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SEED SOURCE AFFECTS PERFORMANCE OF SIX WILDFLOWER SPECIES

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Abstract. **Plantings of six native wildflower species—*Cassia fasciculata* Michx. (partridge-pea), *Coreopsis lanceolata* L. (lanceleaf coreopsis), *Gaillardia pulchella* Foug. (blanketflower), *Ipomopsis rubra* (L.) Wherry (standing cypress), *Rudbeckia hirta* L. (black-eyed susan), and *Salvia lyrata* L. (lyreleaf sage) —were established during winter 1997 at five sites in Jefferson County, Florida. Seeds of each species were derived from native populations (local ecotype) and purchased from commercial sources outside of Florida (nonlocal ecotype). Plantings were irrigated as needed up until early April to ensure germination but received no supplemental fertilizer. No pesticides were applied except to control weeds on the perimeter of the plantings and fireants; plots were handweeded as necessary. Plants were evaluated once per month from June to October 1997. It was clearly evident from these evaluations that the local ecotypes generally were better adapted to north Florida conditions than were the nonlocal ecotypes. The most noteworthy differences were as follows: 1) local ecotypes of black-eyed susan and blanketflower had longer flowering periods than their nonlocal counterparts; 2) the local ecotype of lanceleaf coreopsis flowered profusely while flowering of the nonlocal ecotype was sparse; 3) the local ecotypes of lanceleaf coreopsis and lyreleaf sage had less disease incidence than nonlocal ecotypes; 4) flower color and blooming date of standing cypress ecotypes varied substantially.**

Introduction

Indigenous populations of Florida's native wildflowers have adapted to our environment through a process of natural selection. This process involves climatic adaptations, and adaptation to the complex relationships between soils, insects, and microorganisms. Because of these adaptations, it is highly likely that native wildflowers derived from seed collected in Florida will perform better under our conditions than seed derived from elsewhere.

The issue of wildflower ecotypes may prove to be important to the Florida Department of Transportation's (FDOT) wildflower program. Roadside wildflower plantings serve not only an aesthetic purpose but more importantly help to stabilize the soil. The FDOT has been very successful in planting and managing wildflowers in the northern half of Florida but there have been many failures in south Florida. This may be related to the sole use of seed from out-of-state sources, that is, using seed from plants not adapted to Florida's subtropical and tropical conditions. Other states have recognized the need to increase support for developing seed sources for regionally adapted native wildflowers and grasses for roadsides. The Iowa Ecotype Project developed out of a concern that cultivars of western ecotypes of native prairie grasses used in roadside and restoration projects would out-compete local ecotypes of native grasses, but then die out because they weren't adapted to the local conditions. The use of local ecotypes of native wildflowers and grasses is also being encouraged and supported in other states including Michigan, Idaho, Ohio, and Wisconsin. Seed source has also become an increasingly important issue to those involved in restoration and reclamation.

Unfortunately, there has been little published research concerning ecotype differences in native wildflowers. Beckwith (1991) showed that flowering response to daylength, height, and leaf number of black-eyed susan were affected by ecotype (latitudinal) origin. Similarly, Celik (1996) reported that the primary differences in black-eyed susan ecotypes were in flowering. Differences in flowering were also noted for latitudinal ecotypes of goldenrod (*Solidago sempervirens* L.) (Goodwin, 1944).

The objective of this study was to compare the performance of local and nonlocal ecotypes of six native wildflower species when grown under low maintenance conditions.

Materials and Methods

Native populations of partridge-pea (*Cassia fasciculata*), lanceleaf coreopsis (*Coreopsis lanceolata*), blanketflower (*Gaillardia pulchella*), standing cypress (*Ipomopsis rubra*), black-eyed susan (*Rudbeckia hirta*), and lyreleaf sage (*Salvia lyrata*) were located by checking herbarium sheets at the Florida State University Herbarium. The regional Florida Dept. of Transportation maintenance offices in north Florida were also contacted to determine whether potential roadside collection sites were planted by FDOT. Seeds of local ecotypes were collected and cleaned during summer and early fall 1996. Collections were made from plants growing in USDA hardiness zone 8B of the Florida panhandle, or in one case (black-eyed susan), extreme southern Georgia. Soil at the collection sites generally would be described as dry. The site habitats were either ruderal or upland.

Nonlocal seeds of these species were purchased from the following suppliers: S&S Seeds, Carpentaria, Calif. ('Comanche' partridge-pea—seed grown in Texas); Applewood Seed Co., Arvada, Col. (lanceleaf coreopsis); Companion Plants, Athens, Ohio (lyreleaf sage); Wildseed Farms, Eagle Lake, Texas (black-eyed susan, blanketflower, standing cypress).

