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Title: Growth promotion and productivity of tomato using two plant biostimulants: Arbuscular mycorrhizal fungi and seaweed extract

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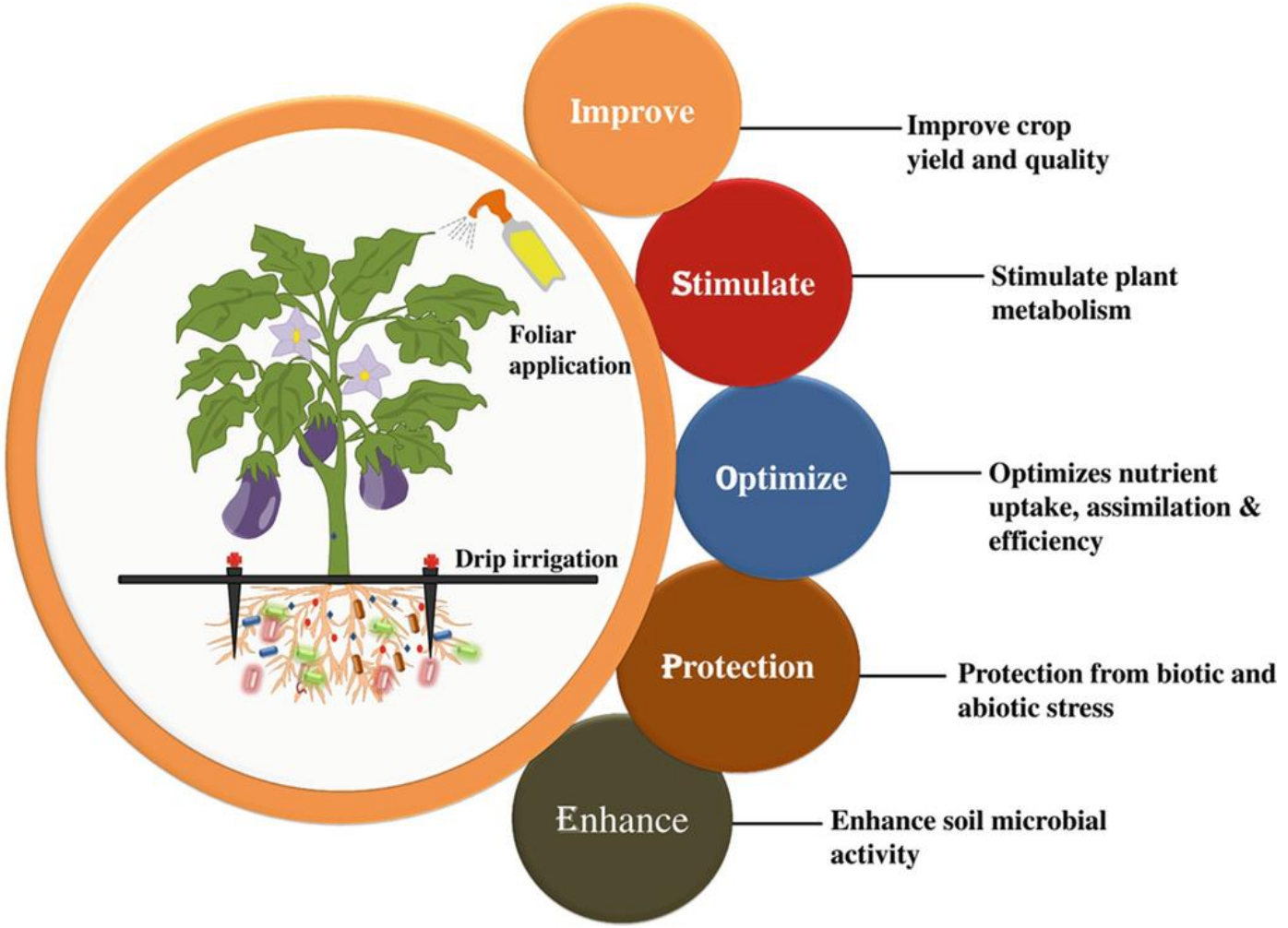
Plant biostimulants

Any substance or microorganism that improves nutritional efficiency, tolerance or quality of particular traits.

