

# AQUATIC ENVIRONMENTS

## FISHERY CHEMICALS (PARASITES, PISCICIDES, AND OTHER TREATMENTS)<sup>1</sup>

Gary J. Burtle, Extension Aquaculture and Fisheries

|  | CHEMICAL   | APPLICATION RATE   | CATEGORY OF USE <sup>2</sup>            | COMMENTS  |
|--|--|--|---|---|
| Fish Parasites   | <i>formalin</i><br>Parasite-S<br>Formalin-F<br>Formacide-8   | 15-25 ppm in ponds<br>(4.5-7.5 gal/A-ft)   | Approved                                | Use in warm weather may cause oxygen depletion. Provide aeration during treatment to prevent low oxygen. Use with extreme caution when dissolved oxygen is 5 ppm or lower.  |
|  |  | 125-250 ppm (1-2 pt/1000 gal in tanks for 1 hour)  |   | In tanks, if stress is excessive, flush with fresh water. Use lower rate in water above 50° F.  |
| Piscicides   | <i>rotenone</i> (Restricted Use)<br>Prenfish toxicant  | 0.005-0.25 ppm active ingredient (depends on species)                                      | Not Approved                            | <b>Restricted Use pesticides can only be purchased or used by individuals who have, or are directly supervised by, commercial pesticide licensees who are engaged in commercial production and sales of an agricultural commodity.</b><br>Do not use in waters colder than 65°F. Rotenone products are restricted use pesticides.             |
| Miscellaneous Aquatic Treatment                            | <i>calcium hypochlorite</i><br>(disinfectant & sterilant)  | 10 ppm available chlorine<br>(38.8 lb/A-ft)  | Approved                                | Kills all fish and some parasites. Turbid water affects treatment.  |
|  | <i>florfenicol</i><br>Aquaflor   | 10-15 mg/kg fish per day in feed for 10 consecutive days                                   | Approved                                | <b>A veterinarian must prescribe <i>florfenicol</i>. Wait 15 days prior to harvesting fish for human consumption.</b> Approved for use on catfish, salmonids and freshwater finfish for select bacterial infections.  |
|  | <i>hydrated lime</i><br>(disinfectant)   | 1,338 lb/A burnt lime  | Approved                                | Drained pond treatment. Standing water reduces effect.  |
|  |  | 1,784 lb/A slaked lime   |   | Drained pond treatment.   |
|  | <i>hydrogen peroxide</i><br>Perox-aid<br>PAK-27<br>GreenClean<br>Phycomycin  | Warm water at 700-1,000 mg/L for 15 minutes, once per day.<br>Cold water at 500-1,000 mg/L | Approved                                | 0 day withdrawal time.  |
|  | <i>ormetropin</i> +<br><i>sulfadimethoxine</i><br>Romet 30 (bactericide)   | 2.3 g ai/100 lb fish per day for 5 days in feed  | Approved                                | <b>A veterinarian must prescribe Romet under the Veterinary Feed Directive.</b> 3-day pre-slaughter withdrawal period for catfish, do not use on trout within 6 weeks of marketing or release as stocker fish.  |
|  | <i>oxytetracycline</i><br>Terramycin (bactericide)   | 2.5-3.75 g ai/100 lb fish per day for 10 days in feed                                      | Approved                                | <b>A veterinarian must prescribe Terramycin under the Veterinary Feed Directive.</b> 21-day pre-slaughter withdrawal period.  |
|  | <i>potassium permanganate</i><br>Proline Potassium<br>Permanganate, 97%  | 2 ppm (5.4 lb/A-ft)<br>Pond treatment of fish that are not intended for human consumption  | Not Approved                            | <b>Not approved for use on fish intended for human or animal consumption.</b><br>Treatment may have to be repeated within 24 hours to be effective. Turbid water has a higher permanganate demand and requires either repeat treatment or higher rates of application. Residual manganese is limited to 0.05 mg/L or less for drinking water. |
|  | <i>salt (sodium chloride)</i><br>Brightwell Aquatics Fish<br>Haul-C  | 0.5-3% (83 to 250 lb/1000 gal)<br>In live fish hauling tanks.                              | Approved                                | Do not use iodized salt with fish. Various purities and mixes include sodium chloride for fisheries uses. When applying to ponds for indefinite treatment, a concentration of 50-100 mg chloride/liter is targeted. A low regulatory priority chemical.   |
| <i>tricaine methanesulfonate</i><br>Tricain-S (anesthetic) | 15-66 ppm active ingredient for 6-48 hours for sedation;<br>50-330 ppm active ingredient for 1-40 minutes for anesthesia | Approved   | 21-day pre-slaughter withdrawal period. |   |

<sup>1</sup> Adapted from Approved Drugs for use in Aquaculture, 2010. US Fish and Wildlife Service, Aquatic Animal Drug Approval Partnership Program, American Fisheries Society Fish Culture Section, and US Food and Drug Administration Center for Veterinary Medicine.

<sup>2</sup> Approved for use on fish intended for human or animal consumption or not approved for use on fish intended for human or animal consumption.

