Optimizing abiotic conditions for higher efficacy of 3 fungal pathogens against chilli thrips, *Scirtothrips dorsalis* Hood

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Abstract

Chilli thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) is a United States quarantine pest known to cause significant economic damage on a variety of crops worldwide. Since there is paucity of information on biological control of this pest chemical control is always primary mode of its management. Thus we evaluated the efficacy of 3 fungal pathogens; *Beauvaria bassiana*, *Metarhizium anisopliae* and *Paecilomyces fumosoroseus* against chilli thrips. The efficacy of these fungal pathogens depends greatly on the abiotic conditions including relative humidity and time of application and many other factors. In this study we evaluated effect of 3 different moisture levels on the efficiency of these 3 fungal pathogens. In addition, we also determined the activity of 3 fungal pathogens against chilli thrips when applied at different timings of the day. Although the effectiveness of these fungal pathogens was inconsistent against chilli thrips, but they provided significant reduction in population of chilli thrips during current studies.

Introduction

Chilli thrips, *Scirtothrips dorsalis* Hood, is a pest of various vegetable, ornamental and fruit crops in southern and eastern Asia, Africa, and Oceania (Ananthakrishnan 1993, CABI/EPPO 1997, CAB 2003). In Western Hemisphere, chilli thrips was reported for the first time in 2003, established in St. Lucia and St. Vincent in the insular Caribbean Plants in 120 taxa are reported to be the hosts of chilli thrips. One or more chilli thrips life stages occur on all above ground plant parts of its hosts, and causes scarring damage due to its feeding (Chang et al. 1995).

To date, 65 positive records have been identified from 16 counties in Florida. Most of these records have been from rose, but a few were from *Capsicum annuum*, and one was from *Jasminum*.

Worldwide distribution of chilli thrips

Florida (1991, 1994, 2005, landscape ornamentals & retail plants)
Texas (2005, roses in landscape; roses & peppers in retail centers)
Puerto Rico (2006, mango)
Barbados (2005, sea island cotton, beans, carrots, peppers, eggplant)
Jamaica (1995; 2007, 2008; still no major outbreak up to 2008)
St. Lucia (2004, pepper, cucumber, eggplant, amaranth; Was found in 4 of 8 Districts in 2004)
St. Vincent (2003, pepper, amaranth, bean, eggplant, okra, pumpkin, tomato, watermelon; in 8 of 8 Districts)
Trinidad & Tobago (2004, pepper, cucurbits, eggplant, okra; in 6 of 8 counties; not of concern in 2008)
Venezuela (2000 causing damage on grapevines)
Suriname (2004, hot pepper, Momordica bitter melon, Citrus - Cleopatra rootstock, lab.

Distribution of chilli thrips in the greater Caribbean

Knowledge on the management of this pest is still in an early stage; and principally based on synthetic insecticides. Thus we evaluated effectiveness of various fungal pathogens to be included in integrated pest management program against this serious pest. Considering the importance of this pest, we tried to optimize various abiotic factors which may affect the potential of these entomopathogens.

Objectives

Objective 1. Effect of timing of application of fungal pathogens on populations of chilli thrips

Objective 2. Effect of moisture (irrigation) on the efficacy of selected fungal pathogens in regulating chilli thrips

Products evaluated are:

S.N	Fungal Pathogen	Formulation	Source	Rate of application	Mode of application
1	*Beauvaria bassiana*	BotaniGard® ES $2x10^{13}$ CFU /qt	Agri-Turf Supplies, Inc.	2 qt/acre	Foliar spray
2	*Metarhizum anisopliae*	NZBPC2102 $4x10^{9}$ CFU/ml	Novozymes Bio. Inc.	29oz/acre	Foliar spray
3	*Paecilomyces fumosoroseus*	PFR-97 20% EDG $1x10^{9}$ CFU/gm	Certis USA	16oz/acre	Foliar spray

a. Larva of *S. dorsalis*
b. Adult of *S. dorsalis*

c. Host plants damaged by *S. dorsalis*

Material and methods

Two different studies were conducted on diel timing of application of fungal pathogens and irrigation (single vs. multiple applications) to improve the potentiality of these entomopathogens in an outdoor growing area of Tropical Research and Education Center campus, Homestead FL. 'Jalapeno' pepper seedlings were planted in 1 gallon plastic pot containing Fafard Mix® potting mix. All four treatments were applied once a week for interval of four weeks. All four treatments including non-treated control were applied on 6 plants each, arranged in a randomized complete block design (RCBD) with four replicates. Evaluation of treatments were made weekly by counting the numbers of larvae and adults of chilli thrips on whole plant. . Bio-pesticides were prepared in water with neutral pH 7.21

Study 1: Four treatments were applied at different times of the day i.e., 8:00 EST, 13:00 EST and 18:00 EST to study the effect of time of application on activity of these entomopahtogens.
Study 2: Experimental design was factorial. The main plot was three moisture levels and subplot was three entomopathogens to be tested.

