

Original Research Article

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Management of Alternaria Leaf Spot of Lehsua through Plant Extracts and Fungicides

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ABSTRACT

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Lehsua (*Cordia myxa* Roxb.), also known as Lasoda, Gunda and Indian cherry, is a major fruit of the family *Boraginaceae*. To manage the disease, efficacy of plant extracts and fungicides were tested *in vitro* and *in vivo* against *Alternaria alternata*, causing Alternaria leaf spot. Among plant extracts, extracts of garlic (10%) was found most effective in inhibiting mycelial growth (83.33%) followed by neem (79.03%) while in case of fungicides, tebuconazole + trifloxystrobin (300 ppm) was found most effective in inhibiting cent per cent mycelial growth followed by hexaconazole (95.56 %). Individually, two sprays of garlic cloves extract (10%) and tebuconazole + trifloxystrobin (0.1%) at an interval of 20 days were found most effective in reducing disease intensity (51.85% & 80.84%, respectively) over control.

Introduction

Lehsua (*Cordia myxa* Roxb.), also known as Lasoda, Gunda and Indian cherry, is a major fruit of the family *Boraginaceae*. It is native of north western India and distributed throughout the country in arid and semi arid regions especially in warmer regions up to 5,000 ft. It is a perennial, medium size tree with crooked stem attaining a height of nearly 3 to 4 meter and the total height of the tree comes to nearly 10 to 15 meter. Fruits of

lehsua contain a good amount of protein (2%), carbohydrate (92%), fat (2%) and also a good source of vitamins, calcium and minerals (Duhan *et al.*, 1992 and Chandra *et al.*, 1994). In India, it is mostly grown in Rajasthan, Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, Assam, Maharashtra and Gujarat. In Rajasthan, lehsua is mainly cultivated in Ajmer (267 ha. area and 390 tonnes production) followed by Bhilwara, Sikar, Karauli, Dholpur, Jhalawar and SwaiMadhopur districts (Anonymous, 2017a).

Lehsua is affected by foliar and post harvest diseases, which are responsible for their qualitative and quantitative deterioration. *Alternaria* leaf spot, die-back, gummosis, fruit rot, blue mould rot and *Rhizopus* rot have been observed from different locations of Jhalawar district of Rajasthan (Anonymous, 2017b). The symptoms of the disease initially were observed as brown or black coloured spots of indefinite size appearing on leaves with light brown or dark brown rings and prominent bright yellow halo. Affected leaves further blighted and fall down (Maurya *et al.*, 2016). The intensity of *Alternaria* leaf spot (*Alternaria alternata*) has been recorded in the range of 2.00-22.00 per cent in surveyed areas of Rajasthan (Anonymous, 2017b and 2018). Therefore, it was decided to control the disease through plant extracts and fungicides for improving quality and quantity of the produce.

Materials and Methods

Efficacy of plant extracts (*in vitro*)

The present investigation was carried out using five natural phyto-extracts viz. neem (*Azadirachta indica*), ginger (*Zingiber officinale*), garlic (*Allium sativum*), *Alstonia* (*Alstonia scholaris*) and datura (*Datura stramonium*) to see their antimycotic behaviour on the growth of *Alternaria alternate* on PDA following Poisoned Food Technique (Schmitz, 1930) at 5 and 10 per cent concentrations. To get these concentrations, the required plant part was thoroughly washed with sterilized water and ground separately in electric grinder using equal amount of sterilized distilled water (*i.e.* 1:1 ratio, w/v). The mixture was squeezed with double layered sterilized cheese cloth. The extracts thus obtained were considered as of 100 per cent concentration.

Required quantity of each plant extract (*i.e.* stock solution) was mixed thoroughly in melted PDA, to get desired concentration (5

and 10%), just before pouring in sterilized 9 cm diameter glass Petridishes and was allowed to solidify for 12 hours. Each plate was inoculated with 5 mm disc of mycelial bit taken with the help of sterilized cork borer from the periphery of 7 days old culture of *A. alternata* growing on PDA. The inoculated petridishes were incubated at 25±1°C. Four petridishes were used for each treatment serving as four replications. A control was also maintained where medium was not supplemented with any plant extract. The experiment was conducted in completely Randomized Design (CRD). Colony diameter (two diagonals) was measured at 7th day of incubation. Per cent growth inhibition was calculated by Vincent's (1947) formula as follows:

$$\text{Per cent growth inhibition} = \frac{C - T}{C} \times 100$$

Where,

C = diameter of the colony in check (average of both diagonals)

