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Evaluation of Plant Growth Regulators on Sweetpotato Slip Morphology

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Abstract. **Sweetpotato production faces challenges with low transplant survival rates, particularly for greenhouse-grown slips, often attributed to reduced stem rigidity. We evaluated the effects of four plant growth regulators (PGRs)—flurprimidol, paclobutrazol, uniconazole, and indole-3-butyric acid—applied foliarly at varying concentrations on the growth and development of sweetpotato slips. Results showed that uniconazole at 20 mg·L^{-1} applied twice reduced slip height by 41.60%, whereas flurprimidol and uniconazole also reduced stem diameter at middle rates. Soil plant analysis development measurements indicated increased leaf greenness with flurprimidol, paclobutrazol, and uniconazole applications, with flurprimidol producing a 7% to 10% enhancement. No significant differences in number of nodes, fresh or dry weights, leaf area, or root weight were observed across treatments. These findings highlight the potential of targeted PGR applications to optimize sweetpotato slip growth. Further research is recommended to refine application rates and evaluate long-term effects on field performance.**

Sweetpotato (*Ipomoea batatas* L.) is a globally important crop valued for its nutritional benefits, resilience in diverse environments, and economic significance. In the United States, production is concentrated in North Carolina, California, and Mississippi, with 133,000 acres planted in 2022, yielding a crop worth ∼$598 million (Agricultural Marketing Resource Center 2021; US Department of Agriculture, National Agriculture Statistics Services 2022). Despite its importance in global food security, sweetpotato production lacks robust private-industry support for the development of mechanical, technological, or agronomic solutions.

A critical challenge in sweetpotato cultivation is the low transplant survival rate of greenhouse-produced slips, with reported success rates as low as 50% (unpublished data). The high mortality rate can be attributed to the reduced rigidity of greenhouse-grown slips compared with those produced in the field, which may result from the more protected environment, leading to less compact growth (Hoppenstedt et al. 2019). This makes slips more susceptible to wilting, collapsing, and heat stress at the surface of the soil. Previous studies have explored slip survivability and hardening techniques to reduce transplant shock, but results have been inconclusive (Hall 1985; Villordon et al. 2006).

An underexplored potential option to resolve this issue is to use plant growth regulators (PGRs). PGRs offer a promising alternative to enhance transplant quality. Triazole compounds such as flurprimidol, paclobutrazol, and uniconazole, along with auxins such as indole-3-butyric acid (IBA), have been shown to modify physiological responses in transplants, aiding their acclimatization in both field and greenhouse environments. Flurprimidol has been shown to enhance chlorophyll content and increase soil plant analysis development (SPAD) readings and bulb weight in *Eucomis autumnalis*, reducing plant size by 48% regardless of application method (Salachna and Zawadzińska 2017). Paclobutrazol application improved sweetpotato establishment and yield by regulating vegetative growth under different nitrogen regimes (Silva et al. 2021) and by enhancing drought resilience through increased accumulation of soluble sugars and free proline (Lin et al. 2017). Foliar applications of uniconazole have proved to enhance photosynthate partitioning and translocation to tuberous roots, resulting in increased yield in sweetpotato cultivars Jishu 26 and Xushu 32, with higher uniconazole concentrations showing greater effects on carbon distribution and yield in ‘Jishu 26’ (Duan et al. 2019), highlighting its potential to enhance growth in other areas of sweetpotato production. Olive tree cuttings treated with 300 ppm IBA showed a 69.17% survival rate compared with 5% in the control, with treated cuttings exhibiting significantly more leaves and branches, greater root mass and root length, and thicker stems (Jan et al. 2014).

In our investigation, four different PGRs (flurprimidol, paclobutrazol, uniconazole, and IBA) were applied at various concentrations to sweetpotato slips 14 d post-transplantation. We aimed to evaluate the effects of the four PGRs on sweetpotato slip growth and morphology. By assessing a range of concentrations applied foliarly, the objective was to identify PGR treatments that improve slip quality.

Materials and Methods

Plant material and growth conditions. Virus-tested, two-node sweetpotato slips with similar dimensions of ‘Beauregard’ (B-14) were transplanted into 38-cell trays filled with a soilless growing medium comprised of 75% to 85% sphagnum peatmoss, 10% to 20% perlite, and 1% unregulated components, maintaining a pH range of 5.2 to 5.8 (PRO-MIX® BX; Premier Tech Growers and Consumers Inc., Quakertown, PA, USA). The trays were situated in a single greenhouse bay at Mississippi State University, Starkville, MS, USA. The greenhouse maintained a ventilation set point of 78 °F and an average humidity of 70% to 80%, and had a natural photoperiod from 29 Aug to 31 Oct 2023 for the first experimental trial and from 16 Apr to 23 May 2024 for the second experimental trial. The plants received bottom watering as needed and were fertilized twice during the trials with 20–8.8–16.6 fertilizer at 200 ppm (Peters Professional 20-20-20; Everris NA Inc., Dublin, OH, USA).

