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Identification and Management of Giant Salvinia (*Salvinia molesta*)

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Giant salvinia (*Salvinia molesta*, family Salviniaceae) is a non-native, extremely invasive aquatic fern that has infested the southern United States. Native to southeastern Brazil, the weed was introduced for use in aquariums and garden ponds. Giant salvinia may also have been brought in as packing with fresh, iced fish. It has been sold under many common names, including water velvet, salvinia, African pyle, aquarium watermoss, kariba weed, water fern, and koi kandy.

Since its escape, giant salvinia has become a serious problem in rivers, streams, lakes, dams, and rice fields. It is now found in at least 12 southern states from California to North Carolina, and is threatening waterways in southern Nevada. It is named on the federal noxious weed list and is expected to be listed as noxious in Nevada by the Nevada Department of Agriculture in early 2003. As a noxious weed, it is illegal to sell giant salvinia.

Why should we be concerned?

Giant salvinia is considered to be one of the world's worst aquatic pests. It is an aggressive, competitive species that impacts aquatic environments, local economies, and human health. When conditions are favorable, the weed can double in size in as little as 2.2 days. A single plant may be capable of multiplying to cover 40 square miles in only three months. Eight plants placed in a ¼-acre spring-fed pond in April in Moselle, Mississippi had completely covered the water surface within six weeks.

Mats of giant salvinia may grow as large as 96 square miles in area and 3 feet in thickness, blocking sunlight and oxygen from reaching waters below, and killing beneficial plants, insects and fish trapped below the mat. These huge mats can weigh as much as 36 tons per acre! As plants die and decay, they can decrease dissolved oxygen in the water, affecting fish viability.

Migrating birds may not recognize or stop at waterbodies covered with giant salvinia. Recreationists abandon infested areas, finding it impossible to fish or navigate through the dense mats. As water intakes and ditches are clogged by the rapid-growing weed, agricultural irrigation and electrical generation are impaired. The floating

Giant salvinia grows rapidly to cover the surface of ponds and lakes.

mats of vegetation create ideal conditions for the growth of disease-carrying mosquitoes.

What does giant salvinia look like?

Giant salvinia is a free-floating aquatic fern with small, oblong, ½-inch to 1-inch long spongy green leaves along the stem. Young plants are smaller and the leaves lie flat on the water surface. Stems branch in an irregular fashion. The leaves occur in whorls of three: two floating and one submerged. The plant has no flowers, and the submersed leaves are thread-like and look like roots. As the leaves mature, they become thick and curl at the edges in response to crowding. As infestations grow in size, leaves become more vertical, forming upright chains that form mats of floating plants.

The leaf surfaces of giant salvinia have rows of hairs that, when magnified, look much like egg beaters in shape. The hairs give the leaves a velvety appearance and repel water. This characteristic is useful in identifying the species. A similar species, common salvinia (*Salvinia minima*), has leaf hairs with branches that are always free at the tips.

The rootlike submerged fronds of giant salvinia often support chains of egg-shaped spore-bearing structures. Any spores produced, however, appear to be genetically defective, as they do not produce viable plants.

Where does it grow?

Giant salvinia grows best in quiet waters of lakes and ponds, oxbows, ditches, slow-flowing streams and rivers, marshes, and rice fields. Its growth is favored in water with a high nutrient content, such as eutrophic waters or waters polluted by wastes. It does not usually colonize brackish or marine environments, but it has been reported in tidally influenced streams in southeast Texas.

While moderate temperatures between 40 degrees and 90 degrees Fahrenheit are required, giant salvinia has survived severe winters. The United States Geological Service estimates that the weed

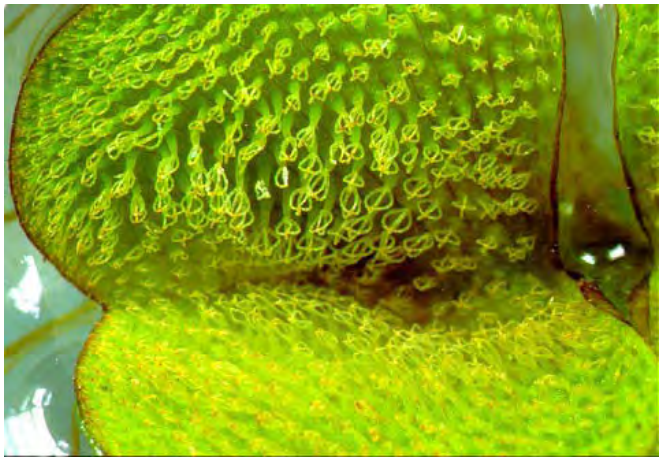
Giant salvinia has small, spongy, vertical leaves.

