THE MEPRT METHOD TO DETERMINE TIME AND RATE OF MEPIQUAT CHLORIDE APPLICATIONS: USES AND MISUSES

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Abstract

The use of the MEPRT stick and software has increased considerably during the last two years. The objective of the MEPRT system is to determine the time and rate of mepiquat chloride (MC) applications based on well-defined parameters that can be readily measured under field conditions. The system is made-up of two components: (1) The MEPRT stick used to determine the time of application and (2) the MEPRT software used to determine the rate of application. The MEPRT stick measures average length of the uppermost five internodes (ALT5). Since ALT5 is related to potential plant growth rate, this measurement is used to determine the time for MC applications. The technique was designed for use during the time of square initiation until the onset of carbohydrate stresses induced by the developing fruit load. Best results are obtained when the stick is used from matchhead square stage (approximately 40 days after emergence) until two weeks after the appearance of the first bloom. Using this technique outside this range requires a different interpretation of the results than that given by Landivar et al., 1995. The MEPRT software estimates the rate of application by estimating the amount of product needed to increase the concentration of MC in the plant to a pre-determined level. The program accomplished this by estimating plant weight with a regression model that uses plant density, number of mainstem nodes and plant height as independent variables. A strong correlation between plant height and weight exist during vegetative development. As the fruit load develops, the relationship between plant height and weight becomes insignificant. In mature plants (after cutout) this relationship is non-existent. Since the estimation of plant weight is essential for the calculation of the rate of application, we recommend the use of the MEPRT software only until the second week of bloom.

Introduction

Mepiquat Chloride (MC) is a plant growth regulator commonly used in commercial cotton production to regulate vegetative growth. Considerable research has been conducted on the effect of MC on plant growth and yield. Results often show that MC is effective in suppressing vegetative growth but its effect on yield is not always consistent. The reason for the inconsistent yield response is the unpredictable nature of weather conditions after application. Most applications of MC are made from the pinhead square stage until one or two weeks after the appearance of the first bloom. Weather conditions (as well as insect's injury and plant nutrition) after the application of MC has a large influence on final lint yield. MC applications in periods of dry and/or cool weather conditions often result in excessive inhibition of vegetative growth. Wet and/or warm weather conditions may require additional applications to obtain the desired plant size. Lint yields are often reduced under either of these weather scenarios. Since plant growth rate is the result of the integration of environmental parameters (weather, insects, and nutrition), it may be used to determine the timing and rate of MC applications. In cooperation with researchers from universities across the Cotton Belt and industry we have developed a system to determine the time and rate of MC applications. The system is called MEPRT which stands for **MEP**iquat **C**hloride **R**ate and **T**iming. The system is made-up of two components: (1) The MEPRT stick (Landivar et al., 1996), used to determine the time of application and (2) the MEPRT software (Landivar et al., 1992 and Landivar et al., 1995), used to determine the rate of application. The objective of the system is to determine the rate or time of MC applications based on well-defined growth parameters that can be readily measured under field conditions.

The use of the MEPRT stick and software has increased considerably during the last two years. As the number of farm managers and consultants adapting this technology increases, the potential for misuses of the technique also increases. The objective of this presentation is to discuss assumptions made in the design of the MEPRT system, stressing its limitations to insure proper use.

Materials and Methods

The MEPRT stick proposes the use of the average length of the uppermost five internodes (ALT5) as an indicator of actual plant height elongation rate. The reason for considering only the top five internodes of the plant is that internodes below this zone have already completed most of their elongation phase an will no longer contribute to plant height. More information on the factors and data used in the development of the MEPRT stick are described in Landivar et al., 1996.

The MEPRT software is a computer program used to estimate the rate of application by calculating the amount of product needed to increase the concentration of MC in the plant to a pre-determined level. Estimation of the MC concentration in the plant requires an estimate of plant weight. This is accomplished by the use of a regression model, which uses plant density, number of main stem nodes and plant height as independent variables. A complete description of the data and assumptions used in

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the development of the MEPRT software are presented by Landivar et al., 1992 and Landivar et al., 1995.

Discussion

The MEPRT stick measures the average length of the uppermost five internodes (ALT5). Since ALT5 is related to potential plant growth rate, this measurement can be used to determine the time for MC applications. The technique is based on the following two assumptions; (1) individual internodes attain their maximum length in a period of 12 to 15 days after their initiation and (2) mainstem nodes are initiated approximately every three days. Then, dividing the days to attain maximum length (15) into the number of days to initiate a new node (3) gives the number of elongating nodes in a plant (5).

Assumption one is supported by data collected in 1991 at Corpus Christi, TX. (Landivar et al., 1996). Their data shows that internodes elongate at an increasing rate during the first five to six days and then enter a phase of rapid linear development. Elongation proceeds at a linear rate for approximately five to six days and continues at a decreasing rate until growth become negligible 12 to 15 days after initiation. This pattern of development has been observed for all internodes of the plant. However, it seems that the elongation period of an internode is controlled by temperature (Hodges et al., 1993). Under cooler temperatures, an internode may elongate for up-to 15 days while this period may be reduced to 12 days under warmer temperatures.

