RESEARCH ARTICLE Volume 1, 2018

ISSN Print 2663-0141
ISSN Online 2663-015X

THE INTERNATIONAL JOURNAL OF GLOBAL SCIENCES (TIJOGS)

Insecticidal Potential of Aqueous extracts of Neem and Datura on Khapra beetle, *Trogoderma granarium*

Aneeb Ali[1], Mirza Aizaz Asim[1]✉, Adeel Aslam[1], Muhammad Ishtiaq Sarwar[1], Muhammad Zia-ul-Haq[1], Mubashir Tariq[1], Faisal Mushtaq[2] and Muhammad Umair Gulzar[1]

1.Department of Entomology, University of Agriculture, Faisalabad, Pakistan.
2.Department of Agronomy, University of Agriculture, Faisalabad

✉**Corresponding author:**
Mirza Aizaz Asim
Department of Entomology
University of Agriculture, Faisalabad, Pakistan.
Email: mirzaaizazbaig8@gmail.com

Article History
Received: 03 September 2018
Accepted: 19 December 2018
Published: 28 December 2018

How to Cite?
Aneeb Ali, Mirza Aizaz Asim, Adeel Aslam, Muhammad Ishtiaq Sarwar, Muhammad Zia-ul-Haq, Mubashir Tariq, Faisal Mushtaq and Muhammad Umair Gulzar. Insecticidal Potential of Aqueous extracts of Neem and Datura on Khapra beetle, *Trogoderma granarium*. *The Int. J. Global. Sci*. 2018, 1, 06-12

ABSTRACT

Aqueous extracts of Datura and Neem were evaluated for their repellent and mortality effect against the Khapra Beetle (*Trogoderma granarium*). The different concentrations were used (1.5%, 3%, 6% and 9%) for the time period of 24, 48, 72 and 96 hours. After 24 hours the results showed that the highest mortality 23.33% caused by Neem at concentration of 9% and minimum 4.13% at 1.5% concentration. while the maximum mortality caused by datura was 16.67% and minimum 3.33% at concentration 9% and 1.5% respectively. After 48 hours, maximum mortality 36.67% was recorded at highest concentration (9%) of Neem and it was statistically different from 10.13% mortality caused at 1.5% concentration of Neem. Maximum mortality 23.33% was recorded at 9% concentration and minimum 6.67% at 1.5% concentration of aqueous extract of datura. After 90 hours, after 96 hours, highest mortality caused by maximum concentration 9% of Neem was recorded 69.67% and minimum 30.00% at 1.5% concentration while by Datura maximum mortality recorded was 51.7% and minimum 22.67% at concentrations 9%and 1.5% respectively. The maximum repellency percentage was 86.66% achieved in plant extract of *Azadirachta indica* while minimum repellency was 18.00%. From all these results it was concluded that plant extracts of Neem are more effective as their repellent and toxicant action against *Trogoderma granarium*.

Key words: *Trogoderma granarium*, Plant extracts, Repellent, Toxicity

INTRODUCTION

The Khapra beetle, *Trogoderma granarium* (Coleoptera, Dermestidae) is considered to be one of the most serious pests of stored grain products, various leguminous crops, rice, oat, barley, and rye throughout the world (Lowe et al., 2000). It is originally occurred in India, and spread to Africa, Europe, South America and East Asia (Harris, 2009). The Khapra beetle occurs in very low numbers and can

survive for a long period as an inactive state (Dwivedi and Shekhawat, 2004). According to FAO estimate, 10 to 25% of the world harvested food is destroyed annually due to insects and rodent pests (Anonymous, 1980). Losses caused by *Trogoderma granarium* have been reported to range from 0.2 to 2.9% over a period of 1 to 10.5 months (Irshad et al., 1988). Chemical insecticides such as malathian, cypermethrin, bifenthrin are used for rapid control, but are expensive, not readily available and may be poisonous to humans and environment (Tsumura et al., 1994). Moreover, malathian and cypermethrin have gone ineffective due to development of resistance in insect pests of stored grain, particularly in *Trogoderma granarium* (Saxena and Sinha, 1995). The larval period of development of Khapra beetle had been prolonged after treatment with DDT (Shantaram, 1958).

