



**START DATE:** 1 September 2021

**END DATE:** 1 September 2022

**GRADUATE STUDENT INFORMATION:**

Emily Lefrancois, B.A. in Psychology and Neuroscience

Currently pursuing MPS in Horticulture

**FACULTY ADVISOR INFORMATION:**

Dr. Neil Anderson, B.S. in Ornamental Horticulture, M.S. in Horticulture, Ph.D. in Horticulture

Cody Jennings, B.S. in Geography, M.S. in Community and Regional Planning

Currently pursuing an MPS in Horticulture

**INSTITUTION CONTACT INFORMATION:**

Regents of the University of Minnesota

Department of Horticultural Science – 305 Alderman Hall

1970 Folwell Avenue

Saint Paul, MN 55108

**WORK LOCATION:**

Plant Growth Facilities

1552 Gortner Ave

Saint Paul, MN 55108

**PROJECT CATEGORY INFORMATION:** Crop Production **COMMODITY CATEGORY:** Ornamentals & Turf

**REQUESTED AMOUNT FOR FUNDING:** \$11,210.00

# PROJECT SUMMARY

## PROJECT SUMMARY

*Gaillardia suavis* is an herbaceous perennial forb that is not currently commercially grown or cultivated. Due to various desirable characteristics, such as its mild aroma, pollinator friendly nature, drought tolerance, and long peduncles, the pincushion

daisy could find success on the horticulture market as an ornamental crop or cut flower. As there is not much research or information available about *G. suavis* currently, there is an opportunity to study and cultivate a unique new crop species for commercial distribution and sale that could prove to be ecologically and financially beneficial to consumers and producers alike.

This proposal seeks to create a first-draft product information guide for protected environment growing of *Gaillardia suavis* by testing various different environmental characteristics during germination and observing growth patterns to a finishing stage.

Variables tested are the use of a pre-sowing seed priming treatment of gibberellin, sowing depth of the seed, and growing on media.

Results will be summarized in an article submitted to peer-reviewed journals for evaluation, as well as written and submitted for publication in university and trade publications. The manufactured product information guide will be useful to other researchers, educators, and commercial growers in the horticulture industry seeking to invest in a new attractive crop species.

### **Description**

This study aims to determine the best germination and growing environment for *Gaillardia suavis* as well as create a first-draft version of a product information guide for protected environment growing.

### **Outcomes**

In the short-term, exploring best germination and growing practices for *Gaillardia suavis* will lead to increased knowledge and understanding of the species; awareness from outreach and published articles will shed light on the commercial marketability of the

