International Journal of Sciences

Research Article Volume 9 – October 2020 (10)

In Vitro Effects of Some Ethanolic Crude Extracts of Medicinal Plants against *Colletotrichum gloeospoioides*, The Pathogen of Antharacnose Disease in Chilli

Sawatdikarn Sanit[1]

[1]Department of Applied Science, Faculty of Science and Technology
Phranakhon Si Ayutthaya Rajabhat University, Phranakhon Si Ayutthaya, Thailand

Abstract: The anthracnose disease is one of the major economic diseases in chilli production of Thailand. The present study was aims to test and evaluate the fungicidal activity of the ethanolic crude extracts from thirty-four medicinal plants were tested against *Colletotrichum gloeosporioides* (the pathogen of anthracnose disease in chilli of Thailand) by poisoned food technique at 0, 2,000, 4,000, 6,000, 8,000 and 10,000 ppm. The inhibition of mycelial growth was evaluated. From the testing, All the used of thirty-four crude extracts showed significant antifungal activity against *C. gloeosporioides*. The result showed that the *Curcuma aromatica*, *Zingiber zerumbet*, *Piper betle*, *Kaempferia galanga*, *Rosmarinus officinalis* and *Origanum vulgare* crude extracts showed 100% inhibition of mycelial growth at all concentrations, whereas, the *Wedelia trilobata* and *Polygonum odoratum* crude extracts at 10,000 ppm gave the lowest inhibition of 70 and 82%, respectively. The study noted that the crude extracts namely *C. aromatica*, *Z. zerumbet*, *P. betle*, *K. galanga*, *R. officinalis* and *O. vulgare* showed the completely control of mycelial growth against *C. gloeosporioides* (the pathogen of anthracnose disease in chilli). These research pointed the oppurtunities for screening and application of some ethanolic crude extracts for a eco-friendly environmental management and exploited method as the biological control in chilli production.

Keywods: Fungicidal Activity, Anthracnose Disease, *Colletotrichum Gloeosporioides* Medicinal Plants, Ethanolic Crude Extracts, Chilli

Introduction

Anthracnose disease is one of the major economic disease in chilli production of Thailand and worldwide. Than *et al*. (2008) reported that the anthracnose disease caused by three pathogens namely *C. gloeosporiodes*, *C. acutatum* and *C. capsici*. The anthracnose disease control in chilli production in Thailand had five methods namely mechanical control, cultural control, biological control, chemical control and integrated control. For the chemical control is the best method for anthracnose disease managements, whereas this method as harmful for environmental condition, product residues and human health (Sawatdikarn, 2016).

Although, the management of anthracnose disease with the application of several fungicides. Filoda (2008) reported the effects of three fungicides (Sarfun 500 SC, Amistar 250SC and Gwarant 500 SC) at 0.01 0.20 and 0.40% ihhibited on the colony growth of *C. gloeosporiodes* and Nagaraju *et al*. (2020) reported that carbendazim (25 50 75 and 100 µl) inhibited on the mycelial growth of *C. gloeosporiodes* (the pathogen of anthracnose in mango).

Fungicides can be controlled the anthracnose disease but the toxicity effects on products in human health and environmental issues are studies. Nowadays, the farmers use the biological control for anthracnose disease control in chilli. Sawatdikarn (2016) noted that the medicinal herb crude extracts for the soil and seed borne pathogen control have attracted wide interest. In general, several researches have been focused on medicinal herb crude extracts to control of plant disease management. (Sawatdikarn, 2011).

Several experiments reported of some plants crude extracts and essential oil for antimicrobial activity. Abera et al. (2011) showed the ethanolic crude extracts of two species (*Eucalyptus globules* and *Eucalyptus*

Published at: http://www.ijsciences.com/pub/issue/2020-10/
DOI: 10.18483/ijSci.2310; Online ISSN: 2305-3925; Print ISSN: 2410-4477

Sawatdikarn Sanit (Correspondence)
+

citriodera) to inhibit the mycelial growth of *Colletotrichum kahawae* (the pathogen of berry disease in coffee) for 64-76 %.

Sawatdikarn (2011) studied the antifungal activity of crude extracts of six Zingiberaceae species namely *Boesenbergia pandurata, Zingiber officinale, Zingiber cassumunar, Amonum xanthioides, Kaempferia galanga* and *Amonum krervanh* against *Curvularia* sp. (the pathogen of dirty panicle disease in rice), selected crude extracts of *B. pandurata* at 1,000 ppm showed the highest of mycelail growth inhibition for 57% and the crude extracts of *A. Krervanh* at 1,000 ppm showed the lowest of mycelail growth inhibition for 43%. Sawatdikarn (2016) noted the crude extract of three medicinal plants namely *Curcuma aromatica Syzygium aromaticum* and *Origanum vulgare* showed 100% inhibition on mycelial growth and spore germination of *Alternaria* sp. (the pathogen od dirty panicle disease in rice at all concentrations (1,000-10,000 ppm) and Palhano *et al*. (2008) reported that the essential oil of *Cymbopogon citratus* to inhibited on mycelial growth of *C. gloeosporioides.*

Jun-Young et al. (2006) noted that the antifungal activity of crude extracts from *Curcuma longa* against three red pepper anthracnose (*Colletotrichum coccodes*, C. *gloeosporioides* and C. *acutatum*). Rahman et al. (2011) reported that the seed extracts and the pulp extracts from *Jatropha curcas* had higher antifungal activity than whole fruit extracts against C. *gloeosporioides* (the pathogen of anthracnose in papaya).

