MEP PLUS BIOCHEMICAL PLANT GROWTH REGULATOR

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Abstract

Bacillus cereus can be used in combination with mepiquat chloride to significantly improve yield performance versus an untreated Check and mepiquat chloride alone. Both the consistency of positive yield responses and the average yield increase can be improved without effecting height control or early maturity achieved with mepiquat chloride alone.

Introduction

Micro Flo Company (MFC) discovered *Bacillus cereus* (BC) and other strains of *Bacillus* have plant growth regulating characteristics. BC when combined with mepiquat chloride (Pix® plant regulator or Mepichlor® plant growth regulator) provides significantly better yield performance than mepiquat chloride (MC) without causing significant differences in plant height or maturity versus MC alone. A patent which includes the use of BC with MC was issued to MFC in August of 1996. BC is extremely active and will be used at very low use rates; e. g., a total of less than one gram per acre per season.

When first commercialized, MC was applied in one application of one pint per acre at early bloom. These applications provided the highest average yield increases over an untreated Check, but had wide variations in the percentage of positive and negative yield responses. In an effort to improve the consistency of positive yield responses, low rate multiple applications of MC were initiated beginning at match-head square. These applications decreased the wide variance in positive and negative responses, but also reduced the average yield increase obtained from applying MC; e.g., the average yield increases from using MC was reduced, but the probability of achieving a positive yield responses was increased. The decrease in average yield response from low rate multiple applications versus early bloom applications can be explained by the well-documented effects of mepiquat chloride. Height reduction is achieved through reduction of cell elongation and reduction of main-stem nodes (MSN). The decrease in average yield response between early bloom applications and low rate multiple applications is thought to be a function of MSN reduction. Early bloom applications typically occur on plants with 14 to 16 MSN. Thus, applications occur when all potentially high yielding MSN are present. Reducing subsequent MSN development and upper level fruiting sites is not an important issue relative to yield and earliness at this time. However, applications beginning at match-head square or earlier typically occur when 6 to 8 MSN are present and the subsequent restriction of MSN reduces potentially high yielding fruiting sites. Regression analysis (Parvin and Atkins, 1997a) comparing Micro Flo Experimental (MFX) treatments to MC shows the number of MSN at mid-bloom explains 35% of final yield. A one node difference at this stage of development represents an expected yield increase of 60 pounds of lint.

MFC began testing BC in 1994 to determine its potential for overcoming the early season reduction in high value MSN inherent in multiple applications of MC. MC has proved its commercial value and is a widely accepted practice for increasing yield, reducing plant height, and enhancing early maturity. MFC's objectives in developing this new PGR are to improve the consistency of positive yield responses and/or the average yield increase without effecting height control or early maturity.

Method

Formulations: Over a three year period, various combinations of MC and BC were tested in over 70 replicated trials including six trials in three foreign countries. The experimental designation of these combination products is MFX (M)(B) 94 where M equals the rounded percentage of MC in the solution and B equals the number of grams of BC per gallon. Standard liquid formulations of Pix® plant regulator and Mepichlor® plant growth regulator contain 4.2% MC. MFX MB94 products with M = 4 have the same percentage of active ingredient as these commercial products. When M = 2, the active percentage is 2.1% or one-half the standard formulation. When B = 2 or when B = 4, a gallon contains this number of grams of BC. Four formulations were tested against MC: MFX 2294, MFX 2494, MFX 4294, and MFX 4494. See Table 1. These combination products were tested as tank-mixes and pre-mixes. Statistical analysis using t-test revealed no statistical differences in performance between the pre-mixes and the tank-mixes.

Protocol: The standard test protocol for product comparisons was four applications of four ounces (4 x 4 = 16 oz/ac); although, in some tests, additional late season applications were applied. The first application was applied at match-head square and subsequent applications were made at 10 to 14 day intervals.

Results

Yield: Yield results from over 70 plots were standardized to percentage increase or decrease and examined using chi square to determine if any products were significantly better than others. Yield results revealed neither MC alone or MFX 2494 were significantly better than the untreated Check, but MFX 2294, MFX 4294, and MFX 4494 were all

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significantly better than the Check and MC. Mean yield responses and the probability of a positive or negative yield response versus the Check and MC are given in Table 2. MFX 4294 has the best average yield performance of all products tested and was significantly better than the untreated Check and MC. It averaged a 5.1% yield increase above the Check and a 3.3% yield increase above MC. This provides an additional $17.50 to $23.00 per acre above MC on yields of 750 to 1000 pounds, respectively.

