Hosta Propagation

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INTRODUCTION

Hostas are a group of popular shade tolerant herbaceous perennials known more for their foliage effects than for their flowering characteristics. Increased market demand by consumers due in part to the long market window of a plant sold primarily for its attractive foliage, and the number of cultivars available, has resulted in limited supplies of popular cultivars.

Hosta taxa are commonly propagated by division or tissue culture. Sexual propagation is used by hybridizers to develop new cultivars, but is not a commercially viable propagation method because seed propagation does not produce a plant identical to the parent. Hostas are slow growing (Armitage, 1997) and simple division does not produce adequate numbers of new plants. "Mowing" and "the Ross method" (Grenfell, 1996) and the application of benzyladenine (BA) (Garner, et al., 1995, 1996, 1997; Hoover, et al., 1998; Keever, 1995; Keever, et al., 1995a and 1995b; Keever and Bass, 1998; Schultz, et al.,1998) increase the number of offsets resulting in a greater number of divisions that are identical to the mother plant. Tissue-culture propagation has produced large numbers of plants, but its use as a propagation technique requires careful monitoring in both the technique and evaluating the product of that technique.

DIVISION

Division is the primary means of propagating hosta. Field-grown plants are traditionally dug and divided in the spring when the shoots are dormant or less that 1 inch (2.5 cm) (Nau, 1996). The third spring of growth is when the greatest number of divisions occurs (Aden, 1990a). Most think of division as the separating of shoots with roots, but it is possible to remove the terminal shoot or dormant bud and further divide to a plant having a single lateral bud and a root or rhizome (Summers, 1969). As this results in significant wounds there is an increased chance of disease.

Amateur gardeners divide in the spring, but to maintain a good landscape appearance, may separate the division away from the mother plant with a sharp trowel or knife without removing the mother plant from its site. Even though spring division is considered the optimum time to produce a quality containerized plant for market in a relatively short time of 2 to 5 weeks (Nau, 1996), nurseries may divide to fill an order anytime (Summers, 1969). It seems hostas are frequently divided from late winter through fall (Davis, 1998). Diana Grenfell recommends removal of leaves from plants divided in the summer (Grenfell, 1996). David Beattie recommends a reduction in leaf area and shade whenever dividing after the leaves have fully expanded (Beattie, 1996). Older plants tend to be more difficult to divide (Gear, 1996). While young plants and certain cultivars are easily pulled apart, knives or pruners are sometimes needed to cut divisions apart. Selecting large vigorous plants to maintain as mother plants (Davis, 1998) rather than smaller plants typically used (Keever et al., 1995b) will result in more divisions, as will proper care and providing a good growing environment.

TECHNIQUES TO INCREASE THE NUMBER OF DIVISIONS

Hosta do not naturally produce a large number of shoots that can be harvested. This limitation has forced the development of several methods to increase the number of potential divisions. The objective of increasing the number of divisions is to be able to sell more plants but increasing the size of plants in the landscape is desirable as well.

The first methods to increase the number of divisions is "mowing" the plants down to approximately 0.5 inches (1.25 cm) during the summer forcing buds to break and increasing the number of shoots. The second, "Ross-izing" or the "Ross method", is described as cutting through the stem just above the basal plate down through the basal plate to the roots and then making a similar cut at 90° to the first, essentially quartering the plant in the late spring or early summer (Ross, 1982, Zumbar, 1991). Additional shoots will develop at the cuts. The third method is to apply benzyladenine, a cytokinin, as a foliar spray or drench to the plants (Garner, et al.,1995, 1996, 1997; Hoover, et al., 1998; Keever, 1995; Keever, et al., 1995a and 1995b; Keever and Bass, 1998; Schultz, et al.,1998) to increase offset formation. In several studies the application of BA resulted in offset formation when the controls produced no offsets. Researchers have used the synthetic cytokinin Pro-shear (BA) in several of their studies and found it to be effective in increasing the number of offsets formed, but consistent results have not been found for all cultivars (Garner, et al.,1995).

N-6-benzylaminopurine (BAP) has been shown to be effective in increasing offsets in 11 hosta cultivars (Hoover et al., 1998). The presence of offsets at the time of BA application resulted in fewer offsets being produced compared to plants with no offsets at the time of a BA application (Keever and Brass, 1998; Keever, et al., (1995b) reported that the stage of development of the offsets resulting from cytokinin treatments affected the rooting of the stem cuttings. Those offsets with two or more leaves unfurled rooted more readily that those with less unfurled leaves. It would appear that a research program developed around BA treatments to increase offset formation would benefit *Hosta* propagators.

SEED PROPAGATION

Hosta species can be propagated by seed. However, sexual propagation is mostly limited to producing plants from seed resulting from selected crosses by hosta hybridizers. Methods of hybridizing hosta, including: selecting parents, the handling and storage of pollen, making the cross, and producing plants from seed are described in *The Gardener's Guide to Growing Hosta* by Diana Grenfell (1996) and *The Hosta Book*, Second Edition edited and compiled by Paul Aden (1990b). Rarely does a good variegated hosta cultivar result from uncontrolled pollination (Micheletti, 1996).

