International Journal of Agricultural Technology 2017 Vol. 13(2):141-147
Available online http://www.ijat-aatsea.com
ISSN 1686-9141

Screening for Plant Extract, Antagonistic Microorganism and Fungicides to Control *Ganoderma Boninense* Caused Stem Rot of Oil Palm in Vitro

Chaisit Preecha[1], Wethi Wisutthiphaet and Pornsil Seephueak

Tropical Fruit Crop and Tree Research Center, Department of Plant Science, Faculty of Agriculture, Rajamangala University of Technology Srivijaya, Nakhon Si Thammarat, 80110, Thailand.

Chaisit Preecha, Wethi Wisutthiphaet and Pornsil Seephueak (2017). Screening for plant extract, antagonistic microorganism and fungicides to control *Ganoderma boninense* caused stem rot of oil palm in vitro. International Journal of Agricultural Technology. 13(2): 141-147.

The basal stem rot of oil palm caused by *Ganoderma boninense* has been reported as the severe disease in growing area, a few studies of this disease was reported in Thailand. This research was carried out to screen plant extract, antagonistic microorganism and fungicides for control *Ganoderma boninense* caused stem rot of oil palm in vitro. Plant extract from leaves of *Antigonon leptopus* and *Carica papaya*; rhizome of *Zingiber montanum*, *Curcuma longa* and *Zingiber offcinale*; and latex of *Carica papaya* was test by poison media technique. The result showed that all of plant crude extract were not the high effective control of this pathogen. The highest was *Carica papaya* with mycelium growth inhibition 41.26 %. The indigenous antagonistic microorganism isolated from rhizosphere showed the high efficiency to control this pathogen was antagonistic bacterial isolate B001, B002 and B003 and antagonistic fungus isolate T003. For fungicides, in vitro screening, prochloraz, kresoxim methyl and chlorotalonil was the high efficacy control *Ganoderma boninense* with mycelium growth inhibition percentage of 96.22, 98.96 and 88.44 % respectively.

Keywords: basal stem rot, plant extract, antagonistic microorganism, fungicides

Introduction

The basal stem rot caused by *Ganoderma boninense* has been reported as the severe disease of oil palm in Indonesia and Malaysia (Susanto *et al*., 2005) Africa, Papua New Guinea (Turner, 1981), Colombia (Nieto, 1995). In Thailand, a few studies of oil palm diseases was be reported on surveying by Limsriwilai *et al.* (1984) and Pornsuriya *et al* (2013). Basal stem rot occurred most serious of all diseases affecting the oil palm in southern Thailand. The pathogen attacks the palm at the stem base, the external symptoms do not observe at the early stage when the disease symptom appear, the plant cannot respond to treatment (Najmie *et al*., 2011). The alternative control of disease is various fungicidal treatment control (Idris *et al*., 2002).and more report of biological control thorough

[1] **Coressponding Author:** Chaisit Preecha. **E-mail:** skpreecha@yahoo.co.uk

Trichoderma spp. (Abdullah *et al*., 1999; Ilias, 2000; Sariah *et al*., 2005; Susanto *et al*., 2005 and Sariah *et al*., 2005). However, several effective fungicides that high efficient control *in vitro* was often low or ineffective in field application (Idris *et al*., 2002 and Susanto *et al*., 2005). This research was trialed *in vitro* screening antagonistic microorganism, plant extract and fungicides, to control *Ganoderma boninense* caused stem rot of oil palm before bring to test on plant at greenhouse condition.

Materials and methods

Screening for plant extract to control Ganoderma boninense in vitro

Pathogen, *Ganoderma boninense* was isolated from basidiocarp collected on best stem of oil palm growing at surathani province. It was cultured on PDA for 5 days before brought to test with crude plant extract. Plants used in this test were extract from leaves of *Antigonon leptopus and Carica papaya*; from rhizome of *Zingiber montanum*, Curcuma longa and *Zingiber offcinale*; and the latex of *Carica papaya*. Plant leaves and rhizomes of plant above were blended and macerated in sterile distilled water at ratio 500 g of fresh sample/ 500 ml (1 g/ml). After 24 hours, crude extract was filtrated using microfilter micron. Poison medium was used to test for mycelial inhibition of this pathogen. Plant crude extract was added 10 ul/ml to PDA before inoculation with 5 mm diameter of pathogen mycelium. Mycelial growth diameter was measured after 5 days incubation at room temperature and inhibition percentage was calculated.

