

Independent Study Report for the North Carolina Botanical Garden Certificate in Native Plant Studies Program

“Seed Propagation of Six Native Southeastern United States Wildflowers”

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INTRODUCTION

This report is for the *Independent Study Project (ISP)* which finalizes the learning experience of the team members for the *North Carolina Botanical Garden (NCBG) Certificate in the Native Plant Studies Program*.

The project deals with a key interest of the NCBG - the critical issue of native plant conservation through propagation. We investigate and report in this project some of the methods and issues related to plant propagation. The NCBG has earned a reputation as a location for seed storage for plants of Southeastern USA. This means that, if propagation techniques are standardized and well documented, native plants can become more readily available to the general public and there will be less pressure on wild plant harvesting.

A comment on this problem was made in the second addition of the North Carolina Native Plant Propagation Handbook, NC Wildflower Preservation Society ...

*“At the time of the original manual [of this society] many native species offered to the public were collected from wild populations, often with disastrous results. In many cases both the native populations and plants collected failed to survive this commercial assault. **It was recognized that reducing the collecting pressure could help preserve the native populations. One way to do this was to develop propagation procedures that would allow plants to be produced in nursery conditions.** This allows many more people to learn more about the cultivation requirements of unique native plants and to provide a plant supply and advice to the public.” [Ref #13]*

There are several other types of plant propagation methods available that have their advantages and disadvantages. We will not report on these, other than to mention them:

- Propagation by division is conducted typically between the Fall and Spring. For some plants this division will often rejuvenate the plant. (Plant examples: White Wild Indigo, the Mallows and Blue-eyed Grass.) This method is also used to quickly multiply ('bulk up') the number of plants of that species and will often rejuvenate older plants, like Iris.
- Propagation by root cuttings is done at the end of the dormant season, usually in late February and March. It is relatively easy, reliable, inexpensive, and requires little of the plant material. (Plant examples: Stokes' Aster and Butterfly Weed.)
- Propagation by stem cuttings is more demanding in terms of environmental requirements during the propagation.
[Ref #17, pages 48-52]

PROJECT ADVISOR & TEAM MEMBERS

Project Advisor **Mr. Matt Gocke:** MS Forestry, BA Social Studies, Greenhouse and Nursery Mgr NCBG.
Interests: Music, tennis, traveling, gardening, the Tropics

Team Members: **Ms. Sandy Young:** MS Science Education, BS Elementary Education;
Native Plant Certificate Program since 2009

Interests: Nature, drawing, yoga

Mr. Paul Young: BS Engineering Physics,
Native Plant Certificate Program since 2008

Interests: Bio-conservancy, SCUBA diving, motorbike touring.

ABSTRACT

In this ISP best practices were developed for the propagation of a select number of native southeastern species of wildflowers from seeds. To this end, a germination trial was conducted for the following plants: *Anemone virginiana*; *Chrysopsis mariana*; *Eurybia macrophylla*; *Liatris spicata*; *Rudbeckia triloba* and *Vernonia acaulis*. Three treatments were selected to be followed during this trial, the results of this trial were analyzed and summarized. Recommendations for future trials were made.

Additionally, this effort was to be a learning experience and become a potential teaching/training aid. To this end, all protocols that were conducted were recorded in detail.

SCOPE OF PROJECT

The project covers the entire seed-propagation process, from plant selection to potting for sale at NCBG. We describe the most significant steps of the process in detail in the *PROCEDURES* sections of this report. This section presents a brief overview of the elements of the process that were followed:

Plant Selection:

The plants to propagate were selected by the Project Advisor for their rarity, salability, and interest.

Seed Collection:

The seeds for this project were provided by NCBG.

Seed Cleaning:

This aspect of the project describes how we cleaned the seeds presented and what we learned through discussions with NCBG staff.

Seed Storage & Retention:

This aspect of the project is reported based upon our handling of the collected seeds complemented by observations at the NCBG and discussions with NCBG staff.

Seed Counting:

For a meaningful comparison of results, it was necessary to know, to a high level of accuracy, the number of seeds used in each phase of the procedure. We reported on the methodologies used for counting seeds.

Growing Medium Preparation:

We reported on the preparation methods used to create the media determined to be optimal for the chosen plants.

Sowing:

We reported on the sowing methods used to prepare the plant trays for the various treatments they would receive in the following months. (See next section.)

Treatments:

Many species of plants produce seeds that require special conditions to germinate. These occur in nature. For our propagation we refer to these conditions as 'Treatments'. We reported on the three treatments we used to improve germination results.

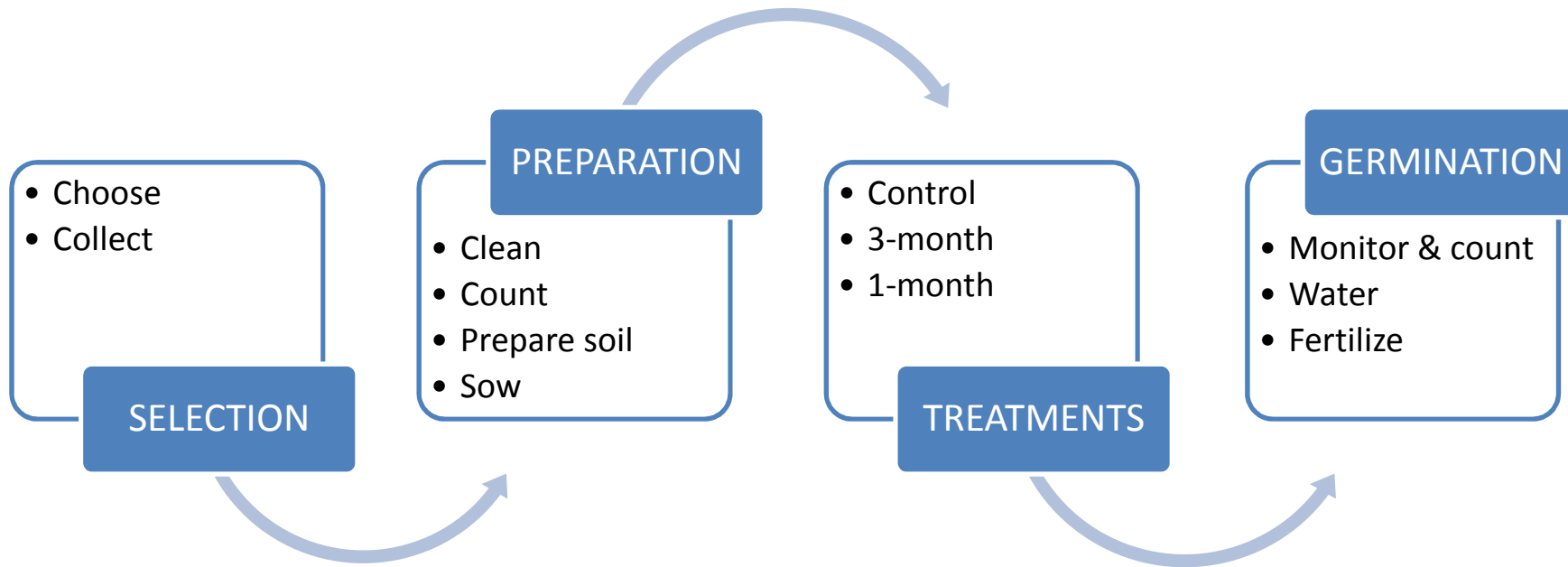
Germination Oversight:

We monitored and recorded germination activity for the various seed flats.

On April 15th, all of the flats went into the greenhouse. During their time in the green house we continued to monitor germination, water and fertilize as required.

Plant Harvesting:

Viable plants were extracted from the germination trays and moved to pots, ready for presentation at a future plant sale.



Overview of the entire project process

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PROCEDURES

Plant Selection

The plants for the propagation were primarily selected by the Project Advisor. We selected these plants based upon the following criteria:

- ⤴ Availability of viable seeds
- ⤴ Sufficient space in refrigerator/greenhouse/other resources and the number of species planned
- ⤴ Germination in less than one year
- ⤴ Salable species for the daily and fall plant sales.
- ⤴ Species of interest
- ⤴ Some seeds needing cleaning (to provide experience for the team members)

In consultation with the Project Advisor, we decided to have six plants for the project. This number was determined based primarily on the availability of greenhouse space that could be committed for this project and the level of effort required. This calculation was as follows:

$$\text{Number of species (6) X Number of Treatments (3) X Number of Replications (3) = 54}$$

This calculation meant that there would be space needed for 54 germination/growth trays. The Project advisor who also manages the greenhouse, determined that he could commit to this amount of space and the timeframe for which it would be needed.

Final plants for the project:

<u><i>Anemone virginiana</i></u>	(Tall thimbleweed)
<u><i>Chrysopsis mariana</i></u>	(Maryland goldenaster)
<u><i>Eurybia macrophylla</i></u>	(Bigleaf aster)
<u><i>Liatris spicata</i></u>	(Dense blazing star)
<u><i>Rudbeckia triloba</i></u>	(Browneyed susan)
<u><i>Vernonia acaulis</i></u>	(Stemless ironweed)

Seed Collection

NCBG staff performed the seed collection.

Seed Cleaning

We took the collected plants and extracted (cleaned) the seeds from them. We used various techniques to perform these tasks:

GENERAL DIRECTIVES

- ⤴ We thoroughly dried the plant material before attempting separation.
- ⤴ We placed plant material into paper bag, crushing entire contents to help separation of gross material, or ‘chaff’ - see PHOTOS 5 & 8.
- ⤴ We then placed the crushed material onto large white surface (i.e. poster board). **(Note: If seeds were predominantly white or light-colored, we used a black surface.)**

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- ⤴ We used a variety of sieve sizes; at times more than one size was used per plant (PHOTO 1)
- ⤴ We used the seed blower (PHOTO 2) to separate chaff from the seeds but it could not be used with seeds still attached to their pappus because aerodynamics of the combination of pappus and seed head did not allow differentiation.
- ⤴ We used a “Fennel test” to determine the presence of a fennel-like object which indicated to us a viable seed. This test involved rolling a seed under the finger to. (Although we acknowledge that this was not the most scientific approach, it gave us a level of confidence when selecting the 270 seeds for each species.)

