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Avoid Backyard Pond Overspray

Spray drift into nontarget areas causes a considerable number of problems. One of these is the toxicity of pesticide drift to fish. When applied near residential areas by either aerial or ground application, pesticides are likely to have impact on the fish in backyard ponds.

Fish breathe by actively flowing water across their gills to remove oxygen from it and release carbon dioxide into it. In this process, they effectively remove other chemical compounds from the water, including active ingredients, solvents, and other chemical compounds in pesticides. Because they move a considerable amount of water across their gills, they can inadvertently remove considerable amounts of chemicals present as even small percentages of the water. As a result, fish tend to be more susceptible to chemicals than many other animals.

When fish die, gasses produced during decomposition of their flesh build up in the body cavity, causing them to float on the water surface. Thus, their death is obvious to their owners and regulatory officials.

Fish are more susceptible to some pesticides than others. The insecticide rotenone is also a piscicide, commonly used to eliminate undesirable fish from bodies of water. Fish are also particularly susceptible to pyrethroid insecticides, such as esfenvalerate (Asana), lambda-cyhalothrin (Warrior, Scimitar), permethrin (Ambush, Pounce, Astro), and zeta-cypermethrin (Mustang-Max). Fungicides can also be toxic to fish, including pyraclostrobin (Headline). Herbicides that are toxic include bromoxymil (Buctril), fluazifop (Fusilade DX 2EC), and pendimethalin (Prowl). Refer to the pesticide label for fish-toxicity warnings in the "Environmental Hazards" section. Even if the pesticide active ingredient is not highly toxic to fish, solvents and other ingredients in the pesticide may be toxic.

Backyard ponds tend to be only a few feet across. They can be easily covered with a plastic tarp, which will keep any drift from reaching the water surface. It is best to support the tarp above the water surface by draping it across 2-by-4s or other supports that stretch across the pond. This reduces the likelihood of pesticide on the tarp getting washed off into the pond when the tarp is removed. It also allows an air space between the tarp and the water surface.

In a pond, oxygen is absorbed by the water surface, and excess carbon dioxide is released from the water surface. If the tarp is on the water surface, this gas exchange is limited and oxygen depletion can result, causing a fish kill. Similarly, a tarp that remains over a pond, even with an air space, does not allow as much gas exchange with the atmosphere. An additional concern during the summer is that the tarp causes a rise in water temperature. Warm water holds much less oxygen than cool water, so keeping a tarp over a pond for too long could cause oxygen depletion and a fish kill.

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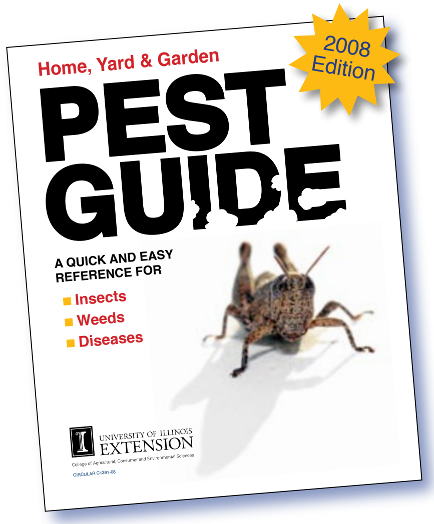
During spray applications, aerators should be turned off, as they pull in atmospheric air and inject it into the pond. They can, effectively, pull pesticide drift out of the air and force it into the water. Unfortunately, turning off the aerator also increases the likelihood of a fish kill from oxygen depletion. Artificial streams containing fish or running into ponds containing fish should have the water pumps turned off and/or the stream covered to avoid drift into them and uptake of pesticide drift in the air. Even small waves in moving water increase the uptake of pesticides, as well as the exchange of oxygen and carbon dioxide with the water.

Consider the following when spraying near a backyard pond.

