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Occurance of mango anthracnose on inflorescence in Multan (Punjab) and it's *in vitro* control through various fungicides

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Abstract

Mango (*Mangifera indica*) is the most important fruit crop in the world as well as in Pakistan, called the king of fruits. Anthracnose of mango on inflorescence caused by *Colletotrichum gloeosporiodes* is among those diseases responsible for low yield of crop in Pakistan. The apparent symptoms can be observed on both vegetative and reproductive structure. Tiny dark brown to black spots appear at first which enlarge and join together and kill the blossoms before the production of fruit. Survey of mango orchards showed the prevalence of Mango anthracnose at all visited locations. Maximum disease incidence was recorded in Band Bosan (43.66 %) followed by Shujabad (37.99 %) and Qadir Pur Rawan (36.99 %) whereas minimum was in Nawab Pur (34.66 %). With respect to the farmers information most of the orchards showed heavy soils, sub soils with hard pan, a high soil pH, unbalanced fertilizer applications, poor irrigation, intercropping with other crops and zero pruning. *Colletotrichum gloeosporiodes* was isolated with maximum infestation frequency (61.66 %). Efficacy of different fungicidal chemistries (Topsin-M, Antracol, Captan, Benlate and Bavistin) was evaluated *in vitro* by the poison food technique against *Colletotrichum gloeosporiodes*. Topsin-M was significantly superior to all other chemistries at 100, 75, 50 and 25 ppm concentrations followed by the Bavistin and Benlate whereas Antracol and Captan could not prove to be responsive against the fungus. Antracol performed relatively well to some extent at 100 ppm concentration as compared to the Captan. All the fungicides showed higher efficacy with the increase in the concentration levels. These investigations provide fresh information on the current status of mango anthracnose on inflorescence in orchards of mango zone in Pakistan, regarding chemical control against *Colletotrichum gloeosporiodes* under *in vitro* conditions and serve as a guide for the future management strategy against this holistic disease of mango.

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Introduction

Mango (*Mangifera indica* L.) is a delectable fruit grown in less than ninety tropical and sub-tropical countries in the world. Mango belongs to the family Anacardiaceae, originated in South Asia or Malayan archipelago India. India, China, Mexico, Thailand, Philippines, Pakistan, Nigeria, Indonesia, Brazil and Egypt are top ten mango producing countries in the world. In Pakistan, total area under mango cultivation is 167.5 thousand hectares with the production of 1,732 thousand tones being the second major fruit crop of Pakistan (Anonymous, 2012). It ranked fourth in the world for its production. Yet, the mango production is severely affected by a number of diseases and disorders. However, among the fungal diseases, is the anamorph stage of the ubiquitous fungus *Colletotrichum gloeosporiodes* is accountable for poor fruit set and low yield causing mango anthracnose in tropics (Ploetz, 1999). The disease badly affects the vegetative and reproductive structures of mango causing pre harvest and post harvest diseases. Initial infection begins from the leaves and proliferates to flowers causing the mango blossom blight, which completely blemish the inflorescence (flower panicles) leading towards the significant reduction in fruit setting and ultimately severe yield loss (Coates *et al*., 1993; Coates and Gowanlock 1994; Singh 2000). The mostly associated fungus with mango anthracnose on inflorescence is *Colletotrichum gloeosporiodes* (Ploetz, 1999). The countries, where mango is an economic crop, much of the attention is given about the pre harvest and post harvest management of the disease by using the fungicidal chemistries. Cole *et al*., (2005) observed the successful control of anthracnose can be achieved by using the pre harvest and post harvest fungicides. By the use of (Dithio-Carbamates) organic sulphur fungicides and heterocyclic nitrogen compounds such as maneb, zineb and captan respectively, adequate control over mango anthracnose can be achieved (Ruehl and Ledin, 1960) yet these chemistries have display the phytotoxic effects to flowers (McMillan, 1973). The fungicide mancozeb belonging to the organic sulphur group was effective in the control of anthracnose (Dodd *et al*, 1991). The *Colletotrichum gloeosporiodes* have developed resistance to a systemic fungicide benomyl at (0.1 %), excessively used for the pre harvest and post harvest control of anthracnose (Akhtar *et al*., 1998). The use of dithiocarbamates either alone or in combination with other fungicides showed not significant results in the control of mango anthracnose because dithiocarbamates as a group were relatively low toxic to *Colletotrichum gloeosporiodes* as compared to the benzimidazole group of fungicides (Brodrick, 1971; Tandon and Singh, 1968). There is a dead need for enough work to be done on this issue. So far in Pakistan a little work had been done on the control of this drastic disease. Keeping in view the economic potential of mango crop and taking magnitude of Mango Anthracnose into consideration the present study was carried out to evaluate the most effective fungicidal chemistry against *Colletotrichum gloeosporiodes*.