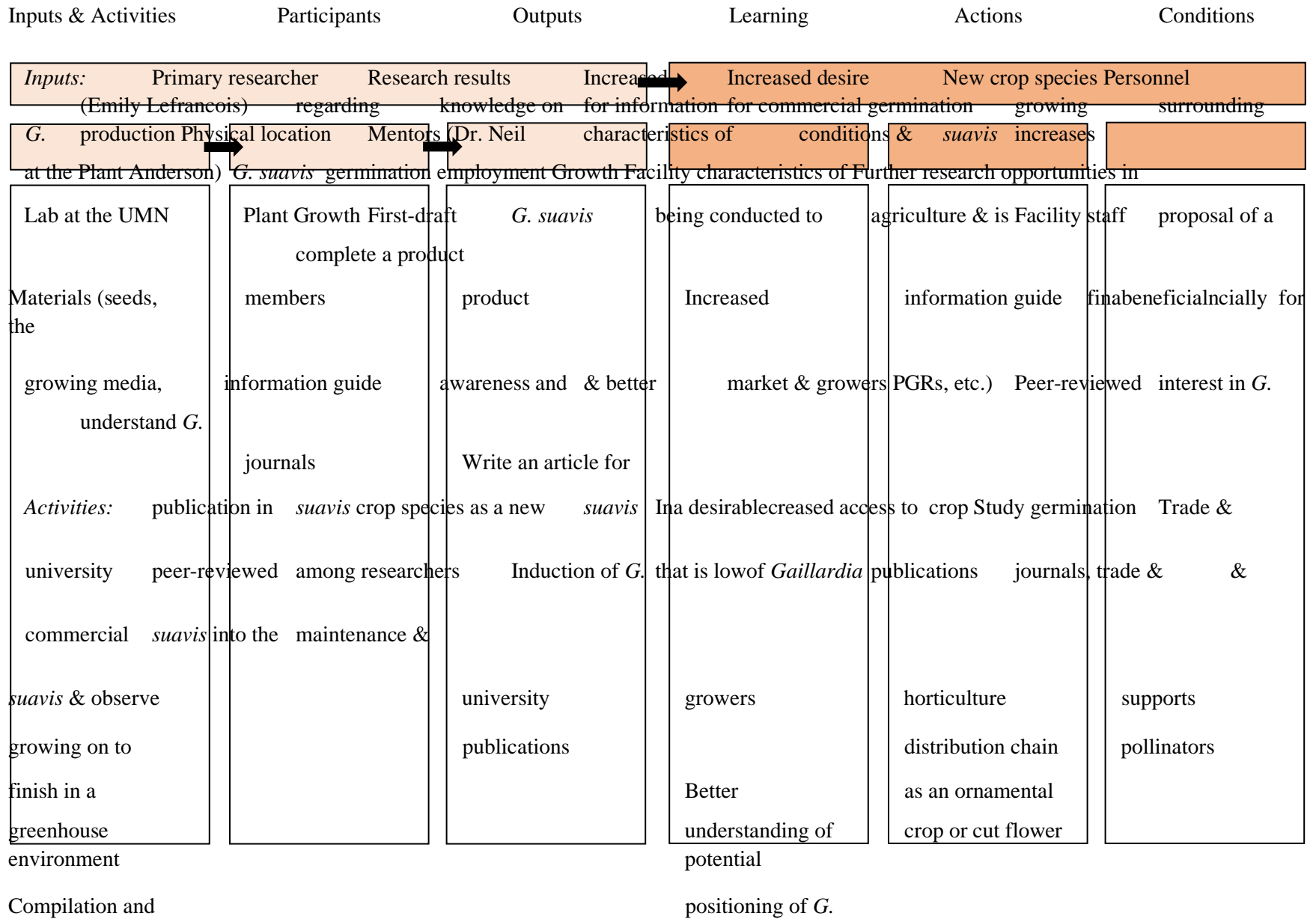
pincushion daisy as well as create increased interest in potentially introducing *G. suavis* to the horticulture market as either an ornamental herbaceous perennial or a cut flower. Intermediate outcomes of this study primarily surround further research being conducted to determine exactly where *G. suavis* could be positioned on the market as well as further developing the product information guide to a complete culture guideline for growers. Ideally, long-term outcomes of this project are the successful introduction of *Gaillardia suavis* as a viable new crop to the horticulture market and a more widespread awareness and availability of *G. suavis* to growers and consumers alike.

## **PROGRAM LOGIC MODEL**

The program logic model below outlines the anticipated process and outcomes of this research regarding the study of *Gaillardia suavis* as a potential marketable new crop species. More details of each subcategory can be found throughout the proposal narrative.

**Process**

**Outcomes**



analysis of results

*suavis* in the  
horticulture distribution  
chain

# PROPOSAL NARRATIVE

## PROPOSAL NARRATIVE

### Statement of Problem

This proposal investigates greenhouse growing of *Gaillardia suavis* for potential market introduction as an ornamental or cut

flower crop, as it is a plant with desirable horticultural characteristics. There is currently little research or information available regarding *G. suavis* and its best growing practices, much less how it could be positioned within the horticultural market as a viable commercial crop. As other cultivars within the genus *Gaillardia* have been bred for ornamental use, it is promising *G. suavis* will be successful as well. This proposal contains an overview of current knowledge surrounding *G. suavis*, and if funded, will help establish guidelines for commercial production of *G. suavis* by determining germination and growing on requirements for plugs and containers.

## **Background**

### *Taxonomy*

*Gaillardia*, commonly known as blanketflower, is a genus in the family Asteraceae (USDA 2020). Asteraceae, the sunflower family, consists of 23,600 species, making it the largest plant family on Earth (Bayton & Maughan 2017). *Asteraceae* can be found in a wide variety of environments across all continents except Antarctica, and are highly populated in arid regions of lower latitudes, including deserts (Bayton & Maughan 2017; Barkley et al. 2020). Several species and cultivars within the genus *Gaillardia* have been successfully marketed for ornamental use, such as *G. aristata* and *G. pulchella*. However, there are currently no cultivars of *G. suavis* (also known as perfumeballs and pincushion daisy) on the market, and little research has been done with the species.



