Dikegulac, but Not Benzyladenine, Enhances the Aesthetic Quality of Boston Fern

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Abstract. Greenhouse studies conducted in 1990 and 1991 evaluated the influence of dikegulac and benzyladenine on frond initiation and vegetative growth of Boston fern [*Nephrolepis exaltata* (L.) Schott 'Compacta']. Four weeks after transplanting, fern liners were sprayed with aqueous solutions of dikegulac (0, 250, 500, or 750 mg·L⁻¹) or benzyladenine (BA; 0, 50, 100, or 150 mg·L⁻¹). The effect of dikegulac and BA on the number of shoots, frond length, leaf area, and dry weight was measured. Dikegulac stimulated shoot initiation and increased leaf area and dry weight without affecting frond length. BA reduced frond length and had no effect on shoot initiation and dry weight. This study suggests dikegulac has potential to improve the appearance and aesthetic quality of Boston fern. Chemical names used: 2,3:4,6-bis-0-(1-methylethylidene)- α -L-Xylo-2 hexulofuranosonic acid (dikegulac); N-(phenylmethyl)-1H-purine-6-amine (benzyladenine).

Ferns in hanging baskets are in high demand for patio and interior decoration. Density of foliage is the main factor contributing to their appearance and aesthetic quality and determines marketability and price. Density of foliage is a result of shoot count and total leaf area. Therefore, increasing these attributes of ferns is a high priority.

Dikegulac (Atrinal; Gordon Corp., Kansas City, Kan.) and benzyladenine (BA) (ProShear; Abbott Lab., Chicago) are commercially marketed plant growth regulators that have successfully modified growth in several plant species (Frost and Kretschman, 1987; Johnson, 1981; Mahotiere et al., 1988; Matta, 1984). Dikegulac application to bougainvillea (*Bougainvillea × buttiana* Holtt and Standl) enhanced flowering and aesthetic quality, but did not alter branch count or plant height (Norcini et al., 1992). Al-Juboory and Williams (1991) observed that dikegulac stimulated branching but reduced branch length in golden pothos (*Scindapsus aureus* L.). Cytokinins affect apical dominance by releasing lateral shoot buds from inhibition (Philips, 1969). They increase shoot count, shoot length, and leaf area in alfalfa (*Medicago sativa* L.) (Tomkin and Hall, 1991). Applying kinetin directly to buds induced axillary shoot stimu-

lation in poinsettia (*Euphorbia pulcherrima* Willd.) (Millbocker, 1972) and branching in *Kalanchoe tormentosa* Bak. (Lyons and Hale, 1987). Green and Autio (1989) reported BA released axillary apple (*Malus domestica* Borkh.) buds from correlative inhibition. Mahotiere et al. (1993) obtained an increase in shoot emergence and proliferation by applying BA to asparagus (*Asparagus officinalis* L.) ferns. Carter and Mahotiere (1991) studied the effects of BA, promalin, and dikegulac on caladium (*Caladium hortulanum* L.) shoot count and found only dikegulac to be effective in promoting shoot initiation. In contrast, research with 'Bradford' pear (*Pyrus calleryana* Decne) (Keever et al., 1993), tree fruit nursery stock (Cody et al., 1985), and apple trees (Greene and Miller, 1988; Williams and Billingsley, 1970) showed lateral shoot count increased while lateral shoot length decreased from BA and promalin (GA₄₊₇ + BA) applications. Therefore, the behavior of dikegulac and BA differ with plant species.

There is a lack of knowledge on the response of Boston fern to growth regulators.

Therefore, the present study was carried out to determine the effect of dikegulac and BA on frond initiation and growth of Boston fern.

Materials and Methods

Greenhouse studies to determine the behavior of dikegulac and BA on Boston fern were conducted at Fort Valley State College Agricultural Research Station in 1990 and repeated in 1991. For all experiments, uniform 70-mm tissue culture fern liners (Fender's Flora, Apopka, Fla.) were transplanted into 1.7-L pots containing Pro-Mix BX [3 sphagnum moss : 1 perlite : 1 vermiculite (by volume); Premier Brand, New Rochelle, N.Y.]. Transplanting was on 7 and 10 Oct. 1990 and 1991, respectively. Each liner consisted of one well-developed shoot. Fertilizer (20N–4.4P–16.6K) was applied at every watering with N at 250 mg·L⁻¹. Throughout these experiments, the greenhouse was set at 24 °C day/18 °C night.

