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Watermeal and Duckweed Control in Arkansas Ponds

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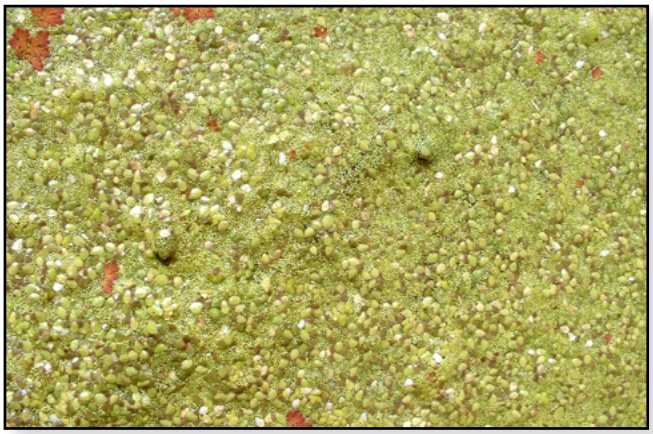
It is estimated that there are more than 300,000 private ponds and lakes in Arkansas. Because of the interactions of sunlight, water and nutrients, these waterbodies have the potential to develop problems with nuisance aquatic plants. For small ponds with little to no water flow, duckweed and watermeal can frequently become problem plants.

Pond covered with watermeal and duckweed

Duckweed (Lemna spp.) and watermeal (Wolffia spp.) are free-floating aquatic plants. They are commonly found together. Often, mosquito fern (Azolla spp.) will also be found with these two plants, but its population is usually too low to be a nuisance.



Mix of duckweed watermeal and mosquito fern

The potential problems caused by duckweed and watermeal fall into two categories. On calm, still days the plants will spread over the entire surface of the pond, giving it an even, green appearance. This can be aesthetically unpleasant, a recreational or production nuisance, and even has the potential to be unsafe by fooling the unaware individual into thinking there is no pond present.

The plants can also kill fish in these conditions. By blocking sunlight penetration, little to no oxygen is produced by phytoplankton. Since plankton, fish and bacteria continue to use oxygen dissolved in the water, the pond can quickly become depleted of dissolved oxygen. The result is the suffocation of fish. If the pond has a productive

fishery, removal or control of these two plants becomes essential.

Biology

Watermeal is the smallest and simplest of the flowering plants. It is rootless and tiny, usually less than 1 mm, and appears as little green pin heads floating on the surface. To the touch, it can feel somewhat like dry grits. Duckweed is a little bigger, but still very small, usually 1/8 to 1/4 of an inch across. The fronds tend to be elliptical, and a small root is present on the lower surface of each frond.

Watermeal

Duckweed

The growth of these plants is linked to high nutrient levels, particularly nitrogen and/or phosphorus, which is why they are common in residential, park and cattle ponds. Both of these plants tend to grow in dense colonies in quiet waters. Individual plants stick readily to birds, animals and equipment, often resulting in their spread from one pond to another. Once in a new pond, growth can be explosive under optimal conditions. Both species can reproduce by budding, and in some cases double their population every 24 hours.

Both watermeal and duckweed tend to "disappear" from the pond surface in the late fall. During the summer, the plants have buoyancy due to trapped oxygen from photosynthesis. In the fall, photosynthesis slows down, leading to less oxygen in the plant, and the accumulated starch from a season of growth makes the plant heavier, so it sinks to the sediments. In the spring, the plants start photosynthesizing, accumulate oxygen and float to the surface again. On occasion, the plants will not reappear the following spring, though this should not be relied upon as a control strategy.

Control Options

Prevention

Both plants are linked to high nutrient loads in the pond. Eliminating, capturing or diverting nutrient inputs will reduce, but not eliminate, the chance of watermeal or duckweed problems. This includes growing vegetative buffer strips around the pond, using a fertilizer application setback, excluding livestock, and possibly using materials that can bind up phosphorous, rendering it unavailable for plant grow. Draining, drying and deepening a pond to eliminate accumulated nutrients may be necessary, but this will be a waste of time if the pond is allowed to become nutrient loaded again. Removing or inactivating nutrients will not remove or kill plants, or correct an existing problem. It can potentially lead to lower populations, or reduce the chance of problems occurring in the first place, by reducing nutrients critical for growth.

