EFFECT OF TIME AND FREQUENCY OF TOPPING ON STORAGE ROOT AND CUTTING PRODUCTION OF A BUSHY SWEET POTATO CULTIVAR

Federico G. Villamayor, Jr. and Rudy D. Perez

Professor and Research Assistant, Philippine Root Crop Research and Training Center, Visayas State College of Agriculture, Baybay, Leyte, Philippines.

ABSTRACT

The effect of topping on storage root and apical stem cutting production of a bushy sweet potato cultivar (VSP-2) was studied. In the first experiment, all terminal cuttings at least 16 cm long were cut either at 38, 45, 52, or 59 days after planting (DAP). Storage root yield was not significantly affected by the time of topping. Meanwhile, the number of cuttings per plant (Y) is significantly related to the time of topping (X) by the equation Y = 0.31X-9.58 at 1% level (r = 0.997).

In the second experiment, the treatments were the frequencies of topping, i.e. one to five times. Topping started at 32 DAP and was repeatedly done at 2-week intervals depending on the topping frequency. Only terminal shoots reaching 25 cm long were cut. The number of cuttings produced per m^2 (Y) is significantly related to the frequency of topping (X) by the equation Y = 7.70X - 1.78 at 1% level (r = 0.988). On the other hand, topping significantly reduced yield. The total storage root yield in t/ha (Y) is also significantly related to the frequency of topping by the equation Y = 18.45 - 2.34X at 1% level (r = -0.985).

Ann. Trop. Res. 10:26-36

KEY WORDS: Sweet potato [*Ipomoea batatas* (L) Lam]. Topping. Pruning. Cutting production .

INTRODUCTION

During the initial adoption of newly recommended sweet potato cultivars, planting materials have to be purchased. At 10 centavos per 25-cm long cutting and at a population of 33,333 plants per hectare, the total cost of planting materials constitutes more than one third of the production cost and can be considered a very big investment for small farmers.

To reduce the cost of planting materials, the farmers can buy a few cuttings and propagate them but this usually takes some time before a big area can be completely planted. Another alternative is to buy sufficient planting materials for a given area and then expand the area for production by topping the plants when enough vines are produced.

Reports on the effect of topping on root production of traditional long and creeping varieties indicate that topping generally reduced yield (Gonzales et al., 1977; Bartolini, 1982) although there were instances when yield was not reduced but was even increased (Bartolini, 1982). Obviously, the response of sweet potato to topping depends on several factors such as varietal growth habit, planting season, soil fertility, and time and frequency of topping.

There is insufficient information on the effect of topping on root production and number of cuttings produced when the plants are topped during a certain period especially for the new varieties which are bushy. Hence, this study was conducted to determine the effect of time and frequency of topping on storage root and cuttings production of a recommended bushy sweet potato cultivar (VSP-2).

MATERIALS AND METHODS

Effect of Time of Topping

The land was prepared for upland crop production. The test cultivar, VSP-2, is a bushy type of sweet potato with a normal vine length of less than 1 meter at harvest. Terminal cuttings (25 cm long) were planted singly and vertically 30 cm between hills on ridges spaced 1 meter apart.

The experiment was laid out using the randomized complete block design (RCBD) with three replications, and a plot size of 2 x 4.8 m. The plants were topped once at 38, 45, 52 or 59 days after planting (DAP) and these served as the treatments. All terminal shoots reaching 16 cm in length were cut, counted and weighed every topping time.

The plants were fertilized with 80 kg N/ha on a per hill basis one day after the first topping. The field was handweeded at 2 and 4 weeks after planting (WAP). To control insect pests, Thiodan was sprayed to the plants at one and 2 months after planting (MAP) following the recommended dosage of the manufacturer.

At harvest (4 MAP), the marketable and non-marketable roots were

counted and weighed. Roots with length and diameter greater than 6.5 and 2.5 cm, respectively were considered marketable regardless of pest incidence. The herbage weight data were also taken. All yield data (roots and cuttings) were taken from the two rows excluding the end plants.

The soil in the experimental area is sandy loam with the following chemical characteristics: pH - 5.94; o.m. content - 2.21%; P (Bray #2) - 12 ppm and K - 211 ppm. Rainfall and solar radiation during the experimental period (Table 1) were favorable for growing sweet potato.

