# HARVEST METHODS IN *Sorghum halepense* INFESTED *Gossypium hirsutum* AND PROFITABLE WEED-CONTROL SYSTEMS IN *Sorghum bicolor*


By

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# INTRODUCTION

Chapters I and II of this dissertation are manuscripts to be submitted for publication in Weed Technology, a journal of the Weed Science Society of America.

# Chapter I

## Harvest Methods in *Sorghum halepense*

## Infested *Gossypium hirsutum*

**Harvest Methods in *Sorghum halepense***

**Infested *Gossypium hirsutum***

**Abstract:** Field experiments were conducted in 1996 and 1997 to evaluate the effects of six johnsongrass densities on picker- and stripper-harvest efficiency, fiber properties, loan rate (value), and lint yield of cotton. The six densities used were 0 (the weed-free check), 3, 4, 5, 8, and 15 weeds/15 m of row. In 1996, stripper-harvest efficiency was higher at a density of 3 weeds /15m of row (98.9%) versus picker-harvest efficiency at the same density (94.0%). In 1997, stripper-harvest efficiencies were also higher (96.6%) versus picker-harvest efficiencies (89.0%) at the density of 3 weeds/15m of row. Machine harvest efficiencies were lower for the picker- versus the stripper-harvest efficiencies in both years. Fiber property analyses showed no significant interaction and were pooled across harvest methods. Micronaire differences were detected at a density of 15 weeds/15 m of row in 1996 (4.0 units) and 8 and 15 weeds/15 m of row in 1997 (3.9 and 3.4 units), when compared to the weed-free check (4.2 units), respectively. In both years these differences would not have resulted in a discount except for a density of 15 weeds/15m of row in 1997. Length differences were detected at a density of 3 weeds/15 m of row in 1996 (2.79 cm), and this difference for length was higher than the weed-free check (2.72 cm). In 1997, no length differences were detected. No differences occurred for strength in 1996, and a difference was detected in 1997 for densities of 3, 8, and 15 weeds/15 m of row (284 mN/tex for all three) when compared to the weed-free check (304 mN/tex). Uniformity showed no differences in either year. In 1997, stripper-harvested cotton loan rate was lower than the stripper-harvested values in 1996, and picker-harvested values in both years. Lint yield was reduced in 1996 by 29.2 kg/ha or 3.5% for stripper-harvested

cotton and 32.0 kg/ha or 3.9% for picker-harvested cotton for each increase by one johnsongrass plant/15 m of row. In 1997, stripper- and picker-harvested cotton was reduced by 43 kg/ha or 5.2 and 5.5 % for each increase by one johnsongrass plant/15m of row, respectively.

**Nomenclature:** Johnsongrass, *Sorghum halepense* (L.) Pers. #[1] SORHA; cotton, *Gossypium hirsutum* L. 'Paymaster HS-26'.

**Additional index words:** Harvest efficiency, economics, fiber properties, loan rate, harvest method, picker harvest, stripper harvest, lint yield, SORHA.

**Abbreviations:** HVI, High Volume Instrument.

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[1]Letters following this symbol are a WSSA-approved computer code from *Composite List of Weeds,* Revised 1989. Available only on computer disk from WSSA, 810 East 10th Street, Lawrence, KS 66044-8897.

## INTRODUCTION

Johnsongrass is the sixth most common and ninth most troublesome weed in Oklahoma cotton (Dowler 1998). Bridges and Chandler (1987) reported that densities of 1, 2, 4, 8, 16, and 32 johnsongrass plants/9.8 m of row reduced cotton yields in Texas by 1, 4, 14, 40, 65, and 70%, respectively. Keeley and Thullen (1989) conducted a time-of-removal experiment in California with johnsongrass in cotton using a weed-free period followed by removal times of 3, 6, 9, 12, and 25 wk. They reported the weed-free and 3 wk-removal yields were not different, but delaying removal time to 6, 9, 12, and 25 wk caused yield reductions of 20, 60, 80, and 90%, respectively. They also transplanted johnsongrass into cotton using the same removal times and reported that a weed-free period of 9 wk was required to prevent yield loss.

Buchanan and Burns (1971) reported that eight tall morningglory [*Ipomoea purpurea* (L.) Roth] weeds/7.3 m of row reduced picker-harvested cotton lint yields 10 to 75% in Alabama. Crowley and Buchanan (1978) reported on the competitiveness of four *Ipomoea* spp. and their effects on picker-harvested cotton in the same state. Species tested included tall morningglory, entireleaf morningglory (*I. hederacea* var. *integriuscula* Gray), ivyleaf morningglory [*I. hederacea* (L.) Jacq.], and pitted morningglory (*I. lacunosa* L.) at densities of 4, 8, 16, and 32 weeds/15 m of row. At the eight-plant density, cotton lint yield was reduced by those species 19, 9, 6, and 3%, respectively. Harvest efficiency was reduced by tall morningglory with each increase in density, but no other morningglory species caused significant reductions in that trait. Harvest efficiency is reduced by an increase in weed competition due to the inability of the harvest machine to go through the field, as well as the harvest machines inability to remove bolls or lint that are present. Buchanan and Burns (1970) reported that early-season weeds in Alabama caused more damage than weeds that germinated later in the season. High weed densities often reduced cotton lint quality and reduced profits in the same state (Buchanan et al. 1977). In an Oklahoma experiment, Wood et al. (1999) reported that a density of 12 weeds/10m of row at Chickasha in 1994, and densities of 10 and 12 weeds/10m of row at Perkins in 1996, could not be stripper-harvested without causing damage to the machine. In another Oklahoma experiment by Rogers et al. (1996), stripper-harvest of cotton with ivyleaf morningglory densities greater than 8 weeds/10 m of row at Chickasha and 16 weeds/10 m of row at Perkins could not be performed without causing damage to the machine.

Vories and Bonner (1995) evaluated picker- versus stripper-harvest methods in a weed-free system over a 3-yr period in Arkansas. Their experiment demonstrated no differences between harvest methods for fiber micronaire, length, strength, and length uniformity. Also, in 2 of the 3 yr, stripper-harvested yields were higher than picker-harvested yields.

Smith et al. (2000) conducted a dryland cotton experiment evaluating palmer amaranth (*Amaranthus palmeri* S. Wats.) densities of 0 (weed-free check) 650, 1300, and 3260 weeds/ha. Only at a denisty of 3260 weeds/ha was stripper-harvested cotton lint and seed yields reduced. No densities affected fiber properties and only at the highest density was harvest efficiency percentage different when compared to the other densities.

Most experiments focus on yield reduction caused by weed interference. It would also be valuable to cotton producers to evaluate what effect the weed has on fiber quality and then associate an economic value to those losses due to interference and harvest method. With this information producers could determine if they need to control the weed and what price reductions might incur if they do not. The objectives of this experiment were to evaluate picker- and stripper-harvest efficiency, fiber properties, loan rate (value), and lint yield associated with johnsongrass density in cotton. Loan rate was used because it provided more stability than day-to-day market value. It was also based on a 5-yr average, 1994-1998.

## MATERIALS AND METHODS

**Field Parameters.** Field experiments were conducted in 1996 and 1997 at the Irrigation Research Station in Southwest Oklahoma, near Altus, on a Tillman-Hollister clay loam (a fine, mixed, thermic Pachic Paleustoll) with a pH of 7.5 and an organic matter of 0.9%. The experiment received furrow irrigation each year as judged necessary. In 1996, an application of 30-15-0 was applied at 96 kg/ha; and in 1997, 46-0-0 was applied at 178 kg/ha.

**Experimental Design.** Plots were arranged in a randomized complete-block design and replicated four times. 'Paymaster HS-26', a commonly grown picker- and stripper-harvested cultivar, was planted each year using a 1 m row spacing. Planting dates were May 29, 1996 and 1997. Plots were four-rows wide by 17 m long, with 1 m removed from each end immediately before harvest to reduce the end-row effect; thus, there was a harvested row length of 15 m.

**Johnsongrass Densities**. Six weed densities of 0 (the weed-free check), 3, 4, 5, 8, and 15 weeds/15 m of row were tested. Immediately after cotton planting, johnsongrass seed were hand planted in hills with 10 to 15 seed/hill, approximately 1.25 cm deep and 5 cm to the left side of the center two rows. Approximately 2 wk after planting, johnsongrass hills were thinned to one plant/hill. In some cases in 1996, establishing the weed stand with seed failed (less than 17% of the hills). In those cases, johnsongrass seedlings grown from peat pellets in a greenhouse were transplanted into those hills. Those transplants had been started on the same day as cotton planting and allowed to germinate and grow in anticipation of such cases. This was also done in 1997, but transplanting was not necessary in that year. Research by Albers-Nelson et al. (2000) reported no differences in direct seeded vs. peat pellets for common cocklebur (*Xanthium strumarium* L.) propagation methods in the field.

**Experimental Area.** In both years, a PRE treatment of prometryn [*N*,*N*′-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine] plus metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide] were applied at rates of 1.7 and 1.4 kg ai/ha, respectively. Before treatment, circular paper disks (28 cm in diameter) were placed over the johnsongrass hills to protect the weeds from herbicide injury. The paper disks were removed immediately after herbicide application. Previous research has reported the prevention of herbicide damage to desired weeds by this procedure (Pawlak et al. 1990; Smith et al. 1990; Jacobson et al. 1994; Rogers et al. 1996; Rowland et al. 1999; Wood et al. 1999). Herbicides were applied at rates slightly below recommended rates to ensure against potential crop and johnsongrass injury. Weeds not controlled chemically were removed by hand hoeing periodically throughout the season.

**Data Collection.** Cotton from the center two rows was harvested on December 16, 1996 and November 17, 1997. Stripper-harvested plots were harvested using a commercial two-row brush-roller stripper, which did not have a lint cleaner. Picker-harvested plots were harvested twice in each year with a commercial two-row self-propelled cotton picker. All plot samples were weighed immediately after harvest.

**Harvest Efficiency Investigations.** Picker- and stripper-harvest was conducted by harvesting the weed-free check first and then harvesting progressively higher weed densities. Any seed cotton or lint that remained on the plants, or that fell to the ground in the plots after machine harvest, was harvested by hand and processed separately. Picker- and stripper-harvested cotton and hand harvested cotton were then used to determine harvest efficiency as a percentage based on lint. Harvest efficiency was calculated by dividing the amount of machine harvested cotton by the total cotton harvested (machine plus hand harvested) plus the machine harvested cotton.

**Fiber Property Analyses.** After weighing, plot samples were packaged and shipped to Texas A&M University Research and Extension Center, Lubbock, TX for ginning on a 10 saw laboratory gin with a one stage lint cleaner. Upon completion of ginning, plot weights were converted to a kilogram per hectare basis and the fiber samples were shipped to the International Textile Center, Texas Tech University, Lubbock, TX in 1996 and to the USDA, Agricultural Marketing Service, Cotton Division Classing Office, Lubbock, TX in 1997. All fiber properties were evaluated using High Volume Instrument (HVI) machines.

**Loan Rate Comparisons.** Loan rate is calculated using staple length, leaf grade, strength, and micronaire. Loan rate is based on a point system where 100 points is equivalent to 1 cent. A base price of 11396 points or $1.14/kg of lint (5180 points or $.5180/lb. of lint) is used to calculate loan rate. Premiums or (bonus points) for staple length, leaf grade, strength, and micronaire are added to the base price of 11396 for cotton above the base price in quality. Discounts are also deducted from the base price for the same variables if quality is deficient. Leaf grade premiums are paid in a range from one to four. Above a leaf grade of four, a discount is exacted. Another fiber property that affects loan rate is staple length, for which a penalty can be from 372 points to 2257 points.

All dependent variables (harvest efficiency, fiber properties, and loan rate) were analyzed using ANOVA.

**Yield Loss Examinations.** Lint yield and lint yield as a percentage of the check were tested for goodness-of-fit to linear and curvilinear regression models. These regression models were analyzed using PROC GLM (SAS 1988).

## RESULTS AND DISCUSSION

**Harvest Efficiency Investigations.** Harvest method by density by year interaction was not significant; therefore, johnsongrass density was compared across years and harvest methods, but not between densities (Table 1). For the weed-free check picker-harvest efficiency (92.9 and 90.0%) was different when compared to stripper-harvest efficiency (98.8 and 97.6%) in 1996 and 1997, respectively. In 1996, stripper-harvest efficiency was higher at a density of three weeds/15m of row (98.9%) versus picker-harvest efficiency at the same density (94.0%). In 1997, differences for picker-harvest efficiency were detected when compared to stripper-harvest efficiencies for densities of 0, 3, and 4 weeds/15m of row. In 1997, stripper-harvest efficiencies were higher (96.6%) versus picker-harvest efficiencies (89.0%) at the density of three weeds/15m of row.

When comparisons were made across years for the density of three weeds/15m of row, stripper-harvest efficiencies were also higher. Most densities resulted in stripper-harvest efficiencies that were higher than picker-harvest efficiencies except for a density of eight weeds/15m of row in 1997. However, no significant differences were detected at a 0.05 probability level (using the protected LSD) for 8 and 15 weeds/15m of row. Overall harvest efficiencies were lower in 1997, versus 1996 harvest efficiencies with the stripper tending to have higher harvest efficiencies. In 1997, johnsongrass weeds appeared more robust versus visual appearance in 1996, which could result in the decreased harvest efficiencies we observed.

Because of the way in which a stripper harvests, removing everything from the cotton plant and its surroundings including johnsongrass culms, more material traveled through the stripper than the picker. However, the increased amount of material made it more difficult for the picker to gather the lint from the boll resulting in lower efficiencies.

Regression analysis was performed on harvest methods versus densities and only the stripper-harvest efficiency was significant in 1996, with a 0.3% reduction occurring for each increase by one weed/15m of row.

**Fiber Property Analyses.** Interactions for harvest methods by density by year for all fiber properties were tested; there was a significant density by year interaction, therefore data are pooled over harvest methods, but not years. Comparisons are made for fiber property to the weed-free check only. At a density of 15 weeds/15 m of row in 1996, micronaire was lower (3.9 units) versus the weed-free check (4.2 units) resulting in a difference being detected (Figure 1). Acceptable levels for micronaire are between 3.7 to 4.9 units with a premium being paid at levels between 3.7 to 4.2 units. Although, there was a difference detected, no discounts would be assessed to a bale of cotton with micronaire levels at the reported range in this year. In 1997, densities of 8 and 15 weeds/15 m of row (3.9 and 3.4 units) were lower when compared to the weed-free check

(4.2 units); however, a discount would be assessed only to a density of 15 weeds/15m of row. Staple length differences were detected in 1996, at a density of 3 weeds/15 m of row (2.79 cm) when compared to the weed-free check (2.72 cm), but no other differences were detected in 1996 and 1997 (Figure 2a). No differences for strength were detected in 1996 at any density (Figure 2b). In 1997 densities of 3, 8, and 15 weeds/15 m of row (284 mN/tex for all three) were lower when compared to the weed-free check (304 mN/tex). Premiums for strength are payed when values are above 231 mN/tex and discounts occur below 230 mN/tex. Uniformity demonstrated no differences in either year when compared to the weed-free check and levels in both years remained relatively constant at range of 82-84% (Figure 2c).

**Loan Rate Comparisons.** Loan rate levels for picker-harvested cotton in both years were relatively constant in a range of 11816 to 10910 points ($1.19 to $1.09/kg of lint) with differences being detected at densities of 3 and 15 weeds/15m of row (Table 2). Loan rate for picker-harvested cotton in 1996 and 1997, versus stripper-harvested cotton in both years was higher at a density of eight weeds/15m of row. However, stripper-harvested cotton in 1997, was lower for all densities when compared to picker-harvested cotton in both years and stripper-harvested cotton in 1996. Loan rate was lowered by as much as 1008 points for a density of three weeds/15m of row to 2064 points for a density of 15 weeds/15m of row.

For an example of these point reductions, at a loss of 1008 points and a yield of 1120 kg/ha, (target yield for irrigated cotton production in Southwest Oklahoma), a loss of $112.90/ha would occur for a density of three weeds/15m of row. All prices are based on loan value and not on market value.

Regression analyses demonstrated linear trends for both picker- and stripper-harvested methods in 1997. Reductions for picker-harvested cotton were 48 points for each increase by one weed/15m of row. Stripper-harvested reductions were higher at 84 points for each increase by one weed/15m of row.

**Yield Loss Examinations.** In 1996, stripper- and picker-harvested lint yields were reduced by 29 and 32 kg/ha for each increase by one weed/15 m of row, respectively (Figure 3a). Lint yield reductions in 1997 were 43 kg/ha for each increase by one weed/15 m of row for stripper- and picker-harvested cotton. These yield losses in 1996, when converted to dollars per hectare, are $33.06/ha (29 kg/ha reduction times $1.14/kg of lint) for stripper-harvested cotton and $36.48/ha (32 kg/ha reduction times $1.14/kg of lint) for picker-harvested cotton. Equating these losses to a total gross cost helps identify how significant these losses are on a dollar per hectare basis. For stripper-harvested cotton total loss would be $958.74/ha based on (29 kg/ha times 15 weeds/15m of row times $1.14/kg of lint) and picker-harvested cotton total loss is $112.88/ha based on (32 kg/ha times 15 weeds/15m of row times $1.14/kg of lint).

Because environmental conditions can vary widely each year, it is desirable to evaluate cotton lint yield loss as a percentage of the weed-free check. Similar results have previously been reported, expressing yield loss as a percentage of the weed-free check (Rogers et al. 1999; Rowland et al. 1999; Wood et al. 1999). In 1996, stripper- and picker-harvested yield losses were 3.5 and 3.9 % for each increase by one johnsongrass plant/15 m of row, respectively. In 1997, stripper and picker yield losses were 5.2 and 5.5 % for each increase by one johnsongrass plant/15 m of row (Figure 3b).

Based on the variables evaluated, when weeds are present at the reported densities, machine harvest-efficiencies were higher for stripper-harvested cotton versus picker-harvested cotton. Fiber properties for years, were the only effects showing differences. No differences were detected for harvest methods and only at the highest densities were discounts occurring. Loan rate was lower in 1997, for stripper-harvested cotton versus stripper-harvested cotton in 1996. Picker-harvested cotton in both years was higher than stripper-harvested cotton in 1997. The greatest amount of gross value loss occurred for yield reductions by the johnsongrass densities. Johnsongrass densities caused almost half of the gross return (reduced yield) for harvested cotton to be lost. Based on the overall yield losses it would be very beneficial to control johnsongrass during the growing season or yield will be severely affected which affects gross returns for the harvested cotton.

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*Table 1.* Harvest efficiency for picker- vs. stripper-harvest methods relative to johnsongrass density and comparisons across years, harvest methods, and densities[a].

| | Harvest method | | | |
|---|---|---|---|---|
| | Picker | | Stripper | |
| Johnsongrass density | 1996 | 1997 | 1996 | 1997 |
| no/15 m of row | % | | | |
| 0 | 92.9 b | 90.0 b | 98.8 a | 97.6 a |
| 3 | 94.0 b | 89.0 c | 98.9 a | 96.6 ab |
| 4 | 95.4 a | 88.7 b | 98.7 a | 95.1 a |
| 5 | 94.0 ab | 87.3 c | 99.0 a | 92.0 bc |
| 8 | 91.1 a | 88.7 a | 98.7 a | 81.3 a |
| 15 | 96.2 a | 88.1 a | 94.6 a | 89.4 a |

| Regression equations: | | | |
|---|---|---|---|
| | (Picker 1996) | Y= 93.2 + 0.1X | NS[b] |
| | (Picker 1997) | Y= 89.2 - 0.1X | NS |
| | (Stripper 1996) | Y= 99.8 - 0.3X | ($R^2$ = 0.76) |
| | (Stripper 1997) | Y= 96.3 - 0.7X | NS |

[a]Means within a row followed by the same letter are not significantly different at the 0.05 probability level (using the protected LSD).

