

Bioefficacy of liquid formulation of *Verticillium lecanii* against Aphid (*Aphis gossypii*)

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Accepted : August, 2008

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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 aphids. Formulation A registered 68.23 to 89.54 per cent mortality and Formulation B recorded 70.28 to 96.70 per cent kill of the pest. The per cent concentration of the formulation resulted in highest (96.70 %) mortality. However, it was at par with 0.45, 0.60 and 0.75 per cent concentration.

Key words : Aphid, *Aphis gossypii*, Bioefficacy, Liquid formulation, *Verticillium lecanii*.

V*erticillium lecanii* (Zimmermann) Viegas (Moniliales:Moniliaceae) a deuteromycetes is a cosmopolitan fungus found on insects. In India, Sydow and Butler (1911) reported *C. lecanii* infecting coffee scale insect from Karnataka. *Verticillium lecanii* is a well known pathogen of sucking pests including aphids (Wilding, 1972; Nagaich, 1973 and Hall and Papierok, 1982). The fungus infects insects by producing hyphae from germinating spores that penetrate insects integument, the fungus then destroys the internal content and insect dies. The fungus eventually grows out through the cuticle and sporulates on the outside of the body. Infected insect appears as white to yellowish cottony particle. Considering the eco-friendly benefits of biological control, a strain of *V. lecanii* was isolated from spiralling whitefly, *Aleurodicus dispersus* Maskell (Aleurodidae : Hemipetra) at Biocontrol Research Laboratory of Department of Entomology, M.P.K.V., Rahuri. A wettable powder formulation of this strain of *V. lecanii* was developed and branded as Phule Bugicide (Kadam and Jaichakravarthy, 2003). The results of this formulation for bio-efficacy in the laboratory studies as well as on farmers field are highly encouraging. There is need of basic research to develop potential liquid formulation of *V. lecanii*, which possesses better shelf-life. A liquid formulation was developed with the help of some adjuvants. Initially two formulations were developed and bioassay of these formulations proved the effectiveness against some sucking pests including aphids. Therefore, present investigation has been undertaken with a view to test its bio-efficacy against aphid, *Aphis gossypii*.

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 State, 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.

Medium:

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 as suggested by Kadam and Jaichakravarthy (2003) and incubated at 21±1°C 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.

Laboratory culture of aphids:

The nymphs and adults of aphids collected from the naturally infested fields, situated at the Central Campus, MPKV, Rahuri in May, 2002, were brought to the laboratory and reared under controlled conditions. 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 *A. gossypii*:

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 evaluated with *V. lecanii* alone, Phule bugicide (WP formulation), one insecticide i.e. dimethoate and water spray. The bioefficacy was 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 was 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 results of the study on bioefficacy of liquid

formulations A and B along with Phule bugicide WP and dimethoate against aphid recorded at 1, 3, 5, 7, 9 and 14 days after treatment and are presented in Table 1 .

At 1st day:

The nymphal mortality in the treatments ranged from 0 to 14.70 per cent. Significantly highest mortality (14.7 %) was recorded in dimethoate 0.03 per cent over rest of the treatments, whereas it was 3.48 to 10.21 in formulation B and 2.33 to 9.16 per cent in formulation A of *V. lecanii*.

At 3rd day:

The nymphal kill caused by various treatments ranged from 10.25 to 30.85 per cent against zero per cent kill in untreated control. Formulation A at 0.15 to 1 per cent caused 10.25 to 18.33 per cent mortality, while formulation B at the same concentration inflicted 11.22 to 20.20 per cent kill of the test insect. Dimethoate (0.03%) recorded significantly highest mortality of 30.85 per cent.

At 5th day:

Formulation A gave 25.28 to 35.14 per cent nymphal mortality at 0.15 to 1.00 per cent concentration. Formulation A at 1.00 per cent registered highest mortality of 35.14 %. Formulation B caused 25.69 to 38.67 per cent mortality. Dimethoate at 0.03 per cent recorded 40.08 per cent kill of the pest.

At 7th day:

The mortality was moderate to high (36.55 to 59.53 %) in all the treatments, except zero per cent in untreated control. The mortality was 42.33 to 57.76 % and 42.14 to 59.53 per cent in formulation A and B, respectively. Dimethoate 0.03 % recorded significantly highest mortality (65.86 %) over rest of the treatments except highest concentration of 1 per cent of formulation A and 0.75 to 1 per cent of formulation B.

