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Selectivity of certain biorational insecticides against chrysopid (*Mallada boninensis*) and coccinellid (*Serangium parcesetosum*) predators*

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Citrus spp are attacked by more than 250 insects in India (Srivastava and Butani 1999) right from nursery to harvesting stage. However, the major insect pests are citrus blackfly (*Aleurocanthus woglumi* Ashby) (Hemiptera : Aleurodidae), psylla *Diaphoriana citri* Kuwayama (Hemiptera : Psyllidae) and leaf-miner, (*Phyllocnistis citrella* Stainton) (Lepidoptera : Gracillaridae). Among the various strategies adopted to combat these pests, use of biorational insecticides fits well in to the umbrella of bio-intensive integrated pest management in citrus. On these lines, Rao *et al.* 2008, Rao and Shivankar, 2011 reported that the choicest bio-rational insecticides in their order of toxicity to blackfly are - abamectin > spinosad > novaluron ; to psylla : spinosad > abamectin > novaluron and to leaf miner : abamectin > spinosad > novaluron > *Bt* which have LD_{50} values less than dimethoate. Further, extracts of greater galangal [*Alpinia galanga* (L.) Willd], sweet flag (*Acorus calamus* L.), safed kanher (*Nerium odorum* Soland), nirgundi (*Vitex negundo* L.) and neem (*Azadirachta indica* A. Juss) @ 1% were reported effective against nymphs of citrus psylla (NRCC 2002). Among the predominant bioagents of citrus insect pests, a chrysopid predator (*Mallada boninensis*) Okamoto (Neuroptera: Chrysopidae) is found in abundance (3.5 predators/tree) feeding on several soft bodied insect pests of citrus like blackfly, psylla, leaf miner, aphids, mealy bugs, etc. Similarly, *Serangium parcesetosum* Sicard (Coleoptera: Coccinellidae) also found to feed on nymphs of citrus blackfly. The bioagents, *M. boninensis* and *S. parcesetosum* are more active in *ambia* season (spring flush) in citrus orchards of central India (Shivankar *et al.* 2002). Some studies on selectivity of few biopesticides against *M. boninesis* were conducted earlier at National Research Centre for Citrus, Nagpur, which showed encouraging results. However, detailed studies on the selectivity of bio-rational insecticides against the chrysopid (*M. boninensis*) and coccinellid (*S. parcesetosum*) are lacking. Keeping this in view, a study was conducted to assess the selectivity of nine biorational insecticides to *M. boninensis* and *S. parcesetosum*.

Laboratory experiments were conducted during 2007 and 2008 at National Research Centre for Citrus, Nagpur using bio-rational insecticides, viz spinosad, abamectin, novaluron, petroleum spray oil, neem oil, azadirachtin, sweet flag, *Bacillus thuringiensis*, *Verticillium lecanii* and dimethoate (as standard) against *M. boninensis* and *S. parcesetosum,* respectively (Tables 1, 2). Commercially available biorational insecticides were used for the experiment. In case of sweet flag, *Acorus calamus* shade-dried rhizomes were extracted in ethanol and 1% stock solution was prepared from the extract obtained. The experiments were laid out in completely randomized block design and each treatment was replicated six times.

The chrysopid, *M. boninensis* was reared on the frozen eggs of rice grain moth *(Corcyra cephalonica* Stainton) as described by Shivankar (1997). Laboratory-reared *M. boninensis* eggs, larvae and adults were used as test insects. The experiments were conducted at 25° ± 2°C and 60 ± 5% relative humidity.

To assess the effect of biorational insecticides on the eggs of *M. boninensis* was studied to work out their ovicidal action. The eggs along with stalk collected on black paper strips were sprayed with each biorational insecticide using a hand sprayer. Each treatment was replicated six times with 50-eggs/replication. Untreated check was maintained by spraying distilled water. The number of grubs hatched from each treatment was recorded and per cent hatching was worked out.

In larval feeding method, eggs of *C. cephalonica* were refrigerated to inactivate the embryos and then sprayed with each of these nine biorational insecticides using Potter's Tower. The eggs were dried under air for 10 min. and transferred to Petri-plates (13 cm diameter). For control, the eggs were sprayed with distilled water. First-instar grubs of *M. boninensis* were transferred to these Petri-plates with

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folded papers (to avoid cannibalism) @ 5 grubs/Petri-plate. In each Petri-plate 100 treated eggs were kept and allowed to be fed upon by *M. boninensis* larvae. After completing the feeding on treated eggs the grubs were provided with untreated eggs of *C. cephalonica* until pupation. Observations were recorded on the larval mortality, pupation and adult emergence.

