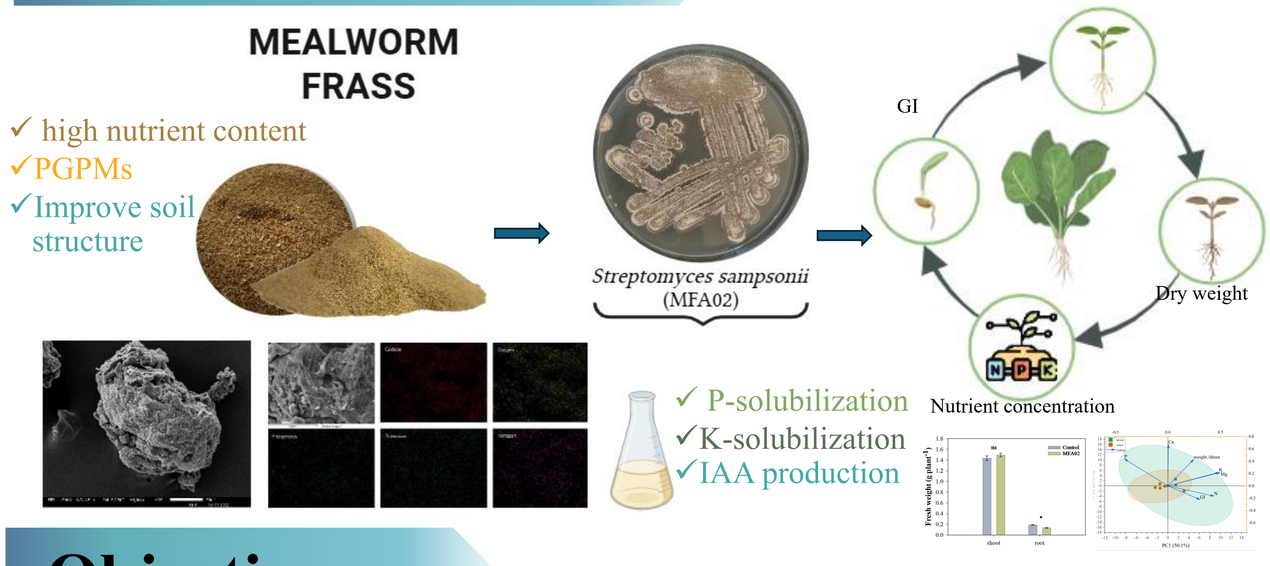
Evaluation of *Streptomyces sampsonii* (MFA02) from mealworm frass as a biofertilizer for Chinese kale

Phanumat Ainta[1], Supawadee Boontui[1], Rattanaphon Chaima[1], Nuttapon Khongdee[2], Nichakarn Pota[1], Tawanchai Khuendee[1], Narin Iamthongin[1], Yupa Chromkaew[1]

[1]Chiang Mai University, Dept. of Plant and Soil Science, Thailand
[2]Chiang Mai University, Dept. of Highland Agric. and Natural Resources, Thailand

*Corresponding author : E-mail yupa.c@cmu.ac.th

Graphical abstract



Introduction

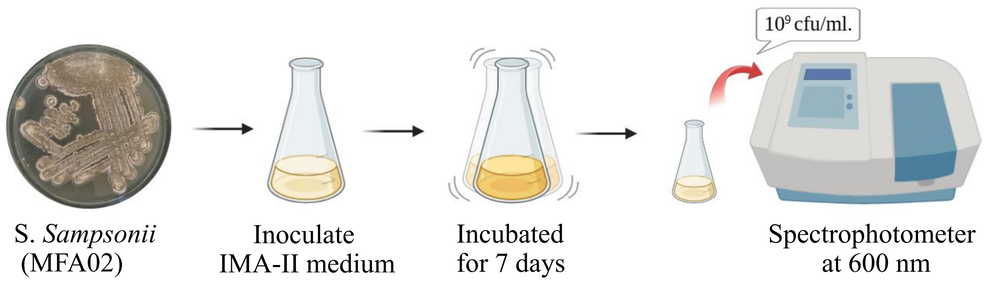
- Mealworm frass shows excellent potential as a sustainable fertilizer alternative due to its rapid mineralization rate and high nutrient availability.
- The mealworm frass microbiota have plant growth promotion properties (K/P solubilization and IAA production).
- However, a significant knowledge gap exists regarding the specific mechanisms by which mealworm frass-associated microbiota promote early plant growth responses.

