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GROWTH OF SINGLE AND MULTINODAL CUTTINGS OF TEA (*CAMELLIA SINENSIS L. O. KUNTZE*) UNDER POLYETHYLENE†

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The growth of single-node tea cuttings raised by the normal method and of single and multinodal tea cuttings raised under a sealed polyethylene cover for 60 days was studied in the nursery.

After 90 days from planting, best growth was shown by the single and double-node cuttings under the cover. They formed more and longer roots of greater dry weight than the roots of the single-node cuttings raised outside. The 5-node cuttings showed greater mortality. Multinodal cuttings had greater weights of callus and floral buds and had greater plant weight due to their initial size.

At 210 days after planting there was no difference in the total length of new shoots among the cuttings. More new shoots were seen in cuttings with more nodes but these were weak. The 5-node cuttings had greater root and plant weight. Cuttings with 3-5 nodes had greater weight of floral buds. The practical implications of raising plants by this method are discussed.

INTRODUCTION

Tea is propagated extensively by "single-node" cuttings consisting of a leaf with the axillary bud at the node and a portion of the internode below it (Tubbs, 1939; 1946). For this purpose suitable cuttings are taken from aperiodic shoots obtained after pruning mature tea bushes (Bond, 1945). Although other vegetative propagation methods can be used, for commercial propagation the most convenient and practical method is the use of the single-node cutting (Visser and Kehl, 1958; Green, 1964; Richards, 1967).

Green (1970) suggested propagation by multinodal cuttings when there is an excess of cutting material available so that larger or standard-sized plants can be obtained in a shorter period. Visser (1959a) showed that although double-node cuttings have potentially greater root and axillary shoot growth, their growth was affected under sub-optimal nursery conditions.

For successful propagation of cuttings, shading to minimize the effects of high temperature and the maintenance of sufficient humidity over the cuttings are essential (Visser, 1962). Tea nurseries shaded by coir matting and watered 1-3 times

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daily need about 0.64 cm - 1.02 cm of water per day during warm weather (Visser, 1959b). Any reduction in the quantity of water applied will therefore result in a saving of water and labour resulting in the production of cheaper plants. Sealed polyethylene covers which conserve moisture and maintain a humid atmosphere over the cuttings have been used in the propagation of Cacao cuttings (McKelvie, 1957; Gnanaratnam, 1964).

The object of this work was to study the growth of single-node and multinodal cuttings under sealed polyethylene cover and to compare their performance with that of single-node cuttings raised by the normal method.

MATERIALS AND METHODS

Cuttings with 1, 2, 3, 4 and 5 nodes, taken from comparable leader shoots of clone TRI 2025, were planted in polyethylene sleeves filled with soil, one cutting being inserted in each bag. The layout was of a randomized block design with 6 treatments, including a control, where cuttings were propagated by the normal method. There were 10 plants in each treatment which were replicated 6 times. After planting, the bags as well as the nursery bed were thoroughly watered and covered with a transparent 300 gauge polyethylene sheet which rested on semi-circular iron hoops placed at intervals along the length of the bed so that the polyethylene tent was well above the 5-node cuttings while the single-node cuttings propagated by the normal method were laid outside the tent. The free ends of the tent were buried in a trench and covered with soil so as to make the tent air tight.

The temperature and humidity within the tent were recorded by a thermometer and hygrometer respectively, suspended inside the tent while a thermometer suspended outside the tent recorded the ambient air temperature. Light intensity was measured by a light meter. The entire bed was covered by coir matting which was above the level of the tent. The cuttings propagated by the normal method continued to be watered 3-4 times a day. The polyethylene cover was removed 60 days after planting and the cuttings watered daily until 90 days when an assessment was made on the last 5 plants of each row. The remaining plants were assessed when they were 210 days old. Figures 1 and 2 show the growth of cuttings at 90 and 210 days after planting respectively. Climatic data are summarised in Table 1.

