The adaptability of *Eurybia sibirica* and its potential as an early or late season flowering cash crop

(Figure 1) *Eurybia sibirica* flowers (closeup). Photo (BY-NC-SA) Gerald and Buff Corsi on CalPhotos. https://idfg.idaho.gov/species/taxa/43924

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Work Location: Plant Growth Facilities-West (Greenhouse Classrooms), 1552 Gortner Ave, St Paul, MN 55108

This research will not primarily focus on socially disadvantaged or limited resource farmers.

Systems Category: Crop Production– Improvement and Selection

Commodity Category. Other– Additional Plants (Flowering)

Summary

The following proposed experiment, "The adaptability of *Eurybia sibirica* and its potential as an early or late season flowering cash crop," aims to identify the optimal growing conditions for the flowering perennial *E. sibirica* as a late-season flower, determining the photoperiod and growing media that are best suited for high germination rates and vigorous growth. The information gathered in the proposed experiment can be shared through the creation and distribution of a Product Information Guide, as well as with a presentation of the findings.

Eurybia sibirica is part of the Asteraceae or aster family, and is native to much of the circumboreal or subarctic region. It grows and flowers in the summer and late into the fall season in colder climates such as Minnesota. *Eurybia sibirica* is considerably hardy, and can tolerate mild frost, as well as being known to grow well in rocky, sandy or otherwise tough to grow spots. This study will allow optimal growing conditions to be determined by direct comparison to different potential conditions, and it will be evaluated on the quality and accuracy of the outputs. In order to best serve flower farmers in the region, supplying them with a beautiful and unique flowering plant that is cold-hardy late into the season is essential for achieving increased revenue and excitement through the release of new desirable products.

Description

Eurybia sibirica is a rhizomatus herbaceous perennial with lavender colored flowers, and it will continue to flower into the late fall of cold regions. The proposed study will determine the optimal growing media for *E. sibirica,* as well as any photoperiod preferences.

Outcomes

The main learning outcome from this experiment is knowledge of the optimal *E. sibirica* growing conditions, including both media type and photoperiod. This knowledge will change things for flower farmers as they find a new stream of revenue and a plant that is well suited to their region. It will, in turn, give gardeners more options for attractive flowering perennials in their yard.

Action outcomes for this experiment include three parts: the first is the creation and distribution of an *E. sibirica* Product Information Guide for use, the second is short- and long-form reports to be shared with the horticultural and academic communities, and the third is a community gathering and presentation of findings. This will allow new information to be shared with all interested horticulturists, researchers, plant scientists, and growers, and it will allow them to recognize the benefits of *E. sibirica* as an adaptable late season pop of color.

Taxonomic Classification

Eurybia is a genus of plants in the family Compositae or Asteraceae, which is often referred to as the aster, daisy or sunflower family. The phylogenetic relationships among eurybioid species have been historically complicated and difficult to establish for a variety of reasons, hybridization and polyploidy among them– because of this, reclassification has become somewhat common amongst eurybioids (Selliah, 2008). The differences in findings of two main *Eurybia sibirica* researchers, G.L. Neson in 1994 and J.C. Semple in 2005, reveal some of the ways in which *Eurybia* species have been classified due to varying interpretations in the past (Selliah, 2008). Given this history of confusing and often contradictory information, it is clear

that more research is needed to fully understand *Eurybia* and the phylogenetic relationships between diploid and polyploid species, as well as relationships amongst other eurybioids.

Consisting of perennials, the genus *Eurybia* has 23 species, all of which are native to North America. One species is also found natively in northern Eurasia: *Eurybia sibirica*, commonly known as arctic aster or Siberian aster. *Eurybia sibirica* is a shorter, hardy herbaceous perennial known for purple or lavender colored flowers. Flowers radiate and appear in corymbiform arrays or sometimes as a single inflorescence, growing up to 1 foot in height. Leaves are veined and serrate, sometimes irregularly so (Flora of North America). Disc florets are often yellow, but can also appear reddish to brown in color. *Eurybia sibirica* is a diploid species; important to note the genus *Eurybia* includes both diploids and polyploids, despite there being no real morphological basis for the split. While *Eurybia* polyploids do not form a clade and their relationships with one another have not yet been fully assessed, we do know that the diploids fall into two separate categories or clades. The clade within which *E. sibirica* resides also encompasses two other species: *E. integrifolia* and *E. eryngiifolia* (Selliah, 2008). The relation of these species to other diploids, as well as the rest of the *Eurybia* genus, can be found below in Figure 2.

