Stratification and Temperature Requirements for Germination of Autumn Olive *(Elaeagnus umbellata)* Seed

Linda J. Fowler and Dale K. Fowler

Wildlife biologist and senior terrestrial ecologist, Tennessee Valley Authority, Norris, TN

*Optimum seed germination requirements were determined for autumn olive (*Elaeagnus umbellata*), an exotic low-growing shrub planted widely on coal surface-mined lands and wildlife management areas in the United States to provide food and cover for wildlife. Study results indicated that optimum germination of autumn olive seed is achieved with a minimum cold stratification period of 16 weeks and a subsequent night/day germination temperature of 10/20 °C.*
Tree Planters' Notes 380) :14-17; 1987

Autumn olive (*Elaeagnus umbellata*), a shrub originally introduced into the United States from Asia in 1830 *(1),* grows to heights of 3 to 5 meters and produces red berries (4 millimeters in diameter) in 3 to 5 years *(3).* The seed of autumn olive has been characterized as having a hard seed coat and an embryo dormancy that can be overcome by cold stratification at 1 to 10 °C for 10 to 90 days *(6).*

The berries stay on the shrub until late winter, when they are consumed by a variety of wildlife species because other foods are scarce *(2, 4).* This shrub is planted extensively on surface mines, wildlife management areas, and disturbed lands in the eastern United States to provide food and cover for wildlife. Autumn olive is particularly useful in reclamation of both abandoned and active coal surface mines because of its adaptability to the wide range of pH conditions found in these sites *(3)*. For example, during spring 1985, reclamation specialists with the Tennessee Valley Authority planted over 122,000 autumn olive shrubs on abandoned coal mine sites in North Carolina, Alabama, and Tennessee *(5).*

Because of the demand for these shrubs, many State and private nurseries are growing autumn olive seedlings. However, little is known about the conditions for optimum germination of these seeds. This information is needed for cost-efficient production of autumn olive seedlings in nurseries. Consequently, this study was designed to determine optimum germination temperatures and cold stratification requirements of autumn olive.

Methods

On 30 November 1979, berries were collected in large plastic storage bags from 25 autumn olive shrubs located on the Ollis Creek Surface Mine, Campbell County, TN. The samples were combined in the laboratory, and the fruit pulp was separated from the hard, inner seed in a Waring Blendor filled with approximately 150 milliliters of water. To avoid damage to the seed coats, the blender was turned on for only short periods of time (about 5 seconds). The resultant mixture was screened through a wiremesh sieve to separate the seeds from the pulp. Seed were then air-dried at room temperature.

The seed were divided into equal lots and placed into naked cold stratification for 8, 12, 16, and 20 weeks at 5 °C. After removal from cold stratification, 600 seeds were randomly selected from each treatment, separated into lots of 50 seeds, and placed in petri dishes lined with moistened filter paper. Filter paper was replaced as necessary to prevent mold growth. Six replications of 50 seeds from each cold stratification treatment and from a nonstratified control seed lot were placed in three germination chambers set at night/day temperatures of 5/15 °C, 10/20 °C, and 20/30 °C. All replications were left in the chambers for 10 weeks and checked three times weekly for germination. At each inspection, germinated seeds (radicle 1 millimeter) were counted and removed from the dishes.

Results and Discussion

After removal from cold stratification, only seed subjected to the 20-week stratification treatment showed signs of mold development. judging by the high germination percentage, mold was not an inhibitory factor at this length of stratification, except possibly at the 20/30 °C night/day germination temperatures. Because there were no significant differences in percentage germination between replications within stratification treatments (Chi-square test), these data were pooled during analysis.

In general, longer lengths of cold stratification resulted in faster germination of a higher percentage of seeds (fig. 1). For example, after 1 week at 10/20 °C night/day germination temperatures, seeds cold stratified at 8, 12, 16, and 20 weeks germinated at 13, 40, 80, and 88 percentages, respectively. Seed germination at all three night/day temperatures for the nonstratified control seeds was significantly lower ($P < 0.05$) with the highest percent germination (51 percent) being achieved at 10/20 °C night/day temperatures.

