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Entomopathogenic fungus, *Metarhizium anisopliae* (Metsch.) (Deuteromycotina: Hyphomycetes): A potential non-chemical option for the management of thrips, *Scirtothrips dorsalis* hood on grapes

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Abstract
Field studies were conducted consecutively for two years at ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru to evaluate the efficacy of two entomopathogenic fungi *viz*., *Metarhizium anisopliae* (Metsch.) and *Beauveria bassiana* (Bals.) Vuill against thrips, *Scirtothrips dorsalis* Hood on grapes (cv. Bangalore Blue). The efficacy was assessed in terms of reduction in population of thrips on leaves and extent of berry damage due to thrips and compared with an insecticide (thiamethoxam 25 WG) used as standard check. The results of two year study had clearly showed that entomopathogen, *M. anisopliae* was significantly effective against thrips. It resulted in 82.27 and 84.24 per cent reduction in thrips population after 14 days of spray in first and second year respectively which was statistically on par with the standard check. Even in terms of berry damage, *M. anisopliae* offered significant protection from thrips. The findings indicate that *M. anisopliae* could be an effective and safer component of integrated management of thrips in grapes.

Keywords: Grapes, *Metarhizium anisopliae,* thrips, management, bio pesticides

1. Introduction

In recent times, thrips have been emerging as one of the most challenging groups of sucking pests and are posing serious threat to several horticultural crops. Changing climate and cropping patterns coupled with indiscriminate use of broad spectrum insecticides are major factors that lead to the emergence of sucking pests like thrips in serious proportions. Several new groups of insecticide molecules are being recommended and used to manage thrips. Often farmers resort to spraying higher dose of insecticides at short intervals to check these pests, which not only increases the cost of production but also leads to undesirable consequences like pest resistance, resurgence and residues in the harvested produce. Hence it is very essential to find alternative means of pest management which are safe and effective. Biological control using entomopathogens is proved to be an environment friendly approach and could be an ideal component of Integrated Pest Management. Entomopathogens have an advantage of being amenable for mass multiplication in desired formulations with a shelf life of up to a year unlike parasitoids and predators. Fungi are known to be pathogenic to thrips under natural conditions and hence they have a greater scope as tools of thrips management [1]. There has been a considerable progress in formulation and use of entomopathogenic fungi as bio pesticides over the years with the isolation of new strains and genetic improvement of the existing ones [2]. Several species of entomopathogenic fungi like *Metarhizium anisopliae, Beauveria bassiana, Verticillium lecanii* etc. were evaluated against different groups of pests and varying degrees of success were reported [3]. *Metarhizium anisopliae,* a soil borne fungus is reported to infect more than 200 species of insects and is one of the first fungi used as biocontrol agent [4].

Thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae), polyphagous in nature, is one of serious pests on grapes and causes economic damage. Both nymphs and adults lacerate the tissues and suck the sap resulting in characteristic blotches on leaves and berries [5]. Besides mealybugs, thrips infestation necessitates application of systemic insecticides which often results in residues. Since pesticide residues are one of the major constraints in expanding global market for Indian grapes, it is highly desirable to standardize pest management strategies with minimum chemical inputs.

In this context, present studies were conducted to evaluate the efficacy of two species of entomopathogenic fungi *viz*., *M. anisopliae* and *Beauveria bassiana* against thrips *S. dorsalis*.

