The Effects of Root Sectioning and Chemicals on Sweetpotato Plant Production[1]

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Abstract. Roots of the 'Centennial' variety of *Ipomoea batatas* Lam. were sectioned and treated with dimethyl sulfoxide (DMSO), Captan, Semesan Bel, and combinations of these chemicals using 5 soaking intervals. A significant difference was found between the effects of chemicals in number of plants produced and mean weight of plants. Combinations of chemicals were better in both cases than chemicals used independently. DMSO treatments yielded significantly more plants than Captan or Semesan Bel treatments; however, the 3 single chemicals produced plants of similar mean weight. Whole roots produced significantly more and a higher average weight of plants than individual root sections. Soaking time had no effect upon number of plants or mean weight of plants.

Introduction

THIS study is concerned with a comparison of the effects of dimethyl sulfoxide (DMSO), Captan, Semesan Bel, alone and in combination, with whole and sectioned roots, on plant production of the 'Centennial' variety of sweet potato. The proximal end of the sweet potato root exercises a strong apical dominance and normally inhibits plant growth over approximately 50% of the root surface. In 1931, Thompson and Beattle (6) reported that apical dominance could be overcome by sectioning sweetpotato roots, thereby making it possible to produce more plants from a given supply of roots and a given area of bed space. These workers pointed out that the practical limitation of this method at that time was the fact that cut roots were highly susceptible to fungus attack so that the increase in plant production by cutting was often more than offset by the losses due to rotting. Welch and Little (7), working with the 'Velvet' sweetpotato variety in California reported that heating the roots produced more slips than whole roots. The effects of heating and cutting on sprout production were independent and additive. Whatley et al. (8) working with 'Centennial', 'Goldrush', and 'Julian' sweet potato varieties in Louisiana presented data which indicated that when whole roots were soaked for 10 and 15 minutes in 10% DMSO aqueous solution the apical dominance was partially broken. DMSO treatments accelerated the growth of and increased significantly the number of plants of all 3 varieties. Peterson (4), using maleic hydrazide at 1000, 2000, 4000, 8000, and 16000 ppm applied as a foliage spray on the 'Goldrush' and 'Porto Rico' varieties, reported results of a loss of proximal dominance along the sweet potato root, accompanied by normal slip production. Using a 2000 ppm maleic hydrazide foliage spray on the 'Goldrush' variety, he found a significant increase in both early and late slip production. Highly significant reduction in slip production followed the application of an 8000 ppm spray. Hernandez et al. (2) reported that soaking sweetpotato roots in 10 ppm 2,4-D acid equivalent significantly increased plant production per root and per bushel for 4 pullings over the control, Semesan Bel, and 2.6 ppm of 2,4-D. Takatori et al. (5) studied the influence of seed piece size and cutting on sweetpotato plant production. These workers found that in general the largest roots produced the most plants, and cut roots produced more plants than intact roots, irrespective of size. The greatest increase in plant production due to cutting occurred in tests where the plants were pulled the least number of times. Plants from cut seed pieces weighed less than plants from whole roots and were reduced progressively as the size of the seed piece decreased. The study reported here was conducted to determine the effects of root sectioning, Captan, DMSO, Semesan Bel, DMSO + Captan and DMSO + Semesan Bel with whole roots, proximal, middle and distal root sections and duration of soaking on plant production.

DMSO (1) is a highly polar, water miscible, hygroscopic organic liquid. It is essentially odorless, water-white and has a low order of toxicity. Keil (3) reported that preliminary tests indicated that DMSO augments the activity of certain antibiotics, fungicides, and bactericides. Whatley et al. (8) reported that DMSO might act as an auxin depressant, or as an auxin stimulant in some yet unexplained manner, which would break the proximal end dominance of the sweetpotato root, thereby increasing slip production.

Material and Methods

The 'Centennial' sweetpotato variety was used in this study. A 5 × 4 × 5 factorial arrangement of treatments in a randomized block design having 3 replications was used (5-chemicals, 4 plant materials, 5 soaking times). Prior to bedding, the roots were cut into equidistant proximal, middle, and distal sections and the respective sections quartered. The whole roots and quartered root sections were then soaked for 0, 5, 10, 15 or 20 minutes in either a 10% saturated solution of Captan, Semesan Bel, a 10% DMSO aqueous solution, solution of DMSO + Captan or solution of DMSO + Semesan Bel. Whole roots and respective quartered sections were drained of excessive solution and were then placed in a greenhouse bench on a medium of peat moss, perlite, and vermiculite v/v and covered to a depth of 3 inches. The greenhouse minimum temperature was maintained at 85° F ± 2°. Roots and quartered sections were bedded on 8–9 February 1968 with the first of 11 pullings made on 28 February, and pulling was continued for 4 weeks whenever the plants reached 6 inches in height. Each treatment contained 1 whole uniform root or 4 quartered sections. The plants were counted and weighed at each pulling. The data consisted of the total number of plants produced by each of the 300 plots and the mean

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weight of these plants in grams. Data were transferred to punch cards and computer analyzed. An analysis of variance and orthogonal comparisons (individual degree of freedom comparisons) were used to determine differences among treatments.

