REPORT ANALYSIS

PREPARED FOR:

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1.0 Introduction

Ganoderma is a genus of fungi that includes several species of medicinal mushrooms. These mushrooms have been used for thousands of years in traditional Chinese medicine to treat a variety of ailments, including high blood pressure, liver problems, and cancer. Ganoderma mushrooms contain compounds called triterpenoids, which have been shown to have anti-inflammatory, antioxidant, and anticancer properties (Cör et. al. 2018).

Unfortunately, not all species of Ganoderma are beneficial. Some species of the fungus which is white rot fungus can cause a devastating disease in oil palm trees known as Ganoderma basal stem rot (BSR). White rot knows for the ability of the fungus to degrade the lignin component of wood while leaving white cellulose exposed. These fungi reproduce through airborne spores that enter wounds caused by the shedding of branches, etc. The *Ganoderma* sp. can enzymatically degrade lignin by mineralise lignin to carbon dioxide and water. Lignin component in plants is the rate-limiting step to biodegradation and barrier to microbial attack. Attacking on lignin allows the fungus to gain energy predominantly from energy-rich cellulose which available once lignin is degraded (Figure 1) (Paterson, 2007). After the initial damage, simultaneous degradation of selective degradation will occur which lead to rapid reduction of wood weight (Fernanda *et. al.,* 2021). This disease affects the lower part of the oil palm tree trunk, causing it to rot and eventually leading to the death of the tree.

The symptoms of BSR can vary depending on the stage of the disease. Early symptoms include the yellowing and wilting of fronds, a reduction in the number of fruit bunches produced by the tree, and the development of a soft, spongy rot on the lower part of the trunk. As the disease progresses, the rot can spread higher up the trunk, causing the bark to crack and fall off. The tree may also produce mushroom-like structures known as conks, which release spores that can spread the disease to other trees. In advanced stages, the tree may collapse or break off at the base, leading to its eventual death. It is important for palm oil producers to be able to recognize the symptoms of BSR early on in order to take preventative measures and minimize the spread of the disease.

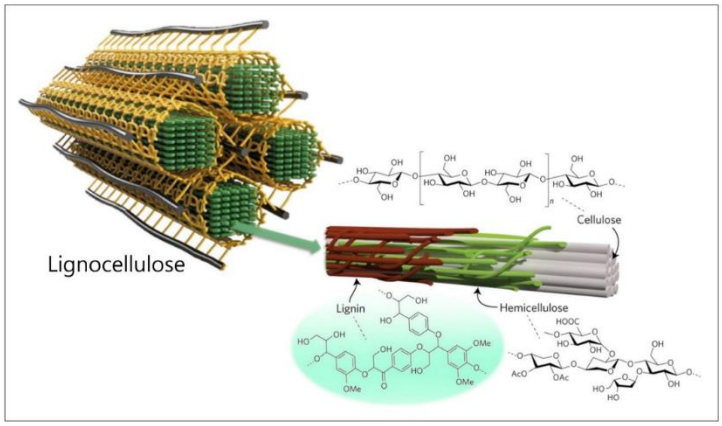

Figure 1 Schematic illustration of lignin and cellulose

2.1 Sampling location and Method

Fifteen swab samples and ten soil samples were collected at Triang, Pahang. Each of the samples was categorized into four different categories based on the treatment with antifungals.
PO with treatment was treated with antifungal, Farmour AF9. The first treatment was done during Middle of February while the second treatment was done on Middle of March. **The swab test is carried out after 2 dose treatments.**

2.1.1 Surface swab

A swab stick was moistened with neutralizing buffer and used to swab the palm oil tree trunk for 30 seconds using firm even pressure and rotation of the swab. A hole is drilled on tree trunk with diameter 6mm for the swabbing purpose. The swab test is done inside the trunk of PO as Ganoderma will affect the plant tissue. By swabbing inside the trunk of PO may give a clear image of condition of the PO after the treatment.

No	Sample ID	Sample	Sample description	Sample received	Sampling method
1	23079-01	PO trunk (Point 1)	Treatment (2k +10k) ppm	1 tube of swab sample	Surface swab
2	23079-02	PO trunk (Point 2)	Treatment (2k +10k) ppm	1 tube of swab sample	Surface swab
3	23079-03	PO trunk (Point 3)	Treatment (2k +10k) ppm	1 tube of swab sample	Surface swab
4	23079-04	PO trunk (Point 4)	Treatment (2k +10k) ppm	1 tube of swab sample	Surface swab
5	23079-05	PO trunk (Point 5)	Treatment (5k +10k) ppm	1 tube of swab sample	Surface swab
6	23079-06	PO trunk (Point 6)	Treatment (5k +10k) ppm	1 tube of swab sample	Surface swab
7	23079-07	PO trunk (Point 7)	Treatment (5k +10k) ppm	1 tube of swab sample	Surface swab
8	23079-08	PO trunk (Point 8)	Treatment (10k +10k) ppm	1 tube of swab sample	Surface swab
9	23079-09	PO trunk (Point 9)	Treatment (10k +10k) ppm	1 tube of swab sample	Surface swab

10	23079-10	PO trunk (Point 10)	Treatment (10k +10k) ppm	1 tube of swab sample	Surface swab
11	23079-11	PO trunk (Point 11)	Control	1 tube of swab sample	Surface swab
12	23079-12	PO trunk (Point 12)	Control	1 tube of swab sample	Surface swab
13	23079-13	PO trunk (Point 13)	Control	1 tube of swab sample	Surface swab
14	23079-14	PO trunk (Point 14)	Control	1 tube of swab sample	Surface swab
15	23079-15	PO trunk (Point 15)	Control	1 tube of swab sample	Surface swab

2.1.2 Soil sample

The soil sample is collected at desired point and kept in sterilized zip lock bag.

