Original Research Article

Efficacy of *Azadirachta indica* and *Datura stramonium* extract with ethanol against different stages of *Tribolium castinium*

ABSTRACT

Tribolium castinium is a devastating stored grain pests of many cereals. Both the larval and adult stages of insect are considered as voracious feeder of cereals. The adult of *T. castinium* secrete certain type of excretion that give foul smell from grains and make it unfit for consumption. The recent study was conducted in Department of Entomology College of Agriculture BZU Bahadur sub campus Layyah. Neem (*Azadirachta indica*) and Datura (*Datura stramonium*) ethanol extracts were tested for their repellant and toxicological effects against the larval and adult stages of *T. castinium* at varying concentrations of 10, 15, and 30mL. The results showed that *D. stramonium* plant extract had the highest repellency (86.66%) and the lowest repellency (4.50%) against *T. castinium*. Minimum mortality was reported at 65% in plant extract of *A. indica* after an interval of 24 hours at 10mL concentration, and maximum mortality was recorded (90.69%) in plant extract of *D. stramonium* at 30mL concentration after an interval of 72 hours. The results showed that neem and Datura plant extracts were more effective at repelling and toxicologically acting against *T. castinium*. The larval stage of *T. castinium* was also particularly vulnerable to *D. stramonium* and *A. indica* ethanol extract.

Keywords: Ethanol extract, Neem, Datura, *T. castinium*, stored grain pest

INTRODUCTION

There have been numerous reports of insect infestations being connected to grains that have been stored. Nearly all species reproduce exceptionally quickly, which increases the risk of destruction of 10–15% of the grain and contamination of the remaining grain with unpleasant smells and odours (Baoua et al., 2015).

Beetles (*Trogoderma granarium*, *Tribolium castinium*, and *Tribolium confusum*), weevils (*Sitophilus oryzae*, *S. granarius*), and rats are the main pests of grains that are kept. Botanical extracts have properties that are antifeedant, arrestant, kill and repel pests, alter insect growth and development. The continued and indiscriminate use of pesticides has led to the buildup of dangerous residues on food grains intended for human consumption as well as the evolution of bacterial strains that are resistant to pesticides (Niroumand et al., 2016). Recently, attention has been focused on using plant products as a novel strategy for protecting grains in many parts of the world. The bioactivity of plant derivatives against several pests found in storage has already been reported in numerous scientific literatures. Higher plants, like neem, have also been employed as antimicrobials against pests in storage because of their widespread consumer acceptance and generally safe status. People have utilised a variety of herbs and spices, including as turmeric, garlic, and cloves, to manage storage pest (Acheuk et al., 2022).

In comparison to synthetic pesticides, plant products may be able to address issues with availability, health hazards, cost, and resistance. More study is required to determine the effectiveness of biocontrol and the practical applicability of botanical insecticides. It is important to do biosafety studies to determine how dangerous they are to people, animals, and crop plants (Dent and Binks, 2020).

Tribolium castaneum, a red flour beetle, has been noted as a widespread pest of stored wheat and other grains all over the world. Since it seriously harms both quality and quantity (Mehmood et al., 2018). Both qualitative and quantitative harm to stored grains and their products is caused by *T. castaneum* (Herbst.). Grain weight loss from insect feeding represents quantitative harm, whereas product modifications such loss of nutritive content and industrial (baking) characteristics induce qualitative damage (Atta et al., 2020).

Plant and essential oil extracts may have different fumigant properties and function as deterrents, anti-feedants, and repellents against stored grain insect pests. (Razmjou et al., 2018). Plant extracts and essential oils have the potential to be effective substitutes for synthetic insecticides in the production of organic foods in wealthy nations, while they can also provide low-cost protection in developing nations (Ahmed et al., 2021). Plant products have been used extensively in traditional approaches to preventing insect infestation. Chemicals originating from plants, like rotenone,

pyrethrum, and nicotine, have been successfully utilized for pest management in the best for many years. Neem extracts and its constituents have proven to be the most effective for the control of diseases and insect pests (Şengül Demirak and Canpolat, 2022).

The plant *Azadirachta indica* acts as an antifeedant against a variety of insect pests that attack stored goods. Neem's acetone extract was the most efficient natural insecticide when tested in vitro against *T. castinium* along with turmeric and sweet flag extracts. (Adusei and Azupio, 2022). In order to isolate these Chemicals, numerous novel procedures and technologies are being applied in the extraction of oils and other products from neem (Benelli et al., 2017). The goal of the current study was to determine how neem extracts affected *T. castaneum* (Herbst.) biology at sub-lethal concentrations of neem oil and neem bio insecticide.

