Evaluation of Envoke by Pix Interaction in Arizona Cotton Production Systems

E.R. Norton and H.J. Borrego

Abstract

A single trial was conducted during the 2005 cotton growing season at The University of Arizona Safford Agricultural Center to evaluate the effects of the selective herbicide Envoke in combination and alone with the plant growth regulator (Pix). Combining applications of chemical inputs in a crop production system has the potential to help reduce costs by eliminating a trip across the field with equipment. The effects of these applications on growth, development, yield, and fiber quality was investigated. The trial was arranged with seven treatments including 1) control, 2) broadcast Envoke, 3) post-direct Envoke, 4) broadcast Pix, 5) broadcast Envoke + Pix, 6) post-direct Envoke followed by broadcast Pix, and 7) broadcast Pix followed by post-direct Envoke. These treatments were imposed in both normal and high soil moisture regimes. Plots were arranged in a randomized complete block design with four replications in two separate studies (normal and high soil moisture). Plots were monitored for effects on plant growth and development throughout the season by collecting a series of plant measurements from each treatment. Effects on final lint yield and fiber quality was determined by harvesting the center two rows of each four-row plot and weighing the resultant seed cotton. A sub-sample was collected for lint turnout and fiber quality analysis. Results indicated very little differences in plant growth and development among any of the treatments in both the normal and high moisture regimes. Significant differences were observed among lint yield and fiber quality parameters. Analysis of variance indicated significant effects due to treatment in lint yield, fiber length, strength, and uniformity. Significant differences were also observed due to soil moisture with respect to micronaire and fiber strength. Significant interaction between treatment and moisture regime was observed in micronaire, fiber length, strength, and uniformity. Results indicate that even though plant growth and development did not appear to be significantly impacted by the application of Pix + Envoke, lint yield was impacted. In both the normal and high soil moisture regimes the treatment receiving the combined application of Pix and Envoke produced the lowest yield.

Introduction

In the current economic environment it is important that a producer critically examine each cultural input in a cotton production system. With the increasing availability of selective herbicides growers are now able to make applications of certain herbicides over the top of the crop with minimal crop injury. This opportunity allows for the potential combination of chemical applications such as PGR applications with selective herbicides. This potential combination of treatments may allow for the elimination of a pass through the field helping to reduce production costs and improve the profitability of the operation.

Evaluation of the potential effect on plant growth, development, yield, and fiber quality of different chemical combinations is critical to ensure no detrimental effects. This project was established to evaluate the effects of the herbicide Envoke, from Syngenta, in combination with the plant growth regulator Pix on plant growth, yield and fiber quality in both a normal and above normal soil moisture regime.

Materials and Methods

This project was planted to the cultivar Deltapine DP488BR on 2 May 2005 into dry soil at a rate of 25 lbs./acre. An irrigation to initiate emergence was applied on 3 May 2005. Plots were arranged in a randomized complete block design with four replications. Plot size was 4, 36" rows wide and extended 30 feet in length. Treatments are outlined in Table 1 including dates and rates of application. All broadcast treatments were imposed using a John Deere 6000 high cycle that has been retrofitted with a small plot CO_2 sprayer with a carrier rate of 20 gallons/acre at 35 psi. All post- directed treatments were applied with a new shielded sprayer with a 20 gallon/acre carrier rate at 35 psi. Each of the seven treatments listed in Table 1 were imposed under a regime of normal soil moisture and also an above normal soil moisture regime (Table 2).

Plots were otherwise managed in an optimum fashion with respect to fertility receiving a total of 158 lbs. N/acre. One insecticide application was made in-season for control of lygus bugs. All cultural inputs are recorded in Table 2. Final irrigation was applied on 12 September and plots were defoliated 21 September 2005. The center two rows of each four row plot was harvested and weighed to determine treatment yields on 11 October 2005. Sub-samples were collected from each plot and submitted to the USDA classing office for fiber quality analysis. Fiber quality data was utilized to determine potential premiums/discounts for fiber quality using the USDA 2005 loan marketing schedule. These premiums/discounts were applied to a base price of $0.52 per pound of lint and multiplied by the total lint yield to determine a total value for each treatment.

In an effort to track the effects of Pix and Envoke treatments on plant growth and development, a series of plant measurements were collected over the course of the season. The measurements included, plant height (cm), number of total mainstem nodes, number of the first fruiting branch, total number of aborted and missing fruiting sites on the first two positions of each fruiting branch, and the number of nodes above the top, first position fresh bloom. This data was used to calculate and monitor height to node ratios, fruit retention levels, and progression towards cut-out.

All data was analyzed using statistical techniques as outlined in Steele and Torrie (1980) utilizing GLM procedures in SAS (2002). Means separation utilizing a protected Fisher's least significant difference was performed on all yield and fiber quality data. Plant measurement data was plotted by treatment against long-term average baselines for the parameters listed above. No statistical analysis was performed on growth and development data.

