Effect of Buctril Rate on Weed Control in BXN® Cotton - 2001

William B. McCloskey
Associate Specialist, Department of Plant Sciences,
University of Arizona, Tucson, AZ

Abstract

Experiments were conducted at the University of Arizona Safford and Maricopa Agricultural Centers during the 2001 cotton season to compare the effectiveness of 0.5 and 1.0 lb a.i./A topical applications of Buctril (bromoxynil) on annual morningglory species. At Safford, the percent control of annual morningglory was statistically greater following 1.0 lb a.i./A Buctril applications at 97 percent control compared to 83 percent control resulting from 0.5 lb a.i./A Buctril applications. Both the 0.5 and 1.0 lb a.i./A Buctril rates, had similar initial effects on morningglory seedlings. Initial leaf symptoms included a dark-green "water soaked" appearance that progressed into leaf necrosis. At both rates, all morninglory leaf tissue was destroyed leaving green stems which sometimes remained viable and produced new leaves rather than turning chlorotic and dying. The number of escapes in the center two rows of four-row plots was significantly greater after 0.5 lb a.i./A Buctril applications at 12.4 escapes compared to 1.5 escapes following 1.0 lb a.i./A Buctril applications. An average of 12 escapes in an area 40 ft by two cotton rows is sufficient to cause substantial yield losses in the absence of other control methods. At Maricopa, there was no statistically significant difference in the phytotoxicity caused by 0.5 and 1.0 lb a.i./A Buctril rates when applied to 1, 2, or 3 true-leaf exposed morningglory seedlings (i.e., not partially covered or shaded by other plants) that were thoroughly contacted by the herbicide sprays. Both experiments found that morningglory control was significantly greater following two sequential 0.5 lb a.i./A Buctril applications compared to a single 1.0 lb a.i./A application due to continued emergence of seedlings. Growers with morningglory infested fields that make a 1.0 lb a.i./A application should be prepared to make an early season post-direct application using other herbicides to control later emerging morningglory plants.

Introduction

Broadleaf weeds are a significant problem in cotton production with annual morningglory (*Ipomea* ssp.) and pigweed (*Amaranthus* ssp.) species being among the most problematic weeds (McCloskey et al., 1998). Competition between cotton and these and other weed species causes the greatest cotton yield losses when weeds emerge with the crop. Traditionally weeds emerging with cotton have been difficult to control, however, the commercialization of herbicide resistant cotton varieties in the 1990's provided growers with selective herbicides that could be topically

This is a part of the 2002 Arizona Cotton Report, The University of Arizona College of Agriculture and Life Sciences, index at http://ag.arizona.edu/pubs/crops/az1283

applied to control broadleaf weeds (e.g., bromoxynil and glyphosate). In addition, DuPont developed the cotton selective herbicide, Staple (pyrithiobac sodium), that can be applied topically to non-transgenic, conventional cotton varieties. Each of these herbicide chemistries has strengths and weaknesses in terms of the spectrum of weeds species controlled but, at current label rates, all three are marginal with respect to controlling annual morningglory species under some field conditions such as moisture stress. All must be sprayed on small annual morningglory plants, preferably two true-leaves or smaller, in order to provide consistent results.

The Buctril (bromoxynil) label first approved for use with BXN cotton specified a maximum use rate of 0.5 lb a.i./planted acre but allowed applicators to concentrate the chemical in a band resulting in rates up to 1.5 lb a.i./sprayed acre. For example, an amount of Buctril equivalent to 0.5 lb a.i./planted acre could be applied in 20 or 13.3 inch bands on cotton planted in 40 inch rows resulting in application rates of 1.0 and 1.5 lb a.i./sprayed acre, respectively. Previous experiments showed that the higher Buctril rates were generally more effective at controlling larger plants and reducing the regrowth of weeds compared to the 0.5 lb a.i./A rate. Recently, the Buctril label was changed to eliminate the ability to concentrate the herbicide in a band. The current Buctril label allows two applications at 0.5 lb a.i./sprayed acre prior to the 12 inch tall cotton growth stage and one 0.5 lb a.i./sprayed acre application on cotton over 12 inches tall. To accommodate grower's needs for better early season weed control when selective herbicide options are limited, there is interest in requesting a label that would allow the combination of two 0.5 lb a.i./A applications into a single 1.0 lb a.i./A application made prior to the 12 inch tall cotton growth stage. The objective of this research was to characterize the differences between early season 0.5 lb a.i./A and 1.0 lb a.i./A topical Buctril applications.