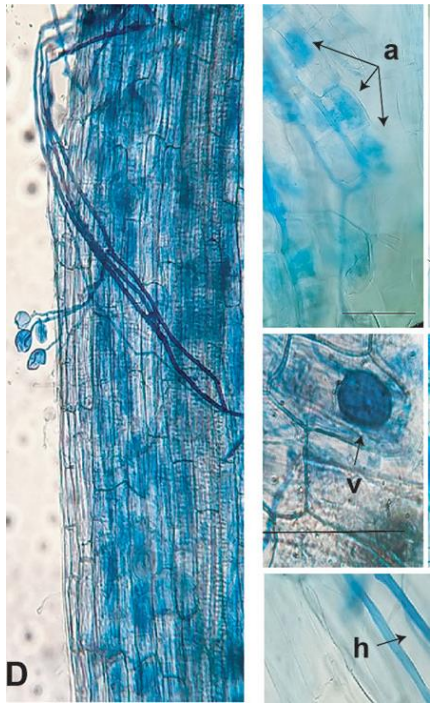
- humic and fulvic acids
- protein hydrolysates
- botanical and seaweed extracts inorganic compounds
- beneficial fungi and bacteria



Rajput 2019

Arbuscular Mycorrhizal Fungi (AMF)

Rhizophagus intraradices



Seaweed Extract (SWE)

Ulva lactuca

AMF

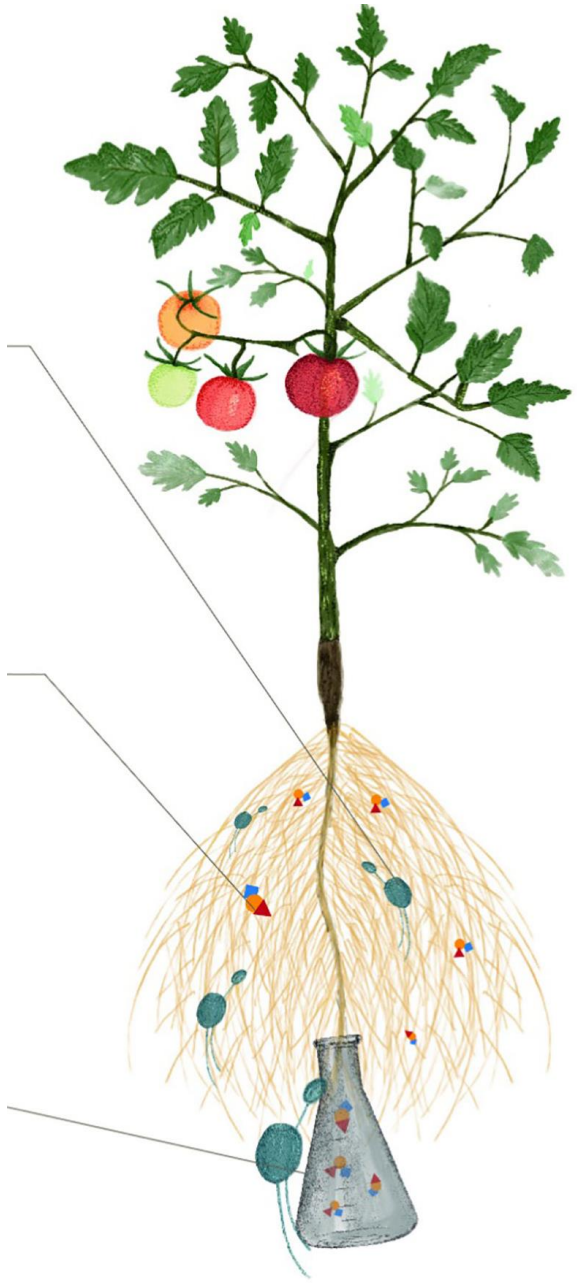
stimulate plant growth
promote abiotic stress tolerance, improve resistance to both pests and diseases
improve the nutritional status
increased yields and fertilization efficiency

SWE

promote seed establishment and germination
increase growth, yields, flower and fruit production
resistance to biotic and abiotic stress
postharvest shelf life