Materials and methods

Study area

The survey was carried out in (March- April) 2011 in the anthracnose worst hit orchards of the mango zone of Punjab i.e. Multan, to determine the disease incidence of disease, role of predisposing factors in facilitating the disease severity as per information given by the farmers, and for the collection of diseased samples from anthracnose affected inflorescence of mango plants to ascertain the association of different fungi. We selected four different locations in Multan district; Qadir pur Rawan (30.270 ˚N and 71.250 ˚E), Nawab Pur (30.264 ˚N and 71.492 ˚E), Band Bosan (30.268 ˚N and 71.495 ˚E) and Shujabad (30.266 ˚N and 71.494 ˚E). In general fourty mango orchards were visited i.e., ten orchards in each location. Similarly in each orchard, three mango plants were randomly selected for the observation of diseased symptoms. For the determination of the disease incidence; ten inflorescence per plant and a total of twelve hundred (1200) inflorescence were examined in District Multan in this study.

Disease incidence

The most obvious symptoms of mango anthracnose on panicles are small black or dark-brown spots, which can enlarge, coalesce, and kill the flowers before fruits are produced (Blossom Blight of Mango). The infected inflorescences were evaluated to determine the diseases incidence percentage by following the scale for anthracnose on inflorescence (Jamadar and desai, 1997).

$$\text{Disease Incidence (\%)} = \frac{\text{No of Infected Inflorescence}}{\text{Total No of Inflorescence}} \times 100$$

Scale for Anthracnose on Inflorescence

Score	Visual Observation
0	No Infection Observed
1	1-10 %
3	10.1 — 15.0 %
5	15.1 — 25 %
7	25.1 — 50%
9	More Than 50 %

Isolation, purification and identification of associated fungi

A total of two hundred samples, fifty samples from each location were collected from infected mango blossoms to isolate the pathogen and to determine the association of different fungi with the disease. Samples were brought in the Mycology & Bacteriology laboratory of department of Plant Pathology, Bahauddin Zakariya University,Multan for investigations. Isolation was done by cutting the small pieces of anthracnose affected blossoms, surface sterilized with 0.1 percent sodium hypochlorite ($HgCl_2$) solution and rinsed twice in autoclaved distilled water and placed on potato dextrose agar medium (PDA) in autoclaved perti dishes. The petri plates having tissue pieces were incubated at 28 ± 2°C. After 1 week of incubation, petri plates were examined to determine the isolation frequency of different fungi. Identification of the isolated fungi was done on the basis of specific characteristics for that fungus (Ellis, 1980; Nelson *et al.*, 1983).

Efficacy of various fungicides for the control of Colletotrichum gloeosporioides

The pathogen (*Colletotrichum gloeosporioides*) culture was purified on Potato Dextrose Agar Media for *In Vitro* Experimentation. Different concentrations viz, 25, 50, 75 and 100 ppm of five fungicides viz. Topsin-M, Antracol, Captan, Benlate, and Bavistin (Table 1) were used to evaluate their efficacy on radial mycelial growth of pathogen by using Poison Food Technique (Dhingra and Sinclair, 1985). Mycelial plug of 0.5 cm was picked with cork borer from the colony of *Colletotrichum gloeosporioides* and transferred to PDA plate amended with different concentrations of fungicides, which were completely randomized with three replicates in incubator at 28 ± 2°C. Similarly, unamended three replicates served as control. After one week of incubation, when the fungus completely covered the control plates with its mycelial growth, the data for inhibition of radial colony was calculated with respect to colony diameter on control plate by the formula (Sundar *et al.*, 1995).

$$\text{(Percent Inhibition) } Mi = \frac{M_c - M_t}{M_c} \times 100$$

Where,

M_i = Inhibition of mycelial growth

M_c = Colony diameter of control

M_t = Colony diameter of target fungi on poisoned medium.

