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Management of Anthracnose of Hyacinth Bean for Safe Fresh Food Production

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ABSTRACT

The experiment was conducted with two sets at ARS, BARI, Pabna during 2008-09 to find out the effective control measure for anthracnose disease of country bean for producing safe fresh food without harmful chemicals. For experiment set 1 (fungal inoculum was sprayed before treatments apply), control treatment showed the highest leaf area diseased (27.67%) and Tilt 250 EC, Bordeaux mixture, Baking powder and *Trichoderma harzianum* sprayed plot showed lower leaf area diseased. Percent infected fruits varied from 12.23 - 25.56%, while the highest was in control and the lowest was in Tilt 250 EC sprayed plot. Control plot showed the highest fruit area diseased (3.20%) and Tilt 250 EC sprayed plot showed the lowest (1.33%) which followed by Bordeaux mixture (1.67%), Baking powder (1.97%) and *Trichoderma harzianum* (2.00%) sprayed plot. Tilt 250 EC sprayed plot resulted the maximum yield (9.17 t/ha). Bordeaux mixture (7.37 t/ha), Baking powder (6.25 t/ha) and *Trichoderma harzianum* (6.08 t/ha) sprayed plot also gave higher yield, and the lowest yield (4.00 t/ha) resulted control plot. Both the experiments gave similar trends of results.

Keywords: Anthracnose, Hyacinth Bean, Safe Fresh Food, Production

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INTRODUCTION

Hyacinth or lablab bean (*Lablab purpureus*) has many other names, including the Dolichos bean, Egyptian kidney bean, Australian pea, Tonga bean, Kikuyu bean, Indian bean, Field bean, Country bean, Seim bean, Chicharo etc.. It originated either in India or Africa, or perhaps both locations. Hyacinth bean is cultivated at almost every household. It is important vegetable among the beans as well as vegetables. It is grown for green pods which are cooked as vegetable like other beans. The dry seeds are also used for various

vegetable preparations. It is a delicious, protein rich nutritious vegetable. The bean is also used as a flavoring to a rice-based breakfast. Even the flowers of the plant can be consumed. Hyacinth bean is a good source of calcium, C vitamin, zinc, carotene, iron, and B1 vitamin. The stem of hyacinth bean is used for the treatment of cholera. The pods juice is use for inflamed throat and ears treatment. Stir-baked, the hyacinth bean is used to reduce vomiting and nausea incidents. Infusion of the leaves is also used into treating gonorrhea. The foliage of the crop provides hay, silage and green manures. The roots are consumed as well, and the soil is enriched with nitrogen by the bacteria found on this plants roots. Hyacinth beans can be planted as forage for livestock and as an ornamental plants. But its yield is very low due to various diseases. Among the diseases, anthracnose disease caused by the fungus *Colletotrichum lindemuthianum* (Sacc. and Magnus) is a major limiting factor in field grown hyacinth bean in subtropical and temperate regions. This disease can cause serious losses in the crops. Anthracnose is mainly a seed-borne disease caused by a fungus which has a wide host range on many legume species. Leaves, stems and pods of bean plants are susceptible to infection. Small reddish-brown, slightly-sunken spots form on the pods and rapidly develop into large, dark-sunken lesions. In moist weather, masses of pink spores develop on these lesions. Black-sunken spots, similar to those on the pods, are produced on the stems and the leaf stalks. Infection of the leaves causes blackening along the veins, particularly on the undersurface. The fungus can survive in plant debris (Ntahimpera *et al*., 1997). The pathogen also affects petioles, leaf veins, stems, and seeds producing characteristic anthracnose sunken lesions filled with many spores. Yield losses can reach or exceed 90%, especially in cases of susceptible bean varieties grown under favorable conditions for the pathogen (Corrales and Tu, 1989; Fernández *et al*., 2000). Management of anthracnose disease of beans may be controlled by chemicals, but chemicals create health hazard and environment pollution. The biocontrol agents and safe chemicals are the viable alternates for the management of many plant pathogenic microbes. Besides the effective and economical management of the diseases, the biocontrol agents reduce the risk of hazardous chemical residues. Plant growth promoting fungi can improve the growth of certain plants and be potential agents for biological control of plant pathogens resulting in disease suppression by antagonism and competition for space and nutrients, production of antifungal compounds, and induction of systemic resistance (Kuc, 2001; Zehnder *et al*., 2001; Jetyanon and Kloepper, 2002). The use of *Trichoderma* spp. for biocontrol of anthracnose (*Colletotrichum* spp.) in large-scale strawberry field experiments, *Trichoderma* applications reduced anthracnose disease incidence and consequently, plant mortality. This work contributes to the development and optimization of biocontrol with *Trichoderma* as alternatives to the traditional use of chemicals in strawberry production (Porras *et al*., 2009). Shovan *et al*. (2008) conducted experiment to control *Colletotrichum dematium* causing anthracnose of soybean with fungicides, plant extracts and *Trichoderma harzianum*. The complete inhibition against the radial colony growth and mycelial dry weight of *C. dematium* was obtained with Tilt-250 EC at all the selected concentrations. A total of 20 *T. harzianum* isolates collected from rhizosphere and rhizoplane of different crops were screened against *C. dematium* following dual plate culture technique. The screened isolates of *Trichoderma* showed significantly variable antagonism ranging from 50.93 to 89.44% reduction of the radial growth of *C. dematium*. From the above facts, these types of research works are absent in Bangladesh. So, the present study was undertaken to find out the effective control measure for controlling anthracnose disease of country bean for producing safe fresh food without harmful chemicals.