Seed viability was tested to determine the approximate amount of seed needed to result in a population density of 17

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plants/ft^2 (11 plants/ft^2 for partridge-pea). The germination conditions were as follows: 16-hr photoperiod; 30°/20°C (day/night); high relative humidity - seed germinated on moist filter paper enclosed in Petri dishes; Petri dishes enclosed in clear plastic shoe boxes with wet paper towels to minimize desiccation. Germination rates were based on three replications (50 seed per rep) per species per source (local/nonlocal), except for standing cypress. Due to time constraints and lack of accessible information about germination conditions, germination rates of standing cypress were based on single replications at ambient room temperature and lighting; this significantly improved germination rates.

In Dec. 1997, seed (except partridge-pea) were sown into tilled, weed-free soil at four of the five sites—NFREC, and at Jefferson County Elementary, Middle, and High Schools; seed at the fifth site, Aucilla Christian Academy, were sown on 7 Jan. *Cassia* was planted in early January because commercial seed was not received until December. Seed was mixed with slightly moist builder's sand to facilitate even distribution. Due to severe weed infestations, Roundup® (glyphosate; Monsanto) was applied to all plots at Aucilla as well as to all plots at the Elementary and High Schools; these sites were totally reseeded on 31 Jan. A thin layer of pine straw was applied to all plots at all sites to reduce moisture loss and facilitate germination.

The five evaluation sites are characterized as follows (soil types were determined using Jefferson County Soil Survey [U.S. Dept. Agr., Soil Cons. Service, 1989]): *NFREC* - Garden is adjacent to main building parking lot; slight slope; native soil is either a Fuquay fine sand [0-5% slopes; 0.5-2% organic matter (OM); pH 4.5-6.0] or a Dothan loamy fine sand [5-8% slopes, eroded; <0.5% OM; pH 4.5-6.0].); *Jefferson County Elementary School*—Site was previously used as a "dump" and was covered with fill dirt; drainage varied from good to poor; site is flat; *Jefferson County Middle School*—Soil varied from sandy nearest the building to loamy; drainage was fair to poor; site is flat; soil is probably a disturbed one nearest the building based on the high percentage of builder's sand we observed in northeast corner of garden. Otherwise, the native soil is either an Orangeburg sandy loam (5-8% slopes, eroded; 0.5-2% OM; pH 4.5-6.0) or a Bonifay fine sand (0-5% slopes; 1-3% OM; pH 4.5-6.5); *Jefferson County High School* —Site was formerly used for football stadium parking; soil appears to be a very sandy loam with good drainage; site is slightly sloped. The native soil is either a Fuquay fine sand (0-5% slopes; 0.5-2% OM; pH 4.5-6.0) or a Dothan loamy fine sand (5-8% slopes, eroded; <0.5% OM; pH 4.5-6.0); *Aucilla Christian Academy*—Site is at the bottom of hill; site is sloped; formerly covered in bahiagrass (*Paspalum notatum* Fluegge); drainage is excellent. The native soil is either a Lucy loamy fine sand (0-5% slopes; 0.5-1% OM; pH 5.1-6.0) or a Surrency fine sand (1-4% OM; pH 3.6-5.0).

Plots were evaluated by the same two observers from June to Oct. 1997. Supplemental irrigation was supplied until April to insure that these species had time enough to germinate and become established. Plots were handweeded on an as-needed basis. The only pesticide applied in the plots was Amdro® (hydramethylnon; Cyanamid) for control of fireants.

The experimental design was a split plot in time, with ecotype as the main plot, evaluation date as the subplot, and site as the replication (Frank Martin, Dept. of Statistics, Univ. of Fla./IFAS, personal comm.). At each site, there was one plot per species per ecotype, with ecotypes within a species being assigned to adjacent plots to minimize variation in soil conditions between ecotypes within a species. Otherwise, species were randomly assigned to plots. Plants in each plot were rated as a single unit for the following parameters: overall look—0 to 3, where 0 = poor and 3 = excellent; wilting, disease damage, and insect damage - 0 to 3, where 0 = no plants and 3 = many; flowering—0 to 4, where 0 = no plants and 4 = all.

Results and Discussion

Partidge-pea. Both ecotypes were similar in size and had similar flowers, foliage, and growth habit. The only difference observed was in the morphology of the petiolar glands.

The establishment rate of both ecotypes was low, which may have been due to the absence of the proper *Rhizobium* species in the soil. However, there were more local than nonlocal plants within a site. At best, only a few of the nonlocal plants became established at any one site while there were a few to several of the local plants; there were no nonlocal plants at Aucilla, the site with the sandiest soil.