In vitro screening for antagonistic microorganism control Ganoderma boninense

Soil at rhizosphere of oil palm was collected and isolated by soil surface dilution plate. Different colony of fungi and bacteria were collected to test with pathogen by dual culture technique. Mycelial inhibition percentage were calculated to compare the control efficacy against *Ganoderma boninense.*

In vitro screening for fungicides to control Ganoderma boninense

Several fungicides distributed at local market was tested at recommendation dosage for efficacy *in vitro* included azoxystrobine (62.5 µg/ml), carbendazim (150 µg/ml), chlorothalonil (500 µg/ml), copper oxychloride (1275 µg/ml), cyproconazole (75 µg/ml), dimethomorph+propiconazole (67.5 µg/ml), dimethomorph (67.5 µg/ml), fluopyrum (100 µg/ml), fosettylaluminium (2000 µg/ml), hexoconazale (62.5 µg/ml), kresoxim methyl (100 µg/ml), metalaxyl (150 µg/ml),

myclobutanil (50 µg/ml), prochloraz (112.5 µg/ml), streptomycin (500 µg/ml), thianosan (800 µg/ml), and tridermorph (562.5 µg/ml). PDA poison medium was used to test for mycelial inhibition of this pathogen. Growth inhibition percentage was calculated for control efficacy of those fungicides.

Screening for plant extract to control Ganoderma boninense in vitro
Fungal isolation

Plant crude extract from several herb tested on poison medium, *Carica papaya*, *Antigonon leptopus* crude extract and latex of *Carica papaya* showed a trend to control, but the control efficiency was low mycelium inhibition of 41.26, 24.44 and 9.63 % respectively. While *Allium sativum*, *Zingiber montanum*, *Curcuma longa* and *Zingiber offcinale* did not affect to mycelium growth (Table 1). Previously research, several plant extract in this test have been reported as the high efficiency control fungal pathogen (Jamkratoke *et al*., 2004 (Herger and Klingauf, 1990; To-anan, 1985; Tsinis *et al*., 2006). Suvichayanon (2009) convinced that *Curcuma longa* and inhibited *Pythium aphanidermatum* in vitro. All plant extract in this research showed high efficient control *Pseudoidium nephelii* causing agent of powdery mildew of rambutan *in vitro* test (Srijan and Preecha, 2012), but only crude extract of *Carica papaya* express a trend of control effective against *Ganoderma boninense* in this test.

Table 1 Efficacy of plant extract at 10 ml/100ml PDA to control *Ganoderma boninense in vitro*

Plant crude extract	mycelium inhibition percentage
Allium sativum	0.00[d1/]
Antigonon leptopus	24.44[b]
Carica papaya	41.26[a]
Zingiber montanum	0.00[d]
Latex of *Carica papaya*	0.00[d]
Curcuma longa	9.63[c]
Zingiber offcinale	0.00[d]
Control	-

1/ =Means with the same letter are not significantly different at 0.05 DMRT mean comparison (CV 30.35)

In vitro screening for antagonistic microorganism to control Ganoderma boninense

Indigenous bacterial from rhizosphere tested by dual culture was founded that only 2 isolates, B001, B002 and B003 was the highest efficacy to inhibit mycelium grow of this pathogen 77.35, 75.13 and 65.93 % respectively (Table 2). They were only 3 out of 22 isolates in this screening which likely control basal stem rot. For the fungi, Isolate T003 showed fair

control efficacy with 51.67 mycelium growth inhibition, T002 and T001 was lightly control this pathogen with low percentage mycelium growth inhibition of 36.11and 45.56 % (Table3). Three isolates, B001, B002 and B003 showed the potential to be used as biological agent as well as the various antagonist previous reported to be control *G. boninense* included *Trichoderma* spp., *Aspergillus* spp., and *Penicillum* spp. (Bruce and Highley, 1991; Badalyan *et al*., 2004).