MATERIALS AND METHODS

The experiment was conducted with two sets at Agricultural Research Station, Pabna during 2008-09. The experimental land was well ploughed and properly leveled before bed preparation. Weeds and stubbles were removed from the field. Cow dung @ 10 t/ha, Urea @ 25 kg/ha, TSP @ 90 kg/ha, MP @ 60 kg/ha, Gypsum 5 kg/ha and Boric acid Gypsum 5 kg/ha were applied according to Anonymous (2011). BARI Hycnth Bean-2 was used in this experiment. The unit plot size was 2.0 m x 2.0 m. For the experiment Set 1, fungal inoculum was sprayed before treatments apply and for experiment Set 2, fungal inoculum was sprayed after treatments apply. For both the sets, the experiment was carried out following Randomized Complete Block Design with three replications. Seven treatments were T_1 = *Trichoderma harzianum* broth (1:5) spray, T_2 = *Trichoderma harzianum* apply in Soil (2 kg NDS compost/plant), T_3 = Bordeaux mixture (1:1:100) spray, T_4 = Baking powder (0.5%) spray, T_5 = Dettol (2.0%) spray, T_6 = Tilt 250 EC (0.05%) spray and T_7 = Control (untreated) for both the sets of experiments. Treatments were applied in case of experiment set 1 three times at an interval of 10 days after two weeks of fungal inoculation, but treatments were applied for set 2 only once before inoculum spray. Intercultural operations were done as per needed and to maintain the normal hygienic condition of crop in the field. Data were recorded on % leaf area diseased, incidence of infected fruits, % fruit area diseased and yield (t/ha). The recorded data were analyzed statistically to find out the level of significance and the variations among the respective data were compared following Duncan's New Multiple Range Test (DMRT) according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effect of *Trichoderma* and safe chemicals in controlling anthracnose of hyacinth bean for experiment set 1

Effect of *Trichoderma* and safe chemicals in controlling anthracnose of hyacinth bean for experiment set 1 are presented in Table 1. Percent leaf area diseased was significantly influenced by the treatments. The highest (27.67%) leaf area diseased was recorded in control plots and the lowest (11.67%) was recorded in Tilt 250 EC sprayed plot which was statistically similar to Bordeaux mixture (12.33%), Baking powder (15.00%) and *Trichoderma harzianum* (13.00%) sprayed plot. Treatments showed significant effect on percent infected fruits. Percent infected fruits varied from 12.23 - 25.56%, while the highest was observed in control and the lowest was in Tilt 250 EC sprayed plot. Significantly higher (3.20%) fruit area diseased was obtained from control plot and the lowest (1.33%) was obtained from Tilt 250 EC sprayed plot which was followed by Bordeaux mixture (1.67%), Baking powder (1.97%) and *Trichoderma harzianum* (2.00%) sprayed plot.

