

# Defoliation of Pima and Upland Cotton at the Safford Agricultural Center, 1998

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## **Abstract**

*Nine defoliation treatments were applied to Pima and upland cotton to compare the treatment effects on percent leaf drop, trash sent to the gin, lint yields, percent lint turnout and percent first pick. All of the treatments were beneficial to leaf drop compared to the untreated check with the Ginstar treatments generally performing better than the others. The addition of non-ionic surfactants and drift retardants seemed to reduce the activity of Ginstar. Yield differences on long staple treatments were noticed and discussed in the paper.*

## **Introduction**

Defoliation of cotton plants prior to harvest is a practice introduced many years ago to reduce leaf trash in the harvested cotton. At higher elevations defoliation is practiced by a smaller percentage of the growers than other parts of the state because cool temperatures at harvest time reduces the effectiveness of many of the chemicals used as defoliant and frost can effectively defoliate the plants with no cost. This study was initiated in 1991 on Pima cotton, and was expanded to include upland cotton as well. The objective of the study was to see how effective each of the defoliation treatments was under the prevailing weather conditions. Yield differences have been tracked to see if premature dropping of the leaves could cause risk of decreased yields.

## **Materials and Methods**

The study was implemented using Pima S-6 and DP 90. Treatments were applied to plots 4 rows wide and approximately 50 feet long, in a replicated randomized complete block design. The following crop history indicates the cultural practices employed in the experiment:

### Crop history

Soil type: Pima clay loam variant

Previous crop: Cotton

Planting date: 21 April, 1998                      Rate: 25 lbs/ac

Herbicide: 1.5 pts/ac Treflan applied pre-plant, Prometryne applied at lay-by

Fertilizer: 100 lbs/ac side dressed 6/2 and 7/8

Irrigation: Planted into moist soil plus 10 irrigations (36 ac in + 3.6 in rain)                      Last date: 11 Sept

Short Staple Defoliation date: Applied 25 September (14 gal/ac, 40 psi)                      Observations: 8 October

Long Staple Defoliation date: Applied 14 October (14 gal/ac, 40 psi)                      Observations: 26 October

Short Staple Cumulative heat units: At defoliation 3179, at obs. 3374 ( $\Delta=195$ )

Long Staple Cumulative heat units: At defoliation 3467, at obs. 3595 ( $\Delta=128$ )

Harvest: 1st pick: 2 November                      2nd pick: 25 November

The treatments listed below were applied at a rate of 14 gallons of water per acre through Teejet flat fan nozzles on 20

inch spacings over 4 rows. About two weeks after defoliation treatments were applied each plot was evaluated to determine the amount of leaf drop from the plants. At harvest grab samples were taken from the plots to determine lint turnouts and percent trash in the seedcotton.

| Number | Treatment Abbreviation | Treatment                                      |
|--------|------------------------|--|
| 1      | GS                     | Ginstar 180 EC 9 oz/ac                         |
| 2      | GS + NIS               | Ginstar 180 EC 9 oz/ac + Bond 2 pt/100 gal     |
| 3      | GS + D-RET             | Ginstar 180 EC 9 oz/ac + Chemtrol 3 qt/100 gal |
| 4      | GS + PRP/2             | Ginstar 180 EC 9 oz/ac + Prep 2 pt/ac          |
| 5      | GS + PRP               | Ginstar 180 EC 9 oz/ac + Prep 1 pt/ac          |
| 6      | CHL2 + SF              | Sodium Chlorate (2 gal/ac) + Starfire (11 oz)  |
| 7      | CHL2.5 + SF            | Sodium Chlorate (2.5 gal/ac) + Starfire (7 oz) |
| 8      | CHL                    | Sodium Chlorate (3 gal/ac)                     |
| 9      | CK                     | Untreated Check                                |

### Results and Discussion

As is shown in the crop history and Table 1 (1) below, climatic conditions were very good for defoliants to work, but not quite as good as the previous year (2). High temperatures for the short staple trial varied from 80 to 100°F, low temperatures averaged about 50°F, lots of sunshine (solar radiation near 500 langleys) and light to moderate winds (maximum wind >25 mph helped to remove leaves). Because the long staple crop was a bit behind, the defoliation treatments were applied 20 days later. High temperatures ranged from 65 to 94°F, minimum temperatures averaged the same, about 50°F, solar radiation declined about 100 units and winds were a bit stronger with a maximum of 46 mph, to help remove leaves. These weather conditions gave good, but variable results from all the defoliation treatments.

