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Compatibility of Gibberellic Acid and Postemergence Herbicides in Rice

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Introduction

Growth regulators like gibberellic acid (GA) have been used in horticultural crops for several years. However, use in agronomic crops, such as rice, has been limited. Early research showed that rice seed treated with GA emerged more uniformly than untreated seed. Coale (2) reported earlier emergence and accelerated growth of plants with GA-treated seed. GA has been labeled in rice as a plant growth regulator, and in 1991, 500,000 acres in the southern United States were planted with treated seed (5).

Several studies have been conducted to evaluate the effect of postemergence application of GA on cereals. Wellso et al. (11) showed that GA reversed ancymidol-induced growth inhibition and elongated leaves. Prakash and Prathapasenan (7) reported a considerable increase in the final length and chlorophyll content in rice leaves. Alyoshin et al. (1) reported reduction of nitrate-reductase in rice leaves after GA application.

The influence GA applications have on spikelet development and grain yield of rice was evaluated by Patel and Mohapatra (6). Shrestha and Heu (8) and Street (9, 10) reported increased plant height after postemergence application of GA under field conditions. By accelerating the growth of rice, earlier flood establishment could be possible, thereby increasing rice competitiveness with weeds. To establish a permanent flood, rice should be about 6 to 8 inches tall in a typical field situation (4).

A good time to apply GA for early flood establishment is when rice is in the 3-leaf stage, which coincides with early season postemergence herbicide applications. By tank-mixing GA with herbicide, application costs could be reduced. Limited research has been published on the compatibility of GA in combination with herbicides. Dunand et al. (3) reported no interference between propanil and GA.

The objective of this research was to evaluate the compatibility of GA with a variety of herbicide combinations commonly applied postemergence in rice. Evaluations included rice injury, rice height, weed control, and yield.

Materials and Methods

Field studies were conducted in 1990 and 1991 at the Delta Branch Experiment Station, Stoneville, MS, on a Sharkey clay soil. Soil pH was 7.4 and organic matter 1.2% both years. Plots were 8 feet by 15 feet, and a randomized complete block design with four replications was used. Treatments included five herbicides with and without GA (Ryzup®) (Table 1). Herbicides evaluated were propanil (Stam M-4®), thiobencarb (Bolero 8EC®), molinate in combination with propanil (Arrosolo®), bromoxynil (Buctril®), and quinclorac (Facet®). BCH 864 was used with quinclorac as a surfactant (BCH 864 surfactant is a product of BASF Corporation Chemical Division, 100 Cherry Hill Road, Parsippany, NJ).

Standard production practices for the southern United States were used for land preparation, fertilizer application, and water management (4).

All treatments were applied postemergence when rice was in the 2-leaf to 4-leaf stage, barnyardgrass [*Echinochloa* crus-*galli* (L.) Beauv.] was in the 2-leaf to 3-leaf stage and pitted morningglory [*Ipomoea* lacunosa L.] was in the cotyledon to 4-leaf stage.

Table 1. Herbicide treatments in combination with GA (1990-1991).

Treatment	Herbicide	Rate
1	Untreated check	
2	Gibberellic acid* + Stam M-4 + Bolero	0.07 oz ai/A 4 lb ai/A 3 lb ai/A
3	Stam + Bolero	4 lb ai/A 3 lb ai/A
4	Gibberellic acid + Arrosolo	0.07 oz ai/A 6 lb ai/A
5	Arrosolo	6 lb ai/A
6	Gibberellic acid + Stam M-4 + Buctril	0.07 oz ai/A 4 lb ai/A 0.25 lb ai/A
7	Stam M-4 + Buctril	4 lb ai/A 0.25 lb ai/A
8	Gibberellic acid + Facet + BCH 864	0.07 oz ai/A 0.38 lb ai/A 3 pt pr/A
9	Facet + BCH 864	0.38 lb ai/A 3 pt pr/A
10	Gibberellic acid + Stam M-4	0.07 oz ai/A 4 lb ai/A
11	Stam M-4	4 lb ai/A

*Ryzup at 2 ounces of product per acre.