T = diameter of colony in treatment (average of both diagonals)

Efficacy of plant extracts (*in vivo*)

Extracts (10%) of above five plants, were also tested in orchard by spraying twice at an interval of 20 days with four replications. First foliar spray of plant extracts was applied at the time of disease initiation (3rd week of May). Per cent disease intensity (PDI) was recorded 20 days after of last spray as follows:

$$\text{PDI} = \frac{\text{Sum of all numerical ratings}}{\text{Total number of leaves observed} \times \text{Maximum disease grade}} \times 100$$

Efficacy of fungicides (*in vitro*)

Efficacy of five systemic and non-systemic fungicides viz., tebuconazole + trifloxystrobin

(Nativo), mancozeb (Indofil M 45), hexaconazole (Avone Plus) copper oxychloride (Blitox 50) and carbendazim + mancozeb (Companion) was assessed against mycelial growth of *A. alternata* by Poisoned Food Technique (Schmitz, 1930). Three different concentrations viz., 100, 300 and 500 ppm of each fungicide was tested. Required quantity of each fungicide was added separately to sterilized medium, mixed thoroughly and poured in sterilized 9 cm diameter glass Petriplates and allowed to solidify. Four replications were maintained for each treatment. A control was also maintained where medium was not supplemented with any fungicides. Each plate was inoculated with 5 mm discs with the help of sterilized cork borer from the edge of the fungal culture and incubated at $25\pm 1^{\circ}\text{C}$ for 7 days. The linear growth of the test fungus was measured and per cent growth inhibition was calculated by Vincent's (1947) formula.

Efficacy of fungicides (*in vivo*)

Above five systemic and non-systemic fungicides were also tested in orchard by spraying twice at an interval of 20 days with four replications. PDI was recorded 20 days after of last spray.

Results and Discussion

Plant extracts

Application of chemical fungicides are often cost prohibitive, impractical and hazardous to environment and human health. Keeping this in view, the need was felt for an alternative method to manage this disease in eco-friendly manner by using plant extracts. Plant extracts is of much significance in view of hazards caused by toxic chemicals or in a situation where pathogens develop resistance to fungi toxicants. The efficacy of five plant extracts was tested *in vitro* at two concentrations viz., 5 and 10 per cent against *Alternaria alternata* on PDA by Poisoned Food Technique (Table

1). Among five plant extracts, extract of garlic cloves was found most effective in inhibiting mycelial growth (83.33%) of *Alternaria alternata* at 10 per cent concentration, followed by neem leaves (79.03%) and ginger (74.08%) over control. Extracts of datura (52.44%) and Alstonia (42.41%) were found least effective in inhibiting mycelial growth of *Alternaria alternata* over control. All the concentrations (5 and 10%) of all the tested plant extracts were found significantly superior with each other. Our observations in accordance with the findings of Singh and Majumdar (2001) who evaluated the efficacy of plant extracts viz., *Allium sativum*, *Allium cepa*, *Curcuma longa*, *Zingiber officinale*, *Azadirachta indica*, *Datura stramonium* and *Ocimum sanctum* against *Alternaria alternata*, causing fruit rot of pomegranate. The results of Mistry (1992), Chattopadhyay (2001) and Choudhary *et al.*, (2003) are also in accordance with our observations. They observed that extracts of garlic, neem and onion were found most effective against the mycelial growth of the *Alternaria alternata* in *in vitro*, causing leaf spot of papaya and tomato.

A perusal of data (Table 2) revealed that minimum disease intensity (11.17%) was recorded with garlic cloves extract (10%) by applying twice at 20 days interval followed by neem leaf extract (12.52%) at 20 days after second spray and statistically found at par with each other. Leaf extract (10%) of Alstonia was found least effective in reducing disease intensity (28.10%) over control. Two sprays of garlic extract (10%) at an interval of 20 days were found promising in reducing disease intensity in orchard of lehsua followed by neem leaves extract. Our findings are also following the results of Singh and Majumdar (2001), Panchali and Patil (2009) and Sallam and Kamal (2012). They reported effectiveness of garlic, neem and turmeric extract (5-10%) in reducing disease intensity, caused by *Alternaria* spp.