Materials and Methods

Two experiments were conducted during the 2001 cotton season at the University of Arizona Safford Agricultural Center (CAC) and Maricopa Agricultural Center (MAC). A randomized complete block design was used in both experiments with 4 row experimental plots that were 40 ft long by 12 ft (SAC) or 13.33 ft wide (MAC). The experiments were replicated either four (SAC) or five (MAC) times. The Safford experiment was dry planted with BXN47 on May 15, 2001 and the Maricopa (MAC) experiment was dry planted on May 14, 2001. The herbicide treatments were applied using either a CO_2 pressurized backpack sprayer or a tractor mounted plot sprayer using extended range TeeJet flat fan nozzles, either XR8002VS or XR8004VS nozzles, for topical applications or TeeJet even flat fan nozzles for post-directed applications. The topical herbicide treatments were broadcast applied to increase the number of morningglory seedlings sprayed but the post-directed herbicide treatments were applied as banded applications. The application speeds were about 3 mph and were made at pressures of 20 to 25 psi depending on the application. The herbicide treatments in each experiment are listed in Tables 1 and 2. In the Safford experiment, the "A" and "B" applications were made on June 8, 2001, the "C" applications were made on June 22, 2001 and the "D" applications were made on July 25, 2001. In addition to Buctril, the "D" herbicide treatments included Caparol (prometryn), Bueno 6 (MSMA), Goal (oxyfluorfen), and Aim (carfentrazone-ethyl). The entire Safford experiment received a layby Caparol application at 1.6 lb a.i./A. The experiment was defoliated on October 19th using Ginstar at 8.8 oz/A, harvested with a spindle plot-picker on November 9, 2001, and ginned on January 9, 2002. In the Maricopa experiment, the topical "A" and "B" applications were made using XR8004VS nozzles on May 30 and June 6, 2001, respectively. Prior to the first topical herbicide applications at MAC, two 1, 2, and 3 true-leaf morningglory seedlings in each plot were flagged. Plants that were flagged were chosen because they were well exposed (i.e., not partially covered by other weeds or the crop) and would be thoroughly contacted by the herbicide sprays. Flagged plants were evaluated on June 4th (5 DAT) using a 0 to 5 rating scale where 0=no injury; 1=slight damage; 2=one or two surviving green leaves with a green terminal and stem; 3=leaves dead but terminal and stem green; 4=leaves and terminal dead with stem green; and 5=completely dead or necrotic. The post-direct "C" application was applied on June 15, 2001 using two 80015EVS per crop row with the spray pattern directed to the base of the cotton plants. However, the Maricopa experiment was abandoned in late June due to the rampant growth of Palmer amaranth escapes and no further data was collected.

