Controlling Cotton Root Rot through Improved Fungicide Application Techniques

Randy Norton and Mark Siemens
University of Arizona

Background

Cotton root rot (CRR) caused by the soil-borne fungi *Phymatotrichopsis omnivora* is a significant pest that affects Arizona cotton production. The only known method for controlling the disease is application of the fungicide flutriafol, marketed under the trade name Topguard™ Terra. The current product label allows for only two application methods. Both methods are at planting and involve either a "t-band" spray over the seed furrow or a modified in-furrow application at planting. Earlier evaluations have demonstrated phytotoxicity issues related to seed germination and seedling emergence using these techniques. Additionally, growers would prefer to apply the material either before planting or after emergence to avoid having to deal with the additional logistical issue of mixing chemicals during planting. For these reasons and because optimal timing and placement of flutriafol is not well understood, we have begun investigating alternative application techniques and their effectiveness. In previous Arizona trials, labeled and alternative application methods were found to reduce disease incidence, but results varied depending on location and year. Further research is needed to address the aforementioned issues and to get a better understanding of how flutriafol can best be utilized in cotton production. A unique aspect of this pathogen is the spatial distribution of the infection. In many cases, localized infection occurs in specific areas of the field resulting in a consistent pattern of disease distribution each year. Identifying these patterns may allow effective control using site-specific application methods which would lower costs and be more environmentally friendly. This technique merits investigation also.

Objectives

The objectives of this study were to:

1) Determine the efficacy and viability of using various alternative techniques of applying flutriafol for control of CRR.
2) Transfer the knowledge gained from this research to producers and industry through various outreach means.

Methods

Experimental trials with various timing and placement techniques for applying flutriafol were established at three sites in Arizona – Yuma, Marana, and Safford. Each location was slightly different with respect to application techniques and timing. Treatment dates and rates of application are presented in Tables 1, 2, and 3 for Yuma, Marana, and Safford respectively. The Yuma and Marana sites were both planted to Upland cotton while the Safford location was planted to extra-long staple (ELS) cotton. Figures 1-4 are pictures of the application techniques that were employed at the three locations in 2017 including a modified in furrow treatment, side dress, point injection, and stem drench for Figures 1-4 respectively. All applications were made using the Topguard Terra formulation at the full label rate of 8 fluid ounces per acre with a carrier rate of approximately 8-10 gallons per acre, depending on application technique.

Results

Yuma

At the Yuma site, disease pressure was minimal and averaged less than 2% incidence in the untreated control plots (Table 4). Incidence was concentrated in one area of the field (mid right of Figure 11), however no noticeable treatment effect was observed. This is unusual in that it is the first time we have observed that disease incidence was not reduced when flutriafol was applied. Differences in disease incidence or yield were not expected due to the low disease pressure and none were found (Table 4 and Figures 5, 8).

Marana

Disease pressure at the Marana location was significant across the trial area with the untreated control having an estimated percent disease level of 55 percent (Table 5 and Figure 6). The side dress and point injection application techniques reduced the disease pressure to approximately 17 percent (70% reduction). The stem drench treatment was less effective with disease pressure around 28 percent (49% reduction). Figure 6 shows the percent disease level (blue bars – left y-axis) and percent disease relative to the control (orange line – right y-axis). Yield and fiber quality for all treatments are presented in Table 5 and Figure 9.

Yield differences among treatments were not statistically significant with an observed significance level of 0.5949 (Table 5). Figure 9 presents lint yield (blue bars – left y-axis) and percent relative yield to the control (orange line – right y-axis). The untreated control produced the lowest yield, around 1257 lbs lint per acre. The other three treatments ranged in yield from 1320 to approximately 1380 (Table 5).

Aerial imagery was collected of the trial field just prior to defoliation in mid-October and is presented in Figure 12. Treatment areas are outlined and labelled on the aerial imagery (Figure 12). Visual analysis of the figure supports the disease incidence data reported.

Safford

The field where the trial was conducted in 2017 had been treated with flutriafol in the previous year which resulted in reduced disease pressure in the field during the year of the trial. General disease incidence as measured in the control plots across the trial area was approximately 18 percent. All treatment application techniques reduced disease level from 18 percent to less than 10 percent, about a 43% reduction (Table 6 and Figure 7). The lowest disease pressure was observed in the modified in-furrow treatment at planting.

Safford was the only location in 2017 that included an at-planting treatment. In 2017 significant impacts on seedling emergence were observed in areas associated with this treatment. The stand loss was significant enough that it led to the lowest yield in the trial (Table 6 and Figure 10) with approximately a 7 percent reduction in yield when compared to the other treatment. This response has been observed in other trials and other years, but it has never been significant enough to impact yield. This particular field had a strong gradient of soil texture from the head (right side of Figure 13) of the field to the tail (left side of Figure 13). Soil texture progressed from a coarse sandy soil at the head end of the field to a fine clay at the tail end. The impact on stand was most pronounced in the head end of the field closely associated with the coarser soil texture and was not observed as the soil texture became finer. However, it impacted enough of the plot area to have a significant effect on yield (Table 6 and Figure 10).

