Crop Profile for Rice in Missouri

Prepared: April, 2000

General Production Information

(*Oryza sativa L.*)

Missouri ranks sixth in the United States in rice production with 3.2 percent of total U. S. production concentrated in a seven-county region in Southeast Missouri (often referred to as the 'Bootheel'). Rice production in Missouri during 1997 totaled 5.78 million cwt, up 16 percent from 1996. The 109,000 acres harvested (out of 114,000 planted) produced an average state yield of 5,300 pounds per acre. Total value of the crop was estimated at $57.8 million, 12 percent more than the 1996 crop. During 1998, Missouri farmers harvested a record 7.44 million cwt of grain from 143,000 rice acres, 20 percent higher than 1997. The average yield was 5,200 pounds (116 bushels) per acre. The average price received was $0.09 per pound, and the overall crop value was $64.3 million.

Eighty one percent of Missouri's rice acreage is located in two counties, Butler and Stoddard. Butler County has produced half or more of the rice grown in Missouri the past two decades. The county ranks consistently among the top twenty-two of the 110 rice-producing counties and parishes in the U.S. As Missouri acreage increases, the distribution is shifting to counties east of Crowley's Ridge. Stoddard County grows almost a third of Missouri's rice. New Madrid, Pemiscot and Dunklin counties have been expanding their rice acreage the most rapidly. Ripley County has planted up to 4,000 acres for many years, but has no room for expansion. Minor acreages of rice have been planted in Mississippi, Scott, Bollinger and Cape Girardeau counties.

Long and medium grain rice varieties are grown in Missouri. Long grain varieties are planted on approximately 81 percent of the rice acreage with four varieties, Cypress, Drew, Kaybonnet and Lemont planted on 31, 21, 19 and 10 percent of the rice acres, respectively. New and improved rice varieties have been the single greatest influence on improved yields and economics. Improved rice varieties provide both higher potential yields and resistance to diseases. Disease resistance in new varieties is especially important, since fungicides and crop rotation are both expensive and limited in effectiveness. The farmers who have learned to adapt their production practices to the demands of the new varieties have been most successful. Professional crop scouts and consultants are being used more and more to help farmers manage more acres and newer varieties more effectively. Costs of production are estimated at $473 per acre for Cypress and $421 per acre for Kaybonnet.

The number of rice producers in Missouri is estimated at 250 to 350, with over half of them in Butler County. The actual number of producers is difficult to ascertain, since USDA- registered farm numbers include operations divided among family members. Nonetheless, rice farm operations continue to decrease in number and increase in size. The increase in number of acres farmed by each farmer means more and bigger equipment, more farm employees, more technical crop management, larger and more sophisticated marketing and finances. More consulting services are being used by farmers for crop, financial and marketing planning and management. These changes have been accelerated by the change in the 1995 Farm Bill. This trend of enlargement and consolidation can be expected to continue, driven by the pressures of economics of size, technological advances and competition among the more capable farm managers.

Cultural Practices

In southeast Missouri, rice is planted between April 15 and June 5. There are four rice production systems used in Missouri: conventional, water-seeded, corrugated tillage and no-till. Currently, approximately 70-80 percent of the production acreage is conventional, 12-15 percent is water-seeded (one producer plants about 90% of the water-seeded acreage) and 15-30 percent is no-till or minimum till (stale seedbed).

I. Conventional rice tillage in Missouri includes drill seeding and broadcast seeding. Machinery and equipment already on the farm can be utilized and other crops can still be grown in rotation. The conventional system nearly always requires some field grading. Precision grading is not necessary, but reduces the field area taken up by the levees and barrow ditches, facilitates water management, lessens the risks of levee weeds and rice blast, and expedites harvest. Advantages of the conventional rice culture system include: research and experience are most extensive by far for this system, crop rotation options are open, herbicide options are most numerous, most of the herbicides and fertilizer applications may be made by ground equipment, rice water weevil can be controlled by field drainage if necessary, and field size can be relatively larger than for other systems. Disadvantages of the conventional rice culture system include: tillage and planting can be seriously delayed by wet spring weather, levee construction and removal require significant labor and timeliness, levee maintenance and water level maintenance require season-long care, levee weeds demand special attention and crop rotation is imperative for red rice control.