Objectives of the study

- To study the repellent effects of Neem and Datura plant extracts against *T. castaneum*
- To observe the toxic effects of Neem and Datura plant extracts against *T. castaneum*

MATERIALS AND METHODS

Study site

The present study was conducted in the Department of Entomology College of Agriculture BZU Bahadur sub campus Layyah during the year 2022.

Insect collection and raring

T. castinium adults were gathered from grain markets, flour mills, and other godowns that housed cereal products in District Layyah. All of these were combined into one sample, which was then placed in a lab for two months in a clammy atmosphere. The wheat grains were covered with muslin cloths in wide mouth jars, where the insects were kept. *T. castinium* was reared under controlled conditions. 250 grammes of sterilized wheat grain were placed in a glass jar together with 50 *T. castaneum* beetles. Adults were separated from the food after five days, and the eggs and the rest of the food were regarded to be a homogenous population.

Preparation of plant extracts

Fresh Datura and Neem leaves were gathered from the district of Layyah. The plant material was ground into powder after drying in the darkness. Each plant's extracts were obtained by mixing 50g of powder with 100ml of ethanol in a flask. The flask was covered with aluminum foil and bunged with cotton. These flasks were then placed in a rotary shaker for 24 hours at 120rpm. The extracts were then

separated using filter paper. The filtered material's ethanol was allowed to completely evaporate. The persistent extract was given as stock solution.

Table 1. Plant Extract and quantity

Plant Extract	Quantity (gm)	Ethanol Quantity (mL)
Neem	50	100
Datura	50	100

Table 2. Plant extract, doses, and No. of exposed insects

Treatment	Plant extract type	Doses	No. of exposed insects
T1	Neem Extract	10mL	30
T2		15Ml	30
T3		30Ml	30
T1	Datura Extract	10mL	30
T2		15Ml	30
T3		30Ml	30

Bioassay for evaluating the toxicological and repellent effect of plant extract against larvae and adult of *T. castinium*

The experiment was conducted using the spray bioassay technique. A total of 30 adults and larvae were exposed to three concentrations (10, 15 and 30mL) three times each. Through CRD, the experiment was carried out. Following application, information on adult and larval mortality was gathered after 24, 48, and 72 hours. Using the spray bioassay approach in a controlled environment, the same experiment was performed to examine the repellent effect of Neem and Datura extract against larvae and adults of *T. castinium.*

Statistical Analysis

At the end of the experiment, statistics 8.2 software was used to statistically analyse the acquired data. The CRD method was used to do a variance analysis on the data, and the Tukey-HSD test was employed to compare several sets of mean values. The graph were made on MS excel 2016.

RESULTS AND DISCUSSION

Toxicological effect of Neem and Datura extract against adult stage of *T. castinium*

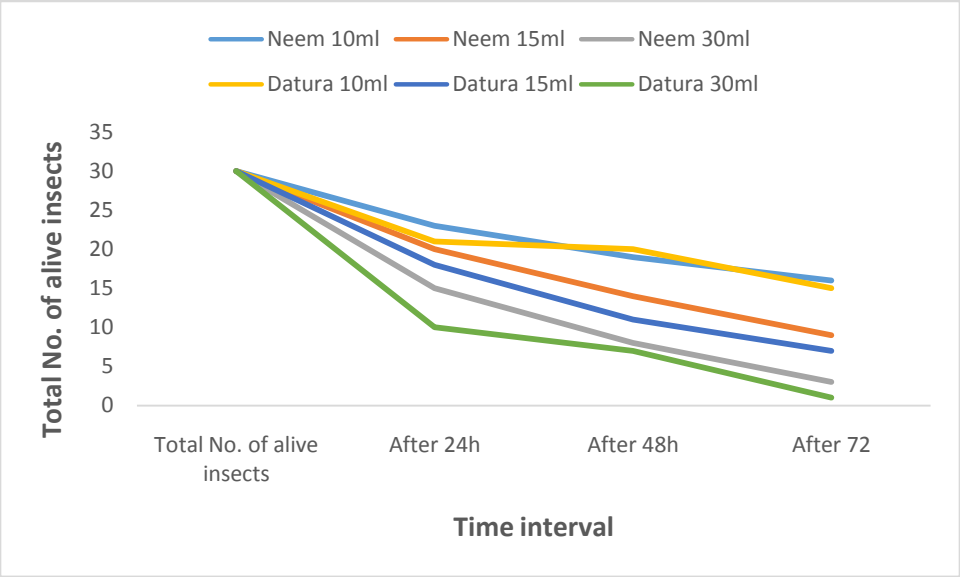

Fig. 1: Toxicological effect of Neem and Datura on adult stage of *T. castinium* under controlled conditions

