



## Bio efficacy of plants extract against the growth of *Colletotrichum gloeosporioides* (Penz.) penz. and sacc. one of the major plant pathogens causing anthracnose disease of plants

Keshamma E<sup>1</sup>, Anil Kumar<sup>2</sup>, Priya Lokare<sup>3</sup>, Sumia Fatima<sup>3</sup>, Laxmi Kirana Pallathadka<sup>4</sup>, Manoharmayum Dolpriya Devi<sup>5</sup>

<sup>1</sup> Assistant Professor, Department of Biochemistry, Maharani Cluster University, Bangalore, Karnataka, India

<sup>2</sup> Department of Botany, DDU Gorakhpur University, Gorakhpur, Uttar Pradesh, India

<sup>3</sup> Pesticides and Plant Protection Research Laboratory, Dr. Rafiq Zakaria College for Women, Aurangabad, Maharashtra, India

<sup>4</sup> Manipur International University, Imphal, Manipur, India

<sup>5</sup> Assistant Professor, Department of Agriculture, Koneru Lakshmaiah Education Foundation (KL deemed University), Guntur, Andhra Pradesh, India

### Abstract

Anthracnose is widely found fungal infection in plants resulted from *C. gloeosporioides* which results in the germination of spores on plant leaves and twigs. The disease has resulted in huge damage to crops and fruit by presenting lesser yield or greater damage to plants. In the past few years certain fungicides and insecticides are used for fixing out the devastation caused by disease but these chemical-based fungicides also have certain drawbacks and after a certain time these plants also become resistant to them. So, there is a need to provide better alternative to all of these problems. The study mainly aims to review on the fact that how natural extracts of plants obtained from leaves, bubs and buds are helpful in the management of Anthracnose and also which compounds in plants extract are effective in this activity. The life cycle of the disease has been reviewed that it starts its propagation in summer and by which mechanism the anti-fungal compounds combat out disease.

**Keywords:** *Colletotrichum gloeosporioides*, pathogens, anthracnose disease

### Introduction

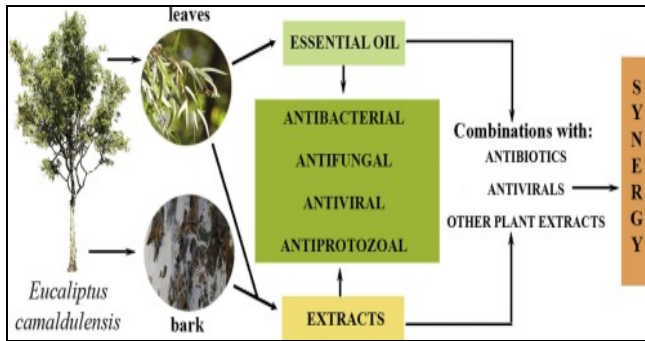
*Colletotrichum gloeosporioides* is the most commonly occurring fungal pathogen and causes anthracnose diseases of most of the commercial fruit plants. Mostly it can cause the rust in the crops of tropical areas or forests. These plants include avocado, eggplant, cocoa, tomato, potato and papaya, most of citrus plants are hosts of this pathogen. In these plants, these pathogens have resulted in the crop lost in both pre and pro harvest conditions. It usually serves the role as secondary invaders of plant tissues and thus serve as saprophyte (Deressa, Lemessa, & Wakjira, 2015) [8]. The most common symptoms in these plants involve black or grey lesions. In the case of appearance of this infection on inflorescence appears in form of blight, necrosis factors and certain streaks. The infectious plants will depict dark areas with the regular or irregular areas having narcotic factors. The discoloration of the stem also occurs in the infected plant. Cankers are also observed in the areas near infected areas. Acervuli are also observed in the fruits having sporulation of fungal specie. Which usually appears in the form of pink spot during periods of much higher humidity (Yanos, Hernandez, & Sabularse, 2021) [25]. A concentric pattern or sequence is observed in the spores of fungi and around the area of necrosis. The fungus most primarily colonize the area which covers the damaged tissues or tissues which are about to undergo senescence or death. The spread of these fungal spores occur via air current, rains, splash, irrigation and dew drops. The colonization of fungal specie occurs after deposition and their accumulation over various parts of younger leaves. Although the sexual spores

are produced in lesser amount, but they are produced in the higher number and are susceptible to larger distant spore spread (Chaudhari & Gohel, 2016) [5].

