

## Determining the Invasive Potential of *Rhamnus frangula* 'Asplenifolia' and 'Columnaris' Based on Seed Germination<sup>©</sup>

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Seed of *Rhamnus frangula* 'Asplenifolia' (cutleaf buckthorn) has significantly lower germination percentage when compared to *R. frangula* L. (glossy buckthorn) and *R. cathartica* L. (common buckthorn). Therefore, based on seed germination, *R. frangula* 'Asplenifolia' is less likely to become an invasive exotic plant in the United States and Canada.

Seed of *R. frangula* 'Columnaris' (columnar buckthorn) had germination percentages and rate comparable to *R. frangula*. Therefore, based on seed germination, *R. frangula* 'Columnaris' is likely to become an invasive exotic plant in the United States and Canada.

### BACKGROUND

Invasive exotic plants are plants that are introduced from outside a native community and have an aggressive growth habit. This results in their spread throughout natural habitats and allows them to out-compete native species for nutrients, space, and sunlight. This often occurs due to their high reproductive capacity and lack of significant predators to keep them in check (The Nature Conservancy of Vermont, 1998).

*Rhamnus cathartica* and *R. frangula* were both introduced to the United States and Canada from Europe in the 19<sup>th</sup> and 20<sup>th</sup> centuries and planted as landscape shrubs (Catling and Porebski, 1994; Dosmann, 2001). Unfortunately, these plants have few desirable ornamental qualities and have since escaped from cultivation. Both species are currently classified as invasive exotic plants in New York, Vermont, and Canada (Haber, 1997a; Haber, 1997b; Invasive Plant Council of New York State, 2001; The Nature Conservancy of Vermont, 1998). Catling and Porebski (1994) claim that in a recent survey, *R. frangula* was rated second to purple loosestrife (*Lythrum salicaria* L.) in both the extent to which it is spreading and the severity of its impact.

Both *R. cathartica* and *R. frangula* produce large amounts of small 2- to 4-seeded drupes which are commonly eaten by birds (Archibold et al., 1997; Howell and Blackwell Jr., 1977; Ridley, 1930). Once eaten it is believed that the birds quickly release the seeds due to a laxative chemical contained within the matrix of the drupe. This act serves as the main vector of plant dispersal.

Currently, *R. frangula* 'Asplenifolia' and *R. frangula* 'Columnaris' are being sold for ornamental use. Surprisingly, these cultivars have not been studied for their invasive potential. Therefore, this study determined if a significant potential exists, based on germination percentage and rate of germination, for either cultivar to become an invasive exotic.

## MATERIALS AND METHODS

Seeds were collected from *R. cathartica*, *R. frangula*, *R. frangula* 'Asplenifolia', and *R. frangula* 'Columnaris' in mid-October from plants located on the campus at The University of Vermont. Seeds were manually removed from the fleshy portion of the drupe, rinsed in distilled water and put in 16.5 cm × 14.9 cm (6.5 inch × 5.9 inch) Zip-lock<sup>®</sup> baggies (S.C. Johnson & Sons, Inc., Racine, Wisconsin) containing vermiculite moistened with distilled water. The four bags, each containing a single species or cultivar were then placed in cold stratification at 5°C ± 0.5°C (41°F ± 1°F) for 2 months. This protocol was based on recommendations compiled by Dirr and Heuser (1987) and was conducted to unify seed germination and eliminate seed dormancy.

Once removed from stratification, germination percentages and rates of germination were evaluated using a blotter paper method (Hartmann et al., 1997). For this procedure, 100 seeds from each of the two species and two cultivars of buckthorn were placed in separate, covered, 9-cm glass petri dishes on pre-washed (rinsed) germination blotters (Filtration Sciences Corp., Mt. Holly Springs, Pennsylvania). Blotters were kept evenly moist using distilled water. Petri dishes were placed in a growth chamber with a 16/8-h thermoperiod of 25°C day/17°C night (77°F/62°F) temperatures. Chamber temperatures varied within 1°C (2°F) of the set point. A 16-h photoperiod was provided by ten Power Groove Cool-White fluorescent tubes [GE model F96PG17-CW (GE Lighting, Cleveland, Ohio)] and four 60-W incandescent bulbs suspended 60 cm above the tops of the petri dishes. Lamps and bulbs provided an average photosynthetic photon flux [PPF (400 to 700)] of 108 μmol·m<sup>-2</sup>·s<sup>-1</sup> as measured within the covered glass petri dish. Thermoperiod high temperature began with the transition from night to day photoperiod. Germination was defined as the emergence of the radicle 1 mm from the seed coat (Deno, 1993). Germination counts were recorded daily for 42 days (6 weeks). The experimental design was a RCBD with three observation per replication and four replications over time with an observation consisting of one petri dish containing 100 seeds per species/cultivar.

Data were analyzed using ANOVA and PROC GLM in SAS (SAS Institute, Inc. 1989a; SAS Institute, Inc. 1989b). Because the outcome measure was percent germination, an arcsin-squareroot transformation was used (Box et al., 1978). Though statistical significance was based on transformed data, means presented in the figures represent nontransformed data. All F-tests corresponding to treatment comparisons utilized the Replicate × Treatment mean square as the error term. Pairwise comparisons are based on the Student-Newman-Keuls test (P 0.01).

