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Research Article


# PERFORMANCE OF DIFFERENT BOTANICALS AGAINST RED COTTON BUG, *DYSDERCUS CINGULATUS* (FAB.) UNDER LABORATORY CONDITIONS

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## ABSTRACT

*Red Cotton Bug (Dysedercus cingulatus) is one the devastating cotton pests, however controlled by various chemical insecticides, while concerning to the environmentalists and public health workers. Therefore, botanicals/bio-pesticides are considered comparatively good options to reduce the use of synthetic insecticides and protect biodiversity to a certain extent. Hence, this study is conducted to aware with the performance of different botanicals against Red Cotton Bug and laboratory experiment was performed at Molecular Entomology Laboratory, Department of Entomology, Sindh Agriculture University Tandojam Pakistan during Rabi-2021 season. The analysis was directed in Complete Randomize Design (CRD), in which four botanicals (Tooh, Neem, Datura, and Chilies) were incorporated on third instar nymphs of D. cingulatus at various (12%, 14%, 16%, 18%, 20%) dosages and time span (24 hrs., 48 hrs., 72 hrs., 96 hrs. and a week). Each treatment was replicated with three replications. In each replication ten 3$^{rd}$ instar nymphs of D. cingulatus were released on the treated seeds of cotton crop. In lab bioassay, the $LT_{50}$, $LT_{90}$, $LC_{50}$, and $LC_{90}$ values were calculated for botanicals. The highest mortality was observed in the insects treated with 20% botanicals, where the most efficient insecticide was found Datura (62.9%) and Tooh remained the least effective botanical with 51.8% mortality. The least time to kill the insects was taken by Neem with $LT_{50}$ and $LT_{90}$ 66.8 and (186.8) hours, respectively. The lowest dose 13.9% was utilized by Datura to kill 50% of tested insect ($LC_{50}$) and $LC_{90}$ was recorded 43.1%. It is recommended to use Datura to control Red Cotton Bug and conduct some in-depth studies considering mixture of Datura, Tooh, Chilies and Neem with multiple ratios to produce most effective organic pesticides for various insects.*

**Keywords:** Cotton Bug, Botanicals, Bio-pesticide, Datura

## INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is an important and highly cultivated crop in Asia (Cororaton & Orden, 2009). Cotton plants are sun loving and require 180 days with temperature 28 to 35 $^0$C. The crop requires approximately 30 inches of rain and irrigation for successful growth and development (Solangi, et al., 2008). Cotton is one of the most economically significant fiber crops on the planet. It is a semi-bush developed as a yearly harvest in both tropical and warm climates. Notwithstanding material assembling, it produces seeds with a potential multi-item base, for example, bodies, oil, build up and nourishment for creatures (Ozyigit, et al., 2007). It plays a very important role in the contribution of the economy and provides employment opportunities to the farmers, growers and those fabricating its products. Approximately, 3 million hectares area is annually captured by cotton throughout the world (Cororaton & Orden, 2009). The share in agriculture production of cotton is about 8.6 percent and 1.8 percent in gross domestic product. Among stable crops of Pakistan, cotton is an economic engine for sustaining country's economy. The export of raw and furnished products of cotton contributes more than 60% of the foreign exchange earnings and provides livelihood to 45% of the population. It was cultivated on an area of 2,976 thousand hectares in 2023 and projected to reach 11.5 million bales (GoP,

