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INSECTICIDAL ACTIVITY OF DIFFERENT BOTANICAL PLANT EXTRACT POWDERS AGAINST RICE MOTH (CORCYRA CEPHALONICA) AN INSECT PEST OF STORE GRAIN

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A B S T R A C T

Rice moth (*Corcyra Cephalonia)* is one of the major insect pests of rice grains. It attacks the grains and reduces the rice quality and makes it unfit for the human consumption. For the management of this insect pest, six different botanical powders (Azadirachta indica seed powder, Azadirachta indica leaves powder, Nicotine powder, Eucalyptus powder, Withania coagulans and Datura stramonium) were used and compared with control group. We observed that the maximum larval and pupal period of rice moth was observed on Azadirachta indica seed powder while minimum larval and pupal period was observed in the control group. Maximum larval mortality % and minimum pupal emergence % of rice moth was noticed on Azadirachta indica seed powder, while a statistically significantly decrease larval mortality % and minimum Pupal emergence % was found in control groups. Similarly, a lowest adult's longevity of rice moth male and female was observed on Azadirachta indica seed powder, however a maximum adult's longevity of rice moth male and female was observed on their control groups. A maximum Fecundity of rice moth was observed in control group, while a minimum Fecundity of rice moth was observed in Nicotine leaves powder group as compared with others treatment. A maximum oviposition rate of rice moth was observed on Withania coagulans and Datura stramonium leaves powder, while a minimum oviposition rate of rice moth was observed in Nicotine leave powder as compared with others treatment. A maximum repellence % of rice moth larvae were observed Azadirachta indica powder and minimum repellency % of rice moth larvae was found on Withania coagulans powder. A maximum antifeedents of rice grain moth larvae was observed in control group. Whereas, a minimum antifeedents % of rice grain moth larvae was found on Azadirachta indica seed powder as compared with control group. We concluded that Azadirachta indica seed, Azadirachta indica leaves and Nicotine leaves powder have great potential to reduce the pest population of rice moth in stored grains.
Keywords: Rice moth; Longevity; Reproductions; Mortality; Antifeedents; Repellency; Botanical insecticides.

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INTRODUCTION

Rice (*Oryza sativa*) is one of the important cereals and staple food for the major part of world's population, mainly in Asian nations (Bird et al., 2000). Rice is generally grown in all kinds of soil apart from sandy soils (Hobbs and Gupta, 2003). Consumption of rice provides 80% calories to about2 billion people of Asian continent. Nutritionally, rice is enriched with carbohydrates (80%), protein (7-8%) fat (3%) and 3% fiber (3%) (Ali et al., 2021) contents and traces of minerals such as iron, magnesium, calcium etc. (Ali et al., 2021) which have antioxidant, anti-cancerous, enzymatic activities as well nourish the skeleton, circulatory, immune

and nervous systems of human body (Chaudhari et al., 2018). Damage of rice grains are caused by various biotic and a biotic factors such as moisture, fungi, mites, rodents, insects and birds and amongst them storage insect pests are main causal agents associate in substantial losses during each annual (Prakash and Rao, 1983). Stored grains and their products are infested by numerous insects which is more noticeable around worldwide. Almost 200 species of insect have been discovered which infest in stored seeds, grains and their products (Maniruzzaman, 1981). Insects feeding on stored grains can cause losses of up to 420 million tons annually (Mesterházy et al., 2020). Among the insect pests, the coleopteran (beetles), lepidopteron (butterflies and moths) insects are noxious pests of stored grains. Approximately, seventeen species of stored grain pests of rice are documented viz. beetles (*Tribolium castaneum*), rice weevil (*Sitophilus oryzae* Linn.) and rice moth (*Sitotroga cerealella*), predominantly infest the parboiled rice grains. At contrary, weevils predominate on mill rice and beetle and moth infests in raw rice (BRRI, 1984). Infestation of insect pests lead towards considerable losses (5-8%) to stored grains and their products annually and 10% losses occur at farm due to extensive infestation of stored grain pests (Alam,1971). Among all the documented stored grain pests, rice moth, *Corcyra cephalonica* (Stainton) is a noxious pest of store grains and their products belongs to order, Lepidoptera and sub-family, Galleriinae. Several store grains including rice (husked and unhusked), wheat, maize, sorghum, flax seeds, millet cotton seeds, almonds, flax seeds and spices as well their various products are infested by rice moth (Bhardwaj et al., 2017; Sabiha-Javied et al., 2015; Shendage et al., 2021) (Jhala et al., 2018; Malik, 2019).

