity with present observations. Similarly, *A. indica* extracts have been reported most effective against various insect pests (Hossain and Haque, 2010; Mamoon-ur-Rashid *et al*., 2012; 2013)

Table 1.
List of indigenous plant materials used against pulse beetle, *C. chinensis.*

S. No.	Common Name	Botanical Name	Family	Plant part used
1	Neem	*Azadirachta indica*	Meliaceae	Leaves
2	Euclyptus	*Euclyptus globules*	Myrtaceae	Leaves
3	Shishum	*Dalbergia sisso*	Fabaceae	Leaves
4	Tobacco	*Nicotiana tabacum*	Solanaceae	Leaves

Table 2.
Mortality (%) of *C. chinensis* on chickpea seeds treated with various concentrations of plant aqueous extracts after one-day exposure period.

Treatments	Concentration		
	1%	2%	3%
Azadirachta indica	10.00 b	18.00 b	23.25 b
Euclyptus globules	6.890 c	14.33 c	17.66 c
Dalbergia sisso	5.33 c	13.00 c	16.33 c
Nicotiana tabacum	18.89 a	25.00 a	29.33 a
Control	1.66 d	2.00 d	2.00 d
LSD Value	2.86	3.18	3.19

Means in a column having similar letters are not significantly different using LSD test

Table 3.
Mortality (%) of *C. chinensis* on chickpea seeds treated with various concentrations of plant products after two days exposure period.

Treatments	Concentration		
	1%	2%	3%
Azadirachta indica	21.33 b	27.33 b	41.00 b
Euclyptus globules	10.66 c	17.66 c	20.66 c
Dalbergia sisso	8.33 c	14.66 d	18.33 c
Nicotiana tabacum	31.00 a	35.66 a	47.66 a
Control	3.33 d	2.00 e	3.33 d
LSD Value	4.83	2.97	4.97

Means in a column having similar letters are not significantly different using LSD test

Table 4.
Mortality (%) of *C. chinensis* on chickpea seeds treated with various concentrations of plant products after three days exposure period.

Treatments	Concentration		
	1%	2%	3%
Azadirachta indica	50.00 b	55.66 b	60.00 a
Euclyptus globules	37.66 c	42.33 c	45.33 b
Dalbergia sisso	32.33 d	34.00 d	37.33 c
Nicotiana tabacum	56.00 a	60.33 a	62.66 a
Control	10.00 e	11.00 e	10.66 d
LSD Value	3.60	4.14	2.73

Means in a column having similar letters are not significantly different using LSD test

Table 5.
Mortality (%) of *C. chinensis* on chickpea seeds treated with various concentrations of plant products after 6 days exposure period.

Treatments	Concentration		
	1%	2%	3%
Azadirachta indica	88.00 b	91.00 b	97.00 b
Euclyptus globules	69.33 c	73.66 c	77.00 c
Dalbergia sisso	58.00 d	61.33 d	66.66 d
Nicotiana tabacum	93.66 a	96.33 a	100.00 a
Control	16.00 e	15.66 e	16.33 e
LSD Value	2.77	2.73	1.75

Means in a column having similar letters are not significantly different using LSD test

Table 6.
Mortality (%) of *C. chinensis* on chickpea seeds treated with various concentrations of plant products after 9 days exposure period.

Treatments	Concentration		
	1%	2%	3%
Azadirachta indica	100.00 a	100.00 a	100.00 a
Euclyptus globules	76.667 b	82.66 b	86.00 b
Dalbergia sisso	63.667 c	69.00 c	75.00 c
Nicotiana tabacum	100.00 a	100.00 a	100.00 a
Control	21.667 d	21.66 d	21.66 d
LSD Value	4.88	3.87	4.40

Means in a column having similar letters are not significantly different using LSD test

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