less thinning and the machine sowing is slightly faster which helps lower these production costs.

Best of all the sink/float method requires no expensive equipment like a gravity table, sorting only requires a container of water. In looking again at Table 2, with the control seed we must sow six seeds per plug to get our 90%+ standard germination rate and the entire lot will only get us a total of 112,271 plugs. Also we must now spend more time sowing and thinning than the sorted seed, not to mention the amount of seed wasted. Also note that even when sowing six seeds per plug for both Lot C or the floated seed lot, you cannot achieve the 90%+ rate of plugs full with seedlings.

SUMMARY

Because conifer seeds have poor germination rates, seed sorting to achieve higher germination rates can lower propagation cost by greatly reducing lost greenhouse space from empty plugs. Seeds that sank proved to be the best sorting method compared to the gravity table method as it resulted in the highest germination rates using the least amount of seeds per plug and gave the greatest number of total plugs produced.

New Hostas From Seeds©

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INTRODUCTION

Hostas are the number-one-selling perennial in North America, and much of that is attributed to cultivar diversity as well as hardiness and ease of use in the landscape. Much of the recent interest is in new distinct cultivars. There are about 250 new cultivars registered each year bringing the current total to about 3000 different cultivars.

Hosta cultivars can be propagated by division and tissue culture, or also by seed for those few species that have a market. The diversity and unpredictability of sexual propagation does not lend to production of true-named cultivars, however it is an excellent source of new and improved cultivars.

Breaking down the various characteristics into all the possible forms shows a huge potential for different cultivars. If we examine the various attributes of hostas we find there to be conservatively 136 different traits. Assuming half of these to be linked, i.e., large plant size with large leaf size, or lance leaf shape with tapered leaf base, we still find there are enough combinations of qualities to produce well over 500 million distinct hostas. That's enough for everyone living in North America to have at least one of their very own unique hostas capable of being keyed out and identified by its special characteristics.

HOSTA HYBRIDIZING PROCEDURE

As with any hybridizing program, breeders must first start with a thorough understanding of the genus. Growing many different species and cultivars of hostas is essential, and a healthy comprehension is also a must. The American Hosta Society

(AHS) now produces three annual issues of their information packed journal, and there are still limited editions of earlier issues going back to 1968 that would be excellent resources. The AHS is also the International Cultivar Registration Authority, and as such publishes a journal containing descriptions of all the new cultivars registered. Networking with other hosta breeders would also add important knowledge, and an easy place to start this is at national, regional, and local events of the AHS.

Once breeders have a good understanding of hosta cultivars the next step is to establish goals for a hybridizing program. Be creative, and don't let your mind place limits on what can or can't be accomplished. Too often hybridizers limit themselves to rearranging traits that are already present. If all hybridizers stopped at that we would not have most of the developments of modern horticulture. Just because we don't currently have red foliage in hostas doesn't mean it is unobtainable and should be abandoned before even starting.

Plan what parents to use according to hybridizing objectives. Here, just because two parents don't normally flower at the same time does not mean they cannot be combined. Parent plants that flower at different times can still be combined. Sometimes it is possible to force later flowering cultivars to flower earlier by bringing them out of dormancy earlier and forcing in a warm greenhouse. Another opportunity is to store pollen from earlier flowering hostas. Although hosta flowers normally only last for 1 day, the whole flower, or just the pollen in the anthers can be saved for a few days to a week under refrigeration. Individual flowers, if harvested early enough in the day, can be saved in refrigeration for 2 to 3 days. Pollen can be saved for as much as a week by removing anthers from the filament and wrapping loosely in wax paper stored in plastic film canisters in a refrigerator. Leaving the filament attached usually causes mold. Anthers can also be stored for as much as a whole season by putting them in gel capsules or folded in wax paper and rolled loosely inside a capped film canister or similar tight container and placed in a freezer.

Of course pollen can also be used fresh if both parents are open on the same day, but in the heat of the summer it degrades quickly if left on the plant.

Most hosta flowers open in the morning and are open for just one day. Dab pollen from selected male parent on stigma of selected female parent. To prevent foreign pollination emasculation or other means of keeping crosses free of insects may be necessary. Hosta pollen is too heavy to be air borne, so the main vector causing contamination from outside pollen is insect. Label each cross with a color-coded telephone wire or other tag wrapped around the peduncle of the flowers pollinated. Keep pod parent disease free and healthy with sufficient moisture.

Not all hostas are fertile, and fertility is variable among seedlings. Fertility is generally higher in species and some of the primary crosses.