Results

General observations made near the day of application revealed yellowing of the leaves on treatments receiving the Envoke broadcast treatments. Within three to five days post application very little evidence of the plant yellowing remained. There appeared however to be a slight response in increased plant vigor and height in treatments receiving the broadcast Envoke treatment alone without Pix. This is evidenced in the plant measurement data when comparing treatments 2 and 3 versus the control on the two dates in July (Figures 1 and 2). These treatments have slightly increased plant vigor compared to the control. This difference appeared to lessen as time progressed.

The study had excellent fruit retention all season which has a tremendous effect on vigor. Above normal fruit retention levels were experienced by all seven treatments in both the normal and high soil moisture regimes (Figures 1 and 2). Height to node ratios remained below the average line due partly to the high fruit load but also to the effect of the second 12 oz application of Pix on 12 July. In retrospect this application should not have been made. It would have allowed for better expression of the treatments and significantly higher growth rates. Height to node ratios are plotted in Figures 3 and 4 for the normal and high soil moisture regimes respectively.

Yield and fiber quality data is presented in Tables 3 and 4 for the normal and high soil moisture regimes respectively. A graphical representation with means separation for all yield and fiber quality parameters is shown in Figures 5-12. Analysis of variance and means separation was performed separately for the normal and high soil moisture regimes and is presented in the above mentioned tables. Overall analysis of variance was performed on the data to look for significant effects due to treatment, moisture level, and their interaction. Table 5 lists significant responses to those effects in the lint yield and fiber quality variables. For the variable lint yield significant differences were only observed due to treatment. In general those treatments receiving Pix applications tended to

produce lower yields. This is particularly the case in the high soil moisture regime. Significant differences due to soil moisture regime were observed in both micronaire and fiber strength. This observation of higher micronaire and fiber strength would be expected with slightly more restricted soil moisture conditions. These effects were not influenced by treatment but only soil water relations.

Some significant interaction was observed between treatments and soil moisture regime in a few fiber quality variables. In general treatments receiving Pix application and normal soil moisture conditions tended to experience higher micronaire levels than other treatments. The significant interaction between treatment and moisture level with respect to fiber length and uniformity is difficult to explain. An opposite response was observed between the two soil moisture regimes. Under normal soil moisture conditions the treatment receiving the combined Pix + Envoke treatment produced the lowest fiber length and uniformity while in the high soil moisture regime the opposite occurred.

In conclusion several important salient points can be gleaned from this project. The first would be that care should be taken when combining the PGR Pix and Envoke in a broadcast application. A significant decline in lint yield was observed with this treatment. Also, in general lint yields were depressed with application of Pix (Norton et. al., 2005; Silvertooth, 1994). Under a different scenario with a crop of higher vigor and less fruit load this same response may not have been observed. This is one year of data and should be evaluated as such. Additional work should be done to further investigate the effects of Envoke in combination with Pix applications and their effect on growth, development, yield, and fiber quality.

Acknowledgments

We would like to acknowledge the staff at the Safford Agricultural Center for their assistance in executing this project and also the financial and product support from Syngenta.

References

Norton, E.R., L.J. Clark, and H.J. Borrego. 2005. On-Farm Evaluation of Mepiquat Formulations in Southeastern Arizona. Cotton, A College of Agriculture and Life Sciences Report. The University of Arizona. Series P 142 p. 55-59.

SAS Institute. 2002. SAS procedures guide. Version 9. SAS Inst., Cary, NC.

Silvertooth, J.C. 1994. Practical uses of crop monitoring for Arizona cotton. Cotton, A College of Agriculture Report. University of Arizona. Series P-96:18-23

Steel, R.G.D., and J.H. Torrie. 1980. Principles and procedures of statistics. McGraw-Hill, New York.

Table 1. Treatment application dates (HUAP) and rates.

Date		Treatments						
	HUAP	1	2	3	4	5	6	7
24 JUN 05	1011	--	Envoke Broadcast 0.11 oz/acre	Envoke Post-Direct 0.11 oz/acre	Pix Broadcast 8 oz/acre	Envoke+Pix Broadcast 0.11 oz/acre 8 oz/acre	Envoke Post-Direct 0.11 oz/acre	Pix Broadcast 8 oz/acre
27 JUN 05	1084	--	--	--	--	--	Pix Broadcast 8 oz/acre	Envoke Post-Direct 0.11 oz/acre
12 JUL 05	1424	----------Pix Broadcast 12 oz/acre----------						

Table 2. Cultural inputs for each of the seven treatments in the normal and high moisture regimes in the Pix by Envoke evaluation, Safford, AZ, 2005.