Results and Discussion

The first herbicide treatments in the Safford Agricultural Center (SAC) experiment were Buctril at either 0.5 or 1.0 lb a.i./A applied with either XR8004VS (application code A) or XR8002VS (application code B) nozzles at the two true-leaf cotton growth stage (Table 1). The average size of morningglory seedlings was also two true-leaves but there was a range of sizes present from cotyledonary leaves only up to 4 to 6 true-leaves. Buctril efficacy on annual morningglory was visually evaluated as percent control 11 days after the topical treatments (DAT). Because many treatments included the same Buctril rate applied with both nozzle sizes, data were appropriately pooled across similar treatments to compare the effect of Buctril rate and nozzle size on morningglory control and regrowth. (In addition, a few plots were incorrectly treated due to an application error and were excluded from the statistical analysis.) For a given rate of Buctril, morningglory control was similar whether the herbicide was applied with XR8002 (14 gallons of water/acre) or XR8004 nozzles (29 gallons of water/acre) as indicated by the lack of a statistically significant P-value (Table 3). In contrast to the effect of nozzle orifice size, there was a trend of greater morningglory control at the 1.0 lb a.i./A Buctril rate compared to the 0.5 lb a.i./A rate in the XR8002 nozzle data and a statistically significant increase in control at the greater Buctril rate in the XR8004 data (Table 3). Since nozzle size did not have a statistically significant effect on morningglory control, the data were pooled across nozzle size to increase the power of the statistical test of the effect of Buctril rate on morningglory control. The percent control of annual morningglory was statistically greater following the 1.0 lb a.i./A Buctril applications at 97 percent control compared to 83 percent control resulting from 0.5 lb a.i./A applications (Table 4).

Both the 0.5 and 1.0 lb a.i./A Buctril rates, had similar initial effects on morningglory seedlings. Initial leaf symptoms included a dark-green "water soaked" appearance that progressed into leaf necrosis. At both rates, all morninglory leaf tissue was destroyed leaving green stems which sometimes remained viable rather than turning chlorotic and dying. Since the effect of nozzle size on the number of escapes was not significant (data not shown), the data were pooled across nozzle orifice size to increase the statistical power of the test of the effect of Buctril rate on the number of escapes. The number of escapes in the center two rows of four-row plots was significantly greater at the 0.5 lb a.i./A rate than at the 1.0 lb a.i./A rate (Table 4). An average of 12 escapes in an area 40 ft by two cotton rows is sufficient to cause substantial yield losses in the absence of other control methods. It is interesting to note that the percent morningglory control on July 11, 2001 (19 days after applying the herbicide applications with the "C" code) was greater in the plots that were sprayed with two sequential 0.5 lb a.i./A Buctril applications than in the plots that were sprayed once with 1.0 lb a.i./A Buctril (Table 4). The difference in efficacy was probably due to the fact that the second 0.5 lb a.i./A Buctril application killed both later emerging morningglory seedlings and plants that survived the first application of Buctril.

After the visual rating on July 11, the entire Safford experiment was aggressively cultivated using a precision guided cultivator and in-row weeding tools (Coates et al., 1998; Thacker and McCloskey, 1996) leaving the plots relatively weed free although there were still some morningglory vines in the seed lines of some plots. After cultivation, the experiment was side-dressed with fertilizer and irrigated which stimulated more annual morningglory germination. Herbicide sprays with an application code of "D" (Table 1) were then applied to 20 inch cotton. The percent foliar necrosis of sprayed morningglory plants was visually estimated 12 DAT on August 6, 2001 along with season-long weed control (Table 5). The best late post-direct treatments were Goal alone, Goal tank-mixed with Buctril and Buctril tank mixed with Aim (Table 5). The best overall herbicide regimes included topical (A or B application codes), early season post-direct (C application code), and late season post-direct (D application code) herbicide sprays. A layby treatment of Caparol at 1.6 lb a.i./A was applied to the entire experiment on August 8, 2001. There were no significant yield differences in this experiment (Table 5) which was characterized by low yields due to the late planting date (May 15, 2001) and lack of heat unit accumulation in the fall.