SPECIFIC DIRECTIVES

Vernonia acaulis (Paul):

- ⤴ We pulled seed from receptacle leaving pappus in place. (PHOTO 3)
- ⤴ We noticed that many of the seeds had already detached from their pappus

Rudbeckia triloba (Paul):

- ⤴ When seeds were still firmly embedded in the flower head; we placed the flower heads into a ‘fire bucket’ (plastic outside, cloth inside => low static electric charge); and then struck the bag against a hard surface vigorously to dislodge the seeds (PHOTO 4)
- ⤴ We used a combination of two sieves to separate major pieces from seeds and chaff
- ⤴ We used the seed blower to further clean seeds

Liatris spicata (Sandy):

- ⤴ We pulled the seed from receptacle leaving pappus in place. (PHOTO 5)
- ⤴ We used the ‘fennel test’ to identify viability

Eurybia macrophylla (Sandy):

- ⤴ We pulled the seed from receptacle leaving pappus in place.
- ⤴ Using the ‘fennel test’ to identify viability we estimated that as much as 2/3 of the seeds were not viable.

Anemone virginiana (Sandy):

- ⤴ We rolled seed one at a time on mouse pad to remove fur-like pappus. (PHOTO 6) **We also tried several unsuccessful methods to remove the pappus** (PHOTO 7)

Chryopsis mariana (Paul):

- ⤴ We were fortunate here, as the seeds were already separated from receptacle. (PHOTO 8)
- ⤴ We used the ‘fennel test’ to identify viability (See below *SEED VIABILITY TESTING below.*)

Seed Storage & Retention

We put our collected seeds in brown grocery bags and held them in a low temperature (65°F) and low humidity room especially built for holding seeds when they were not in NCBG’s long term refrigeration units. Once cleaning and counting had occurred, we put the seeds into smaller envelopes where they awaited use in one of the treatments used. (See *SOWING and TREATMENTS.*)

Seed Counting

SEED VIABILITY TESTING

Seeds rechecked for viability before counting using the following techniques:

- ⤴ We used naked-eye examination
- ⤴ We also used microscopic examination (PHOTO 9)
- ⤴ We tried tactile pressure to detect presence of a seed (we referred to this as the ‘fennel seed’ test)

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GENERAL DIRECTIVES

Whenever feasible, we counted the seeds individually by pulling them from the mass. We used either our bare fingers or a straight-edged object which would not create a static electric charge, eg. metal ruler. This was particularly critical for the Asteraceae plants which had very light seeds. (For example, PHOTO 5.)

It should be noted that for seeds that were too small to count without employing a microscope (For example with *Mimulus ringens* and the *Penstemon smalli*), we used a special technique we call the “Sandy count”. (For a ‘visual’ on this, see PHOTOS 10 & 11). We describe this method as follows:

- ⤴ prepare an envelope or any container that will hold about one tablespoon of sand and can be sealed;
- ⤴ on the white side of the dissecting microscope's pad, mark a small circle (about 1/2inch in diameter); (NOTE: If counting lightly colored seeds, the black side of the pad may be more useful for viewing the seeds.)
- ⤴ pour the seeds onto the pad a little away from the circle previously drawn;
- ⤴ using an object that resists a static electrical charge (eg. a metal probe), carefully move the desired number of seeds into the area of the circle;
- ⤴ press a finger tip against the circle and raise it up (there may be a need here to dampen the finger slightly);
- ⤴ rotate the finger so that the tip is now upwards and can be seen through the microscope;
- ⤴ confirm that the correct number of seeds are still attached to the finger;
- ⤴ carefully move the finger into the sand prepared above and stir the finger slightly.

Growing Medium Preparation

The growing medium selected for this project was one that was generally used for other seed propagation at NCBG.

The medium preparation involved the following steps:

- ⤴ We brought the growing medium* that was stored at the NCBG near the greenhouse and it brought into the Totten Center in a plastic garbage can;
- ⤴ We sifted the soil to remove large pieces of bark that would have inhibited close contact with the germinating seed's roots. (The sieves used were of a 0.25 inch and then a 0.132 inch mesh size. The results of the first sifting is referred to as a 'single sieve' and the results of the second a 'second sieve'.)
- ⤴ We selected the second sieve material and filled 18 new germination trays (6 species X 3 replications). (PHOTO 12)
- ⤴ We put six trays in each flat, giving 3 flats.

** The Growing Medium used was pine bark that had been purchased from <<Sands & Soils; 1414 Stallings Rd, Durham, NC 27703; (919) 596-0801 >>. This company grinds/chops pine bark taken from lumbering operations. In addition, this material is often left to 'age' so as to reduce its acidity. This material is purchased for the garden on a regular basis.*

Sowing

Sowing involved the following steps:

- ⤴ We created three plant tags for each plant species as shown below;
- ⤴ We set out three flats with drainage holes and air troughs;
- ⤴ We set out three sets of six trays and placed each set in one of the three flats;
- ⤴ We inserted one plant tag almost horizontally along the edge of the long side of each tray (PHOTO 13)
- ⤴ We counted out (or recounted, if previously counted and in separate envelopes) the 30 seeds for each

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species being sown;

- ⤴ We evenly distributed the seed on the soil surface making no attempt to push them into the soil;
- ⤴ We covered the surface of the tray with coarse sand, ensuring that no part of the seed was visible (PHOTO 14). This was done for several reasons: to assure seed contact with the soil; to protect against the seeds being blown away (This was of particular concern with *Asteraceae* seeds.); and, lastly, to provide some protection against pathogens.
- ⤴ We sprayed the entire surface with a fine mist of water;
- ⤴ We soaked the tray in a sub-irrigation flat (a flat that has a solid floor) for about one hour; *
- ⤴ We removed the trays from the sub-irrigation flats and let them drain;
- ⤴ We performed the Post-sowing actions of the Treatment Type*** being followed, as described below.

Creating a Plant Tag:

- ⤴ Take a white plant tag and, using a pencil, write on the front, the following information shown in the diagram below;
- ⤴ On the back of each plant tag write the Replication number****

Scientific name of the Plant	Treatment type **
Location where plant collected	
Date when plant was collected	Date of sowing

* **Soaking** of the trays is always the best way to water the plants and it is especially important for the very first watering. Moisture coming from below forces young seedlings to search down into the soil for water; watering from above will sometimes force the un-germinated seeds to come above the surface.

** **Treatment Type** refers to one of the treatments described in the next section

*** **Replication number** refers to a '1', '2' or '3' assigned randomly to each of the three sets of seeds sown. As discussed above in *Plant Selection*, the three replications X the six species X the three treatments gave the number 54 as the number of trays needed. Each replication appeared in only one tray. **Note:** No attempt was made among the six species to place the tray in a particular order within the flat.

Treatments

After discussions with the Project Advisor, we decided that the propagation methodology would entail the following treatments: *Control*, *Three-month Stratification* and *One-month Stratification*. (See Project Timeline.) We followed the same **Sowing** procedures described above, preceding the treatments described here:

Post-sowing actions for Control Treatment:

We took the prepared flats out into the Garden. The area selected in the Garden by the Project Advisor represents a typical, but safe location. We place a mesh cover over the enclosed area to protect against animals and severe weather. (PHOTOS 15 & 16) Also, we monitored germination and the trays were watered if needed. This “treatment” was meant to simulate the action of seeds falling on the ground and being left to basically ‘fend for themselves’.

Post-sowing actions for Three-month Stratification Treatment:

We moved the prepared flats into a refrigerator. Before moving into the refrigerator, we sprayed the top of each tray again with water again. This was done to assure that a relatively high humidity would exist around the seeds. To minimize the space needed in the refrigerator, we stacked the flats vertically. Additionally, we put the flats into a black garbage bag that was loosely folded about them. This was done to help prevent desiccation of the soil medium during refrigeration.

Post-sowing actions for One-month Stratification Treatment:

We followed the same steps as we did for the Three-month Stratification procedure.

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Germination Oversight

As identified below in *Project Timeline*, we brought all treatments together on April 15, 2012. (PHOTO 17) We put all of the flats on one table for ease of oversight. The various treatments were laid out as the diagram shows to create a more random environment in the greenhouse. We were able to record the germination results of these 54 flats with the aid of this diagram.

Layout of the flats on the greenhouse table (Key: Treatment-Rep):

C-3	1-3	3-3
3-2	C-2	1-2
1-1	3-1	C-1

Before April 15, when all treatments were brought into the greenhouse, we took various steps to help make the germination process more successful:

- On March 30 and April 11, we fertilized the control flats with 25ppm N(25 parts per million Nitrogen). Within approximately 30 minutes these flats were then sprayed with water to flush the fertilizer from the seedlings’ leaves and to move the fertilizer into the soil. **Notes:** Henceforth, we used this procedure to fertilize the seedlings. We intend to increase concentration to 50ppm when the seedlings are more robust.
- On April 5, we sprayed Hydrogen peroxide (0.75%) on the three control flats to reduce the chance of ‘damping off’. The solution was sprayed so as to totally wet the surface of the flat and thus sterilize the surface soil.

After April 15, when all treatments were in the greenhouse, we performed oversight to assure the greatest likelihood of success. Our activities while the seedlings were in the greenhouse were as follows:

- April 19 - we again sprayed the flats with hydrogen peroxide.
- April 20 – we fertilized (25ppm N) and watered the flats
- May 1 - we fertilized (25ppm N) the flats
- May 3 – we soaked the flats for approximately 20 minutes in water.
- We soaked the flats weekly until May 31
- We fertilized (25ppm N) the flats May 15 and May 30.