Statistical analysis

Treatments means were judged by using the least significant difference (LSD) tested at ($P \leq 0.05$). Data regarding percent inhibition of the mycelial growth of fungus was subjected to statistical analysis via. the analysis of variance (ANOVA) using SAS (Statistical Analysis System, version 9.1). Percent inhibition of mycelial growth for each fungicidal concentration was determined with respect to (un-amended) control treatment.

Results

The survey results of disease incidence in the all the visited orchards showed the prevalence of Mango anthracnose (Blossom Bight) throughout the Multan District. The mean disease incidence of all the

surveyed locations was 38.32 %. The most characteristic symptoms observed in the orchards were small black or dark-brown spots on panicles which may enlarge and join together. The pathogen destroyed the flowers before the production of fruit and reduced the yield greatly. Petioles, leaves, twigs, Branches and stems are also susceptible to disease. Maximum disease incidence (Graph 1) was recorded in Band Bosan area (43.66 %) followed by Shujabad with (37.99 %), Qadir Pur Rawan with (36.99 %) and minimum disease incidence was observed in Nawab Pur with (34.66 %).

Table 1. Chemicals used for *in vitro* evaluation against the *Colletotrichum gloeosporioides*.

Trade Name	Common Name of Active Ingredient	Formulation	Percent Active Ingredient	Chemical Name
Topsin-M	Thiophanate methyl	WP	70	1, 2,–di–(3–methoxyn carbonyl–2–thiouredo)benzene
Antracol	Propineb	WP	70	Zinc Propylene bisdithiocarbamate
Captan	Captan	WP	50	3a, 4, 7, 7a–tetrahydro–N–trichloromethane sulphenyl pthalimide
Benlate	Benomyl	WP	50	Methyl–1–(butylcarbamoyl) 2 benzimadazol carbonate
Bavistin	Carbendazim	WP	50	2–(methoxy–carbamoyl) – benzimidazole

Predisposing factors were determined on the basis of farmer's information to assess the disease in the context of these aspects. Soil texture, subsoil, Soil pH, Irrigation source, Fertilizer application, intercropping and Tree pruning were kept as the key points to explore the facilitating lines of the pathogen. In soil texture, the mean maximum disease incidence was observed in heavy soils with (45 %), in sub soil, the mean maximum disease incidence was observed in hard pan with (40.44 %), in soil pH, the mean maximum disease incidence was observed in 8.5-9.0 pH with (60.00 %), while in irrigation source, mean maximum disease incidence (37.28 %) was observed where the both means of irrigation were used. Fertilizer is the one of the crucial need for the plants, in our survey mean maximum disease incidence (42.00 %) was observed with the use of NPK. In case of intercropping, maximum incidence (38.56 %) was observed with the intercropping of fodder crops in the mango groves. In case of pruning, mean maximum disease incidence was observed (57.53 %) in the category of zero pruning (Table 2).

Table 2. Farmers perception about predisposing factors.

