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Cotton growth and yield after seed treatment with mepiquat chloride in the tropical winter season

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Abstract

Cottonseed (*Gossypium hirsutum* L.) was treated with mepiquat chloride (MC) to examine its potential for the management of vigorous early growth experienced on cotton grown in the tropical winter season. As there is little published research from the field on this topic, we aimed to determine the effect of seed treatment of cotton with MC grown to maturity. In two field experiments over two seasons the seed surface was treated. Seed surface treatment was compared with pre-sowing priming with MC in experiment 2.

Lint yields were high, 2059 and 2270 kg/ha averaged over all treatments in experiments 1 and 2. In both experiments, seed surface treatment with 2 g MC/kg reduced ($P < 0.05$) plant height for up to 30 days after sowing and there were no significant changes to rate of crop development, time to maturity, lint yield or fibre quality. In experiment 2 treating with MC reduced plant establishment in proportion to the amount of MC applied ($P < 0.01$). Pre-sowing priming caused approximately twice the reduction in plant height per gram of MC than surface treatment and significant differences persisted longer, even until maturity using 8 g MC/kg seed. Priming with $\geq$4 g MC/kg seed had additional effects ($P < 0.05$): (1) reduced node development between first square and first flower, (2) delayed the time to first square, first flower and maturity by 4 days, (3) increased production of bolls on monopodial branches, and (4) reduced lint yield compared to the same concentrations applied to the surface. Fewer smaller plants having smaller bolls were implicated in this response.

It was concluded that the relative benefit of seed treatment with MC at the concentrations and methods that did not reduce lint yield appears questionable as height reductions per gram of MC/ha were less than measured at this location with the same amount applied as a foliar spray.

Keywords: Cotton; Mepiquat chloride; Tropics; Seed treatment; Seed priming

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1. Introduction

Due to higher early season temperatures, irrigated cotton grown during the dry (winter) season in tropical Australia (Lat. 13°–17°S) was found to grow more vigorously for the first nine nodes than irrigated cotton grown during spring in temperate regions, which resulted in rank crops at maturity (Yeates et al., 2002). Rank crops can create operational difficulties such as reduced picking and spraying efficiency. Foliar application of mepiquat chloride (*N*,*N*-dimethylpiperidinium chloride) generally at flowering or as multiple low doses commencing at squaring are accepted cultural practices for the management of excessive vegetative growth in temperate climates (Kerby, 1985; Constable, 1995; Edmisten, 1995). The mode of action of mepiquat chloride (MC) is to distrubt gibberellin biosynthesis (Rademacher, 2000), which is expressed as shortened internodes and reduced rate of node production following treatment (Gausman et al., 1979; Fernandez et al., 1991). Yeates et al. (2002) found earlier foliar treatment (4th–11th node stage) with 9–18 g ai/ha of MC, could suppress the early vigour of cotton grown in the tropical dry season without affecting yield. Seed treatment with MC may have potential to suppress early season growth in the dry season and avoid the need for early foliar application.

The methods of treating cottonseed with MC have varied widely as have the amounts of MC applied. Huang and Gausman (1982) germinated seeds in distilled water solutions containing 0, 25, 50, 75 and 100 ppm MC. Gausman et al. (1984) measured germination percentage and radicle length from seeds exposed to the same solutions with seed soaked for 7–8 h in these solutions prior to germination. Xu and Taylor (1992) soaked seed for 12 h in 0, 500, 1000, 2000 and 4000 ppm solutions prior to germination and transplanting into tubes. MC has also been applied to seed by 'priming', defined as 'soaking seed in osmotic solutions ... that allows them to go through the first stages of germination, but does not permit radical protrusion ... seeds are then dried to original moisture and stored or planted' (Parera and Cantliffe, 1984). Corbin and Frans (1991) primed 1 kg of seed in 2l of 1000 ppm aqueous solution of MC for 3 h prior to planting in the field. Cothren et al. (1983), Albers and Cothren (1983), Zhang et al. (1990) and Becker et al. (1997) applied rates up to 2 g MC/kg of seed to the seed surface as a liquid slurry prior to germination. The application of chemicals, usually fungicides or insecticide, as slurries to the seed surface is the most common method of treating cottonseed (Halloin, 1986; Jeffs and Tuppen, 1986). This method appears to be the most practical for the application of MC to cottonseed in commercial situations.

Published research to evaluate treatment of cottonseed with MC has focused on the germination, establishment and early seedling growth phases. Germination percentage and rate of germination were either unaffected or increased by seed treatment with MC (Cothren et al., 1983; Gausman et al., 1984; Huang and Gausman, 1982). In controlled environments seed treatment with MC reduced early stem and shoot growth (Zhang et al., 1990; Xu and Taylor, 1992). However, these studies were terminated by 30 days after emergence and little is known of the effect of seed treatment with MC on field-produced cotton grown to maturity. Corbin and Frans (1991) grew seed primed with MC to maturity in the field as a protectant for fluometuron; the one treatment with MC alone (priming in 1000 ppm MC) reduced height 21 days after sowing and there was no effect on seed cotton yield compared with untreated seed. There appear to be no studies reporting a yield reduction due to seed treatment with MC.

The aim of the research described here was to measure the effect of seed treatment with MC on cotton field crops grown to maturity and hence to evaluate the potential for managing early vegetative growth in the tropics as an alternative to foliar sprays. Our objective in the first season was to apply MC as slurry to the seed surface. The amount of MC applied was based on previous studies, that is $\leq$2 g ai/kg seed. Treatment rates in the second season were selected on the basis of results from the first season.

2. Materials and methods

Over two growing seasons experiments were conducted at the Frank Wise Institute, 13 km NW of Kununurra WA, Australia (Lat. 15°39′S, Long. 128°43′E) in the ord irrigation area. The soil was a Cununurra clay (Montmorillinitic Typic Haplustert,