



***Ibervillea Sonorae*: Exploring Propagation Methods to Introduce Coyote Melon
to the Indoor Plant Market**

Spring 2022

Vallicelli, V (n.d.) *Ibervillea sonorae* [Photograph]

NC SARE Grant

Graduate Student Proposal

Project Title: *Ibervillea Sonorae*: Exploring Propagation Methods to Introduce Coyote Melon to the Indoor Plant Market

Author: Keeley McCall-Tunell

Start Date: September 2022

End Date: September 2024

Requested Amount of Funding: \$14,423

- **Faculty Adviser Information.**
Dr. Eric Watkins, Ph.D. Rutgers University, Plant Biology, B.Sc. University of Minnesota, Science in Agriculture
- **Institution Contact Information.**
Regents of the University of Minnesota
600 McNamara Alumni Center S.E., 200
SE Oak St, Minneapolis, MN 55455
- **Work Location.**
Plant Growth Facilities
1552 Gortner Ave
Saint Paul, MN 55108
- **Will your proposed research/outreach primarily focus on socially disadvantaged or limited resource farmers/ranchers?** Not explicitly
- **Project Category Information.**
Crop Production
- **Commodity Category.**
Ornamentals and Turf

Project Summary

Summary

Ibervillea sonorae is a perennial caudexform native to the Sonoran Desert in northwest Mexico. Despite its unique form, low-maintenance characteristics, reliable and colorful spring flowers and fruits, *I. sonorae* does not presently hold a large space within the houseplant market, and it is not currently propagated in the Midwest. Moreover, very little propagation information is available to growers for this promising plant. This project, entitled *Ibervillea Sonorae: Exploring Propagation Methods to Introduce Coyote Melon to the Indoor Plant Market*, looks to fill this information gap, and determine best practices for propagating *I. sonorae* in a greenhouse environment, specifically within the Midwest.

The proposed research will be conducted through propagation trials that will take place at the University of Minnesota. The trials will be designed to determine best practices for seed versus cutting, planting depth, and sun versus shade requirements for the commercial production of *I. sonorae*. To best ensure industry relevance, the research will be done with ongoing input and feedback from a panel of local growers. Once complete, the findings of the research will be shared with Midwest growers through production of a one-to-two-page propagation. Additionally, the lead researcher will write journal articles to be shared with academic and trade journals, highlighting the methods and findings of the research.

Description

The aim of this study is to determine the best propagation techniques for *Ibervillea sonorae* in a protected greenhouse environment in the Midwest of the United States, in order to introduce this plant to the commercial houseplant market. From this study, a propagation