SWE + AMF

benefits
additive or synergistic



González-González *et al.* 2020

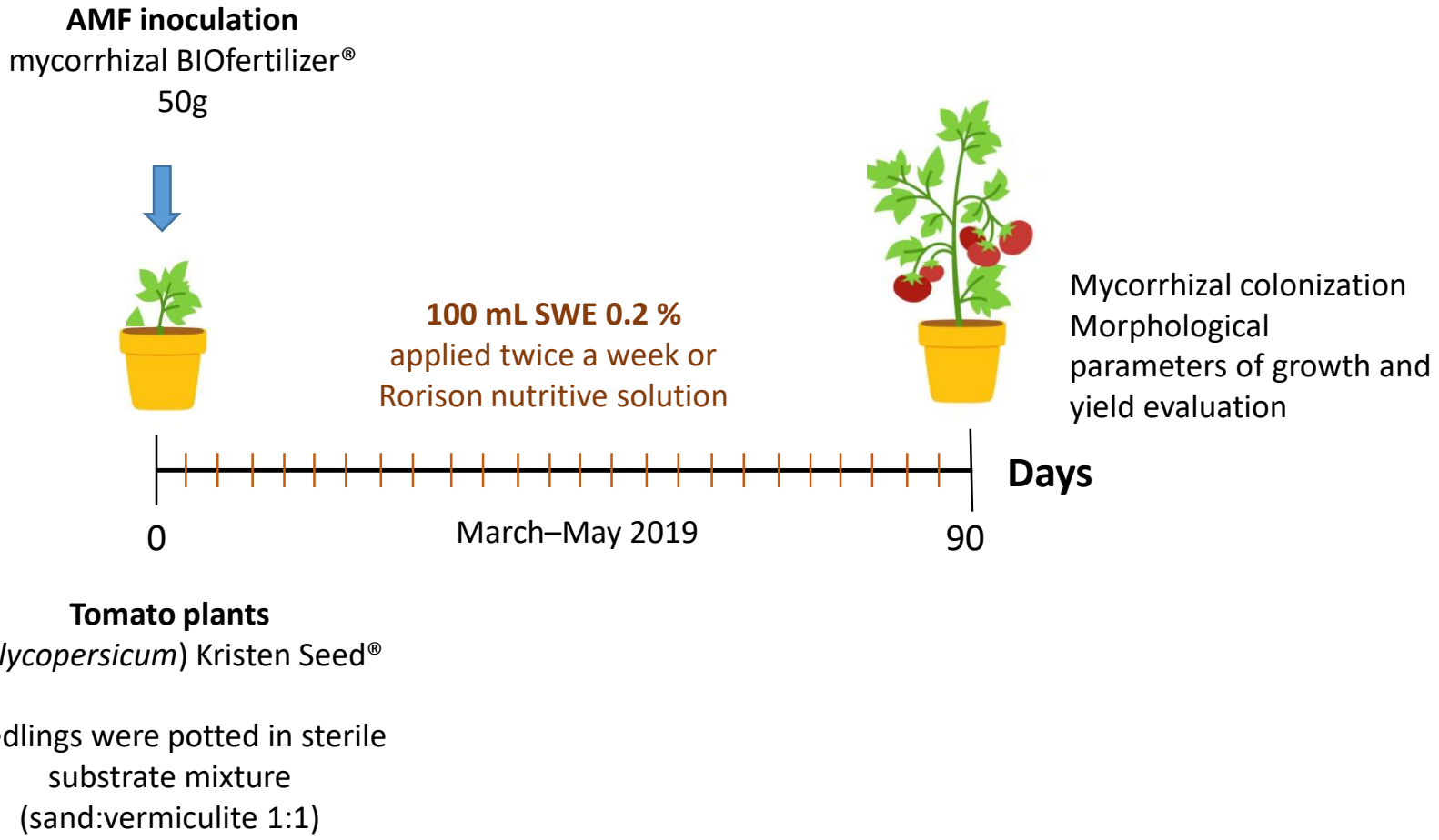
Methodology

Greenhouse plant growth conditions and experimental design

A random block experiment with 4 treatments with 14 repetitions each (n = 56 plants).

Treatments

1) **Control** - plants watered with Rorison nutritive solution
2) **RI** - plants inoculated with AMF
3) **SWE** - plants treated with the seaweed extract
4) **RI + SWE** - plants inoculated with AMF and treated with SWE