Rice moth is noxious insect pest of stored products manly cereal grains and grains in tropical and sub-tropical regions of worldwide. It has been nominated as noticeable insect pest and well recognized as flour moth or rice meal moth. Anciently, it was taxonomically classified into family Pyralidae and order Lepidoptera (Stainton, 1866) (Ramanaji et al., 2020). Larval stages of rice moth infest and feed on various food commodities including groundnut, peanuts, wheat maize, spices, coffee, gram, sorghum, cocoa beans, cocoa beans, cotton seeds, rice, linseed milled products, nutmeg, raisins, army biscuits and currants (Allotey, 1991; Kumar, 2001).

Larval phase is the most destructive that generally feeds on infested or degraded store grains. The feeding of moth resultantly produces the silken threads and the fibers become dense with respect to time, ultimately the infested debris of infested seeds convert into lumps (Samodra and Ibrahim, 2006). Due to contamination with larval exuviae, feces and webbing resultantly reduce the market values of grains and their products (Vincent et al., 2021).

To controlling the stored grain insect pests, fumigation is the most effective method to manage these insect pests with serious disadvantages. Such as fumigants do not penetrate on some commodities in required quantity to control the pests. However, in some cases chemical treatments may have a dangerous influence on the stored grains or may leave undesirable residues. Many problems are observed from chemical control and number of insect pests of stored grains has been resistance against chemicals, so it is necessary to search for an alternate pest control method. Botanical insecticide is safest insecticides because it does not cause residues in plants and food grains botanicals pesticides is eco-friendly methods for human and environment. Botanicals pesticides used in field and stored grains go down, such as antifeedents, repellence and insects' growth regulator. So, keeping in view the above facts, present research was designed to evaluate six different botanicals plants (*Azadirachta indica* seed powder, *,Azadirachta indica* leaves powder, *Nicotine* powder, *Eucalyptus* powder, *Withania coagulans* and *Datura stramonium*) against rice moth (*C.cephalonica)* under lab condition.

MATERIAL AND METHODS

Rearing and Culturing of Stored Grain Insect Pest

Culture of rice moth, (*C.cephalonica)* was obtained from Pakistan Agriculture Research council (PARC), Karachi and reared on rice grains in the laboratory of Entomology at 30±2^{o}C and 70%±5%RH. Seven treatments were used in present experiment. Six botanical powders, Neem seed (*Azadirachta indica*), Neem leaves (*Azadirachta indica*), Tobacco leaves (Nicotine) Eucalyptus powder, Paneer (Withania coagulans) and Datura (Datura stramonium), while one control was used in the experiment. All six applied treatments of botanicals powder on *C. cephalonica* was compared with control group under laboratory condition. Randomized Completed Designed (RCD) was used in present experiment and all treatments were used with three replications.

Preparation of Organic Pesticides Powder

Botanical powders i.e. Neem seed, Neem leaves, Eucalyptus, and Datura was collected from surroundings of LUAWMS Uthal, Baluchistan, however, Tobacco leaves, and Paneer were parched from local market. After collection of botanicals, leaves and seed were dried under shade and grinded with the help of electric blender for making their powder.

Botanical Insecticides and Rice Grains

Ten (10) gm of Neem seed, Neem leaves, Tobacco, Eucalyptus, Paneer and Datura powders was mixed with 100 gm rice/ grains, while control grain was used without any botanical powders mixed.

