J. Biol. Control, 23(2): 151-154, 2009

Potential of liquid formulation of *Verticillium lecanii* against spiralling whitefly, *Aleurodicus dispersus* Russell

B. P. CHAVAN* and J. R. KADAM
Department of Entomology, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth,
Rahuri 413722, Ahmednagar, Maharashtra, India.
E-mail : bpchavan123@mail.com

ABSTRACT: Liquid formulations of entomopathogenic fungus, *Verticillium lecanii* (Zimmermann) Viegas were evaluated against spiralling whitefly, *Aleurodicus dispersus* Russell at Biocontrol Research Laboratory, Mahatma Phule Krishi Vidyapeeth, Rahuri, during 2002-04. The study revealed that liquid formulation A (VGTA 50512) and B (VGTA 50510-5) of *V. lecanii* caused 78.33 to 92.34 and 80.20 to 93.45 per cent mortality of the whitefly, respectively. *V. lecanii* at one per cent concentration gave the highest mortality of 92.34 per cent (Formulation A) and 93.45 per cent (Formulation B) respectively but it was on par with the concentration of 0.45 to 0.75 per cent. So, 0.45 per cent concentration of the liquid formulation is the most economical and feasible concentration for the control of the pest.

KEY WORDS: *Aleurodicus dispersus*, bioefficacy, liquid formulation, *Verticillium lecanii.*

INTRODUCTION

Spiralling whitefly, *Aleurodicus dispersus* Russell (Hemiptera: Aleyrodidae) is an introduced polyphagous pest of vegetables, fruit trees, ornamentals and shade trees. It is a native of the Caribbean islands and Central America (Russell, 1965). In India, it was first recorded in Kerala. The pest has established throughout the country due to rapid dispersal rate and emerged as a key pest on several crops like guava, cassava, cotton, chillies, tomato, brinjal, bhendi and papaya (Geetha, 2000). In Maharashtra, this pest was reported from Kolhapur, Sangli, Satara, Solapur, Osmanabad, Beed, Latur and Pune districts on several agricultural and non-agricultural crops. Many chemical pesticides were tried for the management of the pest. But, it was felt necessary go for alternative control measures due to its ill effects. Biological control is an important component and there is ample scope for microbial control of the crop pests. *Verticillium lecanii* (Zimmermann) Viegas is one of the highly promising fungal bioagents causing infections mostly to Homoptera, including whiteflies (Horn, 1915; Ekbom, 1979; Kanagaratnam *et al.,* 1982). Considering the ecofriendly benefits of biological control, a strain of *V. lecanii* was isolated from spiralling whitefly, *A. dispersus* at Biocontrol Research Laboratory, 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 proved their effectiveness against some sucking pests including whiteflies. Therefore, the present investigations were undertaken with a view to test its bioefficacy against spiralling whitefly, *A. dispersus.*

MATERIALS AND METHODS

Studies on liquid formulations of *Verticillium lecanii* were carried out at Biocontrol Research Laboratory, Department of Agricultural Entomology, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri during 2002-04.

Standardization of concentration of *Verticillium lecanii*

The pure culture of Rahuri *deme* of *V. lecanii* isolated from spiralling whitefly on guava 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 three minutes. Test concentrations were prepared using distilled water as diluent. The required quantity of adjuvants were added to each formulation and liquid formulations A (VGTA 50512) and B (VGTA 50510-5) comprising combinations of inoculum with different concentrations of the adjuvants

*Part of Ph. D. thesis submitted by the first author

were prepared. The stock samples of the formulation were stored in 250ml autoclave sterilized conical flasks. The whole process was carried out in a laminar flow cabinet.

Laboratory culture of *Aleurodicus dispersus*

The nymphs and adults of spiralling whiteflies collected from the naturally infested fields at the Central Campus, MPKV, Rahuri during May, 2002, were brought to laboratory and reared under controlled condition on potted plants of mulberry, *Morus alba* and this formed the stock culture.

Bioefficacy against *Aleurodicus dispersus*

Liquid formulations (Formulations A and B) comprising combination of inoculum with different concentrations of the adjuvants were prepared and evaluated with *V. lecanii* alone, Phule bugicide (WP formulation), one insecticide (dimethoate) and water spray. The bioefficacy of liquid formulations A and B of *V. lecanii* was studied by spraying the different concentrations of formulation on the test insect species released on 60 day old plants in laboratory. The experiment was laid out in completely randomized design with 16 treatments replicated thrice. In each replication, five mulberry saplings for each treatment were treated with respective concentrations. A single spray was given. The insects collected were released on mulberry saplings and the treatments were applied using hand sprayer. The sprayer was rinsed with hot water before switching to the next treatment. The whiteflies were released at the rate of 20 nymphs per sapling.