Table 1: Effect of *Trichoderma* and safe chemicals in controlling anthracnose of hyacinth bean for experiment set 1

Treatments	% leaf area diseased	% infected fruits	% fruit area diseased
T_1 = *Trichoderma harzianum* broth (1:5) spray	13.00 cd	15.19 d	2.00 bc
T_2 = *Trichoderma harzianum* apply in Soil (2 kg NDS compost/plant)	17.33 bc	16.62 c	2.45 abc
T_3 = Bordeaux mixture (1:1:100) spray	12.33 cd	13.21 de	1.67 cd
T_4 = Baking powder (0.5%) spray	15.00 cd	14.19 d	1.97 bcd
T_5 = Dettol (2.0%) spray	20.67 b	19.29 b	2.67 ab
T_6 = Tilt 250 EC (0.05%) spray	11.67 d	12.23 e	1.33 d
T_7 = Control (untreated)	27.67 a	25.56 a	3.20 a

In a column, similar letter(s) do not differ significantly at 5% level of significance.

Effect of *Trichoderma* and safe chemicals on yield of hyacinth bean for experiment set 1

Effect of *Trichoderma* and safe chemicals on the yield of hyacinth bean for set 1 are presented in Fig. 1. Yield was statistically different from one treatment to another treatment. The maximum yield (9.17 t/ha) was obtained from Tilt 250 EC sprayed plot which was also followed by Bordeaux mixture (7.37 t/ha), Baking powder (6.25 t/ha) and *Trichoderma harzianum* (6.08 t/ha) sprayed plot, and lowest (4.00 t/ha) was recorded in control plot.

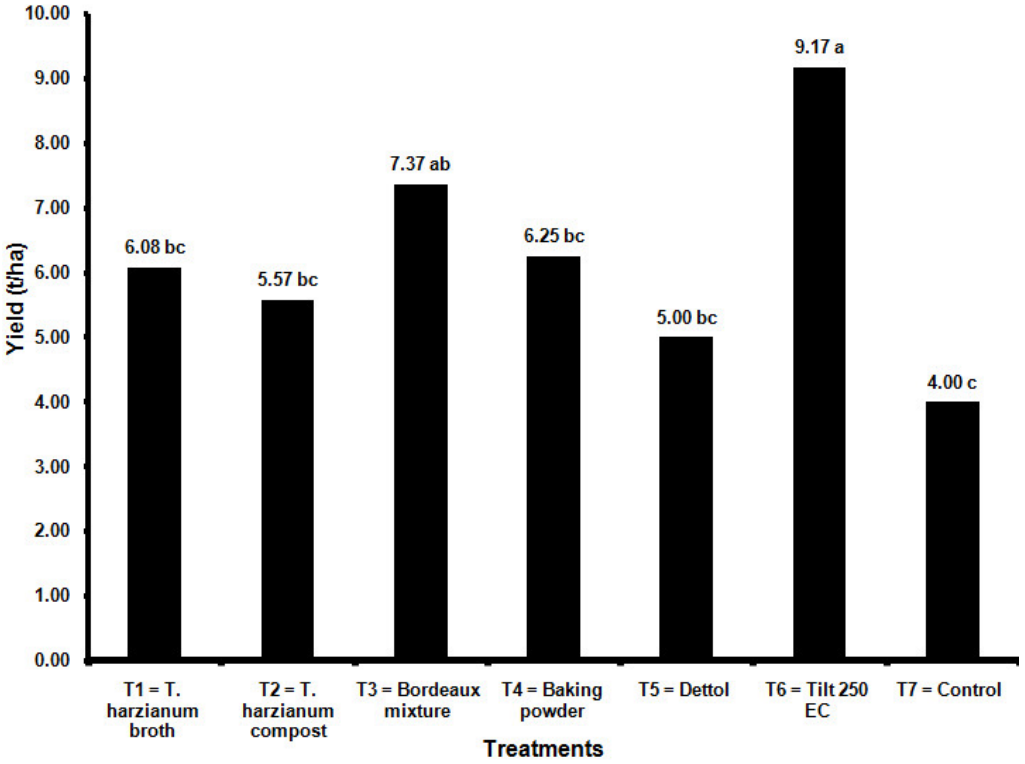

Fig. 1: Effect of *Trichoderma* and safe chemicals on yield of hyacinth bean for experiment set 1

