

**Center for Applied Horticultural Research (CfAHR)
Research Report**

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Project Title: Comparing 'High Strength' Formulation of Paclobutrazol to Piccolo

Abstract

Plant growth regulators (PGR) are an important and extensively used tool among ornamental plant growers. New and more effective chemicals are desirable as they might result in fewer applications, better plant growth control and lower costs. In this trial, we tested two formulations of paclobutrazol, the standard concentration of 0.4% (Piccolo) and a high strength 4% formulation (FAL 491). Plants of *Celosia plumosa* 'Red Velvet', *Petunia x hybrida* 'Dreams' mix, *Salvia greggii* and *Lantana camara* 'Dallas Red' were treated with Piccolo and FAL 491 at 1x and 2x the recommended rate of Piccolo. Four rates and two methods of application (spray and drench) were tested. All plants were kept in a climate controlled greenhouse at 65/75 °F night/day temperature. Height at 0, 7 and 14 days after application and at flower anthesis was measured. The date of flower anthesis for each plant was recorded and the number of days from treatment application to flower anthesis was calculated. The plants were screened for phytotoxicity symptoms at 3, 7 and 14 days after treatment application. In general, FAL 491 and Piccolo were equally effective at controlling height in responsive plants. Petunias were shorter at the higher rates of application while *Celosia* and *Lantana* plants had similar heights at all rates of application but were shorter than untreated plants. *Salvia greggii* did not respond to the application of either FAL 491 or Piccolo at any of the rates tested. FAL 491 and Piccolo reduced the height at flower anthesis of *Petunia* and *Lantana* but did not have any effect on *Salvia*. The effect of the chemicals on height at flower anthesis of *Celosia* was not determined since the plants had flowers before the application of the treatments. None of the plants had symptoms of phytotoxicity at any time during the trial.

Objective:

1. Determine the relative efficacy of two different formulations of the plant growth retardant paclobutrazol (i.e. the 'standard' 0.4% Piccolo versus a 'high strength' 4% formulation) on popular bedding plant crops, applied as a spray or substrate drench.

Materials and Methods

Plant Material:

The crops selected for this study were *Celosia plumosa* 'Red Velvet', *Petunia x hybrida* 'Dreams' mix, *Salvia greggii* and *Lantana camara* 'Dallas Red'. Twenty seven 806s pack of each, *Petunia* and *Celosia* and 72 plants of each, *Salvia* and *Lantana* were obtained from a local grower.

Plant Care and Treatment:

Plants were placed in a climate-controlled greenhouse at 65/75 °F night/day temperature.

Treatments:

No	Product	Formulation	Rate	App. Method
1	Control	NA	NA	NA
2	FAL 491	4% paclobutrazol	20ppm	Spray
3	FAL 491	4% paclobutrazol	40ppm	Spray
4	Piccolo	0.4% paclobutrazol	20ppm	Spray
5	Piccolo	0.4% paclobutrazol	40ppm	Spray
6	FAL 491	4% paclobutrazol	1ppm	Drench
7	FAL 491	4% paclobutrazol	2ppm	Drench
8	Piccolo	0.4% paclobutrazol	1ppm	Drench
9	Piccolo	0.4% paclobutrazol	2ppm	Drench

Applications:

Treatment applications were made using a hand held sprayer. The method of application was either foliar spray, at a volume of 2 quarts per 100 sq.ft. or media drench, at approximately 2 fluid ounces per cell in the 806s packs and 6 fluid ounces per quart pot. This volume was enough to ensure good distribution and retention within the substrate plus an amount that was allowed to drain from the containers.

Measurements:

Height of each plant was recorded before treatment application, 7 and 14 days after application. Plants were screened for symptoms of phytotoxicity at 3, 7 and 14 days after treatment application. Height of the plants at anthesis of the first flower and date of anthesis were also recorded. Height of Celosia, Petunia and Lantana was measured using a digital caliper. The height of Salvia was measured using a ruler.

Experimental Design and Sampling:

For Petunia and Celosia, each treatment consisted of three 806 packs each containing 6 cells (plants), for a total of 27 packs per species. Treatments for Lantana and Salvia consisted of 8 plants, in quarts, per treatment. After treatment application, Lantana and Salvia plants were completely randomized on a greenhouse bench. Petunia and Celosia packs were placed in a complete randomized block arrangement on another bench.

Analysis:

Data were analyzed using analysis of variance and Student's t-test ($p=0.05$) was used to separate means.