The above graph represented the toxicological effect of Neem and Datura extract against adult stage of *T. castinium*. Three different concentrations (10, 15 and 30mL) were applied on 30 adults against each concentration. After 24 hours of application at 10mL of Neem and Datura 45% mortality was recorded. The mortality rate was increased as exposure time and concentration increases. The maximum mortality was observed at 30mL concentration of both plant extract after 72h of exposure followed by 48h.

Repellent effect of Neem and Datura extract against adult of *T. castinium*

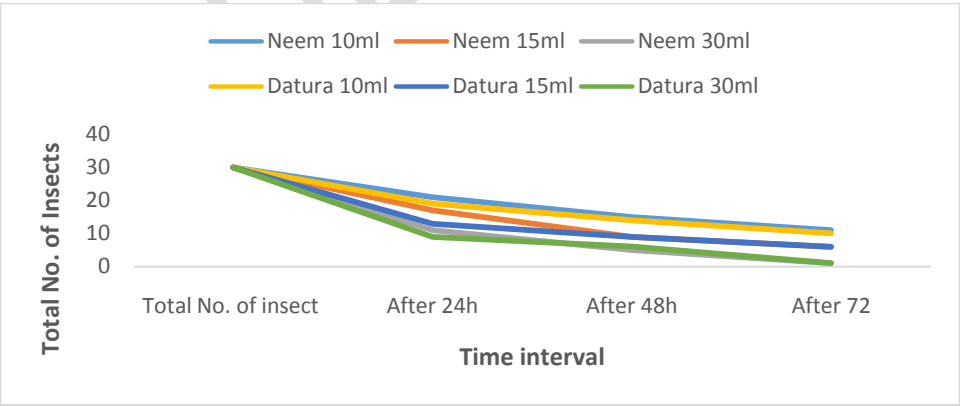

Fig. 2: Repellent effect of Neem and Datura extract against adult of *T. castinium*

The graph showed that the repellent effect of Neem and Datura extract after various time interval against dynamic population of *T. castinium*. After 24h of application 35% repellency were recorded at 10mL of concentration. The maximum repellency were recorded at 30mL of concentration after 72h of exposure. Datura concentration showed maximum repellency as compared to Neem extract after 72h of exposure.

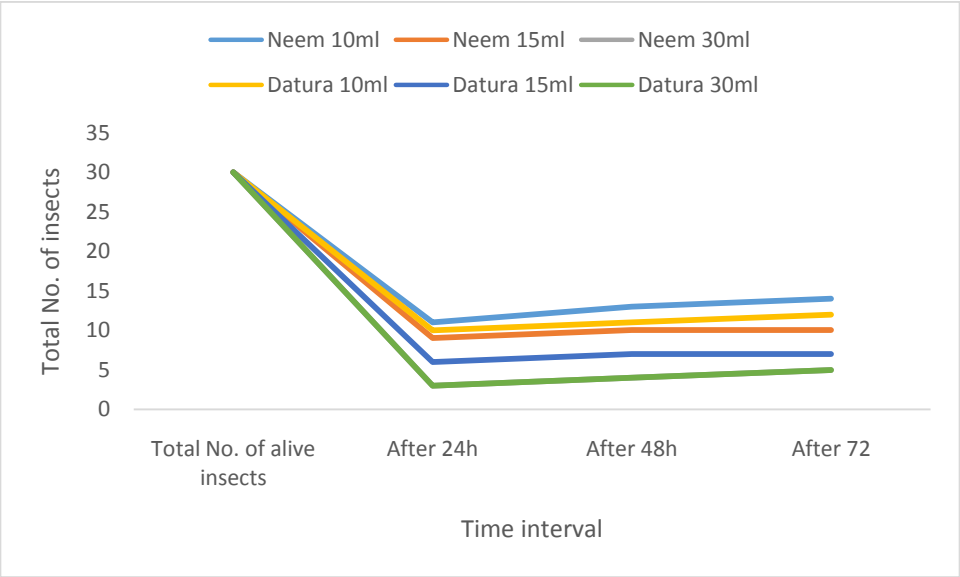

Fig. 3: Toxicological effect of Neem and Datura against larval stage of *T. castinium* at different time interval

Both the plant extract were also assayed against larval stage of *T. castinium* at various concentrations and time interval. After 24h of application the mortality percentage of *T. castinium* larvae were at high rate at 30mL concentration. The death of larvae due to Datura was more than Neem extract at 30mL concentration after 24h of application. The mortality rate were decreases gradually with the passage of time and vice versa.