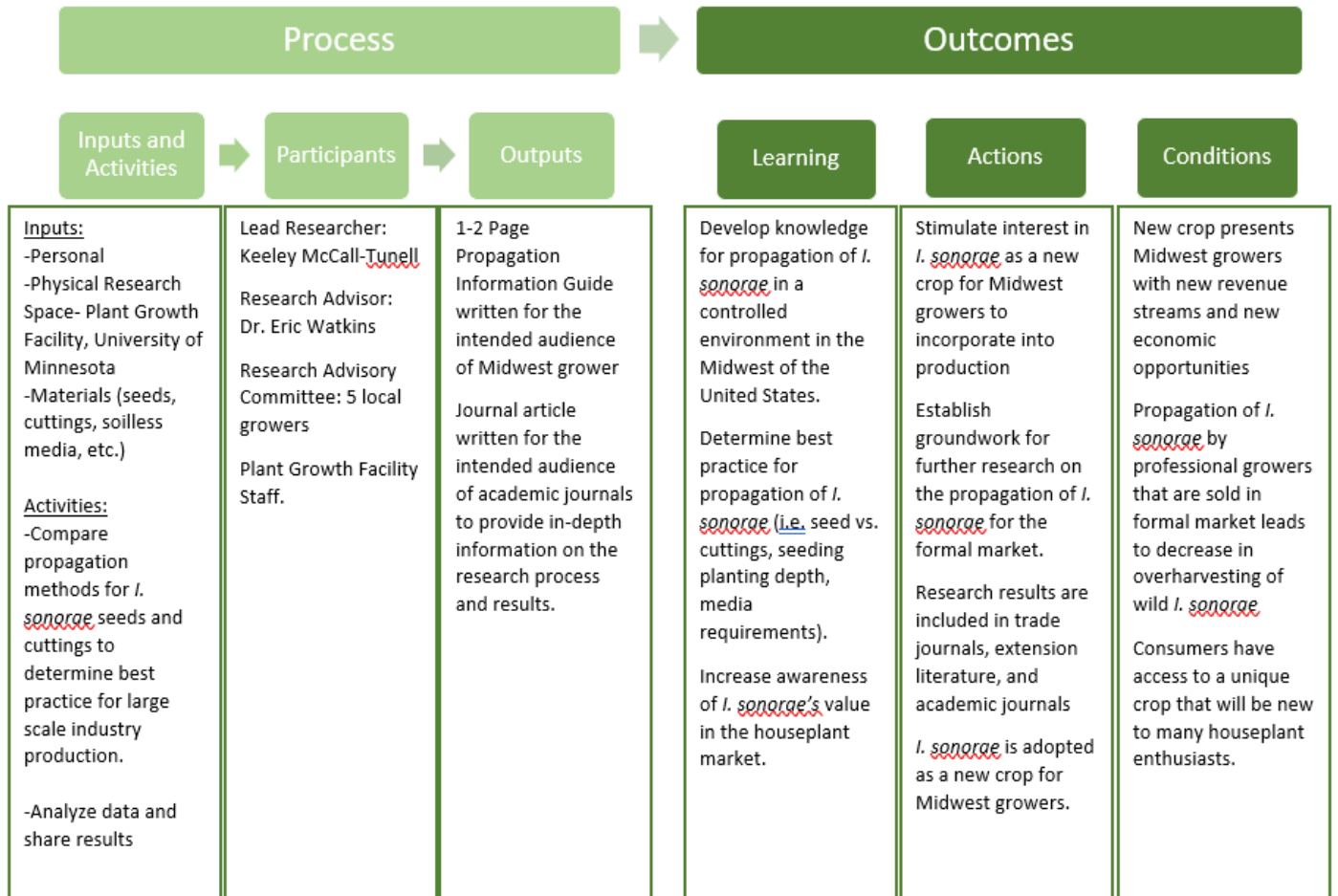
information guide and research article will be produced to share its findings with the professional horticulture community.

Outcomes

This research has the potential to increase industry understanding of the specific propagation requirements for the uniform growth of *I. sonorae* in the North Central region of the United States. This would open a door for a new species to be sold as a potted house plant in the formal market. Learning outcomes include sun requirements, preferred seeding depth, preferred media, and success rates of seed propagation versus vegetative propagation. At the end of the research, an intended action is for Midwest growers to have the necessary information and desire to introduce *I. sonorae* for a local market. A long-term action outcome for this research would be the emergence of local growers adapting *I. sonorae* as a commercial crop.

Primary Logic Model

This model outlines project investments and intended outcomes of this research. More detail can be found throughout the proposal.



Proposal Narrative

Background, Statement of Problem, Justification

Taxonomic Information: *Ibervillea sonorae* E. Greene is a member of the Cucurbitaceae family, also known as the gourd family. In the United States, common names include wereke, wareque, guarequi, and coyote melon. In Mexico, common names include guareque, quarequi, choya guanin, and limon-coytoe (Lira et al. 2016). The first western description of *I. sonorae* was made in 1889 by Sero Watson.

Originally classified as *Maximowcizia sonorae*, it was renamed to *I. sonorae* when Edward Lee Greene created the *Ibervillea* genus in 1895 (Knox 1907).

Morphology: *I. sonorae* is a perennial, tuberous, succulent root that has a round, tan, weathered appearance much like a rock. The round tuberous shape is



Figure 1: Photo of potted *I. sonorae* tuber (Lifestyle Seeds, n.d)

typically not symmetrical or smooth. This characteristic, combined with its tan color, results in it having the appearance of a rock, or a cow-pie (Figure 1). This non-traditional ornamental plant produces bright green shoots in the spring, which can grow up to three meters (Kearns 1994). From these stems, bright green leaves and yellow flowers are produced annually (Figure 2).