At 5/15 °C night/day temperatures, the percentage germination after 8 weeks of cold stratification (75 percent) was significantly lower ($P < 0.05$) than at longer stratification periods

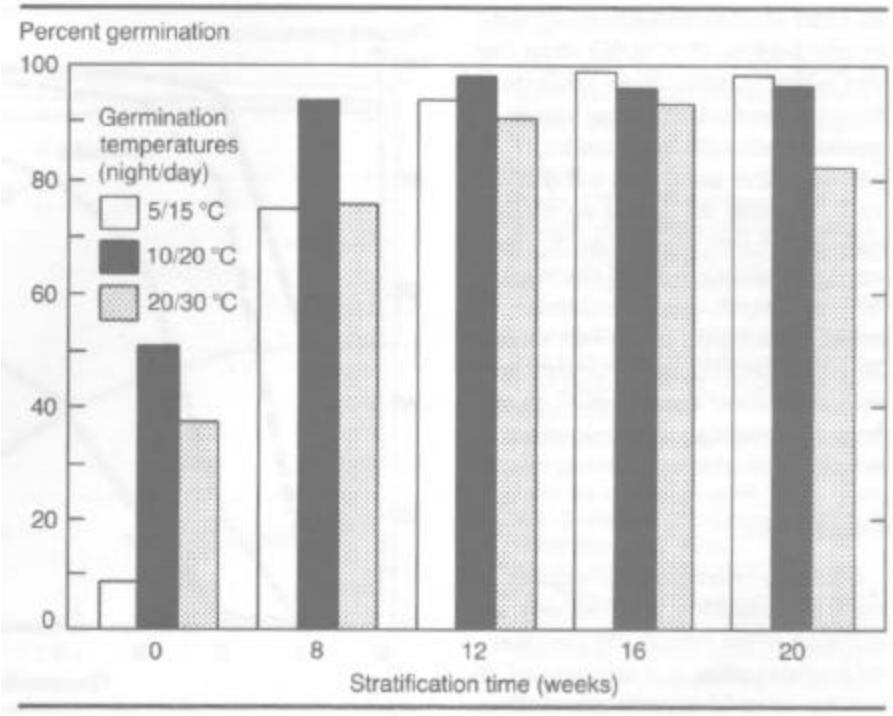


Figure 1—*Percentage germination of autumn olive* (Elaeagnus umbellata) *seed treated with varying lengths of cold stratification and germinated at different night/day temperatures.*

(fig. 2). Seeds cold-stratified at 12 and 16 weeks achieved a total germination percentage of 90 percent or greater after 3 and 8 weeks in the germination chambers, respectively. However, after 20 weeks of cold stratification, 96 percent of the seeds germinated within 2 weeks at the 5/15 °C night/day temperatures.

At 10/20 °C night/day temperatures, there was no significant difference in percent germination ($P < 0.05$) between seed lots subjected to different lengths of cold stratification. However, it took 4 and 2 weeks for seeds at 8 and 12 weeks of cold stratification to exceed 90 percent germination, respectively. By contrast, the seeds stratified for 16 and 20 weeks achieved 95 percent germination within 2 weeks.

At 20/30 °C night/day germination temperatures, percent germination of seeds after 16 weeks

Results and Discussion

of cold stratification was significantly higher ($P<0.05$) than for the other stratification periods. Ninety percent of these seeds germinated within 2 weeks, whereas the seed lots subjected to 8, 12, and 20 weeks of stratification did not reach the 90 percent germination level during the 10-week study period. Some mold developed on seeds in the 20-week stratification treatment and may have contributed to the lower percentage germination results.