2023). Nearly 26 percent of all farmers grow cotton, and over 15 percent of Pakistan's total cultivated area is devoted to this crop, with production primarily in two provinces, Punjab (80%), which has dry conditions and Sindh (20%), which has a more humid climate. In Pakistan, cotton was cultivated on 3054.3 thousand $ha^{-1}$ in 2007-2008 with an average production of 649 kg $ha^{-1}$. It likewise contributes 69.5 % share in national oil production (Awan, 1994). Cotton production in Pakistan is fluctuating since last three decades due to damage of insect pests, fungal and viral disease, and the shortage of irrigation water during sowing and cultivating seasons. The reduction in water shortage is going to be down from 103.5-million-acre feet MAF during 2000-01 to 89.6 MAF during 2012-13, revealing a 13.4 percent shortage of water in the history of supply (GoP, 2023). Production of cotton is limited by various factors among which insect pests are also important. Approximately, 1,326 species of insect pests attacking cotton crops are considered a serious threat throughout the world, which damage either directly or indirectly (Atwal & Dhaliwal, 2002). In Pakistan about 145 types of cotton insect species have been recorded (Bo, 1992). The red cotton bug or cotton stainer *Dysdercus cingulatus* (Fab.) is considered a serious pest of cotton (Waterhouse, 1998). Cotton stainer has been declared as one of the most destructive cotton pests in other parts of the world (Sprenkel, 2000). Red cotton bug is known as the devastating insect pest of malvaceous crops including cotton, okra, and sweet potato (Ranjan & Kumar, 2018). Its attack is found mostly in Pakistan, South-Eastern Asia and is highest raising issue in some states of India. This pest damages crops in various methods by excreting their yellowish raw material on the lint of cotton which causes quality reduction and transmitting cotton staining fungi disease. Through the injection of fungal spores (Nematospora) on the boll and the rising fungus stains the lint (Hill & Waller, 1990). Usually, farmers do not apply any spray against this pest as it appears in the final stages of the crop in recent past it is reported that some chemicals are sprayed to control this pest. The most effective are Dimethoate 40 EC, Triazophos 40 EC, Fenpropathrin 30 EC, Imidacloprid 20 SL, Spinosad 45 SC, Acetamiprid 20 SP and Econeem (Malik, et al., 2018). The use of insecticide is not encouraged by the environmentalists and public because of hazardous effect of chemicals on public health and cause environmental pollution (Gill & Grag, 2014). The chemicals have recently been replaced by botanicals which are effective and have no negative effect. Therefore, the study is designed to evaluate different botanicals against red cotton bug, so the proper management of the pests can be achieved.

Ali, et al. (2016) reported about the positive effects of biopesticides against sucking insect pest of brinjal. Abbasipour, et al. (2011) claimed somehow identical results, sharing that Datura might have high value in grain storage against C. maculatus, where local farmers could save their money by using Datura with little resources. According to Iqbal, et al. (2015), the application of Neem extract, followed by garlic showed the maximum effect to reduce the population of jassid, whitefly and thrips. In another study Aziz & Khoso (2019) determined the effect of different botanical extract such as neem, tobacco and Tooh against the sucking insect pest of brinjal crop, in which he has found effectiveness of Tooh extract (1.96%) reduction of population followed by Tobacco (1.92%) and finally (1.38%) found in Neem under field conditions. The impact of Neem based bug sprays actuated prolongation of *D. cingulatus* nymphal period without shedding to next instar or *ecdysial* stages appear to be brought about by a change in natural JH titer as revealed by Khan & Kumar (2003). Sharma, et al. (2010) demonstrated that the impact of neem items on proliferation have been watched before in creepy crawlies having a place with different request viz, Orthoptera, Hemiptera, Hymenoptera, Lepidoptera and Diptera and furthermore discovered hindrance in egg laying or incubating after azadirachtin containing bug sprays application and in this way our perceptions are in concurrence with Kodandaram, et al. (2008) who has also found the effect of different botanical against *Dysdercus koenigii*. Therefore, the rapid control on the population of red cotton bug is possible to use botanical insecticides as compared to synthetic insecticides which leaves their residual effect and promulgate environment pollution and are also hazardous to the beneficial organisms.

## MATERIALS AND METHODS

### Study area/site

The trial was conducted at Molecular Entomology Laboratory, Department of Entomology, and Faculty of Crop Protection, Sindh Agriculture University Tandojam.

**Datura seed**

**Neem seed**

**Chilies seed**

**Tooh seed**

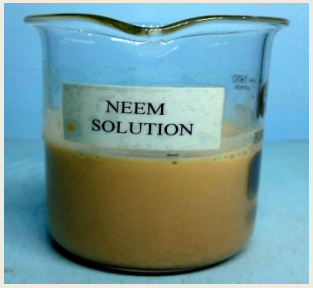
**Datura powder**

**Neem powder**

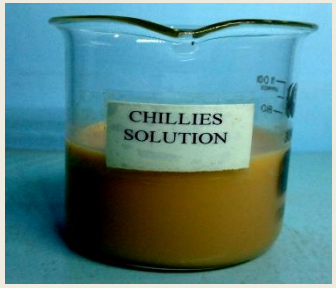
**Chilies powder**

**Tooh powder**

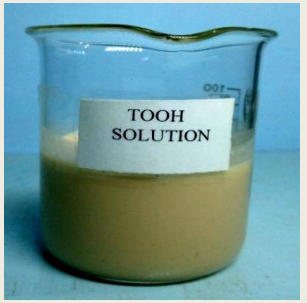

**Datura solution**




**Neem solution**




**Chilies solution**




**Tooh solution**

**Figure-1: Botanicals prepared in the laboratory for experiments.**

**Insect collection and rearing**

The insects were collected in plastic jars from Agriculture Research Institute (ARI) cotton field Tandojam. After collection, the red cotton bug was reared in rearing cages (2.5×2.5 feet$^2$) at Molecular Entomology Laboratory on

natural diet. The controlled environment, Relative humidity (65±2) temperature (29±2) and photo period (12:12) were provided. Both nymph and adults were fed on developing and matured cotton-bolls as suggested by Sahayaraj, et al. (2012).