At 9th day:

The lethal effect of both A and B formulations of *V. lecanii* was maximum in all the treatments. Microscopic examination of *V. lecanii* treated aphid showed presence of *V. lecanii* mycosis. Formulation A inflicted 57.20 to 78.26 per cent mortality and formulation B caused 59.67 to 84.33 per cent kill of the test insect. Phule bugicide (WP) observed 78.67 per cent insect kill while dimethoate at 0.03 per cent observed 76.65 per cent aphid mortality. Untreated control showed zero per cent corrected mortality.

Table 1 : Lethal effect of liquid formulations of *V. lecanii* on Aphid, *A. gossypii*

Sr. No.	Treatments	Conc. (%)	Mortality (%) at days after treatment						
			1	3	5	7	9	14	
1	Form. A 8x10 ⁸ CFU/ml	0.15	2.33	10.25	25.28	42.33	57.20	68.23	
			(8.72)	(18.63)**	(30.20)	(40.57)	(49.14)	(55.67)	
2		0.30	3.76	12.66	28.44	45.62	61.33	71.78	
			(11.24)	(20.88)	(32.40)	(42.48)	(51.33)	(57.52)	
3		0.45	5.22	13.42	30.33	48.33	71.93	82.38	
			(13.18)	(21.56)	(33.40)	(44.03)	(57.99)	(65.20)	
4		0.60	7.29	14.41	32.27	52.08	72.61	84.53	
			(15.68)	(22.30)	(34.63)	(46.20)	(58.44)	(66.81)	
5		0.75	7.42	16.67	33.17	54.34	76.54	88.96	
			(15.79)	(24.12)	(35.18)	(47.47)	(61.00)	(70.54)	
6		1.00	9.16	18.33	35.14	57.76	78.26	89.54	
			(17.66)	(25.33)	(36.33)	(50.07)	(65.24)	(71.09)	
7	Form. B 8x10 ⁸ CFU/ml	0.15	3.48	11.22	25.69	42.14	59.67	70.28	
			(10.78)	(19.55)	(30.46)	(40.46)	(50.59)	(56.98)	
8		0.30	8.67	14.53	27.72	45.81	63.97	75.24	
			(17.16)	(22.38)	(31.76)	(44.31)	(53.07)	(60.13)	
9		0.45	5.67	14.42	31.77	49.34	74.29	86.64	
			(13.81)	(22.30)	(34.33)	(44.60)	(59.54)	(68.53)	
10		0.60	7.81	15.17	34.56	52.76	78.44	88.62	
			(16.22)	(23.73)	(36.03)	(46.61)	(62.31)	(70.27)	
11		0.75	9.32	18.24	35.12	55.44	81.28	93.45	
			(17.76)	(25.25)	(36.33)	(48.10)	(64.38)	(75.11)	
12		1.00	10.21	20.20	38.67	59.53	84.33	96.70	
			(18.63)	(26.71)	(38.47)	(50.48)	(66.66)	(79.53)	
13	Phule Bugicide 2 x 10 ⁸ CFU/ml	0.2	2.80	13.33	19.84	36.55	78.67	84.14	
			(9.63)	(21.39)	(26.42)	(37.23)	(62.51)	(66.50)	
14	Dimethoate	0.03	14.70	30.85	40.08	65.86	76.65	82.19	
			(22.55)	(26.26)	(39.23)	(54.21)	(61.07)	(65.09)	
15	U.C. (only water spray)	-	0.00	0.00	0.00	0.00	0.00	0.00	
			S.E. ±	1.26	1.61	1.88	2.01	2.82	3.08
			C.D. (P=0.05)	3.82	4.84	5.64	6.13	8.42	11.31

* The corrected mortality at 7th, 9th and 14th day using Abbott's formula when actual mortality in U.C. was 10.69, 13.63 and 16.21 per cent, respectively.