II. Water culture of rice requires a field graded to zero slope or to a maximum 0.01 or 0.02 slope for precise water management, never permitting the soil to dry throughout the season. This permits rice culture year after year in the same field while minimizing red rice infestations. Water-seeded culture is expanding particularly in Pemiscot, New Madrid and Dunklin counties. Rice is pre-sprouted and seeded by airplane onto pre-flooded fields. A continuous flood is maintained until just before harvest.

Herbicides, insecticides and nitrogen fertilizer are applied by plane. Much reduced time and labor are required to manage large acreages. In the water-seeded system, economic infestations of rice water weevil are more likely. Thus insecticides are often applied as a prophylactic treatment by aerial seeding of granular formulations after germination. Advantages of water culture include: suppression of red rice after a field has become infested, permits continuous culture of rice year after year, without risk of red rice infestation, eliminates levee construction, maintenance and removal, expedites precision management of water, facilitates a uniform crop emergence and more precise management through the season, and simplifies weed control. Disadvantages of water culture include: zero-grade fields cannot be used dependably to grow rotation crops, precision field grade must be maintained with care, field size must be relatively small in order to pin-point flood and to maintain season-long flood, timeliness and planting is extremely critical, dependent on aerial applications from planting time on, rice water weevil, midge, aquatic weeds, algae and sheath blight are high risk pests in this system, with limited control options, seeding rate and pre-germination costs are higher, and pumping costs are higher.

III. Many rice producers try one or more methods of minimum tillage as a part of the conventional flood irrigated production system. If rice is following another crop, tillage will almost always be necessary in order to level the field. Weeds will be controlled and rice planted into a "stale seedbed". If rice is grown after rice, the levees from the previous crop can be left standing, but nearly always some minor grading or disking will be necessary to remove ruts and potholes. Just prior to planting, emerged weed are controlled with either Gramoxone Extra or Roundup. The rice can be drill seeded. Water seeding is not recommended because of seed drift problems on a smooth soil surface. Prowl and/or Bolero can be applied for pre-emergent weed control if the soil can be flushed and kept moist after herbicide application. Nitrogen fertilization and water management from tillering through harvest will be the same as for the conventional rice culture system. Advantages to the minimum tillage system include: less planting season labor and rush to prepare the seedbed, reduced overall seedbed preparation because of winter weathering, earlier planting because of no spring tillage, and cultural practices are the same as for conventional tillage system except for planting and pre-plant weed control. Disadvantages to the minimum tillage system include: any necessary tillage and leveling needs to be done in the fall, and special attention needs to be paid to chemical control of weeds.

Insect Pests

In general, insect problems in Missouri rice fields are much less severe than those in other rice-producing areas of the United States. The primary insect pest of rice in Missouri is the rice water weevil (RWW). Other key insect pests are the rice stink bug (RSB) and several grasshopper species. Several other insects (ex. armyworms, chinch bugs) rarely build to economic infestations.

Key Insects

<u>Rice Water Weevil</u> (*Lissorhoptrus oryzophilus*): Economic damage from rice water weevil infestations is largely dependent upon the following factors: 1) type of cropping system (drilled-seeded vs. water-seeded), 2) length of time in rice production, 3) prior weevil infestation levels, 4) availability and proximity of overwintering sites, 5) rice stand density, and 6) environmental conditions (ex. rainfall). In particular, water-seeded rice is more susceptible to RWW damage than drilled-seeded rice. A preventive insecticide treatment is recommended in water-seeded fields and in drilled-seeded fields with a history of RWW infestations. This pest will become more troublesome in the future as Missouri's rice acreage increases and production shifts more to water-seeded systems.

Cultural management of RWW infestations is available but generally these techniques can increase costs for fertilizer, irrigation, disease and weed control, and labor. Insecticides are the other control option for RWW infestations. A vast majority (90%) of the treated acreage is water-seeded rice.

<u>Rice Stink Bug</u> (*Oebalus pugnax*): This insect is commonly found in most fields; however, infestations rarely reach economically damaging levels (>5 RSS per 10 sweeps the first two weeks after 75% panicle emergence; 10 RSB per 10 sweeps the remainder of the season). A preventive management technique is to avoid mowing grassy field margins when rice is heading. Yield reductions (2%) are rare, but kernel quality can be affected in some years.