2. Materials and Methods

Field studies were conducted consecutively for two years during 2012-13 and 2013-14 at ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru in a grape vine yard (cv. Bangalore Blue) to evaluate the efficacy of two entomopathogenic fungi *viz*., *M. anisopliae* and *B. bassiana*. These fungi were isolated and formulated into liquid forms with a spore count of 1 x 10^8 by the biocontrol laboratory of ICAR-IIHR. The vines were of about 25 year old planted at a spacing of 3 x 2 m and trained in Bower system. The experiment was laid out in an RBD with four treatments including one insecticide (thiamethoxam 25WG) as the standard check and an untreated control. All treatments were replicated five times and four vines constituted one replication. The dosages of *B. bassiana*, *M. anisopliae* and thioamethoxam were 1ml, 0.5 ml and 0.5g per litre of water respectively. First spraying of treatments was taken up at about 25 days after pruning coinciding with the appearance of thrips population on leaves and shoots followed by the second spray after 15 days. Spraying was done using a backpack knapsack sprayer. Observations on thrips population were recorded from 20 shoots in each replication covering five shoots per plant, a day before and 1, 3, 7 and 14 days after spraying. Thrips population was recorded by gently tapping shoots on a white paper and visually counting the nymphs and adults. From the population counts in different treatments, per cent reduction over control was calculated. Besides thrips population, fruit damage due to thrips was also recorded from bunches in respective treatments and per cent berry damage was calculated. Data were subjected to ANOVA to test the significance of difference between treatments after the means were subjected to angular transformations.

3. Results and Discussion

3.1 Effect of treatments on thrips population

Data presented in Tables 1 and 2 clearly indicate the significant effect of all treatments on the target pest. In both the years, there was a significant reduction in population of thrips on the vines subjected to foliar application of entomopathogens as well as insecticide compared to untreated plants. The pre-treatment count of thrips ranged from 8.70 to 9.25 per shoot and the population in all the treatments was not significantly different. In the first year of the study, a day after spray (DAS), among entomopathogens, *M. anisopliae* brought down thrips population by 61.76% over control while *B. bassiana* showed lesser efficacy (29.41%). The standard check resulted in more than 90% reduction. Perusal of data indicates that with passage of time, the efficacy of entomopathogens has increased. This is because unlike insecticides, entomopathogens do not have quick knock down effect and they take time to cause mortality of insects [6]. However lack of quick knock down effect is compensated to an extent by the reduced feeding of insects infected with entomopathogenic fungi [7]. At 3 DAS, the efficacy of *M. anisopliae* has increased to 81.72% and after a week, *M. anisopliae* was the most effective non-chemical treatment with 86.28% reduction. However *B. bassiana* remained moderately effective with 68.05 and 73.42% reduction. At 14 DAS, there was a slight decline decline in the efficacy of all treatments but *M. anisopliae* maintained an efficacy (82.27%) that was on par with insecticides (88.61%). The efficacy of *B. bassiana* was significantly lower (70.45%) than *M. anisopliae*.

The treatment efficacy followed similar trend in the subsequent year of study where all treatments were found effective against thrips compared to control. Confirming the consistency of results, *M. anisopliae* gave higher reduction of thrips (84.24%) compared to *B. bassiana* (63.41%) and remained statistically at par with the standard check (88.61%) at 14 days after second spray (Table 2). The pooled efficacy of treatments in two years was in the order of thiamethoxam (89.18%) > *M. anisopliae* (83.22%) > *B. bassiana* (66.93%) (Fig.1). Similar results on the efficacy of *M. anisopliae* and *B. bassiana* were reported against the Western flower thrips, *Frankliniella occidentalis* Per. and onion thrips, *Thrips tabaci* Lind [8, 9].

3.2 Effect of treatments on berry damage due to thrips

The efficacy of a pest management tool should ultimately reflect in enhanced qualitative yield. Hence the efficacy of bio-pesticides was also assessed in terms of thrips damage on grape berries**.** Observations on the extent of thrips damage on berries indicated that containing thrips population in vegetative phase could significantly reduce their infestation at fruiting stage. The per cent berries damaged due to thrips was significantly lower in treated plots compared to control. During 2012-13 the thrips damage ranged from 0.8 to 3.4 in different treatments where *M. anisopliae* recorded 1.95%. In the subsequent year too, the trend was same, though damage was relatively higher in all treatments. The pooled data indicate that *M. anisopliae* was at par (3.07%) with standard check (1.05%) in reducing thrips damage to bunches while another entomopathogenic fungus *B. bassiana* resulted in 9.4% damaged berries.

The outcome of the present studies gives strength to the idea of a pest management strategy without solely depending on chemical insecticides. Though in terms of overall efficacy, insecticide, expectedly, has a slight edge over bio pesticide *M. anisopliae*, the long term benefits associated with the latter and fast growing deleterious effects of chemical insecticides make them desirable component of IPM package. Grapes being an export oriented crop with least tolerance to pesticide residues, inclusion of non-chemical tools like *M. anisopliae* in managing serious pests like thrips, goes a long way in achieving safe and sustainable production of grapes.