Both watermeal and duckweed prefer stagnant or slow-moving water. By adding aeration, it might be possible to eliminate the growth of both plants, or limit it to only the pond edges. Aeration will also reduce the chances of a fish kill due to low dissolved oxygen.

Azolla or "mosquito fern"

Mechanical

Raking or seining with a small mesh seine or window screen can reduce coverage. While laborious, this can be effective for small ponds (usually 0.25 acre or less). Due to rapid reproduction, repeated removal will likely be required. If the owner is willing and physically able to manually remove duckweed/watermeal, this can be a cost-effective strategy. Remember to dispose of harvested plant material away from the pond. This prevents it from washing back into the pond in the event of rain.

Duckweed

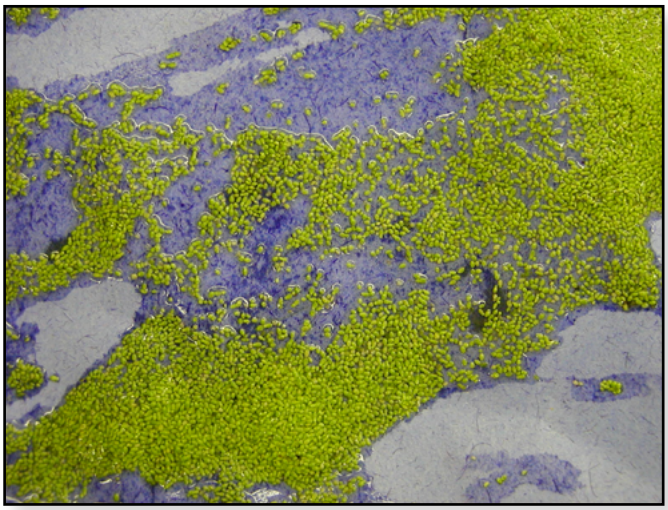
Biological

A biological control agent is a living organism used to control a particular pest. The most commonly used biocontrol for aquatic plants are grass carp. While grass carp will consume both duckweed and watermeal, at their normal stocking rates they will typically not consume the plants at a rate fast enough to keep up with plant reproduction and growth. The typical stocking rates for grass carp are five to 10 per acre. If largemouth bass are present, fish at least 8-10 inches long must be used to reduce predation. Higher stocking rates may lead to the control of these plants, but this has not been proven. Also, once grass carp get to be three or four years of age and weigh more than 10 pounds, their effectiveness as an aquatic vegetation biocontrol is substantially diminished.

Tilapia will consume, and under the right circumstances, control both plants. Unfortunately, tilapia are cold intolerant and do not survive water temperatures below 55 degrees F. As a result, they need to be stocked yearly. Recommended stocking rates are 15-20 pounds per acre of mixed sex adults. Again, largemouth bass predation can prevent the tilapia from effectively controlling problem plant populations.

Tilapia is a non-native species that are on the Arkansas Game and Fish Commission (AGFC) approved species list. This means that they are legal to stock in private ponds, but the AGFC does not recommend their stocking in any lake or pond that has a watershed or spillway that could allow the fish to escape during a flood event. The pond owner is liable for any escapes. In closed-system lakes north of I-40, where the AGFC has stocked tilapia, they have observed no carryover fish surviving the winter. Tilapia should never be stocked in ponds that connect to other ponds, lakes or streams. Tilapia can be an effective biocontrol agent under the right circumstances, if the pond owner is willing to accept their inherent drawbacks.

Another potential biological control option for watermeal, but not duckweed, might be goldfish. The results of this approach have been mixed. They have been stocked into small ponds at a rate of 35-40 pounds per acre and have sometimes brought watermeal under control. But this is not universal. Predation from largemouth bass is suspected as a possible explanation for cases where goldfish failed to control watermeal. While success is not guaranteed, stocking goldfish is fairly inexpensive and is unlikely to cause harm.



Watermeal

Chemical Control

Often, once either or both of these plants have become established, the only viable option for control is the use of herbicides. There are herbicide formulations that have been tested that can provide good (G) to excellent (E) control for duckweed and watermeal. Poor (P) formulations should be avoided. None of these herbicides are restricted use but following label instructions is required and failure to do so is a violation of federal law. The University of Arkansas Cooperative Extension publication MP44 *Recommended Chemicals for Weed and Brush Control* (https://www.uaex.edu/publications/MP-44.aspx) contains a section on aquatic herbicides. For more detailed information, this free publication should be consulted.