<u>Grasshoppers</u> (*Melanopus* species): Infestations generally start near field borders and levees. Foliar damage has little economic importance, but yield reductions (2%) following heavy damage to the seed heads can occur. Insecticide applications are recommended when populations are >1 per square foot during the seedling stage or >10 per 100 seed heads during the heading stage.

Secondary insect pests:

<u>True and Fall Armyworms</u> (*Spodoptera* spp.): Both species will occasionally attack rice but at different times during the season. True armyworm infestations generally occur in May and June, but fall armyworm ones occur in July and August. Rice most at risk to true armyworm infestations are fields adjacent to wheat, and fall armyworm infestations generally start along grassy field borders and levees.

Insect Pest Management

Approximately 12% of the rice acreage in Missouri was treated with an insecticide in 1997. The use of pheromones or attractants to monitor for key insect pests is not used in rice.

Prevention Strategy:

No prevention tactics are used for insect control in Missouri rice.

Avoidance Strategy:
No avoidance tactics are used to control insect pests in Missouri rice.

Monitoring Strategy:
No monitoring tactics are used to control insect pests in Missouri rice.

Suppression Strategy:
Insecticides are applied throughout the season when economic thresholds are exceeded. In 1997, 80% of the treated acres received one application of carbofuran. It is estimated that almost all uses of carbofuran had been replaced by fipronil seed treatment by the 1999 season.

Chemical:

- **Fipronil** (Icon 6.2FS). This product is being used for the first time in 1999 to control RWW larvae. Rates are from 12 to 20 fl. oz. per 100 lbs seed weight. Approximately 10% of Missouri's acreage (mostly water-seeded) was treated with fipronil in 1999.

- **Carbofuran** (Furadan 3G), 60 days PHI. This product's use rate was 20 lb. (0.6 lb a.i. per acre) per acre. Prior to 1999, most of the water-seeded rice acreage was treated with carbofuran.

- **Lambda-cyhalothrin** (Karate Z 2.09CS), 21 days PHI. This product's use rates are 1.6 to 2.56 fl. oz. (0.025-0.04 lbs a.i. per acre) per acre for adult RWW and armyworms. Less than 2% of Missouri's acreage was treated with lambda-cyhalothrin.

- Other insecticides registered for use on rice include: **malathion** (malathion 57% EC), **methyl parathion** (methyl parathion 4EC, penncap-M 2EC) and **carbaryl** (sevin XLR 4L, sevin 80WSP).

Diseases

Two diseases, sheath blight and blast, have caused appreciable rice yield reduction in Missouri in the past. Since 1988, the percent of rice yield loss due to sheath blight in Missouri has ranged from a low of 0.5% in 1998 to a high of 6% in 1994. The average percent yield loss due to this disease since 1988 was 2.2%. Blast is a less serious problem in Missouri rice fields than sheath blight. Yield loss due to blast has never exceeded 0.5%, and blast has only caused yield reductions in four years since 1988. Blast was not known to have developed in any Missouri rice fields in 1998.

Two diseases that have potential to cause widespread economic loss have appeared in the last two years in Missouri in a number of fields -- false smut (*Ustilaginoidea virens*) and kernel smut (*Neovossia horrida* or *Tilletia barclayana*). A third seed-borne disease has been identified in Louisiana in the past two years, panicle blight (*Burkholderia glumae*), a bacterial disease. This has the potential for more serious economic impact.

Sheath Blight (*Rhizoctonia solani*) Sheath blight symptoms appear first at internode elongation. The first symptom is an oblong, water-soaked lesion on leaf sheaths at or near the water line. In two or three days the lesion will have a grayish- white center surrounded by a dark purplish- or reddish-brown margin and may be up to one inch long. This lesion interrupts the flow of water and nutrients to the leaf and the leaf may die. Tissue below the lesion may remain green. As the plants grow and the leaves develop, the humidity inside the canopy increases. In this humid environment the fungus may grow upward inside the sheath and on the surface, causing new lesions. The fungus can also spread to nearby plants. Severely damaged plants may lodge. These patches of lodged plants are easily seen from a combine at harvest.