No	Sample ID	Sample	Sample description
1	23079-16	Soil (Point 1)	Treatment (2k +10k) ppm
2	23079-17	Soil (Point 2)	Treatment (2k +10k) ppm
3	23079-18	Soil (Point 3)	Treatment (2k +10k) ppm
4	23079-19	Soil (Point 4)	Treatment (2k +10k) ppm
5	23079-20	Soil (Point 5)	Treatment (5k +10k) ppm
6	23079-21	Soil (Point 6)	Treatment (5k +10k) ppm
7	23079-22	Soil (Point 7)	Treatment (5k +10k) ppm
8	23079-23	Soil (Point 8)	Treatment (10k +10k) ppm
9	23079-24	Soil (Point 11)	Control
10	23079-25	Soil (Point 15)	Control

2.1.3 Tree Cell

The tree cell is collected at 14 sampling point and kept in sterilized zip lock bag. The tree cell is spread on the centre on agar plate to observe the colony morphology on agar plate.

No	Sample ID	Sample	Sample description
1	23079-26	Tree cell (Point 1)	Treatment (2k +10k) ppm
2	23079-27	Tree cell (Point 2)	Treatment (2k +10k) ppm
3	23079-28	Tree cell (Point 3)	Treatment (2k +10k) ppm
4	23079-29	Tree cell (Point 4)	Treatment (2k +10k) ppm
5	23079-30	Tree cell (Point 5)	Treatment (5k +10k) ppm
6	23079-31	Tree cell (Point 6)	Treatment (5k +10k) ppm
7	23079-32	Tree cell (Point 7)	Treatment (5k +10k) ppm
8	23079-33	Tree cell (Point 8)	Treatment (10k +10k) ppm
9	23079-34	Tree cell (Point 9)	Treatment (10k +10k) ppm
10	23079-35	Tree cell (Point 10)	Treatment (10k +10k) ppm
11	23079-36	Tree cell (Point 11)	Control
12	23079-37	Tree cell (Point 12)	Control
13	23079-38	Tree cell (Point 13)	Control
14	23079-39	Tree cell (Point 15)	Control

2.2 Disease Severity Index

The progress of the disease in the PO was accessed by disease severity index (DSI). The symptoms were indexed by the following formula.

Table 2.1 The score of the DSI

Disease Class	Signs and symptoms
0	Healthy plants with green leaves without appearing of fungal mycelium on any part of plants
1	Appearing of white fungal mass on any part of plans, with or without chlorotic leaves
2	Appearing of basidioma on any part of plants with chlorotic leaves (1 to 3 leaves)
3	Formation of basidioma of any part of plants with chlorotic leaves (>3 leaves)
4	Formation of a well-developed basidioma and the plant dried

The DSI was calculated as the formula below:

$$\text{DSI (\%)} = \frac{\Sigma ab}{N.K} \times 100$$

Where,

∑ab = sum of the product of assessed plants with their corresponding score scale

N = total number of assessed plants

K = highest score scale

3.0 Result and Discussion

Monitoring yeast and mould counts in oil palm plantations can be an important part of managing the health of the trees and ensuring the quality of palm oil (Odoh et. Al 2017). This may involve regular sampling and analysis of plant tissues, soil, or other relevant substrates to assess the presence and abundance of yeast and mould. If yeast and mould counts are found to be elevated, it may indicate a potential issue with disease development or spoilage, and appropriate measures may need to be taken, such as improving sanitation practices, implementing disease management strategies, or applying fungicides, as recommended by qualified agronomists or plant pathologists.

Table 1 showed the total yeast and mould count for each type of treatment done. The control sample which is without treatment have highest total yeast and mould growth compared to other treated PO. **The result indicates that the Farmour AF9 gives effectiveness in reducing around 68.6% of total yeast and mould count in this study. This indicates that the Farmour AF9 maybe effective towards eliminate of Ganoderma which categorized as fungi and generally control other yeast and mould species on PO.** This can be supported by the DSI value and observation on PO in discussion later. Based on the result, the PO with treatment (2k+10K) ppm show least yeast and mould growth, followed by treatment (10k+10k) ppm and treatment (5k+10k) ppm. However, the total yeast and mould count between each treatment does not show a specific trend in this study.

Table 3.1 Result of yeast and mould count

Treatment (ppm)	Total yeast and mould count (cfu/cm2)	Average (cfu/cm2)
2k+10k	1.0×10^2	4.4×10^3
5k+10k	1.0×10^4	
10k+10k	2.6×10^3	
Control	1.4×10^4	1.4×10^4

Table 2 showed the pH of soil. According to the result, the pH does not differ much from each category which is treated or non-treated PO. This indicates that the AF 9 does not influence the pH of soil around the PO.

Table 3.2 pH of soil according to the treatment done

Treatment (ppm)	pH of soil
2k+10k	4.90
5k+10k	3.98
10k+10k	4.96
Control	5.58

Table 3 showed the disease severity index of PO. The PO with treatment gives lower DSI index which is below 55% of control sample. The 5k+10k ppm treatment and 10k+10k treatment have same DSI which is 18.75%. From this, we may indicate the **treatment reduce the Ganoderma growth and its effects on PO through the symptoms observed. The reduction of % DSI in PO with treated AF9 suggest that the AF9 could play vital role in limiting the penetration of Ganoderma infection into plant tissue.** In addition, the PO of this 2 types treatment showing that a good appearance which there is less mycelium observed on PO. The fruiting body grew on the PO also wilt and dry after the treatment which is a good sign showing the effectiveness of AF9 toward Ganoderma. Aside from this, some PO also have new and healthy green shoot grew out from the PO. However, based on the study of Paterson and Sukariawan, the environmental factor like climate changes, soil pH and aeration would affect to the Ganoderma growth on PO. Hence, the environmental factor should be controlled and regulated according to the Po condition.