Table 2. Gibberellic acid study parameters.

	Year	
Event or growth stage	**1990**	**1991**
Variety	Lemont	Lemont
Seeding date	May 1	June 18
Emergence date	May 13	June 26
Application date	May 25	July 8
Rice stage at treatment	2-3 Leaf	3-4 Leaf
Flood date	June 14	July 27

Rice was drill-seeded in 9-inch rows at 90 lb/A. Seedling emergence and application dates are given in Table 2. Herbicides were applied with a CO_2-pressurized backpack sprayer that delivered 10 GPA of water carrier.

Ratings included rice height and weed control in both years and rice injury and yield in 1990. Weed control and injury were visually rated on a scale of 0 to 100, with 0 indicating no weed control or injury and 100 indicating dead plants. Plant height was determined by measuring from the soil line to the uppermost point of extended rice leaves at three locations in each plot. Plots were harvested with a small-plot combine and yield determined after correcting to 12% moisture.

All data were subjected to analysis of variance and means were separated by Waller-Duncan's Multiple Range Test at the 0.05 level of significance. Yield data were recorded only in 1990.

Results and Discussion

Plant height

When comparing the herbicides with and without GA 5 days after treatment (DAT), all treatments containing GA (Ryzup) resulted in increased rice height; however, the combination of GA with Stam M-4 plus Buctril resulted in rice less than 8 inches tall (Figure 1). All other treatments containing GA reached a height greater than 8 inches, at which point flooding would be possible. Treatment with GA would allow flooding rice about 5 days earlier than rice that did not have GA treatment.

AT 10 DAT, all GA treatments except the Stam M-4 plus Buctril reached a height greater than 10 inches (Figure 2). At 10 DAT where no GA was applied, rice treated with Arrosolo or Facet reached a height of 8 inches. At 15 DAT, all rice was 8 inches and could be flooded; however, only rice treated with Arrosolo,

