Restoration and Reclamation Review
Student On-Line Journal
Vol.6, No.3, Fall 2000
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Control of *Elaeagnus umbellata* – (Autumn Olive)

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Introduction

Elaeagnus umbellata Thunb., autumn olive is a rapid-growing large shrub that has been widely planted by government agencies for shelterbelts, for food and cover for wildlife, and for roadside reclamation and soil stabilization (Kuhns 1986). *Elaeagnus umbellata* or autumn olive has become an invasive species in the eastern U.S. In contrast, this olive's relative, *Elaeagnus angustifolia,* Russian olive is a problem in semi-arid western regions of the US, and is considered a small tree. Autumn olive was planted in large numbers because of its fast growth, easy propagation, nitrogen-fixing abilities, tolerance to high pH soils, drought, and pollutants. *E. umbellata's* ability to fruit heavily and be spread rapidly by berry-loving birds makes autumn olive a greatly successful invasive species. This paper will cover autumn olive's biology and geography, uses and problems, and control measures.

Biology and Geography

Autumn olive is also called cardinal olive or autumn elaeagnus and is a member of the Elaeagnaceae family. *Elaeagnus umbellata* is a large spreading, spiny-branched shrub often obtaining 3.5 to 5.5 m in height and 3.5 to 5.5 m in width. The foliage is light green on top and a silvery-green on the bottom (Dirr 1998). The leaves are rather distinct when compared to other genera, but very similar to *Elaeagnus angustifolia*, Russian olive, the small tree relative of autumn olive. The fruits are 1.25 to 1.5 cm in size and start as a spotted light green in mid-summer turning red in the autumn (Dirr 1998). A mature specimen can produce 0.9 to 3.5 kg of seed per year, with the number of seeds ranging from 20,000 to 54,000 (Eckardt & Sather 1987).

Autumn olive can tolerate many types of soils and substances that are toxic to other species. This olive thrives in sand, glacial till, and disturbed soils (Reed 1992). Autumn olive thrives on these degraded soils because the Elaeagnaceae Family can fix atmospheric nitrogen, including autumn olive (Gardner 1958 & Graham 1964). Root nodules on the autumn olive are infected by an endophyte that maintains a symbiotic relationship with the roots and help provide nitrogen or nutrients for the plant (Gardner 1958 & Graham 1964). Therefore autumn olives actually fertilize themselves making them able to thrive in nutrient deficient soils.

Autumn olive prefers dry conditions but will grow in semi-wet sites. *E. umbellata* also prefers full sun or partial sun; full dense shade will kill them over a long period of time, often several years. In the Mid-Atlantic States, autumn olive withstands soil pH as low as 4.0 (Reed 1992). Autumn olive also will tolerate high salt concentrations and has a good tolerance to drought (Dirr 1998).

Autumn olive occurs in disturbed areas, successional fields, pastures and roadsides, and other areas where it has been commonly planted. *E. umbellata* will commonly invade grasslands, open woodlands and forest edges although will rarely intrude into wetlands of dense woodlands.

Elaeagnus umbellata is native to China, Japan, and Korea and was introduced to North America in 1830 by Lake County Nursery (Dirr 1998). In Japan, autumn olive is common and variable, growing in open or thin woods, thickets from lowlands to uplands, explaining its versatility as an exotic (Szafoni 1989). Now as an exotic species, *E. umbellata* it inhabits 41 states in the US and the southern extents of Canada (Reed 1992). *E. umbellata* has become invasive from Maine south to South Carolina west to Oklahoma, and north to southwest Minnesota. In New England and in the Mid-Atlantic states, autumn olive seriously competes with native plant species (Reed 1992). Autumn olive has been listed a noxious weed in 22 north central and western counties of West Virginia (Darlington 1994). *E. umbellata* also occurs in many other states but has not become a problem, though it has potential to become one (Reed 1992). Autumn olive is more invasive in the eastern states and is less invasive the farther west, where *Elaeagnus angustifolia* predominates. Autumn olive has invaded areas adjacent to sites it has been planted and has not yet become a completely widespread problem, but has a great ability to.

Uses and Problems

Autumn olive has many positive uses, but its invasive characteristics have outweighed these benefits. Generally autumn olive is used for conservation plantings, to stabilize slopes, in toxic or otherwise uninhabitable areas for other species, for wildlife habitat and food, for landscape use, and finally for a nurse plant in production forestry operations. The Soil Conservation Service studied *Elaeagnus umbellata* in the 1940's and as a result the variety 'Cardinal' was released in 1963 for commercial propagation (Szafoni 1989). The release of the 'Cardinal' variety was the beginning of the widespread use of this species, most commonly to provide food and cover for wildlife. According to Dr. Larry J. Kuhns of Penn State University Horticulture Department, a major factor in increased invasion of autumn olive is plantings for wildlife food and cover, still recommended by Pennsylvania Game Commission and other conservation agencies (pers. comm. Kuhns).