Figure 13 shows aerial imagery of the treatment area with plot areas outlined and labelled. The stand loss is evident in the modified in-furrow treatment areas near the head end of the field (right side of image). The remainder of the field was treated with the modified in-furrow treatment technique and the effect on stand establishment can be observed in the area of the field (top of image) not included in the trial area.

Conclusions

We continue to observe significant impacts on disease incidence with all techniques of application of the fungicide flutriafol. However, soil incorporated techniques continue to perform at a higher level particularly compared to the stem drench application technique. Application techniques that incorporate the material into the soil in some fashion appear to have more impact on disease incidence in a more predictable and consistent manner. If a surface applied application technique is to be employed, our experience has shown that irrigation immediately after application is critical to ensure soil incorporation of the flutriafol.

The 2017 evaluation was the first year where significant impacts on stand establishment were observed to a point where yield was affected. The at-planting techniques work extremely well in controlling cotton root rot as demonstrated in this year's trial and in previous work. However, it must be understood that there is a risk when applying flutriafol at-planting where the material may come into significant contact with the seed. Setting up equipment to minimize this contact is critical for optimizing plant emergence and seedling health. The new section 2ee (2017) label provides for expanded application techniques that will avoid seed contact. The evaluations conducted in 2017 and in previous years have proven significant control of the disease with these expanded application options giving growers additional options for managing this disease.

Outreach.

Several events were conducted across Arizona to discuss the results from the 2015-2016 trials and the projects executed in 2017 with growers and other stakeholders. The topic of CRR control through effective use of flutriafol was also presented at numerous meetings and field days. Some specific examples include: Southeast Arizona Ag Day, Graham County Farm, Home, and Ranch Day, Desert Ag Conference, Central Arizona Tent Talk meetings (3), and Maricopa and Safford Ag Center Annual Field Days.

Acknowledgements

The authors would like to thank Cotton Inc. and the Arizona Cotton Growers Association for funding this project. We would also like to thank our grower cooperators William Ware, Pat and Daniel Pacheco, and Ron and JR Howard for their contributions of time, equipment and resources. Their assistance is greatly appreciated.

Table 1. Treatment dates and rates for the flutriafol evaluation in Yuma, AZ, 2017.

Treatment	Application Date	Rate (fl oz/acre)
Untreated Control	N/A	0
Knife blade Side Dress	9 May	8
Point Injection	9 May	8
Stem Drench	23 May	8

Table 2. Treatment dates and rates for the flutriafol evaluation in Marana, AZ, 2017.

Treatment	Application Date	Rate (fl oz/acre)
Untreated Control	N/A	0
Knife blade Side Dress	20 June	8
Point Injection	20 June	8
Stem Drench	20 June	8

Table 3. Treatment dates and rates for the flutriafol evaluation in Safford, AZ, 2017.

Treatment	Application Date	Rate (fl oz/acre)
Untreated Control	N/A	0
At-Planting T-Band	19 April	8
Knife blade Side Dress	22 June	8
Point Injection	22 June	8
Stem Drench	22 June	8

Table 4. Percent disease, yield, and fiber quality results for each treatment in the flutriafol evaluation, Yuma, AZ, 2017.

Treatment	Percent Disease	Lint Yield	Percent Lint	Color Grade	Staple	Micronaire	Strength	Length	Leaf Grade	Uniformity Index
Untreated Control	1.7	1906.9	40.8	11	36.7	3.7	29.5	1.13	2	79.4
Stem Drench	1.5	1826.3	41.1	11	36.7	3.6	30.4	1.14	1	80.4
Point Injection	2.8	1818.7	40.1	11	37.3	3.6	30.0	1.17	2	79.9
Side Dress	0.7	1773.5	40.9	11	37.7	3.6	30.4	1.18	1	80.4
Mean	**1.7**	**1831.3**	**40.7**	**---**	**37.1**	**3.6**	**30.1**	**1.15**	**---**	**80.0**
LSD	NS	NS	NS	---	NS	NS	NS	NS	---	NS
OSL	0.6051	0.5351	0.5247	---	0.3617	0.6211	0.5303	0.1086	---	0.4393
CV	108.3	5.9	2.1	---	2.1	3.5	2.7	1.8	---	0.9

Table 5. Percent disease, yield, and fiber quality results for each treatment in the flutriafol evaluation, Marana, AZ, 2017.

Treatment	Percent Disease	Lint Yield	Percent Lint	Color Grade	Staple	Micronaire	Strength	Length	Leaf Grade	Uniformity Index
Stem Drench	27.5 b[1]	1382.8	38.7 a	21	36	4.7	30.3	1.12	2	80.8 ab
Point Injection	18.8 b	1350.1	37.4 b	21	35	4.6	29.6	1.09	1	78.9 c
Side Dress	17.5 b	1320.2	37.6 b	21	36	4.6	30.0	1.12	1	81.1 a
Untreated Control	55.0 a	1256.6	38.6 a	21	36	4.7	30.4	1.12	2	80.4 b
Mean	**29.7**	**1327.5**	**38.1**	---	**35.7**	**4.6**	**30.1**	**1.11**	**---**	**80.3**
LSD	18.0	NS	0.7	---	NS	NS	NS	NS	---	0.6
OSL	0.0036	0.5949	0.0035	---	0.1066	0.5436	0.2062	0.1012	---	<0.0001
CV	37.9	9.9	1.1	---	1.9	2.9	1.8	1.6	---	0.5

Within columns, means followed by the same letter are not significantly different by Fisher's LSD test.

