An Alaska Native Plant-based Horticulture Curriculum for Elementary Schools

Abstract: 3316

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Research Question

- Higher latitude schools with exceptionally cold climates cannot utilize current plant-based curricula unless each activity is adapted to the particular environment.
- Can a successful plant-based curriculum be designed emphasizing the Alaska resources of native plants, Alaska ethnobotany, and cold climate horticulture?

Purpose

To design and adapt existing curricula from other environments to Alaska conditions using native plants and resources in order to expand the partnership between the Georgeson Botanical Garden and K-6 schools in Alaska.

Rationale

- The use of garden-based curricula is justified in the fact that concepts and skills from virtually every subject can be learned through a garden (Braun et al., 1989).
- Garden-based curricula provides a vehicle for higher order thinking in which students are active participants of constructing knowledge and topics in depth instead of passive by-standards accumulating information (Drake, 1998; Subramaniam, 2002).
- The Alaska environment has extreme weather conditions with short hours of daylight in the winter and long hours of daylight in the summer. Teachers must know how the amount of sunlight affects seed germination and plant growth.
- Native plants of Alaska are extremely vast. Teachers must know which native seeds are affected by depth when sown in soil.
- Over 33 varieties of *Salix* spp. (willow) can be found in Alaska. This useful ethnobotanical plant of Alaska can easily be propagated to make new plants. Teachers must know what species of *Salix* have significant rooting in a hydroponics system.

Hypothesis

Adapting plant-based curricula to Alaska environment will create a useful curriculum for grades K-6.

Lesson Plan Criteria

1. Meets Alaska Content Standards
2. Supplies and seed sources are readily available either within the community or through mail order
3. Plants and soils are well-known and easily recognizable by the community
4. Lesson is completed in reasonable time frame (2-3 weeks)
5. Background information relevant
6. Reasonable teacher preparation time length (1-2 hours)
7. Reasonable time frame for lesson (1-2 classes)
8. Plants grow in field soils
9. Useful secondary product (i.e. use in landscaping)

Experiment

Experimentation for three lesson plans using Alaska Native Plants:

- Photoperiod effects on seed germination percent
- Effects of seed depth on seed germination percent
- Effects of hydroponics system on root establishment of *Salix* spp.

Methods and Results

Photoperiod Experiment

- Seeds from 72 Native plant species
- 2 Treatments:
  - Light-covered with clear plastic wrap to retain moisture
  - Dark- covered with aluminum foil
- Light Treatment: 300 μmoles m^{-2} s^{-1}/ 24 hours/ day in Greenhouse
- Dark Treatment: 0 μmoles m^{-2} s^{-1}/ 24 hours/ day
- 4 replicates: 25 seeds per replicate
- Bottom watering system
- After 7 days, remove clear plastic wrap and aluminum foil
- Calculate percent germination across 4 replicates
- Findings suggest that 6 species had a significantly higher germination percent when sown in light compared to dark; 5 species had a significantly higher germination percent when sown in dark compared to light.
- Results:

Germination by Photoperiod: Number of Successful Seed Types

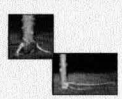
Seeds successfully germinated in...	Dark	not Dark
Light	8	6
not Light	5	53

(based on >40% germination)

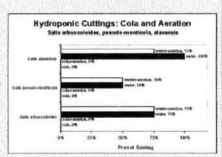
Depth Experiment

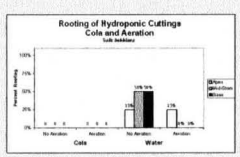
- Seeds from 73 Native plant species
- 2 Treatments:
  - Surface- 0 cm. depth
  - Buried- 3 cm. depth
- Surface seeds-200μmoles m-2 s-1/ 24 hours/ day under Grow Light Table (40 watt fluorescent lights)
- 4 replicates: 25 seeds per replicate
- Trays covered with plastic dome lids or clear plastic wrap to retain moisture
- Overhead watering
- After 30 days, calculate average percent germination across the 4 replicates using 40% germination rate as threshold
- Results:
  - 19 species germinated significantly better at 0 cm. depth
  - 2 species germinated significantly better at 3 cm. depth
  - 4 species thrived on the surface or at 3 cm. depth

