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TO EVALUATE THE BIO-EFFICACY AND PHYTOTOXICTY OF POWDER FORMULATION OF BIODEWCON (*AMPELOMYCES QUISQUALIS* 2.00% WP) AGAINST POWDERY MILDEW (*SPHAEROTHECA FULIGINEA*) IN CUCUMBER CROP

T. Sivakumar, P. Balabaskar, P. Renganathan and K. Sanjeevkumar
Department of plant pathology, Faculty of Agriculture, Annamalai University, Annamalai Nagar 608002, Tamil Nadu.India
E-mail :sivaindu_agri@yahool.co.in

Abstract

Powdery mildew fungi represent one of the most widely distributed and destructive groups of plant pathogens worldwide. Field grown cucurbit crops are often threatened by powdery mildews, which reduce yield and cause important economic losses. At present, the main management practices are the use of repeated fungicide applications. However, increasing public concerns about potential impact of pesticides on the environment, have necessitated alternative or complementary methods that are effective, reliable and environmentally safe. Biological control agents (BCAs) have received most of the attention because of their versatile modes of action to protect plants and their potential to be included in integrated management programmes. An evaluation was made of the ability of mycoparasite-based products Bio Dewcon (*Ampelomyces quisqualis* 2.00% WP) to manage powdery mildew disease, caused by (*Sphaerotheca fuliginea*). Further Bio-Dewcon promoted better yield and application of Bio-Dewcon(2.00 WP) recorded the least Powdery mildew incidence in cucumbers in both leaves and fruit could be successfully employed as an eco-friendly strategy for the management of Powdery mildew disease of cucumber Further, application of Bio-Dewcon showed no phytotoxic symptoms and was found safe to the environment as it did not affect the beneficial insects

Keywords: cucumber crop, Powdery mildew (*Sphaerotheca fuliginea)*, Bio-Dewcon *Ampelomyces quisqualis.*

Introduction

Cucumber plants are attacked by several pathogens causing considerable reduction in its production. Powdery mildew of cucumber is caused by (*Sphaerotheca fuliginea*) is a potent production constraint during cool and dry weather conditions. Cool period that follows monsoon and during winter (Rabi) in both seasons it is a serious problem. Most of the cucumber is highly susceptible to powdery mildew. In many cucumber-growing areas powdery mildew has become severe issues. It is widespread and caustic diseases in semi – arid regions, where high humidity is ubiquitous (Ahmed *et al*., 2000 and El-Nagger *et al*., 2012). Powdery mildew developed quickly cucumber and large number of spores can be produced in a short time (Reuveni and Raviv, 1997). Losses caused by powdery mildew on cucumber may reach to 30- 80% of yield (El-Nagger *et al*., 2012). Although powdery mildew could be controlled by chemical fungicides intensive use of fungicide is regarded undesirable both for environmental pollution and development of resistance populations of the pathogen (Pimentel *et al*., 1992 and Chen *et al*., 2007). Increasing concerns for public health boost researcher to find out eco-friendly safe strategies to contr plant diseases which, are applied in repetition procedures. It is also possible tousle bio control preparations to control of the pathogen (Eladetal, 1995). However, One important aspirant for biological control of powdery mildew is new bioformulations Bio Dewcon (*Ampelomyces quisqualis* 2.00% WP) effective against Powdery mildew (*Sphaerotheca fuliginea*). *Ampelomyces quisqualis* Ces.: Schlidt. from *Oidium* sp. that infects *Catha edulis* in Israel. This specifically parasitizes the powdery mildew fungi. Both mycelium and fruiting bodies are colonized. It could antagonize by parasitism several powdery mildew fungi belonging to the genera *Oidium*, *Erysiphe*, *Podosphaera*, *Uncinula* and *Leveillula* (Sztejnberg *et al*., 1989). The purpose of the present research work was to evaluate the Bio-efficacy and phytotoxicty of powder formulation of Bio Dewcon (*Ampelomyces quisqualis* 2.00% WP) against Powdery mildew (*Sphaerotheca fuliginea*) in cucumber. The following observations were made by recorded on Percent Disease incidence (PDI), Yield (q /ha), Phytotoxicity and Parasite and predator as per the standard procedure.

