**Widgeongrass**

*Ruppia maritima*

- **Scientific Name**: *Ruppia maritima* L.
- **Common Name**: Widgeongrass
- **Group**: Monocotyledon
- **Family**: Ruppiaceae

**Wetland Indicator Category**: OBL

**Growth Form**: Submerged

**Habitat**: Brackish, saline and fresh coastal waters

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**Propagation Guide**
1 Seed Collection

Flowers of *Ruppia maritima* are common in the spring and the fall in Mississippi and the northern Gulf of Mexico. Seeds are produced within about two to four weeks and are generally ripe for collection during May through October; however, the peak may vary from year to year depending on seasonal water temperature.

The flowers are tiny and develop inside a sheath near the tip of the stem. Once the flowers are mature, they are pushed up to near the water surface by a 12” (30 cm), long coiled peduncle (stem).

The pollen is released and floats to the surface, aided by gas bubbles. Self-fertilization is common, but enough pollen floats on the water to ensure some cross-pollination of other individuals (Moffler and Durako 1987). After fertilization, the female flower will produce multiple (typically eight) light green fruits on short stalks (pedicels) that ripen in a few weeks. Fruits are about 0.08” (2 mm) across and each contains one rounded, dark-colored seed ranging in size from 0.04-0.16” (1-4 mm) (Kantrud 1991). The seed drops into the sediment as the pedicel decomposes.

Seeds of *Ruppia maritima* have a hard durable seed coat and form a persistent seed bank in the sediments under surrounding parent plants. Seeds can remain viable in the sediment for up to three years (Kantrud 1991).

2 Fruit and Seed Preparation

Fruit collection from the plants is recommended in this species. The fruits are located at the tip of the plants and are readily visible in shallow water. The plant parts containing seeds should be hand-collected, while wading in the water, leaving the stems and roots intact. The harvested vegetative material is placed in sealable plastic bags with a small amount of water from the collection site.

After collection, the fruits should be stored in water adjusted to the same salinity as the collection site, with aeration (e.g., a small aquarium with air-stone or filter). The fruits will continue to ripen at room temperature until the pedicel decomposes, allowing the seeds to be released. Seeds sink to the bottom of the container where they can be collected and processed by sieving (Cho and Biber 2010).

Alternatively, dormant seeds of *Ruppia maritima* can be obtained from sediment samples by sieving. Seeds are generally found in the upper 5 cm of sediment, but can occur buried as deep as 25 cm (Kantrud 1991). Appropriate sediment samples should be collected during the season when the plants are not growing (typically in winter) to minimize impacts. A series of stacked U.S.A. Standard Test Sieves can be used under running water: No.5 (4 mm mesh size), No. 10 (2 mm), No.18 (1 mm) and No.35 (0.5 mm) with seeds being trapped on the No. 10 and No.18 middle sieves.

After rinsing all mud and sediment from the seeds, the sample will need to be manually sorted to remove all debris. The seeds are then spread out in a white plastic tray, covered with a shallow volume of water and any remaining undesirable material is then removed with forceps (tweezers). This step may need to be repeated several times to ensure the seeds are clean of undesirable material. This is a very time-consuming process, but essential to the successful storage conditions of the seeds.

Kantrud (1991) reported there are approximately 260,000 seeds per pound fresh weight.

3 Seed Storage

Seeds can be stored in tap water in the dark at room temperature at 70°F (21°C) for up to three years (Kantrud 1991). Small plastic containers with screw-on lids work best for prolonged storage. It is better to use multiple containers in case contamination causes problems in a container.
Salinities exceeding 15 parts per thousand (ppt) were found to inhibit germination as did storage at warmer temperatures (Kantrud 1991). In temperate locations, seed germination may be enhanced after simulating winter stratification by placing the seeds in the refrigerator at 39°F (4°C) for one to two months prior to germinating. Some studies have also found that allowing the seeds to dry out and storing them dry will work (Cho and Biber 2010), although viability and germination of desiccated seeds may be lower than for wet stored seeds.

