

Genetic Relationship Among Two Forms of Alligatorweed¹

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INTRODUCTION

Alligatorweed, (*Aternathera philoxeroides* (Mart.) Griseb.) is an aquatic mat-forming plant introduced into the United States in about 1897 from South America (Kay and Haller, 1982). The plant has been observed in coastal states from Virginia to Texas, with some small infestations in California and other states. Dense floating mats in canals and streams can interfere with water flow.

Alligatorweed may grow under a wider range of environmental conditions of soil and water than any other aquatic plant (Zeiger, 1967, Durden et al., 1975). Insects have been used successfully as a form of biocontrol to suppress alligatorweed in Florida and other locations in the southeastern United States. The alligatorweed flea beetle (*Agasicles hygrophila*) Selman Vogt) was the first host-specific insect

to be used and others have been released (Gangstad, 1976). Some difficulties have been experienced in managing this plant by chemical and biological means, and these difficulties may be related to genetic differences among growth forms.

Alligatorweed exhibits two groups of morphological variations (Kay and Haller, 1982). One group has been appropriately assigned to environmentally induced changes, e.g., more lignified tissue, smaller stems of terrestrial forms and thickened leaves in saline-tolerant forms that transform into normal leaves when the plants are returned to fresh water (Gangstad et al., 1971). A second group of variations appear to be innate. One population had very slender stems and short rounded leaves (NSA), whereas the second had broad stems (BSA) and long narrow leaves. Kay and Haller (1982) compared the growth of these morphologically distinct forms of alligatorweed. While neither dry weights nor stem lengths of the two forms (BSA and NSA) were significantly different when grown under controlled conditions in enriched Hoaglands, differences were observed when the plants were grown terrestrially in topsoil. Specifically, BSA produced significantly greater dry weights and shorter stem lengths than NSA. In addition, no morphological changes

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in either population occurred during a 1-year period of hydroponic growth in a greenhouse.

The present study was concerned with examining the genetic relationship among BSA and NSA alligatorweeds.

MATERIALS AND METHODS

Healthy individuals were randomly collected during the summer of 1982 from two study sites in Louisiana. Prior to electrophoresis, leaf tips were macerated by a Plexiglas rod in a drop of grinding solution (0.1 M HEPES, 0.25 M 2-mercaptoethanol, pH 7.0). The crude extract was absorbed onto paper wicks and inserted into 12.4% starch gel. Each individual was assayed for 9 different protein/enzyme systems which resulted in a total of 16 zones of electrophoretic activity (presumed genetic loci). The systems analyzed and the number of loci scored for each system are as follows: acid phosphatase (3), alcohol dehydrogenase (2), esterase (3), general protein stain (1), glutamate dehydrogenase (2), glutamate-oxaloate-transaminase (1), malate dehydrogenase (2), phosphoglucoseisomerase (1), phosphoglucomutase (1).

The gene systems were chosen as before (cf. Wain et al., 1983) solely on the basis of (1) availability of staining reagents, (2) degree of resolution, and (3) consistency of banding. Genetic differentiation among the two populations of alligatorweed was calculated using the statistic of gene identity as described by Nei (1972). By definition, gene identity may range from zero to unity. A value of zero indicates that two populations are completely dissimilar, whereas a value of unity indicates that two populations share the same alleles in essentially the same frequencies. Individuals of both types were analyzed on the same gels to make the scoring of bands more accurate. Though certain individuals were resubjected to electrophoresis several times during the course of study, their isozyme patterns did not change with age.

RESULTS AND DISCUSSION

Table 1 lists sample sizes and allele frequencies for three polymorphic gene loci. The numerical suffices for a protein denote the existence of multiple gene loci. Electromorphs (alleles) are defined by the distance (in centi-

TABLE 1. ALLELE FREQUENCIES, SAMPLE SIZES (N), AND GENETIC IDENTITIES AT THREE DIFFERENTIATED LOCI IN ALLIGATORWEED.

System	allele	BSA N=100	NSA N=125	genetic identity
EST-2	a	0.37	1.00	0.506
	b	0.63	0.00	
Adh-2	a	0.80	0.30	0.605
	b	0.20	0.70	
Got-1	a	0.90	0.20	0.348
	b	0.10	0.80	

meters) that the allele migrated from the gel origin. The mean genetic identity, across all loci, was 0.886. This value is similar to those reported among subspecies of other plants. Considering that alligatorweed was introduced in the United States relatively recently, it is reasonable to believe that these biotypes represent separate introductions of previously differentiated populations.

To supplement the isozyme data, leaf length-to-width ratios were compared for biotypes. A one-way nested analysis of variance (leaves nested within plants) indicated a difference that was statistically significant ($F = 36.63$ D.F. = p 0.001). The BSA form had the higher leaf length-to-width ratio. In this study, all experimental plants were maintained in a common environmental for several months prior to analysis.

The existence of genetically differentiated biotypes of alligatorweed should be considered in any programs that attempt management or utilization of this plant. For example, alligatorweed has been considered as an agent for removal of trace metals from polluted waters (Wolverton and McDonald 1975a,b). Previous studies indicate that genetically differentiated populations of many species often differ physiologically as well. In fact, it has been noted that BSA and NSA have responded differently in management programs. Electrophoresis is capable of detecting genetic differences in very early life history stages and therefore can be a very effective means of screening large numbers of individuals for undesirable genotypes.

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