Date	Input	Normal Soil Moisture	High Soil Moisture
9 JUN 05	Fertilization	105 lbs N/acre	105 lbs N/acre
15 JUN 05	Irrigation	5.0 acre-inches	5.0 acre-inches
24 JUN 05	Fertilization	52 lbs N/acre	52 lbs N/acre
27 JUN 05	Irrigation	--	5.0 acre-inches
1 JUL 05	Irrigation	5.0 acre-inches	--
12 JUL 05	Irrigation	--	5.0 acre-inches
18 JUL 05	Irrigation	5.0 acre-inches	--
25 JUL 05	Fertilization	52 lbs N/acre (water-run)	--
25 JUL 05	Irrigation	--	5.0 acre-inches
1 AUG 05	Irrigation	5.0 acre-inches	--
4 AUG 05	Fertilization	--	52 lbs N/acre (water-run)
4 AUG 05	Irrigation	--	5.0 acre-inches
15 AUG 05	Irrigation	5.0 acre-inches	5.0 acre-inches
25 AUG 05	Irrigation	--	5.0 acre-inches
26 AUG 05	Insecticide (lygus control)	2.5 oz/acre (lambda-cyhalothrin)	2.5 oz/acre (lambda-cyhalothrin)
31 AUG	Irrigation	5.0 acre-inches	--
10 SEP 05	Irrigation	--	5.0 acre-inches
12 SEP 05	Irrigation	5.0 acre-inches	--
21 SEP 05	Defoliation	10 oz/acre Ginstar	10 oz/acre Ginstar

Table 3. Lint yield and fiber quality results for the normal soil moisture regime in the Syngenta Envoke by Pix test conducted in Safford, AZ, 2005.

Treatment	Lint Yield lbs./acre		Turn-out %	Staple 32nds	Micronaire	Strength g/tex	Length inches	Uniformity %	Premium Points	Crop Value $/acre
3	1455	a	35.8	37.0	4.2	30.5	1.16	80.0	613	$850.24
4	1438	a b	35.2	37.0	4.1	30.5	1.15	80.4	656	$842.43
1	1404	a b	34.3	37.5	4.0	30.5	1.17	81.2	669	$823.83
7	1376	a b	35.5	37.0	4.2	30.4	1.15	80.8	665	$806.75
2	1353	a b	34.2	37.0	4.2	29.2	1.15	80.3	630	$788.95
6	1319	a b	33.9	36.5	4.1	29.9	1.15	81.1	636	$769.78
5	1293	b	34.2	35.5	4.2	29.1	1.11	79.3	476	$733.65
LSD§	154		0.0	0.6	0.2	0.9	0.02	0.7	44.732	$3.50
OSL†	0.2959		0.0733	0.0002	0.3277	0.0129	0.0002	0.0006	0.0001	0.1857
CV‡	7.5		2.8	1.2	3.6	2.1	1.2	0.6	4.5	7.8

*Means followed by the same letter are not statistically different according to a Fisher's least significant difference means separation test.

§ Least Significant Difference

† Observed Significance Level

‡ Coefficient of Variation

Table 4. Lint yield and fiber quality results for the wet soil moisture regime in the Syngenta Envoke by Pix test conducted in Safford, AZ, 2005.

Treatment	Lint Yield lbs./acre		Turn-out %	Staple 32nds	Micronaire	Strength g/tex	Length inches	Uniformity %	Premium Points	Crop Value $/acre
1	1494	a	35.1	36.5	4.0	30.2	1.14	80.0	648	$873.63
3	1464	a	34.1	37.0	3.9	30.9	1.16	81.0	640	$842.62
2	1457	a	35.0	36.5	3.8	28.4	1.14	80.8	590	$843.56
7	1450	a	34.2	36.0	3.8	29.9	1.13	80.3	649	$847.89
6	1445	a	34.2	37.0	3.9	30.1	1.16	80.6	653	$845.78
4	1415	a b	34.1	36.5	3.9	29.3	1.14	80.0	618	$822.94
5	1293	b	34.1	37.0	3.9	30.0	1.16	81.2	649	$755.80
LSD§	146		0.0	0.6	0.1	1.0	0.02	0.4	41.631	$94.31
OSL†	0.1613		0.0487	0.0327	0.0001	0.0031	0.0665	0.0001	0.0300	0.2078
CV‡	6.8		1.7	1.2	1.1	2.3	1.3	0.3	4.1	7.1

*Means followed by the same letter are not statistically different according to a Fisher's least significant difference means separation test.

§ Least Significant Difference

† Observed Significance Level

‡ Coefficient of Variation

Table 5. Analysis of variance results for treatment and moisture level effects and their interaction for lint yield and fiber quality results.