The flowers open in the early morning, and close again in the late afternoon. These dioecious flowers develop to form dramatic red-orange fruits that grow to be an inch and a half in length (Figure 3) (Kearns 1994; Knox 1907). The slow-growing tuberous portion of the root is the only edible portion of the plant (Lira et al. 2016; Semotiuk 2018).



Figure 2: Flowers of *I. sonorae* (Núñez, 2017)



Figure 3: Fruit of *I. sonorae* (Basden, 2019)

Geographic Distribution and Native Habitat: *I. sonorae* is endemic to Northwest Mexico, native to the Mexican states of Baja California, Baja California Sur, Sanora, and Sinaloa (Figure 4) (Roberts 2014). It grows in xeric, desert environments such as the Sonoran Desert. *I. sonorae* is found in the lower topographic regions of the desert, with year-round warmth, and annual rainfall is typically under 30 millimeters (Ibervillea Sonorae 2005). Average

temperatures range from 35 °C to 5.9 °C, and almost never fall below zero (Encyclopedia

Britannica n.d.). *I. sonorae* is extremely drought tolerant.

This point is amplified in Alice Knox's *The Stem of the Ibervillea Sonorae*, when she recounts that an *I. sonorae* sat on a wooden plank in the museum for five years, and still produced shoots every spring.

Research addressing the invasion

potential of *I. Sonorae* was not found.



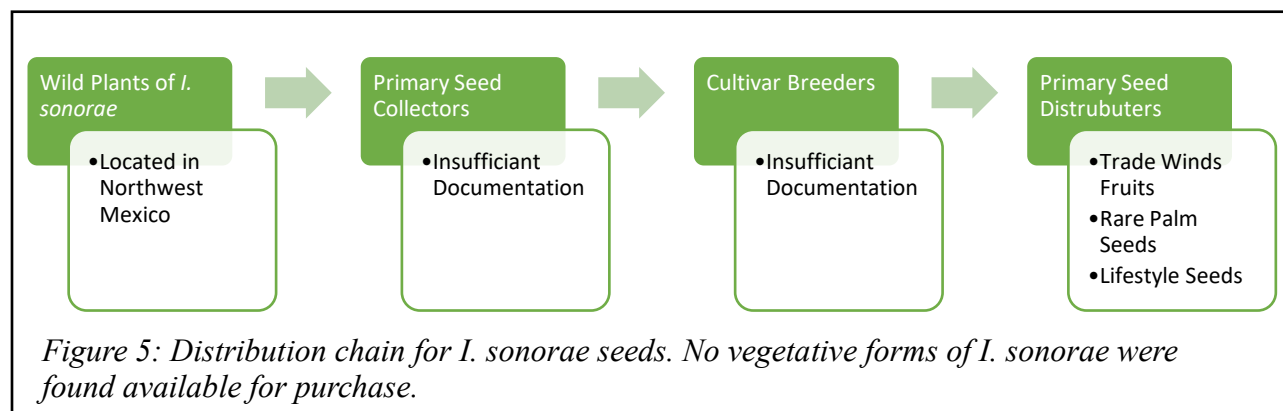
Traditional Use and Cultural Relevance: *I. sonorae* has a long history of medicinal uses within Indigenous cultures in northwestern Mexico. The tuberous portion of the plant has traditionally been dried then mashed to a powder that is ingested to treat rheumatism, heart disease, sores, cancerous symptoms, and diabetes (Lira et al. 2016). Today, many researchers are exploring its broad spectrum of medical uses. As popularity in herbal medicine grows, along with medicinal research of this plant, risk of over-harvest its wild populations increases (Semotiuk 2018). Commercial propagation of *I. sonorae* must be done responsibly and ethically to not contribute to its over-harvesting, or limit Indigenous people's access to this plant.

Life Cycle and Characteristics: *I. sonorae* is a caudiciform, producing perennial shoots and flowers. A primary stem appears on seedlings in the first year and is then followed by secondary stem growth (Knox 1907). It has a germination time of 21 days, and they can live at

least up to 50 years (Knox 1907). Its robust form and niche climate requirements makes it well suited to be a potted plant.