Table 6. Percent disease, yield, and fiber quality results for each treatment in the flutriafol evaluation, Safford, AZ, 2017.

Treatment	Percent Disease	Lint Yield	Percent Lint	Color Grade	Staple	Micronaire	Strength	Length	Leaf Grade	Uniformity Index
Side Dress	9.8	1311.2	35.7	1	51	4.1	44.0	1.47	1	86.4
Stem Drench	7.5	1310.3	35.3	1	50	4.0	43.0	1.45	1	86.4
Untreated Control	18.8	1310.3	35.8	1	51	4.0	43.3	1.48	1	86.6
Point Injection	6.8	1298.6	35.5	1	50	3.9	42.5	1.45	1	86.1
Modified In-Furrow	3.5	1220.6	35.8	1	51	3.9	42.6	1.46	1	86.7
Mean	**9.3**	**1290.2**	**35.6**	**---**	**50**	**4.0**	**43.1**	**1.46**	**---**	**86.4**
LSD	NS	NS	NS	---	NS	NS	NS	NS	---	NS
OSL	0.1076	0.1561	0.9645	---	0.6464	0.1623	0.4508	0.4259	---	0.7790
CV	80.4	4.3	3.1	---	2.1	3.4	2.9	1.6	---	0.8

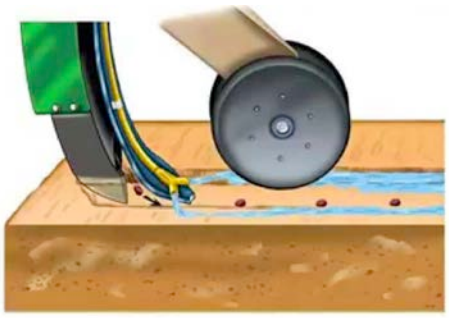

Figure 1. At-planting modified in-furrow application technique.

Figure 2. Side dress application technique utilizing an injection knife.

Figure 3. Post-emergence point injection application technique.

Figure 4. Post-emergence stem drench application technique.

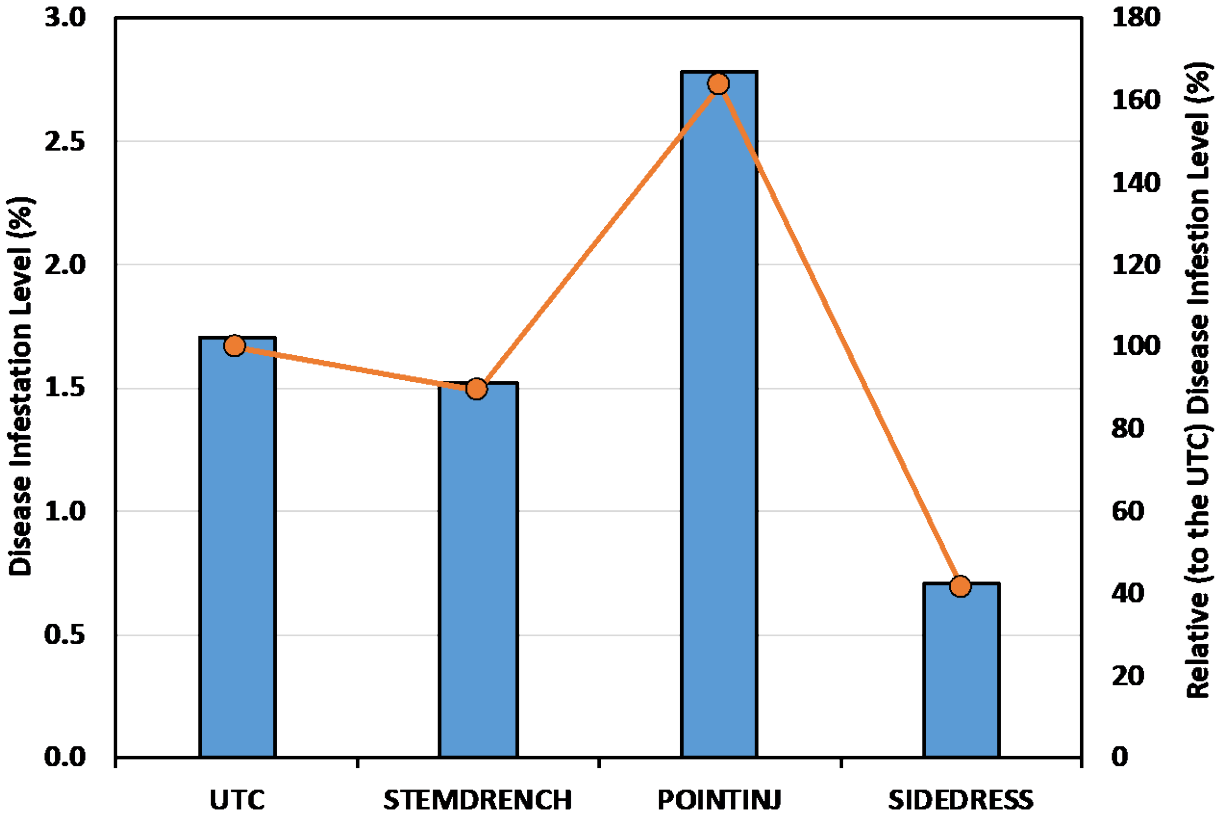

Figure 5. Percent disease level (blue bars – left y-axis) and percent disease relative to the control (orange line – right y-axis) for each of the application techniques utilized in the flutriafol application evaluation, Yuma, AZ, 2017.