Objectives

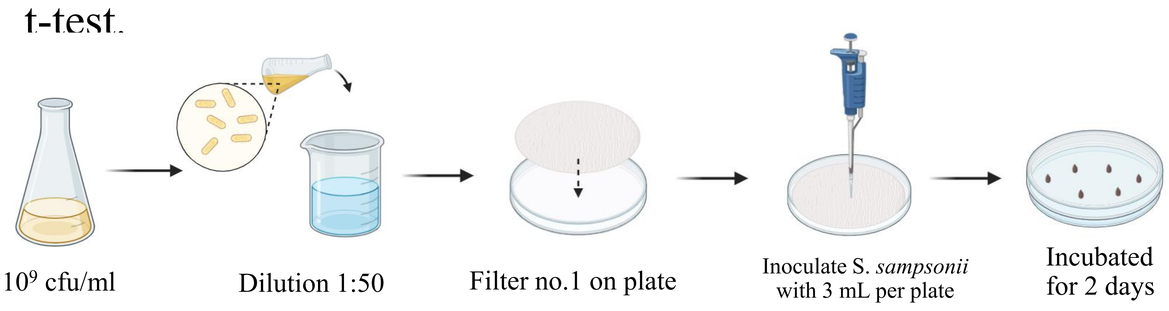
➢ This study examined the influence of *Streptomyces sampsonii* (MFA02) inoculation on growth parameters in Chinese kale seedlings.

Materials and Methods

➢ Preparation of *Streptomyces sampsonii* (MFA02), isolated from mealworm frass.



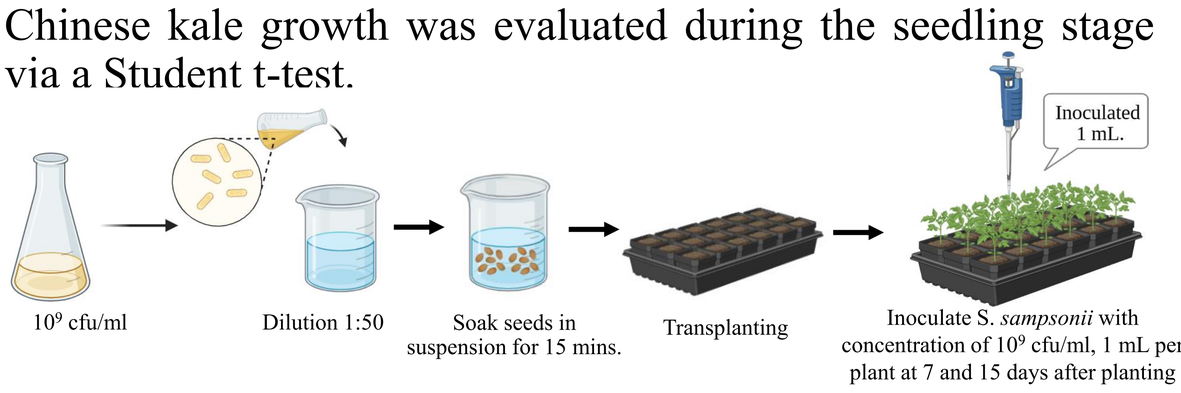
➢ **Experiment I.** The effect of S. *sampsonii* (MFA02) inoculation on Chinese kale seed germination percentage via a Student t-test.



- Calculate germination percentage

$$\text{Germination percentage} = \frac{\text{Number of germinated seeds}}{\text{Total number of seeds}} \times 100$$

➢ **Experiment II.** The efficacy of S. *sampsonii* (MFA02) on Chinese kale growth was evaluated during the seedling stage via a Student t-test.



- Plant sample was analyzed for total nitrogen (N), total phosphorus (P), and total potassium (K).

Results

Table 1 Phosphate solubilization, Potassium solubilization and Indole 3-acetic acid (IAA) production of S. *sampsonii* (MFA02)

Isolate	Phosphate solubilization (mg P L^{-1})	Potassium solubilization (mg K L^{-1})	Indole 3-acetic acid (µg mL^{-1})
MFA02	37.20	1.94	1.63

Results (cont.)

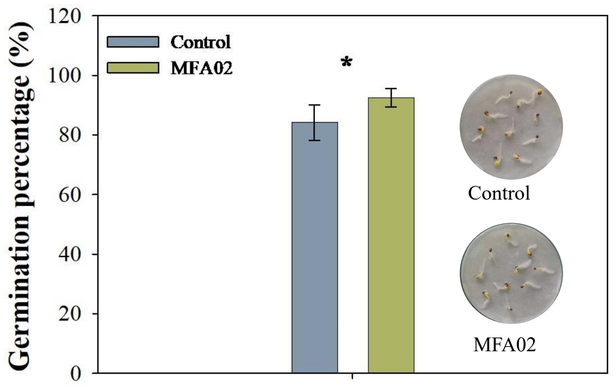


Figure 1. The germination percentage in seedlings.

