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Cornell University

Seaweed Extract Drenches Increase Postharvest Drought Tolerance of Bedding Plants

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Maintaining plant visual appearance and vigor in the retail environment is important for promoting sales to the consumer. Where poor plant care is provided, plant wilting is common. Under extended wilt conditions plants may pass the permanent wilting point where they can no longer recover after being rewatered. Many studies have indicated a wide range of beneficial effects of seaweed extract applications on plants, such as early seed germination and establishment, improved crop performance and yield, increased resistance to biotic and abiotic stress, and enhanced postharvest shelf-life of perishable products.

Stimplex (Acadian Seaplants, Dartmouth, Nova Scotia) is a commercially extract of seaweed Ascophyllum nodosum). Stimplex is registered in the U.S. as a crop biostimulant. The European biostimulants industry council (EBIC) has defined plant biostimulants as "substance(s) and/or microorganisms whose function when applied to plants or the rhizosphere is to stimulate natural processes to enhance/benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stress, and crop quality." Foliar and drench applications of seaweed extract (Stimplex) improved shoot growth and plant water status of citrus exposed to drought stress (Spann and Little, 2011). Neily et al. (2010) reported that drenches of seaweed extract (Stimplex) enhanced root and shoot growth of young seedlings of petunia, pansy, cosmos, lettuce, melon, tomato, pepper, and celery. Further, they found when water was withheld from pepper, lettuce, tomato, petunia and pansy Stimplex treatment extended the time before plants succumbed to wilt. The potential for improved drought stress when seaweed extract is used as well as its potential natural cytokinin benefits (which may improve leaf yellowing, etc.) suggests that it may be beneficial in improving postharvest life of floriculture crops.

The objective of this experiment was to determine the impact of Stimplex seaweed extract drenches on growth and postharvest drought tolerance of container-grown petunia, snapdragon, and tomato.

Summary of Findings

- Weekly drenches with 0.5% seaweed extract (Stimplex) increased stem strength of tomato
- Simplex drenches did not affect plant growth of petunia, snapdragon, or tomato during the greenhouse production phase
- Stimplex drenches delayed wilting of drought-stressed petunia and snadpragon plants in a simulated indoor retail environment

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Acadian Seaplants

Stimplex CROP BIOSTIMULANT

Photo 1. Stimplex treatment led to stronger stems of tomato 'Celebrity' pictured here prior to moving to the postharvest environment. Control plant on Left, Stimplex treated plant on Right.

Materials and Methods

A greenhouse experiment was conducted in the summer at Cornell University (Ithaca, NY). Seeds of petunia 'Hurrah White' and snapdragon 'Montego Pink' were seeded on commercial peat-based substrate (MetroMix 360) on 23 June, 2010. Tomato 'Celebrity' was seeded in a similar manner on 7 July, 2010. 200-cell plug trays were used with a 15 mL volume per cell. During the seed establishment period plants received periodic mist for the first two weeks (10 seconds every five minutes during the day). Seedlings recieved weekly fertilizer drenches with 150 ppm N from Jack's Professional 21-5-20 fertilizer.

On 28 July plants from the three species were transplanted with one plant per 4-inch round pot (volume 500 mL) with a commercial peat-based substrate (Lambert Peat Moss LM-111). At this time plants were irrigated daily with water containing 150 ppm N from Jack's Professional 21-5-20 fertilizer. Plants were arranged into a completely randomized design and assigned to one of two treatments 1) control – no Stimplex, and 2) Stimplex treated. There were 16 replicates per treatment combination. Beginning on 28 July Stimplex treated plants received once weekly drenches for five weeks of a 0.5% Stimplex solution (i.e. 5 mL Stimplex in 1 L of deionized water). Each container received 100 mL of solution per drench event. Over the course of the 5 weeks, the treated plants received a total of 2.5 mL of Stimplex product. Untreated controls received 100 mL of deionized water per drench event. On 1 September, 8 replicates from each species and treatment combination were destructively harvested to determine plant height (to the tallest part of the plant), plant diameter (widest part of the plant as viewed from above averaged with width at a 90 degree angle to the widest part), flower number (flowers open petals), fresh weight (FW) and dryweight (DW, following 3 days in an oven at 80 °C).