Once seed has been produced it can be directly planted or stored in a cool dry environment for a short term or in a refrigerator for a longer term. Hosta seed viability varies greatly (Aden, 1990b). Direct seeding of important crosses would be recommended until a hybridizer becomes familar with the seed characteristics of his/her crosses.

Seeds are broadcast on a fine textured medium, keep moist, and at 60 to 75°F (16 to 24°C) in order to achieve good germination. Light will be needed once the true leaves appear. Hybridizers and amateur gardeners alike must be diligent in culling out the unacceptable seedlings. The use of hosta standards (similar cultivars currently available) for comparison will help in the selection of quality species plants and new cultivars.

TISSUE CULTURE

Considering the slow production of plants by division, it became inevitable that tissue culture would (and does) play a critical role in the propagation of hosta. Tissue culture has made it possible for hosta to be in every landscape. Many new cultivars are propagated by tissue culture. A recurring criticism of tissue culture for hosta propagation has been the production of plants that are not true to type and the older the culture gets the more likely there will be "sports". Meyer (1980) found that when 'Francis Williams', a popular cultivar, was propagated by tissue culture only 45% of the plants produced were variegated, with the rest being 45% a gold sport and 10% a green sport. These kinds of early results with tissue culture of hosta were discouraging and resulted in resistance to tissue-cultured plants in the market. In order to have a successful tissue-culture program with hosta it is important to be able to identify the form of the cultivar at roguing. The purchaser of tissue cultured plants should be able to evaluate the plants they receive to ensure the plants they invest in are true to cultivar. It can take 4 to 5 years before *Hosta* taxa reach maturity of form and color (Armitage, 1997). Establishing standards (plants known to be true to the cultivar grown to the same stage of development) to use to compare plants at different stages of growth in order to rogue several times through the production cycle is important. The source of the tissue to be cultured, florets, flower scapes, or shoot tips can make a difference in maintenance of parent plant characteristics, as can environmental treatments (Papachatzi, et al., 1981). Certain environments and production factors can affect the variegation or form of a plant in nursery production or in the landscape. A loss of variegation can occur in areas of high temperatures when nitrogen fertilizers are used (Armitage, 1997) causing plants to be mistakenly thought not to be true to type. Considering the precise and fastidious care required to propagate hosta in tissue culture the commercial success of this technique is a tribute to those propagators that produce vigorous, disease-free, true-to-name plants.

CONCLUSIONS

Tissue-culture techniques will continue to be refined by both large and small commercial laboratories to eliminate deviant plants from the production cycle and, ultimately, from getting to the consumer. Division will be the propagation method of choice for hosta, especially for small nurseries and specialty nurseries that sell a few plants of many different cultivars. It would seem that treatments and cultural practices that increase offset formation would benefit the propagator, the nursery grower, and the landscaper.

It would be interesting to know if commercial propagators and nurserymen have adopted the application of cytokinin products to increase hosta offset formation.

LITERATURE CITED AND OTHER RESOURCES

Aden, P. 1990a. The Cultivation of hosta. pp. 10-11. In: The hosta book, 2nd Ed., Timber Press, Portland.

Aden, P. 1990b. Variegation and hybridization observations. pp. 104-118. In: The hosta book, 2nd Ed. Timber Press, Portland.

Falstad, III, C.H. American Hosta Society glossary of terms. Hosta J. 29(1):25-28.

Armitage, A.M. 1997. Herbaceous perennial plants, 2nd ed. Stipes Publishing, Champaign.

Beattie, D.J. 1996. Propagating herbaceous perennial liners and plugs. Comb. Proc. *Intl. Plant Prop. Soc.* 46:114-117.

Davis, T. 1998. Daylilies and hosta: Designing a nursery program to grow these popular plants. NM*PRO*: July, pp. 30-37.

Garner, J.M., G.J. Keever, D.J. Eakes, and **J.R. Kessler.** 1995. Benzyladenine-induced offset formation in hosta dependent on cultivar. Comb. Proc. Intl. Plant Prop. Soc. 45:605-611.

Garner, J.M., G.J. Keever, D.J. Eakes, and **J.R. Kessler.** 1996. Sequential BA applications enhance offset formation in hosta. Comb. Proc. Intl. Plant Prop. Soc. 46:689-692.

Garner, J.M., G.J. Keever, D.J. Eakes, and **J.R. Kessler.** 1997. Benzyladenine-induced offset formation in hosta dependent on cultivar. HortScience 32:91-93.

Gear, I.R. 1996. Division, factors for consideration in ensuring success. Comb. Proc. Intl. Plant Prop. Soc. 46:418-420.

Grenfell, D. 1996. The gardener's guide to growing hosta. Timber Press, Portland.

Hammer, P.A. 1976. Tissue culture propagation of *Hosta decorata* Bailey. HortScience 11(3):309. Abstract No. 138.

