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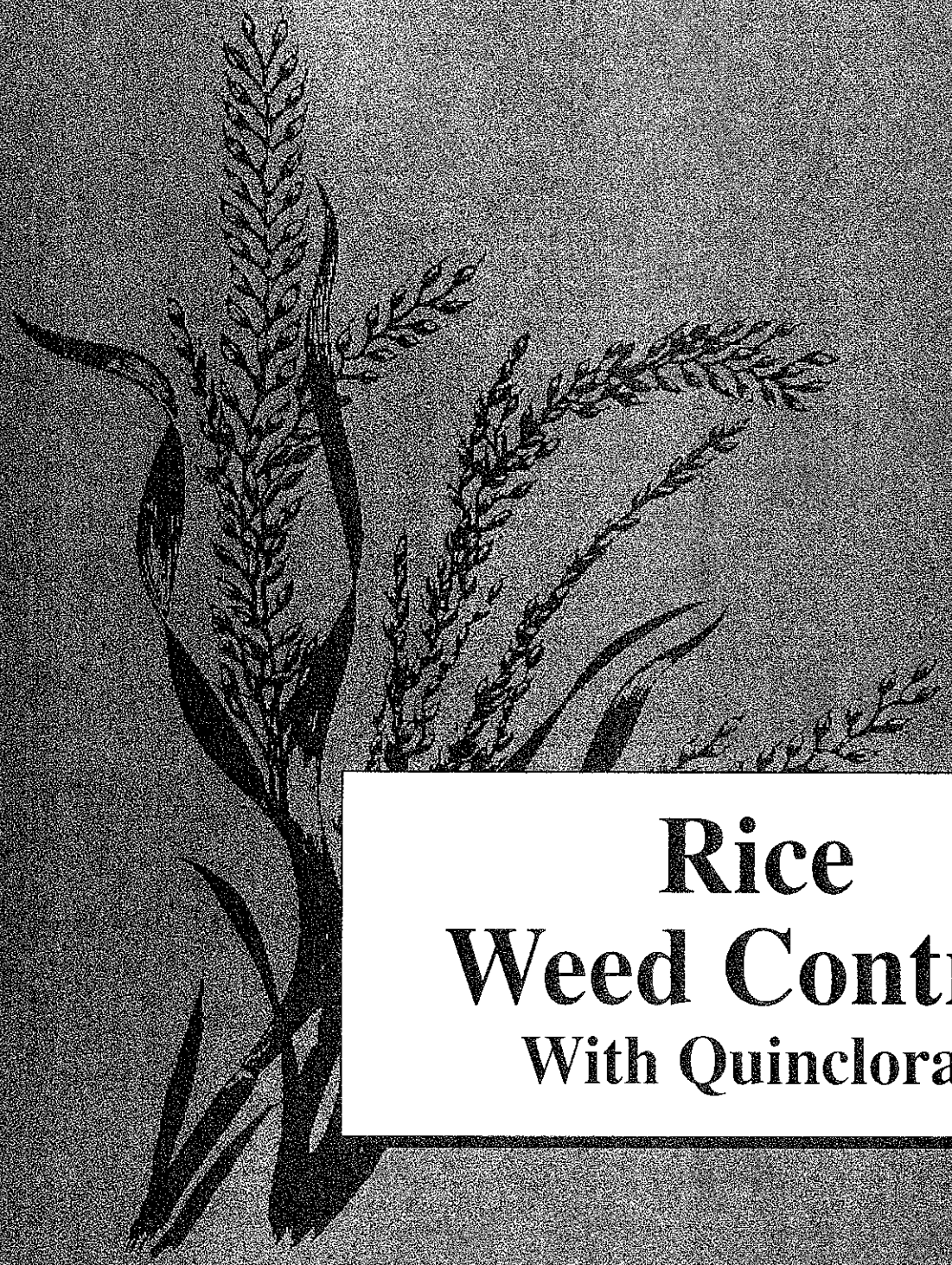

Rice Weed Control With Quinclorac

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Rice Weed Control with Quinclorac

The most common and troublesome weeds in Mississippi rice are barnyardgrass, hemp sesbania, and morninglories (1). All of these weeds can tolerate flooded soil and interfere with rice growth. Season-long competition of 50 barnyardgrass plants per square yard reduced grain yield of Lemont rice by 65% (6).