Local alternatives such as the natural products are cheaper, easily available way for controlling pests, which are safe for humans and environment. Most pesticide plants also have medicinal values, and some are consumed by humans as spices (Okonkwo and Okoye, 1996). There is a growing interest in entomological research to identify and evaluate plant species with insecticide properties for control of various insect pests, including *S. zeamais* (Odeyemi et al., 2008). In stored products pest control, extracts of plant and essential oils may have various types of effects (Papachristo and stamopouls, 2002), they may have fumigant activity and used as contact insecticides or they may act as repellents (Huang *et al.,* 1997) or they may affect some biological parameters of insects such as reproduction, growth rate and life span. In developed countries, plant extracts and essential oils could be useful they can be a mean of low cost protection (Isman, 2006). Plants may provide potential alternatives to currently used insect control agents because they constitute a rich source of bio active chemicals. Plant products have played an important part in traditional methods of protection against insect infestation. Plant derived chemicals such as rotenone, pyrethrum and nicotine used economically for pest control in the west since decades. Many plant extracts are known to possess repellent activities against storage insect pests (Nazli *et al.,* 2003).

Plant extracts constitute a rich source of bioactive chemicals with a potential for development as successful pest control agent (Padin *et al.,* 2002) which can affect insect in different ways: they may disrupt major metabolic pathways and cause rapid death, act as attractants, deterrents, phago-stimulants, anti feedants or modify oviposition, also retard or accelerate development or interfere with the life cycle of the insects.

The extraction of oils and other products from neem is a subject of interest and several new techniques and methods are being used to isolate these chemicals. The present study was conducted to evaluate the effect of neem and Datura extracts on *Trogoderma granarium*. Environmentalists all over the world are proclaiming less use of persistent insecticides.

MATERIALS AND METHODS

The present experiment was conducted in IPM Lab. of department of entomology BZU sub campus Layyah under Complete Randomised Design (CRD).

The materials were comprised of larvae of *Trogoderma granarium*, leaves of Neem and Datura, sterilized wheat, jars, petri dishes, filter papers, muslin cloth, rubber bands, camel hair brush, electric fodder cutter and incubator.

Collection & Rearing of insects

Mixed population of *Trogoderma granarium* (Everts) was collected from grain markets of Layyah Disst. The insects were kept in sterlized jars covered with muslin cloth. The insects were kept in the laboratory for two months for rearing. The adults of *T. granarium* were sieved and placed in breeding containers in the medium of uninfected wheat grains. The samples were placed in an incubator at 30± 2°C and 65± 5% relative humidity for three days (72 hours). Then, the insects were transferred from the jars to new containers.

The media (wheat grains) in which the adults of *T. granarium* were initially retained for 72 hours contained enough eggs laid by females. In these jars, the first larvae appeared after four days and the highest number of larvae appeared

after seven days. Same age and size progeny were removed from these stock. It was further kept for another period of five days before testing (Hasan et al., 2006).

Collection and preparation of plant extracts

Mature leaves of *Datura stramonium* and *Azadirachta indica* were collected from different villages of Layyah. All the plant materials were dried under shade for 6-7 days and then were chopped into 2 cm pieces with electric fodder cutter. Chopped leaves were soaked in distilled water in ratio of 1:10 (w/v) g/lit for 24 hours (Iqbal, 2007). Then extract was filtered through muslin cloth.

Measured quantity of neem and datura leaf extracts was boiled on water bath at 100°C to evaporate water to decrease volume up to 20 times. Boiling of extract was done by using same beaker to achieve the required quantity of extracts.

Bioassay-1

Experiment was carried out in 9 cm of diameter petri dishes and whatman filter paper was used. Four concentrations (1.5, 3, 6 and 9%) were applied and each replicated for three times. Extracts were spread uniformly on filter paper with syringe and allowed to dry. Thirty larvae of *T. granarium* were released in each petri dish and covered with lid tightly so that insects do not escape. Data of mortality was observed after 24, 48, 72, 96 hours.

Bioassay 2

Filter paper were cut into two equal halves. Plant extracts (Datura and Neem) in concentrations 1.5, 3, 6 and 9% were applied on one half of filter paper while other half was kept untreated as control. Both the treated and untreated halves were connected with adhesive tape and placed in petri dishes. Thirty adults were put in the center of each petri dish. Petri dishes were covered. Each treatment was replicated three times. Number of two half paper discs were recorded after 24 hours.

