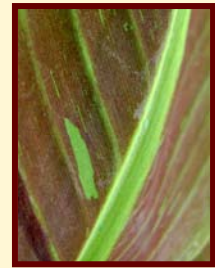


Effect of Paclobutrazol or Uniconazole Spranches on Height Control of Tropical Liners and Evaluation of Liner Post-Transplant Growth with or without Benzyladenine+GA₄₊₇ Sprays

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Executive Summary

- 'Black Magic' colocasia liner height was effectively suppressed by 60 or 90 ppm paclobutrazol for up to 6 weeks in trays largely without post-transplant height suppression. Uniconazole at 3-9 ppm suppressed colocasia liner height only at week 4 after spranches and higher uniconazole rates would be needed to control height for up to 6 weeks. However, some phytotoxicity was observed, particularly with higher concentrations of both PGRs.
- 'Calidora' alocasia was sensitive to paclobutrazol and uniconazole spranches at the rates tested with height suppression for up to 10 weeks, the longest duration tested. The height suppression elicited by 30-90 ppm paclobutrazol was fairly high. Hence, the efficacy of lower rates of paclobutrazol should be tested. Alternatively, uniconazole spranches at ≥ 3 ppm can be used knowing that there will be ~23% post-transplant height suppression with 3 ppm uniconazole application for 4 weeks.
- 'Siam Ruby' Banana was also sensitive to application of both paclobutrazol and uniconazole with liner height suppression observed during all 6 weeks in trays and reduced height of all transplants for up to 4 weeks, the longest duration tested. Under our conditions, 3 ppm uniconazole application effectively suppressed liner height for up to 6 weeks in trays with minimal post-transplant height suppression. Efficacy of lower rates of uniconazole should be evaluated.
- At 5 ppm, BA+GA₄₊₇ (Fresco) only promoted petiole elongation of controls and was ineffective in alleviating the height suppression induced by PGR applications. Evaluating higher rates of Fresco would be beneficial.
- As expected, PGRs only reduced stem and petiole elongation and did not influence growth measured as the rate of leaf unfolding.

Objectives

1. To determine the effect of plant growth retardants (PGRs; paclobutrazol or uniconazole) spranches on height of colocasia, banana, and alocasia liners.
2. To evaluate post-transplant growth of paclobutrazol- or uniconazole-treated liners during greenhouse production.
3. To quantify the effect of pre-shipping BA+GA₄₊₇ spray application on negating the effect of prior paclobutrazol sprays.

Preliminary Experiment Results

- 'Black Magic' colocasia liners were sprayed 2 times at a 2-week interval with 20 or 40 ppm ancymidol (Abide, Fine Americas) or 15 or 30 ppm paclobutrazol (Piccolo, Fine Americas).
- Spray volume of 2 quarts/100 ft² was used.
- Liner height was measured 0 and 2 weeks after each spray. At the rates used, ancymidol and paclobutrazol were ineffective in providing height control.
- Using higher rates of ancymidol would be price-prohibitive. Therefore, paclobutrazol and uniconazole were used in further trials.

Materials and Methods

Starting Material and PGR Application

- Stage-3 tissue cultured liners of 'Calidora' alocasia were received from Agri-Starts on March 19, 2009 and 'Black Magic' colocasia and 'Siam Ruby' banana liners were received on March 26, 2009 in 72-cell trays.

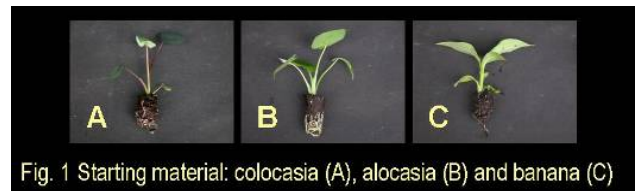


Fig. 1 Starting material: colocasia (A), alocasia (B) and banana (C)



- All liners were treated with PGRs on March 27, 2009.
 - Single application of paclobutrazol at 30, 60 or 90 ppm or uniconazole at 3, 6 or 9 ppm was used.
 - PGRs were applied to sections of liner trays as high-volume sprays, commonly known as sprenches, using 4 times higher volumes than regular sprays (8 quarts/100 ft²) which allowed some PGR solution to drip into the liner medium.
 - Non-sprayed controls were maintained for each species.
- After PGR sprenches, liners were kept in 72-cell liner tray sections for 6 weeks until transplant in a polycarbonate greenhouse at ~74 °F under a 16-hour photoperiod provided at a low intensity using HPS lamps (fewer lamps/ft²).

Evaluation of Height Control and Growth in Liner Trays

- At week 0, 2, 4 and 6 after the sprench, height (from the liner medium to the longest extended petiole in colocasia and alocasia and to the tallest apical leaf tip in banana) and leaf number was recorded for each liner to assess height control and growth in the liner trays, respectively.
- Ten liners of alocasia and banana and 20 liners of colocasia were used per treatment combination. Liners within each treatment were arranged in a single liner section at random and all liner sections were randomly placed on a greenhouse bench in plastic trays (drained after each irrigation) to minimize the airflow and to avoid desiccation.



Evaluation of Post-Transplant Growth with or without BA+GA₄₊₇

- One day prior to transplant (41 days after sprenches), 10 liners each of colocasia controls and PGR treatments were sprayed with 5 ppm BA+GA₄₊₇ (Fresco, Fine Americas) at 2 quarts/100 ft².

