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Bioefficacy of liquid formulation of *Verticillium lecanii* against red spider mite (*Tetranychus cinnabarinus*)

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ABSTRACT

Studies on liquid formulation of *Verticillium lecanii* (Zimmermann) Viegas was carried out at Biocontrol Research Laboratory, Department of Agricultural Entomology, Mahatma Phule KrishiVidyapeeth, Rahuri, Maharashtra State, India during 2002-04. The studies revealed that both the liquid formulation of *V. lecanii* irrespective of dosage tested had showed significantly higher efficacy in controlling red spider mite. Formulation A caused 67.66 to 82.78 per cent mortality and its 1.00 per cent concentration showed highest (82.78 %) kill. However, it was at par with its 0.45 to 0.75 per cent concentrations which recorded 73.46 to 81.59 per cent mortality. The reduction in the mite caused by formulation B was 70.08 to 85.23 per cent. The 1 per cent concentration of formulation B showed highest (85.23 %) mortality of the pest and its 0.60 to 0.75 per cent concentrations (79.97 to 82.40 %) were at par with it.

Key words : Bioefficacy, Liquid formulation, Red spider mite, *Tetranychus cinnabarinus, Verticillium lecanii.*

Integrated Pest Management is gaining importance in recent years in view of risk of synthetic chemical insecticides oriented environmental pollution and health hazards. Biological control is an important, effective, ecofriendly and economical component of IMP for almost all important pests of major crops for the development of sustainable cropping systems. Especially there is ample scope for microbial control of pests. Among the pathogens used in microbial control, entomopathogenic fungi have played an important role in the history of insect pathology and microbial control of insects (Sundarababu, 1992). Some of the important entomopathogenic fungi are *Beauveria bassiana*, *Metarhizium anisopliae*, *Nomuraea rileyii*,*Paecilomyces farinosus* and *Verticillium lecanii*. *Verticillium lecanii* (Zimmermann) Viegas (Moniliales : Moniliaceae) is a cosmopolitan fungus found on insects. Considering the ecofriendly benefits of biological control, a strain of *V. lecanii* was isolated from spiraling whitefly, *Aleurodicus dispersus* Maskell (Aleurodidae : Hemipetra) at Biocontrol Research Laboratory of Department of Entomology, M.P.K.V., Rahuri. A liquid formulation of this strain was developed with the help of some adjuvants. Initially two formulations were developed and bioassay of these formulations was proved for effectiveness against some sucking pests including red spider mite. Therefore, present investigations have been undertaken with a view to test its bioefficacy against red spider mite, *Tetranychus cinnabarinus* Boisduval.

MATERIALS AND METHODS

Studies on liquid formulation of *Verticillium lecanii* (Zimmermann) Viegas was carried out at Biocontrol Research Laboratory, Department of Agricultural Entomology, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India during 2002-04.

Culture of V. lecanii:

The pure fungus culture was available in Biocontrol Research Laboratory of Entomology Department, M.P.K.V., Rahuri. It is the Rahuri *deme* of the fungus isolated from spiralling whitefly, *Aleurodicus dispersus* infesting wild guava plant in 1999.

Media:

The medium used for multiplication and growth of the fungus was Potato dextrose broth medium as suggested by Kadam and Jaichakravarthy (2003). Autoclaved Potato dextrose broth medium adjusted to pH 6.0 was taken in 200 ml capacity conical flasks.

Standardization of concentration of V. lecanii:

The Rahuri *deme* of *V. lecanii* isolated from spiralling whitefly, *Aleurodicus dispersus* was used for the experiment. The fungus was cultured on Potato dextrose broth medium and incubated at 21 ± 1^0c for 10 days. The culture was harvested in a UV light sterilized plastic container and ground with duly sterilized hand blender for 3 minutes. Test concentrations were prepared using distilled water as diluent. The stock samples were stored in 250 ml autoclave sterilized conical flasks. The flask neck was plugged with sterilized cotton wool. The whole process was carried out in laminar flow cabinet. Each preparation was

evaluated for its potential for growth and development of *V. lecanii* upto 10 days and for its bioefficacy.

Laboratory culture of red spider mite:

The nymphs and adults of red spider mite collected from the naturally infested fields, situated at the Central Campus, MPKV, Rahuri in May, 2002, were brought to laboratory and reared under controlled condition. The nymphs and adults were reared on potted plants of okra, *Abelmoschus esculentus* (L.) Moench (Malvaceae : Dicot) and this formed the stock culture. From the stock culture, the nymphs and adults were taken up for evaluation of the liquid formulation of *V. lecanii*.