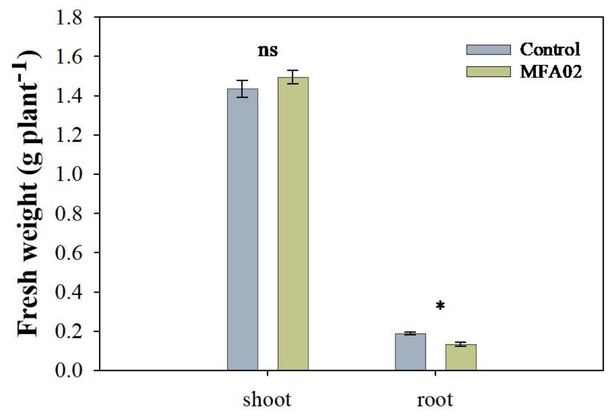


Figure 2. The fresh weight of Chinese kale in seedlings.

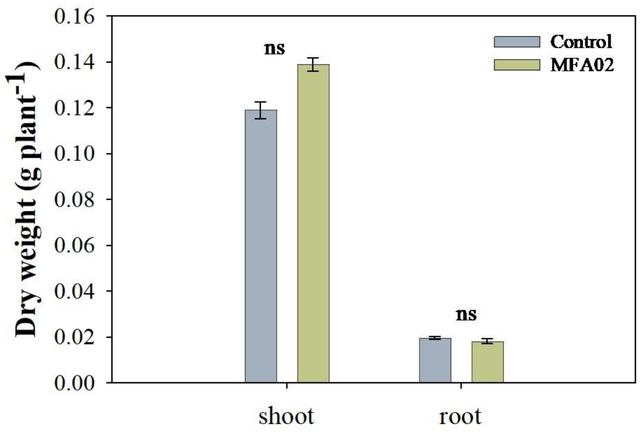


Figure 3. The dry weight of Chinese kale in seedlings.

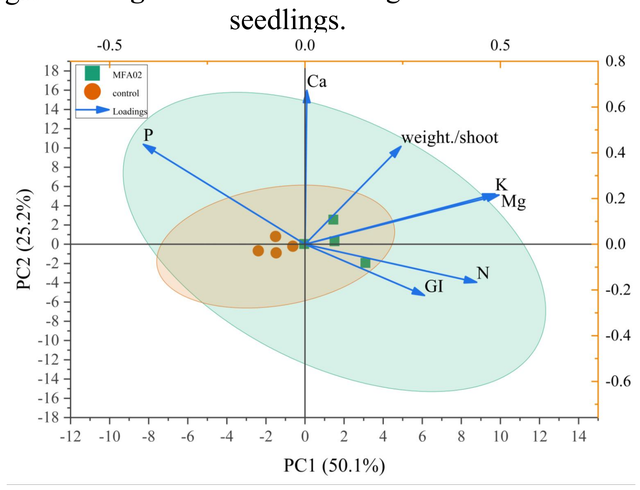


Figure 4. Principal component analysis (PCA) graph showing interactions between fresh weight (shoot/root), germination percentage, and nutrient concentration of Chinese kale in seedlings under inoculation with S. *sampsonii* (MFA02).

Table 2. Influence of S. *sampsonii* (MFA02) on nutrient concentration in seedlings.

Treatments	Concentration (%)									
	root					shoot				
	N	P	K	Ca	Mg	N	P	K	Ca	Mg
Control	2.13	0.41	1.01	0.59	0.21	3.13	0.64	1.58	3.02	0.36
MFA02	2.91	0.42	1.09	0.63	0.23	3.54	0.50	2.84	3.52	0.54
Student t-test	ns	ns	ns	ns	ns	*	ns	*	ns	*
t-critical	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18

Note: * significant difference at $p<0.05$

Table 3. Chemical analysis of the media before and after planting

Treatments	pH (1:10)	EC (µS/m)	OM (%)	Total (%)				
				N	P	K	Ca	Mg
media before planting	6.0	40.0	63.09	1.303	0.002	0.033	6.301	0.156
Control	5.25	1.15	72.88	0.995	0.027	0.075	1.619	0.126
MFA02	5.41	1.87	75.91	1.807	0.033	0.029	1.391	0.193
Student t-test	ns	*	ns	ns	ns	ns	ns	ns
t-critical	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30

Note: * significant difference at $p<0.05$

Conclusion

These findings indicate that S. *sampsonii* (MFA02) could serve as an effective biofertilizer for sustainable farming by reducing dependence on synthetic fertilizers while improving crop quality and yield and minimizing both the costs and environmental impact.

Acknowledgement

This research work was partially supported by the Soil Microbiology Laboratory, Soil Science, Department of Plant and Soil Science, Faculty of Agriculture, Chiang Mai University, Thailand.