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SITE OF BIOSYNTHESIS AND TRANSLOCATION OF THEANINE IN THE TEA PLANT

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Theanine is the predominant amino-acid of tea, and accounts for about 30% of the total amino-acids present in black tea. It is the ethylamide of L-glutamic acid, and is known to play an important role in determining the quality of green tea. It is also a constituent of the coloured thearubigin complex of black tea (Perera 1972). Extensive work in Japan, using homogenates of tea seedlings (Sasaoka, Kito and Inagaki 1963) showed that theanine is formed by the amidation of L-glutamic acid by ethylamine, and the present investigation provides evidence that theanine is biosynthesized in the root, and then translocated to the developing shoot tip. Previous work (Sanderson & Sivapalan 1966) had indicated that theanine was not biosynthesized in tea leaves, and also that the carbon assimilated by mature leaves was translocated out of the leaves into the roots and growing points. In this study, mature leaves at the lower end of tea plants (TRI 2023, eight months old) were fed with radioactive carbon dioxide ($^{14}CO_2$), and the label followed autoradiographically. The plants were assessed for radioactivity 1, 2, 3 and 4 days after the $^{14}CO_2$ had been fed to the mature leaves, and the pictures obtained (Fig 1-4), showed that the products formed from $^{14}CO_2$ was directed to the roots, and translocated therefrom to the developing shoot tip. Analyses showed that no radioactive theanine was present in the mature leaf which had been treated with $^{14}CO_2$, but that radioactive theanine was detectable, first in the roots, and then in the growing shoot tip, but not anywhere else.

The results indicate that

1—The precursors of theanine are made in the leaf, from where they are translocated to the root.

2—Biosynthesis of theanine occurs in the root.

3—Theanine is translocated from the root to the developing shoot tip.

The occurrence of theanine in the tea is unique, as it has not been detected in any other green plant, the only other report of its presence being in the mushroom, *Xerocomus badius*. The high level of this amino acid in tea, together with its rapid translocation to the growing shoot tip, and importance in determining the quality of green tea, would suggest that it plays a specific and important role in the overall characteristics of tea.

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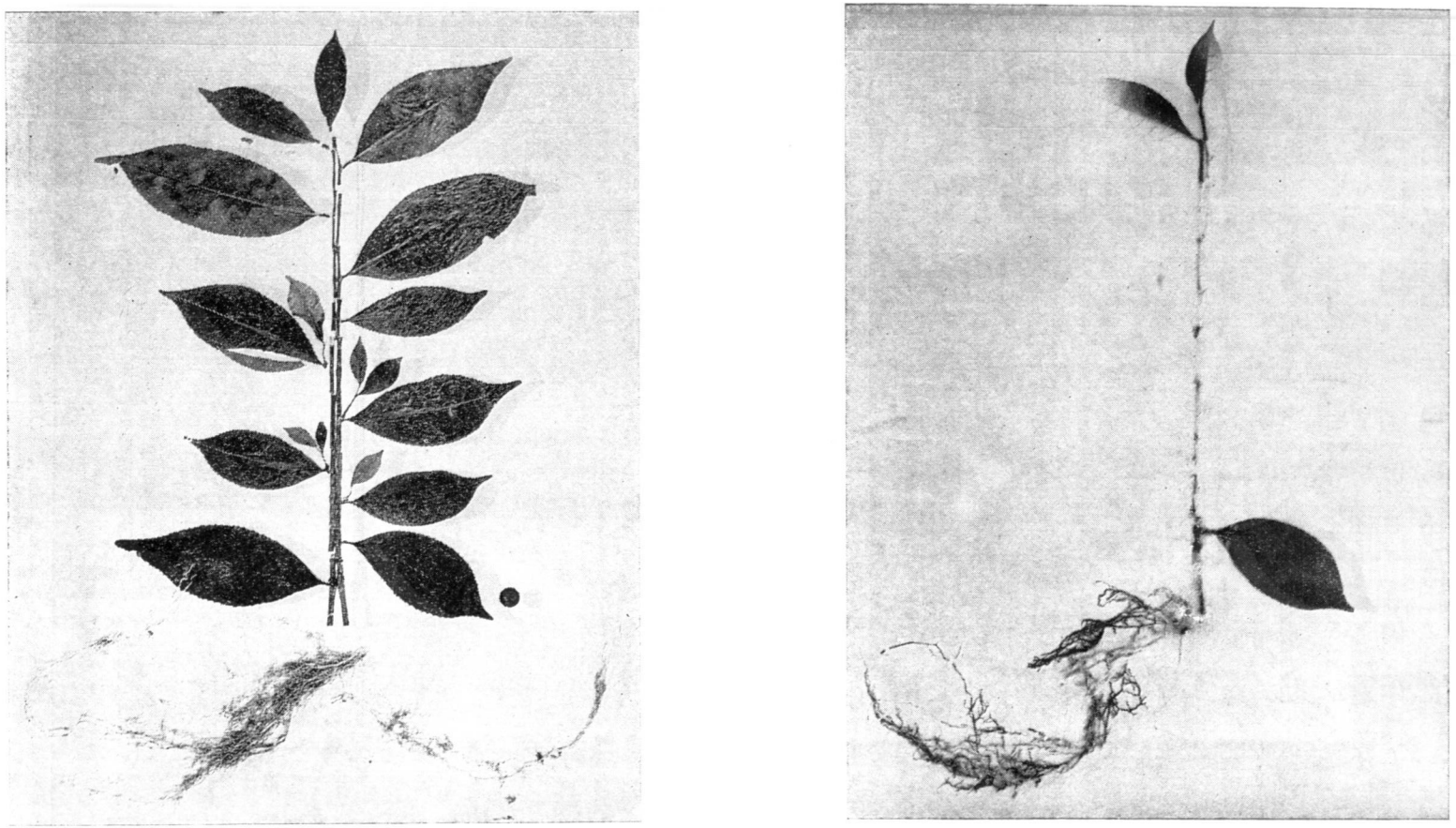