Treatments and application. The chemicals used in the investigation consist of three antigibberellins: TopFlor® (flurprimidol 0.38%; SePRO Corp., Carmel, IN, USA), Piccolo 10 XC® (paclobutrazol 4.0%; Fine Americas Inc., Walnut Creek, CA, USA), and Concise® (uniconazole 0.055%; Fine Americas Inc.), alongside one Auxin: Advocate® (IBA 20%; Fine Americas Inc.). Solutions were created from the growth of retardant stocks by diluting them with distilled water. Based on adjustments after a preliminary study, the following concentrations were identified for further assessment: flurprimidol at 20, 60, and 120 mg·L^{-1}; paclobutrazol at 30, 60, and 120 mg·L^{-1}; uniconazole at 10, 20 × 1, 20 × 2, and 30 mg·L^{-1}; and IBA at 250, 500, and 750 mg·L^{-1}.

Experimental design and data collection. The study used a randomized complete block design with three replications. There were 14 trays per replicate, each representing a different PGR and concentration, with a control group that received a water treatment, resulting in 42 trays for the study. The experimental trials lasted 6 weeks. The first week

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involved transplanting the slips into trays and randomizing them within the designated blocks. In the second week, slips were fertilized to support their maintenance and facilitate root system development. In week 3, initial measurements of each slip were collected and PGRs were applied. Weekly measurements were conducted from weeks 4 to 6, with a supplementary application of uniconazole at 20 × 2 mg·L^{-1} during the fourth week. After acquiring the final set of weekly measurements in week 6, the slips were harvested and additional postharvest measurements were carried out, including the weighing and drying of slips and roots for further analysis.

Vegetative morphological measurements. Baseline measurements (week 0) of each sweetpotato slip, including plant height, stem diameter, number of nodes, and SPAD readings, were recorded before PGR application. Plant height was measured using a standard ruler from the soil level to the apex of the slip. Stem diameter was measured at the slip's base, midpoint, and tip using a caliper. A SPAD meter provided a relative chlorophyll index from the first fully expanded leaf at the top of the slip (model SPAD 502 Plus chlorophyll meter; Spectrum Technologies, Inc., Aurora, IL, USA). These four parameters were measured from week 3, after PGR application, to week 6 before harvest. The slips were harvested at week 6 using a hand pruner and were weighed to determine fresh and dry weights. A random sample of five plants was collected from each tray for total leaf area and root weight analysis. The total leaf area was measured using a LI-3100C Area Meter (LI-COR Environmental, Lincoln, NE, USA). Root samples were washed and weighed for fresh and dry weights.

Statistical analysis. The dataset was analyzed using a mixed-effects model in SAS version 9.4 (SAS Inc., Cary, NC, USA) that accounted for the plants nested within experimental units. The Satterthwaite approximation was used to determine the degrees of freedom for the statistical evaluations. Treatment effects were included as fixed factors for plant weight, leaf area, and cross-sectional metrics variables. Plant height, stem diameter, number of nodes, and SPAD readings considered treatment, week, and the interaction between treatment and week as fixed factors. Baseline measurements (week 0) were incorporated as a covariate in the models for plant height, stem diameter, and node count to adjust for initial plant measurements. In the mixed model, replication and plant were designated as random factors, with the plant nested within replication. An autoregressive covariance structure for repeated measures over time was selected based on the Akaike information criterion. Results were reported as least squares means or covariate-adjusted least squares means, depending on the presence of covariates in the model. Significance was assessed at a P value of 0.05. Four separate analyses were conducted to compare each treatment to the control. In cases when no significant interactions were detected, results were reported based on main effects or the highest order interaction identified.

Results and Discussion

The application and effectiveness of PGRs are highly dependent on factors such as species, cultivar, plant age, health, environmental conditions, and application methods (Basra 2000; Halmann 1990; Smit et al. 2005). Because of the distinct genetic composition and hormonal balance of each plant species, responses to PGRs can vary significantly, even under identical treatment conditions (Tripathi et al. 2022). In addition, the longevity of PGR effects can differ based on their chemical stability and metabolic breakdown, influencing the number of applications required over a growing season (Li et al. 2022; Sterrett and Tworkoski 1987; Sun et al. 2022). With these factors in mind, the following results show the impact of various PGRs on sweetpotato slip growth and development.