The live and dead insects were counted with the 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 whitefly, *A. dispersus* recorded at 1, 3, 5, 7, 9 and 14 days after treatments as influenced by various concentrations (0.15 to 1 %) of the liquid formulation of *V. lecanii* are presented in Table 1. On 1st day, the nymphal mortality in various treatments differed significantly at lowest and highest concentrations. The mortality ranged from 0 to 16.30 per cent. It was significantly superior 16.30% in dimethoate (0.03%) compared to the rest of the treatments.

On 3rd day, the nymphal kill ranged from 18.23 to 26.10 per cent, with zero per cent kill in untreated control. The mortality caused by 0.15 to 1.00 per cent of formulation A was 18.23 to 25.52 against 18.57 to 26.10 per cent in formulation B. It was 16.17 per cent in 0.2 per cent *V. lecanii* (WP). At 5th day, similar trend of nymphal mortality was seen at 5 days after treatment. The mortality was moderate to high (28.28 to 42.30%) in various treatments. It was 34.50 to 41.92 per cent in formulation A and 33.62 to 42.26 per cent in formulation B. Phule bugicide (0.2%) showed 28.28 per cent kill of whitefly against 42.30 per cent kill in dimethoate (0.03%). On 7th day, all the insecticide treatments except formulation B at 0.15 percent (48.87%) exhibited more than 50 per cent mortality against zero per cent kill in untreated control. The mortality caused by formulation A was 50.69 to 63.50 per cent and that by formulation B was 48.87 to 65.97 per cent. *V. lecanii* WP (Phule bugicide) 0.2% caused 51.12 per cent reduction of nymphal population. On 9th day the lethal effect of both the liquid formulations (A and B) of *V. lecanii* was maximum in all the treatments. Microscopic examination of the nymphs treated with *V. lecanii* showed symptoms of mycosis. Formulation A registered 62.67 to 72.27 per cent mortality as against 61.61 to 75.12 per cent kill in formulation B. Phule bugicide caused 62.27 per cent kill of test insect, while dimethoate recorded 78.50 per cent reduction in whitefly. On 14th day, all the treatments with different concentrations of A and B liquid formulation of *V. lecanii* along with its wettable powder formulation and dimethoate (0.03%) recorded appreciably heavy mortality from 78.33 to 93.45 per cent. Formulation A caused 78.33 to 92.34 per cent mortality of the test insect. Formulation A at 1% inflicted highest (92.34%) mortality, but was on par with 0.45, 0.60 and 0.75 per cent concentrations. Similarly, formulation B resulted in 80.20 to 93.45 per cent mortality, on par with 0.45 to 0.10 per cent concentrations. The prevalent wettable powder formulation of *V. lecanii* (Phule bugicide) showed 82.18 per cent, while dimethoate (0.03%) recorded 82.27 per cent mortality.

Kanagaratnam *et al.* (1982) observed that fortnightly application of blastospores of *V. lecanii* resulted in 93 per cent mortality of the whitefly. Ravensberg *et al.* (1990) observed up to 90 per cent mortality of *Trialeurodes vaporariorum*. The effectiveness of *V. lecanii* in controlling whitefly was also documented by Masuda (1993) and Wang Kequn *et al.* (2000). Jaichakravarthy (2002) obtained 83.60 per cent mortality of the whitefly by the wettable powder of the pathogen (Phule Bugicide). Mahajan (2003) reported 93.66 per cent mortality of whitefly with WP formulation (Phule Bugicide) and 95.45 per cent kill of the pest with liquid formulation. These findings support the present study under the conditions of central India.

Table 1. Bioefficacy of liquid formulations of *Verticillium lecanii* against spiralling whitefly, *Aleurodicus dispersus*