Table 2 shows defoliation and yield observations made approximately two weeks after treatments on the long staple cotton plots. Ginstar at 9 oz per acre with Prep added gave complete defoliation with leaf drop near 90%. The treatment with Ginstar alone had about 10% less leaf drop and the other treatments were about 10% lower than that. The standard treatment for the area, Chlorate at 3 gal/ac was the least effective treatment. The addition of a non-ionic surfactant and drift retardant seemed to slow the activity of the Ginstar. This same effect was observed in 1997 (2). It was also noted that the addition of Starfire enhanced the defoliation activity of the chlorate treatments. Lint yields, percent lint turnout and percent first pick are also tabulated in the table to see what effect the treatments might have on them. Even though there are statistical differences in percent lint turnout values, none of these differences can be explained by the authors. The percentage of the crop picked in the first harvest were affected by treatments and the 2 pint/ac of Prep added to Ginstar seemed to hasten the maturity of the crop as did the other treatments to one degree or another. The most troubling note was that the treatments seemed to decrease the yield and the most treatments that were the most effective defoliants seemed to decrease the yield the most. Results of the trials in 1997(2) and 1996(3), when approximately the same treatments were applied, indicated no consistent loss in yield from any of the treatments. It was not felt that this year's treatments were applied so early as to limit the plants necessary photosynthetic processes to produce yield, but this will be studied further.

Table 3 shows the observations made on the short staple cotton. The Ginstar and Ginstar plus Prep treatments were the most effective followed by the Chlorate and Chlorate/Starfire treatments. The surprising observation in these plots was the detrimental effect of the non-ionic surfactant and drift retardant on the effectiveness of Ginstar. Again, data from the previous two years (2,3) were reviewed and this effect was not seen. This, then, will be the subject of further investigations. As with the long staple study, all treatments seemed to hasten maturity of the crop and caused an increase in the percent first pick. Differences in percent lint turnout were less noticeable than in the long staple study and the extreme values were found in Chlorate/Starfire mixes, so the differences are felt to be non-consequential. As with the long staple, the yield of the untreated check was higher than any of the treated plots. This was not corroborated by either of the previous two trials, but will be looked into in the future.

The major reason for applying defoliants is to reduce trash load at the gin and trash content in the fiber and to prevent green stain. A seedcotton pre-cleaner and small saw and roller gins were acquired to aid our research and were used to

separate trash from samples. Grab samples from the field were subjected to two treatments. One sub-sample from each plot was ginned without pre-cleaning and the lint and seed were weighed and compared with the initial weight. Percent trash was calculated in these samples by subtraction. The second sub-sample was run through the pre-cleaner twice to remove leaf trash. The initial weight and final weights were compared and the percent trash deduced by subtraction. Both of these sets of values were recorded in the 3<sup>rd</sup> and 4<sup>th</sup> columns of Tables 2 and 3. Results were not satisfying. Percent trash separated from the fiber by the gins was no different between the defoliated and untreated check plots in both long and short staple cotton. Perhaps this just proves that gins are not the best machines to remove trash. Percent trash separated from the seed cotton by the pre-cleaner were not positively correlated with percent leaf drop either.

The message that can be taken from this study is that almost any defoliant is effective under the conditions of this trial even though some are more effective than other. One must evaluate the costs of the various defoliants against their effectiveness to determine if their use is justifiable.

## References

1. Brown, P.B. The University of Arizona AZMET system. [Http://ag.arizona.edu/azmet](http://ag.arizona.edu/azmet)
2. Clark, L.J. and E.W. Carpenter. 1998. Defoliation of Pima and Upland cotton at the Safford Agricultural Center, 1997. Cotton, A College of Agriculture Report, The University of Arizona, Tucson, AZ. Series P-112, pp. 68-72.
3. Clark, L.J. and E.W. Carpenter. 1997. Defoliation of Pima and Upland cotton at the Safford Agricultural Center, 1996. Cotton, A College of Agriculture Report, The University of Arizona, Tucson, AZ. Series P-108, pp. 82-87.