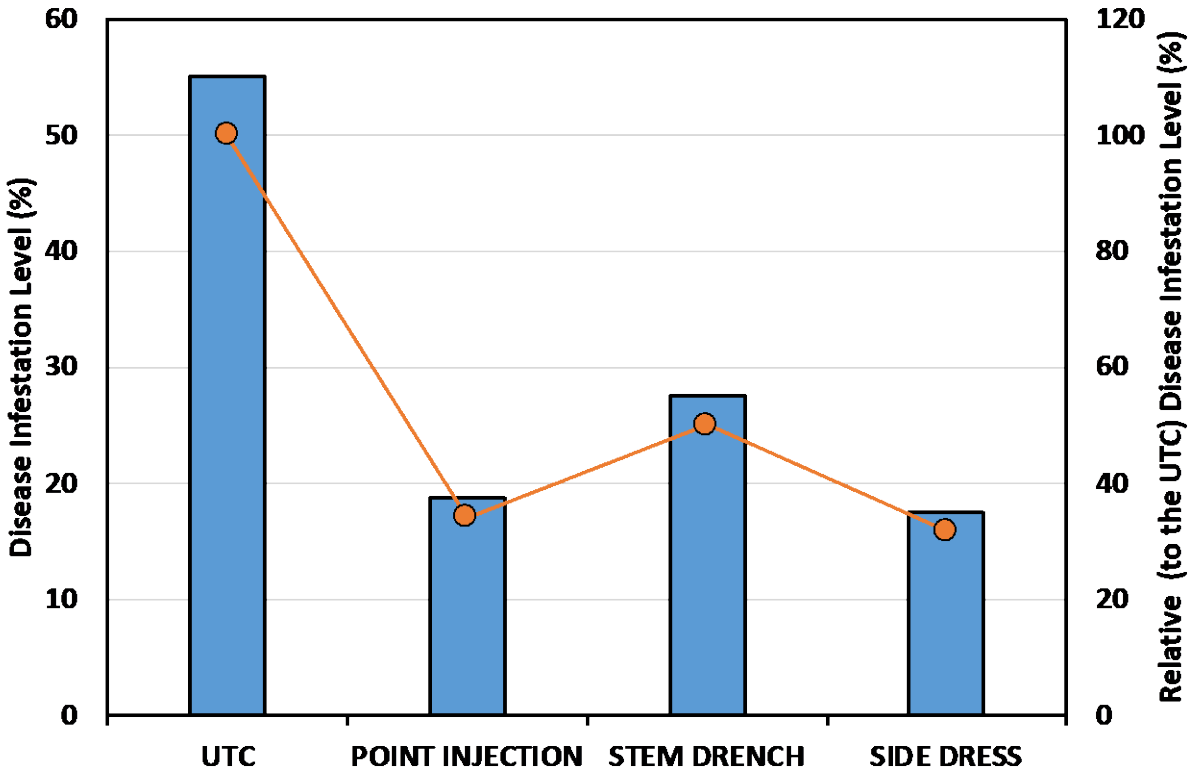

Figure 6. Percent disease level (blue bars – left y-axis) and percent disease relative to the control (orange line – right y-axis) for each of the application techniques utilized in the flutriafol application evaluation, Marana, AZ, 2017.