Treatment	Conc. (%)	Mortality (%) at days after treatment					
		1	3	5	7	9	14
V. lecanii liquid formulation A 8 x 10^8 CFU ml^{-1}	0.15	3.14 (10.14)**	18.23 (25.25)	34.50 (35.97)	50.69 (45.40)	62.67 (52.36)	78.33 (62.24)
	0.30	3.89 (11.39)	19.19 (25.99)	35.67 (36.69)	54.81 (47.75)	63.14 (52.59)	81.45 (64.45)
	0.45	4.62 (12.39)	20.33 (26.78)	36.10 (36.93)	57.75 (49.49)	66.06 (54.39)	84.21 (66.58)
	0.60	7.39 (15.79)	22.00 (26.97)	38.22 (38.17)	59.00 (50.18)	67.76 (55.43)	88.67 (70.36)
	0.75	10.54 (18.91)	23.11 (28.73)	39.00 (38.65)	61.01 (51.35)	69.96 (56.73)	90.07 (71.66)
	1.00	12.23 (20.44)	25.52 (30.33)	41.92 (40.34)	63.50 (52.83)	72.27 (58.24)	92.34 (73.89)
V. lecanii Liquid Formulation B 8 x 10^8 CFU ml^{-1}	0.15	3.74 (11.09)	18.57 (25.55)	33.62 (35.18)	48.87 (40.37)	61.61 (51.71)	80.20 (63.58)
	0.30	4.66 (12.25)	19.91 (26.49)	35.53 (36.57)	51.96 (46.09)	65.28 (53.91)	82.33 (65.12)
	0.45	6.18 (14.42)	21.00 (27.28)	36.36 (37.11)	56.28 (48.62)	68.22 (55.67)	86.79 (68.70)
	0.60	8.20 (16.64)	23.13 (27.35)	39.40 (38.88)	61.61 (51.12)	69.14 (56.23)	90.21 (71.76)
	0.75	10.67 (19.09)	24.22 (29.47)	40.44 (39.47)	63.50 (52.83)	72.72 (59.50)	92.44 (74.00)
	1.00	13.33 (21.29)	26.10 (30.72)	42.26 (41.15)	65.97 (54.27)	75.12 (60.07)	93.45 (75.11)
V. lecanii WP Formulation (Phule Bugicide) 2 x 10^8 CFU ml^{-1}	0.2	4.84 (12.66)	16.17 (23.66)	28.28 (32.14)	51.12 (45.63)	62.27 (52.12)	82.18 (65.05)
Dimethoate	0.03	16.30 (23.81)	25.88 (30.59)	42.30 (40.57)	69.10 (56.23)	78.50 (62.37)	82.27 (65.12)
Control (only water spray) *	-	0.00	0.00	0.00	0.00	0.00	0.00
SEM±	-	0.81	1.28	1.35	1.88	1.87	2.39
C.D. (P = 0.05)	-	2.52	3.83	4.05	5.66	5.64	7.16

*The corrected mortality at 7^{th}, 9^{th} and 14^{th} day using Abbott's formula when actual mortality in control was 8.72, 11.47,13.44 and 15.17 per cent, respectively; **figures in parentheses are arc sin transformed values.

REFERENCES

Abbott, W. S. 1925. Method of computing the effectiveness of an insecticide. *Journal of Economic Entomology*, **18**: 265-267.

Ekbom, B. S. 1979. Investigations on the potential of a parasitic fungus (*Verticillium lecanii*) for biological control of greenhouse whitefly (*Trialeurodes vaporariorum*). *Swedish Journal of Agricultural Research*, **9**: 129-138.

Geetha, B. 2000. Biology and management of spiralling whitefly, *Aleurodicus dispersus* (Russell) (Homoptera: Aleyrodidae). Ph. D. Thesis, Tamil Nadu Agricultural University, Coimbatore, India, 196p.

Gomez, K. A. and Gomez, A. A. 1984. *Statistical procedure for Agricultural Research* Wiley and Sons, New York.

Horn, A. S. 1915. The occurrence of fungi on *Aleurodes vaporariorum* in Britain. *Annals of Applied Biology*, **2**: 109-111.

Jaichakravarthy, G. 2002. *Bioefficacy of* Verticillium lecanii *(Zimm.) Viegas against sucking pests.* M. Sc. (Agri.) 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, pp. 12-15.

Kanagaratnam, P., Hall, R. A. and Burges, H. D. 1982. Control of glasshouse whitefly, *Trialeurodes vaporariorum* by an aphid strain of the fungus, *Verticillium lecanii. Annals of Applied Biology*, **111**: 213-219.

Mahajan, P. V. 2003. *Bioefficacy of* Verticillium lecanii *(Zimmermann) Viegas against sucking pests attacking gerbera,* Gerbera jamesonii *(Hook) in polyhouse.* M. Sc. (Agri.) thesis, M. P. K. V., Rahuri, Maharashtra, India.

Masuda. T. 1993. Control of whitefly, *Trialeurodes vaporariorum* and *Bemisia tabaci* by *Verticillium lecanii. Annual Report of Society of Plant Protection*, **44**: 189-190.

Ravensberg, W. J., Malais, M. and Van der Schaaf, D. A. 1990. *Verticillium lecanii* as microbial insecticide against glasshouse whitefly, pp. 265-268. In: *Proceedings of the Brighton Crop Protection Conference – Pests and Diseases*, Vol. 3, British Crop Protection Council, Farnham.

Russell, L. M. 1965. A new species of *Aleurodicus* Douglas and two close relatives. *Florida Entomologist*, **48**: 47-55.

Wang, K. Q., Li, X. M., Liu, C. L. and Xu, C. Q. 2000. Preliminary study on controlling *Trialeurodes vaporariorum* with toxin extracted from *Verticillium lecanii*. *Journal of Plant Protection*, **26**: 44-45.

(Received: 16.10.08; Revised: 14.01.09; Accepted: 14.02.09)