Effect of *Trichoderma* and safe chemicals in controlling anthracnose of hyacinth bean for experiment set 2

Effect of *Trichoderma* and safe chemicals in controlling anthracnose of hyacinth bean for set 2 are presented in Table 2. Treatment showed significant effect on percent leaf area diseased. The highest (45.00%) leaf area diseased was recorded in control and the lowest (30.00%) was in Tilt 250 EC sprayed plot which was statistically similar to Bordeaux mixture (32.67%), Baking powder (33.33%) and *Trichoderma harzianum* (35.00%) sprayed plot. Percent infected fruits statistically varied from 29.70 - 57.18%, while the highest was observed in control and the lowest was in Tilt 250 EC sprayed plot. Significantly highest (6.95%) fruit area diseased was obtained from control plot and the lowest (2.67%) was obtained from Tilt 250 EC sprayed plot which was also followed by Bordeaux mixture (3.00%), Baking powder (3.33%) and *Trichoderma harzianum* (3.67%) sprayed plot.

Table 2: Effect of *Trichoderma* and safe chemicals in controlling anthracnose of hyacinth bean for experiment set 2

Treatments	% leaf area diseased	% infected fruits	% fruit area diseased
T_1 = *Trichoderma harzianum* broth (1:5) spray	35.00 bc	50.48 ab	3.67 b
T_2 = *Trichoderma harzianum* apply in Soil (2 kg NDS compost/plant)	37.00 abc	51.55 a	4.00 b
T_3 = Bordeaux mixture (1:1:100) spray	32.67 c	32.14 c	3.00 b
T_4 = Baking powder (0.5%) spray	33.33 c	33.91 bc	3.33 b
T_5 = Dettol (2.0%) spray	42.33 ab	55.00 a	4.33 b
T_6 = Tilt 250 EC (0.05%) spray	30.00 c	29.70 c	2.67 c
T_7 = Control (untreated)	45.00 a	57.18 a	6.95 a

In a column, similar letter(s) do not differ significantly at 5% level of significance.

Effect of *Trichoderma* and safe chemicals on yield of hyacinth bean for experiment set 2

Effect of *Trichoderma* and safe chemicals on the yield of hyacinth bean for experiment set 2 is presented in Fig. 2. The maximum yield (6.13 t/ha) was obtained from Tilt 250 EC sprayed plot which was also followed by Bordeaux mixture (4.92 t/ha), Baking powder (5.50 t/ha) and *Trichoderma harzianum* (4.80 t/ha) sprayed plot, and lowest (4.00 t/ha) was recorded in control plot.