[b]NS, not significant at the 0.05 probability level.

*Table 2.* Loan rate for picker- and stripper-harvest methods relative to johnsongrass density and comparisons across years, harvest methods, and densities[a].

| | Harvest method | | | |
|---|---|---|---|---|
| | Picker | | Stripper | |
| Johnsongrass density | 1996 | 1997 | 1996 | 1997 |
| no/15 m of row | points | | | |
| 0 | 11816 a | 11675 a | 11746 a | 10934 b |
| 3 | 11854 a | 11537 b | 11823 a | 10736 c |
| 4 | 11856 a | 11631 a | 11796 a | 10573 b |
| 5 | 11849 a | 11649 a | 11601 a | 10424 b |
| 8 | 11816 a | 11656 a | 11246 b | 10582 c |
| 15 | 11777 a | 10910 b | 11645 a | 9581 c |

| | | | |
|---|---|---|---|
| Regression equations: | (Picker 1996) | Y= 11852.39 - 4.2X | NS[b] |
| | (Picker 1997) | Y= 11793.1 - 48.6X | ($R^2 = 0.72$) |
| | (Stripper 1996) | Y= 11738.3 - 16.3X | NS |
| | (Stripper 1997) | Y= 10969.2 - 85.4X | ($R^2 = 0.89$) |

[a]Means within a row followed by the same letter are not significantly different at the 0.05 probability level (using the protected LSD).

[b]NS, not significant at the 0.05 probability level.

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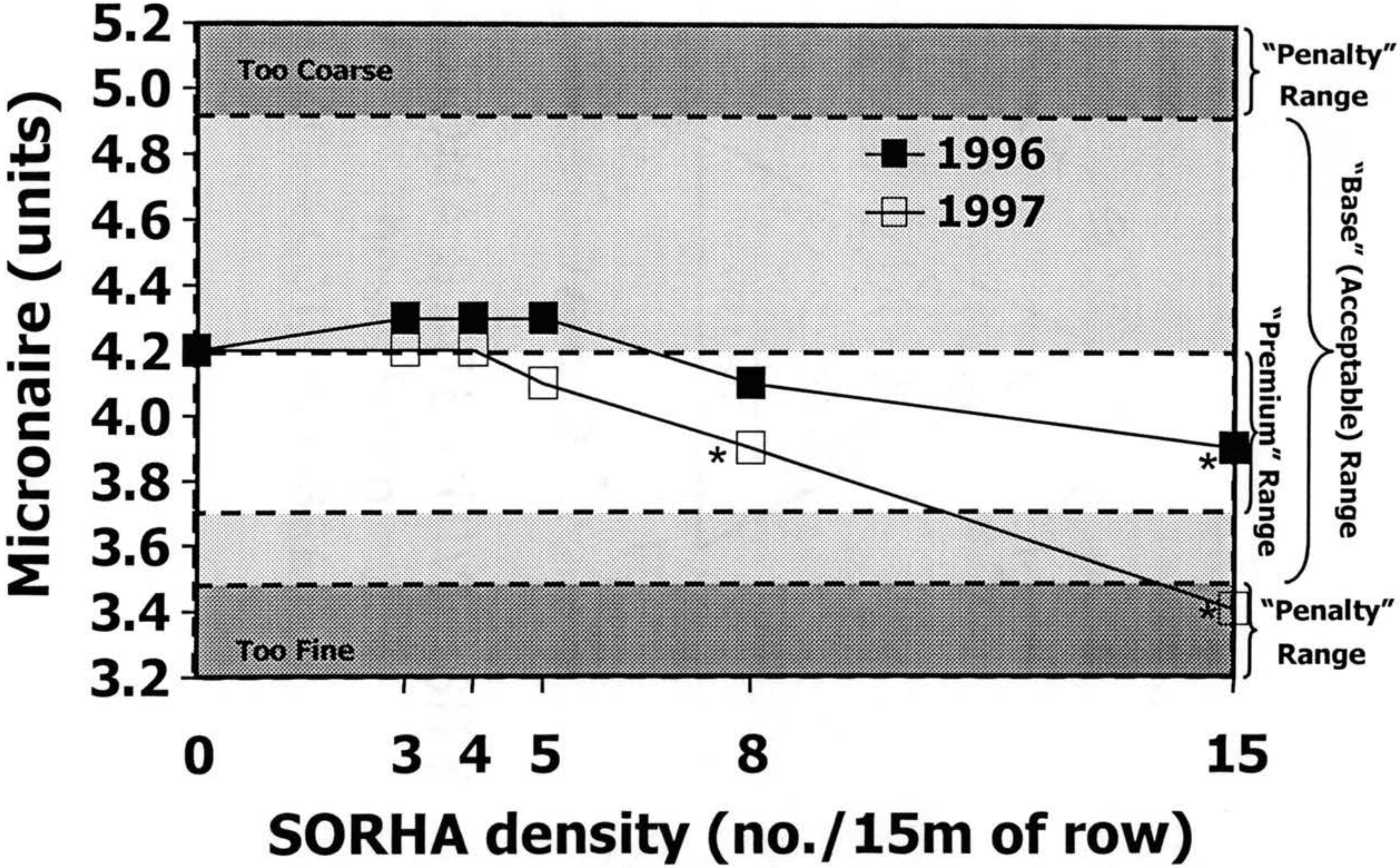
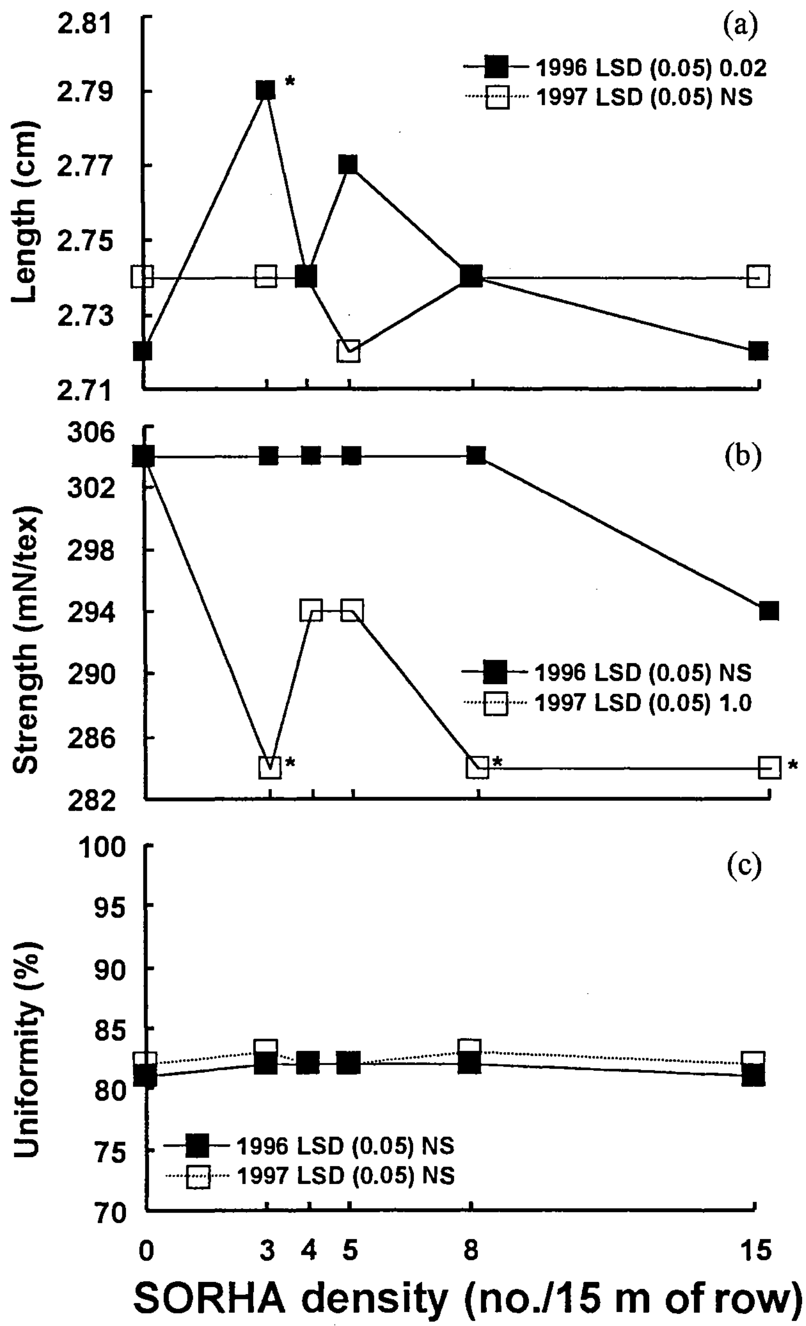
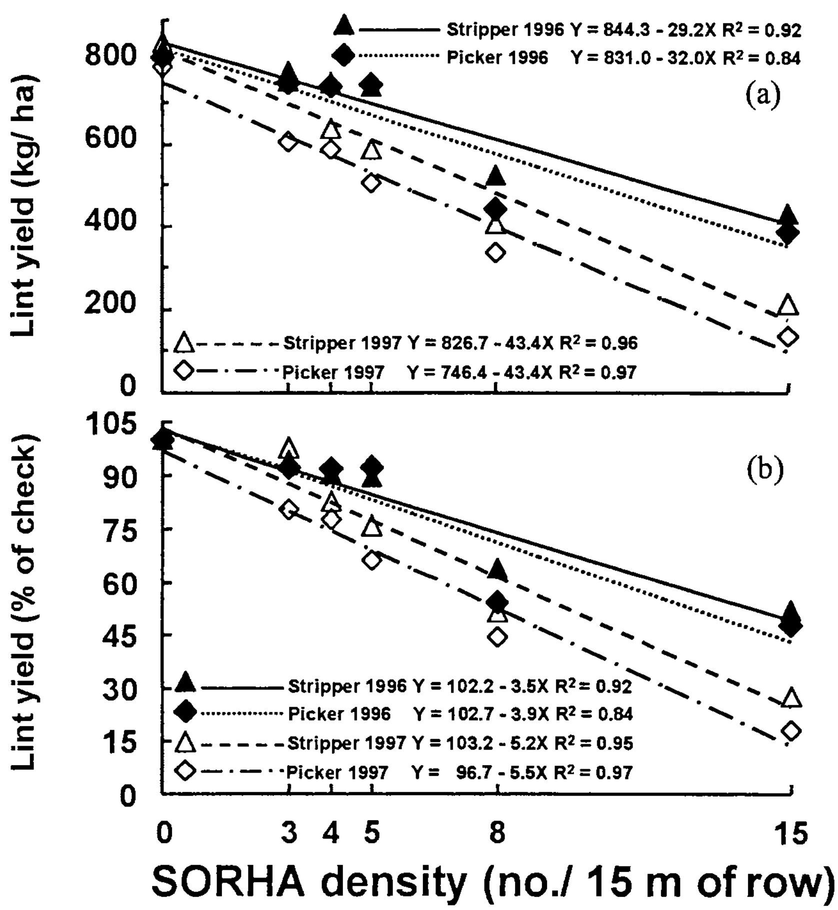

Micronaire (units)
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
Too Coarse
Too Fine
1996
1997
*
"Penalty" Range
"Base" (Acceptable) Range
"Premium" Range
"Penalty" Range
0
3
4
5
8
15
SORHA density (no./15m of row)


2.81
2.79
2.77
2.75
2.73
2.71
Length (cm)
(a)
1996 LSD (0.05) 0.02
1997 LSD (0.05) NS
*
306
302
298
294
290
286
282
Strength (mN/tex)
(b)
1996 LSD (0.05) NS
1997 LSD (0.05) 1.0
*
*
*
100
95
90
85
80
75
70
Uniformity (%)
(c)
1996 LSD (0.05) NS
1997 LSD (0.05) NS
0
3
4
5
8
15
SORHA density (no./15 m of row)



Stripper 1996 Y = 844.3 - 29.2X R² = 0.92
Picker 1996 Y = 831.0 - 32.0X R² = 0.84
(a)
Stripper 1997 Y = 826.7 - 43.4X R² = 0.96
Picker 1997 Y = 746.4 - 43.4X R² = 0.97
Lint yield (kg/ ha)
800
600
400
200
0
(b)
Stripper 1996 Y = 102.2 - 3.5X R² = 0.92
Picker 1996 Y = 102.7 - 3.9X R² = 0.84
Stripper 1997 Y = 103.2 - 5.2X R² = 0.95
Picker 1997 Y = 96.7 - 5.5X R² = 0.97
Lint yield (% of check)
105
90
75
60
45
30
15
0
0
3
4
5
8
15
SORHA density (no./ 15 m of row)

# Chapter II

## Profitable Weed-Control Systems in *Sorghum bicolor*

**Profitable Weed-Control Systems in *Sorghum bicolor***

**Abstract:** Field experiments were conducted in 1997, 1998, and 1999 to evaluate net returns from weed-control systems in grain sorghum with an upper limit cost for weed control of $37.05/ha. These experiments utilized two planting methods, two application timings either PRE and POST or PRE followed by POST, two application methods broadcast and banded, and cultivation or cultivation alone. Net returns were based on variable costs which included: costs of the herbicides, cost of cultivation, and application costs. Planting methods consisted of conventional tillage and drill planted. A further distinction for conventional tillage are 3-yr conventional tillage and Two-year conventional tillage experiments. The 3- and 2-year conventional tillage experiments utilized row spacings of 0.76 m wide by 13.5 m long and the drill planted experiment had a row spacing of 0.41m wide by 13.5 m long. When the weed control cost in our experiments exceeded the upper limit weed control cost, all but one treatment or treatment combination in the seven experiments were profitable. Metolaclhor PRE followed by 2,4-D POST provided excellent weed control (>95%) for Palmer amaranth and large crabgrass in all experiments. In most experiments this treatment provided the highest mean net returns when compared to the other treatments. When cultivation was included in a herbicide treatment combination or by itself, cultivation or cultivation alone ranked higher than most herbicide treatments.

**Nomenclature:** Atrazine, 6-chloro-N-ethyl-N′-(1-methylethyl)-1,3,5-triazine-2,4-diamine; bromoxynil, 3,5-dibromo-4-hydroxybenzonitrile; 2,4-D, (2,4-dichlorophenoxy)acetic acid; dicamba, 3,6-dichloro-2-methoxybenzoic acid; dimethenamid, 2-chloro-N-[(1-methyl-2-methoxy)ethyl]-N-(2,4-dimethyl-thien-3-yl)-acetamide; fluxofenim, ethanone, 1-4(4-

chlorophenyl)-2,2,2-trifluoro-O-(1,3-dioxolan-2-ylmethyl)oxime; halosulfuron, 3-chloro-5-[[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]-1-methyl-1H-pyrazole-4-carboxylic acid; metolachlor, 2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide; pendimethalin, N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine; propazine, 6-chloro-N,N′-bis(1-methylethyl)-1,3,5-triazine-2,4-diamine; prosulfuron, 1-(4-methoxy-6-methyl-triazin-2-yl)-3-[2-(3,3,3-trifluoropropyl)-phenylsulfonyl]-urea; quinclorac, 3,7-dichloro-8-quinolinecarboxylic acid; ivyleaf morningglory, *Ipomoea hederacea* (L.) Jacq. #[1] IPOHE; large crabgrass, *Digitaria sanguinalis* (L.) Scop. # DIGSA; Palmer amaranth, *Amaranthus palmeri* S. Wats. # AMAPA; tall morningglory, *Ipomoea purpurea* (L.) Roth # PHBPU; grain sorghum, *Sorghum bicolor* (L.) Moench 'Cherokee' and ' Pioneer 8446'.

**Additional index words:** Pre-mix of atrazine plus dicamba[1], pre-mix of atrazine plus metolachlor[2], net return, total return, variable cost, weed control, herbicide injury, cultivation.

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[1]Letters following this symbol are a WSSA-approved computer code from *Composite List of Weeds*, Revised 1989. Available only on computer disk from WSSA, 810 East 10th Street, Lawrence, KS 66044-8897.

[1]Marksman herbicide label. BASF Corporation, P. O. Box 13528, Research Triangle Park, NC 27709-3528.

[2]Bicep II herbicide label. Novartis Crop Protection, Inc., P.O. Box 18300, Greensboro, NC 27409-8300.

## INTRODUCTION

Oklahoma grain sorghum acreage has increased from 140,000 planted hectares in 1995 to 208,000 in 1997 (Oklahoma Agricultural Statistics Service. 1997, 1998). Increased acreage may be the result of the Freedom to Farm Act and the boll weevil (*Anthonomus grandis grandis* Boheman) eradication program. Prior to the Freedom to Farm Act, the number of hectares that producers, who participated in government programs were allowed to plant was fixed. In addition to the Freedom to Farm Act, dryland cotton producers have shown interest in planting alternative crops to avoid the costs associated with the boll weevil eradication program.

Grain sorghum may be planted and cultivated with the same equipment currently as cotton. Similar to their cotton crop management, producers must manage weeds with chemical and/or mechanical control. Producers indicate that they cannot afford a chemical weed-control program which costs more than $37.05/ha[4]. If the cost of $37.05/ha is exceeded producers indicate that dryland grain sorghum is not profitable and another crop must be grown. The $37.05/ha cost is associated only with their weed-control program, and does not include other production costs. Producers do not have an actual cost estimate based on research of what can be spent for weed-control.

Previous research has been conducted evaluating the effects of weeds on grain sorghum production (Burnside and Wicks 1967; Feltner et al. 1969; Moore and Murray 2000; Smith et al. 1990; Vencill and Banks 1994). Burnside and Wicks (1967) evaluated time of

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[4]Gary L. Strickland. 1997. Personal communication. (former State Extension Specialist for Agronomic Crops.)

removal of smooth pigweed (*Amaranthus hybridus* L.), foxtail species (*Setaria* spp.), crabgrass species (*Digitaria* spp.), and redroot pigweed (*Amaranthus retroflexus* L.) in grain sorghum. Removal times were 1, 2, 3, 4, 5, 6, and 8 wk after planting. Removal times of 1, 2, and 3 wk resulted in no yield reductions; however, for each week following the 3-wk removal time, yield was reduced. Similar experiments conducted by Feltner et al. (1969) evaluated tall waterhemp [*Amaranthus tuberculatus* (Moq.) J. D. Sauer] time of removal using treatments of 0, 6, and 10 wk and a full-season duration. A decrease in grain sorghum yield was noted with each increasing weed duration.

Several grain sorghum experiments conducted by Smith et al. (1990) in Oklahoma, reported on the interference of three annual grasses in grain sorghum using two row spacings. Grasses evaluated in their experiments were barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.], large crabgrass, and Texas panicum (*Panicum texanum* Buckl.). Their results indicate a 3.6% yield loss for each week that the grasses were allowed to compete with the crop. In another Oklahoma experiment, Moore and Murray (2000) evaluated seven Palmer amaranth densities and a weed-free check on a competitive and non-competitive system. Densities used in their experiment were a weed-free check, 1, 2, 4, 6, 9, 12, and 18 weeds/15m of row. Their competitive experiment results indicate that for each increase by one weed/15m of row, a yield reduction of 97 kg/ha occured. Their non-competitive experiment used the same densities except that the weeds were not allowed to compete full-season, but rather were placed in a holder immediately before harvest to evaluate the effects on moisture and foreign material content due to the presence of Palmer amaranth. Before cleaning and after cleaning moisture content was taken on each plot sample, and results indicate for each increase by one weed/15m of row a 0.7 and

0.3% moisture increase occurred, respectively. Foreign material increased 67 kg/ha for each increase by one weed/15m of row. The moisture and foreign material results indicate a need for weed-control, or a potential grain quality reduction could occur.