Plant height. Uniconazole applied twice at 20 mg·L^{-1} reduced slip height significantly, by 41.60%, compared with the control during the second and third weeks (Fig. 1). Similar shoot growth and internode length reductions have been observed with repeated uniconazole applications in *Citrus reticulata* (Wheaton 1989). In contrast, IBA and paclobutrazol showed significant week-by-treatment interactions, but no differences were detected when analyzed by week (all P values > 0.05). Flurprimidol did not exhibit significant effects at any rate (Fig. 1). The vigorous growth habit of sweetpotatoes in both the greenhouse and in fields likely contributes to the rapid metabolism of PGRs, minimizing vertical growth inhibition (International Potato Center n.d.). Although

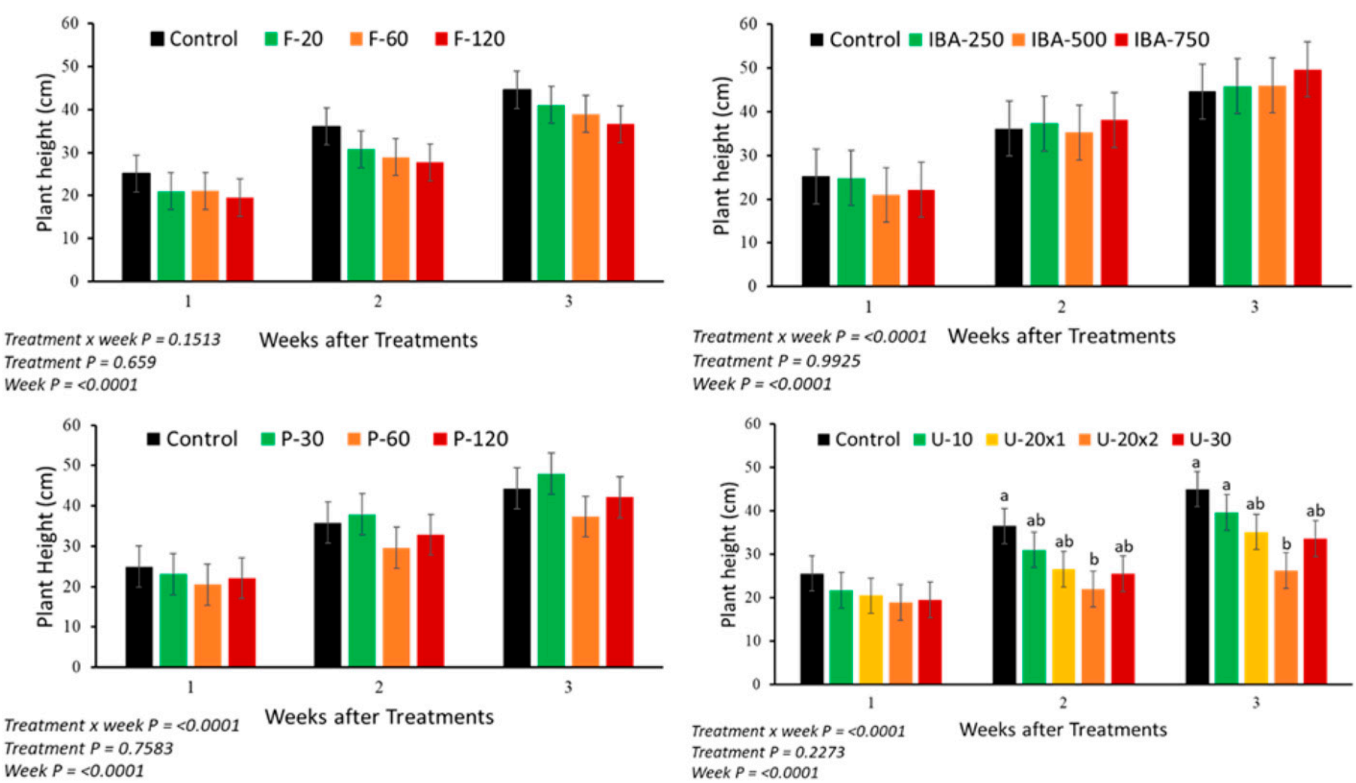

Fig. 1. Weekly plant height of plants treated with control (**all panels**), flurprimidol (F) (**top left**), indole-3-butyric acid (IBA) (**top right**), paclobutrazol (P) (**bottom left**), and uniconazole (U) (**bottom right**) at various concentrations. Bars represent mean plant height; error bars indicate standard deviation. Significant differences from the control within each week are denoted by lowercase letters.

other triazoles did not reduce growth, this may benefit sweetpotato production, where slips are preferred to reach 25 to 30 centimeters for mechanical transplanting.

Stem diameter. A reduction in stem diameter was observed at week 3 with flurprimidol (60 mg·L^{-1}) and with one application of uniconazole (20 mg·L^{-1}), and at week 2 with IBA (250 mg·L^{-1}). Flurprimidol and uniconazole reduced stem thickness by 8.35% and 9.88%, respectively, compared with the control (Fig. 2). Similar reductions have been reported in New Guinea impatiens treated with flurprimidol, and in hibiscus cuttings exposed to uniconazole, which also exhibited internal stem suppression (Currey et al. 2016; Wang and Gregg 1989). Although uniconazole may manage plant height effectively, its negative impact on stem structure may compromise plant resilience during transplantation (Garner and Björkman 1996; Latimer 1998).

