ECOLOGY OF THE PRAIRIE SPECIES OF THE GENUS LIATRIS

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Abstract. Liatris punctata, L. mucronata, L. pycnostachya, L. aspera, L. squarrosa, L. cylindracea, L. ligulistylis and L. spicata occur in the prairie areas of North America. The first five occur in greater frequency throughout the central and western prairies and are discussed in greater detail as to the ecology including hybridization, speciation, and evolution within this complex group of composites.

Prairie species of the genus include Liatris punctata Hook., which occurs on dry prairies and plains from Canada to Mexico and from western Iowa and Missouri to the foothills of the Rocky Mountains; L. mucronata DC. occurs in dry soil in open areas from eastern and central Texas northeastward to Kansas and Missouri; L. pycnostachya Michx. occurs in damp prairies from Indiana to South Dakota across the Great Plains southward to Louisiana, Texas and Oklahoma; L. aspera Michx. occurs on dry sandy soil in open areas from North Dakota southward to East Texas and eastward to North Carolina and Florida; L. squarrosa occurs on rocky sandy soil most often along bluffs or bluff escarpments or in dry open woods and clearings from Canada to Florida and Texas and west to the Rocky Mountains; L. cylindracea Michx., L. ligulistylis (A. Nels.) K. Schum., and L. spicata (L.) Willd. occur in moist marshy lands and damp meadows in eastern prairies of Wisconsin, Illinois, and Missouri.


Free, J. B. 1968 a. The foraging behaviour of honeybees (Apis mellifera) and bumblebees (Bombus spp.) on blackcurrent (Ribes nigrum), raspberry (Rubus idaeus) and strawberry (Fragaria x ananassa) flowers. J. Appl. Ecol. 5:157-168.


Lesphem, Y. and D. Koller. 1965. The control of runner development in the strawberry Fragaria ananassa Duch.
HYBRIDIZATION

The haploid chromosome number for the genus is n = 10 with ploidy reported in the genus, and according to Gaiser (1950a, 1950b, and 1951), occurs frequently in the Punctatae series which includes Liatris punctata and L. mucronata. Natural and artificial hybrids have been reported by Gaiser (1946, 1950a, 1950b, and 1951), Hadley and Levin (1967), Cruise (1964), and Menhuesen (1963b).

As a result of extensive areas of distribution, areas of sympatry occur. Hadley and Levin (1967) reported on a study in Lake County, Illinois, in which they found three species, Liatris aspera, L. cylindeacea, and L. spicata growing in a series of old dunal sand ridges and interdunal depressions with highly variable texture and organic matter content. The three species are distributed in a mosaic pattern reflecting subtle microenvironmental differences found within the prairie. The species intermix creating broad transition zones or ecotones. Densities of species were found to be a function of soil moisture and soil organic matter. Liatris aspera grew on drier upland sites with low soil moisture and mamet and good internal drainage. Liatris cylindeacea occurred downslope in areas of increased soil moisture and organic matter content with less internal drainage. Liatris spicata occurred on the lower slopes and lowland depressions which were high in soil moisture and organic matter but poor internal drainage. In the ecotonal areas they reported 0.99 percent hybrids. The paucity cannot be attributed solely to internal reproductive barriers for these have been readily surmounted by experimental studies. Flowering periods overlap and plants were within pollination range.

Levin (1967) reported sympatric populations of Liatris aspera and L. spicata in Cook County, Illinois, which seasonal and ecological barriers were surmounted and resulted in extensive hybridization to produce an heterogenous assemblage containing F1, advanced generation and backcrossed hybrids. A large proportion of hybrids were backcross derivatives with Liatris spicata being the predominant recurrent parent.

In the prairies of Kansas, Nebraska, and Oklahoma, I have found a few colonies of sympatric species of Liatris punctata and L. aspera, L. mucronata and L. pycnostachya, L. mucronata and L. aspera, and L. punctata and L. pycnostachya. I have not found any patterns of distribution for soil types. Liatris squarrosa and L. pycnostachya occur in prairies chiefly in sandy soil; the first occurs in well-drained areas while the latter occurs in less well-drained areas. The latter three occur principally in areas of limestone deposits. Herbarium specimens of population samples of 25 or more plants have been collected from the three state area and studied carefully for morphological evidences of hybridization but none have been found that could be identified as hybrids.