STATISTICAL ANALYSIS

At the completion of experiments Statistical analysis of recorded data was done using Statix 8.1. Treatments means was separated by Tuckey-HSD test at 1% probability level.

RESULTS

Toxicity of plant extracts on Khapra beetle after different times of intervals.

Insecticidal activity of aqueous extracts of Neem and Datura were studied under laboratory conditions against *Trogoderma granarium*. Two plants Datura and Neem with concentrations of 1.5, 3, 6 and 9% were used to check their insecticidal behaviour with four different time exposure periods 24, 48, 72 and 96 hours.

Table 1. Mortality of *Trogoderma granarium* after 24 hours of Treatment

Treatment	**Percent mortality**		**Mean**
Concentration (%)	Datura	Neem	
9	16.67±0.66ab	23.33±0.36a	20±0.30a
6	13.33±0.33bc	16.67±0.22 ab	15±0.64b
3	10.16±0.33 b	13.33±0.33 b	11.74±0.32bc
1.5	3.33± 0.46c	4.13±0.44c	3.33 ±0.02c
Control	0.00±0.33c	0.00±0.00c	0.00±0.00 d

Means	8.69±0.33 a	11.33±0.31 b	

The table shows the comparison of different concentrations of Neem and datura at time interval of 24 hours. Different letters for interaction of concentrations shows that they are significantly different. Highest mortality 23.33% caused by Neem at concentration of 9% and minimum 4.13% at 1.5% concentration. while the maximum mortality caused by datura was 16.67% and minimum 3.33% at concentration 9% and 1.5% respectively.

Table 2. Mortality of *Trogoderma granarium* after 48 hours

Treatment	**Percent mortality**		**Mean**
Concentration (%)	**Datura**	**Neem**	
12	**23.33±0.11b**	**36.67±0.36a**	**30±0.30a**
6	**16.67±0.33bcd**	**23.33±0.22bc**	**20±0.64b**
3	**16.67±0.66bcd**	**20.00±0.33b**	**18.33±0.32c**
1.5	**6.67±0.47cde**	**10.13±0.33de**	**8.4±0.17d**
Control	**2.00±0.13e**	**3.66 ±0.33e**	**2.83±0.33e**
Means	**13.06±0.33 a**	**18.75±0.31 b**	

The table 2 showed the comparison of aqueous extract of Neem and Datura at time interval of 48 hours. Maximum mortality 36.67% was recorded at highest concentration (9%) of Neem and it was statistically different from 10.13% mortality caused at 1.5% concentration of Neem. Maximum mortality 23.33% was recorded at 9% concentration and minimum 6.67% at 1.5% concentration of aqueous extract of datura.

Table 3. Mortality of *Trogoderma granarium* after 72 hours

Treatment	**Percent mortality**		**Mean**
Concentration (%)	Datura	Neem	
12	36.67±0.17ab	43.33±0.36a	40±0.30a
6	33.13±0.44abc	36.67±0.22ab	34.9±0.64b
3	23.44±0.02cd	26.67±0.33bcd	25.05±0.32c
1.5	13.00 ±0.33ef	20.00±0.39de	16.50 ±0.07d
Control	4.00±0.01f	6.33±0.11f	5.16±0.33 e
Means	22.04±0.33 a	26.5±0.31 b	

The table shows that Neem is more toxic as have highest mortality compared to Datura. Different letters for interaction of concentrations shows that they are significantly different.

Table 4. Mortality of *Trogoderma granarium* after 96 hours

Treatment	**Percent mortality**		**Mean**
Concentration (%)	Datura	Neem	
12	51.67±0.13a	69.67±0.36a	60.67±0.30a
6	43.33±0.33bc	46.67±0.22b	45.0±0.64b
3	33.33±0.44cd	41.33±0.33cd	37.33±0.32c
1.5	22.67±0.33d	30.00±0.13d	26.33±0.32d
Control	6.66±0.33e	6.66±0.33e	6.66±0.33 e
Means	31.53±0.33 a	37.26±0.31 b	

After 96 hours highest mortality caused by maximum concentration 9% of Neem was recorded 69.67% and minimum 30.00% at 1.5% concentration while by Datura maximum mortality recorded was 51.7% and minimum 22.67% at concentrations 9%and 1.5% respectively.

