

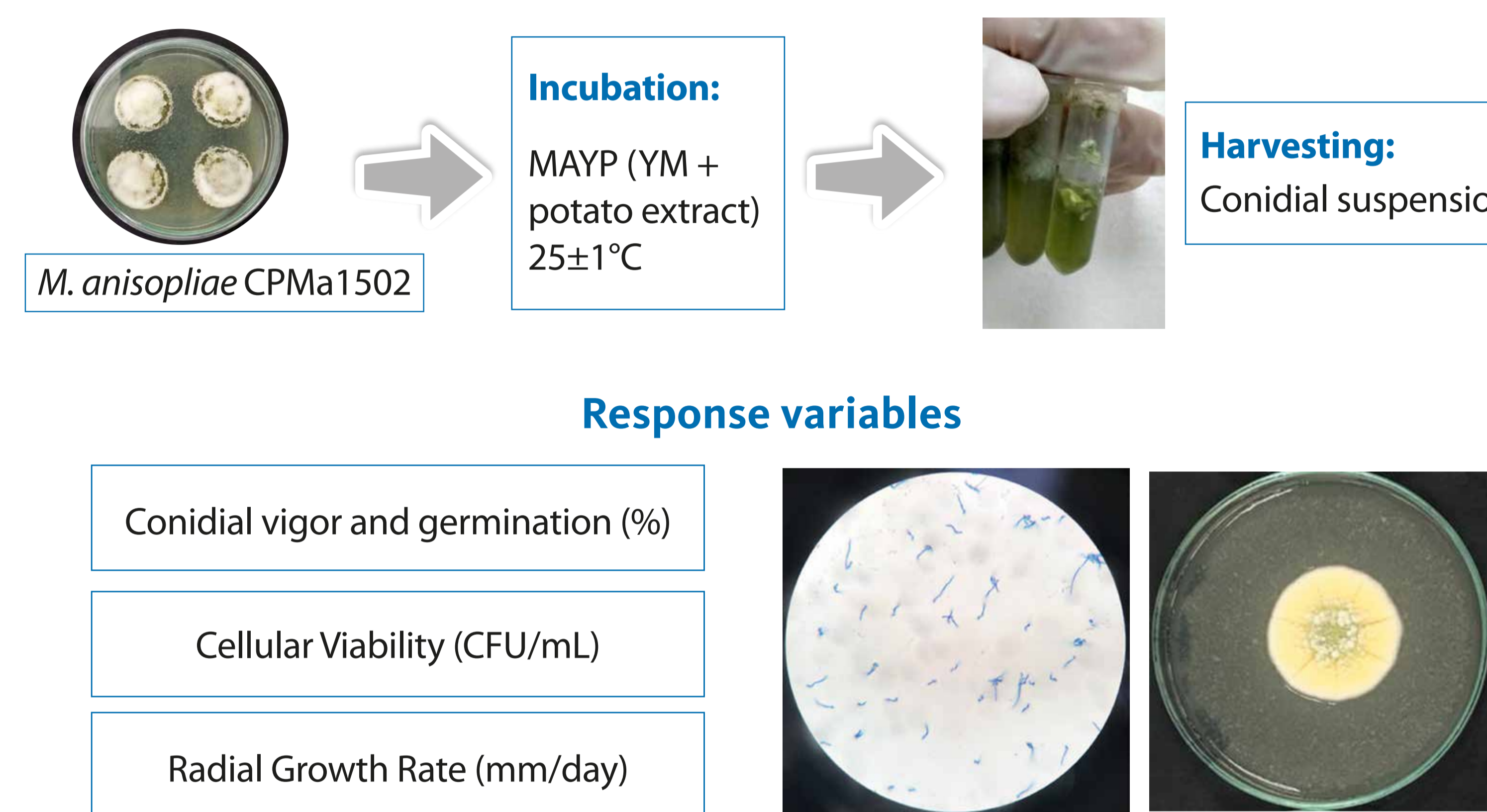
Introduction

The oil palm is an economically important crop due to its high productivity and broad industrial applicability (Sabate 2016). In Colombia, this crop is grown in different agro-ecological zones (Borrerio 2018) where the environmental conditions are favorable to several insect pests. One of the most economically important pests is the fruit scraper *Demotisa neivai* (Bondar, 1940) (Coleoptera: Chrysomelidae) (Aldana *et al.* 2004). To control this pest, CENIPALMA isolated in Colombia (Barrancabermeja), and selected the strain of *Metarhizium anisopliae* CPMa1502 as a new active principle for biological control because it showed the highest mortality on adults of *D. neivai* (87.7%) on laboratory conditions (Aldana *et al.