**Experimental design and treatments**

The experiment was conducted in Complete Randomize Design (CRD) in laboratory having four treatments with three replications (Pilla, et al., 2005). The seeds of locally available botanicals; Tooh, Neem, Datura, and Chilies (Figure 1) were purchased from local market and dried in the hot air oven for one hour prior to grinding. The seeds were grinded until the fine powder is obtained and shifted in the clean glass jar for further experiments. The 3$^{rd}$ instar nymphs of cotton strainer were used to conduct trail through seed dip method with different botanical insecticides treatments (Table-1). Twenty-five cotton seeds were dipped in mentioned doses (12% 14% 16% 18% 20%) for 3 hours to suck the extract of botanicals. Thus, these treated seeds were removed from doses and air dried. The treated cotton seeds were placed in Petri dishes and then nymphs were released to carry out the experiment.

**Data collection and analysis**

Data will be taken at 24-hour intervals, like 24, 48, 72, 96, and one- week and noted in the data book for further analysis. Through statistical software, POLO plus, Lethal concentration and lethal time were calculated. Further, mortality % was calculated through Abbots corrected formula of mortality (Abbott, 1925).

**Table-1: Treatments and doses of various botanicals**

| Treatments | Doses in % | | | | |
|---|---|---|---|---|---|
| T1= Tooh | 12 % | 14 % | 16 % | 18 % | 20 % |
| T2= Neem | 12 % | 14 % | 16 % | 18 % | 20 % |
| T3= Datura | 12 % | 14 % | 16 % | 18 % | 20 % |
| T4= Chilies | 12 % | 14 % | 16 % | 18 % | 20 % |
| T5= Control | 0 | 0 | 0 | 0 | 0 |

**RESULTS**

**Mortality (%) of *Dysdercus cingulatus* on different botanicals under laboratory conditions**

At 12 % after 24 hours the highest mortality (6.67%) was observed in Datura and Chilies and lowest (3.33%) was recorded in Tooh and Neem. Comparably after 48 hours the maximum mortality (20.0%) was recorded in Neem comes after Datura (16.67%), Chilies (16.6%) and Tooh (13.3%). After 72 hours the highest mortality (33.3%) was recorded in Neem followed by Datura (26.6%), Chilies (26.6%) and Tooh (23.3%). After 96 hours the maximum mortality (40.0%) was observed in Neem comes after Tooh (36.6%), Chilies (36.6%) and Datura (33.3%). After a week the maximum mortality (40.7%) was recorded in Neem and Chilies followed by Tooh (37.3%) and Datura (37.0%).

At 14% after 24 hours the maximum mortality (10.0%) was observed in Datura followed by Tooh (6.67%), Chilies (6.67%) and Neem (3.33%). Likewise, after 48 hours the highest mortality (23.3%) was recorded in Datura followed by Tooh (20.0%), Chilies (20.0%) and Neem (13.3%). After 72 hours the maximum mortality (33.3%) was recorded by Datura followed by Tooh (30.0%), Neem (30.0%), Chilies (30.0%). After 96 hours the highest mortality (43.3%) was observed in Datura comes after Chilies (43.3%), Neem (40.0%) and Tooh (40.0). After a week the maximum mortality (44.4%) was observed in Neem followed by Datura (44.4%), Chilies (44.4%) and Tooh (40.7%). At 16% after 24 hours the highest mortality (10.0%) was recorded in Datura comes

after Chilies (10.0%), Tooh (6.67%) and Neem (6.67%). Similarly, after 48 hours the maximum mortality (23.3%) was observed in Datura followed by Chilies (23.3%), Neem (20.0%) and Tooh (20.0%). After 72 Hours the highest mortality (36.6%) was observed in Datura comes after Tooh (33.3.%), Neem (33.3%) and Chilies (33.3%). After 96 hours the maximum mortality (50.0%) was recorded in Datura followed by Neem (46.6%), Chilies (46.6%) and Tooh (43.0%). After a week the highest mortality (51.8%) was recorded in Datura comes after Chilies (48.1%), Neem (48.1%) and Tooh (44.4%).

