WEEDY RICE MANAGEMENT WITH CROP ROTATION

Gustavo M. Teló[1], Eric P. Webster[2], Benjamim M. McKnight[3], Samer Y. Rustom Jr[4], Matthew J. Osterholt[5], L. Connor Webster[6]

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INTRODUCTION

Imidazolinone-resistant (IR) rice (Clearfield® rice, BASF Corporation, Research Triangle Park, NC 27709), became commercially available in the United States in 2002, and is resistant to the imidazolinone family of herbicides. For the first time, producers were able to apply a herbicide during the production of rice and control the most troublesome weed in rice, red rice (*Oryza sativa* L.). Imazethapyr (Newpath® rice, BASF Corporation, Research Triangle Park, NC 27709) and imazamox (Beyond® rice, BASF Corporation, Research Triangle Park, NC 27709) are the two herbicides labeled for use on IR rice in the United States.

IR hybrid rice was introduced in 2004. However, hybrid rice seeds from previous crops have a history of dormancy, and it can become a weedy plant if allowed to establish the following growing season as an F_2. Clearfield F_2 rice plants can have many phenotypic characteristics, and these plants are often resistant to imazethapyr and imazamox (Webster et al. 2014). Some of the characteristics include medium or long grain, pubescent or glabrous leaves, awned and/or awnless seed, and dark to light green vegetation. These resistant F_2 plants can become a tremendous weed problem when IR hybrid rice is grown in consecutive years. Another issue with the IR rice technology is outcrossing of red rice with IR (Webster et al. 2015). This point forward the hybrid F_2, red rice, and the red rice out-crosses will be referred to as weedy rice.

The objective of this study was evaluate long term rotations for control of weedy rice using IR hybrid rice, ACCase-resistant rice (Provisia® rice, BASF Corporation, Research Triangle Park, NC 27709), glyphosate-resistant soybean (Roundup Ready®, Monsanto, St. Louis, MO 63167), glufosinate-resistant soybean (Liberty Link®, Bayer CropScience, Research Triangle Park, NC 27709) and fallow.

MATERIALS AND METHODS

A field study was established in 2013 to evaluate long-term rotations for control of weedy rice using currently available herbicide resistant rice and soybeans and an experimental herbicide resistant rice. The field at located near Estherwood, Louisiana. The four-year study evaluated five rotations (Table 1), the management practices were conducted according to technical recommendations for each crop.

Table 1. Crop rotations employed for the four-year study.

	Year			
Rotation	2013	2014	2015	2016
1	RR Soybean[a]	Provisia Rice	RR Soybean	CL Rice
2	Fallow	Provisia Rice	RR Soybean	CL Rice
3	CL Rice	LL Soybean	Provisia Rice	CL Rice
4	RR Soybean	LL Soybean	RR Soybean	CL Rice
5	RR Soybean	CL Rice	RR Soybean	CL Rice

[a] RR, Roundup Ready® soybean (glyphosate-resistant soybean); LL, Liberty Link® soybean (glufosinate-resistant soybean); Provisia® rice (ACCase-resistant rice); CL, Clearfield® hybrid rice (imidazolinone-resistant hybrid rice).

[1] Post-Doctoral Researcher, LSU AgCenter, 104 Sturgis Hall, Baton Rouge, LA 70808 gtelo@agcenter.lsu.edu
[2] Professor, LSU AgCenter, 104 Sturgis Hall, Baton Rouge, LA 70808
[3] Research Associate, LSU AgCenter, 104 Sturgis Hall, Baton Rouge, LA 70808
[4] Graduate Assistant, LSU AgCenter, 104 Sturgis Hall, Baton Rouge, LA 70808
[5] Graduate Assistant, LSU AgCenter, 104 Sturgis Hall, Baton Rouge, LA 70808
[6] Graduate Assistant, LSU AgCenter, 104 Sturgis Hall, Baton Rouge, LA 70808

Roundup Ready (RR) soybean was treated with glyphosate at 1120 g ai ha^{-1} plus dimethenamid at 945 g ai ha^{-1} at the first trifoliate leaf stage, followed by (fb) glyphosate 21 days later at 1120 g ha^{-1}. Pyroxasulfone at 150 g ai ha^{-1} was added to the first application for Rotation 4 in 2013. Liberty Link (LL) soybean was treated with glufosinate at 820 g ai ha^{-1} plus dimethenamid at 945 g ha^{-1} on soybean in the first trifoliate leaf stage fb glufosinate at 820 g ha^{-1} applied 21 days later. Pyroxasulfone at 150 g ha^{-1} was added to the first application for Rotation 4 in 2014.

