INDIAN JOURNAL OF ARID HORTICULTURE
2010, Vol. 5 (1-2) : 11-15

Effect of temperature, relative humidity and botanicals on *Alternaria* and *Aspergillus* fruit rots in ber fruits.

Suresh Kumar, S.L. Godara and S. Gangopadhyay
Department of Plant Pathology, College of Agriculture, SKRAU, Bikaner

Abstract

The disease severity due to *Alternaria alternata* and *Aspergillus niger* was highest at 25 and 30 °C, respectively. The temperature and relative humidity influenced the development of fruit rots due to *A. alternata* and *A. niger* symptoms ranges tested. Severity of *Alternaria* fruit rot was maximum at 25 °C and 100 per cent relative humidity while severity of *Aspergillus* fruit rot was maximum at 30 °C and 100 per cent relative humidity. Neem oil and groundnut oil used as pre-inoculation treatment effectively reduced the severity of *Alternaria* fruit rot. In case of *Aspergillus* fruit rot neem oil and castor oil treated fruits showed minimum severity of fruit rot. Post- inoculation treatment of neem oil was quite effective in reducing the *Alternaria* and *Aspergillus* fruit rots. Pre or post- inoculation treatments of leaf extracts of *Azadirachta indica* and *Ocimum sanctum* provided effective control of both *Alternaria* and *Aspergillus* rots of ber fruits.

Key words: *Zizyphus mauritiana, Alternaria alternata, Aspergillus niger,* ber, fruit rots.

Introduction

Ber (*Zizyphus mauritiana* Lamk.) belongs to the genus *Zizyphus* of the family Rhamnaceae includes about 40 species in tropical and sub-tropical region. Two species of ber such as Zizyphus *jujube* Mill. known as Chinese date and *Z. mauritiana* Lamk., known as Indian jujube or ber are most important in terms of distribution and economic viability (Lyrene, 1979 and Abbas, 1997). Mostly, ber cultivation is common in water deficient and low rainfall areas of Rajasthan, Gujarat, Maharashtra, Haryana, Bihar, Andhra Pradesh, Madhya Pradesh and Uttar Pradesh. Fruit rots due to *Alternaria alternata* and *Aspergillus niger* are important problems of ber orchards and markets in arid and semi- arid regions of the country. *A. alternata* and *A. niger* fungi cause serious losses in ber fruits during storage and marketing in arid region including Bikaner market. Not much work has been done on post- harvest fungal deterioration in ber fruits. The present paper reports the effect of temperature and relative humidity on development of fruit rots due to *A. alternata* and *A. niger* and also influence of botanicals on management of these two pathogens.

Materials and methods

Effect of temperature on development of disease

Mature fruits of ber were brought from markets and orchards, surface sterilized with dipping them in 0.1 per cent mercuric chloride solution for 1-2 minutes followed by three washing with sterilized distilled water and inoculated with the pathogens. The inoculum was taken from 7 days old cultures of the fungus grown in perti dishes. A hole of 2 mm diameter and 2 mm depth was made with the help of sterilized cork borer. The 2 mm disc cut of the inoculum was inserted in the hole and the host pulp was replaced on the hole, which was corked out earlier. The inoculated fruits were incubated at 20, 25, 30 and 35 °C temperature. The inoculated ber fruits were covered by a thin layer of sterilized cotton saturated with sterilized water. These inoculated ber fruits were kept in fresh surface sterilized polythene bags. The mouth of bags were loosely tied with the help of rubber band and incubated at 26±1 °C temperature.

Effect of relative humidity on development of disease

Surface sterilized ber fruits were inoculated with uniform amount of inoculum of two test pathogens viz., *Alternaria alternata* and *Aspergillus niger* with the sterilized cork borer wounding method. The method of incubation and assessment were same as mentioned earlier. The inoculated fruits were subjected to different levels of relative humidity viz., 50, 60, 70, 80, 90 and 100 per cent levels of relative humidity at 26±1 °C temperature. The inoculated fruits were accommodated in a desiccator which contained sulphuric acid (H_2SO_4) solution to produce a particular level of relative humidity (Buxton and Mellanby, 1934). The desicators were sealed with greese and kept at 26±1 °C temperature.

