Bioefficacy of some botanicals against the sugarcane woolly aphid, *Ceratovacuna lanigera* Zehnter

D. S. Patil and N. S. Chavan (Mulik)

ABSTRACT

*Ceratovacuna lanigera* Zehnter is a serious pest of sugarcane in many parts of India including Maharashtra and Karnataka. In the light of recent increased interest in developing plant based secondary chemistry into products suitable for integrated pest management, the objective of the present study was to investigate the impact of *Acacia concianna*, *Acorus calamus*, *Momordica charantia*, and *Annona squamosa* on *Ceratovacuna lanigera* Zehnter under *in vitro* and *in vivo* conditions. Among the tested plants, *A. concianna* was found to be more effective than other plants. Two rounds of applications of four botanicals along with control were made and the incidence of aphid (*Ceratovacuna lanigera* Zehnter) on sugarcane was recorded. The results indicated that C.I. mortality was concentrations and exposure time dependent one. Among the four botanicals *Acacia concianna* was the most toxic botanical under laboratory condition. Similar impact was also recorded under field condition too.

Key words: Botanicals, *Ceratovacuna lanigera* Zehnter, % mortality, *Acacia concianna*.

INTRODUCTION

Exploration of botanical pesticides in agricultural pest management is urgent need of the era for the sustainable agriculture development. Over 250 species of the superfamily Aphidoidea feed on agricultural and horticultural crops throughout the world. Sugarcane woolly aphid *Ceratovacuna lanigera* Zehnter (Rabindra et al., 2002; Joshi et al., 2004) caused crop loss in many part of India, particularly in Sangali, Kolhapur, Pune, and Solapur districts. A total 15.5 % area under sugarcane got infested with the highest infestation in Sangali, followed by Kolhapur was recorded during 2002. Continuous infestation leads to the reduction in length, circumference, weight and sugar content of stalk leading to loss in tonnages as well as sugar recovery. It collapsed total sugarcane industry which is major part of co-operative area, beneficial economy of the area.

The aphid control measures have largely been depending on the use of chemical pesticides including chlorinated hydrocarbons, organophosphates, carbamates, endosulphon, dimethoate, malathion etc. (Joshi et al., 2004) which besides causing resistant development in the target population (Han and Li, 2004) affect adversely the natural enemies of aphids in the field (Jansen, 2000). In addition, increasing documentation of negative environmental and health impact of synthetic insecticides and increasingly stringent environmental regulation of pesticides (Isman, 2000) have resulted in renewed interest in the development and use of botanical pest management products for controlling aphid pest. Many plant extracts have been reported bioactive against *A. craccivora* and other related species (Tewary et al., 2005; Tewary et al., 2006). Natural enemies like naturally occurring entomopathogenic fungi have been tested against this SWA (Mehetre et al., 2008). However no information was available about the botanical for sugarcane aphid management. In the present investigation an attempt was made to screen extracts of four locally available plants such as *Acacia concianna* (pods), *Acorus calamus* (rhizome), *Momordica charantia* (fruits), *Annona squamosa* (seeds) under *in vitro* and *in vivo* conditions.

MATERIALS AND METHOD

Plants were collected from Western Ghats and also from local cultivars, washed with tap water and distilled water, dried at 60°C and powdered using domestic blender. Plant powder was extracted with ethanol in soxhelet apparatus. Trace of crude extract was used for the insecticidal activity evaluation. Various concentrations (2, 2.5, 10 and 25 %) of the extracts were prepared in water.
Nymphs and adults of aphids were collected from infested sugarcane fields and reared in the laboratory with its natural host. Insects are obtained from established colony maintained for many generations in the laboratory. Test botanicals in four concentrations each were suspended in distilled water were sprayed separately using hand sprayer on the host plants. In the control set, the host plants were sprayed with distilled water. All the treatments were carried out in triplicates. All treated insects on plants were maintained in the laboratory and mortality was determined 24 and 48 h after the spray of test samples on aphid infested plants. Test insects were considered dead if appendages did not respond after being touched with a camel hairbrush. Data from all bioassays were corrected for control mortality using Abbott formula (Abbott, 1925). LC50 values were determined using Pedigo (2002).

In another experiment, the bioefficacy of the botanicals were carried out in the polythene caged field with plot size of 25 x 50 m and spacing of 100 cm. Each treatment was replicated thrice and compared with untreated check. Two rounds of application of above said treatments were given on sugarcane crop. Before the treatment, 11 infested leaves of sugarcane marked and count the number of aphid, expressed number of insects per sq cm long of the mid ribs. Number of insects per leaf was about 56 to 91. Plant extract (25 %) was sprayed in the sugarcane after 131 days after the transplantation using five liter capacity KASS pressure sprayer. The percentage mortality of aphid was recorded 24, 48, 72 and 96 hours after the botanicals sprayed.