Haron et al. (2013) showed that the fungicidal activity of *Allamanda* spp. crude extracts against C. *gloeosporioides* (the pathogen of anthracnose in papaya). Meng et al. (2013) impressed that the antifungal activity of crude extracts from Camellia semiserrata against *C. musae* and C. *gloeosporioides*. Marinho et al. (2018) noted that the fungicidal activity of soapberry (*Sapindus saponaria*) against C. *gloeosporioides* (the pathogen of anthracnose in papaya), Biju and Paveena (2018) showed that the antifungal activity of some crude extracts (*Jatropha curcas*, *Ricinus coomunis*, *Chromolaena odorata* and *Wedelia chinensis*) against C. *gloeosporioides* (the pathogen of anthracnose in black pepper).

Karunarathna et al. (2018) reported that the antifungal activity of six crude extracts (*Mikania micrantha, Tithonia diversifolia, Lantana camara, Clusia rosea, Chromolaena odorata and Clidemia hirta*) against C. *gloeosporioides* (the pathogen of anthracnose of ornamental plants).

For the management on some pathogen (*C. capsici*; the pathogen of anthracnose disease in chilli in Thailand), Sawatdikarn (2016) showed that the three crude extracts namely *Curcuma aromatica*, *Piper betle* and *Origanum vulgare* showed 100% inhibition of mycelial growth at all concentrations, whereas, the *Wedelia trilobata* and *Polygonum odoratum* crude extracts at 10,000 ppm gave the lowest inhibition of 62 and 77%, respectively.

Little information of thirty-four medicinal herb crude extracts on inhibition of mycelial growth of *C. gloeosporioides* (the pathogen of anthracnose disease in chilli). The objective of this research was to evaluate of thirty-four medicinal herb crude extracts on the mycelial growth of *C. gloeosporioides.*

3 Material and methods

This work was conducted at Department of Applied Science, Faculty of Science and Technology, Phranakhon Si Ayutthaya Rajabhat University, Phranakhon Si Ayutthaya province during 2017-2018 to determine the fungicidal activity of crude extract of thirty-four medicinal plants including; *Kaempferia parviflora*, *Curcuma aromatica*, *Cymbopogon nardus*, *Etlingera littorlis*, *Anethum graveolens*, *Sorghum bicolor*, *Tinospora crispa*, *Eucatyptus camaldulensis*, *Carthamus tinctorius*, *Curcuma lomga*, *Zingiber zerumbet*, *Chrysanthemum indicum*, *Wedelia trilobata*, *Piper betle*, *Polygonum odoratum*, *Laurus nobilis*, *Coscimum fenesstratum*, *Astragalus momglolicus*, *Piper sarmentosum*, *Moringa oleifera*, *Kaempferia galanga*, *Codonopsis pilosula*, *Cinnamomum verum*, *Capsicum annuum*, *Glycyrrhiza glabra*, *Paeonia lactifolia*, *Rosmarinus officinalis*, *Erythriana variegate*, *Cymbopogon citratus*, *Alpinia galangal*, *Boesenbergia pandurata*, *Origanum vulgare*, *Caesalpinia Sappan and Curcuma manga* against *C. gloeosporioides* (the pathogen of anthracnose disease in chilli) in sterile distilled water and ethanol treatments by using food poisoned technique (Prasad et al., 2010).

3.1 Preparation of chilli fruits and Isolation of pathogen

Chilli fruits were obtained from two locations in Central area of Thailand, Phranakhon Si Ayutthaya and Aungthong Province. *C. gloeosporioides* from the chilli fruits were isolated and maintained on petri dishs containing in Potato dextrose agar (PDA) and incubated at 25°C. for 3 days before the tests. The preparation of chilli fruits and the isolation of pathogen followed by the methods of Sawatdikarn (2016).

3.2 Collection and preparation of plants samples
Thirty-four medicinal herb crude extracts namely, *Kaempferia parviflora*, *Curcuma aromatica*, *Cymbopogon nardus*, *Etlingera littorlis*, *Anethum graveolens*, *Sorghum bicolor*, *Tinospora crispa*, *Eucatyptus camaldulensis*, *Carthamus tinctorius*, *Curcuma lomga*, *Zingiber zerumbet*, *Chrysanthemum indicum*, *Wedelia trilobata*, *Piper betle*, *Polygonum odoratum*, *Laurus nobilis*, *Coscimum fenesstratum*, *Astragalus momglolicus*, *Piper sarmentosum*, *Moringa oleifera*, *Kaempferia galanga*, *Codonopsis pilosula*, *Cinnamomum verum*, *Capsicum annuum*, *Glycyrrhiza glabra*, *Paeonia lactifolia*, *Rosmarinus officinalis*, *Erythriana variegate*, *Cymbopogon citratus*, *Alpinia galangal*, *Boesenbergia pandurata*, *Origanum vulgare*, *Caesalpinia Sappan* and *Curcuma manga* was extracted by 90% ethanol and tested for fungicidal activity on mycelial growth of *C. gloeosporioides*.