	Lint Yield	Percent Lint	Micronaire	Fiber Length	Fiber Strength	Fiber Uniformity
			Observed Significance Level			
Treatment	**	NS	NS	**	***	*
Moisture Level	NS	NS	***	NS	**	NS
Treatment*Moisture Level	NS	**	***	***	*	***

*** = Significant at $\alpha < 0.01$
** = Significant at $\alpha < 0.05$
* = Significant at $\alpha < 0.10$

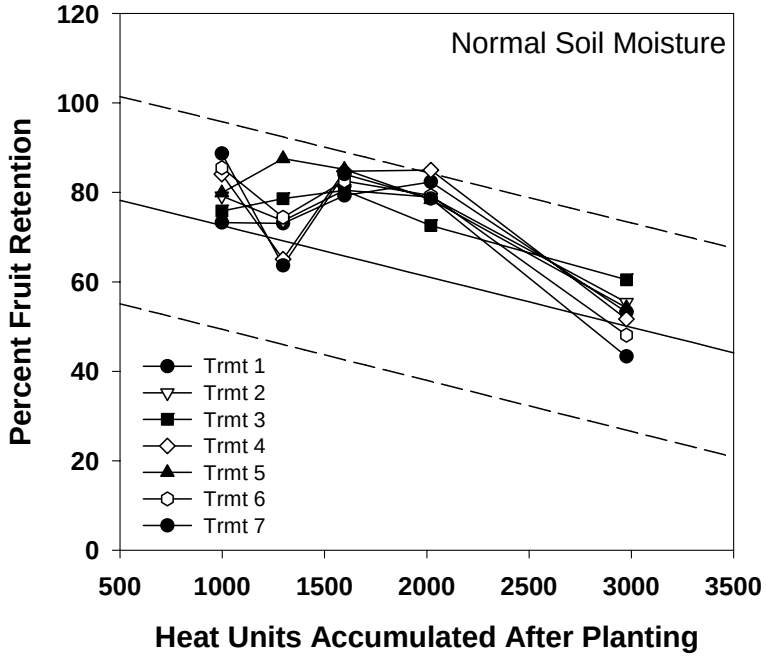

Figure 1. Percent fruit retention levels for each of the seven treatments in the normal soil moisture regime of the Envoke by Pix trial, Safford, AZ, 2005.

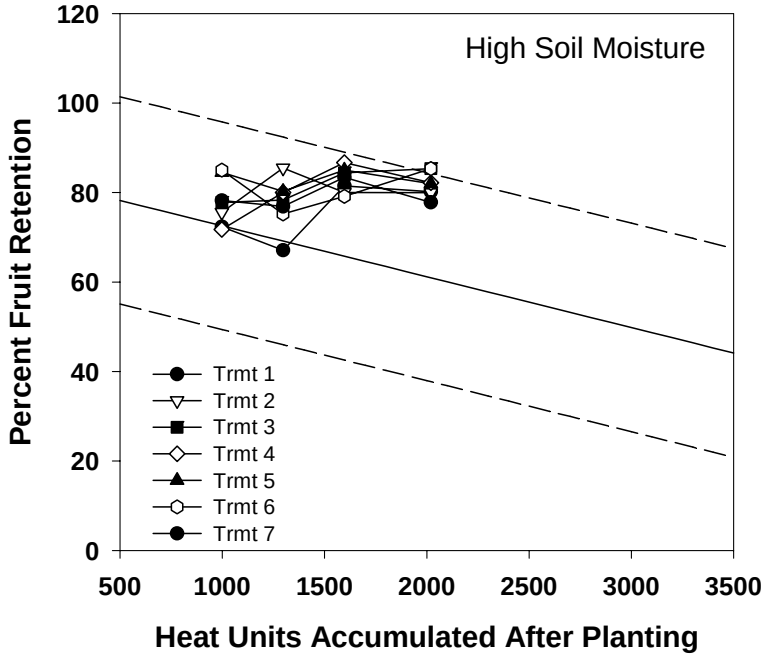

Figure 2. Percent fruit retention levels for each of the seven treatments in the high soil moisture regime of the Envoke by Pix trial, Safford, AZ, 2005.

