FIVE YEARS EXPERIENCE WITH MEP PLUS VERSUS PIX

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Abstract

Mep Plus provides significantly higher yields than PIX in paired comparisons over five years while providing the same degree of height control without sacrificing early maturity. This paper reports possible reasons for the yield increase and discusses implications of the results. This research was privately funded by Micro Flo Company to D W + Associated Consultants.

Introduction

PIX is a 4.2% solution of Mepiquat Chloride (MC). Mep Plus (Mep +) is a combination of PIX and two grams of *bacillus cereus* (BC) per gallon.

Various combinations of MC and *BC* were initially tested in 1994. The major objective of the 1994 testing was to determine the potential for market entry. A secondary objective was to introduce or begin research to determine the appropriate combination of MC and *BC.* In general, all combinations of MC and *BC* testing tended to out perform PIX in terms of yield without a delay in maturity. But combinations with less than a full rate of PIX, did not deliver what was considered to be the desired height control (the level of height reduction the market had come to expect).

The tests were conducted on commercial cotton. The experimental design was paired fields or split fields, i.e., the treatments were in adjacent sets of rows or separated by a turn row. The test rows were planted on the same day to the same variety by the same planter. Growers selected had a history of achieving yield responses and earliness by utilizing PIX. Growers were instructed to decide on their PIX application date and rate and apply the second material (Mep +) on the same date at the same rate with the same equipment.

The basic sampling unit (SU) was ten-row feet. After stand establishment and before pinhead square, reps of ten-row feet were permanently marked in each treatment. Care was taken to standardize the uniformity and number of plants per SU and to avoid traffic rows. For plant mapping purposes the ten "best" plants per SU were selected. The best plants were those with the largest mainstem diameter slightly above the cotyledon leaves. Super plants were eliminated. Yields were estimated by hand-harvesting four or more SU per treatment. Plant height was estimated from permanently marked individual plants. Rules were established for damaged plants selected for measuring height over time and for sampling units with less than ten plants available for mapping. Experience has indicated that occasionally there will be less than ten plants per SU without aborted terminals or other damage that makes the plant unsuitable for mapping.

In two years boll size and frequency by fruiting site (FS) was estimated by hand harvesting 100 or more plants per treatment by FS. The samples were dried to zero moisture, weighed, adjusted to five percent moisture and reported as grams of seedcotton per boll by FS. Frequency was reported as the number of open bolls per 100 plants or the probability the FS would be occupied by an open boll at harvest.

Over the five-year period, thousands of plants were mapped (typically 20 or more per treatment per week) from pinhead until several weeks post cut-out or commercial harvest. In addition, several hundred plants were hand harvested by FS. Copies of the mapping forms and other detailed information is contained in annual reports.

Locations, Varieties, and Applications

Table 1 reports test location and irrigation status by years. In 1994 one test was conducted at Alamo, Tennessee, the second was located at Flora in the brown loam area of west central Mississippi. All other tests were located in the south delta of Mississippi.

Most of the tests are designated dryland or non-irrigated. However, the Onward location was always in the same field adjacent to Deer Creek and the plots were "sub-irrigated" by ground water.

Table 2 provides a list of varieties and number of comparisons by years. In most years the number of comparisons is equal to the number of tests or number of locations. However in 1996 and 1997 Mep + treatments were placed on each side of a single PIX treatment allowing for two comparisons per PIX treatment.

Table 3 reports the number of applications and rates by location and years. All applications are reported in ounces per acre broadcasts equivalent even though most of the early applications were applied on a band.

Results

Tables 4-10 highlight the results. They are presented as examples of tendencies that exist in the data and not as 5-year or annual summaries, or the most (or least) favorable comparisons.

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Mapping Data

Figure 1 summarizes the relationship between the number of mainstem nodes (MSN) per unit of time for the two treatments. Per unit of time, the Mep + treatment grows faster (better) than the PIX treatment. At any point in time, from mid to late squaring until cutout, the Mep + treatment has more MSN than the PIX treatment (See Table 4). An improvement (increase) in the number of MSN per unit of time (a measure of growth rate) is consistent with observations reported by Chaney, Townsend and Zhao and Oosterhuis. Regression analysis (Parvin and Atkins, 1997b) indicated a significant linear relationship between final yield and number of MSN at mid-bloom. A one node difference (at mid-bloom) was estimated to increase yield by 60 pounds of lint per acre.

An average MSN estimate of 18.3 indicates that of a ten plant sample, seven had 18 MSN and three had 19 MSN. The relationship shown in Figure 1 could be relabeled for most of the plant parameters by changing the vertical axis from MSN to height of the bloom, number of green bolls, number of open bolls, etc.

In the midsouth, most varieties, in most years, produce 13 fruiting branches FB with 13 first position and 11 second position FS available for open fruit at harvest. Only 24 FS contribute to the majority of yield. Small differences in percent set or percent missing fruit of these 24 sites will make large differences in yields. Additionally, small differences in average boll size can make a large percentage change in yield.