### *Taxonomic Description*

*Gaillardia suavis* is an herbaceous perennial forb with a taproot reaching between 20 and 80 cm in height (Figure 1). As opposed to leaves borne on the stem, *G. suavis* features a cluster of simple basal leaves that are pinnatifid in a rosette pattern. Leaves and stems may also have minute jointed hairs, sparsely distributed on margins of leaves (Strother 2006; Gibson 2013). All Asteraceae species are distinguished by composite flowers, and *G. suavis* is no different. The terminal inflorescence appearing at the top of long peduncles up to 75 cm in length is a composite of smaller flowers known as disc and ray florets; disc florets are distinguished by symmetrical petal tubes, while the petal tubes of ray florets are asymmetrical and open to the side of the inflorescence, forming a lip (Bayton & Maughan 2017; Strother 2006). In *G. suavis*, the corollas of disc florets are typically pinkish-purple in color, while ray florets may be purplish-red or yellowish-orange. It is common to find *G. suavis* without ray florets, as shown in Figure 2, and can be a differentiating characteristic of the species. *G. suavis* typically flowers March through June, multiple times within a season, and emits a mild, fragrant smell (Strother 2006). Inflorescences are also nectar-rich, attracting pollinators in droves, especially butterflies (Opler 2005). Each inflorescence produces a few seeds per head (Figure 3) with toothed pappi that can attach to passing animals for dispersal (Gibson 2013; Bayton & Maughan 2017).



**Figure 1** Preserved specimen of *G. suavis*; collected by F. Lindheimer in 1846 Texas. Tap root, basal leaves, and composite flower (with both disc and ray florets present) are visible.



**Figure 2** Left: *G. suavis* in Texas lacking ray florets (Hutchins 2020). Right: *G. suavis* in Texas with ray florets present (Kieschnick 2019).



**Figure 3** Left: *G. suavis* seed head (The National Gardening Association 2016). Right: *G. suavis* seeds removed from head with toothed pappi evident (photo taken by author 2021).

### *Geographic Distribution & Native Habitat*

*Gaillardia suavis* has been identified in Kansas, Oklahoma, Texas, and Mexico, thriving at elevations of 30-800 m and latitudes between 20°N and 40°N (Figure 4). *G. suavis* prefers the sandy and calcareous soils of desert scrubs, prairies, and juniper woodlands, and is frequently found growing along the roadsides of its native region (Strother 2006). *G. suavis* tolerates the full sun, high temperatures, and drought conditions of its native habitat with ease.



**Figure 4** Map of native regions for *G. suavis* (Strother 2006).

### *Tendency to Naturalize or Become Invasive*

Currently, there is no evidence that *G. suavis* has a tendency to become invasive or naturalize outside of its typical geographic distribution, especially given its tendency towards arid and dry climates (Strother 2006). Other species within the genus have not shown invasive behavior, and have in fact been used to combat other invasive plant species effectively (Simmons 2005).

### *Crop Species History & Potential Uses*

Though first identified in the mid-1800s, there are no cultivars on the market nor any known uses of *Gaillardia suavis* regarding consumption, pharmacology, or otherwise. Other species within the genus, while successfully marketed, have not had uses beyond ornamentation identified. *Gaillardia* inevitably play a role in the ecology of their environment and have specifically been identified as the food source for various caterpillars, and are popular with pollinators (Ferner & Rosenthal 1981; Knudson et al. 2003). While it does appear to be limited to warm, arid environments, it is possible *G. suavis* could be used in hybridization with other species in the genus, such as *G. aristate* or *G. pulchella* (previously hybridized together to create *G. x grandiflora*), both of which have a more expansive native range (USDA 2020). In general, *G. suavis* offers the benefits of pleasant fragrance, pops of bright color, and pollinator attraction (Opler 2005). It is a hardy plant that tolerates extreme heat and minimal watering, thriving under full sun. All of these characteristics makes it a desirable ornamental crop, especially as the want to use native and pollinator friendly plants for ornamentation increases within consumers. The terminal inflorescence at the end of the long peduncle combined with the mild fragrance of blooms are also attractive attributes that could allow for marketing of *G. suavis* in the cut-flower industry.

