USE OF CROP ROTATION FOR WEEDY RICE MANAGEMENT

Samer Y. Rustom, Jr.[1], Eric P. Webster[1], Benjamin M. McKnight[1], Eric A. Bergeron[1]

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INTRODUCTION

Clearfield® rice (*Oryza sativa* L.) was released 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 and imazamox are the two herbicides labeled for use on Clearfield rice in the United States. Clearfield hybrid rice was introduced in 2003. Hybrid rice seed has 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 and long grains, pubescent or glabrous leaves, awned and/or awnless seed, and dark to light green vegetation (Webster et al 2015a). These resistant F_2 plants can become a tremendous weed problem when Clearfield hybrid rice is grown in consecutive years. Another issue with the Clearfield rice technology is outcrossing of red rice with Clearfield (Webster et al 2015b).

MATERIALS AND METHODS

Previous research has indicated a 4-year rotation is needed to help manage weedy rice (Webster et al. 2014). 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 is located near Esterwood, Louisiana. The field has a large population of red rice, hybrid rice dormancy issues, and Clearfield/red rice out-crosses. This point forward the hybrid F_2, red rice, and the red rice out-crosses will be referred to as weedy rice. The weedy rice plants have a red rice appearance from a distance, but closer evaluation indicates both smooth and pubescent leaf surfaces, pale green to dark-green to purple vegetation, and long- and medium-grain rice. It is apparent the field was close to being a total failure with a loss of profitability due to weedy rice competition, and the field was close to abandonment by the producer. In 2014, a non-GMO herbicide resistant rice was evaluated for the control of weedy rice. This new technology is called Provisia® and it is resistant to the herbicide quizalofop.

The four year study evaluated five rotations including the use of Provisia rice in 2014. The rotations used are: 1) Roundup Ready® (RR) soybean (2013)/Provisia rice (2014)/RR soybean (2015)/Clearfield (CL) hybrid rice (2016); 2) Fallow (2013)/Provisia rice (2014)/RR soybean (2015)/CL hybrid rice (2016); 3) CL hybrid rice (2013)/LL soybean (2014)/Provisia rice (2015)/CL hybrid rice (2016); 4) RR soybean (2013)/ Liberty Link (LL) soybean (2014)/RR soybean (2015)/CL hybrid rice (2016); 5) RR soybean/CL hybrid rice (2014)/RR soybean (2015)/CL hybrid (2016).

In 2013, each 0.2 ha block followed the rotations listed above, and herbicide programs employed for each year are listed below. The Clearfield CLXL 745 was treated with clomazone at 336 g a.i. ha^{-1} plus imazethapyr at 105 g a.i. ha^{-1} on 1- to 2-lf rice, followed by (fb) imazethapyr at 105 g a.i. ha^{-1} on 3- to 4-leaf rice fb a panicle initiation (PI) application of imazamox at 44 g a.i. ha^{-1}. RR soybean was treated with glyphosate at 1120 g a.i. ha^{-1} plus

[1] Louisiana State University Agricultural Center, 104 Sturgis Hall, Baton Rouge, LA 70808. srustom@agcenter.lsu.edu

dimethenamid at 945 g a.i. ha^{-1} at the first trifoliate leaf. A second application of glyphosate at 1120 g a.i. ha^{-1} was applied at 21 days later. Rotation 4 was treated with pyroxasulfone 150 g a.i. ha^{-1} added to first application of glyphosate plus dimethenamid. The fallow area, Rotation 2, was treated with glyphosate at 1120 g a.i. 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.

In 2014, Rotation 1 was planted with 'Provisia' rice and treated with quizalofop at 115 g a.i. ha^{-1} on 2- to 3-lf rice fb by quizalofop, at 115 g a.i. ha^{-1} on 4-lf to 1-tiller rice. Rotation 2 was treated with quizalofop, at 115 g a.i. ha^{-1} on 2- to 3-lf rice fb by quizalofop, at 115 g a.i. ha^{-1} 4-lf to 1-tiller rice. Rotation 3 was treated with glufosinate at 820 g a.i. ha^{-1} plus dimethenamid at 945 g a.i. ha^{-1} on soybean in the first trifoliate leaf stage fb glufosinate at 820 g a.i. ha^{-1} applied 21 days later. Rotation 4 was treated with glufosinate at 820 g a.i. ha^{-1} plus dimethenamid at 945 g a.i. ha^{-1} plus pyroxasulfone 150 g a.i. ha^{-1} on soybean in the first trifoliate leaf stage fb glufosinate at 820 g a.i. ha^{-1} applied 21 days later. Rotation 5 was planted with 'Clearfield CLXL 745' rice and treated with clomazone, at 336 g a.i. ha^{-1} plus imazethapyr at 105 g a.i. ha^{-1} on 2- to 3-lf rice, fb imazethapyr at 105 g a.i. ha^{-1} on 4-lf to 1-tiller rice fb a PI application of imazamox at 44 g a.i. ha^{-1}. The final weedy rice plants were counted on July 16, 2014 immediately prior to destroying Provisia rice and Liberty Link soybean with glyphosate at 1680 g a.i. ha^{-1}.

Table 1. Weed rice count comparison from 2013 and 2014.

	2013		2014	
Rotation	Plants m^{-2}	Plants ha^{-1}	Plants m^{-2}	Plants ha^{-1}
1	17.2	172,000	0.005	50
2	25.1	251,000	0.004	40
3	0.269	2,690	2.6	26,000
4	5.2	52,000	3.1	31,000
5	7.8	78,000	39.6	396,000

[a]1) Roundup Ready® (RR) soybean (2013)/Provisia rice (2014)/RR soybean (2015)/Clearfield (CL) hybrid rice (2016); 2) Fallow (2013)/Provisia rice (2014)/RR soybean (2015)/CL hybrid rice (2016); 3) CL hybrid rice (2013)/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).

RESULTS AND DISCUSSION

In 2013, the rotation planted to Clearfield hybrid rice had the lowest number of weedy rice plants at 0.269 plants m^{-2} at the end of the first growing season (Table 1). The first year fallow rotation had the highest population of weedy rice with 251,000 plants ha^{-1}, or 25.1 plants $m^{-2.}$

In 2014, weedy rice plants for each rotation were: rotation 1 - 0.005 plants m^{-2}; rotation 2 - 0.004 plants m m^{-2}; rotation 3 - 2.6 plants m m^{-2}; rotation 4 - 3.1 plants m m^{-2}; rotation 5 - 39.6 plants m m^{-2} (Table 1). This research indicates that long term crop rotation, herbicide rotation, and employing different production practices can be used to manage weedy rice plants.

CONCLUSION

In conclusion, with the development of Provisia rice, producers will have another tool for the management of this weed complex, and Provisia rice will be a valuable economic tool for producers who need rice as a rotational crop to help maintain profitability. A long term rotation including rice, soybean, and burndown applications in fallow rotations can be useful cultural practice when trying to manage weedy rice.

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