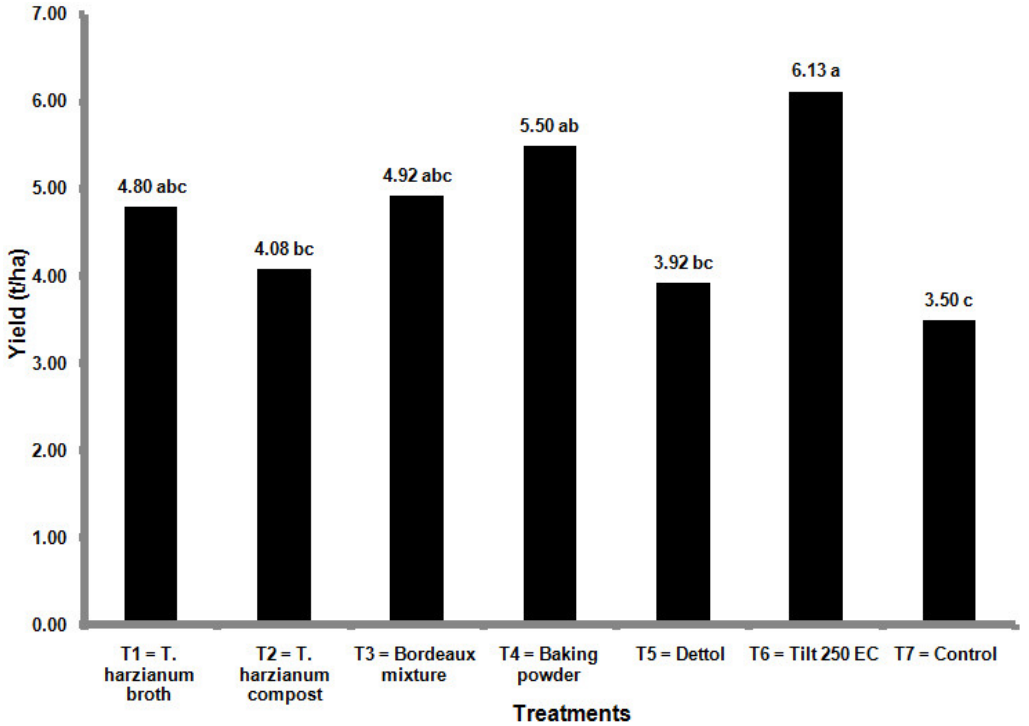

Fig. 2: Effect of *Trichoderma* and safe chemicals on yield of hyacinth bean for experiment set 2

From the above study, it has been revealed that the highest % leaf area diseased, % infected fruits and % fruit area diseased was recorded in control plots and the lowest was recorded in Tilt 250 EC sprayed plot which was followed by safe chemicals Bordeaux

mixture, Baking powder and biocontrol agent *Trichoderma harzianum* sprayed plot. The maximum yield was obtained from Tilt 250 EC sprayed plot which was also followed by Bordeaux mixture, Baking powder and *Trichoderma harzianum* sprayed plot, and the lowest was recorded in control plot. For both sets of experiment, same trends were observed in case of disease reduction and yield. For experiment set 1, yield was higher due to less disease score compared to experiment set 2. On the other hand, yield was lower due to high disease score compared to experiment set 1. In experiment set 1, treatments were applied three times after fungal inoculation, so, disease was reduced and yield was increased. For experiment set 2, treatments were applied only once before fungal inoculation, so, disease was increased and yield was reduced. Here, treatments were not able to reduce disease and increase yield. Porras *et al.* (2009) conducted an experiment in a strawberry farm to evaluate the use of *Trichoderma* spp. for biocontrol of anthracnose (*Colletotrichum* spp.) in large-scale strawberry field experiments. *Trichoderma* applications reduced anthracnose disease incidence and, consequently, plant mortality. This work contributes to the development and optimization of biocontrol with *Trichoderma* as alternatives to the traditional use of chemicals in strawberry production. Porras *et al.* (2007) tested *Trichoderma* in three consecutive annual production cycles in Huelva (southwestern Spain) to evaluate the effectiveness in enhancing strawberry yield and the relationship between *Trichoderma* soil population, root colonization by *Trichoderma*, yield and root weight. *Trichoderma* spp. were applied via drip irrigation and dip, adding to the soil 7-days before planting (108 conidia/m^2), and strawberry roots were dipped in a suspension of *Trichoderma* (106 conidia/ml) prior to planting. *Trichoderma* spp. became established in soil, and by the end of each season it could be recovered from soil samples and from root segments. *Trichoderma* applications increased *Trichoderma* soil populations, root colonization, root weight and strawberry yield 84.9% in year 2 and 17.6% in year 3. Ekefan (2009) evaluated four isolates of *Trichoderma harzianum* (Th-F, Th-G, Th-I and Th-N) obtained from CABI Biosciences, Egham, UK to determine the potential of *T. harzianum* isolates as biocontrol agents of *Colletotrichum capsici*, causing anthracnose of pepper. In-vitro interactions between *C. capsici* and *T. harzianum* isolates showed that *T. harzianum* isolates significantly ($P \leq 0.05$) suppressed the growth of *C. capsici* and reduced the incidence of the pathogen on seeds and soil. Shovan *et al.* (2008) conducted experiment to control *Colletotrichum dematium* causing anthracnose of soybean with fungicides, plant extracts and *Trichoderma harzianum*. The complete inhibition against the radial colony growth and mycelial dry weight of *C. dematium* was obtained with Tilt-250 EC at all the selected concentrations. A total of 20 *T. harzianum* isolates collected from rhizosphere and rhizoplane of different crops were screened against *C. dematium* following dual plate culture technique. The screened isolates of *Trichoderma* showed significantly variable antagonism ranging from 50.93 to 89.44% reduction of the radial growth of *C. dematium.* Parthiban and Kavitha (2014) evaluated *Trichoderma viride* isolates against *Colletotrichum lindemuthianum* growth under *In vitro* condition showed that all the isolates were effective in inhibiting the pathogen growth. Among the seven isolates (TVMGLT1, TV21GL, TVMNT7, *T. harzianum*, TV15, TVUV10 and TVMG5) tested, isolate TVMGLT1 recorded highest mycelial inhibition of 75.00% reduction over control and highest inhibition zone of 18.00 mm. The increased antagonist overgrowth on the *C. lindemuthianum* was observed in TVMGLT1 (65.00 mm) and TV21GL (63.00 mm). Though all the isolates showed mycelial inhibition, the isolate TVMGLT1 recorded greater antagonistic activity against the growth of *C. lindemuthianum*. *Trichoderma* spp. produce non-volatile, thermostable, diffusible, extracellular metabolites, which inhibited *Colletotrichum graminicola* growth. Bangari and Singh (2011) evaluated antagonistic potential of 5 isolates of *Trichoderma harzianum* viz.

