PROPAGATION OF *STEVIA REBAUDIANA* BY CUTTINGS

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Abstract. Three trials were carried out to evaluate the potential of *Stevia rebaudiana* when propagated by cuttings. The effects of cutting collection date, rooting hormone, wounding, position of cutting on parent plant, and length of cutting were compared using a rooting score. October was found to be the optimum time for collecting cuttings, with tip cuttings producing more rooted cuttings than basal cuttings. Wounding was found to improve rooting in tip cuttings but application of high levels of rooting hormone decreased the root score of tip cuttings. The length of cuttings had no effect on the root score.

INTRODUCTION

Stevia rebaudiana Bertoni, a member of the Asteraceae, is a small herbaceous perennial shrub, native to Paraguay, which grows to 80 to 100 cm high.

Stevia is grown primarily for its leaves which contain sweet glucosides. Among these are steviocide, rebaudioside A, and at least six other glucosides. The sweetening power of these glucosides is estimated to be 150 to 300 times that of cane sugar and all are water soluble. Studies at the University of California (7) have shown that the production of stevioside could be equated to the sweetening power of 70 tonnes/ha of sucrose. As a sweetening agent steviocide is non-fermentable and apparently does not encourage mouth bacteria.

Stevia has been used historically as a sweetener in Paraguay and was seriously considered as a sugar substitute in England during World War II (4). At present, it is being grown commercially in Japan (2) and Korea (1). Little is known of the commercial prospects of this crop in New Zealand. As a first step for commercial production there is a need to obtain information on the propagation requirements of this plant. This paper evaluates the propagation of stevia by cuttings.

MATERIALS AND METHODS

Softwood cuttings were collected from one year old plants grown in planter bags in a well ventilated, unheated glasshouse. All cuttings were approximately 20 cm long with at least 5 nodes. The rooting medium for the cuttings was washed silica sand. Watering was by means of an electronic misting system. To prevent fungal attack, the cuttings were alternately sprayed with either Sumisclex (procymidone), Rovral (metalaxyl), or Benlate (benomyl) once every 7 to 10 days. The insecticide, Attack (pirimiphos-methyl and permethrin) and the miticide, Plictran (cyhexatin) were also sprayed when necessary.

Three trials were carried out:

1. *Cutting type and time of collection.* The first trial was to evaluate the time of the year when the cuttings rooted best and whether single node cuttings near the base of the stem had the same rooting potential as shoot tip cuttings. One collection of 14 cuttings was made each month from spring to late autumn (October through May). Due to winter dieback, no material was available during the winter (June through September). Each of the 20 cm long cuttings was then divided into 4 single node cuttings, i.e., one tip cutting, one upper middle cutting, one lower middle cutting, and a basal cutting.

2. *Hormone application and wounding.* The second trial established on November 2, 1983 was to determine whether hormone application or wounding would improve rooting in stevia cuttings. As in the first trial, cuttings were single node with a record made of their relative position on the parent plant, i.e., tip, upper middle, middle, lower middle, or basal. The cuttings were then prepared by either wounding, applying a rooting hormone, or both. Wounding was carried out by removing a thin slice of stem without cutting too deeply. Three hormone treatments, "Seradix" numbers 1, 2 and 3 were used. These contained 0.1%, 0.3% and 0.8% β-indolebutyric acid active ingredient, respectively. Where cuttings received both wounding and hormone treatment, the wounding was carried out first. There were 5 cutting positions for each treatment. Two wounding treatments, three hormone treatments and a control. There were 8 replicates giving a total of 320 cuttings.

3. *Length of cutting.* The third trial was to determine whether the length of the cutting would affect rooting potential. The treatments were cuttings 10 cm long with 4-6 nodes, cuttings 15 cm long with 6-9 nodes, and cuttings 20 cm long with 9-13 nodes. There were 3 replications with 5 cuttings in each treatment. This trial was established in mid-summer, January 20, 1984.

After 5 to 6 weeks, all cuttings were carefully lifted with a spatula and examined. A general score was then assigned to each cutting on a scale from 0 to 5 summarising the growth, vigour, and general health of the root system. The scoring system was designed to cover the range of rooting potentials of stevia and was standardised by a set of line drawings (Fig. 1). The scoring system was as follows:

0 — No roots initiated.

1 — Poor, few roots, unevenly distributed.

2 — Below average — moderate number of small roots or smaller number of longer roots more evenly distributed.

3 — Average — moderate number of roots of average length. Fairly even distribution of roots around stem.

4 — Above average — plentiful number of roots of good length with an even distribution of roots around the stem.

5 — Excellent — abundant long roots, excellent distribution around stem.

