# WEED MANAGEMENT IN CONSERVATION TILLAGE COTTON

**James R. Smart, Joe M. Bradford, and Don J. Makus**
**USDA, ARS**
**Conservation and Production Systems Research**
**Weslaco, TX**

## Abstract

Weed management concerns are a major factor limiting producer adoption of conservation tillage cotton production in South Texas. In conservation tillage systems, pre-plant weeds are chemically controlled with a burn down herbicide, thus leaving the crop residue on the soil surface. Crop residue on the soil surface can interfer with traditional methods of incorporating soil applied herbicides prior to planting. Conservation tillage has several production advantages over conventional tillage systems such as reduced wind and water erosion, reduced time, labor, fuel, equipment, trips over the the field and increased net returns. The primary objective of this study was to determine weed management strategies for no-tillage cotton planted into corn and grain sorghum crop residue compared to conventional tillage cotton production. Weed populations, and plant growth and yield parameters were measured throughout the growing season. Weeds were controlled adequately by cultivation and herbicides currently available such as combinations of pendimethalin plus coteran or clomazone plus coteran. No-tillage cotton planted into corn or grain sorghum stubble show promise in this subtropical, semi-arid environment of the Lower Rio Grande Valley of Texas.

## Introduction

Lack of knowledge of weed management methods in conservation tillage cotton production systems is a major barrier to the adoption of conservation tillage cotton production. The warm subtropical climate of South Texas creates conditions very different from the Midwest United States, where conservation tillage methods are widespread. To assist cotton producers in making decisions regarding conservation tillage in South Texas. USDA-Agricultural Research Service initiated weed management experiments on dryland and irrigated lands in the spring of 1994. Crop residue can intercept soil-applied herbicides and keep them from contacting the soil and being available to control weeds near the soil surface where the weeds are germinating. Crop residue can also interfere with planting and seed placement in the soil if proper equipment is not used in the planting process. Crop residue affects seed placement, closing of the seed furrow, and uniform incorporation of herbicides for weed control. The objective of this study was to determine weed management strategies for no-tillage cotton planted into corn and grain sorghum crop residue compared to conventional tillage cotton production. This study evaluates the effect of tillage and crop residue on weed management and cotton production in conventional tillage conditions, no-tillage dryland grain sorghum stubble, no-tillage irrigated maize stubble which has weathered for seven months, and no-tillage maize stubble which has weathered for only one month.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1550-1556 (1996)
National Cotton Council, Memphis TN

## Materials and Methods

Sixteen weed management treatments, each replicated four times, were examined for cotton planted into maize, and grain sorghum, and conventional tillage (disk, moldboard plow, 2X disk, bed, plant) tillage systems over a two year period. A total of six studies were conducted; 1) in 1994, weed management for dryland cotton planted no-tillage into grain sorghum stubble, and 2) 1995 with 4000 to 5500 kg/ha crop residue on the soil surface; 3)weed management for irrigated cotton planted no-tillage into maize stubble with seven months of stubble weathering, 1994 and 4) 1995 with approximately 9000 and 11,000 kg/ha crop residue on the soil surface; 5) weed management for irrigated cotton planted no-tillage into maize stubble with one month of stubble weathering, 1995 and approximately 5000 kg/ha crop residue on the soil surface (approximately half of the residue originally produced by the maize had been removed mechanically); and 6) weed management for irrigated cotton planted into conventional tillage soil with less than 200 kg/ha crop residue on the soil surface.

### Irrigated site.

The irrigated study was conducted on an Hidalgo silty clay loam soil (hyperthermic Typic Calciustolls) located on the Soil and Water Conservation District Farm north of Weslaco, Texas. Additional soils and precipitation data are listed in Table 1. About 152 mm of water were applied twice in 1994 and four times in 1995 to supplement the 185 and 191 mm of rainfall which fell during the growing seasons (March through July) of 1994 and 1995.

