Research Paper :

Bio-efficacy of different insecticides and bio-pesticides against grape mealybugs *Maconellicoccus hirsutus* (Green)

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SUMMARY

An investigation was undertaken at NRC, Grapes, Pune, during 2009-10. The treatment with buprofezin (0.05%) dichlorvos (0.15%) and methomyl (0.08%) appeared to be the best treatments against the second instar nymphs of *Maconcellicoccus hirsutus* which gave 100 per cent mortality after 13 days of insecticidal spray. The least effective treatment was *Verticillium lecani* which recorded 36.00 per cent mortality of nymphs after 13 days of spray. The LC_{50} value of neem oil 0.32 per cent, *V. lecani* 0.30 per cent,dichlorvos 0.20 per cent, methomyl 0.08 per cent, buprofezin 0.05 per cent, chlorpyriphos 0.04 per cent and thiamethoxam 0.01 per cent were effective against *Maconcellicoccus hirsutus* (Green)

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Key words : Buprofezin, Methomyl, Thiamethoxam, *V. lecani* and *Maconellicoccus hirsutus*, Bio-Pesticides

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In recent years, the mealybugs have caused severe damage to grape vines in certain parts of India and elsewhere. There are about sixteen species of mealybugs, which have been reported on grapevine in the world. There are several species of mealybugs reported in grape *viz., M. hirsutus* (Green), *Ferrisia virgata* (Cockrell), *Nipaecoccus viridis* (Newstead), *Dysmicocccus brevipes* (Cockrell), *Planococcoides* sp. and *Planococcus citri* (Risso.) have been found to be infesting grapevine in South India and Punjab. Among these, *M. hirsutus*(Green) has been found more in Maharashtra state. The outbreak of *M. hirsutus* on grapevine in Maharashtra, Karnataka and Tamil Nadu states has been reported by Manjunath (1985) and Mani (1986). According to Azam (1983), the grape mealybug alone caused yield loss ranging from 50 to 100 per cent in the field.

So far, various chemical pesticides have been attempted for the control of mealybugs either singly or in several combinations. However, they kill only those mealybugs that are exposed on the shoots, those sheltering in crevices of the bark escape and quickly rebuild their population and eventually cause serious damage (Manjunath, 1985). Another problem associated with the use of pesticide is residual toxicity, which is affecting the export potentiality of fruits.

Several new generation insecticides are available in the market and there is a need to evaluate their toxicity to the mealybugs. Biopesticides and botanicals commonly being used near to harvest to avoid the pesticide residues.

Even though many methods are available, chemical control is largely practiced to manage the mealybugs. There is an urgent need to select and recommend the highly effective chemicals for mealybug control, which require the generation of data on the toxicity of different insecticides to mealybugs.

In view of the above, the present research work aims to study the bioassays of insecticides and biopesticides to the grape mealybug, *Maconcellicoccus hirsutus* (Green)

MATERIALS AND METHODS

During the course of present investigation, studies on bioassays of insecticides and bio-pesticides to the grape mealybug, *Maconcellicoccus hirsutus* (Green) were undertaken. Laboratory trials were conducted at Entomology Section, National Research Centre for Grapes, Pune during 2009-10. Mass culturing of host insect is one of the basic needs

in the laboratory experimentation. For the culture, mealybug was brought from grape orchards of NRC farm. The mass production of mealybug was undertaken on red pumpkins as well as on potato sprouts at 25 ± 5^{0}C temperature and 75 ± 5 per cent relative humidity.

The method used by Chacko *et al*. (1976) was followed for rearing of mealybugs on pumpkins to obtain the pure laboratory culture throughout the period of research. For the rearing of mealybug, just ripened red pumpkins (*Cucurbita maima*) with ridges, grooves and small stalk for easy handling were selected. These were cleaned with water to get rid of any dust on them. To prevent rotting, the pumpkins were surface treated with 0.1 per cent carbendazim solution (Bavistin 50% WP @ 1g/l water). The wounds, if any, on the pumpkins were plugged with paraffin wax. Ovisacs of the *M.hirsutus* infested custard apple were transferred over the pumpkins for about two days. The pumpkins infested with *M.hirsutus* were kept on an iron stand in the specially designed wooden cages (45 × 45 × 45 cm) having glass door in front, glass on top and backside and other sides fitted with wire mesh. These cages were arranged on slotted angle iron racks in the rearing room. In order to maintain darkness at the rearing site, individual racks were completely covered with black muslin cloth. The matured *M.hirsutus* adults developed within 35 to 40 days and fully infested pumpkins were obtained

The use of potato sprouts as an insectary host for mealybug culture was first reported by Branigan (1916), the method modified by Smith and Armitage (1920). For mass rearing of *M. hirsutus*, iron trays (30 × 25 × 10 cm) were used for developing sprouts of potatoes. Sandy silt soil was filled in the trays up to 5cm. Potato tubers were placed about 2cm. apart on a layer of sand in the trays and were covered with slightly moist soil. These trays were kept in racks in the rearing room and watered gently. Temperature in the rearing room was maintained between 21^0 to 25^{0}C . Mass culture of *M.hirsutus*, was obtained within 25 to 30 days of transfer culture.

