MICROBIOLOGY ARCHIVES
Original Research Article | ISSN: 3041-590X
Journal homepage: https://microjournal.researchfloor.org/

Efficacy of Plant extract on the Anthracnose causing Pathogen *Colletotrichum gloeosporioides*

Priyanka Ruhela[1], Bhawna Bajpai*[1], Puneet Kumar Tiwari[2], and Kuntal Sarma*[3]

[1]*Department of Botany, Chaudhary Charan Singh University, Meerut, Uttar Pradesh-250004, India*
[2]*Department of Botany, Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj, Uttar Pradesh -211010, India*
[3]*Department of Botany, Ambedkar College, Fatikroy, Tripura-799290, India*

ARTICLE INFO

Citation: Priyanka Ruhela, Bhawna Bajpai, Puneet Kumar Tiwari, and Kuntal Sarma (2026). Efficacy of Plant extract on the Anthracnose causing Pathogen *Colletotrichum gloeosporioides*.
Microbiology Archives, an International Journal.
DOI: https://doi.org/10.51470/MA.2026.8.2.120

Received 12 July 2026
Revised 14 August 2026
Accepted 11 September 2026
Available Online October 18, 2026

Corresponding Author: **Bhawna Bajpai; Kuntal Sarma**
E-Mail: **b_bajpai@yahoo.com; kuntal.algae@gmail.com**

Copyright: *© The Author(s) 2026. This article is Open Access under a Creative Commons Attribution 4.0 International License, allowing use, sharing, adaptation, and distribution with appropriate credit. License details: http://creativecommons.org/licenses/by/4.0/. Data is under the CC0 Public Domain Dedication (http://creativecommons.org/publicdomain/zero/1.0/) unless otherwise stated.*

ABSTRACT

Anthracnose is one of the major fungal diseases affecting mango, causing significant losses in fruit quality, production, and market rate. The disease is commonly associated with Colletotrichum gloeosporioides, which causes characteristic dark, sunken lesions on infected fruits and plant tissues. The present study was undertaken to evaluate the antifungal efficacy of four selected botanicals, namely Neem (Azadirachta indica), Ginger (Zingiber officinale), Eucalyptus (Eucalyptus), and Turmeric (Curcuma longa), against C. gloeosporioides, the causal pathogen of anthracnose. Plant extracts were prepared using a suitable extraction procedure and evaluated for their antifungal activity under in vitro conditions. Different concentrations of the extracts were tested against the pathogen, and their effect on mycelial growth was evaluated. The percentage inhibition of mycelial growth was calculated in comparison with the untreated control, and the relative efficacy of the four botanicals was compared. From the present investigation it was observed that Ginger and Turmeric water extract at 100% concentration level is highly effective in inhibiting the growth (78.44%) and (73.70%) of C. gloeosporioides respectively. Though it was also effective at 20%, 40%, 60% and 80% concentration levels where the inhibition in mycelial growth was recorded as 53.15 %, 65.57%, 75.05% and 77.53% in Ginger and 59.93%, 66.47%, 72.12%, 72.34% and 73.70% in Turmeric respectively.

Keywords: *Anthracnose, Mango, Colletotrichum gloeosporioides, Antifungal Activity, Botanical Extracts, Ginger, Turmeric.*

Introduction

Fruits play an important role in human nutrition through the supply of required minerals and vitamins which helps to make the human body resistance against diseases. They are also very rich source of organic acids which stimulate the appetite and help in digestion of human being. Mangoes are juicy stone fruit (drupe) from numerous species of tropical trees belonging to the flowering plant genus *Mangifera,* cultivated mostly for their edible fruit. Mangoes are belonged to the Anacardiaceae family which is also called as cashew nut family. Its pericarp is divided into three layers: a thin outer layer considered as skin of fruit the epicarp; an edible fleshy layer, the mesocarp and inner hard shell, the endocarp which surround the seed of the fruit [1,2].

Mango has the privilege to grow commercially throughout the country from east to west and north to south. No any region in India is fully devoid of mango cultivation. This is a good situation for farmers of India as they can reap the commercial values of mango cultivation and can fulfil their economic goals with replacing traditional crops with mango. Mango is subjected to a number of diseases at all the stages of development, right from the plants in the nursery to the fruits in storage or transit.

Twenty different genera of fungi are reported to attack mango fruits during pre and post harvesting in India [3] of which anthracnose caused by *C. gloeosporioides* is the most important one [4, 5].