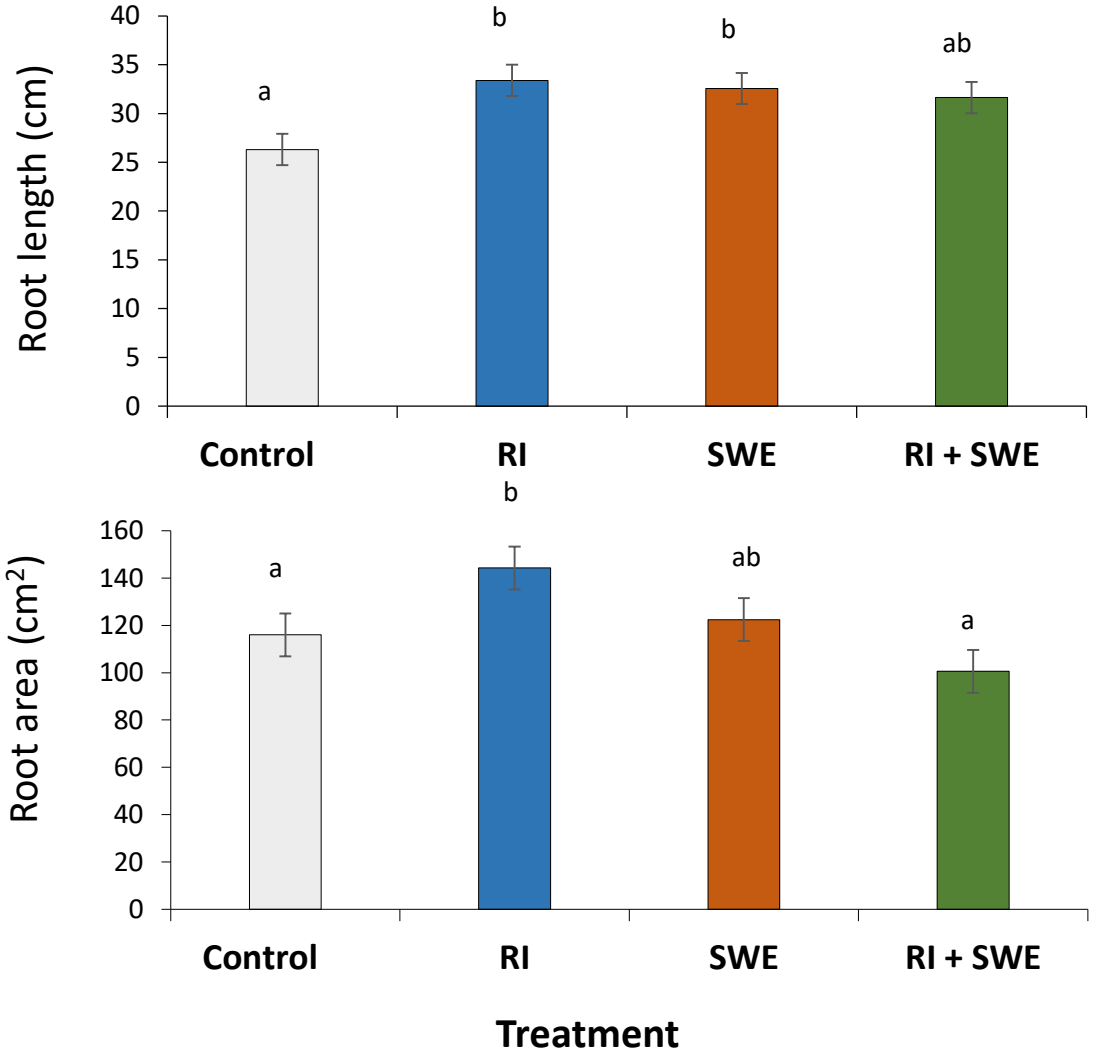


Results

Growth promotion in tomato plants

SWE and AMF inoculation significantly increased root length.

No significant differences were present among plants that were treated with both biostimulants (RI + SWE).

