Biological Forum – An International Journal **13(4): 804-809(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Combination of Fungi Toxicants and Packaging Material on Banana Anthracnose cv. Grand-Naine

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(Received 17 September 2021, Accepted 15 November, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Effect of fungi toxicants in combination with packaging material was investigated in managing anthracnose disease ob banana cv. Grand Naine at 26°C. Fresh green matured banana fruits were treated with 0.1 % carbendazim, propiconazole, cinnamon oil, 20% datura leaf extract and control (without packaging + no treatment). Treated banana fruits were packed in cartoon boxes and news paper stored at 26°C. The results showed significant difference at 7th, 10th and 12th day of storage. The treatment newspaper + carbendazim 0.1%, without packaging + propiconazole 0.1% and cartoon box + carbendazim 0.1% showed lowest PDI 6.47%, 8.44% and 15.67% respectively on 12th day of storage by reducing the physiological loss in weight and increasing shelf life of banana up to 10-14 days.

Keywords: Packaging, fungi toxicants, anthracnose disease.

INTRODUCTION

Banana is one of the most popular fruits in India and many tropical countries. Major economic part of the banana plant is the fruit, suffers from many postharvest diseases. These diseases have had considerable influence on different aspects of cultivation, nutritive value, harvesting, transit and transshipment, storage of fruits. In several cases anthracnose disease has severely deteriorated fruit during transporting from fruit storage facilities to ripening room prior to being displayed for purchasing (Chillet *et al*., 2007). The quality of banana is reduced and considerable amount is wasted, from harvesting to final consumption. This loss can be kept at minimum by improving postharvest handling techniques through the use of packaging materials or through improving traditional packaging practices. Therefore, this study was aimed at the management of anthracnose disease and shelf life extension of banana using appropriate toxicants and packaging material. The quality of the fresh and processed fruit depends on the postharvest handling during harvesting, transportation, storage, and should be monitored effectively to keep the best quality of fruit at harvest (Hofman *et al.*, 2000).

Occurrence of anthracnose disease is closely linked to poor cultural and disease management practices in the banana field, to unclean packing houses and improper postharvest handling. The diseases can be serious problem for growers who fail to manage them with a combination of integrated practices. Infected fruits are safe for humans to consume; however, the infections reduce fruit quality, shelf life and marketability (Nelson, 2008). Hailu *et al*. (2012) reported that the decay loss of banana fruits cultivar Poyo, Gaint Cavendish and Williams packed using high density and low density polythene bags were 43.0 % and 41.2 % respectively at the end of the 36th day of storage. Patel (2012) reported mango fruits were packed with different packaging materials (bamboo basket, plastic crates, CFB box) in which A grade (big size) mango fruits packed in CFB box having newspaper lining increasing the shelf life (6.3 days) of mango and maintained the quality as compared to control. Hailu *et al.* (2014) reported that packaging of banana fruits in high density and low density polyethylene bags resulted in longer shelf life and improved quality of the produce followed by packaging in dried banana leaf and teff straw.

MATERIAL AND METHODS

The effects of different combinations of carbendazim (0.1 % for 5 min), propiconazole (0.1 % for 5 min), cinnamon (0.1 % for 5 min), datura leaf extract (20 % for 5 min) and packaging material *viz.*, cartoon box and news paper on anthracnose disease development in banana cv. Grand Naine was studied. Fresh green matured banana fruits of *cv.* Grand Naine were brought from a farmer's field at Sangam cross of Bagalkot district and thoroughly washed in running tap water to remove dirt and dust, then fruits were air dried under shade. Later banana hands were dipped for five minutes in the above mentioned chemicals/extract, air dried under shade and inoculated the fruits by sparying fungal spore suspension (4×10^6 cfu / ml) of *Colletotrichum gloeosporioides* using an atomizer. The fruits were covered with polythene bags for 48 hours to maintain sufficient humidity. Fruits was later were packed in either cartoon box or in news paper. On seven, ten and twelveth day of storages observations on diseases intensities, physiological loss in weight, and total shelf

life of fruits were recorded. Per cent disease indices (PDI) were calculated with a disease scale 0-4 scale. Where,

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

Fruits from each treatment were weighed on first day of treatment and subsequently their weight loss was recorded at seven day interval up to the end of shelf life. The physiological loss in weight (PLW) was expressed in percentage and calculated as fallow

$$PLW\ \% = \frac{W1 - W2}{W1} \times 100$$

Where, W1 = initial weight and W2 = final weight

The shelf life fruits or keeping quality of ripe fruit was decided based on the appearance and edible stage of the fruits. When the fruits attained beyond the edible stage. Then those fruits were considered to have reached the end of their shelf life and expressed in days.

