Late Application Date: October 16, 1975, plots were evaluated by three individuals on November 5. Results below are an average of the ratings.

| Percentage leaf-drop | Chemical[1] | Rate per acre |
|---|---|---|
| 74 a[2] | DEF-6 and Paraquat w/surfactant | 2 pt and 1 pt |
| 70 ab | Sodium chlorate and Paraquat w/surfactant | 2-1/2 gal and 1 pt |
| 68 abc | Sodium chlorate and Bollseye w/surfactant | 1 gal and 3 pts |
| 64 abc | DEF-6 and Bollseye w/surfactant | 3 pts and 3 pts |
| 61 abc | Sodium chlorate and Paraquat w/surfactant | 2-1/2 gal and 1/2 pt |
| 56 abc | Sodium chlorate and accelerate w/surfactant | 2-1/2 gal and 1 pt |
| 55 abc | DEF-6 and Paraquat w/surfactant | 2 pts and 1/2 pt |
| 55 abc | Sodium chlorate and Bollseye w/surfactant | 2 gal and 2 pts |
| 54 abc | DEF-6 | 2 pts |
| 53 abc | Bollseye w/surfactant | 1 gal |
| 50 abcd | Bollseye w/surfactant | 3 pts |
| 49 abcd | DEF-6 and Bollseye w/surfactant | 1 pt and 2 pts |
| 48 abcd | Nor Am SN49537 w/surfactant | 1/2 lb |
| 48 abcd | DEF-6 Bollseye w/surfactant | 1-1/2 pts and 1-1/2 pts |
| 47 abcd | Sodium chlorate and Bollseye w/surfactant | 2 gal and 1 pt |
| 46 abcd | DEF-6 and accelerate w/surfactant | 2 pts and 1-1/2 pts |
| 46 abcd | Sodium chlorate w/surfactant | 2-1/2 gal |
| 46 abcd | DEF-6 and Red-Top nonphytotoxic oil | 2 pts and 2 pts |
| 46 abcd | Tumbleleaf | 1 gal |
| 46 abcd | DEF-6 and Red-Top nonphytotoxic oil | 2 pts and 1 pt |
| 45 abcd | DEF-6 and Bollseye w/surfactant | 2 pts and 1 pt |
| 42 abcd | Sodium chlorate | 2-1/2 gal |
| 40 abcd | Tumbleleaf | 2 gal |
| 36 bcd | Nor Am SN49537 w/surfactant | 1/8 lb |
| 36 bcd | DEF-6 w/surfactant | 2 pts |
| 35 bcd | Nor Am SN49537 | 1/4 lb |
| 34 cd | Bollseye | 3 pts |
| 18 d | Check | 1/2 lb |

[1] Surfactant added at .5% v/v
[2] Means not followed by same letter are significantly different at 5% probability.

## HARVEST-AID CHEMICAL STUDIES

F.M. Carasso and R.E. Briggs

Cotton as grown in the major producing areas in Arizona has a tendency toward vigorous vegetative growth, which must be controlled before the application of harvest-aid chemicals in order to obtain satisfactory results. Since this condition is relatively difficult to achieve without sacrificing yield potential, Arizona cotton growers are often confronted with the problem of inadequate pre-harvest defoliation. The harvest-aid chemicals now available have not produced consistently satisfactory results, when applied at recommended rates, even after multiple applications.

Since 1967 we have been evaluating a wide variety of selected chemicals in replicated harvest-aid tests at the Yuma Valley Experiment Station. The primary objective of this research is to develop a consistently satisfactory formulation and procedure for cotton defoliation.

We have conducted several defoliation tests each year, involving different chemicals applied at various rates, singly and in mixtures. Investigation of chemical pre-conditioning treatments to facilitate defoliation was begun in 1973. For the last two years we have also investigated the use of U of A experimental surfactants, which were devised specifically for the purpose of increasing foliar absorption.

Previous cotton defoliation research at the Yuma Valley Experiment Station was described in the 1975 Cotton Report, pages 59-65. Investigations conducted in 1975 will be described in this report.

General Experimental Procedure:

Nine of the experiments conducted in 1975 are described in this report. In eight experiments, the chemicals were applied to the upper leaf surfaces at the volume rate of 40 gallons per acre with a three-gallon pressure tank sprayer, single boom and hollow cone tip. The cotton was in a plant two, skip two pattern to facilitate spraying and evaluation. In six experiments, the checmicals were applied to Deltapine 61 cotton; the chemicals were applied to Deltapine 16 cotton in the other three experiments. In one experiment the chemicals were applied as total coverage foliar sprays with a powered, high-clearance sprayer to Deltapine 61 cotton in a full stand with no vacant rows.