Bioefficacy against red spider mite:

Liquid formulations (Formulations A and B) comprising combination of inoculum with different concentrations of the adjuvants *viz.* glycerol, tween-80 and arachid oil were prepared and were evaluated with *V. lecanii* alone, Phule bugicide (WP formulation) , one insecticide *i.e*. dimethoate and water spray. The bioefficacy of liquid formulations A and B of *V. lecanii* were studied by spraying the different concentrations of formulation on the test insect species released on 60 day old potted okra plants in laboratory. The experiment was laid out in completely randomized design with 16 treatments replicated thrice. In each replication, five potted okra plants for each treatment were treated with respective concentrations. Single spray was given.

Thirty 1st instar nymphs were released per plant for the purpose. Hand sprayer was used to treat the aphid infested plants. Initially untreated control was sprayed with water, followed by low and their higher concentration of the formulations to reduce error in spray concentrations. The sprayer was rinsed with hot water before switching to next treatment.

Method of recording observations:

The live and dead insects were counted with help of hand lens. The mortality of insects at 1st, 3rd, 5th, 7th, 9th, and 14th days after treatment was recorded. The per cent mortality was worked out on the basis of total number of live and dead insects.

Corrected mortality was calculated using Abbott's formula (Abbott, 1925) and then converted to arc sin square root transformation (Gomez and Gomez, 1984). It was further subjected to statistical analysis.

RESULTS AND DISCUSSION

The data on nymphal mortality of red spider mite recorded at 1,3,5,7,9 and 14 days after treatment as influenced by various concentrations of 0.15 to 1.00 per cent of liquid formulations of *V. lecanii* are presented in Table 1.

At 1st day:

The nymphal mortality ranged from 0.00 to 15.86 per cent among all treatments. Significantly highest mortality (15.86 %) was obtained in the treatment with dimethoate 0.03 per cent.

At 3rd day:

The red spider mite kill in various treatments was significantly higher (14.40 to 25.21) than zero per cent mortality in untreated control. The mortality caused by formulation A at 0.15 to 1.00 per cent concentration ranged from 14.40 to 21.92 per cent. Formulation B showed 15.82 to 22.43 per cent mortality at 0.15 to 1.00 per cent concentration. One per cent concentration of formulation A (21.92 %) and formulation B (22.43 %) among the test concentrations exhibited highest mortality against 24.33 per cent kill in Phule bugicide (WP) 0.20 per cent and 25.21 per cent reduction of the pest in dimethoate (0.03%).

At 5th day:

Similar trend of the pest mortality was observed at 5 days after treatment. It ranged from 25.44 to 48.67 per cent against zero per cent kill in untreated control. Formulation A inflicted 25.44 to 34.78 per cent mortality as against 29.52 to 36.77 per cent mortality in formulation B. Phule bugicide (WP) registered highest mortality (48.67%) of the mite among all treatments.

At 7th day:

The mortality caused by formulation A ranged between 42.49 and 51.22 per cent and that by formulation B was between 44.34 and 52.91 per cent. The wettable powder formulation (Phule bugicide) showed 62.10 per cent mortality of red spider mite.

At 9th day:

All the treatments exhibited more than 50 per cent mortality of *T. cinnabarinus* against zero per cent kill in untreated control. The lethal effect of both the liquid formulations of *V. lecanii* was maximum among all the treatments. Microscopic examination confirmed mycosis caused by *V. lecanii*. Formulation A caused 52.34 to 65.81 per cent mortality where as formulation B showed 56.50 to 69.74 per cent kill of the test species of mite. Prevailing *V. lecanii* (WP) formulation recorded 70.50 per cent mortality of the pest.

At 14th day:

All the treatments were significantly superior to untreated control recording 67.66 to 85.23 per cent mortality of the mite. Formulation A caused 67.66 to 82.78 per cent mortality and its 1.00 per cent concentration showed highest (82.78 %) kill. However, it was at par with its 0.45 to 0.75 per cent concentrations which recorded 73.46 to 81.59 per cent mortality. The reduction in the mite caused by formulation B was 70.08 to 85.23 per cent. The 1 per cent concentration of formulation B showed highest (85.23 %) mortality of the pest and its 0.60 to 0.75 per cent concentrations (79.97 to 82.40 %) were at par with it. The wettable powder formulation of *V. lecanii* (Phule bugicide) inflicted 80.12 per cent mortality of the mite, while 78.45 per cent kill caused in dimethoate 0.03 per cent concentration.