Experimental Procedure

In the present experiment plastic jar (10 cm) were used for insects rearing and they were covered with cotton yarn cloth. First generations of Fifty one day old larvae were collected from insect culture after hatching eggs and exposed in plastic jar with 100gm treated rice grains to find the larval mortality % and larval developmental days until pupation. Each treatment was replicated three times. Thirty one day old pupae were collected from treated larvae and kept in separate plastic jar to find the pupae days and adults emergence % on different botanicals insecticides.

Ten one day old adult pairs of *C. cephalonica*w collected from treated cultured and released in plastic cups until the death of both male and female. Each pair was reared in a single plastic cup. The plastic cup was closed with cotton net yarn and kept butter paper in glass for egg laying. Cotton net yarn and batter paper was replaced daily. The fecundity, oviposition rate, and adult longevity was noticed on the regular basis. The research was completed until the death of both adult pairs.

Ten 3rd and 4thinstars larvae of *C.cephalonica* were exposed on three hundred (300) treated grains for check the botanicals insecticides antifeedant, Data was observed after 5 days later. To find the botanicals insecticides antifeedant against (*C. cephalonica)* larvae. Following formula was used on damage grain (Zaib et al., 2021).

$$\frac{\text{DGx100}}{300}$$

Ten 3rd and 4thinstars larvae of *C .cephalonica* were released in 10 cm glass Petri dish. Half filter paper was cut and placed in the center of Petri dish and half Petri dish was used without treated grains and remaining half of Petri dish was treated with botanicals and then ten3rd and 4th larval instars larvae were released in the Petri dishes for 24 hours to find the repellence percentage of *C. cephalonica*. Each treatment was replicated three times.

Statistical Analysis

The collected data was statistically analyzed using software SPSS (SPSS inc., Chicago, L, US). One way ANOVA (analysis of variance) was used and means were compared with Tukey's HSD test at 5% probability level.

RESULTS

The maximum larval periods of rice moth was observed on neem seed powder (22.56±0.57) followed by Tobacco leaves powder (21.86±0.78), Neem leaves powder (21.34±0.56), Datura powder (18.12±0.24), Eucalyptus leaves powder (17.56±1.98) and Paneer powder (17.45±1.45). While, minimum larval days of rice moth was observed in control group (16.69±1.45) as compared to other treatments (Table1).

Table 1. Effect of different botanical plant powders on the larval period of rice moth.

Treatment	Larval days
Neem leave powder	21.34±0.56b
Paneer powder	17.45±1.45c
Tobacco leaves powder	21.86±0.78b
Eucalyptus leaves powder	17.56±1.98c
Datura powder	18.12±0.24c
Neem seed powder	22.56±0.57a
Control	16.69±1.45dc

Values (Mean ± SE) in given Colum letters are significantly difference by Tukey test (P<0.05).

A maximum Larval mortality of rice moth was observed on neem seed powder (27.55±2.85) followed by Tobacco leaves powder (24.34±2.87), Neem leaves powder (23.43±1.36), Paneer powder (20.17±0.47), Datura powder (15.63±0.28) and Eucalyptus leaves powder (11.26±1.66) while a minimum Larval mortality of rice moth was observed in control group (5.76±0.77) as compared with other treatments (Table 2).

A maximum Pupal days of rice moth was observed on neem seed powder (12.48±1.63) followed by Tobacco leaves powder (11.34±0.17), Paneer powder (9.76±1.40), Eucalyptus leaves powder (9.27±2.88), Datura powder (8.67±0.37) and Neem leave powder (8.55±1.29) while a minimum Pupal days of rice moth was observed in control group (7.17±2.32) as compared with other treatments (Table 3).