Repellent effects of Aqueous extracts of Neem and Datura against *Trogoderma granarium*

Plant extracts repellent results have been tabulated in Table 5. It has been shown that the aqueous extract of *Daturastra monium* exhibited maximum percent repellents (91.87%) in 4% concentration. Similar results were found by Mohiuddin *et al*. (1987) who observed that the repellents rate was 75% at the treatment of *Xanthium strumarium* against *Trogoderm granarium*.

Table 5. Percentage repellents of plant aqueous extracts against *T.granarium*after 24 hours interval.

Concentrations	Repellency	
	Datura	Neem
1.5	18.00±3.49 C	26.60±11.54 C
3.0	48.88±5.81 BC	57.06±1,87 BC
6.0	63.43±3.84 B	66.23±4.25 B
9.0	81.47±2.22 A	86.66±5.03 A

DISCUSSION

Plant aqueous extracts showed that the mortality rate increased with increasing concentration as well as the length of exposure times. In mortality results Neem showed best results in all concentrations and time exposures than Datura. Maximum mortality recorded was 69.67% caused by neem at maximum concentration and maximum time exposure. Repellency data was recorded after 24 hours. Neem extract proved good repellent at all concentrations than that of datura. The stored grains with high insect mortality could be attributed to the presence of toxic secondary metabolites. It has been reported that some secondary metabolites may act as insecticides or anti-feedants against *Datura*

stramonium contains alkaloid compounds such as atropine, scopolamine in the leaves, stems and fruits in addition to essential oils, while *Azadirachtaindica*contains Azadirachtin (Chakravarty, 1976) which may be the direct reason of killing the insects. Furthermore, similar studies indicated that the effectiveness of insecticides activity of *Acacia nilotica* extracts in controlling pests of *Trogoderma granarium, T. castaneum,Callosobruchus maculatus* and *Sitophiluszeamaiz* (Chairat et al., 2002). The present results showed that plant extracts gave satisfactory mortality rate and match some results of Hasan et al. (2006) who used extract of the plant *Haloxylon recurvum* against Khapra beetle at 17% mortality. The activity of crude plant extracts on insects is composed of both toxic and anti-feedant effects (Akhtar and Isman, 2004). In some studies, it has been found that the compound Azadirachtin, isolated from the neem tree (*Azadirachta indica*), is very important both as toxicant and anti-feedant and has been one of the most widely, tested and successfully implemented plant insecticides over the past two decades (Schmutterer, 1995). Moyin-Jesu (2010) report that the neem leaf extracts decrease the insect population, number of damaged leaves and number of holes per plant in maize plant. Extract of *Datura stramonium* produced larvae mortality rates after one day compared with other plants extract *Azadirachta indica.* Some of the larvae did not die after two days of exposure, but instead they died at the pupal or at the adult stage, this is due to the chronic effects of chemical compounds isolated from plant extract (Sukumar et al., 1991).

CONCLUSION

In general, it could be concluded that, plant extracts used in the present study act as toxicants and repellents against the *Trogoderma granarium*. Furthermore, this study suggested that aqueous extracts of plants belonging to families taxonomically unrelated possess toxic effects with significant insecticidal effect and could be a potential tool to protect stored grains against *T. granarium*, and this may contribute to areduction in the application of synthetic insecticides, which in turn increases the opportunity for natural control of various medically important pests by plant pesticides. It is often active in specific target insects, less expensive, easily biodegradable to non-toxic products and potentially suitable for use in a *Trogoderma granarium* control program (Bream et al., 2010).