1. If temperatures stay below about 80˚F, the pond can probably be covered for a few hours without serious effect to the fish or plants.
2. If it is considerably warmer than 80˚F, the cover should be removed within an hour or so.
3. Overhanging trees will contain a considerable amount of spray drip, and this can blow off into the pond for 30 minutes or more after application, depending on spray-drying conditions. This extends the length of time that the pond should remain covered. Backyard ponds are usually sited in full sun to keep the plants healthy, so overhanging branches are typically not a problem.
4. Realize that some backyard fish can have considerable monetary value in addition to their emotional value to the owner. The most popular backyard pond fish are koi, also known as ornamental carp. Depending on their size and quality, koi purchase price ranges from $4 to $3,000 per fish for those that are easily available. A connoisseur importing the best-quality fish from the Far East may have considerably more than $3,000 invested per fish. *(Phil Nixon)*

Home, Yard & Garden Pest Guide



The 2008 edition of the *Home, Yard & Garden Pest Guide* has just become available. This handbook is written for the homeowner to assist in managing weeds, diseases, and insect pests associated with lawns, trees, shrubs, flowers, vegetables, and fruit, as well as indoor insect pests. There is also a chapter on IPM and pesticide safety. Nonchemical as well as chemical control options are provided, with the pesticide recommendations being for the over-the-counter products sold in garden centers, home centers, and hardware stores.

Many garden-center operators, as well as professional pesticide applicators, recommend the *Home, Yard, & Garden Pest Guide* to clients so that the clients can control pests that do not require professional management. Many professionals carry a copy in the truck to help answer the inevitable questions from clients about pests that they do not address.

The *Home, Yard, & Garden Pest Guide* is revised every four years. It is available for $24.95 plus shipping at pubsplus.uiuc.edu/C1391.html. It will become available soon at local University of Illinois Extension offices. *(Phil Nixon)*

Another Successful (But Quick) Fly-in

The annual Illinois Agricultural Aviation Association (IAAA) Operation S.A.F.E. (Self-regulating Application and Flight Efficiency) fly-in was held on April 23 and 24, 2008. Once again, it took place at the Coles County Memorial Airport in Mattoon. Although the fly-in was originally scheduled to last 3 days, approaching inclement weather forced us to get the majority of aircraft tested on the afternoon of April 23, with the morning of April 24 used to make some final adjustments to a few aircraft. Two Operation S.A.F.E. analysts, certified with the National Agricultural Aviation Association (NAAA), were there to analyze spray patterns and droplet size data: Scott Bretthauer with the Department of Agricultural and Biological Engineering at the University of Illinois and John Garr with Garrco Products. Department of Agricultural and Biological Engineering professor Loren Bode also assisted with the analyses. Despite the fast pace required to get everything done before the weather turned bad, we were able to pattern-test 12 aircraft. A total of 105 passes were made over the flightline. For more information about Operation S.A.F.E. fly-ins and aerial applications, see the following *IPR* issues: vol. 17,no. 3, May 2004; vol. 18, no. 3, May 2005; vol. 19, no. 3, May 2006; and vol. 20, no. 3, May 2007. *(Scott Bretthauer)*

Hiring an Aerial Applicator

If you are looking to hire an aerial applicator this busy year, the best place to start is locally. Although there may not be enough Illinois aerial applicators to handle all of the acres that need to get sprayed this season, Illinois applicators routinely hire out-of-state applicators to help them with large workloads during busy times. What's the difference between hiring an out-of-state applicator yourself and going through a local Illinois aerial applicator who sends someone from out of state that they've hired to spray your field? The answer is simple: professional evaluation. No one knows more about spraying Illinois crops by air than an aerial applicator permanently based in Illinois.