The first herbicide treatments in the Maricopa Agricultural Center (MAC) experiment were Buctril at either 0.5 or 1.0 lb a.i./A applied in 27 gallons/acre with XR8004VS nozzles (application code A in Table 2) at the one true-leaf cotton growth stage (Table 1). The average size of the morningglory seedlings was two true-leaves but there was a range of sizes present from cotyledonary leaves only up to 4 to 6 true-leaves. Buctril efficacy on exposed annual morningglory seedlings of different size categories was visually estimated 5 days after the first topical treatments. Because many treatments included the same rate of Buctril, data were pooled by rate. There was no statistically significant difference in the phytotoxicity caused by the 0.5 and 1.0 lb a.i./A Buctril rates on 1, 2 or 3 true-leaf morningglory seedlings (Table 6). Note that these were well exposed plants that were not partially covered or shaded by other plants and that were thoroughly contacted by herbicide spray. Percent control of annual

morningglory (*Ipomoea hederacea*) and Palmer amaranth (*Amaranthus palmeri*) as a function of Buctril rate were visually estimated 15 days after the first topical Buctril applications which was also 8 days after the second topical 0.5 lb a.i./A Buctril application. Similar to the results in the Safford experiment, morningglory control was significantly greater following two sequential 0.5 lb a.i./A Buctril applications compared to a single 1.0 lb a.i./A application (Table 7). The data also illustrate the relative ineffectiveness on Buctril on pigweed species compared to morningglory species.

The results of the studies reported here indicate that annual morningglory control was greater following a 1.0 lb a.i./A Buctril application compared to a 0.5 lb a.i./A application (97 percent control compared to 83 percent control) and that there were fewer plants that exhibited leaf necrosis but had shoot terminals that survived the Buctril application at the greater rate. In addition, two sequential 0.5 lb a.i./A Buctril applications resulted in more effective early-season morningglory and pigweed control than an single 1.0 lb a.i./A Buctril application. Growers with morningglory infested fields, particularly growers that dry plant cotton, that make a 1.0 lb a.i./A application should be prepared to make an early season post-direct application using other herbicides to control later emerging morningglory seedlings. However, growers who wet plant cotton fields (i.e., plant to moisture) have very little early season weed emergence through the dry soil mulch characteristic of this planting system. The bulk of weed seedling emergence occurs after the first post-planting irrigation. Combining the two 0.5 lb ai/A Buctril applications that can be made prior to the 12 inch tall cotton growth stage into a single 1.0 lb ai/A applications allows these growers to control both the seedlings present after the first post-planting irrigation and the few larger weeds that emerged prior to this irrigation. A 0.5 lb ai/A Buctril application made after the first post-planting irrigation in a wet planted cotton field would not be effective on these larger weeds. Note that BXN cotton is extremely tolerant to Buctril (the first Buctril/BXN labels allowed applications up to 1.5 lb ai/sprayed acre) so crop tolerance is not an issue in making Buctril applications at rates greater than 0.5 lb a.i./A. The data also illustrate the relative ineffectiveness of Buctril on pigweed species compared to morningglory species and the necessity of using a preplant incorporated herbicide such as Prowl (pendimethalin) or Treflan (trifluralin) prior to planting BXN cotton. These limitations of Buctril along with the lack of grass weed control following Buctril applications explain why most cotton producers now grow Roundup Ready cotton in which two topical applications of glyphosate can be made prior to the 5-true leaf growth stage followed by post-directed glyphosate applications on larger cotton. In addition to its greater application flexibility, glyphosate is much more effective on pigweed species than is Buctril.

References

Coates, W.E., W.B. McCloskey, and S.H. Husman 1998. Mechanical weed control for cotton. Proceedings of the Beltwide Cotton Conferences. Vol. 1: 438-439.

McCloskey, W.B., P.B. Baker, and W. Sherman. 1998. Survey of cotton weeds and weed control practices in Arizona upland cotton. Cotton, A College of Agriculture Report, Series P-112, University of Arizona, Tucson, AZ. Pages 241-
254.

Thacker, G.W. and W.B. McCloskey. 1996. Response of cotton to precision-guided cultivation and DSMA in a dense stand of purple nutsedge. Cotton, College of Agriculture Report, Series P-103, University of Arizona, Tucson, AZ. p. 250-255.

