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Asian Soybean Rust Fungicides and Aquatic Organisms

George L. Selden, Jr.
Extension Specialist, Aquaculture and Fisheries

Ples Spradley
Associate Professor, Extension Pesticide Education Specialist

Travis Faske
Assistant Professor, Extension Plant Pathologist

Asian Soybean Rust (SBR) is a potentially devastating fungal disease for soybeans. It arrived in the U.S. in 2004, carried on the winds of Hurricane Ivan. Shortly after, it was confirmed in Arkansas. During the 2012 growing season, SBR was reported in 364 counties in the U.S. including 20 in Arkansas. These counties correspond to those counties where aquaculture is also prevalent. The existence of SBR in areas of fish culture is only a cause of concern for fish farmers because fungicides are the only effective control for SBR and several of these fungicides can be quite toxic to fish, raising concerns of "off-target" application.

Arkansas is the third largest catfish producer in the U.S., the largest baitfish producer, with more than 6 billion fish sold each year, and leads the nation in the production of sportfish fingerlings and hybrid striped bass. Arkansas is ranked sixth overall in U.S. aquaculture production. In addition, the more than 9,700 miles of streams and rivers are home to several endangered mollusk species and many fish species that attract fishermen, contributing over $1.4 billion to the state's economy.

Arkansas is tenth in U.S. soybean production, with soybeans and aquaculture both concentrated in the eastern Delta region. With the possibility of widespread fungicide use in soybeans and the close proximity of aquaculture, streams and rivers, it is important that fungicide applicators read and follow all label instructions with regard to environmental hazards, especially those that apply to aquatic organisms.

The University of Arkansas Extension publication *MP154, Arkansas Plant Disease Control Products Guide*, includes those fungicides legal for use in the control of SBR. Table 1 lists the fungicide names, active ingredients and usage rates/acre. This table is just a summary, and the full labels and Material Safety Data Sheets (MSDS) for each product should be read before use. Labels and MSDSs can be obtained from the manufacturer, the pesticide dealer or the Web (recommended sites include the Arkansas State Plant Board Registered Pesticide Search at plantboard.arkansas.gov and www.cdms.net, although there are other internet sources available).

To determine the potential for a misapplied fungicide to cause a fish kill, the fungicide concentration of a hypothetical application had to be compared to the published toxicity of the active ingredient. The toxicity of an active ingredient to aquatic organisms is included as part of the MSDS. The hypothetical application concentration was determined by calculating what the concentration of an active ingredient (ai) would be if it was applied evenly to a pond 3 feet deep (the average depth of most aquaculture ponds) at the labeled rate. A shallower pond or stream would receive a higher concentration of fungicide.

As an example of this calculation, Tilt contains 3.6 lbs of propiconazole per gallon of fungicide. Its labeled rate is 4-6 fl oz/acre. Assuming a maximum rate application of 6 fl oz/acre, the active ingredient is broadcast at a rate of 0.16875 lbs ai/acre. Assuming

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a 3-foot-deep pond, this equals a concentration of 0.0207 mg/l (ppm). The published LC50 (50% of the organisms dead after 72 hours) concentration of propiconazole is 3.2-6.4 ppm for fish. Based on this, a misapplication of Tilt to an aquaculture pond would be unlikely to cause a fish kill. The summary of these calculations and toxicity information for each product are included in Table 2.

After examining Table 2, while most of the fungicides can be used in the proximity of aquatic environments and aquaculture ponds, four of the fungicide active ingredients have a high potential for causing the unintended deaths of aquatic organisms. They are chlorothanonil, pyraclostrobin, trifloxystrobin and thiophanate-methyl.

As an example, if a 3-foot-deep pond was oversprayed with an aerial application of Headline at the maximum labeled rate of 12 fl oz/acre, the pyraclostrobin concentration would be 0.0240 ppm. This is above the fish LC50 of 0.0062-0.0114 ppm for trout or bluegill. This overspray would be likely to result in a fish kill. Applicators should use extra caution when applying fungicides that contain any of the four above-mentioned chemicals close to fish farms or other sensitive water sources.

Temperature, pH, organic matter and other factors in ponds or rivers/streams will likely reduce the effects of fungicides with respect to sensitive aquatic organisms. Nevertheless, care should be taken to avoid direct application or drift of any agricultural chemical into any body of water. All pesticide labels carry warnings and information on environmental hazards. These should be studied and adhered to closely. The label is the law, and it is the applicator's responsibility to fully follow the label. Following the label precautions is also the best way to avoid problems, and the resulting legal repercussions, with harming non-target organisms. While over the past seven years we have not seen problems associated with fungicide use in the state, care in their use and application is always warranted.

Table 1. Fungicides currently approved for control of soybean rust in Arkansas (2013).

Fungicide	Active Ingredient	Rate/A (fl oz)
Domark 230ME	Tetraconazole	4 - 5
Alto 100SL	Cyproconazole	4 - 5.5
Quadris Xtra	Cyproconazole + Azoxystrobin	4 - 6.8
Folicur 3.6F or Muscle 3.6F or Tebu 3.6F or TebuStar 3.6F or Tebuzol 3.6F or Orius 3.6F	Tebuconazole	3 - 4
Proline 480SC	Prothioconazole	2.5 - 3
Bravo Ultrex or Bravo WeatherStick or Chlorothalonil 720SC or Equus or Echo 720 or Echo 90DF	Chlorothanonil	(See label)
Laredo	Myclobutanil	4 - 8
Quadris 2.08FL	Azoxystrobin	6 - 15.5
Headline	Pyraclostrobin	6 - 12
Stratego	Trifloxystrobin + Propiconazole	10
Stratego YLD	Prothioconazole + Trifloxystrobin	4 - 4.65
Quilt	Azoxystrobin + Propiconazole	14 - 20.5
Quilt Xcel	Azoxystrobin + Propiconazole	14 - 21
Tilt or AmTide Propiconazole 41.8EC or Propiconazole E AG 41.8EC or Bumper	Propiconazole	4 - 6
Evito-T	Fluoxastrobin + Tebuconazole	4 - 6
Evito 480SC or Aftershock	Fluoxastrobin	2 - 5.7
Topguard	Flutriafol	7 - 14
Priaxor	Fluxapyroxad + Pyraclostrobin	4 - 8
Vertisan	Penthiopyrad	10 - 30
Topsin XTR	Thiophanate-methyl + Tebuconazole	20