### Dryland site.

The dryland study was conducted on a Brennan fine sandy loam soil (hyperthermic Aridic Haplustalfs) near McCook, Texas in western Hidalgo County. The previous crop was grain sorghum for both 1993 and 1994. Cotton was handpicked twice once at 129 and 139 days after planting (DAP) in 1994 and on 132 and 145 DAP in 1995. Experiments were arranged in a randomized complete block design with four replications of each treatment. Plot size was 4.6 m by 12.2 m and consisted of six crop rows with 0.76 m spacing for all sites.

Two tillage systems, pre-plant no-tillage PPNT and conventional tillage (CT), were used (Table 2). The PPNT treatment was a modified form of ridge tillage and consisted of planting into existing beds which remained from the previous crop where fall and winter weeds were chemically controlled with a burn down type herbicide (glyphosate) 14 days prior to planting. Maize and grain sorghum stalks were not shredded and cotton was planted into existing crop residue except for study number 5 in 1995 where residue was shredded. Maize residue which had weathered for seven months was mostly horizontal on the soil surface and primarily lay in the furrows. Maize residue which was only 1 month old had approximately 50% of the crop residue horizontal and about 50% laying on the soil surface. Conventional tillage soil consisted of shredding the previous corn stalk residue, tandem disking, moldboard plowing, two passes more with a tandem disk, ridging (bedding) the soil, one pass with a bed shaper, and planting cotton. The conventional tillage had 200 kg/ha crop residue or less on the soil surface.

Cotton was planted in late February or early March each year with a John Deere 7200 Maxemerge conservation tillage planter. Different attachments and settings were used for the tillage systems. In the CT system, double disk openers were used to provide a firm level seedbed on top of the ridges. The PPNT treatments were planted with a 0.559 m diameter fluted (50 mm wide flutes) colters mounted in front of the double disk openers to slice through residue. Disk openers and planter boxes had an increased downpressure from springs to achieve the same planting depth (38 mm) as for the CT treatment. Cotton variety DPL-50 was planted at all locations and at a seeding rate of 123,500 seeds per hectare.

All cotton was fertilized twice with 56 kg/ha N applied as liquid N32 with a "CADY" brand spoke wheel applicator. One application was made at 30 and 50 days after planting for a total of 112 kg/ha N. Cotton for all irrigated treatments were irrigated twice in 1994 and four times in 1995 as needed.

All weed control treatments except the postemergence fusilade (POST) were applied pre-emergence in a 0.25 m width band over the seed row and shallowly incorporated with a 0.3 m wide drag tine which simulates incorporation of herbicides applied at planting directly behind the planter closing wheels. The cotton also received two mechanical cultivations with a "Buffalo" brand high residue cultivator. The second cultivation was done with ridging wings to form a water furrow for irrigation and to rebuild beds for the next cropping season. A pre-plant burndown application of glyphosate (0.66 kg/ha) was used in all fields except the conventional tillage cotton. Panicum Texanum L. and Amaranthus Palmeri Wats. were the major grass and broadleaf weed species present at all sites. Field sites in 1995 were overseeded prior to planting with 2.2 kg/ha Amaranthus Palmeri Wats. seed to assure uniform broadleaf weed populations for all treatments and replications.

Fields were scouted twice a week for insect populations or damage for the entire growing season, and control measurements were only taken after insect populations had reached or surpassed threshold levels for cotton at the particular stage of growth for that sampling date. After sampling of insects was completed and populations were determined to surpass thresholds, an insecticide application was made the same day or the following day. Eleven and nine applications of insecticides were needed to manage insects for irrigated cotton during 1994 and 1995. Two insecticide applications were applied to the dryland cotton each year. Insecticides were applied with a high-clearance ground rig or aerially. Insect pests consisted primarily of silverleaf whitefly, Bemisia argentifolii (Bellows and Perring), boll weevil, Anthonomus grandis (Boheman.), bollworm, Helicoverpa zea (Boddie),/tobacco budworm Heliothis virescens (F.). During 1995 beet armyworms Spodoptera exigua were a mid-late season pest and cotton lint yields were suppressed by these pests even with four insecticide applications.
Cotton was defoliated 132 days after planting (DAP) in 1994 and 130 DAP in 1995 with DEF™ (720 g $L^{-1}$) at 1.68 kg/ha plus 0.165 liters/ha Silwett™ (Registered trademark of Loveland Industries Inc., Greely, CO 80632) a spray additive for adsorption and retention. Estimates of cotton lint yield were made by handpicking 4 m of the center 2 rows of 6 row plots. Cotton was handpicked twice, once at 127 and 139 days after planting (DAP) in 1994 and 134 and 145 DAP in 1995.

