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FIELD AND LABORATORY STUDIES ON THE TOXICITY OF LAMBDA-CYHALOTHRIN FOR CONTROLLING DESERT LOCUST (*SCHISTOCERCA GREGARIA*)

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ABSTRACT

Desert locust has negative impact on world vegetation, severely affected Africa and Asia in 2020-21. The pest persists in both gregarious and solitary forms. In Pakistan, the majority of the nation experienced a desert locust attack in 2020. Seven to ten districts in Khyber Pakhtunkhwa were seriously impacted. The study was carried out to test the efficacy of different concentrations of Lambda-cyhalothrin 2.5 EC against adult and hoppers/nymph in field and laboratory conditions. The applied concentration was 4%,3%, 2%, 1% and 0.5 % for adults in field and lab conditions, while 2%, 1.5%, 1%, 0.5% and 0.25% for nymph's trials. Under field condition against adults all the applied concentrations were at par with each other except 0.5%, which showed significantly lower mortality rate (60%). A similar trend of toxicity was also recorded for the laboratory trials. More than 85% mortality was recorded in all treatment except 0.5%, which was 65%. Against hopper all concentration showed significant higher mortality (above 80%) except the nymphs sprayed with 0.25% concentration under field conditions. Similar results were also obtained for vitro trials against nymphal stage. It is concluded an average concentration (3%) should be applied for adult to avoid resistance and pest escape. For hoppers/nymph the recommended concentration should be 1%. Further studies should be carried out regarding the resistance to different types of insecticides under field and laboratory conditions.

1. INTRODUCTION

The common species of desert locust *Schistocerca gregaria* (Orthoptera: Acrididae) is widely distributed in the world. It has short horned and is considered as devastating pest in Africa and Asia (Song, 2004; Lovejoy et al., 2006; Cheseto et al., 2015). Worldwide a total of 700 disturbed and among them 50 belong to genus *Schistocerca.* Only four species of this genius has swarming formation habitat and considered as trans boundary pests (Song 2004; Song et al., 2017). *S. gregaria* has phase changing ability and can be shifted very quickly from solitary to gregarious. In gregarious form they made swarm and travel across Africa and

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In 2019-2020 Pakistan face sever desert locust plague across three provinces. The species were later identified as *S. gregaria gregaria* travelled all the way from Africa to Asia via Middle *East* (Sultana et al., 2021 Ahmad et al., 2020). This species goes under incomplete metamorphosis. Nymph has further five instars. Environmental conditions greatly affect the life stage and development period. The desert locust takes weeks to months to became mature. In solitary the losses are less and it remains calm, while it causes huge losses to crops in gregarious form (Meinzingen, 1993). Color also different in both forms, solitary phase has greenish to brownish color while gregarious has yellowish to blackish color (Pener, 1991; Ayali, 2019).

Desert locust usually travel from one country to another, having 50 km/day speed. Different control methods were used for the control of desert locust. Among them mainly pesticides are used in emergency situations. Extra use of Pesticides causes environmental pollution as well having adverse effect on non-target organisms as well (Lecoq, 2010). Biocontrol can also be used but they are mostly effective against early stages of the pests (Ali et al., 2021). Bio-pesticides such as *Metarhizium anisopliae* Var. *acridum* were widely used against the pests in Africa and Australia and best results were obtained against nymphs (Abdelatef and Hartbauer 2020; Abdelatef, 2005; Ali et al 2021).

Plant based extracts also good for the control of desert locust, as they are non-toxic to other animals but cannot be apply on large scale in emergency situations (Koul et al. 2008; Abdelatef and Hartbauer 2020). Biocontrol and Bio pesticides require time, optimum temperature and humidity for controlling the desert locust and cannot be applied in emergency situations. Pesticides such as Lambda-Cyhalothrin 2.5 EC, Chlorpyrifos 40 EC, and Deltamethrin 2.5 EC can be sued in emergency situation to obtained immediate results to tackle the situation effectively (Ahmad et al., 2020).