Management of diseases

Oil treatment

Fruits were surface sterilized and inoculated separately with both the test pathogens by cork borer wounding method. Four vegetable oils viz., mustard oil, groundnut oil, castor oil and neem oil were used in the study. These four test oils were smeared on the fruit surface with the help of cotton swab. In pre-inoculation treatment, the fruits were first smeared with test oil and then inoculate. While in case of post-inoculation treatment, the fruits were first inoculated and then smeared with the oils. The interval between inoculation and smearing with oils or *vice-versa* was 12 hours.

Plant extract treatment

Leaf extracts of *Azadirachta indica* A. Juss., *Vinca rosea* Linn., *Withania somnifera* Dunal. and *Ocimum sanctum* Linn., were tested against fruit rots of ber due to *Alternaria alternata* and *Aspergillus niger* separately. Leaves were first washed with sterile distilled water and then air dried. Weighed amount of plant material was homogenized in a tissue homogenized. One ml of sterile distilled water was used for each gram of leaves. The material was homogenized for 5 minutes and the mixture was filtered through muslin cloth followed by filtration through Whatman No. 1 filter paper. Surface sterilized fruits were inoculated with both test pathogens separately. Each plant extract was tested in both pre- and post-inoculation treatments for both of the pathogens. In pre-inoculation treatments, the fruits were first dipped in the test plant extracts for 10 minutes and then inoculated. While in the post- inoculation treatments, the fruits were first inoculated with the individual pathogens and then treated with the test plant extracts. The interval between inoculation and treatment with plant extracts or *vice-versa* was 12 hours. There were four replications in each treatment. Controls were maintained. The method of inoculation of fruits was same as mentioned earlier. The experiment was arranged in Completely Randomized Design. Data on severity of the rots were recorded on 4th and 8th day of inoculations with the assessment key suggested by Mayee and Datar (1986).

Results and Discussion

Effect of temperature and relative humidity on severity of fruit rots

Temperature had profound effect on fruit rots like *Alternaria* rot and *Aspergillus* rot. The maximum rotting severity of *Alternaria alternata* was recorded at 25 °C. While it was quite less at either low temperature (20 °C) or at high temperature (35 °C). In case of *Aspergillus niger,* the fruit rot severity was highest at 30 °C followed by 25 °C and it was lowest at 20 °C (Table 1). Temperature ranges from 20- 30 °C reported to be optimum for the rapid development of fruit rot chillies caused by *Alternaria alternata, Aspergillus niger, Colletotrichum capsici, Drechslera australiensis, Fusarium moniliforme* and *Fusarium solani* (Datar, 1995). Similarly, temperature ranges of 25- 30 °C was found conducive in developing fruit rots of guava due to *Rhizopus* sp. (Patel and Pathak, 1996). The severity of the fruit rots increased with the increasing levels of RH tested in the present investigation. The maximum severity of *Alternaria* fruit rot was at 100 percent RH followed by 90 percent RH after 8 days of inoculation. Similar observations were also recorded in case of *Aspergillus* rot in ber. The severity of rotting was quite high at 90-100 percent RH on both 4th and 8th day of inoculations. The rotting severity due to both the pathogens was quite low at 50 percent RH (Table 2). High RH mostly favours the infection and disease development by fungal pathogens in fruits (Chopra *et al.*, 1993, Ved Ram and Dharamvir, 1996). It may be due to enhanced conidial germination, infection and decreased host resistance at higher RH. In the present studies, both *Alternaria* fruit rot and *Aspergillus* fruit rot were most severe at high level of RH on 4th and 8th day of inoculation.