- On day after Fresco treatment (6 weeks after srenches), liners were transplanted in 1-gallon containers in a peat-based medium (Fafard 3B) and grown under the same greenhouse conditions as the liners. At weeks 0, 2 or 4 from the transplant, the height and leaf number of plants was recorded to evaluate post-transplant growth.



Statistical Analysis

- Data were analyzed using completely randomized design in SAS and pair-wise treatment comparisons were made using Least Significant Difference procedure with $p = 0.05$.

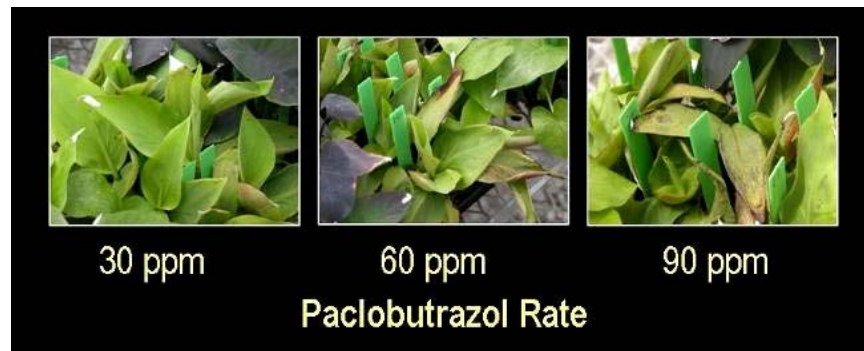
Results and Discussion

Phytotoxicity

Colocasia: Necrosis of some leaf margins and necrotic leaf spots were observed in colocasia liners treated with all PGRs with more noticeable phytotoxicity with 90 ppm paclobutrazol and 9 ppm uniconazole. Although this necrosis was not severe and was largely eliminated by week 6, for up to 4 weeks some leaves on liners appeared “blemished”. The phytotoxicity was more severe with paclobutrazol than uniconazole srenches at tested concentrations.



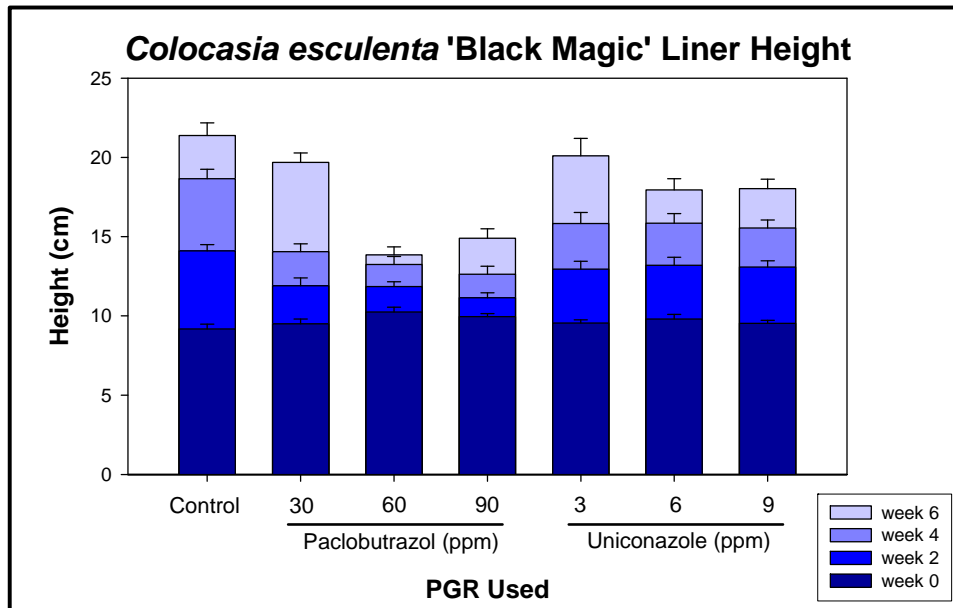
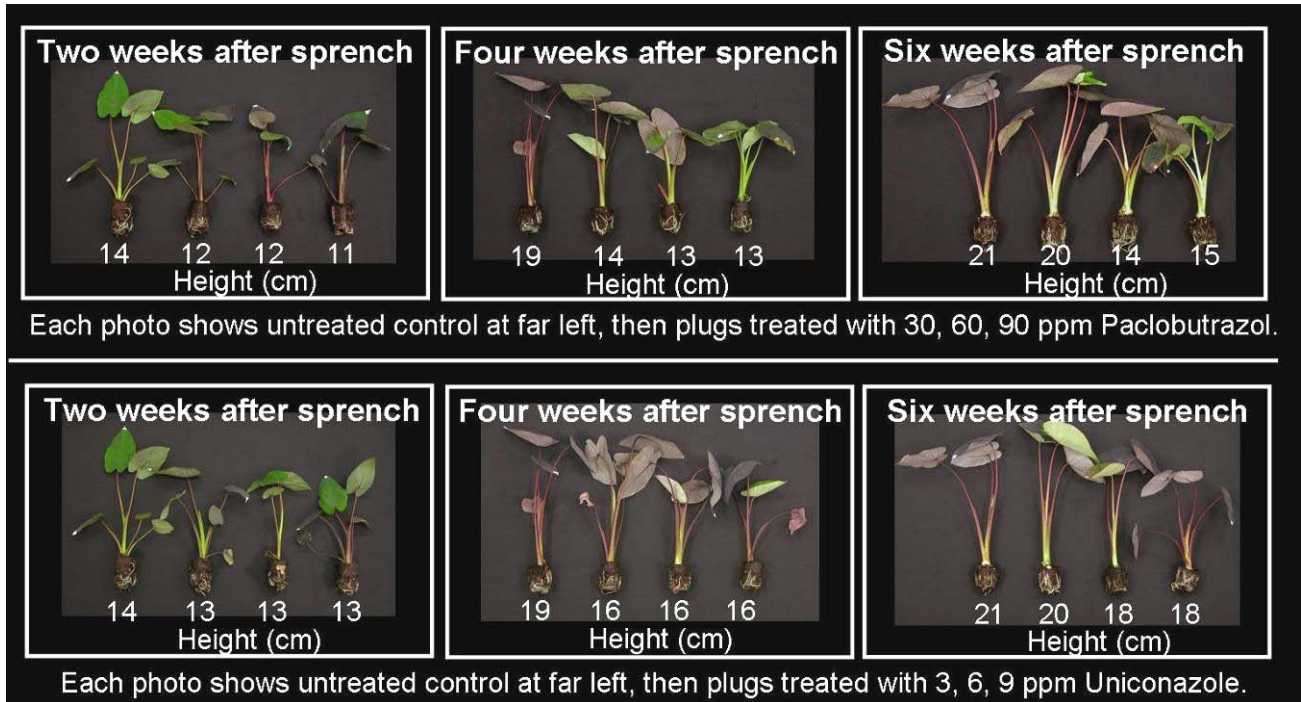
Alocasia: Very minor leaf edge burn was observed after 9 ppm uniconazole srench on alocasia however, we did not think that this would reduce marketability of the liners.



