EFFECTS OF 1-METHYLCYCLOPROPENE ON BOLL DEVELOPMENT OF COTTON

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Abstract

Ethylene regulates multiple physiological processes in cotton (*Gossypium hirsutum* L.) ranging from square and boll abscission to senescence. This field study investigated the effect of an ethylene inhibiting compound 1-methylcyclopropene (1-MCP) on boll development and the corresponding subtending leaves. 1-MCP treatment significantly increased cotton boll weight at 30 days after flowering. This increase of boll weight was due to a significant increase of both seed and lint weight. The cotton bolls primarily get carbohydrates produced by the subtending leaves. Healthier subtending leaves might contribute to increased yield. This study showed that 1-MCP treated subtending leaves exhibited a decreased membrane leakage and lipid peroxidation, and higher chlorophyll content. The healthier state of subtending leaves may have provided more carbohydrates for the fruits which could partially explain the reason for the increased boll weight.

Introduction

Cotton is subjected to biotic and abiotic stress during the cropping season. Stress elicits ethylene synthesis, which promotes fruit abscission and accelerates senescence (Suttle and Hulstrand, 1991; Gan and Amasino, 1997). 1-MCP is known to occupy the ethylene receptor site and has an affinity 10 times greater for the site than that of ethylene (Sisler and Serek, 1997). Thus, 1-MCP may inhibit ethylene action by competing with ethylene for the ethylene receptor and thus alleviate or reduce adverse effects on boll development. The objective of the research is to examine the effect of 1-MCP on cotton boll development and the corresponding subtending leaves of the bolls.

Materials and Methods

The study was conducted in 2011 at the Texas AgriLife Research Farm in Burleson County on a Weswood silt loam field. Gossypium hirsutum L. cotton cultivar FM832LL was planted. A randomized complete block design with three replications was utilized for the two treatments: untreated control and 1-MCP treatment. The center two rows of each four-row plot were treated for evaluation. At the first flower plus one week (FF+1) and first flower plus two weeks (FF+2), 1-MCP (10 g ai/ha at 103 L/ha with 0.035% Silwet) of the A17716A formulation was applied using a compressed air sprayer with 8002XR nozzles according to treatments. One hundred white flowers from the first sympodial fruiting position from the main stem nodes 6 to 10 were tagged on the FF+1 week. Bolls and the corresponding subtending leaves were collected at 20, 30, 40, and 50 days after flower. Malondialdehyde (MDA), relative electrical conductivity (REC), the chlorophyll fluorescence value of Yield, chlorophyll content for subtending leaves, and boll dry weight, seed dry weight, and lint dry weight for bolls were evaluated. All treatments were harvested with a John Deere 9910 two-row, high drum spindle picker. The statistical significance between means were determined by analysis of variance (ANOVA) and LSD (α=0.05) using Student's t test in SAS 9.2.

Results and Discussion

1-MCP treatment significantly decreased membrane leakage at 30 days after flower (DAF) (Fig. 1A), lowered MDA content at 20 and 30 DAF (Fig. 1B), and increased chlorophyll content at 30 DAF (Fig. 1C) on the subtending leaves, which reflects less oxidative damage, better cell membrane integrity and less pigment loss, and thus delayed leaf senescence.