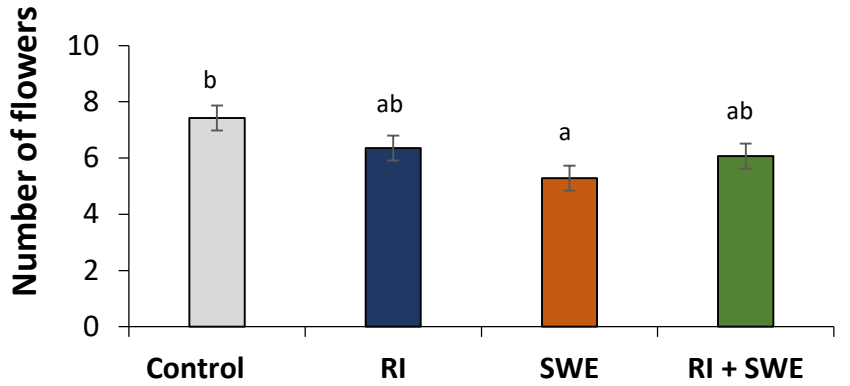


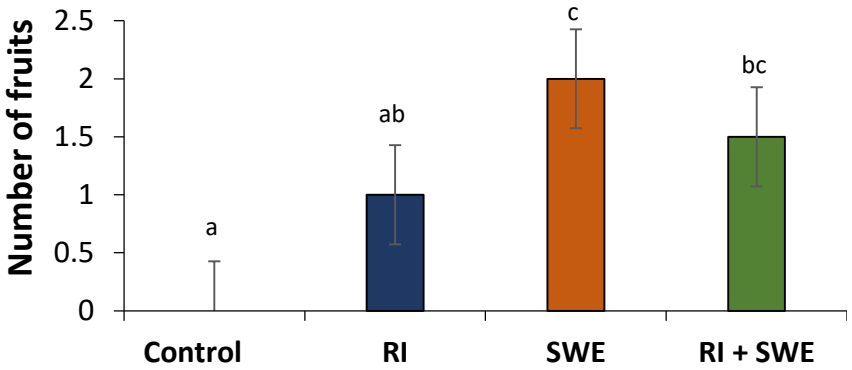
None of the treatments resulted in positive growth promotion in aerial tissues.

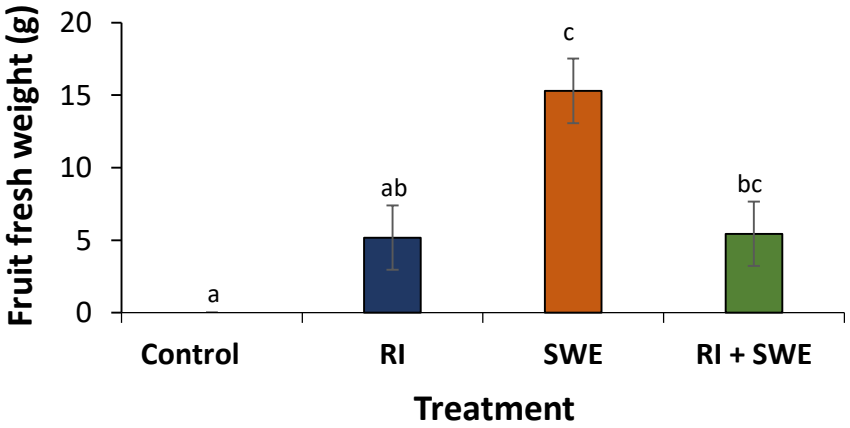
	Foliar area (cm^2)	Number of leaves	Stem lenght (cm)	Sprout fresh weight (g)
Control	185.3 ± 11.6^a	70.9 ± 8.7^a	54.6 ± 7.9^a	16.2 ± 1.6^a
RI	179.8 ± 10.5^a	73.3 ± 5.4^a	56.7 ± 7.7^a	15.5 ± 1.6^a
SWE	170.5 ± 12.3^a	62.3 ± 10.3^a	47.2 ± 5.0^a	15.4 ± 1.5^a
RI + SWE	161 ± 15.6^a	63.7 ± 13.8^a	48.3 ± 5.4^a	14.4 ± 2.1^a

Number of fruits per plant was higher in all biostimulant treatments.