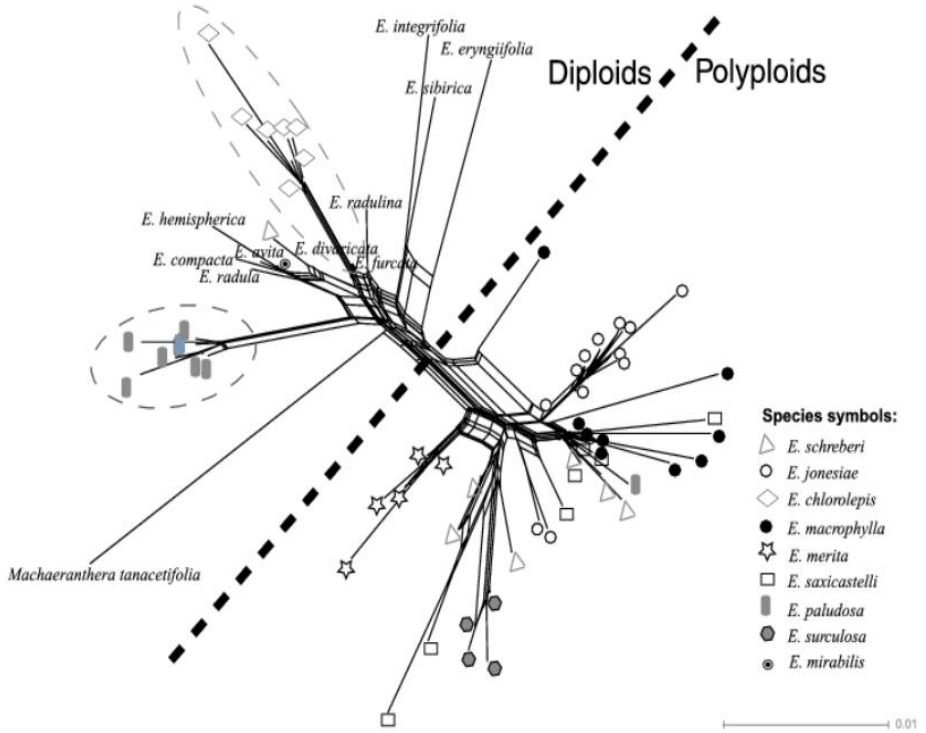

Figure 2. A map of the relationship between *Eurybia* polyploid and diploid species (Selliah, 2008).

Distribution & Native Habitat

Eurybia sibirica is native to much of the circumboreal or subarctic region. This includes the British Columbia and Yukon Canadian territories as well as Alaska, northward toward the boreal forest of the Northern Territories, as well as south into Washington, Oregon, Idaho and Montana. *Eurybia sibirica* is also present in much of north Eurasia, in Scandinavia and, as the common name suggests, Siberia. It grows in a variety of altitudes, from sea level to mountainous, which makes the plant highly adaptable to different environments.

Figure 3. Native distribution of *Eurybia sibirica* across North America. The dots signify states or provinces where the species is reported to occur. Flora of North America. http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242321661

Eurybia sibirica grows and flowers in summer and late into the fall season in colder climates and can even be a wintering or perennial flower in some milder climates. It is considerably hardy, and can tolerate mild frost, as well as being known to grow well in rocky, sandy or otherwise tough to grow spots. These factors make *E. sibirica* favorable for short day conditions, which would coincide with early and late season conditions of Minnesota and surrounding areas.

Eurybia sibirica also grows in a great variety of habitats, from riverbeds and lakeshores to dry, rocky slopes and forest clearings. It will volunteer to grow in dry, sandy places, but can also thrive in wet meadows, and spreads via thin, creeping rhizomes. Further study of the most

desirable conditions for germination and growth are necessary and would include comparisons between various growing media.

Invasive Tendencies

There are no known instances of invasive tendencies of *E. sibirica*. However, because of the limited scope and knowledge surrounding this particular species, it is difficult to definitively rule out invasive tendencies across all locations. From what we know about asters, although not categorized as invasive they do tend to spread. While not aggressive, this means it is best to allow for ample growing space, or to consider using a containerized growing approach depending on each customer's needs.

Figure 4. Group of *Eurybia sibirica* along the Steese Highway in Alaska. http://www.alaskawildflowers.us/Kingdom/Plantae/Magnoliophyta/Magnoliopsida/Asteraceae/Aster_sibiricus/index.html

History and Uses

Native Americans have historically used Aster for its healing abilities (Coulber, 2021). Though it is difficult to determine exactly which species were used, *E. sibirica* is native to many areas that Native Americans previously inhabited and could have easily been recognized for medicinal use. Eurybia sibirica is also edible and can be eaten fresh or dried and ground or incorporated into teas.

