

## Management of Pineapple Disease of Sugarcane through Biological Means

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### ABSTRACT

*Trichoderma harzianum* was found an effective antagonist to *Ceratocystis paradoxa*, the causal organism of pineapple disease of sugarcane. It exhibited a strong antagonism against *Ceratocystis paradoxa* by overgrowing on it, forming lysed zone and inhibiting its growth. In the present investigation *Trichoderma harzianum* was found as effective as fungicide (Bavistin 50WP-Carbendazim 50WP) in controlling *Ceratocystis paradoxa* both in *in vitro* and *in vivo* condition. *Ceratocystis paradoxa* failed to grow on *Trichoderma harzianum* and Bavistin 50WP treated PDA plates. *Trichoderma harzianum* and Bavistin treated sugarcane setts showed significantly higher germination (20.34 to 26.17% higher) over control. *Trichoderma harzianum* and Bavistin treated sugarcane setts showed respectively 40.72 and 62.69% higher yield of cane compared to control. Hence *Trichoderma harzianum* may be used as bio agent and alternative to Bavistin 50WP (a standard sett treating fungicide of sugarcane) in controlling pineapple disease of sugarcane.

**Key words:** Sugarcane, pineapple disease, biological control.

### INTRODUCTION

Sugarcane is an important cash cum industrial crop in Bangladesh. But its production is low as compared to other cane growing countries of the world. Among various factors diseases are considered to be the most severe threat to sugarcane production in the world (Huang and Xu, 1994). Pineapple disease incited by *Ceratocystis paradoxa* cause considerable losses in sett germination. The disease is severe in heavy textured soils and poor drained fields and can reduce germination up to 47% (Anon. 1999). The affected setts emit a smell resembling that of the mature pineapple fruit (Went, 1896). The odour is due to ethyle acetate formed by the metabolic activity of the pathogen. The ethyle acetate content in the infected tissue may rise up to 1% that is sufficient to inhibit germination of buds (Kuo *et al.* 1969). The disease can reduce cane yield by 31-35% (Anon. 2000). The pathogen is soil-borne. At present a systemic fungicide named Bavistin (Carbendazim 50WP) is being used to protect the setts from the attack of pineapple disease (Anon, 1996). But control of the disease with fungicide is expensive and also heavy use of chemicals is hazardous to environment.

Biological control may provide protection to the host (Hyakumachi, 1994). *Trichoderma harzianum* has been found as an effective bio control agent against soil-borne pathogens (Kowalik, 1996). This fungus was also found to stimulate the plant growth (Inbar *et al.* 1994).

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However, the potentiality of using bio control agents in controlling sugarcane disease is yet to be investigated. Considering the above facts, the present study was designed -

1. To assess the antagonism of *Trichoderma harzianum* against *Ceratocystis paradoxa* *in vitro*,
2. To evaluate the efficiency of *Trichoderma harzianum* in controlling pineapple disease.

## MATERIALS AND METHODS

Antagonism between *T. harzianum* and *C. paradoxa* was studied by dual culture technique in laboratory condition. The mycelial block of 5mm of each of the pathogen and the antagonist were placed on oat meal agar medium at the opposite ends of the petriplates. The plates were incubated at room temperature to observe the growth inhibition, overlapping growth, inhibition zone and lysis of the pathogen.

Performance of *T. harzianum* and Bavistin was studied in the laboratory. *C. paradoxa* was allowed to grow on PDA medium containing spore suspension of *T. harzianum* and 0.1% Bavistin (Carbendazim 50WP) separately. Control plates were also maintained. Two ml spore suspension ( $10.8 \times 10^7/\text{ml}$ ) of *T. harzianum* was added to a conical flask containing 250 ml of melted PDA at 40°C, shaken thoroughly and the media was then plated. Mycelial discs (5 mm) of *C. paradoxa* was placed at the center of the plates. An amount of 0.25 gm Bavistin was added to a conical flask containing 250 ml of melted PDA and was shaken thoroughly. The media was then plated and 5mm discs of *C. paradoxa* were placed at the center of each plate. All the plates were incubated at room temperature for 10 days to observe the growth of *C. paradoxa*. Data on radial growth of *C. paradoxa* was recorded after 24, 48 and 72 hours of incubation.