**Dryland site.**: Planting, fertilization, and insect and weed control were identical to the irrigated site with the following exceptions; insecticide applications were made only two times and Guthion was used for each application.

## Results and Discussion

The soil surface for the conventional tillage cotton at planting time had approximately 2% residue cover which is well below levels needed to reduce wind and water erosion. The soil surface for the pre-plant no-tillage cotton had between 52% and 90% residue cover depending on crop rotation cycles which occurred prior to planting and crop residue (grain sorghum residue was 4,500 to 5000 kg/ha and maize residue was from 5,000 to greater than 10,000 kg/ha for each of the two years).

Weed management treatments varied widely in costs from $31.23/ ha ($6.53 herbicide plus $24.70 for 2 mechanical cultivations) to $69.27/ha ($44.57 herbicide plus 24.70 for 2 mechanical cultivations) (Table 3). The best cotton lint yields were not necessarily associated with the most expensive treatments. Adequate control of Panicum Texanum and Amaranthus Palmerii generally required the use of a combination of herbicides for weed populations to be reduced or eliminated sufficiently to prevent a lint yield loss due to competition from the weeds. Caporal applied alone caused crop injury and lint yield reductions of up to 48% compared with pendimethalin in three of the six experiments (Tables 5, 6, 7). Caporal applied in combination with clomazone plus a disyston seed safener also caused unacceptable (27%, 44%, and 47%) lint yield reductions in three of the six experiments. When caporal was used in combination with coteran, lint yields were not affected by the herbicides. Caporal plus coteran not only caused less injury to cotton than caporal alone or in combination with clomazone but also controlled grass and weed species better in three of the six studies.

Clomazone (plus seed safener disyston) plus coteran (treatment 12, Tables 4-9) provided excellent weed control over a wide range of crop residue levels in the irrigated and dryland conditions. Herbicide combinations with clomazone and two or more herbicides (treatments 13, 14, 15, Table 3, and 4-9) generally were much more expensive and did not provide better weed control than many of the two-herbicide combinations with clomazone (treatments 10,11, 12, Tables 3, and 4-9). Herbicide combinations with caporal, especially clomazone plus caporal, tended to reduce cotton lint yield and increase early season crop injury.

Pendimethalin plus either coteran or fusilade applied postemergence to cotton provided very good weed control with very little crop injury. Pendimethalin plus coteran worked well for weed control in all levels of crop residue. A postemergence application of fusilade could control mid to late season germinating grasses for any of the herbicide treatments and would probably be an option producers could choose after grasses were observed to be germinating 30 or more days after planting.

We conclude that the no-tillage cotton planted into corn or grain sorghum stubble show promise in this subtropical, semi-arid environment of the Lower Rio Grande Valley of Texas. Cotton produced under conservation tillage systems have been quite successful in Southern Texas and presumably would be in northeastern Mexico. Weeds can be controlled adequately by cultivation and herbicides currently available. Economics favor a reduced tillage system. Furthermore, wind erosion can be greatly reduced by maintaining higher levels of crop residue on the soil surface.