Although cultural practices, including water management, are used to help reduce weed infestations, the most common control measure is sequential applications of propanil. Because propanil has no residual activity, two applications are usually required to control grass and broadleaf weeds prior to establishing the permanent flood. Fenoxaprop (Whip®) or molinate (Ordram®) can be used to control barnyardgrass (5, 7), however, with these herbicides, timely water management is required to maintain effective weed control, and these herbicides are not effective on broadleaf weeds.

Prior to the 1993 growing season, only thiobencarb (Bolero®) and pendimethalin (Prowl®) were labeled for residual weed control in rice. These herbicides are often tank-mixed with propanil for postemergence control of grass and broadleaf weeds and residual control of grass and aquatic weeds.

Quinclorac (Facet®) has been evaluated in the United States for several years (8, 9) and was labeled in late 1992 for use in rice. Quinclorac offers preemergence and postemergence as well as residual control of barnyardgrass, hemp sesbania, morninglories, and other weeds commonly found in a rice field. Quinclorac persists at least 4 weeks and can be activated by rain after dry periods[1]. The time between rice emergence and permanent flood is generally 3 to 5 weeks, thus application timing could become important if residual weed control is desired to hold until the permanent flood is established.

Quinclorac is absorbed primarily through the roots, but foliar uptake is also an important entry point, thus quinclorac may be applied over a wide range of timings (3). Rice is tolerant to quinclorac if seeds are not exposed to direct contact with the herbicide (2).

Because no other currently labeled rice herbicide provides residual grass and broadleaf weed control, the objective of this research was to evaluate application timings of quinclorac and not to compare it with existing standard treatments. Experiment 1 was a comparison of soil application timings of quinclorac, including preplant and incorporated (PPI), preemergence to dry soil (PRE-D), and preemergence to moist soil (PRE-M). Experiment 2 included the soil applications in Experiment 1 plus an early postemergence application of quinclorac.

[1] Facet® Herbicide-User Guide. BASF Corp. Agricultural Chemicals Group. 100 Cherry Hill Road, Parsippany, NJ 07054.

Materials and Methods

Experiment 1

Experiments were conducted at the Delta Branch Experiment Station near Stoneville, MS in 1988, 1989, and 1990. Soil type was a Sharkey clay with 1.6% organic matter content and pH 7.4. Plots, 8 feet by 15 feet, were overseeded each year with barnyardgrass, hemp sesbania, and pitted morninglory prior to final land preparation and again immediately prior to seeding rice. This resulted in weed populations that reduced rice yields by 75 to 90% in untreated plots. Lemont rice was seeded about 0.75 inch deep into dry soil in rows 9 inches apart at a seeding rate of 90 lb/A. Standard southern U.S. rice production practices were used in land preparation, fertilizer application, and disease and insect management[2]. Rice seeding dates, emergence dates, quinclorac application dates, and first moisture after application are in Table 1.

[2] Miller, T.C. 1992. Mississippi Rice Growers' Guide. Miss. Coop. Ext. Ser., Miss. State, MS 39762.

Table 1. Rice production, herbicide treatment, and moisture variables.

	Experiment 1				Experiment 2
	1988	1989	1990	1990	1991
	dates				
Seeding	4-16	4-18	5- 2	5- 2	6- 1
Emergence	5- 3	5- 1	5-14	5-14	6- 9
Treatment					
PPI	4-16	4-18	5- 2	5- 2	6- 1
PRE-D	4-22	4-25	5- 3	5- 3	6- 3
PRE-M	4-28	4-27	5-11	5-11	6- 7
EP	–	–	–	5-22	6-14
First moisture after treatment					
PPI	4-17	4-25	5-10	5-10	6- 4
PRE-D	4-25	4-25	5-10	5-10	6-10
PRE-M	5- 9	4-28	5-12	5-12	6-10
EP	–	–	–	6- 1	6-20
Permanent flood	6- 1	6- 8	6-13	6-13	7- 1

A 3-by-3 factorial arrangement of treatments plus an untreated control were used in a randomized complete block design with four blocks. Treatments included quinclorac at 0.25, 0.38, and 0.5 lb/A and application times of PPI, PRE-D, and PRE-M. PRE-M applications were made 2 to 6 days after PRE-D applications. PPI treatments were incorporated with one pass of a power-driven rotary tiller set to operate 2 inches deep. The PRE-M soil condition was produced by irrigating (flooding) the plots and then allowing surface water to drain prior to herbicide application. In addition to flood irrigations, rainfall within 2 weeks after the PRE-D application was 0.1, 4, and 2 inches in 1988, 1989, and 1990, respectively. The number of days between the PRE-D application and first irrigation was 3, 0, and 7 in 1988, 1989, and 1990, respectively (Table 1). The delay in irrigation in 1990 was caused by a mechanical malfunction. Previous research showed that quinclorac efficacy decreased as application of moisture after treatment was delayed[3]. Herbicides were applied with a backpack sprayer that delivered 20 GPA of water carrier at a pressure of 30 psi.