Table 2. Toxicities of fungicides for control of soybean rust to selected aquatic organisms.

Fungicide	Active Ingredient(s)	Amount ai/application (ppm lowest rate)	Amount ai/application (ppm highest rate)	LC50 Fish (ppm)	LC50 Daphnia (ppm)	LC50 Algae (ppm)
Domark 230ME	Tetraconazole	0.0073	0.0091	4.3 - 4.8	3.0	
Alto 100SL	Cyproconazole	0.0032	0.0044	0.16 - 0.35	0.14	0.077
Quadris Xtra	Cyproconazole +	0.0064	0.0109	0.16 - 0.35	0.14	0.077
	Azoxystrobin	0.0026	0.0044	0.47 - 1.1	0.259	0.057 - 10
Folicur 3.6F or Muscle 3.6F or Tebu 3.6F or TebuStar 3.6F or Tebuzol 3.6F or Orius 3.6F	Tebuconazole	0.0103	0.0138	4.4 - 6.4	11.8	1.64 - 7.1
Proline 480SC	Prothioconazole	0.0096	0.0115	4.02	2.9	12.7
Bravo Ultrex or Bravo WeatherStick or Chlorothalonil 720SC or Equus or Echo 720 or Echo 90DF	Chlorothanonil	0.0919	0.1838	0.044 - 0.062	0.068	0.21
Laredo	Myclobutanil	0.0077	0.0153	2.2 - 3.9	10.2	0.91 - 2.6
Quadris 2.08FL	Azoxystrobin	0.0119	0.0309	0.47 - 1.1	0.259	0.057 - 10
Headline	Pyraclostrobin	0.0120	0.0240	0.0062 - 0.0114	0.0157	0.152
Stratego	Trifloxystrobin +	0.0100		0.014	0.025	0.037
	Propiconazole	0.0100		4.3 - 6.4	3.2 - 10.2	
Stratego YLD	Prothioconazole +	0.0040	0.0047	4.02	2.9	12.7
	Trifloxystrobin	0.0120	0.0139	0.014	0.025	0.037
Quilt	Azoxystrobin +	0.0083	0.0122	0.47 - 1.1	0.259	0.057-10
	Propiconazole	0.0139	0.0204	4.3 - 6.4	3.2 - 10.2	
Quilt Xcel	Azoxystrobin +	0.0158	0.0237	0.47 - 1.1	0.259	0.057 - 10
	Propiconazole	0.0137	0.0205	4.3 - 6.4	3.2 - 10.2	
Tilt or AmTide Propiconazole 41.8EC or Propiconazole E AG 41.8EC or Bumper	Propiconazole	0.0138	0.0207	4.3 - 6.4	3.2 - 10.2	
Evito-T	Fluoxastrobin +	0.0064	0.0096	0.435 - 0.97	0.48	0.45
	Tebuconazole	0.0089	0.0133	4.4 - 6.4	11.8	1.64 - 7.1
Evito 480SC or Aftershock	Fluoxastrobin	0.0077	0.0218	0.435 - 0.97	0.48	0.45
Topguard	Flutriafol	0.0070	0.0139	7.9	7.5	4.6 - 8.6
Priaxor	Fluxapyroxad +	0.0053	0.0106	0.29 - 1.15	6.78	2.8
	Pyraclostrobin	0.0106	0.0213	0.0062 - 0.0114	0.0157	0.152
Vertisan	Penthiopyrad	0.0160	0.0480	0.32	1.2	1.5
Topsin XTR	Thiophanate-methyl +	0.0689		0.03 - >100*	15.6	
	Tebuconazole	0.0134		4.4 - 6.4	11.8	1.64 - 7.1

* For carp species, Topsin XTR is practically nontoxic (LC50 >100 ppm), but it is highly toxic to channel catfish (LC50 of 0.3 ppm).

Read and follow all labels. The label is the law. Section 18 labels must be in possession of the applicator, and Section 18 pesticide applications must be reported to the Arkansas State Plant Board.

Many fungicides have restrictions on the labels regarding application, drift or runoff into streams, ponds or other aquatic environments or "sensitive" areas. Toxicity to fish, mollusks or other aquatic organisms is largely unknown in natural environments; however, some fungicides listed have been shown to be toxic to aquatic organisms under controlled laboratory experiments. Therefore, IT IS IMPERATIVE THAT ALL APPLICATORS READ LABELS CLOSELY AND USE ALL NECESSARY PRECAUTIONS.

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GEORGE L. SELDEN, JR., is an Extension specialist located at the Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff. **PLES SPRADLEY** is an associate professor and Extension pesticide education specialist located in Little Rock. **DR. TRAVIS FASKE** is an assistant professor and Extension plant pathologist located in Lonoke. All are with the University of Arkansas Division of Agriculture.

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