Acknowledgment

The financial assistance provided by Aventis for partial support of this project is acknowledged.

Table 1. Treatment list for the Safford Agricultural Center 2001 Buctril efficacy experiment.

Trt. #	Treatment	Rate	Cotton Growth Stage	Morningglory Growth Stage	Appl. Code
1	Buctril-8004 Buctril Buctril	0.5 lb ai/A 0.5 lb ai/A 0.5 lb ai/A	Topical, 2 true leaves Post-direct, 6-7 true leaves Post-direct, 20 inches tall	2 true leaves 2 true leaves large to vining	A C D
2	Buctril-8004 Buctril Goal X-77	1.0 lb ai/A 0.5 lb ai/A 0.5 lb ai/A 0.5% v/v	Topical, 2 true leaf stage Post-direct, 6-7 true leaves Post-direct, 20 inches tall	2 true leaves 2 true leaves large to vining	A D D D
3	Buctril-8004 Caparol FL Bueno 6	1.0 lb ai/A 0.8 lb ai/A 2.0 lb ai/A	Topical, 2 true leaf stage Post-direct, 20 inches tall	2 true leaves large to vining	A D D
4	Buctril-8004 Buctril Buctril Goal X-77	0.5 lb ai/A 0.5 lb ai/A 0.5 lb ai/A 0.5 lb ai/A 0.5% v/v	Topical, 2 true leaves Post-direct, 6-7 true leaves Post-direct, 20 inches tall	2 true leaves 2 true leaves large to vining	A C D D D
5	Buctril-8004 Buctril Caparol FL X-77	1.0 lb ai/A 0.5 lb ai/A 0.8 lb ai/A 0.5% v/v	Topical, 2 true leaf stage Post-direct, 20 inches tall	2 true leaves large to vining	A D D D
6	Buctril-8004 Buctril Buctril Aim Herbimax (COC)	0.5 lb ai/A 0.5 lb ai/A 0.5 lb ai/A 0.015 lb ai/A 1.0% v/v	Topical, 2 true leaves Post-direct, 6-7 true leaves Post-direct, 20 inches tall	2 true leaves 2 true leaves large to vining	A C D D D
7	Buctril-8004 Buctril Goal X-77	1.0 lb ai/A 0.5 lb ai/A 0.25 lb ai/A 0.5% v/v	Topical, 2 true leaf stage Post-direct, 20 inches tall	2 true leaves large to vining	A D D D
8	Buctril-8002 Buctril Buctril	0.5 lb ai/A 0.5 lb ai/A 0.5 lb ai/A	Topical, 2 true leaves Post-direct, 6-7 true leaves Post-direct, 20 inches tall	2 true leaves 2 true leaves large to vining	B C D
9	Buctril-8002 Goal X-77	1.0 lb ai/A 0.5 lb ai/A 0.5% v/v	Topical, 2 true leaves Post-direct, 20 inches tall	2 true leaves large to vining	B D D
10	Buctril-8002 Buctril Buctril Aim Herbimax (COC)	0.5 lb ai/A 0.5 lb ai/A 0.5 lb ai/A 0.015 lb ai/A 1.0% v/v	Topical, 2 true leaves Post-direct, 6-7 true leaves Post-direct, 20 inches tall	2 true leaves 2 true leaves large to vining	B C D D D

Table 2. Treatment list for the Maricopa Agricultural Center 2001 Buctril efficacy experiment.