Four species of upland game birds, two migratory game birds, twenty non-game birds, and four mammals eat the fruits (Reed 1992). Deer browse it and cottontail rabbits and meadow mice gnaw the bark. Autumn olive's dense form is also good for nesting and protective cover. *E. umbellata* is commonly sold at very inexpensive prices through state government programs and other conservation organizations. Autumn olive is also used for screens and barriers along highways. Another common use is windbreaks and shelterbelts for farmland and farmsteads. Also autumn olive is utilized for stabilization and revegetation of road banks and other steep disturbed sites. In addition autumn olive is put to use in reclaiming mine spoil, one of the few good uses of the extremely resistant plant, which will grow in some of the most dismal conditions and hopefully will restore at least somewhat the historic quality of that site. Autumn olive can be used as a soil forming plant or nurse plant for more desirable species, and slowly be removed as a higher quality ecosystem is established. Autumn olive is also being used in the production forestry industry. *E. umbellata* has been found to reduce low branching in black walnut, *Juglans nigra,* when planted alternate to black walnut, thus making it more efficient to grow black walnut for its highly prized lumber (Reed 1992).

There are many reasons that *E. umbellata* is invasive in many areas, but the major factor is its ability to produce great amounts of bird-dispersed seed. This prolific fruiting makes it possible

for autumn olive to spread far and wide. To compound autumn olive's ability to spread, autumn olive can also grow in many different sites and conditions, making it an issue in numerous ecosystems. *E. umbellata* can germinate in thickly matted grasslands and thrive even though it has severe competition. Autumn olive can also prosper in open woodlands. Another reason autumn olive has proven to be invasive is that there are no animals that successfully reduce the population though browse or girdling of the plants. The plants are very resilient to browse and girdling, often making them more vigorous, with each regrowth resulting in a thicker stem base and denser branches, after being disturbed (Kuhns 1986). Autumn olive can cause major problems by dominating entire areas, nearly forming a monoculture and replacing the valued indigenous species of the native ecosystems. *E. umbellata* has the ability to seed in entire areas and shade out any native species. Autumn olive will also change the nitrogen concentrations of ecosystems, because of the ability to fix nitrogen, which can cause species displacement. Although autumn olive does not inhibit growth of existing large trees, autumn olive would limit succession of these species, thus contributing to a loss of biodiversity. Autumn olive is becoming a major problem in natural areas, restored sites, and preserves.

Control Measures

There are several major problems in controlling autumn olive. First, when considering control in these areas, one should not only look at the specific area, but also areas adjacent that have large seed producing populations of autumn olive, because the removal of plants on site will only be a temporary solution if seed inputs continue (Darlington 1994). Plants will continue to be seeded in from adjacent areas, causing a reoccurring control issue. Secondly, mowing, cutting, girdling, or fire does not kill or even slow down autumn olive, but seems to encourage thicker stronger growth (Kuhns 1986). Lastly, seedlings can be hard to spot among other dense vegetation. Control practices can be divided into three categories, mechanical, biological, and chemical. These control practices will also be further divided into control practices for natural communities of high quality or practices for disturbed areas.

Mechanical controls include pulling or digging out plants, cutting down plants, girdling, and burning, including any mix of these techniques performed together. In the case of autumn olive on either natural communities or disturbed sites, burning, cutting, or girdling will not successfully kill the plants, even when repeated over many years (eg. Darlington 1994, Eckardt 1987, Reed 1992, and Szafoni 1989). Often burning, cutting, and girdling will encourage even more vigorous regrowth (Reed 1992). Although, cutting may be used in both sites to successfully expose the stump for herbicide treatment. These methods also may temporarily reduce seed production, creating only a short-term control or if continued over time a constant maintenance issue. Young seedlings can be hand pulled or, if slightly larger may be dug out in early spring when is soil moist enough to make it easy to pull out the plant including all the roots(Szafoni 1989). Autumn olive is easily seen in the spring because it leafs out much earlier than most native species (Szafoni 1989). Hand pulling may be used in both natural communities and disturbed sites, but is more practical in natural communities because of the labor-intensive nature of the technique. It is a trade-off for saving important non-target species, when compared to herbicide application. Digging up larger plants with machinery may also work, mainly in degraded sites, but is not recommended because it disturbs the soil more than needed.

Cutting off larger plants at ground level with a chainsaw or handsaw can and should be used in both sites, but should also be followed by an herbicide treatment (detailed in the chemical controls) to prevent regrowth. A brush mower may also be used to cut down plants, which may be faster, but will also create more debris and mess.

Fire may be partially successful in killing seedlings in natural communities where fire is already part of the management of that community, but fire should not be used if not already occurring as a management practice. Fire may only kill a small percentage of seedlings and will not kill established autumn olive plants.

