Journal of Biopesticides, 2(1): 44-47 (2009)

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 recoded 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 form 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). LC_{50} 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 per cent mortality was caused by *A. concinna* followed by *A. calamus* , *M. charantia* and *A. squamosa* (Table 1).

LC_{50} values for 48 hrs reveals that maximum toxicity was recorded in *A. concinna* followed by *Momordica charantia. Acorus calamus* and *Annona squamosa* (Table 2). Both LC_{30} and LC_{90} values also in agreement with the LC_{50} 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 *Acacia concianna, 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 concianna* gave 94.48% mortality at 25 % concentration of extract, 80.27% mortality

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

Treatments	Mortality (in % after)			
	1st Spray		2nd Spray	
	24 hrs	48 hrs	24 hrs	48 hrs
Control	0	0	0	0
Acorus calamus	47.83	56.42	60.57	76.09
Acacia concianna	60.87	69.57	93.48	95.65
Momordica charantia	45.65	58.70	65.22	69.57
Annona squamosa	26.09	30.43	34.78	43.48

Table 2. Impact of plant extracts on the LC_{50} parameters of *C. lanigera*

Plants	Lethal concentrations			Table χ^2	Calculated χ^2	Regression Equation
	LC_{30}	LC_{50}	LC_{90}			
Acorus calamus	0.2024	0.2310	0.2638	7.8147	0.0939	Y = -12.0203 + 7.2004 X
Acacia concianna	0.1624	0.1934	0.2304	7.8147	0.1436	Y = -9.3348 + 6.2690 X
Momordica charantia	0.1803	0.2093	0.2430	7.8147	3.7067	Y = -10.2104 + 6.5534 X
Annona squamosa	0.1867	0.4238	0.9619	7.8147	0.1356	Y = -3.5308 + 3.2470 x

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 ambrosioi des* 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 vaporariorium* (Westwood) (Homoptera: Aleyrodidae) (Chiasson *et al*., 2004).

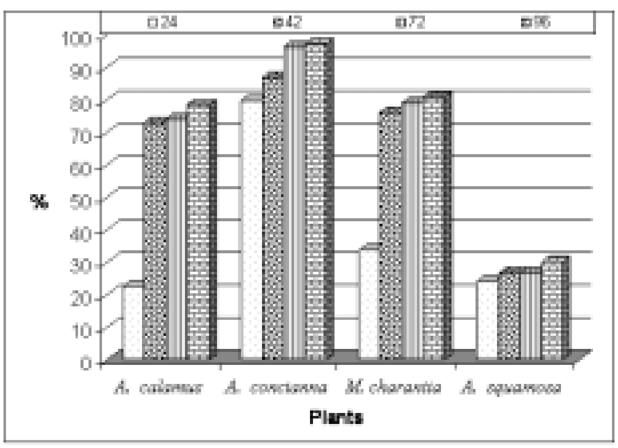

Figure 1. Toxic effect of botanicals (in 25% concentration) on SWA population under polythene cage conditions at different exposence period.

Field studies reveal that aphid's mortality was gradually increased from 24 hurs 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* Zehnter 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

Abott W.S. 1925. A method of computing the effectiveness of insecticide. *Journal of Ecology and Environment*, **18:** 265-267.

Chiasson, H., Vincent, C. and Bostanian, N. J. 2004. Insecticidal Properties of a *Chenopodium*-Based Botanical. *Journal of Economic Entomology*, **97**(4):1378-1383.

Jansen, J.P. 2000. A 3-year field study on the short-term effects of insecticides used to control cereal aphids on plant-dwelling predators in winter wheat. *Pest Manage Sciences*, **56**: 533–539.

Joshi, Sunil and Virklamath, C. A. 2004. The Sugarcane Woolly Aphid, Cautuvainna lanigera, Zehntner (Hemiptera : Aphidae) its biology, pest status and control, *Current Science*, **87** (3): 35-39.

Han, Z. and Li, F. 2004. Mutations in acetyl-cholinesterase associated with insecticide resistance in the cotton aphid, *Aphis gossypii* Glover. *Insect Biochemistry and Molecular Biology*, **34**: 397–405.

Isman, M.B.(2000) Plant essential oils for pest and disease management. *Crop Protect*, **19**:603–608

Mehetre, S., Mukherjee, P. and Kale, S. 2008. Natural occurrence of Gibberella fujikuroi and its potential for control of the woolly aphid *Ceratovacuna lanigera* (Homoptera: Aphididae) in Indian sugarcane plantations. *Biocontrol Science and Technology*, **18** (2) : 215-220.

Pedigo P. Larry, 2002. Entomology and Pest Management, 4th edition . 246-247 **PP**.

Rabindra, R.J., Mohanraj P., Poorani J., Jalali, S.K. Joshi, S.S. and Ramani, S. 2002. *Ceratovacuna lannigera* Zehnter (Momoptera: Aphididae) a serious pest of sugarcane in Maharashtra. *Journal of Biological Control*, **16**: 171-172..

Rechigl, Jack E. and Nancy Rechigl. 1999.Biological and biotechnological control of insect pests.

Regnault-Roger C, Ribodeau M, Hamraoui A, Bareau I, Blanchard P, Gil-Munoz, M. and Barberan, F. T. 2004. Poloyphenolic compounds of mediterranean Lamiaceae and investigation of orientational effects on *Acanthoscelides obtectus* (Say). *Journal of Stored Product Research*, **40**:395–408

Tewary, D.K., Bhardwaj A, Shanker A 2005. Pesticidal activities in five medicinal plants collected from mid hills of western Himalayas. *Indian Crops Production*, **22**(3):241–247

Tewary, D. K., Anu Bhardwaj, Anuj Sharma, Arun Kumar Sinha and Adarsh Shanker. 2006. Bioactivity and structure–activity relationship of natural methoxylated phenylpropenes and their derivatives against *Aphis craccivora* Koch (Hemiptera: Aphididae). *Journal of Pest Control,* 10.1007/s10340-006-0135-8.

Dhanashri Sagar Patil*[1] and N. S. Chavan (Mulik),
[1]Department of Botany, G.K.G College, Kolhapur, India.
[2]Department of Botany, Shivaji University, Kolhapur,
Email: niranjanac_2006 @yahoo.com
*Communication author E-mail: dspbotany_23@ yahoo. com.