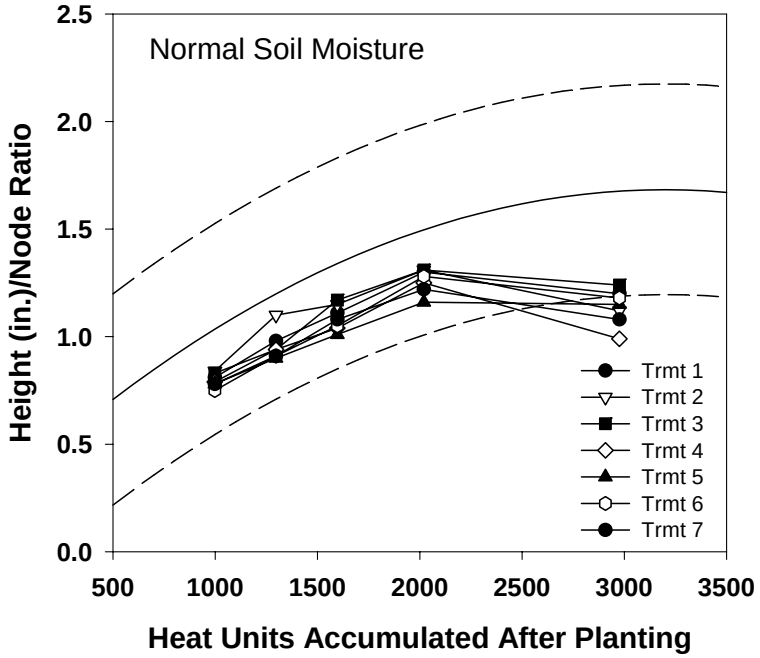

Figure 3. Height to node ratio levels for each of the seven treatments in the normal soil moisture regime of the Envoke by Pix trial, Safford, AZ, 2005.

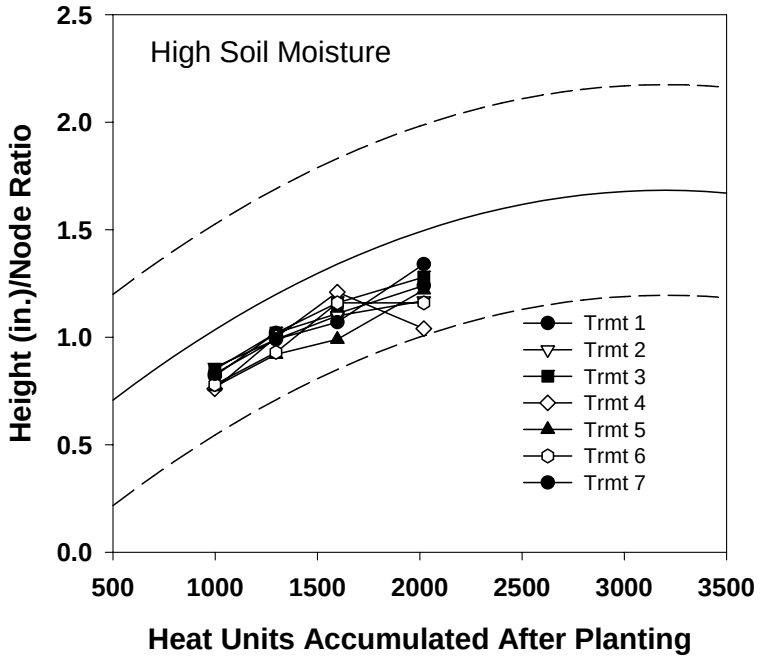

Figure 4. Height to node ratio levels for each of the seven treatments in the high soil moisture regime of the Envoke by Pix trial, Safford, AZ, 2005.

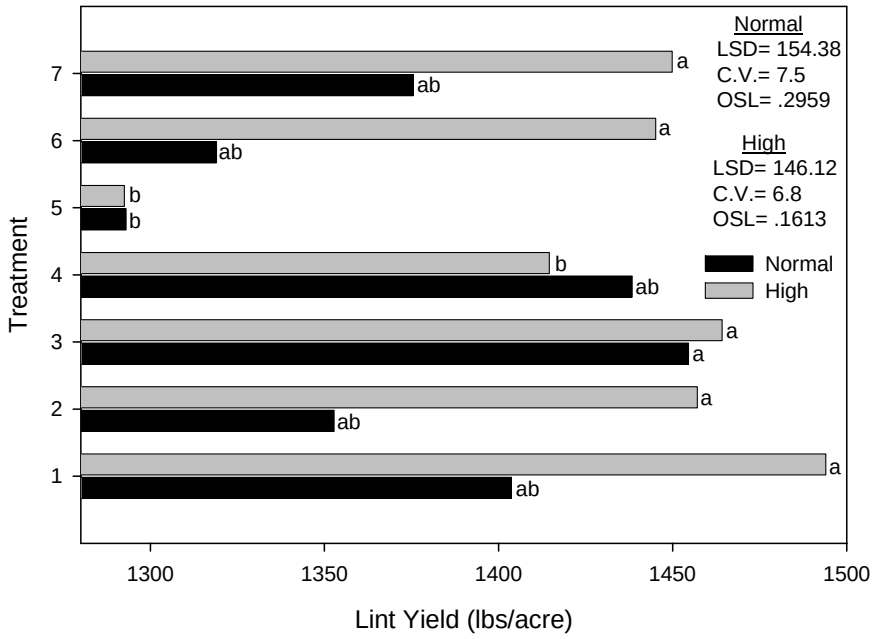

Figure 5. Lint yield levels for each of the seven treatments in both the normal and high soil moisture regime, Pix Envoke interaction evaluation, Safford, AZ, 2005.