Provisia rice was treated with quizalofop at 115 g ai ha^{-1} on two- to three-lf rice fb halosulfuron at 53 g ai ha^{-1} 3 days later fb quizalofop at 115 g ha^{-1} on four-lf to one-tiller rice, and CL hybrid rice was treated with clomazone at 336 g ai ha^{-1} plus imazethapyr at 105 g ai ha^{-1} on two- to three-lf rice, fb imazethapyr at 105 g ha^{-1} on four-lf to one-tiller rice fb a panicle initiation application of imazamox at 44 g ai ha^{-1}. The fallow area was treated with glyphosate at 1120 g ha^{-1} at the same time the soybeans were treated with glyphosate. A tillage operation occurred in the fallow area 2 weeks after the second glyphosate application. A third glyphosate application occurred 4 weeks later in the fallow area. Weedy rice plants were counted in each 0.2 ha block at the end of each growing season.

RESULTS AND DISCUSSION

In 2013, the rotation planted to RR soybean had the lowest number of weedy rice plants at 2,690 plants ha^{-1} at the end of the first growing season (Table 2). The first year fallow rotation had the highest population of weedy rice with 251,000 plants ha^{-1}. In 2014, rotations 1 and 2 with Provisia rice contained 50 to 40 weedy rice plants ha^{-1}, respectively, and the rotations 3 and 4 were planted with LL soybean contained 26,000 and 31,000 plants ha^{-1}, respectively, at the end of the growing season. However, for rotation 5 with CL hybrid rice contained 396,000 plants ha^{-1}.

In 2015, rotations 1, 2, and 4 were planted with RR soybean, and rotation 3 was planted Provisia rice, each rotation contained 0 weedy rice plants ha^{-1} at the end of the 2015 growing season. Rotation 5 was planted with RR soybean and contained 4,000 weedy rice plants ha^{-1}. The utilization of RR soybean and Provisia® rice technology vastly improved rotational flexibility in 2015 and will serve as excellent rotational tools with the Clearfield® technology for weedy rice management.

In 2016, all rotations used CL hybrid rice. For rotations 1, 2, 3 and 4 the number of weedy rice did not exceed 140 plants ha^{-1}, and for rotation 5 the number of weedy rice was 1,690 plants ha^{-1}. This research indicates that long term crop rotation, herbicide active ingredient rotation, and employing different production practices can be used to manage weedy rice and reduce the weedy rice population in future growing seasons.

Table 2. Weedy rice plants count comparison from 2013 to 2016.

	2013		2014		2015		2016	
Rot[1]	Plants m^{-2}	Plants ha^{-1}	Plants m^{-2}	Plants ha^{-1}	Plants m^{-2}	Plants ha^{-1}	Plants m^{-2}	Plants ha^{-1}
1	17.2	172,000	0.005	50	0	0	0.006	60
2	25.1	251,000	0.004	40	0	0	0.009	90
3	7.8	78,000	2.6	26,000	0	0	0.014	140
4	5.2	52,000	3.1	31,000	0	0	0.005	50
5	0.2	2,690	39.6	396,000	0.4	4,000	0.169	1,690

[1] Rotations: 1) RR soybean (2013)/Provisia rice (2014)/RR soybean (2015)/CL hybrid rice (2016); 2) Fallow (2013)/Provisia rice (2014)/RR soybean (2015)/CL hybrid rice (2016); 3) CL hybrid rice (2013)/Liberty Link (LL) soybean (2014)/Provisia rice (2015)/CL hybrid rice (2016); 4) RR soybean (2013)/LL soybean (2014)/RR soybean (2015)/CL hybrid rice (2016); 5) RR soybean/CL hybrid rice (2014)/RR soybean (2015)/CL hybrid (2016).

CONCLUSION

The long term crop rotation, herbicide mode of action rotation, and employing different production practices can be used to manage weedy rice and reduce the weedy rice population in future growing seasons. The utilization of Roundup Ready®, Liberty Link®, and Provisia® technology in a long term crop rotation vastly improves rotational flexibility of herbicide mode of action and will serve as excellent rotational tools in conjunction with Clearfield® technology for weedy rice management.

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