TH-25, TH-36, TH-38, TH-39 and TH-43 against *Colletotrichum graminicola* in vitro using bangle method. TH-36 isolate of *Trichoderma harzianum* was found to be most effective, which gave 71.02% inhibition of radial growth of the pathogen over check followed by TH-38 (63.84%) and TH-39 (57.80%). Villalobos *et al.* (2013) found that seventeen *Trichoderma* isolates showed at least 67% growth inhibition against the fungus *Colletotrichum gloeosporioides* of mango and three *Trichoderma* isolates showed complete overgrowth of this pathogen. One member of this group, identified as *T. asperellum* T8a, was able to control *C. Gloeosporioides* in vitro and in vivo, as well as five *C. gloeosporioides* isolates obtained from mango orchards from the State of Oaxaca. Assay of the lytic enzymes involved suggest that cellulases of *T. asperellum* T8a play a role in biological control against *C. gloeosporioides* more than chitinase or glucanase. Prabakar *et al.* (2008) screened among the seven fungal (*Gliocladium virens, Trichoderma hamatum, T. harzianum, T. koningii, T. longibrachiatum, T. pseudokoningii and T. viride*) and two bacterial (*Bacillus subtilis* and *Pseudomonas fluorescens*) antagonists against *C. gloeosporioides* under *in vitro* conditions, *T. harzianum* exhibited maximum inhibition followed by *Pseudomonas fluorescens* at 5 days after incubation. The fungal antagonists *T. harzianum* and *P. fluorescens* were effective in checking the spread of pathogens on fruits compared with the pathogen-inoculated control. Pascua and Layaoen (2008) stated that *Trichoderma harzianum* and *Bacillus subtilis* could be used as alternatives to commercial chemical fungicides in controlling anthracnose of mango. The use of bio-control agents could also be integrated with mango disease management programs to reduce dependence on chemical fungicides.

CONCLUSION

It may be concluded that Tilt 250 EC (0.05%) was the best fungicide but safe chemicals Bordeaux mixture (1:1:100) spray, Baking powder (0.5%) spray and biocontrol agent *Trichoderma harzianum* broth (1:5) spray also showed better performances as safe materials in controlling anthracnose disease and increasing yield (safe food) of hyacinth bean.

REFERENCES

Anonymous. 2011. Krishi Projukti Hatboi (Handbook on Agro-technology) Part 1. 5th edition. Bangladesh Agricultural Research Institute, Gazipur-1701. pp. 427-428.

Bangari, G and Y. Singh. 2011. Evaluation of antagonistic potential of *Trichoderma harzianum* isolates against *Colletotrichum graminicola* causing anthracnose of sorghum. Pantnagar Journal of Research, 9(1): 70-71.