RESULTS

Project Timeline

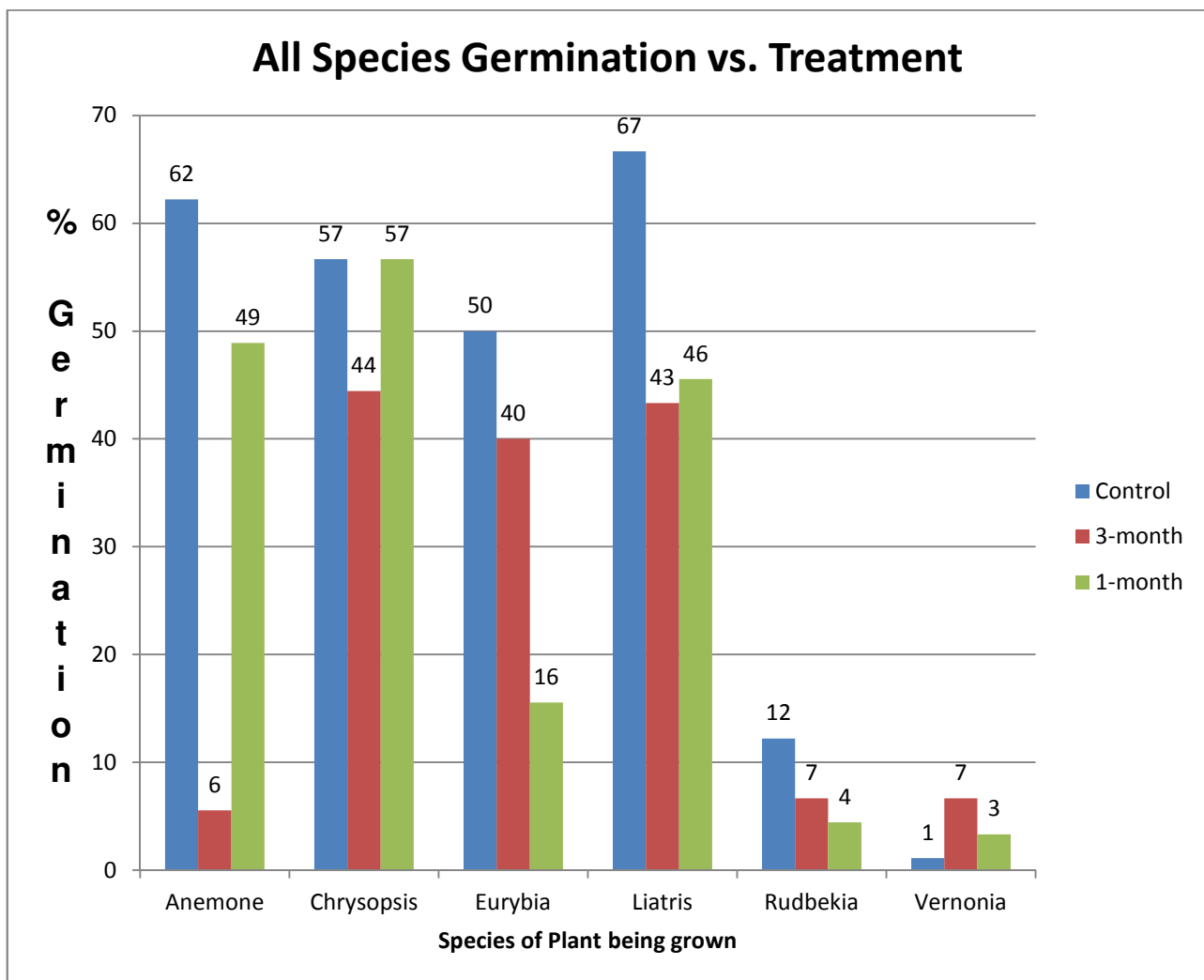
Date	Milestone	Action and Notes
12/1/11	Control Treatment	Moved trays directly outside
01/12/12	Three-month Stratification Treatment	Moved trays into refrigerator
3/15/12	One-month Stratification Treatment	Moved trays into refrigerator
3/15/12		Begin weekly monitoring of all treatments and recording germination results
3/29/12	First treatment into greenhouse	Moved control treatment into greenhouse

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4/15/12	All treatments now together	Moved all plants into greenhouse
4/15/12	Start germination oversight	Start monitoring of all plants in greenhouse
5/31/12	End of Project	Prepare final report
7/8/12	Graduation	Present results ; receive diplomas

Project Results – All Species Germination

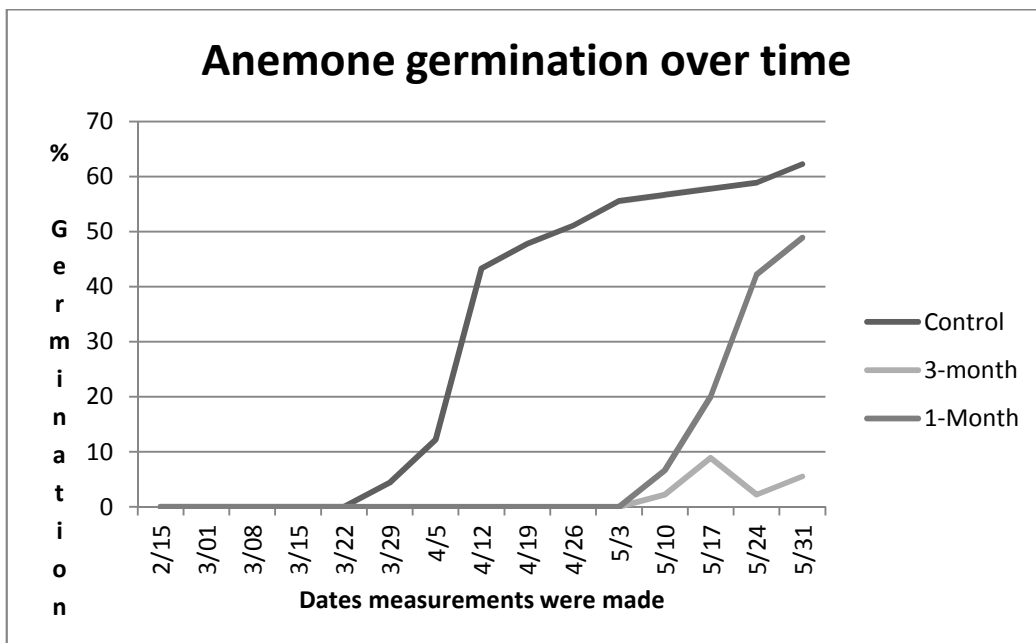
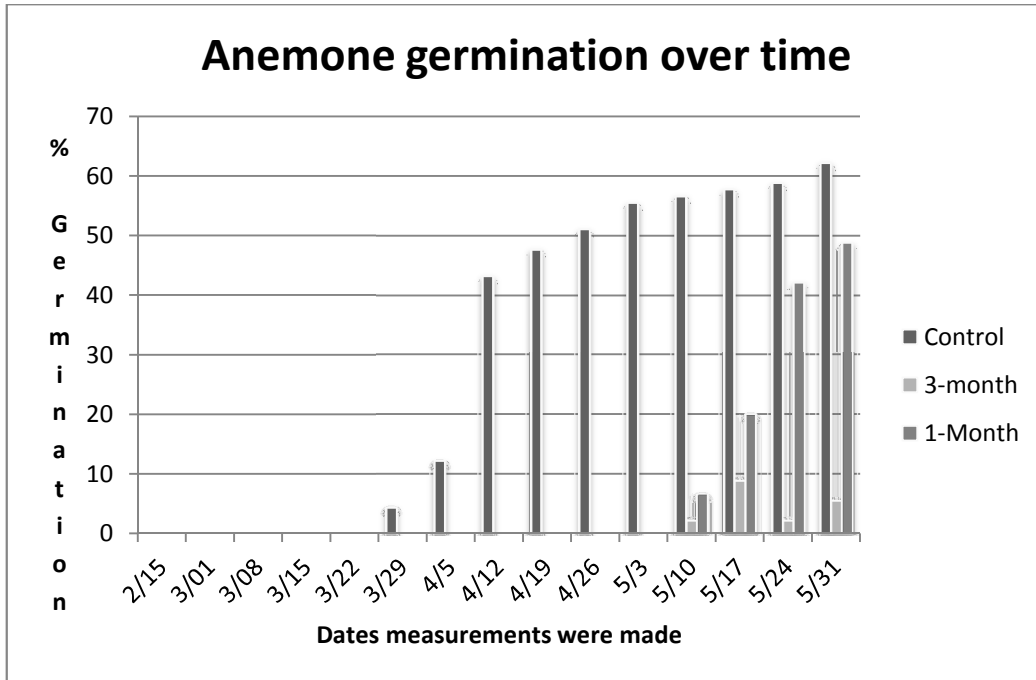
In this section of the document we show the results of our endeavours. Here, we present charts that give an excellent view of progress over the almost six months of the project, from creation of the Control Treatment to the final reading at the end of May. Additionally, for those who want to see numerical results, we have included in Appendix 3 the spreadsheet of recorded counts.



