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OBSERVATIONS ON ROOTS OF TEA PLANTS WITH ACTIVE AND DORMANT SHOOTS

S. Kulasegaram & A. Kathiravetpillai

Information on the pattern of growth, extent of lateral and downward spread and seasonal variation in the development of the root system of the tea plant has been limited to a few reports. It was shown that over 70% of the feeder roots of seedling tea in plucking under different conditions were present in the first 30 cm of soil irrespective of the cultural practices adopted (Eden 1940; Thomas 1944; Barua & Dutta 1961; Patavara 1968) but that the quantity of roots differed markedly under different cultural conditions (Eden 1940). There is evidence to indicate that, as a response to low temperature and other environmental conditions, the growth of the root system exhibits periodicity similar to that shown by tea shoots (Wight & Barua 1955; Barua & Dutta 1961; Patavara 1968). Voroncov (1956) observed a reduction of 12 to 13% in the weight of active roots between December and February in seedling tea of varying age. This reduction was more than compensated for by new growth in March/April and thereafter, the quantity of active roots increased. He also observed a change in the ratio of dead roots to total roots and considered the death of roots as a process comparable to leaf fall.

It must be emphasised that the above citations refer to growth cessation induced by unfavourably low temperatures. Growth resumes subsequently under more favourable temperatures. The available evidence seems to suggest a possible relationship between the growth of the root and that of the shoot.

Under Ceylon conditions, growth takes place throughout the year and the alternating phases of shoot growth and dormancy occur apparently independently of the environment and nutrition. The duration of the phases can, however, be influenced by both these factors. The present study sought to investigate whether there is a relationship between the growth of the root and that of the shoot in free-growing vegetatively-propagated (VP) tea plants at the nursery stage.

EXPERIMENTAL

The youngest roots of tea are succulent, and white in colour but become cream finally reddish-brown with age as they get ruberized. Root hairs are thought to be scanty or poorly developed. The white and cream coloured regions of the roots have been called 'feeder roots' and the reddish-brown regions 'extension roots' (Barua & Dutta 1961) in conformity with the terms used for apples (Rogers 1939).

Visual observations were made on the root systems of plants of Clone TRI 2043, 44 weeks old, with active and dormant terminal buds. The height from the ground to the position of the last dormant bud of the actively-growing plants was about the same as the height of the dormant plants. The actively-growing plants had more feeder roots than dormant plants of comparable height (Fig. 1).

An experiment was conducted on plants of Clone TRI 2024, 40 weeks old, and dormant for 12 weeks. The foliage of some of these plants was sprayed with a solution containing 0.75% ammonium phosphate, 0.75% zinc sulphate, 5 ppm kinetin and 25 ppm gibberellic acid. This solution was found from earlier work (unpublished) to break dormancy and increase shoot growth. The root systems of the dormant plants and of the sprayed plants were then examined after one month. The root system of sprayed plants showed greater quantity of roots compared with the unsprayed plants (Fig. 2).

An experiment was done to see if new growth of shoots above the last dormant bud in actively-growing plants could be related to root growth. For this purpose roots were separated into 'extension roots' and 'feeder roots'. Two sets of actively-growing, and dormant plants of Clone TRI 2043, about 72 weeks old, were selected so that the postion of the last dormant terminal bud of the actively-growing plant was comparable in height to that of the dormant plant.

There were 30 plants in each set with 15 active and 15 dormant plants. The roots of the plants were washed to remove soil and the total fresh weight determined after removing surface moisture, The feeder roots were then clipped off, floated in water, collected and the weight, number and total length determined.

Root and shoot growth measurements in relation to the active and dormant condition of the terminal shoot buds are presented in Table 1. For the two sets of plants in the active and dormant condition, the root system of the actively-growing plants showed increased development compared with that of the dormant plants. The number, length and fresh weight of feeder roots as well as that of the extension roots in the actively-growing plants were about double those of the dormant plants.

DISCUSSION

Information on the relationship between root and shoot growth in tea is lacking and the physiology of the entire plant during both the dormant period and the subsequent period of active growth has not been adequately studied. In a previous study (Kulasegaram 1969b) indications were obtained from grafting experiments that the root system of plants with active terminal buds and those with dormant terminal buds differed in their effects on shoot growth. Observations of the different components of the root system indicate that the actively-growing plant had more roots than the dormant plants. This was also shown in dormant plants which were given foliar sprays of nutrients and hormones. It has been shown earlier that hormones (gibberellic acid and kinetin) applied to foliage were effective in inducing the growth of dormant buds (Kulasegaram 1969a) but no observations were made on the roots of such plants. Results from the present study showed that new shoot growth was always associated with additional feeder root growth, suggesting a possible relationship between new growth of the shoot and feeder root growth.