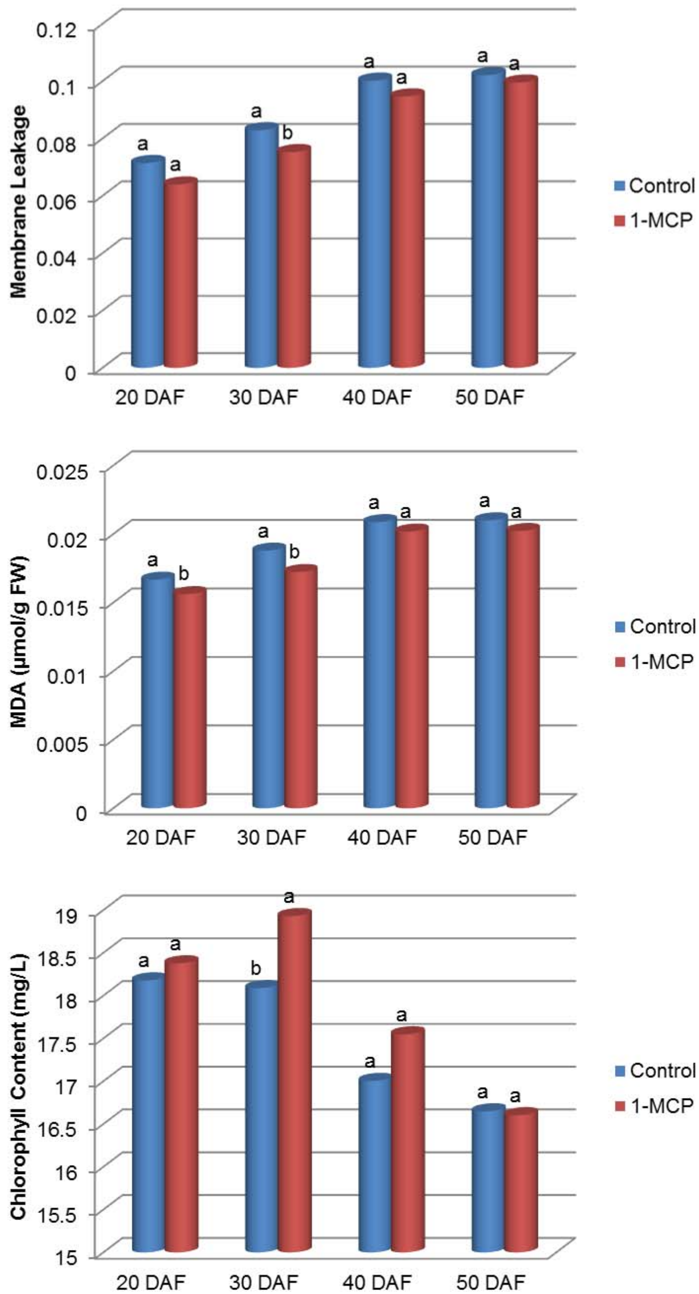

Fig 1. Effect of 1-MCP on membrane leakage (A), lipid peroxidation (B), and chlorophyll content (C) at 20, 30, 40 and 50 days after flower. Groups of columns with the same letters are not significantly different (P=0.05).

1-MCP treated plants showed a significantly higher boll dry weight compared to untreated ones at 30 DAF (Fig. 2A). This increase was due to a significantly higher seed weight (Fig. 2B) and lint weight (p value=0.0702) (Fig. 2C). The cotton bolls primarily get carbohydrates produced by the subtending leaves. Thus, the healthier subtending leaves may contribute to increased boll weight.

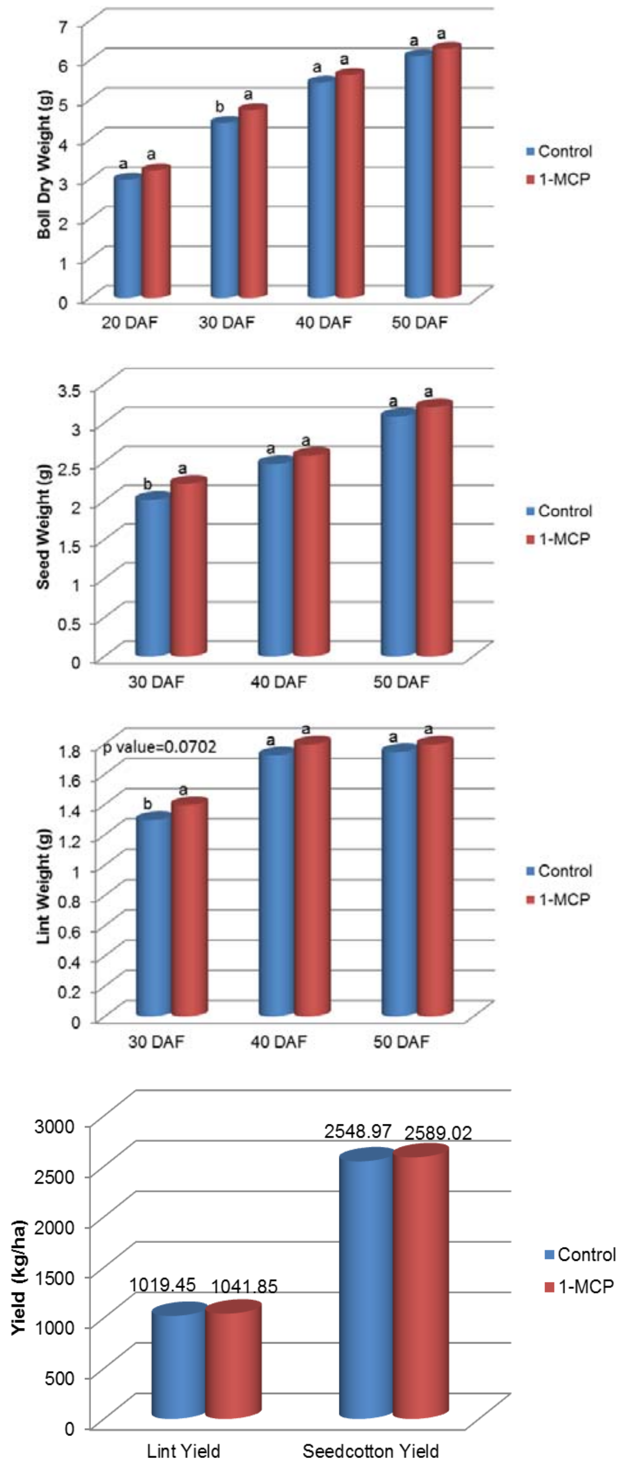

Fig 2. Effect of 1-MCP on boll dry weight (A), seed weight (B), lint weight (C) at 20, 30, 40 and 50 days after flower and on cotton yield (D). Groups of columns with the same letters are not significantly different (P=0.05).

However, the increase of boll weight was not significant at 40 and 50 DAF and there was only a numerical trend for increased cotton yield (Fig. 2D). This may be due to the long growing season of cotton compared to the relatively short duration effect of 1-MCP.

Acknowledgements

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