Rice injury and weed control were estimated visually on a scale of 0 to 100, with 0 indicating no injury or weed control and 100 indicating dead rice or complete weed control. Entire plots were harvested with a plot combine and yields were recorded after correcting to 12% moisture. Barnyardgrass control was evaluated 3 and 6 weeks after seeding. Hemp sesbania and pitted morningglory control were evaluated 3 and 6 weeks after seeding, but control was similar at both dates and only data for 3 weeks after seeding are presented. The untreated control was not included in the analysis and data were not transformed. There was a significant year-by-treatment interaction, so data are presented for each year. Means were compared using Fisher's Protected LSD test at the 0.05 probability level.

Experiment 2

Experiment 2 was conducted at the Delta Branch Experiment Station in 1990 and 1991. Plot establishment and production practices were the same as described for Experiment 1.

A 3-by-4 factorial arrangement of treatments plus an untreated control were used in a randomized complete block design with four blocks. Treatments included quinclorac at 0.25, 0.38, and 0.5 lb/A and application times of PPI, PRE-D, PRE-M, and early postemergence (EP). A surfactant[4] was used with postemergence treatments. PRE-M applications were made 4 to 8 days after PRE-D applications. Herbicide applications were as described for Experiment 1.

Weed control ratings were made 2 and 4 weeks after treatment using the same scale as described in Experiment 1. Data were pooled over years since year was not significant as a main or interactive effect.

Results and Discussion

Experiment 1

Barnyardgrass control was generally better in 1989 than in 1988 or 1990 (Table 2). In 1990, quinclorac applied PRE-D controlled 63% barnyardgrass 3 weeks after seeding (Table 2). With this exception, quinclorac controlled barnyardgrass 80% or better at 3 weeks after seeding regardless of application timing. Barnyardgrass control increased as quinclorac rate was increased from 0.25 to 0.38 lb/A with PPI and PRE-M applications in 1988, PRE-D in 1989, and PPI and PRE-D in 1990. At 3 weeks after seeding in all 3 years, barnyardgrass control was equivalent with 0.38 and 0.5 lb/A regardless of application timing.

When rated 6 weeks after seeding, barnyardgrass control with 0.25 lb/A quinclorac was inconsistent among years and application timings (Table 2). This indicates that 0.25 lb/A is a marginal PRE rate when applied to clay soil. Similar results were reported by Stauber et al. (8). Barnyardgrass control was more consistent with 0.38 lb/A within an application timing,

Table 2. Barnyardgrass control as influenced by various rates and application timings of quinclorac in 1988, 1989, and 1990.

		Barnyardgrass control					
	Quinclorac	3 wk after seeding			6 wk after seeding		
Year	rate	PPI	PRE-D*	PRE-M	PPI	PRE-D	PRE-M
	lb/A	---------- % ----------					
1988	0.25	80	86	80	60	61	50
	0.38	89	91	91	79	75	85
	0.50	95	95	97	86	81	93
LSD	(0.05)	---------- 7 ----------			---------- 11 ----------		
1989	0.25	99	94	99	98	94	98
	0.38	99	99	99	99	98	99
	0.50	99	99	99	99	99	99
LSD	(0.05)	---------- 3 ----------			---------- 2 ----------		
1990	0.25	81	63	95	81	65	92
	0.38	91	81	96	91	83	96
	0.5	93	86	98	93	83	98
LSD	(0.05)	---------- 9 ----------			---------- 8 ----------		

* Abbreviations: PRE-D, preemergence application to dry soil; PRE-M, preemergence application to moist soil.

[3] Street, J. E. 1989. 1988 Annual report – rice weed control. Info. Bull. 141, Miss. Agric. and For. Exp. Stn. p. 165-169.

[4] BCH 864 is a product of BASF Corporation, Research Triangle Park, NC 27709

but controlled only 75% when applied PRE-D in 1988. At the 0.38 lb/A rate, there were no differences in barnyardgrass control caused by application timings in 1988 or 1989. In 1989 and 1990, there were no differences between the 3- and 6-week ratings.