Thirty-four medicinal crude extracts used in this study was obtained from four locations in Phranakhon Si Ayutthaya province (Bangban, Wangnoi Bangsai and Bangpa-in) where produce and export of medicinal herb productions. There were washed with tap water and air dried for three days to eliminate surface moisture. Then each part of medicinal plants were packed in to envelop and kept in oven at 80°C temperature until dried. Dried each parts were grinded separately in an electic grinder to obtain powder which was than kept in plastic bags before the tests (Sawatdikarn, 2016).

3.3 Preparation of crude extracts
One hunderd grams of the dried powdered plant were soaked in 1,000 ml of 90% ethanol. These mixtures were refluxed followed by agitation at 200 rpm for 1 hour. The ethanolic extracts were squeezed and filtered by muslin cloth. The crude extracts were placed in to a wide tray to evaporate ethanol and added with water plant extracts (Prasad et al., 2010)

3.4 Mycelial growth test ; Food poisoned technique**;** Diffusates were added in PDA and poured into petri dishes. PDA medium added only with ethanol and water served as control treatment. Each petri dishes was inoculated with 5 mm plug of pure isolate taken from margins of actively growing culture of pathogen. All petri dishes were incubated at 25°C. (Sawatdikarn, 2016)

The screening of crude extracts for fungicidal activity was conducted using the agar dilution method. Different crude extracts were tested using food poisoning technique. Each tested crude extracts was used at different concentrations; 0 (control treament), 2,000, 4,000, 6,000, 8,000 and 10,000 ppm. The petri dishes were incubated in room temperature for 7 days. The efficacy of treament was assessed from all the four plate by mesuring fungal colony development (cm). The mycelial growth inhibition (M) with respect to the control treament was calculated from the formula (Sheng-Yang et al., 2005; Sawatdikarn, 2016)

$$M = [(A-B) / A] \times 100$$

Where A is the colony diameter of the control treament and B is the colony diameter of the treated of crude extracts.

3.5 Statistical analysis
All experiments were done for four replications. Data (inhibition of mycelial growth at 2,000, 4,000, 6,000, 8,000 and 10,000 ppm.) were subjected to analysis using Duncan 's Multiple Range Tests (DMRT).

4. Results and discussion
The thiry-four medicinal plant crude extracts showed inhibition on mycelial growth of *C. gloeosporioides* at different concentrations (Table 1). The crude extracts of *C. aromatica*, *Z. zerumbet*, *P. betle*, *K. galanga*, *R. officinalis* and *O. vulgare* showed 100% inhibition of mycelial growth at all concentrations, whereas, the *W. trilobata* and *P. odoratum* crude extracts at 10,000 ppm gave the lowest inhibition of 70 and 82%, respectively.

For the *C. aromatica* crude extracts showed 100% inhibition on mycelial growth at all concentration (Table 1) can be used crude extracts of these species for *C. gloeosporioides* management (the pathogen of anthracnose disease in chilli) (1,000-10,000 ppm). These results are in agreement with that the researches of Sawatdikarn (2016) noted that the *C. aromatica* crude extracts showed 100% inhibition on mycelial growth at 5,000-10,000 ppm for *F. semitectum* control (the pathogen of dirty panicle disease in rice) and related to the data of *C. aromatica* crude extracts showed 100% inhibition on mycelial growth at 5,000-10,000 ppm for *C. lunata* control (the pathogen of dirty panicle disease in rice) (Sawatdikarn, 2016) and the *C. aromatica* crude extracts showed 100% inhibition on mycelial growth at 1,000-10,000 ppm for *C. capsici* control (the pathogen of anthracnose disease in chilli) (Sawatdikarn, 2016)

The *C. aromatica* crude extracts showed the inhibition on mycelial growth of *C. gloeosporioides*, the results are in agreement with two researches, Saleem et al. (2011) reported the crude extracts of *C. aromatica* at 0.4% showed the completely inhibition on mycelial growth of three pathogen

namely *Staphylococcus aureus*, *Enterococus faecalis* and *Pseudomonas aeruginosa* and Harit *et al.* (2013) impressed that the ethanolic extract of *C. aromatica* was found to have both antibacterial activity (*S. aureus* and *Bacillus subtilis*) and antifungal activity (*Candida albicans* and *Aspergillus flavus*).