Vencill and Banks (1994) evaluated four weed management strategies on weed population and dynamics. Strategies included zero, low, medium, and high input systems for conventional- and no-tillage grain sorghum production. Weed seed bank populations increased for zero and low input systems when compared to high input systems, based on degree of weed control.

In this research project, seven field experiments which were initiated to evaluate net returns for weed-control programs with an upper limit cost of $37.05/ha. Two planting methods, two application timings and methods, and cultivation were utilized. Application timings consisted of PRE applied broadcast or banded, POST broadcast or banded and a combination of PRE followed by POST either broadcast or banded. All herbicide treatments that contained a banded application were cultivated. Two weed species targeted for weed control in this experiment are pigweed species which rank first and large crabgrass which ranks second as the most common weeds in Oklahoma grain sorghum production, they also rank fifth and eighth as the most troublesome weeds to control, respectively (Dowler 1997). In some years, and at some sites morningglory species were also evaluated.

## MATERIALS AND METHODS

**Experimental Parameters.** Experiments were conducted in 1997, 1998, and 1999 on a Teller loam (fine-loamy, mixed, thermic Udic Argiustoll) in north-central Oklahoma near Perkins. Soil pH was 5.7, and organic matter was 1.0%. Before planting, N as $NH_4NO_3$

was applied in 1997 and as $CO(NH_2)_2$ in 1998 and 1999, at 111 kg N/ha. Plots were arranged as a randomized complete block design replicated four times and all experiments were moved to new sites each year. Two planting methods used in the experiment will be designated as the conventional tillage experiment, with a further designation as the 3-yr conventional tillage and Two-year conventional tillage. The second planting method will be designated as the drill planted experiment. All herbicide applications were made using a tractor mounted compressed air sprayer calibrated to deliver 140 L/ha.

**Three-year Conventional Tillage Experiment, 1997-1999**. 'Cherokee' a medium maturity, drought tolerant, hybrid seed, that was treated with fluxofenim was planted in 1997, 1998, and 1999. Planting dates were on May 9, 12, and 14, in 1997, 1998, and 1999, respectively. Plot size was four rows, that were 0.76 m wide by 15 m long, with 1.5 m removed from each end immediately before harvest to eliminate an end-row effect. A harvested row length of 13.5 m resulted. The center two rows of the four row plots were harvested to obtain grain sorghum yields on September 11, 1997, August 27, 1998, and September 2, 1999.

Preemergence broadcast and PRE banded applications were made at planting for all three years. In 1997, POST broadcast and banded applications were applied 3 wk after planting (WAP) when grain sorghum was 15 cm tall with 4 to 6 leaves. Weed species present at application were Palmer amaranth, 10 cm tall with 3 leaves, and large crabgrass, 8 cm tall with 6 leaves. In 1998, 4 WAP grain sorghum was 30 cm tall with 6 to 8 leaves at the POST broadcast and banded applications. Weed species present were Palmer amaranth 15 cm tall with 8 to 12 leaves, large crabgrass 5 cm tall with 3 to 5 leaves; and morningglory species that consisted of tall and ivyleaf morningglory 5 cm tall with 4 leaves. In 1999, POST broadcast and POST banded treatments were applied at 6 WAP when grain sorghum was 91 cm tall with 8 leaves, Palmer amaranth was 76 cm tall with 50 leaves, large crabgrass was 41 cm tall, tillering, and morningglory species were 30 cm in diameter, and had 25 leaves.

**Two-year Conventional Tillage Experiment, 1998-1999.** 'Cherokee' hybrid seed was planted on May 18 and 19, in 1998 and 1999, respectively. Plot size was four rows, that were 0.76 m wide by 15 m long, with 1.5 m removed from each end immediately before harvest to eliminate an end-row effect. A harvested row length of 13.5 m resulted. The Two-year planted experiment was harvested on September 1 and 8 in 1998 and1999, respectively.

Preemergence broadcast and PRE banded applications were made at planting in 1998 and 1999. In 1998, POST broadcast and POST banded treatments were applied 4 WAP when grain sorghum was 46 cm tall with 6 leaves, Palmer amaranth was 10 cm tall with 6 leaves, and large crabgrass was 10 cm tall with 10 leaves. In 1999, POST broadcast and POST banded treatments were also applied 4 WAP to 30 cm tall grain sorghum with 4 leaves, Palmer amaranth was 8 cm tall with 8 leaves, large crabgrass was 13 cm tall with 12 leaves, and morningglory species were 5 cm tall with 4 leaves.

**Two-Year Drilled No-Tillage, 1998-1999.** 'Pioneer 8446' hybrid seed treated with fluxofenim was planted on May 18 and 19, in 1998 and 1999, respectively. Plot size was 6 rows, that were 0.41 m wide by 15 m long. Similar to the other experiments, harvested row lengths were 13.5 m long. The drill planted experiment was harvested on September 1 and 23, 1998 and 1999, respectively.

Preemergence applications were applied at planting. In 1998, POST treatments were applied 4 WAP when grain sorghum was 41 cm tall with 7 leaves, Palmer amaranth was 3 cm tall with cotyledon to 5 leaves, and large crabgrass was 8 cm tall with two to eight leaves. In 1999, POST applications were made 4 WAP, when grain sorghum was 46 cm tall with 7 to 8 leaves, Palmer amaranth was 2 to 64 cm tall with 10 to numerous leaves, large crabgrass was 30 cm tall and tillering, and morningglory species were 8 cm tall with 30 cm vines.

**Data Collection.** After harvest, plot samples were weighed and moisture was measured. Plot samples were then cleaned to remove any broken kernels, grain sorghum stalks, grain sorghum stems, and green material from weeds. After cleaning, samples were re-weighed and sampled again for moisture. All samples were adjusted to 12% moisture and yield was converted to a kg/ha basis.

**Data Analyses.** Dependent variables were analyzed using the ANOVA statistical model. Variables evaluated were variable cost, total return, net return, return ratio, mean return ratio, yield, crop injury, weed control, crop counts, and crop heights. Total return is the total value obtained from yield times grain sorghum price. Grain sorghum price used was a 3-yr market average for the grain which was $3.85/45 kg (Oklahoma Agricultural Statistics Service 1998). Net return is the total return minus variable cost. Costs included in the variable cost were: cost of the herbicides, cultivation, and herbicide application. The return ratio equals the net return divided by the variable cost. The return ratio equals the increased return for each dollar spent on weed control. Preemergent applications applied in a band were not assessed an application cost, due to the availability of producers to apply a band at planting. Cultivation and application costs assessed were published by the Oklahoma Cooperative Extension Service, cultivation cost was $12.52/ha and application cost was $8.10/ha (Kletke 1996). Planting costs, tillage operations prior to planting, fertilization costs, labor, land rental, and harvesting costs were not evaluated. Data were separated using Fisher's protected LSD at the 5% level of probability.

## RESULTS AND DISCUSSION

**Three-year Conventional Tillage Experiment, 1997-1999.** In all years all treatments for weed control were profitable when the variable costs exceeded the targeted weed control cost of $37.05/ha (Appendix Tables 1,2, and 3). No treatments resulted in a negative return ratio (Table 1). The mean return ratio for all 3-yr ranged from 0.89 to 8.24/ha for each dollar spent on weed control. Two treatments that had mean return ratios higher than most treatments were 2,4-D POST broadcast and the cultivated check, with a mean return ratio for each $8.24. Mean net returns for all 3-yr ranged from $39.49 to $158.87/ha (Table 2). The treatment that had the highest mean net return was neither the cultivated check or 2,4-D POST, but it did include 2,4-D POST. The highest mean net return for all 3-yr was metolachlor PRE band followed by 2,4-D POST broadcast with a mean net return of $158.87/ha. This treatment combination provided excellent weed control (>95%) of Palmer amaranth and large crabgrass 8 WAP in 2- of the 3-yr evaluated (Appendix Table 4, 5, and 6).

**Two-year Conventional Tillage Experiment, 1998-1999.** Cultivation was a component of the weed-control program with either no cultivation, one cultivation or two cultivations included in the treatment. However, inadequate rainfall later in the season did not require two cultivations; therefore, all treatments that included two cultivations were cultivated once. All treatments resulted in no negative mean ratios and when the upper limit weed control cost was exceeded, treatments were still profitable (Appendix Tables 9 and 10).

Mean return ratios ranged from 0.87 to 5.43 (Table 3). The cultivated check had the highest mean return ratio returning 5.43 for each dollar spent on weed control. The next highest was atrazine plus COC applied POST broadcast with a mean return ratio of 4.97 for each dollar spent on weed control. Mean net returns were highest for metolachlor applied PRE broadcast with no cultivation followed by 2,4-D POST broadcast with a mean net return of $121.64/ha (Table 4). This treatment combination provided excellent weed control for Palmer amaranth and large crabgrass in both years 8 WAP (Appendix Tables 11 and 12). The cultivated check had a mean net return of $67.95/ha and this mean net return was higher than four of the herbicide treatments selected.

**Two-Year Drilled No-Tillage Experiment, 1998-1999.** In the 2-yr drilled no tillage experiment one treatment demonstrated a negative mean return ratio and a negative mean net return (Tables 5 and 6). Mean return ratios ranged from -0.06 to 1.39 and mean net returns ranged from $-3.67 to $72.49/ha. The highest mean return ratio was for metolachlor applied PRE followed by 2,4-D POST and this treatment combination also had the highest mean net return at $72.49/ha. Weed control for this treatment was excellent for Palmer amaranth and large crabgrass 8 WAP in 1998, and 7 WAP in 1999, respectively (Appendix Tables 17 and 18). Variable costs for metolachlor applied PRE followed by 2,4-D POST exceeded the upper limit weed control cost of $37.05/ha each year (Appendix Tables 15 and 16). However this treatment combination as were most treatments with the exception of one were profitable in both years.

When the upper limit weed control cost in our experiments were exceeded, all but one treatment or treatment combination in the seven experiments was not profitable. The myth associated with this weed control cost, is just that a myth. Metolachlor applied PRE followed by 2,4-D POST provided excellent weed control for the weed species we targeted in our experiments. Depending upon what species are present in a producers field these data could change and herbicide selection and previous weed species present could impact the returns we observed. When cultivation was included in the treatment combinations most treatments responded with higher net returns. When cultivation was evaluated alone it had a higher net return and mean return ratio than most of our herbicide treatments. Cultivation when used as a method of weed control should not be overlooked. Cultivation is effective for controlling weeds in between the rows; however, weeds within the row will not be controlled; therefore it would be better to include a herbicide in the weed-control system. If control is not achieved within the rows potential grain quality reductions could occur by increased moisture, and foreign material, affecting overall price for the grain (Moore and Murray 2000). It may be more economical based on cost and returns to apply a broadcast herbicide treatment rather than spend money to pay for fuel, labor, and equipment costs associated with cultivation. Costs we did not evaluate, but costs that would be beneficial to a producer planting grain sorghum.

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*Table 1.* Three-year conventional tillage experiment herbicide list and grain sorghum weed control return ratio.

| Treatment[b] | Rate | Timing[c] | Return ratio[a] 1997 | 1998 | 1999 | Mean |
|---|---|---|---|---|---|---|
| | kg ai/ha | | | | | |
| 1. metolachlor | 1.68 | PRE BC | 2.09 | 2.41 | 4.19 | 2.90 |
| 2. metolachlor | 1.68 | PRE BAND | 3.05 | 3.88 | 6.33 | 4.42 |
| 3. dimethenamid | 0.84 | PRE BC | 1.31 | 3.34 | 4.27 | 2.97 |
| 4. dimethenamid | 0.84 | PRE BAND | 3.76 | 3.43 | 8.23 | 5.14 |
| 5. propazine | 1.12 | PRE BC | 0.01 | 1.85 | 3.17 | 1.67 |
| 6. propazine | 1.12 | PRE BAND | 3.43 | 2.87 | 7.64 | 4.65 |
| 7. prosulfuron | 0.071 | PRE BC | 1.71 | 0.69 | 1.40 | 1.27 |
| 8. prosulfuron | 0.071 | PRE BAND | 1.41 | 1.99 | 5.32 | 2.91 |
| 9. metolachlor + | 1.68 | PRE BAND | 5.39 | 1.90 | 4.34 | 3.87 |
| propazine | 1.12 | | | | | |
| 10. metolachlor + | 1.68 | PRE BAND | 2.40 | 2.02 | 2.58 | 2.33 |
| prosulfuron | 0.071 | | | | | |
| 11. dimethenamid + | 0.84 | PRE BAND | 1.92 | 2.17 | 4.48 | 2.86 |
| propazine | 1.12 | | | | | |
| 12. dimethenamid + | 0.84 | PRE BAND | 1.66 | 1.60 | 2.47 | 1.91 |
| prosulfuron | 0.071 | | | | | |
| 13. metolachlor fb | 1.68 | PRE BAND | 3.70 | 3.81 | 4.71 | 4.07 |
| 2,4-D | 0.56 | POST BC | | | | |
| 14. metolachlor fb | 1.68 | PRE BAND | 1.16 | 2.82 | 4.59 | 2.86 |
| 2,4-D | 0.56 | POST BAND | | | | |
| 15. metolachlor fb | 1.68 | PRE BAND | 0.82 | 2.58 | 3.81 | 2.40 |
| dicamba | 0.28 | POST BC | | | | |
| 16. metolachlor fb | 1.68 | PRE BAND | 3.09 | 3.14 | 3.12 | 3.12 |
| dicamba | 0.28 | POST BAND | | | | |
| 17. metolachlor fb | 0.84 | PRE BAND | 4.21 | 1.41 | 3.88 | 3.17 |
| atrazine + COC | 1.12 | POST BC | | | | |
| 18. metolachlor fb | 1.68 | PRE BAND | 4.92 | 2.55 | 4.44 | 3.97 |
| atrazine + COC | 1.12 | POST BAND | | | | |
| 19. metolachlor fb | 1.68 | PRE BAND | 3.19 | 1.10 | 3.15 | 2.48 |
| prosulfuron + COC | 0.071 | POST BAND | | | | |
| LSD (0.05) | | | 1.12 | 1.19 | 1.67 | 1.36 |

[a]Return ratio equals increased return from weed control divided by the cost of weed control. Ratio equals increased return per dollar of weed control cost.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L/ha.

[c]BC, broadcast application; BAND, banded application. All banded treatments were cultivated (twice in 1997, once in 1998 and 1999)

*Table 1. (cont.)* Three-year conventional tillage experiment herbicide list and grain sorghum weed control return ratio.

| Treatment[b] | Rate | Timing[c] | Return ratio[a] 1997 | 1998 | 1999 | Mean |
|---|---|---|---|---|---|---|
| | kg ai/ha | | | | | |
| 20. metolachlor fb | 1.68 | PRE BAND | 0.80 | 1.93 | 4.10 | 2.28 |
| atrazine + dicamba | 0.672 | POST BC | | | | |
| 21. metolachlor fb | 1.68 | PRE BAND | 2.56 | 2.30 | 4.91 | 3.26 |
| atrazine + dicamba | 0.672 | POST BAND | | | | |
| 22. metolachlor fb | 1.68 | PRE BAND | 1.63 | 1.10 | 1.99 | 1.57 |
| halosulfuron + COC | 0.047 | POST BAND | | | | |
| 23. metolachlor fb | 1.68 | PRE BAND | 3.19 | 0.69 | 1.50 | 0.89 |
| bromoxynil | 0.56 | POST BC | | | | |
| 24. metolachlor fb | 1.68 | PRE BAND | 1.27 | 1.81 | 2.94 | 1.86 |
| bromoxynil | 0.56 | POST BAND | | | | |
| 25. atrazine + COC | 1.12 | POST BC | 4.30 | 0.80 | 8.33 | 5.77 |
| 26. atrazine + COC | 1.12 | POST BAND | 6.04 | 3.27 | 5.82 | 5.04 |
| 27. prosulfuron + COC | 0.071 | POST BAND | 3.12 | 1.56 | 3.65 | 2.78 |
| 28. pendimethalin | 0.694 | POST BC | 4.58 | 1.81 | 3.37 | 3.25 |
| 29. bromoxynil | 0.56 | POST BC | 0.29 | 0.80 | 1.60 | 0.90 |
| 30. bromoxynil | 0.56 | POST BAND | 3.00 | 2.07 | 4.18 | 3.08 |
| 31. 2,4-D | 0.56 | POST BC | 4.84 | 7.64 | 12.26 | 8.24 |
| 32. 2,4-D | 0.56 | POST BAND | 4.39 | 4.68 | 6.28 | 5.11 |
| 33. dicamba | 0.28 | POST BC | 2.05 | 3.79 | 5.72 | 3.85 |
| 34. dicamba | 0.28 | POST BAND | 3.99 | 4.00 | 5.25 | 4.42 |
| 35. halosulfuron + COC | 0.047 | POST BAND | 3.36 | 1.81 | 3.54 | 8.24 |
| 36. atrazine + dicamba | 0.672 | POST BC | 2.02 | 3.02 | 7.24 | 4.09 |
| 37. atrazine + dicamba | 0.672 | POST BAND | 3.88 | 2.67 | 6.83 | 4.46 |
| 38. metolachlor + | 1.68 | PRE BAND | 2.76 | 1.51 | 2.56 | 2.28 |
| propazine fb | 1.12 | | | | | |
| atrazine + COC | 1.12 | POST BAND | | | | |
| 39. check | --- | --- | 0.00 | 0.00 | 0.00 | 0.00 |
| 40. cultivated check | --- | --- | 4.77 | 7.10 | 12.92 | 8.26 |
| LSD (0.05) | | | 1.12 | 1.19 | 1.67 | 1.36 |

[a]Return ratio equals increased return from weed control divided by cost of weed control. Ratio equals increased return per dollar of weed control cost.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L/ha.

[c]BC, broadcast application; BAND, banded application. All banded treatments were cultivated (twice in 1997, once in 1998 and 1999).