The present studie was carried out to evaluate the efficacy of different chemicals and concentrations against adults of desert locust and hoppers/nymphs under field and laboratory conditions in southern districts of Khyber Pakhtunkhwa.

2. MATERIALS AND METHODS

Location of the study

The experiments were carried out during February to May 2020 at desert locust affected districts of Khyber Pakhtunkhwa, Pakistan. The laboratory trials were carried out in Agriculture Research Institute, Dera Ismail Khan, while the field experiments were carried out at Dera Ismail Khan, Tank and Lakki Marwat districts.

Adult Trials

Adults of desert locust were selected from Dera Ismail Khan and Tank for the study. For each treatment three different trees were randomly selected and were sprayed. Lambda-Cyhalothrin 2.5 EC, were applied. at 4%, 3%, 2%, 1% and 0.5% solution/concentration. Control was also kept for comparison, having no chemical treatment. For laboratory trials a total of 100 adults were selected for each concentration. Control cage having no treatment was also kept for comparison. Data were recorded on mortality after 3 hours and 24 hours.

Hoppers/Nymph Trials

The 2nd instar nymphs/hoppers were selected for the experiment from the fields and brought to the laboratory for cage experiments to the infield one-meter area was caged with field cages. The cages were sprayed with 2%, 1.5%, 1%, 0.5% and 0.25% concentration of Lambda-Cyhalothrin for nymph's trials. A total of 100 nymphs were selected for each concentration in both field and laboratory trials. For comparison control cage was also placed.

Data Recording

The data was collected at 3 hrs. and 24 hrs. intervals. The number of dead and alive adults and hoppers/nymphs were counted in field and laboratory and the number were recorded. The average temperature during the field experiment ranged from 28-33°C with average humidity range from 30-40%. The weather conditions were generally sunny during the trial period. In laboratory experiment the temperature were kept constant (26-27°C) having 30% humidity.

Statistical Analysis

The data was statistically analyzed by using computer program Statistix. Least significant difference (LSD) was calculated at <0.05.

3. RESULTS AND DISCUSSION

Table-1 shows the efficacy of different concentrations of Lambda-Cyhalothrin 2.5 EC against adults of desert locust during field conditions. All the concentration showed significantly ($P<0.05$) higher mortality than 0.5%, which showed significantly lower mortality after 3 and 24 hours of treatment. Lowest mortality was recorded in control. The data in table-2 shows the efficacy under the laboratory conditions. A similar trend like field were recorded and all the concentration was with par with each other regarding mortality except 0.5%, which was significantly lower in percent mortality (65%) than the other concentrations. In control 3% mortality was recorded after 24 hours under laboratory conditions.

All the tested concentration showed significantly ($P<0.05$) higher mortality (above 80% after 3 hours and 90% after 24 hours in both locations against hoppers in field trials except 0.25%, which showed significantly lower percent mortality (Table-3). In laborator trails after 3 hours above 80% mortality was recorded in cages treated with 2%, 1.5%, 1%, 0.5% of Lambda-Cyhalothrin 2.5 EC. The recorded mortality 53% and 62 % after 3 and 24 hours respectively in 0.25% concentration was significantly lower compared to the remaining concentrations. In control 3% mortality was recorded in laboratory trials (Table-4).