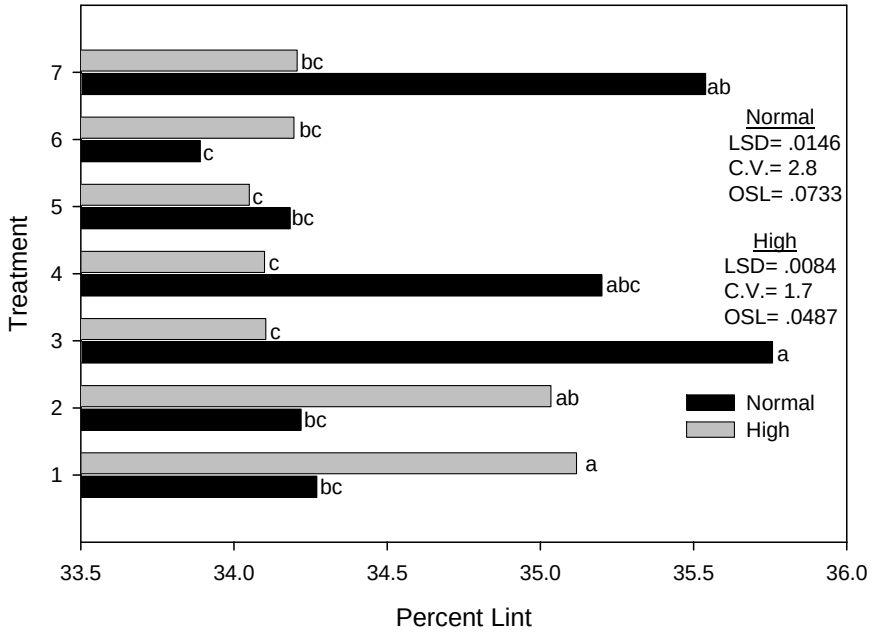

Figure 6. Percent lint levels for each of the seven treatments in both the normal and high soil moisture regime, Pix Envoke interaction evaluation, Safford, AZ, 2005.

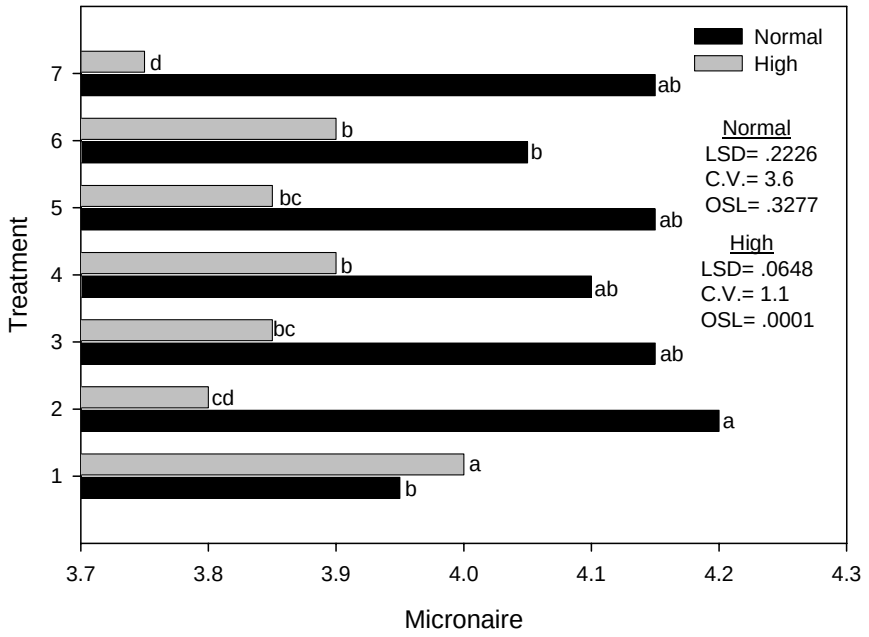

Figure 7. Micronaire levels for each of the seven treatments in both the normal and high soil moisture regime, Pix Envoke interaction evaluation, Safford, AZ, 2005.