Screening for plant extract to control Ganoderma boninense in vitro
Fungal isolation

Plant crude extract from several herb tested on poison medium, *Carica papaya*, *Antigonon leptopus* crude extract and latex of *Carica papaya* showed a trend to control, but the control efficiency was low mycelium inhibition of 41.26, 24.44 and 9.63 % respectively. While *Allium sativum*, *Zingiber montanum*, *Curcuma longa* and *Zingiber offcinale* did not affect to mycelium growth (Table 1). Previously research, several plant extract in this test have been reported as the high efficiency control fungal pathogen (Jamkratoke *et al*., 2004 (Herger and Klingauf, 1990; To-anan, 1985; Tsinis *et al*., 2006). Suvichayanon (2009) convinced that *Curcuma longa* and inhibited *Pythium aphanidermatum* in vitro. All plant extract in this research showed high efficient control *Pseudoidium nephelii* causing agent of powdery mildew of rambutan *in vitro* test (Srijan and Preecha, 2012), but only crude extract of *Carica papaya* express a trend of control effective against *Ganoderma boninense* in this test.

In vitro screening for antagonistic microorganism to control Ganoderma boninense

Indigenous bacterial from rhizosphere tested by dual culture was founded that only 2 isolates, B001, B002 and B003 was the highest efficacy to inhibit mycelium grow of this pathogen 77.35, 75.13 and 65.93 % respectively (Table 2). They were only 3 out of 22 isolates in this screening which likely control basal stem rot. For the fungi, Isolate T003 showed fair control efficacy with 51.67 mycelium growth inhibition, T002 and T001 was lightly control this pathogen with low percentage mycelium growth inhibition of 36.11and 45.56 % (Table3). Three isolates, B001, B002 and B003 showed the potential to be used as biological agent as well as the various antagonist previous reported to be control *G. boninense* included *Trichoderma* spp., *Aspergillus* spp., and *Penicillum* spp. (Bruce and Highley, 1991; Badalyan *et al*., 2004).

Table 2 Screening antagonistic bacteria for high potential control *Ganoderma boninense* caused stem rot of oil palm *in vitro*

Isolate antagonistic bacterium	Mycelium inhibition percentage
B001	77.35[a1/]
B002	75.13[a]
B003	65.93[ab]
B004	20.63[cde]
BN	17.50[cde]
T001	0.00[e]
T002	0.00[e]
B005	33.57[cd]
B006	26.38[cde]
B007	16.51[cde]
B008	20.54[cde]
B009	30.64[cd]
B010	8.81[de]
B011	0.76[e]
B012	20.96[cde]
B013	19.80[cde]
B014	10.66[de]
B015	11.40de
B016	15.87[cde]
B017	43.20[bc]
B018	8.81[de]
B019	0.76[e]
B020	20.96[cde]
B021	19.80[cde]
B022	10.66[de]

[1/] =Means with the same letter are not significantly different at 0.05 DMRT mean comparison (CV 47.37%)

Table 3 Screening antagonistic fungi for high potential control *Ganoderma boninense* caused stem rot of oil palm *in vitro*

Isolate antagonistic bacterium	Mycelium inhibition percentage
T001	36.11[b1/]
T002	45.56[ab]
T003	51.67[a]
Control	-

[1/] =Means with the same letter are not significantly different at 0.05 DMRT mean comparison (CV 16.84)

In vitro screening for fungicides to control *Ganoderma boninense*

Several fungicides sold in the local market was tested *in vitro* by poison medium at the recommend dosage against this pathogen. The result revealed that prochloraz (112.5 µg/ml) was excellent control, it inhibited mycelium growth of 96.22%. For the second group were kresaxim methyl (100 µg/ml) and chlorothalonil (500 µg/ml), with high control efficiency to inhibit mycelium growth of 88.89 and 86.44 %. For difenoconozole (62.5 µg/ml) and difenoconozole (62.5 µg/ml) were good control efficacy but

they were lower than those fungicides mention above with inhibited mycelium growth of 81.11 and 78.67 % (Table 4). Fungicides *in vitro* tested in this research, prochloraz was the highest control efficacy which significant distinguishes from the other. It was reported for the high efficiency to control in postharvest disease of mango (Prusky *et al*, 2006), avocado (Muirhead *et al*., 1982; Mavuso and Niekerk, 2014) and papaya (Diczbalis *et al*., 2014), soil born disease of *Phellinus noxius* (brown root rot) (Ann *et al*., 2002) and *Fusarium oxysporum* f.sp. *lycopercici* (wilt of tomato) (Amini1and Sidovich, 2010).