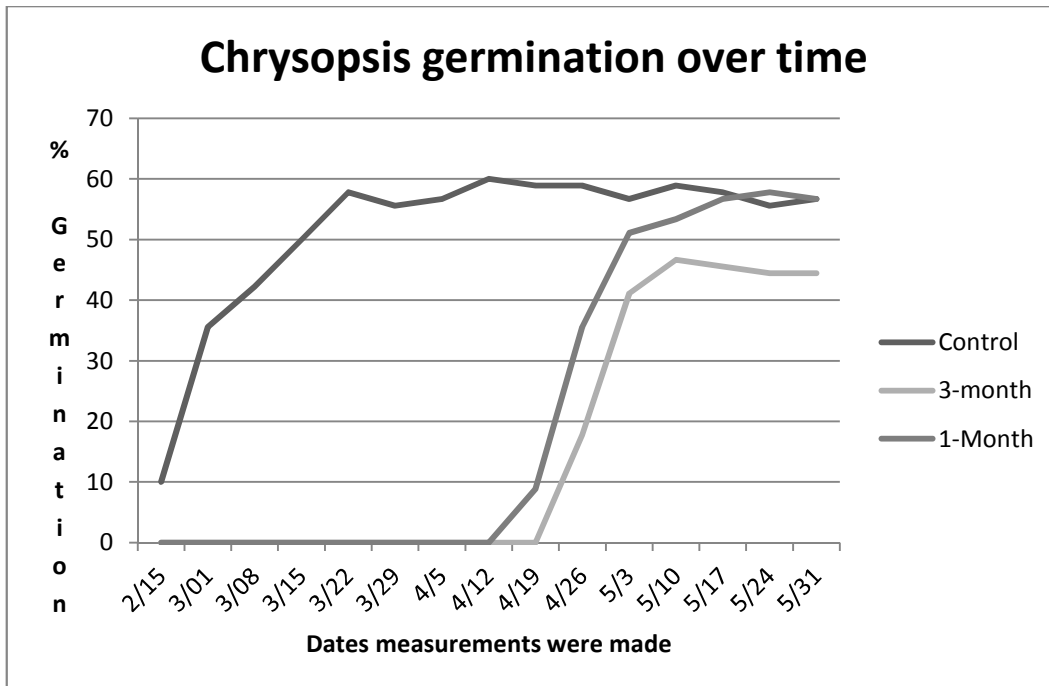
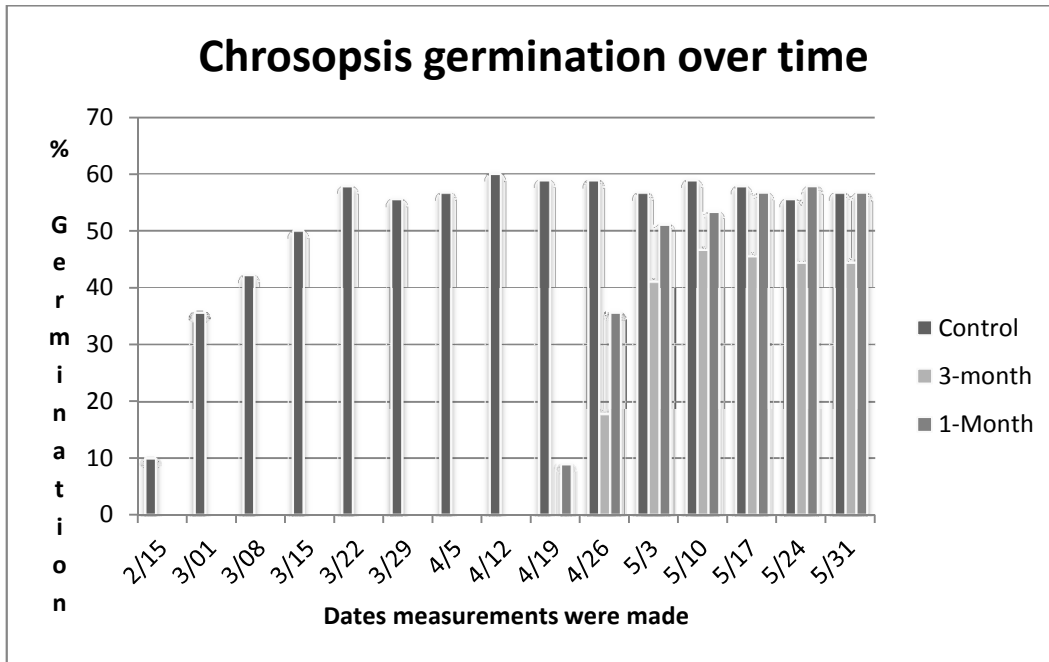
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Project Results – Individual Species Germination (*Anemone virginiana*)

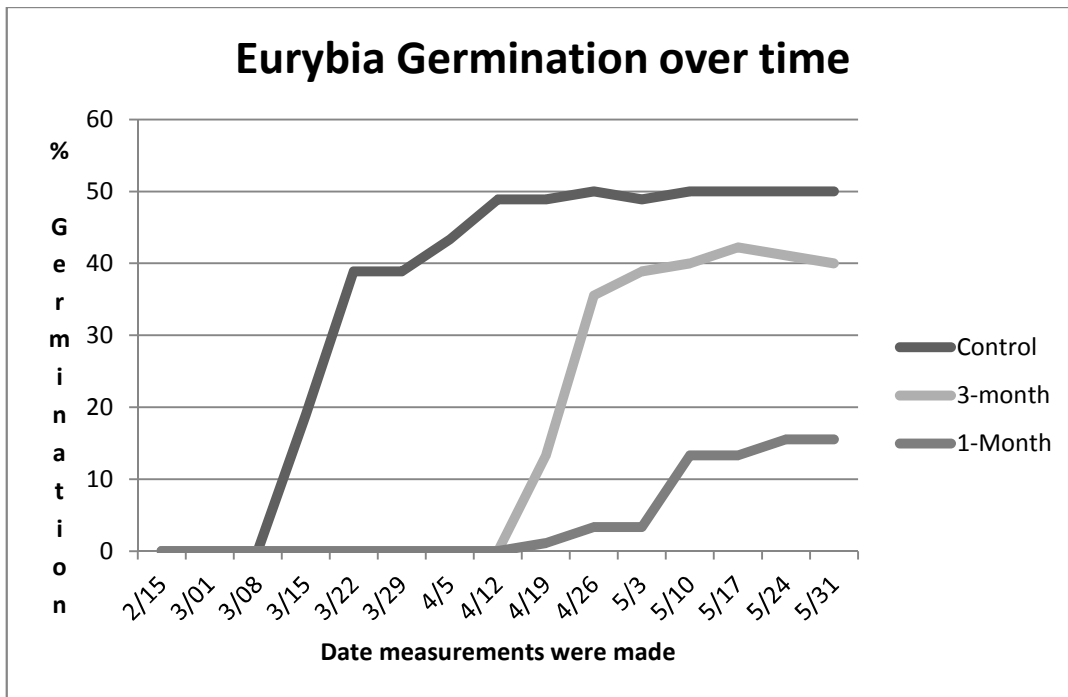
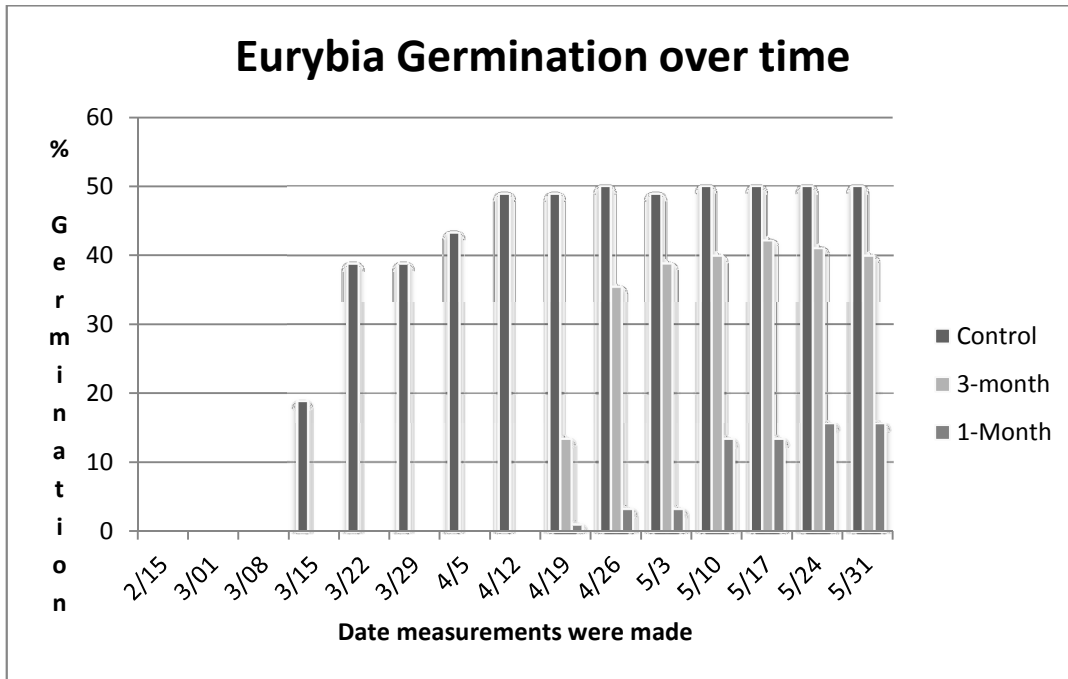
In this and the following sections we show germination results for each species. We have provided two types of charts: the bar chart provides a histogram of results; the line chart gives a clearer view to the reader of the change in germination rate.



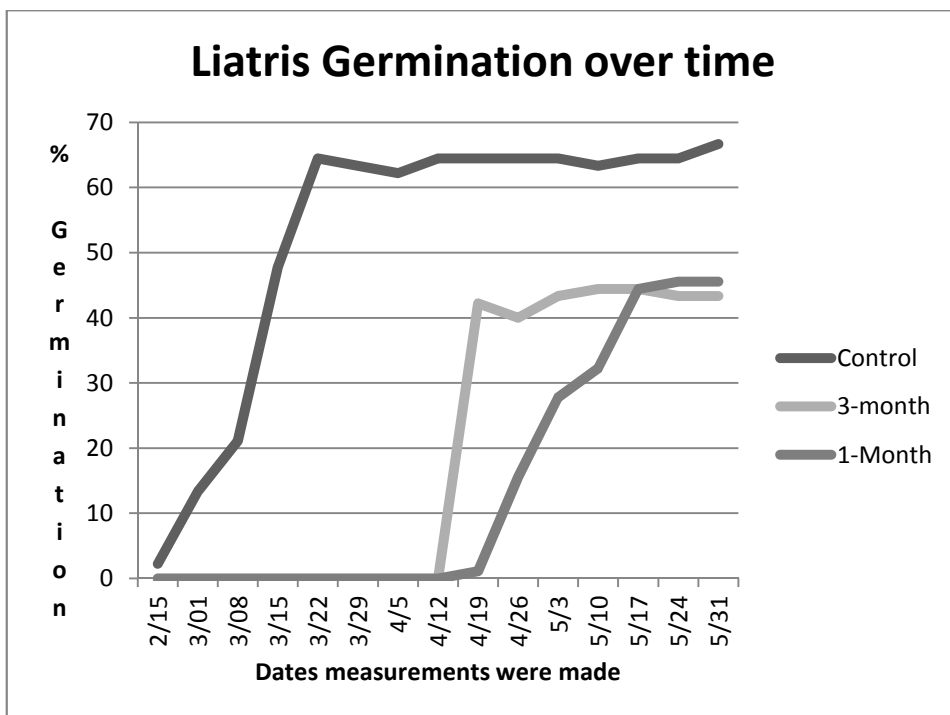
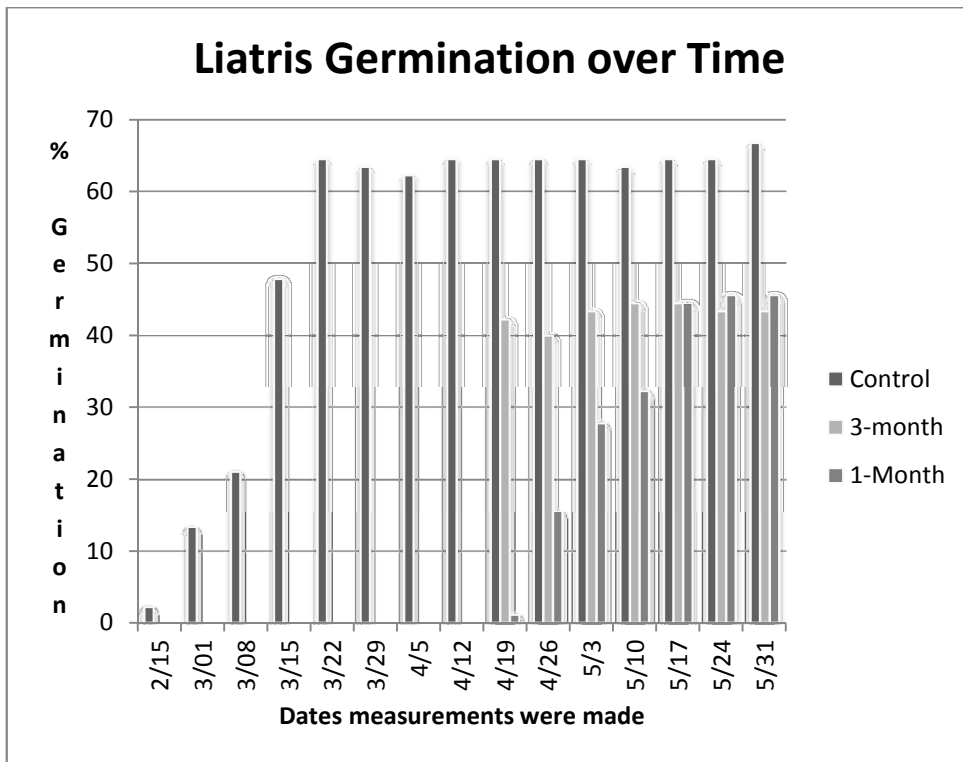
Project Results – Individual Species Germination (*Chrysopsis mariana*)