Attempts made to correlate new growth of the shoot with number of feeder roots and length of feeder roots respectively showed that the correlation coefficients obtained were just short of significance at the 5% level of probability (Kulasegaram & Kathiravetpillai 1972). The active plant also had more extension roots as well (Table 1). Shoot growth and root growth appear to take place at or about the same time. With growth of the shoot it is possible that the rate of maturation and proliferation of roots increases. In the dormant plant some of the roots may die. This would seem to be supported by observations that in dormant plants there are in fact roots showing signs of death. This may perhaps explain why the plant with the active terminal bud has more extension as well as feeder roots compared with the dormant plant. Further study will be necessary to shed light on these and related problems.

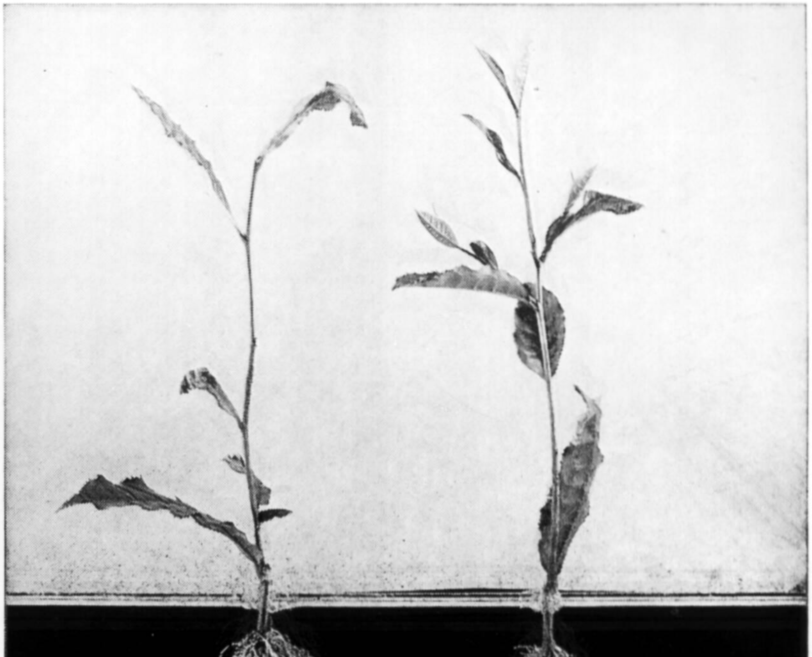

FIG. 1—*Relationship between terminal bud condition and root growth of* **44** ***week old*** *plants of clone TRI* 2043