** Figures in parenthesis are arcsin transformed values.

At 14th day:

All the treatments with different concentrations of A and B formulation of *V. lecanii*, along with Phule bugicide (WP) and dimethoate (0.03%) inflicted appreciably heavy mortality of the aphid from 68.23 to 96.70 per cent. The mortality was significantly more than zero per cent kill in untreated control. Formulation A registered 68.23 to 89.54 per cent mortality and 1 per cent concentration gave 89.54 per cent kill of the aphid, however, 0.45, 0.60 and 0.75 per cent concentrations inflicted at par mortality (82.38 to 88.96 %) to 1 per cent. Formulation B recorded 70.28 to 96.70 per cent kill of the pest and 1 per cent treatment resulted the highest (96.70 %) mortality. However, it was at par with 0.45, 0.60 and 0.75 per cent concentration. The wettable powder formulation of *V. lecanii* i.e. Phule bugicide

(0.2%) also gave appreciable (84.14%) kill of the pest, which was higher than that recorded in dimethoate 0.03 per cent (82.19 %) treatment, against zero mortality in untreated control.

Both the formulations of *V. lecanii* irrespective of dosage tested had showed significantly higher efficacy in controlling aphids when compared to untreated control. Mortality ranged between 68.23 to 96.00 per cent in both the liquid formulations of the mycoagent and the WP formulation (Phule bugicide). Hincapie *et al.* (1990) recorded high (100 %) mortality of *M. persicae* infesting chrysanthemum by the VL-A strain of *V. lecanii*. Pinna (1992) recorded 80.40 to 94.00 per cent kill of *A. gossypii* on cucumber in glasshouse by *V. lecanii* (WP). *V. lecanii* sporulated freely on legs and antennae of live aphid (Hall, 1975). Jaichakravarthy (2003) obtained 85.37 per cent

suppression of *A. gossypii* by *V. lecanii* (WP) 0.2 per cent. The potential of *V. lecanii* as biocontrol agent was confirmed by Mahajan (2003) who observed 91.67 per cent aphid mortality with WP formulation and 93.44 per cent kill with liquid formulation of the mycoagent. These results confirmed that both the liquid formulations were effective against the aphid.

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REFERENCES

- Abbott, W.S. (1925)**. Method of computing effectiveness of an insecticide. *J. Econ. Ent.*, **18**: 265-267.
- Gomez, K.A. and Gomez, A.A. (1984)**. *Statistical procedure for agricultural research*, Wiley and Sons, New York.
- Hall, R.A. (1975)**. A bioassay of the pathogenicity of *Verticillium* conidiophores on the aphid, *Macrosiphoniella sanbornii*. *J. Invert. Path.*, **27**: 41-48.
- Hall, R.A. and Papierok, B. (1982)**. Fungi as biocontrol agents of arthropods of agricultural and medical importance. *Parasitology*, **84**: 205-240.
- Hincapie, V.R., Ospiana, Z.H.A., Bustillo, P.A.E. and Saldarrianga, V.A. (1990)**. Evaluation of entomopathogenic fungus, *Verticillium lecanii* for the control of aphid, *Myzus persicae* on chrysanthemum. *J. Revista Colombiana-de-Entomologia*, **16 (2)**: 21-27.
- Jaichakravarthy, G. (2002)**. Bioefficacy of *Verticillium lecanii* (Zimm.) Viegas against sucking pests. M. Sc. (Ag.) Thesis, M. P. K. V., Rahuri, Maharashtra, India.
- Kadam, J.R. and Jaichakravarthy, G. (2003)**. Bioefficacy of *Verticillium lecanii* (Zimm.) Viegas against nymphs of *Maconellicoccus hirsutus* Green. Proc. of the state level seminar on pest management for sustainable agriculture, Parbhani, Feb. 6-7, 1003, pp. 12-15.
- Mahajan, P.V. (2003)**. Bioefficacy of *Verticillium lecanii* (Zimmermann) Viegas against sucking pests attacking gerbera, *Gerbera jamesonii* (Hook) in polyhouse. M.Sc. (Ag.) Thesis M. P. K. V., Rahuri, Maharashtra, India.
- Nagaich, B.B. (1973)**. *Verticillium* species pathogenic on aphids. *Indian Phytopath.*, **26**: 163-165.
- Pinna, M. (1992)**. Use of *Verticillium lecanii* (Zimm.) for the biological control of *A. gossypii* (Glover) on cucumber in protected cultivation. *Bull. Phytopath.*, **10**: 56-58.
- Sydow, H. and Butler, E.J. (1911)**. Account of some entomopathogenic fungi. *Ann. Mycol.*, **9**: 372-421.
- Wilding, N. (1972)**. The effect of systemic fungicides on the aphid pathogen, *Cephalosporium aphidicola*. *Pl. Path.*, **21**: 137-139.