The condition of the plants in each plot at the time of chemical treatment was carefully noted and recorded. Plant responses were observed almost daily. Percent defoliation and desiccation was carefully estimated one and two weeks after applying the defoliants. The estimates were based upon the amount of foliage on the plants at the time of applying the defoliants. Materials used in the 1975 experiments are listed in Table 1.

General Condition of the Cotton Plants:

Due primarily to unfavorable temperatures, emergence was slow and erratic. The initial stand was marginal; it was supplemented by an additional planting. The later plants had longer internodes, fewer leaves, and a lighter boll set than the earlier plants. The later plants were relatively immature when irrigations were terminated. The variability in the proportion of later plants, in addition to soil variations, resulted in marked differences in the condition of the cotton at the time of chemical treatment. Plants in a major portion of the experimental area were relatively short and showed symptoms of varying degrees of moisture stress. Plants in the south portion were relatively large and nearly prostrate; vigorous vegetative growth continued throughout the entire evaluation period. Persistent excessive soil moisture caused by a leaky irrigation ditch was a major contributing factor to this unwanted late-season excessive vegetative growth. Typical calculated seed cotton yields throughout the experimental area were at the rate of 4500 to 5500 pounds per acre; insect injury to foliage was minimal.

Cultural Data:

Planting Dates: March 28, 1975 in moist soil. Supplementary planting irrigated up May 15, 1975.

Fertilizer: None. Chemical analysis of soil samples indicated a high nitrate content--over 330 PPM.

Herbicides: Trifluralin applied preplant over beds at the rate of 0.75 lb. per acre, incorporated with a rolling cultivator. Prometryn applied as a directed lay-by herbicide on July 10, 1975 and incorporated with the rolling cultivator.

Irrigations: (Preirrigation) March 1, May 15, June 25, July 18, July 31, and August 8, 1975.

Results and Discussion: Results are presented in Tables 2 through 10. Performance of the harvest-aid chemicals was influenced to a considerable extent by the condition of the plants at time of treatment. Plants which continued to grow vigorously were least responsive.

Cacodylic acid, applied at an appropriate rate with an effective surfactant, was effective over a relatively wide range of conditions. The efficacy of cacodylic acid was significantly improved by the addition of a small quantity of Paraquat (Table 10).

The use of surfactant O-H has resulted in a significant improvement in the performance of the harvest-aid chemicals in every test under a variety of conditions both years. However, even the use of an effective surfactant was not enough to insure satisfactory defoliation when the active ingredients were inadequate for the condition of the cotton.

Effective pre-conditioners were beneficial, even in senescent cotton. Certain 2,4,6-trisubstituted-s-triazines which have sufficient foliar activity, applied at appropriate rates and concentrations, are worthy of further investigation. Procyazine looked particularly promising.

We were impressed by the fact that ethephon was ineffective as a pre-conditioner. Previous research at Yuma had shown it to be unsatiafactory as a defoliant. The importance of ethylene in inducing senescence and foliar abscission is emphasized in the literature. However, experimental results suggest that other more basic factor(s) might be involved. Therefore, we plan to study all available information regarding the chemical processes involved in plant senescence and foliar abscission, and to utilize this information in devising appropriate chemical treatments.

Table 1. Materials Used in Cotton Defoliation Experiments at Yuma in 1975.

