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## Use plant extracts for managing and increase the keeping quality of post-harvest banana rot in *in vitro* and *in vivo* condition

**Manasranjan Rout, Kartik Chandra Sahu, Ranjan Kumar Jena and Prados Kumar Jena**

**Abstract**

Banana (*Musa paradisiaca* L.) is considered as the most popular fruit both in ripe and raw condition. Banana is highly perishable and post-harvest rot mostly caused by *Colletotrichum musae* which possess a great threat to ripe banana after harvest and in transit also causing 35% loss. In Dept. of Plant Pathology, Institute of Agricultural Science, SOADU, BBSR was conducted an experiment to get some solution about rotting of banana or *Colletotrichum* spp. To control or manage the post-harvest loss due to *Colletotrichum* spp we were tried different combination of plant extracts *in vitro* condition. Also we were tried alone and combination of plant extracts *in vivo* or field condition to increase the keeping quality. In *in vitro* condition Neem + Onion, Arakha + Garlic, Bael + Garlic retarded 100% radial growth followed by Morning glory + Begunia, Bael + Onion with 91.69% and 91.95% radial growth respectively in 20% concentration. Maximum control of post-harvest rot was observed in Begunia plant extract (56.90%) followed by Onion bulb extract (37.42%). Garlic clove extract (18.56%) was found to be least effective in controlling post-harvest rot of banana in field or *in vivo* condition.

**Keywords:** Post-harvest banana rot, *Colletotrichum musae*, Plant extract, Combinations of plant extracts, *in vitro* and *in vivo* management

**Introduction**

Bananas are one of the most popular fruits worldwide. They contain essential nutrient that can have a protective impact on health. The scientific name of Banana is *Musa acuminata* and *Musa balbisiana*. But the old scientific names of banana are *Musa sapientum* and *Musa paradisiaca*. It belongs to family *Musaceae* in order *Scitamineae*. Banana being a highly perishable commodity, due to lack of awareness in the production causes heavy post-harvest losses up to 35% (Albashir and Imam, 2010) [1] during transport and storage, which deteriorates the fruit quality very rapidly after harvest. The most common post-harvest diseases of banana are fruit rots, crown rot, finger rot and cigar end rot. (Manica, 1997) [4]. Among the post-harvest diseases, banana anthracnose is considered as the most important diseases of banana in the global level and is one of the major constraints to banana production. It deteriorates the quality and nutritive value of the fruits and renders them unfit for marketing and consumption thereby causing severe loss to farmers and traders. The losses may be tune of 100 per cent if they are not managed properly (Ploetz, 1998) [6]. Anthracnose disease is geographically widespread but is most common in the tropics and subtropics regions (Punithalingam, 1980) [7]. The causes of such losses during storage and marketing include; Physical damage to fruits, Attack of pathogen fungi in ripe banana, Uneven and unpredictable ripening of the fruit.

**Materials and Methods****Preparation of combination of Phyto extracts**

The fresh plant parts were washed with tap water followed by distilled water. The plant parts were dried for few minutes. 50 g of each plant part was weighed (to make combination of 100gm) and ground using grinder with addition of equal volume (w/v) of ethanol. These extracts were then filtered through double layered muslin cloth and kept in 100 ml conical flasks. The content was mixed thoroughly and centrifuged at 5500 rpm for 10 minutes and the supernatant was filtered through Whatman filter paper no.1 and after filtration the contents were used for further study (Shamsi, 2016) [9].

After completion of the phyto extract experiment different combinations of the phyto extracts were prepared to test their inhibitory effect in controlling the growth of *Colletotrichum musae* in *in vitro* condition. 20 ml of mixture of crude phyto extracts (ethyl alcohol extract) were mixed with 80ml of the sterilized potato dextrose agar medium so as to get 20% concentration in aseptic combination in laminar air flow chamber. The efficacy of combination products against test pathogen were tested in

poisoned food technique. The Percent inhibition over control was calculated according to formula given by Vincent (1947)<sup>[10]</sup> as follows.

