Control of Black Sigatoka Disease (*Mycosphaerella fijiensis*) Using Effective Microorganisms

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Abstract

The control of the black sigatoka fungus disease in bananas and plantains, estimated to be at a cost of $200 million annually, has been widely related to loss of bio-diversity, increased health hazards, and economic instability of many banana producing countries. Thus, biological control for the disease is deemed a wise alternative. A 0.6 ha area was established at the banana farm of EARTH in Guacimo, Costa Rica, with EM in 1:100 ratio. Evaluations on the leaves were done for 14 alternate weeks and ended four weeks before harvest. The results showed that number of healthy leaves were 8.4 with EM. The position of the YLS (youngest spotted leaf) was 7.4 with EM. The number of diseased leaves was 2.2 for the treatment. The average infection rating was 0.52 for EM. The results indicate that EM can sufficiently control black sigatoka and maintain 8 to 9 leaves at about fruiting time. This is comparable to results using the regular chemical control with 10 leaves.

Introduction

Banana and plantain crops are among the top agricultural commodities produced in Latin America, Asia and the Caribbean. At present, these crops are being threatened by black sigatoka, a severe fungal disease caused by *Mycosphaerella fijiensis.*

In 1992, the cost to control this fungus in Honduras alone was estimated at US$1,000,000 compared to an annual income of US$100 million reported by the banana industry (FHIA, 1991). It is now estimated to be $ 200 million to control the disease in all banana producing and exporting countries.

If left untreated, black sigatoka will attack the leaves of the plants producing a rapid deterioration of the foliar area. This parasite diminishes the photosynthetic ability of the plant and in turn affects its growth and productivity. It also promotes premature ripening of the banana clusters which is the main cause of economic loss. (Marin and Romero, 1991).

Black Sigatoka has been mainly controlled with synthetic fungicides, however, there is documented evidence that these populations of fungi have developed resistance to these fungicides (Stover, 1980).

Due to this, a series of measures to decrease the severity of this disease have been proposed (Miranda, 1996). One alternative is to include biological control methods because when they are used along with sound agriculture practices, it is affordable, stable and environmentally correct (Quezada, 1989, quoted by Gonzalez, 1995). The use of antagonist microorganisms is an option that has not been widely explored for most tropical crops, including those of great economic importance such as the banana. At present, a series of compounds are being assessed in the field and laboratories in order to combat this disease using biological agents.

Accordingly, the purpose of this study is to assess the effect of beneficial microorganisms such as effective microorganisms (EM) as an option for managing black sigatoka.

Effective Microorganisms are a mix microbial culture of selected species which contain a high number of yeasts and acidolactic bacteria as well as smaller amounts of other types of organisms including photosynthetic bacteria and actinomycetes. All these microorganisms are mutually compatible with each other and co-exist in a liquid medium. It is known that some of these microorganisms produce bio-active substances such as vitamins, hormones, enzymes and antibiotics which can directly or indirectly improve the growth and development of the plant as well as its protection. Studies carried out in Brazil have shown that among the main beneficial effects of these microorganisms are a decrease in the growth and activity of deleterious microorganisms (Tokeshi et al 1995).

Materials and Methods

The present study was carried out at the banana farm of the College of Agriculture of the Tropical Humid Region (EARTH). EARTH is located in Las Mercedes de Guacimo, province of Limon, in the west zone of the Atlantic slope of Costa Rica, one of the three key banana producing regions of the country. Annual rain and temperature averages in this area are 3500 mm and 26°C, respectively.

In this study biological control of black sigatoka was carried out on the Grand Naine variety. EM were used as the biological control agent. The cultivated field was 0.6 ha and had approximately 1080 plants. The duration of the study was 3 months.

Effective Microorganisms were sprayed using motorized sprayers. Efforts were made to spray the entire surface of the candle leaf in order to have preventive control. The nearby commercial farm of the College was used as a reference point. The total volume of application was 13 liters treatment. The dosage used for EM was 1:1000. Frequency of application was every two weeks. The variables that were evaluated were the same as those described in Stover's method as modified by Gauhl (1989). This method achieves detailed information regarding the health situation of the plantation (Marin and Romero, 1991). Evaluations were done weekly (5 plants per evaluation).

Results were analyzed based on the following variables: Leaves per plant (L/P), youngest spotted leaf (YSL), infected leaves (IL), weighted average of infection (WAI).

Results and Discussion

The following results were obtained from the study during the period of May to September 1996(Table1).

Table 1 Number of Leaves per Plant (L/P), Youngest Spotted Leaf (YSL), Number of Infected Leaves (IL), and Weighted Average of Infection (WAI) in the treatment with Effective Microorganisms (EM)

	Analyzed Variables			
Week	**L/P**	**YSL**	**IL**	**WAI**
1	8.40	8.20	1.80	0.90
2	8.70	8.00	1.90	1.00
3	8.60	8.10	1.80	0.95
4	8.60	8.10	1.90	0.80
5	8.70	8.00	1.90	0.73
6	8.90	7.90	1.90	0.67
7	9.00	7.80	2.00	0.62
8	9.00	7.80	2.20	0.61
9	10.00	9.20	1.80	0.687
10	9.00	8.40	1.60	0.60
11	9.80	8.80	2.00	0.64
12	9.40	8.20	2.20	0.70
13	7.80	6.20	2.60	0.70
14	8.40	7.40	2.20	0.52

Evaluation of Leaves per Plant

In the last evaluation, the treatment with EM produced 8.4 leaves, and this maintained a constant number of leaves per plant, which indicates that they are capable of suppressing growth of deleterious microorganisms including pathogens. The number of leaves of the commercial farm fluctuated between 9 and 10 per plant.

Evaluation of the Position of the Youngest Spotted Leaf

On the 14th week of treatment with EM of the youngest spotted leaf was 7.4. Thus, we observed that treatment with EM controlled the disease. EM has a bio-stimulating effect which increases the number of leaves and thus the rate of photosynthesis. Normally without any control, the YSL would be between leaf 3-4, or the leaves with 21-28 days of unfurling and exposure.

Evaluation of the Number of Infected Leaves

Effective Microorganisms maintained a constant number of infected leaves which is attributable to the suppression of growth of the fungus. In the last evaluation, the number of infected leaves was 2.2 in the treatment with EM.

Evaluation of the Weighted Average of Infection

The weighted average of infection in the treatment with EM was 0.52. Effective Microorganisms maintained a constant weighted average of infection due to the fact that growth and activity was suppressed in *Mycosphaerella fijiensis.*

Conclusion

Effective Microorganisms are a new option for controlling diseases and for activating the plant's metabolic processes. The number of leaves at harvest time of 8-9 leaves is very close to those plants with chemical fungicidal spray, having 9-10 leaves.

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