Ratings for overall look (Fig. 1a) coincided with the flowering period (Fig. 1b). The overall look of the nonlocal and local plants was good to excellent in mid-July and mid-Aug., respectively, the same times at which flowering had peaked in these ecotypes. Overall look declined during late summer and fall as the plants of both ecotypes senesced. At three of four sites, the main stem of at least one nonlocal plant split at the base, which eventually killed the plant; no stem splitting occurred on any local ecotypes at any site. No insect or disease damage was observed on either ecotype nor was there any consistent symptoms of drought stress (results not shown).

Lanceleaf coreopsis. The nonlocal ecotype was described by Applewood Seed as "the typical garden variety". Compared to the local ecotype, it was two to three times larger—size, foliage, and flowers.

Dense stands of both ecotypes occurred at all sites except Aucilla. At Aucilla, population density of nonlocal plants was greater than that of local plants.

Overall appearance of local plants was generally better than or equal to that of nonlocal plants (Fig. 2a). The difference was attributed to the lack of flowering (Fig. 2b; no flowers at three of five sites) and greater disease incidence (Fig. 2c) of nonlocal plants. According to Applewood Seed (pers. comm.), the nonlocal ecotype flowers primarily the second year after plants are grown from seed. Foliar disease damage was caused by *Alternaria* sp. and *Cladosporium* sp., although the Florida Dept. of Plant Industry (DPI) noted that foliar symptoms suggested injury followed by secondary infection by these two organisms. Flowering of the local ecotype started in early May and peaked by mid-June (Fig. 2b). Insect damage—leaf stippling which was thought to be due to foliar thrips (Thripidae)—was observed on both ecotypes and increased throughout the season (Fig. 2d). However, the damage did not detract from the overall appearance of either ecotype. Stink bug (*Euschistus* sp.) damage (pedicel collapse and necrosis) about ½ inch below the flower was observed on plants of both ecotypes.

No signs of drought stress were observed on plants of either ecotype.

Blanketflower. The local and nonlocal ecotypes were similar in size but ray flowers on the nonlocal plants were relatively uniform in color—the lower half red and the distal half yellow. In contrast, ray flowers of local plants varied in the

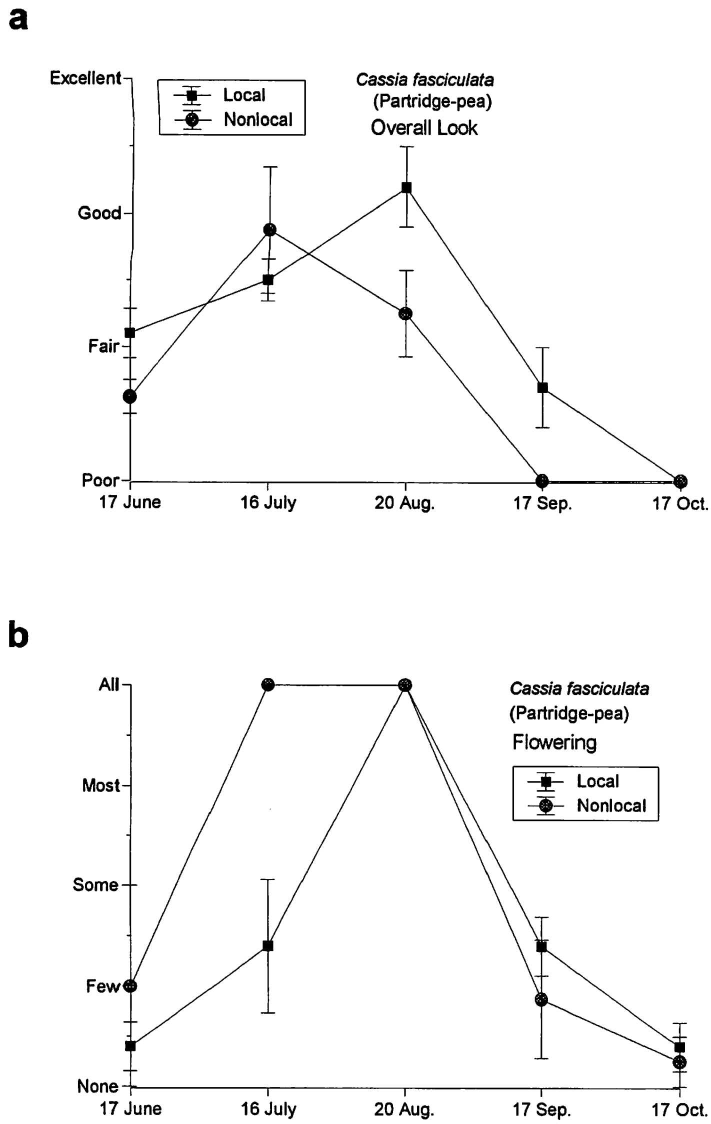

Figure 1. Rating of overall look (**a**) and flowering (**b**) for local and nonlocal ecotypes of partridge-pea from 17 June to 17 Oct. 1997.

amount of yellow from 0 to 100%. Those flowers in which yellow was absent were pinkish towards the apical portion of the ray.