Sheath blight damage can range from partial infection of the lower leaves with little effect on grain development to premature plant death. On some varieties, the panicle can be attacked during hot, humid weather. Both yield and grain quality may be reduced when the disease prevents the flow of water and nutrients to the grain. Grain may then develop only partially or not at all. Poorly developed grains usually break up during milling thus reducing quality.

Sheath blight is more prevalent during periods of warm moist weather, and in thick, lush stands because of the high humidity which develops in the canopy. The pathogen thrives when the canopy humidity is above 95% and temperatures are hot (80-90oF). Little infection will occur in thin, short stands of rice because humidity within the canopy is low.

The sheath blight fungus survives in the soil from year to year as a hard, weather-resistant structure called a sclerotium. A sclerotium will float to the surface of rice flood water, and when it contacts a rice plant, the fungus grows out from the sclerotium and moves into the leaf sheath. Later, new sclerotia that have developed on infected stem surfaces fall from the plant to complete the life cycle. Sclerotia can remain alive in the soil for several years.

Rice Blast (*Pyricularia oryzae*)Blast symptoms can occur on leaves, leaf sheaths, nodes and panicles. Leaf spots are typically elliptical (football shaped), with gray-white centers and brown to red-brown margins. Fully developed leaf lesions are approximately 0.4 to 0.7 inch long and 0.1 to 0.2 inch wide. Both the shape and the color vary depending on the environment, age of the lesion and rice variety. Lesions on leaf sheaths, which rarely develop, resemble those on leaves.

The most serious damage occurs when the fungus attacks nodes just below the head. The stems often break at the diseased node. This stage of the disease is referred to as "rotten neck." Blast damage to the node prevents the flow of water and nutrients to the kernels and they will stop developing. Heads of plants damaged in this way may be completely blank to nearly normal, depending on the stage of head development when infection occurs. Poorly developed grains usually break up badly in milling, reducing quality.

The rice blast fungus overwinters in rice seeds and infected rice stubble. The fungus spores, which are the reproductive structures, can spread from these two sources to new rice plants during the next growing season and initiate new infections. Spores from these new infections can spread by wind to other plants over great distances.

There are several races of *P. oryzae*. To date, four races have been found in

Arkansas -- IG1, IH1, IC17 and IB49. Since 1993, Dr. Fleet Lee in Arkansas has also collected a new race, IE-1k, that can attack the blast-resistant varieties Katy and Kaybonnet. So far, this new race has been of minor importance but may become a bigger problem if large acreage of Kaybonnet is planted in coming years. Only race IB49 has been found in Missouri.

Disease Management

During 1998, approximately 5% of Missouri's rice acreage was treated with a fungicide, primarily for control of sheath blight. All applications were made by air.

Prevention Strategy:
Field sanitation and removal of alternate hosts through tillage are important prevention tactics practiced to prevent diseases from becoming established.

Avoidance Strategy:
Several avoidance tactics are practiced to minimize disease problems in Missouri rice. They include: 1. Reduced rates of nitrogen fertilizer, especially at mid-season, to lessen the severity of all fungal diseases; 2. Flooding is an effective tactic for reducing rice blast in water-seeded systems; 3. Maintaining plant densities below 15-20 plants per ft^2 is effective at reducing sheath blight; 4. Planting resistant varieties is the rice farmers best approach to managing rice blast, sheath blight and straighthead disorder. Unfortunately, no variety has more than moderate resistance to either disease, and no variety has good resistance to both diseases; and 5. Crop rotation is important for sheath blight management.

Monitoring Strategy:
Scouting reports and integration with a degree day model are encouraged for management of rice blast. Scout fields for blast symptoms from the seedling through heading stages. If symptoms are found, prepare to use the fungicide benomyl at the late boot stage and again when 80-90 percent of plants are headed. Apply fungicides during the time frame predicted by the DD50 program, which is about 5 to 7 days before heading (late boot stage). Fungicides are especially needed if blast symptoms have been

observed in the field and the variety is very susceptible. Fungicides should be applied a second time approximately 2 days after 50 percent heading (90 percent head exsertion). In uniform stands, 90 percent heading will occur in 4 to 5 days after the first heads are visible.