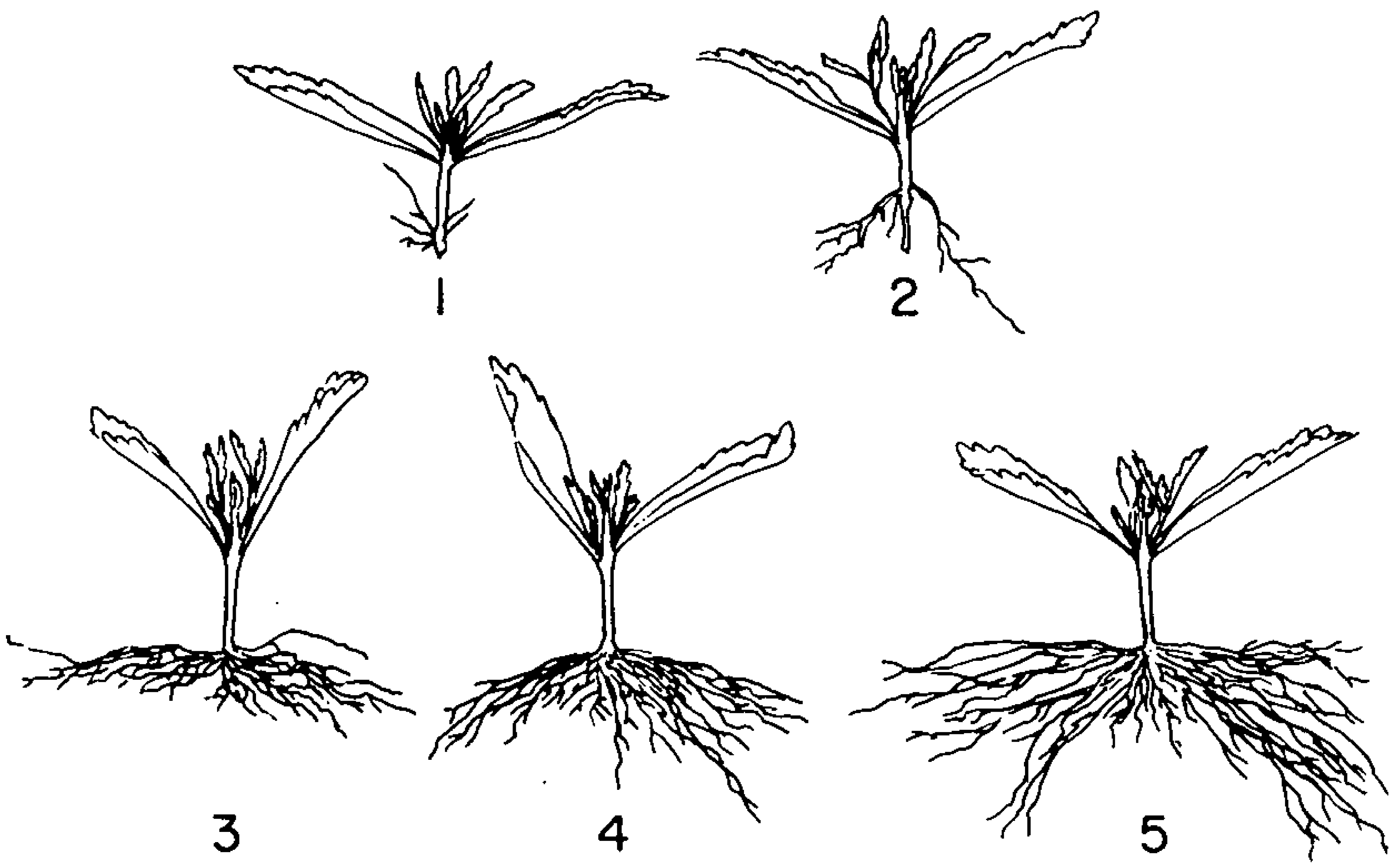

Figure 1. Drawings used as standards for awarding root scores to *Stevia rebaudiana* cuttings.

RESULTS

The highest mean root score was obtained from cuttings collected in October (see Table 1). All cuttings collected in March, April, and May failed to root, this period being associated with flower development. Flower buds were first observed on cuttings collected in March.

For all cutting dates, tip cuttings had the highest root scores (see Table 1). This was followed by cuttings from the upper middle stem, the lower middle stem, with basal cuttings having the lowest root score.

In the second cutting trial, wounding had no effect except on tip cuttings where wounding increased root score (Table 2).

Table 1. Effect of cutting collection date and cutting position on rooting score.