Anthracnose disease of mango is one of the major pre- and post-harvest diseases of mango throughout the world (Uddin *et al.,* 2018). The pathogenic *C. gloeosporioides* was reported in Penzing first time [6]. Butler [7] first time reported it on coffee leaves in India. McRae [8] reported it as the causal pathogen of mango anthracnose. Globally, *Colletotrichum* species was first reported by Corda [9] and Gautam [10]. Since then, the disease has been infecting many crops and trees, including mangoes worldwide [11]. Mango anthracnose disease found in several countries, including Ethiopia, Ghana, Nigeria, South Africa in Africa; Australia in Oceania; Bangladesh, China, India, Indonesia, Taiwan in Asia; and Colombia, Mexico, and Peru in the Americas.

Material and Method

Cleaning and Sterilisation of glassware

For cleaning glassware strong cleaning mixture was prepared by

dissolving 1g potassium dichromate in 100 ml of concentrated sulphuric acid. First of all, the glassware including Petri plates were first wash with cleaning mixture than with the tap water and final with distil water this glassware then dried and finally sterilize in hot air oven at 160ºC for three hours.

Plant Materials

The present investigation was conducted in Department of Botany, Chaudhary Charan Singh University Meerut, Uttar Pradesh-Bharat. Detailed list of plants, their botanical names with families and their parts used in the present investigation are listed in Table-1.

Table1: List of Botanicals and their parts used

S.No	Common name	Botanical name	Family	Plant parts used
1	Neem	*Azadirachta indica*	Meliaceae	Leaves
2	Ginger	*Zingiber officinale*	Zingiberaceae	Rhizome
3	Eucalyptus	*Eucalyptus globulus*	Myrtaceae	Leaves
4	Turmeric	*Curcuma longa*	Zingiberaceae	Rhizome

Isolation and identification and pathogenicity of the experimental organism

The isolation of the pathogen from the diseased Kala variety of mango fruit. The isolated organism was observed under microscope and identified as *Colletotrichum gloeosporioides*. It was compulsory on our side to prove that the fungus concerned is *C. gloeosporioides.* For this pinprick method was used. The pathogenicity test was performed on the kala variety. On The fruit which are inoculated by pinprick method, Characteristic symptoms was appeared after five days of inoculation. The fungus was re-isolated from the fruits and re-inoculated in the healthy fruits to confirm pathogenicity.

Purification of pathogen:

Two percent agar medium was poured about 10 ml in sterilized Petri plates. In sterile distilled water conidial suspension was prepared and 2 ml conidial suspension of pathogen was spread on Petri plates containing agar medium and excess water was drained off incubated at 28± 2° C and examined under the microscope. Single isolated spores were marked with ink on the back side of the Petri plates. These marked areas were cut and transferred to PDA slants and incubated at 28± 2° C. The isolate examined during the present study agreed with the description given by Sattar and Malik (1939) and Bose *et al.,* (1973) and thus identification was confirmed.

Pathogenicity test:

For testing pathogenicity of the causal organism artificial inoculation was done. The pathogenicity test of the *C. gloeosporioides*, the causal organism was carried out on mango fruit and leaves. Healthy fruits of mango were collected from the local market of Meerut and leaves from the Department of Botany, C.C.S. University, Meerut. Fruits and leaves were washed in running tap water and 2-4 times in sterilized water. Then unripe fruit and leaves were surface sterilized with sodium hypochlorite for 30 seconds. Then after, fruits and leaves were washed three times with sterilized water. Fruits and leaves were inoculated by spore suspension by pin prick method (Dhingra and Sinclair, 1985) moist cotton swab with spore suspension spraying of inoculum and dipping of fruits and leaves in water without the causative fungus served as control. Re-isolation of *C. gloeosporioides* from artificially produced symptoms on mango fruits was done. The culture was examined for morphological and cultural details.

Preparation of plant extract:

Three plant parts were used in this study and these were collected from the Chaudhary Charan Singh University Campus Meerut. The procedure of making the botanical extract was followed as described by Abalaka [12]. The leaves of neem (*Azadirchata indica*), rhizome of Ginger (*Zingiber officinale)*, leaves of Eucalyptus (*Eucalyptus globulus*) and rhizome of Turmeric *(Curcuma longa)* free from any disease were selected based on their antifungal properties. Fresh plant materials (leaves, rhizomes) were washed separately with fresh water and finally with sterilised distilled water (SDW). These materials were air-dried and grinded into powder. The grinded powder will be extracted using the process adopted by Abalaka [12] with some modifications. The powdered leaves and root will soak in water and ethanol and put the solution on magnetic stirrer for 96 hours. 20 gram of powder leaves of neem, eucalyptus, Turmeric and ginger were soaked in water and ethanol in a conical flask. The flasks were put on the magnetic stirrer for 96 hours. The concentration of alcohol was 75%. The extracts will filter using Whatman no 1 filter paper and stored in a refrigerator at 4 degrees centigrade for subsequent use then two different extracts were obtained in water and 75% ethanol.