Table.1 Fungitoxicity of plant extracts against *Alternaria alternata* by poisoned food technique at 7th day of incubation at 25 ± 1 °C

| Common name of plant | Part used | Per cent inhibition of mycelial growth at different concentrations* | | Mean |
|----------------------|-----------------|---|----------------------|--------------------------------|
| | | 5 % | 10 % | |
| Garlic | Clove | 75.55 (60.37) | 83.33 (65.90) | 79.44 (63.04) |
| Neem | Leaf | 71.25 (57.58) | 79.03 (62.75) | 75.14 (60.09) |
| Ginger | Rhizome | 56.25 (48.59) | 74.08 (59.39) | 65.16 (53.83) |
| Datura | Leaf | 43.66 (41.36) | 52.44 (46.40) | 48.05 (43.88) |
| Alstonia | Leaf | 31.41 (34.09) | 42.41 (40.63) | 36.91 (37.41) |
| Control | - | 0.00 (0.00) | 0.00 (0.00) | - - |
| | | SEm± | CD (p = 0.05) | |
| | P | 0.35 | 1.01 | |
| | Con. | 0.20 | 0.58 | |
| | P x Con. | 0.57 | 1.64 | |

*Average of four replications. Figures given in parentheses are angular transformed

Table.2 Efficacy of plant extracts against *Alternaria* leaf spot of lehsua (*in vivo*)

| Common name of plant | Dose (%) | Per cent disease intensity* | Per cent disease reduction over control |
|----------------------|----------|-----------------------------|---|
| Garlic | 10 | 11.17 (19.52) | 51.85 |
| Neem | 10 | 12.52 (20.72) | 46.03 |
| Ginger | 10 | 13.90 (21.89) | 40.09 |
| Datura | 10 | 14.82 (22.64) | 36.12 |
| Alstonia | 10 | 16.68 (24.11) | 28.10 |
| Control | - | 23.20 (28.79) | - |
| | | SEm± | |
| | | CD (p=0.05) | |
| | | 0.47 | |
| | | 1.42 | |

* Average of four replications. Figures given in parentheses are angular transformed

Table.3 Efficacy of fungicides on mycelial growth of *Alternaria alternata* at 7th day of incubation at 25 ± 1 °C (*in vitro*)

| Fungicide | Per cent growth inhibition at various concentration (ppm)* | | | Mean |
|---------------------------------------|--|-------------------|-------------------|--------------------------------|
| | 100 | 300 | 500 | |
| Mancozeb | 64.33 (53.33) | 75.67 (60.45) | 84.75 (67.01) | 74.92 (59.94) |
| Copper oxychloride | 66.69 (54.75) | 78.81 (62.59) | 88.64 (70.30) | 78.05 (62.06) |
| Carbendazim + Mancozeb | 68.75 (56.01) | 77.00 (61.34) | 87.17 (69.01) | 77.64 (61.78) |
| Hexaconazole | 91.14 (72.68) | 95.56 (77.84) | 98.61 (83.23) | 95.10 (77.22) |
| Tebuconazole + Trifloxystrobin | 96.20 (78.76) | 100.00 (90.00) | 100.00 (90.00) | 98.73 (83.54) |
| Control | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | |
| | | SEm± | CD(p=0.05) | |
| | F | 0.61 | 1.73 | |
| | C | 0.43 | 1.22 | |
| | FxC | 1.22 | 3.46 | |