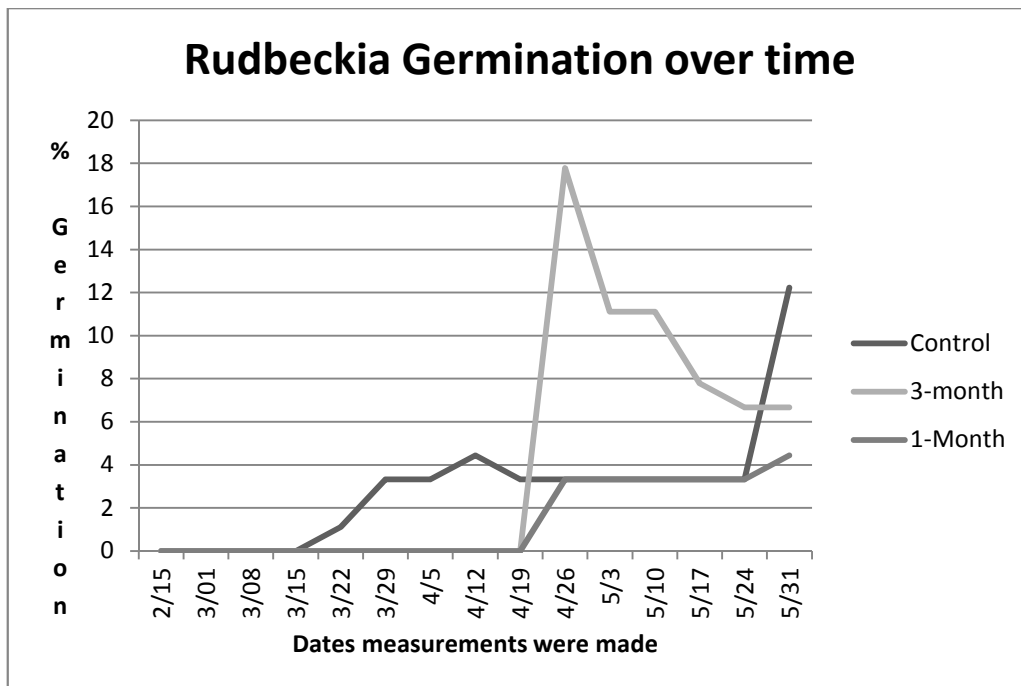
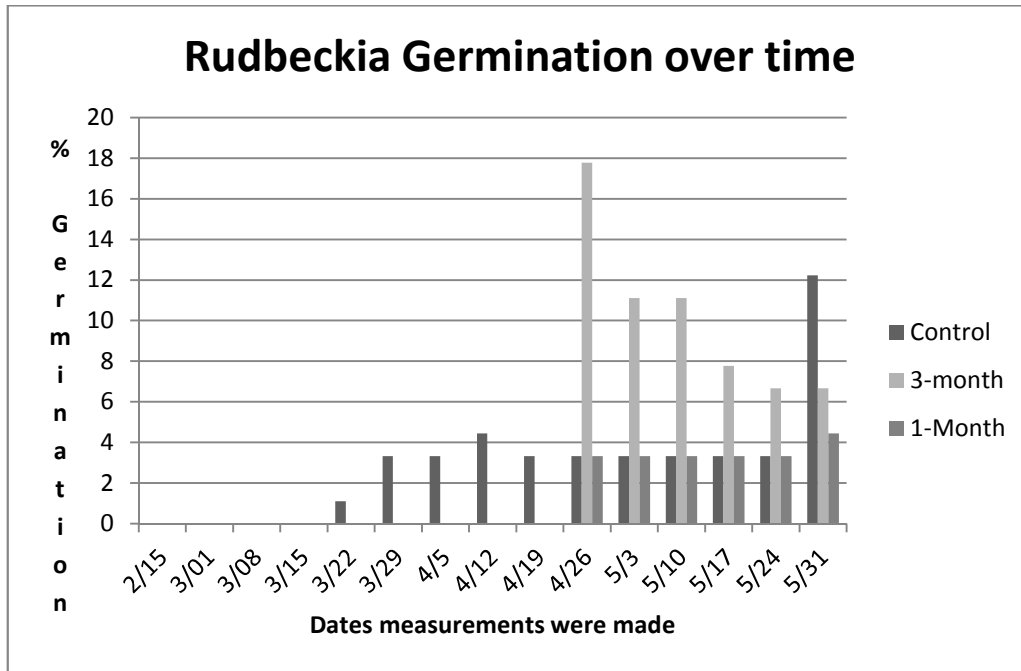
Project Results – Individual Species Germination (*Eurybia macrophylla*)



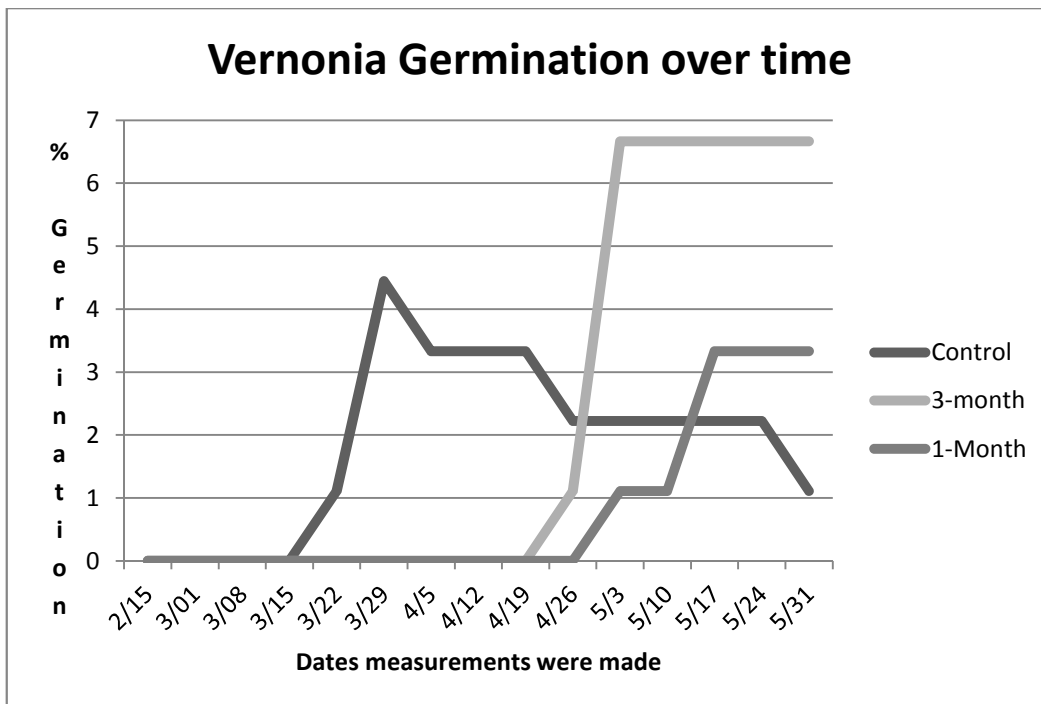
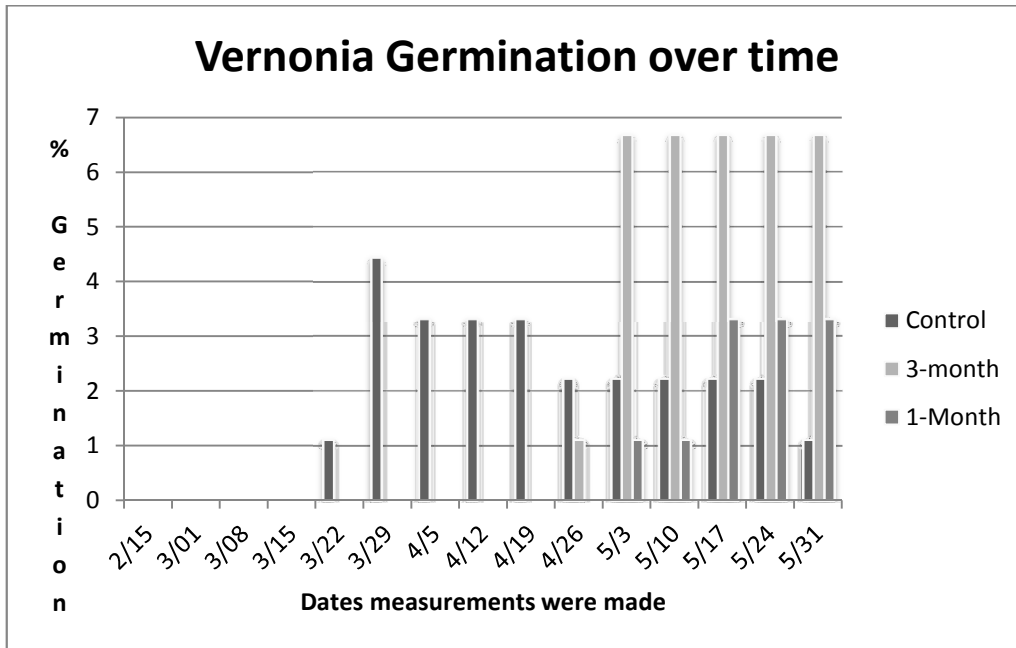
Project Results – Individual Species Germination (*Liatris spicata*)



Project Results – Individual Species Germination (*Rudbeckia triloba*)



Project Results – Individual Species Germination (*Vernonia acaulis*)



OBSERVATIONS, CONCLUSIONS AND RECOMMENDATIONS

Observations

Our observations summarize the results shown above and in **Appendix 3 – Result Data Sheets**. The number of seeds that germinated from our project (the ‘yield’) fell into three categories:

1. the high above 50% for *Chrysopsis* and *Liatris*;
2. around 40% for *Anemone* and *Eurybia*; and
3. under 10% for *Rudbeckia* and *Vernonia*.