The decision to apply a fungicide is more easily made when one or more of the following factors exist: A susceptible variety is grown in the field, the crop has excessive growth and a dense canopy, leaf symptoms have been found in the field, disease is present in southern parts of the field and cool, rainy or cloudy weather with high humidity and heavy dews is predicted during heading.

Suppression Strategy:
Several cultural practices are important to reduce risks from rice blast. These tactics include: reducing fungal overwintering sites through incorporation of the rice stubble soon after harvest to promote early decomposition; grow rice in open fields free of tree lines, particularly on east and south sides; grow rice in fields where flood levels are easily maintained. Damage from blast can be reduced by keeping soil flooded from the time rice plants are 6 to 8 inches tall until draining for harvest; seed over a range of time to spread the heading dates and avoid planting late because blast will be more severe; and avoid excessive nitrogen application rates by monitoring plant area or using a chlorophyll meter at mid-season and applying no more than 30 pounds per acre of nitrogen per application at mid-season. In fields with a history of blast, always split apply nitrogen.

Fungicides are applied to high disease-risk fields and when disease outbreaks are noted.

Chemical:

- **Azoxystrobin** (Quadris). Azoxystrobin was applied to 4% of Missouri's rice acreage at 0.2 lb a.i per acre. Quadris is labeled for control of most foliar diseases at a rate of 12.3 to 18.5 fl. oz/a.

- **Propiconazole** (Tilt EC). Propiconazole was applied to 1% of Missouri's rice acreage at 0.6 lb a. i. per acre. Tilt is labeled for control of most foliar diseases at a rate of 6-10 fl. oz/a. It cannot be used in rice fields where commercial farming of crayfish will be practiced.

- Other fungicides registered for rice diseases include: **Benomyl** (benlate) and **Flutolanil** (Moncut) are labeled for sheath blight control.

Weeds

Barnyardgrass(*Echinochloa crus-galli)*, is the most common weed species. It can be troublesome because a majority of the rice herbicides are somewhat weak on larger grasses or sensitive to moisture levels. It can be generally controlled with herbicides but timing of applications is critical. Propanil-resistant barnyardgrass is a wide-spread problem in Arkansas, but it is not a widespread problem in Missouri.

Red rice (*Oryza sativa)* ranks as the most difficult weed to control in rice. Red rice has a number of weedy characteristics (seed shattering, moderate seed longevity in the soil, and moderate tolerance to several grass-controlling herbicides); however, the main problem is the weed is essentially another variety of commercial rice, and consequently has biochemical tolerance to all rice herbicides. Red rice is normally controlled by crop rotation (most commonly with soybean) and certain (but not all) chloroacetamide pre-emergence herbicides and post-emergence graminicides. Also, red rice is sometimes suppressed by water seeding rice. In water-seeded rice, red rice seeds do not germinate due to anaerobic conditions in the soil. The desirable cultivar is sown on the soil surface and germinates in the thin layer of oxygen that exists on the soil surface; however, the efficacy of water seeding is limited because any red rice seed located on the soil surface also will germinate.

Sprangletop species (*Leptochloa panicoides* and *L. fascicularis*) are other troublesome weeds that have become more serious in recent years as a result of the widespread use of Facet herbicide with limited efficacy on the sprangletops. However, specific herbicides are available to control these weed species.

Northern jointvetch (*Aeschynomene virginica)* is a serious problem in some Missouri fields. It is controlled effectively only by spray application of the live spores of a Colletotrichum fungus, sold as Collego. This product has often not been available to Missouri growers, since Missouri's demand comes after Arkansas growers may have exhausted the season's supply.

Other weeds that which have the potential to become more troublesome due to changing herbicide usage are presently common in Missouri rice fields. These are broadleaf signalgrass (*Brachiaria platyphylla*), foxtails (*Setaria spp.*), crabgrasses (*Digitaria spp.*), smartweeds (*Polygonum spp.*), yellow nutsedge (*Cyperus esculentum*), Indian jointvetch (*Aeschynomene indica*), eclipta (*Eclipta alba*), and gooseweed (*Sphenoclea zeylanica*). All of these can be controlled with available herbicides.