Results:

None of the treated plants had symptoms of phytotoxicity at any time after the application of the treatments. The treatments effect varied depending on the plant species. Since Petunia and Celosia plants were arranged in a randomized block design with subsamples, the block and subsample components of the model were tested and they were not significant; there was no significant variation between packs placed in different blocks on the bench and between cells within the packs. The appearance of the plants at the beginning of the study can be seen in figure 7.

Petunia x hybrida 'Dreams' Mix:

All plants had similar height at the beginning of the study (Figure 1). At 7 and 14 days after treatment application, all treated plants were significantly shorter than the control plants. Piccolo

and FAL 491 were equally effective in controlling plant height. Fourteen days after treatment, plants drenched with Piccolo and FAL 491 at 2ppm and sprayed at 40ppm were significantly shorter than plants in all other treatments (Figure 1). Regarding height at flower, it was reduced in all treatments when compared to the control group. Plants treated with Piccolo at 2 and 40ppm and FAL 491 at 20 and 40ppm had similar height at flower anthesis and they were the shortest plants at anthesis (Figures 1 and 8). The number of days from treatment application to flower anthesis was calculated from the recorded date of flower; it varied between 13.4 and 10.8 days. FAL 491 at 20ppm was the only treatment to differ significantly from the control plants (Figure 2). It seems that neither Piccolo nor FAL 491 affects the time of flower anthesis, the differences observed between FAL 491 at 20ppm and the rest of the treatments might be related to the physiological stage of the plant and not to the effect of the treatments.

Celosia plumosa 'Red Velvet':

All plants had flowers at the time they were received at the center; the chemicals applied had no effect on the flowers already present on the plants and no additional flowers developed after they were applied. Plant height before treatment application was between 38.20 and 49.7mm (Figure 3). At 7 days after treatment, Piccolo and FAL 491 were equally effective in controlling plant height at 1, 2 and 20ppm, but Piccolo was more effective than FAL 491 at 40ppm. Fourteen days after treatment application, Piccolo controlled height better than FAL 491 at 20 and 40ppm (spray), but both chemicals controlled height equally at 1 and 2ppm (drench) (Figure 3). Plants treated with Piccolo at 20 and 40ppm were significantly shorter than the plants treated with FAL 491 at the beginning of the trial, this might be the reason why FAL 491 did not control height as well as Piccolo at 20 and 40ppm. It seems that the chemicals were not very effective controlling height of Celosia (Figure 9), since the difference in height between the control plants and Piccolo and FAL 491 treated plants (40ppm) was only 22.4 and 15.9mm respectively.

Lantana camara 'Dallas Red':

Lantana plants were not uniform in height at the time they were received at the center, the height varied between 69.8mm and 92.3 (Figure 4). Treatments were randomly assigned to plants. At 7 and 14 days after treatment all treated plants were shorter than untreated plants. Plants treated with Piccolo and FAL 491 at all concentrations and regardless of the method of application had similar height at 7 and 14 days after treatment and at flower anthesis but they were significantly shorter than the control plants (Figure 4). Regarding the number of days between the application of treatments and flower anthesis, there were differences among the treatments (Figure 5), but these differences seem random and related to the physiological age and stage of the plant rather than to the effect of the particular chemicals, rate or method of application. The appearance of the plants at the end of the study can be seen in figure 10.

Salvia greggii:

Salvia plants varied greatly within treatments; due to this variability, there were no significant differences between the control and the treated plants (Figure 6). Treated plants appeared to have shorter internodes and a somewhat reduced height when compared to control plants (Figures 11), but this difference in height was not statistically significant. *Salvia greggii* was included in this study because of the difficulty to control its growth. In this trial, not even the higher concentrations of FAL 491 had a statistically significant effect on the plants; the height of treated plants was similar to the height of the control plants at 7 and 14 days after application of the treatments and at flower anthesis. All plants bloomed at similar times after the application of treatments.