*Table 2.* Three-year conventional tillage experiment herbicide list and net grain sorghum return.

| | | | Net return[a] | | | |
|---|---|---|---|---|---|---|
| **Treatment[b]** | **Rate** | **Timing[c]** | **1997** | **1998** | **1999** | **Mean** |
| | **kg ai/ha** | | **$/ha** | **$/ha** | **$/ha** | **$/ha** |
| 1. metolachlor | 1.68 | PRE BC | 83.92 | 96.66 | 168.16 | 116.25 |
| 2. metolachlor | 1.68 | PRE BAND | 108.54 | 89.56 | 146.07 | 114.72 |
| 3. dimethenamid | 0.84 | PRE BC | 45.36 | 115.82 | 147.89 | 103.02 |
| 4. dimethenamid | 0.84 | PRE BAND | 127.20 | 73.08 | 175.33 | 125.20 |
| 5. propazine | 1.12 | PRE BC | 0.46 | 80.50 | 138.14 | 73.03 |
| 6. propazine | 1.12 | PRE BAND | 126.06 | 69.65 | 185.35 | 127.02 |
| 7. prosulfuron | 0.071 | PRE BC | 99.38 | 40.01 | 81.58 | 73.66 |
| 8. prosulfuron | 0.071 | PRE BAND | 58.76 | 57.85 | 154.47 | 90.36 |
| 9. metolachlor + | 1.68 | PRE BAND | 255.12 | 66.00 | 150.89 | 157.34 |
| propazine | 1.12 | | | | | |
| 10. metolachlor + | 1.68 | PRE BAND | 125.16 | 80.02 | 102.18 | 102.45 |
| prosulfuron | 0.071 | | | | | |
| 11. dimethenamid + | 0.84 | PRE BAND | 87.55 | 71.79 | 147.85 | 102.40 |
| propazine | 1.12 | | | | | |
| 12. dimethenamid + | 0.84 | PRE BAND | 83.62 | 60.53 | 93.55 | 79.23 |
| prosulfuron | 0.071 | | | | | |
| 13. metolachlor fb | 1.68 | PRE BAND | 176.68 | 134.09 | 165.85 | 158.87 |
| 2,4-D | 0.56 | POST BC | | | | |
| 14. metolachlor fb | 1.68 | PRE BAND | 52.19 | 91.71 | 149.19 | 97.70 |
| 2,4-D | 0.56 | POST BAND | | | | |
| 15. metolachlor fb | 1.68 | PRE BAND | 47.67 | 117.08 | 172.95 | 112.57 |
| dicamba | 0.28 | POST BC | | | | |
| 16. metolachlor fb | 1.68 | PRE BAND | 149.67 | 112.51 | 111.80 | 124.66 |
| dicamba | 0.28 | POST BAND | | | | |
| 17. metolachlor fb | 0.84 | PRE BAND | 220.24 | 56.24 | 154.42 | 143.63 |
| atrazine + COC | 1.12 | POST BC | | | | |
| 18. metolachlor fb | 1.68 | PRE BAND | 230.72 | 87.71 | 152.58 | 157.00 |
| atrazine + COC | 1.12 | POST BAND | | | | |
| 19. metolachlor fb | 1.68 | PRE BAND | 193.47 | 53.04 | 151.60 | 112.57 |
| prosulfuron + COC | 0.071 | POST BAND | | | | |
| LSD (0.05) | | | 43.65 | 27.52 | 46.13 | 39.96 |

[a]Net return is the difference of total return (price times yield) minus variable cost.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L/ha.

[c]BC, broadcast application; BAND, banded application. All banded treatments were cultivated (twice in 1997, once in 1998 and 1999)

*Table 2. (cont.)* Three-year conventional tillage experiment herbicide list and net grain sorghum return.

| Treatment[b] | Rate | Timing[c] | Net return[a] 1997 | 1998 | 1999 | Mean |
|---|---|---|---|---|---|---|
| | kg ai/ha | | $/ha | $/ha | $/ha | $/ha |
| 20. metolachlor fb | 1.68 | PRE BAND | 45.08 | 84.28 | 179.46 | 102.94 |
| atrazine + dicamba | 0.672 | POST BC | | | | |
| 21. metolachlor fb | 1.68 | PRE BAND | 122.47 | 81.49 | 173.83 | 125.93 |
| atrazine + dicamba | 0.672 | POST BAND | | | | |
| 22. metolachlor fb | 1.68 | PRE BAND | 94.29 | 50.16 | 90.74 | 78.40 |
| halosulfuron + COC | 0.047 | POST BAND | | | | |
| 23. metolachlor fb | 1.68 | PRE BAND | 38.06 | 46.08 | 100.56 | 61.57 |
| bromoxynil | 0.56 | POST BC | | | | |
| 24. metolachlor fb | 1.68 | PRE BAND | 70.54 | 58.31 | 126.66 | 85.17 |
| bromoxynil | 0.56 | POST BAND | | | | |
| 25. atrazine + COC | 1.12 | POST BC | 71.83 | 78.09 | 139.09 | 96.34 |
| 26. atrazine + COC | 1.12 | POST BAND | 219.32 | 77.68 | 138.50 | 145.16 |
| 27. prosulfuron + COC | 0.071 | POST BAND | 38.06 | 58.57 | 137.46 | 117.52 |
| 28. pendimethalin | 0.694 | POST BC | 94.56 | 59.86 | 111.68 | 88.70 |
| 29. bromoxynil | 0.56 | POST BC | 12.71 | 35.35 | 70.41 | 39.49 |
| 30. bromoxynil | 0.56 | POST BAND | 135.15 | 67.38 | 135.62 | 112.72 |
| 31. 2,4-D | 0.56 | POST BC | 58.81 | 92.79 | 148.94 | 100.18 |
| 32. 2,4-D | 0.56 | POST BAND | 151.26 | 102.68 | 137.79 | 130.58 |
| 33. dicamba | 0.28 | POST BC | 45.71 | 84.63 | 127.66 | 86.00 |
| 34. dicamba | 0.28 | POST BAND | 151.15 | 101.33 | 132.95 | 128.48 |
| 35. halosulfuron + COC | 0.047 | POST BAND | 159.52 | 63.29 | 123.57 | 115.46 |
| 36. atrazine + dicamba | 0.672 | POST BC | 41.79 | 62.42 | 149.69 | 84.63 |
| 37. atrazine + dicamba | 0.672 | POST BAND | 145.06 | 66.25 | 169.58 | 126.96 |
| 38. metolachlor + | 1.68 | PRE BAND | 161.65 | 69.49 | 117.80 | 116.31 |
| propazine fb | 1.12 | | | | | |
| atrazine + COC | 1.12 | POST BAND | | | | |
| 39. check | --- | --- | 30.20 | 81.77 | 131.98 | 81.31 |
| 40. cultivated check | --- | --- | 119.44 | 88.94 | 161.75 | 123.38 |
| LSD (0.05) | | | 43.65 | 27.52 | 46.13 | 39.96 |

[a]Net return is the difference between total return (price times yield) minus variable cost.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L/ha.

[c]BC, broadcast application; BAND, banded application. All banded treatments were cultivated (twice in 1997, once in 1998 and 1999).

*Table 3.* Two-year conventional tillage experiment herbicide list and grain sorghum weed control ratio.

| Treatment[b] | | Rate | Timing[c] | Return ratio[a] 1998 | 1999 | Mean |
|---|---|---|---|---|---|---|
| | | kg ai/ha | | | | |
| 1. | metolachlor | 1.68 | PRE BC NC | 2.48 | 1.66 | 2.07 |
| 2. | metolachlor | 1.68 | PRE BC 1C | 1.33 | 1.67 | 1.50 |
| 3. | metolachlor | 1.68 | PRE BAND 2C | 3.31 | 4.83 | 4.07 |
| 4. | metolachlor + | 1.68 | PRE BAND 2C | 1.95 | 1.04 | 1.49 |
| | prosulfuron | 0.071 | | | | |
| 5. | metolachlor + | 1.68 | PRE BC NC | 1.81 | 2.47 | 2.14 |
| | atrazine | 1.12 | | | | |
| 6. | metolachlor + | 1.68 | PRE BC 1C | 1.21 | 1.27 | 1.24 |
| | atrazine | 1.12 | | | | |
| 7. | metolachlor + | 1.68 | PRE BAND 2C | 3.51 | 2.94 | 3.22 |
| | atrazine | 1.12 | | | | |
| 8. | metolachlor fb | 1.68 | PRE BC NC | 1.54 | 2.28 | 1.91 |
| | atrazine + COC | 1.12 | POST BC | | | |
| 9. | metolachlor fb | 1.68 | PRE BC 1C | 0.62 | 1.15 | 0.88 |
| | atrazine + COC | 1.12 | POST BC | | | |
| 10. | metolachlor fb | 1.68 | PRE BAND 1C | 0.80 | 0.90 | 0.85 |
| | atrazine + COC | 1.12 | POST BC | | | |
| 11. | metolachlor fb | 1.68 | PRE BC NC | 2.19 | 2.47 | 2.33 |
| | 2,4-D | 0.56 | POST BC | | | |
| 12. | metolachlor fb | 1.68 | PRE BC 1C | 1.38 | 0.35 | 0.87 |
| | 2,4-D | 0.56 | POST BC | | | |
| 13. | atrazine + COC | 1.12 | POST BC NC | 2.32 | 7.62 | 4.97 |
| 14. | atrazine + COC | 1.12 | POST BC 1C | 2.75 | 3.29 | 3.02 |
| 15. | check | --- | --- | 0.00 | 0.00 | 0.00 |
| 16. | cultivated check | --- | --- | 4.27 | 6.58 | 5.43 |
| | LSD (0.05) | | | 0.95 | 2.42 | 1.48 |

[a]Return ratio equals increased return from weed control divided by cost of weed control. Ratio equals increased return per dollar of weed control cost.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L/ha.

[c]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivations; two cultivations were not required due to low weed infestations.

*Table 4.* Two-year conventional tillage experiment herbicide list and net grain sorghum return.

| Treatment[b] | | Rate | Timing[c] | Net return[a] 1998 | 1999 | Mean |
|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | $/ha |
| 1. | metolachlor | 1.68 | PRE BC NC | 99.61 | 66.42 | 83.01 |
| 2. | metolachlor | 1.68 | PRE BC 1C | 69.72 | 87.99 | 78.85 |
| 3. | metolachlor | 1.68 | PRE BAND 2C | 76.31 | 111.45 | 93.88 |
| 4. | metolachlor + | 1.68 | PRE BAND 2C | 77.07 | 41.04 | 59.05 |
| | prosulfuron | 0.071 | | | | |
| 5. | metolachlor + | 1.68 | PRE BC NC | 87.35 | 119.12 | 103.24 |
| | atrazine | 1.12 | | | | |
| 6. | metolachlor + | 1.68 | PRE BC 1C | 73.50 | 77.13 | 75.32 |
| | atrazine | 1.12 | | | | |
| 7. | metolachlor + | 1.68 | PRE BAND 2C | 90.33 | 75.62 | 82.98 |
| | atrazine | 1.12 | | | | |
| 8. | metolachlor fb | 1.68 | PRE BC NC | 87.63 | 129.43 | 108.53 |
| | atrazine + COC | 1.12 | POST BC | | | |
| 9. | metolachlor fb | 1.68 | PRE BC 1C | 42.70 | 79.87 | 61.28 |
| | atrazine + COC | 1.12 | POST BC | | | |
| 10. | metolachlor fb | 1.68 | PRE BAND 1C | 48.94 | 55.17 | 52.06 |
| | atrazine + COC | 1.12 | POST BC | | | |
| 11. | metolachlor fb | 1.68 | PRE BC NC | 114.26 | 129.01 | 121.64 |
| | 2,4-D | 0.56 | POST BC | | | |
| 12. | metolachlor fb | 1.68 | PRE BC 1C | 89.56 | 22.84 | 56.20 |
| | 2,4-D | 0.56 | POST BC | | | |
| 13. | atrazine + COC | 1.12 | POST BC NC | 38.75 | 127.21 | 82.98 |
| 14. | atrazine + COC | 1.12 | POST BC 1C | 80.45 | 96.22 | 88.34 |
| 15. | check | --- | --- | 53.85 | 113.10 | 83.47 |
| 16. | cultivated check | --- | --- | 53.44 | 82.45 | 67.95 |
| | LSD (0.05) | | | 32.35 | 62.63 | 38.54 |

[a]Net return is the difference of total return (price times yield) minus variable cost.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L/ha.

[c]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivations; two cultivations were not required due to low weed infestations.

*Table 5.* Two-year drilled no-tillage experiment herbicide list and grain sorghum weed control return ratio.

| Treatment[b] | | Rate | Timing | Return ratio[a] 1998 | 1999 | Mean |
|---|---|---|---|---|---|---|
| | | kg ai/ha | | | | |
| 1. | metolachlor | 1.68 | PRE | 0.54 | 2.00 | 1.27 |
| 2. | metolachlor + | 1.68 | PRE | 0.34 | 0.41 | 0.38 |
| | propazine | 1.12 | | | | |
| 3. | metolachlor + | 1.68 | PRE | -0.05 | 0.23 | 0.09 |
| | prosulfuron | 0.071 | | | | |
| 4. | atrazine + metolachlor | 2.98 | PRE | 0.59 | 1.58 | 1.09 |
| 5. | atrazine + metolachlor + | 2.98 | PRE | -0.28 | 0.63 | 0.17 |
| | prosulfuron | 0.071 | | | | |
| 6. | metolachlor fb | 1.68 | PRE | 0.50 | 2.28 | 1.39 |
| | 2,4-D | 0.56 | POST | | | |
| 7. | metolachlor fb | 1.68 | PRE | 0.25 | 1.72 | 0.99 |
| | atrazine + COC | 1.12 | POST | | | |
| 8. | prosulfuron + COC | 0.071 | POST | -0.56 | 0.44 | -0.06 |
| 9. | halosulfuron + COC | 0.047 | POST | -0.19 | 1.02 | 0.41 |
| 10. | quinclorac + | 0.14 | POST | 0.51 | 1.06 | 0.78 |
| | atrazine + COC | 1.12 | | | | |
| 11. | check | --- | --- | 0.00 | 0.00 | 0.00 |
| | LSD (0.05) | | | 0.54 | 0.57 | 0.71 |

[a]Return ratio equals increased return from weed control divided by cost of weed control. Ratio equals increased return per dollar of weed control cost.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

*Table 6.* Two-year drilled no-tillage experiment herbicide list and net grain sorghum return.

| Treatment[b] | | Rate | Timing | Net return[a] 1998 | 1999 | Mean |
|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | $/ha |
| 1. | metolachlor | 1.68 | PRE | 21.53 | 80.17 | 50.85 |
| 2. | metolachlor + | 1.68 | PRE | 25.55 | 31.34 | 28.45 |
| | propazine | 1.12 | | | | |
| 3. | metolachlor + | 1.68 | PRE | -4.81 | 21.01 | 8.10 |
| | prosulfuron | 0.071 | | | | |
| 4. | atrazine + metolachlor | 2.98 | PRE | 28.06 | 74.51 | 51.29 |
| 5. | atrazine + metolachlor + | 2.98 | PRE | -27.55 | 61.21 | 16.83 |
| | prosulfuron | 0.071 | | | | |
| 6. | metolachlor fb | 1.68 | PRE | 25.92 | 119.05 | 72.49 |
| | 2,4-D | 0.56 | POST | | | |
| 7. | metolachlor fb | 1.68 | PRE | 14.46 | 97.89 | 56.17 |
| | atrazine + COC | 1.12 | POST | | | |
| 8. | prosulfuron + COC | 0.071 | POST | -33.06 | 25.72 | -3.67 |
| 9. | halosulfuron + COC | 0.047 | POST | -9.86 | 51.47 | 20.80 |
| 10. | quinclorac + | 0.14 | POST | 21.98 | 46.00 | 33.99 |
| | atrazine + COC | 1.12 | | | | |
| 11. | check | — | — | 29.36 | 68.60 | 48.98 |
| | LSD (0.05) | | | 30.41 | 29.88 | 38.36 |

[a]Net return is the difference of total return (price times yield) minus variable cost.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

# APPENDIX

*Appendix Table 1.* Three-year conventional tillage experiment treatment cost listing ranked by net grain sorghum return in 1997.

| Treatment[a] | | Rate | Timing[b] | Variable cost | Total return | Yield | Net return |
|---|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | kg/ha | $/ha |
| 1. | metolachlor + | 1.68 | PRE BAND | 47.33 | 302.45 | 3563 | 255.12 |
| | propazine | 1.12 | | | | | |
| 2. | metolachlor fb | 1.68 | PRE BAND | 46.86 | 277.57 | 3269 | 230.71 |
| | atrazine + COC | 1.12 | POST BAND | | | | |
| 3. | metolachlor fb | 1.68 | PRE BAND | 52.29 | 272.53 | 3210 | 220.24 |
| | atrazine + COC | 1.0 | POST BC | | | | |
| 4. | atrazine + COC | 1.12 | POST BAND | 36.31 | 255.63 | 3011 | 219.32 |
| 5. | metolachlor fb | 1.68 | PRE BAND | 60.71 | 254.18 | 2994 | 193.47 |
| | prosulfuron + COC | 0.071 | POST BAND | | | | |
| 6. | metolachlor fb | 1.68 | PRE BAND | 47.75 | 224.42 | 2643 | 176.68 |
| | 2,4-D | 0.56 | POST BC | | | | |
| 7. | metolachlor + | 1.68 | PRE BAND | 58.59 | 220.24 | 2594 | 161.65 |
| | propazine fb | 1.12 | | | | | |
| | atrazine + COC | 1.12 | POST BAND | | | | |
| 8. | halosulfuron + COC | 0.047 | POST BAND | 47.47 | 207.00 | 2439 | 159.53 |
| 9. | prosulfuron + COC | 0.071 | POST BAND | 50.17 | 206.68 | 2435 | 156.51 |
| 10. | 2,4-D | 0.56 | POST BAND | 34.48 | 185.74 | 2187 | 151.26 |
| 11. | dicamba | 0.28 | POST BAND | 37.84 | 188.99 | 2226 | 151.15 |
| 12. | metolachlor fb | 1.68 | PRE BAND | 48.39 | 198.06 | 2333 | 149.67 |
| | dicamba | 0.28 | POST BAND | | | | |
| 13. | atrazine + dicamba | 0.672 | POST BAND | 37.35 | 182.40 | 2148 | 145.05 |
| 14. | bromoxynil | 0.56 | POST BAND | 45.00 | 180.16 | 2122 | 135.16 |
| 15. | dimethenamid | 0.84 | PRE BAND | 33.81 | 161.01 | 1896 | 127.20 |
| 16. | propazine | 1.12 | PRE BAND | 36.78 | 162.83 | 1918 | 126.05 |
| 17. | metolachlor + | 1.68 | PRE BAND | 52.12 | 177.28 | 2088 | 125.16 |
| | prosulfuron | 0.071 | | | | | |
| 18. | metolachlor fb | 1.68 | PRE BAND | 47.89 | 170.36 | 2007 | 122.47 |
| | atrazine + dicamba | 0.672 | POST BAND | | | | |
| 19. | cultivated check | --- | --- | 25.05 | 144.49 | 1701 | 119.44 |
| 20. | metolachlor | 1.68 | PRE BAND | 35.59 | 144.13 | 1698 | 108.54 |
| 21. | prosulfuron | 0.071 | PRE BC | 58.17 | 157.55 | 1856 | 99.38 |
| | LSD (0.05) | | | NS[c] | 43.65 | 511 | 43.65 |

[a]Treatments are listed in descending net return; fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application. All banded treatments were cultivated twice.

[c]NS, not statistically estimateable.

