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Studies on the biosafety of botanical insecticides to native natural enemies of mulberry ecosystem

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A B S T R A C T

Laboratory studies were made to compare the toxicity of botanical insecticides viz. Neem oil, Pongamia oil and Nicotine extract in different conc./combinations along with dimethoate and dichlorvos on four coccinellid bio-control agents (*Micraspis crocea, Micraspis discolor, Brumus suturalis* and *Scymnus bourdilloni*). All botanicals tested showed least mortality and was on par with unsprayed control. Dimethoate (0.1%) was highly toxic causing 100% mortality. Whereas, dichlorvos (0.1%) was least toxic in comparison to dimethoate. Botanical insecticides tested in different conc./combinations are compatible with natural enemies and may be incorporated in IPM in mulberry ecosystem.

Introduction

Effective pest management remains as essential part in agricultural production system and it generally involves use of insecticides in combination with natural enemies as parasitoids, predators, and pathogens as use of one component is not always sufficient to manage insect pest population. While using biological agents for control of whitefly desired levels have not been attended, probably intensive use of insecticide adversely affected natural enemies (Oliveira *et al*. 2001). As a result investigations were made to use biorational compounds along with natural enemies as these insecticides are considered to be less harmful to natural enemies compared to conventional insecticides (Clyod 2005). Several studies have been conducted to evaluate compatibility of biorational compounds with predatory insects like green lacewing (*Chrysoperla carnea*), and Lady bird beetles under lab conditions, which indicated that there was no harmful effect and probably those will not be detrimental when used in field or green house conditions (Mazzone & Viggiani 1980; Kismal & Earkin 1984; Smith & Papacek 1990)). Naranjo (2001) evaluated the impact of various pesticides on whitefly predators and parasitoids to develop strategies for conversation of natural enemies.

Mulberry (*Morus* spp.), the sole food plant of silkworm (*Bombyx mori* L.) is grown over 1.92 lakh ha. in India, constitute the basic input of sericulture industry. A wide array of insect pests feed on mulberry and cause damage, of which thrips, mealy bug and whiteflies are major, and are responsible for about 11-24% leaf yield loss in eastern India (Mukhopadhyay 2006). Different concentrations of botanicals were reported effective in suppression of thrips and whitefly in mulberry (Mukhopadhyay *et al.* 2006; 2008). Several natural enemies were recorded from mulberry agro-ecosystem

(Bandyopadhyay & Santha Kumar 2007). Of which at least four bio-control agents like *Micraspis crocea, Micraspis discolor, Brumus suturalis* and *Scymnus bourdilloni* were found effective based on feeding potential and recommended for release to suppress pest population (Santha Kumar *et al.* 1997; 2000). Bio-control agents do not eliminate pest population but they sometimes establish equilibrium with insect population that is below damage thresholds (Prabhaker *et al.* 2007). Thus pesticide intervention is often needed to reduce economic damage. Insecticides used to suppress pests can disrupt the effectiveness of beneficial bio-control agents. Improved understanding of pest, natural enemies and biorational insecticides interaction will help in formulation of more effective IPM in mulberry.

We have conducted bioassay to test the compatibility of different concentration /combinations of botanical insecticides with bio-control agents of mulberry agro-ecosystem to recommend the compatible biorational insecticides for conservation of bio-control agents.

Materials and Methods

Organisms tested: Grub and pupa of bio-control agents were collected from the field and grubs were kept on mealy bug infested pumpkins. Adults, thus emerged were kept at 27 ± 1^{0}C temp. and 16:8 hrs. photoperiod for acclimatization. Three day old adults of *Micraspis crocea, Micraspis discolor, Brumus suturalis* and *Scymnus bourdilloni* were taken for the study.

Botanical insecticides tested

Nine different conc./combinations of three botanicals viz. 1.0% Neem oil, 2.0% Neem oil, 1.5% Pongamia oil, 2.0% Pongamia oil, 1.0% Nicotine extract, 2.0% Nicotine extract, 1.0%(Nicotine extract + Pongamia oil 1: 1), 1.0% (Neem oil+ Pongamia oil 1:1) and 1.0% (Neem oil + Pongamia oil 10:1), those found effective in controlling mulberry pests with two chemical pesticides, 0.1% dimethoate, 0.1% dichlorvos and an unsprayed control.

Bioassay techniques

Botanical pesticides in different concentration /combinations were sprayed on mulberry leaves. Four to six leaves from each treated plant were taken in Petri plates (12 cm.) containing a piece of moist filter paper with medium porosity. Ten adult beetles (3 day-old) were exposed to the treated leaf surface and covered. Beetles were fed with 50% honey solution during the study period. Observation was made after 24 hrs (Mani & Thontadarya 1988). All the treatments were replicated thrice and experiment repeated thrice.