Table 1. Annual rainfall, soil type, and selected soil percentages at dryland and irrigated study sites, Mission and Weslaco, Texas.

| Location | Rainfall (mm) 1994 | Rainfall (mm) 1995 | Soil type | Texture % sand | Texture % sil | Texture % clay | Organic carbon | pH |
|---|---|---|---|---|---|---|---|---|
| Moore Field, Mission, TX (dryland) | 432 | 399 | Brennan fine sandy loam | 63 | 21 | 16 | 1.54 | 7.6 |
| ARS Farm Weslaco, TX (irrigated) | 556 | 279 | Hidalgo, sandy clay loam | 56 | 19 | 25 | 1.23 | 8.0 |

Table 2. Description of tillage systems at dryland and irrigated sites at McCook and Weslaco, Texas 1994, and 1995.

| Conventional (CT) | Pre-Plant No-tillage (PPNT) |
|---|---|
| shred residue | shred residue if needed |
| disk | ----- |
| moldboard plow | ---- |
| 2 X disk | ----- |
| form beds | ----- |
| shape & cult. beds (3) | spray weeds (2) |
| plant | plant |
| cultivate (2) | cultivate (2) |

Table 3. No-tillage pre-emergence herbicide combinations applied in a 25.4 cm wide band for weed control in cotton and their cost per hectare (all chemicals would be applied at planting in a band with the planter except the fluazifop POST which would be applied postemergence broadcast with an application cost of $ 6.18/ha.

| treatment | dosage kg/ha | chemical U.S. $/ha | total herbicide U.S.$ / ha |
|---|---|---|---|
| 1. pendimethalin | 1.12 | 6.53 | $ 6.53 |
| 2. caporal | 1.80 | 10.89 | $10.89 |
| 3. coteran | 1.34 | 9.82 | $ 9.82 |
| 4. pendimethalin | 1.12 | 6.53 | $ 6.53 |
| +coteran | 1.34 | 9.82 | |
| 5. pendimethalin | 1.12 | 6.53 | $ 17.42 |
| +caporal | 1.80 | 10.89 | |
| 6. caporal | 1.80 | 10.89 | $ 20.72 |
| +coteran | 1.34 | 9.83 | |
| 7. caporal | 1.80 | 10.89 | $ 27.25 |
| +coteran | 1.34 | 9.82 | |
| +pendimethalin | 1.12 | 6.53 | |
| 8. pendimethalin | 1.12 | 6.53 | $ 27.68 |
| +fluazifop | 0.17 POST | 21.13 | |
| 9. clomazone 1.12 | 16.00 | $ 17.32 | |
| + disyston[b] | 1.10 | 1.32 | |
| 10. clomazone | 1.12 | 16.00 | $ 23.85 |
| + disyston[b] | 1.10 | 1.32 | |
| +pendimethalin | 1.12 | 6.53 | |
| 11. clomazone | 1.12 | 16.00 | $28.21 |
| + disyston[b] | 1.10 | 1.32 | |
| +caporal | 1.80 | 32.67 | |
| 12. clomazone | 1.12 | 16.00 | $27.14 |
| + disyston[b] | 1.10 | 1.32 | |
| + coteran | 1.34 | 9.83 | |
| 13. clomazone | 1.12 | 16.00 | $38.04 |
| + disyston[b] | 1.10 | 1.32 | |
| + coteran | 1.34 | 9.83 | |
| +caporal | 1.80 | 10.89 | |
| 14. clomazone | 1.12 | 16.00 | $34.74 |
| + disyston[b] | 1.10 | 1.32 | |
| +pendimethalin | 1.12 | 6.53 | |
| +caporal | 1.80 | 10.89 | |
| 15. clomazone | 1.12 | 16.00 | $44.57 |
| + disyston[b] | 1.10 | 1.32 | |
| +pendimethalin | 1.12 | 6.53 | |
| +caporal | 1.80 | 10.89 | |
| + coteran | 1.34 | 9.82 | |
| 16no herbicide, 2 mech. cultivations | | 24.70 | $24.70 |

[b] Applied at planting in-furrow with the cotton seed as a seed safener for clomazone.