For IBA, diameter reduction was significant compared with other IBA treatments, but not the control. Paclobutrazol exhibited significant week-by-treatment interactions, but no differences were found upon weekly analysis (all P values > 0.05) (Fig. 2). These results contrast with previous studies, where IBA-treated olive cuttings displayed twice the stem thickness of controls, and paclobutrazol-treated potato plants showed a 58% increase in stem diameter (Jan et al. 2014; Tsegaw et al. 2005). The absence of a significant response from IBA and paclobutrazol, alongside the reduced stem diameter with flurprimidol and uniconazole, is concerning, as stronger stems are often associated with higher transplant survival rates (Latimer 1998).

Number of nodes. The number of nodes on treated slips remained consistent with the control slips across all treatment conditions, with no significant differences observed (Fig. 3). Although the reason for this lack of variation is unclear, maintaining a uniform node count could benefit crop production. Uniform node counts can promote predictable growth, simplify field management, and enhance overall crop reliability. Further research is needed to confirm these findings (Jett 2006).

Soil plant analysis development. SPAD measurements across all treatments identified a significant interaction between the week and treatment, with the effects of specific treatments persisting over several weeks. SPAD values for IBA-treated slips initially increased before declining, with IBA at 250 mg·L^{-1} maintaining a consistent average. However, IBA-treated slips were less green than other treatments. Flurprimidol enhanced foliage greenness significantly by 7% to 10% at all concentrations during weeks 3 and 4, making it the only PGR with consistent effects across all rates. Paclobutrazol-treated plants maintained stable SPAD values with minimal fluctuation, with the highest rate (120 mg·L^{-1}) producing the greatest increase in greenness during weeks 2 through 4. Uniconazole-treated slips showed increased greenness during weeks 3 and 4 across various rates (10 mg·L^{-1}, two applications of 20 mg·L^{-1}, and 30 mg·L^{-1}), with the most notable increase of 15% at two applications of 20 mg·L^{-1} in week 4 (Fig. 4).

These results are consistent with previous findings, supporting the idea of PGRs in enhancing photosynthetic potential across several plant species. In swamp sunflowers, the highest rates of paclobutrazol and flurprimidol led to the most significant increases in chlorophyll measurements (Barrios and Ruter 2019). Similarly, uniconazole at 10 mg·L^{-1} affected SPAD values of greenhouse-grown tomatoes significantly (Dunn et al. 2022). In addition, IBA is known to enhance chlorophyll concentration, with the greatest effects observed at higher application rates, which is often linked to larger leaf areas and elevated auxin concentrations, promoting greater photosynthate production (Rao et al. 2020). Chlorophyll enhancement may result from inhibiting the gibberellic acid pathway, which triggers secondary biochemical processes, including increased chlorophyll biosynthesis (Whipker 2023). Higher chlorophyll levels improve photosynthetic efficiency, promoting greater plant growth and yield potential (Li et al. 2018).

Postharvest analysis. Slip fresh and dry weights, root fresh and dry weights, and leaf area showed no significant differences between treated plants and the control. This lack of variation may be attributed to minimal or a lack of changes in other growth parameters, including plant height, number of nodes, and stem diameter. Similarly, the absence of significant differences in root weights could be linked to the type or concentration of PGR used not being sufficient enough or the limited cell size within the trays. Root confinement, a known factor influencing root weight

