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Evaluation of different insecticides for the management of red cotton bug *Dysdercus Spp* via flooding and foliar methods of application

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Abstract
The red cotton bug, *Dysdercus spp.* is a serious pest of cotton. Its attack results in the loss of seed weight, oil content and seed germinition percentage. It also acts as vector for transmitting the fungal pathogens in cotton. In the present study different insecticides are tested against red cotton bug on cotton crop by using two different methods of application i.e. flooding and foliar application. In case of flooding, insecticides were applied after the last picking with irrigation water. Maximum population reduction of 96.66 % over control was observed in plot treated with Chlorpyriphos 40EC and minimum (23.31%) reduction was recorded where water alone (without any insecticide) was flooded, after 7 days of treatment. In case of foliar application of insecticides maximum mortality percentage was recorded in plot treated with Carbusulfan 20 EC (86.75%) followed by Bifenthrin 2.5 EC (85.94 %) whereas minimum was recorded in Emmamectin benzoate 75 WDG (52.86 %), after 7 days of treatment.

Keywords: Application methods, Cotton, *Dysdercus spp.*, Insecticides, Mortarlity, Red Cotton Bug

1. Introduction
The red cotton bug (RCB), *Dysdercus spp* is a serious pest of cotton, lady's finger, hibiscus and sumbhal [1]. It is distributed in various parts of Asia, Africa, Australia, Egypt, etc. In cotton agro-ecosystem, nymphs and adults feed on developing and mature cotton seed [2]. Its infestation results in the loss of seed weight, oil content and seed viability. Severe attacks on bolls can kill developing seeds and leads to boll shedding. Lint is stained by its excreta and other body fluids, when crushed in ginning process [3]. Furthermore, it also acts as vector for transmitting the fungal pathogens in cotton [4]. In Pakistan, it has caused substantial economic loss in cotton crop [5].
Red Cotton Bug (RCB) is small deep red coloured insect of about 12-14 mm in length. The wings are of two parts inner part is hard, greyish and has black spot where as outer part is membranous and is black in color. Female can lay 900 hundreds pale yellow colour eggs singly or in small clusters in soil, debris, or decaying vegetable matter. Incubation period is about 7 days. There are five nymphal stages or instars that completes in 29-57 days. In warm weather the life-cycle lasts about 50 days and in cold weather may extend to 90 days. There are 5 generations recorded in a year [6].
Chemical control is an essential and sometimes unavoidable component to achieve high yield. It is reported that about 90% of the farmers use chemical insecticides [7]. According to the pest and its prevalence, synthetic chemicals can be used in different methods such as via foliar and flooding, for effective management. Foliar application is effective when pest is on plant and exposed. Muhammad Rafiq *et al.* [8] screened some available insecticides against red cotton bug via foliar application. Foliar application becomes ineffective when pest is hidden and in cracks and crevices. Insecticide flooding can be effective for soil habitating organisms like red cotton bug, dusky cotton bug, termites and hibernating lepidopterous insects in the cotton agro-ecosystem. Averill *et al.* [9] stated that water flooding reduces the cranberry fruit worm and fungal fruit rots infestation in cranberry. Soil treatment can be an important tool for the management of RCB, as it lay eggs in the soil, its first instar nymph remain underground for about 4-12 days and it hibernate as adult in soil during the winter season. Keeping these in view present studies are designed to test the efficacy of different insecticides against red cotton bug by foliar and flooding application method.

2. Material and Methods
2.1. Experiment-1
Available insecticides were tested against red cotton bug by foliar application at research area of Entomological Research Institute, Faisalabad, Pakistan during October 2014. Cotton variety FH-142 was sown on 21st May in a Randomized Complete Block Design (RCBD) with three repeats in a plot size of 5.5ft X 27ft. Insecticides were applied via knap sack sprayer at recommended doses. Data was recorded before and after 3 and 7 days of treatment application. For data collection, number of RCB (Adults + Nymphs)/plant was recorded by observing 5 plants in each plot. Percentage mortality was calculated by formula:

$$\text{Mortality \%} = \frac{\text{Population in control-population in treated}}{\text{Population in control}} \times 100$$

2.2. Experiment-2
Trial was conducted in the last week of November during 2014 at research area of Entomological Research Institute, Faisalabad, Pakistan. After the last picking and before the field preparation for wheat sowing, treatments were applied in irrigation water with drip kept 5 m inside of plot from the water inlet. Experiment was repeated thrice with plot size of 27 X 90 sq. ft. Data was recorded before and after 3 and 7 days of treatment application. For data collection, number of RCB (Adults + Nymphs) was counted from 1 sq.m sample unit. Percentage reduction was calculated by formula.

$$\text{Reduction \%} = \frac{\text{Population in control-population in treated}}{\text{Population in control}} \times 100$$

3. Results and Discussion

3.1. Experiment-1

After 72 hrs of treatment application maximum mortality (93.25 %) was observed in T8 (Bifenthrin 2.5 EC) followed by T1 Carbosulfan 20 EC with mortality 92.10% whereas minimum (68.55 %) mortality % in T7 (Emmamectin Benzoate 75 WDG) (Table 1).