$$I = (C - T)/C \times 100$$

I = Per cent inhibition

C = Mean Radial growth in control

T = Mean Radial growth in treatment

**Table 1:** Efficacy of Phyto extracts in controlling the post-harvest rots of banana

Sl. No	Treatments	Combination of plant extracts	Plant part used	Concentration used
1	T1	Sadabahar ( <i>Vinca rosea</i> ) + Basanga ( <i>Adhatoda vasica</i> )	Leaf + Leaf	20%
2	T2	Morning glory ( <i>Ipomea</i> sp.) + Begunia ( <i>Vitex negundo</i> )	Leaf + Leaf	20%
3	T3	Neem ( <i>Azadirachta indica</i> ) + Onion ( <i>Allium cepa</i> )	Leaf + Bulb	20%
4	T4	Arakha ( <i>Calotropis gigantea</i> ) + Garlic ( <i>Allium sativum</i> )	Leaf + Clove	20%
5	T5	Bael ( <i>Aegle marmelos</i> ) + Onion ( <i>Allium cepa</i> )	Leaf + Bulb	20%
6	T6	Bael ( <i>Aegle marmelos</i> ) + Garlic ( <i>Allium sativum</i> )	Leaf + Clove	20%

The best Phyto extracts selected from laboratory test were used for soaking of banana fruit collected from market in inoculated conditions for determining the inhibition of rotting by the pathogens. For this purpose healthy bananas were collected from local market and washed properly. Phyto extracts were prepared in solution of required doses and the

fruits were dipped in this solution for 30 minutes. Observations for the expression of rotting symptoms were recorded after 3rd, 5th, 7th and 8th day after dipping. For this purpose percentage of infected fruit area were recorded in different days.

**Table 2:** List of phyto extracts were taken for *in vivo* test for *Colletotrichum musae*

Sl. No.	Treatments	Name of treatments	Plant part used	Dose
1	T1	Begunia ( <i>Vitex negundo</i> )	Leaf	10%
2	T2	Sadabahar ( <i>Vinca rosea</i> )	Leaf	10%
3	T3	Garlic ( <i>Allium sativum</i> )	Clove	10%
4	T4	Onion ( <i>Allium cepa</i> )	Bulb	10%
5	T5	Morning glory ( <i>Ipomea</i> sp.) + Basanga ( <i>Adhatoda vasica</i> )	Leaf + Leaf	10%
6	T6	Sadabahar ( <i>Vinca rosea</i> ) + Basanga ( <i>Adhatoda vasica</i> )	Leaf + Leaf	10%

## Results and Discussion

### Bio-efficacy of combinations of plant extracts against radial growth of *C. musae*

Phyto extracts showing more than 90% radial growth inhibition of causal fungus in 20% concentration were taken in combination for evaluation against *Colletotrichum musae*. Neem + Onion and Arakha + Garlic completely inhibited radial growth of *Colletotrichum musae* in laboratory condition followed by Morning glory + Begunia and Bael + Onion showing more than 90% reduction of radial growth. Sadabahar + Basanga were less effective only reducing 84.4% radial growth. Combinations of plant extracts were also tested

against radial growth of *Colletotrichum musae*. Neem + Onion, Arakha + Garlic and Bael + Garlic completely inhibited radial growth of *Colletotrichum musae* followed by Morning glory + Begunia (91.69%) and Bael + Onion (91.95%) respectively. We are also recorded in Morning glory + Begunia and Bael + Onion in which effectiveness of dual formulation was reduced. This may be due to antagonistic effect of the active ingredient present in plant extracts. In contrast Bael

+ Onion and Arakha + Garlic, there was 100% inhibition due to synergistic effect of active ingredient of plant products. No such references were found in concentration of plant extracts.