Preparation of extract concentration with the help of serial dilution method:

Applying the technique of Arikpo *et al.* [13] the extract in ethanol will be re-constituted in sterile distilled water to obtain various concentration of the extract as follows 5 ml of the extract was reconstituted in 5 ml sterile water to obtain 100% concentration of extract. Also 4 ml of the 100% concentration will be diluted with one ml of sterile water to obtain 80% concentration the serial dilution procedure will continued to obtain lower concentration of the extract as follows 100, 80, 60, 40, 20.

Preparation of culture media using Neem, ginger, eucalyptus and turmeric extract:

Following the procedure of Arikpo *et al.* [13] and Mukherjee *et al*. [14] PDA culture media in conical flask will be sterilized in an autoclave at temperature of 121° C for 50 minutes after autoclaving about 20 ml of the medium will be poured in each 9 cm sterilized Petri dishes. 5 millilitres from each of the concentration of the extract (0, 20, 40, 60, 80 and 100%.) will dispensed into the Petri dishes and agitated thoroughly with the melted PDA forming potato dextrose extract agar. Mycelial disc will prepare using the cork borer (5mm diameter) from the tip of the five days old culture of the test pathogen. One disc of the isolates will place at the centre of a Petri dish after solidification of PDA. Without plant extract served as control. All the plates will incubator at 27° C after which the zones of inhibition on colony diameter will be measured for 7 days and percentage of mycelial growth inhibition was determined [15].

Percent Inhibition = R1-R2/R1 *100.

Where R1- Furthest radial distance of fungus in control plates
R2- Furthest radial distance of fungus in treatment plates

RESULTS

Effect of plant extracts on the radial growth of *C. gloeosporioides*:

Four plant water extracts viz., Ginger, Eucalyptus, Neem, Turmeric and four ethanolic extracts viz., Ginger, Neem,

Eucalyptus Turmeric and were screened using poisoned food technique to identify their efficacy against *C. gloeosporioides*. Mycelial growth inhibition varied significantly with different plant extracts at different concentration levels, viz., 20%, 40 %, 60 %, 80 %, 100 % (Table-2). At 20 % concentration, maximum inhibition of mycelial growth 59.93 % was recorded in Turmeric followed by 53.15 % in Ginger while minimum inhibition was observed in Neem 10.94% followed by Eucalyptus 14.33 % after 7 days of incubation. At 40 % concentration, maximum % inhibition in mycelial growth 66.47% was recorded in Turmeric followed by Ginger 65.57 %. Least inhibition 9.81 % was recorded in Neem followed by Eucalyptus (23.58 %) (Fig.-1). At 60 % concentration maximum inhibition was recorded in Ginger 75.05 % followed by Turmeric 72.12 %. Minimum growth inhibition 9.81 % was recorded in Neem followed by 31.03 % in Eucalyptus. At 80 % concentration, maximum growth inhibition was recorded in Ginger (77.53 %) followed by Turmeric (72.34 %) and Eucalyptus (43.90 %). Minimum growth inhibition was found in Neem 10.94 %. At 100 % concentration maximum growth inhibition was recorded in Ginger (78.44 %) followed by Turmeric (73.79 %) and Eucalyptus (66.23 %) (Fig.-2).

Four extracts from different plant viz. Neem, Ginger, Eucalyptus and Turmeric were screened for the efficacy against *C. gloeosporioides in-vitro*.

It was observed that Ginger and Turmeric water extract at 100 % concentration level is highly effective in inhibiting the growth (78.44 %) and (73.70 %) of *C. gloeosporioides* respectively. Though it was also effective at 20 %, 40 %, 60 % and 80 % concentration levels where the inhibition in mycelial growth was recorded as 53.15 %, 65.57 %, 75.05 % and 77.53 % in Ginger and 59.93 %, 66.47 %, 72.12 % 72.34 % and 73.70 % in Turmeric respectively.