At 18% after 24 hours the maximum mortality (13.3%) was recorded in Neem followed by Datura (13.3%), Tooh (10.0%) and Chilies (10.0%). Likewise, after 48 hours the highest mortality (26.6%) was observed in Datura comes after Neem (23.3%), Chilies (23.3%) and Tooh (20.0%). After 72 hours the maximum mortality (40.0%) was observed in Neem followed by Chilies (40.0%), Datura (36.6%) and Tooh (33.3%). After 96 hours the highest mortality (50.8%) was recorded in Chilies comes after Datura (50.0%), Neem (50.0%) and Tooh (46.6%). After a week the maximum mortality (55.5%) was recorded in Datura followed by Neem (51.8%), Chilies (51.8%) and Tooh (48.8%).

At 20% after 24 hours the highest mortality (16.6%) was observed in Datura comes after Tooh (13.3%), Neem (13.3%) and Chilies (10.0%). comparably after 48 hours the maximum mortality (30.0%) was recorded in Tooh followed by Neem (26.6%), Datura (26.6%) and Chilies (20.0%). After 72 hours the highest mortality (46.6%) was recorded in Tooh comes after Datura (43.3%), Neem (43.3%) and Chilies (33.3%). After 96 hours the maximum mortality (60.00%) was observed in Datura followed by Chilies (56.6%), Neem (53.3%) and Tooh (50.0%). After a week the highest mortality (62.9%) was recorded in Datura comes after Chilies (59.2%), Neem (55.5%) and Tooh (51 .8%).

**$LT_{50}$ and $LT_{90}$ (hours) concentration of 12% 14% 16% 18% and 20% against *Dysdercus cingulatus***

$LT_{50}$ was observed as mentioned in Table-1**.** At 12% the highest, $LT_{50}$ of 104.5 hrs **(**slope 3.66 and Chi-square 17.1) was observed at Tooh and the lowest 91.5 hrs. (Slope 3.54 and Chi-square 9.6) was recorded at Neem respectively. At 14%, the maximum $LT_{50}$ of 99.6 hrs (Slope 3.63 and Chi-square 15.0) was recorded at Neem and the minimum 80.9 hrs. (Slope 3.03 and Chi-square 16.7) was observed at Datura respectively. At 16%, the highest $LT_{50}$ of 98.9 hrs (Slope 3.06 and Chi-square 15.6) was observed at Neem and the lowest 86.9 hrs (Slope 2.89 and Chi-square 18.1) was recorded at chilies respectively. At 18%, the maximum $LT_{50}$ of 90.6 hrs (Slope 3.05 and Chi-square 13.9) was recorded at Tooh and the minimum 74.0 hrs (Slope 2.68 and Chi-square 19.4) was observed at Datura respectively. At 20%, the highest $LT_{50}$ of 77.9 hrs (Slope 3.27 and Chi-square 17.2) was recorded at Chilies and the lowest 66.8 hrs (Slope 2.86 and Chi-square 15.5) was observed at Neem respectively. $LT_{90}$ was observed as mentioned in Table-2. At 12%, the maximum $LT_{90}$ of 240.3 hrs (Slope 3.36 and Chi-square 18.3) was observed at Datura and the lowest 210.6 hrs (Slope 3.54 and Chi-square 9.6) was recorded at Neem respectively. At 14%, the highest $LT_{90}$ of 242.1 hrs (Slope 3.25 and Chi-square 18.8) was recorded at Tooh and the lowest 213.7 hrs (Slope 3.03 and Chi-square 16.7) was observed at Datura respectively. At 16%, the maximum $LT_{90}$ of 259.0 hrs (Slope 3.06 and Chi-square 15.6) was observed at Neem and the lowest 233.1 hrs (Slope 3.26 and Chi-square 16.1) was recorded at Tooh respectively. At 18%, the maximum $LT_{90}$ of 238.0 hrs (Slope 3.05 and Chi-square 13.9) was recorded at Tooh and the lowest 203.6 hrs. (Slope 3.15 and Chi-square 15.4) was observed at Neem respectively. At 20%, the highest $LT_{90}$ of 203.1 hrs (Slope 2.86 and Chi-square 12.8) was observed at Tooh and the lowest 186.8 hrs (Slope 2.86 and Chi-square 15.5) was recorded at Neem respectively.