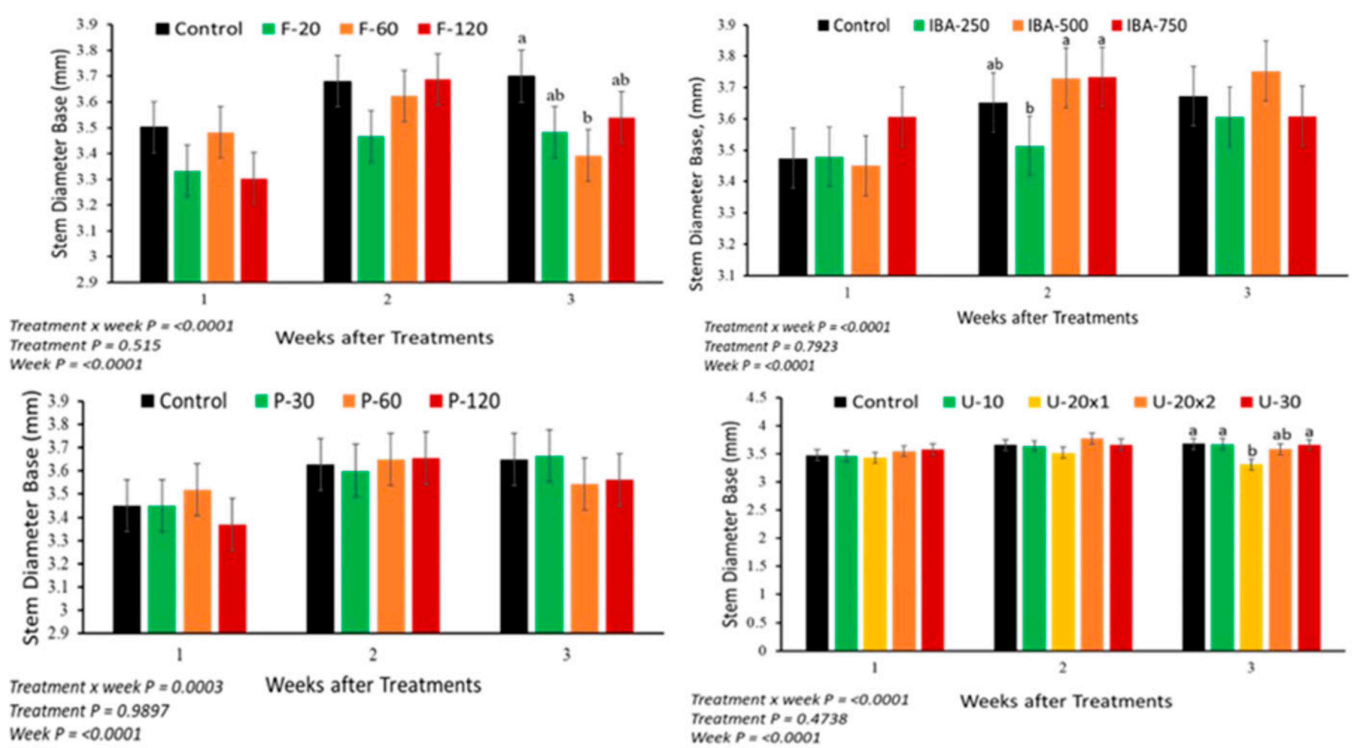

Fig. 2. Weekly stem diameter of plants treated with control (**all panels**), flurprimidol (F) (**top left**), indole-3-butyric acid (IBA) (**top right**), paclobutrazol (P) (**bottom left**), and uniconazole (U) (**bottom right**) at various concentrations. Bars represent mean stem diameter; error bars indicate standard deviation. Significant differences from the control within each week are denoted by lowercase letters.

