The Bioscan 7(4): 649-651, 2012
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

ECO-CHEMICAL MANAGEMENT OF A NEW FUNGAL ROT (*PENICILLIUM FUNICULOSUM* THOM.) OF AONLA

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KEY WORDS
Aonla
Penicillium funiculosum
Fungicides

Received on :
24.07.2012

Accepted on :
22.11.2012

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ABSTRACT
The pathogen was isolated from aonla fruits. The pure culture obtained after re-isolation was sent for identification to I.T.C.C., Division of Mycology and Plant Pathology, Indian Agricultural Research Institute, New Delhi where it was identified as *Penicillium funiculosum* (ITCC: 7046.08). And it was found first report in India. Eleven fungicides (500 and 1000 ppm) were screened in *in vivo,* among them significantly lowest Penicillium rot severity was observed in fruits treated with carbendazim at 1000 ppm both in pre (12.49 %) and post-inoculation (12.83 %) followed by benomyl 1000 ppm both in pre (13.49 %) and post inoculation (15.03 %) treatments at 7 days after inoculation. The higher dose (1000 ppm) of fungicides found more effective in reducing the Penicillium rot severity than the lower dose (500 ppm) in pre and post-inoculation. The pre-inoculation treatment found better in controlling the fruit rot than post- inoculation.

INTRODUCTION

Aonla or Indian gooseberry (*Emblica officinalis* Gaertn. Syn. *Phyllanthus emblica* L.) is one of the most important indigenous fruit of Indian sub continent (Baghel *et al*., 2007). The area under aonla cultivation in India is about 77,000 hectares with an annual production 8, 26, 000 tonnes (Anonymous, 2011). Gujarat state has 17,000 hectares area under aonla cultivation with an annual production of 1, 50, 000 tonnes (Singh *et al*., 2010). Aonla fruits contain different essential nutrients *i*.e. carbohydrates, proteins, phenol, calcium, phosphorus, zinc, vit. C and B. It is a rich source of vit. C ranging from 400-1300 mg/100 gm pulp (Singh, 2006). It's constituents serve as important source of food and medicine (Kumar and Singh, 2002). It is probably the only fruit to fill the gap of a stringent food recommended in ayurvedic medicine and balanced diet for sound health (Singh, 2006). In India, reported nearly 20–25, 30 and 35 per cent of perishables are lost due to post harvest diseases (Sharma and Alam, 1998), (Prakash, 2005) and (Rawal and Saxena, 2005), respectively. The aonla fruit rots caused by various fungi *i.e. Penicillium islandicum* Sopp. (Setty, 1959), *Aspergillus* spp. (Srivastava *et al*., 1964), Pestalotia fruit rot (Tondon and Srivastava, 1964), Cladosporium (Jamaluddin, 1978), *Phomopsis phyllanthi* Punith (Lal *et al*., 1982), *Colletotrichum gloeosporioides* (Penz) Sacc. (Mishra and Shivpuri, 1983), *Alternaria alternata* (Fr.) Keissler (Pandey *et al.,* 1984) and *Penicillium funiculosum* Thom. (Yaday *et al.,* 2009) are the most important as they affect the fruit quality and quantity in relation to the market value (Bhardwaj and Sharma, 1999).

Literature scanned revealed, a very meagre research work has been carried out on fruit rot (*P. funiculosum*) of aonla and their eco-chemical management. The open wounds, created during harvesting, handling and packaging are the major sites of invasion by postharvest wound pathogens, the protection of wounds by chemicals were considerably decrease decay in storage. Many chemical compounds have been used as part of post-harvest treatment of tropical fruits for the presentation or retardation of microbial infection. Find out the better fungicides with minimum dose for maximum control of post harvest rot of aonla.

MATERIALS AND METHODS

The fresh, healthy and uniform size aonla fruits collected from Horticulture Farm Shop, AAU, Anand.

Pre-inoculation

The fresh, healthy, matured, uniform size aonla fruits of 'Gujarat Aonla-1' cultivar were surface sterilized by dipping in 0.1 per cent $HgCl_2$ solution for one min. followed by three washings with sterilized distilled water and inoculated separately by the pin prick method. The fruits were first dipped in the two different fungicidal solution (500 and 1000 ppm) for 5 min., air dried and then inoculated with fruit rot pathogen suspension (10^6 spores/mL) with three replication. The interval between fungicidal treatment and inoculation was kept twelve hours (Verma and Tikoo, 2003). The severity of fruit rots were recorded on 4th and 7th day of inoculation.