Periodic tests for seed viability should be done by a tetrazolium red (TZ) dye test (see Appendix A).

### 4 Seed Germination

The stored seeds are emptied into a U.S.A. Standard Test Sieve No.18 (1 mm mesh size) and rinsed several times with tap water. This step is best performed in a fume hood or outdoors to reduce odors.

The rinsed seeds are placed in 8” (20 cm) diameter 1500 mL glass culture dishes (Carolina Biological Supply Company -741006) and filled with tap water. The water level in the bowl should be checked periodically to make sure seeds do not dry out. At least 1” (2.5 cm) water is recommended.

While the seeds will germinate in the dark, it is best to place these bowls under a bank or four to six fluorescent lights (60-100 W, <100 µmol irradiance) so seedlings will get enough light after germination occurs. Germination occurs best at 59-86°F (15-30°C), with 82°F (28°C) being optimal.

Germination success is also influenced by soil redox potential (Eh), with low oxygen (Eh < 300 mV) inhibiting germination. Cho and Biber (2010) report that seed germination rates vary from year to year, and are typically high (> 50%).

### 5 Seedling Propagation

When the young seedlings are about 1-2” (2.5-5 cm) in height they can be removed from the glass culture dishes and transplanted into hydrated peat pellets (Jiffy Products - Jiffy 7) using forceps. The peat pellets are buried to a depth of 1-1.5” (2.5-3.5 cm) with an organic soil mixture (1:1 topsoil:sand ratio) in small plastic or clay pots and maintained submerged in flowing low salinity water (10 ppt works well).

Seedlings must be kept submerged in water at all times, and do better if there is some flow of water past the leaves. A small aquarium pump or air-stone should be sufficient. Water movement helps to break down the surface boundary layer on the leaves and enhances gas and nutrient exchange, promoting better growth.

Pots with seedlings are best kept in 15-50 gallon aquaria indoors in a temperature controlled room at 81-86°F (27-30°C) under high output T5 daylight (6,500 K) or red-spectrum (3,000 K) fluorescent lights (300-500 W, 150-300 µmol irradiance) on a 18:6 hour (light:dark) photoperiod.

The pots with seedlings can also be placed in 100-500 gallon freshwater tanks inside a greenhouse under natural photoperiod. Pots should be submerged with about 6” (15 cm) of water covering them; this is the space the leaves will grow into.

Seedlings are grown for three to six months until they reach a size of at least 12” (30 cm). These plants can then be transplanted into larger containers that provide at least 4-6” (10-15 cm) sediment depth (see Transplanting section below).

It may take as little as six months to a year for coalescence to 100% cover in this size container, so maintenance costs are reasonable when growing *Ruppia maritima*. For this reason, this species is often propagated for restoration projects, either from seed or by micropropagation (Bird et al. 1994).
1 Plant Collection

This species, like most submerged aquatic vegetation (SAV), is easiest to propagate by vegetative growth. To do so, mature plants need to be obtained from field locations. In many states this will require the necessary permits from local, state, and federal agencies. In some cases it may take three to six months before the permit is available.

The best time to collect plants for vegetative growth is in the early to mid spring, while they are in the growing phase. Alternatively, collection in the early fall may also be successful before the plants go into winter dormancy.

Plants are easiest to harvest in shallow waters during low tide. Water deeper than waist deep will make efforts much more difficult and should be avoided if possible. The easiest method for harvesting is to collect sods approximately 1 x 1 ft square (30 x 30 cm) using a square-point or flat-head shovel. The shovel should be inserted to a depth of at least 4” (10 cm) to capture as much of the below-ground root material as possible. It is necessary to cut all four sides of the sod, before trying to lift it out of the ground, to minimize damage to the delicate roots. To further minimize damage to the root-zone during transportation, a 15 x 11” (38 x 28 cm) aluminum baking pan or similar container can be used to help support the sod.