Currently, there is not distribution of seeds for *G. suavis* beyond native plant vendors found online, and not much research into domestication or distribution. One study conducted by Baskin et al. in 1994 determined that *G. suavis* seeds show a dormancy pattern as an adaptation to dry and hot summers, suggesting that *G. suavis* is a winter annual, though all field observations of the species show flowering beginning in the spring and early summer months. Other studies have identified the genus *Gaillardia* as having seeds that have a non-deep physiological endogenous dormancy requiring light for germination (Geneve 1998). Further research regarding germination of *G. suavis* with specific regard to temperature and light is needed. Additionally, no evidence has been found to suggest vegetative propagation is preferable, though other species in the genus have been successfully propagated via cuttings.

#### *Production Information & Market Position*

In considering *Gaillardia suavis* for greenhouse production, there are aspects that can be gleaned from its native habitat to assist in the development of a product information guide. *G. suavis* prefers well-drained soils and warm temperatures between the mid-teens and mid-30s Celsius with full sun (long day production). When growing from seeds, plug containers size 128 or 288 are ideal, and finishing size pots could be up to a quart in size. If needed, height can be controlled with the plant growth regulator (PGR) daminozide 2500-5000 ppm spray.

*G. suavis* could be positioned in the ornamentation market in a few ways, depending on region of production. For its native environment (USDA hardiness zones 6-9), *G. suavis* could be marketed as an herbaceous perennial; other environments (such as the hardiness zones 3-5 of the North Central Region) would likely experience more success marketing *G. suavis* as an annual with forced

flowering. It is also possible that *G. suavis* could be successfully marketed as a cut flower. Any of these uses for *Gaillardia suavis* could directly benefit the horticultural distribution chain by introducing a crop with qualities desirable to consumers. The nectar production of *G. suavis* is good for attracting pollinators, especially for those interested in cultivating a butterfly garden. *G. suavis* is also low maintenance, and will be forgiving of missed watering; where other flowers may wilt under hot summer suns, *Gaillardia suavis* won't waver.

### **Impact on Sustainable Agriculture in the North Central Region**

When considering the impact the results this project could have on sustainability in the North Central Region, it is important to consider the economic, environmental, and social effects. From an economic standpoint, the potential introduction of a new crop to the horticultural industry could be financially lucrative to farms and other agricultural businesses, especially as *Gaillardia suavis* possesses several attractive attributes that consumers actively seek out (for example: pollinator friendly and low maintenance). Because this crop is not native to the North Central Region, the question of environmental sustainability largely centers around the introduction of a crop to a new environment, and its ability to naturalize or become invasive. Other species in the *Gaillardia* genus have not shown invasive characteristics, and have been able to survive in environments other than their native habitat, so it is unlikely that issues with *G. suavis* will arise, though it should be monitored all the same. Both the economic and environmental facets of sustainability play into the social aspect, as the financial gain of a new crop is beneficial to farmers and plant retailers, but consumers are also able to add a crop with attractive characteristics to their personal gardens.

## Approach and Methods

Inputs necessary for this experiment include personnel, location, and physical supplies. The study will be conducted by primary researcher Emily Lefrancois, a graduate student currently pursuing a Masters in Professional Studies in Horticulture at the University of Minnesota, and will be mentored and advised by Dr. Neil Anderson, Ph.D. in Horticulture and professor at the University of Minnesota. Research will take place in the Plant Growth Facility at the University of Minnesota on the Saint Paul campus, with a specific usage of Production House 369 B-5 (Table 1 summarizes growing conditions). Physical supplies necessary include *Gaillardia suavis* seeds, growing media (germination mix, growing mix, sand, perlite), plant labels, markers, plug trays (128), 1020 trays, containers (4-5” and quart), and plant growth regulators (daminozide and gibberellin). Because the temperatures of 369 B-5 fall towards the lower range for *G. suavis* growth, PGRs will likely not be needed for height control, but if necessary, daminozide 2500-5000 ppm spray can be applied.