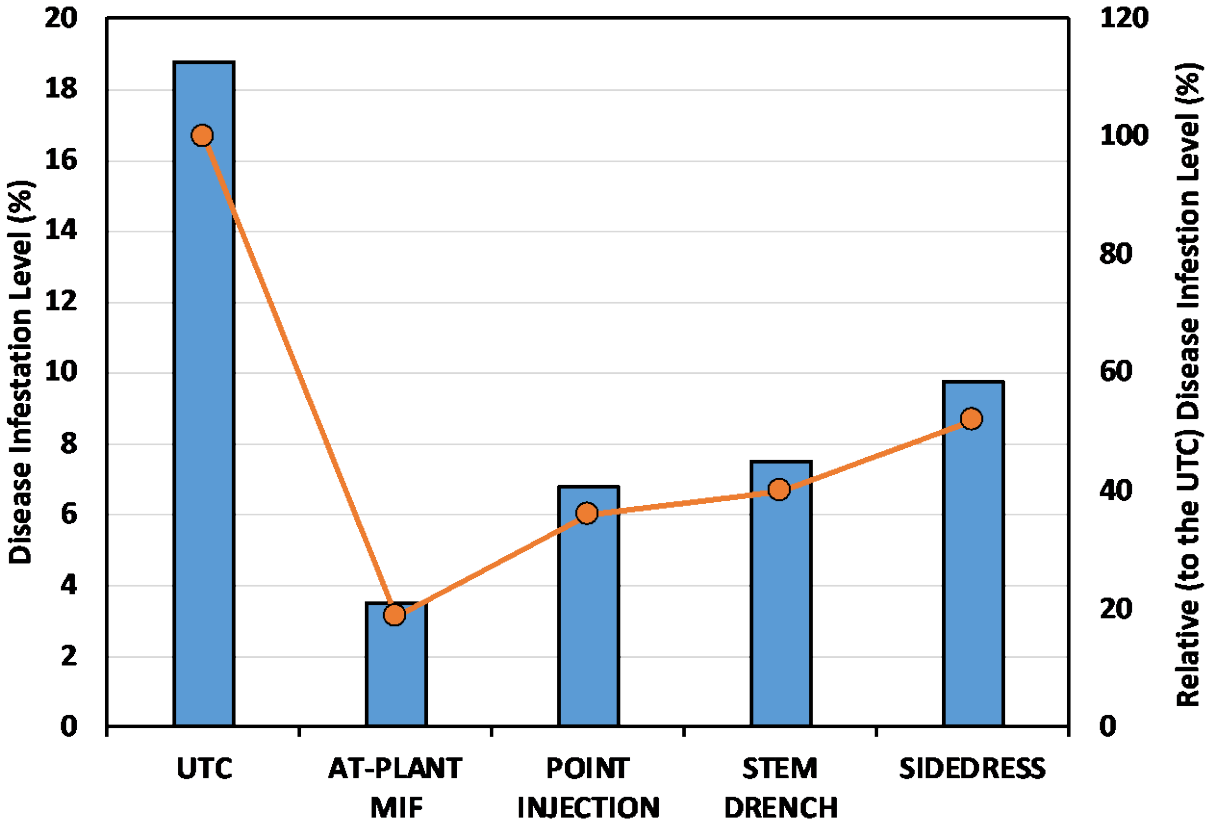

Figure 7. Percent disease level (blue bars – left y-axis) and percent disease relative to the control (orange line – right y-axis) for each of the application techniques utilized in the flutriafol application evaluation, Safford, AZ, 2017.

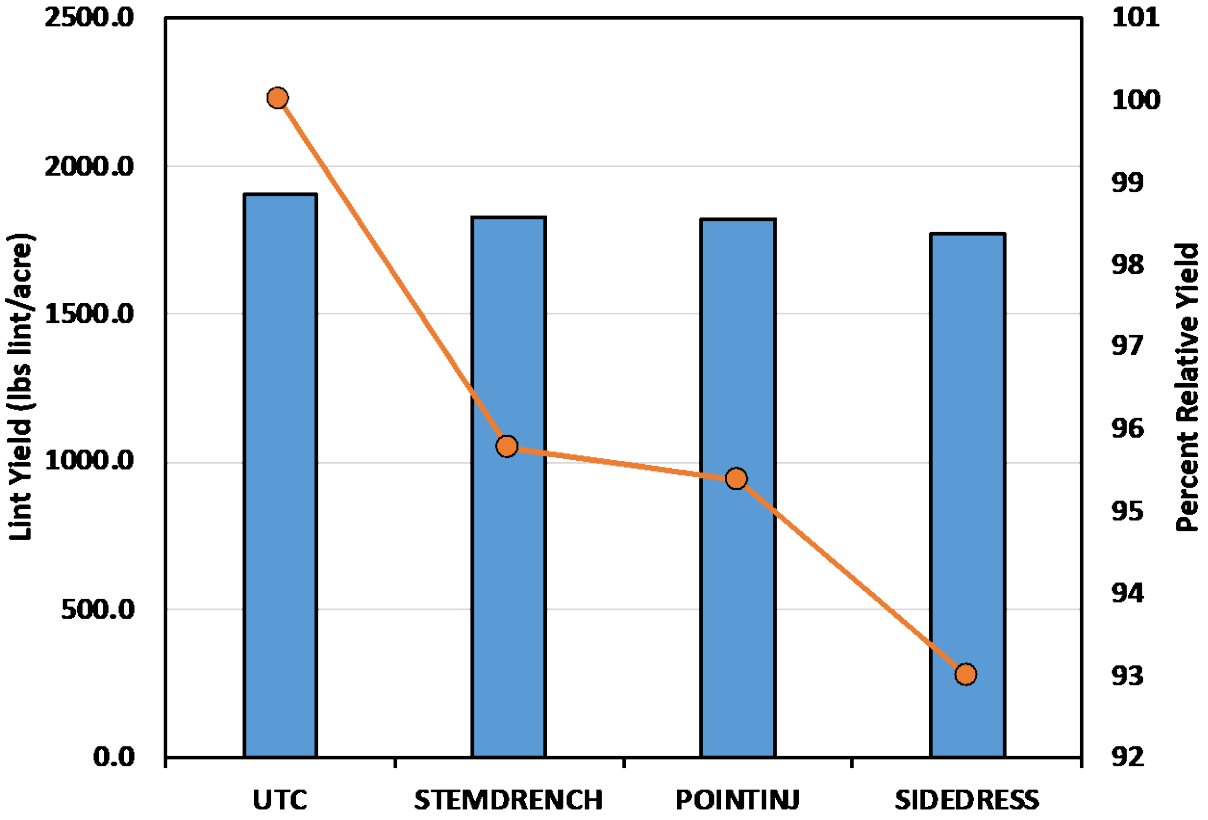

Figure 8. Lint yield level (blue bars – left y-axis) and percent yield relative to the control (orange line – right y-axis) for each of the application techniques utilized in the flutriafol application evaluation, Yuma, AZ, 2017.