Effect of Frequency of Topping

The experiment was laid out using the simple RCBD with 4 replications, and a plot size of 2 x 6 m. The frequency of topping (1, 2, 3, 4 and 5 times during the growing period of sweet potato) served as the treatments. For all the treatments, topping started at 32 DAP and was repeatedly done at 2-week intervals depending on the treatment. The length of the cuttings gathered was 25 cm. Land preparation, planting method, care of plants and data taken were similar to the first experiment.

The soil in the area is clay loam with the following chemical characteristics: pH - 5.65; o.m. content - 1.8%; P (Bray #2) - 9.82 ppm; and K-232 ppm. The growing conditions in terms of rainfall and solar radiation favored sweet potato production (Table 1).

RESULTS AND DISCUSSION

Effect of Time of Topping

Production of Cuttings. The number and weight of terminal cuttings obtained every topping period are shown in Table 2. The number of cuttings per topping increased with plant age. In sweet potato experiments in ViSCA, vegetative growth in terms of leaf area and number of lateral vines generally peaks approximately during the tenth week after planting. Thus, it is expected that the number of cuttings will still increase until the tenth week. The relationship between topping time (X) and number of cuttings produced per plant (Y) can be described by the linear regression equation $Y = 0.31X - 9.58$ which is significant at 1% level ($r = 0.997$). The average weight per cutting seems to increase with plant age at the time of topping but no significant linear relationship between them nor significant differences among the treatments were noted.

Root, Herbage and Total Plant Yield. Regardless of the time of topping, a single topping done between the 38th and 59th day after planting did not significantly reduce all yield parameters, i.e. total root number, marketable and total root yield, herbage yield, total plant weight and harvest index (Table 3). This suggests that a single topping is not detrimental to the growth and development of sweet potato since the plants can still recover from the "damage" caused by topping. Fur-

Table 1. Biweekly accumulated rainfall and solar radiation during the growing period of sweet potato.

Time after Planting (weeks)	Experiment I		Experiment II	
	Rainfall (mm)	Solar Radiation (MJ/m^2)	Rainfall (mm)	Solar Radiation (MJ/m^2)
0 - 2	62.8	195.8	58.3	189.7
2 - 4	114.8	229.6	64.4	238.2
4 - 6	92.1	249.6	94.1	229.2
6 - 8	162.0	226.2	38.3	157.2
8 - 10	100.2	216.4	236.9	158.7
10 - 12	72.3	282.6	237.3	178.3
12 - 14	228.5	212.2	48.1	265.3
14 - 16	144.1	219.2	85.5	227.8
16 - 17.5	126.4	188.5	46.5	139.2
Total	1103.2	1920.1	909.4	1783.6

Table 2. Number and weight of terminal cuttings (16 cm long) topped at various periods after planting.[1]

Time of Topping (DAP)[2]	Number of Cuttings per Plant	Mean Cutting Weight (g)
38	2.34d	16.47a
45	4.01c	16.50a
52	6.46b	17.17a
59	8.72a	20.17a

[1]In a column, means followed by a common letter are not significantly different at 5% level, DMRT.

[2]DAP = days after planting.

thermore, when the weight of the cuttings was included in the total plant weight, the numerical differences among the treatments were even smaller.

The data presented in Tables 2 and 3 suggest that the cost of planting materials for sweet potato production can be possibly reduced by gradually expanding the area of production once enough planting materials are available. Instead of purchasing all the planting materials required for the entire area, only a part may be bought. For example, if 3 hectares of land will be planted to sweet potato, a hectare may be planted initially and the additional 2 hectares will be planted about a month later by utilizing the cuttings from those planted earlier. This means a saving of about ₱6,600.00 for planting materials (at ₱0.10 per cutting) for the 2 hectares planted later. However, one may still profit by planting a big area all at once even with high cost of planting materials provided that the supply is low and the demand is high. However, this rarely happens with sweet potato which can be produced any time of the year except in areas with long dry seasons and without irrigation facilities.

Effect of Frequency of Topping

Production of Cuttings. The number and weight of cuttings produced every topping period are shown in Table 4. The lowest number of cuttings was obtained during the first topping (32 DAP). This is logical since there are still very few shoots during the early stage of growth. Relatively more cuttings were gathered during the second and third topping periods (47 and 62 DAP). This could be attributed to the rapid vine growth

Table 3. Yield parameters as affected by different time of topping.