Sr.No	Predisposing Factors	Sub Factors	*N (%)	Disease Incidence (%)			
				Qadir Pur Rawan	Nawab Pur	Band Bosan	Shujabad
1	Soil Texture	Normal Soil	4(0.4)	31.66	35.66	37.99	26.66
		Light Soil	3(0.3)	39.66	36.66	33.33	41.66
		Heavy Soil	6(0.6)	39.66	46.66	43.66	50.00
2	Sub Soil	Normal Soil	3(0.3)	3.66	11.66	16.66	6.66
		Hardpan	7(0.7)	43.33	35.66	37.22	45.55
		Sandy Subsoil	3(0.3)	34.66	33.33	26.66	23.66
3	Soil pH	7.5-8.0	4(0.4)	29.99	33.33	45.00	37.08
		8.0-8.5	6(0.6)	41.66	46.66	43.25	45.55
		8.5-9.0	5(0.5)	56.66	56.66	60.00	66.66
4	Irrigation Source	Canal	2(0.2)	41.66	23.33	16.66	11.66
		Tubewell	4(0.4)	11.66	23.33	13.66	23.33
		Both	3(0.3)	33.88	34.66	37.99	42.58
5	Fertilizer	NPK	3(0.3)	44.44	37.99	44.44	41.11
		FYM	3(0.3)	47.77	29.99	43.33	41.90
		Gypsum	2(0.2)	26.66	29.99	34.16	48.33
6	Intercropping	Field Crops	6(0.6)	36.10	26.66	39.99	43.22
		Fodder Crops	5(0.5)	37.91	35.92	38.62	41.80
		Vegetable crops	4(0.4)	33.33	26.67	31.66	37.91
7	Pruning	Once in Year	4(0.4)	29.99	33.33	41.66	36.99
		Twice in Year	3(0.3)	23.33	21.66	16.66	23.66
		Zero Pruning	7(0.7)	56.66	66.66	45.55	61.66

*N= Frequency of farmers

The examination of petri plates showed the colonization of three different fungi viz, *Colletotrichum gloeosporioides*, *Fusarium mangiferae* and *Alternaria alternata* from the tissue pieces on PDA. The maximum infection frequency was calculated by *Colletotrichum gloeosporioides* on all the visited locations with (61.66 %, 56.66%, 53.33 % and 45.55 %) at Nawab Pur, Qadir Pur Rawan, Shujabad and Band Bosan respectively (Graph 2).

The efficacy of five fungicides was evaluated by the poison food technique on the radial mycelial growth of *Colletotrichum gloeosporioides* after one week. Topsin-M was found most effective at all concentrations and showed percent inhibition to 98.33 %, 95.00 %, 93.40 % and 89.85 % at 100, 75, 50 and 25 ppm concentrations respectively followed by the Bavistin with the 91.44 %, 85.63 %, 82.58 % and 81.44 % at 100, 75, 50 and 25 ppm concentrations respectively. Benlate was effective at 100 ppm concentration. Antracol and Captan could not prove to be responsive for the control of *Colletotrichum gloeosporioides* (Table 3).

Table 3. Percent inhibition in colony growth of *Colletotrichum gloeosprioides* on PDA amended with different fungicides at different concentrations.

Concentration (ppm*)	Topsin-M	Antracol	Captan	Benlate	Bavistin
25	89.85 ± 0.55 c	54.88 ± 2.11b	18.49 ± 1.61dc	72.44 ± 0.51 c	81.44 ± 0.92 b
50	93.40 ± 1.89bc	58.55 ± 3.85ab	24.07 ± 3.21bc	75.33 ± 0.02bc	82.58 ± 1.17 b
75	95.00 ± 0.74ab	61.48 ± 2.10ab	29.59 ± 3.18ab	77.77 ± 1.70 b	85.63 ± 2.05 b
100	98.33 ± 0.28 a	63.99 ± 2.31a	34.22 ± 2.12 a	82.22 ± 1.11 a	91.44 ± 0.92 a
Control	0.00 ± 0.00 d	5.55 ± 2.22 c	9.99 ± 1.67 d	0.00 ± 0.00 d	0.00 ± 0.00 c
LSD*	3.92	9.09	9.42	4.20	5.00

Means followed by the same letter in each column are not statistically different (P ≤ 0.05). *P* values = < .0001, d.f values = 4, 2. LSD*= Least significant difference. S.E*= Standard error. PPM*= Parts per Million.

