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EXOTIC INVASIVE PLANTS IN SOUTHEASTERN FORESTS[1]

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ABSTRACT. Invasive exotic plants usurp forest productivity, hinder forest-use activities, and limit diversity on millions of acres of forest land in the Southeast. Infestations of these plants and their range are constantly expanding. This paper examines the various aspects of the problem. Outlined are the biology, origin, range, uses, and herbicide control for 14 of the most prevalent exotic trees, shrubs, vines, and grasses. Losses on forest lands will continue to increase until importation of new exotic species is controlled, Integrated Weed Management Programs are organized, and effective control procedures are implemented. Biological control technology using insect and pathogenic predators from the plant's home country offers the best long-term solution for subduing exotic invasive species.

INTRODUCTION

Millions of acres of forest land in the Southeast are being occupied increasingly by non-indigenous harmful plants—exotic escapes. The actual infested acreage and spread rates of encroaching exotic plants are unknown, even though this information is essential for planning eradication and containment strategies (U.S. Congress Office of Technology Assessment 1993). Kudzu and Japanese honeysuckle alone occupy over 7 million acres each and their spread rates are increasing (Watson 1989, Craver 1982). Exotic plant biopollution threatens plant and animal biodiversity across the landscape and continues to capture our highly valued nature preserves and recreational lands. All federal park and forest lands in the Southeast have exotic infestations (Hamel and Shade 1985, Hester 1991). The current problems with exotic imports grow worse, with no foreseeable declines.

The purpose of this paper is two fold: (1) to bring attention to the problem of exotic plants in the sub-tropical part of the Southeastern Forest Region, focusing on the most troublesome invasive species; and (2) to begin to mobilize support for organizing Integrated Weed Management Programs for these species. Herbicide control research is summarized to foster proactive treatment of new infestations as a means to minimize spread. The severe problem with tropical exotic invaders in Florida has already prompted the development of integrated management programs for those species, which is beyond the scope of this paper. It is however recognized that some tropical exotic species in Florida are advancing into the sub-tropical parts of the Southeastern Forest Region (e.g., cogongrass, tallowtree, and Japanese climbing fern) and represent common problems.

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Ecology of exotic plants

Exotic plants can spread rapidly because of our mobile society with "hitch-hiking" seeds and the intentional transportation of ornamental and forage plants (Randall and Marinelli 1996). Crucial aspects of exotic plant ecology that influence control strategies are as follows:

a. Invasive exotics continue to spread because natural predators were not imported from the plant's home range and native predators in the U.S. are too weak;

b. After an exotic plant is introduced there is a "lag phase" of decades to centuries before an exponential spread phase (Baskin 1996). Thus, some species that currently appear non-invasive may eventually begin to spread rapidly. Kudzu is an example that has an apparent lag phase of 10 to 20 years before a rapid spread phase;

c. Most invasive exotic plants spread through abundant seed production, and perennial species spread by well-protected, below-ground rhizomes;

d. Invasive exotic plants can prevent or retard natural succession and reforestation by forming dense infestations, often in mixtures. Control measures for one species can release non-susceptible cohorts;

e. Invasion by exotics continues to decrease biological diversity within natural reserves and parks, and detract from their primary mission (Natural Areas Association 1992);

f. The partial shade tolerance of some exotic species (i.e., Chinese privet, Japanese honeysuckle, lespedeza bicolor, tallowtree, and Japanese grass) allows them to become established under developed forest canopies;

g. Kudzu, Japanese honeysuckle, privets, mimosa, and Japanese grass are invading riparian habitats to the exclusion of native understory species and hardwood regeneration;

h. The initial spread of exotics along highway and utility right-of-ways, "disturbed habitats," and riparian systems, greatly facilitates migration into extensive forest areas; and

i. Because many "disturbed habitats" occur in cities, exotic plants can present severe problems for urban forestry programs, which is made more difficult by exotic species mixtures.

Control and eradication of exotic plants

Current control methods for invasive exotics are expensive, lengthy, and risky because total eradication is required to prevent reestablishment. Effective site-eradication procedures require multi-year treatments, continued monitoring, and follow-up treatments. All infestations on adjacent lands must be treated to prevent reinvasion. This seldom occurs without the leverage of noxious weed laws that places liability on neighbors that do not treat and allow reentry. Unfortunately, infestations common along highway, railroad, and utility right-of-ways are rarely treated for eradication, fostering widespread immigration to adjacent lands. In addition, many federal and State agencies have policies that prevent the use of the most effective herbicides for a particular exotic species. This results in extremely high control costs (often without eradication) on highly valuable sites. It is also becoming clear that older infestations and those near streams, marshes, and other special habitat, and those having abundant seed banks, are probably impossible to eradicate with current methods.

