



UNIVERSITY OF  
FLORIDA

SS AGR 41

EXTENSION

Institute of Food and Agricultural Sciences

## Biology and Control of Duckweed With Herbicides<sup>1</sup>

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### Description

The duckweed family, or Lemnaceae, consists of four genera of small floating aquatic plants: *Lemna*, or Common Duckweed; *Spirodela*, or Giant Duckweed; *Wolffia*, or Water-meal; and *Wolffiella*, or Bog-mat. A body of water may contain a pure stand of one of these plants or a mixed population of several genera. They are often found in association with other aquatic plants, particularly with those that provide protection from wind and wave action.

The duckweed plants are not differentiated into true stems and leaves; the leaf-like stems are called *fronds*. The shape of the fronds varies with each individual species, ranging from globular to spherical, to elliptical, elongated, or strap-like in appearance. The duckweed fronds can be observed growing individually or attached to one or more other fronds. One or more small white, unbranched, cylindrical roots may be present, while some duckweed plants are rootless. The color of the plants on the upper or dorsal side of the fronds varies from light green to dark green, while on the bottom or ventral side they may be green to deep purple.

Seen from a distance, it is difficult to distinguish individual plants in a body of water infested with duckweed because the surface of the water appears green. Upon closer examination the individual duckweed plants can be seen.

Plants in the duckweed family should not be confused with two other small floating plants, *Azolla* and *Salvinia*. These two genera appear quite differently when closely examined.

**Common Duckweed:** The common name for the plants in the genus *Lemna* is Common Duckweed. At least two species are widespread in Florida; *L. perpusilla* Torr. and *L. minor* L., usually occurring more frequently than other members of the family. The size of the fronds of the Common Duckweed generally ranges from 0.070 to 0.16 in (1.7 to 4.0 mm) in length and from 0.032 to 0.16 in (0.80 to 4.0 mm) in width. The fronds of this plant occur solitarily or in groups of two or more.

The color of *L. perpusilla* is light green to green, both on the upper and lower surfaces of the fronds. The fronds of *L. minor* are green to yellowish green with a slight red coloration at times spread over the lower surface and occasionally on the margins of the

1. This document is SS AGR 41, one of a series of the Agronomy Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Published: May 2002. Visit the EDIS Web Site at <http://edis.ifas.ufl.edu>.

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upper surface. In Common Duckweed, there is a single root extending from the base of each frond.

**Giant Duckweed:** Giant Duckweed is the common name for plants in the genus *Spirodela*. Giant Duckweed fronds are usually larger than those of Common Duckweed. The size of the fronds of Giant Duckweed generally ranges from 0.079 to 0.28 in (2.0 to 7.0 mm) in length and from 0.039 to 0.24 in (1.0 to 6.0 mm) in width.

The fronds of the Giant Duckweed plant occur solitarily, or in groups of two or more. Its frond color is green to dark green on the upper surface and reddish-purple on the lower surface. Giant Duckweed usually has two or more roots extending from the lower frond surface; occasionally a frond will be seen which only has a single root.

**Water-meal:** The tiny plants of the genus *Wolffia* have been given the common name Water-meal. The Water-meal fronds are ovoid to globular to ellipsoidal in shape, with the width or length usually less than 0.059 in (1.5 mm).

Water-meal fronds, which are green, grow solitarily or in pairs; usually no more than two are seen connected. When rubbed between the fingers, these plants feel somewhat hard and granular. The plant does not form roots.

**Bog-mat:** Bog-mat is in the genus *Wolffiella*. Its fronds are somewhat linear, being thin and flat in shape. The fronds float near or on the surface of the water with the ends of the fronds bending or twisting downward at times. The elongated bog-mat fronds usually range from 0.059 to 0.39 in (1.5 to 10.0 mm) in length and from 0.012 to 0.063 in (0.3 to 1.6 mm) in width.

The green bog-mat fronds are seen growing solitarily, in pairs, and in groups with several fronds connected. Like Water-meal, the bog-mat plants do not form roots.

## Habitat

The small floating plants of the duckweed family are found in many aquatic sites, including small ponds, canals, marshes, ditches, and in protected areas of lakes and rivers. In the larger bodies of

water these plants are subject to movement by the prevailing wind. In areas where the plants are numerous, floating mats of vegetation are frequently seen on the downwind side of the water body. Two or more members of the duckweed family often are found growing together. They are also frequently seen among other floating plants, marginal grasses or other emergent vegetation. These plants can develop dense infestations, completely covering the surface of a water body, at times to a thickness of more than 1 in (2.5 cm). This heavy growth of weeds can be detrimental to an aquatic system, lowering the level of available light for submersed higher plants and algae.