The third leaf forms a rootlike structure, but the weed is free-floating.

could potentially establish within Zones 7a, 8, 9, and 10 of the USDA Plant Hardiness Map. This encompasses portions of the desert southwest including parts of southern Nevada.

How does it spread?

Salvinia reproduces as fragments break off existing plants as they mature. New plants also develop as dormant buds break away from the original plant. As each node has up to five lateral buds, the weed has high potential for growth. As dormant buds, giant salvinia will survive periods of stress from both low temperature and dewatering.



The egg-beater shaped "hairs" on the leaves create a water repellant surface.

Activities that fragment the weed, including boating, fishing, or intentional harvesting, add to its spread. Giant salvinia is often introduced to new areas as people empty aquariums or infested ponds into waterways, or as infested boats and trailers are moved to new waters. Spread by waterfowl may also occur.

How is giant salvinia controlled?

With rapidly reproducing invasive weed species such as giant salvinia, prevention and early action are essential. Never dump plants or water from an aquarium down storm drains or into water bodies. Inspect and clean boats that have navigated infested water. Remove bilge water, all plant parts and mud from both boat and trailer before moving them to a new location. If possible, pressure-wash the boat, trailer, and vehicle undercarriage and tires.

Control of giant salvinia is complicated by characteristics that make it tolerant to herbicides and freezing. These include below-water buds and stems, "unwettable" hair-covered leaves, and the thick mat of vegetation that it forms.

Mechanical means, such as hand removal and harvesting equipment, have been attempted with varying success. Hand removal is practical only for small infestations. Removed plants must be dried or burnt and disposed of in locations where reintroduction to a waterway is impossible. Harvesting equipment has been used primarily on submersed aquatic vegetation such as Eurasian watermilfoil. This method is less commonly used for control of floating species, but does remove plant mass from the water, decreasing some water quality concerns related to plant decay. Harvesting equipment generally cannot access shallow areas and requires some type of floating boom system to collect the plants. In well-established infestations, the sheer weight of the plant material may present a problem, as may disposal of large weed masses.

Biological control offers promise for reducing giant salvinia populations. The salvinia weevil, *Cyrtobagous salviniae*, has been used with great success in some parts of the world, including Australia and South Africa. It has been found in several areas of Florida, and as it is very specific to *Salvinia* species, introduction to other states should be relatively easy to accomplish.

C. salviniae is a small, brownish to black weevil. Adults live on or beneath the leaves or fronds of salvinia and will feed on salvinia leaves, producing small, irregularly shaped holes. They prefer to feed on newly formed leaf buds. Larvae feed within the roots, rhizomes, and leaf buds. Initially, weevil damage will turn some of the salvinia leaves brown. Eventually, the entire mat of vegetation will turn brown, sink, and decompose. Significant control can be achieved within one to three years in warm areas, and five or more years in cooler areas where more time is required for the weevil to become established.

Both vegetation characteristics and issues of water contamination complicate chemical control of giant salvinia. The weed is susceptible in varying degrees to herbicides including 2,4-D, hexazinone, diquat, ametryne, fluridone, and double chelated copper. Much of the research on the effectiveness of herbicides has been done on common salvinia (*S. minima*). Of the available research on giant salvinia in the United States, fluridone applied at about 20 parts per billion (ppb) to a water body in Texas appeared to give good results until lake waters rose and diluted the herbicide concentration. Fluridone application requires a

long contact period and cannot be used within ¼ mile of a potable water intake at rates of 20 ppb or greater. A mixture of 3% diquat and 5% double chelated copper was reported to be very effective in another area of the same water body. A sequential treatment of a two-acre lake in South Carolina using two treatments with diquat at a rate of 0.75 gallons per acre followed by fluridone at 1.3 quarts per acre eradicated the giant salvinia infestation.

Special care must be taken when applying herbicides near or in streams, rivers, ponds, or lakes, or in areas with shallow water tables. Always read and follow label directions when applying pesticides.

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