Four extracts viz. Neem, Ginger, Eucalyptus and Turmeric ethanolic extracts were screened for the efficacy against *C. gloeosporioides.* It was observed that the Ginger ethanolic extract at 100 % concentration level is highly effective in inhibiting the growth (100 %) of *C. gloeosporioides*. Though it was also effective at 20 %, 40 %, 60 %, and 80 % concentration levels where the inhibition in mycelial growth was recorded as 26.52 %, 36.45 %, 61.51 % and 73.02 %, respectively. Other botanicals at 100 % concentration level also highly effective Turmeric (79.79 %), Eucalyptus (79.34 %) and Neem (78.89 %) were recorded after 7 days of incubation.

From the data it can be summarized that Ginger and Turmeric water extract at 100 % concentration level is highly effective in inhibiting the growth (78.44 %) and (73.70 %) of *C. gloeosporioides* respectively. Though it was also effective at 20 %, 40 %, 60 % and 80 % concentration levels where the inhibition in mycelial growth was recorded as 53.15 %, 65.57 %, 75.05 % and 77.53 % in Ginger and 59.93 %, 66.47 %, 72.12 % 72.34 % and 73.70 % in Turmeric respectively (Fig.-3).

Table 2: Effect of water extract on the radial growth of C. gloeosporioides:

S. No	Botanicals	Concentration									
		20%		40%		60%		80%		100%	
		G	I	G	I	G	I	G	I	G	I
1.	Ginger	31.4	53.15	20.4	65.51	12	75.05	9.8	77.53	9	78.44
2.	Eucalyptus	65.8	14.33	57.6	23.58	51	31.03	39.6	43.90	19.8	66.25
3.	Neem	68.8	10.94	69.8	9.81	69.8	9.81	68.8	10.94	68.8	10.94
4.	Turmeric	25.4	59.93	19.6	66.47	14.6	72.12	14.4	72.34	13.2	73.70
5.	Control	88.6		88.6		88.6		88.6		88.6	

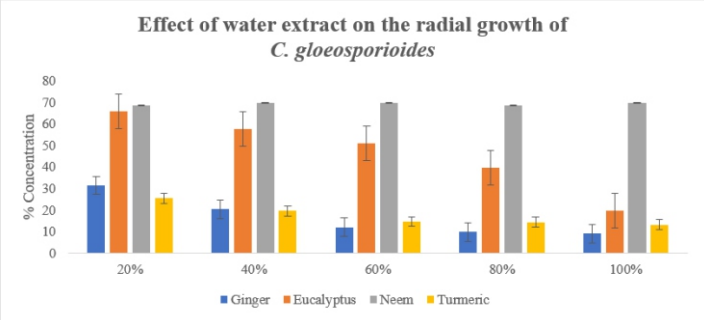


Figure 1: Effect of water extract on the radial growth of C. gloeosporioides

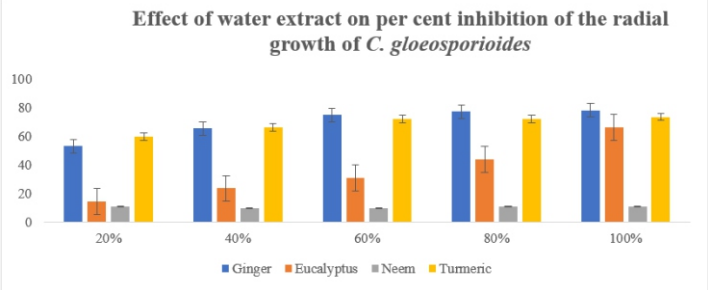


Figure 2: Effect of water extract on per cent inhibition of the radial growth of C. gloeosporioides

