



The Effect of Lemongrass oil (Cymbopogon citratus) against Plant Pathogens

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Purpose

Our purpose was to study the in-vitro effect of Lemongrass oil (*Cymbopogon citratus*) against the growth of five different Plant Pathogens to develop a biological fungicide alternative to chemical fungicides, which currently damage the environment and will not be effective in the long-term battle against plant pathogens.

Hypothesis

If lemongrass oil is used as a biological fungicide at concentrations of 0.1%, 0.25%, 0.5% and 1.0% to treat plant pathogenic fungi such as *Botrytis cinerea*, *Alternaria solani*, *Rhizoctonia solani*, *Fusarium oxysporum*, *Pythium ultimum*, the spore germination or mycelial growth of all fungal strains will be controlled completely due to the antifungal properties of lemongrass oil containing citral and other secondary metabolites.

Background Research

Lemongrass oil:

- Plant Part Used: Leaf
- Collection Method: Steam Distillation
- Major Active Ingredients: Citral α , Citral β , Nerol Geraniol, Citronellal, Terpinolene, Geranyl acetate, Myrecene and Terpinol

Mode of action:

- Essential oils has been proven as an effective preservative in preventing fungal growth
- Lemongrass oil is proven to have several antimicrobial, antibacterial and antifungal properties, as it has been widely used to treat many human pathogens for many centuries.
- There are various proposed antifungal mechanisms of action for lemongrass oil. Lemongrass oil has demonstrated an inhibitory effect on hyphal growth and spore formation in fungi. It also disrupts plasma membrane and disorganization of mitochondrial structure.

Plant Pathogens

1. ***Botrytis cinerea* (Grey Mold)**: Causes devastating diseases on more than 500 plant species, especially on fresh fruits and vegetables
2. ***Alternaria solani* (Early blight)**: Causes a disease in mainly tomato and potatoes that leads to 79% crop loss.
3. ***Rhizoctonia solani***: Soil borne pathogen causes a wide range of commercially significant plant diseases such as damping off in seedlings, black scurf in potatoes, root rot in sugar beet, belly rot in cucumber, bare patch in cereals, and sheath blight in rice
4. ***Pythium ultimum***: Causes the damping off and root rot diseases to diverse plant hosts including soybean, corn, potato and wheat.
5. ***Fusarium oxysporum***: Causes Panama disease of banana, also known as Fusarium wilt. Panama disease is considered to be one of the most severe Race 4 threats facing the banana industry worldwide.

Materials and Methods

Lemon Grass Oil: 100% pure natural steam distilled lemongrass (*Cymbopogon citratus*) was obtained from SVA organics.

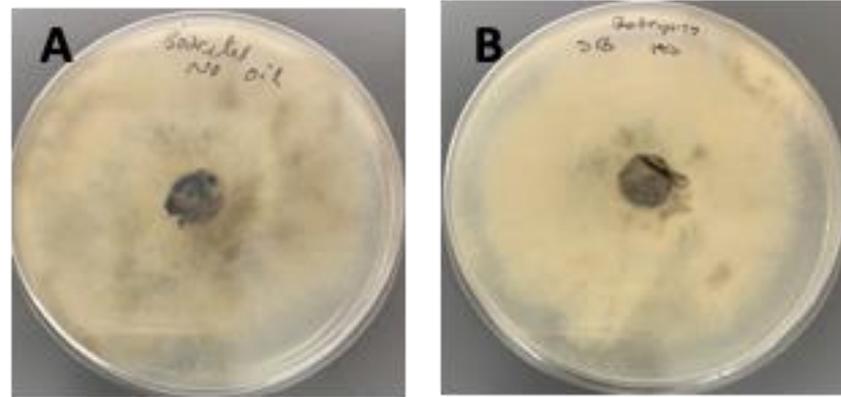
Test Organisms: The test organisms used in this study was obtained from American Type Culture Collection. All the organisms used in this study were maintained on Potato Dextrose Agar medium.

