RESEARCH ARTICLE

Management of *Alternaria alternata* causing fruit rot of Strawberry using various plant extracts

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ABSTRACT

Strawberry (*Fragaria ananassa* L.) is an important fruit in Maharashtra. Twenty five isolates of *Alternaria alternata* were isolated from rotted strawberry fruit and their sensitivity was tested against Mancozeb. The MIC was ranged between 680.0- 2040.0µg/ml *in vitro*. Isolate *Aa*-10 (680µg/ml) was sensitive while isolate *Aa*-08 was resistant showing maximum MIC (2040µg/ml). In present investigation total thirty six plant extracts were used to manage Mancozeb resistant mutant of *A. alternata* (*Aa*-EMS-2) individually as well as in mixture with Mancozeb. The individual PCE of *Zingiber officinale* Rosc., *Mimusops elengi* (L.), *Aloe vera* (L.), *Lantana camara* (L.), *Mentha arvensis* Benth., *Catharanthus roseus* (L.), *Eucalyptus globules* (Labill.), *Allium sativum* L.(Leaf and bulb), *Calotropis gigantea* (L.) R. Br. ex Schult. and *Cymbopogon citrates* DC. Stapf. gave fruitful results in individually. While mixture with Mancozeb, *Allium sativum* L. (leaves) (91.11), *Allium sativum* L. bulb (89.91), *Mimusops elengi* L. (86.67), *Lantana camara* L. (74.45), *Polyalthia longifolia* Benth. & Hook. f. (74.45), *Catharanthus roseus* L. (73.33), *Eucalyptus globulus* Labill. (72.22), *Ficus benghalensis* L. (72.22), *Datura inoxia* Mill. (70.00) and *Aloe vera* L. (68.89) shows fruitful results in controlling Mancozeb resistant mutant of *A. alternata* (*Aa*-EMS-2).

Keywords: *Strawberry rot, Alternaria alternata, Plant extract.*

INTRODUCTION

Strawberry (*Fragaria ananassa* Dutch.) is highly perishable fruits due to their extreme tenderness, vulnerability to mechanical damage and their susceptibility to fungal spoilage (Maxie *et. al.* 1959; Dennis, 1978). Fresh strawberries, therefore, have a very limited postharvest life and cannot be stored except briefly (Dennis and Mountford 1975).

Post-harvest losses are typically more severe, especially when conditions are favorable for disease development; in some cases 80-85% of a crop may be lost (Hong *et. al.* 1998; Larena *et. al.* 2005). Strawberry fruits infected by various fungal pathogens viz. *Alternaria alternata, Colletotrichum acutatum, C. gloeosporioides C. fragariae, Rhizopus nigricans, Phytopthora paracitica, P. cactonum, Botrytis cinerea, Fusarium solani, Aspergillus niger, Aspergillus flavus, Penicillium expansum* (Michel Dignand, 2004) out of which Alternaria rot caused by *Alternaria alternata* is severe. Strawberry growers heavily rely on the use of fungicides for control of fruit diseases in strawberries. But due to adverse effects of fungicides, growers are using integrated disease management methods for controlling various diseases. Several higher plants and their constituents have been successfully used in management of plant diseases and have proved to be harmless and nonphytotoxic, unlike chemical fungicides.

In present, investigated that the mechanisms of disease suppression by plant products have suggested that the active constituents present in plant extracts may either act on the pathogen directly or induce systemic resistance in host plants resulting in a reduction of the disease. In this sense plant extract presently used as an alternative for plant disease management. Wongkaew and Sinsiri (2014) evaluated *C. longa* extract against *Alternaria alternata*, *Colletotrichum gloeosporioides*, *Fusarium oxysporum* f. sp. *lycopersici*, *Sclerotium rolfsii*, *Phytophthora infestans* and *Pythium* sp. in comparison to commercial fungicides such as copper oxychloride and Mancozeb. Kantwa *et. al.,* (2014) reported that garlic clove extract was found most effective in inhibiting the mycelial growth of *A. alternata* (46.60%) followed by neem (43.30%) and datura (40.30%) leaf extract. Harison *et. al.,* (2014) studied the aqueous leaves extract of *Pongamia pinnata*, *Calotropis procera*, *Nerium indicum* and *Curcuma longa* against *Alternaria solani* shows zone of inhibition of 20, 22, 21, 30mm respectively.