Corrales, M.A.P. and J.C. Tu. 1989. Anthracnose In: Schwartz, HF, Pastor-Corrales, MA (Eds), Bean Production Problems in the Tropics CIAT, Cali, Colombia, pp. 77–104.

Ekefan, E.J., A. Jama and S. R. Gowen. 2009. Potential of *Trichoderma harzianum* isolates in biocontrol of *Colletotrichum capsici* causing anthracnose of Pepper (*Capsicum* spp.) in Nigeria. Journal of Applied Biosciences, 20: 1138 – 1145.

Fernández, M.T., M. Fernández, A. Casares, R. Rodriguez and M. Fueyo. 2000. Bean germplasm evaluation for anthracnose resistance and characterization of agronomic traits: A new physiological strain of *Colletotrichum lindemuthianum* infecting *Phaseolus vulgaris* L in Spain, *Euphytica,* 114: 143–149.

Gomez, K. A. and A. A. Gomez. 1984. Statistical Procedures for Agricultural Research. 2nd ed., Intl. Rice Res. Inst., John Willy and Sons, New York, Chichester, Brisbane, Toronto, Singapore. pp. 187-240.

Jetyanon, K. and J. W. Kloepper. 2002. Mixtures of plant growth promoting rhizobacteria for induction of systemic resistance against multiple plant diseases. Biological Control, 24: 285–291.

Kuc, J. 2001. Concepts and directions of induced systemic resistance in plants and its application. European Journal Plant Pathology, 107: 7–12.

Michereff, S. J., M. Menezes and R.L.R. Mariano. 1993. Antagonism of *Trichoderma* species against *Colletotrichum graminicola*, an agent of sorghum anthracnose, under laboratory conditions. Summa Phytopathologica, 19(1): 14-17.

Ntahimpera, N., H.R. Dillard, A. C. Cobb and R.C. Seem. 1997. Influence of tillage practices on anthracnose development and distribution in dry bean fields. Plant Disease, 81: 71–76.

Parthiban, V.K. and R. Kavitha. 2014. *In vitro* screening of effective biocontrol agents against bean anthracnose pathogen, *Colletotrichum lindemuthianum*. International Journal of Pharmacological Screening Methods, 4(1): 32-35.

Pascua, G.S. and T. Z. Layaoen. 2008. Use of *Trichoderma harzianum* and *Bacillus subtilis* in controlling anthracnose in mango. PCARRD Highlights. Mariano Marcos State University. pp. 93-94.

Porras, M., C. Barrau and F. Romero. 2007. Effects of soil solarization and Trichoderma on strawberry production. Crop Protection, 26(5):782-787.

Porras, M., C. Barrau and F. Romero. 2009. Biological control of anthracnose with *Trichoderma* in strawberry fields. *Acta Horticulturae*, 842: 351-354.

Prabakar, K., T. Raguchander, D. Saravanakumar, P. Muthulakshmi, V.K. Parthiban and V. Prakasam. 2008. Management of postharvest disease of mango anthracnose incited by *Colletotrichum gleosporioides*. Archives of Phytopathology and Plant Protection, 41(5): 333-339.

Shovan, L.R., M.K.A. Bhuiyan, J.A. Begum and Z. Pervez. 2008. *In vitro* control of *Colletotrichum dematium* causing Anthracnose of Soybean by Fungicides, Plant Extracts and *Trichoderma harzianum*. Int. J. Sustain. Crop Prod., 3(3): 10-17.

Villalobos, S.S., D.A. G. Ortiz, M.A.G. Lim, J. P. D. Frier, S. Folter, P.S. Garcia and J.J.P. Cabriales. 2013. Potential use of *Trichoderma asperellum* (Samuels, Liechfeldt et Nirenberg) T8a as abiological control agent against anthracnose in mango (*Mangifera indica* L.). Biological Control, 64(1): 37-44.

Zehnder, GW, J.F. Murphy, E.J. Sikora and J.W. Kloepper. 2001. Application of rhizobacteria for induced resistance. European Journal Plant Pathology, 107: 39–50.

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