Herbicidal activity of metabolites from *Colletotrichum* sp. on the development of *Sorghum bicolor* and *Phaseolus vulgaris* in pre-emergence and its potential in weed control

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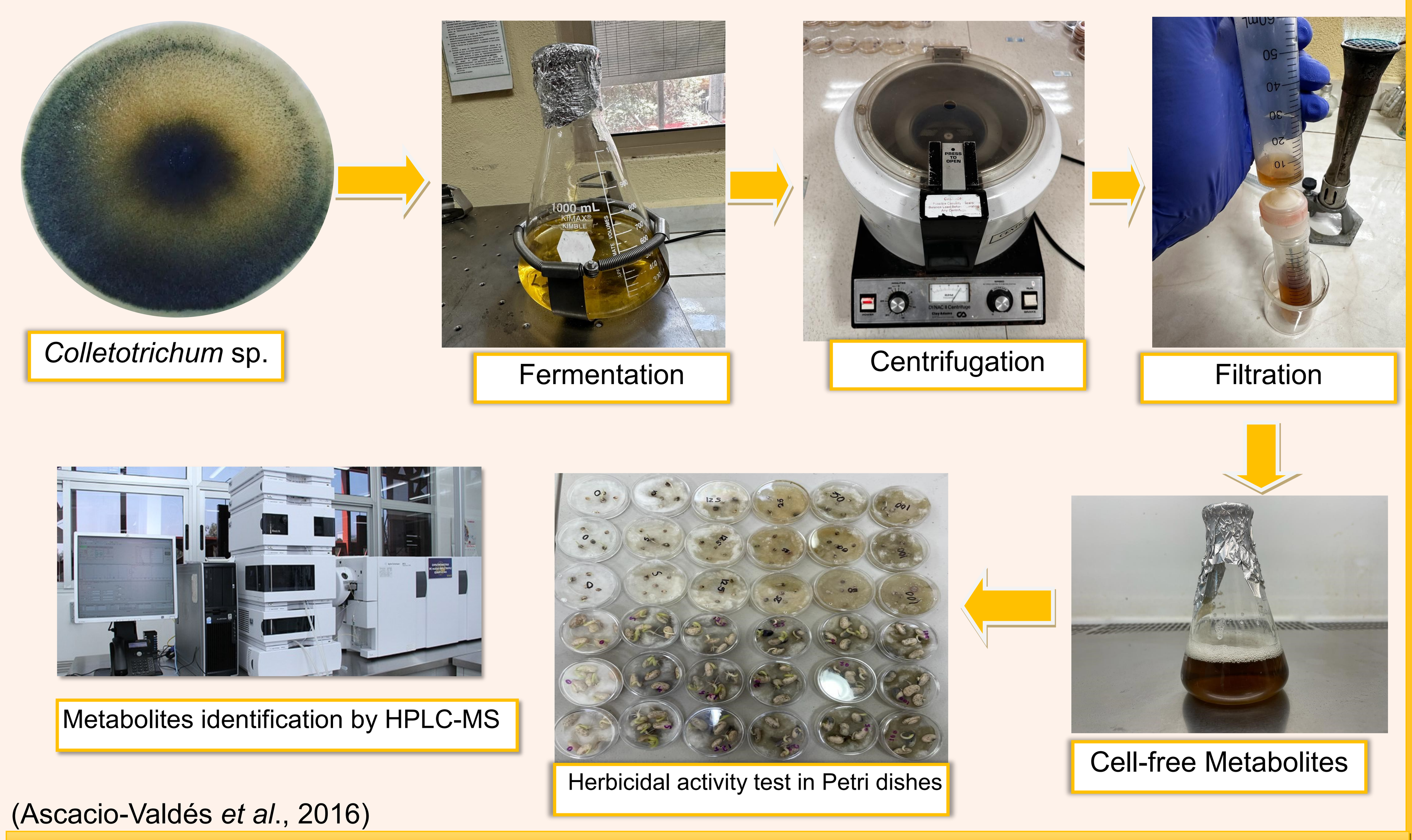
INTRODUCTION

Weeds are a significant challenge in the agricultural context due to their competitive interactions with cultivated crops, resulting in diminished crop yields. Furthermore, weeds serve as reservoirs for various pests and diseases (Monteiro & Santos, 2022). Traditionally, the control of weeds has relied upon the application of synthetic herbicides. However, the widespread use of these chemicals has led to environmental contamination and the development of herbicide-resistant weed populations. Consequently, there is a growing impetus to explore alternative weed management strategies. Among these alternatives, considerable attention has been directed toward harnessing microorganisms' potential and their products. Microorganisms have been recognized as an alternative for weed control in agriculture, given their ability to produce bioactive compounds known as secondary metabolites. These secondary metabolites constitute an emerging and promising field of research in weed control (Singh & Pandey, 2022) and have demonstrated a direct impact on weeds by impeding their growth and disrupting essential metabolic processes for plant development.

