DISCUSSION

This study clearly shows that not all seeds that will germinate under optimal conditions on moist filter paper at 5°C are able to germinate and emerge when sown in a substrate. This partly implies that the seed lot was of medium or low vigour and partly that germination in a substrate impose increased environmental stress on the seeds. Increased stress generally leads to reduced emergence. Seed germination in *A. nordmanniana* seems to be particularly sensitive to high temperatures, high moisture contents, and deep sowing — combinations of these factors giving detrimental results.

The results suggest that oxygen availability is critical. It is shown that it is possible to establish reproducible germination tests with defined stress. Such a test can be used as a vigour test for separating low- and high-vigour seed lots but may also be used to test and predict field emergence, when test conditions are chosen to simulate field stress. An applied vigour test for predicting field emergence based on the sand box system is currently being developed in our laboratory.

ADDITIONAL READING

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Native and Naturalized Plants of North America Worthy of Garden Merit

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INTRODUCTION

The North American portion of the United States is vast with 9,375,000 km^2, 10 climatic zones, over 8000 native species of plants, and 1600 naturalized plant species (Flora of North America, 1993). The climates range from near tropical with rain forest, swamps to deserts, to high plains steppes, and high altitude mountains with arctic conditions at the summits.

Over all summers are hot, usually 25°C or higher, at times near 38°C, highly humid on the East Coast and much drier and less humid west of the Mississippi River. Winters are often cold in the northern portions with wide temperature ranges and snow.

More southernly reaches don't experience severe cold but this is relative with respect to plant populations. These vast climatic differences account for the great potential for natural plant development since many species occur over several climatic and geographic ranges. Plants of the same species found in New York will often be different from those in South Georgia or Texas.

Another factor influencing native plant development is the occurrence of glaciers during the several ice ages. The latest about 13,000 years ago pushed many cold-hardy species into the more southernly reaches of the continent where they have

remained, now being in a more temperate climate. However, genetically they have retained much of their ancestors' genetic potential and have proven remarkably adaptable to new homes in much colder climates. These conditions have allowed observant horticulturists and nurserymen to bring many new and exciting things to the gardening world.

PLANT SELECTIONS

***Juniperus virginiana* 'Blue Sentinal'.** *Juniperus virginiana* has a wide range from near New England to Florida and westward towards the Mississippi River, with a disjunct population in the high plains. The potential for new cultivars is large. 'Blue Sentinal', a Lorax Farms introduction is propagated by grafting during winter.

***Hamamelis vernalis* cultivars.** *Hamamelis vernalis* is native to the Ozark Mountains of Missouri and Arkansas and is winter hardy to at least -28°C, (-20°F). 'Autumn Embers' and 'Sandra' are Roy Khlem (Bear Creek Nurseries) introductions with magnificent fall colors. Flower colors are orange and yellow, respectively. The cultivar Carnea is a red-flowered selection. All can be propagated by budding or rooting cuttings.

***Clethra alnifolia* 'Ruby Spice' and 'Hummingbird'.** *Clethra alnifolia*, a common wetland shrub along the Atlantic Coast of the U.S.A. It is easily propagated from softwood cuttings. It is hardy to our Zone 6, which is -23°C (-10°F). The cultivar 'Ruby Spice' is a bright pink to red and 'Hummingbird' is a dwarf form with white flowers.

***Halesia diptera* var. *magniflora*.** There are two species of *Halesia* (Styracaceae) native to the U.S.A. This variety is a selection chosen for superior flowering. It can be rooted from soft tip cuttings in limited numbers, but budding onto the species or *H. carolina* is preferable. Hardy to -23°C (-10°F).

***Callirhoe alcaeoides* white-flowered form and *C. involucrata*.** The *Callirhoe* (Malvaceae) are from the mid western to far western reaches of the U.S.A. They are cold hardy to -34°C (-30°F) and quite adaptable to a wide range of conditions if given drainage. Propagation is from seed that has been cold stratified.

***Clematis texensis* and *C. fremontii*.** North America is blessed with many overlooked *Clematis* species. *Clematis texensis* is a red-flowered vine native to the more southernly portion of the U.S.A., while *C. fremontii* is a shrubby form found in the high plains of the Western States. Both plants are propagated from seed that has been cold stratified. Hardiness is Zone 5, -28°C (-20°F) and Zone 4, -34°C (-30°F), respectively.