Discussion

Mango anthracnose is caused by the fungus *Colletotrichum gloeosporioides* (also known by the name of its perfect stage *Glomerella cingulata*). Anthracnose is one of the most serious diseases of mangoes. The most characteristic symptoms of the disease appear on inflorescence, Leaves, fruit, and stem. Tiny dark brown to black spots appear at first which enlarge and join together and kill the blossoms before the production of fruit (Brodrick, 1971). The disease is becoming more common and serious in the mango groves of Multan, Pakistan, and is imposing heavy losses to the mango growers. The disease was found in all the surveyed locations of mango zone of Multan with a varying degree. However, the disease was more severe with maximum disease incidence (43.66 %) in Band Bosan area. The severity of disease was assesed in Shujabad with (37.99 %), and followed by the Qadir Pur Rawan with (36.99 %) disease incidence. In Nawab Pur disease incidence was observed with (34.66 %).

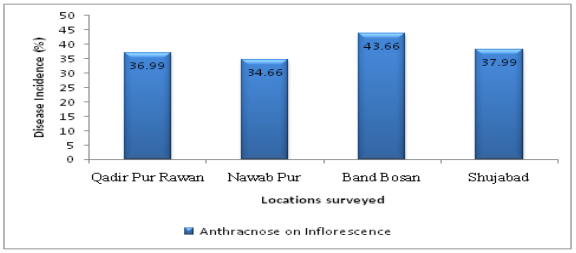

Fig. 1. Disease incidence % of Mango anthracnose in visited locations.

Predisposing factors are those which facilitate the pathogen to come in contact with the host plant. Farmer's information's were collected to correlate the disease incidence with the predisposing factors. We collected the data set regarding the Soil texture; including normal soils consisting of equal proportions of sand (28-51 %), silt (28-50 %) and clay (7-27 %). In

soil texture, the mean maximum disease incidence (45 %) was observed in heavy soils. Subsoil involved three categories viz. sandy sub soils (layer below the top soil, usually less fertile and poorer in texture), Normal sub soils (layer under the top soil also called substrata) and hard pan (cemented or compacted often clayey layer in soil that cannot be penetrated by roots); mean maximum disease incidence was observed in hard pan with (40.44 %). Soil pH was consisted of three levels viz. 7.5 to 8 (slightly alkaline soils), 8.1 to 8.5 (Medium alkaline soils, high in sodium contents) and 8.5 to 9.0 (Strongly alkaline soils, the nutrients present in the soil become locked up for the plant); in this the mean maximum disease incidence (60.00 %) was observed in soils having pH 8.5-9.0.

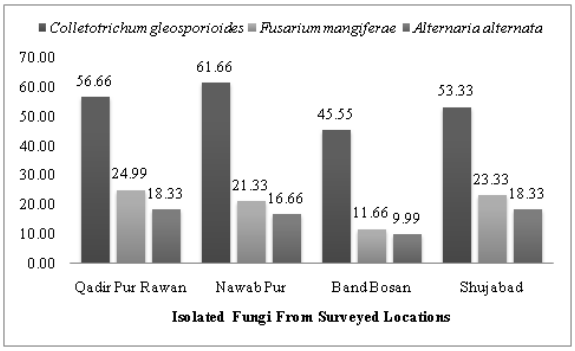

Fig. 2. Isolation frequency of various fungi from visited locations.

Irrigation source was consisted of canal irrigation, tube well irrigation and both, while the mean maximum disease incidence (37.28 %) was observed where the both means of irrigation were used. Fertilizer application was consisted of NPK (Nitrogen, Phosphorous and Potassium), FYM (Farm Yard Manure), and Gypsum. Fertilizer is the one of the crucial need for the plants, in our survey mean maximum disease incidence (42.00 %) was observed where the blind use of NPK was in practice without recommendation. During the survey intercropping was observed with fodder crops, field crops and vegetable crops, the analysis of data set showed maximum incidence (38.56 %) with the intercropping of fodder crops in the mango groves. Tree pruning was an important thing to be questioned, the analysis of data set showed mean maximum disease incidence was found (57.53 %) in the category of zero pruning.