Materials and Methods

Field trial was conducted at makkanur (Dharmapuri district) in Tamil Nadu during January, 2018 - March, 2018 the well-known endemic area for the occurrence of Powdery mildew of cucumber (*Sphaerotheca fuliginea*) disease of cucumber. The Hybrid cucumber Malini (Seminis ma susceptible variety to Powdery mildew, was used for this study. All the agronomical practices were strictly adopted during the cropping period as per the crop production manual for horticultural crops published by the Department of Horticulture, Government of Tamil Nadu.

The Percent Disease incidence (PDI is recorded before the treatment imposition and Three applications: 25 days after transplanting and 10days after 1st spray and 10 days after second spray using a knapsack sprayer of the Bio-Dewcon. The yield, Phytotoxicity and parasite and predator population were recorded at the time of final harvest

Treatment details

Treatments	Product	Dosage kg /ha)	Spray volume (in liter)
T1	Bio-Dewcon	3.0 kg	500
T2	Bio-Dewcon	4.0kg	500
T3	Bio-Dewcon	5.0 kg	500
T4	Hexaconazole	0.1%	500
T5	Control	-	-

Method and date of foliar spray application

As per the treatment schedule, the product was mixed with required quantity of water and sprayed with a high volume knapsack sprayer. The first spray was given 25 days after the sowing of the crop when the weather conditions were favourable for the powdery mildew disease. Another spray was given 10 days after the first spray. Third spray was given 10 days after second spray.

First Spray– 11.02.2018

2nd Spray – 22.02.2018

3rd Spray – 04.03.2018

Assessment of Powdery mildew diseases:

The data pertaining to the incidence of powdery mildew disease the 0-4 scale (0-Healthy-nil powdery growth; 1- trace to 25 per cent; 2- 26 to 50%; 3-50 to 75% and 4- 76-100% leaf area having powdery growth) developed by Rao (1991) was used. The percent disease index (PDI) was estimated using the formula suggested by McKinney (1923).

Scale	Powdery mildew incidence
0	Healthy or no infection
1	trace to 25 per cent infection
2	26 to 50% infection
3	50 to 75% infection
4	76-100%nfection

Fruit yield:

The cucumber were harvested periodically and the yield per hectare was calculated and recorded as tonnes/ha.

Assessment of phytotoxicity

Cucumber plants were observed for phytotoxic symptoms (If any) such as chlorosis, necrosis, scorching, epinasty and hyponasty on 1, 3, 5, 7 and 10 days after treatment of powder formulation of Bio-Dewcon (*Ampelomyces quisqualis* 2.00 WP) and grading was done as per CIB guidelines adopting 0 - 10 scale. Leaf injury was graded based on visual rating on a 1-10 scale (CIB, 1989)

1 - 1 – 10% of leaf injury	6 - 51.1 - 60% of leaf injury
2 – 11.1 – 20% of leaf injury	7 – 61.1 - 70% of leaf injury
3 - 21.1 – 30% of leaf injury	8 - 71.1 – 80% of leaf injury
4 - 31.1 - 40% of leaf injury	9 - 81.1 - 90% of leaf injury
5 - 41.1 - 50% of leaf injury	10 - 91.1 - 100% of leaf injury

Effect on Natural Enemies

The population of the natural enemies viz., Spiders, Dragon fly, Wasp and damsel fly was also assessed following standard procedures in the treatment ofpowder formulation of Bio-Dewcon (*Ampelomyces quisqualis* 2.00 WP) and untreated plots and recorded.

Statistical Analysis:

The data collected were subjected to statistical analysis using computer aided IRRISTAT Version 92 software developed by the International Rice Research Institute, Philippines.

Results

Powdery mildew disease

In general, all the new bioformulations of Bio-Dewcon (*Ampelomyces quisqualis* treatments showed significant inhibitory effect in reducing the powdery mildew disease when compared to control. Among the various treatments, the treatments with Bio-Dewcon 2.00 WP) @ 5.0 kg /ha proved very effective and revealed supremacy in controlling the Powdery mildew disease of Cucumber.