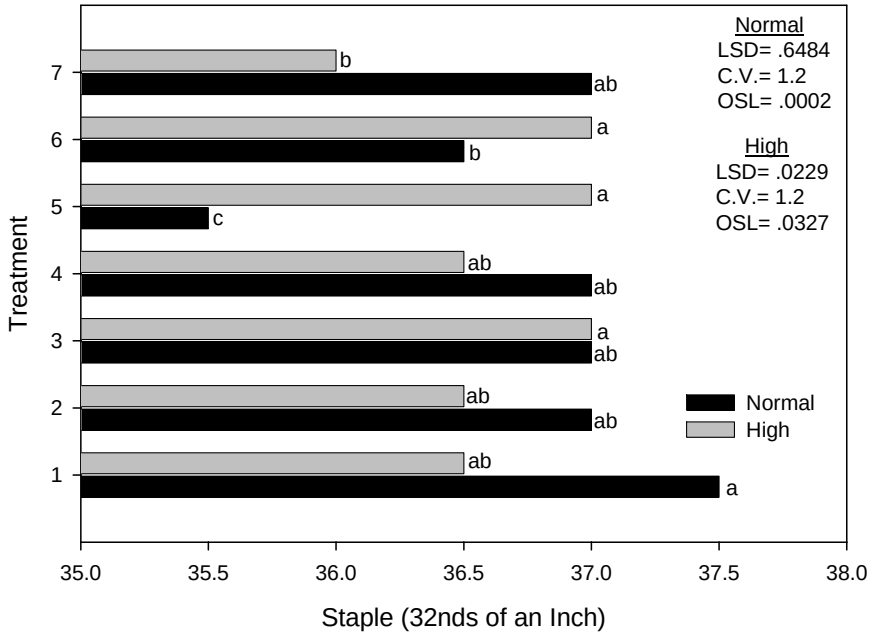

Figure 8. Staple length levels for each of the seven treatments in both the normal and high soil moisture regime, Pix Envoke interaction evaluation, Safford, AZ, 2005.

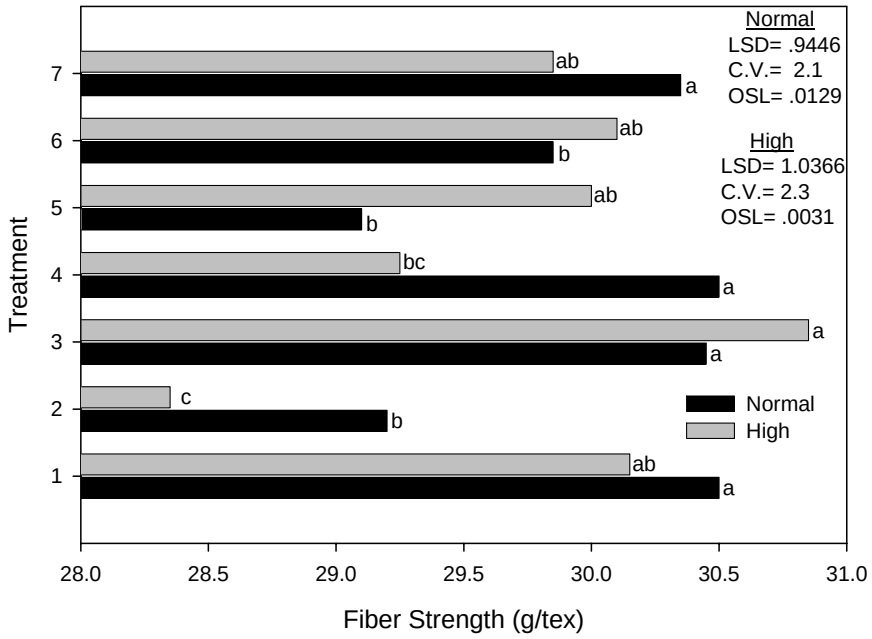

Figure 9. Fiber strength levels for each of the seven treatments in both the normal and high soil moisture regime, Pix Envoke interaction evaluation, Safford, AZ, 2005.