Conclusions

Nursery growers can expect high germination percentages of autumn olive seeds (90 percent or higher) after a minimum of 16 weeks of cold stratification. Our data suggest that the optimum night/day germination temperature for cold stratified autumn olive seed in 10/20 °C. At this temperature, high percentages of seeds stratified for 16 or more weeks will germinate within 2 weeks after placement into germination chambers. Because of possible contamination from cold harmful molds, periods of cold stratification longer than 16 weeks are not recommended unless the seeds are treated with mold preventive chemicals before they are placed in the germination chambers.

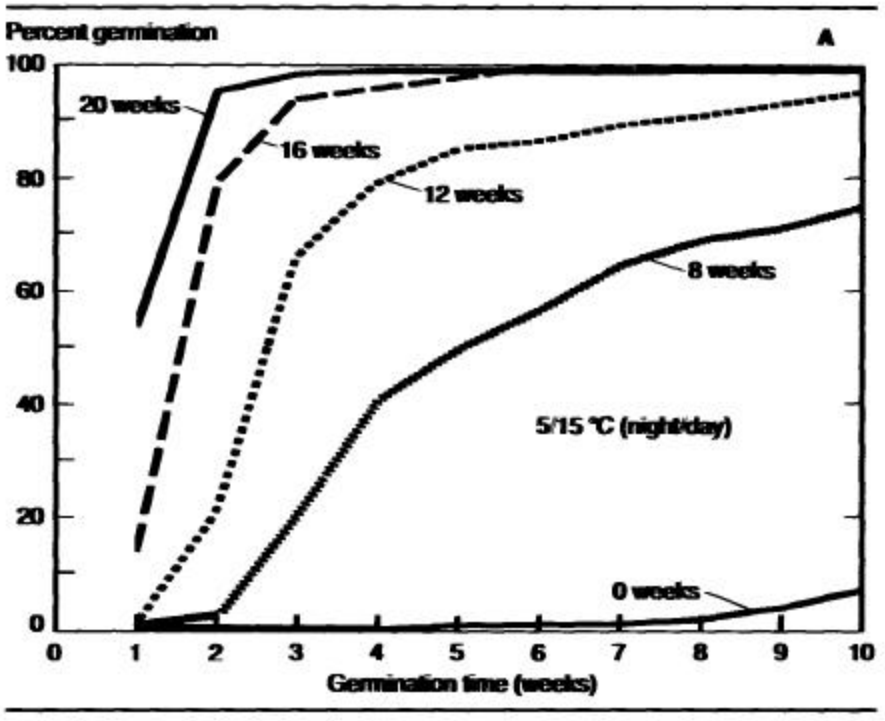
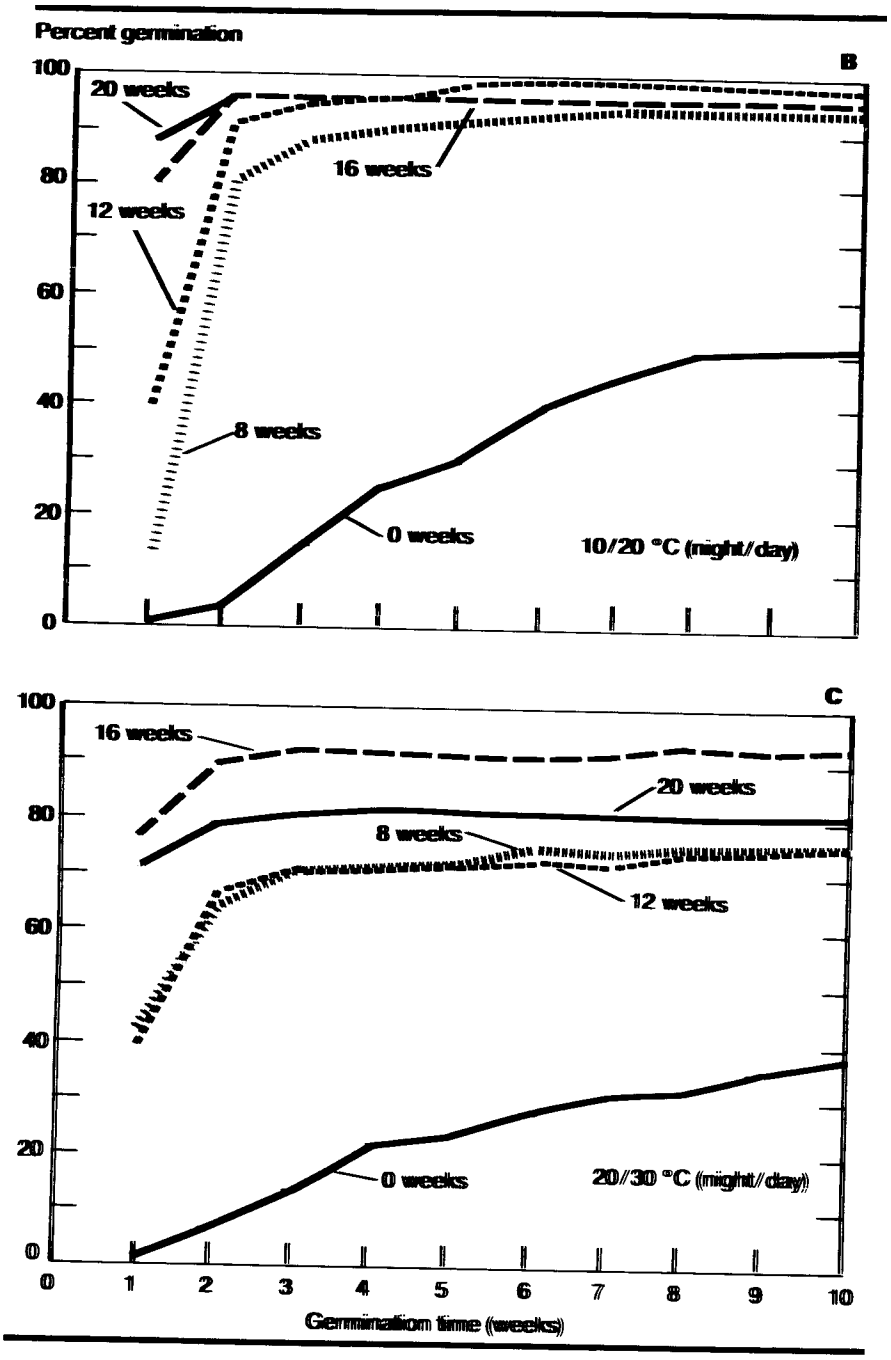