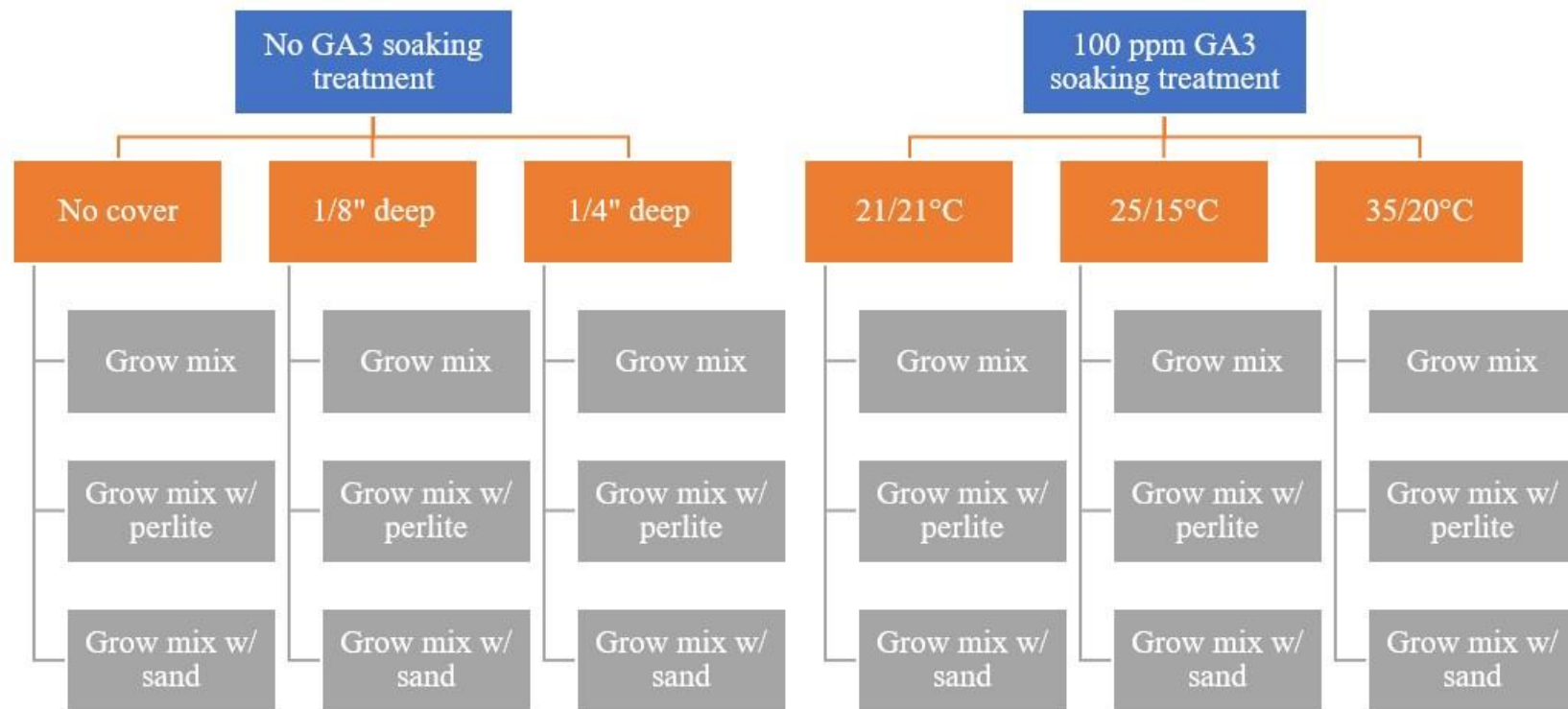
Treatments in this experiment include a pre-sowing soaking treatment of 100 ppm gibberellin (GA3) for 8 hours, light during

Location	Conditions
Mist House 369 B-4 ( <i>germination</i> )	- Day/night temperatures: 21/21°C (0 DIF) - Lights: On for 16 hours (0600-2200) at 150 $\mu\text{mol m}^{-2}\text{s}^{-1}$ - Mist every 10 minutes for 7 second duration
Production House 369 B-5 ( <i>plug growth to finishing</i> )	- Day night temperatures: 19/16°C (+3 DIF) - Lights: On for 16 hours (0600-2200) at 500 $\mu\text{mol m}^{-2}\text{s}^{-1}$ - Fertilization: 125 ppm CLF 15-5-15 CalMag (CLF) - Monthly fungicide drenches will be applied

**Table 1** Growing conditions for various houses within the Plant Growth Facility. germination (no cover, 1/8” deep, and 1/4” deep), and growing on media

(growing mix, growing mix/perlite mix [30% perlite by volume], growing mix/sand mix [10% sand by volume]) in a factorial design, outlined in Figure 4 (Bharathi et al. 2007; Baskin et al.

