Effects of High-Temperature and Soil Moisture Conditions on the Physiological Response of Cucumber

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Objectives

- This study was conducted to determine the effects of a combination of air temperature and soil moisture content and foliar application of biostimulants on growth, physiological response, antioxidant enzyme activity and yield of cucumber (*Cucumis sativus* L.).

Material & Methods

- Cucumber ('Chungchun'/'*C. ficifolia* Bouche') was transplanted on March 12, 2021 in a glasshouse at National Institute of Horticultural and Herbal Science, located in Wanju, Korea.
- At 35 days after transplanting, the plants were moved into extreme weather growth chambers (EWGC; Modified CEEWS model, Environmental Growth Chambers, Chargin Falls, OH, USA) and sprayed with 176 ppm ascorbic acid, 100 ppm salicylic acid, 145 ppm spermidine and water, respectively. These treatments commenced at four days after first treatments and were applied at 200 mL per plant.
- After foliar application, the air temperatures were set at ambient (28/18°C), ambient+3°C (31/21°C) and ambient+6°C (34/24°C), respectively and the soil moisture were controlled at deficit irrigation (DI, 20%) or fully irrigation (OI, 30-35%) for seven days.

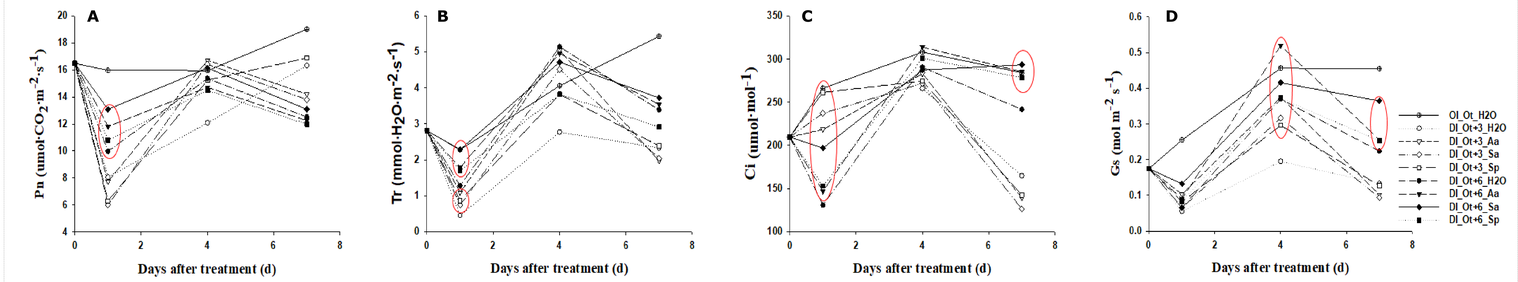

Fig. 1 . Comparison of photosynthetic rate (Pn, A), transpiration rate (Tr, B), stomatal conductance (Gs, C) and intracellular CO_2 concentration (Ci, D) of cucumber leaves as affected by treatment with ascorbic acid (Aa), salicylic acid (SA), spermidine (Sp) and water under exposure to high-temperature and water deficit.

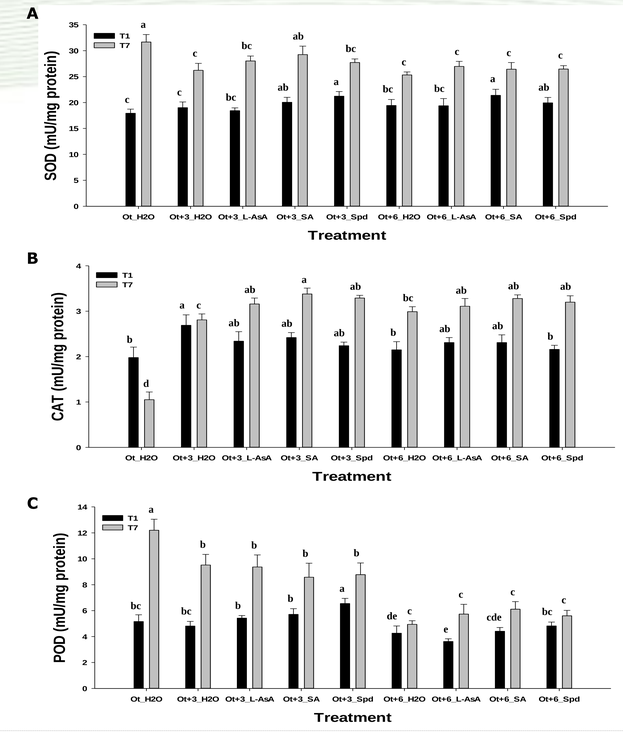

Fig. 2. Comparison of superoxide dismutase (SOD, A), catalase (CAT, B) and peroxidase (POD, C) activity levels in cucumber leaves as affected by treatment with ascorbic acid (Aa), salicylic acid (SA), and spermidine (Sp) on one and seven days after high-temperature and water deficit treatments.