RESULTS AND DISCUSSION

The data on interaction effects of packaging material (Cartoon box, news paper) along with different treatments showed significant difference at 7th, 10th and 12th day of storage at room temperature (26°C) are presented in the Table 1 and plate 1. Percent disease index in banana cv. Grand Naine was significantly reduced by dipping fruits in different treatment was studied. On 12th day of storage, the lowest PDI in the treatment news paper + carbendazim 0.1 % was 6.47 % as against without packaging, which showed (86.76 %) followed by without packaging + propiconazole 0.1 % (8.44 %) and without packaging + carbendazim 0.1 % (13.50 %).

Table 1: Effect of combination of fungi toxicants and packaging material on banana anthracnose.

Treatment	Per cent Disease Index		
	7th day	10th day	12th day
Packaging			
P1-Cartoon Box	15.05	39.28	61.52
P2-News paper	32.19	43.43	63.25
P3-Without packaging	31.54	37.78	49.04
S. Em ±	**0.94**	**1.22**	**2.12**
CD at 5 %	**2.66**	**3.44**	**5.96**
Fungi toxicants			
T_1- Carbendazim 0.1 %	0.00	2.10	8.88
T_2- Propiconazole 0.1 %	0.00	28.64	48.73
T_3- Cinnamon oil 0.1 %	6.70	11.73	68.69
T_4- Datura extract 20 %	48.43	74.63	79.70
T_5- No treatment	76.19	83.72	83.42
S. Em ±	**1.22**	**1.99**	**2.81**
CD at 5 %	**3.44**	**5.60**	**6.02**
Interaction=Packaging × Fungi toxicants			
T_1 = Cartoon box + Carbendazim 0.1 %	0.00(0.42)	1.06 (3.67)	15.67(23.30)
T_2 = Cartoon box + Propiconazole 0.1 %	0.00(0.42)	36.54(37.05)	68.05(55.85)
T_3 = Cartoon box + Cinnamon oil 0.1 %	0.00(0.42)	0.00 (0.42)	59.99(50.82)
T_4 = Cartoon box + Datura extract 20 %	0.00(0.42)	74.99(60.0)	80.26(63.62)
T_5 = Cartoon box	75.29(60.28)	83.65(66.82)	83.85(66.32)
T_6 = News paper + Carbendazim 0.1 %	0.00(0.42)	0.00(0.42)	6.47(11.36)
T_7 = News paper + Propiconazole 0.1 %	0.00(0.42)	44.05(41.48)	66.34(56.80)
T_8 = News paper + Cinnamon oil 0.1 %	60.34(26.64)	71.25(29.16)	80.23(63.96)
T_9 = News paper + Datura extract 20 %	68.61(55.99)	68.35(56.08)	78.30(62.24)
T_{10} = News paper	72.24(58.55)	81.03(64.22)	81.03(64.22)
T_{11} = Without packaging + Carbendazim 0.1 %	0.00(0.42)	5.28(12.98)	13.50(12.24)
T_{12} = Without packaging + Propiconazole 0.1 %	0.00(0.42)	5.37(13.39)	8.44(16.76)
T_{13} = Without packaging + Cinnamon 0.1 %	0.00(0.42)	11.45(19.71)	66.14(54.45)
T_{14} = Without packaging + Datura extract 20 %	76.68(61.13)	80.55(63.83)	80.55(63.83)
T_{15} = Control	81.03(64.18)	86.76(68.25)	86.76(67.70)
S. Em ±	**2.12**	**3.45**	**3.71**
CD at 5 %	**5.96**	**9.70**	**10.43**

Figures in parenthesis are Arc sin values

T_1 - Cartoon box + Carbendazim 0.1 % ; T_2 - Cartoon box + Propiconazole 0.1 % ; T_3 - Cartoon box + Cinnamon 0.1 %; T_4 - Cartoon box + Datura extract 20 %; T_5 - Cartoon box; T_6 - News paper + Carbendazim 0.1 %; T_7 - News paper + Propiconazole 0.1 %; T_8 - News paper + Cinnamon 0.1 %; T_9 - News paper + Datura extract 20 %; T_{10} - News paper; T_{11} - Without packaging + Carbendazim 0.1 %; T_{12} - Without packaging + Propiconazole 0.1 %; T_{13} - Without packaging + Cinnamon 0.1 %; T_{14} - Without packaging + Datura extract 20 %; T_{15} – Control.

Plate 1. Effect of combination of treatment and packaging material on banana anthracnose cv. Grand-Naine on 12th day of storage.