**Table 3:** Efficacy of some mixed formulations of plant extracts against radial growth of *Colletotrichum musae* (mm)

Treatment	Combination of Phyto extracts	Plant parts used	Concused	Mean Colony diameter (mm)	Percent inhibition over control
T1	Sadabahar + Basanga	leaves	20%	10.00	84.42
T2	Morning glory + Begunia	leaves	20%	5.34	91.69
T3	Neem + Onion	Leaves & bulb	20%	0.00	100
T4	Arakha+Garlic	Leaves & clove	20%	0.00	100
T5	Bael + Onion	Leaves & bulb	20%	5.17	91.95
T6	Bael + Garlic	Leaves & clove	20%	0.00	100
T7	Control			64.17	
		SE(m) ±		0.194	
		CD at (5%)		0.594	

### Efficacy of alone and different combinations plant extracts (10% concentration) against post-harvest rot of banana (*Champa*) *in vivo*

Fresh Champa variety banana were collected from market and dipped for 30 minutes in 10% concentration of different

single and combined plant extracts. Observations were taken on percent infection of banana fruit 3 days after dipping. The result revealed that percentage infection of banana fruit increased from 3rd day up to 8th day showing more than 90% infection as against 100% in control. Significant differences

among plant extracts were observed in reducing post-harvest rot of banana at 8th day of dipping. Sadabahar, Onion, Garlic, Sadabahar + Basanga, Morning glory + Basanga could not reduce the postharvest rot after 8 days and the fruits were infected completely more than 93% but Begunia (10% conc.) could reduce 56.90% of the post-harvest rot after eighth day of dipping followed by Onion (37.42%).

Antony *et al.* (2003) [2] tried spraying emulsions of essential oil Ceylon citronella, lemon grass and Indian sweet basil. From that Indian sweet basil oil controlled crown rot and anthracnose enabling banana up to 21 days. Ranasinghe *et al.*

(2003) [8] used cinnamon oil emulsions on banana to reduce anthracnose. In the current study Begunia in both the concentration controlled 100% radial growth in laboratory condition and also proved better in field condition. Onion and Garlic though had 100% radial growth in laboratory condition, could not able to check post-harvest rot in dipping condition and there was 93 and 99% fruit infection on eighth day. It may be concluded that Begunia plant extract at 10% concentration may be used as dipping for 30 minutes of Champa banana for keeping more than 8 days.

**Table 4:** Efficacy of different combination of plant extracts alone or in combinations (10% concentration) against post-harvest rot of banana (champa) *in vivo*

Treatments	Plant extracts	Percent infection on banana fruits in different days					Mean percent reduction compared to control
		Days after dipping					
		3 <sup>rd</sup> day	5 <sup>th</sup> day	7 <sup>th</sup> day	8 <sup>th</sup> day	Mean	
T1	Begunia	11.33	13.64	40.87	78.97	36.20	56.90
T2	Sadabahar	38.20	48.62	84.42	96.40	66.91	20.35
T3	Garlic	36.15	52.87	86.27	98.35	68.41	18.56
T4	Onion	24.32	34.16	57.44	94.37	52.57	37.42
T5	Morning glory + Basanga	28.36	44.14	63.20	87.47	55.79	33.59
T6	Sadabahar + Basanga	25.42	42.36	66.21	95.41	57.35	31.73
T7	Control	60.61	77.16	98.28	100	84.01	
	SE(m) ±	10.12	13.94	22.13	28.99		
	CD at (5%)	24.76	34.17	54.27	71.07		

## Conclusion

Plant formulations showing best result were also tested alone or in combination against radial growth of *Colletotrichum musae* in 20% concentration. Neem + Onion, Arakha + Garlic and Bael + Garlic retarded 100% radial growth of *Colletotrichum musae* followed by Morning glory + Begunia and Bael + Onion having 91.69% and 91.95% radial growth inhibition respectively. Sadabahar + Basanga were found to be least effective with only 84.42% radial growth inhibition.

Different plant extracts alone or in combination were prepared and the market collected Champa variety bananas were dipped for 30 minutes to visualize the extent of damage in subsequent days. Observations were taken from third day to eighth day after dipping. Maximum control of post-harvest rot was observed in Begunia plant extract (56.90%) followed by Onion plant extract (37.42%). Sadabahar + Basanga, Morning glory + Basanga also found to be equally effective reducing 31.73% and 33.59% post-harvest rot in comparison to control. Garlic was found to be least effective in controlling post-harvest rot of banana having only 18.56% reduction.

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