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AUTUMN OLIVE REPRODUCTION IN THREE ILLINOIS STATE PARKS

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ABSTRACT

Elaeagnus umbellata Thunb. (autumn olive) seedling population densities and ages near established shrub rows were determined at three east-central Illinois state parks. Data were collected from 1-meter wide transects through shrub line and adjacent vegetation. Considerable autumn olive reproduction occurred once the original plantation reached 3-4 years of age. Oldfield and disturbed sites offered the optimum habitat for reproduction and growth. The highest densities occurred within the original shrub row, with autumn olive reproducing at levels as high as 225 plants/m square. Densities decreased to as low as 2 plants/m square in oldfields. The age of the naturalized plants averaged 1.5 years within the original shrub row and increased to maturity in adjacent areas. Autumn olive seedlings were absent in the mowed grass areas and in dense woods.

INTRODUCTION

Since 1846 the number of alien vascular plant species in Illinois has been on the increase, and now constitutes approximately 29% of the flora (Henry and Scott 1980, 1981). One of these alien species, *Elaeagnus umbellata* Thunb. (autumn olive) was introduced into U.S. cultivation in 1830 from its native range in China, Japan, and Korea (Rehder 1940). In Japan this species is common and variable, occurring in thickets and thin woods in both lowlands and uplands (Ohwi 1965). Autumn olive is currently being planted in many Illinois areas to provide food and cover for wildlife, as screens and barriers along highways, to stabilize and revegetate road banks, to reclaim mine spoils, and less extensively for nectar production and as edible fruit

for humans (Allan and Steiner 1972, Foose 1974, Geyer 1978, Hayes 1976, USDA 1979).

Its most important use is as wildlife plantings for food and cover. Geyer (1971) found that after three growing seasons autumn olive provided abundant food and cover on a variety of soil types. An individual plant can produce 80 pounds of fruit each year (USDA 1979). Allan and Steiner (1972) noted that 23 individuals of the "Cardinal Strain" yielded more than a total of 900 pounds of fruit per year. A large number of birds are attracted to the red colored fall ripening fruit produced in large quantities (Foose 1974). Allan and Steiner (1972) listed 23 species of song and gamebirds that feed on autumn olive fruit. Raccoons, skunks, oppossums, and black bears are also known to feed on the fruit (Allan and Steiner 1972). They also indicated that songbirds nest in the branches, while rabbits and gamebirds use it for cover.

A survey in three central-Illinois state parks indicated that there has been considerable encroachment by autumn olive into areas adjacent to original shrub rows. Such encroachment is considered to be a disturbance, because the species has replaced native species which would otherwise occupy these sites (Bratton 1982). Population densities and age structure of reproduction within and adjacent to mature shrub rows were studied at Lincoln Trail, Fox Ridge, and Red Hills State Parks in east-central Illinois. The original autumn olive plantings sampled at Lincoln Trail and Fox Ridge were 7-8 years of age and 14-15 years of age at Red Hills, the first autumn olive planting in Illinois state parks.

MATERIALS AND METHODS

A preliminary study was conducted to determine the age/height relationships of autumn olive reproduction. One hundred various sized reproduction individuals were collected and aged by counting terminal bud scale scars and/or annual rings. The heights of aged plants were measured and combined with age data to generate an age/height scale. The smallest plants, 0.0-0.15 m were categorized as 1-2 year old seedlings because both ages were found in this size range. The older age/height categories were 2 years (0.16-0.45 m), 3 years (0.46-1.30 m), and 4 years (1.31-1.70 m). This age/height scale was used to rapidly age the young autumn olives in the field.

Seedling and sapling counts were made to determine autumn olive encroachment and reproduction population densities associated with original plantings. These counts were made in 10 one meter wide transects of variable lengths in each of the three state parks. Transects were placed perpendicular through the original shrub row, including a portion of vegetation on either side. Transects were extended beyond observed autumn olive presence a few meters. Within the first 10m of each shrub row the first transect was randomly located and all other transects were uniformly spaced, from this transect at 10m intervals. Two of the Fox Ridge transects passed through two closely planted (5m separation) shrub rows. Data from the two shrub rows were averaged and treated as one. Data collected within each meter-square quadrat along the transect included total numbers and ages of all autumn olive reproduction. Under shrub rows, where reproduction densities were observed to be particularly high, a sub-quadrat of 0.062 m square was randomly placed within the larger quadrat. The conspicuously dominant herbaceous and woody species were also recorded along each transect.