RESULTS

At 90 days after planting there were more deaths among the 5-node cuttings. The multinodal cuttings had a greater number and weight of floral buds (Tables 2 and 3). The single-node cuttings under the tent showed increased shoot length, leaf area, root number and dry weight of new leaves and roots than the multinodal cuttings and the single-node cuttings outside the tent. In addition, the single-node cuttings under the tent had greater total root length compared to the 4 and 5-node cuttings and those raised by the normal method while the dry weight of new stem was greater compared to the 3-5 node cuttings and the single-node cuttings outside the tent.

The 2-node cuttings under the tent produced longer shoots with more roots compared to the cuttings with more nodes and the single-node cuttings outside the tent. The area of new leaves of these cuttings was also greater compared to the 3 - 5 node cuttings while their root length was greater than the cuttings raised outside. The dry weight of new stem and leaves of the 2-node cuttings was greater than those in the cuttings with more nodes and those raised outside while the dry weight of roots was greater than the single-node cuttings raised by the normal method. On a fresh weight basis the multinodal cuttings and greater callus growth Table 3).

TABLE 1 — *Climatic data*

Month	*Type of propagation*		*8 am*	*10 am*	*12 noon*	*2 pm*	*4 pm*
December 1974	Sealed	Temperature Minimum (°C)	15	18	18	18	18
		Maximum (°C)	29	24	27	28	28
		Relative humidity (%)	100	100	100	100	100
		Light intensity (Lux)	6.5×10^3	28.0×10^3	33.0×10^3	21.0×10^3	2.9×10^3
	Open	Temperature Minimum (°C)	14	18	18	18	18
		Maximum (°C)	27	23	26	26	26
		Relative humidity (%)	50	47	43	40	51
		Light intensity (Lux)	28.0×10^3	110.0×10^3	140.0×10^3	135.0×10^3	100.0×10^3
January 1975	Sealed	Temperature Minimum (°C)	11	16	17	17	17
		Maximum (°C)	39	26	30	36	40
		Relative humidity (%)	100	100	100	100	100
		Light intensity (Lux)	8.0×10^3	33.0×10^3	40.0×10^3	23.0×10^3	4.0×10^3
	Open	Temperature Minimum °(C)	9	17	17	18	18
		Maximum (°C)	30	26	29	30	30
		Relative humidity (%)	47	44	38	38	45
		Light intensity (Lux)	34.0×10^3	135.0×10^3	160.0×10^3	155.0×10^3	115.0×10^3

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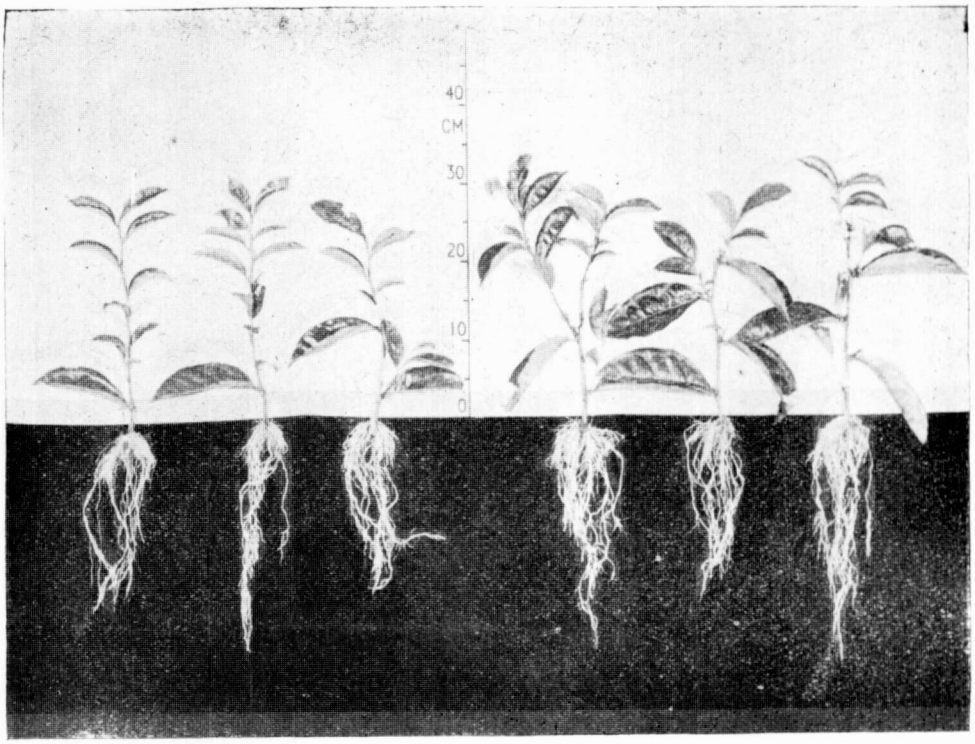