At all sites except the NFREC, approximately equal stands of local and nonlocal ecotypes became established. At the NFREC, the nonlocal ecotype did not become established. It was felt that the seed germinated (85% germination rate as determined in lab test; good germination in soilless medium in the greenhouse [results not shown]) but succumbed to a hard freeze in Jan. (lows ranged from 19–31°F on 17-22 Jan.) because nonlocal plants became established at the three sites replanted on 31 Jan. Moreover, seedlings of nonlocal plants at the Middle School (not replanted on 31 Jan.) were in a protected location and therefore not subjected to the extreme lows present at the open NFREC site.

Flowering started in late Apr. to early May at the NFREC and Middle School, and mid to late May at the other three sites (which were replanted 31 Jan.). Flowering of the local ecotype peaked from mid-June through mid-Aug. Although the number of local plants in flower dropped off as the season progressed (Fig. 3a), plants flowered into Nov. (results not shown). Nonlocal plants also flowered well until mid-July but then rapidly declined (Fig. 3b) apparently due to senescence, although disease could not be ruled out.

The rapid decline of nonlocal plants occurred at three of the four sites. Plants at the High School did not decline probably because they were inadvertently watered and fertilized by caretakers of an adjacent vegetable garden. The better-than-expected appearance of these plants at the High School is the reason for the relatively large deviation of overall look means from July to Oct. (Fig. 3b). The appearance of local plants closely coincided with the level of flowering, but did not seem related to disease or insect damage (results not shown).

The primary insect damage observed was leaf stippling, which occurred on both ecotypes, and was thought to be caused by foliar thrips. This damage did not detract from overall appearance primarily because of the minimal contrast between the whitish stippling and gray-green foliage. The number of local plants affected peaked in mid-Aug. and then decreased (results not shown). Apparent foliar disease injury (chlorotic/necrotic spots/lesions) was observed on a few local plants in June and increased slightly until Oct. (results not shown). The number of nonlocal plants exhibiting apparent disease damage sharply increased in mid-July, but this may have also been the beginning of the rapid decline noted above.

No signs of drought stress were observed on plants of either ecotype.

Standing cypress. The two ecotypes differed in flower color and size. Flowers of local plants were all scarlet while those of nonlocal plants varied from salmon to scarlet. Local plants also were the same height or taller than nonlocal plants (within a site) and appeared to have denser foliage and greater diameter.

Similar to partridge-pea, populations of the local ecotype, within a site, were greater than those of the nonlocal ecotype. No plants of either ecotype became established at the Elementary and Middle School. This may have been because these sites had greater soil moisture levels than the other three sites. Standing cypress in north Florida is found on beaches (Clewell, 1985); seed used in this experiment was collected from plants growing on the roadside in a very dry, well-drained soil.

Another major difference was that nonlocal plants, within a site, grew much faster and flowered earlier (Fig. 4a). It seemed that standing cypress needed to grow to a certain height before it flowered, although toward the end of the summer plants flowered that were shorter than those that initiated flowers in July.

The two factors that affected overall appearance (Fig. 4b) were flowering and disease (Fig. 4c). Peak flowering of nonlocal plants was in mid-June but that of local plants was in mid-Aug. After plants had flowered, senescence seemed to start as the capsules matured. But this decline in appearance was compounded by an increase in shoot disease incidence as the summer progressed. Florida DPI identified the foliar disease as *Fusarium solani* (Mart.) Appel & Wr. Newly infected plants were susceptible to wilting. Then foliage became chlorotic and necrotic, with symptoms first appearing at the base of the shoot and then proceeding upward. All nonlocal plants had died due to disease and apparent senescence by mid-Aug. Most local plants were dead by mid-Oct., including some that had not flowered. Disease incidence did not seem related to