1994). All units will be sown initially in germination mix before being transplanted to varying treatments for growing mixes.



**Figure 5** Factorial outline of treatment groups.

There will be 18 unique treatment groups, each consisting of 40 seeds sown in 128 plug trays for a total of 720 experimental units that will be monitored daily for changes. Measurement methods include days to germination, percent germination, height, days to true leaf emergence, number of leaves, days to transplant readiness, days to flowering, presence of inflorescence, and presence of ray florets, though all treatments will also be continually assessed for health and signs of infections. There will be three stages of the experiment, outlined below:

**Stage 1:** Pre-treatment GA3 soak completed for half of experimental units. Seeds are rinsed with distilled water before all units sown at varying treatment depths. Seedlings monitored daily for radicle and cotyledon emergence. Seedling height, germination rate, days to germination, and possibly days to true leaf emergence measured. Up to 3 weeks.

**Stage 2:** Following germination, plug trays will be moved to Production House 369 B-5 for growing on the capillary mat. Height, days to true leaf emergence, number of leaves, and days to transplant readiness measured. 6-7 weeks.

**Stage 3:** Transplant to 4" containers, and to larger sizes if necessary and as needed. Seedlings will be ready for initial transplant when 2 or 3 true leaves are visible. Pots will remain in Production House 369 B-5. Height, number of leaves, days to flower, presence of inflorescence, and presence of ray florets measured. Up to 14 weeks.

Plants will be grown to seed production with observations taken regarding growth patterns and vitality. Seeds will be collected and stored for further study.



### *Outputs*

This experiment will lead to the creation of a first-draft product information guide that outlines culture guidelines for commercial production of *Gaillardia suavis* in protected environments, and allow for a better understand of ideal germination and growing on environment. More background information and an increased interest of *Gaillardia suavis* will also result from this study.

### *Outreach*

Following the completion of this experiment, background research, methods, and findings will be summarized and submitted to peer-reviewed journals for publication; findings will also be shared with the horticulture community of the North Central Region via university and trade publications. As well, specific universities with horticulture departments as well as commercial growers will be directly provided findings and results from the study to gauge interest in the value of conducting future research. Those contacted may include Iowa State University, University of Wisconsin Madison, Gertens, and Bachman's. Overall results will contribute to the horticultural distribution chain by potentially introducing a new crop for ornamental or cut flower use.

### **Evaluation Plan**

Progress towards desired outcomes will be evaluated following the dissemination of findings and results to growers and universities within the North Central Region as well as publication of article in a peer-reviewed journal or trade and university

publications. This will primarily be achieved through the use of an electronic survey sent to the horticulture departments and commercial growers contacted during outreach. Reader feedback from peer-reviewed, academic, or trade publications will be collected as well, and online popularity and interest in the article(s) monitored. The survey will ask questions regarding awareness and knowledge regarding *Gaillardia suavis* as well as help gauge interest in both future research on the species and the possibility of its introduction to the commercial horticulture market. Feedback from the survey will also help the primary research reflect upon knowledge and skills learned throughout this experiment.

## **Experience and Roles**

### *Project Mentor*

Dr. Neil Anderson will serve as the project mentor for the primary researcher. His credentials include a B.S. in Ornamental Horticulture, M.S. in Horticulture, and Ph.D. in Horticulture, and he currently is a professor of horticulture at the University of Minnesota where he also directs the Herbaceous Ornamental Breeding Program. Dr. Anderson will assist with any questions the primary researcher may have during the experiment process.

### *Primary Researcher*

Emily Lefrancois will serve as the primary researcher for this research proposal. She has B.A. in Psychology and Neuroscience, and is currently a graduate student pursuing a MPS degree in Horticulture at the University of Minnesota. Her

experience includes coursework covering plant propagation, plant identification, crop scheduling, and greenhouse production. She will be responsible for carrying out the bulk of the experiment, as well as experimental design, data collection and analysis, writing a final article compiling findings and results, and other outreach.

### *Miscellaneous Partners*

Various individuals will contribute to the overall success of this experience, such as the Plant Growth Facility staff responsible for watering and fertilizing Production House 369 B-5 as well as application of pesticides and ordering supplies for the greenhouse, as well employees and editors of peer-reviewed and university or trade publications. Other individuals within the horticulture community at the University of Minnesota and within the North Central Regions will also contribute greatly to dissemination of results and findings from this experiment.