OBJETIVE

To assess the herbicidal efficacy of metabolites from *Colletotrichum* sp. during the pre-emergence stage on *Sorghum bicolor* and *Phaseolus vulgaris* seeds as indicator organisms, and to identify the chemical composition of these metabolites by high-performance liquid chromatography-mass spectrometry (HPLC-MS)

METHODOLOGY



(Ascacio-Valdés *et al*., 2016)

RESULTS AND DISCUSSION

The germination tests demonstrated that metabolites from *Colletotrichum* sp. showed that the maximum inhibition of germination was from 53.0 % to 100 % of metabolite concentration, in both plant species.

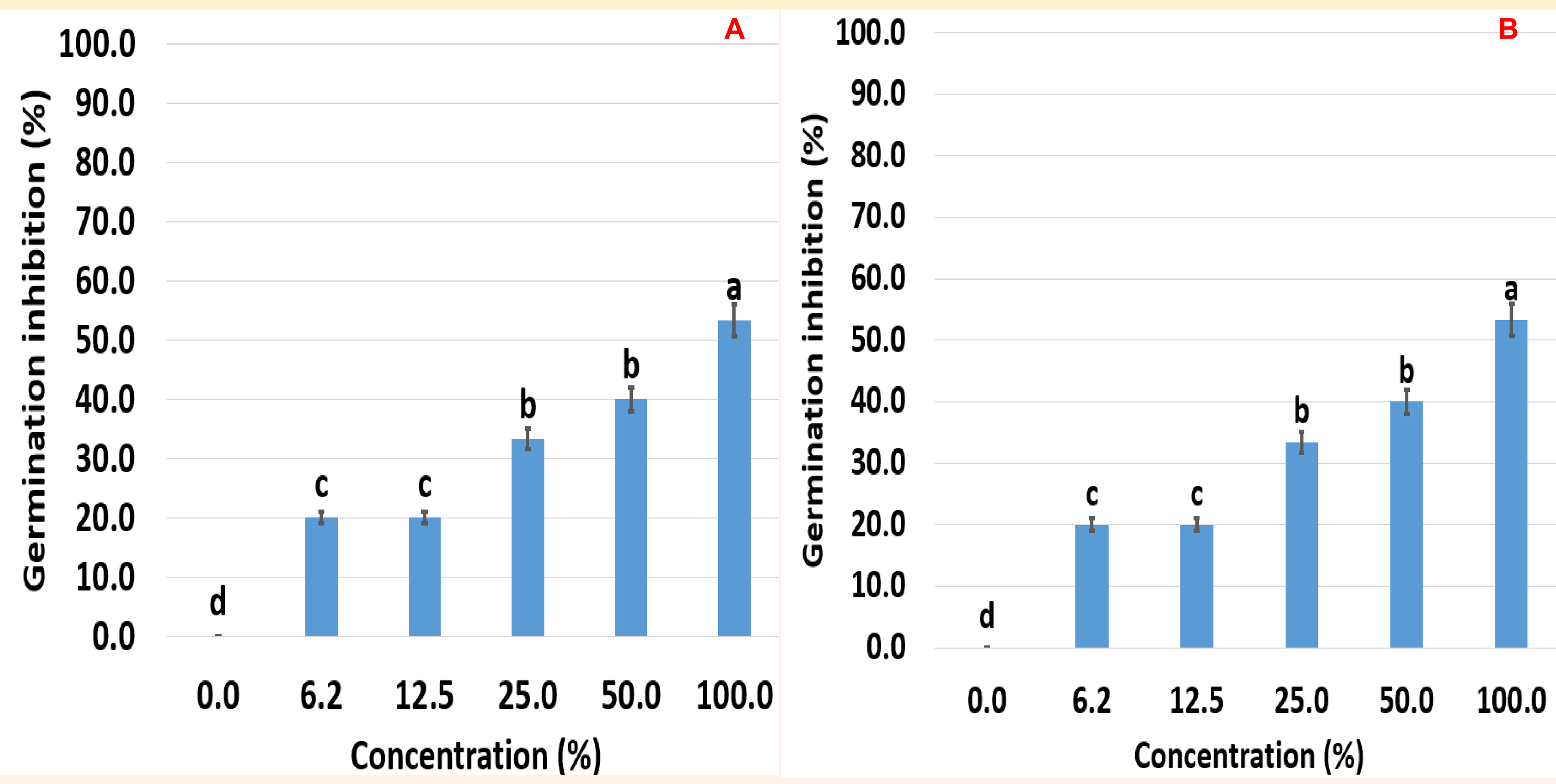


Figure 1. Percentage of germination inhibition in *Sorghum bicolor* (A) and *Phaseoulus vulgaris* (B) seeds treated with metabolites of *Colletotrichum* sp.