A maximum Adults emerge of rice moth was observed on control (95.31±1.21) followed by Eucalyptus leaves powder (92.26±0.79), Datura powder (90.55±2.28), Paneer powder (88.73±1.38), Neem leave powder (87.54±1.46) and Tobacco leaves powder (82.38±0.47) while a minimum Adults emerge of rice moth was observed in Neem seed powder group (76.63±0.39) as compared with other treatments (Table 4).

Table 2. Effect of different botanical plants powder on larval mortality of rice moth

Treatment	Larval mortality (%)
Neem leave powder	23.43±1.36b
Paneer powder	20.17±0.47c
Tobacco leaves powder	24.34±2.87b
Eucalyptus leaves powder	11.26±1.66e
Datura powder	15.63±0.28d
Neem seed powder	27.55±2.85a
Control	5.76±0.77f

Values (Mean ± SE) in given Colum letters are significantly difference by Tukey test (P<0.05).

Table 3. Effect of different botanical plants extracts powder on pupal days of rice moth.

Treatment	Pupal days
Neem leave powder	8.55±1.29bc
Paneer powder	9.76±1.40bc
Tobacco leaves powder	11.34±0.17ab
Eucalyptus leaves powder	9.27±2.88bc
Datura powder	8.67±0.37bc
Neem seed powder	12.48±1.63a
Control	7.17±2.32dc

Values (Mean ± SE) in given Colum letters are significantly difference by Tukey test (P<0.05).

Table 4. Effect of different botanical plants extract powder on adults emerge of rice moth.

Treatment	Adults emerge
Neem leave powder	87.54±1.46c
Paneer powder	88.73±1.38c
Tobacco leaves powder	82.38±0.47d
Eucalyptus leaves powder	92.26±0.79b
Datura powder	90.55±2.28b
Neem seed powder	76.63±0.39e
Control	95.31±1.21a

Values (Mean ± SE) in given Colum letters are significantly difference by Tukey test (P<0.05).

A maximum Adult male days of rice moth was observed on control (16.56±2.77) followed by Neem leave powder (15.30±1.46), Eucalyptus leaves powder (15.26±0.87), Paneer powder (14.45±0.55), Datura powder (12.38±1.65) and Tobacco leaves powder (11.36±2.67) while a minimum adult male of rice moth was observed in Neem seed powder group (10.76±1.39) as compared with other treatment (Table-5).

A maximum Adult female days of rice moth was observed on control (20.31±0.26) followed by Neem leave powder (18.77±2.46), Eucalyptus leaves powder (18.34±1.67), Datura powder (16.32±2.35), Tobacco leaves powder (15.56±1.76) and Paneer powder (14.87±0.30) while a minimum adult female of rice moth was observed in Neem seed powder group (14.23±2.36) as compared with other treatments (Table-6).

A maximum adult reproduction (Fecundity) of rice moth was observed on control (540.54±0.82) followed by datura

powder (520.87±1.78), Eucalyptus leaves powder (490.29±0.32**),** Paneer powder (455.58+1.29), Neem leaves powder (350.37±1.38) Neem seed powder (287.49±2.66) while a minimum adult reproduction (Fecundity)of rice moth was observed in Tobacco leaves powder group (275.85±2.43) as compared with others treatment (Table-7).

A maximum adult oviposition of rice moth was observed on dhatura powder (32.8±0.83) followed by Paneer powder (32.5±0.48), Control (27.25±2.66), Eucalyptus leaves powder (27.22±1.76), Neem seed powder (20.5±1.32) and Neem leave powder (19.44±1.38) while a minimum adult oviposition of rice moth was observed in Tobacco leaves powder group (18.33±2.40) as compared with other treatments (Table 8).

Table 5. Effect of different botanical plants extract powder on adult male days of rice moth.

Treatment	Adult male days
Neem leave powder	15.30±1.46ab
Paneer powder	14.45±0.55b
Tobacco leaves powder	11.36±2.67c
Eucalyptus leaves powder	15.26±0.87ab
Datura powder	12.38±1.65bc
Neem seed powder	10.76±1.39cd
Control	16.56±2.77a

Values (Mean ± SE) in given Colum letters are significantly difference by Tukey test (P<0.05).

