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EFFECT OF NITROGEN LEVEL AND LIGHT INTENSITY ON GROWTH OF *EPIPREMNUM AUREUM*

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Abstract. ***Epipremnum aureum* (Golden Pothos) stock plants were produced utilizing 3 nitrogen levels and 3 light intensities in an attempt to determine the optimum fertilizer rate and shade level combination for the production of healthy Golden Pothos stock plants and cuttings. Experiment 1 tested maximum light levels of 2,000, 3,500 and 5,000 foot-candles (ft-c) and nitrogen (N) rates of 14, 42 and 70 mg/ 15 cm pot/week. Experiment 2 tested maximum light levels of 3,000, 4,500 and 6,000 ft-c and nitrogen application rates of 42, 70 and 98 mg N/15 cm pot/week. Best stock plants produced in experiment 1 were grown with 3,500 ft-c maximum illumination and 42 mg N/15 cm pot/week. The best quality Golden Pothos grown in experiment 2, during the summer months, received 6,000 ft-c light and 70 mg N/15 cm pot/ week. Cuttings taken from experiment 2 showed longest new shoots when stock plants received 98 mg N/15 cm pot.**

Light intensity and nitrogen application rate have been shown to influence growth of tropical foliage plants whether plants are produced for consumers (1, 2, 4, 9) or grown as stock plants (3, 6). Golden Pothos has been a favorite of consumers for decades and still commands a respectable share of the foliage plant market. Most Golden Pothos are propagated by single node leaf bud cuttings.

The production of good quality plants in the shortest possible time from stock plant cuttings depends on strong healthy stock plants. Optimum light and nitrogen levels for the production of many species of indoor plants have already been published (5, 7, 8, 10), but it is not known if these recommended rates produce optimum stock plant and cutting growth. This research examines the effects of various light levels and nitrogen rates on production of Golden Pothos stock plants and quality of the cuttings produced in an attempt to determine optimum light levels and nitrogen rates for Golden Pothos stock plant growth and cutting production.

Materials and Methods

Experiment 1, a 3x3 factorial experiment with 9 replications per treatment, in randomized block design with one 15 cm (6 in) pot serving as an experimental unit, was initiated on 23 April 1990. Rooted *Epipremnum aureum* cuttings were potted into 15 cm (6 in) pots using Vergro Container Mix [Canadian sphagnum peat moss: coarse grade vermiculite: perlite, 2:1:1 by volume plus starter nutrient charge (Verlite Co., Tampa, Fl 33680)]. Plants were grown in a shadehouse with one of three maximum light levels, 2,000, 3,500 and 5,000 ft-c (47, 63 and 80% shade) provided by black polypropylene shade cloth, and one of three nitrogen (NH_4NO_3) rates 14, 42 and 70 mg N/15 cm pot/ wk. Temperature ranged from 65 to 90°F and plants were watered twice a week.

Data recorded at termination of experiment 1 on 6 June 1990 included number of leaves and vines per plant, number of chlorotic leaves per plant, total vine length and pH and soluble salts of the growing medium. Plants were graded based on a scale of 1 = poor quality, unsalable, 3 = fair quality, salable, to 5 = excellent quality. Foliage was evaluated based on a scale of 1 = 40% or more leaf variegation, 2 = 30-39% variegation, 3 = 20-29% variegation, 4 = 10-19% variegation and 5 = 0-9% variegation.

Experiment 2, having a design identical to experiment 1 except replications per treatment were increased from 9 to 10, was established on 19 June 1990. Plants were placed in a shadehouse under maximum light levels of 3,000, 4,500 and 6,000 ft-c (45, 60 and 75% shade) provided by black polypropylene shade cloth as in experiment 1. Nitrogen, at rates of 42, 70 or 98 mg N/15 cm pot was applied

Table 1. Number of chlorotic leaves, plant grade and color grade of *Epipremnum aureum* 'Golden Pothos' grown from 23 April to 6 June 1990.

—	Chlorotic Leaves	Plant Grade[z]	Color Grade[y]
Footcandles			
2000	1.6	4.1	4.4
3500	1.9	4.4	4.1
5000	0.0	2.6	2.8
Significance[x]			
Linear	**	**	**
Quadratic	**	**	**
mg N/15 cm pot/wk			
14	0.4	3.2	3.0
42	1.3	4.0	4.1
70	1.7	3.8	4.2
Significance			
Linear	**	**	**
Quadratic	ns	**	**

[z]Plants graded on a scale of 1 = poor quality, unsalable, 3 = fair quality, salable, 5 = excellent quality.
[y]Leaf color variegation based on a scale of 1 = 40% or higher variegation, 2 = 30-39% variegation, 3 = 20-29% variegation, 4 = 10-19% variegation, 5 = 0-9% variegation.
[x]ns, *, **; Results nonsignificant or significant at P = 0.05 and 0.01%, respectively.