**$LC_{50}$ and $LC_{90}$values of different Botanicals against *Dysdercus cingulatus***

The $LC_{50}$ was observed as mentioned in Table-3. The highest $LC_{50}$ 16.0 values were observed in Tooh (Slope 2.26 and Chi-square 0.82) comes after Neem 14.5 (Slope 2.56 and Chi-square 0.27) Datura 13.9 (Slope 2.61 and Chi-square 0.03) and Chilies 13.8 (Slope 1.80 and Chi-square 0.11) respectively. The $LC_{90}$ was observed as mentioned in table no 4. The maximum $LC_{90}$ 71.0 values were observed in Chilies (Slope 1.80 and Chi-square

0.11) followed by Tooh 58.9 (Slope 2.26 and Chi-square 0.82) Neem 46.1 (Slope 2.56 and Chi-square 0.27) and finally Datura 43.1 (Slope 2.61 and Chi-square 0.03) respectively.

**Table-2: Mortality percentage of different botanical doses against *Dysdercus cingulatus***

| **Treatments** | | **Time interval** | | | | |
|---|---|---|---|---|---|---|
| | Treatments | 24 hours | 48 hours | 72 hours | 96 hours | Week |
| 12% | Tooh | 3.33% | 13.33% | 23.33% | 36.6% | 37.3% |
| | Neem | 3.33% | 20.00% | 33.33% | 40.0% | 40.7% |
| | Datura | 6.67% | 16.67% | 26.67% | 33.33% | 37.0% |
| | Chilies | 6.67% | 16.67% | 26.67% | 36.67% | 40.7% |
| | Control | 0.00% | 0.00% | 0.00% | 0.00% | 10.0% |
| 14% | Tooh | 6.67% | 20.00% | 30.00% | 40.00% | 40.74% |
| | Neem | 3.33% | 13.33% | 30.00% | 40.00% | 44.44% |
| | Datura | 10.00% | 23.33% | 33.33% | 43.33% | 44.44% |
| | Chilies | 6.67% | 20.00% | 30.00% | 43.33% | 44.44% |
| | Control | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 16% | Tooh | 6.67% | 20.00% | 30.00% | 43.00% | 44.44% |
| | Neem | 6.67% | 20.00% | 33.33% | 46.67% | 48.17% |
| | Datura | 10.00% | 23.33% | 36.67% | 50.00% | 51.85% |
| | Chilies | 10.00% | 23.33% | 33.33% | 46.67% | 48.15% |
| | Control | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 18% | Tooh | 10.00% | 20.00% | 33.33% | 46.67% | 48.85% |
| | Neem | 13.33% | 23.33% | 40.00% | 50.00% | 51.85% |
| | Datura | 13.33% | 26.67% | 36.67% | 50.00% | 55.56% |
| | Chilies | 10.00% | 23.33% | 40.00% | 50.85% | 51.85% |
| | Control | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 20% | Tooh | 13.33% | 30.00% | 46.67% | 50.00% | 51.85% |
| | Neem | 13.33% | 26.67% | 43.33% | 53.33% | 55.56% |
| | Datura | 16.67% | 26.67% | 43.33% | 60.00% | 62.96% |
| | Chilies | 10.00% | 20.00% | 33.33% | 56.67% | 59.29% |
| | Control | 0.00% | 0.00% | 0.00% | 0.00% | 09% |