The high mortality (67.66 to 85.23 %) of the mite was caused by both the liquid formulations of *V. lecanii*. In the present study is in agreement with that of Gould (1997). Helyer (1993) also confirmed the biocontrol potential of entomopathogenic fungus, *V. lecanii* against *T. urticae* on cucumber in glasshouse. The effectiveness of the mycoagent (WP) 0.2 per cent in suppression of *T. cinnabarinus* was reported by Jaichakravarthy (2002) and observed 83.60 per cent kill of the pest. Mahajan (2003) also reported 80.67 per cent and 82.40 per cent mortality of the red spider mite by WP and liquid formulations of *V. lecanii*, respectively.

Table 1 : Bioefficacy of liquid formulations of *V. lecanii* against red spider mite, *T. cinnabarinus*

Sr. No.	Treatments	Conc. (%)	Mortality (%) at days after treatment					
			1	3	5	7	9	14
1.	Form. A	0.15	2.32	14.40	25.44	42.49	52.34	67.66
	$8x10^8$CFU/ml		(8.72)**	(22.30)	(30.26)	(40.69)	(46.38)	(55.37)
2.		0.30	3.74	15.92	27.29	43.78	54.70	70.21
			(11.09)	(23.50)	(31.50)	(41.44)	(47.70)	(56.91)
3.		0.45	4.62	17.19	29.14	44.22	57.30	73.46
			(12.39)	(24.50)	(32.65)	(41.67)	(49.20)	(59.02)
4.		0.60	5.22	19.72	31.21	46.66	59.21	78.67
			(13.18)	(26.35)	(33.34)	(43.11)	(50.30)	(62.51)
5.		0.75	7.36	20.14	34.50	48.45	61.37	81.59
			(15.68)	(26.64)	(35.97)	(44.08)	(51.53)	(64.60)
6.		1.00	10.33	21.92	34.78	51.22	65.81	82.78
			(18.72)	(27.90)	(36.15)	(45.69)	(54.21)	(65.42)
7.	Form. B	0.15	3.47	15.82	29.52	44.34	56.50	70.08
	$8x10^8$CFU/ml		(10.78)	(23.42)	(32.90)	(42.73)	(48.73)	(56.85)
8.		0.30	4.22	16.29	29.79	45.20	58.24	74.31
			(11.83)	(23.81)	(33.09)	(42.25)	(49.72)	(59.54)
9.		0.45	5.66	18.50	30.45	47.80	60.40	76.91
			(13.81)	(25.48)	(33.46)	(43.74)	(51.00)	(61.27)
10.		0.60	7.43	19.81	32.28	47.89	62.71	79.97
			(15.79)	(26.42)	(34.63)	(43.80)	(52.36)	(63.29)
11.		0.75	9.45	21.50	34.50	48.23	66.24	82.40
			(18.05)	(27.63)	(36.03)	(43.97)	(54.45)	(65.20)
12.		1.00	12.67	22.43	36.77	52.91	69.74	85.23
			(20.88)	(28.25)	(37.35)	(46.66)	(56.60)	(67.37)
13.	Phule Bugicide 2 x 10^8	0.2	10.50	24.33	48.67	62.10	70.50	80.12
	CFU/ml		(18.91)	(29.53)	(44.25)	(52.00)	(57.10)	(73.54)
14.	Dimethoate	0.03	15.86	25.21	39.99	59.97	65.21	78.45
			(23.50)	(30.13)	(38.88)	(50.71)	(53.85)	(64.08)
15.	U.C. (only water spray) *	-	0.00	0.00	0.00	0.00	0.00	0.00
	S.E .±	-	1.05	1.21	1.49	1.46	2.17	2.59
	C.D. (P=0.05)	-	3.14	3.63	4.44	4.42	6.50	7.77

* The corrected mortality at 7th, 9th and 14th day using Abbott's formula when actual mortality in U.C. was 9.12, 10.56,12.33 and 14.23 per cent respectively.

** Figures in parenthesis are arcsin transformed values.

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