Left — *Plant with dormant bud*
Right — *Plant with active bud*

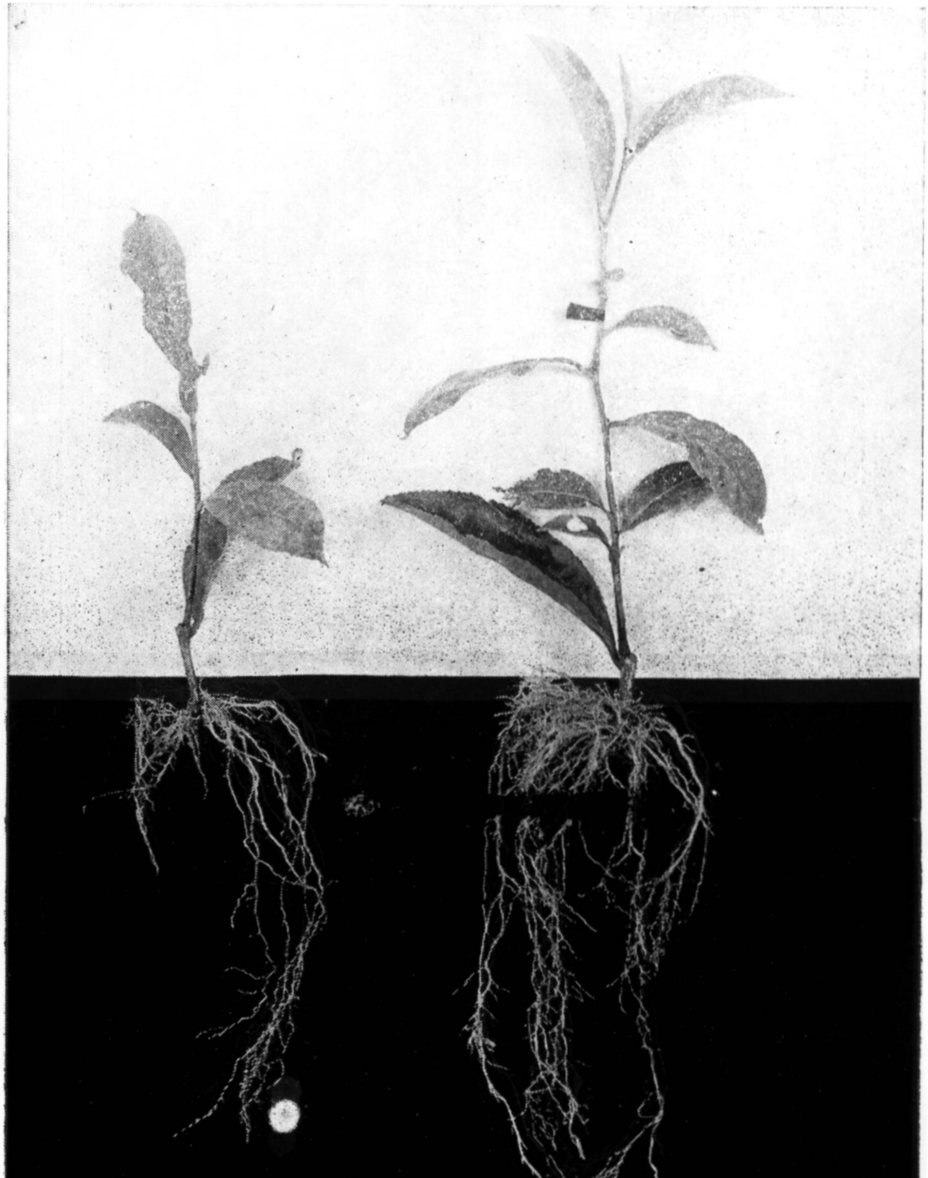

FIG. 2—*Relationship between terminal bud condition and root growth of initially dormant 40 week old plants of clone TRI 2024.*

Left — *Untreated control with dormant terminal bud.*

Right — *Plant treated on 21st August, 1969 with a mixture of 0.75% ammonium phosphate, 0.75 zinc sulphate, 5 ppm kinetin and 25 ppm gibberellic acid. Length of shoot above tape indicates new growth made since treatment when plants were photographed on 27th September, 1969.*

TABLE 1—*Relationship between root and shoot growth in Clone TRI* 2043

	Mean of 15 plants			
	Set 1		Set 2	
	Dormant	Active	Dormant	Active
Height to point of last dormant bud (cm)	17.0±0.5	16.0±0.9	25.0±0.8	29.0±1.4
New growth (cm)	—	6.0±0.1	—	4.0±0.8
Fresh weight of old roots (g)	2.8±0.2	4.2±0.3	4.3±0.3	8.7±1.1
Fresh weight of active feeder roots (g)	0.06±0.01	0.1±0.02	0.03±0.01	0.1±0.02
Length of active feeder roots (cm)	31.0±6.5	62.0±8.2	—	—
No. of active feeder roots	20.8±4.1	44.5±6.6	—	—

Cause and effect relationship in root/shoot growth are generally difficult to establish as each is dependent on the other for factors which are necessary for its growth. In the root system obviously the feeder roots must play a very important role. The feeder roots of tea are supposedly able to absorb water and nutrients over the entire length although the capacity for absorption may diminish in the more mature cream coloured regions (Wight & Barua 1955). The roots are important in the synthesis of gibberellins and kinins (Carr, Reid & Skene 1964; Kende 1965; Sitton, Richmond & Vaadia 1967) both of which are effective in breaking dormancy of buds in tea shoots. Gibberellin activity has been detected in the xylem exudate of tea plants (Selvendran 1970) but no information is as yet available on the kinins in tea.

If tea roots exhibit periodicity similar to that shown by tea shoots, both absorption of nutrients and synthesis of growth factors will necessarily be affected. While the root system depends on the shoot for metabolites and additional factors for growth, it appears that the root system also has regulatory influences on shoot growth.

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