# AQUATIC WEED CONTROL

Gary J. Burtle, Extension Aquaculture and Fisheries

| USE STAGE  | HERBICIDE   | MOA   | BROADCAST RATE/ACRE      |  | REMARKS AND PRECAUTIONS  |
|--|---|---|--------------------------|--|--|
|  |   |   | AMOUNT OF FORMULATION    | POUNDS ACTIVE INGREDIENT   |  |
| Algae  | <i>copper chelates</i> ** ***<br>Cutrine-Plus 0.9L or Cutrine Ultra 0.9L            |   | 0.6-1.2 gal*             | 0.2-0.4 ppm*   | Several formulations are marketed, so check labels for use restrictions. Tank mixing with diquat may allow effective control of vascular plants and copper resistant algae. Granular Cutrine-Plus is for spot treatment at the rate of 1 lb/720 sq ft. Cutrine Ultra has adjuvant to enable penetration into dense algal mats.   |
|  | Cutrine-plus 3.7G   |   | 60 lb/A                  |  |  |
|  | K-Tea 8L  |   | 0.7-1.4 gal*             | 0.2-0.4 ppm*   |  |
|  | <i>copper sulfate</i> **<br>(denatures protein)<br>AP Brand Copper Sulfate Crystals |   | 0.85-5.4 lb/A-ft         | 0.25-2 ppm*  | Copper algaecides may be toxic to fish at high rates. Use the low rate in acid waters and the high rate in alkaline waters. Under heavy infestations, treat only 1/4-1/3 the water body at any one time to avoid fish suffocation caused by oxygen depletion. Products containing copper may be used for spot treatments of algae.   |
|  | <i>copper sulfate + alum</i> **<br>SeClear 15G                                      |   | 3.6 – 18.1 lb/A-ft       | 0.54-2.7 lb/A-ft   | SeClear G is 58.9% <i>copper sulfate pentahydrate</i> or 15% elemental copper and has <i>alum</i> to sequester <i>phosphate</i> from the pond water column. Use early in the year or after burn-down of filamentous algae infestations. Use low rates when alkalinity or hardness are less than 40 mg/Liter.   |
|  | <i>copper sulfate</i> **<br>acidified liquid<br>Earthtec 20L                        |   | 1-40 pt*                 | 0.06-2.5 lb  | Dosage is variable according to algae species, pH and water temperature. Tank mixing with diquat may allow effective control of vascular plants and copper resistant algae.  |
|  | <i>diquat</i> ***<br>(REI 24 hr)<br>Reward 2AS                                      | 22  | 1-2 gal*                 | 2-4 lb   | Diquat is effective for filamentous algae control. Apply diquat as recommended in the SUBMERSED WEEDS section. Use 1 gal Reward per surface acre in water with an average depth of 2 ft. The higher rate may be used in water with an average depth greater than 2 ft. Repeat applications will be necessary.<br><br>The Re-Entry Interval after using diquat is 24 hours.   |
|  | Diquat 2AS  |   |                          |  |  |
|  | Weedtrine D 0.4AS   |   | 3.4-10.2 gal*            | 0.5-1.5 ppm*   |  |
|  | dyes and colorants***<br>Aquashade<br>Crystal Blue<br>Blue Vail                     |   | 1 gal/4 A ft             | 1 ppm  | Dye controls filamentous algae by blocking light penetration for up to 6 weeks after application. Apply when weeds may be seen on bottom of pond. Additional applications will be necessary through the year to maintain an acceptable level of dye in the water. Do not apply to water that will be used for human consumption. Water may be used for swimming after complete dispersal of the dye in water. Aquashade is non-toxic to livestock. |
|  | <i>endothall-dimethylalkylamine</i><br>(dessicates plant cells)<br>Hydrothol 191 5G |   | 3-81 lb/A-ft             | 0.05-1.5 ppm   | <b>Hydrothol formulations are toxic to fish and should be used only on sections by a commercial applicator at rates below 0.3 ppm unless fish kills are not objectionable.</b>   |
|  | Hydrothol 191 2EC   |   | 0.6-1.8 pt/A-ft          | 0.05-1.5 ppm   |  |
|  | <i>flumioxazin</i> **<br>Clipper 51WG<br>Propeller 51G                              | 14  | 6-12 oz/surface-A        | 0.36-0.71 lb   | Disperse in 50-100 gal/A and buffer pH 5-7.  |
| <i>sodium carbonate peroxyhydrate</i><br>(oxydizes chlorophyll)<br>Green Clean Pro 27.6G<br>PAK-27 27G<br>GreenClean Liquid 5L<br>Phycomycin 27G |   | 3-170 lb/A-ft<br>3-100 lb/A-ft<br>2.8-28 gal/A<br>3-100 lb/A-ft | 0.8-47 lb<br>0.8-27.5 lb | Liberates hydrogen peroxide when wet. Wide range of application rates indicate variable response by algal species. Filamentous algae require higher rates than planktonic algae. This product does not have residual effect on algae longer than 24 hours. May improve herbicidal effect of copper-containing algaecides when used on algal species with mucilaginous coating. |  |

\* Indicates rate per acre foot of water. All other formulation rates are based on amount per surface area. \*\* Test water for hardness or alkalinity before copper treatment. \*\*\* Other trade names are sold in Georgia with similar composition.