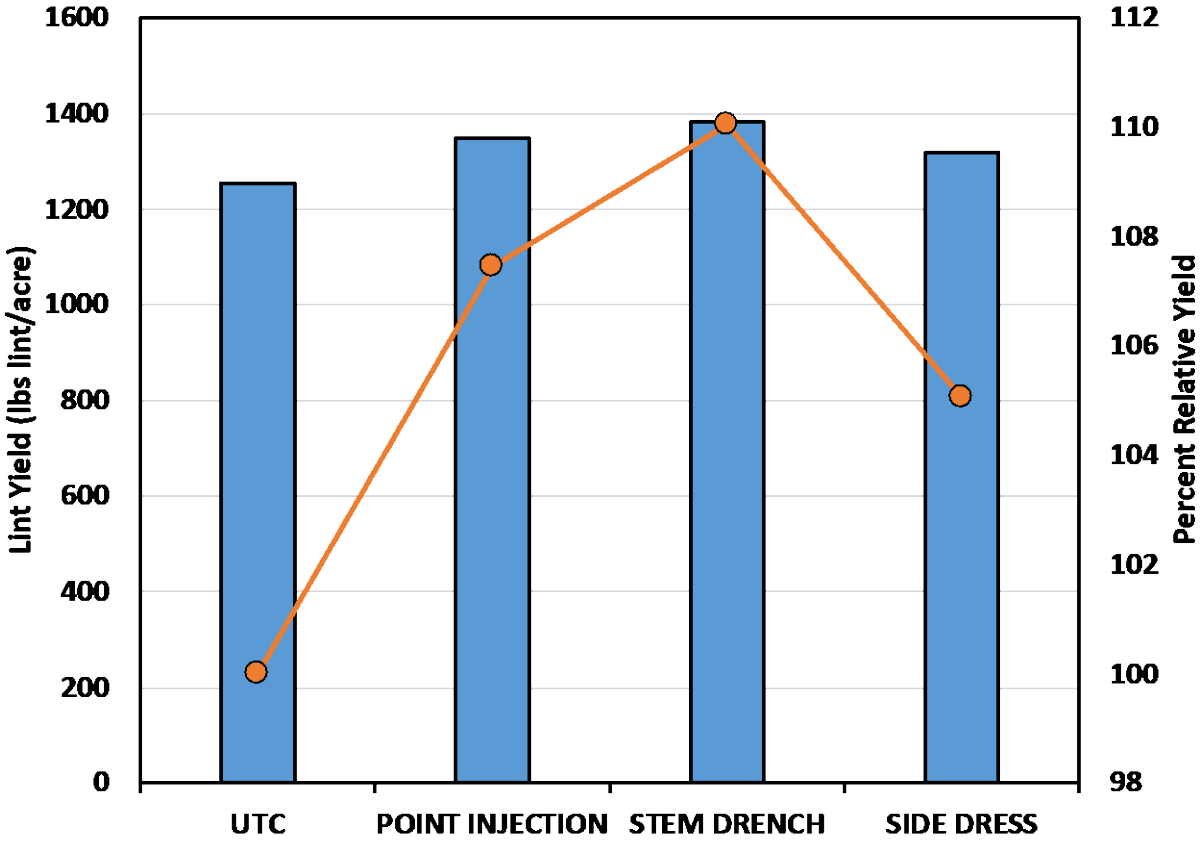

Figure 9. Lint yield level (blue bars – left y-axis) and percent yield relative to the control (orange line – right y-axis) for each of the application techniques utilized in the flutriafol application evaluation, Marana, AZ, 2017.