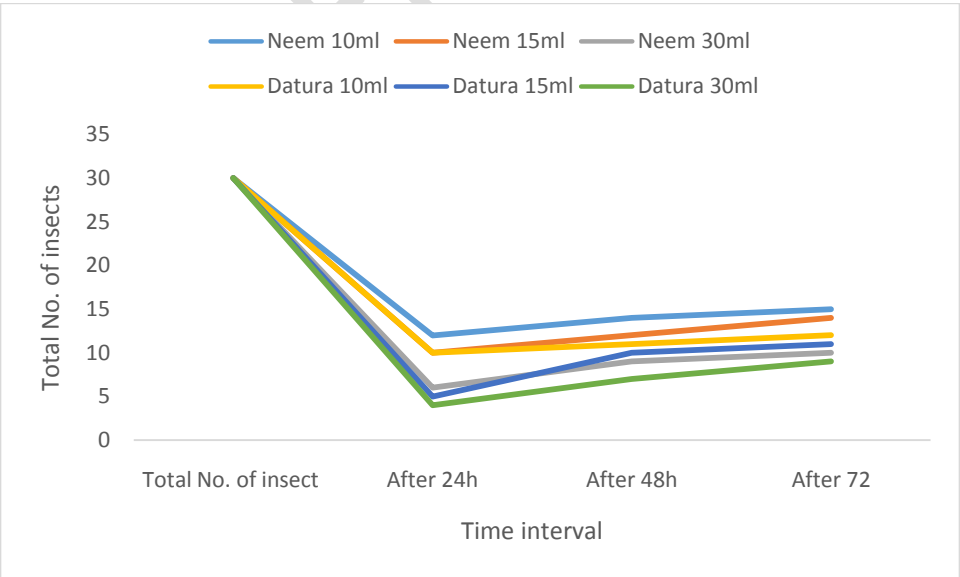

Fig. 4: The repellent effect of Neem and Datura extract against larval stage of *T. castinium* at different time interval

The repellent effect of both plant extract were assayed against larval stage of *T. castinium* at 10, 15 and 30mL concentration with different time interval. After 24h of application the mortality percentage of *T. castinium* larvae were at high rate at 30mL concentration. The death of larvae due to Datura was more than Neem extract at 30mL concentration after 24h of application. The mortality rate were decreases gradually with the passage of time and vice versa.

The existing approaches to controlling pests in stored grain primarily rely on synthetic insecticides. Due to the accumulation of hazardous residues on food grains used for human consumption, their ongoing and indiscriminate use has led to the development of resistant strains as well as health problems (Said and Pashte, 2015). Synthetic fumigants are another technique, however using them has also resulted in higher application costs, insect resistance, fatal effects on unintended organisms, and user toxicity (Haddi et al., 2020). Concern among the general population regarding the quantity of pesticide residues in food is rising. This worry has prompted researchers to hunt for natural pesticide alternatives. Botanical insecticides have long been praised as appealing substitutes to synthetic chemical insecticides for pest control because they pose no damage to the environment or to human health (Radhakrishnan, and Prabhakaran, 2014).

The recent study was conducted to evaluate the efficacy of two plant extract including Neem and Datura against devastating stored grain pest *T. castinium*. Spray bioassay method was used during application. Two prominent stages of *T. castinium* were assayed during experiment. The toxicological and repellent effect of both plant extract were studied in this work. The toxicological effect of both plant extract against larval and adult stages of *T. castinium* showed that Datura was more lethal than Neem extract. The mortality rate of larvae were more than adults. This showed that larval stage of *T. castinium* were more susceptible than adult stage. Same like this repellent effect of both stages of insect was more against Datura in comparison with neem.

CONCLUSION

The current study was conducted to observe the efficacy of ethanol extract of *A. indica* and *D. stramonium*. It is concluded that the higher concentration of both plant extract showed more mortality than lower concentration with the passage of time efficacy increase as exposure time increases. Additionally, it was shown that *D. stramonium* performed better more a repellant than *A. indica*. On the basis of observation it is suggested that both plant extract showed toxicological and repellent effect against *T. castinium*. This study will help to store grain safely.

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