Broadleaf weed control was generally more consistent than barnyardgrass control (Table 3). With equivalent rates of quinclorac, pitted morningglory control was not different among the application timings in 1988. In 1989, pitted morningglory control was lower when quinclorac was applied PRE-M than when applied PPI except at the 0.5 lb/A rate. However, in 1990, pitted morningglory control was lowest with each rate when quinclorac was applied PRE-D. Decreased activity was probably related to the 7-day delay in irrigation after application to the dry soil surface. Increasing quinclorac from 0.25 to 0.38 lb/A increased pitted morningglory control regardless of application timing. Increasing the quinclorac rate from 0.38 to 0.5 lb/A did not improve pitted morningglory control when applied PPI or PRE-D.

Hemp sesbania control was generally lowest with the 0.25 lb/A quinclorac rate and application timing affected the control obtained (Table 3). As with morningglory, control of hemp sesbania with quinclorac was lowest when applied PRE-D in 1990 and irrigation was delayed 7 days. Increasing quinclorac from 0.25 to 0.38 lb/A improved hemp sesbania control when applied at each application timing in 1988, PRE-D and PRE-M in 1989, and PPI and PRE-D in 1990. At 0.38 lb/A, application timing did not affect hemp sesbania control in 1988 or 1989, however control was lower in 1990 with PRE-D applications.

These data indicate the importance of soil moisture on quinclorac activity with marginal rates. Hemp sesbania control was greater in 1990 when 0.25 lb/A was applied to moist soil compared with PPI or PRE-D applications.

When averaged across application timings, rice yields increased each year as quinclorac increased from 0.25 to 0.38 lb/A (Table 4). Increasing quinclorac from 0.38 to 0.5 lb/A resulted in increased yields only in 1988, indicating that 0.38 lb/A is near the optimum rate for weed control in rice. When averaged across rates, rice yields were not different among the application timings in 1988.

In 1989, yields were higher when quinclorac was applied PRE-D compared with PPI but not different compared with PRE-M.

In 1990, when addition of water was delayed for 7 days, yields were lowest with PRE-D application and highest with PRE-M application. Quinclorac applied PPI resulted in lowest yields in 2 of 3 years compared with PRE-M applications. The lower yields in 1990 can be explained because of lower barnyardgrass control. However, weed control with PPI and PRE-M treatments in 1989 was similar and no rice injury was observed. Smith (5) did not reduce rice yields with PPI application of quinclorac.

In 1 of 3 years, rice yields were lowest with quinclorac applied PRE-D. This was a reflection of weed control. Yields were not reduced any year with quinclorac applied PRE-M. These results indicate that quinclorac is most consistent when applied to a moist soil.

Table 3. Pitted morningglory and hemp sesbania control 3 weeks after seeding as influenced by various rates and application timings of quinclorac in 1988, 1989, and 1990.

		Pitted morningglory control			Hemp sesbania control		
Year	Rate	PPI	PRE-D*	PRE-M	PPI	PRE-D	PRE-M
	lb/A			%			
1988	0.25	86	81	80	84	88	80
	0.38	92	90	88	93	95	91
	0.50	97	93	91	98	94	92
LSD	(0.05)		8			6	
1989	0.25	94	94	91	98	94	91
	0.38	99	98	95	99	97	99
	0.50	99	98	99	99	98	99
LSD	(0.05)		3			3	
1990	0.25	90	76	92	80	63	91
	0.38	95	87	95	94	81	96
	0.50	98	92	98	97	85	99
LSD	(0.05)		4			6	

* Abbreviations: PRE-D, preemergence application to dry soil; PRE-M, preemergence application to moist soil.

Table 4. Rice yield as influenced by various rates and application timings of quinclorac in 1988, 1989, and 1990.

	Yield		
	1988	1989	1990
Quinclorac rate (lb/A)		lb/A	
0.25	5,660	9,080	4,860
0.38	7,390	9,570	5,840
0.50	8,190	9,690	6,000
LSD (0.05)	700	270	420
Application Timing			
PPI	7,100	9,200	5,760
PRE-D*	6,910	9,690	5,070
PRE-M	7,230	9,470	6,250
LSD (0.05)	700	270	420
Untreated	1,400	650	770

* Abbreviations: PRE-D, preemergence application to dry soil; PRE-M, preemergence application to moist soil.