Results and Discussion

Among the different conc./combination of botanicals tested it was found that all botanical insecticides are safe to natural enemies like predators when exposed after 4 hrs. of spray, having minimal mortality and on par with the control. Between the two treatments with chemical insecticides, exposure to 0.1% dimethoate (30%EC) treated leaves causes 100% mortality and exposure to 0.1% dichlorvos (76%EC) treated leaves has minimal effect to the predators (Table 1).

Table 1.
Survival (%) of the native natural enemies (days) with botanical insecticides

Treatments	*M. discolor*	*B. suturalis*	*S. bourdilloni*	*M. crocea*
1.5% Pongamia oil	19.66	27.66	19.66	28.33
2.0% Pongamia oil	11.33	16.66	19.66	27.66
1.0% Neem oil	11.33	15.33	20.66	24.66
2.0% Neem oil	9.66	10.33	15.00	15.00
1.0% Nicotine extract	9.66	10.00	14.33	16.00
2.0% Nicotine extract	9.66	9.66	14.33	16.66
1.0% (Nicotine ex+ Pongamia oil 1:1)	17.33	23.33	18.33	25.00
1.0% (Neem oil+ Pongamia oil 1:1)	17.66	22.66	16.66	24.66
1.0% (Neem oil+ Pongamia oil 10:1)	16.66	17.33	15.66	21.33
Dimethoate (0.1%)	1.00	1.00	0.33	0.66
Dichlorvos (0.1%)	9.33	27.66	15.33	16.33
Control	22.33	32.00	22.00	33.66
CD (P=0.01)	1.25	2.94	1.30	1.52

These finding are in conformity with that of Mani & Thontadarya (1988), where exposure of *Cryptolaemus montrouzieri* to dimethoate (0.06%) caused 90% mortality of adults and 0.02% dichlorvos has shown no toxicity to larvae, pupa and adults.

While exposure of beetles to different concentration/ combinations of botanicals showed minimal mortality. It is in agreement with the studies with Banken & Stark (1998) where commercial formulation containing Azadiracthin has not caused mortality to *Coccinella septempunctata* but there was reduction in oviposition and significantly delayed larval development because of presence of potent IGR in Azadiracthin. Sontakke (1993) has also reported that Neem products are safer to parasites and predators in rice ecosystem that corroborates with the study. Clyod and Dickinson (2006) has studied the effect of biorational insecticides on *C. montrouzieri* and *Leptomastix dactyolopi* and found that neither nicotinoids nor IGR's like brufezin and pyriprofexin have any detrimental effect which confirms our findings. Moreover, Mukhopadhyay *et al.* (2008; 2009) has reported that when silkworms were fed with certain botanical sprayed leaves after observing waiting period there was no impact on the economic parameter of the cocoons.

Based on the results of the study mulberry growers may use botanical insecticides *viz.* 1.0% Neem oil, 2.0% Neem oil 1.5% Pongamia oil, 2.0% Pongamia oil, 1.0% Nicotine extract, 2.0% Nicotine extract, 1.0% (Nicotine extract + Pongamia oil 1: 1), 1.0% (Neem oil+ Pongamia oil 1:1) and 1.0% (Neem oil + Pongamia oil 10:1) with the release of natural enemies without forfeiting efficacy because of mortality and these may lead to conservation of natural enemies and sprayed leaves can safely be fed to silkworm after observing certain waiting period.

Literature Cited

Bandyopadhyay UK Santha Kumar MV. 2007 Record of natural enemies of mulberry whitefly *Dialueropora* *decempuncta* and *Alleuroclava pentatuberculata* (Homoptera : Aleyroididae), West Bengal. Insect *Environment* **13**(2): 62-63.

Banken JA Stark JD. 1998 Multiple routes of pesticide exposure and the risk of pesticides to biological controls a study of Neem and seven spotted lady beetle (Coleoptera: Coccinellidae). *Journal of Economic Entomology* **91**: 1-6.

Cloyd R. 2005 Compatibility, conflict: in the use of biological control agents with pesticides a viable management strategy?. In *Proceedings of the International symposium on biological control of arthropods.* US Department of Agriculture & Forest Service, publication FHTEL-2005-08, Vol. II. pp. 546-54

Cloyd AR Dickinson A. 2006 Effect of insecticides on mealy bug destroyer (Coleoptera: Coccinellidae) and parasitoids *Leptomastix dactylopi* (Hymenoptera: Encyrtidae), natural enemies of Citrus mealy bug (Homoptera: Pseudococcidae). *Journal of Economic Entomology* **99**(5): 1596 - 604.