Weed Management

Weeds infest 100% of Missouri's rice acreage and 100% of the rice acreage is treated with herbicides. Rice herbicides are more expensive than corn and soybean herbicides and weed control costs in rice can be as high as $50.00 per acre. The most widely used weed control program involves the use of propanil (a non-residual post-emergence herbicide which controls a majority of common rice weeds) combined with a residual type herbicide such as pendimethalin, quinclorac, or thiobencarb. A major limitation of propanil is that the activity is primarily contact and weeds must be small; therefore, application timing is critical for effective control. Over the next two years, clomazone may emerge as the most common grass herbicide due to its efficacy, cost (<$10.00 per acre), and ease of use. But, one limitation with using clomazone is it will not control a majority of common broadleaf weeds. Herbicide tolerant rice lines are in the experimental stage. These lines could offer selective control of red rice in rice; however, the potential for herbicide tolerant rice to cross breed with the red rice and transfer herbicide tolerance is an important consideration.

Prevention Strategy:
Preplant tillage provides control of winter annual weeds. Most weed germination occurs during the first four weeks after rice planting.

Avoidance Strategy:
Flooding and crop rotation are very important avoidance tactics in weed management. The cultural practice of flooding (combined with crop interference) provides greater than 60% of the weed control in rice fields. But, in delayed flood, drill-seeded rice herbicides must be applied 4 to 8 weeks before flooding. In water-seeded rice, aquatic weeds also grow uninhibited during the first 4 to 6 weeks before the crop canopy can suppress them.

Monitoring Strategy:
100% of rice fields are scouted for weed infestations because herbicide applications are closely ties to weed emergence, weed size and weed species. Pre-flood herbicide applications are routinely adjusted based on the weed species that emerged after or survived earlier herbicide applications. It is estimated that 40-60% of the rice acres are scouted by paid consultants.

Suppression Strategy:
In Missouri, 100% of rice fields are treated with herbicides to suppress weed competition. Each acre receives an average 1.56 herbicide applications. Growers are encouraged to rotate herbicides with different modes of action to delay the emergence of weed resistance.

Chemical:

- **Propanil** (Stam 4L, 80DF). Propanil was applied to 82% of the rice acres in 1997. Propanil is applied post-emergence at 3 to 4 lb a.i. per acre for control of grasses at the 2 to 3 leaf stage. Grasses larger than the 4 leaf stage are not adequately controlled with propanil. Growers are advised to not use propanil alone for more than 3 years continuously.

- **Thiobencarb** (Bolero 8E). Thiobencarb was applied to 34% of the rice acres in 1997. It is most often applied as an early post-emergence tankmix with propanil. Thiobencarb can be pre-plant surface applied in water-seeded rice or delayed pre-emergence in dry-seeded rice at 4 lb a.i. per acre for primary grass control. In water-seeded rice, soils must be flooded within 2 to 3 days after application but not within 1 day after application. In dry-seeded rice, the soil must have been sealed by rain or flush irrigation and the soil must remain moist for the herbicide to control germinating weeds. Thiobencarb does not control broadleaf signalgrass and it must be tank-mixed with propanil if barnyardgrass or sprangletop has emerged.

- **Pendimethalin** (Prowl 3.3EC). Pendimethalin was applied to 17% of the rice acres in 1997. It is most often applied in an early post-emergence tankmix with propanil with the objective of supplying residual weed control after the propanil has controlled emerged weeds. Pendimethalin can be applied in dry-seeded rice only at 0.75 to 1 lb a.i. per acre for primary grass control. Rice seed must have imbibed water or significant injury will occur. Must be tank-mixed with a post-emergence herbicide if weeds have emerged.

- **Molinate** (Ordram 8E, 15G). Molinate was applied to 16% of the rice acres in 1997. In water seeded rice, molinate is most often applied into the floodwater in a tank mixture with Londax. Molinate is applied preplant incorporated in water-seeded rice at 4 lb a.i. per acre or post-emergence at 3 to 4 lb a.i. per acre when applied alone or at 2.25 to 3 lb a.i. per acre when tank-mixed with propanil for primary grass control. In water-seeded rice, molinate must be incorporated shortly after application (within minutes for the 8E formulation and 6 hours for the 15G formulation). The soil must be sealed by flooding and not allowed to dry. In dry-seeded rice, molinate is applied to flooded fields and depending on rate can control from 3 inch to 24 inch barnyardgrass.