Spores can result in the formation of dominant spore structure until they can cause a serious damage in the host cells. They are harvested at a very early level in fruits where ethylene further stimulates the colonization (Burgute, Magar, Patil, Navale, & Bajad, 2019) [3].

Further persistence of pathogens can be gained via infested weed crops, insects and latent loss of weeds which in turn are also helpful in prevention of loss of weed plants and pathogenic strain. Relative level of humidity is required by pathogens when moisture content is high, these alveolar structures produce spores. But this pattern or figure is not active during dry season (Sudha & Narendrappa, 2015) [24]. This can be diagnosed by:

- The appearance of black flecks in any area of plant usually fruit or stem.
- In addition to black spot a pink spot is also observed in the persisting area.
- Certain candida specie or spot also occur which are found to be 15um long and 7-8 um wide and are also in the form of hyaline, curved and avoid in shape.
- Certain Acervuli are also formed containing spores having epidermal candidas.
- In addition, certain type of molecular diagnostic techniques is available for proper diagnosis of disease.



**Fig 1:** Elaborating how plant extracts and essential oils are used as antiviral, antifungal and in synergism.

The disease has resulted in poor and less yield caused by the spoilage and rotting of parts of plants. For this disease use of the commercially available chemical fungicides and insecticide is common choice but it can also cause fungal resistance due to excessive usage (de Guzman Alwindia & Mangoba, 2020) [7]. Moreover, it cannot provide the permanent solution to this disease because of high raise in economy and is also toxic to environment and human health. Because of this scientist were continuously aiming to discover some alternative to their usage. Recent studies are carried out on the use of natural molecules for treatment of anthracnose disease. The use of these natural products especially plant extracts have the capability to combat the number of pathogens and is also environmentally friendly and safe to use as shown in fig.01. The extracts obtained from a number of plants have active ingredients which are active against a number of fungal based pathogens. So the main aim of study is to find out that how these plan extracts are involved in suppressing the fungal disease and to what extent they are effective (Jagtap, Mali, & Dey, 2013) [14].

### Literature review

Namsena *et al.*, has introduced the effect of the natural or crude plant extract against anthracnose disease that damages the fruit of plant and results in lowering of yield of plants. His study was aimed to study the effect of 15 different plant extracts against *C. gloeosporioides*. The effect of different extracts was found to be different with the maximum effect obtained from leaves of *P. sarmentosum*. Maximum inhibition was obtained after the application of crude extract of various plants especially *P. sarmentosu* and maximum concentration applied was in the range from 1.5 to 2.5%. Shortly, the leaf extract of some plants is very effective against anthracnose infection in the case of growth as well as spore germination and has proved to be a novel tool in management of infection (de Alwindia & Mangoba, 2020) [7].

(K. Maryam in 2017) has elaborated that mango is the most commonly grown fruit in tropical as well as sub-tropical areas. The disease caused by fungal strain *C. gloeosporioides* is the most important cause of death and major losses in plants and flower set of mangoes. The study was designed for checking out affectivity of *Datura metal* weed against the fungal infection caused by this strain in mango plants. The methanol extract of weed extract depicts a higher level of affectivity against the fungus and this has been found by applying different concentrations of extracts (Khan, Jabeen, & Iqbal, 2017) [15]. All the applied concentrations were effective in combating effect of fungal sporulation but a concentration of 1.5% was highest in its

affectivity and depicted about 90% of bio efficacy in this regard. The extract was further subjected to fractionation using organic solvents such as organic acids, chloroform and n-hexane. GCMS was further used in case of analysis (Rashid, Awla, & Sijam, 2018) [19].

(K. Joseph *et al.*, 2019) has elaborated that anthracnose has effected yam plant badly and thus resulted in the lesser and reduced production. The anti-health and environmental effects of already available fungicides have put forward the need to provide best alternative to the chemicals (Ishwarya, Vanitha, Panneerselvam, & Kamalakannan, 2018) [11]. The study was performed to evaluate the effect of *Azadirachta indica* and *Capsicum anum* in the management of disease. The antifungal activity was accessed by potato dextrose agar using food poisoning technique. The extracts used each showed p value lesser than 0.5 and quantitative analysis has revealed the presence of tannins, quinolones, sappiness and steroids. The antifungal activities of these plants make them suitable for use as the anti-fungal agent (Shova, Hosen, & Bashar, 2020) [23].

