Fire effects on the highly invasive Oriental bittersweet

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Synopsis of a webinar presented Thursday, October 18th, 2012.

Introduction

While resprouting has been documented in woody, herbaceous, and/or invasive vine species, such as Japanese honeysuckle and kudzu, more research on resprouting and the effects of fire on lianas (woody vines) is needed. One invasive liana species, Oriental bittersweet *(Celastrus orbiculatus)*, is the focus of this webinar.

Lianas are often overlooked and difficult to study as they are not self-supporting and rely on other plants. Examples include poison ivy, grapes, green briar, and Oriental bittersweet. Oriental bittersweet was introduced along the east coast of the United States in the 1860's as a horticultural plant. The native range for this plant is in eastern Asia and includes parts of China, Japan and Korea. The invasive nature of Oriental bittersweet did not receive notice until the mid 1900's as it is very similar and often confused with American bittersweet, a native species. Oriental bittersweet has spread to a few states west of the Mississippi River but does not have as wide a distribution as American bittersweet which grows as far west as Montana and western Texas. The distributions of both species cross many different habitats. One difficulty with recognizing Oriental bittersweet as a problem species is its cultural connections. For example, in the October 2003 edition of *Yankee: The Magazine of New England Living*, used a story on decorating ideas with Oriental bittersweet as the cover story. The article states, "Nothing says autumn in New England like a bouquet of bittersweet." Decorating with Oriental bittersweet can aid in the spread of this plant as birds are attracted to the fruit and disperse the seeds.

Oriental bittersweet can have many impacts on local plant communities including smothering host plants, infiltrating forests, girdling trees, and prolific seed fruit production. The vine of an Oriental bittersweet plant can be as big as 7 inches in diameter. Oriental bittersweet resprouts from rootsuckers that result in large clone patches.

There are ways to identify Oriental bittersweet from American bittersweet including differences in inflorescence (leaf axils vs. branch ends), pollen color (white vs. yellow), fruit capsule color (yellow vs. orange), and presentation of the first leaves in spring (book-like vs. scroll-like). The spring leaf presentation may be helpful to managers wanting to control Oriental bittersweet without requiring fruiting plants.

Research

This webinar presents research that was conducted on Oriental bittersweet in Indiana Dunes National Lakeshore, Indiana. The research had four parts:

1. Fire effects on seed viability,
2. Post-fire effects on establishment,
3. Fire effects on established plants, and

4. Fire effects on Oriental bittersweet at the landscape scale.

Fire effects on seed viability
For this part of the study, the researchers took three approaches to determine the effects of fire on seed viability. They examined the effects of wet heat by exposing seeds to boiling water, the effects of dry heat by cooking seeds in an oven for set periods of time, and the effects of prescription burns by placing seeds in wire packets above and below ground litter during two prescribed burns.

There was a negative relationship between seed viability and maximum wet temperature and also between seed alone and seed within fruit viability and duration of exposure to wet heat with complete loss of viability occurring around 90 degrees Celsius and one hour of exposure. Similar results were found with dry heat experiments where seeds and seeds within fruit lost viability with increasing heat and duration of exposure to dry heat. All seeds and fruits within the prescription burns experienced complete mortality regardless of the temperature of the fire. This study found that the dry and wet heat values that result in zero seed viability are much lower than normal prescribed fire temperatures, thus seeds and fruit available in the ground litter will be killed by fire. Prescription burns may be most effective during the spring season as fruits will be eaten by birds (early winter) and the seeds dispersed by the spring period.

Post-fire effects on establishment
This section of the research addressed the question: After a fire that removes litter and saplings, is the area more conducive to Oriental bittersweet establishment by seed? Seventy-two experimental plots in six different habitat types including prairie, oak hickory, beech maple (these three on moraine soil type), sand prairie, savanna, and oak forest (last three on sand soil type) were chosen for study. Each plot was divided into treatment areas of control (no treatment), litter removal, low intensity burn, and high intensity burn and within each treatment the establishment of 25 seeds was monitored. Mean peak germination rates ranged from 4 to 16 percent during the first year after treatment. Treatment type (litter removal type) did not have a significant effect on seed germination. Litter removal type also did not have an effect on the mean survival rate of seedlings with 7 to 16 percent of germinating seeds surviving through the first year after treatment. The control treatment had the tallest seedlings at initial germination and at the final harvest after two growing seasons. Overall, burning did not make the habitat more susceptible to the establishment of Oriental bittersweet seeds.