Chrysopsis and *Liatris* were also consistent in having an over 40% yield in all treatments.

We offer the following separate observations for each species.

Anemone:

The Control treatment produced the largest yield; followed closely by the One-month treatment.

Chrysopsis:

There was high yield in all treatments.

Eurybia:

The Control, closely followed by the three-month treatment produced the largest yield.

Liatris:

The Control treatment produced the largest yield; the other two treatments were above 40%.

Rudbeckia:

There was generally low yield, but a somewhat higher yield in the Control treatment.

Vernonia:

There was generally low yield, but a somewhat higher yield in the three-month treatment.

Conclusions and Recommendations

The conclusions we present here are based on the results shown and observations, both given above. We want to emphasize that an attempt to reproduce this study may produce different results.

The Control treatment produced a better yield for all species, except *Vernonia*. For this reason, we recommend planting *Anemone*, *Chrysopsis*, *Eurybia*, *Liatris*, and *Rudbeckia*) in the Fall without any stratification process. They should be sown in a well-drained soil medium such as the one we used; watering when. Then they should be moved into a greenhouse or equivalent mid-April to early-May. **(As a general comment, North Carolina had a very mild Winter and Spring this year. This might have been a factor in the success of the Control treatment.)**

Rudbeckia and *Vernonia* had a very poor yield. We suspect that the batch of seeds collected for these species may have been somewhat ‘defective’ (insufficiently mature). We recommend that the seeds for these two species be collected from a wider set of plants in the wild. **(It should be noted, that the plants growing in the site where the seeds were collected are naturalizing well.)**

Another explanation of such a poor showing was that our ‘viability testing’ was ineffective.

The yield of the three-month stratification of *Anemone* was 5.56% compared to the average yield of the other two treatments of 50%. Though other factors may have been at play, we believe that the data suggests that *Anemone* in this study didn’t like the long time in the refrigerator. **(We also note that *Anemone* grows in NC in our Mountain, but does prefer well-drained soil.)**

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THINGS WE WOULD DO DIFFERENTLY

Ensure for each species that we collect seeds from a large community of plants to assure a greater genetic mix.

We should track each species as an individual unit. This may seem obvious, but we had the tendency to think in terms of best practice for germinating *all* native plants. This is unrealistic because each species has its own individual requirements and preferences. In our trials we very deliberately used identical materials and procedures for all plants for ease of study.

We should take into account the seed viability of each species. For example, *Liatris* has 60% seed viability, whereas *Eurybia* has only 37%. The natural viability percentages of each species obviously have a stronger impact on germination than the variables we used.

We should use a larger sample. We were aware of this problem from the beginning but were restricted by the amount of refrigeration, greenhouse and outdoor space for control that was available to us.

We should use plants from different families. The plants we chose were drawn heavily from the *Asteraceae* family (all but one, the *Anemone*). We may have been able to generate more varying information using other families.

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9. [Atlas of Florida Vascular Plants](#)
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11. [American Beauties, Native Plants](#)
12. [US Forestry Service](#)
13. North Carolina Native Plant Propagation Handbook, NC Wildflower Preservation Society
14. [University of Florida, School of Forestry Resources and Conservation](#)
15. [NatureServe, a non-profit conservation organization](#)
16. [Illinois Wildflowers](#)
17. Growing & Propagating Wildflowers, Harry Phillips
18. Plant Identification Terminology, James G. Harris and Melinda Woolf Harris

Note on References

Wikipedia was used extensively, especially to get a first-cut overview of the plant. When information was extracted, sometimes verbatim, from Wikipedia the symbol <W> is used to notify this.

APPENDICES

Appendix 1 – Plant Descriptions

The following section describes the plants we propagated along with a photo of each one. Unfortunately, we do not have photos of our own flowering plants due the fact that the project ran from Dec, 2011 to June, 2012 and no plants had developed blossoms at that time.

Additionally, for the reader of this document in electronic form (MicroSoft® Word), we have included in this section of the document many HyperText Mark-up Language (HTML) links to web locations both for the references, and also for further information to the reader.

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Photo credits

Plant	Credit
<i>Liatrix spicata</i>	Larry Allain @ USDA-NRCS PLANTS Database
<i>Eurybia macrophylla</i>	Thomas G. Barnes @ USDA-NRCS PLANTS Database / Barnes, T.G., and

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S.W. Francis. 2004. *Wildflowers and ferns of Kentucky*. University Press of Kentucky

All other plants

William S. Justice @ USDA-NRCS PLANTS Database

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Anemone virginiana L.

[Tall thimbleweed]

Family: *Ranunculaceae*

Duration & Growth Habit [Ref #1]:

Perennial, Herb/Forb

Native Status & Range (Ref #1,3): Native to the US from the Atlantic east to CO and WY, excluding MN, NM and TX; plus all of Canada below the Territories ([Map](#)).

Height: 1 to 2.5 ft

Bloom Time: May - July

Bloom color: White with thimble-like, center mound of yellowish stamens

Inflorescence type: Solitary capitulum

Fruit: Diaspora(“achene wrapped in woolies”)

Exposure: Full sun to Part shade

Soil type: Dry, Shallow, Rocky Soil

Water needs: Low to medium (Drought tolerant)

Conservation Status [Ref #15]: Secure



INTERESTING ASPECTS OF PLANT

- In NC, this plant occurs principally in the Mountains and the Piedmont and the Tar-Pamlico
- Present in dry woody slopes
- When the fruits, called achenes, are ripe they have gray-white colored, densely woolly styles, that allow them to blow away in the wind and tumble, similar to a tumbleweed; this type of achene is sometimes called a "tumble fruit" or [diaspore](#). <W>
- Thimbleweed gets its name from its fruit which looks like a thimble.
- Excellent spring flower for the shaded or woodland garden. *Anemone virginiana* is also a good choice for naturalized areas or native wildflower gardens.
- Medicinally, this plant is an expectorant, an emetic, and an astringent.
- Natives used the caudex, the thickened, usually underground base of the stem, in many forms to cure many ailments.
- Smoke from roasting seeds was used to revive the unconscious by being blown into the nostrils of the patient.
- As with many medicinal plants, all parts are poisonous when fresh but only if eaten in large quantities.

Chrysopsis mariana (L.) Elliot

[Maryland goldenaster]

Family: *Asteraceae*

Duration & Growth Habit [Ref #1]:

Perennial, Herb/Forb

Native Status & Range (Ref #1,3): Present in the US along the Eastern Seaboard excluding CT north, west to approximately the Appalachina Mountains, west along Gulf states to LA and TX, absent from Canada ([Map](#)).

Height: 1 to 2 ft

Bloom Time: Late Summer into Fall

Bloom color: Yellow petals and centre

Inflorescence type: A loose cluster of solitary capitulum

Fruit: Cypsela (1/8” achene with 1/4” pappus of bristles

Exposure: Full sun to Part shade

Soil type: Dry, Shallow, Rocky Soil

Water needs: Low to medium (Drought tolerant)

Conservation Status [Ref #15]: Secure



INTERESTING ASPECTS OF PLANT

- In NC, this plant occurs throughout the state.
- This is not a true aster. (Ref #5)
- Common in old fields, woods and roadsides. (Ref #5)
- Because of its silky stems, the Maryland golden-asters are also known as *silkgrass* <W>
- Goldenaster is an important food for gopher tortoises. (Ref #14)

Eurybia macrophylla

[Bigleaf aster, largeleaf wood aster]

Family: *Asteraceae*

Duration & Growth Habit [Ref #1]:

Perennial, Herb/Forb

Native Status & Range (Ref #1,3): Native to the entire Eastern USA to Missouri River, excluding Arkansas and the southern coastal states east of Texas ([Map](#)).

Height: 4.5 ft

Bloom Time: Late Summer

Bloom color: Violet to pale blue rays with yellow centers

Inflorescence type: Solitary capitulum flower

Fruit: Cypsela (1/4” achene + 1/4” pappus of bristles)

Exposure: Part shade to full shade

Soil type: dry to moist, well-drained, sandy loams

Water needs: Medium

Conservation Status [Ref #15]: Secure



INTERESTING ASPECTS OF PLANT

- In NC, this plant occurs only in our mountain counties
- The large, thick young leaves can be cooked and eaten as greens <W>
- It is rhizomatous, native to woods and clearings and colonial, often forming dense patches measuring up to 19 × 16 feet (**Ref #12**)
- Regeneration is largely by vegetative means from rhizomes and root crown sprouts (**Ref #12**)
- Can persist in high light environments because of its ability to control stomatal conductance (**Ref #12**)

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Liatriis spicata (L.) Willdenow [dense blazing star, dense gayfeather, marsh blazing star]

Family: *Asteraceae*

Duration & Growth Habit [Ref #1]:

Perennial, Herb/Forb

Native Status & Range (Ref #1,3): Native to the entire Eastern USA excluding Vermont, New Hampshire, Maine and the Canadian Maritime provinces; west principally to Mississippi River ([Map](#)).