Table 1. Plant growth characteristics of petunia 'Hurrah White' and snapdragon 'Montego Pink' tomato 'Celebrity' in response to five weekly 100 mL drenches of 0.5% Stimplex. Numbers represent mean ± SE (n=8). Analysis of Variance found no statistically significant treatment effects for the measured growth parameters.

Treatment	Diameter (cm)	Height (cm)	Flower No.	Fresh weight (g)	Dry weight (g)
Petunia					
Control	30.0 ± 0.7	28.1 ± 0.6	27.1 ± 2.6	95.0 ± 7.3	7.6 ± 0.5
Stimplex	30.4 ± 0.6	27.4 ± 1.1	29.3 ± 2.6	103.9 ± 5.0	7.5 ± 0.5
Snapdragon					
Control	19.8 ± 0.4	17.8 ± 0.5	15.8 ± 2.9	35.1 ± 1.5	4.1 ± 0.2
Stimplex	21.0 ± 0.5	17.7 ± 0.3	16.5 ± 2.7	35.8 ± 2.0	4.1 ± 0.3
Tomato					
Control	46.5 ± 1.4	47.0 ± 0.9	1.5 ± 0.3	88.9 ± 2.6	9.7 ± 0.3
Stimplex	46.5 ± 1.6	48.3 ± 0.9	1.3 ± 0.3	93.5 ± 1.2	9.5 ± 0.2

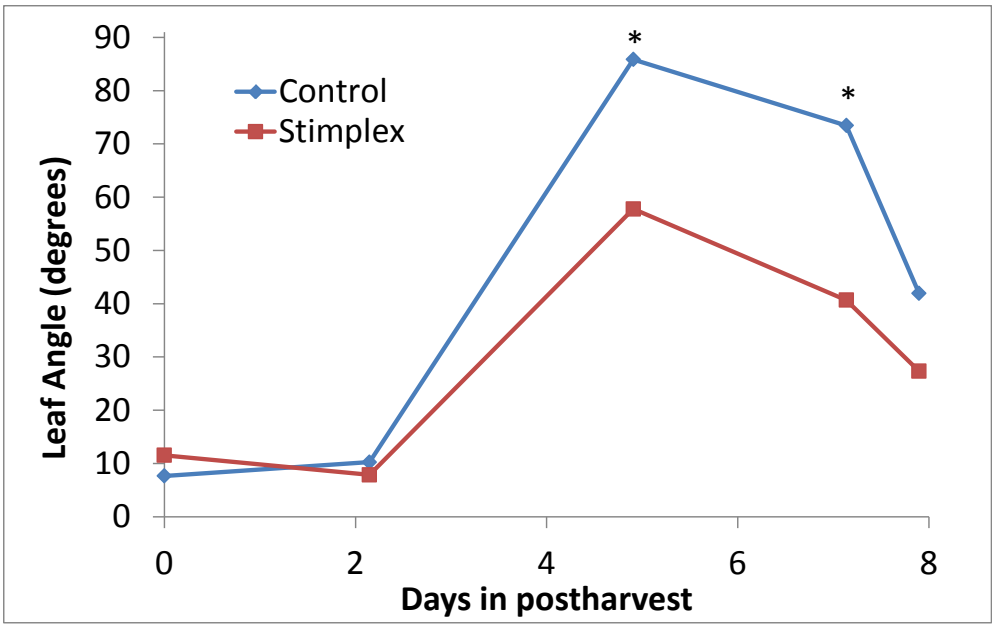

Figure 1. Leaf angle (0°=turgid, 90°=fully wilted) of Petunia 'Hurrah White' plants in response to Stimplex treatment in a postharvest life room. Data are means of 5 plants, with 3 leaf angle measurements per plant. Plants were rewatered 6 days into postharvest, the last two measurements were after rewatering. A * denotes that Stimplex leaf angle was significantly different from control at that time point.