Trt. #	Treatment	Rate	Application Method/ Cotton Growth Stage	Morningglory Growth Stage	Pigweed Growth Stage	Appl. Code
1	Buctril Buctril Staple Bueno 6	0.5 lb ai/A 0.5 lb ai/A 1.5 oz ai/A 2.0 lb ai/A	Topical, 1 true leaf Topical, 2 to 3 true leaves Post-direct, 5-7 true leaves	2 true leaves cotyledon 1 true leaf	3-5 true leaves 8-10 true leaves 20 true leaves	A B C C
2	Buctril Staple Bueno 6	1.0 lb ai/A 1.5 oz ai/A 2.0 lb ai/A	Topical, 1 true leaf Post-direct, 5-7 true leaves	2 true leaves 1 true leaves	3-5 true leaves 20 true leaves	A C C
3	Buctril Caparol FL Bueno 6	1.0 lb ai/A 0.5 lb ai/A 2.0 lb ai/A	Topical, 2 true leaf stage Post-direct, 5-7 true leaves	2 true leaves 1 true leaf	3-5 true leaves 20 true leaves	A C C
4	Buctril Diuron Bueno 6	1.0 lb ai/A 0.4 lb ai/A 2.0 lb ai/A	Topical, 2 true leaves Post-direct, 5-7 true leaves	2 true leaves 1 true leaf	3-5 true leaves 20 true leaves	A C C
5	Buctril Caparol FL Bueno 6	1.0 lb ai/A 0.5 lb ai/A 2.0 lb ai/A	Topical, 2 true leaf stage Post-direct, 5-7 true leaves	2 true leaves 1 true leaf	3-5 true leaves 20 true leaves	A C C
6	Buctril Buctril Staple Bueno 6	0.5 lb ai/A 0.5 lb ai/A 1.5 oz ai/A 2.0 lb ai/A	Topical, 1 true leaf Topical, 2 to 3 true leaves Post-direct, 5-7 true leaves	2 true leaves cotyledon 1 true leaf	3-5 true leaves 8-10 true leaves 20 true leaves	A B C C
7	Buctril Staple X-77 (NIS)	1.0 lb ai/A 1.5 oz ai/A 0.5% v/v	Topical, 2 true leaf stage Post-direct, 5-7 true leaves	2 true leaves 1 true leaves	3-5 true leaves 20 true leaves	A C C

Table 3. Effect of Buctril rate and nozzle size on annual morningglory control in the center two rows of plots at the Safford Agricultural Center in 2001. Percent control ratings were visually estimated 11 days after treatment; values are means " standard deviations (n=number of observations, df=degrees of freedom).

Buctril rate (lb ai/A)	Nozzle Size		Probability (t-test) that the data values are the same for both nozzle sizes
	XR8002	XR8004	
0.5	88 " 12 n=5	80 " 18 n=7	P=0.419 df=10
1.0	98 " 2 n=4	97 " 3 n=15	P=0.585 df=17
Probability (t-test) that the data values are the same for both rates of Buctril	P=0.140 df=7	P=0.001 df=20	

Table 4. Effect of Buctril rate on annual morningglory control and number of escapes (green stems with a viable terminal or axillary bud that developed new leaf tissue) in the center two rows of plots at the Safford Agricultural Center in 2001. Percent control and regrowth were visually estimated 11 days after treatment. Data were pooled across nozzle orifice size; values are means " standard deviations (n=number of observations, df=degrees of freedom).

Buctril rate (lb ai/A)	Percent control June 19, 2001	Number of escapes/2 rows June 19, 2001	Percent control July 11, 2001
0.5	83.0 " 15.7 n=12	12.4 " 16 n=12	80.5 " 7.6 n=11
1.0	97.5 " 3.1 n=19	1.5 " 3 n=19	47.6 " 23.9 n=19
Probability (t-test) that the data values are the same for both rates of Buctril	P#0.001 df=29	P=0.006 df=29	P#0.001 df=28

Table 5. Effect of application code “D” herbicide treatments on percent foliar burn of morningglory (i.e., control of sprayed morningglory), percent control (i.e., season long weed control) and lint yield in the center two rows of plots at the Safford Agricultural Center in 2001. Percent foliar burn and percent control were visually estimated 12 days after treatment. Data values are means " standard deviations; means in a column followed by the same letter do not significantly differ (P=0.05, Student-Newman-Keuls). All treatments received either an A or B application (see Table 1).