Past research studies for developing eradication methods were often limited in duration (only one or two years) and habitats (one site). Appropriate long-term support and funding has been lacking. Biocontrol projects offer a logical, long-term solution but none have been attempted in the

Southeastern Region. The high investments and long-term research required for biocontrol programs have been made only for western rangeland exotic plant species, and more recently for tropical exotics in Florida. The mixture of ownership that characterize eastern and southeastern forests presently stymies organized efforts, compared to the dominance of federal lands and interests in the West.

Integrated Weed Management Programs

Integrated Weed Management Programs incorporating all effective control treatments are needed with appropriate research funding and cost-share treatment programs for landowners. Integrated weed management is a system that utilizes all proven methods based on the best available scientific facts, current technology, and economic considerations. Integrated Weed Management Programs combine methods of control using: preventative measures (e.g., legal controls such as quarantines, inspections, and embargoes), biocontrol agents using natural parasites and predators, herbicides, prescribed burning, mechanical and manual treatments, and developed commercial uses.

Problems in organizing Integrated Weed Management Programs

The extensive weed infestations in southeastern forests often go unseen by the public—hidden invaders. Conflicting attitudes between user groups (e.g., horticulturists, hunters, seed producers, etc.) and landowners with exotic infestations as well as between urban and rural constituents hinders organizing aggressive control programs. Imported plants with developed uses in agriculture and horticulture can be become noxious invasive plants in forests. Widespread chemophobia often reenforces a do-nothing approach to site eradication methods that use herbicides, even though herbicides are now endorsed by conservation groups for treating some sites. In the past, a general attitude of resignation at all levels of both the public and private sectors in the Southeastern Region has hindered gaining support for integrated control and containment programs.

Federal and state governments have no unified policy for limiting entry, reacting to emergency importation, or fostering integrated control methods (U.S. Congress Office of Technology Assessment 1993). There is no regional agency or organization that has clearly-defined responsibility or jurisdiction to organize regional Integrated Weed Management Programs. The formation of state exotic pest plant councils may eventually fill some of this gap. And recently, federal agencies have started to address noxious weed problems in a unified manner by forming the Federal Interagency Committee for Management of Noxious and Exotic Weeds.

Prevalent Exotic Plant Species Invading Southeastern Forests

The exotic plants discussed below are some of the most noxious for forestry and other land use sectors in the Southeast. General descriptions of their biological nature and range have been compiled from several sources (Duncan 1975, Dean 1988, Foote and Jones 1989, Radford et al. 1983, Brown and Kirkman 1990, Randall and Marinelli 1996). An extensive literature search has yielded some herbicide control recommendations. However, very few recommendations for forested areas were found. It is apparent that more research is urgently needed. Only the most effective herbicide treatments are outlined. More details and other options are included in the cited research papers.

EXOTIC TREES

Exotic tree species hinder reforestation and rights-of-way management because of scattered isolated infestations. Silktree is continually spreading along stream networks and tallowtree has extensive infestations in wet forests, replacing native species. These species occur in mixtures with other exotic invasive plants on disturbed habitats.

Albizia julibrissin Durazzini silktree or mimosa
Nature: Leguminous, small trees growing 30 to 40 ft that reproduce by seed and root sprouts.
Origin: Native to Tropic America.
Range: Along roadsides and forest borders from MS to FL and north to KY and VA.
Uses: A traditional ornamental with infestations originating from old homesite plantings.
Herbicide control: Only control recommendations of *A. pigra* are available, which are soil applications of tebuthiuron (Spike) and foliar applications of clopyralid (Transline)(Sutton and Langeland 1993). Clopyralid controls only legumes and is often safe on surrounding non-leguminous species.

Melia azedarach L. chinaberry
Nature: Medium tree growing to about 50 ft that spreads by prolific seeding.
Origin: Introduced from Asia and traditionally planted at home sites in the Southeast.
Range: Forest borders and disturbed habitat throughout the Southeast but rare at high elevations.
Uses: Traditional ornamental and potential uses of extracts as pesticides.
Herbicide control: No control research reports found.