Illinois aerial applicators' continued existence depends on the ability to consistently make accurate and safe applications in their home area. Failure to do so will mean going out of business, so they are very careful when they select out-of-state applicators to work for them. They select only the people they know will also work hard to make accurate and safe applications. Active NAAA membership and participation in national programs such as S.A.F.E. and the Professional Aerial Applicators Support System (PAASS) allow aerial applicators from across the nation to establish professional relationships. It is through these relationships that Illinois aerial applicators often select out-of-state colleagues to help them during busy times. During periods when the workload is low in Illinois, many Illinois aerial applicators leave the state to work elsewhere, often for an aerial applicator local to a different area who is aware of the Illinois applicator's professional commitment. So although your Illinois fields may very well get sprayed by an out-of-state aerial applicator, the best place to start when you are looking to hire someone is your local Illinois aerial applicator. For a directory of Illinois aerial applicators, visit the Illinois Agricultural Aviation Association's Web site at http://www.agaviation.com/. *(Scott Bretthauer)*

Effective and Safe: Calibrating Your Sprayer for Spray-Application Rate and Spray Droplet Size

Whenever pesticides are applied, the primary goal is to eliminate the target pest by making an effective application of the chosen pesticide. A second goal of equal importance is to make sure the application is made safely and drift is reduced as much as possible. Three things primarily influence particle drift (the off-target movement of spray droplets) during an application:

1. Spray droplet size
2. Wind speed and direction
3. Temperature and humidity

In terms of wind, there is nothing you can do to change it, but it is important you are aware of both the speed of the wind and the direction it is blowing. Temperature and humidity affect the evaporation of droplets and can have a big influence on the smaller drift-prone droplets. See *IPR,* vol. 17, no. 5, September 2004, for more information on how weather influences drift and how you can monitor weather conditions while making an application.

What you can control during an application is the size of the spray droplets created by your nozzles. See *IPR,* vol. 17, no.1, January 2004, for more information on how spray droplet size is measured and classified. Smaller droplets are more prone to drift because they are more easily blown off-target by the wind. Droplet size also impacts the efficacy of the application. Using smaller spray droplets increases coverage of the target, and may be required when applying certain products, such as contact insecticide or fungicides.

When choosing the correct droplet size spectrum for an application, it is important to recognize that selection of droplet size is a compromise between drift reduction and coverage on the target. Increasing droplet size reduces your risk of drift but also reduces your coverage; decreasing droplet size increases your risk of drift but also increases your coverage. Another way to increase coverage is to increase your spray-application rate (measured in gallons per acre, abbreviated GPA). Therefore, it is important to keep in mind the coverage required for the product you are applying when calibrating your sprayer. In some cases, using a larger droplet size to decrease your risk of drift may also require the use of a higher spray-application rate to maintain adequate coverage. To determine the best droplet size spectrum for your application, check the product label. If the label does not have a droplet-size spectrum recommendation, use Table 1 to determine the best droplet spectrum based on the type of product you are applying.

So how can you calibrate your sprayer to create a specific droplet size while using the correct application rate? Droplet size selection essentially adds another step to sprayer calibration and should be considered whenever you are calibrating your sprayer. The following is a step-by-step process you can use to calibrate your sprayer for both the required spray-application rate and the recommended spray-droplet size spectrum.

1. Read the product label and determine the spray-application rate in gallons per acre (GPA).
2. Determine the speed at which the application will be made in miles per hour (MPH); if using a sprayer with an automatic spray-rate controller then select the speed most commonly used during the application.
3. Determine the effective sprayed width. For broadcast applications, the effective sprayed width is measured as the

Table 1. Droplet-spectrum category, volume medium diameters, and recommendations for various pesticide types or uses (an X represents a recommendation).

ASAE Standard S-572 droplet spectrum categories	Contact insecticide and fungicide	Systemic insecticide and fungicide	Contact foliar herbicide	Systemic foliar herbicide	Soil-applied herbicide	Incorporated soil-applied herbicide
Very fine (VF)						
Fine (F)	X					
Medium (M)	X	X	X	X		
Coarse (C)		X		X	X	X
Very coarse (VC)					X	X
Extremely coarse (XC)						X

distance between the nozzles in inches (abbreviated W). For banded applications, the effective sprayed width is measured as the width of the band in inches (also abbreviated W).