### Life cycle of anthracnose disease

Most of the anthracnose fungi effects the plant during spring season when the plant leaves start to appear or when first leave appears. The infection then continues to expand during the summer season when the environmental conditions are suitable. The spores causing disease are usually released from damaged, diseased or the last year fallen leaves. Mostly, this disease occurs on the surface of leaves and twigs. These fungi then overwinter in the suitable condition or weather. In spring, it results in the production of a larger number of spores which are then travelled from one place to other using rain water or splash, air winds etc. on entering leaves, these spores germinate resulting in production of new leaves or plants. If the condition of moisture remains same, the spores continues to germinate and thus infect new plants from the older ones (Jagtap, Gavate, & Dey, 2012) [12].

### Anti-fungal effects of plant extracts

Plants produce a whole set of secondary metabolites for their protection against a number of pathogens. These metabolites act as an important barrier or defense system for a huge collection of microorganisms. For this purpose, two main classes of metabolites are found i.e. either they are constitutive or inducible type. The very first class of compounds are produced in almost all healthy plants while on the other hand the inducible belong to category where these compounds are produced in response to any outer stimulus such as attack by pathogens (Sataraddi, Prashanth, Virupaksha Prabhu, Jamadar, & Aski, 2011) [22]. The constitutive one includes flavonoids, tannins or alkaloids etc. these are the compounds mostly found in essential oils and medicinal plants these consecutive types are further classified into qualitative and quantitative ones. The quantitative ones include flavonoids, terpenoids, tannins and phenols which possess higher molecular weight in addition to having lower level of toxicity. While qualitative ones are those which possess lower molecular weight and lower level of toxicity. Thus the biological activities of these compounds are much stronger (Jagtap, Gavate, & Dey, 2014) [13].

In a number of previous researches, the plant extracts have exhibited much higher level of biological activity against

fungal infections under laboratory conditions. In addition to it, wild plants present promising sources having useful metabolites where both essential oils and extracts can be used as the antimicrobial source. The leaves, stem and barks of plants are mostly used for this purpose because it is very easy to obtain extracts from these parts simply by boiling in *in vitro* conditions (Mistry, Sharma, & Patel, 2008) [17]. Moreover, these compounds also act in synergy with other plants and plant parts to be act as antibiotic. The fig.02 shows the secondary metabolites present in plant extract for use in providing antifungal properties. They also include anthocyanidins which are helpful in the overall inhibition of sodium potassium efflux pump system, cellular division, formation of cell wall of plant, change in functional properties of mitochondrial structure and lastly the protein synthesis of plants having infection.

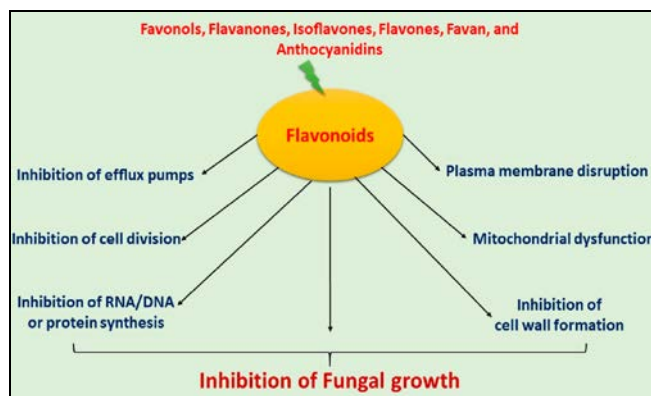


Fig 2: Elaboration of the inhibition of fungal growth via extract containing secondary metabolites such as flavonoids.