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once a week. This increase in nitrogen rates respond to plants higher nutritional requirements during the summer months. Temperatures ranged from 70 to 95°F and plants were watered 3 or 4 times per week as needed.

Single eye-node leaf bud cuttings were taken on 6 August and 26 September 1990 from the stock plants produced in experiment 2. Cuttings were placed in a propagation house and allowed to root for 5 weeks before new shoot length and root grade were recorded.

Data recorded initially and monthly from experiment 2 plants included number of leaves, vine length and soluble salts levels and pH of the growing medium. Plant grade, based on the same scale used in experiment 1, was determined when research ended on 13 November 1990.

Results and Discussion

For experiment 1, conducted during the springtime, the best quality plants grown received 3,500 ft-c light and 42 mg N/15 cm pot/wk (Table 1). Golden Pothos plant grade, total vine length and number of vines and number of leaves per plant were greater on plants receiving 3,500 ft-c light and 42 mg N/15 cm pot/wk (Table 2). Further increases in light and N levels produced smaller plants with fewer leaves, which probably accounted for plants receiving lower plant grades even though this group was judged to have the best overall leaf color variegation. Nitrogen toxicity occurred under the low and intermediate light levels but did not at the highest light level. The number of chlorotic leaves increased as the nitrogen rate increased. Soluble salts and pH of the growing medium were not significantly affected by treatments.

Golden Pothos produced in experiment 2, were grown during the long hot Florida summer season. Best quality stock plants were produced with 6,000 ft-c, the highest light level tested, and 70 mg N/15 cm pot/wk, the intermediate nitrogen level used, although plants grew longer vines and more leaves under the two lower light levels tested (Table 3).

Cuttings taken from stock plants in experiment 2 were allowed to root for 5 weeks, then the length of new shoots were measured. New shoot length was significantly affected by nitrogen rates applied to stock plants, with cuttings from stock plants receiving 98 mg N/15 cm pot/wk having the longest new shoots (Table 4). A high nutritional level in stock plants might provide an important source of nitrogen during the early stage of shoot development. Soluble salts and pH of the growing medium, as in experiment 1, were not significantly affected by the light and N treatments tested (Table 4).

Table 2. Total vine length, and number of vines and leaves per plant of *Epipremnum aureum* 'Golden Pothos' grown from 23 April to 6 June 1990.

—	Total Vine Length (cm)	Number of Vines	Number of Leaves
Footcandles			
2000	184	3.8	37
3500	201	3.7	40
5000	91	2.4	32
Significance[z]			
Linear	**	**	**
Quadratic	**	**	**
mg N/15 cm pot/wk			
14	140	3.0	34
42	182	3.7	40
70	154	3.2	36
Significance[z]			
Linear	ns	ns	ns
Quadratic	**	**	**

[z]ns, *, **; Results nonsignificant or significant at the P = 0.05 and P = 0.01, respectively.

Table 3. Plant grade, vine length and number of leaves of *Epipremnum aureum* grown 19 June-13 November 1990.

—	Plant[z] Grade	Vine Length	Number of Leaves 25 Jul	Number of Leaves 25 Sep
Footcandles				
3000	2.7	200	25.9	56.7
4500	3.5	193	23.5	52.6
6000	4.2	182	23.3	53.3
Significance[y]				
Linear	**	*	*	*
Quadratic	ns	*	ns	ns
mg N/15 cm pot/wk				
42	3.1	187	24.1	50.6
70	3.8	203	23.2	55.9
98	3.6	210	25.3	55.8
Significance[y]				
Linear	*	ns	ns	**
Quadratic	*	*	ns	*

[z]Plant grade based on a scale of 1 = poor quality, unsalable, 3 = fair quality, salable, 5 = excellent quality.
[y]ns, *, **; Results nonsignificant or significant at P = 0.05 or 0.01, respectively.

Table 4. Electrical conductivity (µmhos/cm) and pH of medium containing *Epipremnum aureum* and length of new shoots on cuttings from *Epipremnum aureum* grown from 19 June until 13 November 1990.

—	Length of New Shoots (cm)		µmhos/cm		pH	
	12 Sep	13 Nov	29 Jun	25 Jul	29 Jun	25 Jul
Footcandles						
3000	5.6	4.5	483	164	7.7	7.9
4500	6.2	4.6	366	170	7.8	8.0
6000	5.8	4.0	410	185	7.8	7.9
Significance[z]						
Linear	ns	ns	ns	ns	ns	ns
Quadratic	ns	ns	ns	ns	ns	ns
mg N/15 cm pot/wk						
42	4.7	3.6	346	179	7.8	8.0
70	6.3	4.5	460	166	7.7	8.0
98	6.4	5.0	453	174	7.7	7.9
Significance[z]						
Linear	**	**	ns	ns	ns	ns
Quadratic	**	ns	ns	ns	ns	ns

[z]ns, *, **; Results nonsignificant or significant at P = 0.05 and 0.01, respectively.

