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Bioinsecticidal effect of *Sida acuta* plant extract against red cotton bug, *Dysdercus Cingulatus* fab.

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Abstract
Insecticidal effect of methanol and ethyl acetate leaves extract of *Sida acuta* were studied against *Dysdercus cingulatus.* The plant leaves were dried, powdered and extracted in soxhlet apparatus in methanol and ethyl acetate solvent for 24 hrs. The adult red cotton bug, *D. cingulatus* were exposed to various concentration and percent mortality were recorded after 96hrs.
The insecticidal activity of leaves extract of *Sida acuta* were LD_{10}= 3.741µg/gm. LD_{50}= 9.690µg/gm., LD_{90}=13.38µg/gm., LD_{99}= 14.15µg/gm. in methanol and LD_{10}= 2.671µg/gm., LD_{50}= 6.165µg/gm., LD_{90}= 13.25µg/gm., LD_{99} = 14.32µg/mg. in ethyl acetate. Results revealed that the mortality increase with increase in concentration of the plant extract. The ethyl acetate solvent extract showed more insecticidal property against *Dysdercus cingulatus*. Stastical variance, 95% confidance limits and regression equations are presented.

Keywords: *Dysdercus cingulatus*, *Sida acuta*, mortality

Introduction
Cotton is one of the most important fibers and cash crop of India subjected to destructive action of number of insect pest. Sucking pests have become quite serious from seedling stage; their heavy infestation at times reduces the crop yield to a great extent. The average crop losses worldwide due to pests and diseases are 60% of potential production. Among 1326 species of insect pest of cotton (Hargreeques) recorded worldwide, nearly 130 species occur in India. Out of these the red cotton bug, *Dysdercus cingulatus* Fab. is the severe pest of cotton crop [1]. It is distributed all over the cotton producing regions of India [2].
It is commonly known as red cotton bug causes serious damage by feeding on developing bolls and ripe cotton seeds [3]. Their penetrations into the developing cotton bolls transmit fungi on the immature lint and seed, which latter on stain the lint with typical yellow color, hence the name "cotton strainer". Heavy infestations on the seeds affect the crop mass, oil content and the marketability of the crop [4].
The huge amounts of synthetic pesticide are applied in the field of cotton to protect from insect attack. With a greater awareness of hazards associated with the use of synthetic organic pesticide there has been an increase need to explore suitable alternative methods of pest control. Farmers use different plant materials to protect cotton crop from pest infestation. Natural products in their crude form or plant extract provide unlimited opportunities as biopesticide. Botanical insecticides are ecofriendly and environmentally safer alternative methods for crop protection [5-7].
In recent years research efforts are reported on development of insecticides of plant origin. Most plant species that are used in phytomedicine contain ingredients, which inhibit the development of insects. This paper reports the results of research on the effects of *Sida acuta* plant extracts against red cotton bug, *Dysdercus cingulatus.*
Sida acuta is an erect perennial shrub commonly called as wire weed, belongs to family Malvaceae and found throughout the different parts of India. It grows on farmlands, pastures, roadsides and waste areas [8]. *Sida acuta* has been used as the traditional medicine to cure various ailiments [9-11]. *Sida acuta* is used to treat infectious diseases in children such as malaria, fever, pain, variola, and also have antibacterial, anti-inflammatory, analgesic and hepatoprotective properties [12]. *Sida acuta* act as a source of Antibacterial [13], Antimicrobial [14-16], Anti-inflamentory / Analgesic [17, 18] and also has Antimalerial activity [19, 20]. It was also reported that the *Sida acuta* has wound healing [21] and Antioxidant [22]. Several workers studied the insecticidal activity of plant extracts against *Callosobruchus chinensis*, *Dysdercus cingulatus* [23-26]. The nymphicidal effect of two indigenous plant extracts of *Adathoda vasica* and *Vitex negundo* on cotton pest, *Dysdercus cingulatus* (Fab.) evaluated [27]. Several authors studied the insecticidal activity of *Sida acuta* [28, 29].
Therefore, the present study was undertaken to evaluate the biopesticidal effect of methanol and ethyl acetate extracts of *Sida acuta* leaves against the red cotton bug, *Dysdercus cingulatus*.