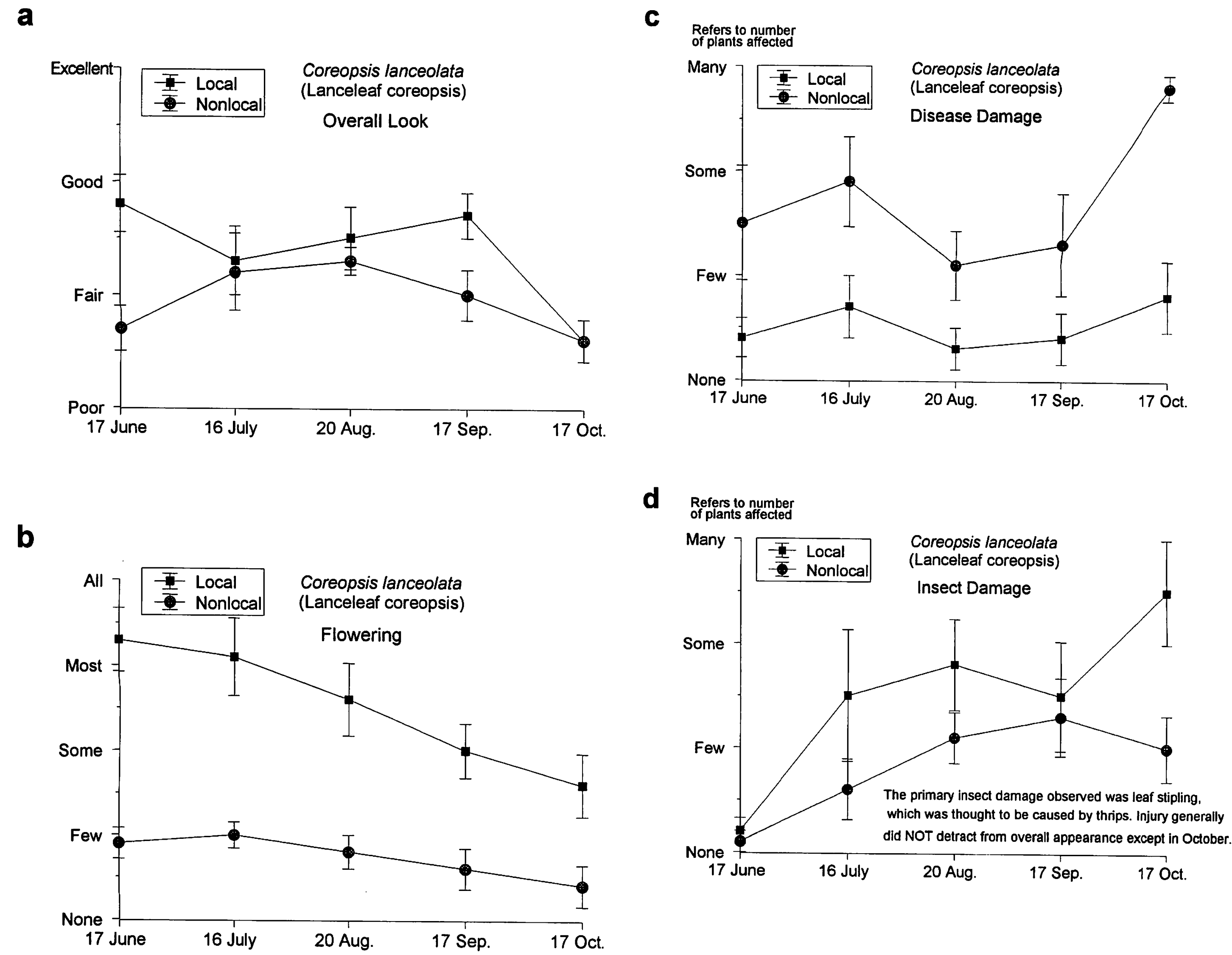

Figure 2. Rating of overall look (**a**), flowering (**b**), disease damage (**c**), and insect damage (**d**) for local and nonlocal ecotypes of lanceleaf coreopsis from 17 June to 17 Oct. 1997.

site conditions as it occurred even on those plants at Aucilla, a site with sandy, well-drained soil.

No insect damage or signs of drought stress were observed on any plants at any site, although leaf hoppers (Circadellidae) were observed feeding on both ecotypes.

Black-eyed susan. Similar to lanceleaf coreopsis, size of the nonlocal plants and foliage was three to four times greater than that of local plants. Flowers of the nonlocal ecotype were showier as they were about twice as large as those of the local ecotype. Also, foliage and stems of the local ecotype were bluish green with short, coarse hairs whereas nonlocal plants had light green leaves with long, soft hairs.

Within a site, approximately equal population densities of local and nonlocal plants became established (except at the Middle School), or there was 100% canopy coverage of the plots by the local and nonlocal plants. At the Middle School site, no nonlocal plants became established, which was probably due to the poor drainage in that particular plot.

Flowering of both ecotypes started in late May, but within a site nonlocal plants started to flower a week or two earlier than local plants (results not shown). However, peak flowering of both ecotypes occurred in mid-July (Fig. 5a). Since both ecotypes originated from similar latitudes (central Texas and Florida panhandle), not much difference in flowering time would have been expected based on previous studies (Celik, 1996; Beckwith, 1991). The number of local plants in flower remained at a high level through mid-Aug. and then decreased slightly through mid-Oct. (Fig. 5a). However, the intensity of the flowering gradually declined.