**Table-3: Lethal Time 50 of different botanicals against *Dysdercus cingulatus***

| **Treatments** | **Concentrations** | **$LT_{50}$** | **95% confidence limits** | | **Slope ± SE** | **$X^2$** |
|---|---|---|---|---|---|---|
| | | | **lower** | **Upper** | | |
| Tooh | 12% | 104.5 | 94.2 | 115.8 | 3.66 ± 0.33 | 17.1 |
| | 14% | 97.8 | 86.7 | 110.7 | 3.25 ± 0.30 | 18.8 |
| | 16% | 94.5 | 84.4 | 105.3 | 3.26 ± 0.30 | 16.1 |
| | 18% | 90.6 | 80.5 | 101.7 | 3.05 ± 0.29 | 13.9 |
| | 20% | 72.5 | 64.5 | 80.7 | 2.86 ± 0.26 | 12.8 |
| Neem | 12% | 91.5 | 83.6 | 99.7 | 3.54 ± 0.31 | 19.6 |
| | 14% | 99.6 | 90.3 | 109.6 | 3.63 ± 0.33 | 15.0 |
| | 16% | 98.9 | 88.2 | 110.8 | 3.06 ± 0.29 | 15.6 |
| | 18% | 79.9 | 70.3 | 89.8 | 3.15 ± 0.29 | 15.4 |
| | 20% | 66.8 | 57.0 | 76.7 | 2.86 ± 0.27 | 15.5 |
| Datura | 12% | 100.1 | 89.2 | 112.1 | 3.36 ± 0.31 | 18.3 |
| | 14% | 80.9 | 70.6 | 91.7 | 3.03 ± 0.28 | 16.7 |
| | 16% | 87.8 | 75.9 | 101.2 | 2.79 ± 0.27 | 18.0 |
| | 18% | 74.0 | 61.8 | 87.3 | 2.68 ± 0.26 | 19.4 |
| | 20% | 68.6 | 58.0 | 79.7 | 2.90 ± 0.27 | 18.2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 12% | 98.0 | 87.3 | 109.7 | 3.36 ± 0.30 | 18.1 |
| | 14% | 96.4 | 85.7 | 108.1 | 3.28 ± 0.30 | 18.1 |
| Chilies | 16% | 86.9 | 75.9 | 98.6 | 2.89 ± 0.26 | 18.1 |
| | 18% | 84.3 | 73.3 | 95.8 | 2.98 ± 0.27 | 19.6 |
| | 20% | 77.9 | 68.2 | 87.9 | 3.27 ± 0.29 | 17.2 |

**Table-4: Lethal Time 90 of different botanicals against *Dysdercus cingulatus***

| Treatments | Concentrations | $LT_{90}$ | 95% confidence limits | | Slope ± SE | $X^2$ |
|---|---|---|---|---|---|---|
| | | | lower | Upper | | |
| | 12% | 234.1 | 197.3 | 300.9 | 3.66 ± 0.33 | 17.1 |
| | 14% | 242.1 | 199.2 | 326.7 | 3.25 ± 0.30 | 18.8 |
| Tooh | 16% | 233.1 | 194.9 | 302.4 | 3.26 ± 0.30 | 16.1 |
| | 18% | 238.0 | 195.3 | 319.0 | 3.05 ± 0.29 | 13.9 |
| | 20% | 203.1 | 171.8 | 255.3 | 2.86 ± 0.26 | 12.8 |
| | 12% | 210.6 | 183.5 | 253.6 | 3.54 ± 0.31 | 19.6 |
| | 14% | 224.4 | 191.7 | 280.9 | 3.63 ± 0.33 | 15.0 |
| Neem | 16% | 259.0 | 212.5 | 347.0 | 3.06 ± 0.29 | 15.6 |
| | 18% | 203.6 | 169.5 | 265.7 | 3.15 ± 0.29 | 15.4 |
| | 20% | 186.8 | 151.6 | 252.2 | 2.86 ± 0.27 | 15.5 |
| | 12% | 240.3 | 198.9 | 319.0 | 3.36 ± 0.31 | 18.3 |
| | 14% | 213.7 | 175.0 | 287.7 | 3.03 ± 0.28 | 16.7 |
| Datura | 16% | 252.7 | 198.3 | 369.9 | 2.79 ± 0.27 | 18.0 |
| | 18% | 222.5 | 170.8 | 343.0 | 2.68 ± 0.26 | 19.4 |
| | 20% | 189.5 | 151.7 | 268.0 | 2.90 ± 0.27 | 18.2 |
| | 12% | 235.6 | 195.6 | 310.5 | 3.36 ± 0.30 | 18.1 |
| | 14% | 236.5 | 195.7 | 313.5 | 3.28 ± 0.30 | 18.1 |
| Chilies | 16% | 241.2 | 195.9 | 328.7 | 2.89 ± 0.26 | 18.1 |
| | 18% | 226.4 | 184.8 | 306.0 | 2.98 ± 0.27 | 19.6 |
| | 20% | 191.8 | 160.2 | 249.3 | 3.27 ± 0.29 | 17.2 |

**Table-5: Lethal Concentration 50 of different botanicals against *Dysdercus cingulatus***

| Treatments | $LC_{50}$ | Slope ± SE | Chi-square | 95% C/L |
|---|---|---|---|---|
| Tooh | 16.0 | 2.2654997±1.3183466 | 0.8260 | 1.3009 |
| Neem | 14.5 | 2.5636138±1.3226708 | 0.2756 | 1.0226 |
| Datura | 13.9 | 2.6142254±1.3249039 | 0.0360 | 0.9866 |
| Chilies | 13.8 | 1.8035535±1.3151168 | 0.1109 | 2.0425 |