4. Read the product label or use Table 1 to determine the droplet spectrum to be used for the application.
5. Use the following equation to determine the required flow rate for your nozzles in gallons per minute (GPM):

$$GPM = \frac{GPA \times MPH \times W}{5{,}940}$$

Where

GPA is spray-application rate in gallons per acre

GPM is nozzle flow rate in gallons per minute

MPH is ground speed in miles per hour

W is effective sprayed width in inches

5,940 is a constant to convert measurement units

6. Determine the nozzle type you will use for your application and locate the flow-rate and droplet-spectrum tables for that nozzle. These tables are sometimes combined into a single table, or they may be separate tables in the catalog, depending on the nozzle manufacturer.
7. Select the appropriate nozzle size and operating pressure to achieve both the required nozzle flow rate and the recommended droplet spectrum. If the flow rate you require occurs between the pressures listed in the table, you can use the following formula to calculate the exact pressure needed:

$$PSI_{required} = PSI_{known} \times (GPM_{required}/GPM_{known})^2$$

8. Convert the required nozzle flow rate from GPM to fluid ounces per minute (OPM); this is done in preparation for step 9 because you can more accurately measure small quantities of liquid in fluid ounces. GPM can be converted to OPM by multiplying GPM by 128. Also, many nozzle companies provide the OPM flow rate right next to the GPM flow rate in their catalogs. If you are using a handheld flow meter to measure nozzle flow rate, you can skip step 8 and proceed to step 9.
9. Partially fill the sprayer with clean water. Mount the nozzles on the sprayer and check the flow rate by collecting spray from a nozzle for a specific amount of time using a container marked in fluid ounces and a stopwatch. As an alterative, you can use a handheld flow meter. To begin, set the sprayer to operate at the pressure determined in step 7, but be aware you will likely have to increase the pressure, depending on where your pressure gauge or sensor is mounted, because pressure measured at the boom is higher than the actual pressure at the nozzles due to pressure drop through hoses, pipes, fittings, and check valves. Adjust the pressure until the OPM you collect is equal to the amount determined in step 8. Check several other nozzles along the boom to verify that their output falls within 5 percent of the desired output.
10. Operate the sprayer in the field at the speed determined in Step 2 and the pressure determined in step 7; you will be applying at the GPA rate selected in step 1. After spraying a known number of acres, check the liquid level remaining in the tank to verify that the sprayer is applying at the correct spray-application rate.

Example:

Steps 1 to 4: You will be making a broadcast application with a postemergence herbicide at a spray-application rate of 10 GPA. Your sprayer has nozzles spaced 20 inches apart, and your normal operating speed is 10 MPH. The label recommends using a coarse or very coarse droplet spectrum.

Step 5: Calculate the required nozzle flow rate using the GPM equation:

$$GPM = \frac{10\ GPA \times 10\ MPH \times 20\ inches}{5{,}940}$$

GPM = 0.34 gallons per minute

Table 2: Flow rates and droplet-size spectrums for 8 sizes of air-induction nozzles at various pressures between 30 and 100 psi.

Nozzle size	PSI	Droplet size	Flow rate (GPM)
AI110015	30	VC	0.13
	40	VC	0.15
	50	VC	0.17
	60	VC	0.18
	70	C	0.20
	80	C	0.21
	90	C	0.23
	100	C	0.24
AI11002	30	VC	0.17
	40	VC	0.20
	50	VC	0.22
	60	VC	0.24
	70	VC	0.26
	80	C	0.28
	90	C	0.30
	100	C	0.32
AI110025	30	XC	0.22
	40	VC	0.25
	50	VC	0.28
	60	VC	0.31
	70	VC	0.33
	80	VC	0.35
	90	C	0.38
	100	C	0.40
AI11003	30	XC	0.26
	40	XC	0.30
	50	VC	0.34
	60	VC	0.37
	70	VC	0.40
	80	VC	0.42
	90	C	0.45
	100	C	0.47