Table 3.3 Disease severity index of PO according to each type of treatment

Treatment (ppm)	DSI (%)
2k+10k	25
5k+10k	18.75
10k+10k	18.75
Control	55

From the result, it's important for oil palm growers to follow good agricultural practices, including proper tree hygiene, timely harvesting and processing of fruit, and maintaining favourable environmental conditions to minimize the risk of Ganoderma infection and yeast and mould growth on oil palm trees. Consulting with qualified experts and adhering to local regulations and guidelines related to oil palm cultivation can help ensure sustainable and healthy oil palm plantations.

4.0 Conclusion

Based on the result, **Farmour AF9 have showed around 68% better effect on treated PO than control sample after 2 doses of treatment.** Through the observation on the PO tree, the treated PO gives positive effect which is less mycelium compared to control. Hence, the Farmour AF9 can be indicated have huge potential in coping the BSR disease in PO.

5.0 Recommendation

1. Test should can be carried out on seedling to see the effectiveness of AF9.
2. Larger sampling size ($n \geq 30$) is required to ensure the validity of the test and for statistically purpose.
3. The volume and concentration of antifungal used should be identified to give the positive effect to PO.

6.0 References

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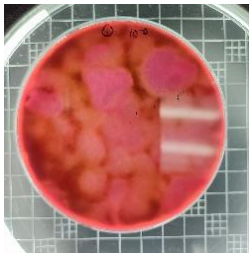
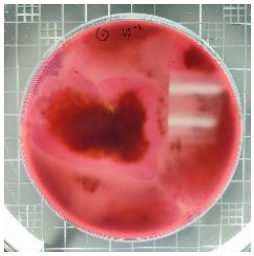
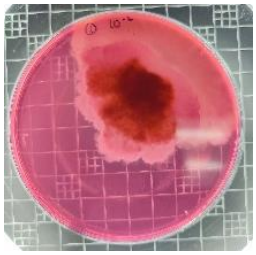
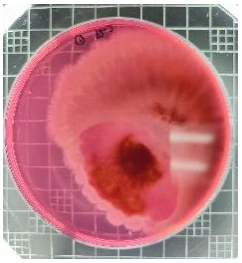
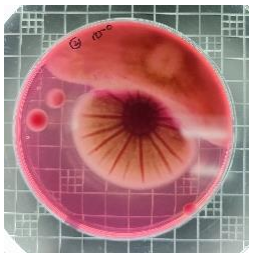
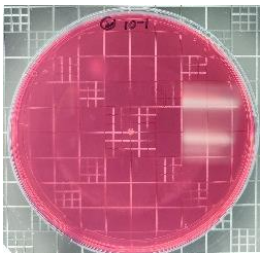