Winter Hardiness & Heat/Drought Tolerance: This crop is extremely drought tolerant but is not winter harder. It survives outdoors in USDA Heat Zones of approximately 9a – 10b and cannot withstand frost., so it is not suited to be an outdoor plant in the north central region.

Potential Production Environment: There are very few sources for *I. sonorae* seeds. In the U.S. seeds can be purchased from distributors primarily located in the southwest (Figure 5). No potted *I. sonorae* available for purchase were found. This crop isn't currently cultivated in the Midwest, though in greenhouse conditions it could be done successfully. *I. sonorae* requires sandy, well-drained soil and sun (Rowley 1987). Plants should be grown several feet apart to prevent entangling of shoots. There is currently a lack of literature on propagation techniques and methods for controlled environments, which this research seeks to fill.



Marketing Story: Over the past two years, as much of the world has spent more time in their homes in response to COVID-19, the demand for houseplants has increased exponentially as people looked to brighten their homes with unique and exciting flora, and this trend is predicted to continue (Machovina 2021). As people return to their busy lives outside of their homes, many people will be looking for lower maintenance house plant options but are still

aesthetically interesting. *I. sonorae* is perfectly suited to fill this need and compete with the popularity of common succulents. This easy to care for plant, with its unique cultural history and an appearance, will offer a sense of individuality to any home, while reliably providing a splash of color every spring.

Statement of Problem & Opportunity: As consumers push for fresh house plant options, an opportunity exists within the market for North Central growers to introduce a new, low-maintenance species to the indoor plant market. However, there is currently a lack of information available on best propagation methods for the commercial production of *I. sonorae*. This project will research best commercial propagation methods for *I. sonorae*. SARE has not yet funded research on *I. sonorae* propagation.

Justification: This research will explore how propagation can be done at a larger scale and provide information for prospective growers with specific propagation instructions for a uniform, reliable product, thus creating a new economic opportunity for growers.

Impact on sustainable agriculture in the North Central Region

By determining the propagation requirements for growing *I. sonorae* in a protected environment setting in the North Central Region of the United States, this project is opening doors to a new market in the houseplant industry that is currently untapped in the Midwest. *I. sonorae* is not only a promising new economic opportunity for grower revenue, but due to its vigor, is also likely to require minimal financial inputs from growers such as water and labor. Furthermore, by growing locally, growers will eliminate the need to ship this plant from its native region in the Southwest United States and Mexico, thus reducing its carbon footprint. Finally, there have been reports of overharvesting *I. Sonorae* from its native region, thus putting its native populations at risk, as well as limiting Indigenous people's access to this culturally and

traditionally significant plant (Semotiuk 2018). By shifting the supply source to cuttings and seedlings sourced out of greenhouses, as this research aims to do, pressure on wild growing *I. sonorae*, and the issues of access surrounding it, can be mitigated.

Approach and Methods

General Approach: The purpose of this research is to determine best practice for greenhouse propagation of *I. Sonorae*, and to develop guidelines for propagation that are useful on a practical level for average midwestern grower. Treatments will be conducted on vegetative cuttings and seeds, which are graphically displayed in figures 7 and 8. This is a slow growing plant and does not begin to produce shoots until its second year, so this research will take place over the course of three years. Local growers will be a vital part of this research. The applicant will invite local growers to be a part of an advisory panel for the duration of the research. The panel would meet on a quarterly basis to review data and protocols, providing feedback to the researcher on how their findings align with the current practices and constraints of the modern midwestern grower. The growers would also serve as editors in the writing of a Growers Guide at the end of the research, providing feedback on clarity and usability. At the end of the study, growers would be invited to take the *I. sonorae* propagated during the research to incorporate into their stock.

Inputs: The inputs for this research include a workspace, personnel, as well as physical materials. The research will take place at the University of Minnesota, Plant Growth Facility in Mist House 369 B-4, Production House 369 B-5, and Production House 369 C-5. Conditions for each space are detailed in figure 6. The personnel working in this research will include the applicant (Keeley McCall-Tunell), and Dr. Eric Watkins as an advisor. K. McCall-Tunell will be responsible for the planting, transplanting, and recording data. Watering will be completed by a

variety of greenhouse staff, employed by the University. The materials required for this research will include 150 *I. sonorae* seeds, 100 *I. sonorae* cuttings, size 72 plug trays, quart-sized pots, germination mix, sand mix, plant labels, and plant markers.