Conclusions:

- In general, Piccolo and FAL 491 were equally effective controlling height of *Petunia x hybrida* 'Dreams' mix, *Lantana camara* 'Dallas Red' and *Celosia plumosa* 'Red Velvet'. There were some differences on the effect of the chemicals on height depending on the treated species:

- In Petunia, FAL 491 and Piccolo were equally effective controlling plant height. FAL 491 and Piccolo drenched at 2ppm and sprayed at 40ppm provided the most reduction in height.
- In Celosia, FAL 491 was as effective as Piccolo controlling plant height at 1, 2 and 20ppm. In general, the difference in height between treated and untreated plants, although significant, was not very noticeable.
- In Lantana, FAL 491 controlled height as effectively as Piccolo. All treated plants were shorter than the control plants but their height was the same among the treatments.
- In *Salvia greggii*, neither Piccolo, nor FAL 491 controlled plant height effectively.
- Effects of FAL 491 compared to Piccolo on height at flower anthesis:
 - Celosia had bloomed before application of the treatments, so the effect could not be evaluated.
 - FAL 491 and Piccolo reduced the height of Petunia plants at flower anthesis compared to the height of untreated plants. The shortest plants in bloom were those treated at higher concentrations.
 - FAL 491 and Piccolo treated Lantana plants were shorter at flower anthesis than control plants, but had similar height among treatments.
 - Neither FAL 491 nor Piccolo had any effect on height at flower anthesis in *Salvia*.
- Although there were differences in the number of days to flower among the treatments, these differences appear to be due the physiological age of the plant, rather than the effect of the treatments.
- None of the treatments caused phytotoxicity in any of the species tested.

Figure 1. Mean (\pm SE) height of Petunia plants at flower anthesis (Height F) and at 0, 7 and 14 days after application of Piccolo and FAL 491 at different concentrations. Bars within days after treatment followed by different letters are significantly different, t-test ($p=0.05$). Treatments (x-axis) were control (untreated plants), FAL 491 and Piccolo at 1, 2 (Drench), 20 and 40ppm (Spray).

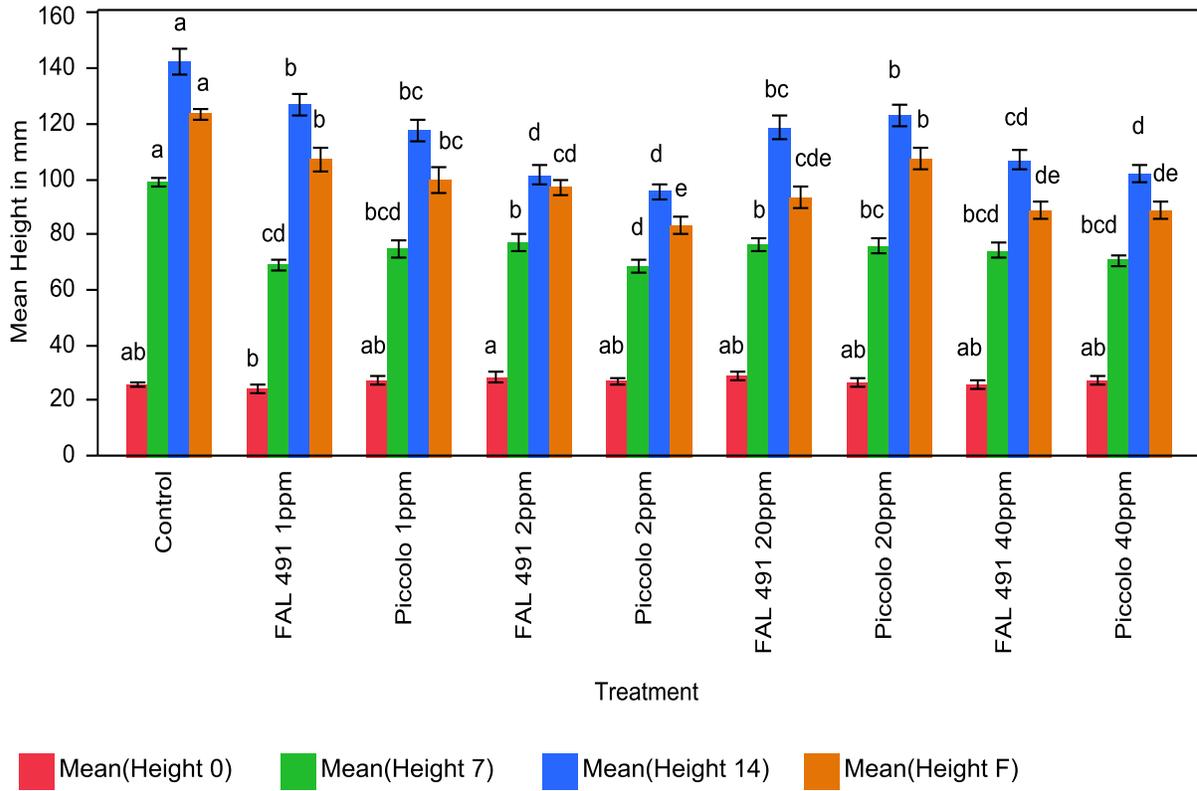


Figure 2. Mean (\pm SE) number of days between treatment application and flower anthesis of Petunia plants. Bars followed by different letters are significantly different, t-test ($p=0.05$). Treatments (x-axis) were control (untreated plants), FAL 491 and Piccolo at 1, 2 (Drench), 20 and 40ppm (Spray).