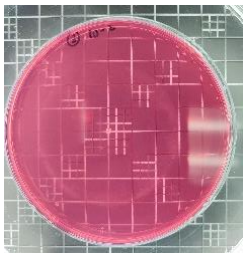
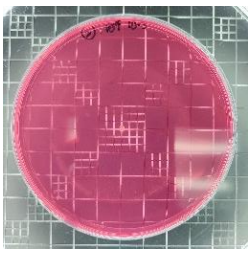
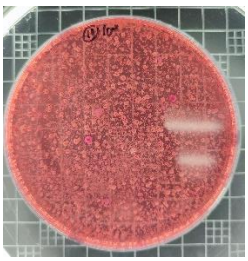
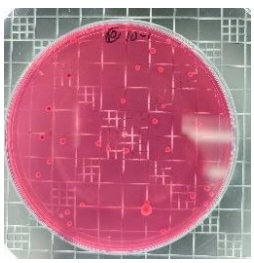
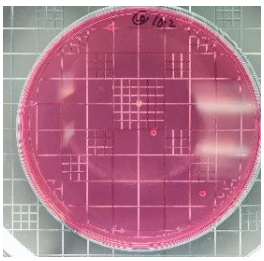
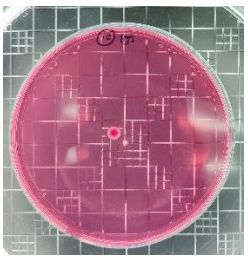
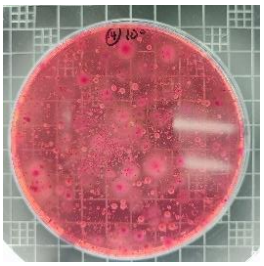
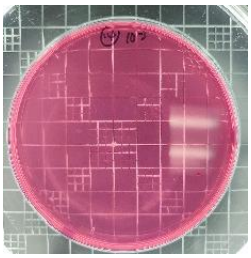
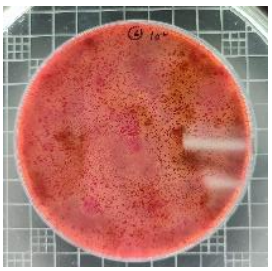
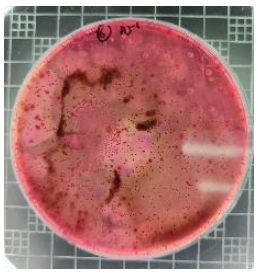
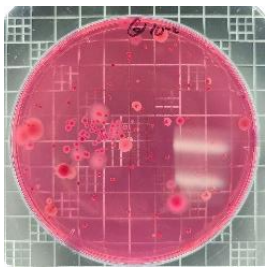
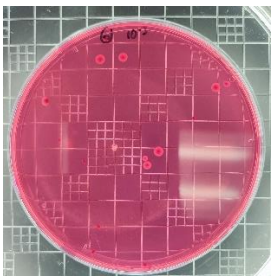
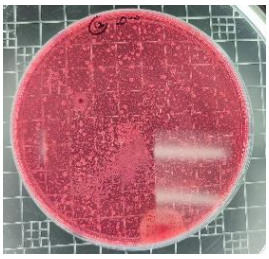
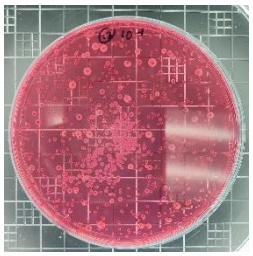
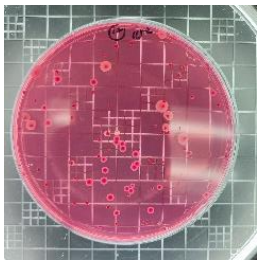
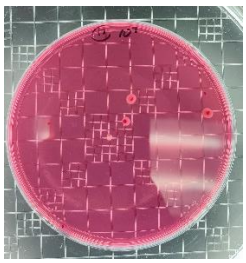
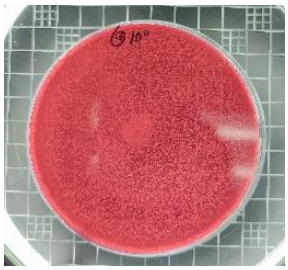
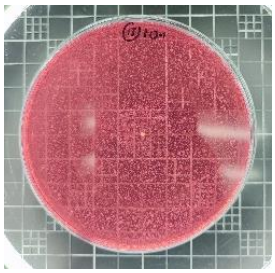
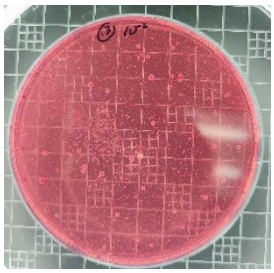
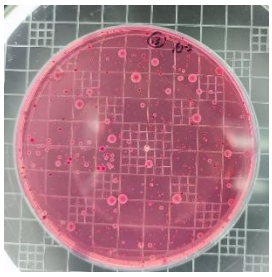
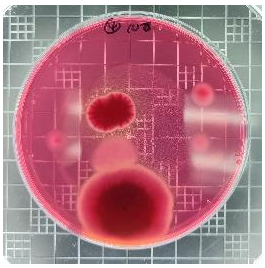
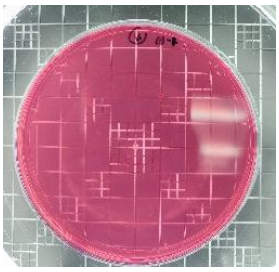
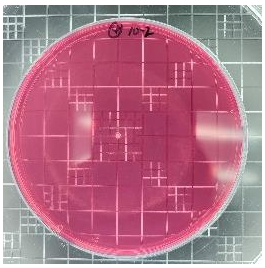
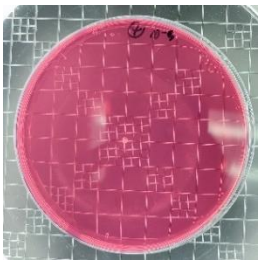
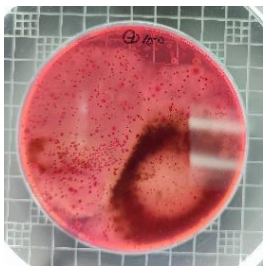
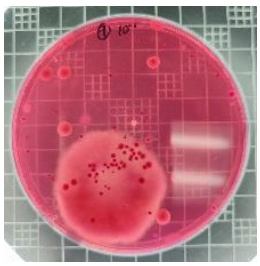
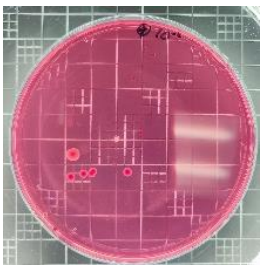
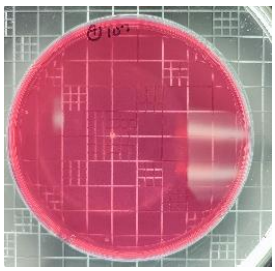
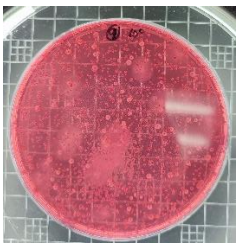
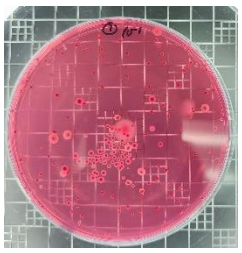
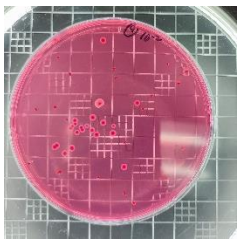
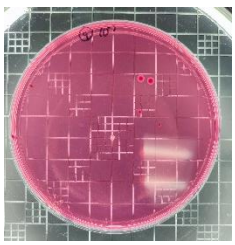
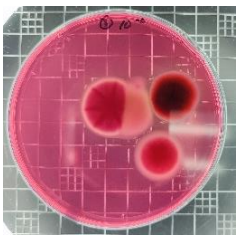
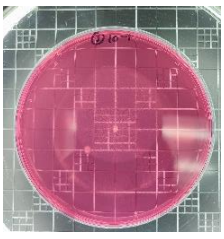
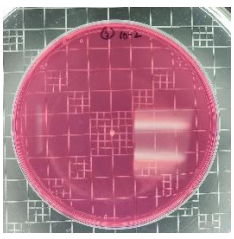
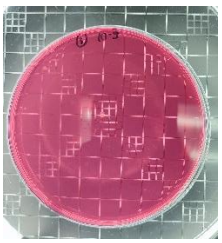
R.R.M. Paterson (2007). Ganoderma disease of oil palm—A white rot perspective necessary for integrated control. 26(9), 1369–1376