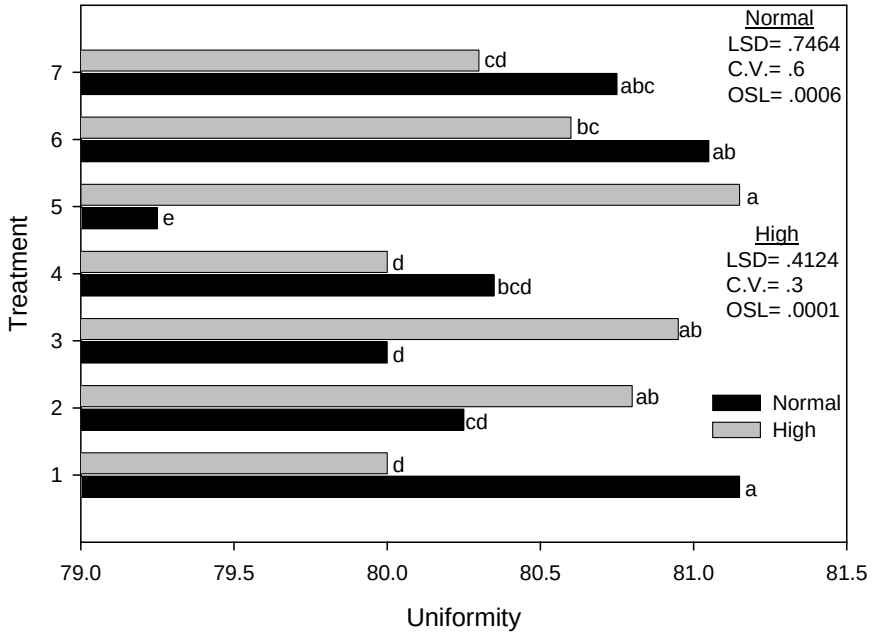

Figure 10. Percent uniformity levels for each of the seven treatments in both the normal and high soil moisture regime, Pix Envoke interaction evaluation, Safford, AZ, 2005.

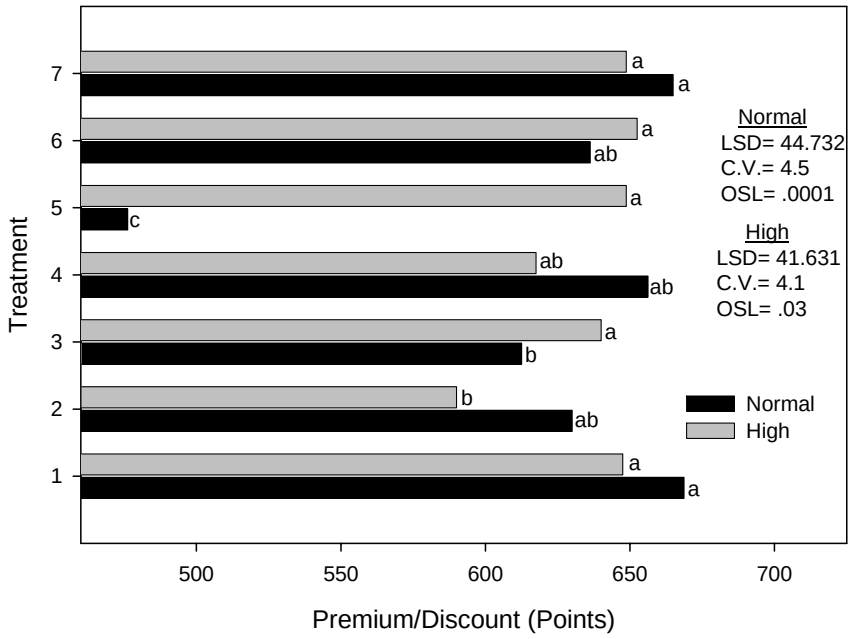

Figure 11. Premium levels for each of the seven treatments in both the normal and high soil moisture regime, Pix Envoke interaction evaluation, Safford, AZ, 2005.

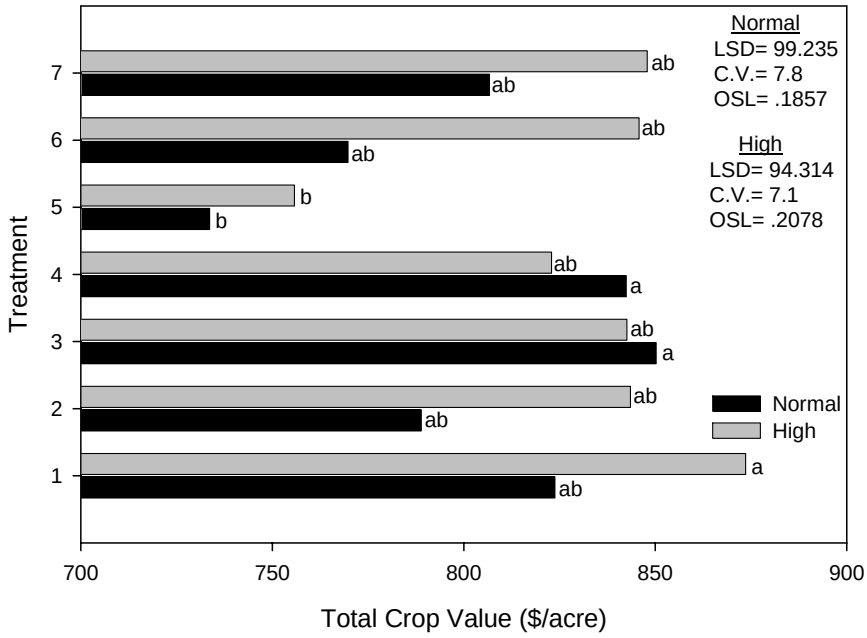

Figure 12. Total crop value for each of the seven treatments in both the normal and high soil moisture regime, Pix Envoke interaction evaluation, Safford, AZ, 2005.