## Reproduction

All plants in the duckweed family reproduce both vegetatively through budding, and by seed. All four of the genera, *Lemna*, *Spirodela*, *Wolffia*, and *Wolffiella* are known to flower and produce seed, though flowering is not frequently observed. *Wolffia* or Water-meal is the smallest in size of all the flowering plants.

The primary means of reproduction of these plants appears to be the vegetative production of daughter plants by budding. This process of forming new plants occurs rapidly under good growth conditions, leading to the occurrence of very dense infestations of weed growth.

*Spirodela*, or Giant Duckweed, has one other means of reproduction that helps the plant survive periods of poor growth conditions, such as drought or low temperatures. Giant Duckweed can produce specialized fronds that have no roots and are called *turions*. These turions are denser than a typical vegetative frond; thus once formed, they sink to the bottom of the body of water. Later, during more favorable growth conditions, the turion begins growth and floats to the surface, forming a new plant.

## Control

Plants in the duckweed family may be difficult to control under certain growth conditions. Dense infestations will usually require re-treatment to achieve an acceptable level of control. To reduce control costs, re-treatment should be initiated when

the size of the remaining infestation is at a minimum. Herbicides with the active ingredient Diquat are not highly effective in controlling *Spirodela*, or Giant Duckweed. Some herbicides labeled for control of duckweed are shown in Table 1 with the suggested treatment rates and additional application suggestions. Shown in Table 2 are the application sites where each product may be used, a description of the formulation, and some use precautions for each product.

**Table 1.** Herbicides Labeled For Duckweed Management with Selected Use Directions.

<b>Product Trade Name</b>	<b>Product Application Rate</b>	<b>Selected Application Suggestions</b>
2,4-D 4 Amine IVM	0.5 –1.0 gal per acre	Apply in 50-100 gal spray mixture per acre with uniform coverage. Do not submerge plants during application. Repeat applications may be required.
2,4-D L.V. 4 Ester	4.5 pts per acre	Apply in 50-100 gal spray mixture per acre with uniform coverage. Do not submerge plants during application. Repeat applications may be required.
2,4-D L.V. 6 Ester	3.0 pts per acre	Apply in 50-100 gal spray mixture per acre with uniform coverage. Do not submerge plants during application. Repeat applications may be required.
Albaugh 2,4-D Amine 4	2.5 to 4.5 pts per acre	Apply in 50-100 gal spray mixture per acre with uniform coverage. Spray to wet foliage thoroughly. Repeat applications may be required.
Avast!	0.25 qts per acre foot (ponds)	Apply as a surface spray in at least 25 gal spray mixture per acre with uniform coverage. Repeat applications may be required. See label for rate restrictions.
Clearigate	4.4 – 8.7 gal per acre	Use lower rates in shallow water and with light weed infestations. Wet plants thoroughly with a light surface spray. Repeat applications may be required.
Liquid Trim	20 gal per acre	Apply in 50-150 gal spray mixture per acre with uniform coverage. Treat all plants along shoreline. Spray to wet foliage thoroughly. Repeat applications may be required.
Quick Kill	20-48 gal per acre	Apply in 50-200 gal spray mixture per acre with uniform coverage. Spray to wet foliage thoroughly. Repeat applications may be required.
Reward	1.0 gal per acre	Apply in 50-150 gal spray mixture per acre with uniform coverage. Use label rates of a 75% or higher non-ionic surfactant. Treat all plants along shoreline. Spray to wet foliage thoroughly. Repeat applications may be required.
Solution Water Soluble IVM	Use one to two packets (2 lbs 13 oz to 3 lbs 10 oz product)	Apply in 50-100 gal spray mixture per acre with uniform coverage. Do not submerge plants during application. Repeat applications may be required.
Sonar A.S.	0.24 qts per acre foot (ponds)	Apply as a surface spray in at least 25 gal spray mixture per acre with uniform coverage. Repeat applications may be required. See label for rate restrictions.
Tenkoz Amine 4 2,4-D Herbicide	2.5 to 4.5 pts per acre	Apply in 50-100 gal spray mixture per acre with uniform coverage. Spray to wet foliage thoroughly. Repeat applications may be required.

**Table 1.** Herbicides Labeled For Duckweed Management with Selected Use Directions.

Product Trade Name	Product Application Rate	Selected Application Suggestions
Weedtrine-D	5.0 gal per acre	Apply in 130 gal spray mixture per acre with uniform coverage. Use 1.0 oz of non-ionic surfactant per 10 gal of spray mixture. Spray to wet foliage thoroughly. Repeat applications may be required.