The powdery mildew disease in plants at 35day and45 days after spray and recorded the least per cent disease index 10.92 and 14.32.This was followed by treatment Bio Dewcon 2.00 WP4kg/ha, Bio Dewcon 2.00 WP 3.kg/ha and market sample of Hexaconazoleand were on par with each other. While in the untreated control the maximum PDI of 20.17 and 24.19 was recorded (Table 1).

Fruit Yield

The results showed that all the treatments with new bioformulations of Bio-Dewcon (*Ampelomyces quisqualis*) recorded higher yields when compared to control. However, among all treatments, Bio Dewcon 2.00 WP5kg/ha, recorded the maximum fruit yield with 18.42t/ha which was at par with Bio Dewcon 2.00 WP4kg/ha 17.03t/ha. The treatment with Market sample of Hexaconazole yielded 18.12 t/ha the untreated control recorded the lowest fruit yield with 12.79t/ha (Table 2).

Phytotoxicity

Periodical observations were made for the phytotoxic effect if any due to treatment with new bioformulations of Bio-Dewcon (*Ampelomyces quisqualis* in field conditions. There was no phytotoxic symptoms *viz*., leaf tip injury, leaf surface injury, vein clearing, necrosis, epinasty and hyponasty in all the concentrations of Bio-Dewcon treated plots and during the entire cropping period (Table 3).

Effect on the population of natural enemies

It was conspicuous to note that the occurrence of natural enemies spiders, Dragon fly, Damsel fly and wasps population increased appreciably in Bio-Dewcon (*Ampelomyces quisqualis*) treated plots as compared to chemical treatment. Observation of natural enemy population throughout cropping period has indicated that the plants

treated with Bio-Dewcon attracted the natural predators and parasites in especially, the spiders population was found increased in Bio-Dewcon treated plots. Also appreciable number of Dragon fly and Damsel fly were observed with the Bio-Dewcon treated plots when compared with the plots treated with Hexaconazole (Table 4).

Discussion

Application of new bioformulations of Bio-Dewcon (*Ampelomyces quisqualis* (2.00 WP) was found to be effective against Powdery mildew (*Sphaerotheca fuliginea*). Further Bio-Dewcon promoted better yield. Further, application of Bio-Dewcon showed no phytotoxic symptoms and was found safe to the environment as it did not affect the beneficial insects. Similar results were also reported by several workers, The first significant trial using *Ampelomyces* was reported by Jarvis and Slingsby (1977) who used conidial suspensions of the mycoparasite to control cucumber powdery mildew in greenhouse trials successfully. In most experiments, Ampelomyces was sprayed onto infected plants as a conidial suspension and the applications were repeated several times during the season to ensure a high level of control (e.g., Sztejnberg *et al*., 1989; Philipp *et al*., 1990). Ampelomyces has been shown to be compatible with a large number of fungicides used in the control of powdery mildews, such as triforine, quinomethionate (Sundheim, 1982; Shishkoff & McGrath, 2002), myclobutanil (Shishkoff & McGrath, 2002. AQ10 has also been shown not to interfere with the activity of another fungal biocontrol product, Trichodex, when co-inoculated onto cucumber for dual control ofpowdery mildew and grey mould (Elad *et al* ., 1998). The effectiveness of this mycoparasite was shown on young, newly infected leaves and on older leaves. Evaluation of the degree of parasitisation of *S. fusca* thallu by the mycoparasiter revealed an even better degree of disease control. This resulted in healthier leaves, as described previously by Abo-Fouletal.(1996), who showed that *A. quisqualis*-treated leaves showed improved photosynthesis ability. Control of the powdery mildews by AQ10was reported previously (Hofsteinand Fridlender,1994; Pasini *et al*.,1997). Rose powdery mildew is another major problem in greenhouse systems. Verhaar *et al*. (1999) compared the efficacy of five fungal biocontrol agents (*A. quisqualis* , Aph. album , *Pseudozyma rugulosa* , T. minor Nyland and V. lecanii) against this pathogen at different RHs, and found that only one isolate of *V. lecanii* was able to control the disease efficiently at a RH B 100%. In conclusion of application of new bioformulations of Bio-Dewcon(*Ampelomyces quisqualis* (2.00 WP) was found to be effective against Powdery mildew (*Sphaerotheca fuliginea*). Further Bio-Dewcon promoted better yield and application of Bio-Dewcon (2.00 WP) recorded the least Powdery mildew incidence in cucumbers in both leaves and fruit could be successfully employed as an eco-friendly strategy for the management of Powdery mildew disease of cucumber Further, application of Bio-Dewcon showed no phytotoxic symptoms and was found safe to the environment as it did not affect the beneficial insects