Table 5 reports the height of the bloom, by MSN, position one equivalent, for late July, 1997. Not only has the Mep + treatment got the bloom at a higher MSN, it is also growing at a faster rate. Since all occupied sites below the bloom are bolls, the Mep + treatment has more bolls than the PIX treatment. The difference in the number of bolls is exaggerated if the percent missing fruit is larger for the PIX treatment. Table 6 indicates that Mep + is superior to PIX in terms of missing fruit. Townsend also observed that PIX had a larger percent missing fruit than Mep +. The yield impact of the improvement in percent missing fruit associated with the Mep + treatment is enhanced if the bolls are larger. In 1997 boll size was estimated for FS 10.1 (MSN ten, position 1). The average boll size was 4.07 grams of seedcotton for the PIX treatment and 4.41 for the Mep + treatment (an estimated increase of 8.3 percent). Chaney and Townsend noted an improvement in boll size for Mep + when compared to PIX.

Because the bloom is higher per unit of time, there are more potential FS with bolls and because the percent missing fruit is improved, there is a possibility of more open bolls and green bolls for the Mep + treatment (see Table 7). The net result of more open bolls and more green bolls per unit of time is that the Mep + treatment will either cutout higher on the same date with an improvement in yield or cutout at the same MSN slightly earlier (three to five days) with an increase in yield.

Size and Frequency Studies

Size and frequency studies were conducted in 1996 (Parvin and Atkins, 1997a) and 1997 with similar results. In 1997 there were 10.4% more open bolls at harvest on position one in the Mep + treatment than the PIX treatment, 8.6% more in position two, 36.0% more on position three and wider and 112.9% more on vegetative branches. The average weight per boll for the 1997 test is reported in Table 8. In general, Mep + improves boll size, especially position two and wider and on vegetative branches. The percent increase in yield by positions is reported in Table 9 as a percent of the increase. In 1996, 28% of the yield increase was located on vegetative branches. In 1997, 50% of the yield increase was located on vegetative branches. While much of the improvement in boll size and frequency is in position two and wider, because much of the yield is on position one, more of the increase tends to be located on position one than position two. However, the yield increase located on position two and wider is important.

Yield

Yield estimates for the five years are provided in Table 10. Nine of 16 comparisons differ significantly when compared by years. 15 of the 16 comparisons favor Mep + over PIX. When a binomial test or Chi square test is made of the hypothesis that the PIX yield is equal to the Mep + yield, the hypothesis is rejected, (the average difference of 82 pounds (8.2%) of lint per acre is significant). The 82 pounds or 8.2% average improvement in yield (Mep + over PIX) is similar to the two year average increase of 12.4% listed by Chaney and the 84 pounds observed by Wells. Atkins reported a significant yield increase of 3.3% based on more than 70 replicated tests of various combination of MC and BC versus PIX.

Oosterhuis, Zhao and Murphy found yield increases of 3.1% to 5.1% to not be significant. The lack of statistical significance may have been related to the rigid protocol of four applications of 4 ounce on a 10-14 day schedule beginning at match-head square. Zhao and Oosterhuis measured a nonsignificant yield increase of 4.8%. Their test contained 11 treatments, which may have caused the lack of statistical significance.

Summary

When Mep + was compared directly with PIX in 16 comparisons over five years, the average yield increase was 8.2%. Relative to PIX, Mep + treated plants grow at a faster rate, i.e., more MSN per unit of time. In lay terms this means plant is performing better, and that boll size will be improved, and percent missing fruit will also be improved. In addition, the faster growth rate means that less energy is spent on plant maintenance indicating that more is available for plant growth and yield. Because a

large part of the plant's yield is located on very few fruiting sites, and any improvement in the plants rate of growth places a larger percentage of the plants largest FS into climatic conditions that are more favorable (figure 2) , small improvements in the rate of growth, and the resulting improvements in number of FS, boll size, percent set, etc., combine to make significant differences in yield.

Implications

Mep + is not as stressful on the plant as PIX (ounce per ounce). As growers become familiar with this product, they will apply higher rates possibly earlier. Initials applications may begin at pinhead instead of match-head square. Early rates may be increased from two to four ounces, from four to six ounces or from six to eight ounces, for example. Certainly rates associated with later applications as the plant nears bloom and the bloom moves up the plant will be larger.

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Table 1. Location and irrigation status, PIX versus Mep + Tests, 1994-1998.

Year	Location 1	Location 2
1994	Flora, MS, D*	Alamo, TN, I*
1995	Mayersville, MS, D	Onward, MS, D
1996	Cary, MS, I	Onward, MS, D
1997	Onward, MS, D	
1998	Mayersville, MS, D	

* D = dryland, I = irrigated

Table 2. Varieties and Comparisons by Location, PIX versus Mep + Tests, 1994-1998.