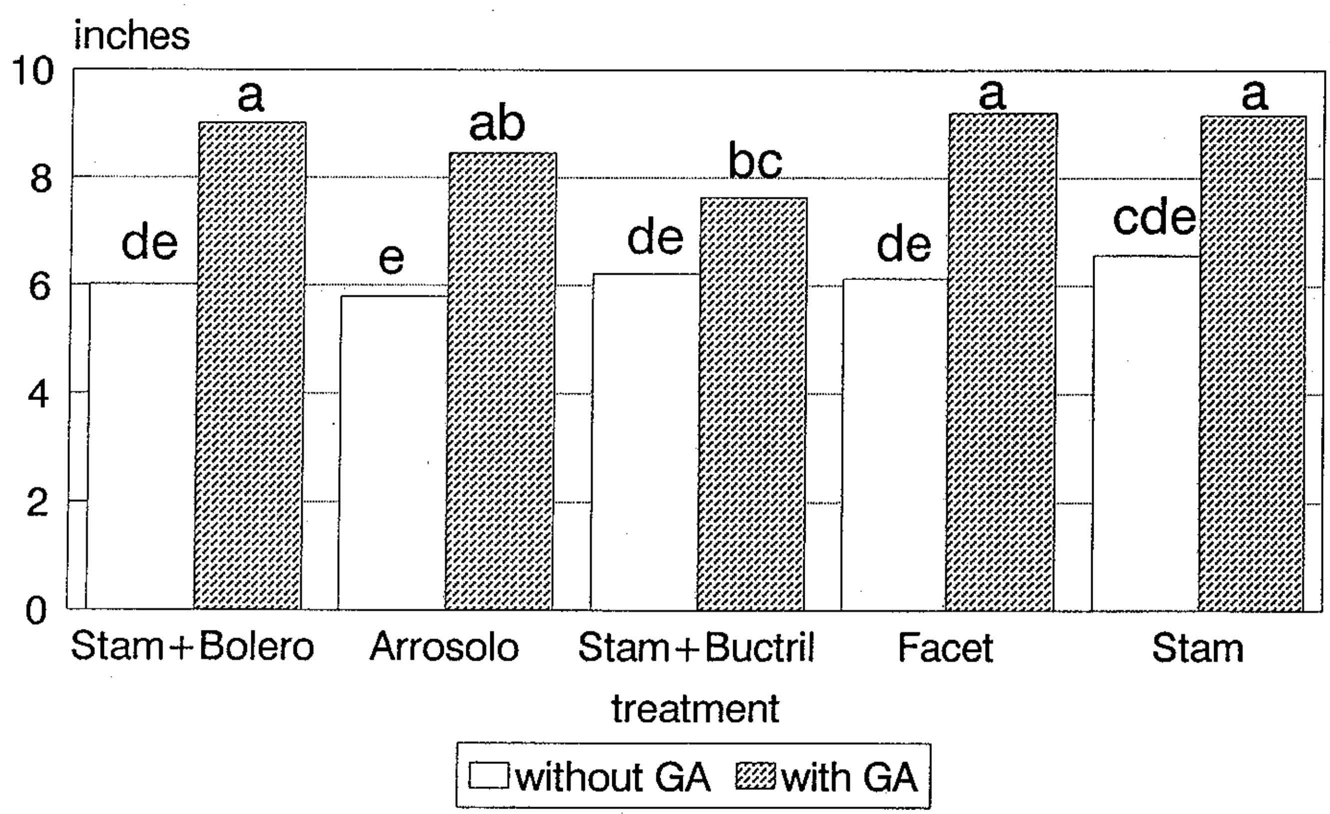

Figure 1. Rice height 5 days after application of herbicides with and without gibberellic acid (1990-1991). Means not followed by a common letter are different according to Duncan's multiple range test (P<0.05).