Preparation of PDA plates with Lemon Grass Oil: The different concentrations of lemongrass oil ranging from 0.1 to 1% were added aseptically on to Potato Dextrose Agar medium, Autoclaved, Cooled to 50°C. 20mL of media was added to several sterilized petri plates and allowed to solidify. The plates were incubated at room temperature for 4-5 days before using for bioassays.

Antifungal activity: The antifungal properties of the lemon grass oil was determined at different concentrations against five fungal pathogens by colony diameter measurement method. All fungal pathogenic cultures were grown on PDA plates for 5-7 days. A plug of mycelium of each fungus was placed at the middle of the PDA plates. The plates were incubated for 7 days at 28C and the fungal radial growth was assessed by colony diameter.

Note: All the experiments were conducted more than three times by using triplicate plates.

Lemongrass oil against *Botrytis cinerea*

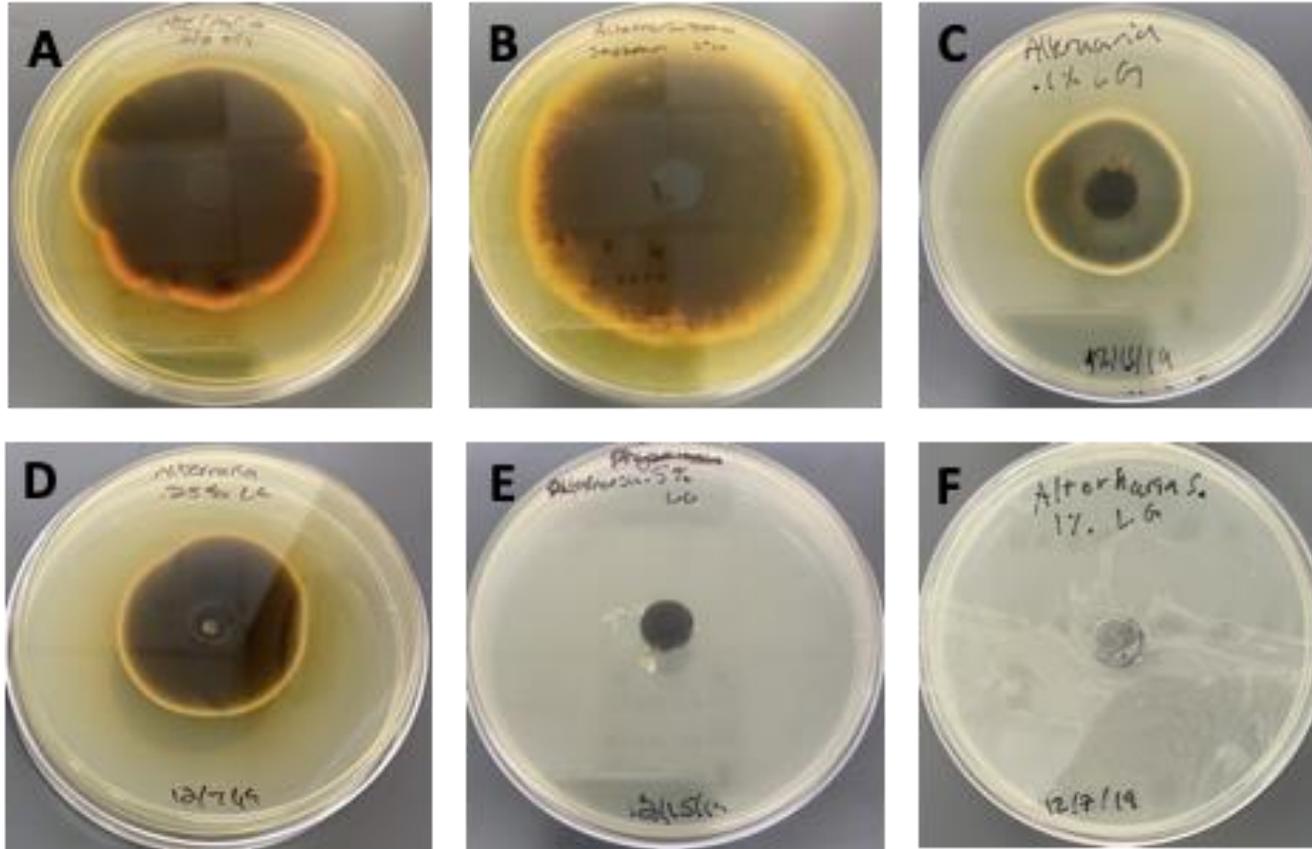


Results: 0.5 % and 1.0% lemongrass oil was effective against *Botrytis cinerea*



- A. Control: *Botrytis cinerea* + No Lemongrass Oil B. *Botrytis cinerea* + 1.0% Soybean Oil
C. *Botrytis cinerea* + 0.25% Lemongrass Oil D. *Botrytis cinerea* + 0.5% Lemongrass Oil
E. *Botrytis cinerea* + 1.0% Lemongrass Oil

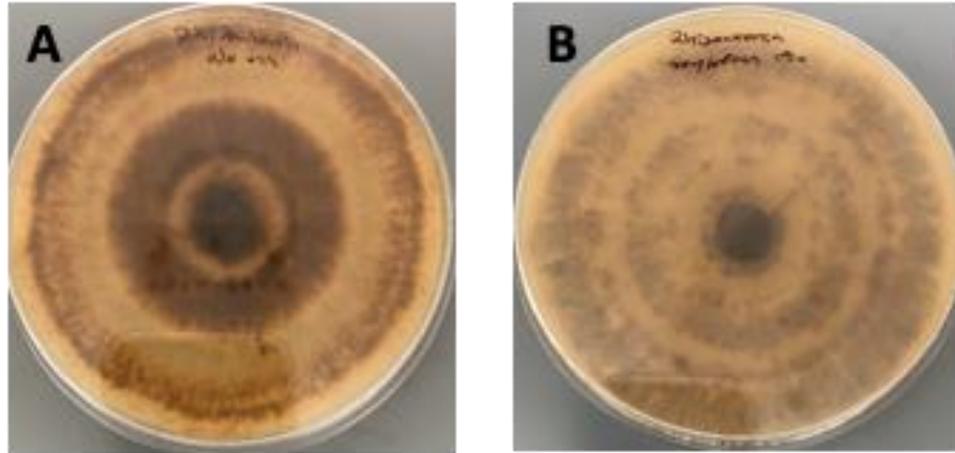
Lemongrass oil against *Alternaria solani*



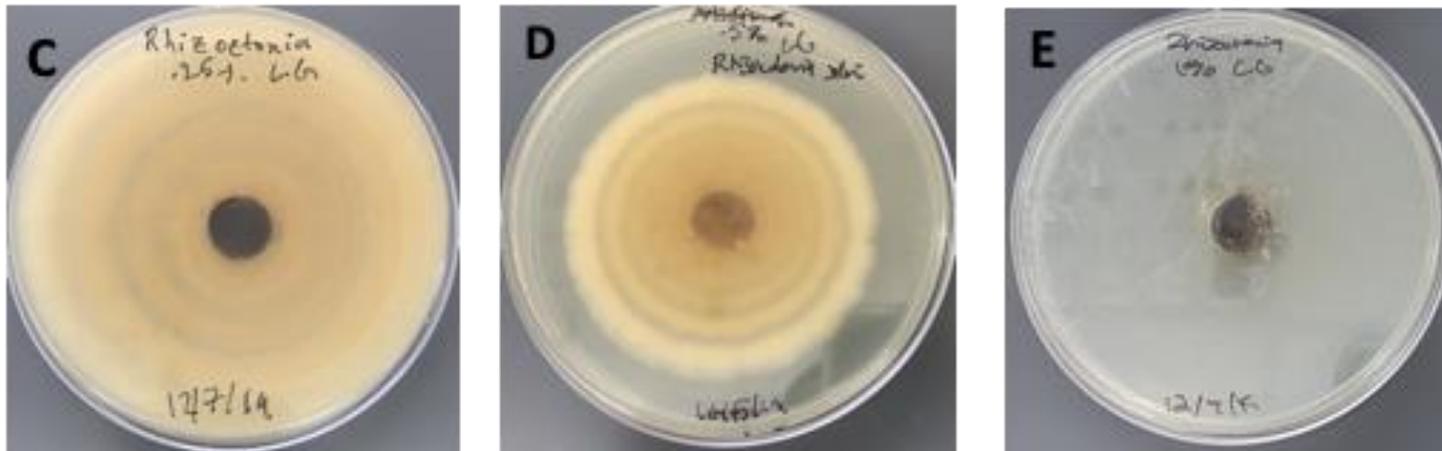
Results: Lemongrass oil was very effective against *Alternaria solani* at 0.5% and above and partial at 0.25 and 0.1% concentrations