Soil cores, 10cm square × 5cm deep within the A horizon, were randomly col-

lected in each area sampled. Two samples were collected from different areas within the shrub rows, mowed areas, oldfields, and woods. Soil analyses for cation exchange capacity, soil pH, and organic matter were performed on each sample by Agronomic Service Laboratory, Washington, Ohio.

RESULTS

Autumn olive was found to have spread from its original plantings in each of the three sites. The highest reproduction densities occurred directly under the shrub rows and densities decreased in the oldfield areas. Autumn olive was also found at the woods edge but not within the woods. There was no reproduction in grass areas. The age of all reproduction 2m or more distant from shrub rows at Lincoln Trail and Fox Ridge ranged from 1.5-3.5 years of age. The age at Red Hills was greater than 3.5 years. The average age of reproduction under or within 1-2m of shrub rows at all three state parks was 1.5 years.

The highest density of reproduction autumn olive at Lincoln Trail State Park occurred within the shrub row with 139 plants/m square and densities decreased toward the shrub row outer edges (Figure 1). Densities of 12 plants/m square were found at the oldfield edge, then leveled at 1-2 plants/m square. The density increased to 6 plants/m square within the forest edge then decreased to zero under the woods canopy. Average ages were 1.5 years within the shrub row and at the forest edge. Average ages within the oldfield varied from 2.5-3.5 years of age. Dominant plants in the oldfield were *Solidago canadensis*, *Aster* spp., and *Potentilla simplex*. *Quercus alba* and *Liriodendron tulipifera* were dominant oldfield saplings, with a few individuals of *Ulmus rubra*, *Acer saccharum*, *Carya ovata*, and *Prunus serotina*. The woods was dominated by large *Quercus alba* and *Acer saccharum* trees.

Autumn olive reproduction densities at Red Hills State Park averaged 225 plants/m sqaure within the shrub row (Figure 2). No reproduction was found in a very dense grove of *Ulmus rubra*, *Sassafras albidum*, and *Liriodendron tulipifera* saplings adjacent to the shrub row. Reproduction was also absent from the mowed grass area. Very low densities of 0.1-0.4 plants/m sqaure occurred in the oldfield. This area was covered by a very dense vine growth of *Lonicera japonica* with scattered individuals of *Liriodendron tulipifera*, *Quercus alba*, *Ulmus rubra*, and *Sassafras albidum*. Reproduction ages within the shrub row were 1.5 years, with one quadrat near the shrub row edge having as average age of 2 years. Oldfield reproduction ages were almost all greater than 7 years. No attempt was made to distinguish ages of individuals older than 7 years.

The highest densities of autumn olive reproduction at Fox Ridge State Park occurred within the original shrub rows, with 128 plants/m square, then decreased below 57 plants/m square (Figure 3). Oldfield densities ranged from zero to 3 plants/m square. Reproduction was absent from the mowed area. The average age of reproduction within the shrub row was 1.5 years. Oldfield ages were 1.5-3.5 years. The dominant plants in the oldfield areas were *Solidago canadensis*, *Aster* spp., and *Potentilla simplex*. *Fraxinus americana* and *Quercus alba* were the dominant sapling trees in this area, with occurrences of *Rosa multiflora*, *Cornus florida*, and *Viburnum prunifolium*. The wooded area was dominated by *Quercus alba* with a few individuals of *Acer saccharum*.

Soil tests for cation exchange capacity, soil pH, and organic matter indicated there were no significant differences among the habitats sampled for these properties. The same was also true for the habitats studied when each of the state parks was compared to the others.

DISCUSSION

This study indicates that autumn olive has been rather rapidly becoming naturalized in areas adjacent to the original shrub plantings. The results at Lincoln Trail and Fox Ridge State Parks indicate that considerable autumn olive reproduction can occur once the original plantation is 3-4 years of age. Allan and Steiner (1972) previously listed fruit production beginning at 3-5 years while Olson (1974) listed the minimum seed-bearing age being 6 years.

Autumn olive appears to compete well with seveal types of herbaceous and woody species under specific successional and/or disturbance conditions. Oldfield and disturbed sites offered the optimum habitat for successful autumn olive reproduction, while highest densities occurred within the mature shrub row. Dispersal appears to be mainly by falling fruit and bird droppings. A group of 50-70 cedar waxwings (*Bombycilla cedrorum*) were observed feeding on the fruit while the senior author was taking habitat pictures in mid-October. Birds seem to be the primary vector for seed dispersal.

