Environment and Ecology 36 (2) : 457—460, April—June 2018
Website: environmentandecology.com ISSN 0970-0420

Management of Post Harvest Anthracnose Disease of Banana cv Grandnaine (AAA) under *In vivo* Conditions

Rani R. Unnithan, Thammaiah N.

Received 4 December 2017 ; Accepted 5 January 2018 ; Published on 24 January 2018

Abstract Anthracnose disease of banana caused by *Colletotrichum musae* has been occurring in serious form in fruit markets and affecting the quantity as well as quality of fruits. Banana fruits were dipped in 6 different treatments for controlling banana anthracnose disease caused by *Colletotrichum musae*. Among all the six treatments the banana fruits dipped in 0.1% carbendazim recorded lowest disease intensity (6.25%) followed by *Solanum nigrum* 20% (12.50%), *Trichoderma viride* 20g/l (19.00%), Chitosan 0.1% (30.00%) and *Pseudomonas fluorescens* 20g/l (37.85%). Fruits dipped in yeast solution 0.1% recorded the disease intensity of 39.50%. Maximum shelf life (13 days) was found in fruits dipped in 0.1% carbendazim followed by Chitosan 0.1% (12 days), *Trichoderma viride* 20g/l of water (11 days), *Solanum nigrum* 20% and yeast solution (10 days) each. The lowest shelf life of 7 days was recorded in control.

Keywords *In-vivo*, Dipping, Banana, Shelf life, *Colletotrichum musae*.

Introduction

Banana (*Musa* sp.) is one of the important fruit crops of the world as well as India. It is a good source of energy, minerals and vitamins and is one of the biggest single trade items in international fruit trade [1]. Banana is susceptible to several diseases resulting in massive and extensive postharvest losses during transportation and storage [2]. Anthracnose, caused by the fungus *Colletotrichum musae* (Berk. and M. A. Curtis) Arx, is the most important postharvest disease of banana that can result in 30 to 40% losses of marketable fruit [3]. Anthracnose is a latent infection where fungal spores infect immature banana in the field but symptoms occur as peel blemishes as black or brown sunken spots of various sizes on fruit that may bear masses of salmon-colored acervuli with their associated conidia on the fruit peel after ripening [4]. Thus, any potential control measure which can effectively delays the symptoms of anthracnose infection would have an important role in extending the shelf life of banana fruit during storage. Synthetic fungicides e.g. benomyl and thiabendazole (TBZ) are the most commonly used synthetic fungicides for controlling postharvest diseases [5]. However, persistent use of these fungicides has resulted in the emergence of resistant strains of *Colletotrichum musae* [6]. In addition, there is concern that residues of chemical fungicides may cause health problems viz., carcinogenic risk. The use of chemical fungicides to control postharvest diseases of fruit is scheduled to be phased out worldwide by year 2020 under the terms of the Montreal Protocol [7]. Therefore, there has been an increasing pressure on the banana industry to minimize the use of synthetic fungicides and discover sustainable non-chemical alternative fungicides for controlling postharvest diseases. So,

Rani R. Unnithan*, Thammaiah N.
College of Horticulture, Mysuru, India
e-mail: nthammaiah@gmail.com
*Correspondence

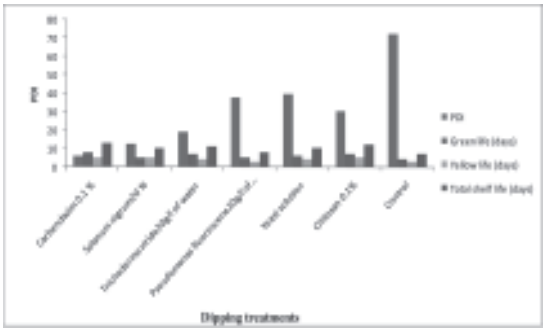

Fig. 1. Management of postharvest anthracnose disease of banana cv Grand Naine under *in vivo* conditions.

the present study was therefore conducted to examine effect of chitosan, biocontrol agents, fungicides and plant extracts against *Colletotrichum musae*.

Materials and Methods

An experiment was conducted at Kittur Rani Chanamma College of Horticulture, Arabhavi during 2014. There were six treatments viz., Carbendazim (0.1%), *Solanum nigrum* leaf extract (20%), *Trichoderma viride* (20 g/liter water), *Pseudomonas fluorescens* (20 g/l) of water, Yeast solution, Chitosan 1%. Each treatment was replicated four times in a completely randomized design.

