Abstract:
The concept of outbreeding depression is of interest to restorationists because of its implications for the choice of genetic stock in restoration projects. Outbreeding depression is a reduction in fitness that occurs when individuals that are very different genetically, such as plants from widely separated populations, are crossed. Our study was designed to test for outbreeding depression over three generations in two species of Lobelia siphilitica, a species that vary in neighborhood size. In 1998, two populations each of L. siphilitica and L. siphilitica var. blue flowered were chosen, one population each for the two Lobelia species near Chicago Botanic Garden (CBG) and one on near Midewin National Tallgrass Prairie (MNTP) by road. Fifteen plants of each species were crossed with the nearest neighbor, crossing within the same population but with a plant 100-200 meters away, and crossing with a plant from the other population (total 300 crosses per species, but the order of crosses was randomized to avoid position effects). Common gardens were created at both the Chicago Botanic Garden and at Midewin National Tallgrass Prairie. Plants from each of the 12 lines (2 species x 2 locations x 3 cross types) were pooled. Five hundred F2 seedlings (100 from each line) were planted in each common garden in August 1999, allowed to overwinter, and were harvested in the fall of 2000 after set seed. Harvested plants were scored for flower number, fruit number and dry weight of above ground parts. There was very little signficant difference between treatments in the F1 generation.

Results:
For both species, plants in the shadier and wetter CGG common garden were larger and produced more flowers and fruits than plants in the MNTP common garden and in most cases these differences were significant (Table 1).

Table 1. The effect of site grown on flower number, fruit number and dry weight in L. siphilitica and L. siphilitica var. blue flowered.

<table>
<thead>
<tr>
<th>Cross Type</th>
<th>Flower Number</th>
<th>Fruit Number</th>
<th>Dry Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGG</td>
<td>123</td>
<td>64</td>
<td>93.36</td>
</tr>
<tr>
<td>MNTP</td>
<td>93.36</td>
<td>64</td>
<td>93.36</td>
</tr>
</tbody>
</table>

Plants did not perform significantly better in the local common garden, than in the distant common garden. L. siphilitica var. blue flowered plants were smaller in the home site (dry weight= 34.73 g, vs. 34.73 g, P=0.36) by t-test though no-observed difference was significant. Flower and fruit number showed similar trends (data not shown).

Flower number, fruit number, and dry weights were not significantly different between cross types, but in every case there was a trend for the offspring of long-crosses to be smaller with fewer flowers and fruits (Figs. 1 and 2).

Introduction:
The concept of outbreeding depression is of interest to restorationists because of its implications for the choice of genetic stock in restoration projects. Outbreeding depression is a reduction in fitness that occurs when individuals that are very different genetically, such as plants from widely separated populations, are crossed. Outbreeding depression may be a consequence of local adaptation in the sense that crosses between plants adopted to different local conditions may yield offspring that are poorly adapted to both of the parental environments (Price and Waser, 1979; Schmick and Christmann, 1996). Evidence for outbreeding depression in plants is most readily visible with the site years (Price and Waser, 1992; Frame and Conoley, 2000).Despite the lack of evidence, the danger of outbreeding depression is often a concern of restorationists. Empirical studies are needed to determine whether this is a common phenomenon in plants and if at what spatial scales it occurs.

We chose to examine outbreeding depression in two species of Lobelia siphilitica, one native to the eastern United States and the other native to the western United States. These species are closely related and occur in sympatry. They are native species that occur in the Chicago region at several sites (Swink and Wilhelm, 1994). The taxa are of restoration interest, especially in wetland mitigation projects. A substantial amount of research has been done on the breeding systems of Lobelia species (Parker, 1992). These species are self-compatible, but have a relatively high degree of self-incompatibility. In 1998, two populations each of Lobelia cardinalis and L. siphilitica var. blue flowered were selected near Chicago Botanic Garden and 600 seedlings were planted in each common garden in August 1999, allowed to overwinter, and were harvested in the fall of 2000 after set seed. Harvested plants were scored for flower number, fruit number and dry weight of above ground parts. There was very little significant difference between treatments in the F1 generation.

Progress to date:
Year One (1998). Two large (>20 plants) populations of each Lobelia species were selected, one near Chicago Botanic Garden in Glenwood, IL and one about 100 km away, near Midewin National Tallgrass Prairie in Willington, IL. Fifteen plants of flowering size were selected at each site. A key was taken from each line for future genetic analysis using ISSRs (inter simple sequence repeats) in order to test-generate genetic differentation within and between the populations. When plants began to flower, fifteen plants received three pollinations on two flowers at each of the three types: 1) self, 2) nearest neighbor, and 3) crossing with a plant from the other population. The three pollination treatments were crossing with the nearest neighbor, crossing within the same population but with a plant 100-200 meters away, and crossing with a plant from the other population (total 300 crosses per species, but the order of crosses was randomized to avoid position effects). Common gardens were created at both the Chicago Botanic Garden and at Midewin National Tallgrass Prairie. Plants from each of the 12 lines (2 species x 2 locations x 3 cross types) were pooled. Five hundred F2 seedlings (100 from each line) were planted in each common garden in August 1999, allowed to overwinter, and were harvested in the fall of 2000 after set seed. Harvested plants were scored for flower number, fruit number and dry weight of above ground parts. There was very little significant difference between treatments in the F1 generation.

Flowers were emasculated and bagged to prevent illegitimate pollinations. Every plant received all three types of pollinations: self, nearest neighbor, and the staff and volunteers at Midewin National Tallgrass Prairie and Chicago Botanic Garden for assistance. Thanks go to National Fish and Wildlife Foundation and the six GCA Garden Clubs in the Chicago region for funding, and the staff and volunteers at Midewin National Tallgrass Prairie and Chicago Botanic Garden for assistance.

References:


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Figure 2. A comparison between the final growth (top) and flowering (bottom) of two generations of L. siphilitica in the common garden experiment.