7.0 Appendix

Table 7.1: Yeast and Mould Growth After Incubation

Sample ID	Description (ppm)	10^{-0}	10^{-1}	10^{-2}	10^{-3}
23079-01	2k+10k				
23079-02	2k+10k				
23079-10	2k+10k				
23079-14	2k+10k				
23079-06	5k+10k				

23079-12	5k+10k				
23079-13	5k+10k				
23079-04	10k+10k				
23079-07	10k+10k				
23079-09	10k+10k				
23079-03	Control				

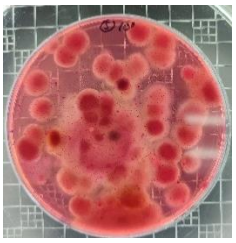
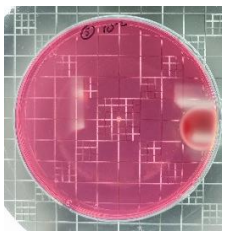
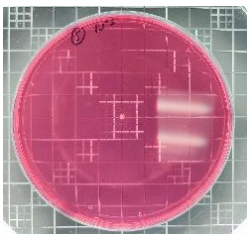
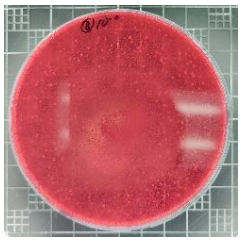
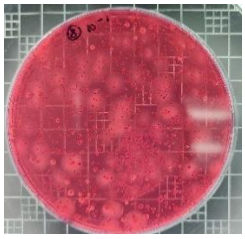
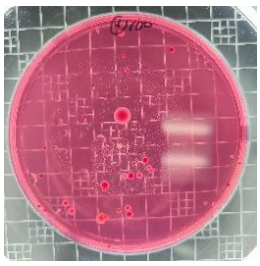
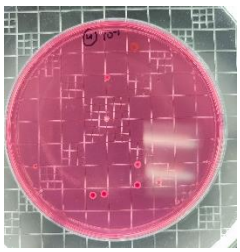
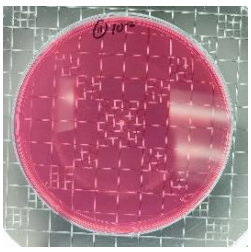
