



Research Article

ENVIRONMENT FRIENDLY WAY TO MANAGEMENT OF FUSARIUM FRUIT ROT DISEASE OF BANANA *IN VIVO* BY ESSENTIAL OILS

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Abstract: Fruit rot disease caused by *Fusarium musae* is one of the post-harvest diseases of banana and is adversely affects the fruit quality and the market value. In present study various essential oils were screened to know their bio efficacy in controlling the *Fusarium* fruit rot of banana. Among various oils (5 %) screened against *Fusarium* fruit rot of banana, the Lowest *Fusarium* fruit rot severity was recorded under the application of eucalyptus oil at 5 percent both in pre inoculation (10.57%) and post-inoculation (13.00%) methods at 8th day after inoculation and it was found at par with neem oil and safflower oil at 5 percent.

Keywords: Banana, *Eucalyptus* oil, *Fusarium musae*, Fruit rot, post-harvest

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Introduction

Banana (*Musa paradisiaca* L.) is one of the most important commercial fruit crop grown all over the world in the tropical and subtropical areas. It is the second largest fruit crop, belongs to family Musaceae in order Zingiberales. It is indigenous to Indo-Malayan region. In India, banana is fourth important food crop in term of gross value exceeding only by paddy, wheat and milk products. It is also a desert fruit for million apart from a staple food owing to it's rich and easy digestibility. The ripe fruits are edible, delicious and very nutritious. The content of carbohydrates 22.84g is very high with a calorific value of 89kcal/100g fruit. It is good source of vitamin A (64 IU/100g of edible portion) and vitamin C (8.7mg/100g of edible portion) and fair source of vitamin B₁, B₂, B₃, B₅, B₆ and B₉. The fruits are rich in magnesium, sodium, potassium and phosphorus. The food value is about three times that of wheat [1].

The current postharvest problems for bananas are mainly concerned with storage and marketing. Crown rot due to, *Fusarium pallidoroseum* (Cooke) Sacc, *Colletotrichum musae* (Berk. and Curt.), *Verticillium theobromae* (Turc.) Mason and Hughes, *Thielaviopsis paradoxa* (Desseynes) Sacc., *Lasiodiplodia theobromae* (Pat.) Griffth and Maubl, *Fusarium musae* (Syd.) M. B. Ellis and *Fusarium roseum* (Link) Snyder and Hansen pathogens causes losses of bananas in grown for local consumption and export of bananas [2]. Banana fruit majorly infected by *Alternaria alternata* (Fr.) Keissier, *Colletotrichum musae*, *Fusarium moniliforme* (Cooke) Sacc and *F. oxysporum* (Schlecht. Emend. Snyder and Hansen) pathogens. *Aspergillus flavus* Link., *A. fumigatus* Fresenius., *A. niger* Van.Teigh., *A. terreus* Thom., *Penicillium* spp. *Rhizoctonia solani* (Kuhn) and *Macrophomina phaseolina* (Tassi) Goid. also caused considerable damage to fruits [3].

The banana fruit infecting fungus *Fusarium musae* was originally known as a distinct population within *Fusarium verticillioides*. However, Van Hove et al., (2011) [4] recently, showed, by multilocus phylogeny and mating experiments that this population represents a unique lineage in the *Fusarium fujikuroi* species complex (FFSC) and consequently they installed the new species *Fusarium musae* being closely related to (i.e. sister species) but distinct from *Fusarium verticillioides*. An alternative hypothesis is that *Fusarium musae* is not only present on banana fruits, but also on other plant hosts or environmental sources.

In a more recent survey performed laboratory testing the feasibility of an in house developed MALDITOF-MS identification assay and there by using 390 fungal isolates collected between July 2012 and July 2013 from 2 hospitals located in Brussels, one *Fusarium musae* strain was found among the 20 *Fusarium* isolates identified.

Use of fungicide on harvested fruits to manage the diseases is not desirable from health point of view, also continuous and indiscriminate use has led to the development of fungicide resistant strains of the pathogens. It also reduces the export quality due to high residues. An attempt was made to explore the possibility of using various essential oils for the management of *Fusarium* fruit rot of banana

Materials and Methods

Nine oils at 5 percent were screened to study their effect on development of banana *Fusarium* fruit rot disease.