Fig. 1.—Growth of single node cuttings and of single and multinodal cuttings raised under sealed polyethylene cover at 90 days after planting. Left to right: 1—node cutting (normal propagation) 1, 2, 3, 4 and 5 node cuttings (under polyethylene cover).

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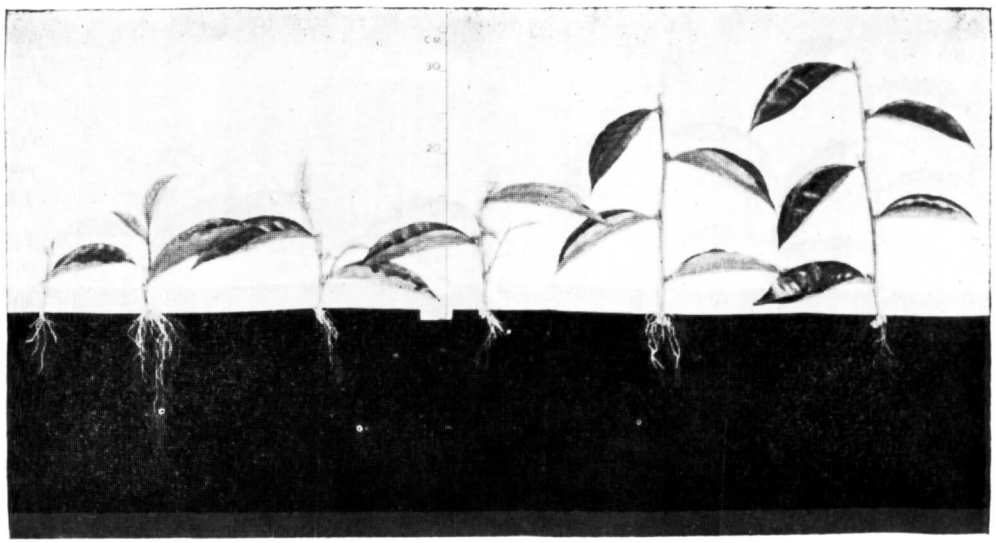

Fig. 2.—Growth of single node cuttings and of single and multinodal cuttings under sealed polyethylene cover at 210 days after planting. Left to right: 1—node cutting (normal propagation). 1, 2, 3, 4 and 5 node cuttings (under polyethylene cover).

