Short-duration Presprouting, Ethephon, and Cutting Increase Plant Production by Sweetpotato, Roots

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Abstract. Sweetpotato [*Ipomoea batatas* (L.)] plants were harvested earlier following immersion of roots in 1500 mg ethephon/liter for 10 minutes or cut transversely 1 to 2 cm from the proximal end before bedding than when roots were not treated. Combined ethephon and cutting treatments did not promote earlier harvests than either applied separately. Presprouting for 10 days reduced the time to first plant harvest from whole or cut roots of 'Georgia Red', but not from roots of 'Georgia Jet'. Immersion in ethephon increased the number of early and total plants produced by both cultivars. Short-duration presprouting and cutting of roots increased the number of early and total plants produced by 'Georgia Red', but not by 'Georgia Jet'. Total plant production was increased by cutting non-presprouted roots that had been immersed in ethephon. Cutting did not significantly increase total plant production from presprouted roots, but immersion in ethephon increased total number of plants produced from presprouted whole roots. Plant weight and deterioration of the bedded roots during plant propagation were not influenced by treatments. Chemical name used: (2-chloroethyl)phosphonic acid (ethephon).

Propagation of plants from bedded roots is a major cost of commercial sweetpotato production in the United States, and cultivars vary in their plant production potential. Treatments that decrease the interval from bedding to plant harvest or increase the total number of plants from bedded roots can help reduce the cost of propagation and may be beneficial for both profuse and sparse plant-producing cultivars. Holding roots under presprouting conditions (32 ± 1 C, 85% RH) for ≈ 3 weeks before bedding is a standard method of increasing plant production (Deonier and Kushman, 1960). Shorter durations of presprouting (Hall, 1987), immersion in ethephon (Tompkins and Bowers, 1970; Tompkins and Horton, 1973, 1974), and cutting (Kushman et al., 1970) also increase plant production, but the combined influence of these three factors on plant production has not been reported. The objective of this study was to determine the influence of short-duration presprouting, immersion in ethephon, and cutting on plant production from bedded roots of a profuse and a sparse plant-producing cultivar.

Three weeks after harvest, small (2.5 to 5.0 cm in diameter, 5.0 to 18 cm in length),

cured (32 ± 1 C and $85\% \pm 5\%$ RH for 7 days) sweetpotato roots of the profuse plant-producing cultivar Georgia Red and the sparse plant-producing cultivar Georgia Jet were removed from storage (16 ± 1 C and $85\% \pm 5\%$ RH) and randomly assigned to 10-root lots. Thirty-two lots were prepared for each cultivar. 'Georgia Red' lots weighed 967 ± 22 g and 'Georgia Jet' lots 812 ± 19 g. One

half of the lots of each cultivar were returned to storage conditions and the other one half was subjected to presprouting conditions (32 ± 1 C and $85\% \pm 5\%$ RH) for 10 days. After removing from storage or presprouting conditions, each lot was either immersed for 10 min in 1500 mg ethephon/liter (Tompkins and Horton, 1973) or not immersed and either cut transversely 1 to 2 cm from the proximal end (Thompson and Beattie, 1932) or left whole. Next, each lot was immersed for 15 sec in a fungicide solution prepared with 640 g of 75% wettable powder 2,6-dichloro-4-nitroaniline (dicloran) in 40 liters of water, and air dried. Lots were then placed in 30×40 -cm contiguous plots in a 3.2×4.8 -m greenhouse bed and covered with 5 cm of fumigated Tifton loamy sand (fine-loamy, siliceous, thermic Plinthic Paleudults). Plots were watered immediately after bedding and thereafter as needed (when the bed surface was dry to a depth of 1 cm) to ensure adequate moisture levels for plant production. After the first plant harvest, granular fertilizer [28.0N-12.3P-23.2K ($\text{g}\cdot\text{m}^{-2}$)] was broadcast over the bed surface before application of 5 mm of water. Air minimum in the greenhouse was 24C and the soil was at 28 ± 4 C.