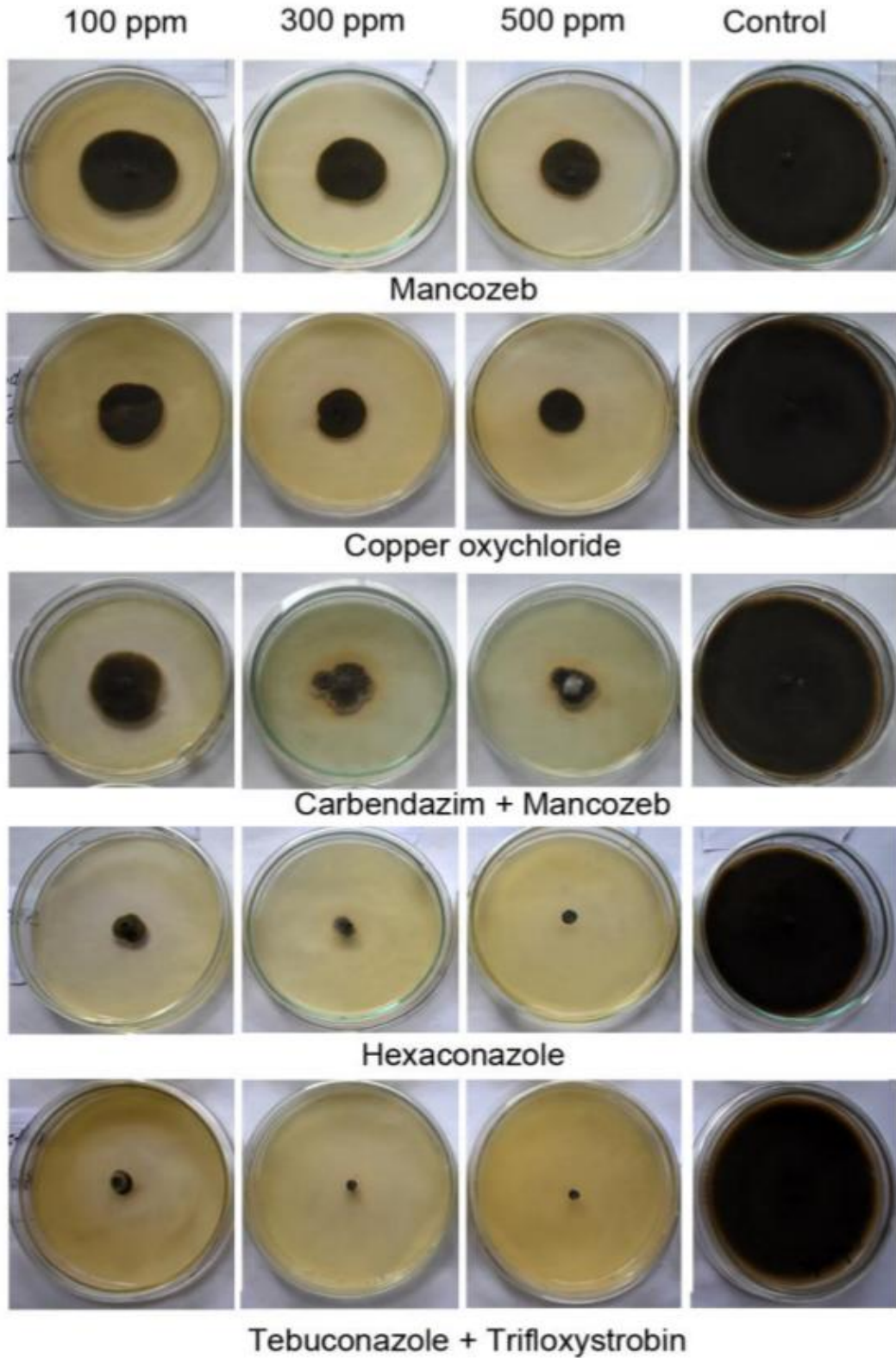
*Average of 4 replications, Figures given in parentheses are angular transformed

Table.4 Efficacy of fungicides against *Alternaria* leaf spot of lehsua (*in vivo*)

| Fungicide | Dose (%) | Per cent disease intensity* | Per cent disease reduction over control |
|---------------------------------------|----------|-----------------------------|---|
| Mancozeb | 0.25 | 8.71 (17.17) | 60.10 |
| Copper oxychloride | 0.25 | 7.37 (15.75) | 66.24 |
| Carbendazim + Mancozeb | 0.20 | 6.32 (14.56) | 71.05 |
| Hexaconazole | 0.10 | 5.55 (13.63) | 74.58 |
| Tebuconazole + Trifloxystrobin | 0.10 | 4.27 (11.93) | 80.44 |
| Control | - | 21.83 (27.85) | - |
| | | SEm± | |
| | | 0.29 | |
| | | CD (p=0.05) | |
| | | 0.87 | |