# BUDGET

## **BUDGET**

The total requested budget for this proposal is a fixed request of \$11,210.00. A breakdown of fund distribution can be found in Table 2, with an in-depth look at more specific line-item expenses outlined below.

### *Salaries*

The salary for the primary research encompasses all phases of the proposal outlined above from experimental design to submission of an article to various publications and follow-up outreach. A 12-month salary will be paid as a monthly stipend of \$700.00 for a total of \$8,400.00. Greenhouse staff salaries are included in the rental fee for the Plant Growth Facility.

### *Materials and Supplies*

All necessary materials and supplies are itemized below:

- *Gaillardia suavis* seeds  
(\$18.00 [per 2g seed packet,  
approx. 150 seeds] x 5 =  
\$90.00) ○ Germination mix ○  
Growing mix ○ Distilled water
- Spray bottles ○ Sand
- Perlite
- Plant labels ○ Sharpie markers  
(\$13.00) ○ Plug trays (288) ○  
1020 trays ○ Containers (4-5",

quart) ○ Gibberellic acid

(GA<sub>3</sub>) ○ Daminozide ○

Miscellaneous items as needed

Items underlined are included in the rental fee for the Plant Growth Facility, as indicated in the direct costs category; total cost for supplies not included in the rental fee is estimated to be \$103.00.

### *Travel*

The cost of travel to the university over a 12-month period is estimated to be \$350.00 for the year, and is based upon the purchase of a parking pass or public transit pass.

### *Direct Costs*

Rental fee for the Plant Growth Facility falls under the category of direct costs and is \$0.0308 per ft<sup>2</sup> per day, which includes various necessary materials such as growing media, plug trays, pots, labels, plant growth regulators, and more. One 75 ft<sup>2</sup> bench costs \$2.31 per day, so renting one bench in the mist house (369 B-4) for the duration of two months, or 60 days (September 2021—October 2021), totals out to be  $2.31 \times 60 = \$138.60$  and rounded up to \$139.00. Renting a total of four benches in production house 369 B-5

for the duration of eight months, or 240 days (September 2021—April 2021) totals out to be  $(\$2.31 \times 240) \times 4 = \$2,217.60$ , and rounded up to \$2,218.00. The total for direct costs comes out to be  $\$139.00 + \$2,218.00 = \$2,357.00$ .

<b>Category</b>	<b>Cost</b>
Salaries	\$8,400.00
Fringe Benefits	\$0
Non-expendable Equipment	\$0
Materials & Supplies	\$103.00
Travel	\$350.00
Direct Costs	\$2,357.00
Indirect Costs	\$0
<b>Total</b>	<b>\$11,210.00</b>

*Table 2 Estimated total budget.*

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

<b>Expected Outcomes</b>	<b>Inputs and Activities</b>	<b>Outputs</b>	<b>Evaluation, Monitoring &amp; Measurement Methods</b>

<p><i>Learning:</i> This proposal is centered around an experiment that will contribute to the overall background and knowledge of germination and growth requirements of <i>Gaillardia suavis</i> in protected environments.</p> <p><i>Action:</i> Results of this experiment will allow for <i>G. suavis</i> to potentially be produced on a commercial scale as an ornamental or cut flower crop.</p>	<p><i>Personnel:</i> The primary researcher is Emily Lefrancois, and will be advised and mentored by Dr. Neil Anderson.</p> <p><i>Location:</i> Research will take place at the plant growth facility at the UMN.</p> <p><i>Physical supplies:</i> Seeds, germination mix, growing mix, sand, perlite, plant labels, markers, plug trays (288 and 128), 1020 trays, containers (4-5" and quart), and plant growth regulators (daminozide and gibberellin)</p>	<p>A potential product information guide will be produced as a result of this experiment. As well, an article summarizing the details of this experiment will be written and submitted to peer-reviewed journals.</p>	<p><i>Evaluation:</i> Results will be submitted to peer-review, academic, and trade publications, and shared with other academic institutions and growers in the North Central Region. After dissemination, an electronic survey will be sent to partners to collect data regarding interest in future work with the species.</p> <p><i>Measurement/Monitoring:</i> Growth of seedlings and plants will be monitored daily and measured using the following:</p> <ul style="list-style-type: none"> <li>- Days to germination</li> <li>- Percent germination</li> <li>- Height</li> <li>- Days to true leaf emergence</li> <li>- Number of leaves</li> <li>- Days to transplant readiness</li> <li>- Days to flowering</li> <li>- Presence of inflorescence</li> <li>- Presence of ray florets</li> </ul>
--	---	---	---