To date, there is no evidence that *E. sibirica* has been domesticated. There are no known cultivars available on the market, and seeds are difficult to find. If marketed, this species would likely be seed propagated. With further research of optimal conditions and market niche, *E. sibirica* could play an important role in the bedding and cut flowers market, allowing late season displays to have an adaptable and visually appealing element that comes back year after year.

Plant Life Cycle and Characteristics

In Minnesota and the surrounding Midwestern states, it can be difficult to find flowering plants that are well suited to the harsher climate in the area as summer turns to fall and fall turns to winter. Eurybia sibirica is a flowering herbaceous perennial with a creeping rhizomatus habit, and would perform well on the market as a bedding plant, providing colorful displays throughout the growing season. Both its unique color and length of flowering time are valuable; as a bedding plant, Eurybia sibirica will flower in the summer and well into autumn, which provides a beautiful and necessary pop of color in an increasingly dull landscape as the seasons progress. Because of its tendency to spread, albeit not aggressively, some consumers may prefer to utilize containers or raised beds to grow *E. sibirica* depending on the wants and needs of their growing space. In some cases, *E. sibirica* could also perform well in the commercial market as a cut

flower; it produces one of the smaller aster flowers from a shorter plant, resulting in shorter stems, but the lovely lavendar color can still provide an essential visual element to cut flower arrangements, and future breeding could select for a longer stem length or larger flower size.

Eurybia sibirica is drought tolerant, as well as being mildly frost tolerant. It can be found in a range of USDA Hardiness Zones, inhabiting Zone 2 in Canada as well as Zones 3 and 4 in the United States. Although not native to the North Central region of the U.S., *E. sibirica* is native to other areas of the country with similar climates, and has the ability to do well in Midwestern conditions.

Potential Production Environments

Eurybia sibirica can be found growing in all kinds of conditions, including both dry and wet landscapes. From what is known about the crop, it appears to prefer well-drained rocky or sandy surfaces, however, it can be successful in wet meadowland areas and streambanks as well (Flora of North America). Further research is necessary to determine the optimal growing medium for *E. sibirica*; details for said experimentation can be found in the Approach and Methods section below.

When collected from seed, *E. sibirica* must undergo a cold moist stratification period of 6-8 weeks, which acts as the wintering period before spring in a naturally occuring plant (Edmonton Native Plant Group). *Eurybia sibirica* grows under short day conditions and can tolerate low temperatures and mild frost. Little is known about growing *E. sibirica* vegetatively, and further research is needed on the potential for vegetative propagation through cuttings or separation of rhizomes from established plants. Because *E. sibirica* is one of the shortest aster species, plant growth regulators are not necessary for height control.

Although it is well suited for short day conditions later in the season, *E. sibirica* also flowers throughout the summer. Further experimentation is required to determine optimal photoperiod (or neutrality) for knowledge and use in commercial growth– see Approach and Methods section for proposed initial *E. sibirica* photoperiod research.

Figure 5: Steen og Wormsen Stauder. *Eurybia sibirica* closeup. www.stewo.no/stauder_e.htm.

Vibrant purple flowers and an attractive mounding habit make *E. sibirica* a great candidate for a new bedding plant on the market, and the adaptability of *E. sibirica* makes it easy to grow in a wide array of soil types and conditions. For growers in the North Central region, this new flowering crop is an opportunity to provide their customers with a long-lasting splash of color for their garden that will stick around as the temperatures cool late in the season.

Impact on sustainable agriculture in the North Central Region

In Minnesota and across the Midwest, it is very important to have plant species that perform well and continue to produce visual interest and color late into the fall, as growing conditions worsen, and temperatures begin to drop. Adding *E. sibirica* as a new bedding plant option would allow growers to fulfill that need for consumers, giving the grower a revenue stream from a new crop species and giving the consumer an attractive and adaptable option that will outlast other flowering plants as the weather turns each year.

Eurybia sibirica flowers support pollinators including butterflies, moths, bees and other beneficial insects. This is becoming increasingly important for food production as beneficial pollinator populations such as bees continue to decline; pollinator decrease is a direct threat to global agriculture, and continued loss will cause lower crop yields, creating a need for even more agricultural land and increased habitat destruction (Aizen, 2009). Increased use of pollinator-friendly flowers like *E. sibirica* across the state and the region will allow for increased support of these vital populations.

Supplying North Central U.S. farmers and growers with a stunning new addition that lasts well beyond most other flower types will increase their quality of life by allowing them to meet the needs of their customers more successfully. In turn, communities will have the opportunity to continue enjoying the eye-catching purple flowers of *E. sibirica* across the landscape, even as the weather starts to turn.