Material and Methods
Plant Collection and Extraction
Leaves of *Sida acuta* were collected from Aurangabad and nearby areas and were properly identified from the taxonomist. The plants were washed three times in tap water and rinsed in distilled water. The excess water was soaked and the leaves were separated and dried in shade. The dried leaves materials were powdered in a domestic grinder and stored in air tight containers in refrigerator till further use. From this stock 50gm. of powder was extracted separately with 750 ml. of solvent using Soxhlet apparatus. Extractions were done in methanol and ethyl acetate solvents separately, for 24 hr.

Insect Culture

Nymphs and adults of *Dysdercus cingulatus* Fab. were collected from the cotton fields around the Aurangabad city. The collected insects were maintained in the laboratory conditions, at a temperature of 28±2ºC and at 70-80 % relative humidity in acrylic plastic jars feed with fresh leaves, cotton bolls and water soaked cotton seeds. The laboratory emerged adults were used for the experiments.

Insecticidal Bioassay

Fresh cotton bolls and their weighted pieces were taken in each acrylic plastic jar and were exposed to several doses of methanol and ethyl acetate extracts of *Sida acuta*. The dose was prepared by mixing the extract with respective solvent and was applied and sprayed to fresh cotton ball and their pieces. One jar of control containing only fresh cotton boll and their pieces sprayed with only respective solvent was maintained. The treated cotton boll and their pieces were allowed to evaporate the solvent for 24 hours. 10 newly emerged adults were released in each experimental and control acrylic plastic jar containing the cotton boll and their pieces. The mortality in response to plant extract of different solvents was recorded after 24h up to 96h of treatment. The percent mortality was calculated after 96h and the observed data was subjected to probit analysis (Finney 1947).

Results

The toxic effect of *Sida acuta* leaves extract were evaluated against red cotton bug, *Dysdercus cingulatus*. The number of dead *Dysdercus cingulatus* were counted after 24, 48, 72 and 96h at different doses of methanol and ethyl acetate crude extract. The total percent mortality was observed after 96h. The results showed that the mortality increases with increase in concentration at all doses (Table and Figure).

The results of the probit analysis for the estimation of LD_{10}, LD_{50}, LD_{90}, LD_{99}, variance, 95% confidence limits and regression equation at 96h for the mortality of red cotton bug, *Dysdercus cingulatus* are presented in table-2. In bioassay of methanol and ethyl acetate leaves extract of *Sida acuta* were LD_{10}=3.741µg/gm., LD_{50}=9.690µg/gm., LD_{90}=13.38µg/gm., LD_{99}=14.15µg/mg. in methanol and LD_{10}=2.671µg/gm., LD_{50}=6.165 µg/gm., LD_{90}= 13.25µg/gm., LD_{99}=14.32µg/mg. in ethyl acetate respectively. Among the various estimate of regression based probit analysis, the χ^2 values for the regression coefficients showed homogeneity to the data.

Table 1: Percent mortality of *Dysdercus cingulatus* treated with leaf extract of *Sida acuta* after 96 h treatment.

Solvent	Dose in µg.	No. of insect used	Mortality after 96h.	Percent mortality	Corrected mortality
Control	-	10	-	-	-
Methanol	3	10	1	10	10
	6	10	2	20	20
	9	10	4	40	40
	12	10	6	60	60
	15	10	8	80	80
	18	10	10	100	100
Ethyl acetate	3	10	2	20	20
	5	10	3	30	30
	7	10	5	50	50
	9	10	7	70	70
	11	10	9	90	90
	13	10	10	100	100

Table. 2 Effect of *Sida acuta* plant extract on regression equation, LD_{10}, LD_{50}, LD_{90}, LD_{99}, variance, chis-quare, confidence limits of *Dysdercus cingulatus*

Solvent	LD_{10}	LD_{50}	LD_{90}	LD_{99}	Variance	95% CL		Regression equation	x^2
						Lower	Upper		
Methanol	3.741	9.690	13.38	14.15	0.004064	0.6814	1.1112	Y=3.1008+1.9416	0.909 (2)
Ethyl acetate	2.671	6.165	13.25	14.32	0.002912	0.6814	0.8957	Y=3.5280+2.2133	1.386 (2)