Table 4. No-tillage pre-emergence herbicide combinations for weed control in irrigated cotton applied in maize residue which exceeded 10,000 kg/ha at Weslaco, Texas, 1994 .

| treatment | dosage kg/ha | Panicum[a] Texanum plts/10 m$^2$ | Palmer[a] Amaranth plts/10 m$^2$ | crop injury % | lint yield kg/ha |
|---|---|---|---|---|---|
| 1. pendimethalin | 1.12 | 4 | 14 | 0 | 615 |
| 2. caporal | 1.80 | 2 | 1 | 3 | 620 |
| 3. coteran | 1.34 | 2 | 3 | 3 | 627 |
| 4. pendimethalin | 1.12 | 4 | 24 | 0 | 692 |
| +coteran | 1.34 | | | | |
| 5. pendimethalin | 1.12 | 4 | 2 | 3 | 690 |
| +caporal | 1.80 | | | | |
| 6. caporal | 1.80 | 1 | 1 | 5 | 624 |
| +coteran | 1.34 | | | | |
| 7. caporal | 1.80 | 1 | 1 | 5 | 599 |
| +coteran | 1.34 | | | | |
| +pendimethalin | 1.12 | | | | |
| 8. pendimethalin | 1.12 | 2 | 1 | 5 | 574 |
| +fluazifop | 0.17 POST | | | | |
| 9. clomazone | 1.12 | 3 | 9 | 0 | 692 |
| + disyston[b] | 1.10 | | | | |
| 10. clomazone | 1.12 | 2 | 6 | 6 | 751 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| 11. clomazone | 1.12 | 1 | 4 | 5 | 681 |
| + disyston[b] | 1.10 | | | | |
| +caporal | 1.80 | | | | |
| 12.c lomazone | 1.12 | 2 | 2 | 0 | 763 |
| + disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| 13. clomazone | 1.12 | 1 | 1 | 5 | 763 |
| + disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| +caporal | 1.80 | | | | |
| 14. clomazone | 1.12 | 1 | 1 | 15 | 522 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| 15. clomazone | 1.12 | 2 | 1 | 8 | 606 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| + coteran | 1.34 | | | | |
| 16. no herbicide, 2 mech. cultivations | | 24 | 46 | 0 | 602 |
| Least significant difference (α=0.05) | | 4 | 3 | 7 | 286 |

[a] Weed counts were taken 56 days after planting, all treatments were applied the day of planting except Post treatments which were applied 42 days after planting.
[b] Applied at planting in-furrow with the cotton seed as a seed safener for clomazone.

Table 5. No-tillage pre-emergence herbicide combinations for weed control in irrigated cotton applied in maize residue which exceeded 10,000 kg/ha at Weslaco, Texas, 1995 .

| treatment | dosage kg/ha | Panicum[a] Texanum plts/10 m$^2$ | Palmer[a] Amaranth plts/10 m$^2$ | crop injury % | lint yield kg/ha |
|---|---|---|---|---|---|
| 1. pendimethalin | 1.12 | 13 | 64 | 0 | 459 |
| 2. caporal | 1.80 | 8 | 17 | 25 | 239 |
| 3. coteran | 1.34 | 17 | 47 | 20 | 300 |
| 4. pendimethalin | 1.12 | 3 | 27 | 0 | 633 |
| +coteran | 1.34 | | | | |
| 5. pendimethalin | 1.12 | 2 | 18 | 0 | 329 |
| +caporal | 1.80 | | | | |
| 6. caporal | 1.80 | 3 | 2 | 0 | 511 |
| +coteran | 1.34 | | | | |
| 7. caporal | 1.80 | 0 | 1 | 10 | 548 |
| +coteran | 1.34 | | | | |
| +pendimethalin | 1.12 | | | | |
| 8. pendimethalin | 1.12 | 2 | 9 | 0 | 523 |
| +fluazifop | 0.17 POST | | | | |
| 9. clomazone | 1.12 | 2 | 10 | 10 | 419 |
| + disyston[b] | 1.10 | | | | |
| 10.clomazone | 1.12 | 7 | 65 | 10 | 540 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| 11.clomazone | 1.12 | 4 | 9 | 25 | 243 |
| + disyston[b] | 1.10 | | | | |
| +caporal | 1.80 | | | | |
| 12.clomazone | 1.12 | 9 | 36 | 10 | 711 |
| + disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| 13.clomazone | 1.12 | 11 | 4 | 10 | 477 |
| + disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| +caporal | 1.80 | | | | |
| 14.clomazone | 1.12 | 5 | 1 | 10 | 435 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| 15.clomazone | 1.12 | 2 | 7 | 10 | 444 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| + coteran | 1.34 | | | | |
| 16.no herbicide, 2 mech. cultivations | | 13 | 63 | 0 | [illegible] |
| Least significant difference (α=0.05) | | 10 | 8 | 16 | 274 |