The highest observed inhibition rates for hypocotyl and radicle growth in *S. bicolor* seeds were 83% and 91%, respectively, achieved at the maximal metabolite concentration of 100%. On the other hand, in *P. vulgaris* seeds, the maximum inhibition rate for hypocotyl growth was 64%, while radicle growth inhibition reached 59% at the highest metabolite concentration. These outcomes can be attributed to the influence of specific compounds, such as caffeic acid, which have been shown to stimulate the generation of reactive oxygen species, inhibit the synthesis of detoxifying enzymes and growth-promoting hormones, and perturb the photochemistry of photosystem II, resulting in disturbances in electron transport and the production of ATP and NADPH. These biochemical perturbations ultimately impact the germination and developmental processes of plant seeds (Chen *et al*., 2022; Xu *et al*., 2021).

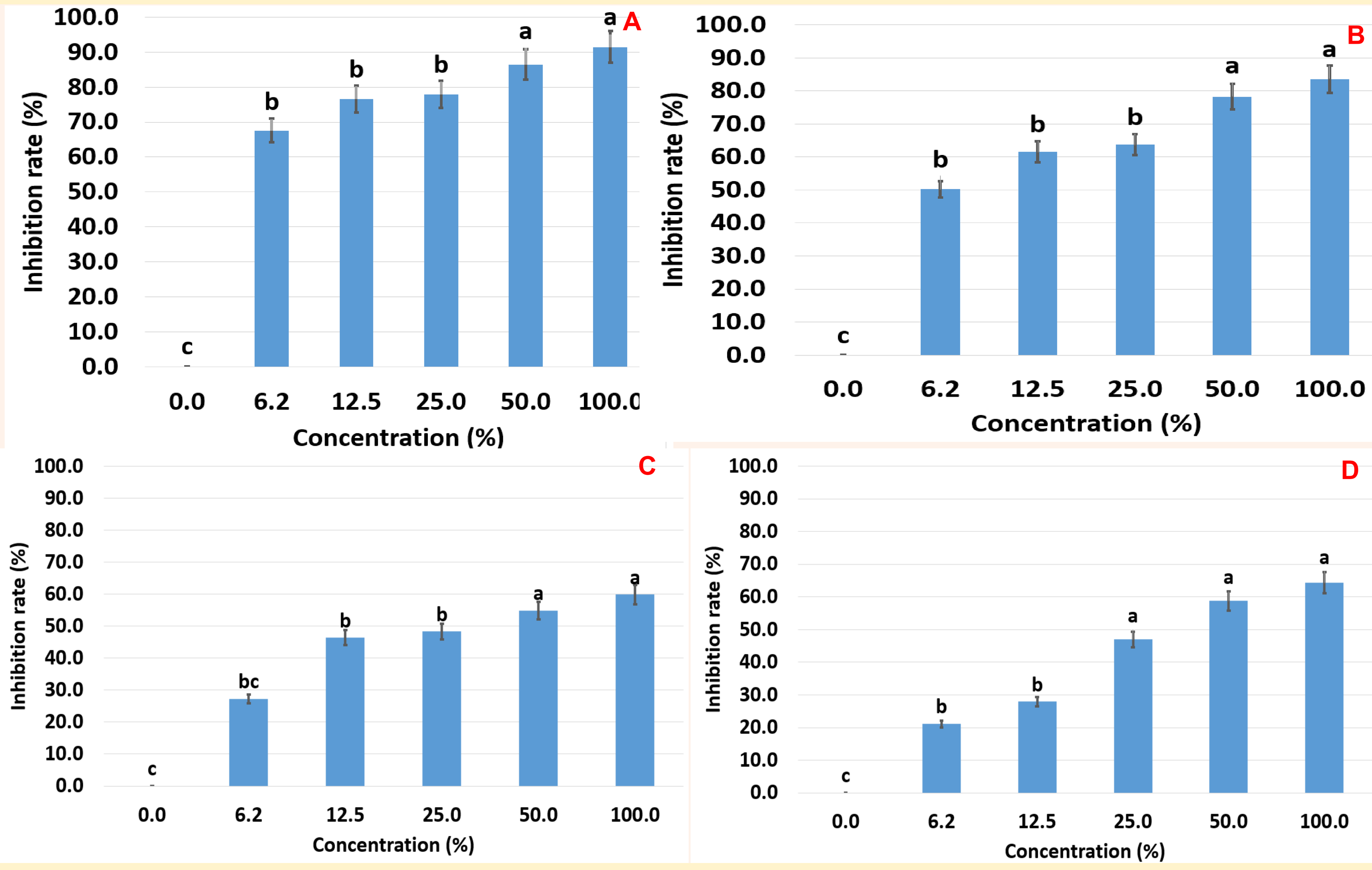


Figure 2. Inhibition rate of radicle (A) and hypocotyl (B) of *S. bicolor*, and radicle (C) and hypocotyl (D) on *P. vulgaris* seeds by metabolites of *Colletotrichum* sp.