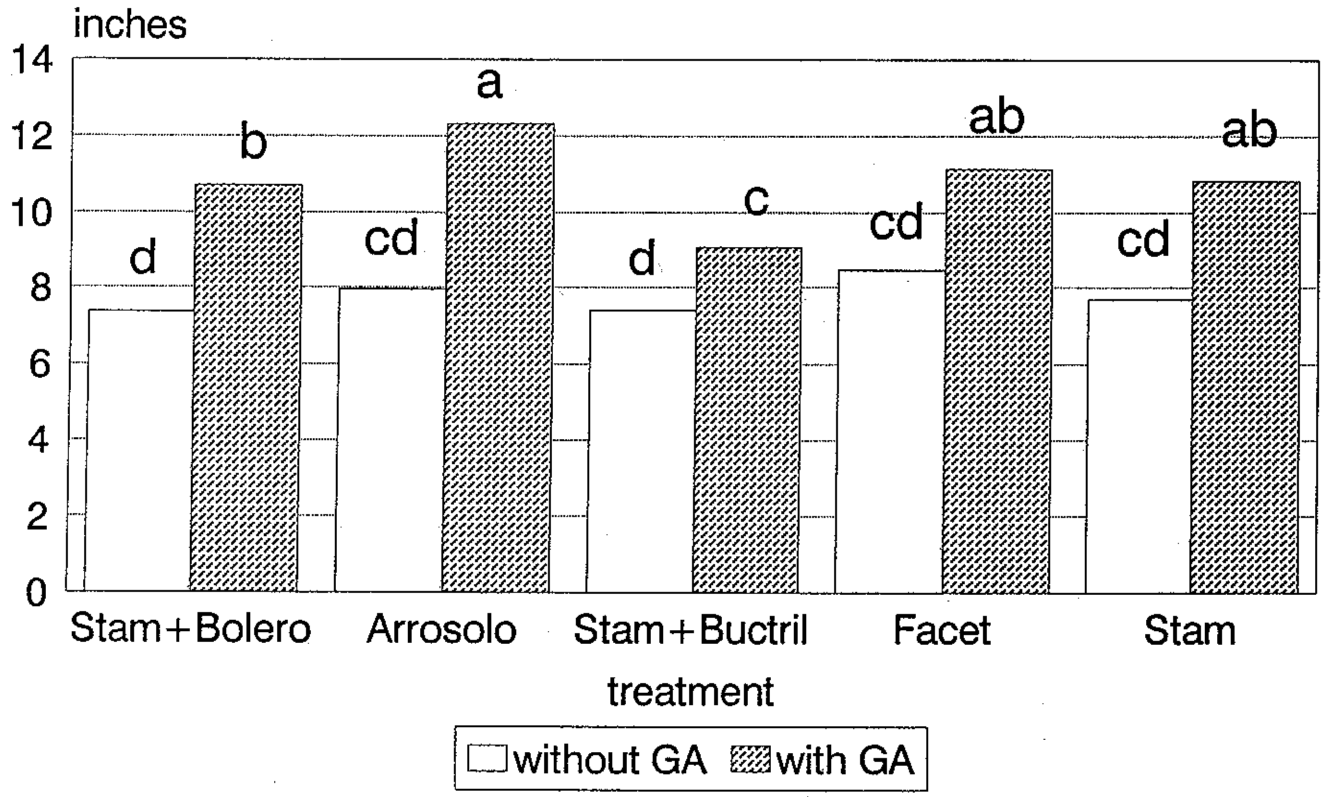

Figure 2. Rice height 10 days after application of herbicides with and without gibberellic acid (1990-1991). Means not followed by a common letter are different according to Duncan's multiple range test (P<0.05).

Facet, or Stam was significantly taller when combined with GA than without (Figure 3). Shrestha and Heu (8) found the difference in plant height to be transient with the return of a uniform stand by 10 to 14 days after application. The combination of Stam plus Buctril with and without GA shows that GA does not perform the same with all herbicides. Although there was no difference in height at 5 DAT between herbicide treatments, Stam plus Buctril with GA was the only treatment containing GA that did not accelerate growth enough to allow flooding within 5 DAT.

Weed control

Although there were differences in weed control due to herbicide treatment, GA did not influence herbicidal efficacy on barnyardgrass or pitted morningglory (Table 3). While these mixtures were not evaluated

Table 3. Influence of gibberellic acid (GA) on weed control 10 days after treatment (1990-1991).

		Barnyardgrass control		Pitted morningglory control	
		GA (oz. ai/A)		GA (oz ai/A	
	Rate	0	0.07	0	0.07
	lb ai/A	(%)		(%)	
Stam M-4 + Bolero	4 + 3	89 ab*	91 a	89 b	91 b
Stam M-4 + Buctril	4 + 0.25	88 abc	89 ab	96 a	96 a
Arrosolo	6	87 bcd	85 de	85 c	84 c
Facet + BCH 864	0.38	86 cde	85 de	95 a	95 a
Stam M-4	4	83 e	84 e	83 c	85 c

*Means not followed by the same letter are significantly different according to Waller-Duncan's multiple range test.