Figure 2—Germination time and percentages for autumn olive (Elaeagnus umbellata) seed treated with 8 to 20 weeks of cold stratification and germinated at 5/15 °C (A), 10/20 °C (B), and 20/30 °C (C) night/day temperatures.



Literature Cited

1. Allan, P.F.; Steiner, W.W. Autumn olive --- for wildlife and other conservation uses. Leaflet 458. Washington, DC: U.S. Department of Agriculture; 1959. 8 p.
2. Engle, J.W. Observations on the growth and wildlife utilization of autumn olive (*Elaeagnus umbellate*) on the George Washington National Forest, Virginia. Proceedings, 16th annual meeting, Association of Game and Fish Conservation Committees, 1962 October 15-17, Charleston, NC. 1962: 32-34.
3. Fowler, D.K.; Adkisson, L.F. Survival and growth of wildlife shrubs and trees on acid mine spoil. Tech. Note B37. Knoxville, TN: Tennessee Valley Authority; 1980. 49 p.
4. Fowler, L. J.; Fowler, D.K.; Thomas, J.E. Dispersal of autumn olive seeds by foxes on coal surface mines in east Tennessee Academy of Science 57(3,4):83-85; 1982
5. Muncy, Jack. Personal communication.
6. Olson, D.F., Jr. Seeds of woody plants of the United States. Agric. Handbk. 450. Washington, DC: U.S. Department of Agriculture; 1974.