* Average of four replications. Figures given in parentheses are angular transformed

Fig.1 Efficacy of fungicides on mycelial growth of *Alternaria alternata*



Fungicides

The importance of chemicals cannot be denied in disease management. In lieu of this, the efficacy of five fungicides (Table 3) was tested *in vitro* at three concentrations viz. 100, 300 and 500 ppm against *A. alternation* PDA by Poisoned Food Technique. Among five fungicides, tebuconazole + trifloxystrobin was found most effective in inhibiting mycelial growth (96.20, 100 and 100%) of *A. alternata* at 100, 300 and 500 ppm, respectively followed by hexaconazole (91.14, 95.56 and 98.61%) over control. Fungicides, carbendazim + mancozeb (68.75, 77.00 and 87.17%), copper oxychloride (66.69, 78.81 and 88.64%) and mancozeb (64.33, 75.67 and 84.75%) were found least effective in inhibiting mycelial growth over control. All the concentrations (100, 300 and 500 ppm) of tested fungicides were found significantly superior with each other except tebuconazole +trifloxystrobin at 300 and 500 ppm. Similar observations were also drawn by Kumar and Singh (1997), Kamble *et al.*, (2000) and Rao and Rao (2002) while working with *Alternaria* spp. *in vitro*. They have reported that carbendazim, mancozeb, captan and copper oxychloride had inhibited the mycelial growth of the pathogen.

The results depicted in (Table 4) revealed that two sprays of all the fungicides at an interval of 20 days were found significantly superior over control in reducing disease intensity after 20 days of last spray. Minimum per cent disease intensity (4.27%) was recorded with tebuconazole + trifloxystrobin(0.1%) followed by hexaconazole (5.55%) and found at par with each other. Maximum disease control over check was also recorded with tebuconazole + trifloxystrobin (80.44%) followed by hexaconazole (74.58%) over control at 20th day of last spray. Among these fungicides, the least effective in reducing per cent disease intensity was mancozeb

(60.10%) followed by copper oxychloride (66.24%). These observations are in line with those recorded by Rao and Rao (2002), Arun Kumar (2008), Meena *et al.*, (2010) and Singh *et al.*, (2016). Arun Kumar (2008) reported the effectiveness of hexaconazole (0.1%) against leaf blight of chrysanthemum in a field. Chlorothalonil (Kavach 25 WP) and difenoconazole (Score 25 EC) @ 0.2 and 0.1 per cent concentrations respectively were found highly efficient in the management of *Alternaria* leaf blight of cluster bean. Meena *et al.*, (2010) tried nine fungicides viz. mancozeb (Dithane M-45 75 WP, 0.2%), zineb (0.5%), carbendazim 2% + mancozeb 63 % (Companion 65 WP, 0.2%), propineb (Antracol 70 WP, 0.2 %), propiconazole (Tilt 25 EC, 0.1%), hexaconazole (Contaf 5 EC, 0.1%) and difenoconazole (Score 25 EC, 0.1%) against *Alternaria* blight of clusterbean. They concluded that disease severity was low with chlorothalonil and difenoconazole. Singh *et al.*, (2016) conducted an experiment for managing *Alternaria* leaf spot of ber. Out of seven treatments tried, maximum per cent disease control (77.33) was recorded with difenoconazole followed by propiconazole (75.00) and copper oxychloride (68.71) whereas neem oil (53.45) proved least effective. Maximum fruit yield/plant was recorded with difenoconazole (92.00 kg) followed by propiconazole (89.50 kg) and copper oxychloride (80.00 kg).

In conclusion, efficacy of above five systemic and non-systemic fungicides viz., tebuconazole +trifloxystrobin, hexaconazole, carbendazim + mancozeb, copper oxychloride and mencozeb tested by Poisoned Food Technique. Among these, tebuconazole + trifloxystrobinwas found most effective against *Alternaria alternate* followed by hexaconazole. While mencozeb was found least effective. Increase in concentration of fungicides was more effective in inhibiting the mycelial growth of the pathogen. In

orchard, application of two sprays of tebuconazole + trifloxystrobin (0.1%) at an interval of 20 days was found highly effective in controlling disease followed by hexaconazole against *Alternaria alternata*.

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