Herbicide	Duckweed	Watermeal
Diquat	G	P
Fluridone	E	G
Imazapyr	G	P
Carfentrazone	G-E	G
Penoxsulam	E	G
Flumioxazin	E	E
Bispyribac Sodium	E	E

E=Excellent G=Good P=Poor

Diquat (Reward, Weedtrine D, others)

Diquat is a contact herbicide that causes rapid plant death. Results are noticeable within a couple of days. Diquat will kill duckweed, but not have much effect upon watermeal. As a result, its use may selectively eliminate the duckweed leading to a pond with only watermeal present. There are many diquat formulations labeled for aquatic use in Arkansas, but most list 1-2 gallons per acre as the recommended rate. Consult the label for the rate of the selected formulation.

If the duckweed has been pushed to one side of the pond by wind, the diquat might only affect the top layers. Repeated application of this product seven to 10 days apart will probably be necessary. Diquat can be used as a spot treatment. Use of a non-ionic surfactant is recommended to increase effectiveness. Product rates vary with formulation.

Diquat has various use restrictions for drinking water, dairy cattle and other livestock and crop irrigation. Please consult the label. Diquat requires at least 30 minutes of contact time and is rain-fast in one to two hours.

Copper Complexes (Cutrine and others) have been shown to increase the effectiveness of Diquat. Used alone, it will not kill duckweed or watermeal. The general recommendation is one part chelated copper to two parts diquat. If adding a copper product other than one of the copper complexes, the alkalinity of the water should be tested to ensure safety of the fish.

Fluridone (Sonar, Avast, Whitecap, others)

Fluridone comes in both liquid and granular formulations and can provide excellent control of both plants. It can be applied to the water surface or subsurface. Fluridone is a systemic herbicide, is absorbed slowly and can require up to 45 days of contact time to reach maximum effectiveness. Between 30-90 days may be needed before control is achieved. This herbicide is not recommended if the pond has any outflow. Due to the length of contact time, a "bump" application where a partial dose is added, may be needed to maintain an effective concentration in the water.

Label rates are between 45-90 parts per billion (ppb), though it is legal to use less, and control may be achieved. Adding fluridone to the water early in the spring, the moment watermeal or duckweed is spotted, will lead to better results. Fluridone has a seven to 30 day withdrawal period for crop irrigation and can not be applied within 1/4 mile of a water intake at rates above 20 ppb.

Imazapyr (Habitat, Arsenal, Alligare Imazapyr 2SL, others)

Imazapyr is a systemic herbicide that can be effective against duckweed, but probably not watermeal. There are currently seven herbicides containing imazapyr that are labeled for aquatic use in Arkansas. Not all of them list duckweed on the label. Those that do recommend a 1-1.5 pints per acre (as a 1 percent solution) as the rate, with 100 percent coverage of the actively growing foliage. Imazapyr typically is absorbed by the foliage within 24 hours. Effects may not be noticeable for one to two weeks. This herbicide will not work in the water, so it should not be applied subsurface. It should also be noted that imazapyr has a 120 day withdrawal period if the water body is used for crop irrigation.

Carfentrazone (Stingray)

This is a contact herbicide and is reported to be effective on both duckweed and watermeal. Use rates are 6.7-13.5 ounces per acre for duckweed and 13.5 ounces per acre for watermeal as a foliar treatment. Use of a nonionic surfactant is also recommended to increase effectiveness. Depending on the percentage of pond surface treated, the label has variable water use restrictions for drinking, livestock and irrigation, so consult the label.

This product is rainfast within one hour and results might be visible within several hours. This product is also sensitive to the pH of the tank water. At pH 7, its half-life is 8.6 days while at pH 9 its half-life is 3.6 hours, so tank water pH should be measured prior to filling and buffered accordingly. A single application will not control plants with high regeneration rates, so it is likely that multiple treatments will be required. Tank mixing with another herbicide may lead to only a single application being needed.

Penoxsulam (Galleon SC)

Penoxsulam is a selective herbicide that has a use patterns similar to fluridone. While comparatively little product is required, it requires a long contact time, so it shouldn't be used in ponds with rapid water turnover. It can take several weeks for maximum effectiveness and may require 60-120 days for complete plant death. The label information lists duckweed as a plant controlled by this herbicide and is said to partially control watermeal. The recommended rates are 25-75 ppb and should never exceed 150 ppb. For Galleon SC, this translates to 4.4-13.1 ounces of product per acre-foot.

There are restrictions for using treated water for crop irrigation, which vary by crop being irrigated, so consult the label for details.