## AQUATIC WEED CONTROL

| USE STAGE                                    | HERBICIDE   | MOA | BROADCAST RATE/ACRE   |   | REMARKS AND PRECAUTIONS   |
|--|---|-----|---|---|---|
|  |   |     | AMOUNT OF FORMULATION   | POUNDS ACTIVE INGREDIENT                              |   |
| Floating Weeds<br>(Also see Floating Plants) | 2,4-D***<br>Weedar 64 3.8EC<br>or granular formulations   | 4   | 2-4 qt/A  | 1.9-3.8 lb/A  | Treat 1/3-1/2 of the water body to avoid oxygen depletion problems.   |
|  | <i>carfentrazone</i><br>Stingray 1.9EC  | 14  | 3.4-13.5 oz   | 0.025-0.2 lb  | Use a non-ionic surfactant and 100 gal of dilution water per surface acre. 80% of foliage should be exposed to treatment. Use tank mixes with 2,4-D, <i>glyphosate</i> or <i>diquat</i> products for better control at the lower rates of application.  |
|  | <i>diquat</i> ***<br>Diquat 2AS   |     | 1 gal   | 2 lb  | Spray to wet exposed plants with 50-150 gal of water per acre plus 1 pint of nonionic surfactant/100 gal of spray mix. Do not apply to muddy water. Labeled also for commercial fish production ponds. Consider tank mixes with chelated copper formulations for resistant duckweeds.   |
|  | Reward 4AS  |     |   |   |   |
|  | Weedtrine D 0.4AS   |     | 5 gal   | 2 lb  |   |
|  | <i>flumioxazin</i><br>Clipper 51G<br>Propeller 51G  |     | 6-12 oz/A   | 0.36-0.71 lb  | Disperse in 50-100 gal/A and buffer to pH 5-7. Up to 14.8 lb/surface A of Clipper 51G is labeled for use on submerged aquatic weeds. (See submersed weeds).   |
|  | <i>fluridone</i> ***<br>Sonar AS 4EC  | 12  | 0.25-2 qt   | 0.25-2 lb   | Apply Sonar AS as a surface application to duckweed at labeled rates. Apply only once per year when duckweed is present. Apply Sonar to bladderwort as suggested in the EMERSED WEEDS section. See REMARKS AND PRECAUTIONS for Sonar as listed in the EMERSED WEEDS AND SUBMERSED WEEDS sections. Watermeal control requires the highest rate of application..  |
|  | <i>imazapyr</i> ***<br>Habitat 2AS  | 2   | See label   | See label   | Use of spreader-stickers will improve results. Ensure complete coverage by applying with 100 gal water/A.   |
| Emersed Weeds<br>(Also see Floating Plants)  | 2,4-D<br>Aqua-Kleen 19G   |     | 100-200 lb  | 19-38 lb  | Spray to wet foliage or spread granules uniformly in infested area in spring or early summer. Read the label for specific weeds controlled and special precautions. Do not apply to more than 1/2 the pond in any one month. Do not apply to waters used for irrigation, agricultural sprays, watering dairy animals, or domestic waters. This group of products is also labeled for commercial fish production ponds. Applications made after September may be less effective depending on water temperatures and weed growth. |
|  | Navigate 19G  |     | 100-200 lb  | 27.6-55.2 lb  |   |
|  | Renovate Max G 14+4G<br>(2,4-D + triclopyr)   |     | 20-100 lb/A   | See label   |   |
|  | Weedar 64 3.8EC   |     | 2-4qt/A   | 1.9-3.8 lb  |   |
|  | <i>carfentrazone</i><br>Stingray 1.9EC  |     | 3.4-13.5 oz   | 0.025-0.2 lb  | Use a non-ionic surfactant and 100 gal of dilution water per surface acre. 80% of foliage should be exposed to treatment. Use tank mixes with 2,4-D, <i>glyphosate</i> or <i>diquat</i> products for better control at the lower rates of application.  |
|  | <i>fluridone</i><br>Sonar 4AS<br>Alligare Fluridone 4AS   |     | 1-2 qt/A  | 45-90 ppb   | Apply <i>fluridone</i> liquids as a surface spray, or near the bottom with weighted trailing hoses, or meter into pumping system. Trees or shrubs growing in water treated with <i>fluridone</i> may be injured. Thirty to 90 days are required before desired weed control is achieved. The emersed weeds treated with <i>fluridone</i> are spatterdock and water lily.  |
|  | <i>glyphosate</i> ***<br>Rodeo 5.4EC<br>Alligare Glyphosate 5.4EC<br>AquaNeat 5.4EC<br>ShoreKlear 5.4EC | 9   | See label.<br>0.75-1.5% solution<br>is typical for spot<br>treatment. | See label for<br>rates matched to<br>specific plants. | Apply after drawdown or when water is present. Allow 7 or more days after drawdown treatment before reintroduction of water (apply within one day after drawdown). Add 2 qt of a manufacturer-approved surfactant per 100 gal of spray solution. Water lily and floating islands respond to <i>glyphosate</i> treatment but repeat when regrowth is observed.   |
|  | <i>imazapyr</i><br>Habitat 2SL, Imazapyr<br>4SL, Arsenal 2SL  |     | 1-6 pt/A, See label   | See label   | Use of spreader-stickers will improve results. Ensure complete coverage by applying with 100 gal water/A.   |
|  | <i>triclopyr</i> ***<br>Renovate 3 3EC  | 4   | 0.25-3 gal  | 0.75-9 lb   | Do not spray open water. Use non-ionic surfactant for foliar application according to surfactant label. Not for water intended for irrigation. Avoid overspray to open water.   |