Approach and Methods

Eurybia sibirica is valuable for its long flowering season length, hardiness and adaptability. However, further knowledge about optimal growing conditions for the species is

needed for it to be grown for commercial production. Because *E. sibirica* has been known to grow in such a diverse set of conditions, determining which of these conditions garners the highest germination rates and flower yields will make a big difference, especially whengrown on a larger commercial scale.

Figure 6: University of Minnesota Plant Growth Facilities and surrounding St. Paul campus. University of Minnesota Agricultural Experiment Station.

To determine optimal conditions for growing *E. sibirica* from seed, one must examine the rate of success of *E. sibirica* when sown across a variety of growing media. To do this, the experiment will be utilizing growing space in the Plant Growth Facilities at the University of Minnesota's Twin Cities Campus shown above in Figure 6. We will utilize three different greenhouses with varying conditions for each stage of growth, as described below.

<u>Stage 1: Cold Moist Stratification</u> (Teaching Cooler)

- 100 *E. sibirica* seeds will be planted ¼ inch deep in moistened soil and stored at a cool temperature (<50 degrees Farenheit) in dark conditions for 6 weeks.

<u>Stage 2: Mist House Germination</u> (PGF 369 B-4)

- Seeds will be moved to the mist house after cold moist stratification and will remain there until germination. Germination time and percent germination will be recorded at this stage. Conditions are as follows: Day/night temps: 70F/70F (Zero DIF). Lights are on for 16 hrs (0600-2200 HR) at 150 μmol m-2s-1. Mist frequency is every ten minutes for a 7 sec duration.

Stage 3: Capillary Mat Development (PGF 369 B-5, Production house 1)

- Seedlings will be transferred to the capillary mat after germination to further develop for a short period before being transplanted. Conditions are as follows: Early morning temp dip at sunrise to 50F for 2-3 hours. Day/night temps: 67F/62F (+5 DIF). Lights are on for 16 hrs (0600-2200 HR) at 500 μmol m-2s-1. Fertilization consists of 125 ppm N CLF 15-5-15 Cal-Mag (CLF).

Stage 4: Short Day Conditions/Long Day Conditions (PGF 369 C-7, Production house 2)

- Seedlings will be being transplanted into 2.5-inch pots with four different combinations of growing media. 10 seedlings of each medium will be moved into long day conditions, and 10 seedlings of each medium will be moved into short day conditions. Growing media scenarios will consist of the following:
  - Professional growing mix (100%) – 25 seeds
  - Professional growing mix (70%) and vermiculite (30%) – 25 seeds
  - Professional growing mix (30%) and vermiculite (70%) – 25 seeds
  - Vermiculite (100%) – 25 seeds
- Conditions are as follows: Early morning temp dip at sunrise to 50F for 2-3 hours. Day/night temps: 70F/65F (+5 DIF). Lights are on for 16 hrs (0600-2200 HR) at 500 μmol m-2s-1. Short day benches have 8 hours of lighting; black cloth opens

daily at 0800 HRS and closes daily at 1600 HRS. Fertilization consists of 125 ppm N CLF 15-5-15 Cal-Mag (CLF). Monthly fungicide drenches are applied.

The experiment and methods are designed to determine which growing medium is most suitable for the growth of *E. sibirica* from seed in order to most effectively introduce the species in the North Central region. Knowledge gained from the experiment will inform growers in the region about best practices and optimal conditions for germination and seedling success in *E. sibirica*.

Outputs + Outreach

The findings of this experiment will include experiment data and results, as well as written information about the crop and experiment, compiled in the form of two reports. One will be a full-length version for use in academia, further research, and breeding; this will include more detail and experimental design. The other version will be a shorter report for growers, students and interested horticulturists and/or community members. In addition, a Product Information Guide (PIG) growing sheet for *E. sibirica* will be produced after experimentation is complete to allow for increased *E. sibirica* community knowledge and commercial growing use, as well as to promote further future experimentation and selective breeding. A horticultural community gathering and presentation of findings will be completed following the research to inform the community about our findings pertaining to *E. sibirica*.

This gathering and presentation of findings will consist of interested faculty, students, community members and local or commercial growers. It will be hosted on the University of Minnesota St. Paul Campus with the goal of communicating the value of *E. sibirica* as a late

season flowering crop to interested members of the horticultural industry and beyond. Findings of the experiment and the best practices for growing E. sibirica will be communicated at this time via presentation, and a completed PIG handout will be available for distribution, and will also be made available electronically via PDF. Both the short and long form versions of the report will be available at the presentation.