For the *Z. zerumbet* crude extracts showed 100% inhibition on mycelial growth at all concentration (Table 1) can be used crude extracts of these species for *C. gloeosporioides* control (the pathogen of anthracnose disease in chilli) (1,000-10,000 ppm). These results are in agreement with that Sawatdikarn (2016) noted that the plants species (The Zingiberaceae species), the two crude extracts namely *Z. zerumbet* and *C. longa* showed 100% inhibition on mycelial growth at 5,000-10,000 ppm for *F. semitectum* control (the pathogen of dirty panicle disease in rice).

The *Z. zerumbet* crude extracts showed the inhibition on mycelial growth of *C. gloeosporioides*, the results are in agreement with some researches, Singh *et al.* (2014) impressed that the the essential oil of the rhizome of *Z. zerumbet* showed the inhibition on mycelial growth of *Cryptococcus neoformans* and Kader *et al.* (2011) noted that the ethanolic extract from rhizome of *Z. zerumbet* showed the antifungal activity of the three pathogens (*Candida albicans*, *Aspergillus niger* and *Sacharomyces cerevaceae*).

Mukherjee *et al.* (2011) showed the crude extract of *Zingiber officinale* on the mycelial growth of *C. gloeosporioides* (the causal agent of anthracnose in mango) and Ademe *et al.* (2011) reporded the fungicidal activity of *Zingiber officinale* crude extract against *C. gloeosporioides* (the pathogen of anthracnose in papaya (*Carica papaya*)).

For the *P. betle* crude extracts showed 100% inhibition on mycelial growth at all concentration (Table 1) can be used crude extracts of these species for *C. gloeospoioides* control (the pathogen of anthracnose disease in chilli) (1,000-10,000 ppm). These results are in agreement with that the researches of Sawatdikarn (2016) impressed that the *P. betle* crude extracts showed 100% inhibition on mycelial growth at 2,500-10,000 ppm for *F. semitectum* control (the pathogen of dirty panicle disease in rice) and related to the researchs of *P. betle* crude extracts showed 100% inhibition on mycelial growth at 2,500-10,000 ppm for *Curvularia lunata* control (the pathogen of dirty panicle disease in rice) (Sawatdikarn, 2016)

Johnny *et al*. (2010) stated that the antifungal activity of *Piper betle* crude extract also showed high inhibition against *C. gloeosporioides* (the causal agent of anthracnose disease in mango). Sawatdikarn (2016) noted that the *P. betle* crude extracts showed 100% inhibition on mycelial growth at 1,000-10,000 ppm for *C. capsici* control (the pathogen of anthracnose disease in chilli).

The *P. betle* crude extracts showed the inhibition on mycelial growth of *C. gloeosporioides*, the results are in agreement with some researches, Ali *et al.* (2010) focused the crude extract from the leaves of *P. betle* showed the strongly inhibition on mycelial growth of *Candida albican* and *Candida glabrata* and Neela *et al.* (2011) showed that the ethanolic extract from the leaves of *P. betle* at 20 and 25% concentrations showed the completely inhibition of mycelial growth on *Fusarium oxysporum* (the causal agent of fusarium wilt disease in tomato).

For the *K. galanga* crude extracts showed 100% inhibition on mycelial growth at all concentration (Table 1) can be used crude extracts of these species for *C. gloeospoioides* control (the pathogen of anthracnose disease in chilli) (1,000-10,000 ppm). These results are in agreement with in some the researches, Kochuthressia *et al.* (2012) reported that the ethanolic crude extract from rhizome of *K. galangal* inhibited of mycelial growth in the four fungal pathogens namely *Aspergillus niger, A. flavus, A. fumugatus* and *Candida albicans* and Umar *et al.* (2011) noted that the *K. galanga* crude extracts have been found to inhibit of mycelial growth in some microorganisms such as *Candida albicans, Escheriachia coli, Salmonella typhi* and *Enterococcus faecalis*

For the *R. officinalis* crude extracts showed 100% inhibition on mycelial growth at all concentration (Table 1) can be used crude extracts of these species for *C. gloeospoioides* control (the pathogen of anthracnose disease in chilli) (1,000-10,000 ppm). These results are in agreement with that the researches of Sawatdikarn (2016) impressed that the *R. officinalis* crude extracts showed 100% inhibition on mycelial growth at 2,500-10,000 ppm for *F. semitectum* control (the pathogen of dirty panicle disease in rice) and these data related to the researchs of *R. officinalis* inhibited of some pathogens, Centeno *et al.* (2010) noted that the crude extracts of *R. officinalis* showed 100% inhibition on mycelial growth at all concentrations (0.004-0.4%) for two pathogens control (*Aspergillus flavus* and *A. ochraceus*) and Matsuzaki *et al.* (2013) reported that the essentail oil from *R. officinalis* had an effect on mycelail growth of *Candiada albicans*.

In agreement with this research, Alemu *et al.* (2014) noted that the methanol extract of *R. officinalis* has

focused fungicidal activity against *C. gloeosporioides* (the pathogen of anthracnose disease in mango).