RESULT AND DISCUSSION

It has been well recognized that plant based secondary chemistry could be developed into products suitable for integrated pest management because many of them are selective to pests, have no or few harmful effects on non-target organisms and the environment, act in many ways on various types of pest complex, and may be applied to the plant in the same way as other chemical pesticides. In vitro screening of SWA shows that maximum percent mortality was caused by A. concinna followed by A. calamus, M. charantia and A. squamosa (Table 1). LC50 values for 48 hrs reveals that maximum toxicity was recorded in A. concinna followed by Momordica charantia, Acorus calamus and Annona squamosa. Both LC30 and LC90 values also in agreement with the LC50 value. Field experiment on smaller scale within polythene cages helped in recording toxic-range for various concentrations. Observations recorded in table-2 depicts % mortality in vivo at smaller scale as 97.5%, 80.75%, 78.56% and 30.11% for Acorus concinna, Acorus calamus, Momordica charantia and Annona squamosa respectively. Figure 1 gave graphical presentation of sampling at larger scale showing 75.81 % mortality at 25% concentration, 63.36 % mortality at 10 % concentration, 38.84 % at 2.5 %, 20.86 % at 2% concentration of Acorus calamus after 48 hours. Acacia concinna gave 94.48% mortality at 25 % concentration of extract, 80.27% mortality on various types of pest complex, and may be applied to the plant in the same way as other chemical pesticides. In vitro screening of SWA shows that maximum percent mortality was caused by A. concinna followed by A. calamus, M. charantia and A. squamosa (Table 1).

Table 1. Toxic effect of chosen plants (25% concentration) on sugarcane woolly aphids (in 2.5 cm length along midrib) under in-vitro condition.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>1st Spray</th>
<th>2nd Spray</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 hrs</td>
<td>48 hrs</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Acorus calamus</td>
<td>47.83</td>
<td>56.42</td>
</tr>
<tr>
<td>Acacia concinna</td>
<td>60.87</td>
<td>69.57</td>
</tr>
<tr>
<td>Momordica charantia</td>
<td>45.65</td>
<td>58.70</td>
</tr>
<tr>
<td>Annona squamosa</td>
<td>26.09</td>
<td>30.43</td>
</tr>
</tbody>
</table>

Table 2. Impact of plant extracts on the LC50 parameters of C. lanigera.

<table>
<thead>
<tr>
<th>Plants</th>
<th>Lethal concentrations</th>
<th>Table $\chi^2$</th>
<th>Calculated $\chi^2$</th>
<th>Regression Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LC$_{50}$</td>
<td>LC$_{90}$</td>
<td>LC$_{99}$</td>
<td></td>
</tr>
<tr>
<td>Acorus calamus</td>
<td>0.2024</td>
<td>0.2310</td>
<td>0.2638</td>
<td>7.8147</td>
</tr>
<tr>
<td>Acacia concinna</td>
<td>0.1624</td>
<td>0.1934</td>
<td>0.2304</td>
<td>7.8147</td>
</tr>
<tr>
<td>Momordica charantia</td>
<td>0.1803</td>
<td>0.2093</td>
<td>0.2430</td>
<td>7.8147</td>
</tr>
<tr>
<td>Annona squamosa</td>
<td>0.1867</td>
<td>0.4238</td>
<td>0.9619</td>
<td>7.8147</td>
</tr>
</tbody>
</table>
for 10% concentration, 51.14 to 2.5%, 41.83% to 2% concentration. Thus it proves best to control the pest. *Momordica charantia* gave 76.05% mortality at 25% concentration of extract, 73.23% at 10%, 69.18% at 2.5% and 21.11% to 2% concentration of extract. *Annona squamosa* gave comparatively poor result to control pest as 26.67% for 25% concentration, 22.71% for 10%, 19.95% for 2.5% and 16.79% for 2% concentration after 48 hrs.

The emulsifiable concentrate UDA-245 based on an essential oil extract from *Chenopodium ambrosioides* variety near *ambrosioides*, a North American herbaceous plant, was compared with commercially available pesticides for their effectiveness to control green peach aphid, *Myzus persicae* (Sulzer) (Homoptera: Aphididae), western flower thrips, *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae), and greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood) (Homoptera: Aleyrodidae) (Chiasson et al., 2004).

Field studies reveal that aphid’s mortality was gradually increased from 24 hrs to 92 hrs. As observed in the laboratory bioassay, field experiment confirms the in-vitro experiments. Among the four plants maximum mortality was recorded in *A. concianna* followed by *M. charantia, A. calamus* and *A. squamosa* (Figure 1). In the light of the above considerations and our results, *Acacia concianna* appear to be promising botanical insecticide against *Ceratovacuna lanigera* Zehntner and may hold potential for identification of new lead structures. As they are naturally obtained compounds, organic farmers could use them but they also could be used in association with organic synthetic pesticides in insecticide soaps. Their incorporation within insecticidal formulations could increase the number of biochemical targets in the insects, limiting prospect for the onset of resistance and offering the prospect of reducing pesticide dose (Regnault-Roger et al., 2004). Further investigations are necessary in regard to evaluating the bioactivity against other economically important insects like *Spodoptera litura, Plutella xylostella* and *Helicoverpa armigera* and developing various formulations with enhanced activity.

REFERENCES


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