MATERIALS AND METHODS:

A total 36 *viz. Hyptis suaveolens* (L.), *Ricinus communis* (L.), *Syzygium cumini* (Lam.), *Allium cepa* (L.), *Allium sativum* (L.), *Eclipta alba* (L.), *Calotropis gigantea* (L.) R. Br. ex Schult., *Lantana camara* (L.), *Mentha arvenses* (Benth.), *Zingiber officinale* (Rosc.), *Aloe vera* (L.), *Vernonia spp.*(Schreb.), *Carica papaya* (L.), *Anethum graveolens* (L.), *Coriandrum sativum* (L.), *Murraya koenigii* (L.), *Ficus globosa* (Blume.), *Ficus religiosa* (L.), *Ficus benghalensis* (L.), *Azadirachta indica* (A. Juss.), *Plumaria alba* (L.), *Psidium guajava* (L.), *Mangifera indica* (L.), *Jasminium grandiflorum* (Dumort), *Datura inoxia* (Mill.), *Mimusops elengi* (L.), *Polyalthia longifolia* (Benth. & Hook. f.), *Catharanthus roseus*(L.), *Ocimum sanctum* (L.), *Ocimum basilicum* (L.), *Cymbopogon citratus* (DC. Stapf.), *Nerium indicum* (L.), *Eucalyptus globulus* (Labill.), *Citrus limonum* (Risso.) and *Hibiscus rosasinensis* (L.) medicinal plants were collected from Dombivali Shikshan Prasarak Mandal's, K. V. Pendharkar College campus and nearby college area for experiment.

The part of the plant v*iz*. leaves; rhizome and root were washed under the running tap water and finally rinsed with sterilized distilled water. 100 gm of plant parts were cut into small pieces and minced with the help of grinder by adding 100 ml sterilized distilled water. These leaf extracts were filtered through double-layered muslin cloth in 150 ml conical flasks and plugged with non-absorbent cotton. These filtered extracts were autoclaved at 15 lbs pressure for 20 minutes. The plant extracts were tested against mycelial growth of Mancozeb resistant mutant of *A. alternata* (*Aa*-EMS-2) by poisoned food technique (Nene and Thapliyal, 1992). Each plant extracts were tested at four different concentrations *viz;* 25, 50, 75 and 100% individually and in mixture with Mancozeb. Each plate was inoculated with 5 mm disc of mycelial bit taken from the periphery of 7days fresh culture of *A. alternata* (*Aa*-EMS-2) growing on PDA. The inoculated petriplates were incubated at 27$\pm$2^{0}C. Petri-plates were used for each treatment serving as three replications.

Medium without extract was served as control. Similar set was prepared using plant extract in mixture with Mancozeb (680µg/ml). Colony diameter was noted after 7 days of incubation. Percentage Control Efficacy was calculated by Baviskar and Suryawanshi (2014).