For the *O. vulgare* crude extracts showed 100% inhibition on mycelial growth at all concentration (Table 1) can be used crude extracts of these species for *C. gloeospoioides* control (the pathogen of anthracnose disease in chilli). These results are in agreement with that the researches of Sawatdikarn (2016) noted that the *O. vulgare* crude extracts showed 100% inhibition on mycelial growth at all concentrations for *F. semitectum* control (the pathogen of dirty panicle disease in rice) and related to the researchs of *O. vulgare* crude extracts showed 100% inhibition on mycelial growth at all concentrations for *C. lunata* control (the pathogen of dirty panicle disease in rice) (Sawatdikarn, 2016) and these results are in agreement with that the researches of Sawatdikarn (2016) noted the crude extract of *O. vulgare* showed 100% inhibition on mycelial growth and spore germination of *Alternaria* sp. (the pathogen od dirty panicle disease in rice at all concentrations (1,000-10,000 ppm) and Lee *et al.* (2001) tested essential oils of *O. vulgare* for their antimicrobial activities against four plant pathogens (*Botrytis cinerea, C. gloeosporioides, Pythium altimum* and *Rhizoctonia solani*), selected essential oils of *O. vulgare* showed the inhibition of mycelial growth for 90% of *C. gloeosporioides*.

Sawatdikarn (2016) noted that the *O. vulgare* crude extracts showed 100% inhibition on mycelial growth at 1,000-10,000 ppm for *C. capsici* control (the pathogen of anthracnose disease in chilli) and the data related to the researchs of *O. vulgare* crude extracts showed 100% inhibition on mycelial growth at 2.50 mL/100 mL for three pathogen control (*Pencillium aurantiogriseum*, *P. glabrum* and *P. bravicompactum* (Kocic-Tanackov et al., 2011).

For the *E. camaldulensis* crude extracts at 2,000-8,000 ppm showed the inhibition on mycelial growth for 65-82% (Table 1). This agreed with the results of Abera et al (2011) showed the ethanolic crude extracts of *Eucalyptus globules* and *Eucalyptus citriodera* to inhibit the mycelial growth of *Colletotrichum kahawae* (the pathogen of berry disease in coffee) for 64-76 %.

In the present study, extrect from *Moringa oleifera* (2,000-8,000 ppm) showed the inhibition on mycelial growth for 58-75% (Table 1). This agree with the data of Dissanayake et al. (2019) showed the crude extracts of *M. oleifera*to inhibit the mycelial growth of *C. gloeosporioides* (the pathogen of anthracnose disease in papaya) for 35-44%.

The ethanolic crude extract from lemon grass (*C. citratus*) showed the highest antifungal activity (100% inhibition of mycelial growth) against *C. gloeosporioides* (Table 1). This data corresponds with research done by Perez-Cordero et al. (2017) who reported that extract of *C. citratus* have antifungal activity and inhibit the growth of *C. gloeosporioides* (the pathogen of anthracnose disease in yam) and this agree with the data of Palhano et al. (2004) exhibited the essential oil from lemon grass (*C. citratus*) inhibit the mycelial growth of *C. gloeosporioides*.

For the two crude extracts (*W. trilobata* and *P. odoratum*) at 10,000 ppm concentration gave the lowest inhibition of 70 and 82%, respectively (Table 1). These results are in agreement with that the researches of Sawatdikarn (2016) noted the crude extract of *W. trilobata* and *P. odoratum* showed 62 and 77% inhibition, respectively on mycelial growth of *C. capsici* (the pathogen of anthracnose disease in Chilli) at 10,000 ppm concentration. Inaddition, Biju and Praveena (2018) reported that the crude extract of *W. chinensis* showed 17-33 inhibition on mycelial growth of *C. gloeospoioides* (the pathogen of anthracnose disease of black pepper) at 2.5 5 10 and 20% concentrations.

The goal of this study was to screening of the thirty-four crude extracts on the mycelial growth of *C. gloeospoioides.*The management of all crude extract was the best for *C. gloeospoioides* control due to their harmless on enviromental condition, to user and to consumer. The study that the related to the several researcher have noted the antifungal activity of crude extracts and essential oils including, the researchs of Sawatdikarn (2016) noted the crude of plant species namely *Curcuma aromatica, Piper betle* and *Origanum vulgare* crude extracts showed 100% inhibition of mycelial growth at all concentrations.

Sawatdikarn (2016) impressed that the crude of plant species namely *Curcuma aromatica, Piper betle* and *Origanum vulgare* crude extracts showed 100% inhibition of mycelial growth of *C. capsici* (the pathogen of anthracnose disease in chilli) at all concentrations.