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## AQUATIC WEED CONTROL

| USE STAGE  | HERBICIDE  | MOA                                | BROADCAST RATE/ACRE      |  | REMARKS AND PRECAUTIONS  |
|--|--|------------------------------------|--------------------------|--|--|
|  |  |                                    | AMOUNT OF FORMULATION    | POUNDS ACTIVE INGREDIENT                       |  |
| Submersed Weeds                                    | 2,4-D***<br>Aqua-Kleen 19G   |                                    |                          |  | See comments for granular formulations in "Emersed Weeds" section. Effective on parrotfeather, coontail and Eurasian watermilfoil. Also labeled for commercial fish production ponds. Renovate Max G rate depends on weed and water depth.   |
|  | Navigate 19G   |                                    | 100-200 lb               | 19-38 lb                                       |  |
|  | Renovate Max G 14+4G   |                                    | 5-375 lb/A               | See label                                      |  |
|  | Weedar 64 3.8EC  |                                    | 2.5-10 gal/A             | 4.3-17 lb/A                                    |  |
|  | <i>bispyribac</i><br>Tradewind 80SP                                    | 2                                  | 0.8-2.4oz/A-ft<br>1-2 oz | 20-45ppb<br>0.8-1.6 oz                         | Use when pond has limited outflow. Up to 2 months for full effect on target plants. Best when applied to actively growing plants. Not recommended for ponds with irrigation or livestock watering.   |
|  | <i>copper ethylenediamine complex**</i><br>Komeen 8L                   |                                    | 1.7-3.3 gal/A-ft         | 0.5-1 ppm                                      | Use Komeen for ponds with crop irrigation on most submerged aquatic weeds.   |
|  | <i>diquat</i><br>Reward 2AS  |                                    | 1-2 gal                  | 2-4 lb   | Apply in early season where submersed growth has not reached the surface by pouring directly from the container into the water while moving slowly over the water surface in a boat. Distribute in strips 40 feet apart. In late season or where submersed weed growth has reached the surface, use the high rate indicated on the label for the weeds present. Also labeled for commercial fish production ponds. Do not apply to muddy water.  |
|  | Diquat 2AS   |                                    |                          |  |  |
|  | Weedtrine D 0.4AS  |                                    | 5-10 gal                 | 2-4 lb   |  |
|  | <i>dyes and colorants***</i><br>Aquashade<br>Crystal Blue<br>Blue Vail |                                    | 1 gal/4 A ft             | 1 ppm  | Dye controls several submersed weeds, such as naiads, by blocking light penetration for up to 6 weeks after application. Apply when weeds are seen on bottom of pond. Additional applications will be necessary through the year to maintain an acceptable level of dye in the water. Do not apply to water that will be used for human consumption. Water may be used for swimming after complete dispersal of the dye in water. Aquashade is non-toxic to livestock.   |
|  | <i>endothall</i><br>Aquathol 10.1G                                     |                                    | 13-81 lb*                | 0.5-3 ppm*                                     | Aquathol and Aquathol K are contact killers and must be applied as early as possible after weeds are present. Water temperature should be a minimum of 65° F. Water containing heavy weed growth should be treated in sections 5-7 days apart. Apply on a calm day. <b>Hydrothol formulations are toxic to fish and should be used only on sections by a commercial applicator at rates below 0.3 ppm unless fish kill is not objectionable.</b> Hydrothol formulations are not recommended for commercial fish production ponds. Aquathol formulations are also labeled for commercial fish production ponds. Apply Aquathol Super K evenly over the treatment area and as early as possible after weed growth is observed. |
|  | Aquathol Super K 63G   |                                    | 0.3-1.9 gal*             | 0.5-3 ppm*                                     |  |
|  | Aquathol K 4.2AS   |                                    | 3-27 lb*                 | 0.05-0.5 ppm*                                  |  |
|  | Hydrothol 5G   |                                    | 0.6 pt-0.7 gal           | 0.05-0.5 ppm*                                  |  |
|  | Hydrothol 191 2AS  |                                    |                          |  |  |
|  | <i>fluridone***</i><br>Sonar AS 4, Alligare<br>Fluridone               |                                    | 1-2 qt/A                 | 45-90 ppb                                      | Check label for susceptible weeds. Trees or shrubs growing in water or having roots growing in water treated with <i>fluridone</i> may be injured. Thirty to 90 days will be required before desired weed control is achieved. Multiple applications may be needed where dilution of the treated area occurs.  |
| Sonar One 5G                                       |  | Up to 5 lb/A-ft                    | 30-90 ppb                |  |  |
| <i>flumioxazin</i><br>Clipper 51G<br>Propeller 51G |  | Not more than<br>14.8 lb/surface A | 0.1-0.4 ppm              | Disperse in 50-100 gal/A and buffer to pH 5-7. |  |

\* Indicates rate per acre foot of water. All other formulation rates are based on amount per surface area. \*\* Test water for hardness or alkalinity before copper treatment. \*\*\* Other trade names are sold in Georgia with similar composition.