$$\text{Percentage Control Efficacy} = \frac{C-T}{C} \times 100$$

Where,

C = Diameter of the colony in control

T = Diameter of colony in treatment

RESULTS AND DISCUSSION

The results are revealed in table 1. Individually, plant extracts showed PCE ranges from 06.67-61.67. The individual PCE of *Zingiber officinale* Rosc., *Mimusops elengi* (L.), *Aloe vera* (L.), *Lantana camara* (L.), *Mentha arvensis* Benth., *Catharanthus roseus* (L.), *Eucalyptus globules* (Labill.), *Allium sativum* L.(Leaf and bulb), *Calotropis gigantea* (L.) R. Br. ex Schult. and *Cymbopogon citrates* DC. Stapf. ranges (61.67 to 48.89) gave fruitful results in individually at @ of 25, 50, 75 and 100 percent and mixture with Mancozeb PCE ranges 91.11-43.33% gave fruitful results followed by *Allium sativum* L. (leaves) (91.11), *Allium sativum* L. bulb (89.91), *Mimusops elengi* L. (86.67), *Lantana camara* L. (74.45), *Polyalthia longifolia* Benth. & Hook. f. (74.45), *Catharanthus roseus* L. (73.33), *Eucalyptus globulus* Labill. (72.22), *Ficus benghalensis* L. (72.22), *Datura inoxia* Mill. (70.00) and *Aloe vera* L. (68.89).

Table1: Efficacy of fresh plant extracts against Mancozeb resistant mutant isolate of *A. alternata* (*Aa*-EMS-2) *in vitro***.**

Sr. no.	Scientific name	Family	Part used	Individual/ Mixture	Percentage Control Efficacy			
					25%	50%	75%	100%
1.	*Hyptis suaveolens* (L.)	Lamiaceae	Leaves	Individual	13.33	21.11	27.78	32.22
				Mixture	43.33	47.78	53.33	62.22
2.	*Ricinus communis* (L.)	Euphorbiacea e	Leaves	Individual	28.89	34.44	41.11	46.67
				Mixture	64.44	65.56	66.67	68.89
3.	*Syzygium cumini* (Lam.)	Myrtaceae	Leaves	Individual	38.33	42.78	44.44	48.89
				Mixture	46.67	49.90	56.67	68.89
4.	*Allium cepa* (L.)	Liliaceae	Bulb	Individual	18.89	20.56	23.89	25.56
				Mixture	43.33	49.91	53.33	62.22
5.	*Allium sativum* (L.)	Liliaceae	Bulb	Individual	38.89	41.11	42.78	52.78
				Mixture	56.67	66.67	85.56	89.91
6.	*Allium sativum* (L.)	Liliaceae	Leaves	Individual	31.11	37.78	47.78	52.22
				Mixture	57.78	65.56	84.44	91.11
7.	*Eclipta alba* (L.)	Asteraceae	Leaves	Individual	06.67	35.00	46.11	47.78
				Mixture	42.22	50.00	54.45	64.45
8.	*Calotropis gigantea* (L.)	Apocynaceae	Leaves	Individual	23.89	29.45	50.00	51.67
				Mixture	62.23	62.23	61.12	64.45
9.	*Lantana camara* (L.)	Verbenaceae	Leaves	Individual	29.44	31.11	36.67	57.78
				Mixture	62.78	67.22	69.90	74.45
10.	*Menthaarvenses* (Benth.)	Lamiaceae	Leaves	Individual	05.56	22.22	36.67	56.67
				Mixture	47.22	52.78	58.33	63.33
11.	*Zingiber officinale* (Rosc)	Zingiberaceae	Rhizho me	Individual	31.67	46.11	55.56	61.67
				Mixture	47.11	50.56	59.44	66.11
12.	*Aloe vera* (L.)	Liliaceae	Leaves	Individual	41.11	47.78	52.22	59.98
				Mixture	49.90	52.33	61.11	68.89
13.	*Vernonia spp.* (Schreb.)	Asteraceae	Leaves	Individual	10.00	12.22	18.89	32.22
				Mixture	43.33	46.67	50.00	52.22