In adult feeding method, five pairs of *M. boninensis* adults were released in oviposition chamber and were provided with a diet consisting of protinex 40 g + fructose 70 g in 250 ml water (Shivankar 1997) treated with different bio-rational insecticides while in an untreated check, the adults were fed with the standard adult diet alone. The eggs laid in each treatment were collected daily from citrus twig (provided in the chamber) and black paper placed along the inner side of the plastic container (21 cm × 9 cm). Observations were recorded on the adult longevity and number of eggs laid.

Various stages (grubs and pupae) of *S. parcesetosum* from blackfly infested twigs were collected from citrus blackfly infested Nagpur mandarin (*Citrus reticulata* Blanco) orchards during *ambia* (January – February) 2008 and were kept in incubator (BOD) at 25°C temperature and 60% relative humidity. On emergence the adults were provided with nymphs of blackfly as diet. They were allowed to lay the eggs on blackfly infested citrus twigs kept in a conical flask (25 ml capacity) with its cut end dipped in water secured in a plastic jar (21 cm × 9.5 cm). On hatching the larvae were used for the experimental purpose. These twigs with *S. parcesetosum* were kept in Petri-plates and were treated with each biorational insecticide using Potter's Tower which were then shade dried for 10 min. and were kept in incubator (BOD) at 25°+ 2°C temperature and 65 + 5% RH. The treated larvae were provided with nymphs of blackfly, collected from untreated field, until pupation. Observations were recorded on the larval mortality, pupation and adult emergence.

The egg hatchability of *M. boninensis* was significantly low in neem oil and petroleum oil (53.8–54.5%) and high in *A. calamus, V. lecanii* and *B. thurigiensis* (92.7–94.0%) which was at par with Control (96.5%) (Table 1). Probably the neem oil and petroleum oil filled the pores present on the egg chorion, thereby resulted in low egg hatching.

All the biorational insecticides tested caused larval mortality in *M. boninensis*. Among the biorational insecticides, *A. calamus* recorded significantly low larval mortality (25.8%), whereas spinosad @ 0.49 ml/l and

Table 1 Effect of biorational insecticides on eggs, larvae and adults of *Mallada boninensis*

Biorational insecticides	Egg hatchability (%)	Larval mortality (%)	Pupation (%)	Adult emergence (%)	Adult longevity (days)	Fecundity (eggs/female)
Spinosad 45 SC @ 0.49 ml/l	75.1 (60.07)[de]	85.2 (67.37[a]	62.5 (52.24)[de]	56.8 (48.91)[de]	25.2[f]	59.5[g]
Abamectin 1.9 EC @ 0.42 ml/l	79.6 (63.15)[cd]	82.5 (65.27[a]	63.7 (52.95)[de]	54.2 (47.41)[e]	25.1[f]	55.7[g]
Novaluron 10 EC @ 0.87 ml/l	78.1 (62.10)[de]	70.4 (57.04)[bc]	50.4 (45.23)[f]	45.4 (42.36)[f]	24.6[f]	58.1[g]
Petrolium spray oil @ 3.72 ml/l	53.8 (47.18)[f]	62.7 (52.36)[c]	70.1 (56.85)[cd]	61 (51.35)[de]	32.1[de]	94.4[e]
Neem oil @ 6.87 ml/l	54.5 (47.58)[f]	67.6 (55.30)[bc]	72 (58.05)[c]	64.1 (53.19)[d]	33.7[d]	92.8[e]
Azadirachtin 10,00 PPM @ 3.65 ml/l	87.2 (69.04)[bc]	52 (46.15)[d]	60.2 (50.89)[e]	61.6 (51.71)[de]	35.9[cd]	89.6[e]
Sweet flag, *Acorus calamus* extract @ 3.4%	94 (75.82)[a]	25.8 (30.53)[f]	90.9 (72.44)[a]	82.4 (65.20)[ab]	40.5[ab]	127.2[b]
Bacillus thuringiensis @ 4.14 g/l	92.7 (74.32)[ab]	37.5 (37.76)[e]	75.6 (60.40)[bc]	74.3 (59.54)[c]	39.3[bc]	120.7[c]
Verticillium lecanii @ 6.17 g/l	93.4 (75.11)[a]	35.2 (36.39)[e]	79.3 (62.94)[b]	76.5 (61.00)[bc]	38.9[bc]	115.2[d]
Dimethoate 30 EC @ 0.05%	70.9 (56.85)[e]	74.3 (59.54)[b]	69.8 (56.66)[cd]	59.8 (50.65)[de]	29.4[e]	64.9[f]
Control	96.5 (79.22)[a]	6.4 (14.65)[g]	92.4 (74.00)[a]	87.2 (69.04)[a]	45.2[a]	140.4[a]
SED±	2.874	2.608	2.314	2.416	1.977	2.073
CD (*P* = 0.05)	5.96	5.41	4.8	5.01	4.1	4.3