Banana: Four weeks after srenching with paclobutrazol, possible phytotoxicity appeared as necrotic edges and stippling throughout older leaves of banana. It was worse as the concentrations of PGRs increased. By week 6,

phytotoxicity by 30 ppm uniconazole was not noticeable. Liners srenched with 60 ppm paclobutrazol recovered ~8 weeks. However, some stippling and distortion was evident in liners treated with 90 ppm paclobutrazol for 10 weeks, the longest duration tested.

'Black Magic' Colocasia: Evaluation of Height Control in Liner Trays



Liner Height Control

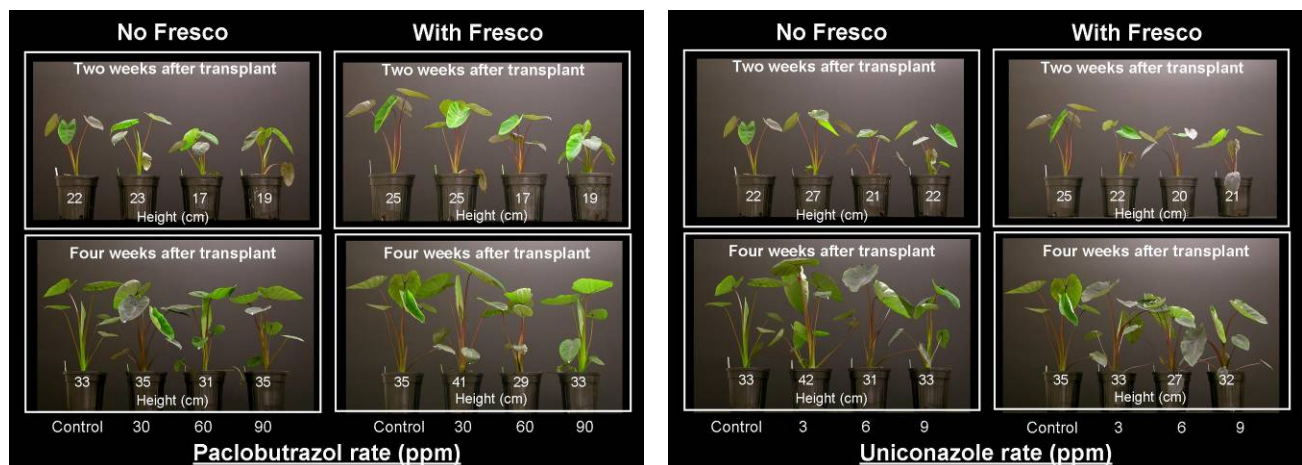
- At week 2 after sponches, paclobutrazol effectively suppressed liner height by 16-21% compared to the controls and there was no significant difference between the heights of plants treated with three paclobutrazol rates. Uniconazole was ineffective in suppressing height of colocasia liners at week 2. Therefore, for height control for 2-week duration, paclobutrazol was the effective PGR at the rates used.