Alternatively, a 6” (15 cm) diameter or larger coring device can be used to rapidly extract a plug of roots and leaves from the seagrass bed, while leaving a relatively small disturbance that can be recolonized within a few months by the surrounding plants.

2 Transportation

It is imperative that the plant sod be transported and maintained completely submerged at all times to maximize the survival potential. Even as little as one to two minutes of air exposure will completely dry out the leaves, killing them. To minimize stress, water from the collection site should be used. We have found that 9 sods in aluminum pans stack well inside a 100 quart (94.6 liter) white cooler. Wood dowels are used as spacers between the pans and reduce the problem of the plants on the bottom getting crushed. Filling the cooler with multiple sods helps to minimize the motion of the water and, therefore, the loss of the delicate sediments around the plant roots.

Alternatively, plant plugs obtained with a coring device can be placed in large resealable plastic bags and then tightly packed in the cooler in a single layer. The tops of the bags remain open and the entire cooler is filled with water from the collection site.

The cooler should be kept shaded and cool as much as possible. It may be necessary to bring additional water from the collection site and replace lost volume in the cooler if long transportation times are expected. This will also help to maintain dissolved oxygen concentration and reduce mortality of any associated animals (usually marine worms or clams). Having a portable battery-powered aerator can also help in this regard.

3 Transplanting

On return to the nursery, the plants can be planted immediately or left in the cooler with aeration overnight. It may be beneficial to exchange about half of the water in the cooler with water from the destination tanks to enable the plants to acclimate to the change in salinity and temperature more easily. In no circumstances should the salinity be more than 10 ppt different from the collection location if survival is expected. Temperature changes of greater than 9°F (5°C) are to be avoided. It is better to let the water cool or heat gradually in the cooler until it reaches a temperature similar to the destination tank.

Planting of the sods into the growing tanks can be done many different ways. Generally an organic soil mixture (1:1 topsoil:sand ratio) works well. More sand in the mix can be used if the collection location was dominated by sandy rather than muddy sediments. The soil mix should be added to at least half-fill the planting container and then fully saturated with water from the destination tank before placing the seagrass sods in them.

Once the sods are placed, additional soil can be added to completely cover the roots, and additional water is added to completely saturate the soil. It is a good idea to add enough
water to submerge the leaves also, if the container will not be placed in the destination tank immediately. Minimize the amount of time the plants are out of the water and get them from the cooler into the container, and then the container into the destination tank as quickly as possible.

We have found that larger containers [28 x 20" (71 x 51 cm) high density polyethylene cement mixing tubs] that are bigger than the sods and provide at least 4-6" (10-15 cm) sediment depth work best, but quickly become very heavy and require two or more people to lift. Two sods can be planted per large tub and allow room for expansion and growth outwards from the sod into the tub.

Smaller plastic tubs [14 x 12" (36 x 30 cm) 12 quart plastic dishpans] are ideal for planting a single sod, and are generally light enough for a single person to handle. Alternatively large pots (8 or 12" plastic or clay) can also be used, however smaller pots are not recommended as too small a container size will reduce the likelihood of vegetative expansion.

This is because Ruppia maritima has a growing region at the end of the horizontal rhizome, called the apical meristem. Without this vital region present, the remainder of the plant will slowly die off and no new growth will occur. Meristem density varies by collection location, but generally only 10-20 are present in a 1 x 1 ft (30 x 30 cm) area, so larger sods and larger planting containers maximize the potential for success.

4 Growing Methods

Once the newly planted sods in their container have been gently and slowly lowered into the destination tank, it is important to monitor conditions at least weekly. Salinity should be maintained at 0-20 ppt, water temperature should be at least 77°F (25°C) and high light levels (at least 300-500 µmol irradiance) are all necessary for success.

It is not recommended to add any fertilizer, as this will just cause the water to go green with phytoplankton and stress the seagrass plants with not enough light. There are more than sufficient nutrients in the soil and the sod to sustain plant growth for at least one to two years.