In selecting which parents to use, maternal inheritance contributes greatly to the characteristics of the offspring, but it is sometimes a good practice to do reciprocal crosses, reversing the male and female parents. The color of the leaf center of the pod parent is a main factor in determining the leaf color of the seedlings. Since gametes are formed in the L2 layer, the color of the leaf margin (L1 layer) of the pod parent, or the pollen parent, has little or no impact on the leaf color of seedlings.

Many traits in hostas display incomplete dominance. Hostas have a complicated set of 60 chromosomes, and may even be auto-tetraploids, having naturally doubled the chromosome set from an original of only 30. Some of the new cultivars coming out have 120 chromosomes. This tends to produce slightly larger flowers, thicker stems and more rigid leaves.

Although variegation is a common hybridizing goal, crossing two variegated hostas rarely produces variegated seedlings. The highest percentage of variegated offspring (15% to 50%) is achieved using female parents with unstable streaked or splashed variegation in the leaf center. Scapes and pods with streaked variegation produce a higher percentage of seedlings with variegation. Most variegated seedlings do not emerge with stable variegated patterns. That is, most variegated seedlings do not start with complete uniform margins and centers of different colors. Normally these start out as sectorial chimeras that after a few months or a few seasons may stabilize into forms with a single-colored margin and a center of different color (periclinal chimeras).

Hosta 'Revolution', with its unique green speckled center on a white background, also tends to produce variegated seedlings in a typical snow-flurry pattern. However, the majority of the offspring appear very similar to 'Revolution' without the added vigor contributed from the green margin.

Generally, the more complex the background of the parents the greater is the variability of the offspring. Unfortunately, in some cases too great of a variation in parents can make the resulting seedlings much less fertile.

Allow seed to ripen for 2 to 3 months, or if possible until pod begins to turn yellow. Generally, the earlier flowering cultivars need more time for seed to mature than the late-flowering plants.

GERMINATION AND GROWTH OF SEEDLINGS

When seeds are dark brown to black they can be separated from the pods. Those seeds with swollen protuberances at one end of the seeds are worth sowing. Frequently, sterile seeds can have the same dark color as viable seeds, so the swollen embryo is the only way to distinguish between sterile and fertile seed. Keep the labels for your cross and sow seeds in trays or flats covered with a domed tent, or lightly covered with soil. Seeds sown indoors with 16 to 24 h per day given by fluorescent lights should be of flowering size by the following summer.

Seeds can be sown immediately or stored below 0 ºC for more than 1 year if protected from excessive drying. Alternately, seeds can be sown in prepared beds outdoors in the fall. Germination will occur in the spring, and flowering will be delayed and may not occur for 18 months or more.

Best germination conditions include supplemental fluorescent lights hung 15 to 25 cm from seeds. Ideal germination temperatures should be between 23 to 26 ºC. The minimum photoperiod is 16 h, but 24 h is advantageous and will be more likely to obtain flowering seedlings by the summer after seed harvest. Photoperiods of 16 h or less may allow transplanted seedlings to go dormant earlier than with the longer photoperiods. Germination occurs in about 5 to 10 days with fresh seeds, longer with stored or drier seeds.

At the two- or three-leaf stage transplant into individual 2.5-cm plug, or rogue seedlings based on hybridizing objectives and plant appearance. Frequent repotting seems to encourage growth, so do not over-pot in too large of a container in one step. Depending on growing conditions and plant genes this could take 3 weeks to 2 months for first repotting. Fertilize lightly while under fluorescent lights.

This first repotting is an excellent time to perform the first of several selections. Maintain labels of crosses on all plants not rouged. Continue growing under fluorescent lights or lightly shaded greenhouse.

When seedlings have 5 to 7 leaves, or when nearly root bound transplant into 5- to 7-cm pots, select those seedlings showing desired qualities. Rogue out and destroy all other seedlings. After danger of frost, transplant into lightly shaded garden those seedlings showing desired characteristics. Resist the temptation to save too many seedlings that do not show promise. In most hybridizing programs, by the time of garden transplanting you should have eliminated at least 50% to 90% of the original seedlings.

Grow and evaluate a plant throughout the first garden/field season. Observe flowering if any. Discard any seedlings not measuring your established standards. Continue to evaluate for 5 to 7 years or more so you can determine the mature characteristics of the selected seedlings. Maintain cross identification.

Divide the best hostas at some point in this process so it can be evaluated under different conditions and for determining how well it propagates and grows from single divisions.

Make final selections. Sometimes this is best done with some trusted, honest but frank friends. It's easy to become too attached to plants that have received so much care over the years.

Pick a cultivar name that is not already being used. Fill out registration form and send to International Cultivar Registration Authority for cultivar name approval. Now your hosta is ready for propagation and introduction.

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