***Veronicastrum virginicum* 'Alboroseum' (Scrophulariaceae).** An eastern U.S.A. native. *Veronicastrum* is equally at home in the high plains. It is easily propagated from seed that has been stratified, by division, or by tip cuttings taken early in the season. Hardy to Zone 3, -40°C (-40°F).

***Eupatorium rugosum* 'Chocolate', syn. *Ageratina altissima* 'Chocolate'.** Native to the North East U.S.A. *E. rugosum* 'Chocolate' is a purple-leaved selection. The species is commonly found on disturbed sites and is quite tough. Propagation is by tip cuttings early in the year. Hardy to Zone 6, -23°C (-10°F).

***Spiranthes cernua* f. *odorata*.** An orchid species native to wetlands. *Spiranthes cernua* var. *odorata* is commonly produced via tissue culture, but can be propagated via division and in some cases by cuttings from bloom shoots. Hardy to Zone 3, -40°C (-40°F). It is native from Canada to Florida.

***Morus alba* 'Green Wave'.** *Morus alba* is a naturalized species from China. 'Green Wave' is a weeping selection that can be rooted from softwood cuttings or top grafted. It is hardy to Zone 5, -28°C (-20°F).

***Aesculus parviflora* and *A. pavia*.** Both of these species are from the south-central part of the U.S.A. *Aesculus parviflora* is stoloniferus, forming large tickets and is white flowered. *Aesculus pavia* is a small tree with pink to red flowers. It is one of the parents of *A.* ×*briotti*. *Aesculus parviflora* can be propagated by division, root cuttings, seed, or stem cuttings (Bir and Barnes, 1994). *Aesculus pavia* is propagated solely by seed. Both are hardy, Zone 5, - 28°C (-20°F).

***Ulmus alata* 'Lace Parasol'.** The species *U. alatus* is native to the northern and southeastern portions of the U.S.A. 'Lace Parasol' was discovered in North Carolina about 35 years ago and given its name by J.C. Raulston of North Carolina State University. It is propagated by grafting. Cold hardy to Zone 4, -34°C (-30°F).

***Rudbeckia fulgida* 'Pot of Gold'.** The species is native to the southeastern portion of the U.S.A. 'Pot of Gold' is a more compact and dwarf selection being about ⅔ the size of *R. fulgida* 'Goldstrum'. It is propagated via division or early season off shoots. Cold hardy to Zone 4, -34°C (-30°F).

***Hydrangea quercifolia* 'Snow Queen'.** *Hydrangea quercifolia* is native to southeastern U.S.A. It is quite hardy to Zone 5, -28°C (-20°F). It is easily propagated by seed for the species, whereas the cultivars are grown from softwood cuttings. 'Snow Queen' is an especially floriferous form discovered at Princeton Nurseries, Princeton, New Jersey.

***Thuja* 'Green Giant'.** 'Green Giant' was bred in Denmark and brought to the worlds' attention by the U.S. National Arboretum. It is a hybrid of an North American species, *T. plicata,* and a Japanese species, *T. standishii*. Having hybrid vigor it is a fast grower and has earned quite a reputation for being deer resistant. It is quite hardy to Zone 5, -28°C (-20°F) , and is easily propagated via hardwood cuttings in fall or winter.

***Coreopsis major*.** This plant is native to the Appalachian Mountains and sadly is not used much by the American nursery industry. It is quite floriferous in late summer and is easily propagated via spring cuttings, seed, or division. It is hardy to Zone 6, -23°C (-10°F).

***Cotinus obovatus*.** This a small tree grown principally for magnificent fall color. While native to the Southern U.S.A. it is hardy to Zone 5, -28°C (-20°F). It is propagated via seed that has been stratified and via extremely soft cuttings taken early in the season (Dirr, 1998).

***Salvia lyrata*, lyre-leaf form and red form.** An especially wide spread plant as it ranches from Maine to Florida. The name "lyrata" refers to the central red blotch in an otherwise green leaf. The red leaf form has a darker blotch with a dark leaf. It has blue flowers. It is easily raised from seed or division. Hardy to Zone 3, -40°C (-40°F).

Hibiscus coccineus. *Hibiscus coccineus* is a wetland species found in the swamps of the Mid-Atlantic States. It is easily propagated from seed and from soft tip cuttings. Hardy to Zone 7 and possibly 6 with protection, -17°C (0°F).