Biological controls would include introduced mammals, insects, fungus, or disease that selectively feed, browse, infect, destroy, or otherwise obstruct growth of a target plant. Currently the only methods of biological control attempted on autumn olive have been the use of sheep and goats to browse on the plants. Although this method has been used it is not a very viable option to control autumn olive. Often these animals do a less than adequate job and can only cover so much area and also require fencing and husbndry (Darlington 1994). This method, if viable, would only be used in disturbed sites, because the animals will eat all species in the area including non-target species. There has been no attempt to introduce a natural biological control agent to slow the spread of autumn olive. A natural biological control agent should be studied, because it may be a viable option.

Chemical control is in general the most effective mode of control for autumn olive and can be used in both natural communities and in disturbed. There are many different techniques to apply the herbicides to the plants. The methods can be categorized into four main divisions. Soil application- a granular form chemical applied to the soil in the area of the target plants. Stem and bark treatment- a liquid sprayed or dripped onto the stems and bark of the plant without cutting down or trimming the plant. Cut stump or crown treatment- the application of a liquid to the stump or trimmed crown by spray, drip, painting, or sponging. Foliar application- a liquid sprayed on the foliage while in the active growing season.

Soil application of granular herbicide should be avoided in most sites, but Spike pellets have shown to be effective (Kuhns 1986). Soil application of herbicide can be dangerous for the ecosystem and persist in the soil for a long time.

Stem and bark treatment of herbicide has been used for the control of autumn olive, but may be hard to perform because of the dense growth habit of this olive (Darlington 1994). The application of herbicide by stem and bark treatment may also be hard because of the common occurrence of thorns among the stems of autumn olive (Darlington 1994). Stem and bark treatment may be less labor intensive then cut stump or crown treatment because nothing is cut down, the plant is killed in place. Caution should be taken to not apply herbicide to non-target species, when using this method. Thin-line basal bark treatments with Garlon 4 a triclopyr herbicide have demonstrated a 95% kill (Szafoni 1989). Undiluted Garlon 4 or mixed 50:50 with diesel fuel, should be applied in a thin line around the base of the plant, 6-12 inches above the ground (Szafoni 1989). The herbicide may also be applied with a hand-held sprayer directly to the lower stems of the plant in the dormant season to minimize risk to non-target species. Also Garlon 4 should not be applied if rain is forecasted in the next four days (Darlington 1996).

Other common chemicals used with this same treatment, but that have not shown the same effectiveness are 2,4-D, 2,4-D + Banvel, and Crossbow (Darlington 1996). Results for these chemicals vary between sites and climate conditions, but often provide an effectiveness of 60-90% (Darlington 1996).

Cut stump and crown treatment is the most suggested method of control for autumn olive in both disturbed sites and natural communities. This technique includes two steps, first cutting down the plant to the ground or close to the ground and then applying a liquid herbicide to the stump or crown (Darlington 1994). The plant can be cut down with a chainsaw; handsaw, long handled pruner, or in disturbed sites mowed with a brush mower. After the brush is cleared the herbicide application can take place. The herbicide can be applied in several different ways; it can be sprayed on the stump with a pressurized sprayer or wiped on to the stump with a sponge-type applicator. The use of a sponge is suggested in natural areas, because it limits the risk of effecting non-target species, although it may be more time consuming. The most suggested chemical for this method is Roundup, a glyphosate herbicide. Roundup has been proven effective at controlling autumn olive at a 10 –20% concentration, although the Roundup label suggests a 50-100% concentration (Szafoni 1989). Banvel, Crossbow, and 2,4-D have also proven effective for this technique in controlling autumn olive (Darlington 1996). This technique is most effective late in the growing season, from July to September, but is also effective in the dormant season. Glyphosate is a non-selective herbicide and care should be taken to avoid killing desirable plants.

Foliar application is only mildly suggested in disturbed sites only because the threat to non-target species. Foliar application can use many different chemicals, including 2,4-D, Ally, Banvel, and Crossbow. This technique is most effective in summer, July to August (Darlington 1996). Application can be problematic because of chemica drift to adjacent areas, affecting non-target plants. This method can be rather effective at controlling autumn olive, but is often also too effective in killing non-target species.

Conclusion

Autumn olive is an introduced species that was and still is widely planted with good intentions without the foresight of the consequent problems. This mistake has resulted inan invasive species to the eastern United States that is very hard to control. The longer autumn olive is allowed to spread though our natural and controlled areas the bigger problem this plant will be. Autumn olive should be restricted in its use and should no longer be suggested by government agencies and conservation programs. Autumn olive seeds prolifically and therefore spreads quickly. Autumn olive would be a great plant if future genetic technology could create a selection that would have all the benefits of this plant, but would not fruit and become an invasive plant. Autumn olive has proven extremely hard to kill without the use of herbicides. The best method of control is the combination of hand weeding of small plants in the spring or when the ground is moist and cutting down large plants near the ground and following up with a stump or crown herbicide treatment with a Roundup, a glyphosate herbicide, at 10 to 20% concentration in the autumn.

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