The experiment was carried out in the laboratory of NRC for grapes section in August-Sept., 2009 with a view to study the toxic effects of different insecticides and bio-pesticides and their compatibility for the control of mealybug, *Maconellicoccus hirsutus*. The toxicity of insecticides was evaluated by direct spraying with potter tower sprayer for uniform spraying for this insecticide and compatibility of eight insecticides were tested.

The details of these pesticides are given in Table1 The desired concentrations of insecticides were prepared by taking the quantity of these insecticides on weight basis and dissolving in 500 ml distilled water. Where's the concentrations of tested insecticides were worked out by calculating the quantity of toxicant required for its dissolution in 500 ml distilled water with following formula:

A= X/Y x Z

where,

A- Quantity of insecticides formulation required

X- Desired strength

Y- Percentage of insecticides in formulation

Z-Quantity of spray material required

The exact quantity of these insecticides was dissolved in distilled water and final volume was made up to 500 ml taken in a glass beaker of 100 ml capacity. In all cases, commercially available formulations were used (Table 1).

For preparing the solutions, distilled water was used. Fresh spray solution of each insecticide and bio-pesticide was prepared whenever required.

The experiment was laid out in Completely Randomized Design with three replications. There were eight treatments including the untreated control.

Treatment details	
T_1	Buprofezin 0.05 %
T_2	*Verticillium lecani* 0.12 %
T_3	Chlorpyriphos 0.04 %
T_4	Dichlorvos 0.15 %
T_5	Neem oil 0.12 %
T_6	Methomyl 0.08 %
T_7	Thiamethoxam 0.01%
T_8	Untreated control

To find out average the number of eggs in each ovisac of *M.hirsutus,* a precounting by randomly selecting 10 ovisacs was carried out and after calculation, average number of eggs per ovisac was found to be 198. For each replication of different treatments, one ovisac was transferred on each potato sprouts with fine camel brush. These were kept in Petri dish and spraying of insecticide was carried out using potter tower sprayer for uniform spray of insecticide and the Petri dish was covered with white nylon net and tightened.

Observations were recorded after 5 days of spray of insecticide and only hatched eggs were counted which were further transformed with arcsine. The data were subjected to statistical analysis.

Late nymphs of *M.hirsutus* (Green) were collected from pure laboratory culture and 10 (ten) nymphs were transferred with fine camel brush to each potato sprout

kept in Petri dishes, each of which constituted a single replication. Then spraying of insecticides was done with potter tower sprayer for uniform spray. After spraying Petri, dishes were covered with white nylon net and tightened.

Observations were recorded at 3rd, 5th, 7th, 9th and 13th days after spraying of insecticide and these values were further transformed in arcsine. The data were subjected to statistical analysis.

Second instar nymphs of *M. hirsutus* were selected for studying the LC_{50} values. Before fixing the insecticide doses for final test, second instar nymphs were initially exposed to a wide range of concentrations of each insecticide and on the basis of mortality recorded, a series of concentrations of narrow range were selected i.e three doses of each insecticide were tested to know the mortality.

Toxicant was applied topically by using Potters tower sprayer. A controlled treatment was maintained with nymphs treated with plain water. Mortality was assessed for two days at 24 hours interval. A nymph was considered dead when it was unable to move in a coordinated manner when provided with blunt of needle. Nymph was considered alive if it had grown significantly since the time of dosing and eaten at least some of food. Dose mortality regression was computed by probit analysis (Finney,1952)

RESULTS AND DISCUSSION

Insecticides and pesticides used in the present investigation are given in Table 1. The results of ovicidal action obtained are expressed in Table 2 .Due to toxicity of insecticide methomyl found the most effective in ovicidal action among the insecticides tested, a finding in accordance with that reported Sinha (2004).

The results with respect to effectiveness of chlorpyriphos, buprofezin against hatching of eggs were 41.00 and 46.00 per cent, respectively. No evidence on this aspect of study was found in literature available.

Table 1 : Insecticides and bio-pesticides used in the present investigations

Sr. No.	Technical mame of insecticides	Formulation
1.	Buprofezin	25 SC
2.	*Verticillium lecani*	5%
3.	Chlorpyriphos	20% EC
4.	Dichorvos	76% EC
5.	Neem oil	25%
6.	Methomyl	40 SP
7.	Thiomethoxam	25 WG
8.	Fish oil	25%

Table 2 : Ovicidal action of different insecticides and biopesticides against ovisacs of *Maconellicoccus hirsutus* (Green)

Sr. No.	Treatments	Average egg hatching (%)
1.	Buprofezin 0.05 %	46.00 *(42.71)
2.	*Verticillium lecani* 0.12 %	71.33 (57.33)
3.	Chlorpyriphos 0.04 %	41.00 (39.82)
4.	Dichlorvos 0.15 %	46.33 (42.90)
5.	Neem oil 0.12 %	65.00 (53.73)
6.	Methomyl 0.08 %	23.33 (28.88)
7.	Thiomethoxam 0.012 %	56.00 (48.45)
8.	Untreated control	96.33 (78.96)
	S.E ±	0.68
	C.D. (P=0.05)	2.05

Treatment with dichlorvos was found 46.33 per cent eggs hatching. Similar finding with dichlorvos (0.12%) was noticed by Beevi *et al.* (1992) and Sinha(2004).