**Table-6. $LC_{90}$ values (hours) of different botanicals against *Dysdercus cingulatus***

| Treatments | $LC_{90}$ | Slope ± SE | Chi-square | 95% C/L |
|---|---|---|---|---|
| Tooh | 58.9 | 2.2654997±1.3183466 | 0.8260 | 1.30090 |
| Neem | 46.1 | 2.5636138±1.3226708 | 0.2756 | 1.02260 |
| Datura | 43.1 | 2.6142254±1.3249039 | 0.0360 | 0.9866 |
| Chilies | 71.0 | 1.8035535±1.3151168 | 0.1109 | 2.04250 |

## DISCUSSION

Kodandaram, et al. (2008) found that the effect of different botanical against red cotton bug is possible, however synthetic insecticides leave their residual effect and promulgate environment pollution and are also hazardous to the beneficial organisms. Therefore, this study was undertaken to evaluate the efficiency of various botanical insecticides against red cotton bugs. The findings of the study indicated that among four (Tooh, Neem, Datura, and Chilies) treatments in which Datura observed best as compared to rest treatments against red cotton bug and the highest mortality (62.9%) of red cotton bug was observed at 20% of Datura. Similarly, Shahzad, et al. (2016) reported positive effects of biopesticides against sucking insect pest of brinjal. In the same way, Abbasipour, et al. (2011a) also claimed somehow identical results by using extract of Datura as insecticide against C. maculatus, sharing that Datura might have high value in grain storage against *C. maculatus*, where local farmers could save their money by using Datura with little resources. In another study Abbasipour, et al. (2011b) divulged that *Datura stramonium L.* (Solanaceae) has comparatively better results against the red flour beetle, for its toxic and antifeedant activity. The application of neem extract was also found satisfactory performance but less than Datura and Chilies. The mortality of red cotton by the sprayed of Neem (55.5%) was recorded but, it has been seen that the sensitivity of the creepy crawlies against neem-based bug sprays (NBIs) differs enormously relying on area and surface of the body. This variety in their reaction appears to lie in the reality, that the Neem-based bug sprays could have acted straightforwardly upon focal sensory system lying on the ventral side and eventually on the cerebrum which lies at the front finish of the body. The impact of Neem based bug sprays which actuated prolongation of *D.cingulatus* nymphal period without shedding to next instar or *ecdysial* stages appear to be brought about by a change in natural JH titer as revealed by Khan & Kumar (2003).

## CONCLUSION

Red Cotton Bug (*Dysedercus cingulatus*) is one the devastating cotton pests, while controlled by various chemical insecticides, that is concerning to the environmentalists and public health workers. Yet botanicals are also the good option to reduce the use of synthetic insecticides, and the highest mortality could be achieved by using Datura (62.9%) and the least effective botanical was Tooh with 51.8% mortality. The least time to kill the insects was taken by Neem with LT50 and LT90 66.8 and (186.8) hours, respectively. The lowest dose 13.9% was utilized by Datura to kill 50% of tested insect (LC50) and LC90 was recorded 43.1%. It is therefore recommended to use Datura to control Red Cotton Bug and conduct some in-depth studies considering mixture of Datura, Tooh, Chilies and Neem with multiple ratios to produce most effective organic pesticides for various insects.

## AUTHORS CONTRIBUTIONS

All authors contributed equally.

## REFERENCES

Abbasipour, H., Fahimeh Rastegar, Mohammad Mahmoudvand, and Mohammad Hossein Hosseinpour, 2011a. Insecticidal activity of extract from *Datura stramonium* (F.) (Solanaceae) against *Callosobruchus maculatus*. *Integrated Protection of Stored Products*, 69, pp. 251-256.

Abbasipour, H., Mohammad Mahmoudvand, Fahimeh Rastegar, and Mohammad Hossein Hosseinpour, 2011b. Bioactivities of *jimsonweed* extract, *Datura stramonium L.* (Solanaceae), against *Tribolium castaneum. Turkish Journal of Agriculture and Forestry*, *35*, pp. 623-629.

Abbott, W.S., 1925. A method of computing the effectiveness of an insecticide. *J. econ. Entomol*, *18*(2), pp. 265-267.