But higher per cent disease index was 83.85 and 81.03 when kept in cartoon box and news paper without fungicide treatment respectively on 12th day of storage period. Control (without packaging + no treatment) fruits showed about 81.03 and 86.76 per cent disease index on 7th and 10th day of storage respectively, it may be due to the capability of newspaper cuttings to slow down the rate of respiration, ethylene evolution, oxidative metabolism and pectin hydrolysis, resulting in retention of firmness for longer period, which in turn

might have imparted some resistance against the growth of pathogens on fruits (Alam *et al.,* 2015). Findings were reported by Alemu *et al.,* (2014), methanol extract of *Datura stramonium* showed remarkably strong antifungal activity against *Colletotrichum gloeosporioides.* This result corresponds with the findings of Satish *et al.,* (2007), who reported the potent antifungal activity of methanol extract of *Datura stramonium* against wide range of plant pathogenic fungi. The greatest reduction of incidence of mango anthracnose (*C. gloeosporioides*) was recorded in carbendazim 13.3 % and *Datura stramonium* at 50 % concentration, reduced the incidence of anthracnose to 80 % (Alemu *et al.,* 2014). Cinnamon is also reported as a promising source of antifungal compounds (Win *et al.,* 2007; Barrera-Necha *et al.,* 2008). The antifungal activity of cinnamon is mainly due to the presence of cinnamaldehyde that interferes in biological processes involving electron transfer and reacts with nitrogen containing compounds and there by inhibits growth of microorganisms (Gupta *et al.,* 2008). The physiological loss in weight of fruit is mainly due to evaporation of water, respiration and degradation process occurring during handling of fruits. The temperature during storage affects the weight loss to a great extent. Physiological weight loss was found to be increased on 7^{th}, 10^{th} and 12^{th} day of storage conditions and data are presented in Table 2.

Table 2: Effect of combination of fungi toxicants and packaging material on physiological loss in weight of banana.

Treatment	PLW (%)		
	7^{th} day	**10^{th} day**	**12^{th} day**
Packaging			
P_1-Cartoon Box	8.84	10.72	12.17
P_2-News paper	12.03	14.13	15.08
P_3-Without packaging	12.62	14.06	19.52
S. Em ±	**0.62**	**0.97**	**0.78**
CD at 5 %	**1.77**	**2.73**	**2.21**
Fungi toxicants			
T_1- Carbendazim 0.1 %	10.06	11.05	18.05
T_2- Propiconazole 0.1 %	6.50	7.5	8.46
T_3- Cinnamon oil 0.1 %	10.02	10.95	12.69
T_4- Datura extract 20 %	8.55	12.79	14.87
T_5- No treatment	20.67	22.58	23.86
S. Em ±	0.81	1.25	1.01
CD at 5 %	**2.28**	**3.52**	**2.86**
Interaction=Packaging × Fungi toxicants			
T_1 = Cartoon box + Carbendazim 0.1 %	5.03	6.13	7.23
T_2 = Cartoon box + Propiconazole 0.1 %	4.82	5.25	7.53
T_3 = Cartoon box + Cinnamon oil 0.1 %	6.34	6.57	8.5
T_4 = Cartoon box + Datura extract 20 %	2.17	4.71	8.74
T_5 = Cartoon box	25.85	29.04	30.76
T_6 = News paper + Carbendazim 0.1 %	18.42	19.72	21.04
T_7 = News paper + Propiconazole 0.1 %	10.42	11.80	11.92
T_8 = News paper + Cinnamon oil 0.1 %	5.23	10.16	12.50
T_9 = News paper + Datura extract 20 %	6.49	12.38	13.63
T_{10} = News paper	12.11	13.52	25.9
T_{11} = Without packaging + Carbendazim 0.1 %	6.75	7.29	14.71
T_{12} = Without packaging + Propiconazole 0.1 %	4.46	5.46	5.93
T_{13} = Without packaging + Cinnamon oil 0.1 %	11.03	11.10	17.41
T_{14} = Without packaging + Datura extract 20 %	20.01	21.29	22.25
T_{15} = Control	24.05	25.17	26.12
S. Em ±	**1.40**	**2.17**	**1.76**
CD at 5 %	**3.96**	**6.11**	**4.95**