Trt. #	Treatment	Rate	Appl. Code	Percent Foliar Burn August 6, 2001	Percent Control August 6, 2001	Lint Yield (lb/A)
1	Buctril Buctril	0.5 lb ai/A 0.5 lb ai/A	C D	61 " 27 ab	74 " 20 ab	326 " 87 a
2	Buctril Goal X-77	0.5 lb ai/A 0.5 lb ai/A 0.5% v/v	D D D	88 " 5 a	63 " 33 abc	243 " 128 a
3	Caparol FL Bueno 6	0.8 lb ai/A 2.0 lb ai/A	D D	60 " 29 ab	33 " 36 bc	274 " 129 a
4	Buctril Buctril Goal	0.5 lb ai/A 0.5 lb ai/A 0.5 lb ai/A	C D D	91 " 3 a	74 " 18 ab	247 " 168 a
5	Buctril Caparol FL X-77	0.5 lb ai/A 0.8 lb ai/A 0.5% v/v	D D D	76 " 14 ab	25 " 20 c	280 " 117 a
6	Buctril Buctril Aim Herbimax (COC)	0.5 lb ai/A 0.5 lb ai/A 0.015 lb ai/A 1.0% v/v	C D D D	93 " 3 a	74 " 39 ab	379 " 149 a
7	Buctril Goal X-77	0.5 lb ai/A 0.25 lb ai/A 0.5% v/v	D D D	85 " 8 a	35 " 29 bc	294 " 141 a
8	Buctril Buctril	0.5 lb ai/A 0.5 lb ai/A	C D	48 " 30 b	59 " 30 abc	257 " 130 a
9	Goal X-77	0.5 lb ai/A 0.5% v/v	D D	93 " 3 a	45 " 41 bc	353 " 209 a
10	Buctril Buctril Aim Herbimax (COC)	0.5 lb ai/A 0.5 lb ai/A 0.015 lb ai/A 1.0% v/v	C D D D	93 " 4 a	92 " 8 a	293 " 176 a

Table 6. Phytotoxicity of Buctril as a function of rate on different size classes of annual morningglory (*Ipomoea hederacea*) seedlings at the Maricopa Agricultural Center in 2001. Phytotoxicity was visually estimated 5 DAT on June 4, 2001 using a 0 to 5 rating scale where 0=no injury and 5=completely necrotic or dead. Data were pooled by Buctril rate; values are means " standard deviations (n=number of observations).

	Morningglory seedling growth stage		
Buctril rate (lb ai/A)	1 True Leaf	2 True Leaves	3 True Leaves
0.5	5.0 " 0 n=10	4.85 " 0.34 n=10	4.82 " 0.24 n=10
1.0	4.79 " 0.33 n=23	4.80 " 0.29 n=24	4.59 " 0.49 n=24
Probability of a greater F value for the effect of Buctril rate on the ANOVA	P=0.0641	P=0.664	P=0.174

Table 7. Percent control of annual morningglory (*Ipomoea hederacea*) and Palmer amaranth (*Amaranthus palmeri*) as a function of Buctril rate at the Maricopa Agricultural Center in 2001. Percent control was visually evaluated 8 days after the second topical 0.5 lb a.i./A Buctril application (application code “B” in Table 2) which was 15 days after the first set of Buctril applications (application code “A” in Table 2). Data were pooled by Buctril rate; values are means " standard deviations (n=number of observations).

	Percent control	
Buctril rate (lb ai/A)	Ivyleaf morningglory	Palmer amaranth
0.5 (2 sequential applications)	94.0 " 2.1 n=10	58.0 " 11.1 n=10
1.0	49.2 " 26.5 n=25	26.2 " 9.5 n=25
Probability of a greater F value for the effect of Buctril rate on the ANOVA	P<0.0001	P<0.0001