Four weeks after transplanting, the liners were sprayed to drip with aqueous solutions of dikegulac (0, 250, 500, or 750 mg·L⁻¹) or BA (0, 50, 100, or 150 mg·L⁻¹). Tap water was used as a control. Each treatment was replicated six times with one potted fern liner as an experimental unit arranged on the greenhouse bench in a randomized complete-block design. The experiments were terminated 12 weeks after chemical application. At this time, the plants were cut off at the soil level. Fronds were counted and then bunched and the longest one was measured. Leaf area for each plant was determined with a leaf area meter (model LI-3100; LI-COR, Lincoln, Neb.). The fronds were then dried at 60 °C for 48 h to determine dry weight. The experiment × treatment interaction was nonsignificant; therefore, data from both experiments were combined for statistical analysis. All data were subjected to analysis of variance and regression analysis (SAS Institute, Cary, N.C.).

Results and Discussion

Dikegulac. Shoot count was significantly increased by dikegulac application (Table 1, Fig. 1); a quadratic equation provided the best fit for the relationship. The linear component of the regression equation predicted shoot count increase by 3.3 for every 100 mg·L⁻¹

Table 1. Effect of dikegulac on shoot count and growth of Boston fern by 12 weeks after treatment.^z

Dikegulac (mg·L ⁻¹)	Growth characteristics			
	Shoot (no.)	Frond length (cm)	Leaf area (cm ²)	Dry wt (g)
0	6.9	30.4	1440	7.7
250	13.7	30.4	2909	14.0
500	17.0	27.6	3555	15.8
750	17.3	29.4	3146	13.1
Significance ^y	Q ^{**} , x	NS ^w	Q ^{**} , v	Q ^{**} , u

^z1990 and 1991 data combined.

^yQ = quadratic.

^xY = 6.9 + 0.033x – 0.0x², r² = 0.70.

^wY = 30.3 – 0.002x, r² = 0.04.

^vY = 1428.6 + 7.94x – 0.008x², r² = 0.57.

^uY = 7.7 + 0.034x – 0.0x², r² = 0.48.

NS, **Nonsignificant or significant at P ≤ 0.01, respectively.

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Fig. 1. Effect of dikegulac on the growth of Boston fern [left to right (mg·L⁻¹): 1 = nontreated control; dikegulac at 2 = 250, 3 = 500, and 4 = 750].

Table 2. Effect of benzyladenine (BA) on shoot count and growth of Boston fern by 12 weeks after treatment.^z

BA (mg·L ⁻¹)	Growth characteristics			
	Shoot (no.)	Frond length (cm)	Leaf area (cm ²)	Dry wt (g)
0	8.3	33.8	1811	12.0
50	11.3	29.4	2752	14.6
100	11.2	24.6	1995	10.8
150	10.3	29.9	2277	11.5
Significance ^y	NS ^x	Q ^{**w}	C ^{**v}	NS ^u

^z1990 and 1991 data combined.

^yC = cubic, Q = quadric.

^xY = 9.4 + 0.012x, $r^2 = 0.06$.

^wY = 34.3 - 0.18x + 0.0x², $r^2 = 0.40$.

^vY = 1811.2 + 54.02x - 0.89x² + 0.004x³, $r^2 = 0.21$.

^uY = 13.0 - 0.01x, $r^2 = 0.02$.

NS, **Nonsignificant or significant at $P \leq 0.01$, respectively.

Fig. 2. Effect of benzyladenine (BA) on the growth of Boston fern [left to right (mg·L⁻¹): 1 = nontreated control; BA at 2 = 50, 3 = 100, 4 = 150].

increase in dikegulac. The r^2 for the equation indicates that 70% of the total variation in shoot count was attributable to dikegulac. Frond length was not affected by dikegulac use. These findings concur with previous results indicating dikegulac stimulated shoot emergence, but not plant height (Al-Juboory and Williams, 1991; Carter and Mahotiere, 1991; Mahotiere et al., 1988). Our results, however, disagree with those of Norcini et al. (1992), who reported no dikegulac effect on 'Rainbow Gold' bougainvillea branching.

The response for leaf area development with dikegulac was quadratic (Table 1, Fig. 1). The average increase in leaf area due to dikegulac amounted to 794 cm²/100 mg·L⁻¹ in the linear portion of the model, but 750 mg·L⁻¹ was detrimental to leaf development. The regression of dikegulac on frond dry weight also was quadratic. The increase in dry weight due to more and larger leaves averaged 3.4 g/100 mg·L⁻¹ in the linear portion of the model. Our results contrast with those of Mahotiere et al. (1988), who reported a decrease in asparagus fern dry weight following dikegulac application.

Benzyladenine. BA did not affect shoot count in Boston fern (Table 2, Fig. 2). Frond length declined significantly with BA application. There was a cubic increase in leaf area with BA application. However, the regression equation had a low r^2 value. BA was not effective in increasing fern dry weight. Therefore, cytokinin-induced growth, as noted previously in alfalfa (Tomkins and Hall, 1991), does not hold for Boston fern.

Results from these experiments suggest that dikegulac has potential for improving the appearance and aesthetic quality of Boston fern. Dikegulac increased shoot count, leaf area, and dry weight without decreasing frond length.

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