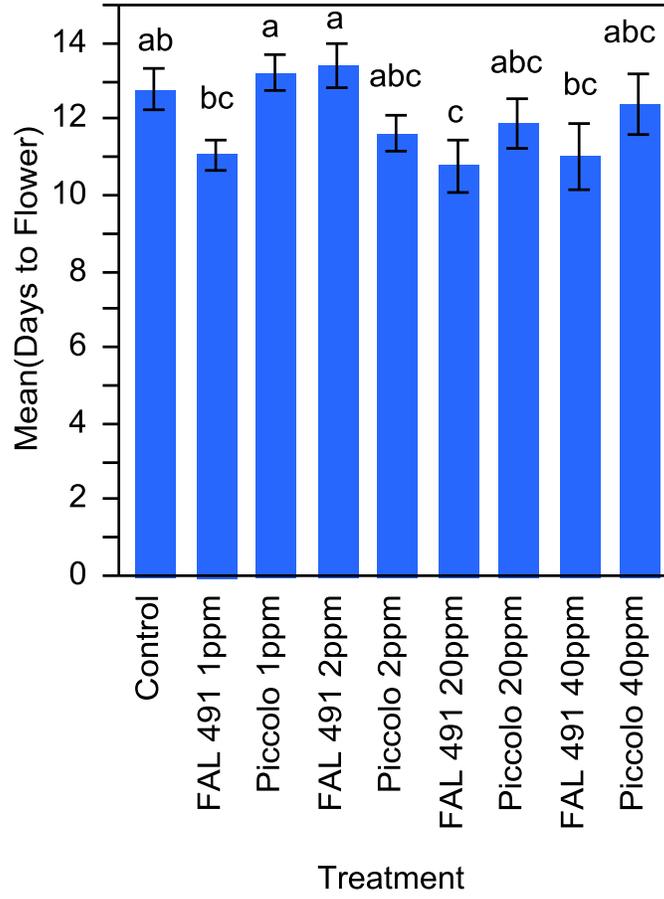


Figure 3. Mean (\pm SE) height of Celosia plants at 0, 7 and 14 days after application of Piccolo and FAL 491 at different concentrations. Bars within days after treatment followed by different letters are significantly different, t-test ($p=0.05$). Treatments (x-axis) were control (untreated plants), FAL 491 and Piccolo at 1, 2 (Drench), 20 and 40ppm (Spray).