Effect of oils

The severity of fruit rots induced by the pathogens viz. *Alternaria* and *Aspergillus* was significantly reduced by all the test oils used in pre- and post- inoculation experiment. Neem oil was most effective, but it was at par with ground nut oil, and it was significantly better over the castor and mustard oils in reducing the disease severity of *Alternaria* fruit rot in pre-inoculation treatment (Table 3). In case of *Aspergillus* fruit rot, the neem oil also found to be most effective and was at par with castor oil but it was significantly better than groundnut and mustard oil in reducing the severity of fruit rot. The data recorded in post-inoculation treatments recorded that neem oil treatment was significantly better than mustard and groundnut oil in reducing the severity of fruit rot due to *A. alternata.* In case of *Aspergillus* fruit rot, neem oil also provided effective control as compared to other oils tested (Table 4). Effectiveness of commercial oils against storage rots of different fruits has been reported by various workers (Aulakh and Grover, 1968, Raoof and Om Prakash, 1983, Vyas and Pathak, 1995). In the present investigation neem oil used in pre-and post- inoculation treatments proved most effective protection against both fruit rots.

Effect of leaf extracts

Azadirachta indica treatment was found most effective against both the rots in pre- and post- inoculation treatments. *Ocimum sanctum* was found to be next best treatment against these two post- harvest rots. While the performance of *Withania somnifera* pre- and post-inoculation treatment was relatively low in protecting both kind of rots *Alternaria* and *Aspergillus* rots in ber fruit (Tables 5 & 6).

The efficacy of plant extracts against fungal rots in many other fruits and vegetables have been reported. (Bisht and Kamal, 1994, Srivastava and Lal, 1997, Dargan and Saxena, 2002, Meena, *et al.*, 2009). The efficacy of *Azadirachta indica* and *Ocimum sanctum* against the fungal pathogens involved in post- harvest rots in fruits and vegetables have also been reported (Sinha and Saxena, 1989, Ahmed and Prasad, 1995). Looking to residual toxicity and other side effects of pesticide, the use of oils and botanicals in the management of post- harvest rots of ber fruits should be encouraged.

Table 1. Effect of temperature treatment on severity of fruit rots in ber

Temperature	*Alternaria alternata* severity (%)		*Aspergillus niger* severity (%)	
	4th day of inoculation	8th day of inoculation	4th day of inoculation	8th day of inoculation
200 C	9.00	16.00	9.00	15.00
	(17.45)*	(23.57)*	(17.45)*	(22.78)*
250 C	16.00	27.50	13.25	22.75
	(23.58)	(31.63)	(21.34)	(28.49)
300 C	13.50	21.00	18.50	28.00
	(21.55)	(27.27)	(25.47)	(31.95)
350 C	8.75	14.25	11.50	19.25
	(17.20)	(22.17)	(19.59)	(26.02)
S.Em+	(0.33)	(0.21)	(0.32)	(0.23)
CD at 5 %	(1.00)	(0.65)	(0.99)	(0.70)

*Figures in parentheses are angular transformed values.

Table 2. Effect of different levels of relative humidity on severity of fruit rots in ber

Relative humidity (%)	*Alternaria alternata* severity (%)		*Aspergillus niger* severity (%)	
	4^{th} day of inoculation	8^{th} day of inoculation	4^{th} day of inoculation	8^{th} day of inoculation
50	3.75	7.50	6.00	10.00
	(11.08)*	(15.89)*	(14.15)*	(18.43)*
60	7.50	11.25	10.25	15.00
	(15.86)	(19.59)	(18.67)	(22.78)
70	10.00	14.00	12.50	18.50
	(18.41)	(21.76)	(20.70)	(25.47)
80	12.50	17.50	16.00	21.75
	(20.69)	(24.72)	(23.58)	(27.80)
90	15.00	23.25	18.00	25.50
	(22.77)	(28.83)	(25.10)	(30.33)
100	16.25	24.00	21.00	26.00
	(23.76)	(29.32)	(27.45)	(30.65)
S.Em±	(0.75)	(0.43)	(0.36)	(0.40)
CD at 5 %	(2.22)	(1.28)	(1.08)	(1.19)

*Figures in parentheses are angular transformed values.