Sapium sebiferum (L.) Roxb. tallowtree, popcorn tree
Nature: Shade-tolerant, small trees growing to 40 ft that spreads by bird-dispersed seeds (Jones and McLeod 1989).
Origin: Introduced from China to the U.S. gulf coast in early 1900's .
Range: Coastal plain from NC south to FL to TX with severe infestations on wet forest sites and coastal prairies in east TX to FL. Occurs as ornamental in OK and AR.
Uses: Waxy seeds traditionally used to make candles. Honey plant for beekeeping. Ornamental.
Herbicide control: No control research reports found.

EXOTIC SHRUBS

Exotic shrubs often occur with exotic tree species and present similar problems. The most extensive invader in forested areas is chinese privet that is replacing native riparian species and prevents regeneration of bottomland hardwood-pine forests. These exotic shrubs have value for wildlife forage, and are often established by hunter groups.

Lespedeza bicolor Turcz. bicolor
Nature: Shade-tolerant, leguminous shrub up to 10 ft tall that spreads by bird- and animal-dispersed seeds.
Origin: Introduced from Japan.
Range: Piedmont and coastal plains in SE.
Uses: Wildlife food for birds and soil stabilization.
Herbicide control: No control research reported.

Ligustrum japonicum Thunb. Japanese privet
Nature: Shade-tolerant, tall shrub or small tree growing to about 35 ft, with evergreen leaves, that spreads by bird-dispersed seeds and by rhizomes.
Origin: Introduced from Japan and Korea.
Range: NC and SC to GA west to TX.
Uses: Ornamental and wildlife food and habitat.
Herbicide control: Glyphosate (Accord and Roundup) has demonstrated control on horticultural potted plants (Neal and Skroch 1985).

Ligustrum sinense Lour. Chinese privet
Nature: Shade-tolerant, tall shrub or small tree growing to about 30 ft, with evergreen leaves, that spreads by bird-dispersed seeds and by rhizomes.
Origin: Introduced from China.
Range: Scattered throughout MS north to TN and KY and east to AL, GA, SC, and NC.
Uses: Ornamental and wildlife food and habitat.
Herbicide control: No control research reports found.

Rosa multiflora Thunb. ex Murr multiflora rose
Nature: Erect shrub up to 10 ft tall with arching stems that forms dense thickets, that spreads by bird-dispersed seeds.
Origin: Introduced from Japan and Korea in 1860's and widely promoted in the 1930's by conservation agencies for cover, wildlife food, and "living fence."
Range: Fence rows, pastures, and thin woodlands, ME to MN south to FL and west to TX.
Uses: Wildlife food and cover, and livestock fences.
Herbicide control: Foliar sprays of metsulfuron (Escort) and metsulfuron and dicamba plus 2,4-D (Veteran 720) in the spring (Derr 1989, Underwood and Sperow 1985).

EXOTIC VINES

Exotic vines are some of the most troublesome invaders because they form the most dense infestations. Kudzu and Chinese wisterias can overtop even mature forests, while Japanese honeysuckle can form dense cover below the canopy. Reforestation after harvest of infested stands require high-cost treatments. Japanese climbing fern is a relatively new entry that is extending its range through wind-blown spore dispersal and infestations on forest margins along rights-of-ways and disturbed sites.

Lonicera japonica Thunb. Japanese honeysuckle
Nature: Shade-tolerant, climbing and trailing semiwoody vine with evergreen leaves that spreads by stolons and seeds. This is the only exotic of 7 species of Lonicera in SE.
Origin: Introduced from Japan.
Range: Eastern U.S.
Uses: Valued as deer browse in Piedmont and erosion control.
Herbicide control: Foliar sprays of metsulfuron (Escort) plus surfactant at 2 oz ai/a in May (in Georgia) with tolerance by pine seedlings (Edwards and Gonzalez 1986). Foliar sprays of glyphosate (Accord and Roundup) at 1.5% v/v in December (in Delaware) (Regehr and Frey 1988).

Lygodium japonicum Thunb. Sw. Japanese climbing fern
Nature: Rhizomatous delicate vine, climbing and twining to form clumps that can cover shrubs and trees. One of three species of climbing fern (the others--*L. palmatum* in the Blue Ridge and *L. microphyllum* in FL—are native.)
Origin: Introduced from Japan
Range: Lower halves of SC, GA, AL, MS, and LA, and central FL.
Uses: Ornamental
Herbicide control: No control research reports found.

