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Rooting Response of Herbaceous Perennial Cuttings to Foliar Applications of a Novel Indole-3-butyric Acid Liquid Product

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Abstract

A research trial was conducted to evaluate a novel indole-3-butyric acid (IBA) liquid-based product for rooting of herbaceous perennial cuttings. Foliar spray applications of deionized water (0 $mg·L^{-1}$) or 200, 400, 800, or 1200 $mg·L^{-1}$ IBA were applied to unrooted cuttings of 'Lemoncello Golden' coreopsis (*Coreopsis auriculate*), 'Sweet Daisy Christine' shasta daisy (*Leucanthemum maximum*), Flame Pink® ('Bartwelve') garden phlox (*Phlox paniculata*), and 'Salute Pink' meadow sage (*Salvia nemerosa*) 1 day after placement into propagation trays. For all genera, stem caliper, shoot length, and shoot dry weight were unaffected by increasing IBA concentrations at 21 days while rooting varied. Shasta daisy root dry weight increased by 123% from 0 to 800 $mg·L^{-1}$ IBA and then decreased. For coreopsis, garden phlox, and meadow sage, root dry weight was unaffected by IBA concentration. Hastened rooting and increased root dry weight is important to propagators who desire high-quality rooted liners therefore further investigation is warranted. Overall, 200–800 $mg·L^{-1}$ IBA foliar spray applications resulted in similar rooting among the perennials trialed.

Keywords: Adventitious root formation, Auxin, Floriculture, IBA, Propagation, Rooting hormone

1. Introduction

Rooting of unrooted cuttings is affected by endogenous and exogenous factors; many of these have been intensively investigated for annual bedding plants but to a lesser extent, herbaceous perennials (Owen, 2017). Exogenous auxin applications, used to promote rooting, are traditionally applied during commercial propagation as powder or liquid basal quick-dips. After cutting stick, post-foliar IBA applications has gained attention by researchers and growers to improve rooting of moderate to difficult-to-root genera. Blythe et al. (2003, 2004) investigated the influence of potassium salt-IBA (K-IBA) powder-based foliar spray application and concentrations on rooting of six ornamental genera cuttings and found rooting to be genus-specific. They also suggest further work with auxin formulations and to determine whether foliar IBA applications prove commercial value (Blythe et al., 2003). Therefore, the objectives of this trial were to evaluate foliar spray applications of a novel liquid-based IBA product for rooting herbaceous perennial cuttings. The four herbaceous perennial genera trialed were selected from an industry survey and rooting difficulty reported by Owen (2017).

2. Materials and Methods

2.1 Plant Material

On 4 Feb. 2020, unrooted cuttings of coreopsis, shasta daisy, garden phlox, and meadow sage were received from a commercial cutting supplier (Dümmen Orange, Columbus, OH). Cuttings were individually inserted into 105-cell propagation trays (30-mL individual cell volume, 54 × 28 × 5 cm; Grower Select®, BFG Supply, Burton, OH) excised into 35-cell sections. Trays were filled with a pre-moistened commercial peat-based substrate (LM-111; Lambert Peat Moss, Rivière-Ouelle, QC, Canada) amended with (by volume) 50% coarse perlite (PVP Industries Coarse Horticultural Perlite, North Bloomfield, OH).

2.2 Propagation Environnent

Unrooted cuttings were placed on one of three benches under propagation tents created with fixed 4-mil opaque construction film (3 × 30.5 m roll; Blue Hawk, Poly-America, Grand Prairie, TX) and ≈56% shade (Solaro 5620 O-R-FR; Ludvig Svensson, Inc., Charlotte, NC). Ambient daylight was supplemented with a photosynthetic photon flux density (*PPFD*) of 73.6 μmol·m^{-2}·s^{-1} at cutting height [as measured with a quantum sensor (LI-190SL; LI-COR Biosciences, Lincoln, NE)] delivered from 150 W high-pressure sodium lamps (Sun System® HPS 150 Grow Light Fixture; Sunlight Supply, Inc., Vancouver, WA) from 0600 to 2200 HR. The air temperature set point was 23 °C. Benches were insulated with a cellofoam board (1.2 m × 2.4 m × 2.3 cm; Polyshield®, Whiteland, IN), covered with heating mats (Redi-heat mat; Phytotronics, Inc., Earth City, MO), and covered with a 4-mil black construction film (Poly-America). On each bench, heating mats were independently controlled with a thermostat (Phytotronics, Inc.) to maintain a substrate temperature of 23 °C. Relative humidity was monitored and controlled by hygrostat-thermometer and delivered by a fogging system (MistKing; Jungle Hobbies, Ltd., Windsor, ON, Canada).