**Table 2.** Herbicides Labeled For Duckweed Management with Application Sites, Active Ingredients, and Use Precautions.

Herbicide Trade Name	Application Sites	Active Ingredient	Use Precautions
2,4-D 4 Amine IVM	bayous (quiescent or slow moving); canals ; drainage ditch banks; drainage ditches; lakes; marshes; reservoirs; rivers (quiescent or slow moving); streams; (quiescent or slow moving)	2,4-D	Avoid spray or drift contacting susceptible crops or plants. Delay use of treated water for irrigation or domestic use for three weeks or until water contains no more than 0.1 ppmw 2,4-D acid. In dense weed infestations, treat only 1/3 to 1/2 the water body and wait 10-14 days between treatments.
2,4-D L.V. 4 Ester	drainage ditch banks; drainage ditches (still); lakes (still); marshes (still); ponds (still)	2,4-D	Avoid spray or drift contacting susceptible crops or plants. Delay use of treated water for irrigation or domestic use for three weeks or until water contains no more than 0.1 ppmw 2,4-D acid. In dense weed infestations, treat only 1/3 to 1/2 the water body and wait 10-14 days between treatments.
2,4-D L.V. 6 Ester	drainage ditch banks; drainage ditches (still); lakes (still); marshes (still); ponds (still)	2,4-D	Avoid spray or drift contacting susceptible crops or plants. Delay use of treated water for irrigation or domestic use for three weeks or until water contains no more than 0.1 ppmw 2,4-D acid. In dense weed infestations, treat only 1/3 to 1/2 the water body and wait 10-14 days between treatments.
Albaugh 2,4-D Amine 4	bayous; canals; drainage ditch banks; drainage ditches; lakes; marshes; ponds; potable water; reservoirs; streams	2,4-D	Avoid spray or drift contacting susceptible crops or plants. Delay use of treated water for irrigation or domestic use for three weeks or until water contains no more than 0.1 ppmw 2,4-D Amine 4. Do not apply to more than 1/3 to 1/2 of a lake or pond in any one month to avoid oxygen depletion.

**Table 2.** Herbicides Labeled For Duckweed Management with Application Sites, Active Ingredients, and Use Precautions.

Herbicide Trade Name	Application Sites	Active Ingredient	Use Precautions
Avast!	canals; canals (static); drainage canals; irrigation canals; lakes; ponds (fresh water); reservoirs; rivers; potable water intakes (not at application rates greater 20 ppb within 1/4 mile of any functioning potable water intake)	fluridone	Delay irrigation from <b>ponds</b> of the following crops for the indicated period: Established tree crops – 7 days; established row crops, turf, and plants – 30 days; newly seeded crops, seedbeds, or areas to be planted (including overseeded greens) – 30 days. Delay irrigation from <b>canals</b> of the following crops for the indicated period: Established tree crops – 7 days; established row crops, turf, and plants – 14 days; newly seeded crops, seedbeds, or areas to be planted (including overseeded greens) – 30 days. Delay irrigation from <b>lakes and reservoirs</b> of the following crops for the indicated period: Established tree crops – 7 days; established row crops, turf, and plants – 14 days; newly seeded crops, seedbeds, or areas to be planted (including overseeded greens) – 14 days. Do not apply within 1/4 mile of a functioning potable water intake.
Clearigate	canals; ditches; farm ponds; fish ponds; golf course ponds; industrial ponds; irrigation conveyance systems (crop and non-crop); lakes; laterals; potable water reservoirs; swimming ponds	copper	Potential fish toxicity at rates above 0.5 ppmw copper. Treatment rates above 0.5ppmw are suggested for use only by experienced applicators. To reduce the possibility of fish toxicity and oxygen depletion, treatments above 0.5 ppmw should not exceed 1/3 to 1/2 of the water body, with one to two weeks between treatments.
Liquid Trim	drainage ditches (where there is little or no outflow of water and which are totally under the control of the product's users); lakes (where there is little or no outflow of water and which are totally under the control of the product's users); ponds (where there is little or no outflow of water and which are totally under the control of the product's users)	diquat	In dense weed infestations, treat only 1/3 to 1/2 the water body and wait 10-14 days between treatments. Do not use treated water for animal consumption, spraying or irrigation within 14 days of treatment.