Ali, S.S., Sher, A., Ahmed, S.S., Rizwana, H., Siddiqui, S., Ali, S.S., Rattar, I.A. and Shah, M.A., 2016. Effect of biopesticides against sucking insect pests of brinjal crop under field conditions. *Journal of Basic & Applied Sciences*, *12*.

Atwal, A.S. and Dhaliwal, G.S., 2002. *A textbook on Agricultural Pests of Southeast Asia and their Management.* p-177-434.

Awan, M.N., 1994. Evaluation of some insecticidal combinations and neem extracts for the control of cotton pests (jassids, thrips, whiteflies, and boll worms). *PhD diss., Thesis, M. Sc. (Hons.) Agric., Deptt. of Entomology, Faculty of Agri., Gomal University, DI Khan*, *92*.

Aziz, E. and Khoso, A.G., 2019. Evaluation of repellency of plant-derived insecticide against brinjal and pepper pest populations. *International Research Journal of Insect Sciences*, *4*(1), pp.1-18.

Bo, B.Y., 1992. IPM on cotton in Asia and the Pacific region. *Pak. Cottons*, *36*(2), pp.87-100.

Cororaton, C.B. and Orden, D., 2009. *Poverty implications of agricultural and non-agricultural price distortions in Pakistan* (No. 1856-2016-152603).

Gill, H.K. and Garg, H., 2014. Pesticide: environmental impacts and management strategies. *Pesticides-toxic aspects*, *8*(187), pp.10-5772.

GoP (Government of Pakistan)., 2023. Agriculture. *Finance Division*. 02_Agriculture.pdf (finance.gov.pk) Chapter-2. Pp.19.

Hill, D. S. and J. M. Waller. 1990. *Pests and diseases of crops*. Longman, Group Ltd, Hong Kong. pp: 153-4.

Iqbal, J., Ali, H., Hassan, M.W. and Jamil, M., 2015. Evaluation of indigenous plant extracts against sucking insect pests of okra crop. *Pakistan Entomologist*, *37*(1), pp.39-44.

Khan, I.A. and Kumar, K., 2003. Heterochrony in cotton bollworm, Earias vitella (Fb) following ethoxyprecocene administration.

Kodandaram, M.H., Thakur, N.A. and Shylesha, A.N., 2008. Toxicity and morphogenetic effects of different botanicals on red cotton bug Dysdercus koenigii Fab. (Hemiptera: Pyrrhocoridae) in Northeastern Hill (NEH) region of India. *Journal of Biopesticides*, *1*(2), pp.187-189.

Malik, S.U., Zia, K., Ajmal, M., Shoukat, R.F., Li, S., Saeed, M., Zafar, J. and Shoukat, R.F., 2018. Comparative efficacy of different insecticides and estimation of yield losses on BT and non-BT cotton for thrips, red cotton bug, and dusky cotton bug. *J. Entomol. Zool. Stud*, *6*, pp.505-512.

Ozyigit, I.I., Kahraman, M.V. and Ercan, O., 2007. Relation between explant age, total phenols and regeneration response in tissue cultured cotton (Gossypium hirsutum L.). *African Journal of Biotechnology*, *6*(1), p.3.

Pilla, R.S., Kitska, D.J. and Loader, C., 2005. Statistical analysis of modified complete randomized designs: applications to chemo-orientation studies. *Journal of experimental biology*, *208*(7), pp.1267-1276.

Sahayaraj, K., Tomson, M. and Kalidas, S., 2012. Artificial rearing of the red cotton bug, Dysdercus cingulatus using cotton seed-based artificial diet (Hemiptera: Pyrrhocoridae). *Entomologia Generalis*, *33*(4), pp.283-288.

Sharma, T., Qamar, A. and Khan, M.A., 2010. Evaluation of neem (Azadirachta indica) extracts against the eggs and adults of Dysdercus cingulatus (Fabricius). *World Applied Sciences Journal*, *9*(4), pp.398-402.

Solangi, G.S., Mahar, G.M. and Oad, F.C., 2008. Presence and abundance of different insect predators against sucking insect pest of cotton. *Journal of Entomology*, *5*(1), pp.31-37.

Sprenkel, R.K., 2000. *Cotton plant and pest monitoring manual for Florida*.

Waterhouse, D.F., 1998. *Biological control of insect pests: Southeast Asian prospects* (No. 435-2016-33746).

Pilla, R.S., Kitska, D.J. and Loader, C., 2005. Statistical analysis of modified complete randomized designs: applications to chemo-orientation studies. *Journal of experimental biology*, *208*(7), pp.1267-1276.