List of oils used for study

SN	Treatments	Concentration
1	Safflower oil	5.0%
2	Lemon grass oil	5.0%
3	Mustard oil	5.0%
4	Neem oil	5.0%
5	Eucalyptus oil	5.0%
6	Groundnut oil	5.0%
7	Sesamum oil	5.0%
8	Sunflower oil	5.0%
9	Castor oil	5.0%

Experimental details

I	Design	Completely Randomized Design (CRD)
II	Treatments	10 (Ten) (including control)
III	Repetitions	3 (Three)

Pre- inoculation of oils on banana fruit

The healthy, semi-matured uniform size of banana fruits were surface sterilized by dipping in 0.1 percent NaOCl solution for one min. followed by three washings with distilled sterile water and inoculated separately with the pathogen by the stylar-end pricking method.

Table-1 Efficacy of oils on the severity of banana fusarium fruit rot in vivo

SN	Oils (5%)	Fusarium fruit rot severity (%)			
		Pre-Inoculation		Post-Inoculation	
		4 th DAI	8 th DAI	4 th DAI	8 th DAI
1	Safflower oil	16.02** (07.63) *	20.06** (11.77) *	17.72** (09.29) *	22.92** (15.17) *
2	Lemon grass oil	17.32(08.87)	24.15(16.75)	16.29(07.89)	23.88(16.41)
3	Mustard oil	17.49(09.06)	25.31(18.29)	17.38(08.93)	25.43(18.46)
4	Neem oil	15.19(06.88)	19.33(10.98)	15.26(06.95)	21.88(13.91)
5	Eucalyptus oil	14.83(06.55)	18.95(10.57)	15.60(07.24)	21.11(12.99)
6	Groundnut oil	17.63(09.21)	22.95(15.22)	17.88(09.43)	23.59(16.04)
7	Sesamum oil	17.50(09.05)	25.29(18.26)	17.39(08.96)	25.00(17.86)
8	Sunflower oil	17.64(09.24)	24.55(17.27)	17.54(09.11)	23.85(16.35)
9	Castor oil	16.17(07.80)	22.87(15.11)	16.54(08.13)	23.08(15.38)
10	Control	21.50(13.49)	29.80(24.73)	21.29(13.19)	30.57(25.92)
	SEm ±	0.77	0.6	0.63	0.71
	CD at 5 %	2.27	1.77	1.86	2.08
	CV %	7.78	4.47	6.32	5.07

*Figure in parenthesis is original value, **outside is arcsine transform value & DAI: Day after incubation.

The fruits were first dipped in the oil suspension (5%) solution for 15 min., air dried and then inoculated with fruit rot pathogen (10^6 spores/ml) then bagged in sterilized polythene bags with sterilized moist absorbent cotton swab. The mouth of the bag was loosely tied and incubated at $27 \pm 2^\circ\text{C}$. The untreated and inoculated and uninoculated fruits were kept as control. The interval between oil treatment and inoculation was kept twelve hours. The severity of fruit rots was recorded on 4th and 8th day after inoculation with the help of assessment key.

Post- inoculation of oils on banana fruit

The procedure mentioned in above was followed except that the fruits were first inoculated with test pathogen and then treated with oil suspension (5%) solution.

Assessment key used for severity of fusarium fruit rot disease of banana

(The Scale 0, 1, 2, 3, 4 and 5 percent infection 0%, 1-10%, 11-20%, 21-40%, 41-50%, > 60%, respectively.)

Severity (%) = [Area of infected fruits / Total area of fruit tissue] x 100

Results and Discussion

Total nine oils viz., safflower oil, lemon grass oil, mustard oil, neem oil, eucalyptus oil, groundnut oil, sesamum oil, sunflower oil and castor oil at 5 percent were evaluated.