*Appendix Table 1. (cont.)* Three-year conventional tillage experiment treatment cost listing ranked by net grain sorghum return in 1997.

| Treatment[a] | | Rate | Timing[b] | Variable cost | Total return | Yield | Net return |
|---|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | kg/ha | $/ha |
| 22. | pendimethalin | 0.694 | POST BC | 20.62 | 115.18 | 1357 | 94.56 |
| 23. | metolachlor fb | 1.68 | PRE BAND | 58.02 | 152.31 | 1794 | 94.29 |
| | halosulfuron + COC | 0.047 | POST BAND | | | | |
| 24. | dimethenamid + | 0.84 | PRE BAND | 45.55 | 133.10 | 1568 | 87.55 |
| | propazine | 1.12 | | | | | |
| 25. | metolachlor | 1.68 | PRE BC | 40.09 | 124.01 | 1461 | 83.92 |
| 26. | dimethenamid + | 0.84 | PRE BAND | 50.34 | 133.96 | 1578 | 83.62 |
| | prosulfuron | 0.071 | | | | | |
| 27. | atrazine + COC | 1.12 | POST BC | 16.70 | 88.53 | 1043 | 71.83 |
| 28. | metolachlor fb | 1.68 | PRE BAND | 55.55 | 126.09 | 1485 | 70.54 |
| | bromoxynil | 0.56 | POST BAND | | | | |
| 29. | 2,4-D | 0.56 | POST BC | 12.15 | 70.96 | 836 | 58.81 |
| 30. | prosulfuron | 0.071 | PRE BAND | 41.57 | 100.33 | 1182 | 58.76 |
| 31. | metolachlor fb | 1.68 | PRE BAND | 45.03 | 97.22 | 1145 | 52.19 |
| | 2,4-D | 0.56 | POST BC | | | | |
| 32. | metolachlor fb | 1.68 | PRE BAND | 57.92 | 105.59 | 1244 | 47.67 |
| | dicamba | 0.28 | POST BC | | | | |
| 33. | dicamba | 0.28 | POST BC | 22.33 | 68.04 | 801 | 45.71 |
| 34. | dimethenamid | 0.84 | PRE BC | 34.65 | 80.02 | 942 | 45.37 |
| 35. | metolachlor fb | 1.68 | PRE BAND | 56.27 | 101.35 | 1194 | 45.08 |
| | atrazine + dicamba | 0.672 | POST BC | | | | |
| 36. | atrazine + dicamba | 0.672 | POST BC | 20.67 | 62.46 | 736 | 41.79 |
| 37. | metolachlor fb | 1.68 | PRE BAND | 79.61 | 117.67 | 1386 | 38.06 |
| | bromoxynil | 0.56 | POST BC | | | | |
| 38. | check | --- | --- | 0.00 | 30.20 | 356 | 30.20 |
| 39. | bromoxynil | 0.56 | POST BC | 44.02 | 56.73 | 668 | 12.71 |
| 40. | propazine | 1.12 | PRE BC | 43.62 | 44.08 | 519 | 0.46 |
| | LSD (0.05) | | | NS[c] | 43.65 | 511 | 43.65 |

[a]Treatments are listed in descending net return; fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application. All banded treatments were cultivated twice.

[c]NS, not statistically estimateable.

*Appendix Table 2.* Three-year conventional tillage experiment treatment cost listing ranked by net grain sorghum return in 1998.

| Treatment[a] | | Rate | Timing[b] | Variable cost | Total return | Yield | Net return |
|---|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | kg/ha | $/ha |
| 1. | metolachlor fb | 1.68 | PRE BAND | 35.22 | 169.31 | 1994 | 134.09 |
| | 2,4-D | 0.56 | POST BC | | | | |
| 2. | metolachlor fb | 1.68 | PRE BAND | 45.40 | 162.48 | 1914 | 117.08 |
| | dicamba | 0.28 | POST BC | | | | |
| 3. | dimethenamid | 0.84 | PRE BC | 34.65 | 150.47 | 1772 | 115.82 |
| 4. | metolachlor fb | 1.68 | PRE BAND | 35.86 | 148.37 | 1747 | 112.51 |
| | dicamba | 0.28 | POST BAND | | | | |
| 5. | 2,4-D | 0.56 | POST BAND | 21.96 | 124.64 | 1468 | 102.68 |
| 6. | dicamba | 0.28 | POST BAND | 25.32 | 126.65 | 1492 | 101.33 |
| 7. | metolachlor | 1.68 | PRE BC | 40.09 | 136.75 | 1611 | 96.66 |
| 8. | 2,4-D | 0.56 | POST BC | 12.15 | 104.94 | 1236 | 92.79 |
| 9. | metolachlor fb | 1.68 | PRE BAND | 32.51 | 124.22 | 1463 | 91.71 |
| | 2,4-D | 0.56 | POST BC | | | | |
| 10. | metolachlor | 1.68 | PRE BAND | 23.07 | 112.63 | 1326 | 89.56 |
| 11. | cultivated check | --- | --- | 12.52 | 101.47 | 1195 | 88.94 |
| 12. | metolachlor fb | 1.68 | PRE BAND | 34.33 | 122.04 | 1437 | 87.71 |
| | atrazine + COC | 1.12 | POST BAND | | | | |
| 13. | dicamba | 0.28 | POST BC | 22.33 | 106.96 | 1260 | 84.63 |
| 14. | metolachlor fb | 1.68 | PRE BAND | 43.74 | 128.03 | 1508 | 84.29 |
| | atrazine + dicamba | 0.672 | POST BC | | | | |
| 15. | check | --- | --- | 0.00 | 81.77 | 963 | 81.77 |
| 16. | metolachlor fb | 1.68 | PRE BAND | 35.37 | 116.86 | 1376 | 81.49 |
| | atrazine + dicamba | 0.672 | POST BAND | | | | |
| 17. | propazine | 1.12 | PRE BC | 43.62 | 124.12 | 1462 | 80.50 |
| 18. | metolachlor + | 1.68 | PRE BAND | 39.59 | 119.61 | 1409 | 80.02 |
| | prosulfuron | 0.071 | | | | | |
| 19. | atrazine + COC | 1.12 | POST BC | 16.70 | 94.79 | 1116 | 78.09 |
| 20. | atrazine + COC | 1.12 | POST BAND | 23.79 | 101.46 | 1195 | 77.67 |
| 21. | dimethenamid | 0.84 | PRE BAND | 21.29 | 94.37 | 1111 | 73.08 |
| | LSD (0.05) | | | NS[c] | 27.52 | 325 | 27.52 |

[a]Treatments are listed in descending net return; fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[c]NS, not statistically estimateable.

*Appendix Table 2. (cont.)* Three-year conventional tillage experiment treatment cost listing ranked by net grain sorghum return in 1998.

| Treatment[a] | | Rate | Timing[b] | Variable cost | Total return | Yield | Net return |
|---|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | kg/ha | $/ha |
| 22. | dimethenamid + | 0.84 | PRE BAND | 33.02 | 104.81 | 1235 | 71.79 |
| | propazine | 1.12 | | | | | |
| 23. | propazine | 1.12 | PRE BAND | 24.26 | 93.91 | 1106 | 69.65 |
| 24. | metolachlor + | 1.68 | PRE BAND | 46.07 | 115.56 | 1361 | 69.49 |
| | propazine fb | 1.12 | | | | | |
| | atrazine + COC | 1.12 | POST BAND | | | | |
| 25. | bromoxynil | 0.56 | POST BAND | 32.48 | 99.86 | 1176 | 67.38 |
| 26. | atrazine + dicamba | 0.672 | POST BAND | 24.82 | 91.07 | 1073 | 66.25 |
| 27. | metolachlor + | 1.68 | PRE BAND | 34.80 | 100.80 | 1187 | 66.00 |
| | propazine | 1.12 | PRE BAND | | | | |
| 28. | prosulfuron + COC | 0.071 | POST BAND | 34.95 | 98.24 | 1157 | 63.29 |
| 29. | atrazine + | 0.672 | POST BC | 20.67 | 83.10 | 979 | 62.42 |
| 30. | dimethenamid + | 0.84 | PRE BAND | 37.82 | 98.34 | 1158 | 60.53 |
| | prosulfuron | 0.071 | | | | | |
| 31. | pendimethalin | 0.694 | POST BC | 33.15 | 93.01 | 1095 | 59.86 |
| 32. | prosulfuron + COC | 0.071 | POST BAND | 37.64 | 96.21 | 1133 | 58.57 |
| 33. | metolachlor fb | 1.68 | PRE BAND | 43.03 | 101.34 | 1194 | 58.31 |
| | bromoxynil | 0.56 | POST BAND | | | | |
| 34. | prosulfuron | 0.071 | PRE BAND | 29.05 | 86.89 | 1023 | 57.85 |
| 35. | metolachlor fb | 0.84 | PRE BAND | 39.77 | 96.01 | 1131 | 56.24 |
| | atrazine + COC | 1.12 | POST BC | | | | |
| 36. | metolachlor fb | 1.68 | PRE BAND | 48.19 | 101.23 | 1192 | 53.04 |
| | prosulfuron + COC | 0.071 | POST BAND | | | | |
| 37. | metolachlor fb | 1.68 | PRE BAND | 45.50 | 95.66 | 1127 | 50.16 |
| | halosulfuron + COC | 0.047 | POST BAND | | | | |
| 38. | metolachlor fb | 1.68 | PRE BAND | 67.09 | 113.17 | 1333 | 46.08 |
| | bromoxynil | 0.56 | POST BC | | | | |
| 39. | prosulfuron | 0.071 | PRE BC | 58.17 | 98.18 | 1156 | 40.01 |
| 40. | bromoxynil | 0.56 | POST BC | 44.02 | 79.36 | 935 | 35.35 |
| | LSD (0.05) | | | NS[c] | 27.52 | 325 | 27.52 |

[a]Treatments are listed in descending net return; fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[c]NS, not statistically estimateable.

*Appendix Table 3.* Three-year conventional tillage experiment treatment cost listing ranked by net grain sorghum return in 1999.

| Treatment[a] | | Rate | Timing[b] | Variable cost | Total return | Yield | Net return |
|---|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | kg/ha | $/ha |
| 1. | propazine | 1.12 | PRE BAND | 24.26 | 209.60 | 2468 | 185.34 |
| 2. | metolachlor fb | 1.68 | PRE BAND | 43.74 | 223.21 | 2629 | 179.47 |
| | atrazine + dicamba | 0.672 | POST BC | | | | |
| 3. | dimethenamid | 0.84 | PRE BAND | 21.29 | 196.62 | 2316 | 175.33 |
| 4. | metolachlor fb | 1.68 | PRE BAND | 35.37 | 209.20 | 2469 | 173.83 |
| | atrazine + dicamba | 0.672 | POST BAND | | | | |
| 5. | metolachlor | 1.68 | POST BAND | 45.40 | 218.35 | 2572 | 172.95 |
| | dicamba | 0.28 | POST BC | | | | |
| 6. | atrazine + dicamba | 0.672 | POST BAND | 24.82 | 194.40 | 2290 | 169.58 |
| 7. | metolachlor | 1.68 | PRE BC | 40.09 | 208.25 | 2453 | 168.16 |
| 8. | metolachlor fb | 1.68 | PRE BAND | 35.22 | 201.08 | 2368 | 165.86 |
| | 2,4-D | 0.56 | POST BC | | | | |
| 9. | cultivated check | --- | --- | 12.52 | 174.28 | 2053 | 161.76 |
| 10. | prosulfuron | 0.071 | PRE BAND | 29.05 | 183.52 | 2161 | 154.47 |
| 11. | metolachlor fb | 0.84 | PRE BAND | 39.77 | 194.19 | 2287 | 154.42 |
| | atrazine + COC | 1.12 | POST BC | | | | |
| 12. | metolachlor fb | 1.68 | PRE BAND | 34.33 | 186.91 | 2201 | 152.58 |
| | atrazine + COC | 1.12 | POST BAND | | | | |
| 13. | metolachlor fb | 1.68 | PRE BAND | 48.19 | 199.79 | 2353 | 151.60 |
| | prosulfuron + COC | 0.071 | POST BAND | | | | |
| 14. | metolachlor + | 1.68 | PRE BAND | 34.80 | 185.69 | 2187 | 150.89 |
| | propazine | 1.12 | | | | | |
| 15. | atrazine + dicamba | 0.672 | POST BC | 20.67 | 170.36 | 2007 | 149.69 |
| 16. | metolachlor fb | 1.68 | PRE BAND | 32.51 | 181.69 | 2140 | 149.18 |
| | 2,4-D | 0.56 | POST BC | | | | |
| 17. | 2,4-D | 0.56 | POST BC | 12.15 | 161.09 | 1897 | 148.94 |
| 18. | dimethenamid | 0.84 | PRE BC | 34.65 | 182.55 | 2150 | 147.89 |
| 19. | dimethenamid + | 0.84 | PRE BAND | 33.02 | 180.87 | 2130 | 147.85 |
| | propazine | 1.12 | | | | | |
| 20. | metolachlor | 1.68 | PRE BAND | 23.07 | 169.14 | 1992 | 146.07 |
| 21. | atrazine + COC | 1.12 | POST BC | 16.70 | 155.79 | 1835 | 139.09 |
| | LSD (0.05) | | | NS[c] | 46.13 | 551 | 46.13 |

[a]Treatments are listed in descending net return; fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[c]NS, not statistically estimateable.

*Appendix Table 3. (cont.)* Three-year conventional tillage experiment treatment cost listing ranked by net grain sorghum return in 1999.

| Treatment[a] | | Rate | Timing[b] | Variable cost | Total return | Yield | Net return |
|---|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | kg/ha | $/ha |
| 22. | atrazine + COC | 1.12 | POST BAND | 23.79 | 162.29 | 1911 | 138.50 |
| 23. | propazine | 1.12 | PRE BC | 43.62 | 181.76 | 2141 | 138.14 |
| 24. | 2,4-D | 0.56 | POST BAND | 21.96 | 159.75 | 1881 | 137.79 |
| 25. | prosulfuron + COC | 0.071 | POST BAND | 37.64 | 175.10 | 2062 | 137.46 |
| 26. | bromoxynil | 0.56 | POST BAND | 32.48 | 168.10 | 1980 | 135.62 |
| 27. | dicamba | 0.28 | POST BAND | 25.32 | 158.27 | 1864 | 132.95 |
| 28. | check | --- | --- | 0.00 | 131.98 | 1554 | 131.98 |
| 29. | dicamba | 0.28 | POST BC | 22.33 | 149.99 | 1767 | 127.66 |
| 30. | metolachlor fb | 1.68 | PRE BAND | 43.03 | 169.69 | 1999 | 126.66 |
| | bromoxynil | 0.56 | POST BAND | | | | |
| 31. | prosulfuron + COC | 0.071 | POST BAND | 34.95 | 158.52 | 1867 | 123.57 |
| 32. | metolachlor + | 1.68 | PRE BAND | 46.07 | 163.87 | 1930 | 117.80 |
| | propazine fb | 1.12 | | | | | |
| | atrazine + COC | 1.12 | POST BAND | | | | |
| 33. | metolachlor fb | 1.68 | PRE BAND | 35.86 | 147.67 | 1739 | 111.81 |
| | dicamba | 0.28 | POST BAND | | | | |
| 34. | pendimethalin | 0.694 | POST BC | 33.15 | 144.83 | 1706 | 111.68 |
| 35. | metolachlor + | 1.68 | PRE BAND | 39.59 | 141.77 | 1670 | 102.18 |
| | prosulfuron | 0.071 | | | | | |
| 36. | metolachlor fb | 1.68 | PRE BAND | 67.09 | 167.65 | 1974 | 100.56 |
| | bromoxynil | 0.56 | POST BC | | | | |
| 37. | dimethenamid + | 0.84 | PRE BAND | 37.82 | 131.36 | 1547 | 93.54 |
| | prosulfuron | 0.071 | | | | | |
| 38. | metolachlor fb | 1.68 | PRE BAND | 45.50 | 136.24 | 1604 | 90.74 |
| | halosulfuron +COC | 0.047 | POST BAND | | | | |
| 39. | prosulfuron | 0.071 | PRE BC | 58.17 | 139.75 | 1646 | 81.58 |
| 40. | bromoxynil | 0.56 | POST BC | 44.02 | 114.42 | 1348 | 70.40 |
| | LSD (0.05) | | | NS[c] | 46.13 | 551 | 46.13 |

[a]Treatments are listed in descending net return; fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[c]NS, not statistically estimateable.

*Appendix Table 4.* Three-year conventional tillage experiment grain sorghum ratings for crop injury and weed control in 1997.

| | | | | Crop Injury[a] | Palmer amaranth | | | Large crabgrass | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatment[b] | | Rate | Timing[c] | 4 WAP | 3 WAP | 4 WAP | 8 WAP | 3 WAP | 4 WAP | 8 WAP |
| | | kg ai/ha | | % | % Control | | | | | |
| 1. | metolachlor + | 1.68 | PRE BAND | 0 | 63 | 89 | 84 | 78 | 99 | 99 |
| | propazine | 1.12 | | | | | | | | |
| 2. | metolachlor fb | 1.68 | PRE BAND | 18 | 73 | 98 | 99 | 84 | 99 | 99 |
| | atrazine + COC | 1.12 | POST BAND | | | | | | | |
| 3. | metolachlor fb | 1.68 | PRE BAND | 20 | 65 | 98 | 91 | 80 | 95 | 95 |
| | atrazine + COC | 1.12 | POST BC | | | | | | | |
| 4. | atrazine + COC | 1.12 | POST BAND | 20 | 18 | 98 | 90 | 13 | 85 | 75 |
| 5. | metolachlor fb | 1.68 | PRE BAND | 28 | 70 | 55 | 85 | 69 | 50 | 96 |
| | prosulfuron + COC | 0.071 | POST BAND | | | | | | | |
| 6. | metolachlor fb | 1.68 | PRE BAND | 18 | 70 | 89 | 95 | 78 | 65 | 45 |
| | 2,4-D | 0.56 | POST BC | | | | | | | |
| 7. | metolachlor + | 1.68 | PRE BAND | 18 | 70 | 89 | 89 | 74 | 94 | 96 |
| | propazine fb | 1.12 | | | | | | | | |
| | atrazine + COC | 1.12 | POST BAND | | | | | | | |
| 8. | halosulfuron + COC | 0.047 | POST BAND | 23 | ND[d] | 93 | 88 | ND | 83 | 94 |
| 9. | prosulfuron + COC | 0.071 | POST BAND | 10 | ND | 95 | 99 | ND | 85 | 88 |
| 10. | 2,4-D | 0.56 | POST BAND | 25 | ND | 76 | 95 | ND | 70 | 66 |
| 11. | dicamba | 0.28 | POST BAND | 8 | ND | 93 | 96 | ND | 93 | 89 |
| 12. | metolachlor fb | 1.68 | PRE BAND | 28 | 70 | 93 | 98 | 75 | 99 | 98 |
| | dicamba | 0.28 | POST BAND | | | | | | | |
| 13. | atrazine + dicamba | 0.672 | POST BAND | 15 | ND | 78 | 83 | ND | 85 | 98 |
| 14. | bromoxynil | 0.56 | POST BAND | 23 | ND | 84 | 91 | ND | 79 | 95 |
| 15. | dimethenamid | 0.84 | PRE BAND | 8 | 83 | 78 | 79 | 88 | 83 | 95 |
| 16. | propazine | 1.12 | PRE BAND | 15 | 78 | 93 | 91 | 78 | 85 | 81 |
| 17. | metolachlor + | 1.68 | PRE BAND | 0 | 68 | 80 | 91 | 73 | 88 | 98 |
| | prosulfuron | 0.071 | | | | | | | | |
| 18. | metolachlor fb | 1.68 | PRE BAND | 30 | 50 | 89 | 90 | 63 | 90 | 74 |
| | atrazine + dicamba | 0.672 | POST BAND | | | | | | | |
| 19. | cultivated check | --- | --- | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20. | metolachlor | 1.68 | PRE BAND | 13 | 76 | 73 | 36 | 73 | 99 | 99 |
| | LSD (0.05) | | | 13 | 19 | 23 | 18 | 12 | 29 | 23 |

[a]No crop injury was observed at the 3 WAP and 8 WAP rating dates.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[c]BC, broadcast application; BAND, banded application. All banded treatments were cultivated twice.

[d]ND, no data, at time of rating treatment had not been applied.