The gradual decrease in flowering intensity combined with the presence of seedheads and slow decline (due to senescence and some diseased foliage) resulted in a moderate reduction in overall appearance (Fig. 5b). Although the number of flowering nonlocal plants peaked in mid-July, nonlocal plants started a rapid decline in mid-July similar to the decline observed with blanketflower (Fig. 3b). And just like blanketflower, most nonlocal plants at all sites were nearly or totally dead due to senescence and/or disease. The rapid decline of this nonlocal ecotype after peak flowering has also been noted in a 1998 study of black-eyed susan ecotypes (unpubl. data).

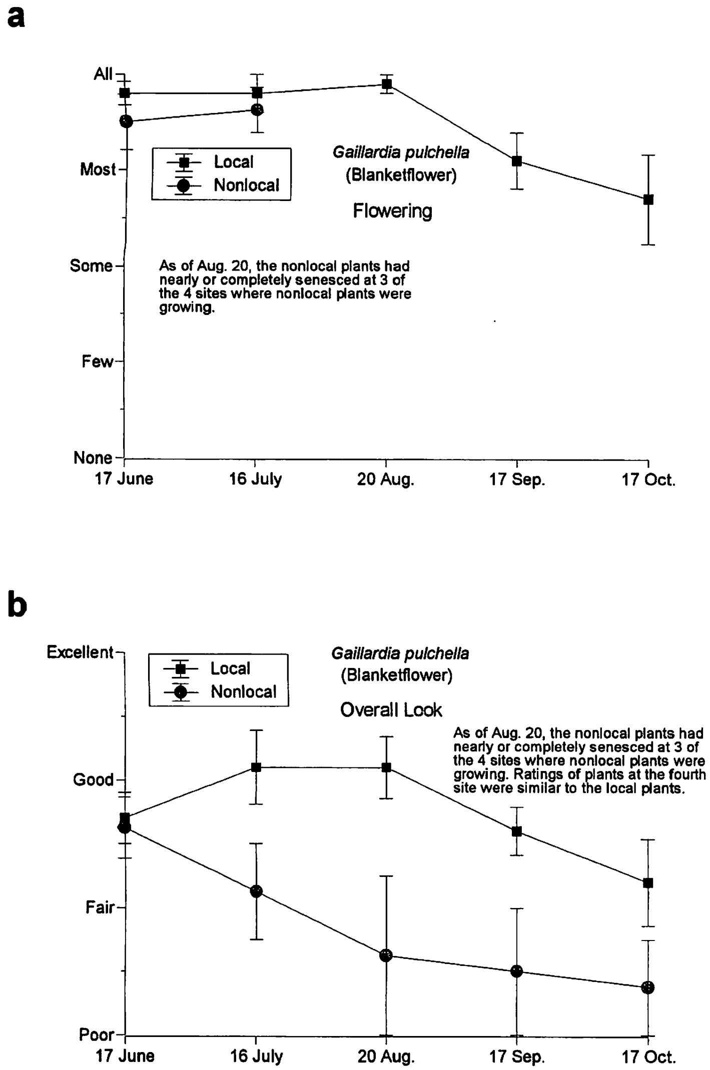

Figure 3. Rating of flowering (**a**) and overall look (**b**)for local and nonlocal ecotypes of blanketflower from 17 June to 17 Oct. 1997.

Occasional chlorotic/necrotic foliage, thought to be due to disease, occurred on a few to some plants at all sites from mid-June to mid-Oct. (results not shown). The only insect damage noted was leaf stippling thought to be due to thrips. This damage was observed on both ecotypes but not at all sites. This stippling had little affect on overall appearance. Spittlebug (Cercopidae) egg masses were observed on both ecotypes, and at most sites; aphids (Aphidae) were present on a few plants of both ecotypes at the NFREC. No signs of drought stress were observed on plants of either ecotype.

Lyreleaf sage. Foliage of the nonlocal ecotype was showier than that of the local ecotype due to the more intense purplish veination. Leaves of nonlocal plants were also slightly larger. However, foliage of local plants was more upright. Approximately equal populations of ecotypes became established within a site.