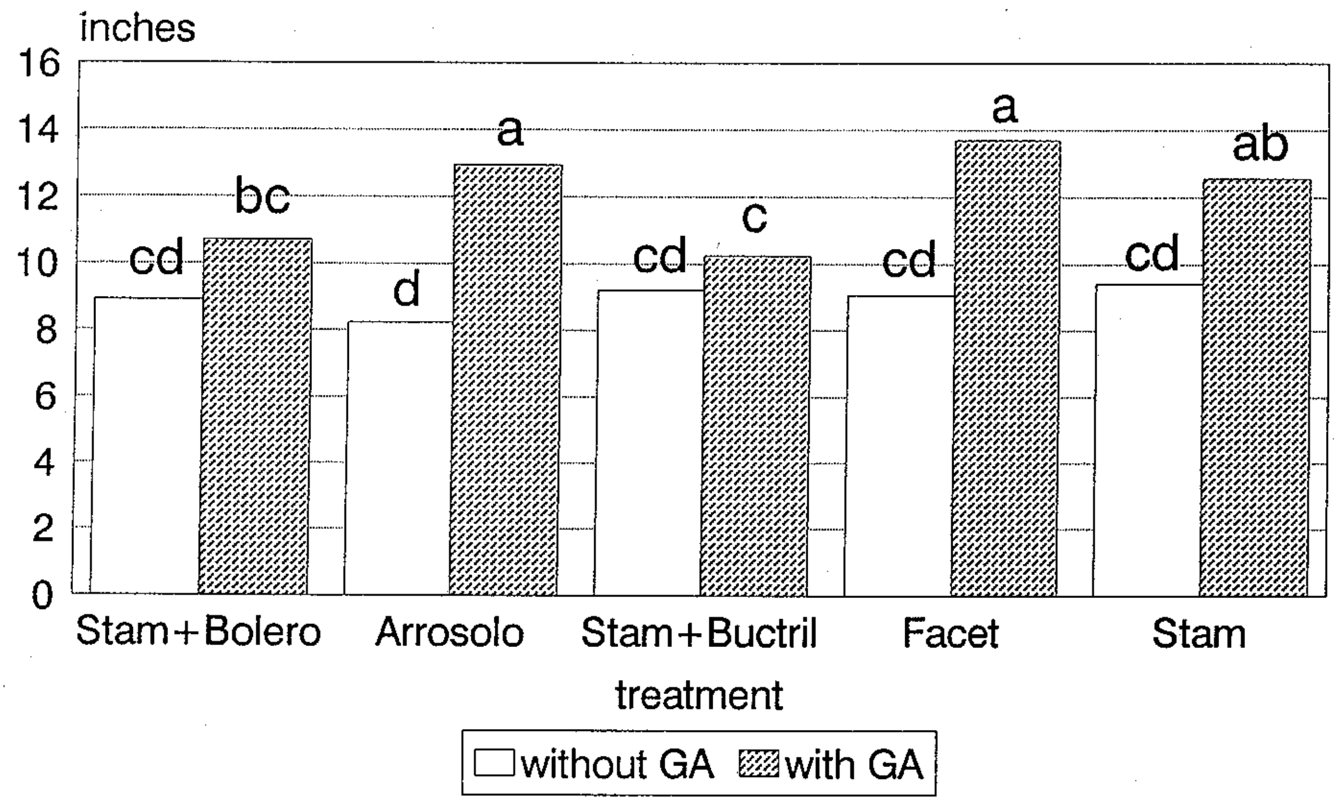

Figure 3. Rice height 15 days after application of herbicides with and without gibberellic acid (1990-1991). Means not followed by a common letter are different according to Duncan's multiple range test ($P < 0.05$).

on all weeds present in a rice field, there are no indications that any antagonistic reactions should be expected.

Rice injury

Addition of GA to herbicide treatments did not influence rice injury in 1990 (Table 4). Overall, there was no practical difference in rice injury with or without GA. Dunand et al. (3) indicated similar results.

Rice yield

These studies were designed to evaluated rice culm elongation with GA. All treatments were flooded simultaneously, therefore effects due to timing of flood were not evaluated. Thus, no yield increase or decrease related to GA applied to 2- to 3-leaf rice was demonstrated (Table 4), which is in agreement with Dunand (3).

The advantage of GA applied postemergence was taller seedlings in early season, which could allow

Table 4. Influence of tank mixtures of gibberellic acid (GA) and herbicides on rice injury and yield (1990).

	Injury		Yield	
	GA	No GA	GA	No GA
	(%)		(lb/A)	
Stam M-4 + Bolero	10 c*	10 c	8,100 a	7,975 a
Stam M-4 + Buctril	12 b	14 ab	7,905 ab	8,125 a
Arrosolo	15 a	15 a	6,850 c	7,171 c
Facet + BCH 864	0 d	0 d	8,120 a	8,160 a
Stam M-4	10 c	10 c	7,070 c	7,275 bc

*Means not followed by the same letter are significantly different according to Waller-Duncan's multiple range test.

earlier flooding. Applying postemergence herbicides in combination with GA to 2- to 3-leaf rice should allow flooding 5 to 7 days after application. The initial flood should be shallow and not allowed to submerge the elongated rice plants. With earlier flood establishment especially with residual herbicides, GA application could, in some situations, eliminate the need for subsequent herbicide applications. However, with no yield increase, the cost of GA can only be offset by reduction in weed competition or herbicide use.

Acknowledgment

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