Similarly, after 7 days of treatment application maximum mortality (85.94 %) was observed in T8 (Bifenthrin 2.5 EC) followed by T1 Carbosulfan 20 EC with mortality 86.75% whereas minimum (52.86 %) mortality % in T7 (Emmamectin Benzoate75 WDG) (Table 1).

In the present study results Bifenthrin 2.5 EC and Carbosulfan 20 EC found to be most effective for the management of red cotton bug by foliar insecticide application. Similar experiment was performed by Rafiq *et al* [8]. They screened some available insecticides and found Alphacypermethrin 5EC, Deltamethrin, and Cypermethrin 10 EC to be more effective against red cotton bug. Results can't be compared with the study of Rafiq *et al* [8] as different insecticides were used in the studies

3.2. Experiment-2

After 3 days of insecticide flooding in the field, maximum RCB population reduction of 95.63% over control was observed in T1 (Chlorpyriphos 40 EC) followed by T2 (Endosulfan 35%EC) with population reduction of 92.67%. While minimum reduction (20.29%) was recorded in T5 where alone water (without any insecticide) was flooded followed by T4 (Imidacloprid 20%SL) with 62.93% population reduction over control (Table 2).

After 7 days of insecticide flooding, maximum population reduction of 96.66 % over control was observed again in T1 (Chlorpyriphos 40EC) followed by T2 (Endosulfan 35% EC) and T3 (Fipronil 5% EC) with reductions 85.65% and 72.93%, respectively. Whereas minimum (23.31%) RCB population over control was reduced in T5 (Water Flooding without Insecticides) followed by T4 (Imidacloprid 20% SL) with 58.35% reduction over control (Table 2).

In the present study, water flooding alone resulted in little fluctuation of RCB population. These findings are in line with those of Sahayaraj and Belsi [10] who observed that simple water flooding has no impact on egg hatchability and nymphal survival of RCB. But present study results differs with those of Averill *et al* [9]. They stated that water flooding reduces the cranberry fruit worm and fungal fruit rots infestation in cranberry.

Table 1: data regarding efficacy of different insecticides against red cotton bug by foliar application.

Treatments		Dose/ HLW	Pre-Treat. Data of RCB pop./ Plant	Post-Treatment Data of RCB population/Plant		Mortality % after	
				72 HAT	7 DAT	72 HAT	7 DAT
T1	Carbosulfan 20 EC	500ml	4.93	0.47	1.07	92.10 a	86.75 a
T2	Profenofos 50 EC	800ml	5.07	1.07	1.87	81.98 cd	76.83 de
T3	Deltamethrin 2.5 EC	250 ml	4.67	0.73	1.60	87.65 b	80.20 bc
T4	Gamma Cyhalothrin 60 CS	100ml	4.93	1.13	1.73	80.83 d	78.45 cd
T5	Lamda Cyhalothrin 2.5 EC	330ml	5.00	0.87	1.53	85.35 bc	81.00 bc
T6	Imidacloprid 20 SL	250ml	4.80	1.60	2.87	73.08 e	64.46 f
T7	Emmamectin 75 WDG	50g	4.67	1.87	3.80	68.55 f	52.86 g
T8	Bifenthrin 2.5 EC	250ml	3.67	0.40	1.13	93.25 a	85.94 a
T9	Chlorfenapyr 360 SC	100ml	4.40	0.87	1.47	85.35 bc	81.79 b
T10	Methomyl 40 SP	250g	3.87	1.27	2.07	78.60 d	74.32 e
T11	Check		3.93	5.93	8.07	0.00 g	0.00 h
LSD at 5%						3.73	2.78

Table 2: Data regarding efficacy of different insecticides against red cotton bug by flooding method

Treatments		Dose rate	Pre-Treatment RCB Pop./Sqm	Pre-Treatment RCB Pop./Sqm after		Percentage Reduction over control after	
				3 Days	7 Days	3 Days	7 Days
T1	Chlorpyriphos 40EC	2 lit/ac	142.67	7.33	6.33	95.63 A	96.66 A
T2	Endosulfan 35%EC	1.5 lit/ac	168.67	12.33	27.20	92.67 A	85.65 B
T3	Fipronil 5%EC	1.5 lit/ac	159.33	22.89	51.11	86.40 B	72.93 C
T4	Imidacloprid 20%SL	800 ml/ac	157.33	62.22	78.89	62.93 C	58.35 D
T5	Water Flooding Without Insecticides		157.00	133.89	145.45	20.29 D	23.31 E
T6	Check		144.33	168.22	189.78	0.00 E	0.00 F
LSD at 5%						5.8046	5.561

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