Both ecotypes of this early spring-flowering species produced persistent, inflorescences that arose from the basal rosette beginning in late Apr./early May. Environmental conditions were such that corolla the showy purple petals) either never formed or aborted early in their development. Seed was produced but viability was not determined. The per-

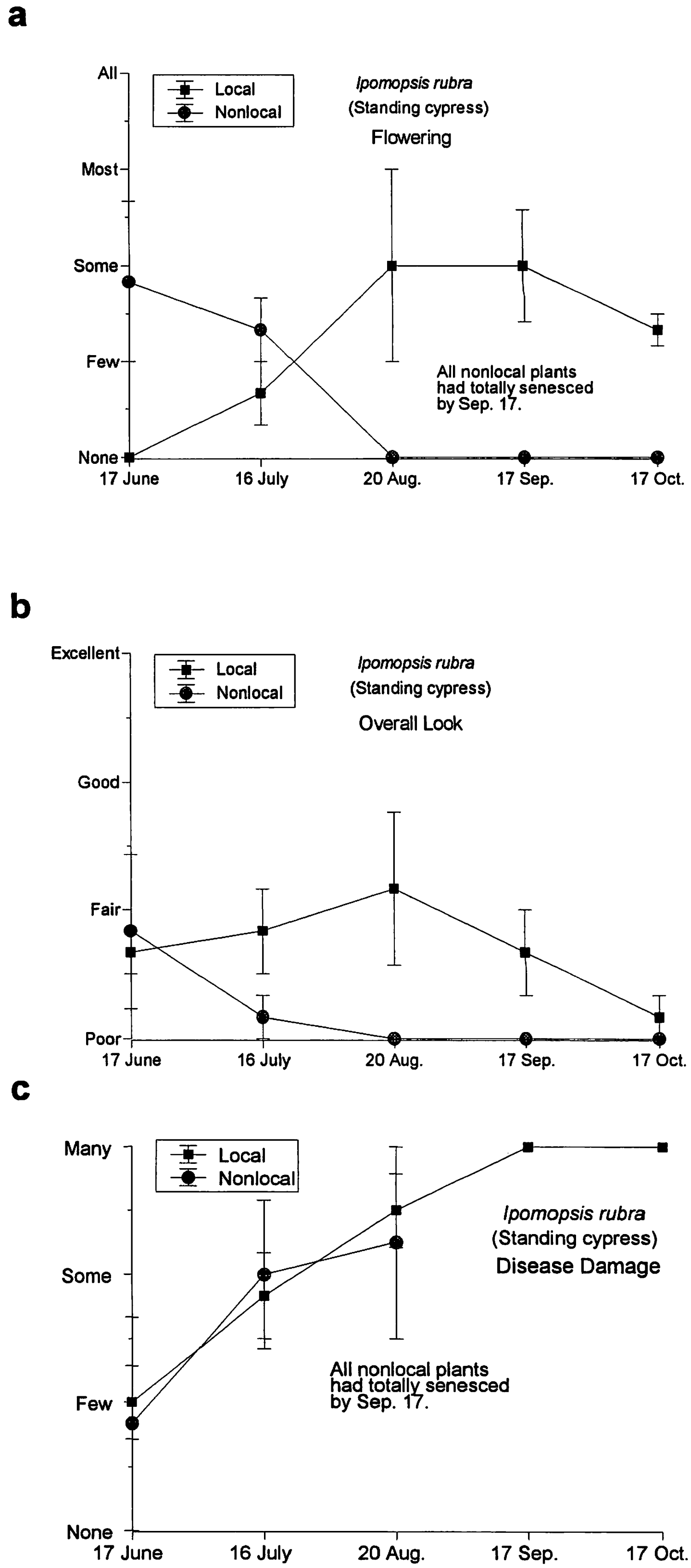

Figure 4. Rating of flowering (**a**), overall look (**b**), and disease damage (**c**) for local and nonlocal ecotypes of standing cypress from 17 June to 17 Oct. 1997.

sistent inflorescences and absence of the showy corolla resulted in relatively low ratings for overall appearance (Fig. 6). The showier foliage of the nonlocal ecotype accounted for