| Common name or code number | Chemical name or description |
|---|---|
| Activate plus | A proprietary nonionic surfactant |
| Alar | Succinic acid 2,2-dimethyl hydrazide |
| Atlas A1-411F | An emulsifiable non-phytotoxic petroleum oil, containing 83% Sunoco Superior Oil No. 11 and 17% nonionic emulsifier |
| Bollseye | A proprietary sodium cacodylate formulation containing the equivalent of 3.1 lbs dimethylarsinic acid per gallon plus an unidentified surfactant |
| Cyanazine (Bladex) | 2-[(4-chloro-6-[ethylamino]-s-triazin-2-yl)amino]-2-methyl-propanenitrile |
| DEF 6 | S-s-s-tributylphosphorotrithioate |
| Endothall | 7-oxabicyclo(2.2.1)heptane-2,3-dicarboxylic acid, as the di(N,N-dimethylalkylamine) salt(alkyl) groups as in coconut oil fatty acids |
| Ethephon (Ethrel) | 2-chloroethylphosphonic acid |
| Paraquat | $1,1^1$-dimethyl-4,$4^1$-bipyridiniumoion |
| Phytar 160 | A sodium cacodylate formulation containing the equivalent of 3.25 lbs dimethylarsinic acid per gallon without surfactant |
| Procyazine | 2-[(4-chloro-6-[cyclopropylamino]-1,35-triazin-2-$y^1$) amino]-2-methylpropanenitrile |
| Sodium chlorate | Sodium chlorate |
| Surfactants O-L, O-H, O-G, and C-H | U. of A. Experimental surfactants |
| Surfactant WK | Dodecyl ether of polyethycene glycol |
| Surfactant X-77 | Alkylarylpolyoxyethylene glycols, free fatty acids, isopropyl alcohol |
| TD-1123 | 3,4-dichloroisothiazole-5-carboxylic acid |
| UBI-N252 | 2,3-dihydro-5,6-dimethyl-1,4-dithin 1,1,4,4-tetroxide |
| UBI-1126 | Spray adjuvant recommended for use with UBI-N252 |

Table 2. Evaluation of Six Cotton Defoliation Treatments at Yuma, 1975[a]

| Treatment | Percent defoliation, estimated average of six replications[b] |
|---|---|
| Untreated check | 16 d |
| 1.5 lb/A DEF 6, 0.0975 lb/A endothall[c] | 63 ab |
| 1.5 lb/A DEF 6, 0.195 lb/A endothall, 2.5% Atlas A1-411F[c] | 66 a |
| 1.5 lb/A UBI-N252, 1% v/v UBI-1126 | 51 c |
| 1.5 lb/A DEF 6, 1 lb/A UBI-N252, 1% v/v UBI-1126 | 57 bc |
| 2 lb/A UBI-N252, 1% v/v UBI-1126 | 50 c |
| 1.5 lb/A DEF 6, 0.5 lb/A TD-1123[c] | 61 ab |

[a]The treatments were applied on September 29, 1975. Final evaluation was on October 13, 1975.
[b]Values followed by a common letter are not significantly different at the 1% level, according to Duncan's Multiple Range Test.
[c]0.5% v/v surfactant WK included.

Table 3. Effect of Five Surfactants on the Performance of 1.5 lb/A DEF 6 plus 0.195 lb/A Endothall as a Cotton Defoliant at Yuma[a].

| Treatment | Percent defoliation, estimated[b,c] 1974 | 1975 | Two-year average |
|---|---|---|---|
| Untreated check | 13 d | 5 d | 8 c |
| No surfactant | 46 c | 16 c | 28 b |
| 0.5% v/v surfactant X-77 | 60 b | 19 c | 36 b |
| 0.5% v/v surfactant O-L | 70 a | 30 b | 46 a |
| 0.5% v/v surfactant O-H | 75 a | 42 a | 55 a |
| 0.6% v/v surfactant O-G | 71 a | 38 a | 51 a |
| 0.5% v/v surfactant C-H | 71 a | 36 ab | 50 a |

[a]The treatments were applied on September 30, 1974 and October 4, 1975. Final evaluations were on October 12, 1974 and October 18, 1975, respectively.
[b]Values in the 1974 column are averages of four replications; values in the 1975 column are averages of six replications.
[c]Values within a column followed by a common letter are not significantly different at the 1% level, according to Duncan's Multiple Range Test.
[d]The plants were large and badly lodged--nearly prostrate. Vigorous vegetative growth continued throughout the entire evaluation period. Vigorous young shoots, covered by large lodged branches could not be reached by the spray. Persistent excessive soil moisture caused by seepage from a leaky irrigation ditch was a major contributing factor to this unwanted late-season excessive vegetative growth.