**Table 1. AZMET weather data from the time defoliants were applied to when ratings were made.**

| DATE  | AIR TEMP |    |    | REL HUM |    |    | SOIL TEMP |    | WIND SPEED |     | SOLAR RAD | RAIN | ET <sub>o</sub> | HEAT UNITS |    |    |
|-------|----------|----|----|---------|----|----|-----------|----|------------|-----|-----------|------|-----------------|------------|----|----|
|       | MX       | MN | AV | MX      | MN | AV | 2"        | 4" | MX         | AV  |           |      |                 | 55         | 50 | 45 |
| 9/25  | 91       | 51 | 72 | 76      | 15 | 38 | 72        | 73 | 17         | 3.6 | 526       | 0.00 | 0.22            | 16         | 20 | 25 |
| 9/26  | 94       | 48 | 70 | 71      | 9  | 37 | 71        | 72 | 12         | 2.5 | 533       | 0.00 | 0.22            | 15         | 19 | 24 |
| 9/27  | 94       | 47 | 72 | 71      | 14 | 34 | 72        | 72 | 9          | 2.7 | 517       | 0.00 | 0.22            | 16         | 19 | 24 |
| 9/28  | 100      | 55 | 78 | 64      | 14 | 33 | 74        | 74 | 16         | 3.4 | 488       | 0.00 | 0.22            | 19         | 24 | 29 |
| 9/29  | 96       | 59 | 79 | 66      | 19 | 34 | 76        | 76 | 17         | 4.7 | 472       | 0.00 | 0.23            | 20         | 25 | 30 |
| 9/30  | 94       | 55 | 76 | 66      | 18 | 32 | 76        | 76 | 20         | 4.0 | 478       | 0.00 | 0.22            | 18         | 23 | 28 |
| 10/ 1 | 89       | 50 | 71 | 65      | 8  | 31 | 74        | 74 | 25         | 6.3 | 502       | 0.00 | 0.26            | 15         | 19 | 24 |
| 10/ 2 | 86       | 46 | 67 | 66      | 16 | 37 | 73        | 74 | 12         | 2.7 | 502       | 0.00 | 0.20            | 13         | 17 | 21 |
| 10/ 3 | 89       | 46 | 69 | 71      | 13 | 37 | 73        | 74 | 11         | 2.5 | 498       | 0.00 | 0.20            | 14         | 18 | 22 |
| 10/ 4 | 88       | 57 | 73 | 62      | 22 | 37 | 74        | 74 | 25         | 7.2 | 478       | 0.00 | 0.24            | 17         | 22 | 27 |
| 10/ 5 | 80       | 42 | 64 | 58      | 8  | 28 | 72        | 72 | 18         | 5.4 | 503       | 0.00 | 0.22            | 9          | 12 | 16 |
| 10/ 6 | 83       | 37 | 61 | 57      | 7  | 24 | 69        | 69 | 15         | 4.0 | 506       | 0.00 | 0.22            | 10         | 13 | 16 |
| 10/ 7 | 89       | 44 | 67 | 36      | 10 | 21 | 67        | 68 | 21         | 5.1 | 493       | 0.00 | 0.23            | 14         | 17 | 21 |
| 10/ 8 | 91       | 51 | 69 | 47      | 11 | 27 | 66        | 67 | 13         | 3.8 | 450       | 0.00 | 0.20            | 16         | 20 | 25 |
| 10/14 | 94       | 49 | 72 | 58      | 8  | 25 | 68        | 69 | 16         | 3.1 | 459       | 0.00 | 0.21            | 16         | 20 | 25 |
| 10/15 | 89       | 50 | 70 | 40      | 3  | 20 | 67        | 67 | 22         | 6.5 | 472       | 0.00 | 0.25            | 15         | 19 | 24 |
| 10/16 | 76       | 43 | 62 | 63      | 15 | 35 | 66        | 67 | 23         | 6.3 | 458       | 0.00 | 0.20            | 8          | 11 | 15 |
| 10/17 | 75       | 37 | 57 | 65      | 9  | 28 | 64        | 65 | 12         | 3.1 | 470       | 0.00 | 0.18            | 7          | 9  | 13 |
| 10/18 | 84       | 42 | 62 | 38      | 11 | 24 | 64        | 64 | 20         | 6.0 | 458       | 0.00 | 0.22            | 11         | 14 | 18 |
| 10/19 | 85       | 52 | 70 | 57      | 30 | 40 | 67        | 67 | 22         | 8.3 | 398       | 0.00 | 0.21            | 14         | 18 | 23 |
| 10/20 | 79       | 65 | 70 | 74      | 41 | 57 | 70        | 70 | 21         | 9.6 | 375       | 0.00 | 0.18            | 17         | 22 | 27 |
| 10/21 | 67       | 55 | 60 | 97      | 60 | 81 | 64        | 65 | 21         | 8.1 | 66        | 0.28 | 0.02            | 6          | 11 | 16 |
| 10/22 | 65       | 57 | 60 | 97      | 64 | 79 | 62        | 63 | 18         | 8.1 | 129       | 0.20 | 0.03            | 6          | 11 | 16 |
| 10/23 | 72       | 58 | 63 | 90      | 51 | 74 | 64        | 64 | 16         | 5.8 | 293       | 0.00 | 0.10            | 10         | 15 | 20 |
| 10/24 | 80       | 52 | 64 | 96      | 40 | 73 | 64        | 65 | 13         | 3.8 | 353       | 0.00 | 0.11            | 11         | 16 | 21 |
| 10/25 | 83       | 56 | 71 | 93      | 26 | 56 | 64        | 65 | 46         | 9.4 | 225       | 0.00 | 0.13            | 14         | 19 | 24 |
| 10/26 | 80       | 46 | 64 | 99      | 26 | 68 | 65        | 65 | 17         | 4.5 | 296       | 0.08 | 0.10            | 10         | 13 | 18 |

