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Sequential BA Applications Enhance Offset Formation in Hosta

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Abstract. **A study conducted in 1995 and repeated in 1996 determined the effects of repeated BA applications and subsequent repeated removals on yields of offsets in *Hosta* Tratt. (*Funkia* K. Spreng; *Niobe* Salisb.) stock plants. Two hosta cultivars, 'Francee' and 'Francis Williams', received zero, one, two, three, or four foliar applications of benzyladenine (BA) at 3000 mg·L^{-1}. Plants receiving multiple applications were retreated at 30-day intervals following offset removal from all plants. A single BA application stimulated offset formation in both cultivars in both years, but repeated applications were necessary for a continued response following offset removal. Total offset yield increased linearly as the number of BA applications increased. At 120 days after the first treatment in 1995, 'Francee' plants receiving four applications had produced an average of 22 offsets, and 'Francis Williams' plants 18 offsets, whereas control plants produced 9.8 and 0 offsets, respectively. Similar data for 1996 were 31.2 offsets for 'Francee' and 22.4 offsets for 'Francis Williams,' whereas control plants produced 6.8 and 2.6 offsets, respectively. Offset stage of development, as indicated by leaf number, and growth index generally were not affected by BA treatment. No phytotoxicity was observed, and plant appearance was enhanced due to the outgrowth of BA-stimulated lateral buds. Chemical name used: *N*-(phenylmethyl)-1*H*-purin-6-amine (benzyladenine, BA).**

Hostas are conventionally propagated by crown division or tissue culture. However, yields from crown division are relatively small and are typically obtained only once a year (Walters, 1981). Tissue-cultured explants are costly to produce and may not be true-to-type (Meyer, 1980). Tissue culture also requires skilled technicians, specialized materials, and expensive facilities that are unavailable to most growers. Rapid increases in plant numbers and the introduction of new cultivars often are hindered by these limitations. Promoting the outgrowth of lateral buds in hosta is a viable option for increasing propagule numbers.

Offsets in hosta develop from lateral or rhizomic buds (Schmid, 1991), but outgrowth of these buds appears to be suppressed by apical dominance. Hormonal interaction between auxins and cytokinins is a primary mechanism of apical dominance (Cline, 1988), and exogenous applications of cytokinin can stimulate lateral bud growth (Mok and Mok, 1994). Application of the synthetic cytokinin BA can induce the outgrowth of lateral buds in hosta (Keever, 1994), and offsets formed from BA-induced buds can be removed from the mother plant within 30 d of BA application and rooted under intermittent mist (Keever et al., 1995). These findings suggest that BA might facilitate conventional propagation methods by increasing the number of offsets available. BA application enhanced offset cutting production of *Gerbera jamesonii* Hook. stock plants when it was reapplied after each cutting harvest (Kaminek et al., 1987). A successful strategy for producing hosta offsets throughout the growing season might require treatment of stock plants with BA at 30-d intervals. This study investigated the effects of multiple BA applications and subsequent repeated removals of BA-induced offsets on offset yield from hosta stock plants.

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Materials and Methods

On 20 Feb. 1995, dormant, bare-root divisions of hosta cultivars Francee and Francis Williams were potted in 2.7-L containers filled with a 6 pine bark : 1 sand medium (v/v). Previous studies indicated that 'Francee' forms offsets readily in the absence of BA, while 'Francis Williams' does not (Garner et al., 1996). The medium was amended with 3 kg dolomitic lime, 0.9 kg Micromax (The Scotts Co., Marysville, Ohio), and 7.4 kg 24N–1.8P–10K (Polyon 24–4–14, 12-month formulation; Pursell Industries, Sylacauga, Ala.) per m^3. Plants were grown outdoors under 47% shade and irrigated by overhead rotary nozzles twice daily for ≈30 min per application, for a total of ≈3 cm per day.

On 7 July 1995, 50 single-eye (no offsets) plants of each cultivar were selected for uniformity, and 10 plants of each cultivar were randomly assigned to one of five treatments, either zero, one, two, three, or four foliar applications of BA at 3000 mg·L^{-1} (Abbott Laboratories, N. Chicago, Ill.). Buffer-X (Kalo Agr. Chemicals, Inc., Overland Park, Kans.) at 2 mL·L^{-1} was added to all BA solutions as a surfactant prior to foliar application at 0.2 L·m^{-2}. Applications were made at 207 kPa with a CO_2 sprayer fitted with a cone nozzle. Forty plants of each cultivar received BA treatment at the first application, leaving 10 nontreated controls. Plants were then completely randomized within cultivars. At 30-d intervals thereafter, all offsets were removed from each plant, and BA was reapplied to all but 10 of the remaining treated plants. This resulted in a total of five treatments 90 d after initial treatment (DAT).

