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Chlorine Did Not Reduce Plant Production by Sweetpotato Seed Stock

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INTRODUCTION

Production of large numbers of high-quality sweetpotato transplants is important to sweetpotato production so that fields may be planted in a timely manner. Suppressed plant production delays planting, results in late harvest, missed early markets, and often the loss of late plantings due to cold, wet field conditions. To insure the greatest number of quality transplants, roots should be pre-sprouted by holding at 30°C and 90-95% relative humidity for 7-10 days prior to bedding (Thompson, et al., 1997; Wilson, et al., 1989).

Disease prevention methods have been recommended to prevent sweetpotato seed stock rots prior to bedding roots for plant production. Chlorine as sodium hypochlorite or calcium hypochlorite used as a bactericide in combination with fungicides is recommended for use on sweetpotato seed stock prior to bedding. New Zealand research found that sodium hypochlorite could be used to prevent fresh market sweetpotatoes from sprouting during shipment to European markets (Lewthwaite and Triggs, 1995). Consistent problems with plant production (low plant numbers and lack of uniformity) at the Pontotoc Ridge-Flatwoods Branch Experiment Station in Pontotoc, Mississippi, led to research to determine if chlorine prevented or delayed plant emergence in sweetpotato.

The objective of this trial was to determine if pre-bedding treatments of chlorine or a combination of chlorine and fungicide at different exposure times would delay or suppress plant production from 'Beauregard' seed stock.

MATERIALS AND METHODS

Trials were conducted in a greenhouse at the Pontotoc Ridge-Flatwoods Branch Experiment Station in 1999 and in a Department of Plant and Soil Science greenhouse at Mississippi State University in 2000. Roots selected for seed stock ranged in size from 10 to 20 cm in length and 5 to 8 cm in diameter. Weight and number of roots per tray were recorded each year and averaged 5 kg and 22 roots in each tray. Roots were bedded in plastic trays that measured 49 x 39 cm and 16 cm deep with media consisting of two parts commercial soil-less media (Sunshine Complete Mix No.1; 3:1 sphagnum peat moss: perlite. Sun Gro Horticulture, Inc., Bellevue, WA) and one part composted pine bark. Pine bark was added to improve media drainage. Each tray was an experimental unit.

In all treatments, chlorine was provided by chlorine bleach (sodium hypochlorite 5.25%) mixed in water at 5% v/v. The fungicides dichloran in a 75% water-soluble formulation at 9.97 lb ai/100 gal and thiabendazole in a 4-lb-per-gallon formulation at 3.3 lb ai/100 gal were used both years. Chlorine and fungicide treatments were applied as two separate dips (two stages). Unless other-

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wise noted, roots were submerged in one solution for 15 seconds and immediately submerged in a second solution for another 15 seconds. There were six treatments in 1999: (1) chlorine, let dry then dichloran\thiabendazole; (2) chlorine then dichloran\thiabendazole; (3) chlorine then water; (4) water then dichloran; (5) water then thiabendazole; and (6) water then water (control). Due to observations in 1999, treatments were modified for 2000 to focus more on time of exposure to chlorine. In addition, no control without water was included in 1999. Water would be expected to increase the incidence of rot on sweetpotato, so a control with nothing applied was added in 2000. The 2000 experiment also included six treatments: (1) chlorine, let dry then water; (2) chlorine then dichloran\thiabendazole; (3) chlorine (20-minute dip) then water; (4) water then dichloran; (5) air control (bedded with no chemicals or water); and (6) water then water (control).

Treatments were randomly assigned to experimental units in a randomized complete block design. Due to space limitations, only two replicates were used. In 1999, roots were bedded on 8 March. First and second plant cuttings were made on 20 May and 23 June, respectively. In 2000, roots were bedded on 23 February with the first plant cutting made on 19 April and the second on 10 May. Plant emergence was measured weekly by counting each emerged plant. Two 10-plant samples were cut from random locations in the bed, and green weights were taken immediately after cutting. Samples were then dried at 72°C for 7-12 days to determine dry weight. Seed roots were dug after the second cutting to determine root condition. Depending on the amount of deterioration, decay was classified as severe or as nonsevere surface lesions. Analyses of variance were performed using the General Linear Model Procedure in SAS vers. 6.03 (SAS Institute Inc, Cary, NC, 1988).