Flumioxazin (Clipper, Flumigard, others)

This is a contact herbicide similar to carfentrazone. Typical use rates are 6-12 ounces of product per surface acre for foliar applications, or 0.53-2.1 pounds of product per acre-foot (100-400 ppb) for subsurface application. Higher rates may be needed if the plants are mature. The decision to treat the plants on the surface or subsurface will depend upon available equipment and other local factors specific to application site.

This active ingredient is very sensitive to water pH. At pH 9, the half-life of this product is measured in minutes. The spray solution should be buffered to pH 7 or less. Reports by professional applicators indicate that duckweed and watermeal are susceptible regardless of pond water pH, if applied to tops of plants, not into the water.

The label suggests that no more than half of the pond be treated at one time and then wait 10-14 days before treating the remaining area. Do not retreat the same section within 28 days. For subsurface application, application in early morning might enhance effectiveness, due to rapid break down of product in water with pH 8.5 or greater. Flumioxazin may be tank mixed with other approved herbicides for increased effectiveness. Foliar contact can cause rapid desiccation and necrosis of exposed plant tissue.

Bispyribac Sodium (Tradewind)

This is a systemic herbicide. It can be applied either sub-surface or foliar, but for watermeal and duckweed, application to the floating foliage is recommended. Labeled use rates are 1-2 ounces per acre (0.8-1.6 ounces of active ingredient per acre). For dense or mature vegetation, repeat treatments may be needed, but should not occur prior to 30 days after initial treatment. No more than 8 ounces per acre per year should be applied. As a systemic herbicide, the effects of bispyribac sodium on the target plant may take several weeks to become apparent.

The label has variable use restrictions if the water is to be used for irrigation, so consult the label.

Herbicide Labels

In addition to reading herbicide labels for use rates, they should also be consulted for other information. Most of the herbicides recommend the addition of an adjuvant to increase their efficacy. This is usually, but not always, a non-ionic surfactant. When using any adjuvant or second herbicide as a tank mix partner, it is always a good idea to perform a jar test to determine compatibility. This is accomplished by placing small amounts of both herbicides in a jar with some water. The jar is sealed and then shaken vigorously. Incompatible herbicides will form an emulsion, often a mayonnaise-like substance, that is very difficult to clean out of spray equipment. If the materials are physically compatible, the jar will be cool to the touch and there will be no separation of materials or forming of clumps or emulsions.

Labels will also contain application tips, such as good tank mix partners, and the personal protection equipment (PPE) that is required to be worn during mixing and application. For further information, Cooperative Extension Service publication MP556 *Aquatic Vegetation Control in Arkansas* (https://www.uaex.edu/MP556.pdf) might prove a useful resource.

Herbicide Use Costs

Aquatic herbicides tend to be more expensive than their terrestrial counterparts. The reasons for this are numerous. Aquatic herbicides also tend to be much more expensive on a per ounce basis if ordered in smaller volume packaging when compared to larger volume packaging. For example, at an on-line retailer, Sonar AS was $18.75 per ounce when purchased in a quart container and $12.50 per ounce when purchased in a gallon container. Since prices change fairly regularly, approximate prices used at the time of writing this publication should not be considered as current. The pond owner should search the prices for each of the herbicides and make a comparison based on the price per acre or acre-feet it would cost to apply.

Herbicide	Approximate Cost (2020)
Diquat	$99-198/acre (duckweed only)
Fluridone	$47.50-95/acre*ft (a)
Imazapyr	$11.68-17.52/acre (duckweed only)
Carfentrazone	$76/acre
Penoxsulam	$25.82-241.56/acre*ft
Flumioxazin	$37.50-75/acre (foliar) $53-210/acre*ft (subsurface)
Bispyribac Sodium	$37.50-75/acre

(a) - With early application, it may be possible to use a rate lower than the labeled rate, reducing cost.

Conclusions

If a pond is small, nutrient rich and generally has little water movement, duckweed and watermeal can be expected to become a nuisance vegetation at some point. Plants in the duckweed and watermeal family can be very difficult to control under optimal growth conditions. Dense infestations can often require repeated treatments to achieve an acceptable level of control. To reduce control costs, treatments should be initiated when the size of the infestation is at a minimum. If these plants have been a nuisance in the past, they can be expected to be present in the future. With planning, early treatment and taking steps to minimize nutrient loading, control costs and effort can be minimized.

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