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TABLE 2 — *Effect of treatments on the growth of tea cuttings at 90 days after planting. (Figures in parentheses indicate back-transformed numbers).*

Type of cutting	*% of plants surviving*	*Length of original cutting (cm)*	*Area of mother leaves (cm²)*	*No. of floral buds+*	*New leaves*		*New shoots*		*Roots*	
					*Number**	*Area (cm²)*	*Number**	*Length (cm)*	*Number**	*Length (cm)*
Normal propagation										
Single-node	100	3.25	64.60	1.09 (0.19)	2.42 (5.86)	3.09	1.00 (1.00)	4.20	2.00 (3.00)	2.54
Propagation under polyethylene cover										
Single-node	100	3.62	71.40	1.25 (0.56)	2.78 (7.78)	10.26	1.00 (1.00)	8.80	3.62 (12.10)	6.51
Double-node	100	10.22	137.70	2.19 (3.80)	2.76 (7.62)	4.84	1.35 (1.82)	7.05	2.64 (5.97)	5.16
Three-node	95	16.47	187.20	3.37 (10.36)	2.54 (6.45)	2.01	1.08 (1.17)	2.43	1.91 (2.65)	4.49
Four-node	97	23.99	265.80	3.61 (12.03)	2.17 (4.71)	1.80	1.01 (1.02)	1.42	1.79 (2.20)	4.01
Five-node	83	28.27	325.30	3.97 (14.76)	2.60 (6.76)	1.50	1.21 (1.46)	1.96	1.69 (1.86)	4.00
L.S.D. (P=0.05)	—	1.85	14.70	0.37	NS	2.22	NS	1.46	0.46	2.22

* Analyses done on $\sqrt{n}$ transformed data.
\+ Analyses done on $\sqrt{n+1}$ transformed data.

TABLE 3 — *Effect of treatments on fresh weight of callus and on dry matter production at 90 days after planting (g).*

Type of cutting	*Fresh weight of callus (g)*	*Dry weight (g)*						
		Floral buds	*New stem*	*New leaves*	*Original cuttings*	*Mother leaves*	*Roots*	*Plant*
Normal propagation								
Single-node	0.83	0.01	0.06	0.04	0.31	0.84	0.02	1.28
Propagation under polyethylene cover								
Single-node	1.62	0.01	0.13	0.24	0.30	0.79	0.12	1.59
Double-node	3.61	0.06	0.12	0.17	0.82	1.53	0.07	2.77
Three-node	3.09	0.15	0.04	0.05	1.15	2.30	0.04	3.73
Four-node	6.97	0.18	0.05	0.01	1.72	3.03	0.03	5.02
Five-node	2.97	0.21	0.05	0.03	2.16	4.10	0.04	6.59
L.S.D. (P=0.05)	1.13	0.05	0.05	0.05	0.26	0.37	0.04	0.50

TABLE 4 — *Effect of treatments on the growth of tea cuttings at 210 days after planting. (Figures in parentheses indicate back-transformed numbers).*

Type of cutting	*Length of original cutting (cm)*	*Area of mother leaves (cm²)*	*No. of floral buds+*	*New leaves*		*New shoots*		*Roots*	
				*Number**	*Area (cm²)*	*Number**	*Length (cm)*	*Number**	*Length (cm)*
Normal propagation									
Single-node	3.18	54.89	1.42 (1.02)	4.01 (16.08)	10.74	1.00 (1.00)	16.42	4.28 (18.32)	11.97
Propagation under polyethylene cover									
Single-node	3.52	65.84	1.09 (0.19)	3.99 (15.92)	11.90	1.00 (1.00)	19.37	5.01 (25.10)	11.69
Double-node	9.85	107.83	1.39 (0.93)	4.57 (20.88)	13.13	1.28 (1.64)	19.67	5.20 (27.04)	11.57
Three-node	16.57	173.57	2.17 (3.71)	4.35 (18.92)	11.79	1.33 (1.77)	13.86	5.10 (26.01)	11.54
Four-node	19.88	179.06	2.95 (7.70)	4.96 (24.60)	13.01	1.67 (2.79)	14.06	4.98 (24.80)	11.81
Five-node	25.97	249.45	3.41 (10.63)	5.63 (31.70)	9.56	1.81 (3.28)	14.52	5.45 (29.70)	11.57
L.S.D. (P=0.05)	3.34	33.00	0.41	0.94	NS	0.23	NS	NS	NS

* Analyses done on $\sqrt{n}$ transformed data.
\+ Analyses done on $\sqrt{n+1}$ transformed data.