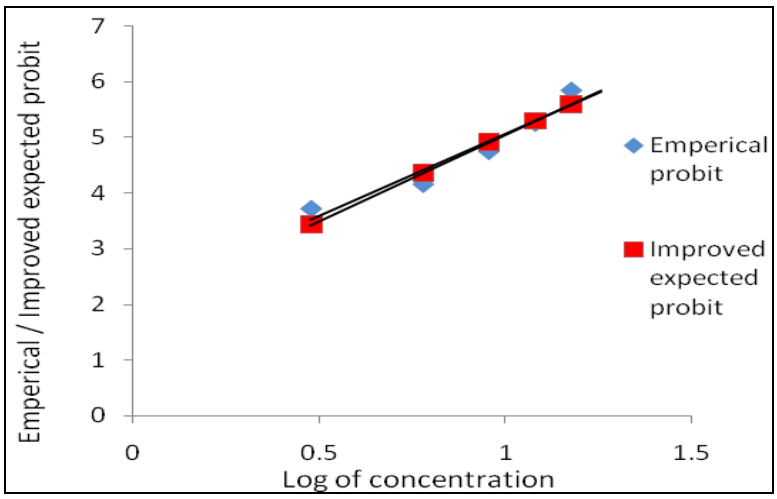

Fig. 1 Regression and provisional lines for *Dysdercus cingulatus* exposed to methanol leaf extract of *Sida acuta* after 96 h.

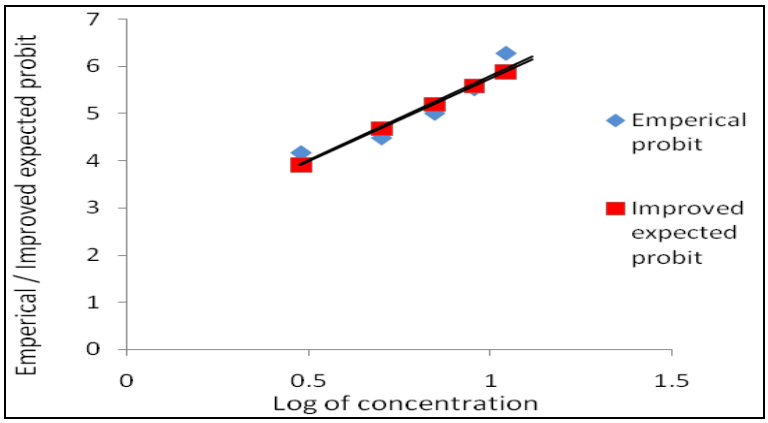

Fig. 2 Regression and provisional lines for *Dysdercus cingulatus* exposed to methanol leaf extract of *Sida acuta* after 96 h.

Discussion

Sida acuta is the medicinal plant for the treatment of several diseases and also have insecticidal property against several pests. Adeniyi *et al.* [30] studied ethanol extracts of the leaves of *Sida acuta* for insecticidal activity against beans weevil, *Acanthscelides obtectus.* At the concentration of 1.00,2.00,3.00,4.00% showed overall mean mortality18.60, 22.27, 28.60, 31.47 respectively and analysed the phytochemical constituents of *Sida acuta*. Wahab and Akinterinwa [31] reported the insecticidal activity of ethanol solvent extracts of the leaves of *Sida acuta* against bean weevil (*Acanthscelides obtectus).* The total percent mortality after 72h was 86%. Adewole *et.al*. [28] observed the larvicidal activity of plant extract of common wire weed *Sida acuta* against the larva of mosquito, *Anopheles Gambiae*.

Narasimhan *et al.* [29] investigated the leaves and root methanol extracts of *Sida acuta* was proved to be toxic against *Plasmodium berghei.* The mortality among the different larval stages was increased with increased concentration (30, 50.75, 100 and 125 ppm.). According to Kebe *et al.* [32] ethanol leaf extract of *Sida acuta* affect the micro-anatomy of the liver and some biochemical parameters in adult Wistar rats. The acute toxicity test of *Sida acuta* against *Burkina faso* (LD_{50} values of 3.2 g/kg) observed by Kiessoun *et al.* [33].