2.3 Indole-3-butyric acid Treatment

One day after cutting stick, nine unrooted cuttings of each genera received foliar spray applications of deionized water 0 mg·L^{-1}) or 200, 400, 800, or 1200 mg·L^{-1} IBA (Advocate®; Fine Americas, Walnut Creek, CA) at a rate of 97.6 mL·m^{-2}, with a handheld spray bottle from 0600 to 0700 HR. Solutions were sprayed until the leaves were saturated, slightly dripping, and allowed to dry before misting resumed.

2.4 Propagule Culture

At 10 days, RH was reduced to 70%. Cuttings were irrigated daily with 75 mg·L^{-1} N provided by 17N–1.7P–14.1K Jack's Professional Pure Water XL (J.R. Peters Inc., Allentown, PA) and water supplemented with 35% sulfuric acid at 0.16 mg·L^{-1} to neutralize alkalinity from 4.0 to 1.6 meq·L^{-1} calcium carbonate and reduce pH from 7.3 to a range of 5.8 to 6.0. Young plants were never allowed to wilt throughout the duration of the trial.

2.5 Propagation Environmental Data

On each propagation bench, thermocouples (ST-100; Apogee Instruments, Inc., Logan, Utah) measured propagation air and substrate temperatures, and full spectrum quantum sensors (SQ-500-SS; Apogee Instruments, Inc.) measured *PPFD*. Measurements were recorded every 30 s and the average of each sensor was logged every 15 min by a data logger (Model CR1000; Campbell Scientific, Inc., Logan, UT). A bench-top data logger (WatchDog Model 2475 Plant Growth Station; Spectrum Technologies, Inc., Aurora, IL) recorded RH at intervals previously reported. Propagation environmental data after 21 days (termination) were 11 ± 1.8 mol·m^{-2}·d^{-1}, 23 ± 3.2 °C air temperature, 23 ± 4.5 °C substrate temperature, and 76% ± 6.2% RH.

2.6 Data Collection

At 21 days after spray application, data were collected on nine individual cuttings per genera from each treatment. For coreopsis and meadow sage, stem caliper and shoot length were measured below the lowest leaf with a digital caliper (digiMax; Wiha, Schönach, Germany) and from the base of the cutting to the apical meristem, respectively. Roots were gently washed free of the substrate and excised from each cutting, and roots and shoots were dried separately in an oven at 70 °C for 1 week. Shoots and roots were weighed (New Classic ME Analytical Balance; Mettler Toledo, Columbus, OH) to determine shoot dry weight (SDW) and root dry weight (RDW), respectively.

2.7 Experimental Design and Statistical Analysis

The experiment was laid out in a randomized complete block design with three blocks and five IBA treatments. Three experimental units (cuttings) per genera per IBA concentration per replication were randomized on each propagation bench. Within each block, no significant differences occurred among replications per genera; therefore, data were pooled. Effects of IBA concentrations per genera were analyzed using SAS (version 9.2; SAS Institute, Cary, NC) general linear model procedure (PROC GLM) for analysis of variance (ANOVA). For each genus, regression analyses were performed using SAS regression procedure (PROC REG). For all analyses, a $P \leq 0.05$ was used to determine significant effects.

3. Results and Discussion

Except for RDW of shasta daisy, application of IBA did not affect shoot (data not shown) or root metrics of any genera (data not shown). No effect of auxin application is common among perennials (Blythe et al. 2003; 2004). Root dry weight of shasta daisy increased (P = 0.025) by 123% (80.5 mg) when cuttings were sprayed with concentrations from 0 to 800 mg·L^{-1} IBA. Results are consistent with Taylor and Hoover (2018), who reported a 204% (30.6 mg) RDW increase in germander (*Teucrium chamaedrys*) cuttings sprayed with 0 to 3000 mg·L^{-1} K-IBA. Generally, RDW of the statistically nonsignificant genera increased with increasing IBA concentrations. For example, RDW of coreopsis, garden phlox, and meadow sage increased by 29%, 39%, and 41%, respectively, as foliar spray concentrations increased from 0 to 800 mg·L^{-1} IBA and decreased. This observation (Fig. 1) could be significant to propagators and potentially result in robust pullable rooted cuttings earlier, thus hastening crop timing of moderate to difficult-to-root genera but further investigations are warranted. Nonetheless, similar rooting among increasing IBA concentrations may suggest reduced effectiveness of IBA applications as cuttings matured and rooting occurred. It is speculated that analyzing RDW data prior to 21 d may reveal differences in rooting with increasing IBA concentrations. Furthermore, reduced RDW was observed at 1200 mg·L^{-1} IBA and is consistent with a trial investigating K-IBA on 'Sweet Yellow' osteospermum (*Osteospermum ecklonis*; Kroin, 2018). Epinasty was also observed among all genera trialed at 1200 mg·L^{-1} IBA, thus reducing rooted cutting quality.