The phytochemical compounds from the six crude extracts *(C. aromatica, Z. zerumbet, P. betle, K. galanga, R. officinalis* and *O. vulgare*) inhibited the mycelial growth of *C. gloeospoioides*, these results have been confirmed by several researches, for examples curcumin from the rhizome of *C. aromatica* (Husein et al., 2009), piperine from the leaves of *P. betle* (Sawatdikarn, 2016), 1,8-cineole and camphor from the leaves of *R. Officinalis* (Papajani et al., 2015), zerumbone from the rhizome of *Z. zerumbet*

(Singh et al., 2014), ethyl-cinnamate and 1,8-cineole from the rhizome of *K. galanga* (Umar et al., 2011) and carvacrol and p-cymene from the leaves of *O. vulgare* (Papajani et al., 2015)

This study noted that the thirty-four crude extracts can be use for *C. gloeospoioides* management and can be used the six plants crude extracts for anthracnose disease control. The six crude extracts (*C. aromatica, Z. zerumbet, P. betle, K. galanga, R. officinalis* and *O. vulgare*) showed 100% inhibition of mycelial growth of *C. gloeospoioides* (the pathogen of anthracnose disease in chilli) at all concentrations.

The study noted that the six crude extracts (*C. aromatica, Z. zerumbet, P. betle, K. galanga, R. officinalis* and *O. vulgare*) gave the completely control of mycelial growth. In addition, the six crude extracts namely *C. aromatica, Z. zerumbet, P. betle, K. galanga, R. officinalis* and *O. vulgare* can be used for anthracnose disease management in chilli production as strongest inhibition crude extract and the two crude extract (*W. trilobata* and *P. odoratum*) as weakest inhibition crude extract.

Data of the research pointed the oppurtunities for screening and application of some ethanolic crude extracts for a eco-friendly environmental management and exploited method the biological control of chilli production in Thailand.

Table 1 Efficacy of different concentration of some medicinal plants crude extracts on mycelial growth inhibition of *C. gloeospoioides* (the pathogen of anthracnose disease in chilli)

Medicinal herb crude extracts	Mycelial growth inhibition (%)				
	2,000 ppm	4,000 ppm	6,000 ppm	8,000 ppm	10,000 ppm
1. Kaempferia parviflora	70c	80c	89b	95b	100a
2. Curcuma aromatica	100a	100a	100a	100a	100a
3. Cymbopogon nardus	60e	77c	86b	89b	100a
4. Etlingera littorlis	50f	60e	77c	88b	96ab
5. Anethum graveolens	60e	80c	88b	92b	100a
6. Sorghum bicolor	57e	70d	78c	82c	98ab
7. *Tinospora crispa*	40f	55e	68d	78c	89b
8. *Eucatyptus camaldulensis*	65d	70d	82c	95b	100a
9. *Carthamus tinctorius*	45f	67d	76c	85b	100a
10. *Curcuma longa*	75c	88b	94b	100a	100a
11. *Zingiber zerumbet*	100a	100a	100a	100a	100a
12. *Chrysanthemum indicum*	70d	80c	95b	100a	100a
13. *Wedelia trilobata*	20h	30h	55e	60e	70d
14. *Piper betle*	100a	100a	100a	100a	100a
15. *Polygonum odoratum*	40f	59e	72d	79c	82c
16. *Laurus nobilis*	67d	78c	89b	100a	100a
17. *Coscimum fenesstratum*	80b	100a	100a	100a	100a
18. *Astragalus momglolicus*	40g	60e	70d	82c	91b
19. *Piper sarmentosum*	42g	65d	70d	85b	97b
20. *Moringa oleifera*	58e	67d	75c	92b	100a
21. Kaempferia galanga	100a	100a	100a	100a	100a
22. Codonopsis pilosula	50e	65d	78c	82c	96b
23. Cinnamomum verum	48f	64e	78c	81c	100a
24. Capsicum annuum	51e	62e	77c	82c	94b
25. Glycyrrhiza glabra	55e	60e	72d	85b	100a
26. Paeonia lactifolia	40g	52f	64e	77c	88b
27. Rosmarinus officinalis	100a	100a	100a	100a	100a
28. Erythriana variegata	58e	60e	67d	75c	89b
29. Cymbopogon citratus	55e	67d	77c	82c	100a
30. Alpinia galanga	70d	80c	92b	100a	100a
31. Boesenbergia pandurata	75c	92b	100a	100a	100a
32. Origanum vulgare	100a	100a	100a	100a	100a
33. Caesalpinia Sappan	57e	68d	77c	90b	100a
34. Curcuma mangga	85b	88b	100a	100a	100a
C.V. (%)	8.64	9.82	7.65	5.86	10.24

In the same column, mean followed by a common letter are not significantly different at the 5% level by DMRT.

5 Conclusion

All the used of thirty-four crude extracts showed significant antifungal activity against *C. gloeospoioides*. The result showed that the *C. aromatica, Z. zerumbet, P. betle, K. galanga, R. officinalis* and *O. vulgare* crude extracts showed 100% inhibition of mycelial growth at all concentrations, whereas, the *W. trilobata* and *P. odoratum* crude extracts at 10,000 ppm gave the lowest inhibition of 70 and 82%, respectively.