## AQUATIC WEED CONTROL

| USE STAGE                     | HERBICIDE   | MOA | BROADCAST RATE/ACRE   |                          | REMARKS AND PRECAUTIONS   |
|-------------------------------|---|-----|-----------------------|--------------------------|---|
|                               |   |     | AMOUNT OF FORMULATION | POUNDS ACTIVE INGREDIENT |   |
| Floating Plants               | <i>imazamox</i><br>Clearcast 1AS                    | 2   | 16-128 oz/A           | Up to 500 ppb            | Spot spray foliage with 0.25-5% solutions in water with a surfactant. Treat submerged vegetation at 50-300 ppb for most aquatic weeds. Granules for shoreline and spot treatment.   |
|                               | Clearcast 2.7G                                      |     | 5-20 lb/A-ft          |                          |   |
|                               | <i>penoxsulam</i><br>Galleon SC 2                   |     | 2-5.6 oz              | 0.031-0.087 lb           |   |
| Emersed Weeds                 | <i>imazamox</i><br>Clearcast 1 AS                   |     | 32-64 oz              | 0.24-0.5 lb              | Spot spray foliage with 0.25-5% solutions in water with a surfactant.   |
|                               | <i>penoxsulam</i><br>Galleon SC 2                   | 2   | 2-5.6 oz              | 0.031-0.087 lb           | Do not use if pond is used to irrigate food crops unless analyses show less than 1 ppb residue. Do not use in successive years.   |
| Drawdown Application          | <i>glyphosate</i><br>Rodeo, Touchdown Pro, Aquaneat |     | See label             |                          | After draw down and glyphosate application wait 7 days before filling pond with water.  |
|                               | <i>imazamox</i><br>Clearcast 1 AS                   |     | 64 oz                 | 0.5 lb                   | Wait 2 weeks before re-flooding the pond.   |
|                               | <i>penoxsulam</i><br>Galleon SC 2                   |     | 5.6-11.2 oz           | 0.087-0.175 lb           | Mix with up to 100 gpa water and a surfactant for post- or pre-emergence use.   |
| Commercial Applicator Systems | ProcellaCOR EC 2.7% AI                              | 4   |                       |                          | The rate of ProcellaCOR EC application is by Prescription Dose Unit and is determined by plant species, water depth, and area of pond treated. Trained Commercial Applicators associated with SePro Corporation can obtain and apply this herbicide system for homeowners or homeowner associations. Long-term control of a broad spectrum of aquatic plants is achieved including bacopa, hydrilla, watermilfoil, alligatorweed, and azolla. Irrigation restrictions apply to treated water. |

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\*\* Test water for hardness or alkalinity before copper treatment.

\*\*\* Other trade names are sold in Georgia with similar composition.

# RESPONSE OF COMMON AQUATIC WEEDS TO HERBICIDES<sup>1</sup>

| WEED                       | <i>copper complexes, copper sulfate</i> | <i>2,4-D dimethylamine</i> | <i>diquat</i>  | <i>endothall</i> | <i>flumioxazin</i> | <i>fluridone</i> | <i>glyphosate</i> | <i>carfentrazone</i> | <i>triclopyr</i> | <i>imazapyr</i> | <i>imazamox</i> |
|----------------------------|---|----------------------------|----------------|------------------|--------------------|------------------|-------------------|----------------------|------------------|-----------------|-----------------|
| MOA                        |   | 4                          | 22             | NC               | 14                 | 12               | 9                 | 14                   | 4                | 2               | 2               |
| <b>ALGAE</b>               |   |                            |                |                  |                    |                  |                   |                      |                  |                 |                 |
| planktonic                 | E                                       | P                          | P              |                  | G                  | P                | P                 | NR                   | NR               | NR              | NR              |
| filamentous                | E                                       | P                          | E              | G <sup>2</sup>   | E                  | P                | P                 | NR                   | NR               | NR              | NR              |
| chara                      | E                                       | P                          | G              | G <sup>2</sup>   |                    | P                | P                 | NR                   | NR               | NR              | NR              |
| nitella                    | E                                       | P                          | G              | G <sup>2</sup>   |                    | P                | P                 | NR                   | NR               | NR              | NR              |
| <b>FLOATING WEEDS</b>      |   |                            |                |                  |                    |                  |                   |                      |                  |                 |                 |
| bladderwort                | P                                       | G <sup>3</sup>             | E              |                  |                    | E                |                   | —                    |                  | NR              |                 |
| duckweeds                  | P                                       | P                          | G <sup>5</sup> | P                | E                  | E                | P                 | G                    | P                | G               |                 |
| salvinia                   | G <sup>5</sup>                          | P                          | G              | P                | E                  | E                | G                 | G                    | P                | P               | E               |
| water hyacinth             | P                                       | E                          | E              |                  |                    | P                | F                 | G                    | P-E              | G               |                 |
| watermeal                  | P                                       | P                          | P <sup>5</sup> |                  | E                  | G                | P                 | P                    | NR               | NR              |                 |
| <b>EMERSED WEEDS</b>       |   |                            |                |                  |                    |                  |                   |                      |                  |                 |                 |
| alders                     | P                                       | E                          | F              | P                |                    | P                | E                 | —                    | —                | —               | G               |
| alligatorweed              | P                                       | F                          | P              | P                | E                  | G                | E                 | F                    | G                | G               | E               |
| American lotus             | P                                       | E                          | P              | P                |                    | F                | G                 | —                    | G                | G               | G               |
| arrowhead                  | P                                       | E                          | G              | G                |                    |                  | E                 | —                    | —                | —               | G               |