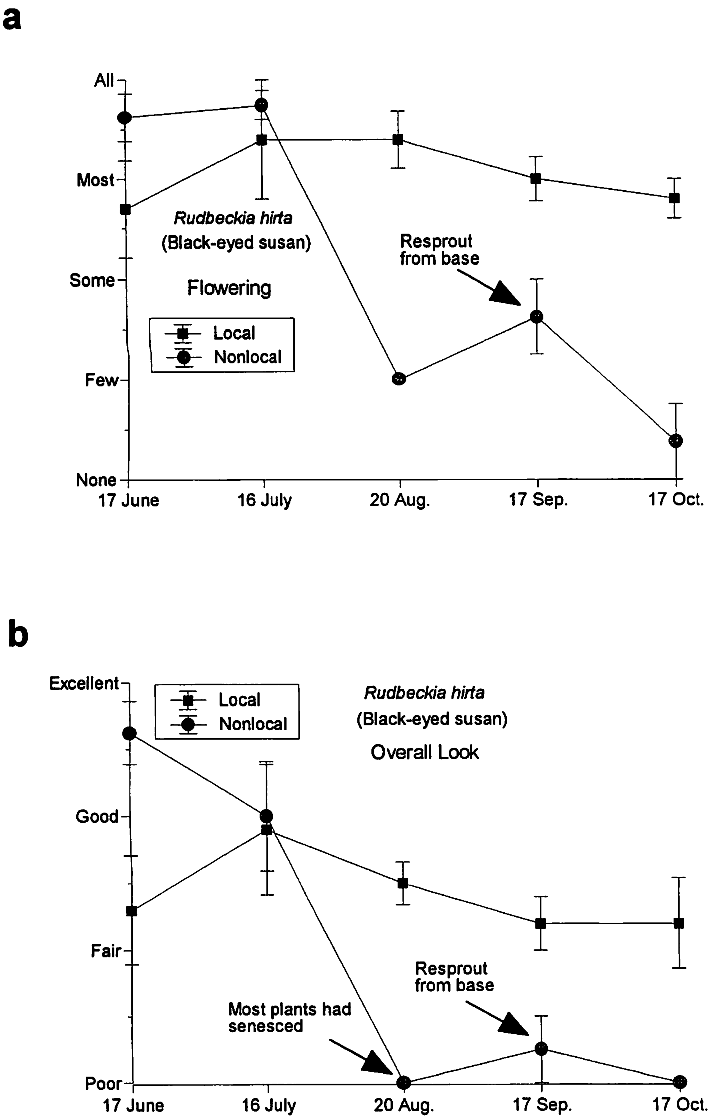

Figure 5. Rating of flowering (**a**) and overall look (**b**) for local and nonlocal ecotypes of black-eyed susan from 17 June to 17 Oct. 1997.

the generally better overall appearance of nonlocal plants early in the summer.

As the season progressed into mid-Sep. overall appearance of nonlocal plants substantially decreased due to the increasing number of dead or declining leaves. However, the lyreleaf sage plots at the Middle School had moist, relatively well-drained soil. As a result, there was much less dead or declining foliage on both ecotypes. Overall appearance ratings

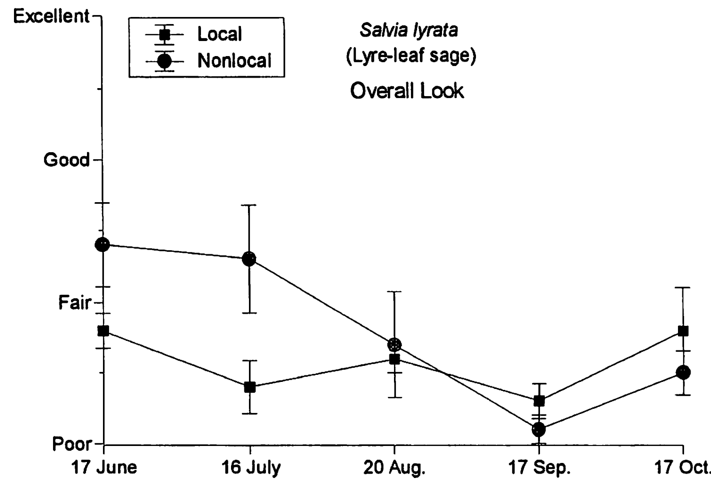

Figure 6. Rating of overall lookfor local and nonlocal ecotypes of lyreleaf sage from 17 June to 17 Oct. 1997.

increased slightly by mid-Oct. as the temperatures cooled and dead foliage dropped off.

No insect damage was observed on either ecotype. Disease damage ratings are not presented because foliar decline and death may have been due to intolerance to the full sun summer conditions. No drought stress (i.e., wilting) was observed on either ecotype.

Conclusion

In general, local ecotypes of partridge-pea, lanceleaf coreopsis, blanketflower, standing cypress, black-eyed susan, and lyreleaf sage seemed to be better adapted to north Florida conditions than nonlocal ecotypes when these species were directly seeded into plots and grown under low maintenance conditions for one season. However, nonlocal ecotypes tended to be showier than local ecotypes when both were at their optimum appearance.

Literature Cited

Beckwith, D. D. 1991. Characterization of juvenility and photoperiodic responses of *Rudbeckia hirta* originating from different latitudes. MS Thesis, Va. Polytech. Inst. and State Univ., Blacksburg.

Clewell, A. F. 1985. Guide to the vascular plants of the Florida panhandle. Univ. Presses of Fla., Fla. State Univ. Press, Tallahassee.

Celik, M. 1996. Photoperiod and gibberellic acid effects on juvenility and flowering of *Rudbeckia hirta*. MS Thesis, Miss. State Univ., Miss. State.

Goodwin, R. H. 1944. The inheritance of flowering time in a short day species, *Solidago sempervirens* L. Genetics 29:503-519.

U.S. Dept. Agr., Soil Cons. Serv. 1989. Soil survey of Jefferson County, Florida. 193 pp.