TABLE 5 — *Effect of treatments on dry matter production at 210 days after planting (g).*

Type of cutting	*Floral buds*	*New stem*	*New leaves*	*Origina. cuttings*	*Mother leaves*	*Roots*	*Plant*
Normal propagation							
Single-node	0.03	0.44	0.79	0.42	0.75	0.98	3.41
Propagation under polyethylene cover							
Single-node	0.01	0.42	1.13	0.68	0.89	1.21	4.34
Double-node	0.02	0.56	1.39	1.21	1.50	1.90	6.58
Three-node	0.11	0.37	0.96	1.48	2.29	2.11	7.32
Four-node	0.20	0.30	0.86	1.60	2.47	2.12	7.55
Five-node	0.25	0.28	0.96	2.46	3.42	2.61	9.98
L.S.D. (P=0.05)	0.05	NS	NS	0.41	0.46	0.29	1. 25

At 210 days after planting 5-node cuttings had more floral buds with greater dry weight of floral buds and of roots. The multinodal cuttings had a greater number of new shoots compared to the single-node cuttings. New leaves were greater only in the 4 and 5-node cuttings (Tables 4 and 5).

DISCUSSION

The use of a sealed polyethylene cover to propagate cuttings has the advantage that it effects considerable saving of water and of labour. This method could be expected to promote faster vegetative growth due to the higher temperature and humidity that prevails within. The use of this method, however, involves an initial outlay on polyethylene which, with proper care, can be used repeatedly. The supports may be of any convenient material. The two sets of supports used in this study are those used in normal propagation and therefore, should not be considered as an additional expenditure.

Cuttings raised by the normal method need watering 3-4 times daily for the first two months, which involves the use of labour and a high requirement of water particularly during dry periods.

At the 90th day the single and 2-node cuttings that were under polyethylene for 60 days showed better growth than the cuttings with more nodes or those raised outside. They produced more roots that were longer and had a greater dry weight than the roots of the single-node cuttings raised outside. Green (1970) using cuttings up to 4 nodes showed that the rate of root and shoot growth increased markedly as node number increased from 1 - 3. Venkataramani (1957) showed that single-node cuttings under a polyethylene cover had a higher percentage of rooted cuttings than those raised by the normal method.

The 5-node cuttings showed greater mortality. Green (1970) found no difference in the percentage survival of cuttings up to 3 nodes which was confirmed in this study. Cuttings with 2 - 5 nodes produced greater number and weight of floral buds and weight of callus than the single-node cuttings raised by the two methods. It is known that flowering retards axillary shoot growth (Visser, 1962). It is conceivable that the flowering in multinodal cuttings may have been due to the greater amount of carbohydrate resources in them associated with the forcing growth conditions and comparatively slower root growth in the early stages in relation to the size of these cuttings. Although the multinodal cuttings produced less new shoot growth during this period, the plant dry weight was greater because of their large initial size and more leaves of larger area.

The second assessment was done at 210 days after planting when the plants are normally ready for field planting. At this stage there was no difference in total length of the new shoots amongst the treatments indicating that shoot growth in the multinodal cuttings had improved. There were more new shoots when the cuttings had more nodes but the individual shoots were smaller. However, since the plant and root weight of multinodal cuttings were greater, this may be a factor influencing its subsequent growth.

It has been suggested that when there is an excess of cutting material available multinodal cuttings could be propagated in order to raise standard-sized plants in a shorter time (Green, 1970). While propagation of single-node cuttings by the normal method appears to be the most convenient and efficient method for raising plants on a large scale it should be noted that the growth of plants raised under the polyethylene cover, either by single or multinodal cuttings was good and was

not inferior when the plants were ready for field planting. In fact the multinodal cuttings showed improved growth with time and their performance in the field needs to be evaluated.

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