Biological Control Of Alligatorweed With *Agasicles n. sp.* In Florida

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Alligatorweed (*Alternanthera philoxeroides*), a green scourge of inland waterways, is a native plant of South America. The first known description of the plant was published in 1826 and is based on plants that came from Brazil. Presumably it reached the United States by way of ballast dumps of sailing ships and was first found near Mobile, Alabama, in 1897 and later in the vicinity of New Orleans, Louisiana, in 1898. From those locations it spread to all Southern States, including Texas and California. Florida alone has ever 3,000 acres covered with alligatorweed[1].

Alligatorweed is an extremely prolific plant which is most difficult to control and even more difficult to kill. Both cultivated areas and low marshlands are infested by alligatorweed. The menace to cultivated areas is readily apparent. Less evident but equally devastating is its effect in conservation areas where plants offering sustenance to fish and wildlife are unable to survive competition with this pernicious plant. It has invaded waterways seriously clogging canals, drainage ditches, boat slips, and tributary streams and, in some instances, it breaks free and floats into navigable waters.

Alligatorweed is considered to be a useless plant in most areas where it occurs in the United States. It is about 90 percent air and water and with no beauty in its favor. The stem of alligatorweed is hollow and contains nodes at intervals of two to four inches from which roots extend downward and the growing shoots extend upward. These shoots branch and rebranch to form a formidable mat with the roots. The mat can extend 40 to 50 feet into the water from the bank, and upright shoots in heavily matted bunches have been found extending three feet or more above the water surface. The plant is most easily recognized by the white cloverlike blossom and vivid green leaves.

At the start of the "Expanded Project for Aquatic Plant Control" authorized by Public Law 85-500, 85th Congress, approved in 1958, the Corps of Engineers realized the need for research on chemical, mechanical and biological control of aquatic plants. As a result, in 1959, cooperative investigations on biological control were initiated between the Corps of Engineers and the Agricultural Research Service, U. S. Department of Agriculture. The Entomology Research Division, U. S. Department of Agriculture, was requested to conduct research on insects as potentially valuable agents to control aquatic weeds. It was deemed advisable to work first on alligatorweed, and the search for biological agents that attack this weed was initiated early in 1960.

[1]Central & Southern Florida Flood Control District, 1957. An Investigation of alligatorweed and its implications for Central and Southern Florida.

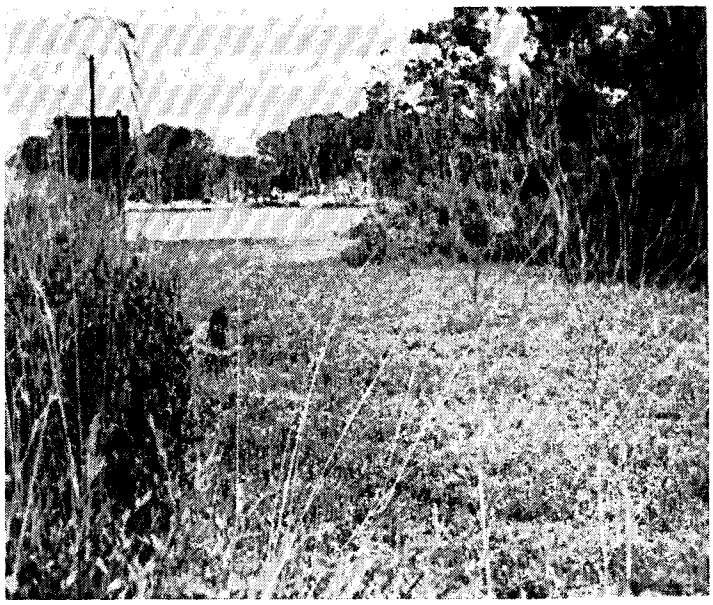
Exploration and investigation was conducted in South America by personnel of the Insect Identification and Parasite Introduction Research Branch, Entomology Research Division, U. S. Department of Agriculture, to permit detailed observations of insects that feed on alligatorweed and two other hydrophytic species of *Alternanthera* in their representative habitats. Observations made in 1961 and 1962 indicated that growth of alligatorweed in its native haunts was inferior to the growth in the United States. Significantly, the plant does not pose a serious weed problem in South America, where 40 to 50 species of insects act as suppressing biotic agents. Only one of these insects was known to occur in the United States (1).

Four of the insects were found to be major suppressants of alligatorweed. They are a species of flea beetle of the genus *Agasicles*, a thrip species, a stemboring moth and, a second species of flea beetle of the genus *Disonycha*. It was decided to conduct host specificity tests on the species of *Agasicles*.

