Assessing Fertility among Cultivars of Winged Euonymus

Thomas G. Ranney, Thomas A. Eaker, and Joel A. Mowrey

NC State University, Dept. of Hort. Science, Mountain Horticultural Crops Research and Extension Center, 455 Research Drive, Fletcher, NC, 28732-9244

tom_ranney@ncsu.edu

Index Words: Alien Species, Adventive Species, Fertility, Invasive Species, Invasiveness, Naturalized Exotic Species, Non-indigenous Species, Seedless, Sterility, Weed Free

Significance to Industry: Invasive species are an important issue for the nursery industry. A limited number of non-native species that are grown for landscape use can be weedy to the point of being invasive, i.e., their introduction causes or is likely to cause economic or environmental harm or harm to human health that outweighs any beneficial effects (http://www.invasivespeciesinfo.gov/docs/council/isacdef.pdf). Winged euonymus (*Euonymus alatus*), for example, has been found to naturalize over broad areas and habitats (http://www.natureserve.org/explorer/). Concern over potential environmental impacts has recently led numerous states to ban or limit sales of winged euonymus. However, winged euonymus continues to be an economically, aesthetically, and environmentally important crop. As such, the selection/development of seedless/noninvasive cultivars would be an ideal solution whereby these valuable plants can be utilized without detriment. The objective of this study was to evaluate and compare fertility of *E. alatus* 'Compactus' with *E. alatus* 'Odom' Little Moses™ (USPP# 13168), a cultivar that has been observed to have low fertility in field and production settings.

Nature of Work: Container-grown plants of *E. alatus* 'Compactus' and 'Odom' were grown in full sun, with drip irrigation, and standard production practices at the Mountain Horticultural Crops Research Station in Fletcher, N.C. in 2004. Six plants of each cultivar were arranged in a completely randomized design. Plants were similar in size and ranged from 3 to 4 feet in height and 2 to 3 feet in width. In addition to natural pollination, 3 branches on each plant were marked and all receptive flowers on those branches were hand pollinated daily with a mixture of fresh pollen collected each day from both 'Compactus' and 'Odom'. Up to 100 fruit were randomly collected from each plant. Seeds were extracted and sowed in an equal mixture of peatmoss and perlite. Seeds were then subjected to cold, moist stratified at 40 °F for 90 days, followed warm, moist stratification (65-75 °F) for 90 days, followed by as second period of cold, moist stratification at 40 °F for 90 days, then germinated in a glass greenhouse at 65-75 °F. Pollen germination tests were performed in 5 mL Petri dishes containing Brewbaker-Kwack media

supplemented with 15% sucrose and solidified with 2% agarose (2). Pollen grains with pollen tubes greater than one-half the diameter of the pollen grain after 6 h were scored as germinated. Each replicate included100 pollen grains. Data were collected for the total number of fruit formed on each plant, number of flowers and fruit produced on branches receiving supplemental hand pollination, and percent pollen germination.

Results and Discussion: Pollen germination under our experimental conditions averaged 16% and was not significantly different between the two cultivars indicating similar levels of male fertility (Table 1). Natural pollinators including a variety of Diptera and Hymenoptera insects were prevalent and actively visiting flowers throughout the bloom period. Total fruit set for open pollinated plants averaged 270 for 'Compactus' and was significantly more than the average of 7 for 'Odom', despite all plants being similar in size with a similar number of flowers. However, fruit set per flower, on branches that received supplemental hand pollination, averaged 0.06 and was not significantly different between cultivars. Seed germination was 51% for 'Compactus' and significantly greater than the 11% germination for 'Odom'.

Overall fruit production for 'Odom' was only 3% of that compared to similar sized plants of 'Compactus', yet fruit set was similar on branches that received supplemental pollination. These results suggest that the lower fruit production found for 'Odom', may have resulted from lower natural pollination. The different cultivars appeared to have similar numbers of flowers, but the foliage and branching of 'Odom' was much denser than 'Compactus', which might have deterred pollinators. In addition to producing fewer fruit, seed germination of 'Odom' was only 22% that of 'Compactus', demonstrating reduced post-fertilization fertility.

The frequency, intensity, and distribution of new propagules (e.g., seeds) is a principal factor in predicting invasiveness (1, 3, 4). Reduced fertility, including reduced fruit production and reduced seed germination, would limit propagule pressure and invasive potential. In a study of scotch broom (*Cytisus scoparius*), Sheppard et al. (5) estimated that a 62% reduction in seed set was needed to reverse dominance of this species in native grasslands. Under our conditions, the cultivar 'Odom' had 2.6% of the fruit set and 22% of the germination rate of 'Compactus', corresponding to 0.6% of the total reproductive potential (a 99.4% reduction). The reduced fruit set and reduced seed germination of 'Odom' should reduce the potential for this cultivar to naturalize. However, because some of the reduced fruit set of 'Odom' appears to be from reduced pollination efficacy, it would be prudent to evaluate fertility in other environments with other pollinators. Additional research is warranted to better understand how a substantial reduction in fertility impacts invasive potential.

Literature Cited:

1. Crawley, M.J. and S.L. Brown. 1995. Seed limitation and the dynamics of feral oilseed rape on the M25 motorway. Proc. R. Soc. Lond. B Biol. Sci. 259:49-54.
2. Marquard, R.D. 1992. Pollen tube growth in *Carya* and temporal influence of pollen deposition on fertilization success in pecan. J. Amer. Soc. Hort. Sci. 117: 328-331.
3. Martínez-Ghersa, M.A. and C.M. Ghersa. 2006. The relationship of propagule pressure to invasion potential in plants. Euphytica. 148:87-96.
4. Sakai, A.K., F.W. Allendorf, J.S. Holt, D.M. Lodge, J. Molofsky, K.A. With, S. Baughman, R.J. Cabin, J.E. Cohen, N.C. Ellstrand, D.E. McCauley, P. O'Neil, I.M. Parker, J.N. Thompson, and S.G. Weller. 2001. The population biology of invasive species. Ann. Rev. Ecol. Syst. 32:305-332.
5. Sheppard, A.W., P. Hodge, Q. Paynter, and M. Rees. 2002. Factors affecting invasions and persistence of broom *Cytisus scoparius* in Australia. J. Appl. Ecol. 39: 721-734.

Acknowledgements: Thanks to Odom Nursery for providing support for this project.

Table 1. Pollen germination, fruit set, and seed germination for two cultivars of *Euonymus alatus*.

Taxa	Pollen Germination (%)	Fruit Set per Plant	Fruit Set per Flower (%)[z]	Seed Germination (%)
'Compactus'	18 a	270 a	7.4 a	51 a
'Odom'	14 a	7 b	5.4 a	11 b

[z]Received supplemental hand pollinations with a mixture of pollen.