Time of Topping[1] (DAP)	Total Root Count (#/m²)	Root Yield (t/ha)		Herbage Yield (t/ha)	Total Plant Weight (t/ha)	Harvest Index (%)	Accumulated Plant Weight[2] (t/ha)
		Marketable	Total				
No topping	13.89	19.55	19.79	28.99	48.78	40.6	48.78
38	16.19	17.11	17.62	28.47	46.09	38.2	47.21
45	15.59	19.27	19.74	26.56	46.30	42.6	48.23
52	13.85	17.32	17.57	26.04	43.61	40.3	46.90
59	14.92	16.49	16.91	23.09	40.00	42.3	45.85
F - test	ns	ns	ns	ns	ns	ns	ns
CV (%)	15.27	10.73	10.59	12.29	10.16	7.37	10.60

[1] DAP = days after planting

[2] Includes weight of cuttings topped aside from root and herbage yield at harvest.

Table 4. Average number and weight of terminal cuttings (25 cm long) of sweet potato (cv. VSP-2) per topping.[1]

Topping Order	Topping Time (DAP)[2]	Number of Cuttings/m^2	Mean Cutting Weight (g)
First	32	3.67	30.9
Second	47	9.98	25.0
Third	62	9.43	27.3
Fourth	77	6.18	27.0
Fifth	92	5.79	23.7

[1]Mean of 20, 16, 12, 8, and 4 plots for the first, second, third, fourth, and fifth toppings, respectively.

[2]DAP = days after planting

during this period coupled with the loss of apical dominance resulting from removal of terminal shoots. The number of cuttings produced declined during the fourth and fifth topping period. This decline could be due to the competition between shoot and root production during this period. According to Edmond and Ammerman (1971), the early phase of sweet potato growth is dominated by vine growth while the later phase is dominated by storage root growth. The middle phase is a balance between vine and root growth.

The average weight of the cuttings ranged from 23.7 g (92 DAP) to 30.9 g (32 DAP). However, the numerical differences among treatments were insignificant.

Table 5 shows the accumulated number of cuttings and the mean weight of cuttings at different topping frequencies. The weight per cutting was not significantly affected while the number of cuttings produced significantly increased with more frequent topping. The relationship between topping frequency (X) and number of cuttings produced per m^2 (Y) is described by the linear regression equation $Y = 7.70X - 1.78$ which is significant at 1% level ($r = +0.988$).

Root, Herbage and Total Plant Yield. The frequency of topping significantly affected all the yield parameters (Table 6). The marketable and total root number and weight of sweet potato were significantly reduced by the topping treatment. However, the total number of storage roots did not markedly decrease after the second topping (47 DAP) which indicates that storage root initiation has been completed at this time. This agrees with the observation of Lowe and

Table 5. Accumulated number of terminal cuttings produced and the mean weight per cutting at different topping frequencies.[1]

Topping Frequency (Number)	Number of Cuttings/m^2	Mean Cutting Weight (g)
1	3.54c	25.3a
2	11.50bc	26.4a
3	24.30ab	26.9a
4	29.90a	27.1a
5	35.50a	26.4a

[1] Within a column, means followed by a common letter are not significantly different at 5% level, DMRT.

Wilson (1974) that storage root initiation is usually completed on the eighth week after planting. Significant linear relationships were also noted between topping frequency, and root number and weight (Table 7).

The herbage weight was significantly reduced by topping (Table 6). This is expected because a large part of the vines is removed during topping. Since topping reduced root and herbage weight, it also decreased total plant weight. However, even if the weight of the cut terminal shoots was added to the plant weight, the accumulated total plant weight was still low. This implies that the plants did not fully recover from the "shock" of topping. More frequent topping has more severe effect on crop productivity. Harvest index increased with more frequent topping (Table 6) since vine weight was proportionately reduced by topping.

Simple linear regression equations show highly significant relationships between number of topping (X) and the plant parameters such as herbage weight, total plant weight, and harvest index (Ys) (Table 7).