References

1. Abera A, Lemessa F & Multa D : 2011. The antigungal activity of some medicinal plants against coffee berry disease caused by *Colletotrichum kahawae*. Int. J. Agric. Res. 6:268-279.
2. Ademe A, Ayalew A & Woldetsadik K : 2013. Evaluation of antifungal activity of plant extracts against payaya anthracnose (*Colletotrichum gloeosporioides*). J. Plant Pathol. Microb, 4 :1-4.
3. Alemu K, Ayalew A & K. Weldetsadik : 2014. Evaluation of antifungal activity of botanicals for poatharvest management of mango anthracnose (*Colletotrichum gloeosporioides*). International Journal of Life Sciences, 8 :1-6.
4. Ali I, Khan FG, Suri KA, Gupta BD, Satti NK, Dutt P, Afrin F, Qazi GN, & Khan IA : 2010. In vitro antifungal activity of hydroxychavical isolated from *Piper betle* L. Annals of Clinical Microbiology and Antimicrobials, 9: 1-9.
5. Biju CN, & Praveena R: 2018. Evaluation of plant extracts for antifungal activity against *Colletotrichum gloeosporioides*, the incitant of leaf blight in small cardamom and anthracnose of black pepper. Journal of Plantation Crops, 46 : 92-101.
6. Centeno S, Calvo MA, Adelantado C, & Figueroa S : 2010. Antifungal activity of extracts of Rosmarinus officinalis and Thymus vulgaris against *Aspergillus flavus* and *A. ochraceus*. Pak. J. Biol. Sci, 13: 452-455.
7. Dissanayake MLM, Dahanayaka VS & Ranasinghe C : 2019. Antifungal potential of some plant extracts against *Colletotrichum gloeosporioides* causal organism of papaya anthracnose disease. Asian J. Biol. Sci, 12:589-595.
8. Filoda G : 2008. Impact of some fungicides on mycelium growth of *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc. Pestycydy/Pesticides, 3 :109-116.
9. Harit J, Barapatre A, Prajapati M, Aadil MR. & Senapati S : 2013. Antimicrobial activity of rgizome of selected Curcuma Variety. Int. J. Life Sci. Bt & Pharm. Res, 2 :183-189.
10. Haron FF, Sijam K, Omar D. & Rahmani M : 2013. Chemical composition and screening for antifungal activity of Allamanda spp. (Apocynaceae) crude extracts against *Colletotrichum gloeosporioides*, causal agent of anthracnose in papaya. Australian Journal of Basic and Applied Sciences, 7:88-96.
11. Husein S, Parhusip A. & Ramasi EF : 2009. Study on antibacterial activity from Temulawak (*Curcuma xanthorrhiza* Roxb.) rhizomes against pathogenics microbes cell destruction. J. Applied Industrial Biotechnol. in Tropical Region, 2 : 1-4.
12. Johnny L, Yusuf UK, & Nulit R : 2010. The effect of herbal plant exteact on the growth and sporulation of *Colletotrichum gloeosporioides*. J. Appl. Biosci, 34 :2218-2224.
13. Jun-Young C, Choi GJ, Lee S, Jang KS, Lin HK, Lim CH, Lee SO, Cho KY. & Kim J : 2006. Antifungal activity against *Colletotrichum* spp. of curcuminoids isolated from *Curcuma longa* L. rhizome. J. Microbiol. Biotechnol, 16 :280-285.
14. Kader G, Nikkon GF, Rashid MA. & Yeasmin T : 2011. Antimicrobial activities of the rhizome extract of *Zingiber zerumbet* Linn. Asian Pac J. Trop Biomed, 1: 409-412.
15. Karunarathna TCM, Damunupola JW. & Bandara BMR: 2018. Screening of selected invasive plant extracts for antifungal activity against *Colletotrichum gloeosporioides*. P. 21-28. In Proceeding of the 3 rd International Research Symposium on Pure and Applied Sciences. University of Kelaniya, Sri Lanka.
16. Kochuthressia KP, Britto SJ, Jaseentha MO. & Raphael R : 2012. In vitro antimicrobial evaluation of Kaempferia galangal L. rhizome extract. Am. J. Biotechnol. Mol. Sci, 2: 1-5.
17. Kocic-Tanakov SD, Dimic GR, Tanakov TT, Pejin DJ, Mojovic LV. & Pejin JD : 2011. Antifungal activity of Oregano (*Origanum vulgare* L.) extract on the growth of Fusarium and Penicillium species isolated from food. Hem. Ind, 66 : 33-41.
18. Lee SE, Park BS, Kim MK, Choi WS, Kim HT, Cho KY, Lee SG. & Lee HS : 2001. Fungicidal activity of pipernonaline. A piperidine alkaloid derived from long pepper, *Piper longum* L. against phytopathogenic fungi. Crop protection, 20: 523-528.
19. Marinho GJP, Klein DE. & Junior CLS : 2018. Evaluation of soapberry (*Sapindus saponaria* L.) leaf extract against papaya anthracnose. Summa Phytopathol, 44:127-131.
20. Matsuzaki Y, Tsujisawa T, Nishihara T, Nakamura M. & Kakinoki Y: 2013. Antifungal activity of chemotype essential oils from rosemary against *Candida albicans*. Open Journal of Stomatology, 3: 176-182.
21. Meng X, Li J, Bi F, Zhu L. & Ma Z: 2015. Antifungal activities of crude extractum from *Camellia semiserrata* Chi (Nanshancha) seed cake against *Colletotrichum musae*, *Colletotrichum gloeosporioides* and *Penicillium italicum* in vitro and in vivo fruit test. Plant Pathol. J, 31 :414-420.
22. Mukherjee A, Khandker S, Islam MR. & Shahid SB: 2011. Efficacy of some plant extracts on the mycelial growth of *Colletotrichum gloeosporioides*. J. Bangladesh Agril. Univ, 9 :43-47.
23. Nagaraju RS, Sriram RH. & Achur R : 2020. Anrifungal activity of carbendazim-conjugated silver nanoparticles against anthracnose disease caused by *Colletotrichum gloeosporioides* in mango. Journal of Plant Pathology, 102 :39-46.
24. Neela FA, Sonia IA. & Shamsi S. 2014. Antifungal activity of selected medicinal plant extract on *Fusarium oxysporum* Schlechtthe causal agent of fusarium wilt disease in tomato, American Journal of Plant Sciences, 5: 2665-2671.
25. Palhano FL, Vichens TB, Santos RB, Orlando MTD, Ventura JA. & Fernandes PMB : 2004. Inactivation of *Colletotrichum gloeosporioides* spores by high hydrostatic pressure combined with citral or lemongrass essential oil. Int. J. Food Micro, 95: 61-66.
26. Papajani V, Haloci E, Goci E, Shkrel R. & Manfredini S : 2015. Evaluation of antifungal activity of *Origanum vulgare* and *Rosmarinus officinalis* essential oil before and after inclusion in B-cyclodextrine. Int. Pharm. Pharm. Sci., 7: 270-273.
27. Perez-Cordero A, Chamorro L, Vitola-Romero D. & Hernandez-Gomez J : 2017. Antifungal activity of Cymbopogon citratus against *Colletotrichum gloeosporioides*. Agron Mesoam, 28:465-475.
28. Prasad MNN, Bhat S. & Sreenivasa MY : 2010. Antifungal activity of essential oils against *Phomopsis azadirachtae*-the causative of die-back disease of neem. J. Agric. Technol, 6: 127-133.
29. Rahman MS, Ahnad H, Mohamad MTM. & Rahman MZA : 2011. Extraction of *Jatropha curcas* fruits for antifungal activity against anthracnose *(Colletotrichum gloeosporioides*) of papaya. Afr. J. Biotechnol, 10:9796-9799.
30. Saleem MB, Daniel B. & Murli K : 2011. Antimicrobial activity of three different rhizomes of *Curcuma longa* & *Curcuma aromatica* on Uropathogens of Diabetic patients. Int. J. Pharm Pharm Sci, 3 : 273-279.
31. Sawatdikarn S : 2016. Antifungal activity of crude extracts of some medicinal plants against *Curvularia lunata*, The pathogen of dirty panicle disease in rice, p 1232-1242. *In* 2016 Conference Proceedings on International Congress on Chemical, Biological and Environmental Sciences.
32. Sawatdikarn S : 2011. Antifungal activity of twenty-four medicinal crude extracts against *Curvularia* sp., The pathogen of dirty panicle disease in rice, p. 1-8. *In* 37th Congress on Science and Technology of Thailand.
33. Sawatdikarn S : 2016. Fungicidal activity of crude extracts of forty medicinal plants against *Fusarium semitectum*, The pathogen of dirty panicle disease in rice, p. 593-602. *In* 2016 Conference Proceedings on International Symposium on Life Science and Biological Engineering.