Figure 1 shows a hypothetical time course of plant height development for cotton, displaying a distinct linear phase of growth from 40 to 80 days after emergence. Carbohydrate stresses during phase 2 and in the early stages of phase 3 are at a minimum because the boll load is just developing. Therefore, mainstem node initiation rate is mainly controlled by temperature. Depending on cultivar, nodes are initiated approximately every 50 to 60 heat units (base 60 F). As the boll load develops, carbohydrate stresses delays the initiation of new main stem nodes. Since the MEPRT stick measurements assume that a new node is initiated approximately every 3 days, the technique can be used only prior to the onset of carbohydrate stresses induced by the developing fruit load. This period of time is designated in Figure 3 as phases 2 and part of phase 3 or approximately from 40 to 80 days after emergence. Using this technique outside this range requires a different interpretation of the results than that given by Landivar et al., 1995. It also represents the main misuse of the MEPRT stick technique to determine the time of MC applications.

Once the timing of MC application has been determined, the MEPRT software can be used to estimate the rate of application. The MEPRT software estimates the rate of application by estimating the amount of product needed to increase the concentration to a pre-determined level. The recommended level is 10 to 12 PPM (Landivar et al., 1992, Landivar et al., 1995). The program calculates the rate of application by estimating plant weight with a regression model that uses plant density, number of mainstem nodes and plant height as independent variables. A strong correlation between plant height and weight exist prior to the development of the fruit load. Figure 2 illustrates this observation. Plant height is plotted in relation to total plant weight for ten cultivars ranging from early to full season. The relationship is linear until 77 days after emergence (DAE). As the boll load develops, plant height elongation rate is reduced and eventually stopped. However, plant weight continues to increase reflecting reproductive weight gain. For this reason, the slope of the relationship is considerably reduced at 89 DAE and becomes non-existent at 103 DAE. Since the estimation of plant weight is essential for the calculation of MC application rate, we recommend not using the MEPRT software after the second week of bloom.

Summary and Conclusions

The use of the MEPRT stick and software has increased considerably during the last two years. As the number of farm managers and consultants adapting this technology increases, the potential for misuses of the technique also increases. The technique assumes that a mainstem node is initiated every 3 days and that it takes approximately 15 days for each internode to obtain its maximum length. As the fruit load develops, nodes are initiated at a slower rate and eventually carbohydrate stresses stops the initiation of new nodes. The MEPRT stick was designed to measure the average length of the uppermost five internodes prior to the onset of carbohydrate stresses induced by the developing fruit load. We recommend the using the MEPRT stick 40 to 80 days after emergence. Using this technique outside this range requires a different interpretation of the results than that given by Landivar et al., 1995.

The MEPRT software estimates the rate of application by estimating the amount of product needed to increase the concentration to a pre-determined level. The program accomplished this by estimating plant weight with a regression model that uses plant density, number of mainstem nodes and plant height as independent variables. A strong correlation between plant height and weight exist prior to the development of the fruit load. Since the estimation of plant weight is essential for the calculation of the rate of application, we recommend the use of the MEPRT software only until the second week of bloom.

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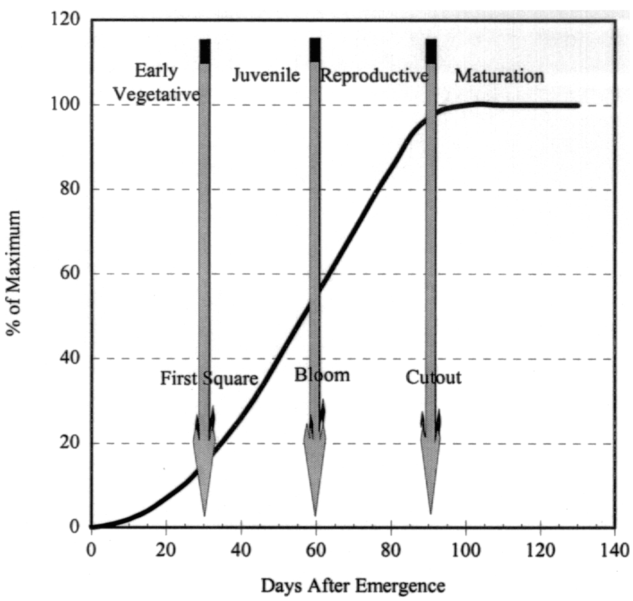

Figure 1. Ontogenetic phases of cotton crops development in relation to time course of plant height increase and time of first square, bloom and cutout.

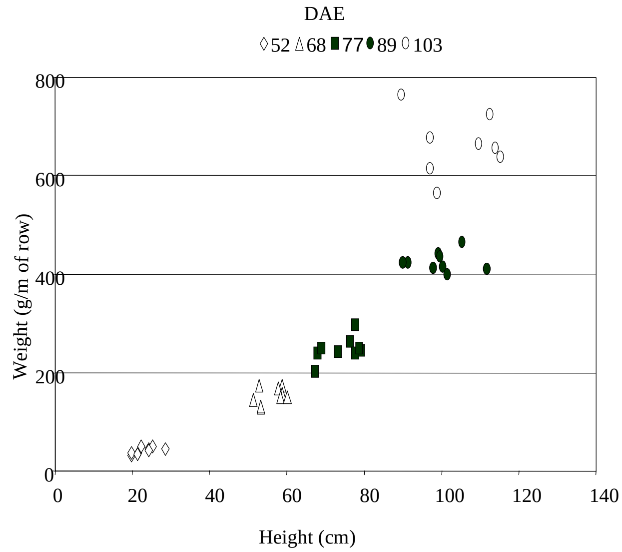

Figure 2. Relationship between plant height and total plant weight for eight cotton cultivars grown under irrigated conditions. Corpus Christi, TX. 1992.