FIG. 1—*Left - Photograph of tea shoot and roots taken one day after feeding leaf marked* ● *with* $^{14}CO_2$
Right - Autoradiogram of same showing translocation of theanine from root to developing shoot one day after feeding.

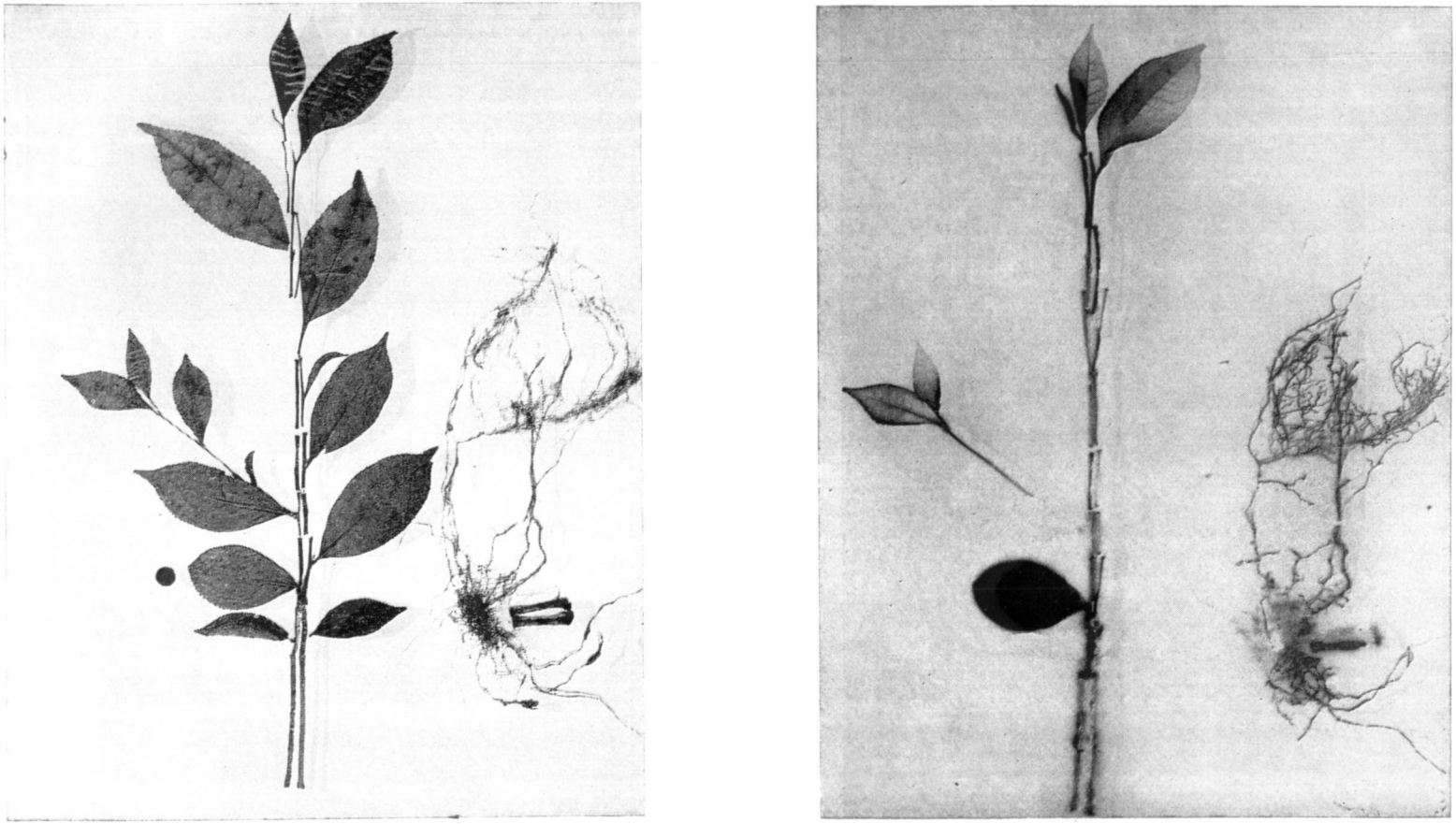

FIG. 2—*Left - Photograph of tea shoot and roots taken two days after feeding leaf marked* ● *with* $^{14}CO_2$
Right - Autoradiogram of same showing translocation of theanine from root to developing shoot two days after feeding.