## References

Barkley, T.M., Brouillet, L., and Strother, J.L. 2020. *Asteraceae* Berchtold & J. Presl – Composite Family. Flora of North America



North of Mexico [Online] 21. <http://floranorthamerica.org/Asteraceae>

- Baskin, C.C., Baskin, J.M., and Van Auken, O.W. 1994. Germination response pattern during dormancy loss in achenes of six perennial Asteraceae from Texas, USA. *Plant Species Biology* 9(2): 113-117. <https://doi-org.ezp3.lib.umn.edu/10.1111/j.1442-1984.1994.tb00091.x>
- Bayton, R. and Maughan, S. 2017. *Plant Families*. The University of Chicago Press, Chicago. p. 204-207.
- Bharathi, A., Palanisamy, V., Raja, K., Natesan, P., Krishnasamy, V., and Vanangamudi, K. 2009. Seed development, maturation, and germination improvement in *gaillardia*. *Madras Agricultural Journal* 94(7): 183-188.
- Ferner, J.W. and Rosenthal, M. A cryptic moth, *Schinia masoni* (Noctuidae), on *Gaillardia aristate* (Compositae) in Colorado. *The Southwestern Naturalist* 26(1): 88-90.
- Geneve, R.L. Seed dormancy in commercial vegetable and flower species. *Seed Technology* 20(2): 236-350.
- Gibson, A.C. 2013. *Gaillardia suavis*—fragrant *gaillardia*, perfume-ball, rayless *gaillardia* [Asteraceae]. *Vascular Plants of Williamson County*.
- Knudson, E., Bordelon, C., and Pogue, M.G. 2003. A new species of *Schinia Hübner* (Lepidoptera: Noctuidae: Heliothinae) from Texas, Oklahoma, and Louisiana. *Zootaxa* 382(1): 1-7. <https://doi.org/10.11646/zootaxa.382.1.1>
- Opler, P.A. and Cranshaw, W.S. 2005. *Attracting butterflies to the garden*. Colorado State University, Fort Collins, PhD Diss.

Simmons, M.T. 2005. Bullying the Bullies: the selective control of an exotic, invasive annual (*Rapistrum rugosum*) by oversowing with a competitive native species (*Gaillardia pulchella*). *Restoration Ecology* 13(4): 609-615.

<https://doi.org.ezp3.lib.umn.edu/10.1111/j.1526-100X.2005.00078.x>

Strother, J.L. *Gaillardia suavis*. 2006. *Gaillardia suavis*. *Flora of North America North of Mexico* [Online] 21.

[http://floranorthamerica.org/Gaillardia\\_suavis](http://floranorthamerica.org/Gaillardia_suavis)

United States Department of Agriculture. 2020. *Gaillardia aristate*. <https://plants.usda.gov/core/profile?symbol=gaar>

United States Department of Agriculture. 2020. *Gaillardia pulchella*. <https://plants.usda.gov/core/profile?symbol=GAPU>

United States Department of Agriculture. 2020. *Gaillardia suavis*. <https://plants.usda.gov/core/profile?symbol=GASU>

United States Department of Agriculture. 2020. *Gaillardia xgrandiflora* Van Houtte [*aristate* x *pulchella*] blanketflower.

<https://plants.usda.gov/core/profile?symbol=GAGR11>

## Figures

Hutchins, G. 2020. <https://www.gbif.org/occurrence/2603445231>

Kew, Herbarium Specimens. <http://plants.jstor.org/stable/10.5555/al.ap.specimen.k000943167>

Kieschnick, S. 2019. <https://www.gbif.org/occurrence/2236285610>

Konings, G. 2005. <http://museum2.utep.edu/chih/gardens/plants/GtoM/gaillardiasuavis.htm>

Lindheimer, F. 1846. *Gaillardia suavis* (A. Gray & Engelm.) Britton & Rusby [family COMPOSITAE]. Royal Botanic Gardens,

The National Gardening Association. 2016. <https://garden.org/plants/photo/386978/>