- A. Control: *Alternaria solani* + No Lemongrass Oil
- B. *Alternaria solani* + 1.0% Soybean Oil
- C. *Alternaria solani* + 0.1% Lemongrass Oil
- D. *Alternaria solani* + 0.25% Lemongrass Oil
- E. *Alternaria solani* + 0.5% Lemongrass Oil
- F. *Alternaria solani* + 1.0% Lemongrass Oil

Lemongrass oil against *Rhizoctonia solani*

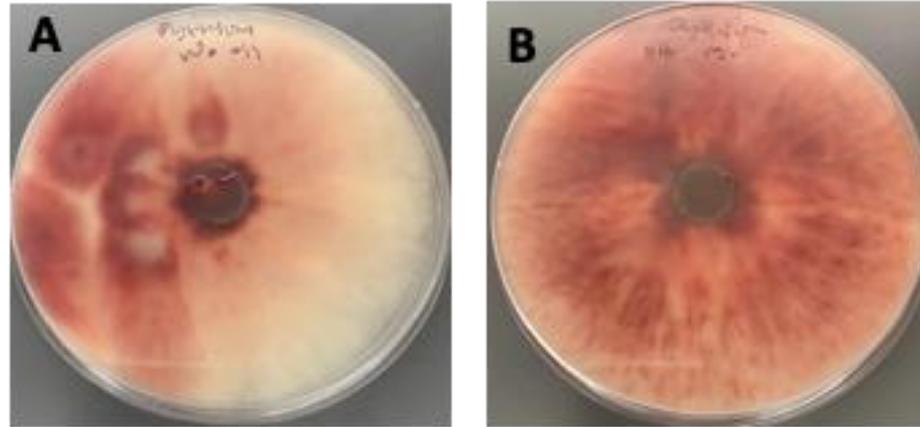


Results: 1.0% lemongrass oil was effective against *Rhizoctonia solani*

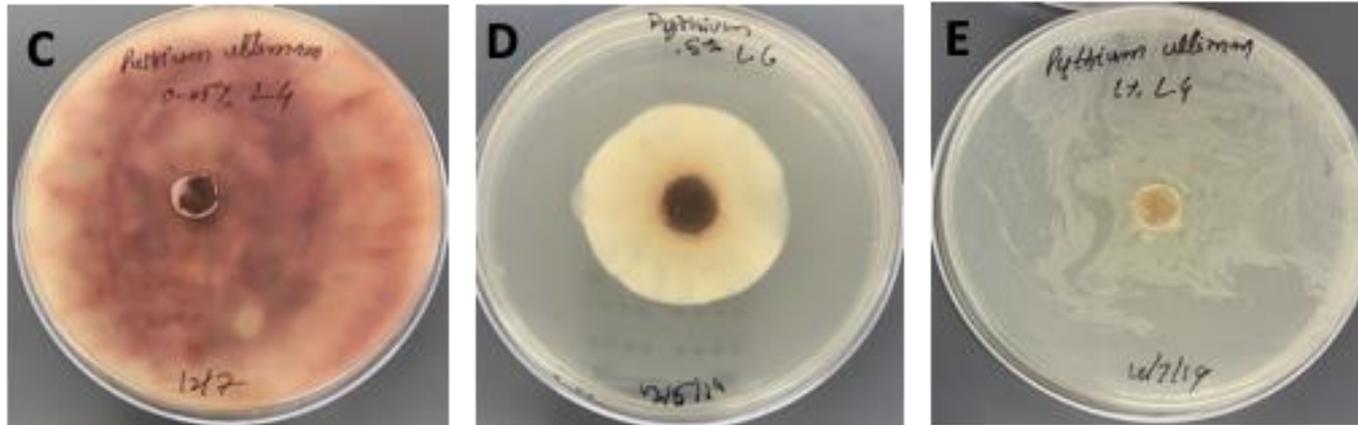


- A. Control: *Rhizoctonia solani* + No Lemongrass Oil B. *Rhizoctonia solani* + 1.0% Soybean Oil
C. *Rhizoctonia solani* + 0.25% Lemongrass Oil D. *Rhizoctonia solani* + 0.5% Lemongrass Oil
E. *Rhizoctonia solani* + 1.0% Lemongrass Oil