At 30, 60, 90, and 120 DAT, visible offset counts and a growth index [(height + width at widest point + width 90° to first width) ÷ 3] were determined for each plant. All offsets were removed from each plant, and stage of development (SOD) was determined for each offset (SOD 1 = elongated bud with first leaf furled; 2 = one unfurled leaf; and 3–12 = 2–11 unfurled leaves, respectively). Data were tested by analysis of variance using the SAS General Linear Model procedure, and single degree of freedom contrasts were used to make specific planned comparisons (SAS Institute, 1988). Analysis of total offset yield data was accomplished by orthogonal polynomial contrasts. Commencing on 1 May 1996, the experiment was repeated under similar conditions with the same methodology.

Results and Discussion

As in previous studies (Keever, 1994), BA application promoted formation of offsets in hosta. In 1995, 30 DAT, offset counts were higher in treated than in control plants of both cultivars (Fig. 1). At 60 DAT, plants of 'Francis Williams' that received two BA applications had more offsets than controls or plants that received only one BA application, but control 'Francee' plants had produced as many offsets as plants that received one or two BA applications. At 90 and 120 DAT, plants of both cultivars that were retreated following offset removal had higher offset counts than controls or plants not retreated.

Repeated BA application was required to achieve a continued increase in offset production. Removal of offsets prior to reapplication of BA did not appear to affect subsequent positive response to BA. Total offset yield at 120 DAT in 1995 increased linearly with number of BA applications (Fig. 2); four applications of BA increased offset counts 124% in 'Francee.' With four BA applications, 'Francis Williams' averaged 18 offsets per plant, while no offsets formed in controls over the 120-d period. Offset stage of development and growth index were generally not affected by BA treatment (data not shown).

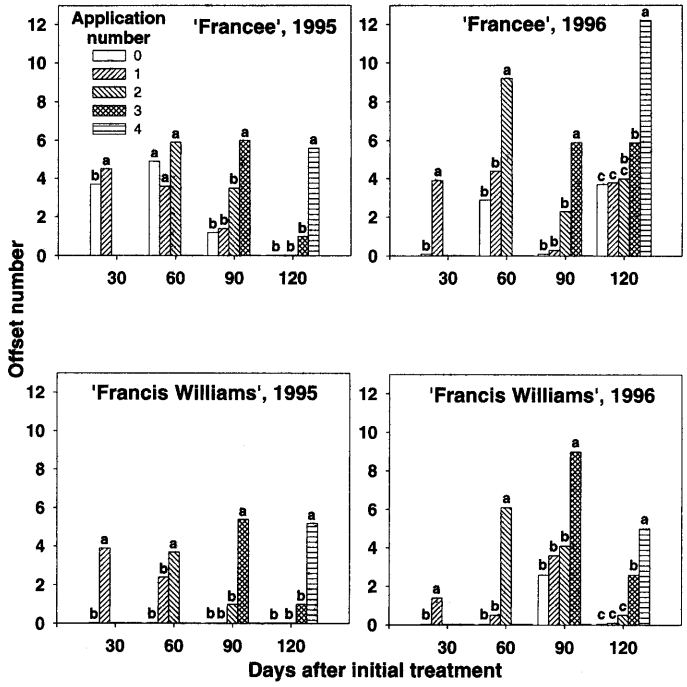

Fig. 1. Offset counts in hosta cultivars Francee and Francis Williams at 30, 60, 90, and 120 d after initial treatment (DAT) with 0, 1, 2, 3, or 4 applications of benzyladenine (BA) at 3000 mg·L^{-1} in 1995 and 1996. Mean separation within cultivars, years, and DAT by single degree of freedom contrasts, $P \leq 0.05$.