Artificial hybrids are comparatively easy to produce; Gaiser (1950a and b, 1951), Cruise (1964), and Menhuesen (1963b) have all reported this. In the University of Kansas Experimental Gardens, I found that the following putative hybrids could be produced:

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\text{Liatris punctatae} \\
\text{L. aspera} \\
\text{L. pycnostachya} \\
\text{L. mucronata}
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The percentage of seed set was less than 25 with less than 50 percent germination. The survival rate of the seedlings was above 90 percent for the first growing season. Liatris plants are perennial and do not produce flowers and fruits during the first growing season. Construction work in the experimental garden area necessitated transplanting the seedlings; climatic conditions were unfavorable and all seedlings died.

Within the Punctatae Series of the genus, however, the species Liatris mucronata and L. punctatae hybridize freely in the experimental garden and apparently do so in the field. One of the most reliable distinguishing characteristics between the two species is the type of root or rhizome. Liatris mucronata plants of the eastern one-third of the three states produce a globose or ovoid root or corn while L. punctata plants of the western one-half to two-thirds of the states produce elongated tuberous roots and rhizomes, especially in loose sandy soils. Gaiser (1946) described L. densispicata from sandy soils in Minnesota. I found the same in the Sand Hills in Nebraska. In the experimental gardens L. punctata plants develop adventitious buds and new shoots along the rhizome in soft soil that had not done so in the prairies in uncultivated soils with competition from other plants. This seems to be an "ecotype" species or ecotypes. Across the Flint Hill area and the area to the west for approximately 30 to 60 miles the two species hybridize and it is nearly impossible to find a colony of either parent that can be classified as either L. mucronata or L. punctata. The characteristics of the root system is about the only character that remains stable and not overlapping. In the apparent hybrids often a globose root structure develops which becomes much elongated as the plant matures. No adventitious growth ever occurs from roots of Liatris mucronata, even as a result of experimental cuts which produce stems in L. punctata.

Much morphological variation occurs within a population in the field with the original collections or in the experimental garden. Variation of phyllary shape and size within a population was great (Menhuesen, 1963b). The height of plants, number of heads, leaf length, corolla and style length, also, vary within populations in the experimental garden as well as yearly growth patterns. The most important factor in determining mean plant heights across the state was the amount of rainfall. The phenology seemed to be genetically controlled. Flowering dates in the experimental garden correlated with those in the field. Though some would designate these populations as races or varieties, I consider these to be a cline across the area from east to west. On the eastern side, I feel that Liatris mucronata is a well-defined taxon and the western side of the distribution area that L. punctata is a well-defined taxon but that through the Flint Hills there is an ecotone area in which the two taxa hybridize freely. Endler (1979) indicates that gene flow may be unimportant in the differentiation of populations along such environmental gradients.

ECOLOGY

The genus is able to adapt to many factors and survive. Weaver (1958) listed Liatris punctata as a plant of the true prairie and mixed prairie hard lands and stated that their effect upon grasses is not marked except where they occur in unusually dense clumps. He found that in clay soil with sandy subsoil roots penetrated only about 6.5 feet with a scarcity of absorbing laterals.

Weaver and Albertson (1943) found that during periods of drought, that Liatris punctata decreased in abundance and height. Examination of root systems of L. punctata near the end of the drought showed normal root conditions in every respect and no modification that could be attributed to drought. The forbs probably survived because of the moderately moist soil at 5 to 16 feet. In a study of vegetation on two prairies in western Kansas, Tomamek and Albertson (1957) list Liatris punctata as a common forb at the Atwood site with an abundance of 1.5 plants per 100 square feet. At the Ashland station Liatris punctata was one of the five most abundant forbs on the upland; there were 3.2 plants per 100 square feet, where it is listed as one of the most common decreasers at these two stations.

Few diseases or insects appear to harm Liatris plants. Ants appear to be some of the most frequent visitors of the Liatris plants during the growing season. Lady beetles and bees are attracted to the plants. Grant (1950) attributes an important evolutionary role to the flower constancy of bees.