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1st treatment: Plants were irrigated once at 8:00 EST with no additional application of water
2nd treatment: Plants were irrigated once at 8:00 EST with one additional application of water at 12:00 EST.
3rd treatment: Host plants were irrigated once at 8:00 EST with two additional application of water at 13:00 EST and 16:00 EST

Results and Discussion

Time of application	Treatments	1-June Pre-spray	8-Jun	15-Jun	22-Jun	29-Jun
8:00 EST	Control	0	2.33	33.66	60	58
8:00 EST	*B. Bassiana*	0	0.17	42.5	39.33	54.67
8:00 EST	*M. Anisopliae*	0	2	36.33	19.67	47.67
8:00 EST	*P. fumosoroseus*	0	3.33	29.17	20.17	38.83
13:00 EST	Control	6.33	7.67	65.33	50.50	60.17
13:00 EST	*B. bassiana*	3.83	2.83	32.67	36.83	48.17
13:00 EST	*M. anisopliae*	0.17	2.67	24.67	22.83	43.33
13:00 EST	*P. fumosoroseus*	0.17	0.00	30.50	38.83	39.17
18:00 EST	Control	0.50	8.83	37.50	61.83	57.33
18:00 EST	*B. bassiana*	5.50	10.83	10.50	27.17	33.67
18:00 EST	*M. anisopliae*	13.17	5.67	20.33	28.17	29.83
18:00 EST	*P. fumosoroseus*	11.50	26.00	18.67	19.33	24.67

Table 1. Mean numbers of chilli thrips larvae/plant in study 1

Time of application	Treatments	1-June Pre-spray	8-Jun	15-Jun	22-Jun	29-Jun
8:00 EST	Control	1.00	8.17	3.83	39.17	26.67
8:00 EST	*B. bassiana*	1.67	6.83	3.67	23.00	21.83
8:00 EST	*M. anisopliae*	2.17	7.17	4.33	12.50	21.67
8:00 EST	*P. fumosoroseus*	2.33	8.00	4.83	11.00	16.83
13:00 EST	Control	1.50	7.83	5.00	24.17	23.00
13:00 EST	*B. bassiana*	1.83	5.17	4.17	18.67	19.33
13:00 EST	*M. anisopliae*	0.33	2.33	4.00	20.00	20.83
13:00 EST	*P. fumosoroseus*	1.00	4.33	4.50	13.33	17.00
18:00 EST	Control	1.67	4.00	8.67	22.83	23.00
18:00 EST	*B. bassiana*	2.17	3.17	5.67	12.17	14.50
18:00 EST	*M. anisopliae*	3.33	4.17	3.67	13.33	14.50
18:00 EST	*P. fumosoroseus*	5.83	2.67	2.67	9.50	12.17

Table 2. Mean numbers of chilli thrips adult/ plant in study 1

Moisture level	Treatments	4-June Pre-spray	11-Jun	18-Jun	25-Jun	1-Jul
1	Control	1.16	16.66	31.33	47.5	66.66
1	*B. bassiana*	4.83	11.83	13.33	30.33	46
1	*M. anisopliae*	2.66	6	22.16	25	43.5
1	*P. fumosoroseus*	2.166	11.16	22	25.33	50.66
2	Control	2.5	13	41.83	69.66	80.16
2	*B. bassiana*	2.166	7.83	31.33	22.83	49.66
2	*M. anisopliae*	2.83	9.5	12.83	17.83	31.66
2	*P. fumosoroseus*	4.5	7.83	15.33	25.66	37.5
3	Control	4.83	6	29.16	64.83	106
3	*B. bassiana*	1.166	3.66	22	28.33	33.16667
3	*M. anisopliae*	2.166667	3.66	10.66	27.83	22.16667
3	*P. fumosoroseus*	1.166667	4.66	17.5	22.33	29.66

Table 3. Mean numbers of chilli thrips larvae/plant in study 2

Moisture level	Treatments	4-June Pre-spray	11-Jun	18-Jun	25-Jun	1-Jul
1	Control	2	4.16	10	24.16	27.33
1	*B. bassiana*	1.5	2.5	8	11.16	23.5
1	*M. anisopliae*	1.33	4	6.66	11.66	18.66
1	*P. fumosoroseus*	2.33	3.5	7	11	19.16
2	Control	2.16	7.66	15.16	25.16	41
2	*B. bassiana*	1.5	4.83	11.33	12	17.83
2	*M. anisopliae*	2.83	3.66	9.83	9.33	11.5
2	*P. fumosoroseus*	4.83	5.16	8.83	9.66	13.66
3	Control	0.33	3	10.66	27.16	35.5
3	*B. bassiana*	0.5	4.16	7.33	17	11.66
3	*M. anisopliae*	1.16	3.66	9.16	17.33	11.5
3	*P. fumosoroseus*	1.83	3.5	6.5	18.83	13.16

Table 4. Mean numbers of chilli thrips adult/plant in study 2

Study 1. Chilli thrips larval distribution was inconsistent at the initiation of the management program. It is evident from results that application of fungal pathogens at different timing showed variation in activity of fungal pathogens against chilli thrips. For first two weeks there was not major difference in larval counts among various treatments (applied at different time of the day) but once population of fungal pathogen got established, great reduction in number of larvae and adults (Table 1 & 2) was observed in the treatments applied at 18:00 EST. It suggests optimum control of chilli thrips can be obtained by application of entomopathogens at around 18:00 EST when availability of sunlight is insufficient to alter pathogenicity of these fungal pathogens and helps in its establishment on host surface.

Study 2. Fungal virulence is highly associated with the speed of germination. Due to high heat, viability of fungal spores reduces and in turn affects the efficacy of the entomopathogens. Aim of this study was to check if cultural practice like, provision of high moisture availability can induce any change in effectiveness of fungal pathogens and we found that treatments applied with high moisture level showed enhanced activity (Table 3 & 4) towards regulating the population of chilli thrips.