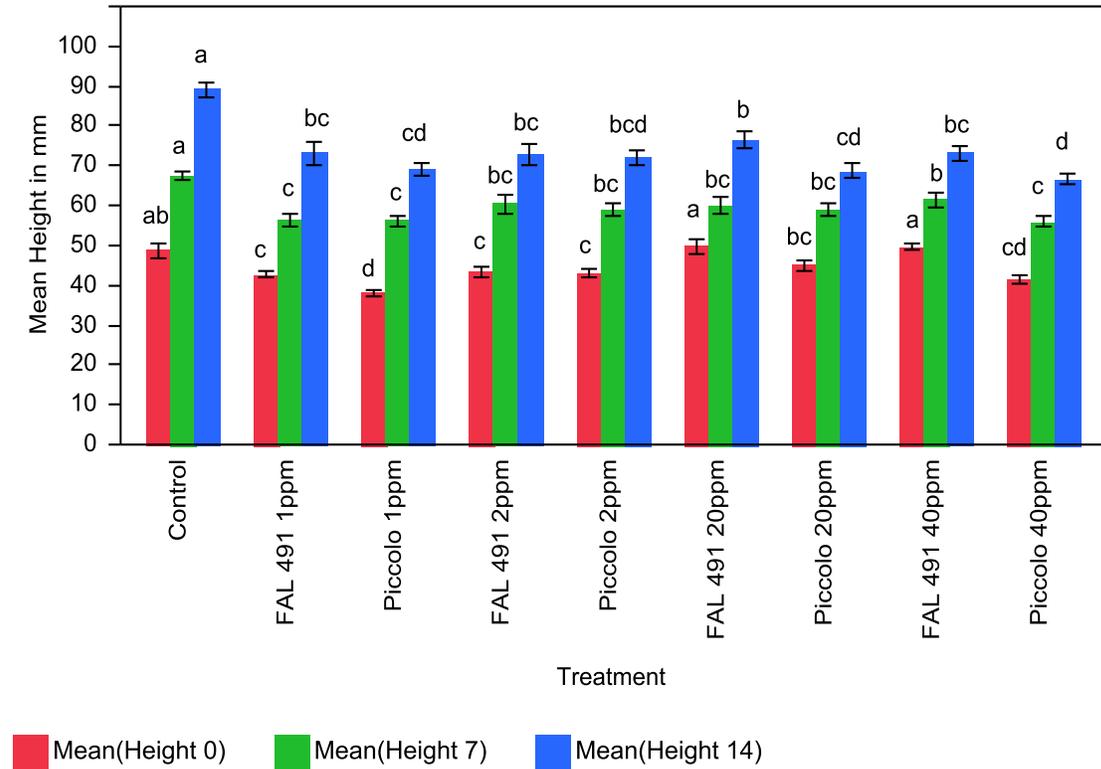


Figure 4. Mean (\pm SE) height of Lantana plants at flower anthesis (Height F) and at 0, 7 and 14 days after application of Piccolo and FAL 491 at different concentrations. Bars within days after treatment followed by different letters are significantly different, t-test ($p=0.05$). Treatments (x-axis) were control (untreated plants), FAL 491 and Piccolo at 1, 2 (Drench), 20 and 40ppm (Spray).

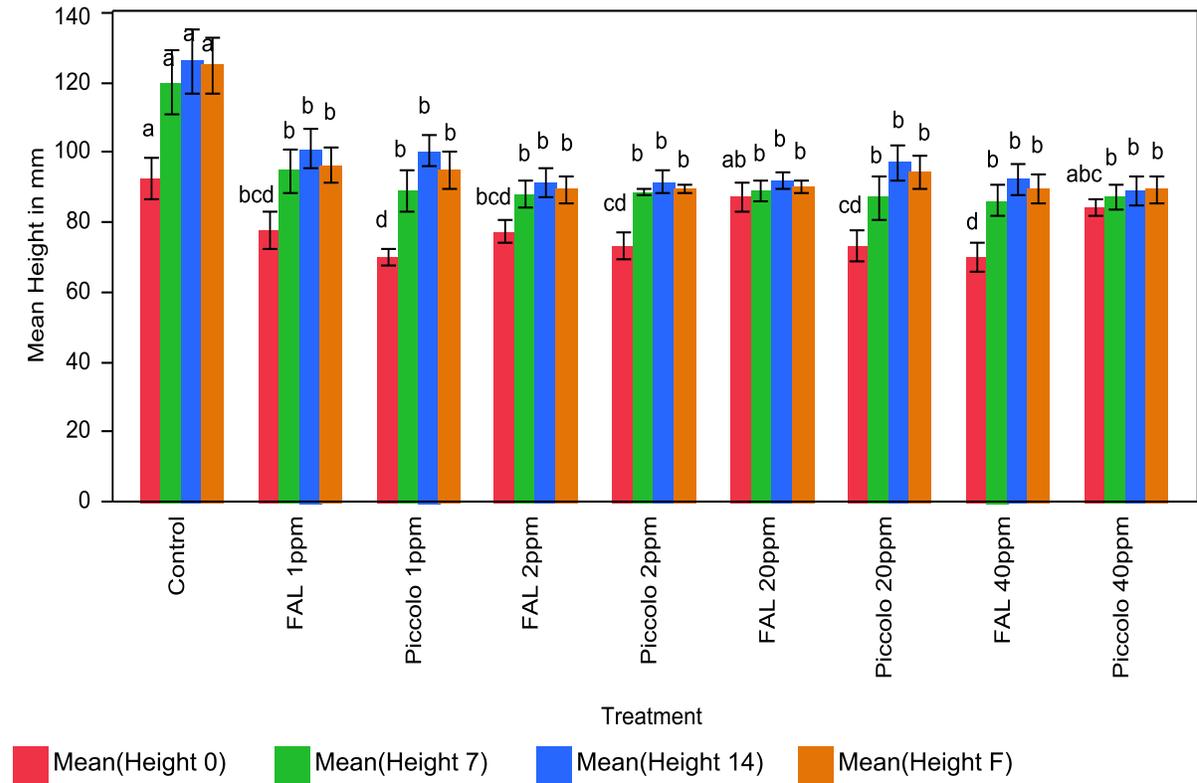


Figure 5. Mean (\pm SE) number of days between treatment application and flower anthesis of Lantana plants. Bars followed by different letters are significantly different, t-test ($p=0.05$). Treatments (x-axis) were control (untreated plants), FAL 491 and Piccolo at 1, 2 (Drench), 20 and 40ppm (Spray).