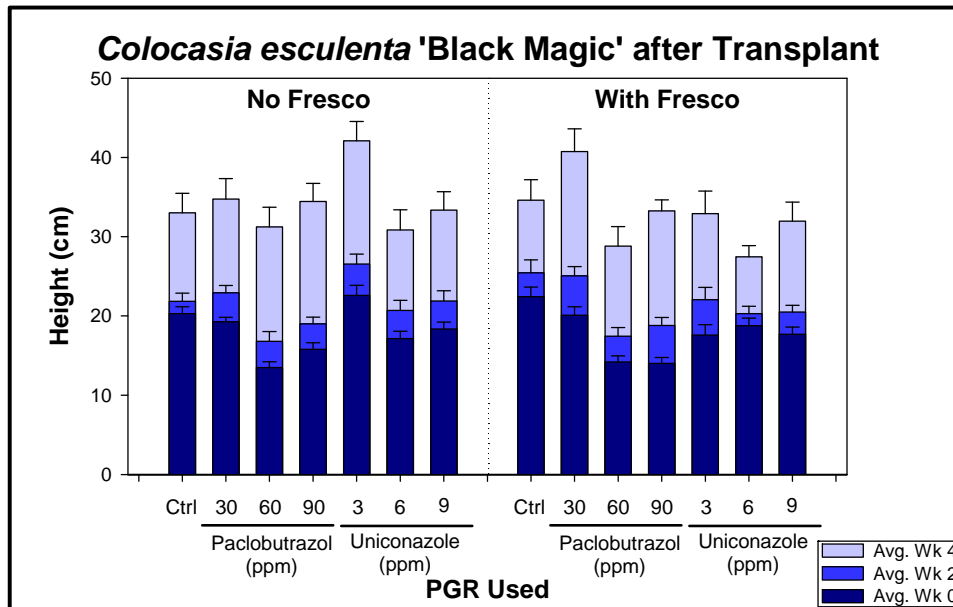
- At week 4 after spranches, controls were significantly shorter than all PGR-treated plants. Overall, at the rates tested, paclobutrazol suppressed height more than uniconazole. There was no dose-response of either PGR with paclobutrazol suppressing liner height by 25-33% and uniconazole suppressed height by 15-17% compared to the controls. Hence, for height control for 4 weeks, paclobutrazol at all three rates was the most effective PGR.
- The effect of 30 ppm paclobutrazol and 3 ppm uniconazole on height suppression was negated at week 6 after spranches compared to the controls. Liners sprached with 6 or 9 ppm uniconazole were 16% shorter compared to the controls at week 6. Whereas, liners sprached with 60 or 90 ppm paclobutrazol were 30 or 35% shorter than the controls, respectively with no significant difference between the two rates. For effective height control for 6 weeks, 60 and 90 ppm paclobutrazol were the most effective treatments.

Liner Growth

- As expected, PGR treatments did not influence growth of colocasia as indicated by unchanged rate of leaf unfolding between the PGR treatments and the controls. At week 0, 2, 4 and 6 liners had 2-3, 4-5, 5-6 and 6-7 leaves, respectively.

'Black Magic' Colocasia: Evaluation of Fresco Application and Post-Transplant Growth





Post-transplant Height

- At transplant, height of liners previously sprenched with 30 ppm paclobutrazol was similar to the controls. Additionally, 3 out of 10 plants sprenched with 3 ppm uniconazole were taller than the remaining plants in the treatment. Hence, these 3 tall plants inflated the average liner height of that treatment and therefore, the height at week 0 was similar to the controls. This inflation was not observed in 10 plants sprenched with 3 ppm uniconazole and subsequently sprayed with Fresco. Therefore, 3 ppm uniconazole treatment with or without Fresco was eliminated from further analysis.
- At week 2 after transplant, the height of liners with or without Fresco was similar within each liner PGR treatment group except for the controls. Control liners treated with Fresco were significantly taller than control liners without a Fresco treatment. Thus, at the rate used, Fresco did not alleviate the height suppression elicited by the liner PGR sprenches. In 2 weeks after the treatment, Fresco-treated controls were still taller compared to the controls without Fresco. With an exception of 60 ppm paclobutrazol-treated plants with or without Fresco, height of plants with other PGR treatments were similar to the controls without Fresco. Hence, by week 2 after transplant, plants had largely grown out of height suppression due to PGRs. The height suppression of plants previously sprenched with 60 ppm paclobutrazol compared to the controls without Fresco would likely be an anomaly since this height suppression was not observed in plants treated with 90 ppm paclobutrazol.
- At week 4 from transplant, height of controls with or without Fresco was similar. There was no height suppression observed in any PGR-treated plants compared with the controls without Fresco. Also, with an exception of plants sprenched with 6 ppm uniconazole, the height of all PGR-treated plants was similar to controls sprayed with Fresco.

