ML 2016 Project Abstract
For the Period Ending June 30, 2023

PROJECT TITLE: Management of Invasive Knotweeds
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FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION:
ML 2016, Ch 186, Sec. 2, Subd 6a,

APPROPRIATION AMOUNT: $476,723
AMOUNT SPENT: $476,723
AMOUNT REMAINING: $0

Sound bite of Project Outcomes and Results
Three distinct species of knotweeds and their hybrids were confirmed present from the sampling. Cold tolerance measures indicate all knotweeds have the potential to grow throughout Minnesota and into colder climates. Seed production is inconsistent among populations and dispersal appears to be predominantly asexual and human facilitated. These data predict seed dispersal will become more prevalent, increasing diversity and the probability of resistance to herbicides and other management practices.

Overall Project Outcome and Results
This project focused on genetic structure analysis, measurement of key invasive traits, and optimization of herbicide management for knotweeds in Minnesota. Genetic analysis has definitively confirmed *Fallopia japonica, F. sachalinensis, F. compacta,* and their hybrid, *F. xbohemica,* in Minnesota. *Fallopia compacta* was previously unreported. Although dispersal occurs predominantly through asexual mechanisms facilitated by humans, seed is produced and germinates in the field and will impact management by increasing genetic diversity and the potential for development of resistance to control measures. Cold will not limit distribution of knotweed in Minnesota. Carbohydrate storage in knotweed crowns show the typical patterns for herbaceous perennial dicots. Total nonstructural carbohydrate levels reached seasonal lows in July and August, corresponding to the observed nonstructural carbohydrate depletion to support the development of photosynthetic structures above ground with maximum shoot elongation and vegetative development complete by the end of June, just prior to entering the reproductive phase in August. Maximum starch accumulation occurred in October to December following complete senescence of above ground tissues by mid-October. Herbicide translocation to below ground tissue should be maximized with applications in mid- to late-August and early-September.

Our work improved understanding of differential unit activity on knotweed for the herbicide mode of action (MoA) groups considered to have potential to control knotweed, though not specifically tested in side by side comparisons. The best performing herbicides for knotweed control in order from highest to lowest environmental load in kg/ha were triclopyr (6.72 to 8.97 kg/ha), tebuthiuron (4.48 kg/ha), picloram (2.24 kg/ha), and imazapyr (0.56 kg/ha). Glyphosate (4.48 to 5.97 kg/ha) was more inconsistent and likely would require more sequential follow-up treatments, and with current legal challenges at the time this research was conducted, availability for home use markets is questionable.

Project Results Use and Dissemination
Results were reported at several professional meetings and to land managers. Several reports were made at the Upper Midwest Invasive Species Conference, American Society of Horticultural Science. A review on the history

of knotweed has been published. We are completing data analysis that will be submitted to peer-reviewed journals with the provisional titles:

- Cold Hardiness of Invasive Knotweed (*Fallopia spp*.) Rhizomes
- Genetic Diversity and Structure of Knotweeds with a focus on the Midwestern Knotweeds
- Ploidy Diversity in Four Taxa of Midwestern Knotweeds
- Sexual Reproduction: Production and Viability of Seeds and Pollen among Midwestern Knotweeds
- Asexual Reproduction: Adventitious Rooting Competency among Midwestern Knotweeds
- Growth Potential and Biomass Production a Key Invasive Trait of Midwestern Knotweeds
- Herbicide Sensitivity and Control Trials for Knotweed Management
- Seasonal Carbohydrate Distribution for Herbicide Optimization of Knotweed Taxa

Our genetic structure analysis and the genetic identification of species and their hybrid composition has been provided to EDDMapS via the Minnesota Department of Agriculture to correct miss-identified populations of knotweed reported by many sources.