| buttonbush                 | P                                       | E                          | F              | P                |                    | P                | G                 | —                    | —                | —               | G               |
| cattails                   | P                                       | G                          | G              | P                |                    | F                | E                 | —                    | F                | E               | E               |
| fragrant & white waterlily | P                                       | E                          | P              | P                |                    | E                | E                 | —                    | G                | E               | E               |
| frogbit                    | P                                       | E                          | E              |                  | E                  |                  |                   |                      |                  |                 | E               |
| maidencane                 | P                                       | P                          | F              |                  |                    | F                | E                 | —                    | —                | —               | —               |
| pickerelweed               | P                                       | G                          | G              |                  |                    | P                | F                 | —                    | NR               | E               | E               |
| pond edge                  |   |                            |                |                  |                    |                  |                   |                      |                  |                 |                 |
| annuals                    | P                                       |                            | G              | P                |                    | F                | E                 | —                    | —                | E               | E               |
| sedges/rushes              | P                                       | F                          | F              |                  |                    | P                | G                 | —                    | NR               | G               | G               |
| slender spikerush          | P                                       | P                          | G <sup>5</sup> |                  | G                  | G                | P                 | —                    | NR               | —               | G               |
| smartweed                  | P                                       | E                          | F              |                  |                    | F                | E                 | —                    | EF               | E               | E               |
| spatterdock                | P                                       | E                          | P              |                  |                    | E                | G-E               | —                    | —                | E               | E               |
| So. watergrass             | P                                       | P                          |                |                  |                    | G                | E                 | —                    | NR               | —               | —               |
| torpedograss               | P                                       | P                          | P              |                  |                    | F                | G                 | —                    | P                | E               | E               |
| watershield                | P                                       | E                          | P              | P                |                    | G                | G                 | —                    | —                | P               | E               |
| water pennywort            | P                                       | G                          | G              |                  |                    | P                | G                 | —                    | G                | —               | —               |
| water primrose             | P                                       | E                          | F              | P                |                    | F                | E                 | F                    | —                | E               | E               |
| willows                    | P                                       | E                          | F              |                  |                    | P                | E                 | —                    |                  | —               | G               |
| <b>SUBMERSED WEEDS</b>     |   |                            |                |                  |                    |                  |                   |                      |                  |                 |                 |
| watermilfoil               | P                                       | G                          | E              | E                |                    | E                | P                 | —                    | G                | NR              | G               |
| coontail                   | P                                       | P                          | G              | F                |                    | E                | P                 | —                    | NR               | NR              | G               |
| egeria                     | P                                       | P                          | E              | F                |                    | E                | P                 | —                    | NR               | NR              | —               |
| elodea                     | P                                       | E                          | E              | E                |                    | E                | P                 | —                    | E                | NR              | —               |
| eurasian watermilfoil      | P                                       | F                          | G              | E                |                    | E                | P                 | G                    | NR               | NR              | G               |
| fanwort                    | F <sup>4</sup>                          | P                          | G              | G                |                    | E                | P                 | —                    | NR               | NR              | —               |
| hydrilla                   | P                                       | F                          | E              | E                |                    | E                | P                 | —                    | NR               | NR              | G               |
| naiads                     | P                                       | E                          | E              | E                |                    | F                | F                 | —                    | E                | NR              | —               |
| parrotfeather              | F <sup>4</sup>                          | E                          | E              | E                |                    | E                | NR                | —                    | E                | NR              | G               |
| pondweeds (Potamogeton)    | P                                       | P                          | G              | E                |                    | E                | P                 | NR                   | NR               | NR              | G               |

