**Quizalofop can be antagonized when mixed with ALS inhibiting herbicides in ACCase-resistant rice production**

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**Introduction**

The introduction of imidazolinone-resistant (IR) rice allowed growers to control red rice (*Oryza sativa* L.) with a herbicide during cultivated rice production for the very first time (Croughan 2003). IR hybrid rice has a history of dormancy and rapid seed shattering and can become weedy if allowed to establish in following growing seasons as an $F_2$ (Sudianto et al. 2013). Research conducted by Rajguru et al. (2005) suggested the IR resistant gene used in Clearfield technology was transferred by natural outcrossing to produce IR red rice. Red rice, $F_2$ hybrids, and outcrosses form a complex that will be referred to as weedy rice. Barnyardgrass (*Echinochloa crus*-galli L.) resistant to propanil and quinclorac has also become a common problem in rice production and the potential exists for the continued spread of resistant biotypes (Talbert and Burgos 2007). BASF and the LSU AgCenter are currently developing ACCase-resistant rice cultivars, sold under the trade name Provisia, in response to the evolution of IR weedy rice and propanil- or quinclorac-resistant barnyardgrass. Previous research has indicated ACCase herbicide activity is often antagonized when mixed with broadleaf and/or sedge herbicides (Barnwell and Cobb 1994).

**Materials and Methods**

A study was established at the LSU AgCenter H. Rouse Caffey Rice Research Station in Crowley, Louisiana to evaluate quizalofop mixture interactions with acetolactate synthase (ALS) herbicides. The experimental design was a randomized complete block with a two-factor factorial arrangement of treatments with four replications. Factor A consisted of quizalofop applied at 120 g ai/ha or no quizalofop. Factor B consisted of penoxsulam at 40 g ai/ha, penoxsulam plus triclopyr at 352 g ai/ha, halosulfuron at 53 g ai/ha, bispyribac at 34 g ai/ha, orthosulfamuron plus halosulfuron at 94 g ai/ha, orthosulfamuron plus quinclorac at 491 g ai/ha, imazosulfuron at 211 g ai/ha, bensulfuron at 43 g ai/ha, or no mix partner. Applications were made with a $CO_2$-pressurized backpack sprayer calibrated to deliver 140 L/ha.

Plot size was 1.5 by 5.2 m with eight 19.5 cm drill-seeded rows containing 4 rows of 'Provisia' rice, 2 rows of 'CL-111', and 2 rows of 'CLXL-745'. Awnless red rice seed was also broadcast across the plot area. CL-111, CLXL-745, and red rice were planted to represent weedy rice. The plot area is also naturally infested with barnyardgrass. Evaluations were recorded as percent control on a scale of 0 to 100 at 14, 28, and 42 days after treatment (DAT), with 0 = no control and 100 = complete plant death. A second application of quizalofop was applied at 120 g/ha immediately following the 28 DAT evaluation.

**Results and Discussion**

At 14 DAT, quizalofop applied alone controlled barnyardgrass 91% (Table 1). The addition of penoxsulam, penoxsulam plus triclopyr, bispyribac, orthosulfamuron plus halosulfuron, or orthosulfamuron plus quinclorac to quizalofop reduced barnyardgrass control to 39, 43, 49, 83, and 78%, respectively (Table 1). Quizalofop applied alone controlled CLXL-745 92% at 14 DAT (Table 2). The addition of penoxsulam, penoxsulam plus triclopyr, bispyribac, or orthosulfamuron plus halosulfuron to quizalofop reduced CLXL-745 control to 70, 73, 78, and 85%, respectively (Table 2).

At 28 DAT, quizalofop applied alone controlled barnyardgrass 98%. The addition of penoxsulam, penoxsulam plus triclopyr, bispyribac, orthosulfamuron plus halosulfuron, orthosulfamuron plus quinclorac, or bensulfuron to quizalofop reduced barnyardgrass control to 26, 28, 21, 86, 76, and 89%, respectively (Table 1). Quizalofop applied alone controlled CLXL-745 98% at 28 DAT (Table 2). The addition of penoxsulam, penoxsulam plus triclopyr, bispyribac, orthosulfamuron plus halosulfuron, orthosulfamuron plus quinclorac, imazosulfuron, or bensulfuron to quizalofop reduced CLXL-745 control to 76, 76, 80, 91, and 83, 88, and 89%, respectively (Table 2). A second application of quizalofop applied alone at 28 days after the

initial treatment controlled barnyardgrass and CLXL-745 at least 84% to 99% for those plants that survived the initial application due to antagonism.

**Table 1. Barnyardgrass control for each mixture 14, 28, and 63 DAT**

| Herbicide Program | % Control | | |
|---|---|---|---|
| | 14 DAT | 28 DAT | 63 DAT |
| Quizalofop | 90 | 98 | 99 |
| Quizalofop + penoxsulam | 39 | 26 | 85 |
| Quizalofop + penoxsulam + triclopyr | 43 | 28 | 84 |
| Quizalofop + halosulfuron | 88 | 95 | 97 |
| Quizalofop + bispyribac | 49 | 21 | 90 |
| Quizalofop + orthosulfamuron + halosulfuron | 83 | 86 | 97 |
| Quizalofop + orthosulfamuron + quinclorac | 78 | 76 | 86 |
| Quizalofop + imazosulfuron | 86 | 93 | 91 |
| Quizalofop + bensulfuron | 88 | 89 | 94 |

**Table 2. CLXL 745 control for each mixture 14, 28, and 63 DAT**

| Herbicide Program | % Control | | |
|---|---|---|---|
| | 14 DAT | 28 DAT | 63 DAT |
| Quizalofop | 92 | 98 | 99 |
| Quizalofop + penoxsulam | 70 | 76 | 97 |
| Quizalofop + penoxsulam + triclopyr | 73 | 76 | 95 |
| Quizalofop + halosulfuron | 90 | 93 | 98 |
| Quizalofop + bispyribac | 78 | 80 | 98 |
| Quizalofop + orthosulfamuron + halosulfuron | 90 | 91 | 99 |
| Quizalofop + orthosulfamuron + quinclorac | 85 | 83 | 95 |
| Quizalofop + imazosulfuron | 86 | 88 | 91 |
| Quizalofop + bensulfuron | 89 | 89 | 95 |

**Conclusion**

This research indicates the addition of common ALS-inhibiting herbicides, especially penoxsulam, penoxsulam plus triclopyr, and bispyribac, to quizalofop in ACCase-resistant rice production can reduce quizalofop activity on barnyardgrass and weedy rice. Halosulfuron could be a viable mix partner with quizalofop, but caution should be taken when mixing any ALS-inhibiting herbicide with quizalofop. This research also indicates a second application of quizalofop alone will be necessary when quizalofop antagonism occurs.

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