Production House	Conditions
Mist House 369 B-4	<ul style="list-style-type: none"> • Day/night temps: 70F/70F (Zero DIF). • Lighting: lights on for 16 hrs (0600-2200 HR) at 150 $\mu\text{mol m}^{-2}\text{s}^{-1}$ • Mist frequency: Every ten minutes
Production house 369 B-5	<ul style="list-style-type: none"> • Early morning temp dip at sunrise to 50F (if possible) for 2-3 hours • Day/night temps: 67F/62F (+5 DIF) • Lighting: lights on for 16 hrs (0600-2200 HR) at 500 $\mu\text{mol m}^{-2}\text{s}^{-1}$ • Fertilization: 125 ppm N CLF 15-5-15 Cal-Mag (CLF)
Production house 369 C-5	<ul style="list-style-type: none"> • Early morning temp dip at sunrise to 50F (if possible) for 2-3 hours • Day/night temps: 70F/65F (+5 DIF). • Lighting: lights on for 16 hrs (0600-2200 HR) at 500 $\mu\text{mol m}^{-2}\text{s}^{-1}$ • One short day bench (8 hours lighting; black cloth opens daily at 0800 HRS and closes daily at 1600 HRS) and one long day bench are for use. • Fertilization (M-F): 125 ppm N CLF 15-5-15 Cal-Mag (CLF)

Figure 6: Table illustrating production house conditions for each production house (University of Minnesota, 2022).

Seed Treatment: 150 seeds will be used in this research. 50 seeds will be planted uncovered, 50 planted at 1 cm, and 50 planted at 2 cm. All seeds will be planted in size 72 plug trays in a standard germination mix. The plug trays will be placed in the Greenhouse 369 B-4 mist house, under a clear plastic cover and kept lightly watered. Data will be collected on germination time and rate will be collected.

Once seeds have germinated, plugs will be relocated to Greenhouse 369 B-5. Measurements will be taken on a weekly basis. Once seedlings have reached time for transplant, seedlings will be transplanted into media mix of standard potting soil and gravel mix. Dates of transplant and size at transplant will be recorded. 50% of the samplings from each planting depth treatment will remain in Greenhouse 369 B-5 in full sun conditions, and 50% of the seeds from each planting depth treatment will be

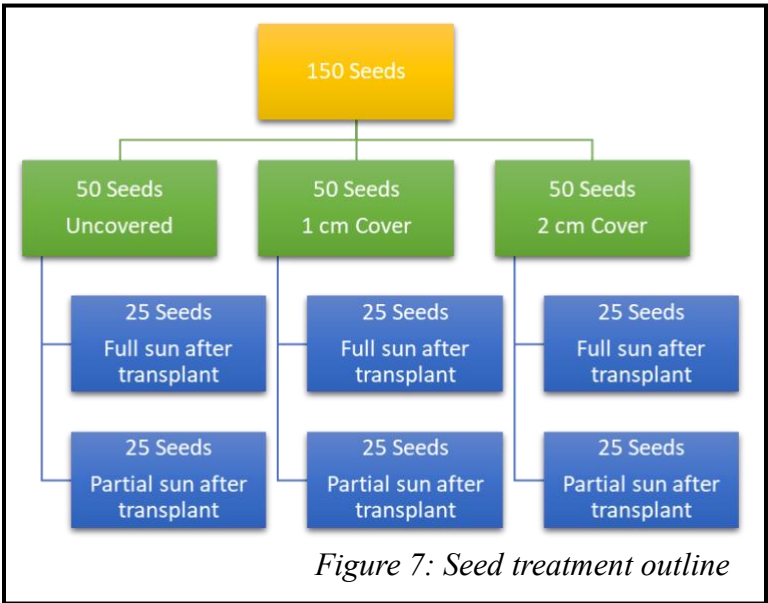
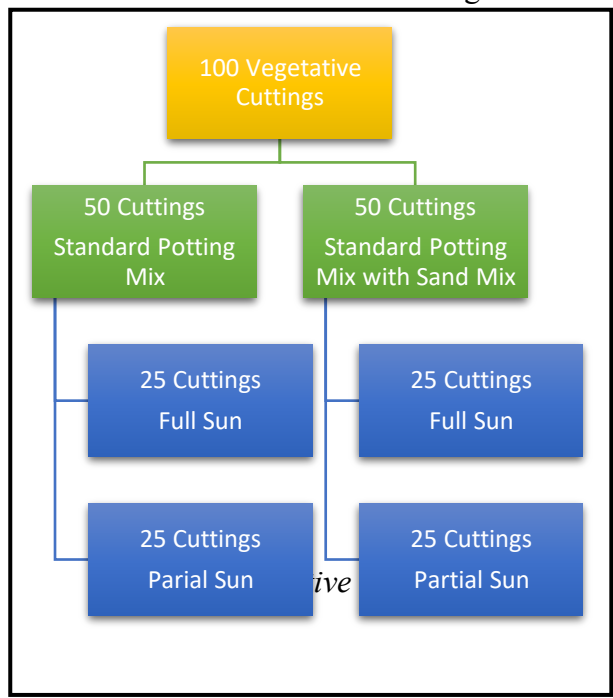