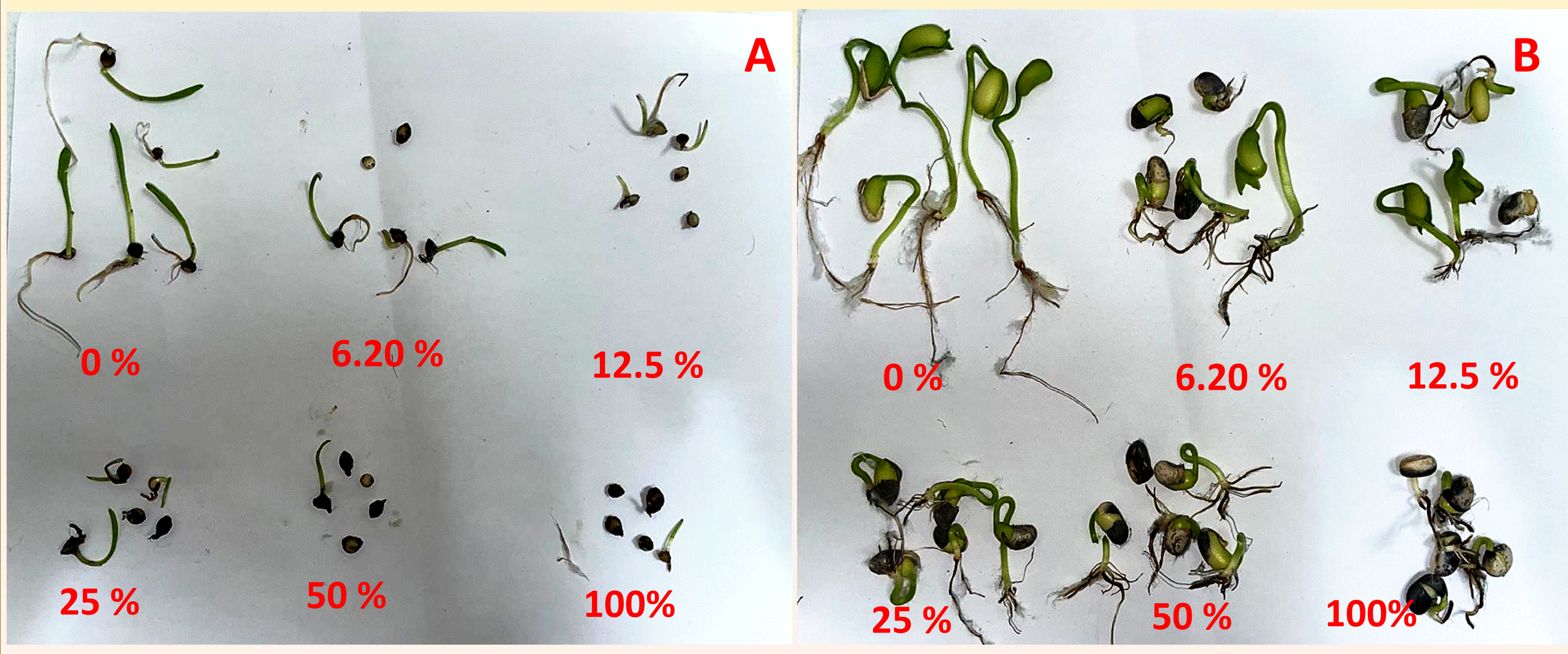


Figure 3. Effect of metabolites from *Colletotrichum* sp. on *Sorghum bicolor* (A) and *Phaseolus vulgaris* (B) seeds at different concentrations.

Table 1. Metabolites found in *Colletotrichum* sp. by high-performance liquid chromatography in the reverse phase (HPLC-MS).

Metabolites	Compound	Retention time (minutes)	Mass	Family
Colletotrichum sp.	Caffeic acid 4-O-glucoside	5.302	341.6	Hydroxycinnamic acids
	p-HPEA-EA	17.288	361.8	Tyrosols
	Chrysoeriol 7-O-(6''-malonyl-glucoside)	17.185	547	Methoxyflavones
	Malvidin 3,5-O-diglucoside	22.893	654.9	Anthocyanins

CONCLUSIONS

The secondary metabolites produced by Colletotrichum sp. have the potential to be used as bioherbicides for the control of pre-emergence weeds. Neverthless, studies must continue to be carried out to improve their effectiveness and better understand metabolites' action on plants.

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