Nozzle size	PSI	Droplet size	Flow rate (GPM)
AI11004	30	XC	0.35
	40	XC	0.40
	50	VC	0.45
	60	VC	0.49
	70	VC	0.53
	80	VC	0.57
	90	C	0.60
	100	C	0.63
AI11005	30	XC	0.43
	40	XC	0.50
	50	VC	0.56
	60	VC	0.61
	70	VC	0.66
	80	VC	0.71
	90	VC	0.75
	100	C	0.79
AI11006	30	XC	0.52
	40	XC	0.60
	50	VC	0.67
	60	VC	0.73
	70	VC	0.79
	80	VC	0.85
	90	VC	0.90
	100	C	0.95
AI11008	30	XC	0.69
	40	XC	0.80
	50	XC	0.89
	60	VC	0.98
	70	VC	1.06
	80	VC	1.13
	90	VC	1.20
	100	VC	1.26

Step 6. Because drift is a concern for this application, you will be using air-induction nozzles; a sample nozzle flow rate and droplet-size table is shown below (Table 2).

Step 7. An AI11003 operated at 50 psi will provide the required flow rate of 0.34 GPM and the recommended very coarse droplet spectrum. Alternatively, you could use an AI110025. As the required flow rate of 0.34 GPM is not listed directly in the table, you will need to calculate the pressure at which to operate the AI110025 to achieve a flow rate of 0.34 GPM. To determine the required operating pressure for the AI110025 nozzles, use the formula given above and a known pressure/GPM combination from the table:

$$PSI_{required} = 40 \text{ PSI x } (0.34 \text{ GPM}/0.25 \text{ GPM})^2$$

$$PSI_{required} = 74 \text{ psi}$$

Step 8. Determine how many fluid ounces you need to catch from a single nozzle in 1 minute:

OPM = 0.34 GPM x 128

OPM = 44

Step 9: Operate your nozzles, starting at the operating pressures listed above, depending on the size of nozzle you chose, and make small adjustments in pressure until you collect 44 fluid ounces from a nozzle in 1 minute.

Step 10: After successfully calibrating the sprayer, verify the correct GPA spray application rate by measuring the quantity of spray applied to a known acreage.

If you are using a sprayer with an automatic spray-rate controller, the controller will automatically maintain the GPA rate you set it to during speed changes. It does so by changing nozzle flow rate, which in turn is done by adjusting the operating pressure. In addition to changing the nozzle flow rate though, the change in operating pressure by the automatic spray-rate controller also changes the droplet size produced by the nozzle. At certain times during an application, the speed changes you make may require an operating pressure that exceeds the upper or lower pressure limit for the nozzles mounted on your sprayer (see *IPR,* vol. 17, no. 2, March 2004, for more details on how automatic rate controllers work). To make sure you do not exceed these pressure limits, you need to set minimum and maximum speed limits for your application based on the type and size of nozzle you are using. To calculate the speed required to make a specific application, use the following formula:

$$\text{MPH} = \frac{\text{GPM} \times 5{,}940}{\text{GPA} \times \text{W}}$$

You will already know your GPA and W. To determine GPM, first find the minimum and maximum recommended operating pressures for the nozzle you are using. These will be used to calculate the minimum and maximum speeds at which you can travel during the application. It is a good idea to actually use a minimum pressure slight higher and a maximum pressure slightly lower than those listed in the catalog. At the low end of a nozzle's pressure range, you can experience reduced overlap and thus skips in your coverage. At the high end of a nozzle's pressure range, an increasingly large portion of the spray volume is expelled in smaller droplets, which may increase your risk of drift. Once you determine the minimum and maximum operating pressures for your nozzle, find the corresponding nozzle flow rates at those pressures; these will be the GPM flow rates you use in the above equation.