[a] Weed counts were taken 56 days after planting, all treatments were applied the day of planting except Post treatments which were applied 42 days after planting.
[b] Applied at planting in-furrow with the cotton seed as a seed safener for clomazone.

Table 6. Pre-emergence herbicide combinations for weed control in irrigated cotton applied in conventional tillage (disk, moldboard plow, 2X disk) with less than 200 kg/ha crop residue on the soil surface at Weslaco, Texas 1995.

| treatment | dosage kg/ha | Panicum[a] Texanum plts/10 m$^2$ | Palmer[a] Amaranth plts/10 m$^2$ | crop injury % | lint yield kg/ha |
|---|---|---|---|---|---|
| 1. pendimethalin | 1.12 | 20 | 922 | 0 | 461 |
| 2. caporal | 1.80 | 23 | 1149 | 25 | 211 |
| 3. coteran | 1.34 | 17 | 47 | 25 | 217 |
| 4. pendimethalin | 1.12 | 5 | 588 | 0 | 515 |
| +coteran | 1.34 | | | | |
| 5. pendimethalin | 1.12 | 24 | 291 | 10 | 435 |
| +caporal | 1.80 | | | | |
| 6. caporal | 1.80 | 12 | 124 | 0 | 704 |
| +coteran | 1.34 | | | | |
| 7. caporal | 1.80 | 8 | 393 | 10 | 425 |
| +coteran | 1.34 | | | | |
| +pendimethalin | 1.12 | | | | |
| 8. pendimethalin | 1.12 | 15 | 320 | 10 | 476 |
| +fluazifop | 0.17 POST | | | | |
| 9. clomazone | 1.12 | 8 | 612 | 25 | 303 |
| + disyston[b] | 1.10 | | | | |
| 10.clomazone | 1.12 | 4 | 337 | 0 | 600 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| 11.clomazone | 1.12 | 11 | 332 | 25 | 340 |
| + disyston[b] | 1.10 | | | | |
| +caporal | 1.80 | | | | |
| 12.clomazone | 1.12 | 9 | 36 | 10 | 438 |
| + disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| 13.clomazone | 1.12 | 57 | 305 | 30 | 269 |
| +disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| +caporal | 1.80 | | | | |
| 14.clomazone | 1.12 | 3 | 226 | 25 | 288 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| 15.clomazone | 1.12 | 3 | 627 | 25 | 371 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| + coteran | 1.34 | | | | |
| 16.no herbicide, | | | | | |
| 2 mech. cultivations | | 8 | 137 | 0 | 480 |
| Least significant difference ($\alpha$=0.05) | | 25 | 98 | 16 | 371 |

[a] Weed counts were taken 56 days after planting, all treatments were applied the day of planting except Post treatments which were applied 42 days after planting.
[b] Applied at planting in-furrow with the cotton seed as a seed safener for clomazone.