Results and Discussion

Highly significant differences were found among type of plant material and chemicals for total number of plants and mean weight of plants produced (Tables 1, 3, 4). Soaking for 10, 15, and 20 minutes gave no increase in number of plants or mean weight of plants over soaking for 5 minutes (Tables 1, 2). It was apparent that contact of the chemical on the root was the important factor since increased soaking time did not increase the total number of plants produced or mean weight of plants. The average effect of combinations of chemicals was higher than the average effect of chemicals alone, for both variables (Tables 1, 2). DMSO treatments were superior to Captan or Semesan Bel treatments for total number of plants. Semesan Bel was significantly inferior to Captan and DMSO for total number of plants. The 2 combinations, DMSO + Captan and DMSO + Semesan Bel, were similar in affecting the total number and mean weight of plants; however, DMSO alone did not differ significantly from the combinations. Whole roots produced significantly more plants and a higher mean weight of plant than any of the individual cut sections (Tables 1, 4). Proximal end sections produced no more plants than the average of the middle and distal end sections. Middle root sections produced significantly more plants than the distal sections. The middle root sections were higher than either proximal or distal sections in total number of plants. There were no significant differences between the mean weight of plants produced by the proximal, middle, or distal sections (Tables 1, 4).

The results reported here agree with those of Thompson and Beattie (6), Welch and Little (7) and Takatori et al. (5), that cut roots produce a greater total number of plants for a given root than roots left whole. These results also agree with Takatori et al. (5) that the mean weight of plants produced by whole roots is significantly greater than for plants produced by cut roots sections. DMSO treatments produced significantly more plants than Captan or Semesan Bel treatments. The data clearly indicated that root sectioning breaks the proximal end dominance of sweet potato roots. If cut root sections vs. whole roots are used, plant production will be more than double for a given area of bed space and a given supply of roots (Table 4). The interactions among chemicals, plant material, and time were not significant except for the interaction between chemicals and time (Table 1).

Table 2. Average number and mean weight of plants ae effected by soaking time.

Soaking time (min)	Total plants (no.)	Mean wt of plants (g)
Control	7.98	5.90
5	7.53	6.02
10	7.53	6.35
15	7.93	5.97
20	8.33	6.19

Table 3. Average number and mean weight of plants as effected by chemical soak.

Chemicals	Total plants (no.)	Mean wt of plants (g)
Captan	7.70	5.78
DMSO	8.30	6.15
Semesan Bel	6.77	5.59
DMSO × Captan	8.23	6.72
DMSO × Semesan Bel	8.33	6.19

Table 4. Average number and mean weight of plants as effected by plant material.

Plant materials	Total plants (no.)	Mean wt of plants (g)
Whole roots	9.13	7.47
Proximal end sections	7.60	5.71
Middle sections	7.93	5.51
Distal end sections	6.79	5.65

Table 1. Analysis of variance for total number and mean weight of plants with orthogonal comparisons.

Source of variation	df	Total plants	Mean sq	Mean wt pl
Total	299			
Replications	2	57.14**	33.43**	
Chemicals	4	26.44**	11.43**	
Captan, DMSO, Semesan Bel vs DMSO + Captan, DMSO + Semesan Bel	1	33.89*		27.80**
DMSO vs Captan, Semesan Bel	1	45.51**		8.56
Captan vs Semesan Bel	1	26.13*		1.18
DMSO + Captan vs DMSO + Semesan Bel	1	00.21		8.32
Plant materials	3	71.16**	64.56**	
Whole root vs Proximal, Middle Distal sections	1	161.29**		192.28**
Proximal sections vs Middle, Distal sections	1	2.88		00.84
Middle sections vs Distal sections	1	49.31**		00.72
Time	4	6.87	1.95	
Chemicals × plant materials	12	6.57	1.73	
Chemicals × time	16	10.42*	4.53*	
Plant materials × time	12	8.41	4.63	
Chemicals × plant materials × time	48	7.43	3.07	
Error	198	5.73	2.47	

**P $\geqq$ 0.01.
*P $\geqq$ 0.05.

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