Evaluation Plan

This experiment will allow horticulturists, researchers, plant scientists, and growers to discover not only a new, adaptable plant species, but the optimal methods to grow that species. Addition of *E. sibirica* to mainstream horticultural knowledge will provide a new hardy late-season flower for growers and distributors in the North Central region, and it will also result in an exciting new feature for home gardeners looking to improve their fall gardens.

We will evaluate the success of the experiment and outreach methods by assessing the resulting *E. sibirica* Production Information Guide for quality, accuracy and clarity for the reader. We will also evaluate outreach success based on the total amount of PIGs and informational papers distributed. Another way we will assess the impact of our outreach is by keeping track of the attendance of the presentation. Registration for the event will ask whether the attendee is a researcher, horticulturist, plant scientist, or interested community member in order to establish an idea of the audience distribution and interest in *E. sibirica*.

Experience & Roles

The proposed experiment will be facilitated by Dr. Neil Anderson at the University of Minnesota's St. Paul campus. Dr. Anderson specializes in winter hardy herbaceous perennials, and his crop specialty is on the genus Chrysanthemum. Found within the Asteraceae family with *E. sibirica*, Chrysanthemum has very similar functions within a garden landscape, often acting as a tall, attractive splash of color. Dr. Anderson will ensure necessary access to the Plant Growth Facility throughout the experiment for use of potting materials, media (professional potting mix and vermiculite), and space on the greenhouse bench, along with any other miscellaneous needs throughout the process. In addition, Dr. Anderson will provide additional writing and experimental guidance and facilitation throughout the course of the experiment.

The primary researcher, Maya O'Brien McLeod, has a background in Journalism and Environmental Science, Policy and Management. She is currently pursuing her Master's of Professional Studies in Horticulture with the College of Continuing and Professional Studies at the University of Minnesota, Twin Cities and has completed relevant coursework in plant propagation, environmental education, soil science, and crop scheduling and production.

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

Expected Outcome	Inputs & Activities	Outputs	Evaluation
Learning Outcome	Graduate Student Research, Experiment Design, Instructor Mentorship, Facilities and Materials	Knowledge of optimal *E. sibirica* growing conditions (media type & photoperiod)	Comparative quantitative success rates for germination and seedling growth

Action Outcome	Graduate Student Research, Experiment Design, Instructor Mentorship, Facilities and Materials	*Eurybia sibirica* Product Information Guide (PIG)	PIG Production, Quality and Accuracy
Action Outcome	Graduate Student Research, Experiment Design, Instructor Mentorship, Facilities and Materials	Short- and long-form written reports to be shared with the horticultural and academic communities	Report Quality and Accuracy
Action Outcome	Graduate Student Research, Experiment Design, Instructor Mentorship, Facilities and Materials	Community Gathering and Presentation of Findings	Presentation Attendance and Powerpoint Clarity

Budget and Budget Justification

The total cost of completing this experiment in full in the designated one year timeline is $9,023. This includes personnel salaries, materials and supplies, travel costs, printing costs, and direct costs of renting space at the Plant Growth Facility. All categories are broken down below, and a complete itemized breakdown of costs can be found at the end of this section.

Salary necessary to complete this experiment has been totaled based on the length of the experiment, one year, with a monthly stipend of $650. This totals $7,800 for all labor from the primary researcher associated with seed sowing, transplanting, and data collection.

Materials and supplies necessary for this experiment include the following:

- *Eurybia sibirica seeds*
- *Plug trays*
- *2.5-inch transplant pots*
- *Professional soil mix and vermiculite*
- *Labels*
- *Sharpie markers*
- *Fertilizer*

The cost for materials and supplies for this experiment is included within the direct costs section, in the rate for greenhouse rental.

Travel costs associated with completing all aspects of the project will include regular transportation to and from the Plant Growth Facility on the University of Minnesota's St. Paul campus. This cost has been based upon the cost of a transit pass (UPass), at $114 a semester for two semesters equals $228 in total transportation costs.

Printing costs include the cost of printing both the Production Information Guides and the informational paper for distribution. Total printing costs (ink, paper, etc.) are estimated at $150 total.

Direct costs include the cost of renting space at the Plant Growth Facility, which is available by the square foot. The cost of renting one square foot of the facility is $0.0308 per day. A 75 square foot bench used for this project, then, will cost $2.31 per day. When multiplied for 365 days in a year, the total cost of greenhouse space for the year will be $843.15, rounded up to $845. This cost includes all materials needed for all stages of the experiment.

Personnel: $7,800

Travel: $228

Printing and publications: $150

Supplies and materials/Direct costs: $845

Indirect costs: $0

Total Costs: $9,023

References

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