* 2004, Bustillo, 2014; Montes *et al.* 2016). Temperature and UVB radiation are factors that can affect the mass production and biocontrol activity of the fungus. The evaluation of its influence is an important part of the development of a future bioproduct. This work evaluated the conidia tolerance to different stress conditions of temperature (20, 25, 30, 35°C) and several exposure times of UVB radiation, measuring conidial vigor and germination, cellular viability, and radial growth rate.

Keywords: *Metarhizium anisopliae*, fruit scraper insect, oil palm, ecophysiological characterization

Materials and methods

Ecophysiological characterization

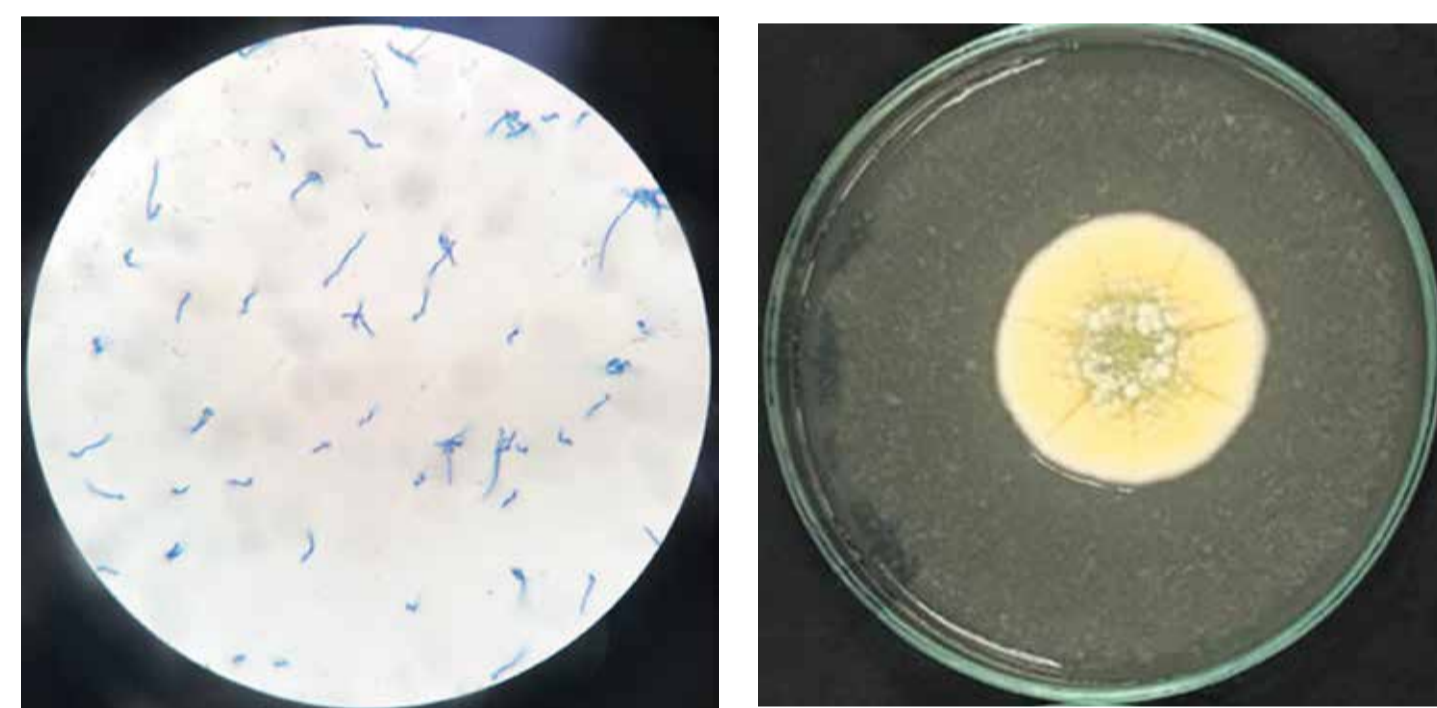


Response variables

Conidial vigor and germination (%)