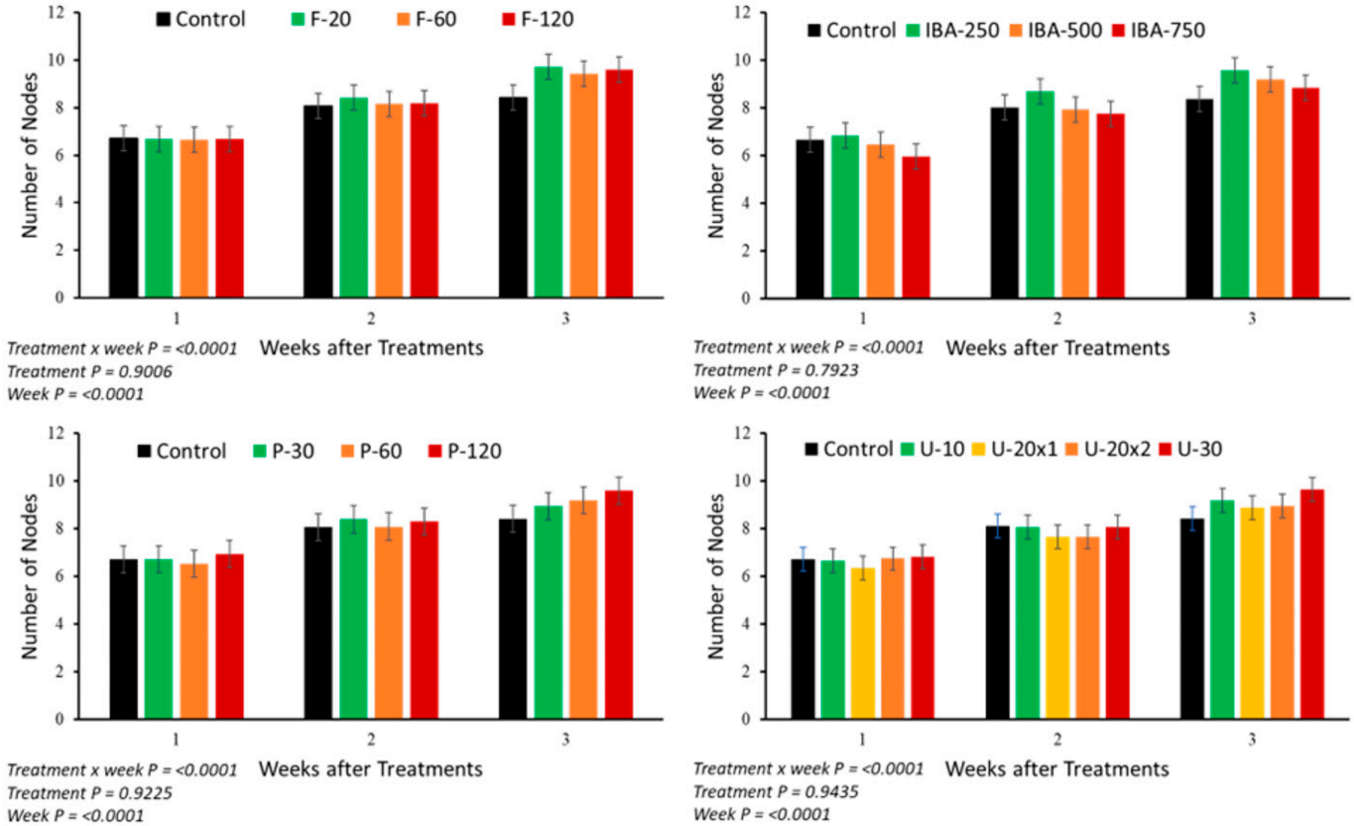

Fig. 3. Number of nodes per sweetpotato slip recorded weekly over a three-week period under control (**all panels**), flurprimidol (F) (**top left**), indole-3-butyric acid (IBA) (**top right**), paclobutrazol (P) (**bottom left**), and uniconazole (U) (**bottom right**) treatments at various concentrations. Bars represent mean node count; error bars indicate standard deviation.

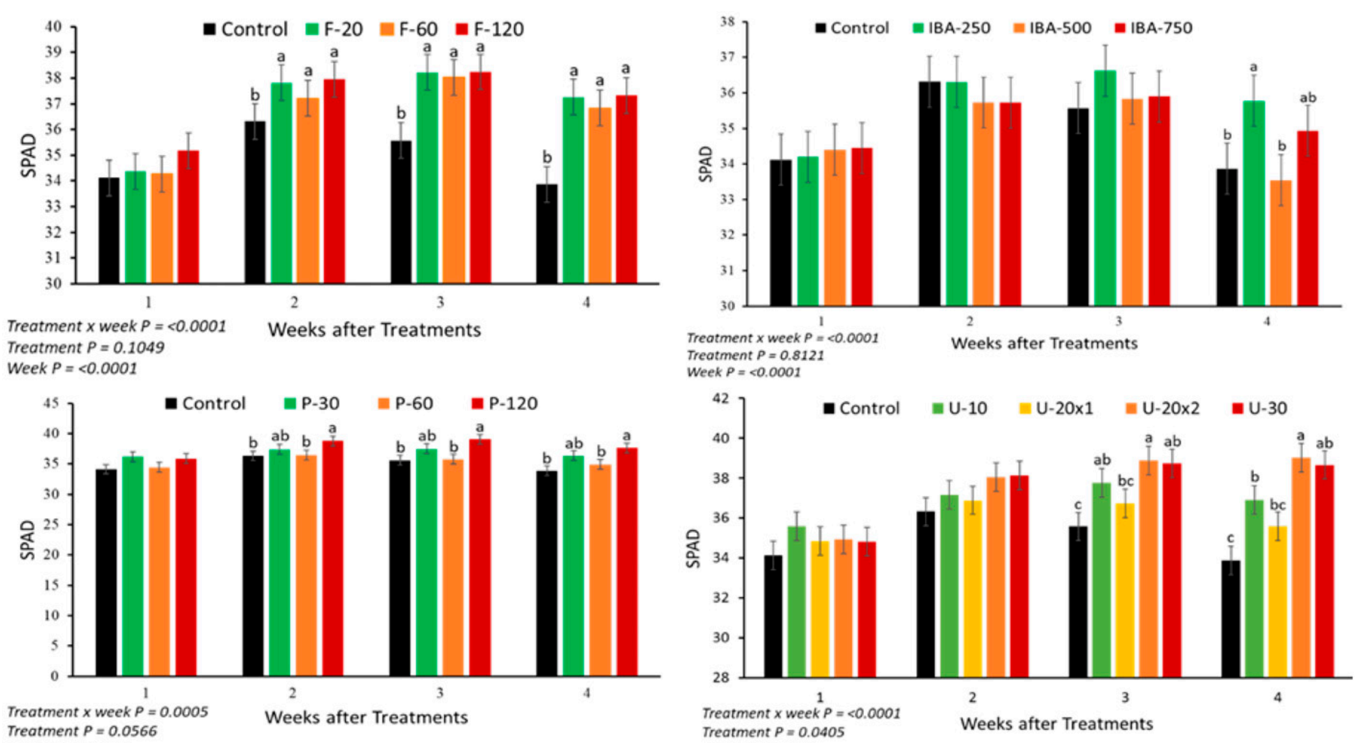

Fig. 4. Weekly soil plant analysis development (SPAD) values of plants treated with control (**all panels**), flurprimidol (F) (**top left**), indole-3-butyric acid (IBA) (**top right**), paclobutrazol (P) (**bottom left**), and uniconazole (U) (**bottom right**) at various concentrations. Bars represent mean SPAD readings; error bars indicate standard deviation. Significant differences from the control within each week are denoted by lowercase letters.