Table 5. Weed control as influenced by various rates of quinclorac averaged across application timing and years.

Application rate	Barnyardgrass	Hemp sesbania	Pitted morningglory	Palmleaf morningglory
(lb/A)			%	
14 Days after Treatment				
0.25	86	85	88	95
0.38	93	93	93	97
0.50	96	96	97	98
LSD (0.05)	6.1	8.1	5.6	3.2
28 Days after Treatment				
0.25	84	86	96	98
0.38	93	95	98	99
0.5	96	98	99	99
LSD (0.05)	6.4	6.1	1.3	1.5

Experiment 2

When rated 14 days after treatment and averaged across application timings, barnyardgrass control was the lowest with the 0.25 lb/A rate (Table 5). Barnyardgrass control was similar with the two higher rates. The ratings 28 days after treatment showed similar results. When averaged across quinclorac rates, the best application timing was early post, which was equivalent to PRE-M (Table 6). When applied PRE-D, quinclorac controlled less barnyardgrass than PRE-M or early post applications.

At 14 days after treatment, control of hemp sesbania was better with 0.5 lb/A of quinclorac than with 0.25 lb/A (Table 5). When rated 28 days after treatment, hemp sesbania control increased as the quinclorac rate increased from 0.25 to 0.38 lb/A. Increasing the rate from 0.38 to 0.5 lb/A did not improve hemp sesbania control. Of the soil applications, only quinclorac applied PRE-D controlled less hemp sesbania than early post application when rated 14 and 28 days after treatment (Table 6).

Pitted morningglory control increased as the quinclorac rate increased to 0.5 lb/A (Table 5). However there was no rate response with palmleaf morningglory when rated 14 and 28 days after treatment. At 14 days after treatment, application timing did not influence pitted morningglory control, however by 28 days after treatment, pitted morningglory control was lower with PRE-D application (Table 6). Application timing did not influence palmleaf morningglory control 28 days after treatment.

When averaged across application timings, rice yield increased as the quinclorac rate increased from 0.25 lb/A to 0.38 lb/A. There was no yield difference between 0.38 and 0.5 lb/A. Application of quinclorac PPI or PRE-D resulted in the lowest yields compared with PRE-M or early post (Table 7).

Table 6. Weed control as influenced by various application timings of quinclorac averaged across rates and years.

Application timing	Barnyardgrass	Hemp sesbania	Pitted morningglory	Palmleaf morningglory
			(%)	
14 Days after Treatment				
EP	98	98	96	99
PRE-M	95	91	91	95
PRE-D	84	85	90	96
PPI	90	90	95	97
LSD (0.05)	7.1	9.3	6.5	3.7
28 Days after Treatment				
EP	98	99	99	99
PRE-M	93	92	99	99
PRE-D	84	88	96	99
PPI	89	92	98	99
LSD (0.05)	7.4	7.1	1.5	0.6

Table 7. Rice yield as influenced by various rates and application timings of quinclorac in 1990-1991.

Quinclorac Rate (lb/A)	Yield (lb/A)
0.25	4,975
0.38	5,696
0.5	5,914
LSD (P<0.05)	505
Timing	
EP	6,206
PRE-M	5,871
PRE-D	4,856
PPI	5,180
LSD (P<0.05)	583

In summary, quinclorac is a versatile herbicide that controls barnyardgrass, hemp sesbania, and pitted and palmleaf morningglory when applied PPI, PRE-D, or PRE-M or early post. The most consistent control of the weeds evaluated was with early postemergence application of quinclorac.

Preemergence application to dry soil was, in general, the least consistent application timing. Application timing may not be as critical as the period between quinclorac treatment and irrigation or rainfall. When applied PRE to a dry soil surface, moisture after application becomes important for activation. Rainfall or irrigation prior to 7 days after application to dry soil improves weed control consistency. To obtain consistent results, rates above 0.25 lb/A should be applied.

Application flexibility increases the utility of quinclorac to rice producers, and will allow them to drill-seed rice independently of herbicide application requirements. Application PPI or PRE-D could eliminate the cost of aerial application which is generally required with postemergence applications to moist soil. Because quinclorac has good activity when applied prior to rice emergence, the potential for injury of nontarget crops is minimized. Rice is normally planted prior to other commercial summer annual crops, which are sensitive to quinclorac. One application of quinclorac will, in some situations, eliminate the need for late postemergence applications of other pesticides.

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