***Iris virginica* selected form.** This selection of southern blue flag is native to the eastern portion of the U.S.A. It blooms in midsummer with an especially large blue flower. It is hardy to Zone 6, -23°C (-10°F). Propagation by division.

***Zenobia pulverulenta* 'Woodlander's Blue' (Ericaceae).** A selection by Woodlanders Nursery, Aiken, South Carolina. 'Woodlander's Blue' has especially blue-grey leaves that make the plant quite different than the species and a superior selection. Easily raised from cuttings. The species can be produced via seed. Hardy to Zone 5, -28°C (-20°F).

***Stokesia laevis* 'Purple Parasol' and *Stokesia laevis* 'Mary Gregory'.** Native to the lower Southern U.S.A. These two selection are outstanding. 'Purple Parasol' is self descriptive and 'Mary Gregory' is a soft yellow. Propagation is via root cuttings or by shoot offsets early on. Hardy to Zone 6, -23°C (-10°F).

***Schizachyrium scorparium* 'The Blues'.** A dry-land grass from Eastern North America. 'The Blues' is unique in having intensely blue foliage. It is easily propagated via division. Hardy to Zone 4, -34°C (-30°F).

***Wisteria frutescens* 'Amethyst Falls'.** Two *Wisteria* are native to the U.S.A. *Wisteria frutescens* normally has white flowers but this blue-flowered selection was brought to the trade by HEADLEE Nursery in Seneca, South Carolina. Propagated via cuttings in early summer. Hardy to Zone 5, -28°C (-20°F).

Aster carolinianus. *Aster carolinianus* is an enigma in that it is the only climbing form of *Aster* known. It can be a strong vine, climbing with support to 3 m. It has light blue flowers in late summer or early fall. Hardy to Zone 7 and possibly 6 with protection, -17°C (0°F).

***Acer pensylvanicum* 'Erythrocladum'.** The snake bark maples are exceptionally popular in the U.S.A. and *A. pensylvanicum* 'Erythrocladium' is especially desirable in that the bark is red with white stripes as opposed to the normal green/white stripe combination. As with all snake barks these plants require shade for good development. Hardy to Zone 3, -40°C (-40°F). It can be propagated via budding or grafting onto other snake barks and a more recent report suggests *A. rubrum* as an understock.

Magnolia ashei. Coming from North Florida in the Southern U.S.A., *M. asheii* challenges convention. It is a strong robust tree with huge (30 cm to 40 cm) white, highly fragrant flowers that have a sweet smell of vanilla and lemon. It is hardy to Zone 6, and possibly colder, -23°C (-10°F). Propagation is by seed.

***Betula nigra* 'Tecumse Compact'.** There are few cultivars of *Betula nigra*. Studebaker Nurseries of Carlise, Ohio, have come up with this dwarf form. It is approximately ⅓ the size of the species. 'Tecumse Compact' is easily propagated by cuttings in early summer and by budding. It is hardy to Zone 4 -34°C (-30°F).

***Cercis canadensis* 'Covey'.** Found in New York State and developed by Brotzman Nursery, East Madison, Ohio, 'Covey' has a strong weeping form. Flowering is a bright pink, making for a spectacular effect. It is hardy to Zone 5, -28°C (-20°F). Propagation is via budding onto the species.

***Monarda fistulosa* 'Carmen Miranda'.** 'Carmen Miranda', developed by Lorax Farms, has stunning purple-fuchsia flowers and has not shown signs of powdery mildew in tests. It is easily propagated via soft tip cuttings. Hardy to Zone 4, -34°C (-30°F).

***Gillenia trifoliata* 'Pink Profusion' (syn. *Porteranthus trifoliatus* 'Pink Profusion') (Rosaceae).** 'Pink Profusion' is a variation of the normally white-flowered form. It is easily propagated via soft tip cuttings in early spring. The jury is still out when it comes to seed propagation. Perhaps there is hope that it will come true via seed. Hardy to Zone 6. An introduction of the Mt. Cuba Center for the Study of Piedmont Flora, Greenville, Delaware.

Lithospermum caroliniense. A shrubby type perennial native to the high plains of Central North America, *L. caroliniense* (Boraginaceae) is stunning with an explosive burst of yellow flowers. However, attempts at propagation have defied even the best of propagators so this plant has not made it into cultivation. Seed would seem to be the logical choice but its specific requirements have not to date been met. A Holy Grail that deserves pursuit. Hardy to Zone 5, - 28°C (-20°F).

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