in other vegetable species, may have restricted root growth even more (NeSmith and Duval 1998). Further research is needed to identify specific chemicals, application rates, or application methods that may more enhance root development effectively.

Conclusion

This study demonstrated the varying effects of different PGRs on sweetpotato slip growth. Uniconazole was the most effective in reducing slip height, with a 41.60% reduction after repeated applications at 20 $mg \cdot L^{-1}$. Flurprimidol and uniconazole at moderate rates reduced stem diameter, whereas IBA and paclobutrazol had minimal impacts. SPAD measurements revealed significant week-by-treatment interactions, with flurprimidol enhancing leaf greenness consistently. Uniconazole and paclobutrazol also increased greenness, particularly at higher rates during later weeks. No significant differences were observed in fresh and dry weights, leaf area, or root weights across treatments, indicating that PGR applications did not affect plant biomass adversely. These results emphasize the importance of selecting suitable PGRs and application rates to achieve specific growth objectives in sweetpotato slips. Further research is needed to understand the underlying mechanisms driving sweetpotato responses to PGRs. Expanding studies on optimal rates, application timing, and physiological effects will enhance the effective use of PGRs in sweetpotato production.

References Cited

Agricultural Marketing Resource Center. 2021. Sweet potatoes. https://www.agmrc.org/commodities-products/vegetables/sweet-potatoes. [accessed 12 Dec 2024].

Barrios K, Ruter JM. 2019. Substrate drench applications of flurprimidol and paclobutrazol influence growth of swamp sunflower. HortTechnology. 29(6):821–829. https://doi.org/10.21273/HORTTECH04400-19.

Basra A, ed. 2000. Plant growth regulators in agriculture and horticulture: Their role and commercial uses (1st ed). CRC Press, Boca Raton, FL, USA.

Currey CB, Flax NF, Walters KJ. 2016. Foliar sprays of flurprimidol, paclobutrazol, and uniconazole suppress height of seed-propagated New Guinea impatiens. HortTechnology. 26(1):20–25. https://doi.org/10.21273/HORTTECH.26.1.20.

Duan W, Zhang H, Xie B, Wang B, Hou F, Li A, Dong S, Qin Z, Wang Q, Zhang L. 2019. Foliar application of uniconazole improves yield through enhancement of photosynthate partitioning and translocation to tuberous roots in sweetpotato. Arch Agron Soil Sci. 66(3): 316–329. https://doi.org/10.1080/03650340.2019.1614170.

Dunn B, Goad C, Brandenberger L. 2022. Growth and flowering of greenhouse-grown tomato transplants in response to uniconazole. HortTechnology. 32(6):485–490. https://doi.org/10.21273/HORTTECH05071-22.

Garner LC, Björkman T. 1996. Mechanical conditioning for controlling excessive elongation in tomato transplants: Sensitivity to dose, frequency, and timing of brushing. J Am Soc Hortic Sci. 121(5):894–900. https://doi.org/10.21273/JASHS.121.5.894.

Hall M. 1985. Influence of storage conditions and duration on weight loss in storage, field survival, and root yield of sweet potato transplants. HortScience. 20(2):200–203. https://doi.org/10.21273/HORTSCI.20.2.200.

Halmann M. 1990. Synthetic plant growth regulators. Adv Agron. 43:47–105. https://doi.org/10.1016/s0065-2113(08)60476-9.

Hoppenstedt ZN, Griffin JJ, Pliakoni ED, Rivard CL. 2019. Yield, quality, and performance of organic sweetpotato slips grown in high tunnel compared with open field. HortTechnology. 29(2):140–150. https://doi.org/10.21273/HORTTECH04139-18.

International Potato Center. n.d. How sweetpotato grows. https://cipotato.org/sweetpotato/how-sweetpotato-grows/#:~:text=The%20crop%20has%20relatively%20few,%2C%20fertilizer%2C%20or%20harmful%20pesticides. [accessed 13 Dec 2024].

Jan I, Bhutta M, Rab A, Iqbal A, Khan O, Jamal Y, Ahmad N, Ali A, Shakoor M, Shah S. 2014. Effect of various concentrations of indole butyric acid (IBA) on olive cuttings. ResearchGate. 64(9):127–136.