Table 6. Effect of different botanical plants extract powder on adult female days of rice moth.

Treatment	Adult female days
Neem leave powder	18.77±2.46b
Paneer powder	14.87±0.30c
Tobacco leaves powder	15.56±1.76c
Eucalyptus leaves powder	18.34±1.67b
Datura powder	16.32±2.35c
Neem seed powder	14.23±2.36c
Control	20.31±0.26a

Values (Mean ± SE) in given Colum letters are significantly difference by Tukey test (P<0.05).

Table 7. Effect of different botanical plants extract powder on adult reproduction (Fecundity) of rice moth.

Treatment	Adult reproduction (Fecundity)
Neem leave powder	350.37±1.38e
Paneer powder	455.58±1.29d
Tobacco leaves powder	275.85±2.43g
Eucalyptus leaves powder	490.29±0.32c
Datura powder	520.87±1.78b
Neem seed powder	287.49±2.66f
Control	540.54±0.82a

Values (Mean ± SE) in given Colum letters are significantly difference by Tukey test (P<0.05).

Table 8. Effect of different botanical plants extract powder on adult oviposition of rice moth.

Treatment	Adult oviposition
Neem leave powder	19.44±1.38c
Paneer powder	32.8±0.48a
Tobacco leaves powder	18.33±2.40cd
Eucalyptus leaves powder	27.22±1.76b
Datura powder	32.5±0.83a

Neem seed powder	20.5±1.32c
Control	27.25±2.66b

Values (Mean ± SE) in given Colum letters are significantly difference by Tukey test (P<0.05).

A maximum repellence % of rice mot" lar'ae was observed Neem seed powder (88.00%), followed by Neem leave powder (85.00%), tobacco leaves powder (77.00%), Eucalyptus leaves powder (63.67%) and Datura powder (58.34%). Whereas, a minimum repellence % of rice moth larvae was found on Paneer powder (53.00%) as compared with their treated groups (Figure 1)

A maximum antifeedents of rice grain moth larvae was observed in control group (73%), followed by Eucalyptus leaves powder (41%), Datura powder (39%), paneer powder (36%) and neem leave powder (21%), tobacco leaves powder (20%). Whereas a minimum antifeedents % of rice grain moth larvae was found on neem seed powder (15%) as compared with control groups (Figure 2)

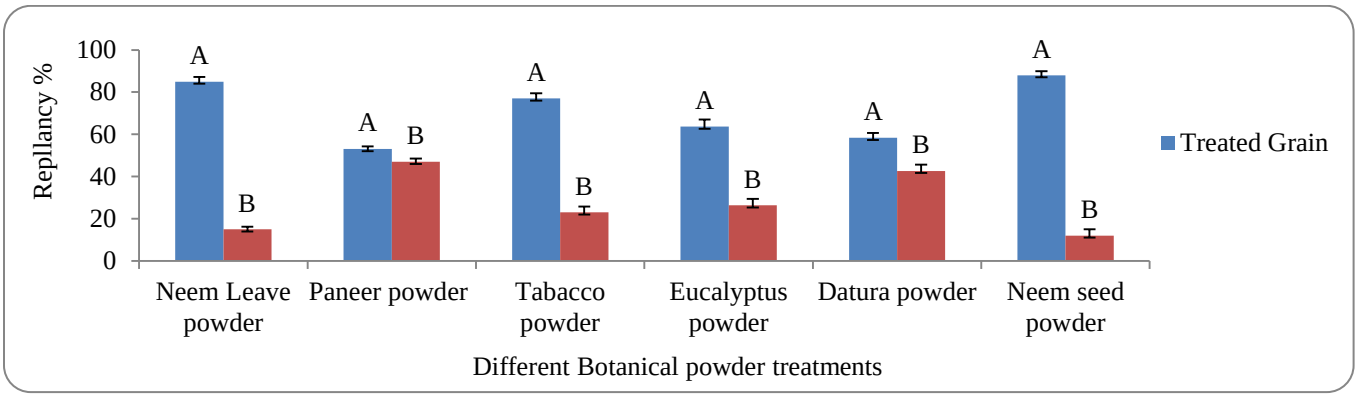

Figure 1. Repellence (%) of rice moth against different botanicals plants Powders.