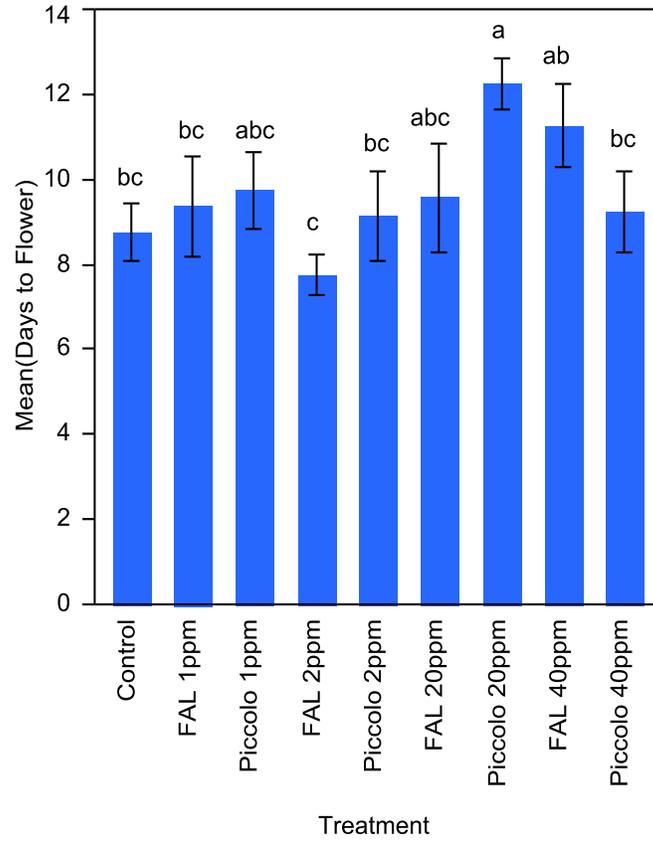


Figure 6. Mean (\pm SE) height of *Salvia* plants at flower anthesis (Height F) and at 0, 7 and 14 days after application of Piccolo and FAL 491 at different concentrations. Bars within days after treatment followed by different letters are significantly different, t-test ($p=0.05$). Treatments (x-axis) were control (untreated plants), FAL 491 and Piccolo at 1, 2 (Drench), 20 and 40ppm (Spray).