**Table 2.** Herbicides Labeled For Duckweed Management with Application Sites, Active Ingredients, and Use Precautions.

Herbicide Trade Name	Application Sites	Active Ingredient	Use Precautions
Quick Kill	drainage ditches (little or no outflow of water and totally under the control of the product's user); lakes (little or no outflow of water and under total control of the product's user); ponds (little or no outflow of water and totally under the control of the product's user)	diquat	In dense weed infestations, treat only 1/3 to 1/2 the water body and wait 10-14 days between treatments. Do not use treated water for animal consumption, spraying or irrigation within 14 days of treatment.
Reward	bayous (public waters); canals (public waters); drainage ditches (public waters); drainage ditches (still water, where there is minimal or no outflow to public waters); flowing waters (rivers, streams, canals) not within 1600 feet upstream or within 400 feet downstream of operating potable water intake sites; lakes (public waters); lakes (still water, where there is minimal or no outflow to public waters); marshes (public waters); ponds (public waters); ponds (still water, where there is minimal or no outflow to public waters); quiescent or slow moving bodies of water; reservoirs (public waters); rivers (public waters); standing water (lakes, reservoirs) not within 1400 feet for rates of 2 gal/acre or within 700 feet for rates at 1 gal/acre or within 350 feet for rates equal to or less than 0.5 gal/acre of potable water intake sites; streams (public waters); ditches (edges and non-flooded portions); lakes (edges and non-flooded portions); ponds (edges and non-flooded portions)	diquat	In dense weed infestations, treat only 1/3 to 1/2 the water body and wait 10-14 days between treatments. Do not use treated water for animal consumption, spraying or irrigation within 14 days of treatment. Delay use of treated water for livestock consumption and agricultural sprays and irrigation to turf and ornamentals for 1 day. Delay use of treated water for agricultural sprays and irrigation to food crops for 5 days. See label for application site restrictions.

**Table 2.** Herbicides Labeled For Duckweed Management with Application Sites, Active Ingredients, and Use Precautions.

Herbicide Trade Name	Application Sites	Active Ingredient	Use Precautions
Solution Water Soluble IVM	bayous (quiescent or slow moving); canals (quiescent or slow moving); drainage ditch banks; drainage ditches (quiescent or slow moving); lakes (quiescent or slow moving); marshes (quiescent or slow moving); ponds (quiescent or slow moving); reservoirs (quiescent or slow moving); rivers (quiescent or slow moving); streams (quiescent or slow moving)	2,4-D	Avoid spray or drift contacting susceptible crops or plants. Delay use of treated water for irrigation or domestic use for three weeks or until water contains no more than 0.1 ppmw 2,4-D acid. In dense weed infestations, treat only 1/3 to 1/2 the water body and wait 10-14 days between treatments.
Sonar A.S.	streams (quiescent or slow moving) drainage canals; irrigation canals; lakes; ponds (fresh water); potable water sources; reservoirs	fluridone	Delay irrigation from <b>ponds</b> of the following crops for the indicated period: Established tree crops – 7 days; established row crops, turf, and plants – 30 days; newly seeded crops, seedbeds, or areas to be planted (including overseeded greens) – 30 days. Delay irrigation from <b>canals</b> of the following crops for the indicated period: Established tree crops – 7 days; established row crops, turf, and plants – 14 days; newly seeded crops, seedbeds, or areas to be planted (including overseeded greens) – 30 days. Delay irrigation from <b>lakes and reservoirs</b> of the following crops for the indicated period: Established tree crops – 7 days; established row crops, turf, and plants – 14 days; newly seeded crops, seedbeds, or areas to be planted (including overseeded greens) – 14 days. Do not apply at rates greater than 20 ppbw within 1/4 mile of a functioning potable water intake.
Tenkoz Amine 4 2,4-D Herbicide	bayous; canals; drainage ditch banks; lakes; marshes; ponds; potable water; reservoirs; streams	2,4-D	Avoid spray or drift contacting susceptible crops or plants. Delay use of treated water for irrigation or domestic use for three weeks or until water contains no more than 0.1 ppmw 2,4-D Amine 4. Do not apply to more than 1/3 to 1/2 of a lake or pond in any one month to avoid oxygen depletion.
Weedtrine-D	ditches (still, in and around); drainage ditches (little or no outflow of water and under total control of user); lakes (little or no outflow of water and under total control of user); lakes (still, in and around); ponds (little or no outflow of water and under total control of user); ponds (still, in and around)	diquat	In dense weed infestations, treat only 1/3 to 1/2 the water body and wait 14 days between treatments. Do not use treated water for animal consumption, spraying, irrigation or drinking within 5 days of treatment.