Colletotrichum gloeosporioides was isolated with the maximum percentage on all the visited locations with 61.66 %, 56.66%, 53.33 % and 45.55 % infestation ratio at Nawab Pur, Qadir Pur Rawan, Shujabad and Band Bosan respectively followed by the *Fusarium mangiferae* with the infestation of 24.99 %, 21.33 %, 11.66 % and 23.33 % from Qadir Pur Rawan, Nawab Pur, Band Bosan and Shujabad respectively. Similarly, *Alternaria altenata* was isolated with the infestation ratio of 18.33 %, 16.66 %, 9.99 % and 18.33 % from the orchards of Qadir Pur Rawan, Nawab Pur, Band Bosan and Shujabad respectively.

Our fallouts demonstrated that out of five fungicides belonging to different fungicides groups, three fungicides (Topsin-M, Bavistin and Benlate) found to be the best in percent inhibition in the colony growth of *Colletotrichum gloeosporioides*. The striking similarities in the fungitoxic response of Topsin-M at all the concentrations with the Bavistin belonging to the benzimidazole group could be attributed to similarities in biochemical mode of action (Clemonas and Sisler, 1969). Methyl benzimidazole-2-yl carbamate has been reported primarily to suppress mitosis in fungi whereas suppression of DNA is a secondary effect (Hammers and Sisler, 1972). Topsin-M was found most effective at all concentrations and showed percent inhibition to 98.33 %, 95.00 %, 93.40 % and 89.85 % at 100, 75, 50 and 25 ppm concentrations respectively. Bavistin was also responsive with the inhibition percentage 91.44 %, 85.63 %, 82.58 % and 81.44 % at 100, 75, 50 and 25 ppm concentrations respectively. Benlate was effective at 100 ppm concentration. Antracol and Captan could not prove to be responsive for the control of *Colletotrichum gloeosporioides*. Lim 1980, showed Thiophantae methyl and Carbendazim to be the best fungicidal chemistries for the control of *Colletotrichum gloeosporioides* at 100, 70, 50 ppm concentrations. McMillan, (1973); Zauberman *et al*, (1976) reported benlate to give better control of *Colletotrichum gloeosporioides* either used in combination with other fungicides or singly.

Zuberman *et al*., (1976) demonstrated Captan to give good control of mango anthracnose pathogen. Haq *et*

al., (2013) evaluated the efficacy of different chemistries and bio agents against *Colletotrichum gloeosporioides* and found the benzimidazole group fungicides to be the best for the control of anthracnose of mango at all the concentrations. Gullino *et al.*, (1985) checked the efficacy of different fungicides against *Colletotrichum gloeosporioides* and found all thiophanate methyl and mancozeb to be the best at 50 ppm concentrations. Kumar *et al.*, (2007) reported the emerging resistance in the different isolates of *Colletotrichum gloeosporioides* against different fungicides chemistries. In this study, Topsim-M, Bavistin and benlate performed well so our results are confirmatory with (Clemonas and Sisler, 1969; McMillan, 1973; Zauberman *et al*, 1976; Haq *et al.*, 2013; and Gullino *et al.*, 1985). Unsurprisingly, the Captan and Antracol showed negligible fungitoxicity towards the *Colletotrichum gloeosporioides*. Our study demonstrates that the management of *Colletotrichum gloeosporioides* exclusively depend on chemical fungicides, yet there is a need to integrate cultural and biological management strategies to attain a satisfactory control.

Conclusion

Colletotrichum gloeosporioides is the mostly associated fungus with the Mango anthracnose on inflorescence. Cultural practices should be performed in mango groves properly. Although fungicidal chemistries control the disease but we should plan out the environment friendly control program of this disease.

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References

Akthar KP, Khan I, Khar IA, Khan SM. 1998. Studies on the incident and pathogenesis of *Colletotrichum gloeosporioides* Penz. causing anthracnose of mango and chemical control. Pakistan Journal of Phytopathology **10,** 42-44.

Anonymous. 2012. Agricultural statistics of Pakistan. Ministry of Food and Agriculture. Govt. of Pakistan. Food and Agriculture Division. Planning Units, Isalamabad. **89** p.

Brodrick HT. 1971. Mango diseases. Farming in South Africa **47,** 29-32.

Coates L, Gowanlock D. 1994. Infection process of *Colletotrichum* species in subtropical and tropical fruits. In 'International Conference on Postharvest Handling of Tropical Fruit'. Chiang Mai, Thailand. (Eds B. R. Champ, E. Highley and GI. Johnson). P. **162**-168 p. Australian Centre for International Agricultural Research, Canberra.