The field experiment was laid out in a randomized block design with 3 replications. BSRI released variety Ild 34 was used in this experiment. The land was prepared following the usual agrotechniques used for sugarcane cultivation. Nine different treatment combinations including control were used for the study. The treatments were as follows:

T<sub>0</sub> = Untreated Control

T<sub>1</sub> = Setts treatment with *T. harzianum*

T<sub>2</sub> = Setts treatment with Bavistin (0.1%)

T<sub>3</sub> = Application of saw dust inoculated with *T. harzianum* in the furrow

T<sub>4</sub> = Drenching of furrows with spore suspension ( $10.8 \times 10^7/\text{ml}$ ) of *T. harzianum*

T<sub>5</sub> = Drenching of furrows with Bavistin (0.1%)

T<sub>6</sub> = T<sub>1</sub> + T<sub>3</sub>

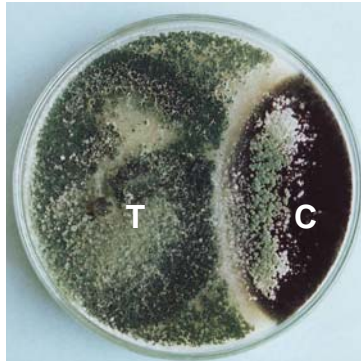
T<sub>7</sub> = T<sub>1</sub> + T<sub>4</sub>

T<sub>8</sub> = T<sub>2</sub> + T<sub>5</sub>

Data was collected on germination of setts after 75 days of planting and yield of cane at harvest.

## RESULTS AND DISCUSSION

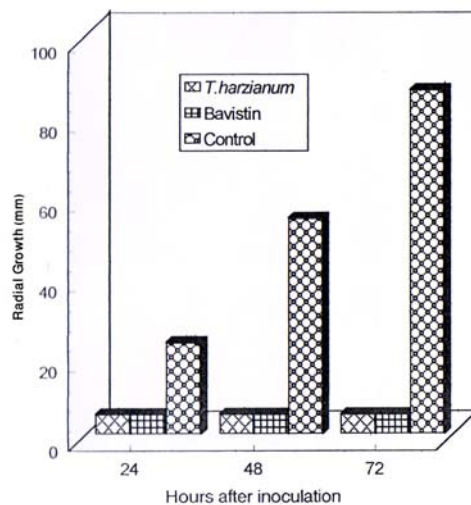
The study on mycoparasitism between *T. harzianum* and *C. paradoxa* was carried out on PDA in petriplates having 9 cm diameter. Both the fungi were found to grow and advanced to each other. After 10 days of incubation *T. harzianum* exhibited stronger antagonistic effect on *C. paradoxa* by overgrowing on it forming lysed zone and inhibiting the growth of *C. paradoxa* (Fig. 1). In the present investigation, it was found that *Ceratocystis paradoxa* failed to grow on Bavistin (0.1%) treated plates and in dual cultured plates with *T. harzianum* under laboratory condition. In control plates *C. paradoxa* showed 23, 54.1 and 87.3 mm radial growth respectively after 24, 48 and 72 hrs of incubation (Fig. 2). On the other hand, the radial growth of *C. paradoxa* was restricted within 5 mm in dual culture plates with *T. harzianum* and Bavistin amended plates. After 5 days of inoculation the pathogen occupied full petridish and produced huge amount of spores in the control plates. This result has conformity with the result obtained by Jee and Kim (1987) who worked with *Trichoderma sp* against *Fusarium oxysporum* fsp *cucumerinum*. They had reported several mycoparasitism such as coiling, penetration, overgrowing and lysis on dual culture on water agar between antagonistic fungi namely *Trichoderma harzianum*, *Trichoderma viride* and *Fusarium oxysporum* fsp *cucumerinum*.



**Figure 1. Mycoparasitism between *Trichoderma harzianum* and *Ceratocystis paradoxa***

They also pointed out that the antagonistic fungi produce lytic enzymes on contact with the host fungi which degrade the cell wall of the host and ultimately lead to its death. According to Bakker *et al.* (1990) sometimes the antagonists produce materials like antibiotics or functional inhibitors to inhibit the pathogens. The antagonistic activity of *T. harzianum* against *C. paradoxa* may be due to parasitism (Mousa and Mousa, 1994), predation (Kwok *et al.*, 1987) or chemicals produced by the antagonist that caused lysis of *C. paradoxa*. The lysis may be due to production of chemicals like Trichodermin (Tverdyukov *et al.* 1994) or chitinase or  $\beta$ 1,3- glucanase which excreted by *Trichoderma* (Sivan and Chet, 1986, 1989). It is also reported that *Trichoderma harzianum* can produce 6-pentyl  $\alpha$  pyrone (6-p-p) which could lyse the *C. paradoxa*.

In vitro test of *Trichoderma harzianum* and fungicide Bavistin were found equally effective in controlling *C. paradoxa*, because the pathogen was failed to grow on the PDA media amended with the spores of *T. harzianum* and 0.1% Bavistin even after 10 days of incubation (Fig. 3). After 3 days of incubation *C. paradoxa* in the control plate grew well and covered almost entire area of petri plates i.e. the radial growth reached to 87 mm (Fig. 2) where as in the *Trichoderma* and Bavistin treated plates no growth of *C. paradoxa* was observed. The results revealed that *T. harzianum* is a strong antagonist to *C. paradoxa* and Bavistin is effective for controlling the pathogen. The result is supported by Sankar and Jeyarajan (1996) who found *T. harzianum* and Bavistin equally effective in controlling pathogen of root rot of sesame and Zinger yellow disease.