Height: MC, MFX 2294, MFX 2494, MFX 4294 and MFX 4494 are all significantly shorter than the untreated Check. Final plant height as a percentage of the untreated Check and the percentage of responses which were shorter than or taller than the Check are in Table 3.

Maturity: Significant differences in maturity between the untreated Check and all treatments were observed, but no significant differences between MC and MFX treatments were found.

Distribution by MSN: Yield increases versus MC tend to occur on Position 2 and wider fruiting sites and on lower MSN, including vegetative branches (Parvin and Atkins, 1996b). The incremental dollar value by MSN for MFX 4294 in a study conducted by Joe Townsend in Clarksdale, MS and in a study conducted at MSU in Starkville, MS are presented in Table 4. In each study, MFX 4294 returned approximately $20.00 per acre more than MC alone. These results also support monetary increases tend to occur lower in the plant on earlier positions.

Summary

MFC has a new active ingredient which when combined with MC significantly improves the consistency of yield performance versus an untreated Check and MC alone. After three years of testing and over 70 experiments, MFX 4294 has the best combined performance on yield and height of all the products tested. It is significantly better in yield than the untreated Check and MC and there are no significant differences in height control or earliness between MFX 4294 and MC. MFX 4294 will be the first product registered incorporating BC and will be trade named Mep Plus. Current results suggest ratios of MC and BC can be manipulated to improve yield performance by geographic area and by determinant versus non-determinant varieties. Further tests will be conducted to explore the possibilities of providing more targeted formulations which will allow growers even more ability to customize height and yield characteristics based on their local field conditions. These formulations will also allow growers who have not used MC in the past to gain the benefits of earliness and improved harvest efficiency without incurring unacceptable probabilities of negative yield responses.

References

Parvin, D. W., and R. R. Atkins. 1997a. Three years experience with a new PGR. Proceedings Beltwide Cotton Conference. In press.

Parvin, D. W., and R. R. Atkins. 1997b. Comparative value per acre by fruiting site for two plant growth regulators. Proceedings Beltwide Cotton Conference. In press.

Table 1. Percent mepiquat chloride and grams per gallon of *Bacillus cereus* in formulations tested.

Product/Formulation	% MC (M)	g/gl BC (B)
Pix® / Mepichlor®	4.2	0
MFX 2294	2.1	2
MFX 2494	2.1	4
MFX 4294	4.2	2
MFX 4494	4.2	4

Table 2. Percent Yield Increase and Percent of Positive and Negative Responses by Product versus the Untreated Check and Mepiquat Chloride.

Product	% Yield > Ck	% Yield > MC	% (+)	% (-)	ChiSq
MC	1.7%	------	59.3%	40.7%	2.28
MFX 2294	4.8%	------	75.4%	24.6%	15.75*
	------	3.9%	78.1%	21.9%	23.03*
MFX 2494	3.3%	------	60.7%	39.3%	1.29
	------	1.2%	58.3%	41.7%	1.0
MFX 4294	5.1%	------	71.4%	28.6%	5.14*
	------	3.3%	70.6%	29.4%	5.76*
MFX 4494	3.8%	------	70.5%	29.4%	10.25*
	------	3.0%	65.7%	34.3%	6.58*

* Designates significant responses at the .05 level.

Table 3. Height as a Percent of Untreated Check and Percentage of Responses which were Shorter and Taller than Check.

Product	Height % Ck	% Shorter	% Taller	ChiSq
MC	86.8%	95.2%	4.8%	68.76*
MFX 2294	89.6%	92.3%	7.7%	74.46*
MFX 2494	91.2%	70.0%	30.0%	6.4*
MFX 4294	87.3	100%	0%	40.0*
MFX 4494	84.0%	95.7%	4.3%	76.7*

* Designates significant responses at the .05 level.

Table 4. Incremental Dollars per Acre by MSN for MFX 4294 versus MC.

	Townsend	MSU
MSN 15 - 20	-$1.87	-$7.11
MSN 10 - 14	-$24.19	$15.80
MSN 4 - 9	$46.72	$11.03
Total $/ac	$20.66	$19.60

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