Pre-inoculation of oils on banana fruit

The results presented in [Table-1] revealed that significantly lowest fusarium fruit rot severity was noticed in fruits treated with eucalyptus oil (6.55%), which was at par with neem oil (6.88 %), safflower oil (7.63%) and castor oil (7.80%) on 4th day after inoculation. While, lemon grass oil was found mediocre effect in reducing the fusarium fruit rot of banana (8.87%). However, sunflower oil (9.24%), groundnut oil (9.21%), mustard oil (9.06%) and sesamum oil (9.05%) found least effective.

Among all the tested oils, eucalyptus oil was found significantly superior over all other treatments in preventing fusarium fruit rot severity (10.57%) on 8th day after inoculation and it was at par with neem oil (10.98%) and safflower oil (11.77%). While, groundnut oil (15.22%) and castor oil (15.11%) were found mediocre effect in controlling the fusarium fruit rot of banana. However, mustard oil (18.29%), sesamum oil (18.26%), lemon grass oil (16.75%) and sunflower oil (17.27 %) found least effective.

Post-inoculation of oils on banana fruit

The results presented in [Table-1] the neem oil (6.95%) proved significantly most effective in controlling the fusarium fruit rot severity, and it was at par with eucalyptus oil (7.24%), lemon grass oil (7.89%) and castor oil (8.13%) on 4th day after inoculation. While, mustard oil (8.93%), sesamum oil (8.96%) and sunflower oil (9.11%) were found mediocre effect in controlling fusarium fruit rot severity. Groundnut oil (9.43%) and safflower oil (9.29%) found least effective. Eucalyptus oil (12.99%) proved significantly superior over all other treatments in controlling fusarium fruit rot severity after 8th day of inoculation but it was at par with neem oil (13.91%), safflower oil (15.17%) and castor oil (15.38%). While, groundnut oil (16.04%) was found mediocre effect in controlling fusarium fruit rot severity.

However, sesamum oil (17.86%), mustard oil (18.46%) lemon grass oil (16.41%) and sunflower oil (16.35%) were found least effective. Fungicidal nature of oil is basically due to their toxic compounds which are mainly monoterpenoids and sesquiterpenes and hydrocarbons with general formulae $(C_5H_8)_n$ and its derivatives which could able to inhibit the growth of *Fusarium musae* after its application. The results of present investigations corroborate with the results obtained by Singh (2011) [5] evaluated nine oils viz., safflower, lemon grass, mustard, neem, eucalyptus, groundnut, sesamum, sunflower and castor against *Fusarium moniliforme* causing fusarium rot in banana and observed that application of castor oil significantly lower the fusarium rot severity (13.33 and 12.66%) followed by neem oil (16.66 and 14.00%) at 5 percent in pre and post inoculation treatments at 7th day after inoculation. Singh and Tripathi (2015) [6] found that *Azadirachta indica*, *Cinnamomum zeylanicum* and *Mentha arvensis* oil used at 100ppm and 200ppm concentration were recorded 100 percent inhibition of *Colletotrichum musae*. Chimaka et al. (2016) [7] reported that *Eucalyptus globulus* oil at 75 and 100 percent concentrations was recorded 100 percent inhibition of mycelial growth of *Colletotrichum* sp. causing tomato fruit rot.

Conclusion

Among various oils tested at (5%) were tested against fusarium fruit rot of banana, significantly lowest fusarium fruit rot severity was recorded in fruits coated with eucalyptus oil (10.57 & 12.99%) was found significantly superior over all other treatments in preventing severity and it was at par with neem oil (10.98 & 13.91%) and safflower oil (11.77 & 15.17%) in pre and post- inoculation treatments at 8th day after inoculation, respectively.

Application of research: Results of the present study strongly reflected that the environment friendly way to management by essential oils play important role in disease development.

Research Category: Plant sciences

Abbreviations: CRD: completely randomized design

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Study area / Sample Collection: Experimental of N. M. College of Agriculture, Navsari Agricultural University, Navsari, 396450, Gujarat, India

Cultivar / Variety / Breed name: Banana (*Musa paradisiaca* L.), Grande Naine

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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