V.lecani treatment noticed less toxic to the eggs of *M.hirsutus* (Green) as percentage eggs hatch was 71.33 per cent. No literature is available on ovicidal action on *V.lecani*.

The results obtained (Table 3) on mortality of nymphs of grape mealybug due to toxicity of insecticides revealed that buprofezin was the most toxic amongst the insecticides tested under laboratory conditions. Buprofezin gave 100 per cent mortality (Table 3), a finding in accordance with that reported by Srivastava(1997).

The results with respect to effectiveness of dicholorvos after 13th day against mealybug was found to be in corroboration with that reported by Reddy and Lakshminarayana (1986), Duraraj and Ganapathy (2000) and Shelke (2001)

The next effective insecticides bringing down population of mealybug pest were methomyl followed by thiamethoxam and *V.lecani* which gave 99.00, 54.33 and 38.00 per cent mortality, respectively. Evidence of studies on this aspect was not available on review of literature.

The least mortality of nymphs observed with neem oil similar finding reported by Shelke (2001)

The findings obtained on mortality of nymphs of *M.hirsutus* (Green) due to toxicity of insecticides revealed that buprofezin was the most toxic amongst the insecticides tested under laboratory conditions. Buprofezin gave 100 per cent mortality, a finding in accordance with that reported by Srivastava (1997).

The treatment with dicholorvos (99.33 per cent) after 13th day against mealybug was found to be in corroboration with that reported by Reddy and

Table 3 : Bio-efficacy of different insecticides and bio-pesticides against second instar nymph of *Maconellicoccus hirsutus* (Green)

Sr. No.	Treatments	Mean per cent second instar nymphal mortality				
		3rd day	5th day	7th day	9th day	13th day
1.	Buprofezin 0.05 %	91.66 *(73.21)	94.00 (75.82)	96.00 (78.46)	98.00 (81.87)	100 (100)
2.	*Verticillium lecani* 0.12 %	25.00 (30.00)	28.00 (31.95)	31.00 (33.83)	33.00 (35.06)	36.00 (36.87)
3.	Chlorpyriphos 0.04 %	60.00 (50.77)	62.00 (51.94)	63.00 (52.54)	64.00 (53.13)	96.00 (78.46)
4.	Dichlorvos 0.15 %	83.00 (65.65)	85.33 (67.48)	88.00 (69.73)	89.66 (71.24)	99.33 (85.30)
5.	Neem oil 0.12 %	9.66 (18.11)	13.00 (21.13)	18.00 (25.10)	19.00 (25.84)	20.00 (26.57)
6.	Methomyl 0.08 %	70.33 (57.00)	73.33 (58.91)	74.33 (59.56)	77.66 (61.79)	98.33 (82.57)
7.	Thiamethoxam 0.012 %	40.66 (39.62)	42.33 (40.59)	46.00 (42.71)	48.33 (44.04)	51.00 (45.57)
8.	Untreated control	1.33 (6.62)	1.66 (7.40)	3.33 (10.51)	4.66 (12.47)	5.66 (13.76)
	S.E ±	0.80	0.62	0.72	0.58	0.73
	C.D. (P=0.05)	2.41	1.86	2.16	1.75	2.20

*Figures in parentheses are arcsine values

Lakshminarayana (1986), Duraraj and Ganapathy (2001) and Shelke (2001).

The next effective insecticides bringing down population of mealybug pest were methomyl followed by thiamethoxam, *V.lecani* which gave 98.33, 51.00 and 36.00 per cent mortality, respectively. Evidence of studies on this aspect was not available on review of literature.

The least mortality of nymphs was observed with neem oil and similar was finding reported by Shelke(2001) as results are expressed in Table 3.

The data on LC_{50} values due to spray of different insecticides of various concentrations each insecticides of three concentrations at one day interval are presented in Table 4.

The buprofezin LC_{50} value was 0.05 per cent, *V. lecani* 0.30 per cent, chlorpyriphos 0.04 per cent, dichlorvos 0.20, neem oil 0.32 per cent, methomyl 0.08 per cent and thiamethoxam 0.01 per cent. Evidence of LC_{50} studies was not available on review of literature.

Table 4 : LC_{50} values of different insecticides, botanicals and biopesticides against second instar nymph of *Maconellicoccus hirsutus* (Green) in per cent

Sr. No.	Treatments	LC_{50} values (%)	Fiducial limits
1.	Buprofezin	0.05	0.03-0.07
2.	*Verticillium lecani*	0.30	0.21-0.39
3.	Chlorpyriphos	0.04	0.01-0.07
4.	Dichlorvos	0.20	0.13-0.32
5.	Neem oil	0.32	0.21-0.41
6.	Methomyl	0.08	0.05-0.11
7.	Thiamethoxam	0.01	0.01-0.03
8.	Untreated control	0.0	0.0

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