- **Bentazon** (Basagran 4SL) Bentazon was applied to 4% of the rice acres in 1997. Bentazon is applied post-emergence for primary broadleaf weed control at 0.75 to 1.0 lb a.i. per acre. Bentazon alone will not control cocklebur and smartweed so often must be tank-mixed with propanil for broader spectrum weed control.

- **Aciflourfen** (Blazer 4L). Aciflourfen was applied to 3.5% of the rice acres in 1997. Aciflourfen is applied post-emergence for primary broadleaf weed control at 0.125 to 0.5 lb a.i. per acre. It is often tank-mixed with propanil for broader spectrum weed control.

- The following registered herbicides were used on less than 3% of the rice acres in Missouri in 1997: **Quinclorac** (Facet), **triclopyr** (Grandstand), **bensulfuron** (Londax), **halosulfuron** (Permit), **Fenoxaprop** (Whip), **2,4-D** (MCPA, 2,4-D amine), **Gramoxone Extra** (paraquat), **Glyphosate** (Roundup Ultra), and **Thifensulfuron + tribenuron** (Harmony Extra). **Quinclorac**, **triclopyr** and **halosulfuron** could capture significant market share in future years. In addition, **clomazone** registration is expected for 2000 or 2001. Once registered, this herbicide could quickly become the most commonly used herbicide on rice in Missouri.

Integrated Pest Management Strategies

The estimated percent of rice farmers utilizing an integrated pest management program in 1998 was 40%.

Contacts

Authors:
B. Beck and G. S. Smith

Contacts:

Mr. Bruce Beck, Regional Agronomy Specialist, University Outreach and Extension, 222 North Broadway, Poplar Bluff, MO 63901. Phone (573) 686-8064. E-mail: beckb@missouri.edu

Dr. Michael Boyd, State Entomology Specialist, University of Missouri Delta Center, PO Box 160 Portageville, MO 63873. (573)379-5431. E-mail: boydm@missouri.edu

Mr. David Guethle, Regional Agronomy Specialist, University Outreach and Extension, Stoddard County Extension Office, P.O. Box F, Bloomfield, MO. 63825. (573) 568-3344. E-mail: guethled@missouri.edu

Dr. Andy Kendig, State Weed Specialist, University of Missouri Delta Center, PO Box 160 Portageville, MO 63873. (573)379-5431. E-mail: kendiga@missouri.edu

Dr. J. Allen Wrather, State Plant Pathology Specialist, University of Missouri Delta Center, PO Box 160, Portageville, MO 63873. (573)379-5431. E-mail: wratherj@missouri.edu

Dr. George S. Smith, Extension Plant Pathology, 1-31 Agriculture Bldg., University of Missouri, Columbia, MO 65211. (573) 882-4314. E-mail: smithge@missouri.edu

References

1. Missouri Agricultural Statistical Service. 1994-99. Missouri Farm Facts. Missouri Department of Agriculture and United States Department of Agriculture.

2. Missouri Rice Page, Agricultural Electronic Bulletin Board, University of Missouri, URL: http://agebb.missouri.edu/rice/index.htm

3. National Agriculture Statistical Service. 1997. 1997 Census of Agriculture.

4. Personal Communication with Bruce Beck, University of Missouri Agronomy and Rice Extension Specialist, Butler County, Poplar Bluff, Missouri.

5. Pesticide Use Surveys: Missouri, 1997. Soybean, Corn, Sorghum, Cotton and Rice. Pesticide Impact Assessment Program, University Extension publication MP ___. (in press).

The Missouri Rice Crop Profile was developed from interviews with Extension Specialists at the University of Missouri. Other information sources were from the Missouri Rice Page (http://agebb.missouri.edu/rice/index.htm) and pesticide usage data obtained from USDA and the Pesticide Impact Assessment Program.