Lemongrass oil against *Pythium ultimum*

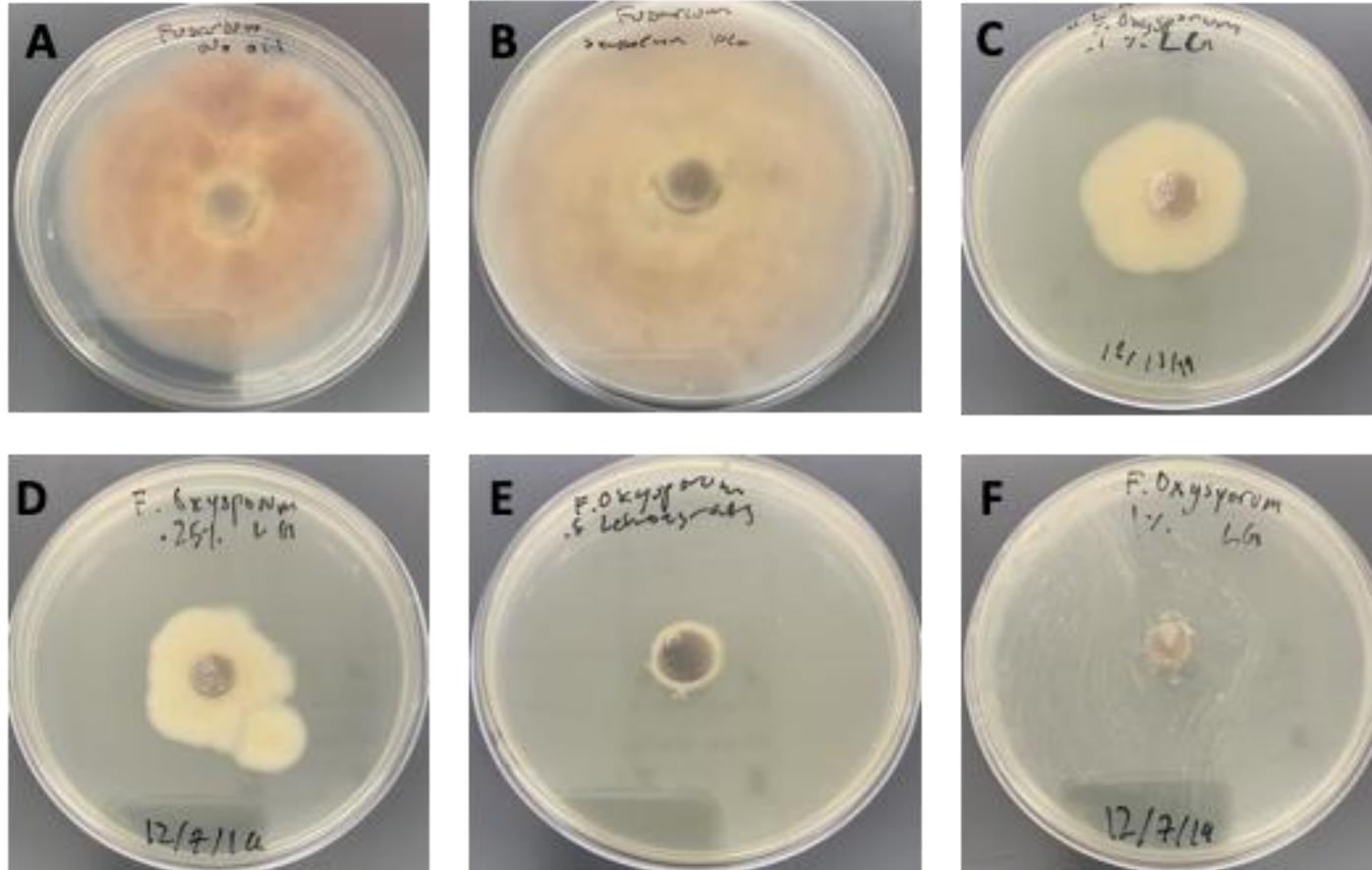


Results: Lemongrass oil was very effective against *Pythium ultimum* at 1.0% and partial at 0.5% concentration.



- A. Control: *Pythium ultimum* + No Lemongrass Oil B. *Pythium ultimum* + 1.0% Soybean Oil
C. *Pythium ultimum* + 0.25% Lemongrass Oil D. *Pythium ultimum* + 0.5% Lemongrass Oil
E. *Pythium ultimum* + 1.0% Lemongrass Oil

Lemongrass oil against *Fusarium oxysporum*



Results: Lemongrass oil completely inhibited the growth of *Fusarium* at 0.5% and 1.0% concentrations, and partially at 0.25% and 0.1% concentrations tested.

- A. Control: *Fusarium oxysporum* + No Lemongrass Oil
- C. *Fusarium oxysporum* + 0.1% Lemongrass Oil
- E. *Fusarium oxysporum* + 0.5% Lemongrass Oil

- B. *Fusarium oxysporum* + 1.0% Soybean Oil
- D. *Fusarium oxysporum* + 0.25% Lemongrass Oil
- F. *Fusarium oxysporum* + 1.0% Lemongrass Oil

Radial mycelial growth on agar plates