Pueraria montana (Lour.) Merr. (formerly *Pueraria lobata* (Willd.) Ohwi) kudzu
Nature: Leguminous, trailing or climbing, semi-woody vine that spreads by vine growth, rhizomes, and seeds (Miller 1996).
Origin: Introduced from Japan with the home range in China into MS, AL, GA, and SC.
Range: Roadsides, fields, and forests throughout the Southeast and scattered north to OH to CT.
Uses: Erosion control, livestock feed, and folk art.
Herbicide control: Foliar sprays of picloram (Tordon), picloram plus 2,4-D, or tebuthiuron (Spike) for successive years applied from June to September (Miller 1986, 1988). Other options provide partial control and may be useful in specific situations .

Wisteria sinensis (Sims) DC Chinese wisteria
Nature: Leguminous semiwoody vine (or shrub) that spreads by vine growth and seeds. One of four species in SE with one other being exotic but rare, *W. floribunda* (Willd.) DC. (Japanese wisteria), while the native or naturalized *W. frutescens* (L.) Poiret is the more frequent.
Origin: Introduced from Asia.
Range: Piedmont and coastal plains from VA to LA and north to AR and TN.
Uses: Ornamental
Herbicide control: Glyphosate (undiluted Accord) immediately applied to cut vines in November (Thomas 1993).

EXOTIC GRASSES

Exotic grasses present severe competition for establishing forest plantations on abandoned row-crop and pasture lands. Some of these are generally considered naturalized, e.g., bermudagrass (*Cynodon dactylon* (L.) Pearsoon), crabgrass (*Digitaria* spp. Heister), and giant fescue (*Festuca arundiacea* Schreb.), and are not listed here. Most exotic grasses spread and reside along highway and utility right-of-ways, where eradication treatments are not applied.

Imperata cylindrica (L.) Palisot cogongrass
Nature: Dense, erect perennial grass that spreads by prolific seed (short-lived) production and rhizome movement in fill-dirt. A South American species, *I. brasiliensis*, is less invasive. Both species invade new forests and prevent establishment of planted seedlings.
Origin: Native to Southeast Asia and listed as the world's seventh worst weed (Holm et al. 1977).
Range: All MS, lower AL, and isolated infestations in SW GA and SC (Bryson and Carter 1993). State-wide eradication program in LA apparently successful.
Uses: Forage initially projected without success and initially for soil stabilization.

Control: Imazapyr (Arsenal AC) and glyphosate (Accord), singly or in combinations, with multiple applications (Townson and Butler 1990).

Microstegium vimineum (Trin.) A. Camus Japanese grass, stiltgrass, Nepal microstegium
Nature: Dense, mat-forming annual grass that roots at nodes and is shade tolerant and occupies various habitats including creek banks, floodplains, forest roadsides and trails, damp fields, and swamps (Barden 1987).
Origin: Native to temperate and tropical Asia, it was introduced near Knoxville, Tennessee around 1919 (Fairbrothers and Gray 1972).
Range: MS to FL north to AR, KY, OH, NY and CT.
Uses: None
Control: Glyphosate (Accord) and sethoxydin (Vantage, formerly Poast) as dilute foliar sprays in late summer (Johnson 1997).

Sorghum halepense (L.) Pers. johnsongrass
Nature: Dense, erect perennial grass that reproduces by seed and rhizomes. Invading new forest plantations.
Origin: Introduced from Mediterranean region of Africa.
Range: Throughout the Eastern and Midwest U.S. and lower NM, AR, and CA.
Uses: Livestock pasture.
Control: Sulfometuron (Oust) plus imazapyr (Arsenal AC) applied in April-May for suppression to establish loblolly pine (Dougherty et al. 1991, Nelson and Franklin 1990)

RECOMMENDATIONS

Weed scientists and extension specialists in the region need to coordinate efforts and be aggressive in performing research projects aimed at developing integrated control approaches for these species. Legal and policy strategies are needed at all governmental levels to prevent future importation and spread, as well as, to support development of regional-scope integrated management programs. Extension specialists can help to educate various public sectors to the need for weed management, the cost-benefits, and how to perform effective control treatments.

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