The young age of the seedling populations within the shrub rows indicates that there is near total seedling mortality in this habitat. The advanced age groups in adjacent areas indicate that autumn olive seedlings and saplings can successfully compete in selected habitats such as early secondary successional or disturbed areas.

Light appeared to be an important factor limiting seedling success, but further evidence is needed to confirm this. Autumn olive was absent in areas with very low light intensity, such as under the dense forest canopy. Low light intensity resulting from dense ground cover also reduced seedling success. This was observed in the oldfield at Red Hills, where there is a very dense ground cover of *Lonicera japonica*.

Autumn olive seedlings did not spread into areas with dense grass cover that were mowed frequently. These areas in the parks are managed by weekly mowing and grooming during the summer months. A previous study had reported an autumn olive density of 0.52 stems/m square in mowed areas (Ebinger and Lehnen 1981). That study site was considerably more disturbed than the state park study sites.

Sharp (1977) stated that autumn olive can be easily grown in a range of soil types because of its nitrogren fixing abilities. Autumn olive appeared to grow well in the different soil types at each state park. The mean values for soil characteristics studied in the three parks indicated that the soils were very similar (Table 1). Other factors must be promoting or inhibiting seedling growth. Possible limiting factors that should be investigated include allelopathy, nutrient competition, soil moisture stress and light intensity.

In conclusion, autumn olive is becoming naturalized in east-central Illinois and possibly throughout the state. Several characteristics contributing to its adventive nature include its rapid growth rate, high fruit production, nitrogen fixing abilities, dispersal of seeds by birds and mammals, and its ability to grow in a range of disturbed and semidisturbed habitats. The adventive nature of this shrub and its potential to spread may cause considerable control problems for landowners, disrupt natural

successional patterns, compete with desirable native species, and may require large expenditures for maintenance and control. Therefore, the propagation and planting of this shrub should be strongly discouraged for many sites that are receiving it currently.

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Table 1 — Averaged results of soil testing for Cation Exchange Capacity, pH, and Organic Matter at Fox Ridge (FR), Lincoln Trail (LT), and Red Hills (RH) State Parks.

Habitat Sampled	C.E.C. (m.e.)			pH			O.M. (%)		
	FR	LT	RH	FR	LT	RH	FR	LT	RH
Mowed Grass	10.5	9.9	11.0	5.2	6.4	5.0	3.0	3.0	2.6
Shrub Line	12.0	14.0	11.5	5.3	5.1	5.4	2.5	2.7	2.5
Oldfield	11.5	10.3	9.8	5.5	5.5	5.2	2.8	3.4	2.5
Woods	13.0	14.0	10.0	5.0	5.4	5.5	2.9	3.5	2.5
Sapling Area	—	—	12.0	—	—	5.5	—	—	2.8
TOTAL AVERAGE	11.7	11.9	10.9	5.2	5.6	5.3	2.8	3.1	2.6

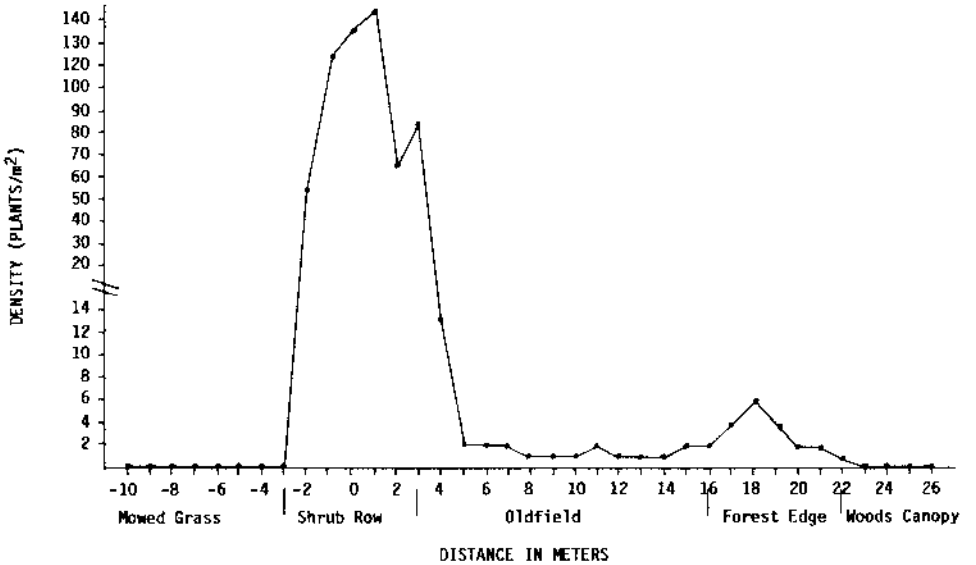

Fig. 1. Average density of autumn olive as a function of distance from original shrub row at Lincoln Trail State Park.