Figure 7: Seed treatment outline

brought to Greenhouse 369 C-5, for a short-day treatment for three months (Figure 7). Data will be collected on growth rate and survivorship. In the spring of the second and third year, data will be collected on shoot, flower, and fruit production. Data collection table can be seen in figure 9.

Vegetative Cuttings Treatment: 100 cuttings will be used in this research. Due to the limited access to vegetative forms of *I. sonorae*, this segment of the experiment will commence in year two the experiment, and cuttings will be selected from viable shoots developed from the seeded samples in year one of the experiment. All cutting will be initially planted into rooting media and placed in Greenhouse 369 B-5. Weekly



measurements on rooting will be collected. At time of transplant, 50% of viable cuttings will be randomly assigned to a standard potting mix, and 50% to a standard potting mix mixed with 25% sand. 50% of the units from each treatment will remain in Greenhouse 369-B5 in full sun conditions, and 50% of the units from each treatment will be placed in Greenhouse 369 C-5 in a short-day treatment for three months (Figure 8). Data will be collected on growth rate and survivorship. In the spring of the second year of growth (third year of experiment), data will be collected on shoot, flower, and fruit production (Figure 9).

Treatment	Data Collected
<u>Seed Propagation Treatments</u> <ul style="list-style-type: none"> • Uncovered • 1 cm covered • 2 cm covered • Full sun • Partial sun 	<ul style="list-style-type: none"> • Germination rate • Time to germinate • Date of transplant • Size at transplant • Weekly measurements (length and circumference) • Number of shoots and fruits in second growth year • Number of shoots and fruits in third growth year • Survivorship %
<u>Vegetative Cuttings Propagation Treatments</u> <ul style="list-style-type: none"> • Standard potting mix • Standard potting mix and sand mix • Full sun • Partial sun 	<ul style="list-style-type: none"> • Weekly root measurements until transplant • Date of transplant • Size at transplant • Weekly measurements (length and circumference) • Number of shoots and fruits in second growth year • Survivorship %
<p><i>Figure 9: Table highlighting data points to be collected throughout research for each treatment protocol for both seeds and cuttings.</i></p>	

Outputs

The aim of this research is to determine best propagation techniques for cultivating *I. sonorae* in a protected environment. Once determined, the research results will be used to

develop a first draft of a propagation information guide, or growers guide, to provide future commercial growers with a clear stage-by-stage manual for growth. This manual will provide guidance on whether to use cuttings or seeds, soilless media requirements, and sun/shade requirements. This grower-relevant information will be distilled into a one-to-two-page guide that can be sold with seeds. Additionally, a complete journal article will be compiled at the conclusion of this research, outlining the full methods, findings, and implementations for practice.

Outreach

The growers guide referenced above will be shared with local growers and production houses, such as Gertens, Bachman's, and Wagners. Upon completion, the methods and findings of this research will be analyzed and compiled into a journal article that will be submitted to academic journals so that it may be shared with a broader audience, as well as to a variety of trade publications within the horticulture industry. Possible journals include *Folia Horticulturae* or *Hort Science*. Research findings will also be submitted to universities with extension programs across the North Central region for inclusion in their publications as well. Possible universities include the University of Minnesota, The University of Wisconsin, and Purdue University.