Fresh banana fruits of cv Grand Naine were harvested from the experimental field of AICRP on Fruits, Arabhavi and thoroughly washed in running tap water in laboratory for removing dirt and dust then fruits were air dried. Banana fruits were dipped in different treatments for five minutes and dried them in air. Later, inoculation with spore suspension of *Colletotrichum musae* to the fruits was done with the help of automizer with a concentration of 4×10^6 cfu/ml. The fruits were covered with polythene bags for 48 h to maintain sufficient humidity. Control fruits were maintained by automizing sterile distilled water. Observations were recorded with respect to intensity of disease, green life and yellow life (at an interval of seven days). Per cent disease index was calculated A 0-4 scale was followed for scoring the disease index.

Where, 0 =No disease symptoms, 1=Small restricted lesions covering 25% of the fruit surface, 2=Large restricted lesions covering 50% of fruit surface, 3= Radiating lesion formed by coalescence of small ones covering 75% of the fruit surface, 4=Fruits completely rotten.

Table 1. Management of postharvest anthracnose disease of banana cv Grand Naine under i*n vivo* conditions.

Treatments	PDI (%)	Percent reduction of disease over control
T_1-Carbendazim 0.1%	6.25	91.30
T_2-*Solanum nigrum* 20%	12.50	82.61
T_3-*Trichoderma viride* 20g/l of water	19.00	73.56
T_4-*Pseudomonas fluorescene* 20g/l of water	37.85	47.34
T_5-Yeast solution	39.50	45.04
T_6-Chitosan 0.1%	30.00	58.26
T_7-Control	71.87	–
SEm±	0.34	
CD @ 1%	1.38	
CV (%)	2.22	

Results and Discussion

Results revealed that the banana fruits dipped in 0.1% carbendazim recorded lowest disease intensity (6.25%) followed by *Solanum nigrum* 20% (12.50%), *Trichoderma viride* 20g/l (19.00%), Chitosan 0.1% (30.00%) and *Pseudomonas fluorescens* 20g/l (37.85%). Fruits dipped in yeast solution 0.1% recorded the disease intensity of 39.50%. The highest PDI was recorded in untreated control (71.87%). The results are presented in Table 1 and depicted in Figure 1.

Fruits dipped in 0.1% carbendazim showed maximum shelf life (13 days) followed by Chitosan 0.1% (12 days), *Trichoderma viride* 20g/l of water (11 days), *Solanum nigrum* 20% and yeast solution (10 days) each. The lowest shelf life of 8 days was recorded in the fruits dipped in *Pseudomonas fluorescens*.

The treatment dipping the banana fruits in 0.1% carbendazim recorded the maximum green life (8 days) followed by *Trichoderma viride* (7 days) and

Table 2. Management of postharvest anthracnose disease of banana cv Grand Naine.

Treatments	Green life (days)	Yellow life (days)	Total shelf life (days)
T_1- Carbendazim 0.1%	8	5	13
T_2- *Solanum nigrum* 20%	5	5	10
T_3- *Trichoderma viride* 20g/l of water	7	4	11
T_4- *Pseudomonas fluorescene* 20g/l of water	5	3	8
T_5- Yeast solution	6	4	10
T_6- Chitosan 0.1%	7	5	12
T_7- Control	4	3	7

Chitosan 0.1% (7 days). With regard to yellow life, the treatment dipping the banana fruits in *Solanum nigrum* @ 20% and Chitosan 0.1% took more number of days for yellow life.

It clearly indicates that, the treatment dipping the banana fruits in carbendazim 0.1% effectively controlled the disease followed by *Solanum nigrum* @ 20% and *Trichoderma viride* @ 20g/l of water (Table 2). Banana fruits dipped in 0.1% carbendazim effectively controlled the anthracnose disease at Arabhavi, Gandevi, Coimbatore, Jorhat, Jalgaon and Kannnara [8].Chitosan is known to form a semi-permeable coating around plant tissues and thereby inhibits the activity of plant pathogenic fungi. The effectiveness of Chitosan was reported by Hewajulige et al.[9] which interfered with the growth of several pathogenic fungi including *Colletotricum gloeosporioides* Jinasena et al. [10] and Xiangchun et al. [11] reported that dipping of banana fruits in chitosan reduced the anthracnose lesion diameter. Percent reduction of disease over control was the highest (91.30%) in the treatment of banana fruits dipped in carbendazim 0.1% followed by banana fruits dipped in *Solanum nigrum* 20% (82.61%), *Trichoderma viride* 20g/l (73.56%) and Chitosan (58.26%). The lowest percent reduction of disease over control was recorded in yeast solution (45.04%) followed by *Pseudomonas fluorescens* @ 20 g/l of water.