Table 4 Efficiency of fungicides to control *Ganoderma boninense* caused stem rot of oil palm *in vitro*

Fungicide	Mycelia Inhibition percentage
Azoxystrobine (62.5 µg/ml)	56.89^{g}
Carbendazim(150 µg/ml),	62.59^{e}
Chlorothalonil(500 µg/ml)	86.44^{b}
Copper oxychloride(1275 µg/ml)	50.00^{i}
Cyproconazole(75 µg/ml)	53.33^{h}
Difenoconozole(62.5 µg/ml)	81.11^{c}
Dimethomorph+ propiconazole(67.5 µg/ml)	50.00^{i}
Difenoconozole(62.5 µg/ml)	78.67^{c}
Fosetyl aluminium(2000 µg/ml)	50.00^{i}
Hexoconazale(62.5 µg/ml)	50.00^{i}
Kresaxin methyl(100 µg/ml)	88.89^{b}
Metalaxyl(150 µg/ml)	63.15^{e}
Myclobutanil(50 µg/ml)	50.89^{hi}
Prochloraz(112.5 µg/ml)	96.22$^{a1/}$
Thianosan(800 µg/ml)	58.89^{gh}
Streptomycin(500 µg/ml)	60.93^{eg}
Tridermorph(562.5 µg/ml)	70.56^{d}
Control	-

[1/] =Means with the same letter are not significantly different at 0.05 DMRT mean comparison (CV 2.79%)

References

Amini1, J., and Sidovich, D. F. (2010). The effects of fungicides on *Fusarium oxysporum* f.sp. *lycopercici* associated with fusarium wilt of tomato J. Plant Prot. Res. 50(2):172-178.

Ann, P. J., Chang, T. T., and Ko, W. H. (2002). *Phellinus noxius* brown root rot of fruit and ornamental trees in Taiwan. Plant Disease. 86 (8)

Badalyan, M. S., Innocenti G, Garibyan GN (2004). Interactions between xylotrophic mushrooms and mycoparasitic fungi in dual-culture experiments. Phytopathol Mediterr. 43: 44–48.

Bruce, A. and Highley, L. T. (1991). Control of growth of wood decay Basidiomycetes by *Trichoderma* spp. and other potentially antagonistic fungi. Forest Product J. 41: 63–76.

Diczbalis, Y., Henriod, R., Sole, D., and Campbell, T. (2014). Evaluation of the use of prochloraz in the control of postharvest disease of papaya in Australia. Acta Hortic. 1022, 133-142.

Idris, A. S., Ismail, S., Ariffin, D. and Ahmad, H. (2002). Control of *Ganoderma* infected palm – development of pressure injection and field applications. MPOB Information Series No 148, MPOB TT No. 131, May 2002. p.2.

Jamkratoke, S, Rattanakreetakul, C. Leksomboon, C., Farungsang, N. Wanichkul, K. and Farungsang, U. (2004). Effects of *Boesenbergia rotunda*, *Curcuma longa* and *Zingiber officinalis* extracts on postharvest disease fungi. In Proceedings of 42nd Kasetsart University Annual Conference: Plants,Agricultural Extension and Communication, Bangkok (Thailand), p. 521-528.

Limsriwilai, P., S. Likhitekarat and P. Surin (1984). Diseases of oil palm in Thailand. Agric. Res. J., 2: 221-228.

Najmie, M. M. K.., Khalid, K., Sidek, A. A, and Jusoh, M. A. (2011). Density and ultrasonic characterization of oil palm trunk infected by *Ganoderma boninense* disease Meas Sci Rew. 11(5): 160-164.

Mavuso, Z. S., and Niekerk, J. M. van. (2014). Development of a more effective postharvest treatment for the control of postharvest diseases of avocado fruit South African Avocado Growers' AssociationYearbook 36: 23-26.

Muirhead, I. F., Fitzell, R. D., Davis, R. D. and Peterson, R. A. (1982). Post-harvest control of anthracnose and stem-end rots of Fuerte avocados with prochloraz and other fungicides. Aust J Exp Agric and Anim Husb. 22(119) 441 - 446 .

Pornsuriya, C., Sunpapao, A. Srihanant, N., Worapattamasri, K. Kittimorakul, J., Phithakkit, S. and Petcharat, V. (2013). A Survey of diseases and disorders in oil palms of southern Thailand. Plant Pathol. J, 12: 169-175.

Prusky, D., Kobiler, I., Akerman, M., Miyara, L. (2006). Effect of acidic solutions and acidic prochloraz on the control of postharvest decay caused by *Alternaria alternata* in mango and persimmon fruit. Postharvest Biol Technol. 42(2) 2: 134–141.

(Received 23 January 2017, accepted 23 February 2017)