FIG. 3—*Left* - *Photograph of tea shoot and roots taken three days after feeding leaf marked* ● *with* $^{14}CO_2$
Right - *Autoradiogram of same showing translocation of theanine from root to developing shoot three days after feeding.*

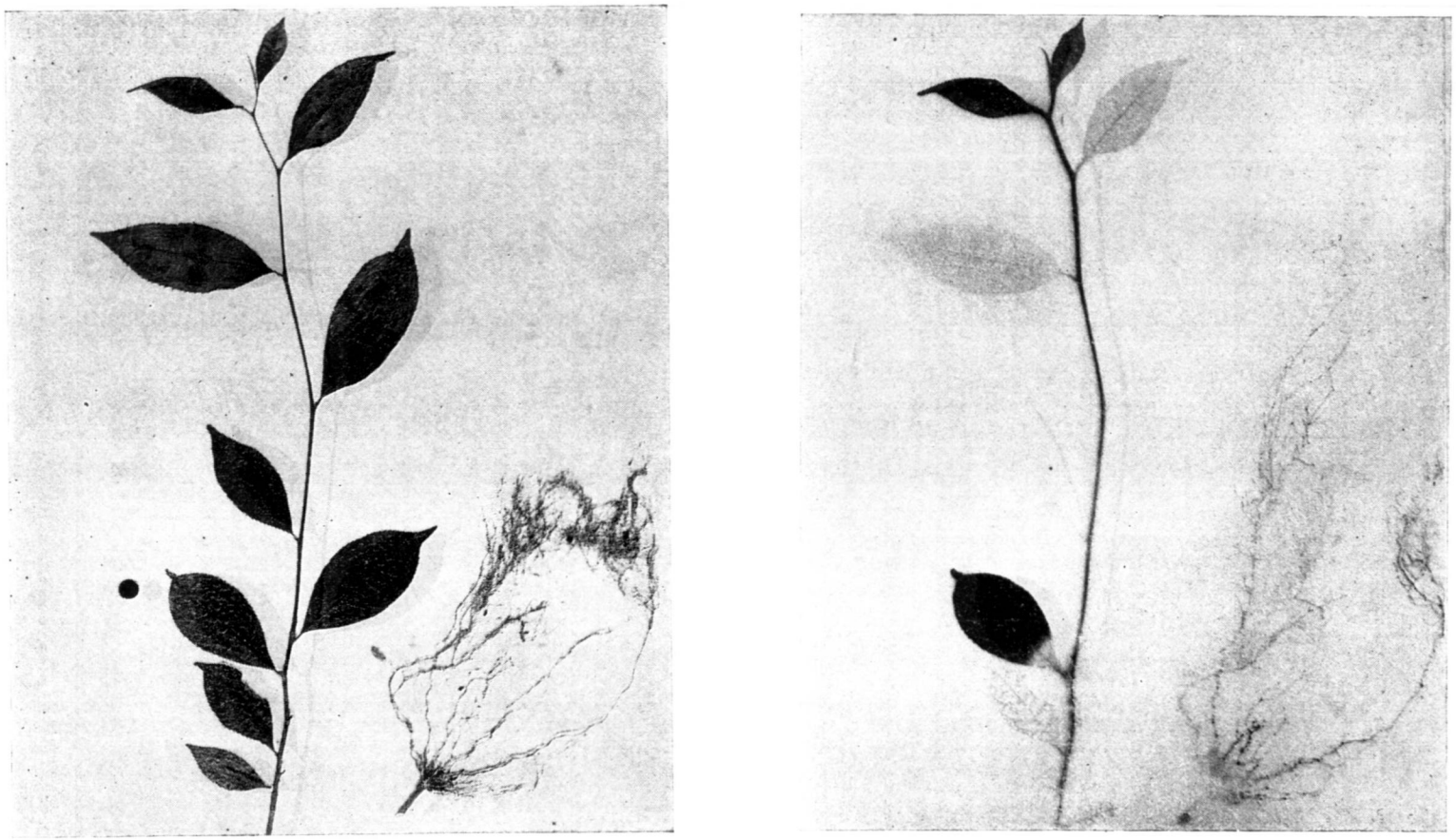

FIG. 4—*Left - Photograph of tea shoot and roots taken four days after feeding leaf marked* ● *with* $^{14}CO_2$
Right - Autoradiogram of same showing translocation of theanine from root to developing shoot four days after feeding.