Extracts of 50 plants were screened *in-vitro* against fungal pathogen *Colletotrichum musae*. Those of *Solanum torvum*, *Jatropha curcas* and *Emblica officinalis* inhibited mycelia growth of *Colletotrichum musae*. *Solanum torvum* extract 25% and 50% conc (w/v) completely inhibited growth of *Colletotrichum musae*. While those of *Emblica officinalis* and *J. glandulifera* growth to 7.6 mm day^{-1} at 50% concentration. The same extracts were tested *in-vivo* at room temperature (28±2^{0}C) and in cool store (13.5^{0}C) against anthracnose disease on three banana varieties Robusta (AAA), Rasthali (AAB) and Ney Poovan (AB). *Solanum torvum* extract was found to be very effective in reducing the incidence of the disease, the extract also significantly increased the shelf life of banana, particularly their green life [12]. Aqueous leaf extracts of *Carica papaya* also completely inhibited postharvest rots of pawpaw, while leaf and stem extracts of *Dyospiros ebenaster* had an adequate fungicidal effect on the anthracnose disease of mango caused by *Colletotrichum gloeosporioides* [13].

References

1. Snehalatharani A, Khan ANA (2009) Bio-control of tip-over disease of banana. Ann Pl Prot Sci 17 : 149—151.
2. Basel RM, Racicot K, Senecal AG (2002) Long shelf life banana storage using MAP storage coupled with post harvest MCP treatment. In: Annual Meeting and Food Expo-Anaheim, California, USA, Jun 15—19, 2002.
3. Ranasinghe LS, Jayawardena B, Abeywickrama K (2002) Use of waste generated from cinnamon bark oil extraction as a postharvest treatment of Embul banana. Food Agric Environ 1 : 340—344.
4. Ranasinghe LS, Jayawardena B, Abeywickrama K (2005) An integrated strategy to control post-harvest decay of Embul banana by combining essential oils with modified atmosphere packaging. Int J Food Sci Technol 40 : 97—103.
5. Khan SH, Aked J, Magan N (2001) Control of the anthracnose pathogen of banana (*Colletotrichum musae*) using antioxidants alone and in combination with thiabendazole or imazalil. Pl Pathol 50 : 601—608.
6. De Lapeyre de Bellaire L, Chilin-Charles Y (2008) A laboratory method to evaluate the sensitivity of *Colletotrichum musae* to postharvest fungicides. Fruits 63 : 263—266.
7. Anonymous (2013a) Indian horticulture database. Min of Agrico, Govt of India, pp 34—41.
8. Anonymous (2013b) Group Discussion of All India

Co-ordinated Research Project and ICAR Adhoc schemes on Fruits, Dapoli, Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Ratnagiri Dist, Maharashtra, pp 359.

9. Hewajulige IGH, Sivakumar D, Sultanbawa Y, Wijeratnam RSW, Wijesundera RLC (2006) Effect of chitosan coating on postharvest life of papaya (*Carica papaya* L.) var Rathna Grown in Sri Lanka. Trop Agric Res 18 : 135—142.
10. Jinasena D, Pathiratna P, Wickramarachchi S, Marasinghe E (2011) Use of chitosan to control anthracnose on Embul banana. Int Conf on Asia Agric and Anim IPCBEE 13 : 56—60.
11. Xiangchun M, Yanxia T, Aiyu Z, Xuemei H, Zhaoqi Z (2011) Effect of oligochitosan on development of *Colletotrichum musae, in vitro* and *in situ* and its role in protection of banana fruits. Fruits 67 : 147—155.
12. Thangavelu R, Sundararaju P, Sathiamoorthy (2004) Management of anthracnose disease of banana caused by *Colletotrichum musae* using plant extracts. J Hort Sci and Biot 79 : 664—668.
13. Bautista-Banos S, Barrera-Necha LL, Bravo-Luna L, Bermudez Torres K (2002) Antifungal Torres K (2002) Antifungal activity of leaf and stem extracts from various plant species on the incidence of *C. gloeosporioides* of papaya and mango fruit after storage. Revista Mexicana de Fitopatologia 20 : 8—12.