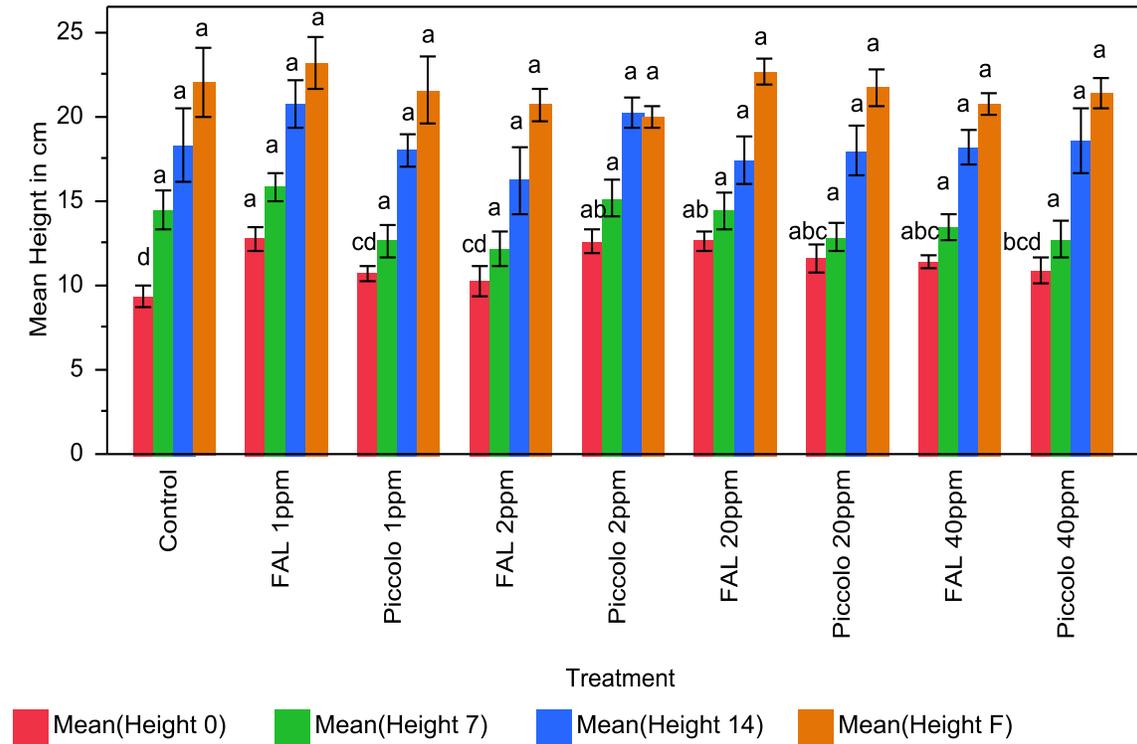


Figure 7. *Petunia x hybrida* 'Dreams' (A), *Celosia plumosa* 'Red Velvet' (B), *Salvia greggii* (C) and *Lantana camara* 'Dallas Red' (D) before treatment application.