Table 3. Effect of pre- inoculation treatment with oils on severity of fruit rots in ber

Oils	*Alternaria alternata* severity (%)		*Aspergillus niger* severity (%)	
	4^{th} day of inoculation	8^{th} day of inoculation	4^{th} day of inoculation	8^{th} day of inoculation
Mustard oil	5.00 (12.91)*	8.00 (16.35)	6.50 (14.76)	9.00 (17.45)
Groundnut oil	3.00 (9.99)	5.50 (13.55)	5.00 (12.88)	7.25 (16.36)
Neem oil	2.75 (9.54)	4.00 (11.72)	3.25 (10.38)	4.50 (12.24)
Castor oil	3.25 (10.51)	5.50 (13.79)	3.75 (11.14)	5.25 (13.07)
Control	15.50 (23.28)	25.00 (30.00)	17.00 (24.35)	26.50 (30.98)
S.Em±	(0.64)	(0.64)	(0.51)	(0.63)
CD at 5%	(1.93)	(1.94)	(1.55)	(1.90)

*Figures in parentheses are angular transformed values.

Table 4. Effect of post- inoculation treatment with oils on severity of fruit rots in ber

Oils	*Alternaria alternata* severity (%)		*Aspergillus niger* severity (%)	
	4th day of inoculation	8th day of inoculation	4th day of inoculation	8th day of inoculation
Mustard oil	5.00 (12.91)*	8.00 (16.35)	6.50 (14.76)	9.00 (17.45)
Groundnut oil	3.00 (9.99)	5.50 (13.55)	5.00 (12.88)	7.25 (16.36)
Neem oil	2.75 (9.54)	4.00 (11.72)	3.25 (10.38)	4.50 (12.24)
Castor oil	3.25 (10.51)	5.50 (13.79)	3.75 (11.14)	5.25 (13.07)
Control	15.50 (23.28)	25.00 (30.00)	17.00 (24.35)	26.50 (30.98)
S.Em+-	(0.64)	(0.64)	(0.51)	(0.63)
CD at 5%	(1.93)	(1.94)	(1.55)	(1.90)

*Figures in parentheses are angular transformed values.

Table 5. Effect of pre- inoculation treatment with leaf extracts on severity of fruit rots in ber

Leaf extracts	*Alternaria alternata* severity (%)		*Aspergillus niger* severity (%)	
	4th day of inoculation	8th day of inoculation	4th day of inoculation	8th day of inoculation
Vinca rosea	3.50 (10.77)*	5.75 (13.86)	7.00 (15.31)	11.00 (19.36)
Withania somnifera	6.00 (14.17)	8.50 (16.95)	4.25 (11.86)	6.25 (14.47)
Azadirachta indica	3.00 (9.90)	4.75 (12.56)	3.50 (10.77)	5.00 (12.89)
Ocimum santum	3.25 (10.32)	5.75 (13.84)	4.00 (11.48)	6.00 (14.01)
Control	14.50 (22.38)	24.00 (29.33)	18.50 (25.47)	27.00 (31.30)
S.Em+-	(0.69)	(0.47)	(0.67)	(0.54)
CD at 5%	(2.09)	(1.41)	(2.03)	(1.61)

*Figures in parentheses are angular transformed values.

Table 6. Effect of post- inoculation treatment with leaf extracts on severity of fruit rots in ber

Leaf extracts	*Alternaria alternata* severity (%)		*Aspergillus niger* severity (%)	
	4th day of inoculation	8th day of inoculation	4th day of inoculation	8th day of inoculation
Vinca rosea	8.00 (16.31)*	11.50 (19.82)	10.00 (18.43)	14.00 (21.68)
Withania somnifera	9.50 (17.95)	14.00 (21.97)	8.25 (16.69)	12.00 (20.26)
Azadirachta indica	5.00 (12.91)	7.00 (15.33)	5.25 (13.23)	8.50 (16.94)
Ocimum santum	5.75 (13.86)	8.25 (16.57)	6.50 (14.76)	9.00 (17.45)
Control	17.00 (24.34)	26.25 (30.82)	16.50 (23.96)	28.00 (31.95)
S.Em+-	(0.34)	(0.31)	(0.34)	(0.31)
CD at 5%	(1.02)	(0.92)	(1.03)	(0.95)

*Figures in parentheses are angular transformed values.