Cellular Viability (CFU/mL)

Radial Growth Rate (mm/day)



Growth temperature

10⁷ conidia/mL

10⁸ conidia/mL

UVB radiation

Exposure time: 3 days

Temperature: 20, 25, 30 and 35°C

Treatment	Exposure time in laboratory*	Field equivalency time**
T1	2 min 6 sec	15 min
T2	4 min 25 sec	30 min
T3	8 min 25 sec	1 h
T4	12 min 37 sec	1,5 h
T5	16 min 50 sec	2 h
T5	60 min	7h 7 min

Completely randomized experimental designs with three replications. Mean Comparisons (Tukey or Kruskal-Wallis test, 95%) used for statistical analysis

*UVB lamp with 302nm wavelength, radiation 0.28kW/m²

** 10% max. global solar radiation Barrancabermeja (Col.) = 0,45kWh/m² (IDEAM, 2018)

Results and discussion

Growth temperature tolerance

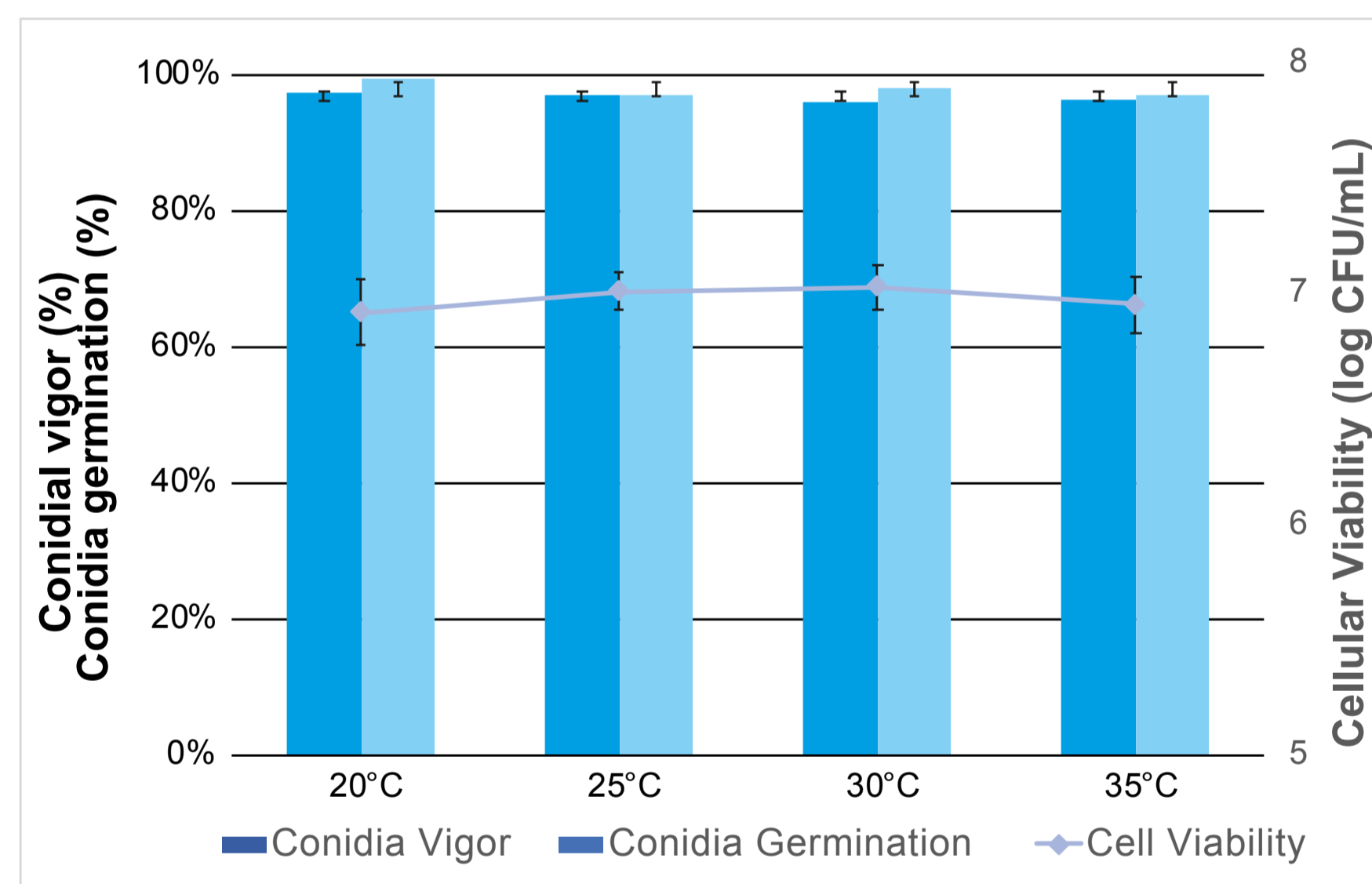


Figure 1. Cellular viability (log CFU/mL) and conidial vigor and germination (%) of *M. anisopliae* CPMa1502

- All conidial vigor and germinations were above 96%.
- Cellular viabilities had the same value as the initial conidia suspension.
- The highest radial growth rate was observed at 35 °C, with a difference of 2.5% with the lowest value.

The growth of *M. anisopliae* CPMa1502 was not affected by temperatures between 20°C to 35 °C. This resistance was attributed to the mean temperature, 40°C, of the natural region where the strain was isolated (IDEAM, 2019). These results indicate that CPMa1502 could resist high temperatures as well intensive drying processes, and it could have persistence in the field (Rangel *et al.* 2005; Olivera *et al.* 2016).

Table 1. Radial Growth rate of *M. anisopliae* CPMa1502

T (°C)	Radial growth rate (mm/day)
20	1.14 ± 0.07
25	1.13 ± 0.06
30	1.13 ± 0.13
35	1.16 ± 0.09

NOTE: Response variables of all treatments do not show statistical differences (Tukey/Kruskal-Wallis test, p > 0.05).