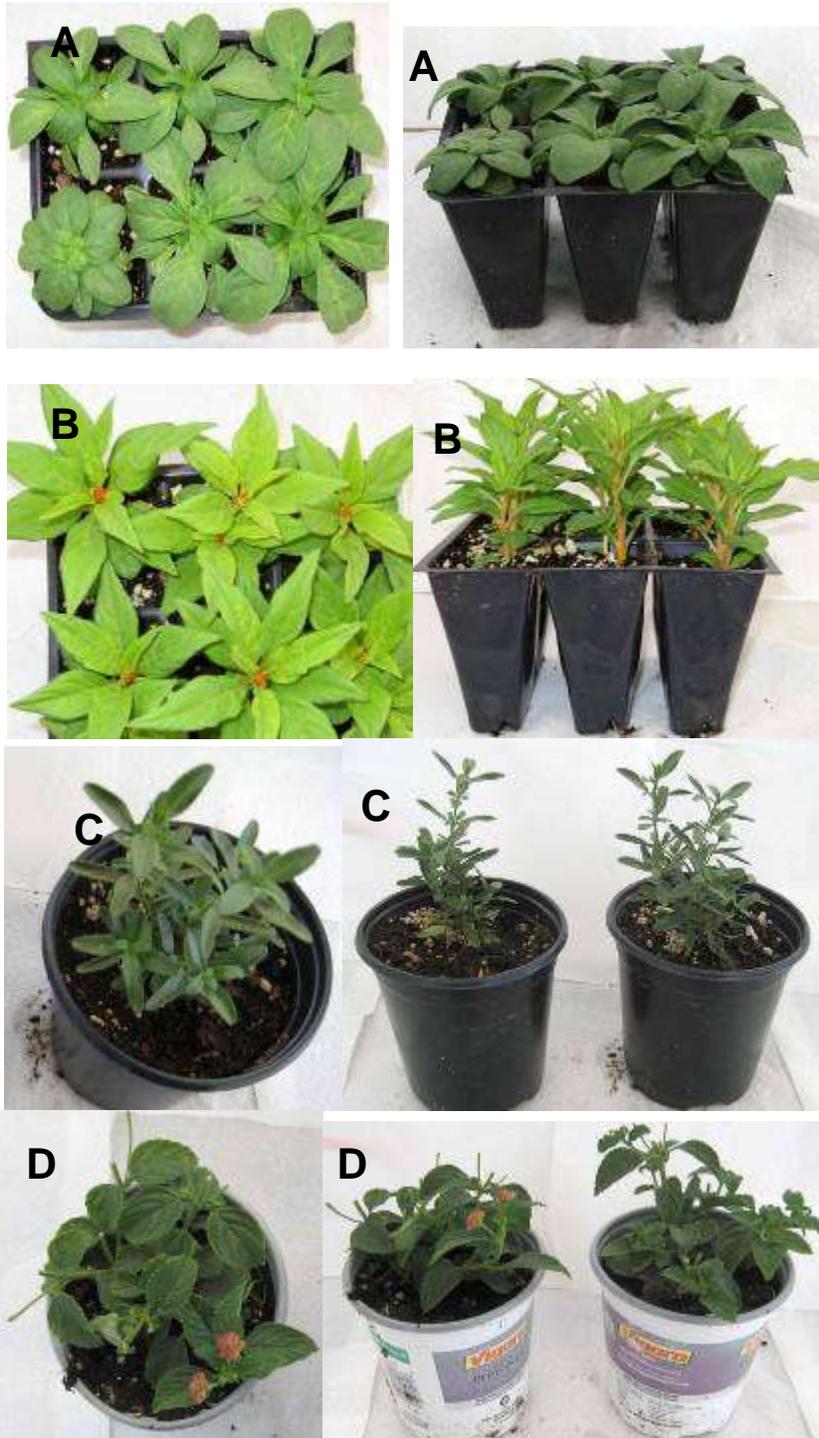


Figure 8. *Petunia x hybrida* 'Dreams' 14 days after treatment application. Treatments were Control (C), FAL 491 20ppm (F20), FAL 491 40ppm (F40), Piccolo 20ppm (P20), Piccolo 40ppm (P40), FAL 491 1ppm (F1), FAL 491 2ppm (F2), Piccolo 1ppm (P1) and Piccolo 2ppm (P2). Method of application was spray (A) or drench (B).

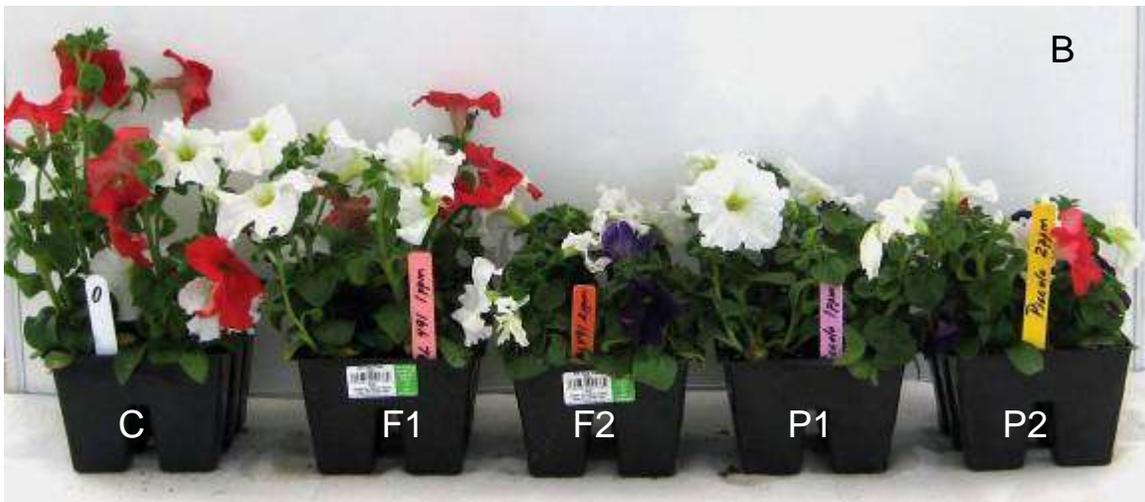


Figure 9. Celosia 'Red Velvet' 14 days after treatment application. Treatments were Control (C), FAL 491 20ppm (F20), FAL 491 40ppm (F40), Piccolo 20ppm (P20), Piccolo 40ppm (P40), FAL 491 1ppm (F1), FAL 491 2ppm (F2), Piccolo 1ppm (P1) and Piccolo 2ppm (P2). Method of application was spray (A) or drench (B).



Figure 10. *Lantana camara* 'Dallas Red' 14 days after treatment application. Treatments were Control (C), FAL 491 20ppm (F20), FAL 491 40ppm (F40), Piccolo 20ppm (P20), Piccolo 40ppm (P40), FAL 491 1ppm (F1), FAL 491 2ppm (F2), Piccolo 1ppm (P1) and Piccolo 2ppm (P2). Method of application was spray (A) or drench (B).



Figure 11. *Salvia greggii* 14 days after treatment application. Treatments were Control (C), FAL 491 20ppm (F20), FAL 491 40ppm (F40), Piccolo 20ppm (P20), Piccolo 40ppm (P40), FAL 491 1ppm (F1), FAL 491 2ppm (F2), Piccolo 1ppm (P1) and Piccolo 2ppm (P2). Method of application was spray (A) or drench (B).