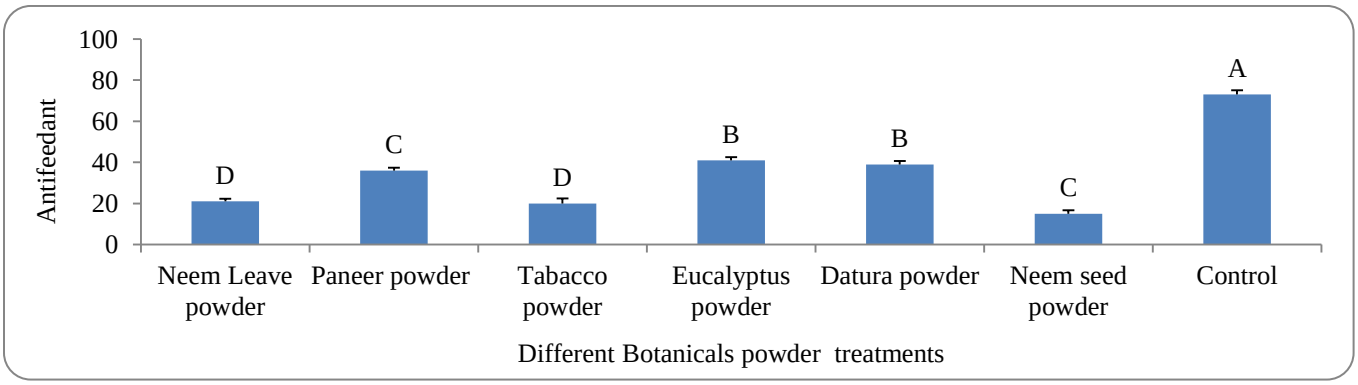

Figure 1 Antifeedent of rice grain moth on different botanicals plants treatments

DISCUSSION

Botanical plant extracts are being used since many years to control insect pests of household, field corps and stored grain products. Botanical plant extracts have been used as antifeedants, repellents, antibacterial and antifungal agents (Al-Moajel, 2004). Several herbal products such as Neem leaves powder, Neem seed powder, tobacco leaves powder, paneer leaves powder, datura leave powder, eucalyptus leave powder etc. have been used against different insect pests of stored grains (Zaib et al., 2021). The present research work conducted to check the efficacy of six different botanicals plants powder extract against rice moth managements in stored godowns.

In present study, we observed a maximum developmental periods and highest mortality of rice grain moth on all stages was observed on Neem seed powder, Neem leaf powder and Tobacco leaves powder as compared with other plant extract powder treatments and control groups. Whoever a lowest fecundity of rice moth also was observed on neem seed powder, neem leaf powder and Tobacco leaves powder as compared with control and others given treatments. Similar study also was observed by (Zaib et al.,

2021) who reported that Azadirachtin indica and nicotine chemical caused the number of mortality of in red flour beetle and pulse beetle and its chemical effectiveness enhance the developmental stages of both beetles. Further these finding are agreed with the findings of (Muhammad et al., 2018) examined that highest concentration of need seed plants and tobacco caused the maximum death of adults and larvae by some plant species whereas lower concentrations had no significant result. Another significant research that coordinated current findings on mortality was carry out by (Chayengia et al., 2010) who examined very peak mortality (40%) of insect pests caused by botanicals extract. They also examined antifeedents losses that are related to current results. A few studies reported that lower value of mortality as contrasted to current conclusion.