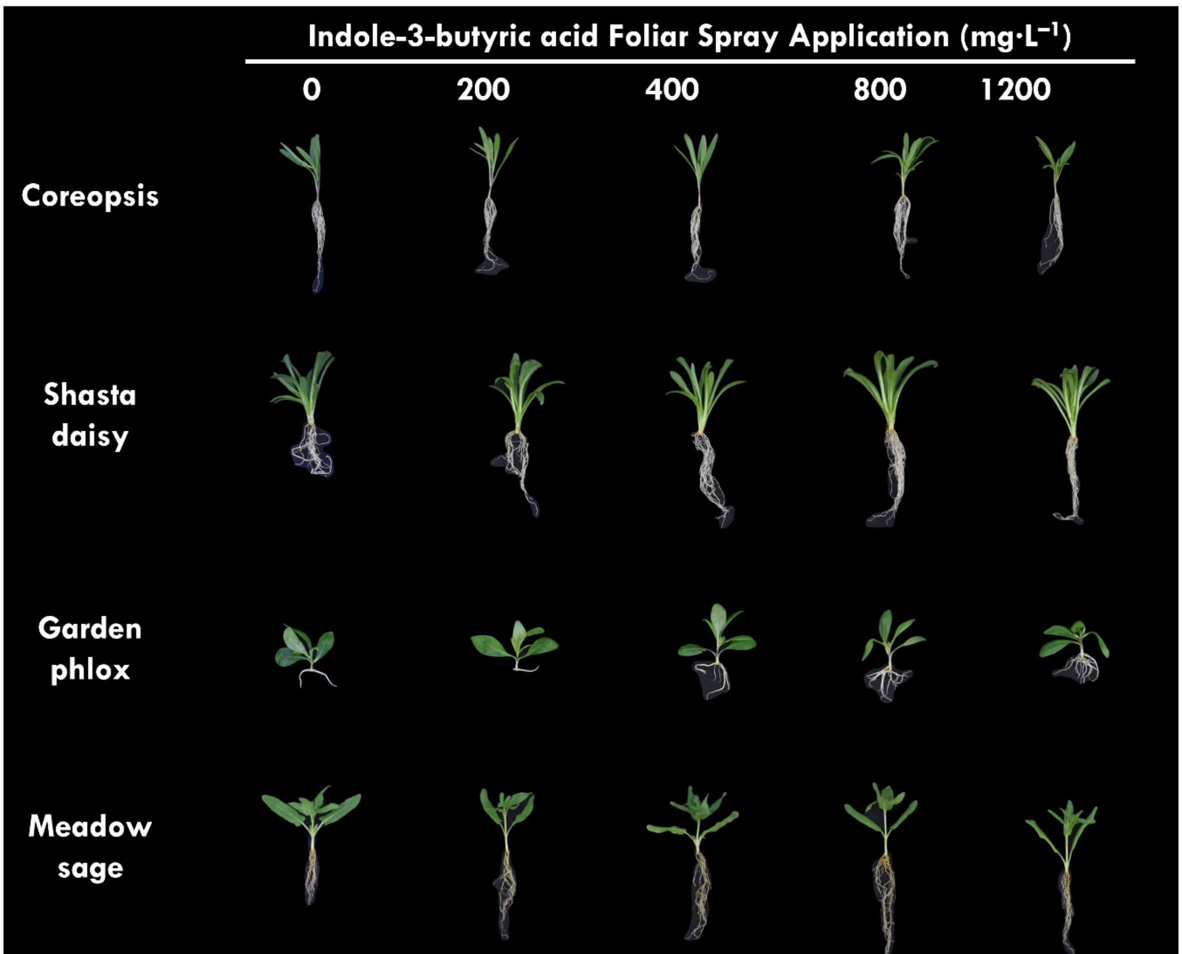

Figure 1. Depiction of 'Lemoncello Golden' coreopsis (*Coreopsis auriculate*), 'Sweet Daisy Christine' shasta daisy (*Leucanthemum maximum*), Flame Pink® ('Bartwelve') garden phlox (*Phlox paniculata*), and 'Salute Pink' meadow sage (*Salvia nemerosa*) cuttings after 21 days of propagation that received foliar spray applications of deionized water (0 mg·L^{-1}) or a novel indole-3-butyric acid (IBA) liquid product at 200, 400, 800, or 1200 mg·L^{-1}. Cuttings were propagated under 11 ± 1.8 mol·m^{-2}·d^{-1}, 23 ± 3.2 °C air temperature, 23 ± 4.5 °C substrate temperature, and 76% ± 6.2% RH for 21 days.

4. Conclusions

Foliar applied auxin application between 200–800 mg·L^{-1} IBA will result in similar or superior rooted coreopsis, shasta daisy, garden phlox, and meadow sage cuttings. It is not recommended to exceed 800 mg·L^{-1} IBA when propagating the cultivars and genera reported herein. Trials investigating other genera are warranted to establish optimum foliar spray application concentrations and mitigate phytotoxicity effects. Furthermore, multiple low IBA concentration applications to improve rooting of moderate and difficult-to-root herbaceous perennial genera should be explored.

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