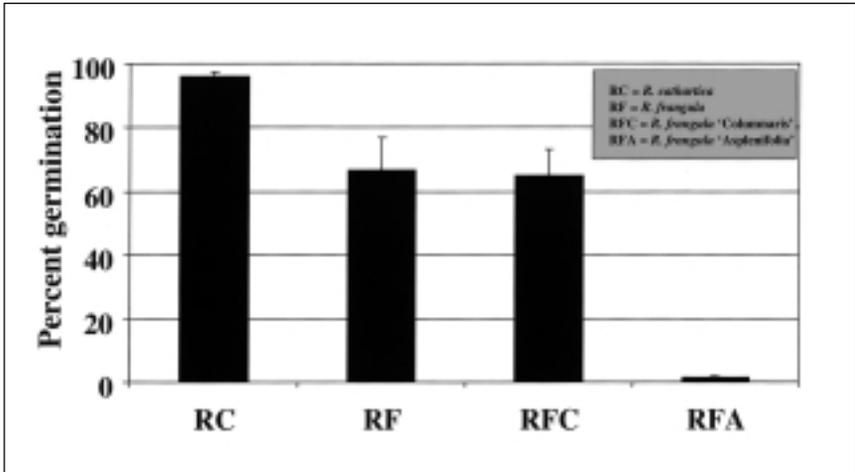
## RESULTS

By 42 days, seed germination of *R. frangula* and *R. frangula* 'Columnaris' was comparable with germination of 66.7% and 64.9% respectively (Fig. 1). *Rhamnus frangula* 'Asplenifolia' had substantially lower seed germination (1.5%) while *R. cathartica* had the highest germination percentage (96.1%) when compared to other species and cultivars of *Rhamnus* during this same period (Fig. 1).

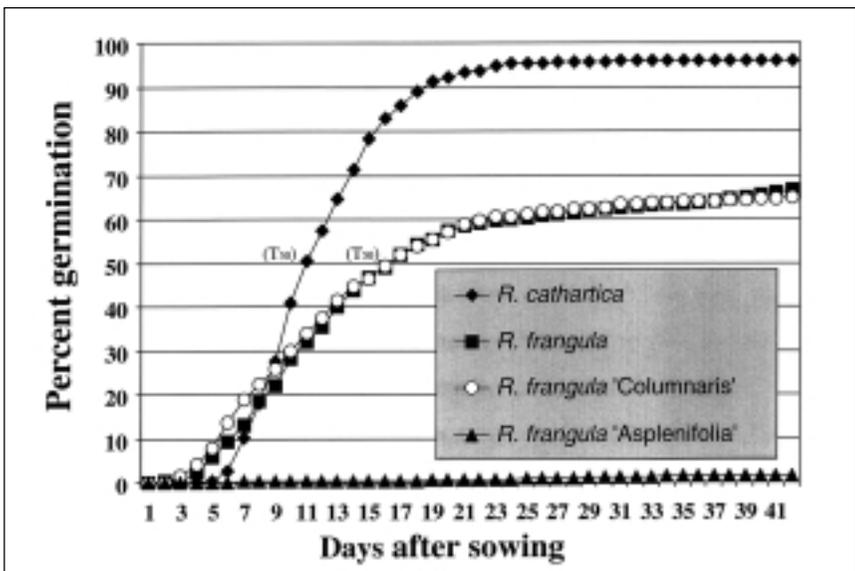
The T<sub>50</sub> value for *R. frangula* and *R. frangula* 'Columnaris' was comparable and occurred between Days 16 and 17, while *R. cathartica* occurred by Day 11 (Fig. 2). Rate of germination of *R. cathartica*, *R. frangula* and *R. frangula* 'Columnaris' slowed after 20 days in the growth chamber. Seeds of *R. frangula* 'Asplenifolia' never achieved 50% germination by the termination of the study.

**CONCLUSION**

Both species of buckthorn are already significant invasive exotic plants in the upper Midwest, northeastern United States and parts of Canada. It is important to understand the invasive potential of the cultivars of *R. frangula* to prevent the outbreak of additional invasive exotic plants or to promote them as valid ornamental species for use in North America.



**Figure 1.** Mean percent germination of *Rhamnus*.



**Figure 2.** Seed germination of *Rhamnus* over time.

The results of this study indicate that seed of *R. frangula* 'Asplenifolia' has significantly lower germination percentage when compared to *R. frangula* and *R. cathartica*. Therefore, based on seed germination, *R. frangula* 'Asplenifolia' is less likely to become an invasive exotic plant in the United States and Canada and can continue to be used as an ornamental landscape plant.

Additionally, the seed of *R. frangula* 'Columnaris' has germination percentages and rate comparable to *R. frangula*. Therefore, based on seed germination, *R. frangula* 'Columnaris' is likely to become an invasive exotic plant in the United States and Canada and should not continue to be used as an ornamental landscape shrub.

Further research needs to be conducted to determine the time to maturity of seeds of these cultivars as well as the quantity of seeds produced per mature plant.

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