Table 4. Effect of Five Surfactants on the Performance of 0.4 lb/A Paraquat as a Cotton Harvest-aid at Yuma[a].

| Treatment | Percent defoliation, estimated[b,c] 1974 | 1975 | Two-year avg. | Percent total effect, estimated[b,c,d] 1974 | 1975 | Two-year avg. |
|---|---|---|---|---|---|---|
| Untreated check | 14 d | 8 e | 10 d | 20 d | 15 e | 17 d |
| No surfactant | 38 c | 33 d | 35 c | 56 c | 49 d | 52 c |
| 0.5% v/v surfactant X-77 | 43 c | 38 cd | 40 c | 63 c | 54 d | 58 c |
| 0.5% v/v surfactant O-L | 55 b | 46 bc | 50 b | 76 b | 71 c | 73 b |
| 0.5% v/v surfactant O-H | 69 a | 58 a | 63 a | 88 a | 86 a | 87 a |
| 0.5% v/v surfactant O-G | 54 b | 53 ab | 54 ab | 78 ab | 76 bc | 77 b |
| 0.5% v/v surfactant C-H | 55 b | 52 ab | 53 ab | 79 ab | 81 ab | 80 ab |

[a]The treatments were applied on October 1, 1974 and October 2, 1975. Final evaluations were on October 15, 1974 and October 16, 1975, respectively.
[b]Values in the 1974 columns are averages of four replications; values in the 1975 columns are averages of six replications.
[c]Values within a column followed by a common letter are not significantly different at the 1% level, according to Duncan's Multiple Range Test.
[d]Defoliation plus desiccation.

Table 5. Effect of Four Surfactants on the Performance of 3.1 lb/A Cacodylic Acid[a] as a Cotton Harvest-aid at Yuma, 1975[b]

| Treatment | Percent defoliation,[c,d] estimated | Percent total effect,[c,d,e] estimated |
|---|---|---|
| Untreated check | 15 d | 20 d |
| No surfactant | 63 bc | 75 bc |
| 0.5% v/v surfactant X-77 | 54 c | 64 c |
| 0.5% v/v surfactant O-L | 69 b | 81 b |
| 0.5% v/v surfactant O-H | 84 a | 93 a |
| 0.6% v/v surfactant O-G | 73 b | 85 ab |

[a]Phytar 160 at a rate equivalent to 1 gal/A Bollseye.
[b]The treatments were applied on September 29, 1975. Final evaluation was on October 13, 1975.
[c]Values in each column are averages of four replications.
[d]Values within a column followed by a common letter are not significantly different at the 1% level, according to Duncan's Multiple Range Test.
[e]Defoliation plus desiccation.

Table 6. Effect of Four Surfactants on the Performance of 1.16 lb/A Cacodylic Acid[a] as a Cotton Harvest-aid at Yuma, 1975[b]

| Treatment | Percent defoliation[c,d] estimated | Percent total effect,[c,d,e] estimated |
|---|---|---|
| Untreated check | 17 d | 23 d |
| Phytar 160, no surfactant | 55 c | 62 c |
| Bollseye, 0.5% v/v surfactant X-77 | 53 c | 61 c |
| Phytar 160, 0.5% v/v surfactant X-77 | 48 c | 53 d |
| Phytar 160, 0.5% v/v surfactant O-L | 73 a | 84 a |
| Phytar 160, 0.5% v/v surfactant O-H | 76 a | 86 a |
| Phytar 160, 0.6% v/v surfactant O-G | 63 b | 73 b |

[a]Rate of application equivalent to three pints Bollseye per acre.
[b]The treatments were applied on October 4, 1975. Final evaluation was on October 18, 1975.
[c]Values in each column are averages of six replications.
[d]Values within a column followed by a common letter are not significantly different at the 1% level, according to Duncan's Multiple Range Test.
[e]Defoliation plus desiccation.

Table 7. Evaluation of Five Chemical Pre-conditioning Treatments at Yuma, 1975[a,b]

| Pre-conditioner | Percent defoliation,[c,d] estimated | Percent total effect[c,d,e] estimated |
|---|---|---|
| Untreated check | 21 c | 27 c |
| None | 55 b | 60 b |
| 0.375 lb/A UBI-N252, 1% v/v UBI-1126 | 53 b | 58 b |
| 0.75 lb/A UBI-N252, 1% UBI-1126 | 52 b | 57 b |
| 0.3 lb/A cyanazine, 0.5% v/v surfactant WK | 49 b | 60 b |
| 0.3 lb/A procyazine, 0.5% v/v surfactant WK | 70 a | 82 a |
| 0.375 lb/A TD-1123, 0.5% v/v surfactant WK | 62 a | 67 b |

[a]The pre-conditioning treatments were applied on September 27, 1975.
[b]A uniform defoliation treatment of 1.5 lb/A DEF 6, 0.195 lb/A endothall, 2.5% v/v Atlas AL-411F, and 0.5% v/v surfactant WK was applied to all plots except the untreated check with a high clearance powered sprayer on October 9, 1975. Final evaluation was on October 23, 1975.
[c]Values in each column are averages of six replications.
[d]Values within a column followed by the same letter are not significantly different at the 1% level, according to Duncan's Multiple Range Test.
[e]Defoliation plus desiccation.