**Commonly used plants as antifungal in anthracnose infection**

A number of plants have been reported whose extract contain active compounds being used as an antifungal agent. A few of them include:

- *Curcuma longa* whose leaves as well rhizome is used for extraction of crude plant extract. It is found to be most powerful antifungal agent which plays its role by disrupting cell membrane, inhibiting synthesis of steroids, in addition to inhibition of specific substrates for respiration as for example succinate dehydrogenase being abbreviated as SDH and NADH oxidase (Kumari, Singh, & Thakur, 2016) [16].
- *Zingiber officinales* involves the use of its rhizome part for the extraction of plant extract. It is commonly known as ginger and is used as the medicinal plant and also as a spice. The present study has revealed that the ginger has greater antifungal activity as compared to antimicrobial effects. Especially it is active against candida specie when isolated from patients.
- *Tagetes erecta* with its leaves being used in the production of extract and it is edible in addition to its use as medicinal plant. Its plant extracts show better antifungal properties as depicted by disc diffusion method. Moreover its petal also possess anti- cancer effect inn addition to its anti-microbia (by Cam Scanner).
- Similarly, leaves of *Eugenia uniflora* are also used for this purpose whose extracts and essential oils are proven to have anti-fungal component such as Selina, trien, and was also termed as fungi static agent. These

natural compounds have power to inhibit virulence mechanism of Candida specie.

- *Salvia sclara* are also considered as most potent source of antifungal agent for treatment of fungal diseases in plants. They have shown the maximum activity even in the presence of lowest concentration and also the fungicide effects in form of chemical fungicides (Sanjeevkumar, 2020) [21].
- *R. officinalis* also called as rosemary and is used as shrub having needle like leaves and flowers of different colors. The extract is prepared from leaves, flowers and buds. It possess bioactive compounds such as insecticides, antioxidants and antifungal. The properties are due to presence of phenol based compounds (Haider, Khan, Atiq, Shahbaz, & Yaseen). Other plants whose extract are used are depicted in table 01.

Table 1: Plant extracts, plant parts and ratings on the basis of scale 10 as antifungal agent.

Serial number	Plant name	Plant tissue used for extract	Effectiveness as antifungal compound
01	<i>Camassia scilloides</i>	Leaf and bulb	8/10
02	<i>Tradescantia tharpitii</i>	leaves	7/10
03	<i>Allium canadense</i>	Flowers and bulbs	5/10
04	<i>Astragalus drummondii</i>	Only bulbs	9/10
05	<i>Oenothera sp.</i>	Leaves	8/10
06	<i>Artemisia sp.</i>	Leaf	9.5/10
07	<i>Yucca glauca</i>	Buds, leaves and shoots	9/10
08	<i>Annona reticulata</i>	Fruit	4.5/10
09	<i>Psidium guajava</i>	Fruits	6/10
10	<i>Mimosa pudica</i>	Leaves	3/10

**Advancement in the diagnosis and management of anthracnose disease**

A huge progress has made in the field of phytopathogenic analysis of plant fungal diseases. Conventional methods involved the use of visible sign symptoms for accessing the damage caused by fungus spores which usually appears in form of candida or mycelia etc. (Ridzuan *et al.*, 2018) [20]. Further methods employed included inoculation, culturing, microscopic and biochemical techniques (Biju *et al.*, 2017) [2]. But they have shown some sort of defect or drawback in the terms of pathogenesis of disease. On the basis of this immunological based methods were suggested which have shown some sort of less sensitivity, reduced exposure to contaminants and more productivity based on antigen-antibody binding. Modern method involves the use of real time polymerase chain reaction also abbreviated as q-PCR (Gahukar, 2017) [9]. Moreover, the combination with other hybridization technique is found to be more potentate such as with biomarkers such as RFLP. Greater efficacy, lesser sensitivity and more productivity of molecular based techniques have enabled a huge progress in field of plant physiology and pathogenetic (Arunakumara & Satyanarayana, 2017) [1].

For the management of fungal disease, a number of fungicides are available on commercial level which aid in stopping spread of disease from one place to other. But the drawback here is that these fungicides fail to protect existing tissues instead they only have effect on healthy cells. But these insecticides are more harmful than beneficial effects such that they can cause both human and environmental problems. So the overall trends has been shifted to the use

of natural organic compounds for stopping growth of fungi on leaves and twigs (Pandey, Shukla, & Kumar, 2016)<sup>[18]</sup>.

### Conclusion

The study has depicted the overall effectiveness of a number of extracts in finishing up the effects of anthracnose disease in plants. As the plants contain a number of bioactive compounds such as flavonoids, terpenoids and many other present in leaves, barks and bulbs thus these compounds can be used as a best alternative to other treatment and preventive methods used for management of anthracnose disease. This also suggests the use of such products as better future recommendation for catching out anthracnose disease and thus is helpful in increasing yield, product and bio efficacy of citrus plants without any side effects.

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