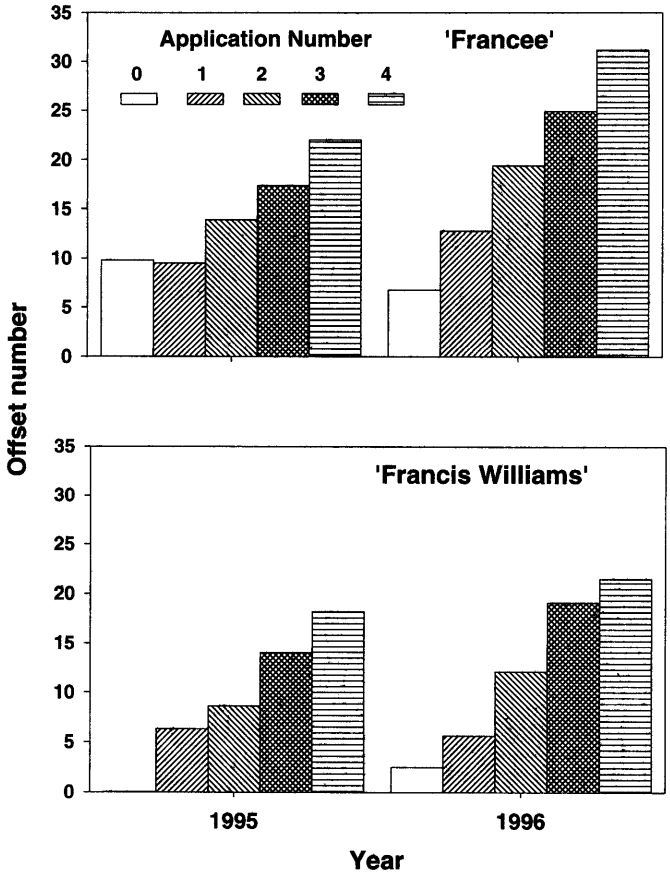

Fig. 2. Total cumulative offset yield in hosta cultivars Francee and Francis Williams at 120 d after initial treatment with 0, 1, 2, 3, or 4 applications of benzyladenine (BA) at 3000 mg·L^{-1} in 1995 and 1996. Regression response was linear ($P \leq 0.001$) for both cultivars in both years.

Repetition of the study in 1996 provided similar, yet more pronounced, effects on offset counts. At 30 DAT, offset counts for treated plants of both cultivars were again higher than those of controls (Fig. 1). At 60 DAT, unlike the response observed in 1995, retreated plants of 'Francee' had higher offset counts than either controls or plants receiving one BA application. As in 1995, retreated plants of 'Francis Williams' at 60 DAT had formed more offsets than controls or plants not retreated. At 90 DAT, plants of both cultivars that had been retreated following offset removal had higher offset counts than controls or plants that received one or two applications. Additionally, plants of 'Francee' that received two applications had more offsets than controls or plants that received one application. At 120 DAT, plants of both cultivars that were retreated following offset removal had higher offset counts than controls or plants not retreated. Offset numbers in plants that received three applications were higher than those in controls or plants that received one application in both cultivars, and higher than those in plants that received two applications in 'Francis Williams'. Total offset counts again increased linearly with number of BA applications (Fig. 2). Four BA applications increased offset counts for plants of 'Francee' and 'Francis Williams' 359% and 760%, respectively. 'Francee' controls averaged a total of 9.8 offsets in 1995 and 6.8 offsets in 1996, while 'Francis Williams' controls formed no offsets in 1995, and 2.6 in 1996.

As in the 1995 study, offset stage of development or growth index was not affected by BA treatment (data not shown). No phytotoxic symptoms were observed in any treatments, and plant appearance was actually enhanced by BA application in many cases. Hostas often develop foliar necrosis and grow more slowly in midsummer, probably due to heat stress. New growth arising from BA-induced offsets appeared to ameliorate the visual effects attributable to midsummer heat stress and late-season senescence. Outgrowth of BA-stimulated lateral buds also appeared to offset the reduction in foliage caused by offset harvests. This enhancement of plant appearance resulting from BA application may increase product marketability for growers, in addition to providing an important tool for the propagator.

These data indicate that hosta stock plants can be treated with BA at 30-d intervals throughout the growing season to provide more offsets than would otherwise be obtained by conventional division. Offset formation in response to BA application was cultivar-dependent, but in both cultivars, repeated application was required for a continued response, and offset removal did not prevent subsequent response to BA. By increasing the number of propagules available, time and cost of hosta production may be reduced. A practical system for the rapid multiplication of hosta that employs BA application can accelerate the increase and introduction of cultivars, particularly those that do not readily form offsets.

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