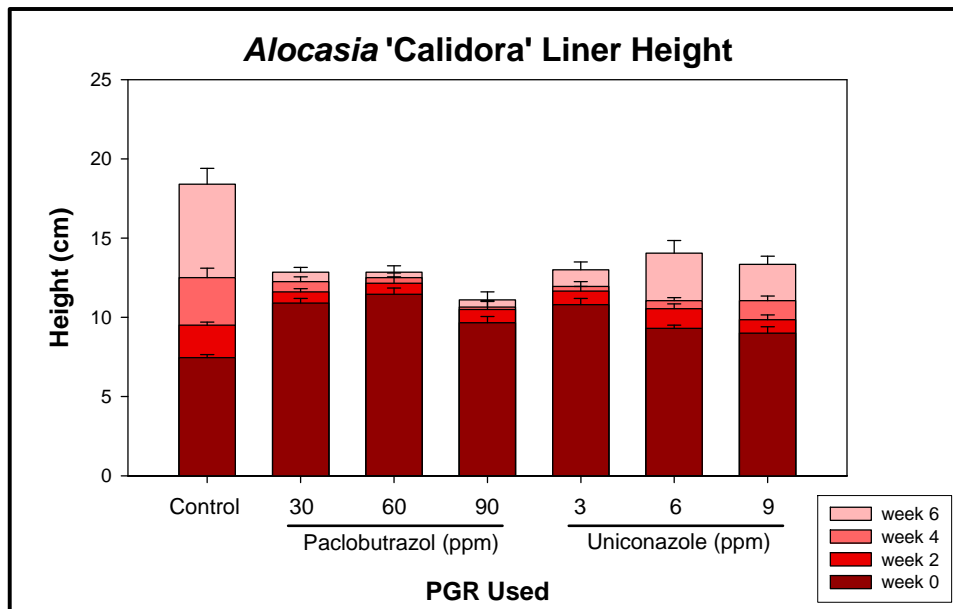
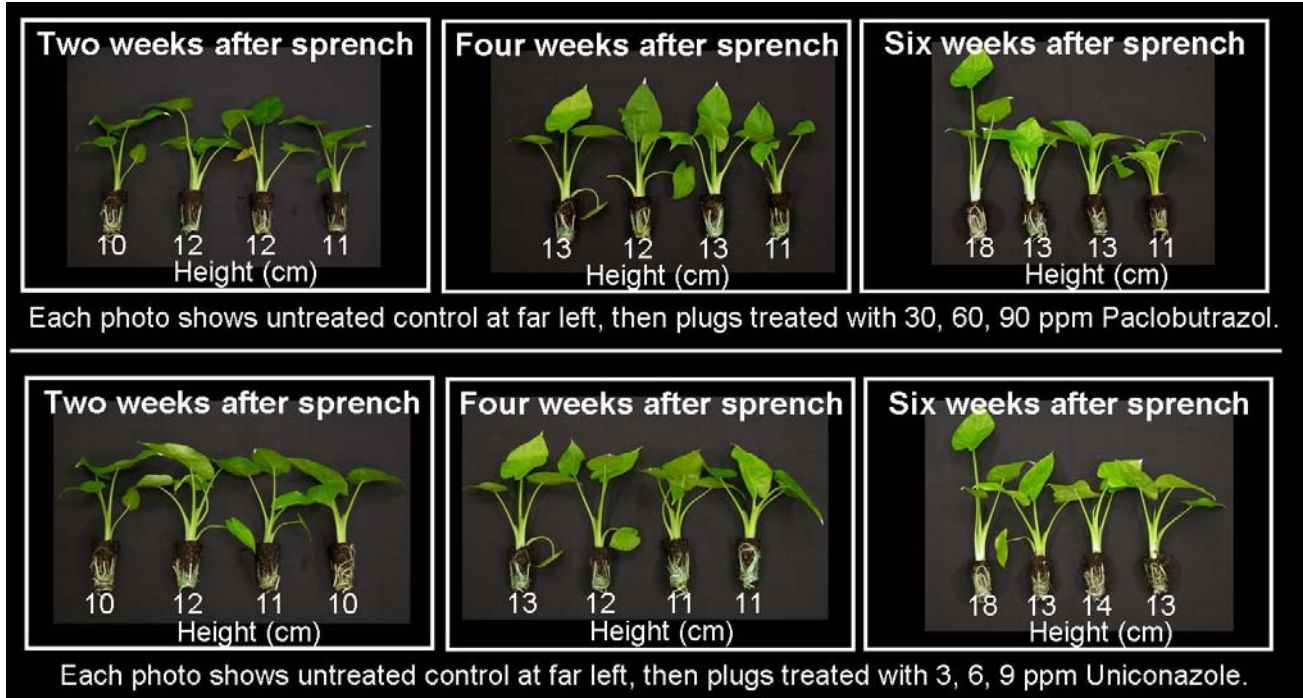
Post-transplant Growth

- At week 0, 2 and 4 after transplant, colocasia plants had 6-7, 8-9 and 10-11 leaves. Thus, as anticipated, PGR treatments did not influence post-transplant growth as indicated by unchanged rate of leaf unfolding.

Colocasia: Conclusion

A single liner sprunch with 60 or 90 ppm paclobutrazol can provide up to 30-35% height suppression for 6 weeks in liner trays without suppressing post-transplant height of the plants. Note that this study does not provide information on the post-transplant growth of 60 or 90 ppm paclobutrazol-treated liners if transplanted after holding them for 2 or 4 weeks.