UVB radiation tolerance

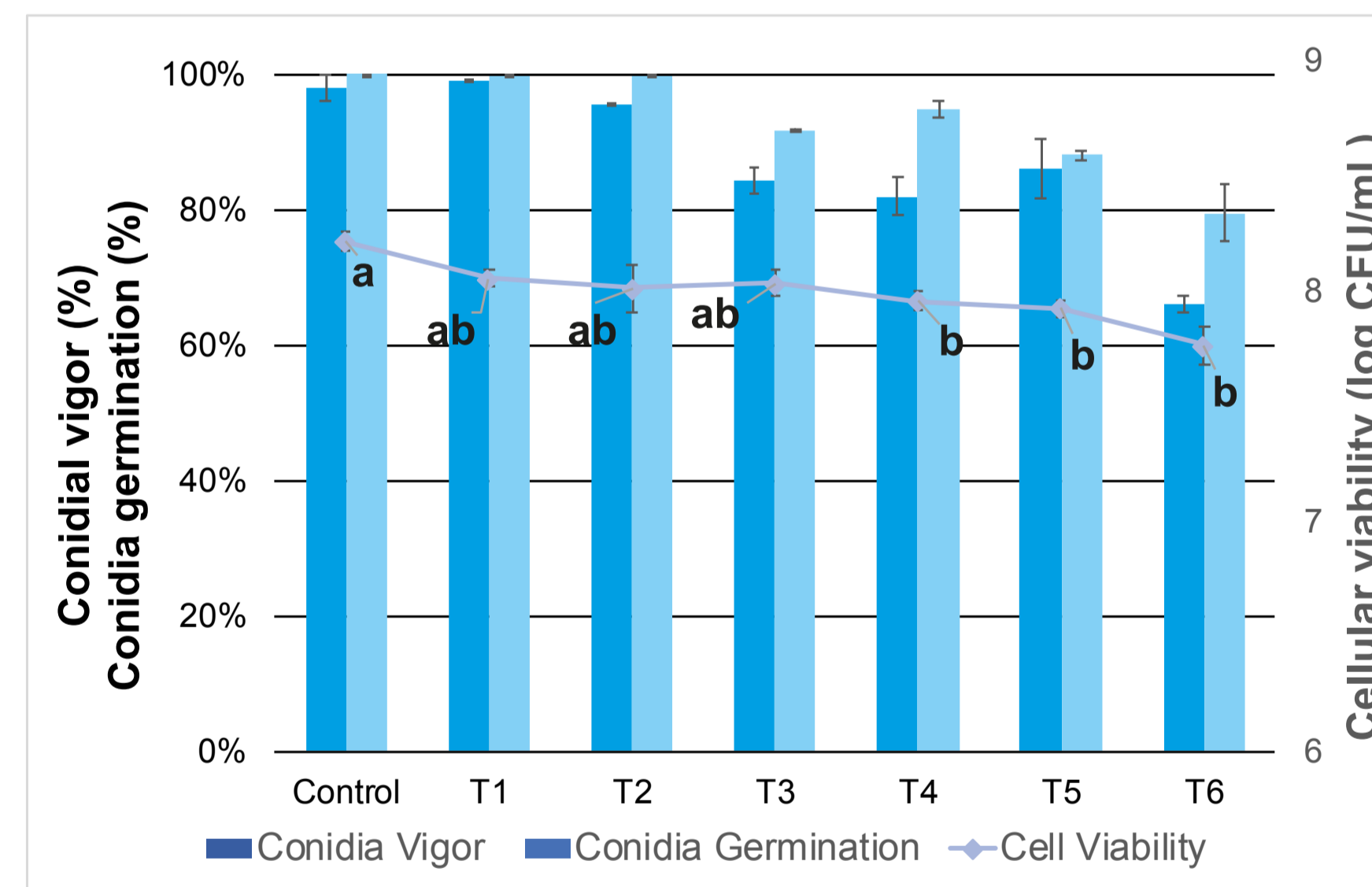


Figure 2. Cellular viability (log CFU/mL) and conidial vigor and germination (%) of *M. anisopliae* CPMa1502

- Conidial vigor, germinations, and cellular viabilities were affected from treatment T3 (Fig. 2).
- Radial growth rates did not show statistically significant differences (Tukey's test, p>0.05).

The delayed of conidia viability caused by exposure to UVB radiation it seems to be proportionally with the exposure time. This behavior may be due to the oxidative stress that can induce several protective mechanisms affecting its growth (DNA repair, antioxidant synthesis, etc) (Braga *et al.* 2001; Rangel *et al.* 2005; Braga *et al.* 2007). The maximum reduction on conidial germination and cellular viability were 20.4%, and 5.5 %, respectively. Besides, CPMa1502 did not showed changes in its capacity of micellar growth.

Table 2. Radial Growth rate of *M. anisopliae* CPMa1502

Exposure time	Radial growth rate (mm/day)
Control	1.18 ± 0.29
T1	1.24 ± 0.44
T2	1.18 ± 0.28
T3	1.20 ± 0.33
T4	1.30 ± 0.30
T5	1.14 ± 0.39
T6	1.15 ± 0.32

Conclusions

- No deleterious effects were observed in *M. anisopliae* CPMa1502 during incubation in a temperature range of 20 to 35°C.
- Under an exposure time of UVB radiation that simulates one solar day in Barrancabermeja (Col.), a decrease in cellular viability and conidial germination was observed (5.81x10⁷ CFU/mL; 79.5%). Despite this fact, the radial growth capacity was not affected.
- The ecophysiological characterization allowed to conclude that *M. anisopliae* CPMa1502 presented a high resistance to growth temperatures, although the fungus showed a moderate tolerance to UVB radiation under different exposure times.

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