Only plants 20 cm or more above the bed surface were harvested, and plots were harvested individually starting when the first plant in a plot was 20 cm above the bed surface. The initial plant harvest date varied by 5 weeks for the various treatment combinations. Including the initial harvest, plants were pulled at five consecutive weekly intervals of a 9-week total period. Plants from individual plots were counted and weighed after each har-

Table 1. Effects of cultivar, 10-day presprouting, immersion in 1500 mg ethephon/liter, and transverse cutting 1 to 2 cm from the proximal end on plant production after five consecutive plant harvests during a 9-week harvest period from plots of 10 bedded sweetpotato storage roots.

Variables	First plant harvest ² (days from bedding)	Plants per plot (no.)	
		Early ³	Total
Cultivar (C)			
Georgia Red	46	20	26
Georgia Jet	56	2	6
Significance	*	**	**
Prespouted (P)			
No	52	6	12
Yes	49	12	17
Significance	NS	**	**
Ethephon (E)			
No	55	6	11
Yes	47	13	19
Significance	**	**	**
Roots cut (R)			
No	53	5	9
Yes	49	13	21
Significance	NS	**	**
Significant interactions	C $\times$ R**	C $\times$ P**	C $\times$ P*
	E $\times$ R**	C $\times$ R**	C $\times$ R**
	C $\times$ P $\times$ R**		P $\times$ R*
			P $\times$ E $\times$ R*

²Means within main effects within columns pooled across other main effects and four replications. Means do not average because of rounding and because analyses were conducted on transformed data, and back-transformed means are presented.

³Cumulative number of plants harvested at any time during the first five of the nine weekly harvests.

NS,*,**Nonsignificant or significant at $P = 0.05$ or 0.01 , respectively.

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Table 2. Influence of immersion in 1500 mg ethephon/liter and transverse cutting 1 to 2 cm from the proximal end on days from bedding until first plant harvest from plots of 10 bedded sweetpotato storage roots.

Ethephon	Root cut ^a		Significance
	No	Yes	
	Days		
No	61	50	*
Yes	45	48	NS
Significance	**	NS	

^aMeans do not average because of rounding and because analyses were conducted on transformed data, and back-transformed means are presented.

NS,*,**F test for simple effects nonsignificant or significant at $P = 0.05$ or 0.01 , respectively.

vest. Data presented include the cumulative number of plants harvested at any time during the first five of the nine weekly harvests (early plants) and the total number of plants harvested during the 9 weeks, regardless of when the five consecutive weekly harvests occurred during those 9 weeks. After the fifth plant harvest from individual plots, bedded roots were removed and evaluated for severity of deterioration. A root was classified as deteriorated if one half or more was decayed. Data were subjected to a $(x + 0.5)^{1/2}$ transformation for analyses and transformed means were back-transformed for presentation. The experimental design was a $2 \times 2 \times 2 \times 2$ factorial in a split-split-split-plot with four replications. Cultivars were main plots, presprouting treatments were sub-plots, ethephon immersion treatments were sub-sub-plots, and cutting treatments were sub-sub-sub-plots. Each replication contained 16 sub-sub-sub-plots. Each sub-sub-sub-plot was a 10-root lot, as described above, of either 'Georgia Jet' or 'Georgia Red', with a combination of treatments of presprouted or not presprouted, immersed or not immersed in ethephon, and cut or not cut.

Immersion in ethephon tended to decrease the time interval from bedding until first plant harvest (Table 1), and lack of interactions with main effects for cultivar or presprouting indicated that ethephon reduced this time interval with both cultivars whether or not roots were presprouted. Immersion in ethephon or

transverse cutting at the proximal end decreased the time interval from bedding until first plant harvest, but a combination of ethephon and cutting was no more effective than either treatment alone (Table 2). Cutting of nonpresprouted roots reduced the time interval from bedding until first plant harvest from 59 days to 40 days ($P = 0.01$) for 'Georgia Red', but increased the time interval to 62 days from 50 days ($P = 0.01$) for 'Georgia Jet'. Presprouting reduced the time interval by 14 days for uncut 'Georgia Red' ($P = 0.01$), but the interval was unchanged for uncut 'Georgia Jet' roots or cut roots of either cultivar (data not shown).