Table 7. No-tillage pre-emergence herbicide combinations for weed control in irrigated cotton applied in maize residue aged one month, which exceeded 5,000 kg/ha at Weslaco, Texas, 1995.

| treatment | dosage kg/ha | Panicum[a] Texanum plts/10 m$^2$ | Palmer[a] Amaranth plts/10 m$^2$ | crop injury % | lint yield kg/ha |
|---|---|---|---|---|---|
| 1. pendimethalin | 1.12 | 11 | 8 | 0 | 996 |
| 2. caporal | 1.80 | 50 | 18 | 10 | 639 |
| 3. coteran | 1.34 | 20 | 65 | 10 | 1100 |
| 4. pendimethalin | 1.12 | 35 | 0 | 0 | 959 |
| +coteran | 1.34 | | | | |
| 5. pendimethalin | 1.12 | 3 | 3 | 0 | 890 |
| +caporal | 1.80 | | | | |
| 6. caporal | 1.80 | 2 | 2 | 0 | 772 |
| +coteran | 1.34 | | | | |
| 7. caporal | 1.80 | 8 | 1 | 10 | 1115 |
| +coteran | 1.34 | | | | |
| +pendimethalin | 1.12 | | | | |
| 8. pendimethalin | 1.12 | 5 | 5 | 0 | 1105 |
| +fluazifop | 0.17 POST | | | | |
| 9. clomazone | 1.12 | 33 | 18 | 10 | 713 |
| + disyston[b] | 1.10 | | | | |
| 10. clomazone | 1.12 | 3 | 0 | 10 | 1151 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| 11. clomazone | 1.12 | 12 | 15 | 25 | 557 |
| + disyston[b] | 1.10 | | | | |
| +caporal | 1.80 | | | | |
| 12. clomazone | 1.12 | 30 | 20 | 10 | 734 |
| + disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| 13. clomazone | 1.12 | 0 | 0 | 10 | 1022 |
| + disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| +caporal | 1.80 | | | | |
| 14. clomazone | 1.12 | 10 | 0 | 10 | 944 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| 15. clomazone | 1.12 | 0 | 0 | 15 | 776 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| + coteran | 1.34 | | | | |
| 16. no herbicide, | | | | | |
| 2 mech. cultivations | | 29 | 30 | 0 | 778 |
| Least significant difference ($\alpha$=0.05) | | 11 | 9 | 18 | 493 |

[a] Weed counts were taken 56 days after planting, all treatments were applied the day of planting except POST treatments which were applied 42 days after planting.
[b] Applied at planting in-furrow with the cotton seed as a seed safener for clomazone.

Table 8. No-tillage pre-emergence herbicide combinations for weed control in dryland cotton applied in grain sorghum residue aged 8 months, which exceeded 5,500 kg/ha at McCook, Texas, 1994.

| treatment | dosage kg/ha | Panicum[a] Texanum plts/10 m$^2$ | Palmer[a] Amaranth plts/10 m$^2$ | crop injury % | lint yield kg/ha |
|---|---|---|---|---|---|
| 1. pendimethalin | 1.12 | 3 | 16 | 0 | 553 |
| 2. caporal | 1.80 | 1 | 3 | 3 | 517 |
| 3. coteran | 1.34 | 8 | 8 | 3 | 467 |
| 4. pendimethalin | 1.12 | 3 | 3 | 4 | 641 |
| +coteran | 1.34 | | | | |
| 5. pendimethalin | 1.12 | 0 | 8 | 8 | 486 |
| +caporal | 1.80 | | | | |
| 6. caporal | 1.80 | 5 | 0 | 3 | 548 |
| +coteran | 1.34 | | | | |
| 7. caporal | 1.80 | 1 | 0 | 3 | 498 |
| +coteran | 1.34 | | | | |
| +pendimethalin | 1.12 | | | | |
| 8. pendimethalin | 1.12 | 0 | 13 | 0 | 518 |
| +fluazifop | 0.17 POST | | | | |
| 9. clomazone | 1.12 | 0 | 20 | 9 | 476 |
| + disyston[b] | 1.10 | | | | |
| 10. clomazone | 1.12 | 1 | 1 | 3 | 495 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| 11. clomazone | 1.12 | 3 | 1 | 5 | 413 |
| + disyston[b] | 1.10 | | | | |
| +caporal | 1.80 | | | | |
| 12. clomazone | 1.12 | 1 | 1 | 8 | 456 |
| + disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| 13 .clomazone | 1.12 | 1 | 2 | 0 | 507 |
| + disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| +caporal | 1.80 | | | | |
| 14. clomazone | 1.12 | 2 | 1 | 0 | 558 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| 15. clomazone | 1.12 | 1 | 1 | 5 | 502 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| + coteran | 1.34 | | | | |
| 16. no herbicide, 2 mech. cultivations | | 25 | 251 | 0 | 491 |
| Least significant difference (α=0.05) | | 8 | 25 | 7 | 148 |