PLW: Physiological Loss in Weight

However, it was observed that on 12th day of storage minimum weight loss 5.93 and 7.23 percent was observed in without packaging + propiconazole (0.1 %) and cartoon box+ carbendazime (0.1%) respectively as compare to control (without packaging + no treatment). The treatments Cartoon box and news paper without fungicide treatment resulted higher weight loss (25.90-30.76%). In order to determine the effect of combination of packaging materials and treatments on shelf life of banana are presented in table 3. Fruit weight loss was significantly increased as the storage period was increased. The maximum weight loss was recorded after 10th and 12th day of storage period (20-30 %) at different treatments and minimum at 7th day of storage period (2-9 %). This may be due to the major factors responsible for fruit weight loss are higher respiration and transpiration rates, which fruit experience during ripening at room temperature (Bora & Narain, 1997). Increased weight loss of banana with prolonged storage periods and during ripening has been noticed in this study. The shelf life of a product depends on initial quality of the food products, amount of quality change that can be allowed, prevailing environmental condition and brakes properties of the packaging material, and compatibility between food product and packaging (Esa *et al*., 2015). Significant variation was obtained among the treatment in relation to shelf life extension of bananas the maximum shelf life (14 days) was observed in Cartoon box+ Carbendazim (0.1 %) followed by News paper + Carbendazim 0.1 % and without packaging + Propiconazole (0.1 %) (12 days). The minimum shelf life was recorded in news paper + cinnamom oil (0.1 %) (3.9 days). Godana (2018) reported the banana fruit treated by clove oil with cartoon (CC) and ginger by cartoon (GC) showed the longest shelf life (8 days).

Table 3: Effect of combination of fungi toxicants and packaging material on shelf life of banana.

Treatment	Days		
	Green life	**Yellow life**	**Total Shelf life**
Packaging			
P1-Cartoon Box	5.93	4.20	10.13
P2-News paper	4.0	3.20	7.2
P3-Without packaging	4.86	4.26	9.12
S. Em ±	**0.11**	**0.12**	-
CD at 5 %	**0.32**	**0.34**	-
Fungi toxicants			
T_1- Carbendazim 0.1 %	6.22	6.11	12.33
T_2- Propiconazole 0.1 %	5.88	4.55	10.43
T_3- Cinnamon oil 0.1 %	4.66	3.44	8.10
T_4- Datura extract 20 %	4.33	3.22	7.55
T_5- No treatment	3.55	2.11	5.66
S. Em ±	**0.14**	**0.15**	-
CD at 5 %	**0.42**	**0.44**	-
Interaction=Packaging x Fungi toxicants			
T_1 = Cartoon box + Carbendazim 0.1 %	7	7	14
T_2 = Cartoon box + Propiconazole 0.1 %	6.6	4.3	10.9
T_3 = Cartoon box + Cinnamon oil 0.1 %	7	5	12
T_4 = Cartoon box + Datura extract 20 %	5.6	3.0	8.6
T_5 = Cartoon box	3.3	1.6	4.9
T_6 = News paper + Carbendazim 0.1 %	6	6	12
T_7 = News paper + Propiconazole 0.1 %	5.0	3.3	8.3
T_8 = News paper + Cinnamon oil 0.1 %	2.3	1.6	3.9
T_9 = News paper + Datura extract 20 %	3.3	3.3	6.6
T_{10} = News paper	3.3	1.6	4.9
T_{11} = Without packaging + Carbendazim 0.1 %	5.6	5.3	10.9
T_{12} = Without packaging + Propiconazole 0.1 %	6	6	12
T_{13} = Without packaging + Cinnamon oil 0.1 %	4.6	3.6	8.2
T_{14} = Without packaging + Datura extract 20 %	4	3.3	7.3
T_{15} = Control	4	3	7
S. Em ±	**0.25**	**0.27**	-
CD at 5 %	**0.73**	**0.77**	-

CONCLUSION

The postharvest fungi toxicant treatment and packaging material has a significant effect on anthracnose disease, quality and shelf life of banana fruit stored for 7th, 10th and 12th days. Fruits treated by carbendazim 0.1 % packed in news paper and cartoon box were found to be the best in terms of PDI, PLW and shelf life of banana followed by propiconazole 0.1 % without packaging. Banana stored without any treatment and packing shows least performance in terms of PDI, PLW and shelf life. So from this experiment it could be concluded that postharvest fungi toxicant treatment and

different packaging material can extend the shelf life of banana fruits and maintain the post harvest quality of the fruits. Further research investigation should be made by including advanced packaging materials with treating gents in different times to come up with conclusive recommendation.

Acknowledgments. The authors acknowledge the help rendered by the guide, members and department of microbiology, college of Horticulture Bagalkot.

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How to cite this article: Vasundhara, B. A., Rajashekhara, E., Thammaiah, N., Kulapati, H., Mesta, R. K. and Ragavendra, S. (2021). Effect of Combination of Fungi Toxicants and Packaging Material on Banana Anthracnose cv. Grand-Naine. *Biological Forum – An International Journal*, *13*(4): 804-809.