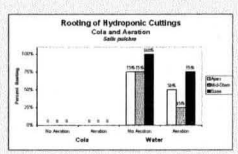
Hydroponics Experiment



Vegetative cuttings-5 species *Salix* spp.
- 4 treatments: water, water with aeration, 4:1 water/cola mix, water/cola mix with aeration
- Apical dominance tested for *Salix bebbiana* and *Salix pulchra*
- Cuttings exposed to 200μmoles m^{-2} s^{-1}/ 24 hours/ day
- Aeration: 15 seconds/ 3 times week
- After 30 days, calculate significant rooting differences across replicates
- Findings suggest that for *Salix* all species produced significantly more roots in water than water with aeration, cola, or cola with aeration. Cola and cola with aeration produced zero roots for all species.







Curriculum Recommendations

Seed Germination & Photoperiod Lesson Plan

- Teachers should use the following seeds for the seed photoperiod lesson.
  - If focusing primarily on plant germination, use any listed species.
  - If focusing on photoperiod and not using a Grow Light Table, seeds that germinate well in light can be planted during spring daylight hours.
  - Seeds that germinate well in dark can be planted during fall daylight hours.

Recommended Seeds
For Study of Germination* and Photoperiod

Seeds successfully germinated in...		
Both Dark and Light	Light, not Dark	Dark, not Light
Dianthus repens	*Plantago maritima*	*Cerastium maximum*
Beckmannia syzigachne	*Tripleurospermum maritima*	*Arnica alpina*
Artemisia tilesii	*Dryas octopetala*	*Erigeron glabellus*
Festuca rubra	*Chrysanthemum arcticum*	*Hedysarum alpinum*
Allium schoenoprasum	*Polemonium pulcherrimum*	*Campanula rotundifolia*
Deschampsia beringensis	*Poa alpina*	
Deschampsia caespitosa		
Trisetum spicatum		

*(based on >40% germination)

Seed Depth Lesson Plan

- Teachers should use the following seeds, when available, for the seed depth lesson.
- Expect 40% or greater germination rate for these plant species.
- Extension: Teachers can discuss "seed banks"

Both Surface and SubSurface	Surface Only	SubSurface Only
Allium schoenoprasum	Anemone multifida	Lathyrus maritimus
Astragalus alpinus	Anemone virginiana	Lupinus nootkatensis
Deschampsia beringensis	Arctagrostis latifolia	
Festuca rubra	Arnica alpina	
	Arnica lessingii	
	Beckmannia syzigachne	
	Cerastium maximum	
	Chenopodium capitatum	
	Chrysanthemum arcticum	
	Deschampsia caespitosa	
	Dianthus arenarius	
	Dianthus repens	
	Hedysarum alpinum	
	Myosotis alpestris	
	Plantago maritima	
	Polemonium pulcherrimum	
	Potentilla fruticosa	
	Trisetum spicatum	
	Trollius laxipetalus	

Hydroponics & Rooting Lesson Plan

- Teachers should use water as a control variable in hydroponics experiments.
- *Salix* spp. cuttings should be taken in the middle of the stem at 24" (discard first 12" from apex).
- Aeration for 15 seconds did not show a significant difference in rooting, disregard or increase aeration time.
- Cola treatment produced 0 rooting but is an important variable in testing pH, nutrient solution.

Discussion

The Presently Proposed Curriculum...

1. Meets Alaska Content Standards
2. Supplies and seed sources are readily available within the community
3. Plants and soils are common and easily recognizable by the community
4. Lesson is completed in reasonable time frame
5. Background information relevant
6. Reasonable teacher preparation time length
7. Reasonable time frame for lesson
8. Plants grow in field soils
9. Useful secondary product

Limitations

- Seed lot outdated (1980-present)
- Limited sample size
- Species may not be common in all areas of Alaska

Future Areas Of Research

- Pilot lesson plans to local K-6 classrooms
- Cola titration for hydroponics experiment
- Test other native plant species

Conclusion

The experimentation of plant-based curricula was successful in creating a practical K-6 plant-based horticulture curriculum for Alaskan schools, using native plants and resources.

REFERENCES

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