Coates LM, Johnson GI. Cooke AW. 1993. Postharvest disease control in mangoes using high humidity hot air and fungicide treatments. Annals of Applied Biology **123,** 441-448. http://dx.doi.org/10.1111/j.17447348.1993.tb04106.x

Cole JT, Cole JC, Conway KE. 2005. Effectiveness of selected fungicides applied with or without surfactant in controlling anthracnose on three cultivars of Euonymus Fortunei. Journal of Applied Horticulture **7,** 16-19.

Clemons GP, Sisler HD.1969.Formation of a fungi toxic derivative from benlate. Phytopathology **59,** 705.

Dhingra OD, Sinclair JB. 1985. Basic Plant Pathology Methods. CRC Press, Inc. Boca Raton, Florida. **132**-163 p.

Dodd JC, Bugante R, Koomen I, Jeferies P, Jeger MJ. 1991. Pre and post harvest control of mango anthracnose in the Philippines. Plant Pathology **40,** 576-583. http://dx.doi.org/10.1111/j.13653059.1991.tb02422.x

Ellis MB. 1980. Dematiaceous hyphomycetes. Common Wealth Mycological Institute, Kew. Surrey,

England P. 595.

Gullino ML, Romano ML, Garibaldi A. 1985. Identification and response to fungicides of *Colletotrichum gloeosporioides*, incitant of strawberry black rot in Italy. Plant Disease **69,** 608-609.

Hammerschlag RS, Sisler HD. 1972. Differential action of benomyl and methyl -2 – benzimidazole carbamate (MBC) in *Saccharomyces pastorians*. Pesticide Biochemistry and Physiology **3,** 42-45.

Haq IU, Sajjad M, Sajid MK, Jaskani MJ. 2013. Occurrence of Guava anthracnose in Punjab and its integrated management. Pakistan Journal of Agricultural sciences **50,** 707-710.

Jamadar M, Desai SA. 1997. Bioefficacy of dimethomorph against downy mildew of grapevine. Advances of Agriculture Research in India **4,** 81-85.

Kumar AS, Reddy NPE, Reddy KH, Devi MC. 2007. Evaluation of fungicidal resistance among *Colletotrichum gloeosporioides* isolates causing mango anthracnose in agriculture export zone of Andhra Pardesh, Indian Plant Pathology Bulletin **16,** 157-160.

Nelson PE, Tousson TA, Marasas. 1983. Fusarium species. An Illustrated Manual forIdentification. Pennsylvania State University Press. 193 p .

Prusky D, Freeman S, Rodriguez RJ, Keen NT. 1994. Nonpathogenic mutant strain of *Colletotrichum magna* induces resistance to *Colletotrichum gloeosporioides* in avocado fruits. Molecular Plant-Microbe Interactions **7,** 326-333.

Perez L, Hernandez A, Hernandez L, Perz M. 2002. Effect of trioxystrobin and azoxystrobin on the control of black sigatoka; *Mycosphaerella fijiensis* Morelet on banana and plantain. Crop Protection **21,** 17-23.

Ploetz R. 1999. Anthracnose: The most important disease in much of the mango producing world. The News Letter of the Plant Pathology **3,** 1-6.

Ruehl GD, Ledin RD. 1960. Florida Agriculture, Experiment Station Bulletion. **174** p.

Singh RS. 2000. Diseases of Fruit Crops, Science Publications, Plymouth, UK.

Sundar AR, Das ND, Krishnaveni D. 1995. *In vitro* antagonism of *Trichoderma spp.* against two fungal pathogens of castor. Indian Journal of Plant Protection **23,** 152-155.

Tandon JN, Singh BB.1968. Control of mango anthracnose by fungicides. Indian Journal of Phytopathology **21,** 212-216.

Zauberman G, Schiffman NM, Yonko M. 1976.Control of fungi causing decay of mango fruits during storage. Special Publication of the Agriculture Research Organization Israel **65,** 105-106.