Evaluation Plan

Research outcomes will partially be evaluated based on the feedback received from the panel of local growers at the end of the study. Anonymous questionnaires will be sent to all panel participants, seeking feedback of usability of guide and practicality for commercial incorporation and practice. This data will be consolidated and shared with SARE in final post-project reporting.

In compliance with the SARE evaluation and reporting matrix, research outcomes will also be evaluated based on how successfully the research team is able to share the findings, and data will be collected accordingly. This information will be collected by tracking the number of growers to whom the growers guide is distributed. One month after distribution, a survey will be sent to the growers to collect information on their interest in and the likelihood of their introducing *I. sonorae* to their crop production, and track online to see if any growers do incorporate *I. sonorae* into their commercial stock. Another measure of evaluating outcomes will be tracking the number of academic and trade journals in which the research findings are published. The researcher will also track the number of times this research is shared by extension programs through Midwest universities or cited in other literature. Finally, the researcher will monitor future SARE grants, to see if any further study of the commercial propagation of *I. sonorae* is conducted, as a result of this initial research. All data collected will be included in the final post-project reporting for SARE.

Experience and roles

Project Mentor: This research will be overseen by Dr. Eric Watkins, who will serve as the primary mentor for the student researcher. Dr. Watkins will assist the student researcher in reserving the needed greenhouse space through the University and offer guidance in setting up her research. Dr. Watkins has his Ph. D. in Plant Biology from Rutgers University. He is currently a professor at the University of Minnesota. Dr. Watkins focuses his research on winter hardiness of perennial wild rye. Dr. Watkins will advise the student researcher throughout the research on best practices and data collection. Dr. Watkins will also advise the student researcher at the end of the research on writing and submitting academic articles.

Primary Researcher: Keeley McCall-Tunell will be the primary researcher for this project. She is currently a graduate student studying horticulture at the University of Minnesota. Her related coursework experience includes plant propagation, greenhouse production, crop scheduling, and plant pathology. Keeley will lead implementation of the research, data collection, and data analysis. Keeley will also lead coordination with the advisory panel of local growers, serving as the main point of contact and lead the panel meetings. Finally, Keeley will be responsible for writing and disseminating the outputs of this research (i.e., the growers guide and journal article).

Other Contributors: A variety of partners will be involved in this project. University of Minnesota Plant Growth Facility staff will assist with watering *I. sonoreae* that are residing in the greenhouses on campus. Local growers involved in the advisory panel detailed above will provide insight and feedback on a quarterly basis throughout the research process. Additionally, advisory panel members will provide feedback during the development of the grower's guide for *I. sonoreae*.

Budget

Budget and Budget Justification

Personnel: The lead researcher will receive an annual salary of \$4,500 in the first year of research when the volume of planting work and data collection will be the highest. The salary will decrease to \$2,000 in years two and three of the research, to reflect the change in work intensity during these periods of time. Total personnel cost will be \$8,500 for the three-year period. All personnel costs associated with the Plant Growth Facility are covered in the rental fee.

Materials: Total materials will cost \$135.32. Cost of materials are detailed in Figure 10.

Item	Cost
150 <i>I. sonoreae</i> Seeds	\$62.41 per 100 seed pack. ($\$62.41 \times 2$) = \$124.82
100 <i>I. sonoreae</i> Cuttings	N/A
Germination Mix	Included in rental fee of Plant Growth Facility
Potting Mix	Included in rental fee of Plant Growth Facility
Size 72 Plug Trays	Included in rental fee of Plant Growth Facility
3.5" Cell Trays	Included in rental fee of Plant Growth Facility
Quart Sized Pots	Included in rental fee of Plant Growth Facility
Sand Mix	Included in rental fee of Plant Growth Facility
Plant Labels	Included in rental fee of Plant Growth Facility
Permanent Markers	\$10.79
Clear Plug Tray Cover	Included in rental fee of Plant Growth Facility
Miscellaneous Items as Needed	Included in rental fee of Plant Growth Facility

Figure 10: Breakdown of supplies expenses.