*Appendix Table 4. (cont.)* Three-year conventional tillage experiment grain sorghum ratings for crop injury and weed control in 1997.

| | | | | Crop Injury[a] | Palmer amaranth | | | Large crabgrass | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatment[b] | | Rate | Timing[c] | 4 WAP | 3 WAP | 4 WAP | 8 WAP | 3 WAP | 4 WAP | 8 WAP |
| | | kg ai/ha | | % | % Control | | | | | |
| 21. | prosulfuron | 0.071 | PRE BC | 10 | 71 | 80 | 75 | 91 | 45 | 45 |
| 22. | pendimethalin | 0.694 | POST BC | 3 | ND[d] | 58 | 81 | ND | 73 | 95 |
| 23. | metolachlor fb | 1.68 | PRE BAND | 30 | 73 | 83 | 90 | 80 | 20 | 89 |
| | halosulfuron + COC | 0.047 | POST BAND | | | | | | | |
| 24. | dimethenamid + | 0.84 | PRE BAND | 18 | 68 | 58 | 86 | 85 | 35 | 95 |
| | propazine | 1.12 | | | | | | | | |
| 25. | metolachlor | 1.68 | PRE BC | 5 | 83 | 50 | 20 | 91 | 89 | 83 |
| 26. | dimethenamid + | 0.84 | PRE BAND | 10 | 55 | 86 | 95 | 85 | 88 | 91 |
| | prosulfuron | 0.071 | | | | | | | | |
| 27. | atrazine + COC | 1.12 | POST BC | 33 | ND | 100 | 100 | ND | 39 | 13 |
| 28. | metolachlor fb | 1.68 | PRE BAND | 40 | 75 | 63 | 96 | 80 | 30 | 79 |
| | bromoxynil | 0.56 | POST BAND | | | | | | | |
| 29. | 2,4-D | 0.56 | POST BC | 40 | ND | 98 | 98 | ND | 28 | 13 |
| 30. | prosulfuron | 0.071 | PRE BAND | 10 | 78 | 73 | 84 | 88 | 35 | 66 |
| 31. | metolachlor fb | 1.68 | PRE BAND | 18 | 73 | 60 | 59 | 78 | 35 | 96 |
| | 2,4-D | 0.56 | POST BC | | | | | | | |
| 32. | metolachlor fb | 1.68 | PRE BAND | 18 | 55 | 75 | 95 | 75 | 20 | 33 |
| | dicamba | 0.28 | POST BC | | | | | | | |
| 33. | dicamba | 0.28 | POST BC | 28 | ND | 95 | 100 | ND | 13 | 3 |
| 34. | dimethenamid | 0.84 | PRE BC | 18 | 90 | 79 | 65 | 90 | 78 | 86 |
| 35. | metolachlor fb | 1.68 | PRE BAND | 25 | 76 | 99 | 100 | 84 | 29 | 21 |
| | atrazine + dicamba | 0.672 | POST BC | | | | | | | |
| 36. | atrazine + dicamba | 0.672 | POST BC | 25 | ND | 98 | 100 | ND | 28 | 10 |
| 37. | metolachlor fb | 1.68 | PRE BAND | 28 | 60 | 90 | 99 | 76 | 60 | 84 |
| | bromoxynil | 0.56 | POST BC | | | | | | | |
| 38. | check | --- | --- | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 39. | bromoxynil | 0.56 | POST BC | 33 | ND | 95 | 100 | ND | 38 | 15 |
| 40. | propazine | 1.12 | PRE BC | 20 | 64 | 90 | 88 | 90 | 45 | 33 |
| | LSD (0.05) | | | 13 | 19 | 23 | 18 | 12 | 29 | 23 |

[a]No crop injury was observed at the 3 WAP and 8 WAP rating dates.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[c]BC, broadcast application; BAND, banded application. All banded treatments were cultivated twice.

[d]ND, no data, at time of rating treatment had not been applied.

*Appendix Table 5.* Three-year conventional tillage experiment grain sorghum ratings for crop injury and weed control in 1998.

| | | | Palmer amaranth | | | Large crabgrass | | | Morningglory spp.[a] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment[b] | Rate | Timing[c] | 4 WAP | 8 WAP | 14 WAP | 4 WAP | 8 WAP | 14 WAP | 4 WAP | 8 WAP | 14 WAP |
| | kg ai/ha | | % Control | | | | | | | | |
| 1. metolachlor fb | 1.68 | PRE BAND | 99 | 98 | 99 | 55 | 94 | 80 | 100 | 95 | 100 |
| 2,4-D | 0.56 | POST BC | | | | | | | | | |
| 2. metolachlor fb | 1.68 | PRE BAND | 100 | 98 | 98 | 75 | 90 | 88 | 100 | 94 | 78 |
| dicamba | 0.28 | POST BC | | | | | | | | | |
| 3. dimethenamid | 0.84 | PRE BC | 96 | 99 | 98 | 99 | 100 | 100 | 98 | 70 | 100 |
| 4. metolachlor fb | 1.68 | PRE BAND | 99 | 90 | 95 | 99 | 89 | 95 | 100 | 96 | 100 |
| dicamba | 0.28 | POST BAND | | | | | | | | | |
| 5. 2,4-D | 0.56 | POST BAND | ND[d] | 99 | 84 | ND | 33 | 59 | ND | 98 | 75 |
| 6. dicamba | 0.28 | POST BAND | ND | 89 | 75 | ND | 18 | 35 | ND | 73 | 100 |
| 7. metolachlor | 1.68 | PRE BC | 90 | 89 | 88 | 100 | 98 | 100 | 93 | 71 | 98 |
| 8. 2,4-D | 0.56 | POST BC | ND | 91 | 95 | ND | 0 | 0 | ND | 100 | 100 |
| 9. metolachlor fb | 1.68 | PRE BAND | 98 | 91 | 81 | 100 | 85 | 75 | 99 | 85 | 100 |
| 2,4-D | 0.56 | POST BC | | | | | | | | | |
| 10. metolachlor | 1.68 | PRE BAND | 98 | 69 | 88 | 100 | 78 | 100 | 98 | 73 | 74 |
| 11. cultivated check | --- | --- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12. metolachlor fb | 1.68 | PRE BAND | 99 | 98 | 89 | 100 | 98 | 98 | 99 | 70 | 98 |
| atrazine + COC | 1.12 | POST BAND | | | | | | | | | |
| 13. dicamba | 0.28 | POST BC | ND | 73 | 98 | ND | 0 | 5 | ND | 100 | 100 |
| 14. metolachlor fb | 1.68 | PRE BAND | 99 | 90 | 91 | 100 | 76 | 98 | 100 | 98 | 100 |
| atrazine + dicamba | 0.672 | POST BC | | | | | | | | | |
| 15. check | --- | --- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16. metolachlor fb | 1.68 | PRE BAND | 95 | 84 | 78 | 100 | 84 | 95 | 95 | 95 | 98 |
| atrazine + dicamba | 0.672 | POST BAND | | | | | | | | | |
| 17. propazine | 1.12 | PRE BC | 99 | 96 | 98 | 81 | 33 | 45 | 100 | 95 | 100 |
| 18. metolachlor + | 1.68 | PRE BAND | 100 | 94 | 96 | 100 | 95 | 96 | 100 | 70 | 100 |
| prosulfuron | 0.071 | | | | | | | | | | |
| 19. atrazine + COC | 1.12 | POST BC | ND | 75 | 95 | ND | 0 | 18 | ND | 98 | 100 |
| 20. atrazine + COC | 1.12 | POST BAND | ND[d] | 44 | 64 | ND | 58 | 75 | ND | 96 | 100 |
| 21. dimethenamid | 0.84 | PRE BAND | 99 | 61 | 86 | 88 | 89 | 71 | 95 | 46 | 80 |
| LSD (0.05) | | | NSD[e] | 34 | 32 | 29 | 40 | 31 | NSD | NSD | NSD |

[a]Morningglory species were ivyleaf and tall.

[b]fb, followed by; COC, crop oil concentrate was applied at a rate of 2.33 L ha.

[c]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[d]ND, no data at time of rating treatment had not been applied.

[e]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 5. (cont.)* Three-year conventional tillage experiment grain sorghum ratings for crop injury and weed control in 1998.

| | | | Palmer amaranth | | | Large crabgrass | | | Morningglory spp.[a] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treatment[b]** | **Rate** | **Timing[c]** | **4 WAP** | **8 WAP** | **14 WAP** | **4 WAP** | **8 WAP** | **14 WAP** | **4 WAP** | **8 WAP** | **14 WAP** |
| | **kg ai/ha** | | | | | **% Control** | | | | | |
| 22. dimethenamid + | 0.84 | PRE BAND | 100 | 96 | 96 | 100 | 93 | 95 | 100 | 94 | 100 |
| propazine | 1.12 | | | | | | | | | | |
| 23. propazine | 1.12 | PRE BAND | 99 | 74 | 78 | 84 | 50 | 70 | 100 | 96 | 100 |
| 24. metolachlor + | 1.68 | PRE BAND | 100 | 99 | 99 | 88 | 100 | 100 | 100 | 100 | 100 |
| propazine fb | 1.12 | | | | | | | | | | |
| atrazine + COC | 1.12 | POST BAND | | | | | | | | | |
| 25. bromoxynil | 0.56 | POST BAND | ND | 61 | 71 | ND | 18 | 30 | ND | 98 | 98 |
| 26. atrazine + dicamba | 0.672 | POST BAND | ND | 65 | 51 | ND | 24 | 73 | ND | 93 | 100 |
| 27. metolachlor + | 1.68 | PRE BAND | 99 | 91 | 93 | 100 | 89 | 100 | 100 | 93 | 100 |
| propazine | 1.12 | | | | | | | | | | |
| 28. prosulfuron + COC | 0.071 | POST BAND | ND | 53 | 49 | ND | 49 | 58 | ND | 98 | 100 |
| 29. atrazine + dicamba | 0.672 | POST BC | ND | 61 | 69 | ND | 21 | 10 | ND | 95 | 100 |
| 30. dimethenamid + | 0.84 | PRE BAND | 100 | 98 | 98 | 75 | 94 | 94 | 98 | 88 | 99 |
| prosulfuron | 0.071 | | | | | | | | | | |
| 31. pendimethalin | 0.694 | POST BC | ND | 43 | 49 | ND | 84 | 80 | ND | 100 | 73 |
| 32. prosulfuron + COC | 0.071 | POST BAND | ND | 73 | 58 | ND | 53 | 60 | ND | 95 | 100 |
| 33. metolachlor fb | 1.68 | PRE BAND | 94 | 90 | 78 | 100 | 95 | 85 | 75 | 76 | 95 |
| bromoxynil | 0.56 | POST BAND | | | | | | | | | |
| 34. prosulfuron | 0.071 | PRE BAND | 90 | 86 | 80 | 43 | 71 | 78 | 99 | 100 | 100 |
| 35. metolachlor fb | 0.84 | PRE BAND | 95 | 100 | 100 | 100 | 98 | 100 | 100 | 94 | 100 |
| atrazine + COC | 1.12 | POST BC | | | | | | | | | |
| 36. metolachlor fb | 1.68 | PRE BAND | 99 | 93 | 88 | 100 | 76 | 100 | 76 | 100 | 100 |
| prosulfuron + COC | 0.071 | POST BAND | | | | | | | | | |
| 37. metolachlor fb | 1.68 | PRE BAND | 91 | 98 | 91 | 100 | 99 | 100 | 100 | 98 | 95 |
| halosulfuron + COC | 0.047 | POST BAND | | | | | | | | | |
| 38. metolachlor fb | 1.68 | PRE BAND | 96 | 91 | 91 | 100 | 98 | 98 | 100 | 100 | 100 |
| bromoxynil | 0.56 | POST BC | | | | | | | | | |
| 39. prosulfuron | 0.071 | PRE BC | 100 | 100 | 99 | 8 | 8 | 0 | 100 | 100 | 100 |
| 40. bromoxynil | 0.56 | POST BC | ND[d] | 0 | 23 | ND | 24 | 18 | ND | 95 | 100 |
| LSD (0.05) | | | NSD[e] | 34 | 32 | 29 | 40 | 31 | NSD | NSD | NSD |

[a]Morningglory species were ivyleaf and tall.

[b]fb, followed by; COC, crop oil concentrate was applied at a rate of 2.33 L ha.

[c]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[d]ND, no data at time of rating treatment had not been applied.

[e]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 6.* Three-year conventional tillage experiment grain sorghum ratings for crop injury and weed control in 1999.

| | | | Palmer amaranth | | Large crabgrass | | Morningglory spp.[a] | |
|---|---|---|---|---|---|---|---|---|
| **Treatment[b]** | **Rate** | **Timing[c]** | **4 WAP** | **8 WAP** | **4 WAP** | **8 WAP** | **4 WAP** | **8 WAP** |
| | kg ai/ha | | % Control | | | | | |
| 1. propazine | 1.12 | PRE BAND | 100 | 96 | 100 | 95 | 100 | 99 |
| 2. metolachlor fb | 1.68 | PRE BAND | 100 | 93 | 100 | 95 | 90 | 95 |
| atrazine + dicamba | 0.672 | POST BC | | | | | | |
| 3. dimethenamid | 0.84 | PRE BAND | 83 | 93 | 100 | 95 | 100 | 98 |
| 4. metolachlor fb | 1.68 | PRE BAND | 100 | 99 | 100 | 100 | 98 | 100 |
| atrazine + dicamba | 0.672 | POST BAND | | | | | | |
| 5. metolachlor fb | 1.68 | PRE BAND | 91 | 95 | 100 | 88 | 98 | 98 |
| dicamba | 0.28 | POST BC | | | | | | |
| 6. atrazine + dicamba | 0.672 | POST BAND | ND[d] | 46 | ND | 93 | ND | 95 |
| 7. metolachlor | 1.68 | PRE BC | 98 | 91 | 100 | 100 | 83 | 88 |
| 8. metolachlor fb | 1.68 | PRE BAND | 100 | 96 | 100 | 98 | 100 | 98 |
| 2,4-D | 0.56 | POST BC | | | | | | |
| 9. cultivated check | --- | --- | ND | 0 | ND | 0 | ND | 0 |
| 10. prosulfuron | 0.071 | PRE BAND | 100 | 98 | ND | 93 | 98 | 100 |
| 11. metolachlor fb | 0.84 | PRE BAND | 96 | 93 | 100 | 100 | 96 | 100 |
| atrazine + COC | 1.12 | POST BC | | | | | | |
| 12. metolachlor fb | 1.68 | PRE BAND | 100 | 94 | 100 | 95 | 94 | 100 |
| atrazine + COC | 1.12 | POST BAND | | | | | | |
| 13. metolachlor fb | 1.68 | PRE BAND | 99 | 100 | 100 | 100 | 68 | 100 |
| prosulfuron + COC | 0.071 | POST BAND | | | | | | |
| 14. metolachlor + | 1.68 | PRE BAND | 100 | 100 | 100 | 100 | 100 | 100 |
| propazine | 1.12 | | | | | | | |
| 15. atrazine + dicamba | 0.672 | POST BC | ND | 48 | ND | 73 | ND | 73 |
| 16. metolachlor fb | 1.68 | PRE BAND | 98 | 96 | 100 | 100 | 98 | 100 |
| 2,4-D | 0.56 | POST BC | | | | | | |
| 17. 2,4-D | 0.56 | POST BC | ND[d] | 74 | ND | 89 | ND | 98 |
| 18. dimethenamid | 0.84 | PRE BC | 96 | 98 | 100 | 83 | 96 | 91 |
| 19. dimethenamid + | 0.84 | PRE BAND | 100 | 100 | 100 | 96 | 100 | 100 |
| propazine | 1.12 | | | | | | | |
| LSD (0.05) | | | NSD[e] | 21 | NSD | 22 | 10 | 22 |

[a]Morningglory species were ivyleaf and tall.

[b]fb, followed by; COC, crop oil concentrate was applied at a rate of 2.33 L ha.

[c]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[d]ND, no data at time of rating treatment had not been applied.

[e]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 6. (cont.)* Three-year conventional tillage experiment grain sorghum ratings for crop injury and weed control in 1999.

| | | | Palmer amaranth | | Large crabgrass | | Morningglory spp.[a] | |
|---|---|---|---|---|---|---|---|---|
| **Treatment[b]** | **Rate** | **Timing[c]** | **4 WAP** | **8 WAP** | **4 WAP** | **8 WAP** | **4 WAP** | **8 WAP** |
| | **kg ai/ha** | | **% Control** | | | | | |
| 20. metolachlor | 1.68 | PRE BAND | 100 | 98 | 100 | 100 | 98 | 98 |
| 21. atrazine + COC | 1.12 | POST BC | ND | 0 | ND | 25 | ND | 23 |
| 22. atrazine + COC | 1.12 | POST BAND | ND | 51 | ND | 80 | ND | 95 |
| 23. propazine | 1.12 | PRE BC | 100 | 99 | 98 | 66 | 96 | 98 |
| 24. 2,4-D | 0.56 | POST BAND | ND | 54 | ND | 78 | ND | 99 |
| 25. prosulfuron + COC | 0.071 | POST BAND | ND | 84 | ND | 83 | ND | 75 |
| 26. bromoxynil | 0.56 | POST BAND | ND | 73 | 23 | 91 | ND | 95 |
| 27. dicamba | 0.28 | POST BAND | ND | 75 | 23 | 88 | ND | 100 |
| 28. check | --- | --- | 0 | 0 | 0 | 0 | 0 | 0 |
| 29. dicamba | 0.28 | POST BC | ND | 65 | 27 | 13 | ND | 73 |
| 30. metolachlor fb | 1.68 | PRE BAND | 95 | 98 | 24 | 100 | 98 | 99 |
| bromoxynil | 0.56 | POST BAND | | | | | | |
| 31. prosulfuron + COC | 0.071 | POST BAND | ND | 33 | ND | 78 | ND | 99 |
| 32. metolachlor + | 1.68 | PRE BAND | 100 | 100 | 22 | 95 | 100 | 99 |
| propazine fb | 1.12 | | | | | | | |
| atrazine + COC | 1.12 | POST BAND | | | | | | |
| 33. metolachlor fb | 1.68 | PRE BAND | 100 | 99 | 22 | 100 | 98 | 99 |
| dicamba | 0.28 | POST BAND | | | | | | |
| 34. pendimethalin | 0.694 | POST BC | ND | 74 | ND | 68 | ND | 88 |
| 35. metolachlor + | 1.68 | PRE BAND | 100 | 100 | 100 | 99 | 100 | 100 |
| prosulfuron | 0.071 | | | | | | | |
| 36. metolachlor fb | 1.68 | PRE BAND | 100 | 94 | 87 | 95 | 90 | 99 |
| bromoxynil | 0.56 | POST BC | | | | | | |
| 37. dimethenamid + | 0.84 | PRE BAND | 100 | 100 | 85 | 96 | 98 | 100 |
| prosulfuron | 0.071 | | | | | | | |
| 38. metolachlor fb | 1.68 | PRE BAND | 98 | 96 | 76 | 100 | 95 | 100 |
| halosulfuron + COC | 0.047 | POST BAND | | | | | | |
| 39. prosulfuron | 0.071 | PRE BC | 100 | 100 | 90 | 9 | 100 | 100 |
| 40. bromoxynil | 0.56 | POST BC | ND[d] | 0 | 84 | 0 | ND | 0 |
| LSD (0.05) | | | NSD[e] | 21 | NSD | 22 | 10 | 22 |

[a]Morningglory species were ivyleaf and tall.

[b]fb, followed by; COC, crop oil concentrate was applied at a rate of 2.33 L ha.

[c]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[d]ND, no data at time of rating treatment had not been applied.