**Table 2. Yield and other defoliation observations on long staple cotton (Pima S-6) on the Safford Agricultural Center, 1998.**

| Treatment   | % Leaf Drop | % Trash (Gin) | % Trash (Cleaner) | Lint Yield (lbs/ac) | % Lint Turnout | % 1 <sup>st</sup> Pick |
|-------------|-------------|---------------|-------------------|---------------------|----------------|------------------------|
| GS          | 77.5 bc     | 1.1 a         | 8.3 ab            | 684 c               | 35.5 ab        | 74.1 abc               |
| GS + NIS    | 68.1 cd     | 1.1 a         | 8.5 ab            | 801 ab              | 34.8 bc        | 71.7 bc                |
| GS + D-RET  | 68.1 cd     | 0.7 a         | 7.3 b             | 803 ab              | 35.5 ab        | 75.3 ab                |
| GS + PRP/2  | 89.4 a      | 1.4 a         | 9.3 a             | 687 c               | 34.2 c         | 79.6 a                 |
| GS + PRP    | 88.8 ab     | 0.8 a         | 7.2 b             | 752 bc              | 35.4 ab        | 73.1 abc               |
| CHL2 + SF   | 68.1 cd     | 1.1 a         | 9.2 a             | 809 ab              | 35.7 ab        | 68.9 bc                |
| CHL2.5 + SF | 70.6 cd     | 1.5 a         | 8.8 ab            | 767 bc              | 34.7 bc        | 72.6 bc                |
| CHL         | 63.1 d      | 0.8 a         | 8.3 ab            | 806 ab              | 35.4 ab        | 72.4 bc                |
| CK          | 8.8 e       | 1.3 a         | 8.0 ab            | 875 a               | 35.9 a         | 67.6 c                 |
| Average     | 66.9        | 1.1           | 8.33              | 775.9               | 35.2           | 72.8                   |
| LSD(05)     | 11.3        | 1.57          | 1.59              | 98.8                | 1.08           | 6.8                    |
| CV(%)       | 13.9        | 119.3         | 15.75             | 10.5                | 2.5            | 7.7                    |

1. Values within columns followed by the same letter are not significantly different at the 95% level of confidence using Duncan's Multiple Range test.

2.

**Table 3. Yield and other defoliation observations on short staple cotton (DP 90) on the Safford Agricultural Center, 1998.**

| Treatment   | % Leaf Drop | % Trash (Gin) | % Trash (Cleaner) | Lint Yield (lbs/ac) | % Lint Turnout | % 1 <sup>st</sup> Pick |
|-------------|-------------|---------------|-------------------|---------------------|----------------|------------------------|
| GS          | 91.3 a      | 3.5 a         | 7.6 b             | 1088 ab             | 35.9 ab        | 90.5 ab                |
| GS + NIS    | 61.9 d      | 3.8 a         | 9.5 b             | 1079 ab             | 35.7 ab        | 90.3 ab                |
| GS + D-RET  | 49.4 e      | 3.9 a         | 11.3 b            | 1045 ab             | 35.4 ab        | 90.4 ab                |
| GS + PRP/2  | 91.3 a      | 3.8 a         | 12.2 ab           | 990 b               | 35.9 ab        | 90.8 a                 |
| GS + PRP    | 89.4 ab     | 4.4 a         | 11.8 ab           | 1009 b              | 35.5 ab        | 91.2 a                 |
| CHL2 + SF   | 71.3 cd     | 4.7 a         | 11.6 b            | 1038 ab             | 34.8 b         | 91.6 a                 |
| CHL2.5 + SF | 78.1 bc     | 3.4 a         | 9.8 b             | 1035 ab             | 36.7 a         | 91.2 a                 |
| CHL         | 75.6 c      | 4.4 a         | 10.8 b            | 1065 ab             | 35.7 ab        | 91.0 a                 |
| CK          | 9.4 f       | 3.8 a         | 16.9 a            | 1188 a              | 35.8 ab        | 88.8 b                 |
| Average     | 68.6        | 4.0           | 11.3              | 1059.4              | 35.7           | 90.6                   |
| LSD(05)     | 12.3        | 1.5           | 5.3               | 178.6               | 1.43           | 1.9                    |
| CV(%)       | 12.2        | 26.1          | 31.9              | 11.6                | 2.7            | 1.4                    |

1. Values within columns followed by the same letter are not significantly different at the 95% level of confidence using Duncan's Multiple Range test.