Kismali S Earkin A. 1984 Effect of Juvenile hormone analogue of the development of some useful insects and effects of egg hatch in *Coccinella septemunctata* L. Turkyo.Bulki Koruma Dorgisi. **8**:99-04.

Mani M Thontadarya TS. 1988 Response of *Cryptolaemus moutrouzieri* Muls. (Coleoptera: Coccinellidae) to commonly used pesticides in vineyard. *Journal Biological Control* **2**(1): 17-18.

Mazzone P Viggiani G.1980 Effects of diflubenzuron (dimilin) on the larval stages of the predator *Cryptolaemus montrouzieri* (Coleoptera: Coccinellidae). *Bulletin of Entomology Agraria "filipoppo silvestry," Portici.* **37**:17-21.

Mukhopadhyay SK. 2006 Technologies for management of mulberry pests. In *Proceedings of Workshop on Appropriate Technology for Mulberry Sericulture in the Eastern and North Eastern India,* 17th -18th January 2006 at Central Sericultural Research and Training Institute, Berhampore, India, pp.136-39.

Mukhopadhyay SK. Santha Kumar M V Das SK. 2006 Management of thrips, *Pseudodendrothrips mori* (Niwa) in mulberry through botanicals. In *Proceedings of Workshop on Appropriate technologies for mulberry sericulture in eastern and north eastern India* held at Berhampore on 17-18 January, 2006:pp148-51

Mukhopadhyay SK Santha Kumar MV Mitra P Das SK Bajpai AK. 2008 Botanical mediated control of whitefly in mulberry *(Morus alba* L.) and their impact on leaf yield and silkworm rearing pp 233-38, In *Insect Pest Management & Environment* Safety, Sup.4. Vol.-I (Ed SC Goel) Uttar Pradesh Zoological Society, Muzaffarnagar, India.

Mukhopadhyay SK Santha Kumar MV Mitra P Das SK Bajpai AK. 2009 Studies on the residual effect of botanical pesticides on silkworm *(Bombyx mori* L) and its economic characters pp 171-80, In *Mulberry Sericulture: Problems & Prospects* (Eds. Jaiswal, Tribedi, Pandey & Tripathi) APH Publishing Corporation, New Delhi, India.

Naranjo SE. 2001 Conservation and evaluation of natural enemies in IPM Systems for *Bemisia tabaci. Crop Protection* **20**: 835-52.

Oliveira MRV Henneberry TJ Andesrson PK. 2001 History, current status and collaborative research projects for *Bemisia tabaci. Crop Protection* **20**:709-23.

Prabhaker N Morse JG Castle FJ Naranjo SE Henneberry TJ Toscano NC. 2007 Toxicity of seven foliar insecticides to four insect parasitoids attacking citrus and cotton pests. *Journal of Economic Entomology* **100**(4): 1053-61.

Santha Kumar MV Chakraborty N Gupta SK Bandyopadhyay UK Raina SK. 1997 Studies on the biology of *Scymnus bourdilloni* Kapur (Coleoptera: Coccinellidae), the native predator of pink mealy bug, *Maconellicoccus hirsutus* (Green) (Hemiptera: Psudococcidae). In *International Symposium on Tropical Crop Research and Development, India,* held on 9-12th September, 1997 at Kerala Agricultural University, Pattambi, Thrissur, Kerala, p. 45.

Santha Kumar MV Bandyopadhyay UK Das KK Chakraborty N Saratchandra B. 2000 Assessment of optimum number of natural enemies required per unit area of mulberry plantation for the biological control of mealy bug. In *Regional*

Seminar on Environment and Agro-based Activities on 22nd-23rd April 2000 at Institute of Agriculture, Visva Bharati, Sriniketan, Birbhum, West Bengal, p.32.

Smith D Papacek DF. 1992 Buprofezin: an effective and selective IGR against *Unaspis citri* (Hemiptera: Diaspididae) on citrus on southeast Queensland. *General Applied Entomology* **22**: 25-28.

Smith SF Krischik VA. 2000 Effects of botanical pesticides on four Coccinellid species (Coleoptera: Coccinellidae) having potential as biological control agents in interior scapes. *Journal of Economic Entomology* **99**(3): 732-36.

Sontakee BK. 1993 Field efficacy of insecticides and in combination with neem oil against insect pests and their predators in rice. *Indian Journal of Entomology* **55**(3): 260-66.