Figures in parentheses are arcsine-transformed values.

Values followed by same letter in a column are not significantly different (*P*=0.05) abamectin @ 0.42 ml/l recorded significantly high larval mortality (82.5–85.2%). There was significant difference in the number of larvae pupated except in sweet flag, *A. calamus.* The highest pupation was observed in untreated check (92.4%), followed by *A. calamus* (90.9%) and the lowest in novaluron (50.4%). Among the biorationals, *A. calamus* recorded significantly more % adult emergence (82.4%) than other biorational insecticides, the highest being in untreated check (87.2%) (Table 1).

Adult longevity of *M. boninensis* was 45.2 days in untreated check, while it ranged from 24.6 days in novaluron to 40.5 days in *A. calamus.* Significantly higher egg laying was recorded in untreated check (140.4 eggs/female), followed by *A. calamus* (127.2 eggs/female) (Table 1).

All the biorational insecticides tested caused larval mortality in *S. parcesetosum* (Table 2). Among the biorational insecticides, larval mortality was significantly low in case of *A. calamus* @ 3.4% (19.1%), whereas it was significantly more in case of spinosad @ 0.49 ml/L (87.5%) and abamectin @ 0.42 ml/L (84.3%). The lowest pupation was observed in novaluron (45.3%) and the highest in untreated check (93.5%),

Table 2. Effect of biorational insecticides on larvae of *Serangium parcesetosum*

Biorational insecticides	Larval mortality (%)	Pupation (%)	Adult emergence (%)
Spinosad 45 SC @ 0.49 ml/l	87.5 (69.30)[a]	55.4 (48.10)[e]	54.5 (47.58)[ef]
Abamectin 1.9 EC @ 0.42 ml/l	84.3 (66.66)[a]	52.7 (46.55)[e]	56.1 (48.50)[ef]
Novaluron 10 EC @ 0.87 ml/l	69.2 (56.29)[bc]	45.3 (42.30)[f]	42.5 (40.69)[g]
Petrolium spray oil @ 3.72 ml/l	65.7 (54.15)[cd]	72.9 (58.63)[cd]	52.4 (46.38)[f]
Neem oil @ 6.87 ml/l	61.8 (51.83)[d]	68.5 (55.86)[cd]	54.6 (47.64)[ef]
Azadirachtin 10,00 PPM @ 3.65 ml/l	50.4 (45.23)[e]	55.2 (47.98)[e]	58.7 (50.01)[ef]
Sweet flag, *Acorus calamus* extract @ 3.4%	19.1 (25.92)[h]	89.3 (70.91)[a]	81.5 (64.52)[b]
Bacillus thuringiensis @ 4.14 g/l	40.5 (39.52)[f]	73.8 (59.21)[c]	69.2 (56.29)[d]
Verticillium lecanii @ 6.17 g/l	32.1 (34.51)[g]	80.1 (63.51)[b]	74.4 (59.60)[c]
10. Dimethoate 30 EC @	73.4 (58.95)[b]	68 (55.55)[d]	60.5 (51.06)[e]
Control	4.2 (11.83)[i]	93.5 (75.23)[a]	92.3 (73.89)[a]
SED±	1.712	1.916	1.975
CD (*P*=0.05)	3.52	3.94	4.06

Figures in parentheses are arcsine-transformed values.

Values followed by same letter in a column are not significantly different (*P* = 0.05)

followed by *A. calamus* (89.3%). Among the biorational insecticides, *A. calamus* recorded significantly more% adult emergence (81.5%) the highest being in untreated check (92.3%).

The low pupation (%) and adult emergence (%) in *M. boninensis* and *S. parcesetosum* in the treatment novaluron might be due to its insect growth regulating action, novaluron, being chitin synthesis Inhibitor.