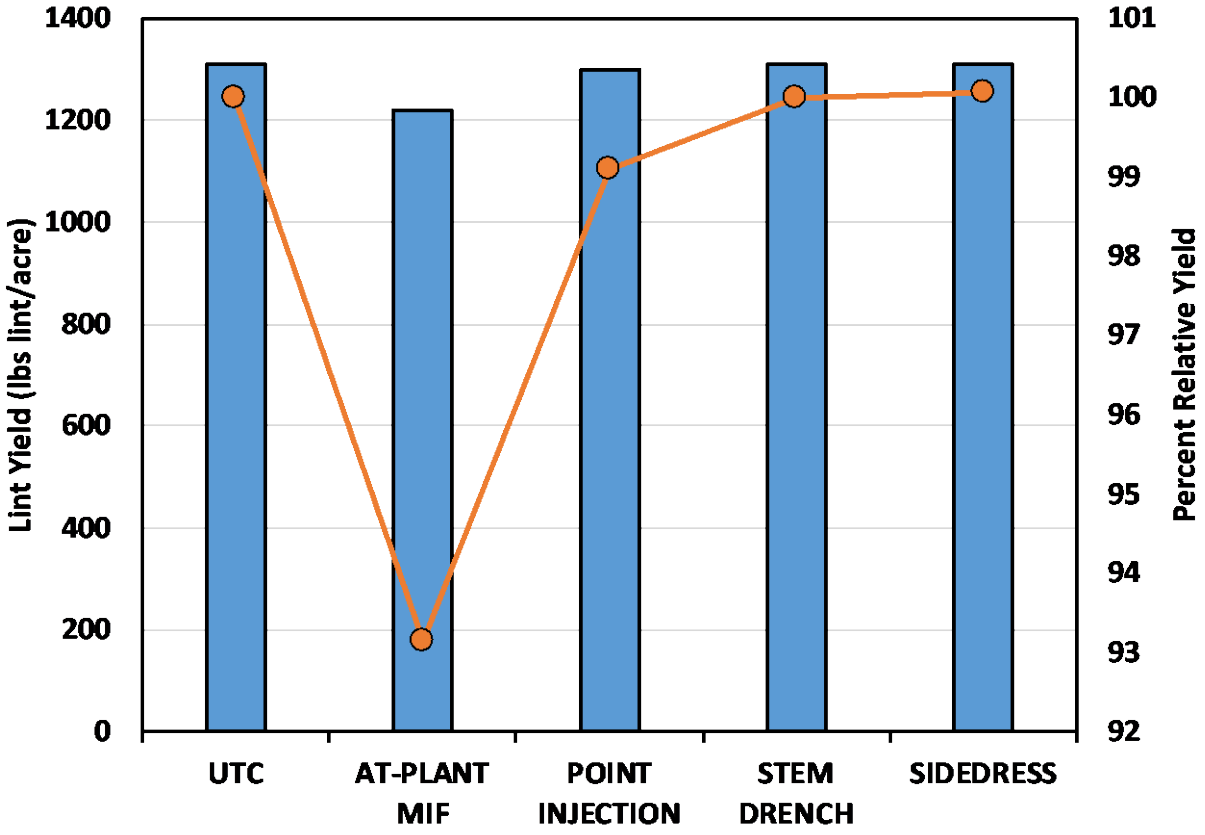

Figure 10. Lint yield level (blue bars – left y-axis) and percent yield relative to the control (orange line – right y-axis) for each of the application techniques utilized in the flutriafol application evaluation, Safford, AZ, 2017.

Figure 11. Aerial imagery collected just after defoliation with plot outlines overlain on top from the 2017 flutriafol evaluation, Yuma, AZ.