Niraimathi *et.al.* [34] evaluated the larvicidal activity of leaf crude extract of *Sida acuta* against third instars of *Anopheles subpictus* and *Culex tritaeniorhynchus*. At 24 h, LC_{50} value was observed at the concentration of 38.68, 50.81 mg/l and 9.98, 12.69 mg/l. Akilandeswari *et.al.* [35] proved the antimicrobial activity of *Sida acuta* on the two gram +ve and two gram –ve bacteria and fungi. Damintoti *et al*. [36] demonstrated that the alkaloids of *Sida acuta* posses antimicrobial activity against different microorganisms.

In the present investigation, the toxicity of Ethyl acetate and Methanol leaf extract of *Sida acuta* was tested against red cotton bug, *Dysdercus cingulatus.* In our study the mortality increases with increase in concentration at all the doses at 96 h of exposure.

Similar to the present investigation several studies documented the insecticidal activity of plant extracts against Red cotton bug, *D. cingulatus.* Sharma *et al.* [1] showed the percent mortality of *Azadiracta indica* against *D. cingulatus*. The highest mortality (75.00%) found at 1.0% concentration of neem seed kernel extract and when eggs treated with the neem extract increased percent mortality (12.25%) was noticed at a concentration of 0.005%.

Evengelin *et al*. [37] reported the third instar nymphs of *Dysdercus cingulatus* were treated with *Adhatoda vasica* extract, in increasing concentration from (0.5 to 2.0 %) egg mortality and the survival rate gradually decreased. Such a

dose dependant mortality was also observed by Sahayaraj and Shobha [38] and found that the aqueous seed extract of *Tephrosia purpurea* and *Acalypha indica* at 96 h showed insecticidal activity (LC_{50}=2.46, LC_{90}=2.53) and (LC_{50}=2.44, LC_{90}=2.50) respectively against *Dysdercus cingulatus* .Sontakke *et al.* [4] observed the crude extract of *Ailanthus excelsa* at different concentration affected the egg mortality (1-56.66%, 2-75.33%, 3-81.33%) and adult emergence of *Dysdercus cingulatus.* Ranilalitha *et.al*. [27] concluded that crude methanol extract of *Adathoda vasica* and *Vitex negundo* showed percent mortality against nymph instar of Dys*dercus cingulatus*. Similarly Asha *et al*. [39] reported that the methanol extract of marine green algae, *Ulva lactuca* caused dose dependant mortality after 96 h. of treatment (LC50=313.59, LC90=1329.46) against *Dysdercus cingulatus*. Sahayaraj and Kalidas [40] observed the benzene and chloroform extract of seaweed *Padina pavonica* against nymph instars of *D. cingulatus*. The nymph mortality in benzene extract was (LC50=0.004, LC90=0.0084) and in chloroform was (LC50=0.039, LC90= 0.045) at 96h respectively. According to Asaraja and Sahayaraja [41] the brown macro algal extract of *Sargassum wighti* showed higher mortality than *Padina pavonica* against *Dysdercus cingulatus*. Sahayaraj and Jeeva [42] investigated the insecticidal activity of brown seaweed algae, *Sargassum tenerrimum* against *D. cingulatus* (LC50 = 0.009%). Gadewad and Pardeshi [26] observed the ethyl acetate solvent extract (LD_{50}=6.486µg/gm) of *Chrysanthemum indicum* shows more insecticidal property than methanol solvent extract ($LD_{50=}$9.230 µg/gm) against red cotton bug, *Dysdercus cingulatus* Fab.

The finding of the present investigation revealed that, the leaf extract of *Sida acuta* possesses remarkable insecticidal activity against *Dysdercus cingulatus.* $LD_{10=}$2.671µg/gm., LD_{50}=6.165µg/gm., LD_{90}=13.25µg/gm., LD_{99}=14.32µg/mg. in ethyl acetate and LD_{10}=3.741µg/gm., LD_{50}=9.690µg/gm., LD_{90}=13.38µg/gm., LD_{99}=14.15µg/mg. in methanol were observed. The study needs further investigation to find out active ingredients responsible for insecticidal properties against cotton pest and to reach any final recommendations.

Conclusion

The results of the study have confirmed that the *Sida acuta* have explored the potential of biopesticide and crop protecting activity against cotton pest.

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