[e]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 7.* Three-year conventional tillage experiment counts and heights ranked by net grain sorghum return in 1998.

| | | | Counts | Heights | |
|---|---|---|---|---|---|
| Treatment[a] | Rate | Timing[b] | 5 WAP | 5 WAP | 9 WAP |
| | kg ai/ha | | # 1.5m | cm | |
| 1. metolachlor fb | 1.68 | PRE BAND | 8 | 53 | 110 |
| 2,4-D | 0.56 | POST BC | | | |
| 2. metolachlor fb | 1.68 | PRE BAND | 10 | 53 | 113 |
| dicamba | 0.28 | POST BC | | | |
| 3. dimethenamid | 0.84 | PRE BC | 10 | 58 | 109 |
| 4. metolachlor fb | 1.68 | PRE BAND | 9 | 59 | 115 |
| dicamba | 0.28 | POST BAND | | | |
| 5. 2,4-D | 0.56 | POST BAND | 9 | 62 | 114 |
| 6. dicamba | 0.28 | POST BAND | 9 | 59 | 113 |
| 7. metolachlor | 1.68 | PRE BC | 10 | 62 | 108 |
| 8. 2,4-D | 0.56 | POST BC | 9 | 55 | 106 |
| 9. metolachlor fb | 1.68 | PRE BAND | 9 | 62 | 114 |
| 2,4-D | 0.56 | POST BC | | | |
| 10. metolachlor | 1.68 | PRE BAND | 8 | 58 | 118 |
| 11. cultivated check | --- | --- | 10 | 59 | 114 |
| 12. metolachlor fb | 1.68 | PRE BAND | 10 | 59 | 113 |
| atrazine + COC | 1.12 | POST BAND | | | |
| 13. dicamba | 0.28 | POST BC | 7 | 54 | 108 |
| 14. metolachlor fb | 1.68 | PRE BAND | 6 | 53 | 111 |
| atrazine + dicamba | 0.672 | POST BC | | | |
| 15. check | --- | --- | 9 | 59 | 114 |
| 16. metolachlor fb | 1.68 | PRE BAND | 9 | 53 | 110 |
| atrazine + dicamba | 0.672 | POST BAND | | | |
| 17. propazine | 1.12 | PRE BC | 9 | 64 | 108 |
| 18. metolachlor + | 1.68 | PRE BAND | 11 | 59 | 113 |
| prosulfuron | 0.071 | | | | |
| 19. atrazine + COC | 1.12 | POST BC | 9 | 58 | 107 |
| 20. atrazine + COC | 1.12 | POST BAND | 8 | 60 | 112 |
| LSD (0.05) | | | NSD[c] | 6 | 7 |

[a]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[c]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 7. (cont.)* Three-year conventional tillage experiment counts and heights ranked by net grain sorghum return in 1998.

| | | | Counts | Heights | |
|---|---|---|---|---|---|
| Treatment[a] | Rate | Timing[b] | 5 WAP | 5 WAP | 9 WAP |
| | kg ai/ha | | # 1.5m | cm | |
| 21. dimethenamid | 0.84 | PRE BAND | 9 | 59 | 117 |
| 22. dimethenamid + | 0.84 | PRE BAND | 8 | 55 | 117 |
| propazine | 1.12 | | | | |
| 23. propazine | 1.12 | PRE BAND | 9 | 65 | 113 |
| 24. metolachlor + | 1.68 | PRE BAND | 8 | 58 | 116 |
| propazine fb | 1.12 | | | | |
| atrazine + COC | 1.12 | POST BAND | | | |
| 25. bromoxynil | 0.56 | POST BAND | 9 | 56 | 116 |
| 26. atrazine + dicamba | 0.672 | POST BAND | 7 | 59 | 113 |
| 27. metolachlor + | 1.68 | PRE BAND | 10 | 59 | 114 |
| propazine | 1.12 | PRE BAND | | | |
| 28. prosulfuron + COC | 0.071 | POST BAND | 10 | 53 | 110 |
| 29. atrazine + dicamba | 0.672 | POST BC | 9 | 59 | 108 |
| 30. dimethenamid + | 0.84 | PRE BAND | 10 | 57 | 113 |
| prosulfuron | 0.071 | | | | |
| 31. pendimethalin | 0.694 | POST BC | 10 | 57 | 112 |
| 32. prosulfuron + COC | 0.071 | POST BAND | 10 | 53 | 115 |
| 33. metolachlor fb | 1.68 | PRE BAND | 9 | 53 | 117 |
| bromoxynil | 0.56 | POST BAND | | | |
| 34. prosulfuron | 0.071 | PRE BAND | 9 | 61 | 115 |
| 35. metolachlor fb | 0.84 | PRE BAND | 9 | 58 | 116 |
| atrazine + COC | 1.12 | POST BC | | | |
| 36. metolachlor fb | 1.68 | PRE BAND | 9 | 53 | 113 |
| prosulfuron + COC | 0.071 | POST BAND | | | |
| 37. metolachlor fb | 1.68 | PRE BAND | 10 | 52 | 113 |
| halosulfuron + COC | 0.047 | POST BAND | | | |
| 38. metolachlor fb | 1.68 | PRE BAND | 10 | 57 | 112 |
| bromoxynil | 0.56 | POST BC | | | |
| 39. prosulfuron | 0.071 | PRE BC | 9 | 58 | 104 |
| 40. bromoxynil | 0.56 | POST BC | 9 | 59 | 108 |
| LSD (0.05) | | | NSD[c] | 6 | 7 |

[a]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[c]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 8.* Three-year conventional tillage experiment counts and heights ranked by net grain sorghum return in 1999.

| | | | Counts | Heights | |
|---|---|---|---|---|---|
| Treatment[a] | Rate | Timing[b] | 3 WAP | 3 WAP | 8 WAP |
| | kg ai/ha | | # 1.5m | cm | |
| 1. propazine | 1.12 | PRE BAND | 10 | 24 | 92 |
| 2. metolachlor fb | 1.68 | PRE BAND | 10 | 24 | 94 |
| atrazine + dicamba | 0.672 | POST BC | | | |
| 3. dimethenamid | 0.84 | PRE BAND | 10 | 25 | 89 |
| 4. metolachlor fb | 1.68 | PRE BAND | 9 | 22 | 90 |
| atrazine + dicamba | 0.672 | POST BAND | | | |
| 5. metolachlor fb | 1.68 | PRE BAND | 9 | 22 | 93 |
| dicamba | 0.28 | POST BC | | | |
| 6. atrazine + dicamba | 0.672 | POST BAND | 10 | 30 | 92 |
| 7. metolachlor | 1.68 | PRE BC | 9 | 24 | 104 |
| 8. metolachlor fb | 1.68 | PRE BAND | 11 | 22 | 93 |
| 2,4-D | 0.56 | POST BC | | | |
| 9. cultivated check | --- | --- | 11 | 23 | 89 |
| 10. prosulfuron | 0.071 | PRE BAND | 12 | 23 | 87 |
| 11. metolachlor fb | 0.84 | PRE BAND | 10 | 24 | 90 |
| atrazine + COC | 1.12 | POST BC | | | |
| 12. metolachlor fb | 1.68 | PRE BAND | 13 | 25 | 85 |
| atrazine + COC | 1.12 | POST BAND | | | |
| 13. metolachlor fb | 1.68 | PRE BAND | 9 | 27 | 89 |
| prosulfuron + COC | 0.071 | POST BAND | | | |
| 14. metolachlor + | 1.68 | PRE BAND | 9 | 24 | 88 |
| propazine | 1.12 | | | | |
| 15. atrazine + dicamba | 0.672 | POST BC | 11 | 28 | 86 |
| 16. metolachlor fb | 1.68 | PRE BAND | 11 | 26 | 90 |
| 2,4-D | 0.56 | POST BC | | | |
| 17. 2,4-D | 0.56 | POST BC | 10 | 25 | 87 |
| 18. dimethenamid | 0.84 | PRE BC | 9 | 21 | 92 |
| 19. dimethenamid + | 0.84 | PRE BAND | 10 | 23 | 88 |
| propazine | 1.12 | | | | |
| 20. metolachlor | 1.68 | PRE BAND | 11 | 23 | 86 |
| 21. atrazine + COC | 1.12 | POST BC | 12 | 25 | 85 |
| LSD (0.05) | | | 2 | NSD[c] | 9 |

[a]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[c]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 8. (cont.)* Three-year conventional tillage experiment counts and heights ranked by net grain sorghum return in 1999.

| | | | Counts | Heights | |
|---|---|---|---|---|---|
| Treatment[a] | Rate | Timing[b] | 3 WAP | 3 WAP | 8 WAP |
| | kg ai/ha | | # 1.5m | cm | |
| 22. atrazine + COC | 1.12 | POST BAND | 11 | 26 | 92 |
| 23. propazine | 1.12 | PRE BC | 11 | 23 | 91 |
| 24. 2,4-D | 0.56 | POST BAND | 12 | 23 | 89 |
| 25. prosulfuron + COC | 0.071 | POST BAND | 9 | 25 | 82 |
| 26. bromoxynil | 0.56 | POST BAND | 10 | 23 | 87 |
| 27. dicamba | 0.28 | POST BAND | 10 | 23 | 88 |
| 28. check | --- | --- | 10 | 26 | 93 |
| 29. dicamba | 0.28 | POST BC | 12 | 27 | 92 |
| 30. metolachlor fb | 1.68 | PRE BAND | 10 | 24 | 86 |
| bromoxynil | 0.56 | POST BAND | | | |
| 31. prosulfuron + COC | 0.071 | POST BAND | 11 | 27 | 85 |
| 32. metolachlor + | 1.68 | PRE BAND | 11 | 22 | 90 |
| propazine fb | 1.12 | | | | |
| atrazine + COC | 1.12 | POST BAND | | | |
| 33. metolachlor fb | 1.68 | PRE BAND | 13 | 22 | 87 |
| dicamba | 0.28 | POST BAND | | | |
| 34. pendimethalin | 0.694 | POST BC | 10 | 24 | 84 |
| 35. metolachlor + | 1.68 | PRE BAND | 10 | 21 | 88 |
| prosulfuron | 0.071 | | | | |
| 36. metolachlor fb | 1.68 | PRE BAND | 10 | 21 | 87 |
| bromoxynil | 0.56 | POST BC | | | |
| 37. dimethenamid + | 0.84 | PRE BAND | 12 | 21 | 85 |
| prosulfuron | 0.071 | | | | |
| 38. metolachlor fb | 1.68 | PRE BAND | 11 | 24 | 76 |
| halosulfuron + COC | 0.047 | POST BAND | | | |
| 39. prosulfuron | 0.071 | PRE BC | 10 | 19 | 90 |
| 40. bromoxynil | 0.56 | POST BC | 9 | 26 | 84 |
| LSD (0.05) | | | 2 | NSD[c] | 9 |

[a]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application. All banded treatments were cultivated once.

[c]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 9.* Two-year conventional tillage experiment treatment cost listing ranked by net grain sorghum return in 1998.

| Treatment[a] | | Rate | Timing[b] | Variable cost | Total return | Yield | Net return |
|---|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | kg/ha | $/ha |
| 1. | metolachlor fb | 1.68 | PRE BC NC | 52.24 | 166.50 | 1961 | 114.26 |
| | 2,4-D | 0.56 | POST BC | | | | |
| 2. | metolachlor | 1.68 | PRE BC NC 2C | 40.09 | 139.70 | 1645 | 99.61 |
| 3. | metolachlor + | 1.68 | PRE BAND 2C | 25.74 | 116.07 | 1367 | 90.33 |
| | atrazine | 1.12 | | | | | |
| 4. | metolachlor fb | 1.68 | PRE BC 1C | 64.76 | 154.32 | 1818 | 89.56 |
| | 2,4-D | 0.56 | POST BC | | | | |
| 5. | metolachlor fb | 1.68 | PRE BC NC | 56.79 | 144.41 | 1701 | 87.62 |
| | atrazine + COC | 1.12 | POST BC | | | | |
| 6. | metolachlor + | 1.68 | PRE BC NC | 48.19 | 135.54 | 1596 | 87.35 |
| | atrazine | 1.12 | | | | | |
| 7. | atrazine + COC | 1.12 | POST BC 1C | 29.22 | 109.67 | 1292 | 80.45 |
| 8. | metolachlor + | 1.68 | PRE BAND 2C | 39.59 | 116.66 | 1374 | 77.07 |
| | prosulfuron | 0.071 | | | | | |
| 9. | metolachlor | 1.68 | PRE BAND 2C | 23.07 | 99.38 | 1170 | 76.31 |
| 10. | metolachlor + | 1.68 | PRE BC 1C | 60.71 | 134.21 | 1581 | 73.50 |
| | atrazine | 1.12 | | | | | |
| 11. | metolachlor | 1.68 | PRE BC 1C | 52.61 | 122.33 | 1441 | 69.72 |
| 12. | check | --- | --- | 0.00 | 53.85 | 634 | 53.85 |
| 13. | cultivated check | --- | --- | 12.52 | 65.96 | 777 | 53.44 |
| 14. | metolachlor fb | 1.68 | PRE BAND 1C | 61.21 | 110.14 | 1297 | 48.93 |
| | atrazine + COC | 1.12 | POST BC | | | | |
| 15. | metolachlor fb | 1.68 | PRE BC 1C | 69.31 | 112.01 | 1319 | 42.70 |
| | atrazine + COC | 1.12 | POST BC | | | | |
| 16. | atrazine + COC | 1.12 | POST BC NC | 16.70 | 55.45 | 653 | 38.75 |
| | LSD (0.05) | | | NS[c] | 32.35 | 392 | 32.35 |

[a]Treatments are listed in descending net return; fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivations; two cultivations were not required due to low weed infestations.

[c]NS, not statistically estimateable.

*Appendix Table 10.* Two-year conventional tillage experiment treatment cost listing ranked by net grain sorghum return in 1999.

| Treatment[a] | | Rate | Timing[b] | Variable cost | Total return | Yield | Net return |
|---|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | kg/ha | $/ha |
| 1. | metolachlor fb | 1.68 | PRE BC NC | 56.79 | 186.22 | 2193 | 129.43 |
| | atrazine + COC | 1.12 | POST BC | | | | |
| 2. | metolachlor fb | 1.68 | PRE BC NC | 52.24 | 181.25 | 2135 | 129.01 |
| | 2,4-D | 0.56 | POST BC | | | | |
| 3. | atrazine + COC | 1.12 | PRE BC NC | 16.70 | 143.91 | 1695 | 127.21 |
| 4. | metolachlor + | 1.68 | PRE BC NC | 48.19 | 167.31 | 1971 | 119.12 |
| | atrazine | 1.12 | | | | | |
| 5. | check | --- | --- | 0.00 | 113.10 | 1332 | 113.10 |
| 6. | metolachlor | 1.68 | PRE BAND 2C | 23.07 | 134.52 | 1584 | 111.45 |
| 7. | atrazine + COC | 1.12 | POST BC 1C | 29.22 | 125.44 | 1477 | 96.22 |
| 8. | metolachlor | 1.68 | PRE BC 1C | 52.61 | 140.60 | 1656 | 87.99 |
| 9. | cultivated check | --- | --- | 12.52 | 94.98 | 1172 | 82.46 |
| 10. | metolachlor fb | 1.68 | PRE BC 1C | 69.31 | 149.18 | 1757 | 79.87 |
| | atrazine + COC | 1.12 | POST BC | | | | |
| 11. | metolachlor + | 1.68 | PRE BC 1C | 60.71 | 137.84 | 1623 | 77.13 |
| | atrazine | 1.12 | | | | | |
| 12. | metolachlor + | 1.68 | PRE BAND 2C | 25.74 | 101.36 | 1194 | 75.62 |
| | atrazine | 1.12 | | | | | |
| 13. | metolachlor | 1.68 | PRE BC NC | 40.09 | 106.51 | 1254 | 66.42 |
| 14. | metolachlor fb | 1.68 | PRE BAND 1C | 61.21 | 116.38 | 1371 | 55.17 |
| | atrazine + COC | 1.12 | POST BC | | | | |
| 15. | metolachlor + | 1.68 | PRE BAND 2C | 39.59 | 80.63 | 950 | 41.04 |
| | prosulfuron | 0.071 | | | | | |
| 16. | metolachlor | 1.68 | PRE BC 1C | 64.76 | 87.60 | 1032 | 22.84 |
| | 2,4-D | 0.56 | POST BC | | | | |
| | LSD (0.05) | | | NS[c] | 62.63 | 718 | 62.63 |

[a]Treatments are listed in descending net return; fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivations; two cultivations were not required due to low weed infestations.

[c]NS, not statistically estimateable.

*Appendix Table 11.* Two-year conventional tillage experiment grain sorghum ratings for crop injury and weed control in 1998.

| Treatment[a] | Rate | Timing[b] | Crop Injury 3 WAP | Crop Injury 8 WAP | Palmer amaranth 3 WAP | Palmer amaranth 8 WAP | Palmer amaranth 14 WAP | Large crabgrass 3 WAP | Large crabgrass 8 WAP | Large crabgrass 14 WAP |
|---|---|---|---|---|---|---|---|---|---|---|
| | kg ai/ha | % | | | % Control | | | | | |
| 1. metolachlor fb | 1.68 | PRE BC NC | 0 | 1 | 100 | 99 | 100 | 100 | 100 | 100 |
| 2,4-D | 0.56 | POST BC | | | | | | | | |
| 2. metolachlor | 1.68 | PRE BC NC | 3 | 0 | 100 | 74 | 83 | 100 | 100 | 100 |
| 3. metolachlor + | 1.68 | PRE BAND 2C | 1 | 0 | 75 | 80 | 68 | 100 | 96 | 100 |
| atrazine | 1.12 | | | | | | | | | |
| 4. metolachlor fb | 1.68 | PRE BC 1C | 3 | 1 | 100 | 100 | 100 | 100 | 100 | 100 |
| 2,4-D | 0.56 | POST BC | | | | | | | | |
| 5. metolachlor fb | 1.68 | PRE BC NC | 0 | 0 | 99 | 99 | 98 | 100 | 100 | 100 |
| atrazine + COC | 1.12 | POST BC | | | | | | | | |
| 6. metolachlor + | 1.68 | PRE BC NC | 3 | 0 | 100 | 100 | 100 | 100 | 100 | 100 |
| atrazine | 1.12 | | | | | | | | | |
| 7. atrazine + COC | 1.12 | POST BC 1C | ND[c] | 0 | ND | 64 | 88 | ND | 25 | 43 |
| 8. metolachlor + | 1.68 | PRE BAND 2C | 0 | 0 | 100 | 53 | 65 | 100 | 95 | 100 |
| prosulfuron | 0.071 | | | | | | | | | |
| 9. metolachlor | 1.68 | PRE BAND 2C | 3 | 0 | 93 | 20 | 33 | 100 | 75 | 75 |
| 10. metolachlor + | 1.68 | PRE BC 1C | 0 | 0 | 100 | 99 | 100 | 100 | 100 | 100 |
| atrazine | 1.12 | | | | | | | | | |
| 11. metolachlor | 1.68 | PRE BC 1C | 0 | 0 | 100 | 98 | 95 | 100 | 100 | 100 |
| 12. check | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13. cultivated check | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14. metolachlor fb | 1.68 | PRE BAND 1C | 1 | 3 | 98 | 69 | 75 | 100 | 88 | 95 |
| atrazine + COC | 1.12 | POST BC | | | | | | | | |
| 15. metolachlor fb | 1.68 | PRE BC 1C | 0 | 0 | 96 | 99 | 99 | 100 | 100 | 100 |
| atrazine + COC | 1.12 | POST BC | | | | | | | | |
| 16. atrazine + COC | 1.12 | POST BC NC | ND | 0 | ND | 43 | 44 | ND | 25 | 0 |
| LSD (0.05) | | | NSD[d] | NSD | NSD | 40 | 35 | NSD | 34 | 24 |

[a]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivation's; two cultivations were not required due to low weed infestations.

[c]ND, no data at time of rating treatment had not been applied.