Five of the remaining plants of each treatment combination were selected for subsequent drought stress experiments in a simulated indoor retail environment. The selected plants were moved to a postharvest room maintained at 22 °C with fluorescent lighting provided for 12 hours per day. As the plants were moved into the postharvest room there were watered to container capacity once. Wilting was monitored periodically by determining a visual wilt index (table below) and by measuring leaf angle (of three upper most expanded leaves) using a digital protractor. (That is a leaf angle close to 0° would be completely turgid, while a completely wilted leaf would register an angle of 90°). Petunia and snapdragon were rewatered (to container capacity) once plants had nearly completely wilted to determine subsequent recovery from wilt.

Results

After five weekly drenches of Stimplex or deionized water in the greenhouse, 8 representative plants were destructively sampled to determine treatment effects on plant growth. There were no statistically significant differences in plant diameter, height, flower number, fresh weight or dry weight based on Stimplex application (Table 1). An interesting visual observation was made for tomatoes. Control tomatoes had weak stems and plants could not remain upright without stakes. Stimplex treatment led to stronger stems of tomatoes and greatly lessened plant

Photo 2. Petunia plants after 4½ days of drought stress in the postharvest environment. Control plant on Left, Stimplex treated plant on Right.

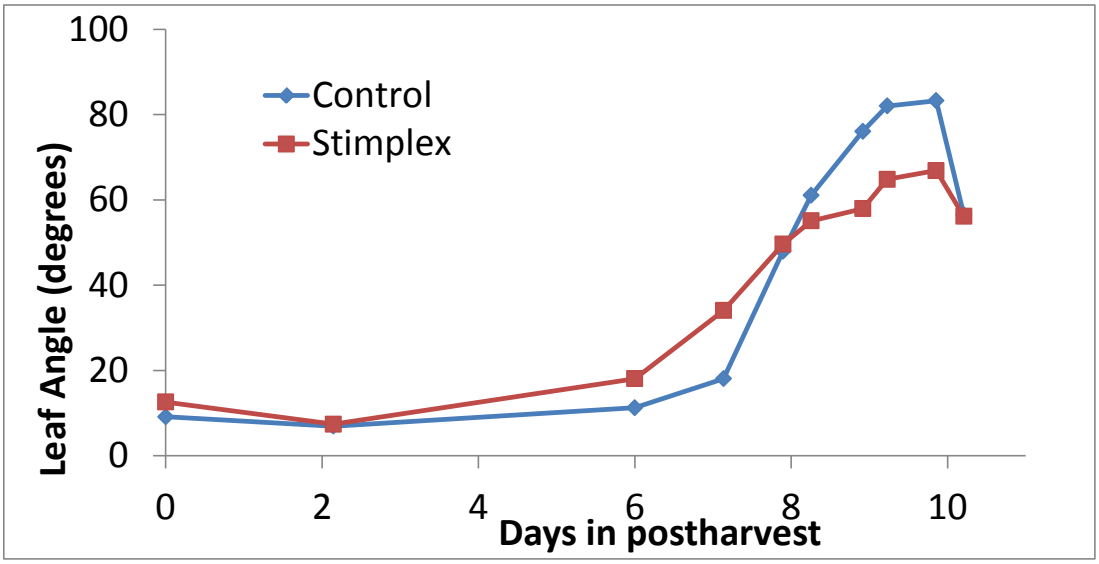

Figure 2. Leaf angle of Snapdragon 'Montego Pink' plants in response to Stimplex treatment in a postharvest life room. Data are means of 5 plants, with 3 leaf angle measurements per plant. Plants were rewatered 8 hours before the last measurement. According to Analysis of Variance, leaf angles were not significantly different at the measured time points.

leaning (Photo 1). Five representative remaining plants were moved to a simulated indoor retail environment. The plants were well-watered once and then left unwatered for several days. Base line and subsequent leaf angle measurements (a quantitative measure of wilting) were recorded. For the first two days petunias exhibited no symptoms of wilting in either treatment (Figure 1). At 4½ days without water, control petunias exhibited severe wilting and were considered unsaleable, Stimplex treated plants were beginning to show signs of wilt but this was much less severe (Photo 2). Petunias were rewatered at day 6 to observe recovery from wilt. By day 7, Stimplex treated plants showed greater recover from wilt; at day 8, both control and Stimplex plants had recovered from wilt (Figure 1).