Travel: No travel expenses are anticipated for this research.

Printing and Publication: Estimated printing costs of the grower's guide is \$500.

Direct Costs: Total direct costs are \$5,287.59. The rental cost for the U of M Plant Growth facility will cover much of the necessary expenditures for this study. Greenhouse space is \$0.0308/ft² per day. The rental cost covers the cost per the space, as well as various growing supplies such as containers, growing media, and plant labels are covered in this cost. One 75-foot bench costs \$2.31 per day ($\0.0308×75). 2 benches rented for 3 years will cost \$5,058.9 ($\$2.31 \times 2 = \$4.62 \times (365 \times 3)$). One 75-foot bench in the mist house also costs \$2.31 per day to rent. The 30-day rental needed for germination will cost a total of \$173.25 ($\$2.31 \times 30 = \173.25). 10 feet of bench space for a total of 6 months in 369-B5 (short-day greenhouse) will cost \$55.44 ($(\$0.0308 \times 10 = \$308) \times 180 = \55.44).

Indirect Costs: No indirect costs are anticipated for this project.

Total Project Costs: Total project expenses will be \$14,423, rounded up to the nearest dollar. Total expenses are detailed in Figure 11.

Estimated Total Budget	
Category	Cost
Personnel	\$8,500
Materials	\$135.32
Travel	\$0
Printing and Publication	\$500
Direct Costs	\$5,287.59
Indirect Costs	\$0
Total Cost	\$14,423 (rounded to nearest dollar)

Figure 11: Breakdown of estimated total budget.

Summary Table of Outcomes, Outputs, Activities, Inputs, and Evaluation

Expected Outcomes	Inputs	Activities	Outputs	Evaluation & Monitoring
<p>Learning -To understand the specific propagation requirements for the uniform growth of <i>I. sonorae</i> in the North Central region of the United States, suitable to be sold as a potted house plant in the formal market.</p> <p>Actions - At the end of the research, an intended action is for Midwest growers to have the necessary information and desire to introduce <i>I. sonorae</i> for a local market.</p>	<p>Workspace: University of Minnesota, Plant Growth Facility - Mist House 369 B-4 - Production house 369 B-5 - Production house 369 C-5.</p> <p>Personnel: - Applicant—Keeley McCall-Tunell—planting, transplanting, data collection - Advisor—Dr. Eric Watkins—advising and overseeing research - University of Minnesota Greenhouse staff—watering</p> <p>Materials: - 150 <i>I. sonorae</i> seeds - 100 <i>I. sonorae</i> cuttings - Size 72 plug trays - Clear plug tray cover - 250 Quart-sized pots - Germination mix - Potting mix - Sand</p>	<p>Test effect of planting depth on <i>I. Sonorae</i> seeds - Seed 50 uncovered - Seed 50 at 1 cm depth - Seed 50 at 2 cm depth</p> <p>Test effect of media mixture on <i>I. Sonorae</i> cuttings - Transplant rooted cuttings into standard potting mix - Transplant rooted cuttings into 75% potting mix and 25% sand mixture</p> <p>Test effect of full sun and partial sun on transplanted seedlings and cuttings - 50% of stage 3 seedlings placed in partial shade - 50% of transplanted cutting placed in partial shade - 50% of stage 3 seedlings placed in full sun - 50% of transplanted cuttings placed in full sun.</p>	<p>Written Materials - Publication of a 1–2-page Propagation information guide, with the intended audience of professional growers - Publication in an academic or trade journal, highlighting methods and findings.</p>	<p>Data Monitoring and Evaluation - Germination rate of seeds - Root development of cutting - Weekly stem growth measurements - Survivorship at 1 month, 3 months, and one year - Number and measurement of shoot production in year one, two, and three - Number of flowers and fruiting bodies produced at second and third spring</p> <p>Output Monitoring and Evaluation - Request members of this study's Growers' Advisory Panel provide anonymous feedback on usability of study's findings -Track number of growers who receive PIG - Survey growers who received PIG to measure growers' interest in producing <i>I. sonorae</i> - Track number of extension programs, academic journals, and trade journals in which research is published and shared -Monitor SARE for future research on <i>I. sonorae</i> done as result of this initial study.</p>

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