Plant Pathogen	Lemon grass oil concentration (%)	Radial growth after 7 days of inoculation (mm)
<i>Botrytis cinerea</i>	Control- No oil	35
	Soybean oil	35
	0.25	35
	0.5	10
	1.0	0
<i>Rhizoctonia solani</i>	Control	35
	Soybean oil	35
	0.25	35
	0.5	30
	1.0	0
<i>Alternaria solani</i>	Control	32
	Soybean oil	34
	0.1	12
	0.25	12
	0.5	0
<i>Pythium ultimum</i>	Control	39
	Soybean oil	39
	0.25	39
	0.5	17
	1.0	0
<i>Fusarium oxysporum</i>	Control	39
	Soybean oil	39
	0.1	15
	0.25	13
	0.5	0
	1.0	0

Conclusions and Next Steps

- Growth of all five plant pathogens was suppressed at 1.0% lemongrass oil; there was a clear dose response from 1.0 to 0.1%
- *Fusarium oxysporum* and *Alternaria solani* were less potent compared to other pathogens due to the complex nature of pathogenicity
- This study clearly demonstrated that lemongrass oil can be used as a safe eco-friendly candidate for future use as an alternatives to chemical fungicides
- Further studies are required to test the unique antifungal properties and broad-spectrum activity against other pathogens