Snapdragons took the longest to wilt of the three species studied. At 6 days with no water, plants were still marketable with very little evidence of wilting (Figure 2). Over the next three days wilting occurred rapidly and by day 9 control plants were severely wilted. There is some evidence that Stimplex decreased wilting at day 8 and 9 but the differences compared to the control were not statistically significantly. Plants were rewatered after 9½ days of drought stress, and by day 10 plants from both treatments were beginning to recover.

Tomatoes were the quickest to wilt of the three species. After 2 days without water, control plants had wilted severely, while Stimplex treated plants were somewhat less wilted (Figure 3, Photo 3). By 2½ days without watered, plants had further wilted and there was no longer a significant differences in wilting between control and Stimplex treated plants.

Summary

Weekly drenches of 0.5% Stimplex did not affect plant growth characteristics of petunia, snapdragon and tomato in the greenhouse production phase. Visually, Stimplex treatments increased stem strength of tomato plants as they exhibited less toppling than untreated controls. During the postharvest drought treatments in a simulated retail environment, Stimplex treated plants exhibited significantly delayed wilting for petunia and tomato. This suggests that Stimplex drenches may be a useful tool during greenhouse production to improve postharvest life (plant shelf life) and reduce crop shrinkage in the retail environment. More work is needed to look at varying concentration of Stimplex and to compare foliar sprays to substrate drenches.

Acknowledgements

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References

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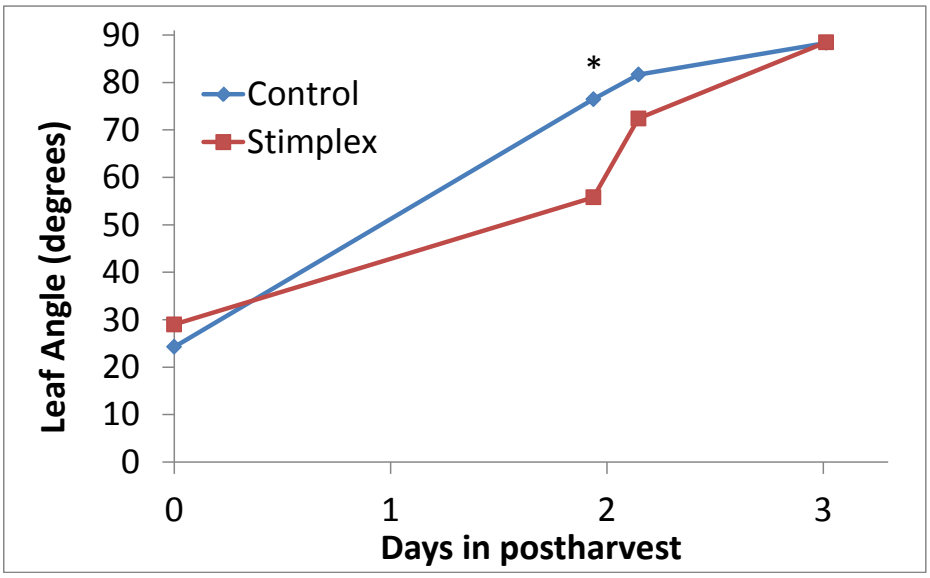

Figure 3. Leaf angle (0°=turgid, 90°=fully wilted) of Tomato 'Celebrity' plants in response to Stimplex treatment in a postharvest life room. Data are means of 5 plants, with 3 leaf angle measurements per plant. A * denotes that Stimplex leaf angle was significantly different from control at that time point.

Photo 3. Tomato plants after 2 days of drought stress in the postharvest environment. Control plant on Left, Stimplex treated plant on Right.

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