Fire effects on established plants
This part of the study addresses the research questions: How does fire effect established plants? and, are cutting versus burning similar in their effects on resprouting? Besides looking at stem density and plant biomass, this research also considered the reserve of starches and sugars (total non-structural carbohydrates, or TNC) stored in the roots and readily available for regrowth if the plant is damaged.

Eight experimental sites with 7 to 9 treatment plots at each location were chosen. Each plot four subplots for sampling. Treatments were included a spring and a fall series: control

(no treatment), burn, cut, cut and burn, and herbicide (fall series) or additional July cut (spring series). Resprouted plants and root suckers associated with each stem were measured pre- and post-treatment. Root samples were collected and processed in a laboratory for TNC throughout the treatment periods.

The results suggest a significant relationship between plant survival and the combination of size class (size of stem), soil type (sand or moraine), and treatment type. The cut and burn treatment significantly reduced overall survival on both soil types but all treatments, except the control, reduced plant survival on sand soil plots. The control treatments did not see a change in the number of resprouts and root suckers but all treatment plots had an increasing number of resprouts and root suckers with increasing Oriental bittersweet plant size. There was a greater reduction in cover with the spring treatments than the fall treatments. There was also a significant increase in stem density in cut, burn, and cut and burn treatments; the treatments that included fire saw an over 100 percent increase in stem density after treatment. Within the smallest class size (stems < 2.5 mm) there was an over 400 percent increase in stem density after a treatment that included fire. Dormant season treatments had no effect on TNC, however the summer cut treatment reduced TNC by 50 percent compared to all other treatments. Plants that had had herbicide applied had reduced sugar concentrations in the following growing season.

Fire provided for the prolific resprouting of Oriental bittersweet. When top-killed, Oriental bittersweet stems can root sucker to greater numbers than resprouts on surviving stems. Burning reduced the cover of bittersweet but increased the total stem density. The level of resprouting after burning will depend on the interaction between fire intensity and the local size distribution of stems. There will be a greater resprouting response with larger stems.

Fire effects on Oriental bittersweet at the landscape scale
The objective of the last part of this research was to examine where Oriental bittersweet was located at Indiana Dunes National Lakeshore in relation to the past fire frequency and the time since the last burn. This study also examined if Oriental bittersweet distribution was related to the proximity to road and railroad right-of-ways and environmental factors such as habitat, soil moisture, and canopy cover.

The researchers sampled 368 plots across differing fire frequencies and habitat types for presence, abundance, distribution, and cover of Oriental bittersweet as well as noting the environmental factors at each plot. Oriental bittersweet was prevalent throughout Indiana Dunes National Lakeshore and the abundance has increased by an order of magnitude over a survey conducted 10 years ago (2.4 to 27 %).

Preliminary findings from this study suggest that the presence of Oriental bittersweet is negatively influenced by canopy cover, fire frequency, and distance to road or rail right-of-way. Abundance of Oriental bittersweet was greater in plots with low-moderate burn frequency and marginally lower in plots with greater canopy cover.

Conclusions

The results of this research suggest that burning is not a good option for the control of existing Oriental bittersweet plants because of the "resprouting vortex" that leads to higher numbers of plants. However, burning could be used to kill seeds and seedlings and it does not make a landscape more susceptible to infestion by Oriental bittersweet.

Strategies of control of Oriental bittersweet include:

1. If flowering or fruiting, cut and herbicide to eliminate the seed source.
2. If cutting, it is best to do it in late July or early July and then apply herbicide to the stumps.
3. If burning, it is best to cut and apply herbicide prior to the burn.
4. Late winter burns would be the best option to kill seeds.
5. Fall burns will kill seedlings.

Fire is a double-edged sword with Oriental bittersweet. It can control younger populations but will only aid the regrowth and prevalence of established plants.