Table. Growth and fruit characteristics of cucumber as affected by foliar application of ascorbic acid, salicylic acid, and spermidine and exposure to high temperature and water deficit at 70 days after transplanting.

Temperature	Soil moisture	Foliar application	Plant height (cm)	No. of leaves (ea)	Leaf area (cm^2)	No. of branches (ea)	Top (g)		Root (g)		No. of harvested fruit (/plants)	No. of marketable fruit (/plants)	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	No. of disorder (/plants)			Marketible yield (kg/10a)[z]	Yield index
							Fresh weight	Dry weight	Fresh weight	Dry weight						Aborted fruit	Curved fruit	Unformal fruit		
Ambient	Fully irrigation	H_2O	245.1 a[y]	21.9 c	5,022.8 cd	28.4 c	254.8 b	48.9 a	15.6 d	1.5 a	6.8 a	3.4 a	142.2 b	24.3 ab	29.6 b	3.3 ab	0.1 a	-	558.7	100
Ambient+3°C	Deficient irrigation	H_2O	232.3 abc	23.1 bc	4,932.3 d	29.5 bc	256.1 b	44.4 b	20.4 a	1.8 a	6.3 a	2.5 ab	150.4 ab	23.9 ab	30.2 ab	3.6 b	0.1 a	0.2 a	432.4	77
		L-ascorbic acid 176 ppm	229.4 c	23.3 bc	5,618.4 ab	30.1 ab	270.2 ab	31.5 cd	17.2 bcd	1.7 a	5.0 a	2.5 ab	159.2 ab	24.2 ab	30.0 b	2.3 ab	0.3 a	0.0 a	457.6	82
		Salicylic acid 100 ppm	235.0 abc	22.6 c	5,557.0 abc	29.7 b	268.6 ab	45.1 b	19.0 abc	1.7 a	6.3 a	2.9 ab	150.5 ab	24.4 ab	30.3 ab	3.1 ab	0.3 a	0.0 a	504.8	90
		Spermidine 145 ppm	230.3 bc	23.3 bc	5,190.5 bcd	30.0 ab	257.8 b	32.8 c	16.1 cd	1.5 a	6.2 a	2.5 ab	173.8 a	24.9 a	32.4 a	3.3 ab	0.2 a	0.2 a	508.7	**91**
Ambient+6°C	Deficient irrigation	H_2O	239.9 abc	24.1 ab	6,071.5 a	30.0 ab	288.1 a	45.6 b	19.3 ab	1.8 a	5.3 a	2.3 b	145.6 b	24.2 ab	29.5 b	2.8 ab	0.3 a	0.1 a	376.6	67
		L-ascorbic acid 176 ppm	225.5 c	23.3 bc	5,599.5 abc	29.6 bc	265.5 ab	30.0 d	18.0 abcd	1.8 a	4.8 a	3.1 ab	150.5 ab	23.7 ab	30.4 ab	1.4 a	0.3 a	0.1 a	533.8	**96**
		Salicylic acid 100 ppm	243.9 ab	25.1 a	5,880.9 a	31.1 a	284.6 a	31.7 cd	14.9 d	1.5 a	6.1 a	3.1 ab	143.1 b	23.6 b	30.6 ab	2.7 ab	0.1 a	0.2 a	507.4	91
		Spermidine 145 ppm	239.7 abc	24.3 ab	5,659.9 ab	30.6 ab	270.7 ab	31.7 cd	16.3 bcd	1.6 a	6.5 a	2.7 ab	167.4 ab	24.5 ab	31.5 ab	3.5 ab	0.3 a	0.1 a	513.3	92

[z] Yield was calculated by density (1,150/10a, 40cm X 150cm) X fresh weight of fruit.

[y] Mean separation within columns by Duncan's multiple range test at $P = 0.05$.

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