A Texas horned lizard, Phrynosoma cornutum, was collected in a rocky hillside area with many plants of Liatris punctata; the lizard had apparently been feeding upon the ants around the plants.

Weaver and Fitzpatrick (1934) state that young Liatris plants are eaten by rodents. Kennicott (Jameson, 1947) reports finding
five or six quarts of roots of two species of Liatris among food stored in a cache for winter use in Illinois of Microtus ochrogaster. In an investigation of the feeding habits of Microtus ochrogaster, Sigmund hispidus, Reithredontomyys neagai, and Peromyscus maniculatus, Menhussen (196a) found the animals to feed freely and eagerly upon the buds, seedlings, and new leaf growth of the Liatris plants. The animals all ate the starchy material from the centers of the large tuberous roots when these were split. The seeds were eaten eventually, but only as a tertiary choice of food.

Evans and Dahl (1955) reported that a herd of white-tailed deer, Odocoleus virginianus, fed on forbs including Liatris on a reserve in southeastern Michigan. Martin, Zim and Nelson (1951) list Liatris as one of the plants composing 1/2 to 2 percent of the diet of the pronghorn antelope, Antilocapra americana, in New Mexico.

Hetzer and McGregor (1951) list Liatris pycnostachya as one of the prairie forbs that decreases under grazing. I have seen cattle graze on the plants and have seen damage caused from livestock grazing.

From observation it seems that burning by a fast fire or mowing the prairies, especially in the Flint Hills, does not damage the Liatris plants; this, in fact, may be advantageous to the plants for it prevents the build up of dense litter and promotes earlier emergence. Most Liatris plants cannot seem to tolerate deep litter or shading; grasses do provide competition, especially those tall enough to shade the Liatris plants.

**SUMMARY**

Gaiser (1940, 1950, 1951), Leven (1967), Endler (1973), and others report that Liatris aspera, L. pycnostachya, L. squarrosum are chiefly diploid plants with little ploidy found; these plants are much more limited by their ecological environmental tolerances, while in L. mucronata and L. punctata much ploidy and hybridization occurs. These latter two species are widely distributed with broad ecological tolerances and a wide transition zone across the middle onethird to one-fourth of the states of Kansas, Nebraska, and Oklahoma.

The results of the hybridization experiments demonstrate the close genetic relationship which exists among the Liatris species of L. aspera, L. squarrosum, L. pycnostachya, L. mucronata, and L. punctata. It appears that differences in ecological adaptation are the most significant barriers in preventing partial or complete fusion of taxa. Since hybrid progeny develop in most crosses these may be defined by the bio-systematist as ecotypes and L. aspera, L. pycnostachya, L. squarrosum, L. mucronata, and L. punctata are ecotypes of the same species. Morphological and ecological criteria permit a separation of these five into species. We are faced then with the situation in which populations have one and at the same time the status of species, and the bio-systematic status of ecotypes.

This situation is encountered in cases of gradual speciation where morphological and physiological differences between species arise ahead of genetic differences whose accumulation would lead to intersterility. Evolutionary changes are occurring among these five at very different rates; either the rate is more advanced by L. punctata and L. mucronata than the other three or the reverse with these two being the least rapid to change. Through such vast geographic areas as the prairies it seems these evolutionary changes will be a long, slow process.

**LITERATURE CITED**


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**SPECIES PATTERNS IN RELATION TO SOIL MOISTURE GRADIENTS IN KALSWO PRAIRIE**

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**Abstract.** Species presence was determined for vascular plants in 968 contiguous 30 by 30 foot quadrats in Kalsow Prairie, an original remnant of the tall-grass prairie in central Iowa preserved by the State of Iowa. Soil series and elevations were determined for each plot so that species distributions could be correlated with changes in soils and microlief. Cover estimates showed that Sporobolus heterolepis and Andropogon gerardi were dominant's of the upland prairie. Strong zonation occurred around shallow prairie potholes. Dominants of zones from upland prairie to the center of potholes consisted of Helianthus grosseserratus, Calamagrostis canadensis, Carex atherodes, Scirpus fluitati, and Polygonum coccineum, respectively.

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