[a] Weed counts were taken 56 days after planting, all treatments were applied the day of planting except Post treatments which were applied 42 days after planting.
[b] Applied at planting in-furrow with the cotton seed as a seed safener for clomazone.

Table 9. No-tillage pre-emergence herbicide combinations for weed control in dryland cotton applied in grain sorghum residue aged 8 months, which exceeded 4,500 kg/ha at McCook, Texas, 1995.

| treatment | dosage kg/ha | Panicum[a] Texanum plts/10 m$^2$ | Palmer[a] Amaranth plts/10 m$^2$ | crop injury % | lint yield kg/ha |
|---|---|---|---|---|---|
| 1. pendimethalin | 1.12 | 3 | 20 | 0 | 340 |
| 2. caporal | 1.80 | 5 | 3 | 18 | 399 |
| 3. coteran | 1.34 | 8 | 8 | 19 | 213 |
| 4. pendimethalin | 1.12 | 0 | 23 | 25 | 485 |
| +coteran | 1.34 | | | | |
| 5. pendimethalin | 1.12 | 0 | 8 | 32 | 451 |
| +caporal | 1.80 | | | | |
| 6. caporal | 1.80 | 5 | 0 | 26 | 275 |
| +coteran | 1.34 | | | | |
| 7. caporal | 1.80 | 1 | 0 | 8 | 232 |
| +coteran | 1.34 | | | | |
| +pendimethalin | 1.12 | | | | |
| 8. pendimethalin | 1.12 | 0 | 13 | 5 | 296 |
| +fluazifop | 0.17 POST | | | | |
| 9. clomazone | 1.12 | 0 | 20 | 40 | 136 |
| + disyston[b] | 1.10 | | | | |
| 10. clomazone | 1.12 | 0 | 13 | 32 | 225 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| 11. clomazone | 1.12 | 10 | 3 | 28 | 222 |
| + disyston[b] | 1.10 | | | | |
| +caporal | 1.80 | | | | |
| 12. clomazone | 1.12 | 0 | 13 | 53 | 225 |
| + disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| 13. clomazone | 1.12 | 0 | 10 | 25 | 280 |
| + disyston[b] | 1.10 | | | | |
| + coteran | 1.34 | | | | |
| +caporal | 1.80 | | | | |
| 14. clomazone | 1.12 | 0 | 10 | 30 | 289 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| 15. clomazone | 1.12 | 0 | 0 | 35 | 290 |
| + disyston[b] | 1.10 | | | | |
| +pendimethalin | 1.12 | | | | |
| +caporal | 1.80 | | | | |
| + coteran | 1.34 | | | | |
| 16 no herbicide, 2 mech. cultivations | | 8 | 10 | 0 | 219 |
| Least significant difference (α=0.05) | | 12 | 18 | 29 | 251 |

[a] Weed counts were taken 56 days after planting, all treatments were applied the day of planting except Post treatments which were applied 42 days after planting.
[b] Applied at planting in-furrow with the cotton seed as a seed safener for clomazone.