'Calidora' Alocasia: Evaluation of Height Control in Liner Trays



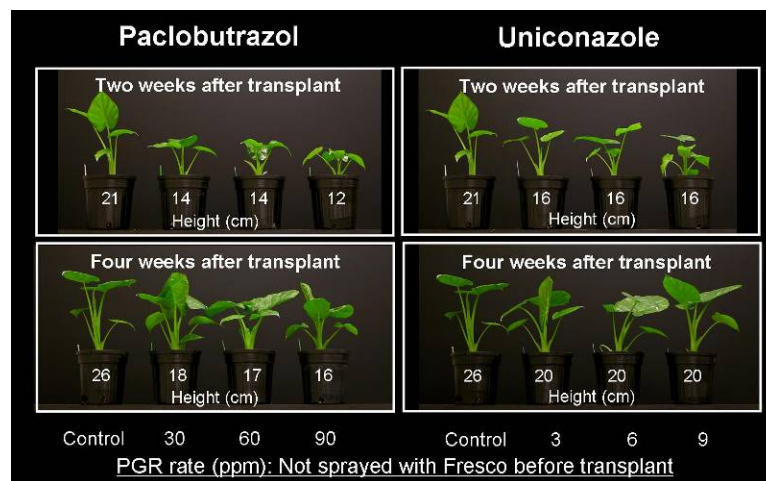
Height Control

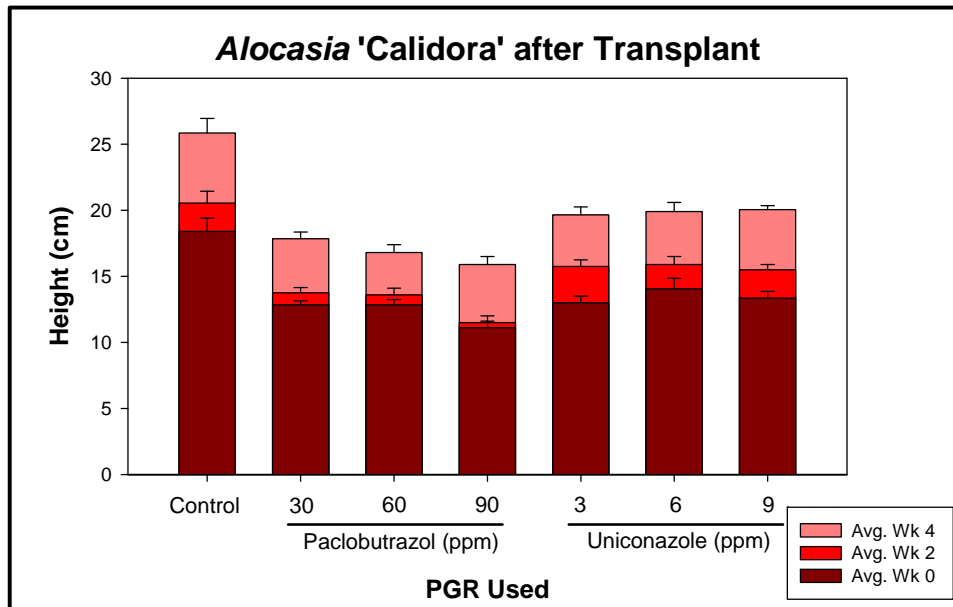
- At the initiation of the experiment liners were randomly selected and we can not explain why alocasia control liners were slightly shorter than all PGR-treated liners except liners sprenched with 9 ppm uniconazole. The same trend was seen at week 2 after sprenches, where controls and 9 ppm uniconazole-treated liners were shorter than other treatments.
- At week 4 after sprenches, 30 or 60 ppm paclobutrazol and 3 ppm uniconazole did not influence the liner heights compared to the controls. However, height of alocasia liners was suppressed by 90 ppm paclobutrazol by 14% and 6 or 9 ppm uniconazole suppressed height similarly by 11-12%.
- At week 6, all PGR-treated liners were shorter compared to the controls. Paclobutrazol at 30 or 60 ppm suppressed liner height similarly by 30-31% whereas, with 90 ppm rate, height suppression was significantly higher at 41% compared to the controls. The three concentrations of uniconazole suppressed height similarly by 23-29% compared to the controls. Therefore, the holding rate for 6 weeks can be 30 or 60 ppm paclobutrazol or 3-9 ppm uniconazole based on liner height.

Liner Growth

- As expected, PGR treatments did not influence growth of alocasia as indicated by unchanged rate of leaf unfolding between the treatments. However, compared to colocasia and banana, the liner leaf numbers were more variable from the beginning of the experiment.

'Calidora' Alocasia: Evaluation of Post-Transplant Growth





Post-transplant Height

- At transplant, all PGR-treated liners were 24-41% shorter compared to the controls, with 90 ppm paclobutrazol-treated liners being the shortest.
- At week 2 from transplant, all PGR-treated liners were shorter compared to the controls. The height suppression by uniconazole was lesser than that by paclobutrazol at the rates used with the three rates of uniconazole eliciting similar height suppression of 24%. Paclobutrazol at 30 and 60 ppm elicited 34% height suppression while 90 ppm paclobutrazol-treated plants were 45% shorter compared to the controls.
- The height suppression by PGR application on liners was not overcome by week 4 after transplant and controls were shorter than PGR-treated plants and largely followed a similar trend as 2 weeks after transplant. At the rates tested, height suppression by uniconazole was less than that of paclobutrazol. All three rates of uniconazole similarly suppressed height of alocasia by 23%. Height suppression by paclobutrazol was dose-dependent with 30 ppm uniconazole eliciting least height suppression of 31% and 90 ppm paclobutrazol eliciting most height suppression of 38%.

