Gibberellin regulation of root growth and flowering in tea plant (*Camellia sinensis* L.)

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ABSTRACT

We investigated the growth-regulating functions of GA in the adventitious roots (AdR) of tea plants cultivated in hydroponics. Anc suppressed root growth and promoted thickening of AdR in the elongation zone. Development of suberin layer in root exodermal cell walls was promoted by Anc, but delayed by GA. Anc also promoted flower bud formation, and turned all new buds into flower buds in the typical case. All these effects of Anc were suppressed by the exogenously applied GA in hydroponics. We also investigated sugar composition of cell walls. By comparing soil-, hydroponics- and mist-cultured AdR and GA-starved (Anc-treated) AdR, it was found that the most apical part of the roots (0-2 mm behind root tip) responded most remarkably to the growth conditions. Mist-cultured roots, under the least mechanical stress, had the softest cell walls with the highest content of pectin and with the lowest content of cellulose. Gradient of cellulose content along root axis in GA-starved mist-cultured roots were similar to that of soil-grown roots with slowest growth rate. These results show that GA regulates also the root growth of woody plant with changes in cell wall components.
KEY WORDS: cell wall, exodermis suberinization, flowering, gibberellin, root growth, tea root

INTRODUCTION

Gibberellin (GA), a shoot-growth-promoting hormone, regulates also root growth of herbaceous plants (Tanimoto, 1987). However, we have limited information of GA function in the roots of woody plants (Tanimoto, 2002: 2005). By using Ancymidol (Anc), an inhibitor of GA biosynthesis, we found the growth-regulating functions of GA in the adventitious roots (AdR) of tea plants for the first time (Tanimoto *et al*., 2004). Recent advances in cell-wall analyses of AdR cultivated with mist hydroponics will also be presented in this paper.

MATERIALS AND METHODS

Cuttings of tea plants, *Camellia sinensis* L. cv. Yabukita, were grown under fluorescent light in hydroponics containing an inhibitor of gibberellin biosynthesis, 10 μM ancymidol (Anc), with or without 1 μM gibberellin A_3(GA). The apical elongating zone of secondary adventitious roots (AdR) were either observed by microscopically or excised for the analysis of cell wall

polysaccharides. For staining suberin layer, fluorol yellow 088(Sigma) in lactic acid was used for free-hand sections (Lux *et al*., 2005). Cell wall sugars were analyzed by the method for pea roots (Tanimoto and Huber, 1997) .

RESULTS AND DISCUSSION

Anc suppressed root growth and promoted thickening of AdR in the elongation zone (Fig. 1) with increased diameter of cortical cells, whereas GA keeps roots long and slender. Anc-treated roots were short but produced dense laterals. Development of suberin layer in root exodermal cell walls was promoted by Anc, but delayed by GA. Anc also promoted flower bud formation, and turned all new buds into flower buds in the typical case. All these effects of Anc were canceled by the exogenously applied GA in hydroponics. We also investigated polysaccharide composition of cell walls to provide fundamental data of growing cell walls of AdR.

By comparing soil-, hydroponics- and mist-cultured AdR and GA-starved (Anc-treated) AdR, it was found that the most apical part of the roots (0-2 mm behind root tip) responded most remarkably to the growth conditions. Mist-cultured roots, under the least mechanical stress, had the softest cell walls with the highest content of pectin and with the lowest content of cellulose. Gradient of cellulose content along root axis in GA-starved mist-cultured roots were similar to that of soil-grown roots with slowest growth rate. These results show that GA regulates also the root growth of woody plant with changes in cell wall components.

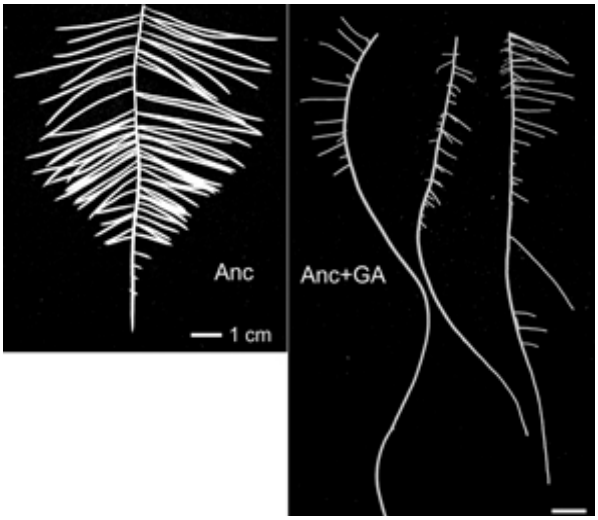

Figure 1. Adventitious roots of tea, treated for 60 days by 10 μM Anc with or without 1 μM GA.

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