Chamaecrista Flowering: Environmental and Genetic Effects

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Identifying environmental and genetic factors that effect flowering time in Chamaecrista in both controlled conditions and in prairies.

Introduction
Chamaecrista fasciculata (partridge pea) is an annual prairie legume native to regions from Central Mexico to central Minnesota.
- Chamaecrista thrives in sandy, loose areas; able to grow on marginal land and/or nitrogen depleted farmland, which makes it an ideal plant to use in mixed prairies grown for biofuels.
- Past Chamaecrista studies have been used in climate prediction models suggesting how plants of different ecotypes may respond to increasing global temperatures.

Chamaecrista is a Short Day Plant

In Growth Room Experiments
- Chamaecrista flowered earlier under short day conditions than under long day. (short day = 8hrs light. Long day = 12 hrs light.)
- Within each environmental condition, different ecotypes flowered earlier than others (first Minnesota, second Kansas, third Oklahoma). These findings support the previous work of Etterton, Shaw (2001) in field plots.
- Several key morphological differences were identified between short day (SD) vs. long day (LD) plants:
  1. In SD plants the Node of First Open Flower (NFOF) and Node of First Floral Initiation (NFI) were the same. In LD plants they were different.
  2. The total number of expanded leaves and total plant height at the time of flowering was much greater in LD plants than in SD.
  3. In long day plants the inflorescence was almost always fused to the stem whereas in short day plants the inflorescence emerged straight from the leaf axillary. (Fused vs. Unfused)

Flowering in the Prairies
The growth room experiments focused on how plants of different ecotypes (genetically different) were effected by the environment. In our wild plant study on Chamaecrista in the Cowling Arboretum, McKnight Prairie and Weaver Dunes, we focus on how genetically identical plants (all seed came from Weaver Dunes originally) behave in different natural environments to determine a) how controlled condition experiments compare to Chamaecrista in the wild, and b) to determine environmental factors that affect flowering time.

Chamaecrista Growth in the Wild
- Twice a week, the number of leaves of 50 plants in the Arb and McKnight were counted (total of 156 plants in the study). After flowering the total plant height, NFI and NFOF were counted at all three sites.
- Soil core samples and biodiversity surveys were done to investigate if the specific soil composition of each site may influence the overall plant morphology and growth. (Soil maps provided by Max Timm and the GIS lab.)

Applying Growth Room Findings to Prairie Evidence
- Plants at Weaver Dunes had the largest number of expanded leaves and were the tallest.
- NFI and NFOF locations varied depending on prairie environment, NFI=NFOF not only limited to short day plants.
- The only phenotype exclusively limited to one environmental condition was flower fusion directly to the flower axillary in SD.
- Biomass distribution and internode length below and above NFOF varied between environments.
- Soil composition and micro-ecosystem biodiversity varied depending on environment.

Conclusions
- Chamaecrista is a SD plant, which contrasts with LD Arabidopsis and Pisum sativum (garden pea) on which previous studies have been done. This expands opportunities for future genetic and plant studies using Chamaecrista as a SD plant model.
- Even within similar environments like Arb sites 1 and 2, micro-ecosystem and soil influences can effect plant morphology and flowering time.
- Plants in the wild did not demonstrate the same trait homogeneity for NFI, NFOF, and plant height as LD and SD growth room grown plants.
- Weaver Dunes is the putative genetic origin of McKnight and Arboretum plants. Thus those plants may be best adapted to Weaver Dunes, which may be a reason why Chamaecrista plants at Weaver Dunes were tallest and had the largest number of leaves.
- We established that within a genetically identical population of Chamaecrista photoperiod, soil composition, and temperature may effect flowering time and plant morphology.

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