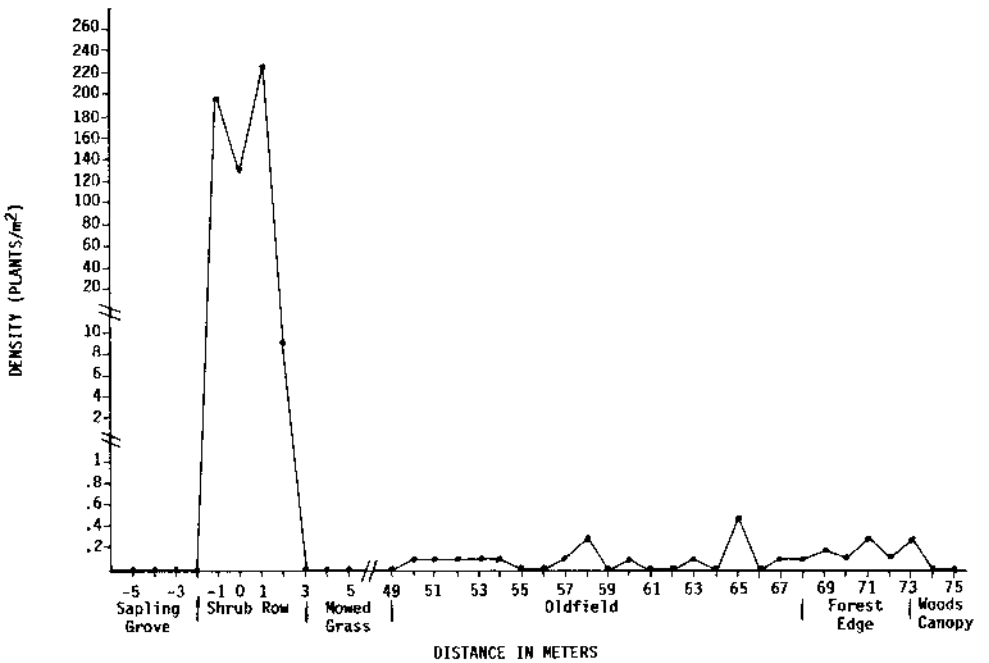

Fig. 2. Average density of autumn olive as a function of distance from original shrub row at Red Hills State Park.

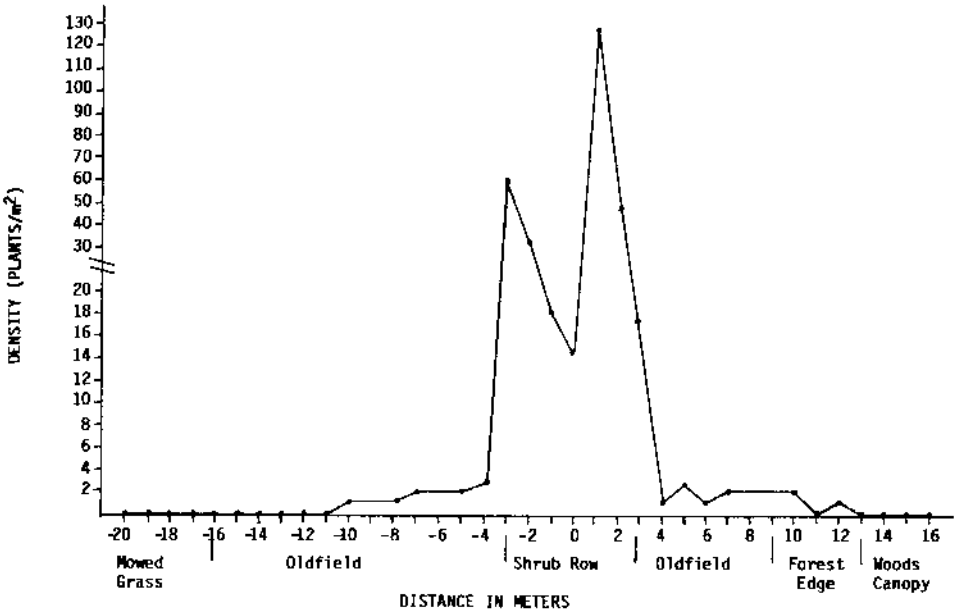

Fig. 3. Average density of autumn olive as a function of distance from original shrub row at Fox Ridge State Park.