For instance, (Rafi et al., 2021) examined that neem extract induced only 14.4% mortality in *Trogoderma granarium* Larvae while (*P. nigrum*) caused only 6.78% mortality. The reason of these contradictory findings might belong exposure time, which decrease its value because of high volatility and lesser persistency. Various type of observations is reported in literature. (Don-Pedro, 1989) reported that plant extracts/ materials, mainly act against egg so rarely larval stages restrict their possible utilization in stored grains. (Rao et al., 2005) observed that botanical insecticides were capable of introducing antifeedents and developmental inhibitory influence against *Trogoderma granarium*. (Al-Moajel, 2004) noticed the influence of botanical plants extract on the young one stages of *Trogoderma granarium*. A fewbotanical plants such as powder of Neem on mortality and emergence of *Trogoderma granarium* larvae were examined by Egwurube (Egwurube et al., 2010) and they reported significant impact of seed powders on these parameters. In present research, we observed that the maximum antifeedents of rice grain moth larvae was observed in control group (73%), followed by Eucalyptus leaves powder (41%), Datura powder (39%), paneer powder (36%) and Neem leave powder (21%), tobacco leaves powder (20%). Whereas, a minimum antifeedents % of rice grain moth larvae were found on neem seed powder (15%) as compared with control group (Fig 2). These results are agreed with the findings of Zaib and his co-worker (2021) who examined that the lowest antifeedents of red flour beetles and pulse beetles was found on Neem seed, Neem leaves and tobacco leaves powder extract as compared with control groups. Further (Rao et al., 2005) examined that antifeedents losses by the use of some botanicals plant proved that *Trogoderma granarium* can be managed by using botanicals plant extracts, including with currentresult to some extent. Use of Neem seed and leaf powder showed severe impact against *Trogoderma granarium* as reported by (Egwurubeet et al., 2010). In current research investigation we found that a maximum repellence % of rice moth larvae was observed Neem seed powder (88.00%), followed by Neem leave powder (85.00%), tobacco leaves powder (77.00%), Eucalyptus leaves powder (63.67%) and Datura powder (58.34%).

Whereas, a minimum repellence % of rice moth larvae were found on Paneer powder (53.00%) as compared with their treated groups. These results finding regarding repellence are supporting with the finding results of (Zaib et al., 2021) who also found the maximum repellence % of red flour beetle and pulse beetle on neem seed powder extract and tobacco plant extract. (Mishra and Fiddick, 2012) investigated the repellent effectiveness of essential oils from (*Eucalyptus globules*) (Myrtaceae) and (*Ocimumbasilicum*) (Lamiaceae) leaves against adults of (*T. castaneum*) and (*S. niger*).. They discovered that (*E. coli*) has repellent properties. (O. globules) and (*T. castaneum*) was greatly outperformed by (*Ocimumbasilicum*), also at very low concentrations. When operating on four wild plants of Argentina, (Novo et al., 1997) discovered that some rudimentary extracts had promising repellent action against *T. castaneum*.

CONCLUSION

In presents results, we observed that a maximum mortality and developmental timeof rice moth was observed on Neem seed powder, Neem leave powder and tobacco leaves powder as compared to control group. While a minimum mortality and developmental days were noticed on paneer, Eucalyptus, datura plants powder and in control group. Similarly, a maximum antifeedant and repellence % were observed on neem seed powder, Neem leaves powder and tobacco leaves powder as compared with control group, whereas, the minimum antifeedents and repellence % were observed on paneer, Eucalyptus, datura plants powder and in control group. Results are indicating that Neem seed, Neem leaves and Tobacco leaves powder have great potential to reduce the pest population of rice moth in stored grains. This research data will be useful for the scientific community, researchers, and stakeholders for the managements of rice moth.

CONFLICT OF INTEREST

The authors declare that there is no conflict in the publication of this article.

AUTHOR'S CONTRIBUTION

All the authors contributed equally in the manuscript.

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