Finally, the choice between buying all the planting materials required for a given area or having an initial propagation area depends on the relative profitability of producing either the roots or the cuttings. If one intends to plant a 10-hectare field to sweet potato, the profitability of using one hectare for propagation and the other nine for root production or of buying all the planting materials required for the 10 hectares at one time should be determined. Based on the relationship between the number of toppings and the number of cuttings produced ($Y = 7.70X - 1.78$), a hectare planted to VSP-2 sweet

Table 6. Yield parameters as affected by different frequencies of topping.[1]

Number of Topping	Root Count (#/m²)		Root Weight (t/ha)		Herbage Weight (t/ha)	Total Plant Weight[2] (t/ha)		Harvest Index (%)
	Marketable	Total	Marketable	Total		At Harvest	Accumulated	
0	8.38a	12.10a	17.54a	18.87a	18.27a	37.14a	37.14a	50.8cd
1	7.79ab	10.35b	15.13b	16.46b	16.65a	33.10a	34.04a	50.2d
2	6.90bc	9.85bc	12.44c	13.33c	12.71b	26.04b	29.10b	51.2c
3	5.92cd	10.23b	9.46d	10.68d	8.92c	19.60c	26.22bc	54.2b
4	4.77d	8.33c	6.94e	8.32e	6.56c	14.88cd	22.98c	55.9a
5	4.60d	8.71bc	6.79e	7.90e	6.44c	14.33d	23.73c	55.2a

[1] Within a column, means followed by a common letter are not significantly different at 5% level, DMRT.

[2] Total plant weight at harvest is the sum of total root weight and herbage weight, while the accumulated plant weight includes weight of the cuttings at different topping periods.

Table 7. Simple linear regression equations between plant parameters (Ys) measured and the number of toppings done (X), regression coefficients and test of significance.

Parameters	Linear Regression Equation	Regression Coefficient (r)	Test of Significance[1]
Total plant weight (t/ha)	Y = 36.69 - 5.00X	- 0.981	**
Herbage weight (t/ha)	Y = 18.25 - 2.66X	- 0.975	**
Total root yield (t/ha)	Y = 18.45 - 2.34X	- 0.985	**
Marketable root yield (t/ha)	Y = 17.19 - 2.32X	- 0.984	**
Total root count (#/m²)	Y = 11.54 - 0.65X	- 0.900	*
Marketable root count (#/m²)	Y = 8.12 - 0.75X	- 0.964	**
Harvest index (%)	Y = 49.93 + 1.17X	+ 0.919	**
Total plant weight at harvest (t/ha)	Y = 36.69 - 5.00X	- 0.981	**
Total plant weight including cuttings (t/ha)	Y = 36.23 - 2.95X	- 0.964	**

[1] * - significant ** - highly significant

potato cultivar can produce about 367,000 cuttings which is sufficient for 11 hectares between the 32nd and the 92nd day after planting. Using the equation, Y = 17.19 - 2.32X which relates number of toppings (X) with marketable yield (Y), the marketable yield will only be 5.59 t/ha with a reduction of 11.60 t/ha (17.19 - 5.59). This will mean a los of ₱23,200 at a price of ₱2.00/kg of roots. On the other hand, the cost of planting materials (33,333 plants/ha x ₱0.10/cutting x 9 hectares = ₱29,997) for the other 9 hectares can be saved. In this case, topping the plants is better than buying the cuttings required for the entire area. However, if the price of the cuttings decreases and/or the price of the roots increases, then it may be more profitable to just buy

the entire bulk of planting material required for the area.

It is also worthwhile to note that with topping, one is forced to stagger the planting and, therefore, also the harvesting of sweet potato. This could be advantageous or disadvantageous depending on the market situation, and the labor and capital investments needed by the planter.

LITERATURE CITED

BARTOLINI, P.U. 1982. Timing and frequency of topping sweet potato at varying levels of nitrogen. *In* Proc. First Inter. Sweet Potato Symp. R. L. Villareal and T. D. Griggs (eds.). AVRDC, Shanhua, Tainan, Taiwan, China. pp. 209-214.

EDMOND, J.B. and AMMERMAN, G.R. 1971. Sweet Potatoes: Production, Processing, Marketing. The AVI Publishing Co., Inc., Westport, Connecticut. 334 p.

GONZALES, F.R., CADIZ, T.G. and BUGAWAN, M.S. 1977. Effect of topping and fertilization on the yield and protein content of three varieties of sweet potato. Phil. J. Crop Sci. 2 (2): 97-102.

LOWE, S.B. and WILSON, L.A. 1974. Comparative analysis of tuber development in six sweet potato [*Ipomoea batatas* (L) Lam] cultivars. 1. Tuber initiation, tuber growth and partition of assimilate. Ann. Bot. (Lond.) N.S. 138: 307-317.