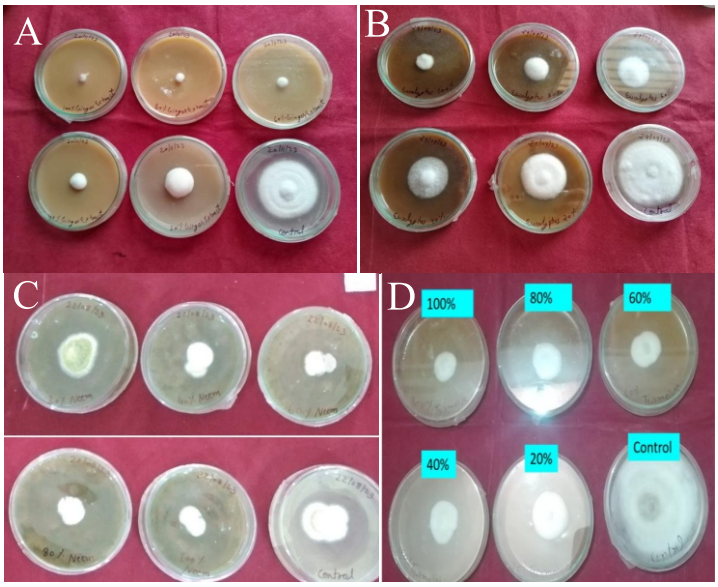


Figure 3: (A) Effect of Ginger extract on the growth of C. gloeosporioides (B) Effect of Eucalyptus extract on the growth of C. gloeosporioides (C) Effect of Neem extract on the growth of C. gloeosporioides (D) Effect of Turmeric extract on the growth of C. gloeosporioides

Discussion

Relative tolerance of plant extracts:

Several researchers have shown the possibility of controlling disease using plant products. Hasabins and D'Souza [16] reported that the dipping of fruits in neem leaf extract or living with bamboo packing baskets with Neem leaves as cushion material gave best reduction. Chauhan and Joshi [17] investigated 14 plant extracts for controlling of anthracnose disease of mango fruits. Gambari [18] studied the effect of *Azadirachata indica* (Neem) and *Zingiber officinale* (Ginger) extract on the leaf spot disease of mango fruit. He found the water and ethanolic extract of *Z. officinale* and *A. indica* inhibit the growth of all tested fungi of different concentration. As the concentration increase the antifungal activity also increase. The highest inhibition of growth of fungi was recorded at 60, 80 and 100 % extract concentration which were 94.47, 96.69 and 98.88% respectively.

Sefu *et al*. [19] investigated the effect of Ginger and Cinnamon leaf essential oil on mango anthracnose disease causing fungi *Colletotrichum gloeosporioides*. In the study they found that in both treatment cinnamon and ginger essential oil showed high antifungal effect on the mycelia growth of *C. gloeosporioides*. Bhutia [20] reported the antifungal activity of plant extracts against *C. musae*, the postharvest anthracnose pathogen of banana. In his investigation he uses 42 plant species.

The extracts were obtained from leaves, shoot, rhizomes, bulbs, seeds and fruits. In his study he found that *Z. officinale* rhizome extract as well as *Polyalthia longifolia* and *Clerodendrum inereme,* leaf extracts showed more than 80% of mycelia growth and spore germination. Hence the affectivity of the botanicals can be explored under integrated management strategy on large scale.

Conclusion

Four extract viz. Neem, Ginger, Eucalyptus and Turmeric were screened for the efficacy against *C. gloeosporioides* in vitro. It was observed that Ginger and Turmeric water extract at 100 % concentration level is highly effective in inhibiting the growth (78.44 %) and (73.70 %) of *C. gloeosporioides* respectively. Though it was also effective at 20 %, 40 %, 60 % and 80 % concentration levels where the inhibition in mycelial growth was recorded as 53.15 %, 65.57 %, 75.05 % and 77.53 % in Ginger and 59.93 %, 66.47 %, 72.12 % 72.34 % and 73.70 % in Turmeric respectively.

Acknowledgement

The authors are thankful to Prof. Rama Kant, Head Department of Botany, Chaudhary Charan Singh University Meerut, Bharat for providing necessary facilities.

Conflicts of Interest

The authors declare no conflicts of interest.



Dr. Bhawna Bajpai, Assistant Professor

Department of Botany, Chaudhary Charan Singh University, Meerut, India. She earned her M. Phil and Ph. D **from Ujwal University, Gwalior, Madhya Pradesh,** India. Her core research focuses on Mycology, Plant Pathology, Seed Health, and Environmental Biotechnology. Her recent publications and supervised theses examine fungal diversity in medicinal plants, biological control of weeds using fungal strains, and the impact of industrial effluents on crop germination.



Dr. Priyanka Ruhela, Tutor

Department of Botany, R.K.P.G. College Shamli, Uttar Pradesh, India. She completed her M. Phil and Ph. D from Department of Botany, Chaudhary Charan Singh University, Meerut. Her research is focused on fungal diversity, taxonomy and value-added compounds.



Dr. Kuntal Sarma, Lecturer

Department of Botany, Ambedkar College Fatikroy Tripura, India is primarily an academician and researcher specializing in Biotechnology and Phycology, with a particular focus on the North-East region of India. He completed his Ph.D. from the Department of Biotechnology, Amity University, Gurugram, Haryana, India. His research expertise includes Cyanobacteria (Blue-green algae), biofuels, biofertilizers, and green nano-biotechnology.