Height: 2 to 4 ft (may be up to 6ft)

Bloom Time: July to August

Bloom color: Rose-purple (sometimes white)

Inflorescence type: A long, dense spike

Fruit: Cypsela (1/4” achene + 1/4” pappus of bristles)
(PHOTO 5)

Exposure: Full sun

Soil type: Moist and fertile

Water needs: Medium

Conservation Status [Ref #15]: Secure



INTERESTING ASPECTS OF PLANT

- In NC, this plant occurs throughout the state, although more frequently in the mountain and southern coastal counties
- Individual flowers are rayless
- Native to moist prairies and sedge meadows <W>
- Tolerates clay soil, but performs better in moist soils than most other species of *Liatriis*. However, it is intolerant of wet soils in winter. Tolerant of summer heat and humidity. (Ref #6)
- May be grown from seed, but is slow to establish. (Ref #6)

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Rudbeckia triloba

[Brown-eyed Susan]

Family: Asteraceae

Duration & Growth Habit [Ref #1]:

Perennial, Herb/Forb

Native Status & Range (Ref #1,3): Native to the entire Eastern USA excluding Vermont, Maine and the Canadian Maritime provinces; west to Missouri River and south to Texas ([Map](#)).

Height: 3 to 4 feet

Bloom Time: June to August

Bloom color: Yellow

Inflorescence type: Solitary capitulum; with a 'woody' crown

Fruit: 1/4" achene with a scale pappus

Exposure: Full sun to part shade (a few hours a day)

Soil type: Moist, well-drained

Water needs: Dry to medium (tolerates drought)

Conservation Status [Ref #15]: Secure



INTERESTING ASPECTS OF PLANT

- In NC, this plant is common in the mountain counties and occurs in Warren county
- A herbaceous biennial to weak perennial <W>
- This plant is, in part, distinguished from black-eyed Susan (*R. hirta*) by having a more profuse bloom of smaller flowers that usually have fewer rays per flowerhead. <W>
- Basal leaves are often trifoliate (three leaflets, sometimes each of the three also divided.) <W>
- Great nectar source for butterflies and other pollinators (**Ref #11**)
- Produces lots of seeds for songbirds (**Ref #11**)
- Spent flowers should be removed to encourage additional bloom and/or to prevent any unwanted self-seeding (unless you want to feed the birds). (**Ref #11**)

Vernonia acaulis (Walter) Gleason

[Stemless ironweed]

Family: Asteraceae

Duration & Growth Habit [Ref #1]:

Perennial, Herb/Forb

Native Status & Range (Ref #1,3): Native to only North & South Carolina and Georgia. (However, a 'vouchered' siting is reported in Polk county Florida. **Ref #9**)

Height: 3 to 3.5 feet

Bloom Time: July to August

Bloom color: Purple-blue

Inflorescence type: Loose, corymbiform arrays

Fruit: Cypsela (1/4” achene + 1/4” pappus of bristles)

Exposure: Full sun to part shade

Soil type: Dry, sandy soils.

Water needs: Dry to medium (tolerates drought)

Conservation Status [Ref #15]: Apparently secure



INTERESTING ASPECTS OF PLANT

1. In NC, this plant is common in only the southern Piedmont counties and on the coast in Carteret county ([Map](#))
2. In late summer, when many perennials have lost their shine, stemless ironweed delights us with refreshingly bright reddish purple flowers. Although the name ironweed is said to refer to the rusty colored seed clusters, this plant is also tough as iron, undemanding and easy-to-grow. Stemless ironweed forms a basal rosette of absolutely flat leaves with 36”-42” tall stems rising from its center. It performs well in situations from partial shade to sun and well-drained to dry soils. (**Ref #8**)
3. “ The term, 'Stemless' comes from the fact that much of the year it grows only as a rosette of ground-hugging deep green leaves. In July it sends up a tall branched stalk and blooms its heart out. (**Ref #5**)
4. Some hybridization is noted in several NC counties: (**Ref #10**)

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Appendix 2 – Photos of our Procedures

- Photo 1. Sample sieve and collection pan
- Photo 2. Seed blower
- Photo 3. *Vernonia acaulis* – seeds and flower heads
- Photo 4. Cleaning method – strike bag full of flowerheads
- Photo 5. *Liatris spicata* – seeds and chaff
- Photo 6. *Anemone Virginia* – seeds with and without blanket
- Photo 7. Cleaning method - unsuccessful
- Photo 8. *Chysopsis mariana* – seeds and chaff
- Photo 9. Microscopic view of viable vs. non-viable seeds
- Photo 10. Sandy count method – step 1
- Photo 11. Sandy count method – step 2
- Photo 12. Soil preparation - three sieve steps
- Photo 13. Control plants ready – showing plant tag
- Photo 14. Light dusting of sand
- Photo 15. Control plants in their outside home – 1
- Photo 16. Control plants in their outside home – 2
- Photo 17. All plants together in greenhouse

Photo Credits

All photos in this section were taken by either Sandy Young or Paul Young.



Photo 1 - Sample sieve and collection pan

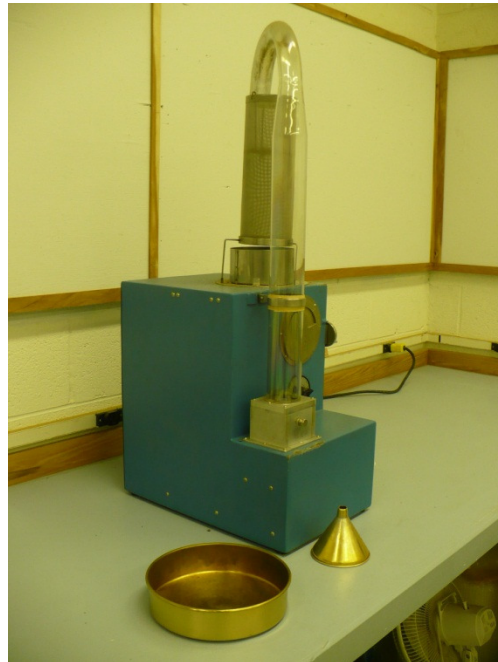


Photo 2 - Seed Blower

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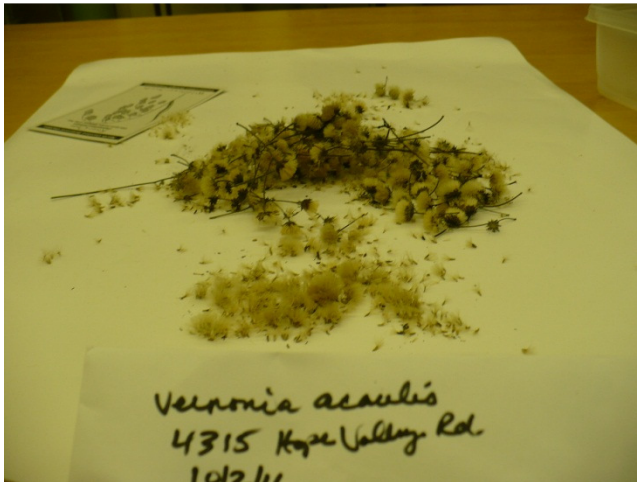


Photo 3 - *Vernonia acaulis* seeds and chaff



Photo 4 Cleaning method - strike bag full of flowerheads

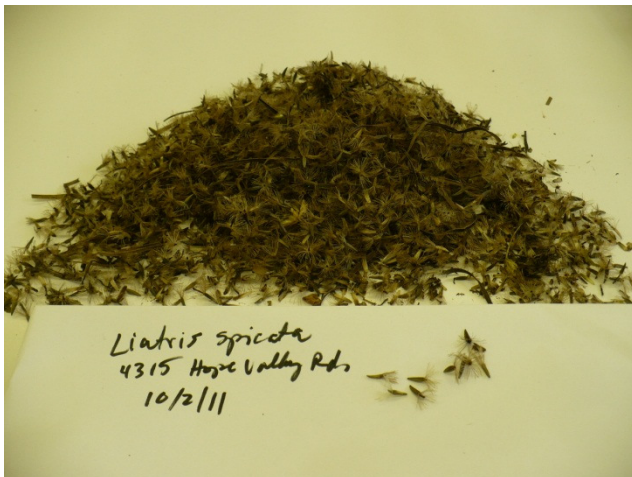


Photo 5 - *Liatris spicata* - seeds and chaff

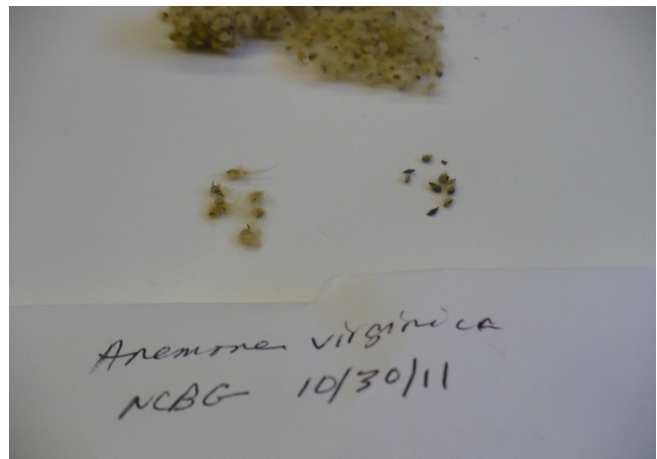


Photo 6 - *Anemone Virginia* - seeds with and without blanket

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Photo 7 – Unsuccessful cleaning methods



Photo 8 – *Chrysopsis mariana* – seeds & chaff



Photo 9 – Microscope view of viable seed

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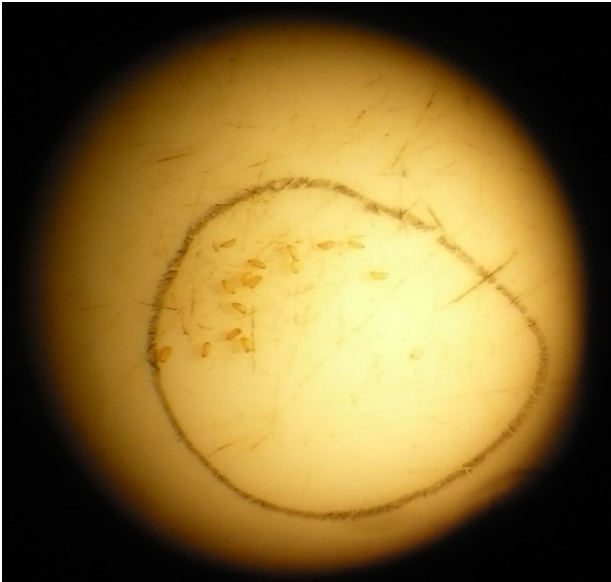