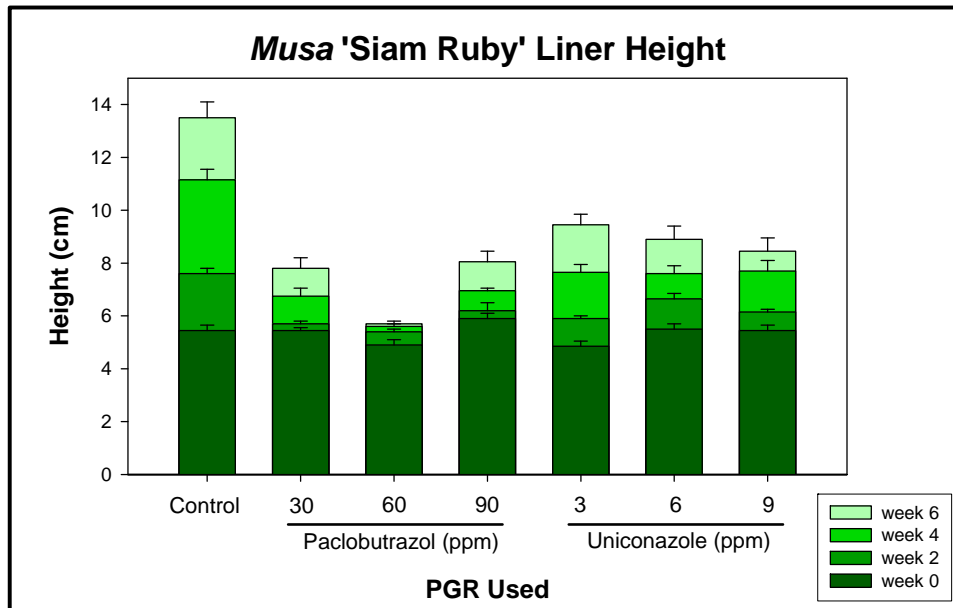
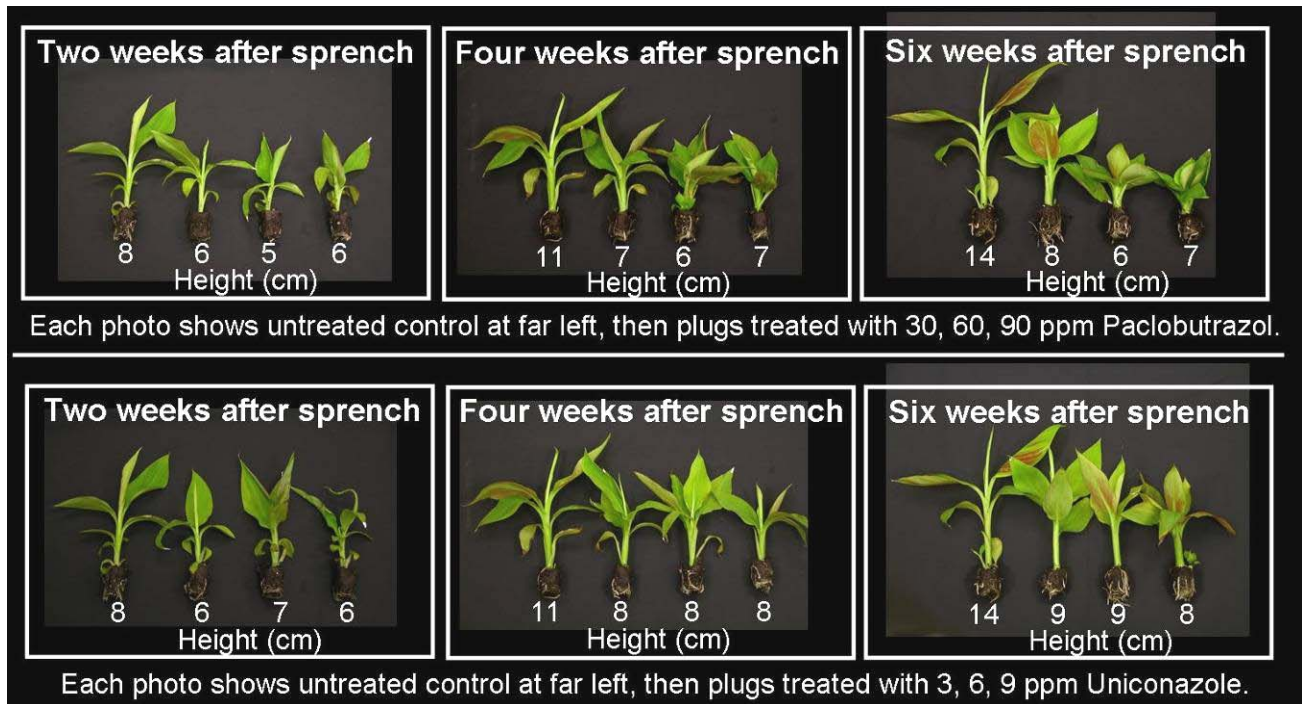
Post-transplant Growth

- At week 0, 2 and 4 after transplant, alocasia plants had 5-6, 6-7 and 7-8 leaves. Thus, as anticipated, PGR treatments did not influence post-transplant growth as indicated by unchanged rate of leaf unfolding.

Alocasia: Conclusion

Overall, the effect of PGR application on liners persisted in colocasia for up to 10 weeks (6 weeks in liner trays and 4 weeks in containers). At the rates tested, the height suppression elicited by paclobutrazol was fairly high. Hence either lower rates of paclobutrazol should be tested or uniconazole can be used at ≥ 3 ppm rate realizing that there will be ~23% height suppression with 3 ppm uniconazole application.