References

Abbas, M.F. 1997. Jujube In: Post- harvest physiology and storage of tropical and subtropical fruits. (Ed. S.K. Mitra), CAB International. pp. 405-415.

Ahmad, S.K. and Prasad, J.S. 1995. Efficacy of foliar extracts against pre- and post- harvest of sponge gourd fruits. *Letters Appl. Microbio.* 21: 373-375.

Aulakh, K.S. and Grover, R.K. 1968. Ripe fruit rots in tomato and their control by oils. *Pl. Dis. Reptr.* 52: 555-559.

Bisht, S.S. and Kamal. 1994. Garlic extract, an antifungal treatment for the control of storage rot of apple. *Proc. Nat. Acad-India.* 64 BII: 233-234.

Buxton, P.A. and Mellanby, K. 1934. Measurement and control of humidity. *Bull Ento. Res.* 25: 171-175.

Chopra, S., Metha, A. and Mehta, P. 1993. Fruit rot of *Emblica officinalis, Prunus domestica* and *Citrus medica* caused by *Aspergillus niger. Indian J. Mycol. Pl. Pathol.* 23 (2): 129-134.

Dargan, P. and Saxena, S.K. 2002. Effect of extract of *Withania somnifera* on fruit rot of tomato caused by *Aspergillus niger* in presence of *Drosophila busckii. Indian Phytopath.* 55 (1): 112-113.

Datar, V.V. 1995. Pathogenicity and effect of temperature on six fungi causing fruit rot of chilli. *Indian J. Mycol. Pl. Pathol.* 25 (3): 195-197.

Lyrene, P.M. 1979. The Jujube Tree (*Zizyphus jujube* Mill.) *Fruit variety J.* 33: 100-104.

Mayee, C.D. and Datar, V.V. 1986. Phytopathometry Tech. Bulletin. 1 (Special Bulletin-3). Maradhawada Agriculture University, Prabhni (Maharashtra).

Meena, O.P., Godara, S.L., Rathore, G.S. and Vijay Pal. 2009. Eco-friendly management of post- harvest fruit rot of guava caused by *Pestalotiopsis palmarum. J. Mycol. Pl. Pathol.* 39 (3): 445-448.

Patel, K.D. and Pathak, V.N. 1996. Temperature and relative humidity in relation to development of Rhizopus rot of guava fruits. *Indian J. Mycol. Pl. Pathol.* 26 (1): 9-13.

Raoof, M.A. and Om Prakash. 1983. Evaluation of fixed oils for the control of black rot of mango fruits. *Indian J. Mycol. Pl. Pathol.* 10: 348-349.

Sinha, P. and Saxena, S.K. 1989. Effect of treating tomatoes with leaf extracts of certain plants on the development of fruit rot caused by *Aspergillus niger* in presence of *Drosophila busekii. J. Phyto. Res.* 2: 97-101.

Srivastava, A.K. and Lal, B. 1997. Studies on bio fungicidal properties of leaf extracts of some plants. *Indian Phytopath.* 50 (3): 408-411.

Ved, Ram and Dharamvir. 1996. Effect of temperature and relative humidity of fungal deterioration of banana fruits. *Indian J. Mycol. Pl. Pthol.* 26 (3): 302-304.

Vyas, R.K. and Pathak, V.N. 1995. Management of Aspergillus rot of mango fruit. *Indian J. Mycol. Pl. Pathol.* 25: 1-2.