Jett LW. 2006. Growing sweet potatoes in Missouri. University of Missouri Extension Publication G6368. Published by MU Extension. https://extension.missouri.edu/publications/g6368.

Latimer JG. 1998. Mechanical conditioning to control height. HortTechnology. 8(4):529–534. https://doi.org/10.21273/HORTTECH.8.4.529.

Li Y, He N, Hou J, Xu L, Liu C, Zhang J, Wang QF, Zhang X, Wu X. 2018. Factors influencing leaf chlorophyll content in natural forests at the biome scale. Front Ecol Evol. 6:64. https://doi.org/10.3389/fevo.2018.00064.

Li C, Huang L, Zhang Y, Guo X, Cao N, Yao C, Duan L, Li X, Pang S. 2022. Effects of triazole plant growth regulators on molting mechanism in Chinese mitten crab (*Eriocheir sinensis*). Fish Shellfish Immunol. 131:646–653. https://doi.org/10.1016/j.fsi.2022.10.059.

Lin KH, Hwang SY, Lo HF, Chang YS, Chang SH. 2017. Water-deficit tolerance in sweet potato [*Ipomoea batatas* (L.) Lam.] by foliar application of paclobutrazol: Role of soluble sugar and free proline. Front Plant Sci. 8:1407. https://doi.org/10.3389/fpls.2017.01407.

NeSmith DS, Duval JR. 1998. The effect of container size. HortTechnology. 8(4):495–498. https://doi.org/10.21273/HORTTECH.8.4.495.

Rao GSK, Bisati IA, Sharma A, Kosser S, Bhat SA. 2020. Effect of IBA concentration and cultivars on number of leaves, leaf area, and chlorophyll content of leaf in pomegranate (*Punica granatum* L.) cuttings under temperate conditions of Kashmir. J Pharmacogn Phytochem. 9(6):86–90. https://doi.org/10.22271/phyto.2020.v9.i6j.

Salachna P, Zawadzińska A. 2017. Effect of daminozide and flurprimidol on growth, flowering and bulb yield of *Eucomis autumnalis* (Mill.) Chitt. Folia Hortic. 29(1):33–38. https://doi.org/10.1515/fhort-2017-0004.

Silva JAA, Oliveira FG, da Silva EF, da Silva GFS, de Oliveira PS, Araújo WR, da Silva JF Jr. 2021. Growth and yield of sweet potato in response to the application of nitrogen rates and paclobutrazol. Bragantia. 80:e20200447. https://doi.org/10.1590/1678-4499.20200447.

Smit M, Meintjes J, Jacobs G, Stassen P, Theron K. 2005. Shoot growth control of pear trees (*Pyrus communis* L.) with prohexadione-calcium. Sci Hortic. 106(4):515–529. https://doi.org/10.1016/j.scienta.2005.05.003.

Sterrett JP, Tworkoski TJ. 1987. Flurprimidol: Plant response, translocation, and metabolism. J Am Soc Hortic Sci. 112(2):341–345. https://doi.org/10.21273/JASHS.112.2.341.

Sun P, Huang Y, Yang X, Liao A, Wu J. 2022. The role of indole derivative in the growth of plants: A review. Front Plant Sci. 13:1120613. https://doi.org/10.3389/fpls.2022.1120613.

Tripathi DK, Yadav SR, Mochida K, Tran L-SP. 2022. Plant growth regulators: True managers of plant life. Plant Cell Physiol. 63(12):1757–1760. https://doi.org/10.1093/pcp/pcac170.

Tsegaw T, Hammes S, Robbertse J. 2005. Paclobutrazol-induced leaf, stem, and root anatomical modifications in potato. HortScience. 40(5):1343–1346. https://doi.org/10.21273/HORTSCI.40.5.1343.

US Department of Agriculture, National Agriculture Statistics Services. 2022. 2022 State agriculture overview for North Carolina. North Carolina Agricultural Statistics Publication No. 222. https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NORTH+CAROLINA. [accessed 13 Apr 2025].

Villordon AQ, Franklin JW, Talbot TP, Cannon JM, McLemore W. 2006. Transplant and stand survivability studies in sweetpotatoes. HortScience. 41:518D–518. https://doi.org/10.21273/HORTSCI.41.3.518D.

Wang Y, Gregg LL. 1989. Uniconazole affects vegetative growth, flowering, and stem anatomy of Hibiscus. J Am Soc Hortic Sci. 114(6): 927–932. https://doi.org/10.21273/JASHS.114.6.927.

Wheaton TA. 1989. Triazole bioregulators reduce internode length and increase branch angle of citrus. Acta Hortic. 239:277–280. https://doi.org/10.17660/ActaHortic.1989.239.41.

Whipker B. 2023. Plant growth regulator guide for annuals. Fine Americas Inc., Walnut Creek, CA, USA.