'Siam Ruby' Banana: Evaluation of Height Control in Liner Trays



Height Control

- At 2 weeks after srenches, banana controls were significantly shorter than the PGR-treated liners. There was some variability in the dose responses with some lower PGR rates resulting in more height suppression than higher rates. Overall, paclobutrazol-treated liners were 18-29% shorter and uniconazole-treated liners were 12-22% shorter compared to the controls.
- At week 4 after srenches, all PGRs were highly effective suppressing the liner height compared to the controls. The paclobutrazol rates and percent height suppression did not always correlate with a height

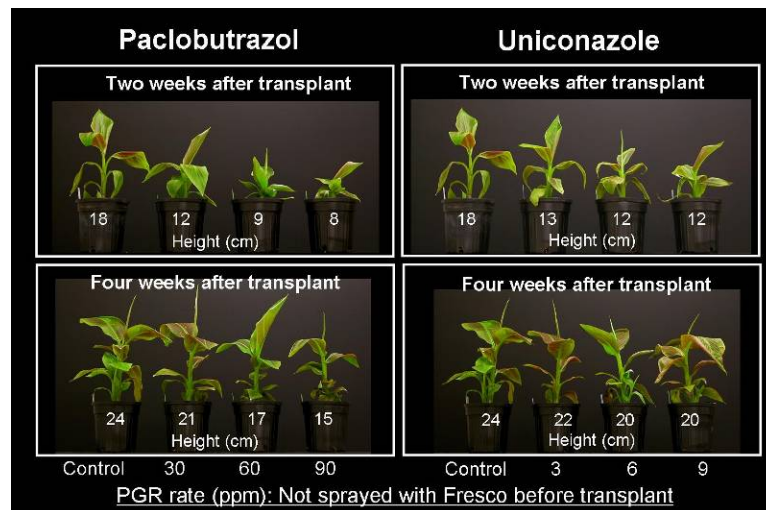
suppression of 38-50% compared to the controls. All rates of uniconazole similarly suppressed height by 31-32% compared to the controls.

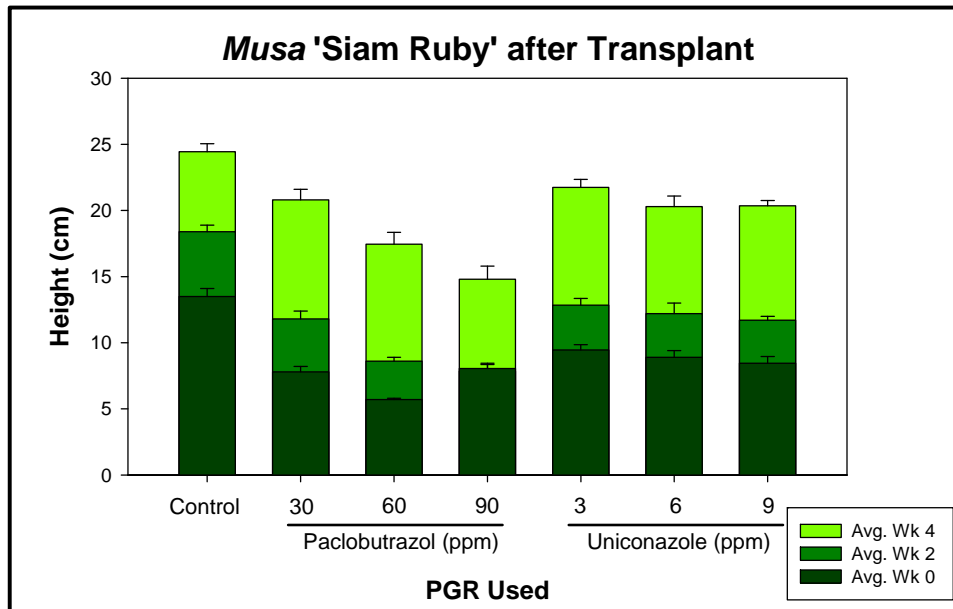
- Liner height suppression at week 6 after spranches followed a trend similar to that of week 4. Paclobutrazol suppressed liner height by 42-59% compared to the controls but the rates and liner heights did not exhibit a dose-response. All concentrations of uniconazole were equally effective and suppressed height by 30-37% compared to the controls. Based on these data, 3 ppm uniconazole would suppress the height for up to 6 weeks without excessive height suppression.

Liner Growth

- As expected, PGR treatments did not influence growth of banana as indicated by unchanged rate of leaf unfolding between the treatments. At week 0, 2, 4 and 6 liners had 6-7, 7-8, 9-10 and 11-12 leaves, respectively.

'Siam Ruby' Banana: Evaluation of Post-Transplant Growth





Post-transplant Height

- At transplant, all PGR-treated banana liners were shorter compared to the controls and this height suppression ranged between 30-60% with all rates of uniconazole eliciting less height suppression (34%) compared to 60 and 90 ppm paclobutrazol (60-50%).
- At week 2 after transplant, the residual effect of PGR spranches on liners prevailed with height suppression of 33% with all rates of uniconazole, 36% with 30 ppm paclobutrazol and 55% with 60 or 90 ppm paclobutrazol.
- Four weeks after transplant, the height suppression due to some rates of PGRs was starting to alleviate. All rates of uniconazole and 30 ppm paclobutrazol treatments elicited 15% height suppression compared to the controls and 60 and 90 ppm paclobutrazol-treated plants were 29% and 39% shorter than the controls. Plants spranched with 60 and 90 ppm paclobutrazol had very short lower internodes and longer higher internodes impairing their visual quality.

Post-transplant Growth

- At week 0, 2 and 4 after transplant, banana plants had 11-12, 12-14 and 15-16 leaves. Thus, as anticipated, PGR treatments did not influence post-transplant growth as indicated by unchanged rate of leaf unfolding.

Banana: Conclusion

Our results indicate that for liner height control of up to 6 weeks and minimal suppression of post-transplant growth, liners should be spranched with 3 ppm uniconazole.

We highly recommend conducting in-house trials under your production conditions before using our recommendations in a large scale production system.

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PGRs on Tropical Liners, 2009

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