CONFLICT OF INTEREST: None

REFERENCES

1. Akhtar, Y. and M. B. Isman. 2004. Comparative growth inhibitory and antifeedant effects of plant extracts and pure allelochemicals on four phytophagous insect species. J. Appl. Entomol. 128:32-38.
2. Anonymous,L. 1980. Introduction to detia fumigation detia export GmH: 3 pp.
3. Bream, A. S., T. M. El-Sheikh, M. A. Fouda and M.I. Hassan. 2010. Larvicidal and repellent Activity of extracts derived from aquatic plant *Echinochloastagninum*against*Culexpipiens*.Tunisia n J. Plant Prot. 5:107-123.
4. Chairat, C. T., J. Siripan, M. Suratwade and I. Somchai.2002. Fumigationtoxicity of *Eucalyptus*oil against three stored productbeetle. Thai. J. Agric. Sci. 35(3):265-272.
5. Chakravarty,H.L. 1976. Plant wealth of Iraq. Ministry of Agriculture and Agrarian reform, Iraq: 190-194 pp
6. Harris,D.L.2009.KhapraBeetle,*Trogodermagranarium*Everts (Insecta:Coleoptera: Dermestidae). University of Florida, IFAS Extension (EENY -372 (IN667).
7. Huang, Y., J. M. W. Tan, R. M. kini and S.H. Ho, 1997. Toxic and antifeedant action of nutmeg oil against *Trogodermagranarium*and *Sitophiluszeamaiz*Motsch. J. Stored. Prod. Res., 33: 289-298.
8. Isman, M. B, 2006. Botanical insecticides, deterrents and repellents in modern agriculture and an increasingly regulated world. Ann. Rev. Entomol., 51: 45-66.
9. Lowe, S. M., S. Browne, S. Boudjelas and M. DePoorter. 2000. 100 of the World's Worst Invasive

Alien Species: A selection from the Global Invasive Species Database. Invasive Species Specialist Group, World Conservation Union (IUCN). Available on=line at issg. Org/booklet.

10. Mohiuddin, S., R.A. Qureshi, M.A. Khan, M.K. Nassir and S.A. Qureshi. 1993. Laboratory investigations on the repellents of some plantsoils to red flour beetle*Triboliumcastenum.T.granarium*(Coleoptera : Dermestidae). UttarPradesh J. Zool. 20(1):97-99.
11. Moyin–Jesu, E. L. 2010. Comparative evaluation of modified neem leaf, wood ash and neem leaf extracts for seed treatment and pest control in maize (*Zea mays* L.). Emir. J. Food Agric. 22(1):37-45.
12. Nazli. R., G. Jillani, F. Ibrahim, A. R. Kazmi and A. H. Solangi, 2003. Repellency neem seed oil obtained from different localities of Pakistan against red flour beetle. Pak. Entomol. 25(2): 201-206.
13. Odeyemi, O. O., P. Masika and A. G. Aeolian. 2008. Insecticidal capensis against *Sitophiluszeamais* (Motschulsky) (Coleoptera: Curculionidae). Afri. Entomol. 16(2):220–225.
14. Okonkwo, E. U. and W. I. Okoye. 1996. The efficacy of four seed powders and the essential oils as protectants of cowpea and maize grains against infestation by *Callosobruchusmaculatus* (Fabricius) (Coleoptera:Bruchidae) and *Sitophiluszeamais* (Motsch) (Coleoptera:Curculionidae) in Nigeria. Internat. J. Pest Manage. 42(3):143–146.
15. Padin, S., J. A. Ringulelet, D. Bello, E. L. Cerimele and C. P. Henning, 2002. Toxicology and repellent activity of essential oils on *Sitophilusoryzae* L. and *Triboliumcastaneum,*J. Med.Pl., 7: 67-73.
16. Papachristos, D. P and D. C. Stamopoulos, 2002. Repellent, toxic and reproduction inhibitory effects of essential oil vapours on *Acanthoscelidesobtectus* J. Med. Pl., 7: 67-73.
17. Saxena, J. D. and S. R. Sinha. 1995. Evaluation of some insecticides against malathion resistant strains of red flour beetle, *Triboliumcastaneum* (Herbs). Indian J. Entomol. 75(4):401- 405.
18. Shantaram, H. 1958. The extension of larval duration in *Trogodermagranarium*Everts after DDT treatment. Science 23(5-6):145 -151.
19. Sukumar K., M. J. Perich and L. R. Boobar. 1991. Botanical derivative in mosquito control. A review. J. Am. Mosquito Control Associ. 7:210-216.
20. Tsumura, Y. S., Y. Hasegawa, Y. Sekiguchi, Y. Nakamura and Y. Ito. 1994. Residues of post-harvest applied pesticides in buckwheat after storage and processing into noodle. J. Food Hyg. Soci. Japan 35(1):1-7.