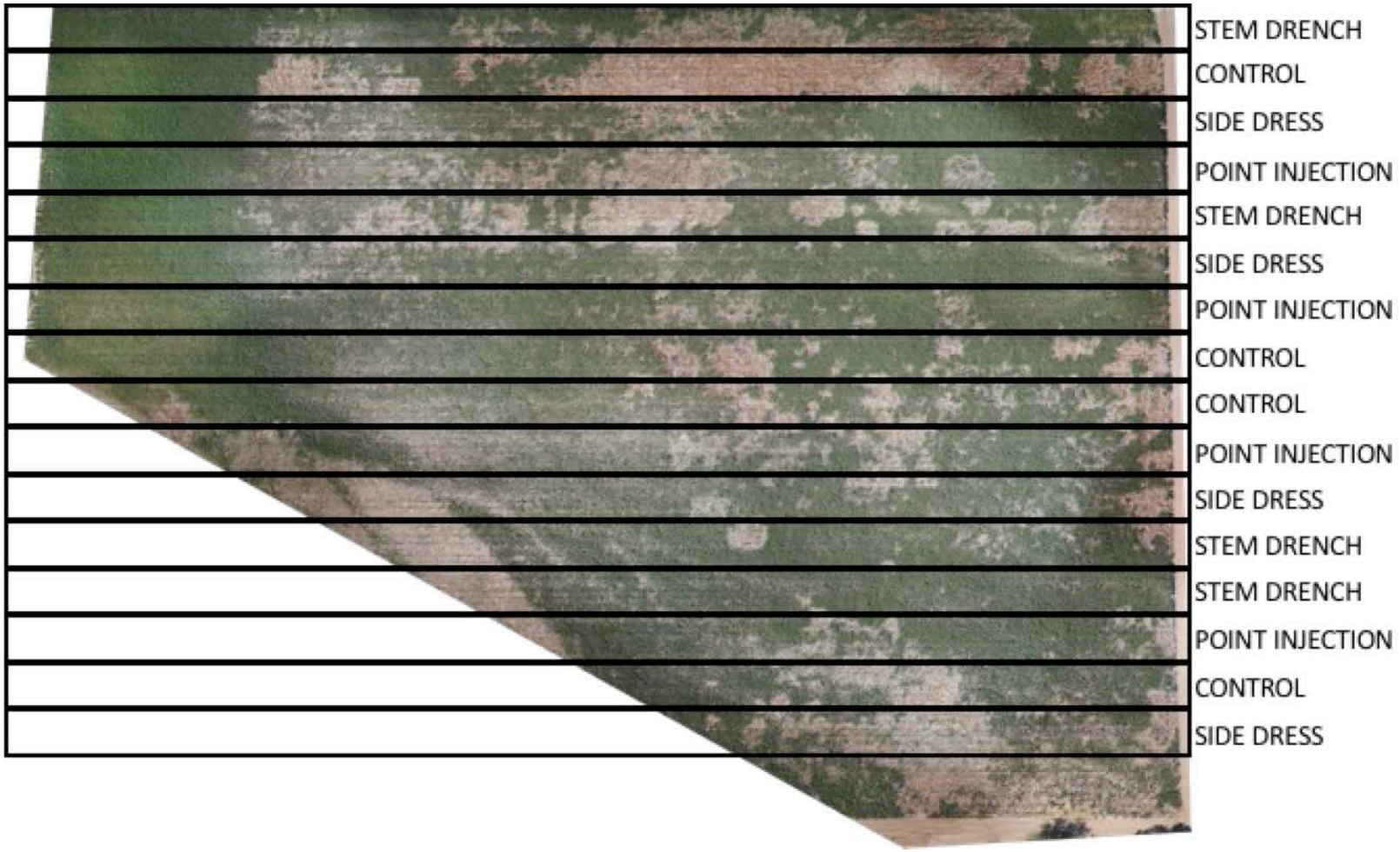

Figure 12. Aerial imagery collected just prior to defoliation with plot outlines overlain on top from the 2017 flutriafol evaluation, Marana, AZ.

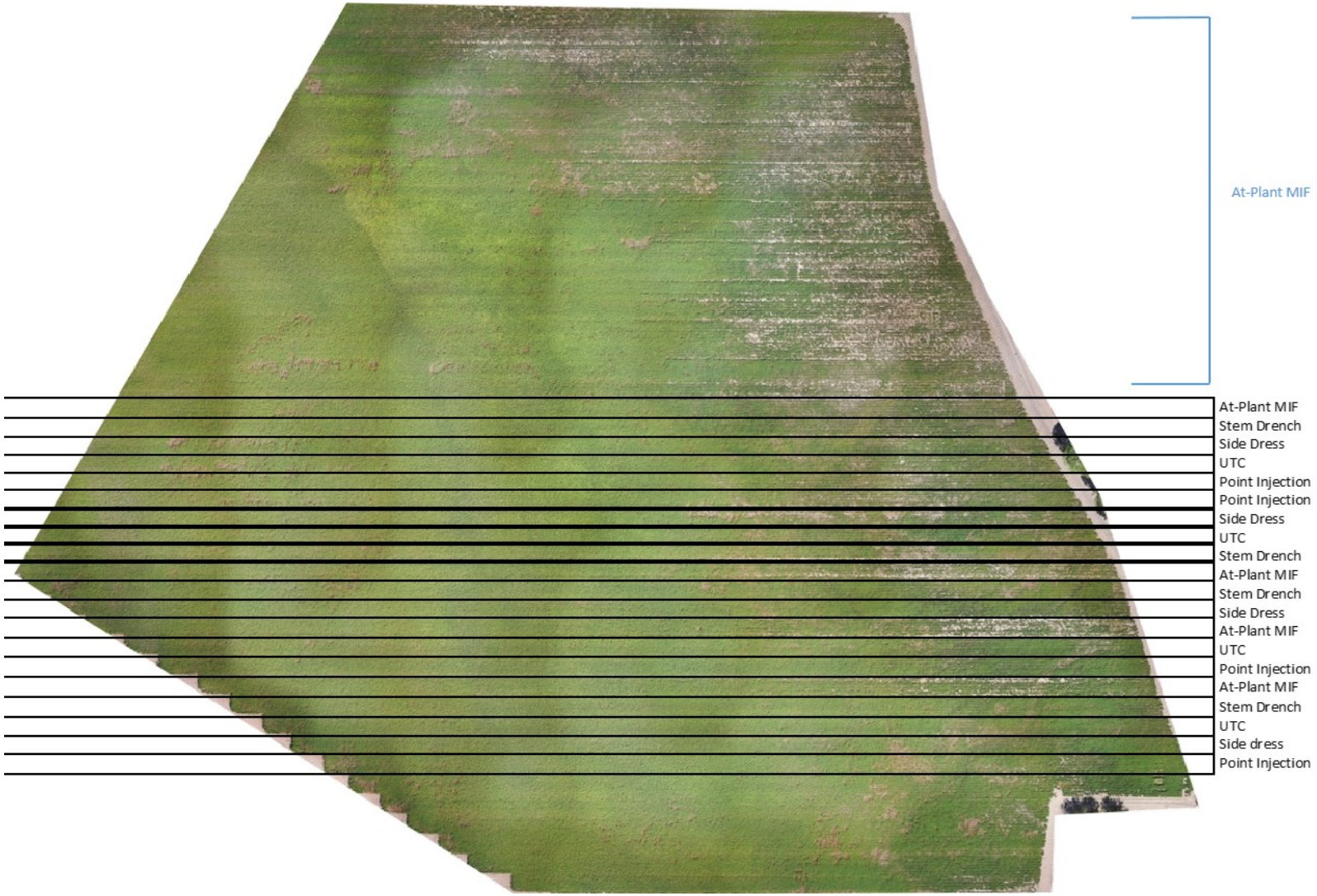

Figure 13. Aerial imagery collected just prior to defoliation with plot outlines overlain on top from the 2017 flutriafol evaluation, Safford, AZ.