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EFFECTS OF ABSCISIC ACID ON PHOTOSYNTHESIS, GROWTH AND DEVELOPMENT OF STAGE III *ARONIA ARBUTIFOLIA* (ROSACEAE)

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Abstract. **Three experiments were conducted to evaluate the effect of ABA on photosynthesis, growth and development of Stage III rooting of *Aronia arbutifolia* (L.) ELL. micropropagules. In the first experiment Stage II micropropagules were transferred onto agar solidified Woody Plant Medium (WPM) supplemented with either 0, 0.1, 1, 10 or 100 mg/L abscisic acid (ABA) in the presence or absence of 1 mg/L indole-3-butyric acid (IBA). In the second experiment, 1 mg/L of IBA and 0, 0.1, 0.5 and 1 mg/L of ABA were used. The final experiment consisted of a 4 x 4 factorial with 0, 2, 4, and 6 mg/L of ABA and 0, 1, 2 and 3 mg/L of IBA. Significant reductions in growth were obtained with increased ABA levels in the first experiment. In the second experiment, negative carbon balances were recorded in Stage III micropropagules under 0, 0.1, 0.5 and 1 mg/L. At lower levels, ABA had no effect on shoot length, leaf area, number of leaves and roots produced. In addition, scanning electron microscopy (SEM) did not show any morphological differences at low ABA levels. In the third experiment, however leaf area and shoot growth were significantly reduced with increased ABA levels independent of the IBA level used. Differences in leaf morphology were observed in treatments with 4 mg/L ABA or greater.**

In vitro produced plantlets desiccate and quickly deteriorate when transferred to an improper acclimatization environment (22, 18). Acclimatization has been defined as the process by which organisms adapt to man-made environments (2). During the acclimatization process, tissue cultured plantlets undergo changes in leaf morphology (5) and physiology (10, 11) which occur over an extended period and confers the plants with a greater potential of survival ex vitro.

Endogenous ABA has been shown to play a role in controlling plant growth and development and alleviating water stress (17). Exogenously applied ABA inhibited the growth rate (6) by inducing stomatal closure (25, 1) or possibly by altering gene expression (4). Other studies have shown that ABA enhanced growth. Hall and McWha (12) found that exogenously applied ABA initially inhibited growth, but after a short lag, increased in leaf and tiller numbers in wheat. Sen et al., (20) observed enhanced shoot morphogenesis in loblolly pine exposed to ABA. Abscisic acid has also mediated water stress by induced changes in stomatal differentiation and leaf cuticle development in aquatic micropropagated heterophyllic angiosperms (14, 9). Similarly, leaves of acclimatized micropropagated plums exhibited greater stomatal density and increased cutin formation (3). Endogenous ABA may play a role in the acclimatization and carbon exchange rates of in vitro regenerated plantlets, but no work has been done to demonstrate this relationship. Under conventional micropropagation protocols, negative and low carbon exchange rates occurred when regenerated plantlets were grown in heterotrophic conditions (10, 21).

The objectives of this study were to characterize the effects of exogenous ABA on photosynthesis, growth and development of Stage III rooted plantlets of *Aronia arbutifolia.*

Materials and Methods

Aronia arbutifolia (L.) Ell. is a woody plant native to Florida with potential as a landscape plant and for use in revegetation efforts (7). The micropropagation protocol used was an adaptation of Kane et al. (13). Stems with lateral buds were cut from actively growing mature plants. Stems were divided into 15 mm length with 2 to 3 lateral buds. The severed explants were rinsed in tap water for 1 hr and surface sterilized by immersion in 50% (v/v) ethanol for 1 min and in 1.05% (v/v) sodium hypochlorite for 12 min, followed by three 5-min rinses in sterile deionized water. Explants were transferred aseptically into 25 x 150 mm culture tubes containing 15 ml of medium consisting of WPM, salts and vitamins (16), 3% (w/v) sucrose, 1 mg/L N^6-benzylaminopurine and solidified with 1.0% (w/v) Sigma Type A®agar. Medium pH was adjusted to 5.5 with 0.1 N KOH before autoclaving at 1.2 Kg cm^{-2} for 20 min at 121°C. All cultures were then grown under a 16-hr photoperiod provided by cool-white fluorescent lamps at

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