**Figure 2: Effect of *Trichoderma harzianum* and Bavistin on growth of *Ceratocystis paradoxa* after 3 days of incubation**

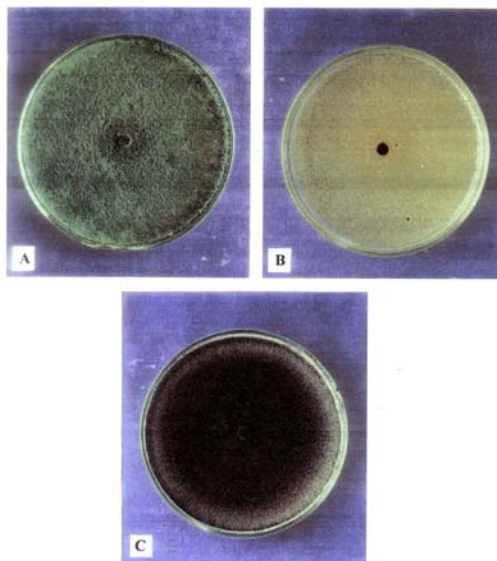


Figure 3: Effect of *Trichoderma harzianum* (A) and Bavistin (B) on growth of *Ceratocystis paradoxa* after 10 days of inoculation. (C) Control.

In the field trial the results on germination of sugarcane setts in different treatments increased by 14.84-30.34% compared to control plots (Table 1). The treatment  $T_8$  ( $T_2 + T_5$ ) resulted the highest per cent of germination of setts (54.50%) followed by the treatment  $T_2$  (50.33%) after 75 days of planting. All the treatments showed significantly higher germination over control ( $T_0$ ). Seed treated by *T. harzianum* yielded 14.83 to 20.33% higher germination compared to control. This result again reflects about the existence of strong antagonism between *T. harzianum* and *C. paradoxa*. On the other hand in the control plots, the germination of setts was too low due to the attack of *C. paradoxa*. Sett treatment with *Trichoderma harzianum* and with Bavistin (0.1%) did not differ significantly regarding germination percentage of setts (Table-1). Though Bavistin treated setts in soil drenched with Bavistin (0.1%) scored first position in case of germination. This finding is an accordance with that of Harman and Stasz (1989) who reported that *T. harzianum* might be an effective seed treating agent with and without fungicides.

**Table 1. Germination (%) of sugarcane setts and yield of cane as influenced by sett treatment with *T. harzianum* and Bavistin**

Treatment	% Germination at 75 DAP	% Increase over control at 75 DAP	Yield of Cane (t ha <sup>-1</sup> )
$T_0$ = Untreated Control	24.17 d	-	28.68 b
$T_1$ = <i>T. harzianum</i> (Sett treatment)	43.83 bc	19.67	40.36 ab
$T_2$ = Bavistin 0.1% (Sett treatment)	50.33 ab	26.17	46.66 a
$T_3$ = Saw dust + <i>T. harzianum</i> in the furrow	39.50 c	15.34	41.42 a
$T_4$ = Spore suspension (Drenching)	39.00 c	14.84	36.90 ab
$T_5$ = Bavistin 0.1% (Drenching)	40.17 c	16.00	37.25 ab
$T_6$ = $T_1 + T_3$	40.50 c	16.34	39.04 ab
$T_7$ = $T_1 + T_4$	44.50 bc	20.34	40.23 ab
$T_8$ = $T_2 + T_5$	54.50 a	30.34	44.28 a

\*Figures in a column followed by the same letter (s) do not differ significantly by DMRT at 5% level of probability.

Guevara (1990) and Sampang (1991) opined about the promising results in controlling pineapple disease of sugarcane by using *Trichoderma* spp. In another investigation Dev and Datta (1991) reported that addition of *T. harzianum* to pathogen infested soil gave 45% control of foot rot disease of soybean and increased yield by 1.5-1.8 g/plant. The present study and other related

references expressed about the bio control potential of *T. harzianum* in controlling foot and root rot and sett rot disease of different crops.

Field trial revealed that yield was significantly higher in all the treatments as compared to control (Table 1). Sugarcane setts treated with Bavistin (0.1%) and *T. harzianum* produced statistically similar yield. The highest yield (46.66 t/ha) was obtained from the treatment T<sub>8</sub> and the lowest (28.68 t/ha) was from T<sub>0</sub>. Again the yield of cane under the treatments T<sub>2</sub>, T<sub>3</sub> and T<sub>8</sub> differed significantly from the control plots. From the results it can be inferred that *T. harzianum* has considerable potentiality in controlling pineapple disease of sugarcane and comparable with Bavistin. The findings of Quarles (1993) also support it who used *Trichoderma* for seed treatment as alternative to methylene bromide and reported that in some crops *Trichoderma* protected plants as effectively as chemical seed treatment, resulting in improved yield.

It is reflected from the present study that the bio agent helped in improving sugarcane sett germination by protecting from *C. paradoxa* and similarly significantly increased the cane yield.

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