Hoover, M.P., J. B. London, W.B. Miller, G.Legnani, and **R.T. Fernandez.** 1998. Benzyladenine induces branching in eleven new hosta cultivars. SNA Res. Conf. Proc. 43:303-305.

Keever, G.J. 1994. BA-induced offset formation in hosta. J. Environ. Hort. 12:36-39.

Keever, G.J. 1995. BA-induced offset formation in hosta. Alabama Ag. Expt. Station 1995 Ornamentals Res. Rept. 10:30-31.

Keever, G.J., D.J. Eakes, and **C.H. Gilliam.** 1995a. Offset stage of development affects hosta propagation by stem cuttings. Alabama Ag. Expt. Station 1995 Ornamentals Res. Rept. 10:32-33.

Keever, G. J., D. J. Eakes, and **C. H. Gilliam.** 1995b. Offset stage of development affects hosta propagation by stem cuttings. J. Environ. Hort. 13:4-5.

Keever, G.J. and **T.J. Brass.** 1998. Offset increase in hosta following benzyladenine application. J. Environ. Hort. 16(1):1-3.

Meyer, M.M. 1976. Propagation of *Hosta* by in vitro technique. HortScience 11(3):309 Abstract No. 137.

Meyer, M.M., Jr. 1980. In vitro propagation of *Hosta seiboldianum*. HortScience 15(6):737-38.

Micheletti, T. 1996. Lotsa hosta. Amer. Nurseryman 184(12):30-37.

Miller, P.D. and **K.G. Wilson.** 1981. Protoplast fusion and organ culture in the genus *Hosta*. Envir. Exp. Bot. 21:431-432.

Nau, J. 1996. Hosta species. pp. 267-268. In: Ball perennial manual, Ball Publishing, Batavia.

Papachatzi, M., P.A. Hammer, and **P.M. Hasegawa.** 1980. In vitro propagation of *Hosta plantaginea*. HortScience 15(4):506-507.

Ross, H. 1992. A foolproof method of rapidly propagating hostas. Amer. Hosta Soc. Bull. 13:51-54.

Ruh, P.1991. Seed, is it worthwhile?. Hosta J.22 (1):53-54.

Schmid, W.G. 1991. The genus *Hosta*. Timber press, Portland.

Schultz, H. C., G.J. Keever, J.R. Kessler., R.R. Dute, and **J.W. Olive.** 1998. Root mass and BA affect offset formation in hosta. SNA Res. Conf. Proc. 43: 300-302.

Summers, A.J. 1969. Propagation. Amer. Hosta Soc. Annual Bull. 1:29-30.

Walters, J. 1981. Propagation of herbaceous perennials. Comb.Proc. Intl. Plant Prop. Soc. 32:583-588.

Wilson, S.B., Nihal C. Rajapakse, and **R.E. Young.** 1998. Low temperature storage of micropropagated hosta under various light qualities. SNA Res. Conf. Proc. 43:320-323.

Zilis, M.R. 1981. Tissue culture propagation of hosta. Amer. Hosta Soc. Bull. 12:19-20.

Zilis, M.R., D. Zwagerman, D. Lamberts, and **L. Kurtz**. 1979. Commercial production of herbaceous perennials by tissue culture. Comb. Proc. Intl. Plant Prop. Soc. 29:404-414.

Zumbar, B.1991. Beginners' propagation of hostas by rossizing, an update. Hosta J. 22(1):19-20.

Evaluation of Root Exudate Production in Six Sorghum Accessions: Chemistry and Root Morphology Studies

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Sorghum (*Sorghum bicolor*) has been used for several decades as a cover crop during crop rotation in nursery production. Sorghum is one of a number of plant species which produce natural products involved in pest management. Sorgoleone production in sorghum has been identified as a component of the exudate associated with the inhibition of other plant (weed) growth.

A detailed study was performed in order to compare root-exudate production and chemistry in six different sorghum accessions (SX - 15, SX - 17, 855F, 8446, Della, and johnsongrass). Comparisons were based on the quantity of root exudates produced and related chemical constituents within each extract. In order to provide mass quantities of root exudates, a novel system of root-exudate collection was developed using a capillary-mat system for seedling growth. Six sorghum accessions were then grown on this system and roots exudates were collected, dried, and weighed. Components of these root exudates were then separated via reverse-phase HPLC, with UV detection set at 280 nm. Each accession differed with respect to the quantity of root exudate produced. Moreover, the amount of each chemical constituent produced varied by sorghum accession. To further understand how the root exudates of sorghum are produced, gross root morphological studies utilizing light microscopy and CryoSEM were performed. These two techniques revealed that root exudates are produced and released by root hairs. Ultrastructure studies were performed using transmission electron microscopy and showed that root exudates are being deposited between the plasmamembrane and the cell wall before secretion of the hydrophobic droplets by the root hairs. Intracellularly, exudate production appears to originate in the endoplasmic reticulum.