Table 1: Efficacy of entomopathogenic fungi in comparison with insecticide against grape thrips (2012-13)

Treatment	Pre-count (No. of thrips/ shoot)	Per cent reduction in thrips population over control			
		1 DAS	3 DAS	7 DAS	14 DAS
Beauveria bassiana	9.25	29.41 (32.83)	68.05 (55.56)	73.42 (58.95)	70.45 (57.06)
Metarhizium anisopliae	8.70	61.76 (51.81)	81.72 (64.69)	86.28 (68.26)	82.27 (65.09)
Thiamethoxam	8.85	94.7 (76.69)	96.77 (79.58)	94.44 (76.39)	88.61 (70.29)
Control	9.10	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00(0.00)
CD (P = 0.05)	NS	6.53	5.82	5.14	5.76

*Figures in parentheses are angular transformed values

Table 2: Efficacy of entomopathogenic fungi in comparison with insecticide against grape thrips (2013-14)

Treatment	Pre-Count (No. of thrips/shoot)	Per cent reduction in thrips population over control			
		1 DAS	3 DAS	7 DAS	14 DAS
Beauveria bassiana	10.42	31.24 (33.97)	74.92 (59.93)	72.45 (58.35)	63.41 (52.77)
Metarhizium anisopliae	10.58	58.76 (50.25)	78.42 (62.38)	84.28 (66.66)	84.24 (66.58)
Thiamethoxam	9.86	90.60 (72.15)	94.45 (76.45)	96.14 (78.61)	89.75 (71.28)
Control	10.52	0.00	0.00	0.00	0.00
CD (P = 0.05)	NS	6.94	6.85	6.27	5.91

*Figures in parentheses are angular transformed values

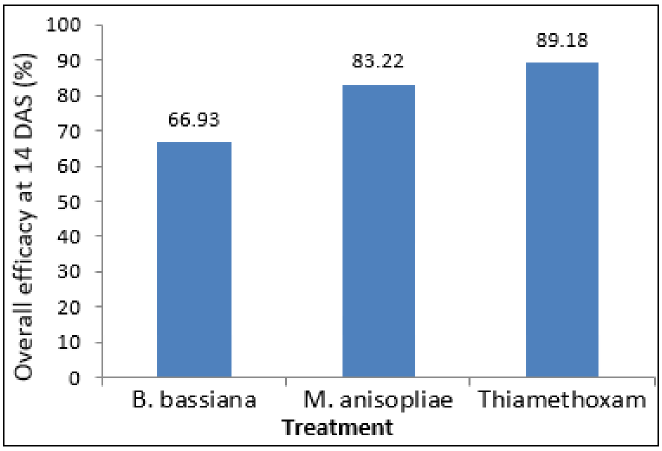

Fig 1: Overall efficacy of treatments (mean of two years) at 14 days after spray

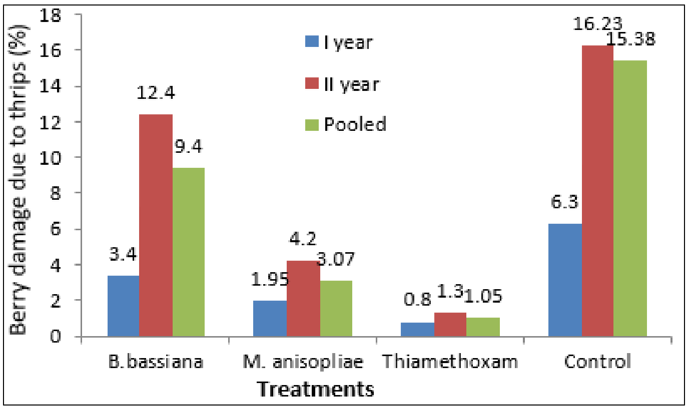

Fig 2: Effect of entomopathogenic fungi and standard check (thiamethoxam) on berry damage due to thrips

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