Month	Tip Cutting	Upper Middle Cutting	Lower Basal Cutting	Basal Cutting	Mean
July	*	*	*	*	
Aug.	*	*	*	*	
Sept.	*	*	*	*	
Oct.	3.14	1.86	0.50	0.36	1.46
Nov.	2.50	0.71	0.21	0.14	0.89
Dec.	3.50	0.29	0.07	0.00	0.96
Jan.	1.64	0.21	0.50	0.00	0.59
Feb.	0.93	0.29	0.36	0.07	0.41
Mar.	0	0	0	0	0
Apr.	0	0	0	0	0
May	0	0	0	0	0
June	*	*	*	*	
Mean	2.34	0.67	0.33	0.11	

* No cuttings collected.

Table 2. Effect of cutting position and wounding on root score.

Cutting Position		No Wounding	Wounding
Tip		1.4	2.1
Upper middle		1.3	1.4
Middle		0.8	0.6
Lower middle		0.3	0.3
Basal		0.3	0.3
SED	0.14		

Using β-indolebutyric acid in two concentrations (0.3% and 0.8%) decreased the root score of tip cuttings while there is a suggestion that for other cuttings the effect of applying hormone increased the root score (Table 3). There was no significant interaction between hormone application and wounding.

The third trial to evaluate the effect of cutting length on root score demonstrated no differences among cutting lengths (Table 4).

Table 3. Effect of cutting position and hormone concentration on root score.

		Indolebutyric acid concentration			
Cutting Position		0	0.1%	0.3%	0.8%
Tip		2.3	2.2	1.8	0.9
Upper middle		1.1	1.3	1.8	1.3
Middle		0.5	0.8	0.9	0.7
Lower middle		0	0.3	0.8	0.4
Basal		0.1	0.3	0.2	0.6
SED	0.2				

Table 4. Effect of cutting length on root score.

Cutting Length	10 cm	15 cm	20 cm
Root Score	2.5	2.8	2.6
SED 0.5			

DISCUSSION

To obtain optimum rooting of stevia cuttings only those with a terminal bud should be used, collected early in the season from new growth produced after winter dieback (see Tables 1, 2, 3). It appears that the terminal bud is essential in promoting healthy root growth.

It is well known that auxins are produced in the terminal bud of a plant and that they are essential for root development (6). This is supported by this work which has demonstrated that in the absence of a terminal bud rooting can be improved by the application of β-indolebutyric acid. However, even with the application of this hormone, the rooting of cuttings without a terminal bud was still inferior in rooting potential to those with the terminal bud, suggesting the need for other root forming compounds besides auxin to be present.

The application of high levels of hormone (0.3 and 0.8% indolebutyric acid) to cuttings with a terminal bud had a deleterious effect on the root score suggesting that additional hormone may have a toxic effect on root development when the presence of naturally occurring hormones and root prompting factors is adequate.

There was no root initiation from stevia cuttings when the parent plant was in a state of strong floral induction. As flowering is also a plant process that requires a considerable resource in terms of carbohydrate, nutrients, and plant hormones, including auxins (6), competition for these resources may occur with flower development being promoted at the expense of root development.

Wounding generally had no effect on root scores except for tip cuttings. Wounding is carried out to either increase the uptake of water (3); or promote wounded cells to produce root primordia (8), encourage the natural accumulation of carbohydrates and hormones in the wounded area, or increase the respiration rate which may aid root production (5). It is, however, difficult to determine why one of these factors should be operating on tip cuttings and not on cuttings collected from further down the stem.

It has been widely reported that the presence of leaves on cuttings exerts a strong stimulating influence on root initation (5) with more leaves supplying more carbohydrate to aid root initiation and development. This appears not to be a major factor in rooting stevia cuttings with additional stem length and therefore leaf area having no effect on the root score.

For the purpose of bulking up large numbers of plants, single node tip cuttings collected before flower initiation should be used.

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PERSIMMON PROPAGATION: RESEARCH HIGHLIGHTS FROM RUAKURA

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The recent upsurge of interest in persimmons (*Diospyrus kaki*), particularly the non-astringent or "sweet" persimmons, has resulted in an increased demand for plants. Persimmon plantings have increased from 3,000 trees (about 4 ha) in 1981 to 200,000 trees (350 to 400 ha) in 1984 (2). Size of commercial plantings range from small units of 0.5 ha to areas of 10 to 15 ha. In 1985 a further 60,000 trees were planted (2).

Demand for plants of preferred cultivars has far exceeded supply and this situation is likely to continue for at least the next 2 to 3 years. Consequently, plant prices will remain high — presently, grafted plants sell for $NZ10-15. Persimmon rootstocks sell for $NZ3-5.