Post-inoculation

The healthy, matured, uniform size aonla fruits were surface sterilized by dipping in 0.1 per cent $HgCl_2$ solution for one min. followed by three washings with sterilized distilled water and inoculated separately by the pin prick method. The fruits were first dipped in the suspension (10^6 spores/mL) of Penicillium fruit rot of aonla, air dried and then dipped in the two different fungicidal solution (500 and 1000 ppm) for 5 min., with three replication. The interval between inoculation and fungicidal treatment was kept twelve hours (Verma and Tikoo, 2003). The severity of fruit rots were recorded on 4th and 7th day of inoculation.

RESULTS AND DISCUSSION

Pre-inoculation

The results presented in Table 1 revealed that on 4th day of inoculation, significantly lowest disease severity was recorded in carbendazim (13.83 and 12.49 %) but it was at par with benomyl 1000 ppm (13.49 %) followed by benomyl 500 ppm (15.59 %), mancozeb (16.65 and 14.98 %), thiophanate methyl (17.92 and 15.48 %) and carbendazim (12 %) + mancozeb (63 %) (21.74 and 19.79 %) at 500 and 1000 ppm, respectively. Where as, metallic copper (31.77 and 30.64 %) at both concentrations found least effective in controlling the rot.

On 7th day of inoculation, carbendazim at 500 and 1000 ppm (16.65 and 15.53 %) proved significantly superior over all other treatments. The next best treatment in order of merit was benomyl (20.02 and 18.14 %). The metallic copper (37.89 and 35.20 %) proved ineffective in controlling the rot and it was at par with metiram (36.40 and 32.72 %). While, the mancozeb (21.32 and 18.84 %), thiophanate methyl (22.36 and 19.06 %) and carbendazim (12 %) + mancozeb (63 %) (25.26 and 23.75 %) showed medicore effect.

Post-inoculation

The results obtained are presented in Table 1 on 4th day of inoculation, trend similar to that obtained in pre-inoculation method was noted. Significantly lowest rot severity was recorded in fruits treated with carbendazim (14.11 and 12.83 %) followed by benomyl (16.65 and 15.03 %) and mancozeb (17.18 and 14.71 %) at 500 and 1000 ppm, respectively. While, metallic copper (32.40 and 30.31 %) found least effective in controlling the rot and it was at par with metiram (32.09 and 29.82 %) at 500 and 1000 ppm, respectively.

On 7th day of inoculation, carbendazim (17.61 and 15.85 %) at 500 and 1000 ppm proved significantly superior over all other fungicides but it was at par with benomyl (17.11 %) at 1000 ppm. Metallic copper (37.59 and 34.58 %) proved ineffective in controlling the rot and it was at par with metiram (36.85 and 33.64 %) at 500 and 1000 ppm, respectively.

Results similar to the present findings have been reported by Sharma and Vir (1984). They reported that carbendazim, benomyl and difolatan @ 1000 ppm and aureofungin @ 500 ppm gave minimum spoilage due to *P. canescens* in stored grape fruits. Post harvest application of thiabendazole (0.5%), benomyl (0.05%) and carbendazim (0.05%) were found effective against the various fungal rots caused by *Aspergillus niger, Penicillium digitatum* and *Penicillium italicum* in citrus

Table 1: Bio-efficacy of fungicides on the severity of *Penicillium* fruit rot of aonla