Because of the high light-levels required for growth, the plants may be better held in outdoor tanks, to minimize electricity costs for lighting, or grown in tanks inside a greenhouse. The local climate will be an important consideration for which option will be best. If cool or cold winters are normal, then it will not be possible to maintain tanks outdoors at a warm enough water temperature for growth. Also, if heavy rainfalls are frequent, then the cost of replacing salt diluted by rain may quickly become prohibitive. For these reasons placing the tanks inside a greenhouse is a better option despite larger initial costs of building a greenhouse.

Shading should be kept to a minimum as water itself will filter out a large amount of sunlight even in shallow tanks. It is not recommended to grow the plants in more than 2 ft (60 cm) of water, as low light-levels will be too limiting for success. Evaporation losses of water from tanks held in the greenhouse will be the main maintenance requirement. Check the salinity to ensure it remains optimal and adjust as needed with additional salt or freshwater.

If indoor growing is necessary (e.g., too cold in winter), artificial lighting is a must. High intensity grow-lights will be needed and the building must be correctly wired to support such a large electricity demand. We have had best success with red spectrum high output compact fluorescent bulbs (e.g., T5 daylight or 3,500 K bulbs in a multiple bulb grow-light fixture). These can output around 300 µmol at a distance of 1-1.5 ft (30 - 45 cm) above the tank and produce very little heat. It is best to use a photoperiod of 20:4 hour (light:dark) to maximize growth at these relatively low light-levels.

Temperature control can be achieved by adding submersible aquarium heaters during the winter, or having an efficient gas burning heater to maintain the air temperature at 9°F (5°C) above the desired water temperature. During hot summer conditions shade cloth (50%) can be hung over the tanks, fans can be used to circulate the air, and many greenhouses have some type of active ventilation system to exhaust hot air. Remember these plants are relatively tolerant of warm water temperatures, but care should be taken to ensure water temperatures do not exceed 95°F (35°C) for prolonged periods (many hours per day).

Growth of Ruppia maritima is fast compared to most other SAV species, but it will not be unusual for the plants to require one or more months to recover from transplanting shock. It will generally take three to six months or longer before the open area of the tub becomes colonized by new shoots under optimal conditions. Sub-optimal growing conditions will prolong this process.

5 Restoration Considerations

Depending on the restoration requirements, the resulting tubs of plants may be transported in their entirety and then the sods placed in sheltered estuarine conditions. Ideal locations have low wave energy, slow tidal currents, and shallow depths with good water clarity (>50% of surface irradiance reaching the bottom).

Alternatively, smaller sods can be extracted from the tub and handled like a transplant sprig. An excellent overview of the different seagrass transplanting methods and the relative success rates can be found in Fonseca et al. (1998). For Ruppia maritima bare-root plantings have shown success, however, it may be better to keep the sediments around the roots than to attempt bare-root plantings.

Given the limited transplanting recovery potential of this species, it may not be the best option for restoration planting in some estuarine locations where high salinities and high wave energy is anticipated. A more suitable species may be Halodule wrightii, under these conditions.
Ruppia maritima Propagation Guide

Seedling and Plant Propagation Charts

- **59-86°F (15-30°C)**
  - Optimal Temperature
  - **Submerge 1" Water**
  - Seed Germination 2-4 Weeks

- **81-86°F (27-30°C)**
  - Temperature Controlled
  - **Fluorescent 18:6 Light:Dark**
  - Seedlings 3-6 Months

- **<95°F (35°C)**
  - Ambient Temperature
  - **Greenhouse Full Sun**
  - Container Plants 6-12 Months

- **82°F (28°C)**
  - No Light Needed
  - Fluorescent Recommended

Citations


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Further Information

USDA PLANTS profile: http://plants.usda.gov/java/profile?symbol=RUMA5

Center for Plant Restoration and Coastal Plant Research: http://sites.google.com/site/coastalplantrestoration/home

Field guide and images of Coastal Mississippi Wetland plant species: http://jcho.masgc.org/


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