Year	Location 1	Location 2	Comparisons
1994	DPL50	ST404	2
1995	SG125	SG501	2
1996	SG501	SG501	6
1997	ST474		4
1998	DPL32		2

Table 3. Applications Rates by Location, PIX versus Mep + Tests, 1994-1998.

Year	Location 1	Location 2
1994	4, 8	4, 4, 4, 8
1995	6, 6, 8, 8	6, 6, 8, 8, 8
1996	4, 8, 8, 6, 6	
1997	8, 6, 6, 8	
1998	8, 8, 8, 8	

Table 4. Number of mainstem nodes, PIX versus Mep + Test, MS, 1997.

Date	Mep +	PIX
7-21	18.3	17.0
7- 30	20.3	18.3
▵	2.0	1.3

Table 5. MSN of bloom, PIX versus Mep + Test, MS, 1997.

Date	Mep +	PIX
7-21	10.25	9.85
7-30	15.25	14.35
▵	5.00	4.50

Table 6. Percent missing fruit, PIX versus Mep + tests, MS, 1998.

Date	Mep +	PIX
8-12	48	51
8-19	49	55

Table 7. Number of bolls/10 plants, (positions 1 and 2), PIX versus Mep + tests, MS, 1997 and 1998.

Date	Item	Mep +	PIX
8-19-97	Green bolls	136	117
9-8-97	Green bolls	75	49
9-8-97	Open bolls	77	63
8-19-98	Green bolls	121	108
9-9-98	Green bolls	59	46
9-9-98	Open bolls	68	58

Table 8. Average weight per boll (gram of seedcotton), PIX versus Mep + Test, MS, 1997.

MSN	Position 1			Position 2		
	PIX	Mep +	%↑	PIX	Mep +	%↑
6	4.17	4.16		3.66	3.78	3.3
7	4.33	4.34		3.92	4.20	7.1
8	4.45	4.45		4.10	4.42	7.8
9	4.68	4.69		4.33	4.63	6.9
10	4.93	5.02	1.8	4.64	4.91	5.8
11	5.19	5.20		4.53	4.63	2.2
12	5.41	5.34	-1.3	4.18	4.29	2.6
13	5.11	5.02	-1.8	3.69	3.92	6.2
14	4.79	4.78		3.34	3.64	8.9
15	4.51	4.63	2.7	2.89	3.28	13.5
16	4.34	4.36		2.30	2.87	12.5
17	3.78	4.24	12.2		2.35	
18	2.97	3.02	1.7		2.26	
19		2.71				
20		2.46				
Wider		2.67		3.26		22.1
VB		3.12		3.64		16.7

Table 9. Percent of yield increase by position, PIX versus Mep + tests, MS 1996 and 1997.

Item	1996	1997	Average
Position 1	28	22	25
Position 2	24	17	21
Wider	17	11	14
Veg. branches	28	50	39

Table 10. Estimated average yield, Mep +versus PIX, 16 comparisons, 1994-1998.

Year	Comparison	Mep +	PIX	Difference
1994	1	1166	987	179*
	2	988	885	103*
1995	1	933	797	136*
	2	851	774	77*
1996	1	1055	1034	21
	2	1032	1034	-2
	3	953	920	33
	4	1005	920	85*
	5	1146	1049	97*
	6	1145	1049	96*
1997	1	1181	1126	55
	2	1208	1126	82
	3	1264	1098	166*
	4	1242	1098	144*
1998	1	1055	1039	16
	2	1057	1039	18
Avg.		1080	998	82*

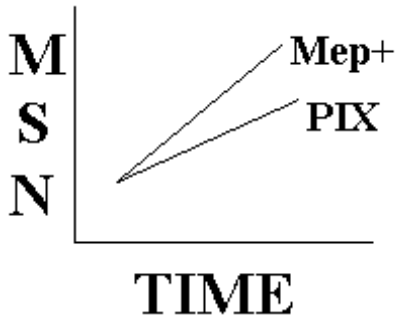

Figure 1. Schematic of the relationship between number of MSN & time, PIX vs. Mep+.

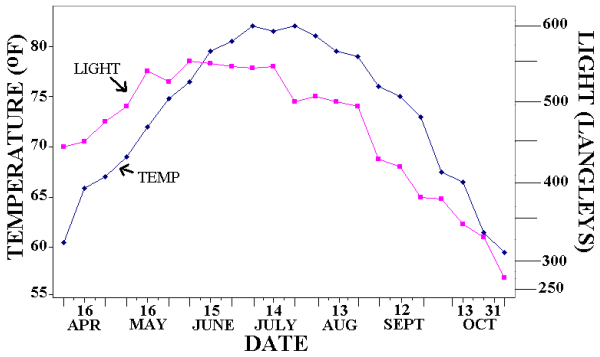

Figure 2. Average light and temperature by month. Stoneville, MS. Source: Boykin et al.