S.No.	Fungicides	*Penicillium* rot severity (%) Pre-inoculation 500 ppm 4th DAI	7th DAI	1000 ppm 4th DAI	7th DAI	Post-inoculation 500 ppm 4th DAI	7th DAI	1000 ppm 4th DAI	7th DAI
1	Carbendazim	13.83 (5.75)*	16.65(8.25)	12.49(4.75)	15.53(7.25)	14.11(6.00)	17.61(9.25)	12.83 (5.00)	15.85(7.50)
2	Benomyl	15.59(7.25)	20.02(11.75)	13.49(5.50)	18.14(9.75)	16.65 (8.25)	20.36(12.25)	15.03 (6.75)	17.11(8.75)
3	Carbendazim (12%) + Mancozeb (63%)	21.74(13.75)	25.26(18.25)	19.79(11.50)	23.75(16.25)	22.95 (15.25)	25.79(19.00)	20.90 (12.75)	23.73(16.25)
4	Cymoxanil (8%) + Mancozeb (64%)	24.14(16.75)	28.12(22.25)	22.36(14.50)	26.00(19.25)	24.50(17.25)	28.46(22.75)	23.35 (15.75)	26.34(19.75)
5	Hexaconazole (5%) + Captan (70%)	25.27(18.25)	30.31(25.50)	23.75(16.25)	28.12(22.25)	26.54(20.00)	31.12(26.75)	24.89 (17.75)	28.81(23.25)
6	Chlorothalonil	26.72(20.25)	32.72(29.25)	25.27(18.25)	30.14(25.25)	28.12(22.25)	32.39(28.75)	26.00 (19.25)	29.99(25.00)
7	Propineb	28.98(23.50)	34.12(31.50)	27.25(21.00)	31.77(27.75)	29.64(24.50)	34.58(32.25)	27.06 (20.75)	32.39(28.75)
8	Thiophanate methyl	17.92(9.50)	22.36(14.50)	15.48(7.25)	19.06(10.75)	18.64(10.25)	22.57(14.75)	16.65 (8.25)	19.56(11.25)
9	Metiram	31.29(27.00)	36.40(35.25)	29.15(23.75)	32.72(29.25)	32.09(28.25)	36.85(36.00)	29.82 (24.75)	33.64(30.75)
10	Mancozeb	16.65(8.25)	21.32(13.25)	14.98(6.75)	18.84(10.50)	17.18(8.75)	21.74(13.75)	14.71 (6.50)	19.06(10.75)
11	Metallic copper	31.77(27.75)	37.89(37.75)	30.64(26.00)	35.20(33.25)	32.40(28.75)	37.59(37.25)	30.31 (25.50)	34.58(32.25)
12	Control	36.55(35.50)	46.27(52.25)	35.95(34.50)	48.29(55.75)	34.88(32.75)	46.13(52.00)	35.04 (33.00)	50.78(60.00)
	S.Em ±	0.543	0.753	0.695	0.721	0.668	0.925	0.665	0.929
	C.D. at 5%	1.558	2.16	1.996	2.07	1.917	2.655	1.910	2.666

* Figures in parenthesis are original value, while outside are the arc sine transformed values

fruits (Verma and Tikoo, 2003). Carbendazim at 1000 ppm gave 100 per cent control of *Penicillium italicum* in kinnow fruits up to 60 days in storage (Singh and Thakur, 2005). Rathod and Patel (2005) observed carbendazim (500 and 1000 μg/mL) and mancozeb (2000 and 4000 μg/mL) most effective against the Colletotrichum, Penicillium and Alternaria rots in aonla fruits both in pre and post inoculation treatments. Verma (2008) reported that post inoculation treatments with thiabendazole, benomyl and carbendazim (each @ 0.05 %) were most effective against the green mould (*Penicilluim digitatum*) and blue mould (*Penicillium italicum*) rots of mandarin oranges. Meena (2006) observed that application of bavistin (0.05 %) and kavach (0.2 %) found effective in minimizing the Penicillium rot (*P. fellutanum*) severity in aonla fruits.

CONCLUSION

Significantly lowest *Penicillium* rot severity was recorded in fruits treated with carbendazim at 500 and 1000 ppm (13.83 and 12.49 %) and (14.11 and 12.83 %) followed by benomyl (15.59 and 13.49 %) and (16.65 and 15.03 %) in pre- and post-inoculation treatments, respectively after 7 days of inoculation. Higher dose of carbendazim (1000 ppm) found most effective in reducing the Penicillium rot severity as compared to lower dose (500 ppm).

ACKNOWLEDGEMENT

Authors are grateful to the Professor and Head, Department of Plant Pathology and Principal, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) for providing necessary facilities.

REFERENCES

Anonymous, 2011. Agriculture Statistics at a Glance, Ministry of Agriculture Government of India.

Baghel, A., Dantre, R. K. and Verma, K. P. 2007. Effect of non conventional chemical on the fruit rot of aonla caused by *Penicillium citrinum* Thom. *Pestology*. **31**: 58-59.