In the current study all the concentration of lambda was effective against adult desert locusts in the field except 0.5%. A lower concentration may be used for the management of desert locust in the emergency to save the environment from contamination. Earlier studies conducted showed good results in chemical treatment against desert locust but it should be judicial application (FAO, 1998). Lambda- Cyhalothrin 2.5EC is very effective under both field and laboratory conditions in the trials and high mortality was recorded in both trials. Our results in similarity with those obtained by Khawar et al, 2020). They tested different pesticides with different concentrations and among all the tested insecticides they found Lambda- Cyhalothrin 2.5 EC more potent and recorded more than 80% mortality against the adult. Furthermore, they also recorded more than 90% mortality in against nymphal stage in both field and laboratory conditions. They found Buprofezin 25 WP least effective against desert locust. In another study conducted by Metaweh and Ali (1999) and Mamadou and Sarr (2009) used different insecticides and among them they found that Lambda-Cyhalothrin is extra effective to adult locusts and pest respond more under control conditions as compared to field conditions. In the current studies against adult's different dose were used and all of them were effective. The 3% and 2% concentration of the Lambda cyhalothrin 2.5 EC showed great mortality against adults in in field and laboratory conditions and can be used. Against hoppers/nymphs lower concentrations were used and they were effective. Similar results were obtained in an earlier studied carried out by Holt and Copper (2006). They used different insecticides against the desert locust hoppers different instar and found that lower concentration can also gave good results. Abdel-Fatah et al.,2012 also observed that Lambda- Cyhalothrin 2.5 EC is more toxic to the hoppers compare to Chlorpyrifos 40 EC and can give more than 80% mortality in field conditions.

4. CONCLUSION

It is concluded from the trials that Lambda-Cyhalothrin is an effective insecticide against desert locust and can be used in emergency situations depending on its availability in Pakistan. The recommended dose for the adult is 3% (3 liters/100 liter of water) for field application against the nymphal stage 1% (1 liter/ 100 liters of water) is good for getting above 80% mortality.

5. CONFLICT OF INTEREST

All authors have declared that there is no conflict of interests regarding the publication of this article.

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Table-1: Toxicity of Lambda-cyhalothrin concentrations against Desert locust adults under field conditions.

Dose/Concentration	% mortality at Dera Ismail Khan		% mortality at Tank	
	3 hours	24 hours	3 hours	24 hours
4 liter/100 liter of water (4%)	75 c	85 c	72 c	87 c
3 liter/100 liter of water (3%)	75 c	83 c	73 c	82 c
2 liter/100 liter of water (2%)	74 c	83 c	72 c	81 c
1 liter/100 liter of water (1%)	70 c	81 c	71 c	82 c
500 ml /100 liter of water (0.5%)	50 b	60 b	55 b	62 b
Control	02 a	02 a	03 a	03 a

Table-2: Toxicity of Lambda-cyhalothrin concentrations against Desert locust adults under laboratory conditions.

Dose/Concentration	% mortality	
	3 hours	24 hours
4 liter/100 liter of water (4%)	78 c	89 c
3 liter/100 liter of water (3%)	78 c	89 c
2 liter/100 liter of water (2%)	77c	87 c
1 liter/100 liter of water (1%)	73 c	85 c
500 ml /100 liter of water (0.5%)	54 b	65 b
Control	01 a	03 a

Table-3: Toxicity of Lambda-cyhalothrin concentrations against Desert locust nymphs under field conditions.

Dose/Concentration	% mortality at Dera Ismail Khan		% mortality at lakki Marwat	
	3 hours	24 hours	3 hours	24 hours
2 liter/100 liter of water (2%)	84 c	93 c	84 c	95 c
1.5 liter/100 liter of water (1.5%)	83 c	93 c	82 c	95 c
1 liter/100 liter of water (1%)	82 c	92 c	83 c	92 c
500 ml/100 liter of water (0.5%)	80 c	89 c	81 c	90 c
250 ml /100 liter of water (0.25%)	55 b	65 b	53 b	66 b
Control	03 a	05 a	04 a	05 a

Table-4: Toxicity of Lambda-cyhalothrin concentrations against Desert locust nymphs under laboratory conditions.

Dose/Concentration	% mortality	
	3 hours	24 hours
2 liter/100 liter of water (2%)	85 c	93 c
1.5 liter/100 liter of water (1.5%)	86 c	92 c
1 liter/100 liter of water (1%)	85c	93 c
500 ml/100 liter of water (0.5%)	80 c	88 c
250 ml /100 liter of water (0.25%)	53 b	62 b
Control	01 a	03 a