RESULTS

For the first cutting in 1999, the chlorine-then-dichloran\thiabendazole treatment produced a greater number of plants per kilogram of root weight than the other treatments, except for the chlorine-let-dry-then-dichloran\thiabendazole treatment and the control treatment (Table 1). In the second plant cutting, the chlorine-then-dichloran\thiabendazole treatment produced more plants per kilogram of root than the water-then-dichloran treatment. The water-then-dichloran treatment produced greater dry weight per plant (DWP) than the chlorine-then-dichloran\thiabendazole treatment in the first plant cutting (Table 2). Although not significantly different, the water-then-dichloran treatment tended to produce greater green weight per plant (GWP) than the chlorine-then-dichloran\thiabendazole treatment in the second cutting. Differences in GWP in the first cutting or for GWP and DWP in the second cutting were nonsignificant. The percentage of decayed roots was very high in 1999, ranging from the lowest (18%) for the chlorine-then-dichloran\thiabendazole treatment to the highest (92%) for the water-then-thi-

Table 1. Plant production as affected by chlorine and fungicidal treatments applied to sweetpotato seed stock in 1999.

Treatment	Plants per kilogram of roots	
	Cutting 1	Cutting 2
Chlorine then dichloran\thiabendazole	30.4 a[1]	25.6 a
Chlorine, let dry then dichloran\thiabendazole	28.9 ab	20.3 ab
Control (water then water)	25.7 ab	17.9 ab
Chlorine then water	17.9 bc	18.6 ab
Water then thiabendazole	17.4 bc	12.3 ab
Water then dichloran	12.8 c	11.3 b

[1]Mean separation within columns by Duncan's multiple range tests at P≤ 0.05.

Table 2. Transplant fresh and dry weights as affected by chlorine and fungicidal treatments applied to sweetpotato seed stock in 1999.

Treatment	Plant weight (grams per plant)			
	Cutting 1		Cutting 2	
	Green	Dry	Green	Dry
Water then dichloran	26.15 a[1]	2.58 a	14.20 a	1.28 a
Water then thiabendazole	21.88 a	2.14 ab	13.86 a	1.18 a
Chlorine then water	20.34 a	1.83 ab	13.31 a	1.11 a
Control (water then water)	18.11 a	1.83 ab	13.06 a	1.34 a
Chlorine, let dry then dichloran\thiabendazole	16.61 a	1.61 ab	12.88 a	1.13 a
Chlorine then dichloran\thiabendazole	12.84 a	1.49 b	10.88 a	0.99 a

[1]Mean separation within columns by Duncan's multiple range tests at P≤ 0.05.

Table 3. Percentage severe and surface lesion seed stock decay as influenced by chlorine and fungicidal treatments applied to sweetpotato seed stock in 1999.

Treatment	Severe decay (%)[2]	Surface lesion decay (%)[2]
Water then thiabendazole	92 a[1]	3 a
Water then dichloran	88 ab	0 a
Chlorine then water	61 ab	7 a
Control (water then water)	35 ab	14 a
Chlorine, let dry then dichloran\thiabendazole	31 ab	7 a
Chlorine then dichloran\thiabendazole	18 b	11 a

[1]Mean separation within columns by Duncan's multiple range tests at P≤ 0.05.
[2]Percentage of roots decayed.

abendazole treatment in the severe rot classification (Table 3). The percentage of surface lesions ranged from 0% to 14% for the water-then-dichloran treatment and the control treatment, respectively. However, the differences were not significant.