Table 1: Bioefficacy of BioDewcon (*Ampelomyces quisqualis* 2% WP) on powdery mildew of cucumber

Treatment No.	Treatment	Dosage	PDI for powdery mildew incidence			% reduction over control	
			25days after 1st spray	35 Days after 2nd spray	45 days after 3rd spray	35 Days after 1st spray	45 days after 2nd spray
T1	Bio Dewcon	3.0 kg	4.0	14.43	18.31	28.45	26.13
T2	Bio Dewcon	4.0 kg	5.0	12.07	16.72	40.65	32.64
T3	Bio Dewcon	5.0 kg	5.0	10.92	14.32	45.86	42.23
T4	Hexaconazole	0.1%	6.0	8.82	12.02	56.27	51.51
T5	Control	-	5.0	20.17	24.79	-	-
	CD @ 5%		NS	2.7	2.8		

Table 2: Bioefficacy of BioDewcon (*Ampelomyces quisqualis* 2% WP) on yield of cucumber

Treatment No.	Treatments	Dosage (kg ha^{-1})	Yield per plot (kg per 40 m^2	Yield (in t ha^{-1})	% Yield increase over control
1	Bio Dewcon	3.0 kg	61.27	15.92	19.66
2	Bio Dewcon	4.0 kg	69.04	17.03	24.89
3	Bio Dewcon	5.0 kg	71.23	18.42	30.56
4	Hexaconazole	0.1%	73.47	18.44	30.63
5	Control	-	51.61	12.79	-
	SE **CD @ 5%**		1.92 4.03	0.25 0.50	

Table 3: Phytotoxicity evaluation of ofBioDewcon (*Ampelomyces quisqualis* 2% WP) on cucumber

Treatments	Dosage (kg/ha)	Phytotoxicity parameters observed (mean data recorded at 10, 15, 20 and 30 days after each application)					
		Leaf injury on tips/ surface	Leaf injury on tips/ surface	Leaf injury on tips/ surface	Leaf injury on tips/ surface	Leaf injury on tips/ surface	Leaf injury on tips/ surface
Bio Dewcon	3.0 kg	Nil	Nil	Nil	Nil	Nil	Nil
Bio Dewcon	4.0 kg	Nil	Nil	Nil	Nil	Nil	Nil
Bio Dewcon	5.0 kg	Nil	Nil	Nil	Nil	Nil	Nil
Hexaconazole	0.1%	Nil	Nil	Nil	Nil	Nil	Nil
Control	-	Nil	Nil	Nil	Nil	Nil	Nil
Bio Dewcon	12.0	Nil	Nil	Nil	Nil	Nil	Nil

Table 4: Effect Bio-Dewcon (*Ampelomyces quisqualis*2.00 % WP)) on the population natural enemies)

T. No	Treatments	*Spiders (Nos.)			*Dragon fly (Nos.)			*Damsel fly (Nos.)			*Wasp (Nos.)		
		Before I SA	After I SA	After II SA	Before I SA	After I SA	After II SA	Before I SA	After I SA	After II SA	Before I SA	After I SA	After II SA
T1	Bio-Dewcon 3.0 kg	8.43	8.60	8.63	1.57	1.65	1.72	2.40	2.45	2.73	2.31	2.40	2.49
T2	Bio-Dewcon 4.0 kg	8.40	8.70	8.76	1.65	1.69	1.79	2.49	2.55	2.63	2.38	2.53	2.56
T3	Bio-Dewcon 5.0 kg	8.43	8.81	8.82	1.45	1.75	1.1.96	2.40	2.65	2.99	2.41	2.70	2.83
T4	Ridomil	8.42	7.28	7.62	2.50	1.45	1.46	2.63	1.30	2.28	2.40	1.41	1.42
T5	Control	8.45	7.22	7.40	1.1.56	1.22	1.20	2.51	1.50	2. 70	2.38	1.47	1.56

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