These results are in conformity with findings of Shivankar and Rao (2002, 2004) who reported safety of *A.galanga* and *A. calamus* extracts towards larvae of *M. boninensis* and *S. parcesetosum* both (Shivankar and Rao 2003).

Thus, *Acorus calamus* was safer to the chrysopid predator with respect to low larval mortality and high egg hatchability, pupation, adult emergence, adult longevity and fecundity than other biorational insecticides tested. There was significant adverse effect of the oils (neem and petroleum) tested on hatching of the eggs of *M. boninensis*. Further, *A. calamus* was also found safer to *S. parcesetosum* with regard to low larval mortality and high pupation and adult emergence than other biorational insecticides tested. *A. calamus* was found safer to eggs, larvae and adults of *M. boninensis* and larvae of *S. parcesetosum* as compared to other biorational insecticides tested.

SUMMARY

The selectivity of nine biorational insecticides, viz spinosad, abamectin, novaluron, petroleum spray oil, neem oil, azadirachtin, sweet flag extract, *Bacillus thuringiensis*, *Verticillium lecanii* and dimethoate (as standard) was evaluated against the chrysopid (*Mallada boninensis* Okamoto) (Neuroptera : Chrysopidae) and *Serangium parcesetosum* Sicard (Coleoptera: Coccinellidae), the predominant predators of the soft bodied insect pests of Nagpur mandarin (*Citrus reticulata* Blanco) in the laboratory at National Research Centre for Citrus, Nagpur, during 2007 and 2008. Of the biorational insecticides tested, rhizome extract of *A. calamus* @ 3.4% was found safer to *M. boninensis* with regard to larval mortality (25.8%) being lowest and egg hatchability (94.0%),% pupation (90.9%),% adult emergence (82.4%), adult longevity (40.5 days) and fecundity (127.2 eggs/female) being highest. Similarly, rhizome extract of *A. calamus* @ 3.4% was also found safer to *S. parcesetosum* with regard to larval mortality (19.1%) being lowest and% pupation (89.3%) and% adult emergence (81.5%) being highest than other bio-rational insecticides tested.

REFERENCES

NRCC 2002. *Annual Report for 2001-2002.* 52 pp. National Research Centre for Citrus, Nagpur, Maharashtra,

Rao C N, Shivankar V J. 2011. Relative toxicity of certain bio-rational insecticides to citrus psylla, *Diaphorina citri* Kuwayama. *Indian Journal of Agricultural Sciences* **81**(7): 91–4.

Rao C N, Shivankar V J and Shyam Singh 2008. Relative toxicity of certain bio-rational insecticides to citrus blackfly, psylla and leaf miner. *Indian Journal of Horticulture* **65** (1): 110–2.

Shivankar V J. 1997. Multiplication of chrysopid predator (*Mallada boninensis*). *Extension Bulletin No. 14,* National Research Centre for Citrus, Nagpur, Maharashtra.

Shivankar V J and Rao C N. 2002. Studies on selectivity of certain botanicals against *Mallada boninensis* Okamoto (Chrysopidae : Neuroptera). *Indian Journal of Citriculture* **1** (1)**:** 6–9.

Shivankar V J and Rao C N. 2003. Studies on selectivity of botanicals against *Serangium parcesetosum. (in) Proceedings of National Symposium on Frontier Areas of Entomological Research*, pp 360–1, held during 5–7 November 2003 at Division of Entomology, IARI, New Delhi.

Shivankar V J and Rao C N. 2004. Selectivity of certain botanicals against *Tamarixia radiata* Waterston and *Mallada boninensis* Okamoto. *Indian Journal of Agricultural Sciences* **74**(9): 508–10.

Shivankar V J, Rao C N and Shyam Singh. 2002. Prospects of biological control of insect pests of citrus in central India. *(in) Strategies in Integrated Pest Management* pp 58-63. Ignacimuthu and Aloksen (Eds). Phoenix Publishing House Pvt. Ltd, New Delhi.

Srivastava K P and Butani D K. 1999. Introduction *(in) Pest Management in Citrus,* pp 17–32. Srivastava K P. and Ahlawat Y S.(Eds) Research Periodicals & Book Publishing House, Texas, USA.

CORRECTION

For article 'Soil fertility management for productivity enhancement of jute under some constrained acid soils of West Bengal, authored by B Maji[1], N C Sahu[2], I Das[3], S Saha[4], S Sarkar[5] and Suprakash Saha[6], the correct desgination, email and address are as follows:

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