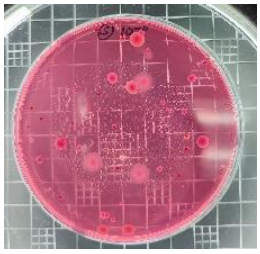
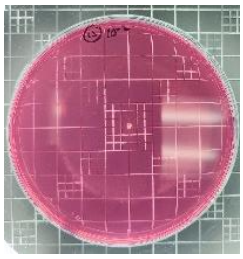
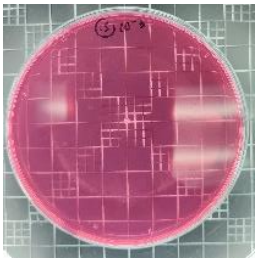
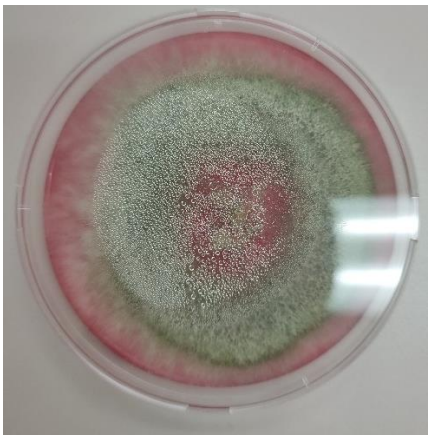
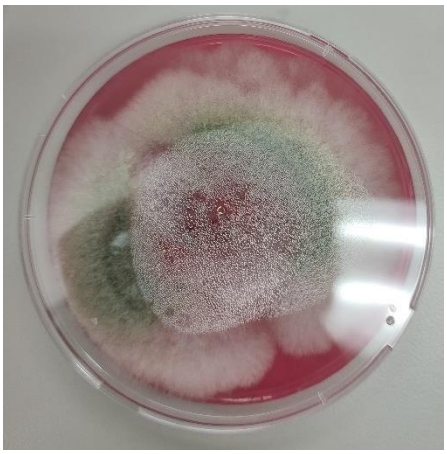
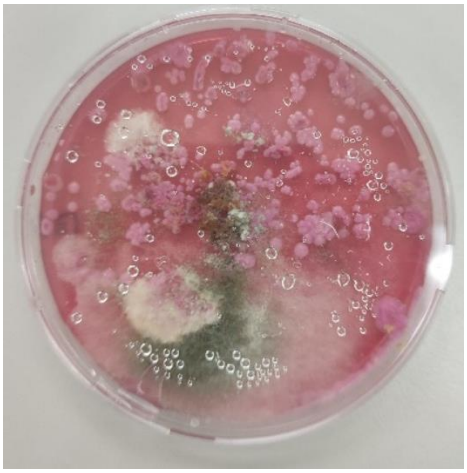
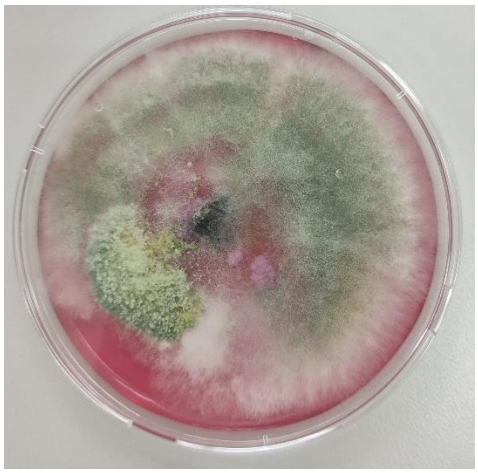
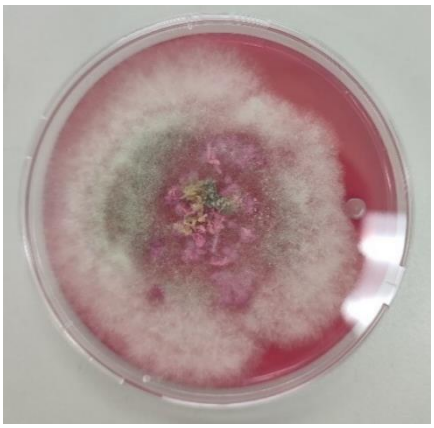
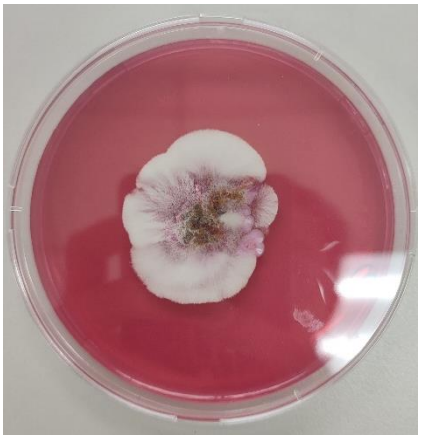
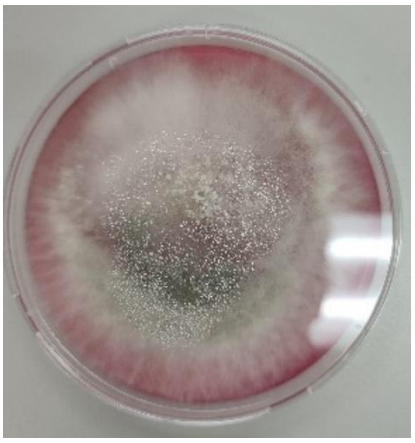
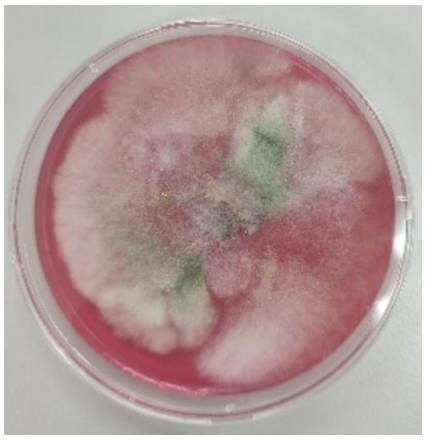
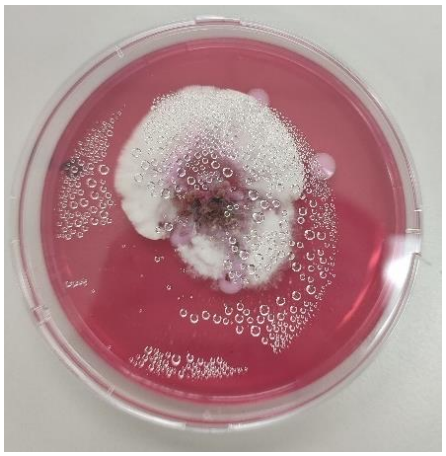
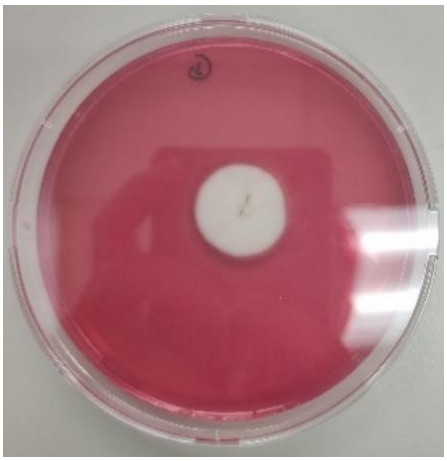
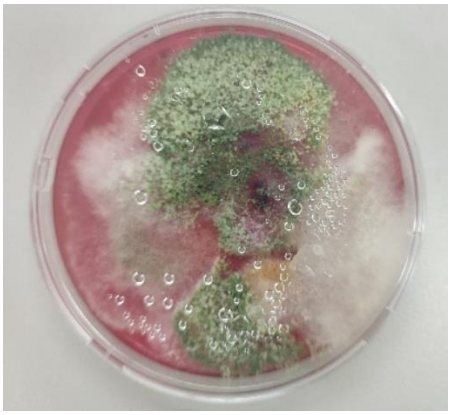
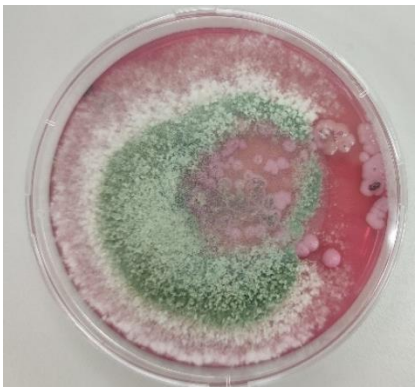
23079-05	Control				
23079-08	Control				
23079-11	Control				
23079-15	Control				