In 2000, there were no significant differences among treatment means. The treatment "chlorine (20-minute dip) then water" appeared to produce greater plant numbers, ranging from 0.8 to 7.9 plants per kilogram higher, than the other treatments, in the first cutting (Table 4). Plant numbers from the chlorine-then-dichloran\thiabendazole treatment was higher for the second cutting, ranging from 1.5 to 6.7 plants per kilogram higher. The water control treatment ranged from 0.22 to 2.27 and 0.53 to 2.45 g per plant higher than the other treatments for GWP in first and second cuttings, respectively (Table 5). DWP in the second cutting was also higher for the water control treatment, ranging from 0.02 to 0.38 g per plant higher than the other treatments. The incidence of surface lesion rot ranged from 2.1% for the air control treatment up to 16.3% for the chlorine-(20-minute dip)-then-water treatment in 2000 (Table 6).

Table 4. Plant production as affected by chlorine and fungicidal treatments applied to sweetpotato seed stock in 2000.

Treatment	Plants per kilogram of roots	
	Cutting 1	Cutting 2
Chlorine, 20 min then water	22.8 a[1]	25.7 a
Chlorine then dichloran\thiabendazole	22.0 a	27.2 a
Water then dichloran	21.0 a	22.9 a
Control (air)	18.6 a	25.0 a
Control (water then water)	17.1 a	25.6 a
Chlorine then water	14.9 a	20.5 a

[1]Mean separation within columns by Duncan's multiple range tests at P≤ 0.05.

Table 5. Transplant fresh and dry weights as affected by chlorine and fungicidal treatments applied to sweetpotato seed stock in 2000.

Treatment	Plant weight (grams per plant)			
	Cutting 1		Cutting 2	
	Green	Dry	Green	Dry
Control (water then water)	8.17 a[1]	0.80 a	8.64 a	0.90 a
Chlorine, let dry then water	7.95 a	0.99 a	6.19 a	0.52 a
Control (air)	7.66 a	1.07 a	7.98 a	0.88 a
Chlorine, 20 min then water	6.93 a	1.05 a	8.11 a	0.81 a
Chlorine then dichloran\thiabendazole	5.96 a	0.76 a	7.48 a	0.78 a
Water then dichloran	5.90 a	0.69 a	6.47 a	0.62 a

[1]Mean separation within columns by Duncan's multiple range tests at P≤ 0.05.

Table 6. Percentage severe and surface lesion seed stock decay as influenced by chlorine and fungicidal treatments applied to sweetpotato seed stock in 2000.

Treatment	Severe decay (%)[2]	Surface lesion decay (%)[2]
Chlorine, 20 min then water	16 a[1]	19 a
Chlorine then dichloran\thiabendazole	16 a	17 a
Chlorine, let dry then water	14 a	17 a
Water then dichloran	10 a	13 a
Control (water then water)	7 a	11 a
Control (air)	2 a	9 a

[1]Mean separation within columns by Duncan's multiple range tests at P≤ 0.05.
[2]Percentage of roots decayed.

Discussion

In 1999, chlorine did not adversely affect the number of plants per root as compared with the other treatments. The water plus dichloran produced fewer plants and a higher percentage of severe rot than the chlorine-then-dichloran\thiabendazole treatment.

In 2000, no significant differences were observed for number of plants, GWP, or DWP at either cutting or for early and late rot percentages. However, treatments containing chlorine tended to produce more plants with lower plant weights than those that did not contain chlorine. The control treatments that did not contain chemicals tended to have a lower incidence of rot.

Conclusions

In the two years of this study, chlorine did not significantly reduce the plant production of pre-sprouted 'Beauregard' sweetpotato seed stock. It should be noted that no serious disease pathogen was observed during this trial. Because of the lack of serious pathogens, we recommend that chlorine continue to be used in combination with fungicides to prevent decay and maintain high numbers of plants in standard production systems. However, the 2000 data indicate that there may be a beneficial organism on the surface of the unwashed sweetpotato suppressing the decay organisms present due to the generally lower rot incidence for the air control treatment than the water control and increasing rot with additional chemical treatment. If a beneficial organism can be found on the sweetpotato, biological controls could be developed reducing the chemical needs in sweetpotato.

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