Revealing the Effects of Climate Change and Fungicides on Soil Microbial Communities in the Lower Rio Grande Valley, Texas

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Background

- Fungicide applications are used to prevent fungal pathogens.
- Fungicides can exert toxic or inhibitory effects on non-targeted organisms such as beneficial soil microbial communities.
- With projected changes in climate, fungicide effects are in need to be explored

Figure 1 Conventionally managed farm in Raymondville, Texas.

Objectives

- The aim of the study was to evaluate soil health parameters from the use of fungicides (Azoxystrobin and Tebuconazole) with anticipated changes in temperatures and soil moisture levels based on the Intergovernmental Panel of Climate Change (IPCC) RCP 8.5 scenario (from the end of the century).

Table 1 Listed soil assessments with relevance to soil health.

Assessments	Description
Soil respiration	measure of carbon dioxide (CO_2) released from the soil from decomposition of soil organic matter (SOM) by soil microbes and respiration from plant roots and soil fauna.
Fluorescein Diacetate (FDA)	measures overall soil microbial activities.
B-glucosidase	considered a soil quality indicator and is directly related to the quantity and quality of soil organic matter.
Alkaline Phosphatase	responsible for mineralizing organic P to inorganic P in alkaline conditions.
Acid Phosphatase	responsible for mineralizing organic P to inorganic P in acidic conditions.
N-acetyl-beta-D-glucosaminidase (NAGase)	plays an important role in the N and C cycle. It is said to be an indicator for fungal biomass

Experimental Approach

Figure 2 Filtration process of Fluorescein Diacetate (FDA) enzyme activity.

Figure 3 Microcosm set up.

Soil Collection
- Collected soil samples on March 2021 from conventional farm.

Microcosm set-up
- Sieved and added 100 g of soils into jars.
- Activation of microbes
- 3 factor (2 levels)

Incubation
- Applied appropriate amount of fungicides.
- Put respective samples to their temperatures
- Monitored soil moistures for 45 days.

Data Analysis and Interpretation
- Calculations

Figure 3 Summarization of the experimental process.

Table 2 Experimental design of a 3 factorial (2 level) lay out. Moisture levels were adjusted to a microcosm level. Current temperatures and moisture level data was extracted through the National Oceanic and Atmospheric Administration (NOAA). Projected temperatures and moisture levels were obtained through the Intergovernmental Panel of Climate Change (IPCC) RCP 8.5 scenario.

Factors	Treatment	Unit
Temperature	24 C	T1
	28 C	T2
Moisture	9 mL	M1
	8 mL	M2
Fungicide	No fungicide	F1
	Azoxystrobin	F2
	Tebuconazole	F3

Results

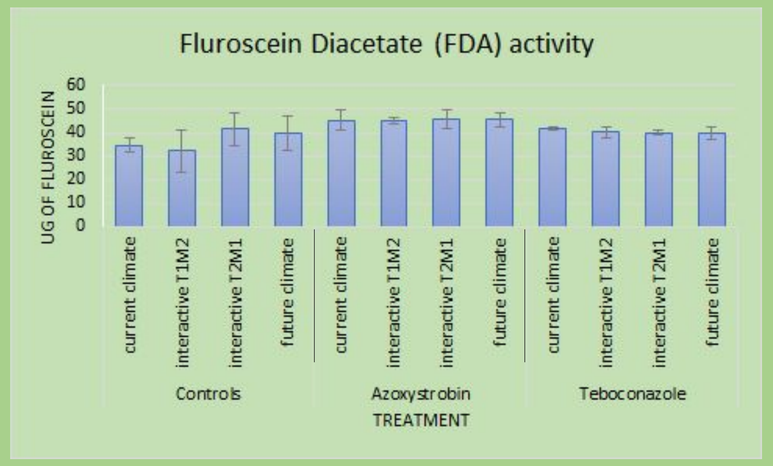

Figure 5 Overall Fluorescein Diacetate (FDA) enzymatic activities across all treatments.

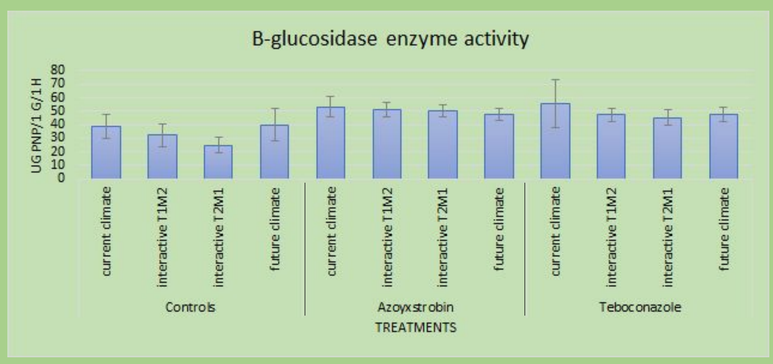

Figure 4 Enzymatic activities of Beta-glucosidase analysis across all treatments.

Key Findings

- **FDA**
  - Azoxystrobin treatment shows higher enzymatic activities.
  - There is an increase of enzyme activities comparing controls to some fungicide treatments.
  - Temperatures seems to drive enzyme activities within the control groups.
- **B-glucosidase**
  - There appears to be a decrease of activity within the fungicide treatments.
  - Controls slightly increases in enzyme activity.

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