Photo 10 – Sandy count method – Step 1



Photo 11 – Sandy count method – Step 2



Photo 12 Soil preparation three sieves

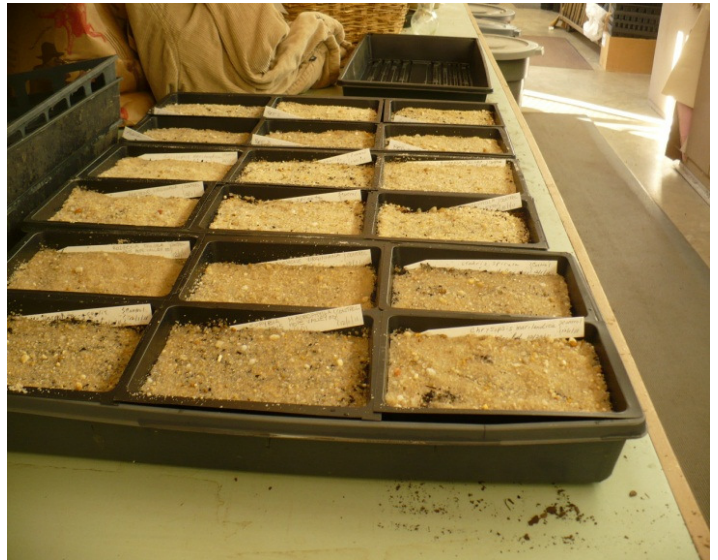


Photo 13 Control plants showing plant tags

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Photo 14 Light dusting of sand



Photo 15 Control plants outside home – 1



Photo 16 Control plants' outside home -2

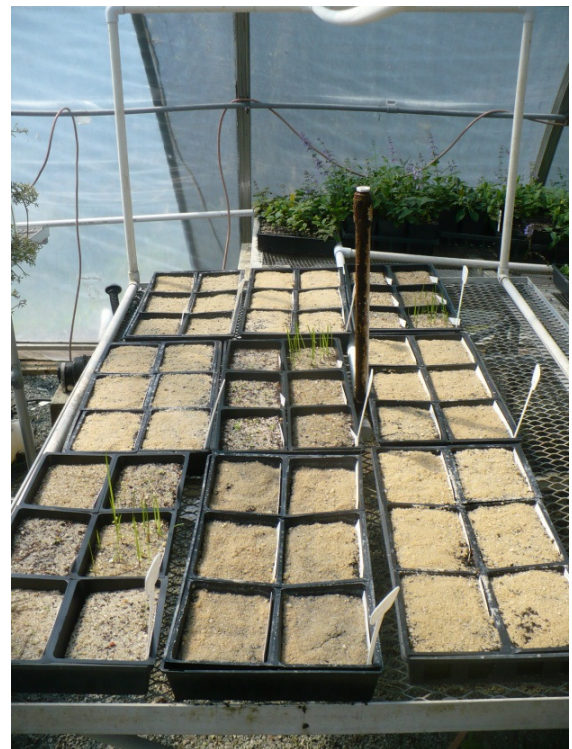


Photo 17 All plants now in greenhouse

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Appendix 3 – Results Data Sheets

In the following charts the shaded area represents the period when plants were in one of the three ‘treatment’ periods: **Control, Three-month stratification or One-month stratification**. On April 15 all of the plants were brought together in the garden greenhouse and placed on one table. All of the readings after that time, up to the end of the project (March 31) were taken in the greenhouse.

Anemone Results

Treatment - Rep	2/15	3/01	3/08	3/15	3/22	3/29	4/5	4/12	4/19	4/26	5/3	5/10	5/17	5/24	5/31
Control - 1	0	0	0	0	0	0	0	13	17	16	19	20	21	21	22
Control - 2	0	0	0	0	0	0	8	15	17	18	18	17	19	23	22
Control - 3	0	0	0	0	0	4	3	11	9	12	13	14	12	9	12
Control TOTAL	0	0	0	0	0	4	11	39	43	46	50	51	52	53	56
3-Month - 1											0	1	1	0	1
3-Month - 2											0	0	5	1	3
3-Month - 3											0	1	2	1	1
3-Month TOTAL	0	0	0	0	0	0	0	0	0	0	0	2	8	2	5
1-Month - 1											0	0	2	5	9
1-Month - 2											0	1	8	19	20
1-Month - 3											0	5	8	14	15
1-Month TOTAL	0	0	0	0	0	0	0	0	0	0	0	6	18	38	44
TOTAL	0	0	0	0	0	4	11	39	43	46	50	59	78	93	105

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Chrysopsis Results

Treatment - Rep	2/15	3/01	3/08	3/15	3/22	3/29	4/5	4/12	4/19	4/26	5/3	5/10	5/17	5/24	5/31
Control - 1	3	9	12	14	17	15	17	19	17	17	17	18	17	16	16
Control - 2	3	13	13	13	17	17	15	18	17	17	16	17	17	16	16
Control - 3	3	10	13	18	18	18	19	17	19	19	18	18	18	18	19
Control TOTAL	9	32	38	45	52	50	51	54	53	53	51	53	52	50	51
3-Month - 1									0	3	9	10	10	10	10
3-Month - 2									0	11	15	17	16	15	15
3-Month - 3									0	2	13	15	15	15	15
3-Month TOTAL	0	0	0	0	0	0	0	0	0	16	37	42	41	40	40
1-Month - 1									4	15	18	19	20	20	20
1-Month - 2									0	5	13	14	15	17	16
1-Month - 3									4	12	15	15	16	15	15
1-Month TOTAL	0	0	0	0	0	0	0	0	8	32	46	48	51	52	51
TOTAL	9	32	38	45	52	50	51	54	61	101	134	143	144	142	142

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***Eurybia* Results**

Treatment - Rep	2/15	3/01	3/08	3/15	3/22	3/29	4/5	4/12	4/19	4/26	5/3	5/10	5/17	5/24	5/31
Control - 1	0	0	0	7	8	13	6	10	10	11	11	11	11	21	21
Control - 2	0	0	0	7	17	19	20	21	21	21	21	21	21	11	11
Control - 3	0	0	0	3	10	3	13	13	13	13	12	13	13	13	13
Control TOTAL	0	0	0	17	35	35	39	44	44	45	44	45	45	45	45
3-Month - 1									7	13	13	13	14	14	14
3-Month - 2									4	13	15	15	16	15	14
3-Month - 3									1	6	7	8	8	8	8
3-Month TOTAL	0	0	0	0	0	0	0	0	12	32	35	36	38	37	36
1-Month - 1									1	2	2	6	6	6	6
1-Month - 2										1	1	4	4	2	2
1-Month - 3										0	0	2	2	6	6
1-Month TOTAL	0	0	0	0	0	0	0	0	1	3	3	12	12	14	14
TOTAL	0	0	0	17	35	35	39	44	57	80	82	93	95	96	95

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***Liatis* Results**

Treatment - Rep	2/15	3/01	3/08	3/15	3/22	3/29	4/5	4/12	4/19	4/26	5/3	5/10	5/17	5/24	5/31
Control - 1		4	7	15	20	21	22	22	22	22	22	22	22	20	20
Control - 2	2	5	6	14	21	20	20	20	20	20	20	19	20	22	22
Control - 3		3	6	14	17	16	14	16	16	16	16	16	16	16	18
Control TOTAL	2	12	19	43	58	57	56	58	58	58	58	57	58	58	60
3-Month - 1									17	15	15	15	15	15	15
3-Month - 2									9	8	11	12	12	11	11
3-Month - 3									12	13	13	13	13	13	13
3-Month TOTAL	0	0	0	0	0	0	0	0	38	36	39	40	40	39	39
1-Month - 1									1	3	4	0	11	11	11
1-Month - 2										2	7	13	13	16	16
1-Month - 3										9	14	16	16	14	14
1-Month TOTAL	0	0	0	0	0	0	0	0	1	14	25	29	40	41	41
TOTAL	2	12	19	43	58	57	56	58	97	108	122	126	138	138	140

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Rudbeckia Results

Treatment - Rep	2/15	3/01	3/08	3/15	3/22	3/29	4/5	4/12	4/19	4/26	5/3	5/10	5/17	5/24	5/31
Control - 1					0	1	0	1	0	0	0	0	0	2	8
Control - 2					1	1	2	3	2	2	2	2	2	0	2
Control - 3					0	1	1	0	1	1	1	1	1	1	1
Control TOTAL	0	0	0	0	1	3	3	4	3	3	3	3	3	3	11
3-Month - 1										7	1	1	3	3	3
3-Month - 2										4	5	5	1	1	1
3-Month - 3										5	4	4	3	2	2
3-Month TOTAL	0	0	0	0	0	0	0	0	0	16	10	10	7	6	6
1-Month - 1										0	0	0	0	0	0
1-Month - 2										1	1	1	1	2	2
1-Month - 3										2	2	2	2	1	2
1-Month TOTAL	0	0	0	0	0	0	0	0	0	3	3	3	3	3	4
TOTAL	0	0	0	0	1	3	3	4	3	22	16	16	13	12	21

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Vernonia Results

Treatment - Rep	2/15	3/01	3/08	3/15	3/22	3/29	4/5	4/12	4/19	4/26	5/3	5/10	5/17	5/24	5/31
Control - 1					0	1	0	0	0	0	0	0	0	1	0
Control - 2					1	0	2	2	2	1	1	1	1	0	0
Control - 3					0	3	1	1	1	1	1	1	1	1	1
Control TOTAL	0	0	0	0	1	4	3	3	3	2	2	2	2	2	1
3-Month - 1										0	1	1	1	1	1
3-Month - 2										1	3	3	3	3	3
3-Month - 3										0	2	2	2	2	2
3-Month TOTAL	0	0	0	0	0	0	0	0	0	1	6	6	6	6	6
1-Month - 1										0	0	1	2	2	2
1-Month - 2										0	0	0	0	1	1
1-Month - 3										0	1	0	1	0	0
1-Month TOTAL	0	0	0	0	0	0	0	0	0	0	1	1	3	3	3
TOTAL	0	0	0	0	1	4	3	3	3	3	9	9	11	11	10