In June 1962 facilities for testing the flea beetle were made available by officials at the Instituto de Patalogia Vegetal of the Instituto Nacional de Technologia Agropecuaria, at Castelar, a suburb of Buenos Aires, Argentina (1). The beetle readily adapted to living in small containers such as petri dishes, and fresh foliage of test plants was offered them in these containers. Feeding tests were made on a number of species of plants from each of the families *Polyganoceae, Chenopodiaceae,* and *Amaranthaceae,* as well as on sugarbeet, rice, watercress, water lily, cotton and cucumber. The flea beetle was unable to go through its life cycle on any plant except its normal host. In addition, frequent observations were made in cultivated areas near infestations of the beetle to see if the insect could be found feeding on any crop plant. At no time was there any evidence that the beetle fed on anything but alligatorweed.

Concurrence in the introduction and release of the flea beetle in all but one of the Southern States was obtained from the Southern Plant Board. Subsequently, specific permission to release the insect in various states was received from regulatory officials of the states involved and the Plant Quarantine Division of the U. S. Department of Agriculture. The first beetles were shipped to the U. S. Department of Agriculture Entomology Research Laboratory at Albany, California, for additional study.

The Division of Plant Industry is the agency which regulates the movement of insects into and within Florida. Presently, the three agencies concerned with introduction of plant-feeding insects, parasites and predators are the Division of Plant Industry, the University of Florida Agricultural Experiment Station, and the Entomology Research and Plant Quarantine Division, Agricultural Research Service, U. S. Department of Agriculture. These agencies



a. Release Site, June 7, 1965

b. Release Site, May 20, 1966

c. Release Site, May 26, 1966

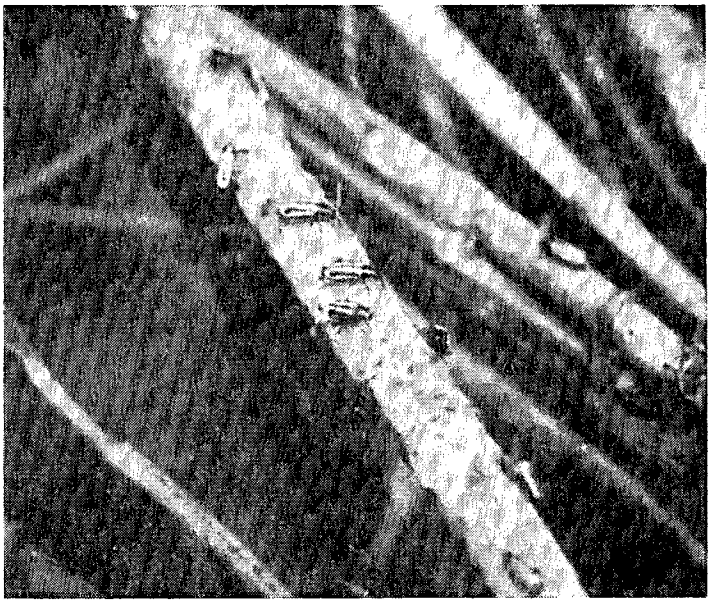
d. Release Site, July 15, 1966

Figure 1. Effect of Flea Beetle on Alligatorweed.

must unanimously agree on the introduction of any plant-feeding insect, parasite or predator within the state. After reviewing the biological data supporting the request to introduce the beetle *Agasicles n.sp.*, these agencies agreed to its introduction (2).

Final State and Federal approval was received in early March 1964 and releases were made by the U. S. Department of Agriculture on March 26, 1964 at the Savannah National Wildlife Refuge, South Carolina. Approximately 150 beetles were released at that time and additional releases were made in the same general area throughout the spring of 1964. Nearly 3,000 beetles were released at the Savannah site. About 450 beetles were released on a small patch of alligatorweed near Los Angeles, California, with about 250 released in July 1965 near Biloxi, Mississippi.

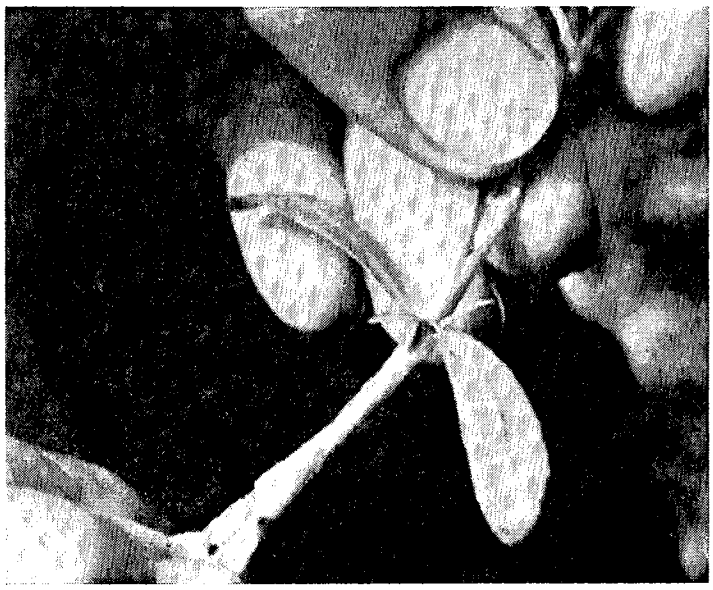
Approximately 250 beetles were received from Albany, California, on April 9 and 10, 1965 and released at the Ortega River and Timuquana Road Bridge in Jacksonville, Florida (Figure 1-a). Nearly all of the floating alligatorweed in this test site has been destroyed by the beetles. On several occasions beetles were collected at the test site and distributed to other locations. The beetles are capable of flying long distances and have spread over all watersheds in Northeast Florida and Southeast Georgia. Within 35 days after release of the colony there was a fresh hatching of beetles. The insects were in all stages of