Ethephon treatment enhanced early and total plant production, and lack of interaction with cultivar main effect indicates that immersion in ethephon increased early and total plant production of both cultivars (Table 1). Also, lack of interaction indicates that immersion in ethephon further enhanced the increase in the number of early plants induced by presprouting, and cutting further enhanced the increase in early plants induced by immersion in ethephon. Cutting also further enhanced the increase in the number of early plants induced by short-duration presprouting.

Presprouting for 10 days increased early plant production of 'Georgia Red' (28 vs. 13 plants; $P = 0.05$), but not 'Georgia Jet' (2 vs. 2 plants). Presprouting also increased total plant production of 'Georgia Red' (33 vs. 21; $P = 0.01$), but not 'Georgia Jet' (6 vs. 5). Transverse cutting at the proximal end of the root increased the number of early plants (35 vs. 9; $P = 0.01$) and total plants (42 vs. 15; $P = 0.01$) of 'Georgia Red', but not 'Georgia Jet' (2 vs. 2 and 4 vs. 8 for early and total plants, respectively). These results differ from previous findings for 'Georgia Jet', where 9-day presprouting caused an increase in early and total plant production from large roots that had been stored for 3 months (Hall, 1987). However, the current results are similar to other findings for 'Georgia Jet', where transverse cutting of the root at the proximal end did not increase plant production (Hall, 1986).

A significant presprouting $\times$ ethephon $\times$ cutting interaction was evident for total plant

production (Table 1). Total plant production was enhanced by cutting roots that had not been presprouted, and the effect was more pronounced when roots had been immersed in ethephon (Table 3). However, cutting did not cause significant increases in total plant numbers when roots were presprouted, and ethephon increased total plant production from whole, but not from cut, roots.

Plant weights, 9.7 g for 'Georgia Red' and 10.5 g for 'Georgia Jet', were not influenced by treatments and all harvested plants were of suitable size for transplanting. Nearly 35% of the bedded roots were at least one-half deteriorated when removed from the plant bed, but there were no differences attributable to treatments (data not shown).

Tompkins and Horton (1973) showed that ethephon maybe as effective as presprouting for increasing plant production from sparse to fair plant-producing cultivars. The present study indicates that ethephon decreases days to first plant harvest from the plant bed and increases early and total plant production of 'Georgia Red' or 'Georgia Jet'. Furthermore, ethephon in combination with 10-day presprouting and transverse cutting 1 to 2 cm from the proximal end increased or tended to increase early and total plant production from the profuse plant-producing cultivar Georgia Red and from the sparse plant-producing cultivar Georgia Jet. Although ethephon is not commercially used on sweetpotato, these findings and earlier information (Tompkins and Bowers, 1970; Tompkins and Horton, 1973, 1974) indicate a good potential for ethephon use to enhance plant production from bedded sweetpotato roots.

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Table 3. Influence of 10-day short-duration presprouting, immersion in 1500 mg ethephon/liter, and transverse cutting 1 to 2 cm from the proximal end on total number of plants harvested per plot from plots of 10 bedded sweetpotato storage roots.

Presprouted	Ethephon	Roots cut ^z		Significance
		No	Yes	
		<i>No. of plants</i>		
No	No	5	14	**
	Yes	6	28	**
	Significance	NS	*	
Yes	No	8	18	NS
	Yes	19	27	NS
	Significance	*	NS	

^aMeans do not average because of rounding and because analyses were conducted on transformed data, and back-transformed means are presented.

NS,*,**F test for simple effects nonsignificant or significant at $P = 0.05$ or 0.01 , respectively.