FOR 218

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IFAS Extension

Biology and Control of Japanese Climbing Fern *(Lygodium japonicum)*[1]

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Japanese climbing fern (*Lygodium japonicum* (Thunb.) SW.) is a non-native, invasive vine which from its introduction around 1900 has become established throughout the southeastern Coastal Plain from the Carolinas to Texas and Arkansas. It is native to eastern Asia from Japan and west to the Himalayas. It has primarily naturalized in Florida, Georgia, Alabama, Mississippi and Louisiana in counties located along the Gulf Coast (USDA Plant Database 2008). In Florida, climbing fern is widespread in north and west Florida and ranges into the south-central part of the Florida peninsula (Nelson 2000, Wunderlin 2006). It occurs in sunny or shady locations, usually in damp areas such as the edges of swamps, marshes, lakes, creeks, hammocks, and upland woodlands (Langeland and Cradock Burks, 1998).

Figure 1. Japanese climbing fern, a common invasive plant in pine plantations of the Coastal Plain, has climbing, twining fronds that can grow to 90 feet long. (Photo: Ronald F. Billings, Bugwood)

Biology

Japanese climbing fern has climbing, twining fronds of indeterminate growth and can reach lengths of 90 feet. Above-ground growth occurs along wiry main stems, properly called "rachises" (the singular is "rachis"). Japanese climbing fern is closely related to

1. This document is FOR 218, one of a series of the School of Forest Resources and Conservation Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date May 2009. Visit the EDIS Web site at http://edis.ifas.ufl.edu.
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Old World climbing fern (*Lygodium microphyllum*), another non-native invasive species in the United States. Both species are listed as Category I noxious weeds by the Florida Exotic Pest Plant Council, with the ability to "alter native plant communities, change community structures and ecosystem function" (FLEPPC 2007). Japanese climbing fern has feathery, light green fronds in contrast to the leathery appearance of Old World climbing fern, which usually has un-lobed leaflets that are glabrous (waxy) below and articulately stalked. While Old World climbing fern is limited in its northern range due to a lack of frost tolerance, Japanese climbing fern is not. Frost causes above-ground portions of Japanese climbing fern to die back but does not necessarily kill the below-ground portion of the plant.

Figure 2. Japanese climbing fern is distinguished by its feathery, light green fronds, with triangular, compound leaf branches (pinnae) and lobed, stalked leaflets (pinnules) on wiry, twining, stems (rachises), often orange to brown in color. (Photo: Ted Bodner, Bugwood)

Japanese climbing fern occurs as both individual scattered plants and as tangled masses of dense canopy which can eliminate the underlying vegetation and cover larger trees. As a fern, it reproduces by spores that are extremely numerous, long-lived, and readily disseminated. Moreover, it can reproduce by self-fertilizing. Pinnae on lower rachises are sterile; but as the rachis develops, successive new pinnae become increasingly fertile. Spore abundance increases through the growing season as the rachis grows. In north Florida, peak spore release occurs in October (Van Loan 2006). Japanese climbing fern also spreads vegetatively by rhizomes located 1 to 3 cm below the soil surface. Rhizomes spread and re-sprout after winter frosts, and the fern rapidly grows back from rhizomes after being burned (Evans et al. 2006). However, no studies have reported the spread rates of fern by these vegetative means.

Figure 3. Prescribed fire alone has not been successful in controlling Japanese climbing fern, which is a ladder fuel that allows fire to climb into the forest canopy, potentially worsening the severity of wildfire and compromising the safety of prescribed burning programs. (Photo: Chuck Bargeron)

Japanese climbing fern poses both economic and ecological threats to forests in Florida. It is especially problematic in pine plantations managed for pine straw production. For years, pine straw bales have been a suspected vector of viable Japanese climbing fern plant parts and spores (Zeller and Leslie 2004). The fern is also problematic during prescribed burning because it provides a fuel ladder to canopy trees. Further, because of its ability to engulf and out-compete native vegetation, Japanese climbing fern can be of particular concern in natural and disturbed areas where restoration of remnant populations of native species is critical.

Control Measures

Biological

Currently there are no published or on-going studies regarding biological control of Japanese climbing fern in the southeastern United States. Progress has been made, however, to identify selective biological control agents for Old World climbing fern (Pemberton, 1998). In 2007, populations of the defoliating moth from Australia,

Figure 4. The three patches of light green vegetation among the dark green junipers in this landscaping are infestations of Japanese climbing fern, which was introduced from commercial pine straw. (Photo: Pat Minogue)

Austromusotima camptozonal were released at nine locations of Old World climbing fern in Florida (Pemberton, 2007). Breeding was detected at three locations, but there was no evidence of persistence or establishment of the insect. Researchers at the USDA Invasive Plant Research Laboratory (IPRL) in Ft. Lauderdale, Florida, are examining several other insect species as well, including lygodium gall mite (*Floracarus perrepae*), lygodium saw fly (*Neostrombocerus sp*.), flea beetles (*Manobia sp.*), and stem borers. The caterpillar stage of *Neomusotima fuscolinealis* is a natural pest of *Lygodium japonicum* in Japan but has yet to be tested for potential host range and environmental safety in Florida or the southeastern United States. (Pemberton, 2002).