a. Adult Beetles Eating on Stems

b. Eggs on Underside of Leaf

c. Larva Eating on Leaf



d. Pupa Inside of Stem

Figure 2. Life Cycle of Flea Beetle *Agasicles, n.sp.*

development from egg to adult. (Figure 2 a through d).

The next three months, June, July, and August, proved to be an inactive period for the *Agasicles* beetle. However, the webworms *Herpetogramma bipumetalis* and *Hymenia fascialis* were quite active, defoliating about 60 percent of the plants. The heavy feeding by the webworms ended about the first part of October and was followed by regrowth of the alligatorweed. Little activity was noted among the beetles until October 12 when beetle activity was noted on the regrowth. Inspections during November, in two to five day intervals, once more found the various stages of beetle development active, with massive evidence of feeding by the adults and larvae.

The adults and larvae were very active on December 10; however, ten days later, following several nights of frost, the adults had migrated away from the alligatorweed to seek shelter under adjacent bankside leaves and other vegetation. Inspection of this site revealed that they were not eating on the sheltering leaves or vegetation but were merely seeking protection from inclement weather.

Inspections during late December 1965 and January, February, March and April 1966 continued to show hatching and movement. It was obvious that the beetles overwintered quite successfully, withstanding a low temperature of abou 20° F during the first week in February.

By the first of May, literally hundreds of thousands of adult beetles were observed in the release area devouring the foliage. When the plants were defoliated, the adults and larvae concentrated their feeding on the stems and within a short time the alligatorweed started dying (Figure

1-b and c). The plants continued to die and disintegrate and by the latter part of June approximately 50 percent of the test area was open water. The most amazing discovery was that some of the plants had also died below the water surface even though the beetles could eat only to the water level. About the first of June most of the floating plants were dead and the beetles were migrating to inaccessible and remote areas (Figure 1-d).

An inactive period was observed in 1966 as in 1965 during the latter part of June, July, Auust, and part of September. Heavy feeding by the beetles started about two to three weeks earlier than was noted in 1965, and the plants began dying the latter part of September with continued beetle activity through December 1966, January, February, March and April 1967.

By the first of May millions of adult beetles were observed on alligatorweed in the Jacksonville area and the floating plants were dying by the acres. Through distribution and the beetles ability to fly long distances colonies of the beatles are established over all of peninsular Florida as far south as the Loxahatchee National Wildlife Refuge and into Southeast Georgia.

From the fall of 1965 approximately 20,000 beetles have been transferred to selected and approved locations in Florida, Georgia, Alabama, North Carolina, South Carolina, Mississippi and Texas. Observations and reports will be made of the activity at these new release points.

Frequent observations have been made in the vicinity of the release sites and at no time was there any evidence that the beetle fed on any plant other than alligatorweed. The beetles also prefer the alligatorweed that is growing in the water and move to the terrestrial growth only when floating weed is no longer available.

Alligatorweed growing in areas treated with 2,4-D in our water hyacinth control project have been checked and beetles were found eating the regrowth apparently unaffected by the spray.

Cooperative studies with the Northeast Duval County Mosquito Control District have shown that the beetles can tolerate and become established in areas fogged for mosquitos with Baytex and Dibrom.

The possibility of a combination biological and chemical and biological and plant management programs are being investigated. Additional observations and releases will be made to determine the long-range effect and range of the beetles.

In the short time the beetles have been used in the Jacksonville area, the possibility of biological control of alligatorweed looks very promising. We expect the combination of chemical, mechanical and biological control methods to each have a role in the control of alligatorweed.

LITERATURE CITED

1. Anderson, W. H. 1965. Search for insects in South America that feed on aquatic weeds. Proceedings Southern Weed Conference, 18:586-587.
2. Denmark, H. A. 1964. Florida Department of Agriculture's position on parasites and predators introduced into Florida for biological control. Hyacinth Control Journal, 3:16-19.