

CIPM Research Grants Final Report

Title

Examining weediness in Chinese medicinal plants: A comparison of the exotic Asian *Coptis chinensis* and the native congener *Coptis trifolia*

Investigator

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Proposal

The booming herbal supplements and nutraceutical industry in the USA draws on plant resources from both North America and other parts of the world (Lange 2006). A growing popularity of traditional Chinese medications in North America has resulted in a huge demand for their raw medicinal plant material. There is a growing interest among popular herbalists and horticulturists to cultivate these plant species, often in the understory of forests (Craker and Giblette 2002, Giblette 2004) in order to meet the industrial demand. Seeds and rhizomes of Chinese medicinal species are available through horticultural catalogues and are also easily accessible through the Internet.

Horticulture and sale of exotic plants are key activities that have been implicated in the large-scale spread of invasive species on the North American continent (Reichard and White 2001). The fact that many of these medicinal species are richly laden with allelopathic secondary plant compounds (of medicinal value to humans) makes them likely candidates for becoming weeds (Ehrenfeld 2006). Owing to the biogeographical affinities of Sino-American flora (Manchester 1999), Chinese medicinal species have congeners with very similar ecological niches in North America (Li 2002). These native plants can be out-competed and displaced by introducing exotics.

The life histories of *Coptis trifolia* (a North American native called ‘goldthread’) and *Coptis chinensis* (a Chinese medicinal that is currently undergoing small scale cultivation in the U.S. and is known commercially as ‘Chinese goldthread’) were compared using an experimental approach. *C. chinensis* is a Chinese medicinal that is valued for its rhizome. *C. trifolia* is a close relative, important to Iroquois ethnopharmacopeia, but not as commercially popular as *C. chinensis*. The range for *C. trifolia* extends along the entire northern border of the U.S. from the west to east coasts. This preliminary research aimed to ascertain the similarities and differences in germination, seedling survival, and rhizome growth of the Asian *C. chinensis* as compared with its North American congener *C. trifolia* under North American environmental conditions. The study investigated whether the exotic *C. chinensis* will competitively displace the native North American *C. trifolia*.

Results

Rhizomes of *C. trifolia* and *C. chinensis* were grown in pure and mixed plantings under high and low light, moisture and nutrient conditions for three months. Seeds of *C. trifolia* and *C. chinensis* were germinated using a “move along” experimental design in germination chambers that mimicked night and day temperatures for spring, summer, and fall in North America.

Increase in biomass of rhizomes of both *C. trifolia* and *C. chinensis* recorded at the end of the experiment indicated that nutrient and moisture availability did not significantly impact the growth of *C. trifolia* and *C. chinensis*. However, when grown in shade, *C. chinensis* increased biomass significantly more rapidly than *C. trifolia*.

During the seed germination experiment, the cold stratified seeds of *C. chinensis* were attacked by a fungal infestation. This occurred during all four repetitions of the experiment, even with the application of fungicides. The seeds of *C. trifolia* responded to the move along experiment with a low germination rate (2%).

Discussion

Wild populations of both *C. trifolia* and *C. chinensis* grow in shady, moist areas. However, the larger rhizome and, hence, its carbohydrate reserves help *C. chinensis* achieve rapid above-ground growth. This in turn helps it to synthesize quickly more photosynthates and consequently grow rapidly in a short time. However, it is important to grow both species in field conditions for a longer period of time to ascertain the effects of competition.

Seeds of *C. trifolia* from their wild populations are hardier and more persistent than those of *C. chinensis* from horticultural suppliers. However, germination studies have to be repeated once a solution to the fungal infestation is determined.

Publications

At this stage, my research is preliminary; as additional data is obtained, results from the study will be published in peer-reviewed journals.

Literature Cited

- Crocker L.E., Giblette J. Chinese Medicinal Herbs: Opportunities for Domestic Production. In: Janick, J., Whipkey, A., eds. *Trends in New Crops and New Uses*. Alexandria, Virginia: ASHS Press, 2002. 491-496.
- Ehrenfeld, J. G. A Potential Novel Source of Information for Screening and Monitoring the Impact of Exotic Plants on Ecosystems. *Biological Invasions*. 2006;8:1511-1521.
- Giblette, J. Can Chinese Herbs Be Produced in North America? *American Journal of Traditional Chinese Medicine*. 2004;5:5-11.
- Lange, D. International Trade in Medicinal and Aromatic Plants: Actors, Volumes and Commodities. In: Bogers, R.J., Craker, L.E., and Lange, D., eds. *Medicinal and Aromatic Plants. Wageningen UR Frontis Series*. The Netherlands: Springer, 2006
- Li, T. S. C. *Chinese and Related North American Herbs: Phytopharmacology and Therapeutic Values*. Boca Raton, FL: CRC Press, 2002.

Reichard, S. H., and White, P. *Horticulture as a Pathway of Invasive Plant Introductions in the United States*. *Bioscience* 2001;51:103-113.

Products

Presentations of the project by project PI and student researcher are planned for several St. Lawrence University events, such as the 2008 Festival of Science. Additional presentations are also planned at regional meetings, such as the annual meeting of the Society of Economic Botany.

Long-Term Goal/s and Continued Progress of Research

The research will continue to examine competition between *C. trifolia* and *C. chinensis* over a longer time scale. More importantly, the research methodology developed during this preliminary research project will be used to examine more species of exotic Chinese medicinal plants of increasing commercial popularity. To realize this objective, the PI plans to write a larger grant proposal seeking funding from agencies such as the National Science Foundation (NSF) and the Horticultural Research Institute (HRI).

Benefits of Seed Money

The seed money was critical for launching this project, because it allowed the PI to test a methodology for application to a larger nascent research program. The grant also gave us the support to establish a methodology to study weediness risk posed by cultivation of exotic medicinal plants, and, it also facilitated an invaluable research and training experience for an undergraduate student.

Advancing This Research

The research will aid in reviving interest in Native American medicinal plant species and cautioning growers on the risks of large-scale cultivation of exotic medicinal plants when native surrogate species might be available. As discussed above, the work supported through the grant from the CIPM has laid the groundwork for studying weediness risk posed by the cultivation of medicinal plants and will contribute to the formulation of future grant proposals to agencies such as the NSF and the HRI.

Website

Not applicable.

Budget Component	Amount
Research Student Summer Wages	\$ 3,500
Social Security (FICA)	\$ 348
Student Summer Campus Housing	\$ 1,050
Indirect Costs	\$ 102
Total	\$ 5,000