Fire

Fire is not thought to be an effective means for control because the fern re-grows quickly following fires. A few researchers have examined the use of fire to control Old World climbing fern with little success (Munger 2005). Stocker and others (1997) used a propane torch to burn off above-ground portions of Old World climbing fern and found that the ferns recovered speedily. Regarding efforts to control Old World climbing fern Roberts (1997) concluded that fire alone will not control this invasive weed. Control of other invasive species with significant above-ground and below-ground biomass such as cogongrass (*Imperata cylindrica*) has been enhanced by using prescribed fire in conjunction with herbicide application (Jose et al. 2002). However, citing a personal communication, Ferriter (2001) stated that prescribed burns, alone and in combination with the herbicide 2,4-D, were not effective in controlling Japanese climbing fern in pine plantations in north Florida. More research is needed to examine the combined use of herbicides and fire to control existing climbing fern plants and those that may arise from numerous, long-lived spores.

Herbicides

Herbicidal control of Japanese climbing fern has only been formally investigated by a few researchers (Valenta, et al. 2001, Zeller and Leslie 2004, Van Loan 2006, Minogue et al. 2008). In a review of herbicide treatments for Old World climbing fern, Langeland (2004) noted that glyphosate and metsulfuron methyl, used alone or in combination, were most common. The effectiveness of glyphosate treatments was observed in early studies of Japanese climbing fern, however it was also noted that metsulfuron treatments were least damaging to surrounding native vegetation (Zeller and Leslie 2004). Van Loan (2006) examined 15 herbicide treatments for selective control of Japanese climbing fern in three north Florida pine forests. She had best results using glyphosate, imazapyr, and metsulfuron methyl, herbicides that inhibit the formation of amino acids in plants. Minogue et al. (2008) examined these same herbicides for efficacy in controlling Japanese climbing fern and for their impact on associated vegetation using various herbicide rates and combinations at six locations on conserved lands in north Florida. Control of Japanese climbing fern improved linearly as the glyphosate product rate was increased from 1 percent to 4 percent of the spray solution, with nearly 100 percent cover reduction at 8 months after treatment using the 4 percent rate. Combinations of glyphosate and metsulfuron methyl were generally more effective than combinations of glyphosate and imazapyr. Damage to associated vegetation, including overstory hardwood trees not sprayed with herbicide, was greatest with imazapyr. Least injury to associated vegetation was with metsulfuron methyl. Native grasses quickly re-colonized treated plots at some locations. Miller (2003) recommends various herbicide treatments for

Figure 5. Fertile leaflets (pinnules) are contracted in shape with two rows of sporangia along the leaf margin. The light brown spores are nearly microscopic. (Photo: Pat Minogue)

the control of Japanese climbing fern (see Table 1 below).

When using Arsenal® AC or Escort®, be sure to add a surfactant (wetting agent) according to label directions to improve plant uptake. From operational experience, best results are obtained with application of these herbicides in late-season, from July to early October, prior to peak spore release. Note that Arsenal® (imazapyr) is a residual, soil-active herbicide and may damage hardwood trees if their roots extend into the treated area. Pines however, are tolerant to imazapyr.

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PLEASE READ AND FOLLOW ALL HERBICIDE LABEL DIRECTIONS

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Table 1. Herbicide control measures as described by Miller (2003). All foliage must be thoroughly covered with the spray.

Escort® XP[1] (metsulfuron methyl)	1-2 oz product /acre	Mix 0.3 to 0.6 dry oz per 3 gallons water, and as a mixture with glyphosate
Aresenal® AC[2] (imazapyr)	1% in water	Mix 4 fluid oz per 3 gallons water
Glyphosate[3], Garlon 3A[4], or Garlon 4[5] (triclopyr)	4% in water	Mix 16 fluid oz per 3 gallons water, or a combination of these herbicides

[1]Escort® XP contains 60% metsulfuron methyl as the active ingredient.

[2]Arsenal® AC contains 4 lb acid equivalent imazapyr per gallon as the active ingredient

[3]Glyphosate is the active ingredient in Roundup®, Accord®, and many other products.

[4]Garlon® 3A contains 3 lb active ingredient per gallon as an amine salt of triclopyr.

[5]Garlon® 4 contains 4 lb acid equivalent triclopyr ester per gallon as the active ingredient.