Table 1: Continued…

Sr. no.	Scientific name	Family	Part used	Individual / Mixture	Percentage Control Efficacy			
					25%	50%	75%	100%
14.	*Carica papaya* (L.)	Caricaceae	Leaves	Individual	12.22	13.33	13.33	30.00
				Mixture	41.12	42.22	45.56	49.90
15.	*Anethum graveolens* (L.)	Apiaceae	Leaves	Individual	07.78	15.56	17.78	28.89
				Mixture	41.11	44.44	47.11	50.00
16.	*Coriandrum sativum* (L.)	Apiaceae	Leaves	Individual	0.0	0.0	04.44	07.78
				Mixture	51.11	54.44	62.23	65.56
17.	*Murraya koenigii* (L.)	Rutaceae	Leaves	Individual	0.0	0.0	04.44	06.67
				Mixture	60.33	62.23	64.44	69.90
18.	*Ficus globosa* (Blume.)	Moraceae	Leaves	Individual	13.33	21.11	26.67	32.22
				Mixture	43.33	47.78	50.00	60.00
19.	*Ficus religiosa* (L.)	Moraceae	Leaves	Individual	18.89	13.33	11.11	08.89
				Mixture	57.78	54.44	46.67	43.33
20.	*Ficus benghalensis*(L.)	Moraceae	Leaves	Individual	18.89	24.44	34.44	41.11
				Mixture	56.67	60.00	68.89	72.22
21.	*Azadirachta indica* (A. Juss.)	Meliaceae	Leaves	Individual	11.11	15.56	21.11	28.89
				Mixture	54.44	60.00	64.44	66.67
22.	*Plumaria alba* (L.)	Apocynaceae	Leaves	Individual	13.33	15.56	24.44	28.89
				Mixture	47.78	50.00	52.22	55.56
23.	*Psidium guajava* (L.)	Myrtaceae	Leaves	Individual	15.56	18.89	21.11	22.22
				Mixture	53.33	55.56	57.78	60.00
24.	*Mangifera indica* (L.)	Anacardiaceae	Leaves	Individual	15.56	17.78	22.22	24.44
				Mixture	54.44	57.78	60.00	62.23
25.	*Jasminium grandiflorum*	Oleaceae	Leaves	Individual	14.45	17.78	20.00	25.56
				Mixture	51.11	54.44	57.78	64.44
26.	*Datura inoxia* (Mill.)	Solanaceae	Leaves	Individual	28.89	34.44	41.11	46.67
				Mixture	64.44	60.00	66.67	70.00
27.	*Mimusops elengi* (L.)	Sapotaceae	Leaves	Individual	47.78	52.22	57.78	61.11
				Mixture	75.56	77.22	80.00	86.67
28.	*Polyalthia longifolia*	Annonaceae	Leaves	Individual	31.11	34.44	40.00	43.33
				Mixture	64.44	68.89	72.22	74.44
29.	*Catharanthus roseus* (L.)	Apocynaceae	Leaves	Individual	28.89	40.00	48.89	54.44
				Mixture	60.00	64.44	71.11	73.33
30.	*Ocimum sanctum* (L.)	Lamiaceae	Leaves	Individual	06.67	08.89	13.33	33.33
				Mixture	53.33	57.78	56.67	60.00
31.	*Ocimum basilicum* (L.)	Lamiaceae	Leaves	Individual	07.78	13.33	17.78	24.44
				Mixture	46.67	44.44	46.67	48.89
32.	*Cymbopogon citratus*	Poaceae	Leaves	Individual	18.89	25.56	32.22	48.89
				Mixture	43.33	48.89	51.11	54.44
33.	*Nerium indicum* (L.)	Apocynaceae	Leaves	Individual	14.44	17.78	34.44	36.67
				Mixture	44.44	46.67	57.78	64.44
34.	*Eucalyptus globulus*(Labill.)	Myrtaceae	Leaves	Individual	32.22	41.11	51.11	53.33
				Mixture	53.33	57.78	64.44	72.22
35.	*Citrus limonum* (Risso.)	Rutaceae	Leaves	Individual	22.22	25.56	33.33	34.44
				Mixture	53.33	55.56	56.67	60.00
36.	*Hibiscus rosasinensis* (L.)	Malvaceae	Leaves	Individual	07.78	15.56	17.78	28.89
				Mixture	41.11	44.44	47.11	50.00
37.	Mancozeb 680µg/ml			Individual	41.11	41.11	41.11	41.11
				Mixture	--	--	--	--

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