E – excellent control (90-100%)

G – good control (80-89%)

F – fair control (70-79%)

P – poor control (<70%)

NR – not recommended

— – Insufficient data

□ – A blank space indicates weed response is not known.

<sup>2</sup> Hydrothol formulations only.

<sup>3</sup> Granular 2,4-D formulations.

<sup>4</sup> Copper complexes only.

<sup>5</sup> Cutrine Plus: Reward, 3:2 tank mix will improve response.

Note: Penoxsulam and Imazamox have been recently labeled for control of floating, emergent and submerged plants, but the labels should be consulted for a list of plants controlled or partially controlled by these herbicides.

# AQUATIC WEED CONTROL USE RESTRICTIONS<sup>1</sup>

Gary J. Burtle, Extension Aquaculture and Fisheries

## NUMBER OF DAYS AFTER TREATMENT BEFORE USE

| Common Name<br>Trade Name          | Company             | Conc. PPM   | HUMAN    |          |                  |
|------------------------------------|---------------------|-------------|----------|----------|------------------|
|                                    |                     |             | Drinking | Swimming | Fish Consumption |
| <i>copper sulfate</i> <sup>2</sup> |                     |             |          |          |                  |
| Copper Sulfate G                   | Tenn. Chem.         | —           | 0        | 0        | 0                |
| Copper Sulfate Snow                | Tenn. Chem.         | —           | 0        | 0        | 0                |
| Copper Sulfate Crystal             | Tenn. Chem.         | —           | 0        | 0        | 0                |
| Triangle Copper Sulfate            | Triangle            |             | 0        | 0        | 0                |
| <i>copper complexes</i>            |                     |             |          |          |                  |
| AquaCure                           | PBI Gordon          | —           |          |          |                  |
| Cutrine-Plus                       | Applied Biochemists | —           | 0        | 0        | 0                |
| Cutrine-Plus G                     | Applied Biochemists | —           |          |          |                  |
| K-Tea                              | Griffin             | —           |          |          |                  |
| Komeen                             | Seapro Corp.        | —           | 0        | 0        | 0                |
| <i>2,4-D</i>                       |                     |             |          |          |                  |
| Aquakleen                          | Rhone-Poulenc       | —           | NL       | 0        | 0                |
| Hardball                           | Helena              |             | —        | 0        | 0                |
| <i>diquat</i>                      |                     |             |          |          |                  |
| Reward <sup>5</sup>                | Zeneca              | —           | 1-3      | 0        | 0                |
| <i>endothall</i>                   |                     |             |          |          |                  |
| Aquathol G                         | Atochem             | 0.5         | 7        | 1        | 3                |
| Aquathol K                         | Atochem             | 1-3         | 7        | 1        | 3                |
| Hydrothol 191                      | Atochem             | < 0.3       | 14       | 1        | 3                |
| Hydrothol 191G                     | Atochem             | 0.5         | 7        | *        | 3                |
|                                    |                     |             | 14       | *        | 3                |
| <i>fluridone</i> <sup>3</sup>      |                     |             |          |          |                  |
| Sonar AS                           | DowElanco           | —           | 0        | 0        | 0                |
| Sonar SRP                          | DowElanco           | —           | 0        | 0        | 0                |
| <i>glyphosate</i> <sup>4</sup>     |                     |             |          |          |                  |
| Rodeo                              | Monsanto            | —           | 0        | 0        | 0                |
| Pondmaster                         | Monsanto            | —           | 0        | 0        | 0                |
| <i>trichlopyr</i>                  |                     |             |          |          |                  |
| Renovate 3                         | Dow Agrosiences     | 2-8 qt./A   | **       | 0        | 0                |
| <i>carfentrazone</i>               |                     |             |          |          |                  |
| Stingray                           | FMC                 | —           | 0        | 0        | 0                |
| <i>imazapyr</i>                    |                     |             |          |          |                  |
| Habitat                            | BASF                | —           | 2        | 0        | 0                |
| <i>penoxsulam</i>                  |                     |             |          |          |                  |
| Galleon SC                         | Seapro Corp.        | 10-30 ppb   | 0        | 0        | 0                |
| <i>imazomox</i>                    |                     |             |          |          |                  |
| Clearcast                          | BASF Corp.          | 0-500 ppb   | 0        | 0        | 0                |
| <i>flumioxazin</i>                 |                     |             |          |          |                  |
| Clipper                            | Valent              | 100-400 ppb | 0        | 0        | 0                |
| <i>bispyribac</i>                  |                     |             |          |          |                  |
| Tradewind                          | Valent              | 20-45 ppb   | 0        | 0        | 0                |

<sup>1</sup> Algae control may result in a fish kill due to oxygen depletion if herbicides are applied to large areas, or when dissolved oxygen levels are low, or if fast-acting contact herbicides are used (*diquat*, *copper sulfate*, etc.). Similar hazards exist when vascular plants or floating weeds are rapidly killed in large masses with *diquat* or other herbicides used on emerged or submersed weeds.

<sup>2</sup> If water is used for drinking, the elemental copper concentration should not exceed 1 ppm (i.e. 4 ppm *copper sulfate*).

<sup>3</sup> Do not apply within 0.25 mile of any potable water intake.

<sup>4</sup> Do not apply within 0.5 mile upstream of potable water intakes.

<sup>5</sup> Drinking water restriction depends on rate of application. Refer to Reward label.

NL = NOT LABELED FOR APPLICATION TO BODIES OF WATER WITH THIS INTENDED USE.

\*Herbicide label does not prohibit use of water for this intended use.

\*\*Drinking water restrictions depend on laboratory analysis, see Navigate or Renovate Max G or *trichlopyr* product label.