Bhardwaj, S. S. and Sharma, I. M. 1999. Diseases of minor fruits. In: Diseases of Horticultural crops- Fruits, Ed. Verma, L.R. and Sharma, R.C., Indus Publishing Co. New Delhi, pp. 540-562.

Jamaluddin, Tandon, M. P. and Tandon, R. N. 1975. A fruit rot of aonla caused by phoma. *Proc. Natl. Acad. Sci. India*. **8(45):** 75-77.

Kumar, S. and Singh, I. S. 2002. Physio-chemical studies of various cultivars of aonla fruits. *Progressive Horticulture.* **34(1):** 102-104.

Lal, B., Arya, A. and Rai, R. N. 1982. A new soft rot of aonla caused by *Phomopsis phyllanthi* Punith and its chemical control. *Nat. Acad. Sci. Letters*. **5(6):** 183-185.

Meena, R. D. 2006. Factors affecting post harvest Penicillium fruit rot of aonla, (*Emblica officinalis* Gaertn) incited by *Penicillium fellutatum*, Biourge and its management. M. Sc. Thesis submitted to S. K. N. College of Agriculture, RAU, Jobner, -Bikaner.

Mishra, A. and Shivpuri, A. 1983. Anthracnose a new disease of aonla. *Indian Phytopath*. **36:** 406-407.

Pandey, R. S., Bhargave, S. N., Shukla, D. N. and Divedi, D. K. 1984. Two new fruit diseases of aonla caused by *Alternaria* sp. *Int. J. Trop.Pl. Dis*. **2**: 79-80.

Prakash, O. 2005. Progress towards integrated management of disease of mango. Abstract in Second Global Conference, Plant Health-Global Wealth, Nov. 25-29, Udaipur, India. pp. 133-134.

Rathod, R. S. and Patel, J. G. 2005. Effect of pre and post inoculation treatment on post harvest rots of aonla fruits. *J. Myco. Pl. Pathol*. **35(3):** 525.

Rawal, R. D. and Saxena, A. K. 2005. Management of post harvest diseases of tropical fruits with reference to India. Abstract in Second Global Conference, Plant Health-Global Wealth, Nov. 25-29, Udaipur, India. p.133.

Setty, K. G. H. 1959. Blue mould of aonla fruits. *Curr. Sci.* **28**: 208.

Sharma, N. and Mashkoor Alam, M. 1998. In: Post Harvest Diseases of Horticultural Perishables. International Books Distributing Co., Lucknow. pp. 226-253.

Sharma, R. C. and Vir, D. 1984. Efficacy of fungicide XXII evaluation of benzimidazole an antibiotic and other fungicides against post harvest spoilage of grapes. *Int. J. Trop. Pl. Dis*. **2**: 5 - 7.

Singh, B. P. 2006. Scintific storage of nutritious aonla. Phal-Phool, (Sept. Oct.): 8-10.

Singh, B. R., Vyash, P. M. and Patil, A. B. 2010. The Arid Crop Productions in Gujarat. National Seminar on Production and Processing of Aonla (*Embica officinalis*. G), 21-23 November, Amadavad, Gujarat.

Singh, D. and Thakur, A. K. 2005. Effect of fungicides on spoilage caused by mycoflora in kinnow (*Citrus reticulate* Blanco) fruits during storage. *J. Myco. Pl. Pathol*. **35(1):** 125-127.

Srivastava, M. P., Chandra, S. and Tandon, R. N. 1964. Post harvest diseases of some fruits and vegetables. Proc. Natl. Acad Sci. India. **34(4):** 339-342.

Tandon, R. N. and Shrivastava, M. P. 1964. (Univ. Allahabad). Fruit rot of Aonla caused by *Pestalotia cruenta* Syd. in India. *Curr. Sci*. **33(3):** 86-87.

Verma, S. V. 2008. Seasonal occurrence and chemical management of post harvest fungal rot pathogens of mandarin orange (*Citrus reticulate* Blanco). *Indian Phytopath*. **61(3):** 317-322.

Verma, V. S. and Tikoo, M. L. 2003. Seasonal disease profile and chemical management of fungal rot loss of citrus fruits, *Ann. of Pl. Protection Sci.* **11(1):** 79-82.

Yadav, S. M., Waghunde, R. R., Patil, R. K. and Pandey, R. N. 2009. A new fruit rot of aonla incited by *Penicillium funiculosum* and its management. *J. Plant Disease Science*. **4(1):** 132-133.