34. Sawatdikarn S : 2016. Fungicidal potentials of crude extracts of thirty-four medicinal plants against *Colletotrichum capsici*, The pathogen of anthracnose disease in chilli, p. 566-575, *In* 2016 Conference Proceedings ; Annual Conference Engineering and Applied Science.
35. Sheng-Yang W, Pin-Fun C. & Shang-Tzen C : 2005. Antifungal activities of essential oil and their constituents from indigenous cinnamon (*Cinnamomum osmophloeum*) leaves against wood decay fungi, Bioresour. Technol, 96: 813-818.
36. Singh CB, Chanu SB, Lenin K, Swapana N, Cantrell C. & Ross RA: 2014. Chemical composition and biological activity of the essential oil of rhizome of *Zingiber zerumbet* (L.) Smith. Journal of Phamacognosy and Phytochemistry, 3: 130-133.
37. Than PP, Prihastuti H, Phoulivong S, Taylor PWJ. & Hyde KD : 2008. Chilli anthracnose disease caused by *Colletotrichum* species. J. Zhejiang Univ Sci B, 10 : 764-778.
38. Umar MI, Asmawi MZB, Sadikun A, Altaf R. & Iqbal MA : 2011. Phytochemistry and medicinal properties of *Kaempferia galanga* L. (Zingiberaceae) extracts. Afr. J. Pharm. Pharmcol, 5: 1638-1647.