Mr. Puneet Kumar Tiwari

completed his M.Sc. in Botany from the Department of Botany, Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj, Uttar Pradesh India, where he developed a strong foundation in core biological concepts.

References

1. Hulmes A.C. (1971). The Biochemistry of fruits and their products. Vol 2. Acedemic Press, London 233-254.
2. Mukherjee A. K., Kumar A. S., Kranthi S., Mukherjee P. K. (2014). Biocontrol potential of three novel Trichoderma strains: isolation, evaluation and formulation. 3 Biotech 4, 275–281. 10.1007/s13205-013-0150-4.
3. Pathak, V.N. (1980). Diseases of fruit crops. Oxford & IBH Publishing Comp. New Delhi. 309.
4. Snowdown, A.L. (1990). A color Atlas of postharvest Disease and disorder of fruits and vegetables. General Introduction and fruits. Wolfe Scientific. London.
5. Johnson, G.I. and Coates, L.M. (1993). Post-harvest disease of mango. *Post-harvest News and Information.* 4: 27N - 34N.
6. Penzing AGO (1882). Fungi agrumicoll.Conttribuzione allo studio dei funghi parassiti degll agrumi. Michella 2: 385-508.
7. Butler, E.J. (1918). Fungi and disease in Plants. Thacker Spink and Co. Calcutta, India.
8. McRae, W. (1924). Economic Botany Part III. *Mycology, Annual Report, Board Scientific Advice*, India 1922-23: 31-35.
9. Corda, A.C.I. (1831). "Die Pilze Deutschlands" in Deutschlands Flora in Abbildungen nach der Naturmit Beschreibungen. ed. J. Sturm, 3: (Nürnberg: Sturm) 33–64.
10. Gautam, A. (2014). *Colletotrichum gloeosporioides*: Biology, Pathogenicity and Management in India. A review. *J. of Pl. Physiolo. and Path*. 2(2) :1-11.
11. Ciofini, A., Negrini, F., Baroncelli, R., and Baraldi, E. (2022). Management of Post Harvest Anthracnose: current approaches and future perspectives. *Pl. Theory* 11:1856.
12. Abalaka, M., Oyewole, O. A., & Kolawole, A. R. (2012). Antibacterial activities of *Azadirachta indica* against some bacterial pathogens. *Advances in Life Sciences*, 2(2), 5-8.
13. Arikpo, I.O., Samuel, E.U., Moses, E.E., Kingsley, H.E., Nsor, O.A., Magdalene, O. (2013). Antifungal activity of extracts of scent leaf (*Ocimum gratissimum*) and alligator pepper (*Aframomum melegueta*) on the postharvest decay of carrot in Calabar, Nigeria. *J. of Bio.* 3(14): 26-30.
14. Mukherjee S.K., Lit, and Richard E. (2011). Introduction to Botany and the Importance, in Lit 3, Richard E. The Mango Botany Production and uses walling ford Oxon. Uki CAB International pp. 1-18.
15. Whipps, J.M. (1987). Effect of media on growth and interactions between a range of soil-borne glasshouse pathogens and antagonistic fungi. New Phytologist, 107(1):127-142.
16. Hasabnis S.N. and D'Souza T.F. (1987). Use of natural plant products in the control of storage rot in Alphonso mango fruit.J.Maharashtra Agri. Univ. 12(1):105-106.
17. Chauhan H.L. and Joshi H.U. (1990). Evaluation of Phyto extracts for control of mango fruit anthracnose. Botanical Pesticides in integrated pest management. *Proc. Of Nat. Symposium held on Jan.21-22, 1990 at Central Tobacco Res. Inst. Rajamundry, India* pp. 455-459.
18. Gambari U.O.B. (2016). Control of Leaf spot disease of Mango (Mangifera indica) with extract of *Azadirchata indica* (Neem) and *Zingiber officinale* (Ginger). *Journal of Agricultural Research and Development* 6(2): 50-55.
19. Sefu, G., Satheesh, N., & Berecha, G. (2015). Effect of Essential oil Treatment on Anthracnose (*Colletotrichum gloeosporioides*) Disease development Quality and Shel life of Mango fruits (*Mangifera indica). American- Eurasian J.Agric. And Environ. Sci.* 15(11) 2160-2169.
20. Bhutia, D.D. (2015). Antifungal activity of Plant extracts against *Colletotrichum musae*, the post-harvest anmthracnose Pathogen of banana cv. Martaman. Emerald. *J. of Nutri. and food Sci*. 46(1): 2-15.