SWE with highest number and weight of fruits, followed by RI + SWE

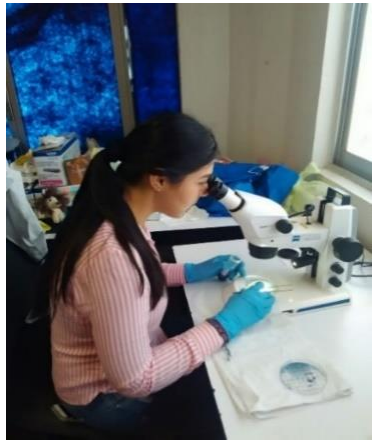


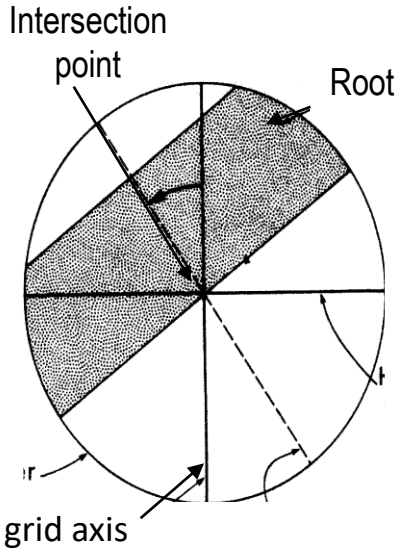


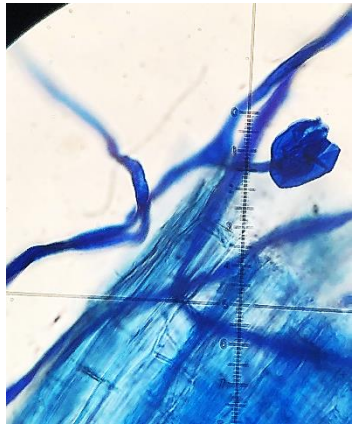


AMF Rhizophagus intraradices colonization

The magnified intersection method
(McGonigle *et al.*,1990)

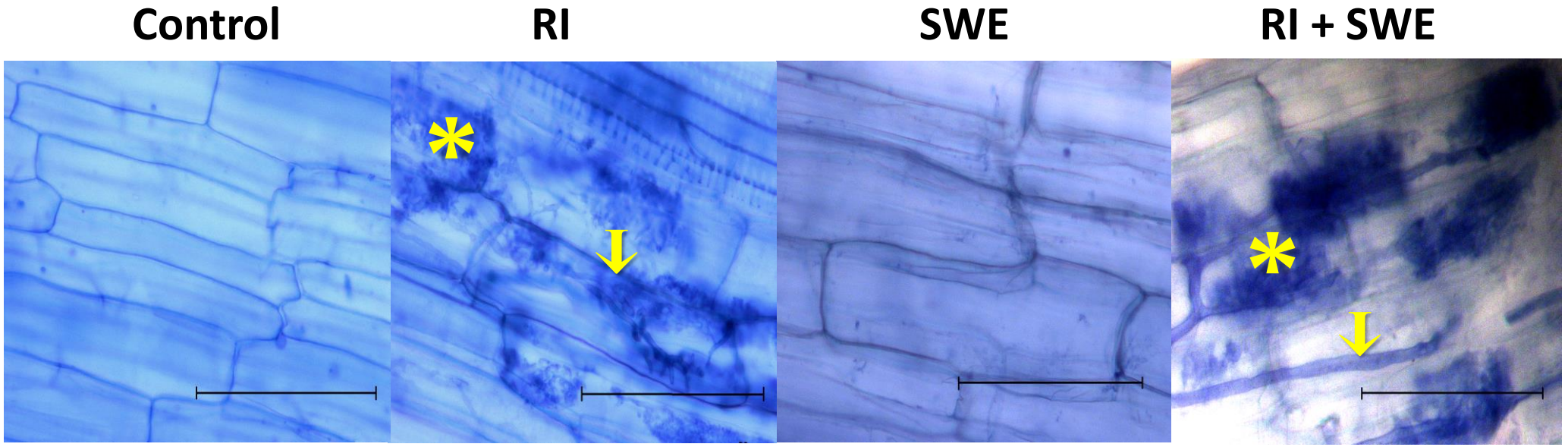






$$\%\ LCR = 100 \times \frac{Number\ of\ intersections\ with\ HMA\ structures}{Total\ number\ of\ counted\ intersections}$$

Rhizophagus intraradices fungal structures in tomato plant roots



SYMBOLS: *, arbuscles; ↓, intraradical hypha; scale bars represent 100mm 40X

U. lactuca extract promotes mycorrhizal symbiosis

	Hypha	Arbuscles	%CRL
RI	49.5[a]	8.8[a]	49.2[a]
RI + SWE	52.3[a]	**65.5[b]**	**82.6[b]**

RI + SWE treatment showed 8-fold the number of arbuscles than those of the RI treatment.

Conclusions

- AMF and SWE each was found to positively stimulate plant growth and performance in different but complementary ways.
- AMF promoted growth and root development, whereas SWE promoted flowering and tomato fruit formation.
- *U. lactuca* extract stimulated the development of fungal structures and *R. intraradices* colonization (%) in tomato plant roots.
- No advantageous effects were observed from the joint application of the two biostimulants.

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