[d]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 12.* Two-year conventional tillage experiment grain sorghum ratings for crop injury and weed control in 1999.

| | | | Crop Injury | | Palmer amaranth | | Large crabgrass | | Morningglory spp.[a] | |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatment[b] | Rate | Timing[c] | 5 WAP | 8 WAP | 5 WAP | 8 WAP | 5 WAP | 8 WAP | 5 WAP | 8 WAP |
| | kg ai/ha | | % | | % Control | | | | | |
| 1. metolachlor fb | 1.68 | PRE BC NC | 4 | 1 | 100 | 99 | 100 | 99 | 93 | 100 |
| atrazine + COC[c] | 1.12 | POST BC | | | | | | | | |
| 2. metolachlor fb | 1.68 | PRE BC NC | 30 | 1 | 100 | 100 | 100 | 100 | 100 | 100 |
| 2,4-D | 0.56 | POST BC | | | | | | | | |
| 3. atrazine + COC | 1.12 | POST BC NC | 3 | 0 | 69 | 25 | 87 | 49 | 96 | 33 |
| 4. metolachlor + | 1.68 | PRE BC NC | 3 | 1 | 100 | 100 | 100 | 98 | 100 | 100 |
| atrazine | 1.12 | | | | | | | | | |
| 5. check | --- | --- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6. metolachlor | 1.68 | PRE BAND 2C | 0 | 6 | 38 | 54 | 94 | 58 | 70 | 71 |
| 7. atrazine + COC | 1.12 | POST BC 1C | 5 | 3 | 88 | 81 | 90 | 98 | 95 | 66 |
| 8. metolachlor | 1.68 | PRE BC 1C | 0 | 5 | 100 | 94 | 100 | 73 | 100 | 100 |
| 9. cultivated check | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10. metolachlor fb | 1.68 | PRE BC 1C | 6 | 1 | 100 | 99 | 100 | 100 | 88 | 100 |
| atrazine + COC | 1.12 | POST BC | | | | | | | | |
| 11. metolachlor + | 1.68 | PRE BC 1C | 0 | 4 | 100 | 99 | 100 | 100 | 96 | 100 |
| atrazine | 1.12 | | | | | | | | | |
| 12. metolachlor + | 1.68 | PRE BAND 2C | 0 | 4 | 86 | 88 | 90 | 91 | 41 | 88 |
| atrazine | 1.12 | | | | | | | | | |
| 13. metolachlor | 1.68 | PRE BC NC | 0 | 0 | 55 | 49 | 100 | 36 | 70 | 50 |
| 14. metolachlor fb | 1.68 | PRE BAND 1C | 8 | 8 | 96 | 94 | 70 | 100 | 100 | 95 |
| atrazine + COC | 1.12 | POST BC | | | | | | | | |
| 15. metolachlor + | 1.68 | PRE BAND 2C | 1 | 4 | 83 | 83 | 93 | 98 | 50 | 90 |
| prosulfuron | 0.071 | | | | | | | | | |
| 16. metolachlor fb | 1.68 | PRE BC 1C | 29 | 11 | 100 | 99 | 100 | 100 | 100 | 98 |
| 2,4-D | 0.56 | POST BC | | | | | | | | |
| LSD (0.05) | | | NSD[d] | NSD | 27 | 35 | NSD | 36 | 34 | 37 |

[a]Morningglory species were ivyleaf and tall.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[c]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivation's; two cultivations were not required due to low weed infestations.

[d]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 13.* Two-year conventional tillage experiment grain sorghum counts and heights ranked by net return in 1998.

| | | | Counts | Heights | |
|---|---|---|---|---|---|
| Treatment[a] | Rate | Timing [b] | 4 WAP | 4 WAP | 9 WAP |
| | kg ai/ha | | # 1.5m | cm | |
| 1. metolachlor fb | 1.68 | PRE BC NC | 8 | 37 | 95 |
| 2,4-D | 0.56 | POST BC | | | |
| 2. metolachlor | 1.68 | PRE BC NC | 8 | 38 | 95 |
| 3. metolachlor + | 1.68 | PRE BAND 2C | 10 | 39 | 101 |
| atrazine | 1.12 | | | | |
| 4. metolachlor fb | 1.68 | PRE BC 1C | 8 | 37 | 93 |
| 2,4-D | 0.56 | POST BC | | | |
| 5. metolachlor fb | 1.68 | PRE BC NC | 10 | 38 | 97 |
| atrazine + COC | 1.12 | POST BC | | | |
| 6. metolachlor + | 1.68 | PRE BC NC | 8 | 38 | 96 |
| atrazine | 1.12 | | | | |
| 7. atrazine + COC | 1.12 | POST BC 1C | 7 | 38 | 102 |
| 8. metolachlor + | 1.68 | PRE BAND 2C | 9 | 37 | 101 |
| prosulfuron | 0.071 | | | | |
| 9. metolachlor | 1.68 | PRE BAND 2C | 8 | 39 | 100 |
| 10. metolachlor + | 1.68 | PRE BC 1C | 9 | 36 | 102 |
| atrazine | 1.12 | | | | |
| 11. metolachlor | 1.68 | PRE BC 1C | 9 | 40 | 105 |
| 12. check | --- | --- | 9 | 38 | 88 |
| 13. cultivated check | --- | --- | 9 | 41 | 95 |
| 14. metolachlor fb | 1.68 | PRE BAND 1C | 8 | 37 | 104 |
| atrazine + COC | 1.12 | POST BC | | | |
| 15. metolachlor fb | 1.68 | PRE BC | 11 | 37 | 104 |
| atrazine + COC | 1.12 | POST BC 1C | | | |
| 16. atrazine + COC | 1.12 | POST BC NC | 7 | 37 | 92 |
| LSD (0.05) | | | NSD[c] | NSD | 8 |

[a]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivation's; two cultivations were not required due to low weed infestations.

[c]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 14.* Two-year conventional tillage experiment grain sorghum counts and heights ranked by net return in 1999.

| | | | Counts | Heights |
|---|---|---|---|---|
| **Treatment**[a] | **Rate** | **Timing**[b] | **8 WAP** | **8 WAP** |
| | **kg ai/ha** | | **# 1.5m** | **cm** |
| 1. metolachlor fb | 1.68 | PRE BC NC | 11 | 90 |
| atrazine + COC | 1.12 | POST BC | | |
| 2. metolachlor fb | 1.68 | PRE BC NC | 9 | 91 |
| 2,4-D | 0.56 | POST BC | | |
| 3. atrazine + COC | 1.12 | POST BC NC | 9 | 90 |
| 4. metolachlor + | 1.68 | PRE BC NC | 12 | 90 |
| atrazine | 1.12 | | | |
| 5. check | --- | --- | 11 | 94 |
| 6. metolachlor fb | 1.68 | PRE BAND 2C | 12 | 90 |
| 7. atrazine + COC | 1.12 | POST BC 1C | 11 | 85 |
| 8. metolachlor | 1.68 | PRE BC 1C | 10 | 87 |
| 9. cultivated check | — | --- | 10 | 85 |
| 10. metolachlor fb | 1.68 | PRE BC 1C | 11 | 84 |
| atrazine + COC | 1.12 | POST BC | | |
| 11. metolachlor + | 1.68 | PRE BC 1C | 11 | 88 |
| atrazine | 1.12 | | | |
| 12. metolachlor + | 1.68 | PRE BAND 2C | 11 | 81 |
| atrazine | 1.12 | | | |
| 13. metolachlor | 1.68 | PRE BC NC | 10 | 89 |
| 14. metolachlor fb | 1.68 | PRE BAND | 9 | 80 |
| atrazine + COC | 1.12 | POST BC 1C | | |
| 15. metolachlor + | 1.68 | PRE BAND 2C | 13 | 87 |
| prosulfuron | 0.071 | | | |
| 16. metolachlor fb | 1.68 | PRE BC 1C | 15 | 92 |
| 2,4-D | 0.56 | POST BC | | |
| LSD (0.05) | | | 2 | 8 |

[a]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivation's; two cultivations were not required due to low weed infestations.

*Table 15.* Two-year drilled no-tillage experiment treatment cost listing ranked by net grain sorghum return in 1998.

| Treatment[a] | | Rate | Timing | Variable cost | Total return | Yield | Net return |
|---|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | kg/ha | $/ha |
| 1. | check | --- | --- | 0.00 | 29.36 | 346 | 29.36 |
| 2. | atrazine + | 2.98 | PRE | 47.23 | 75.29 | 887 | 28.06 |
| | metolachlor | | | | | | |
| 3. | metolachlor fb | 1.68 | PRE | 52.24 | 78.16 | 921 | 25.92 |
| | 2,4-D | 0.56 | POST | | | | |
| 4. | metolachlor + | 1.68 | PRE | 75.61 | 101.16 | 1191 | 25.55 |
| | propazine | 1.12 | | | | | |
| 5. | quinclorac + | 0.14 | POST | 43.45 | 65.43 | 771 | 21.98 |
| | atrazine + COC | 1.12 | | | | | |
| 6. | metolachlor | 1.68 | PRE | 40.09 | 61.62 | 726 | 21.53 |
| 7. | metolachlor fb | 1.68 | PRE | 56.79 | 71.25 | 839 | 14.46 |
| | atrazine + COC | 1.12 | POST | | | | |
| 8. | metolachlor + | 1.68 | PRE | 90.16 | 85.34 | 1005 | -4.82 |
| | prosulfuron | 0.071 | | | | | |
| 9. | halosulfuron + COC | 0.047 | POST | 50.51 | 40.65 | 479 | -9.86 |
| 10. | atrazine + | 2.98 | PRE | 97.29 | 69.75 | 822 | -27.54 |
| | metolachlor + | | | | | | |
| | prosulfuron | 0.071 | | | | | |
| 11. | prosulfuron + COC | 0.071 | POST | 58.66 | 25.60 | 302 | -33.06 |
| | LSD (0.05) | | | NS[b] | 30.41 | 365 | 30.41 |

[a]Treatments are listed in descending net return; fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]NS, not statistically estimateable.

*Table 16.* Two-year drilled no-tillage experiment treatment cost listing ranked by net grain sorghum return in 1999.

| Treatment[a] | | Rate | Timing | Variable cost | Total return | Yield | Net return |
|---|---|---|---|---|---|---|---|
| | | kg ai/ha | | $/ha | $/ha | kg/ha | $/ha |
| 1. | metolachlor fb | 1.68 | PRE | 52.24 | 171.29 | 2018 | 119.05 |
| | 2,4-D | 0.56 | POST | | | | |
| 2. | metolachlor fb | 1.68 | PRE | 56.79 | 154.67 | 1822 | 97.88 |
| | atrazine + COC | 1.12 | POST | | | | |
| 3. | metolachlor | 1.68 | PRE | 40.09 | 120.26 | 1416 | 80.17 |
| 4. | atrazine + | 2.98 | PRE | 47.23 | 121.74 | 1434 | 74.51 |
| | metolachlor | | | | | | |
| 5. | check | --- | --- | 0.00 | 68.60 | 808 | 68.60 |
| 6. | atrazine + | 2.98 | PRE | 97.29 | 158.50 | 1867 | 61.21 |
| | metolachlor + | | | | | | |
| | prosulfuron | 0.071 | | | | | |
| 7. | halosulfuron + COC | 0.047 | POST | 50.51 | 101.98 | 1201 | 51.47 |
| 8. | quinclorac + | 0.14 | POST | 43.45 | 89.44 | 1054 | 45.99 |
| | atrazine + COC | 1.12 | | | | | |
| 9. | metolachlor + | 1.68 | PRE | 75.61 | 106.95 | 1260 | 31.34 |
| | propazine | 1.12 | | | | | |
| 10. | prosulfuron + COC | 0.071 | POST | 58.66 | 84.38 | 993 | 25.72 |
| 11. | metolachlor + | 1.68 | PRE | 90.16 | 111.17 | 1309 | 21.01 |
| | prosulfuron | 0.071 | | | | | |
| | LSD (0.05) | | | NS[b] | 29.88 | 352 | 29.88 |

[a]Treatments are listed in descending net return; fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]NS, not statistically estimateable.

*Appendix Table 17.* Two-year drilled no-tillage experiment grain sorghum ratings for crop injury and weed control ranked by net return in 1998.

| | | | Crop Injury | | Palmer amaranth | | | Large crabgrass | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatment[a] | Rate | Timing[b] | 3 WAP | 8 WAP | 3 WAP | 8 WAP | 14 WAP | 3 WAP | 8 WAP | 14 WAP |
| | kg ai/ha | | % | | % Control | | | | | |
| 1. check | --- | --- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. atrazine + | 2.98 | PRE | 0 | 1 | 100 | 100 | 100 | 100 | 100 | 100 |
| metolachlor | | | | | | | | | | |
| 3. metolachlor fb | 1.68 | PRE | 3 | 10 | 100 | 100 | 78 | 100 | 99 | 100 |
| 2,4-D | 0.56 | POST | | | | | | | | |
| 4. metolachlor + | 1.68 | PRE | 0 | 0 | 100 | 100 | 100 | 100 | 100 | 100 |
| propazine | 1.12 | | | | | | | | | |
| 5. quinclorac + | 0.14 | POST | ND[c] | 0 | ND | 66 | 90 | ND | 43 | 50 |
| atrazine + COC | 1.12 | | | | | | | | | |
| 6. metolachlor | 1.68 | PRE | 0 | 0 | 100 | 98 | 98 | 100 | 100 | 100 |
| 7. metolachlor fb | 1.68 | PRE | 0 | 5 | 100 | 100 | 100 | 100 | 100 | 100 |
| atrazine + COC | 1.12 | POST | | | | | | | | |
| 8. metolachlor + | 1.68 | PRE | 0 | 3 | 100 | 100 | 100 | 100 | 100 | 100 |
| prosulfuron | 0.071 | | | | | | | | | |
| 9. halosulfuron + COC | 0.047 | POST | ND | 8 | ND | 46 | 35 | ND | 50 | 50 |
| 10. atrazine + | 2.98 | PRE | 0 | 0 | 100 | 100 | 100 | 100 | 100 | 100 |
| metolachlor + | | | | | | | | | | |
| prosulfuron | 0.071 | | | | | | | | | |
| 11. prosulfuron + COC | 0.071 | POST | ND | 0 | ND | 10 | 44 | ND | 10 | 50 |
| LSD (0.05) | | | NSD[d] | NSD | NSD | 31 | 30 | NSD | 33 | 44 |

[a]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivation's; two cultivations were not required due to low weed infestations.

[c]ND, no data at time of rating treatment had not been applied.

[d]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 18.* Two-year drilled no-tillage experiment grain sorghum ratings for crop injury and weed control ranked by net return in 1999.

| | | | Crop Injury | Palmer amaranth | Morningglory spp.[a] |
|---|---|---|---|---|---|
| **Treatment**[b] | **Rate** | **Timing**[c] | **7 WAP** | **7 WAP** | **7 WAP** |
| | **kg ai/ha** | | **%** | —— **% Control** —— | |
| 1. metolachlor fb | 1.68 | PRE | 0 | 100 | 95 |
| 2,4-D | 0.56 | POST | | | |
| 2. metolachlor fb | 1.68 | PRE | 0 | 100 | 94 |
| atrazine + COC | 1.12 | POST | | | |
| 3. metolachlor | 1.68 | PRE | 3 | 95 | 0 |
| 4. atrazine + | 2.98 | PRE | 0 | 100 | 85 |
| metolachlor | | | | | |
| 5. check | --- | --- | 0 | 0 | 0 |
| 6. atrazine + | 2.98 | PRE | 0 | 100 | 96 |
| metolachlor + | | | | | |
| prosulfuron | 0.071 | | | | |
| 7. halosulfuron + COC | 0.047 | POST | 4 | 100 | 58 |
| 8. quinclorac + | 0.14 | POST | 1 | 73 | 93 |
| atrazine + COC | 1.12 | | | | |
| 9. metolachlor + | 1.68 | PRE | 0 | 100 | 98 |
| propazine | 1.12 | | | | |
| 10. prosulfuron + COC | 0.071 | POST | 6 | 93 | 60 |
| 11. metolachlor + | 1.68 | PRE | 0 | 100 | 61 |
| prosulfuron | 0.071 | | | | |
| LSD (0.05) | | | NSD[d] | NSD | 35 |

[a]Morningglory species were ivyleaf and tall.

[b]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[c]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivation's; two cultivations were not required due to low weed infestations.

[d]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 19.* Two-year drilled no-tillage experiment counts and heights ranked by net grain sorghum return in 1998.

| | | | Counts | Heights | |
|---|---|---|---|---|---|
| **Treatment**[a] | **Rate** | **Timing**[b] | **4 WAP** | **4 WAP** | **9 WAP** |
| | **kg ai/ha** | | **# 1.5m** | —— cm —— | |
| 1. check | --- | --- | 9 | 38 | 83 |
| 2. atrazine + | 2.98 | PRE | 10 | 36 | 87 |
| metolachlor | | | | | |
| 3. metolachlor fb | 1.68 | PRE | 9 | 41 | 96 |
| 2,4-D | 0.56 | POST | | | |
| 4. metolachlor + | 1.68 | PRE | 9 | 36 | 90 |
| propazine | 1.12 | | | | |
| 5. quinclorac + | 0.14 | POST | 11 | 42 | 99 |
| atrazine + COC | 1.12 | | | | |
| 6. metolachlor | 1.68 | PRE | 12 | 35 | 89 |
| 7. metolachlor fb | 1.68 | PRE | 11 | 39 | 93 |
| atrazine + COC | 1.12 | POST | | | |
| 8. metolachlor + | 1.68 | PRE | 10 | 39 | 90 |
| prosulfuron | 0.071 | | | | |
| 9. halosulfuron + COC | 0.047 | POST | 11 | 38 | 88 |
| 10. atrazine + | 2.98 | PRE | 9 | 35 | 90 |
| metolachlor + | | | | | |
| prosulfuron | 0.071 | | | | |
| 11. prosulfuron + COC | 0.071 | POST | 9 | 36 | 87 |
| LSD (0.05) | | | NSD[c] | NSD | 8 |

[a]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivation's; two cultivations were not required due to low weed infestations.

[c]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

*Appendix Table 20.* Two-year drilled no-tillage experiment counts and heights ranked by net grain sorghum return in 1999.

| | | | Counts | Heights |
|---|---|---|---|---|
| **Treatment[a]** | **Rate** | **Timing[b]** | **7 WAP** | **7 WAP** |
| | **ai ha** | | **# 1.5m** | **cm** |
| 1. metolachlor fb | 1.68 | PRE | 10 | 82 |
| 2,4-D | 0.56 | POST | | |
| 2. metolachlor fb | 1.68 | PRE | 11 | 81 |
| atrazine + COC | 1.12 | POST | | |
| 3. metolachlor | 1.68 | PRE | 9 | 80 |
| 4. atrazine + | 2.98 | PRE | 11 | 81 |
| metolachlor | | | | |
| 5. check | — | — | 10 | 81 |
| 6. atrazine + | 2.98 | PRE | 9 | 80 |
| metolachlor + | | | | |
| prosulfuron | 0.071 | | | |
| 7. halosulfuron + COC | 0.047 | POST | 11 | 62 |
| 8. quinclorac + | 0.14 | POST | 9 | 84 |
| atrazine + COC | 1.12 | | | |
| 9. metolachlor + | 1.68 | PRE | 9 | 81 |
| propazine | 1.12 | | | |
| 10. prosulfuron + COC | 0.071 | POST | 11 | 69 |
| 11. metolachlor + | 1.68 | PRE | 11 | 82 |
| prosulfuron | 0.071 | | | |
| LSD (0.05) | | | NSD[c] | 9 |

[a]fb, followed by; COC, crop oil concentrate applied at a rate of 2.33 L ha.

[b]BC, broadcast application; BAND, banded application; NC, no cultivation; 1C, one cultivation; 2C, two cultivation's; two cultivations were not required due to low weed infestations.

[c]NSD, no significant difference among means at the 0.05 probability level (using the protected LSD).

1

VITA

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Doctor of Philosophy

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