**AQUATIC WEED CONTROL USE RESTRICTIONS<sup>1</sup>**

| Common Name<br>Trade Names         | Company             | Conc. PPM   | ANIMAL DRINKING |           | IRRIGATION    |               | Agric.<br>Sprays |
|------------------------------------|---------------------|-------------|-----------------|-----------|---------------|---------------|------------------|
|                                    |                     |             | Dairy           | Livestock | Turf          | Crops         |                  |
| <i>copper sulfate</i> <sup>2</sup> |                     |             |                 |           |               |               |                  |
| Copper Sulfate G                   | Tenn. Chem.         | —           | 0               | 0         | 0             | 0             | 0                |
| Copper Sulfate Snow                | Tenn. Chem.         | —           |                 | 0         | 0             | 0             | 0                |
| Copper Sulfate Crystal             | Tenn. Chem.         | —           |                 | 0         | 0             | 0             | 0                |
| Triangle Copper Sulfate            | Triangle            |             | 0               | 0         | 0             | 0             | 0                |
| <i>copper complexes</i>            |                     |             |                 |           |               |               |                  |
| Citrine-Plus                       | Applied Biochemists | —           | 0               | 0         | 0             | 0             | 0                |
| Citrine-Plus G                     | Applied Biochemists | —           |                 |           |               |               |                  |
| K-Tea                              | Griffin             | —           |                 |           |               |               |                  |
| AquaCure                           | PBI Gordon          | —           |                 |           |               |               |                  |
| <i>2,4-D</i>                       |                     |             |                 |           |               |               |                  |
| Aquakleen                          | Rhone-Poulenc       | —           | NL              | 0         | NL            | NL            | NL               |
| 2,4-D Granules                     | Riverdale           | —           | 0               | 0         | 0             | **            | 7                |
| Hardball                           | Helena              | —           | 0               | 0         | 0             | **            | **               |
| <i>diquat</i>                      |                     |             |                 |           |               |               |                  |
| Reward <sup>5</sup>                | Zeneca              | —           | 1               | 1         | 1-3           | 5             | 5                |
| <i>endothall</i>                   |                     |             |                 |           |               |               |                  |
| Aquathol G                         | Atochem             | —           | 7               | 7         | 7             | 7             | 7                |
| Aquathol K                         | Atochem             | 0.5         | 7               | 7         | 7             | 7             | 7                |
| Aquathol K                         | Atochem             | 1-3         | 14              | 14        | 14            | 14            | 14               |
| Hydrothol 191                      | Atochem             | < 0.3       | 7               | 7         | 7             | 7             | 7                |
| Hydrothol 191G                     | Atochem             | 0.5         | 14              | 14        | 14            | 14            | 14               |
| <i>fluridone</i> <sup>3</sup>      |                     |             |                 |           |               |               |                  |
| Sonar AS                           | DowElanco           | —           | 0               | 0         | 30            | 30            | *                |
| Sonar SRP                          | DowElanco           | —           | 0               | 0         | 30            | 30            | *                |
| <i>glyphosate</i> <sup>4</sup>     |                     |             |                 |           |               |               |                  |
| Rodeo                              | Monsanto            | —           | 0               | 0         | 0             | 0             | 0                |
| Pondmaster                         | Monsanto            | —           |                 | 0         |               |               |                  |
| <i>trichlopyr</i>                  |                     |             |                 |           |               |               |                  |
| Renovate 3                         | Dow Agrosciences    | 2-8 qt/A    | 0               | 0         | NL            | NL            | NL               |
| <i>carfentrazone</i>               |                     |             |                 |           |               |               |                  |
| Stingray                           | FMC                 | —           | 0-1             | 0-1       | 1-14          | 1-14          | 1-14             |
| <i>imazapyr</i>                    |                     |             |                 |           |               |               |                  |
| Habitat                            | BASF                | —           | 0               | 0         | 120           | 120           | 0                |
| <i>penoxsulam</i>                  |                     |             |                 |           |               |               |                  |
| Galleon SC                         | Seapro Corp.        | 10-30 ppb   | 0               | 0         | 0             | 1 ppb         | 1 ppb            |
| <i>imazomox</i>                    |                     |             |                 |           |               |               |                  |
| Clearcast                          | BASF Corp.          | 0-500 ppb   | 0               | 0         | 1 d pr 50 ppb | 1 d pr 50 ppb | 0                |
| <i>flumioxazin</i>                 |                     |             |                 |           |               |               |                  |
| Clipper                            | Valent              | 100-400 ppb | 0               | 0         | 5             | 5             | 5                |
| <i>bispyribac</i>                  |                     |             |                 |           |               |               |                  |
| Tradewind                          | Valent              | ≤ 1ppb      | ≤ 1ppb          | ≤ 1ppb    | ≤ 1ppb        | ≤ 1ppb        | ≤ 1ppb           |

<sup>1</sup> Algae control may result in a fish kill due to oxygen depletion if herbicides are applied to large areas, or when dissolved oxygen levels are low, or if fast-acting contact herbicides are used (*diquat*, *copper sulfate*, etc.). Similar hazards exist when vascular plants or floating weeds are rapidly killed in large masses with *diquat* or other herbicides used on emersed or submersed weeds.

<sup>2</sup> If water is used for drinking, the elemental copper concentration should not exceed 1 ppm (i.e. 4 ppm *copper sulfate*).

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\*\*Drinking water restrictions depend on laboratory analysis, see Navigate or Renovate Max G or *trichlopyr* product label.



# CALCULATING PESTICIDE CONCENTRATIONS IN AQUATIC SITUATIONS<sup>1</sup>

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Depending on the chemical, pesticides are applied as a surface acre, bottom acre-foot or total water volume treatment. Total water volume treatments are expressed on a part per million by weight (ppmw) basis. Water volume can be measured in gallons, cubic yards, cubic feet, etc.; however, the most commonly used unit of water volume measurement is acre-feet. The following formula may be used to determine the amount of pesticide formulation required to obtain a desired final concentration (ppmw) in the water of a pond or lake on an acre-feet basis:

$$1. \text{ Concentration based on part per million by weight (ppmw) amount of formulation} = \frac{A \times D \times CF \times ECC}{I}$$

A = area of the water surface in acres (Use precise measurement or measure from aerial photos).

D = average depth of the pond or lake in feet.

CF = 2.72 lb/acre foot. The Conversion Factor (CF) when total water volume is expressed on an acre-feet basis. 2.72 lb of a pesticide per acre-foot of water is equal to one ppmw.

ECC = Effective Chemical Concentration of the active ingredient of a pesticide needed in the water to achieve control of the pest.

I = The total amount of active ingredient divided by the total amount of active and inert ingredients. Liquid products usually list the amount of active ingredients as pounds per gallon. For such products:

$$I = \frac{\text{pounds of active ingredients}}{\text{one (1) gallon}}$$

Non-liquid formulations usually list active ingredients as a percentage of the total formulation. For non-liquid formulations:

$$I = \frac{\text{percent active ingredients}}{100\%}$$

The following formula may be used to determine the amount of pesticide formulation on a surface acre basis.

1. Amount of pesticide formulation per surface acre.

$$\text{Amount of formulation} = (\text{Surface acres}) \times (\text{Broadcast formulation rate/acre}).$$

<sup>1</sup> For additional information, refer to UGA Extension Bulletin 866 – “Using Chemicals in Pond Management.”