Table 7.2: Incubation of plant cell on Rose Bengal Agar

Sample	Description (ppm)	Picture
23079-01	2k+10k	

23079-02	2k+10k	
23079-10	2k+10k	
23079-06	5k+10k	

23079-12	5k+10k	
23079-13	5k+10k	
23079-04	10k+10k	
23079-07	10k+10k	

23079-09	10k+10k	
23079-03	Control	
23079-05	Control	
23079-08	Control	

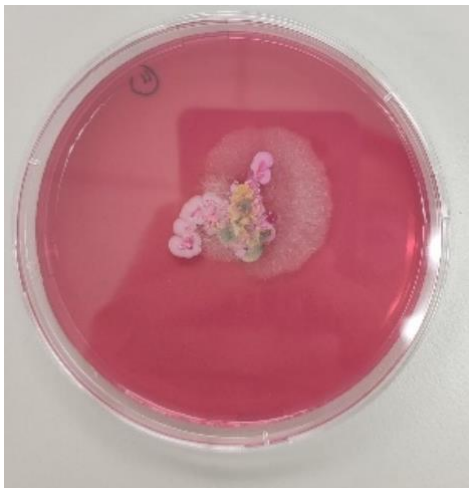
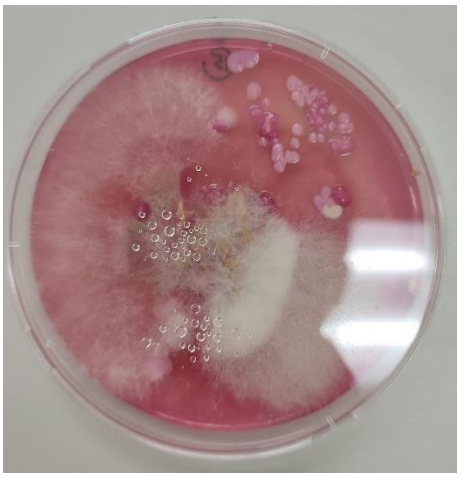
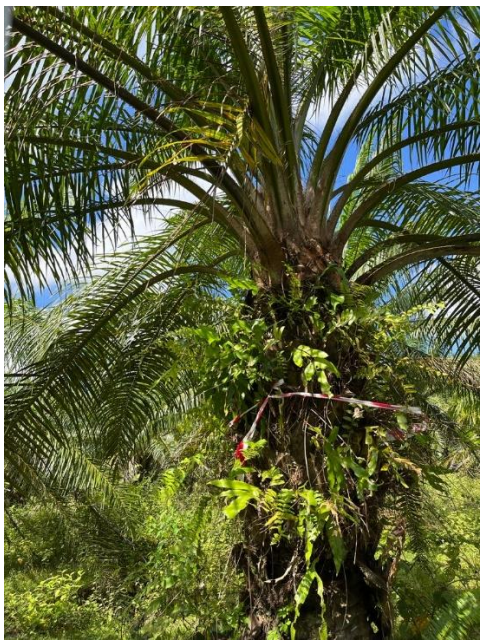
23079-11	Control	
23079-15	Control	

Table 7.3 Observation on PO tree

23079-01	23079-02
	
Mycelium on PO leave on 23079-03	Mycelium on PO bark on 23079-03
	

23079-04	Dried Ganoderma on 23079-05
	
23079-06	Dried Ganoderma on 23079-06
	

23079-07	Dried Ganoderma on 23079-07
	
23079-08	Fresh Ganoderma on 23079-08
	

Mycelium on 23079-14	Ganoderma on 23079-15
	

Table 7.4 Raw Data for Yeast and Mould Count

Sample ID	Description (ppm)	Y&M Count (cfu/cm^2)
23079-01	2K+ 10k	1.0×10^2
23079-02	2K+ 10k	5.0
23079-10	2K+ 10k	3.6×10^2
23079-14	2K+ 10k	2.3×10^4
23079-06	5k+10k	1.2×10^4
23079-12	5k+10k	8.7×10^3
23079-13	5k+10k	TNTC
23079-04	10k+10k	6.0
23079-07	10k+10k	9.0×10^2
23079-09	10k+10k	4.2×10^4
23079-03	control	6.0
23079-05	control	5.0×10^1
23079-08	control	5.5×10^4
23079-11	control	3.8×10^1
23079-15	control	9.4×10^1

检科测试
CAIQTEST
MALAYSIA

CAIQ BIOSECURITY SDN BHD (1467503-K)
检 科 测 试 马来西亚 有 限 公 司

Lot 9-B & 11-B Jalan Riyal U3/38, IPARC 3, Bukit Jelutong, 40150 Shah Alam, Selangor
Tel: 03-7832 6393 / 017-645 8827 Email: enquiry@caiqtest.my Website: www.caiqtest.my

Analysis Report
检 测 报 告

Ref No 参考编号 CAIQ/M/23079/01
Report Date 报告日期 05/04/2023

Customer 顾客 **Fermedic Biotech Sdn Bhd**
B-09-15, Menara Prima, Jalan PJU 1/39, Dataran Prima, 47301, Petaling Jaya.