Table 8. Effect of Time Interval Between Application of 0.3 lb/A Cyanazine as Pre-conditioner[a] and Application of Defoliant[b] at Yuma, 1975.

| Treatment | Percent defoliation, estimated Average of four replications[c,d] |
|---|---|
| Untreated check | 25 d |
| No pre-conditioner | 60 c |
| Three-day interval | 80 ab |
| Seven-day interval | 81 a |
| 11-day interval | 71 b |
| 15-day interval | 80 ab |

[a]0.5% v/v surfactant WK included. The pre-conditioning treatments were applied to the appropriate plots on the following dates: September 28, October 2, October 6, and October 10, 1975.
[b]A uniform defoliation treatment of 1.5 lb/A DEF 6, 0.195 lb/A endothall, and 0.5% v/v surfactant O-H was applied to all plots except the untreated check on October 13, 1975.
[c]Final evaluation was on October 27, 1975.
[d]Values followed by a common letter are not significantly different at the 1% level, according to Duncan's Multiple Range Test.

Table 9. Evaluation of Ethephon and Alar as Pre-conditioners at Yuma, 1975[a]

| Pre-conditioner[b] | Percent defoliation, estimated Average of four replications[c,d] |
|---|---|
| Untreated check | 18 b |
| None | 56 a |
| 0.25 lb/A ethephon | 53 a |
| 0.5 lb/A ethephon | 56 a |
| 1 lb/A ethephon | 54 a |
| 0.25 lb/A Alar | 55 a |
| 0.5 lb/A Alar | 56 a |
| 1 lb/A Alar | 58 a |

[a]The pre-conditioning treatments were applied on September 28, 1975.
[b]0.5% v/v surfactant WK included.
[c]A uniform defoliation treatment of 1.5 lb/A DEF 6, 0.195 lb/A endothall, and 0.5% v/v surfactant O-H was applied to all plots except the untreated check on October 9, 1975. Final evaluation was on October 23, 1975.
[d]Values followed by the same letter are not significantly different at the 1% level, according to Duncan's Multiple Range Test.

Table 10. Powered High-clearance Sprayer Test at Yuma, 1975[a]

| Treatment | Percent defoliation[b,c] estimated | Percent total effect[b,c,d] estimated |
|---|---|---|
| Untreated check | 5 c | 5 c |
| 1.55 lb/A cacodylic acid, 0.5% v/v surfactant O-H, volume rate: 10 gal/A | 41 b | 51 b |
| 0.78 lb/A cacodylic acid, 0.2 lb/A paraquat, 0.5% v/v surfactant O-H, volume rate: 10 gal/A | 69 a | 81 a |
| 1.5 lb/A DEF 6, 0.195 lb/A endothall, 2.5% v/v Atlas AL-411F, 0.5% v/v activate plus. Volume rate: 10 gal/A | 65 a | 71 a |
| 1.5 lb/A DEF 6, 0.195 lb/A endothall, 2.5% v/v Atlas AL-411F, 0.5% v/v activate plus. Volume rate: 37.4 gal/A | 71 a | 79 a |

[a]The treatments were applied on October 20, 1975. Final evaluation was on November 4, 1975.
[b]Values in each column are averages of four replications.
[c]Values within a column followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.
[d]Defoliation plus desiccation.

## CHEMICAL TERMINATION OF COTTON FRUITING IN 1975

D.L. Kittock, H. Fred Arle, L.A. Bariola, and T.J. Henneberry

We have been using plant growth regulators for five years (1971-1975) to reduce late season production of immature cotton bolls and thus reduce food available for the generation of pink bollworms going into diapause (overwintering stage). Percent reduction of immature bolls at first harvest has been a good estimate of reduction in percent of pink bollworms in diapause. Pink bollworms in diapause have been reduced 90 to 97 percent by the most effective chemical termination treatments with only small reductions in yield.