From the previous example, assume that you selected the AI110025 nozzles to make your application. Referring to Table 2, determine that the maximum operating pressure for this nozzle is 100 psi, with a corresponding flow rate of 0.40 GPM. The minimum operating pressure for this nozzle is 30 psi, but at this pressure the droplet spectrum is extremely coarse, which exceeds the recommended droplet size for this application (coarse or very coarse). To maintain at least a very coarse droplet spectrum, the minimum pressure you could operate these nozzles at would be 40 psi, which has a corresponding flow rate of 0.25 GPM. Next, you need to calculate minimum and maximum speeds using the GPM flow rates for the minimum and maximum pressures:

$$\text{Minimum MPH} = \frac{0.25 \text{ GPM} \times 5{,}940}{10 \text{ GPA} \times 20 \text{ inches}}$$

$$\text{Minimum MPH} = 7.4$$

$$\text{Maximum MPH} = \frac{0.40 \text{ GPM} \times 5{,}940}{10 \text{ GPA} \times 20 \text{ inches}}$$

$$\text{Maximum MPH} = 11.8$$

While making your application with an automatic spray-rate controller, you would need to keep your speed between 7.4 and 11.8 MPH. Doing so ensures that you make the application at the correct rate of 10 GPA while maintaining the recommended droplet spectrum of coarse or very coarse. By using the above method to calibrate your sprayer, you will be making an application that is both effective and safe. *(Scott Bretthauer)*

Pesticide Shelf Life

Pesticides in general are manufactured, formulated, and packaged to specific standards. However, when stored improperly, they can break down, especially under conditions of high temperature and humidity.

Dry formulations such as wettable powders (WP), soluble powders (SP), water-dispersible granules (WDG), and granular (G) can become caked and compacted. Emulsifiable concentrates (EC) can lose their ability to form emulsions. Some pesticides can actually become more toxic, flammable, or explosive as they break down.

Pesticide formulations that contain low concentrations of active ingredients generally lose effectiveness faster than more concentrated forms. Sometimes a liquid pesticide develops a gas as it deteriorates, making opening and handling containers quite hazardous. Certain pesticides have a characteristic odor. A strong odor in the storage area may indicate a leak, a spill, or an improperly sealed container. It may also be a clue that the pesticide is deteriorating, because the smell of some chemicals intensifies as they break down. If none of these problems is found, chemical odors can be reduced with exhaust fans or by lowering the temperature of the storage area.

Pesticide containers, including fiber and metal drums, pails, cans, bottles, bags, boxes, over-packs, and liners, have an important effect on storage and shelf life. If stored for long periods, these containers may eventually corrode, crack, break, tear, or fail to seal properly. The label may become illegible as well.

If a pesticide container needs to be replaced, transfer the pesticide to another container of the same type, such as a polyethylene jug, a thick paper bag, or a brown glass bottle. With plastic jugs, try to find a jug made of the same type of plastic. You can at least get a jug from the same group of plastics by checking the recycling number on the bottom of the jug and using a replacement jug with the same number. Obtain a replacement label from your pesticide dealer to put on the new container.

If stored in a cool, dry area that is out of direct sunlight, pesticides will generally have an extended shelf life. Protection from temperature extremes is important because heat or cold can shorten a pesticide's shelf life. At temperatures below freezing, some liquid formulations separate into their various components and lose their effectiveness. High temperatures cause many pesticides to volatize or break down more rapidly. Extreme heat may also cause glass bottles to break or explode.

One way to ensure that you avoid problems with shelf life or storage is to only buy what is needed for one season. Buying more pesticide than is necessary because of reduced case lot prices or a sale may become more expensive in the long run, when it comes to disposing of excess pesticide.

Before storing chemicals, read the label and follow any specific guidelines listed. Store different groups of pesticides, such as herbicides, insecticides, and fungicides, in separate locations in the storage area. This will help prevent cross-contamination from fumes and vapors as well as accidental use of the wrong type of pesticide. Never store chemicals near any type of animal feed. Always store chemicals out of the reach of children, preferably in a locked cabinet or room in which only pesticides are stored. Store personal protective equipment, such as gloves, goggles, aprons, and respirators, in another clean, dry location away from pesticide fumes. *(Martha Smith and Phil Nixon)*

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Michelle L. Wiesbrook, Extension Specialist, Pesticide Application Training and Horticulture

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University of Illinois Extension
Pesticide Safety Education Program
1201 S. Dorner Drive
Urbana, IL 61801