Sample Marking 样品名称 Refer table below 参考下表

Lab ID 实验室编号 Refer table below 参考下表

Test Parameter 检测项目 Yeast and Mould count 酵母和霉菌计数

Sample Condition 样品状态 Sample received: 15 tubes of swab samples
Temperature: Chilled temperature, in good condition when received

Received Date 接收日期 28/03/2023

Analysis Date 检测日期 29/03/2023 to 03/04/2023

Test Result
检 测 结 果

Sample 样品	Sample description 样品名称	Result 检测值	Unit 单位	Method 检测方法
23079-01	2K +10K ppm	1.0×10^2	cfu/cm^2	GB 4789.15-2010
23079-02	2K +10K ppm	5.0	cfu/cm^2	GB 4789.15-2010
23079-10	2K +10K ppm	3.6×10^2	cfu/cm^2	GB 4789.15-2010
23079-14	2K +10K ppm	2.3×10^3	cfu/cm^2	GB 4789.15-2010
23079-06	5K +10K ppm	1.2×10^4	cfu/cm^2	GB 4789.15-2010
23079-12	5K +10K ppm	8.7×10^3	cfu/cm^2	GB 4789.15-2010
23079-13	5K +10K ppm	TNTC	cfu/cm^2	GB 4789.15-2010
23079-04	10K +10K ppm	6.0	cfu/cm^2	GB 4789.15-2010
23079-07	10K +10K ppm	9.0×10^2	cfu/cm^2	GB 4789.15-2010
23079-09	10K +10K ppm	4.2×10^3	cfu/cm^2	GB 4789.15-2010

Nor Fateha Azuan
Chemist
(L/3029/9014/21)

检科测试
CAIQTEST
MALAYSIA

CAIQ BIOSECURITY SDN BHD (1467503-K)
检 科 测 试 马来西亚 有 限 公 司

Lot 9-B & 11-B Jalan Riyal U3/38, IPARC 3, Bukit Jelutong, 40150 Shah Alam, Selangor
Tel: 03-7832 6393 / 017-645 8827 Email: enquiry@caiqtest.my Website: www.caiqtest.my

Analysis Report
检 测 报 告

Ref No 参考编号	CAIQ/M/23079/01
Report Date 报告日期	05/04/2023

Customer 顾客	**Fermedic Biotech Sdn Bhd** B-09-15, Menara Prima, Jalan PJU 1/39, Dataran Prima, 47301, Petaling Jaya.
Sample Marking 样品名称	Refer table below 参考下表
Lab ID 实验室编号	Refer table below 参考下表
Test Parameter 检测项目	Yeast and Mould count 酵母和霉菌计数
Sample Condition 样品状态	Sample received: 15 tubes of swab samples Temperature: Chilled temperature, in good condition when received
Received Date 接收日期	28/03/2023
Analysis Date 检测日期	29/03/2023 to 03/04/2023

Test Result
检 测 结 果

Sample 样品	Sample description 样品名称	Result 检测值	Unit 单位	Method 检测方法
23079-03	Control	6.0	cfu/cm^2	GB 4789.15-2010
23079-05	Control	5.0 ×10	cfu/cm^2	GB 4789.15-2010
23079-08	Control	5.5×10^4	cfu/cm^2	GB 4789.15-2010
23079-11	Control	3.8 ×10	cfu/cm^2	GB 4789.15-2010
23079-15	Control	9.4 ×10	cfu/cm^2	GB 4789.15-2010

Note:
TNTC: Too numerous to count

*** END OF REPORT 报告结束 ***

Nor Fateha Azuan
Chemist
(L/3029/9014/21)

检科测试
CAIQTEST
MALAYSIA

CAIQ BIOSECURITY SDN BHD (1467503-K)
检 科 测 试 马来西亚 有 限 公 司

Lot 9-B & 11-B Jalan Riyal U3/38, IPARC 3, Bukit Jelutong, 40150 Shah Alam, Selangor
Tel: 03-7832 6393 / 017-645 8827 Email: enquiry@caiqtest.my Website: www.caiqtest.my

Analysis Report
检 测 报 告

Ref No 参考编号 CAIQ/M/23079/02
Report Date 报告日期 05/04/2023

Customer 顾客 **Fermedic Biotech Sdn Bhd**
B-09-15, Menara Prima, Jalan PJU 1/39, Dataran Prima, 47301, Petaling Jaya.

Sample Marking 样品名称 Refer table below 参考下表
Lab ID 实验室编号 Refer table below 参考下表
Test Parameter 检测项目 pH
Sample Condition 样品状态 Sample received: 10 plastic bags containing soil
Temperature: Ambient temperature, in good condition when received
Received Date 接收日期 28/03/2023
Analysis Date 检测日期 29/03/2023 to 03/04/2023

Test Result
检 测 结 果

Sample 样品	Sample description 样品名称	Result 检测值	Unit 单位	Method 检测方法
23079-16	2K +10K ppm	4.71	-	HJ 962-2018
23079-17	2K +10K ppm	5.08	-	HJ 962-2018
23079-18	Control	5.38	-	HJ 962-2018
23079-19	10K +10K ppm	5.06	-	HJ 962-2018
23079-20	Control	5.37	-	HJ 962-2018
23079-21	5K +10K ppm	3.98	-	HJ 962-2018
23079-22	10K +10K ppm	4.86	-	HJ 962-2018
23079-23	Control	4.96	-	HJ 962-2018
23079-24	Control	5.94	-	HJ 962-2018
23079-25	Control	6.07	-	HJ 962-2018

*** END OF REPORT 报告结束 ***

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