Modifications of xyloglucan metabolism in azuki bean epicotyls under hypergravity conditions

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Gravity resistance is a response that enables plants to develop against the gravitational force. We have examined the mechanism of gravity-induced mechanical resistance using hypergravity conditions produced by centrifugation. Under hypergravity conditions, plants make the cell wall of shoots mechanically rigid to resist the gravitational force. In dicotyledonous plants, xyloglucans are the only cell wall polysaccharides, whose molecular size was increased by the gravitational force, suggesting that xyloglucans act as anti-gravitational polysaccharides. The molecular size of cell wall polysaccharides is determined as a balance between the synthesis and the depolymerization. In the present study, we examined the effects of hypergravity on both processes of xyloglucan metabolisms. Azuki bean cuttings were incubated with [6-^{3}H]-L-fucose, and the levels and the molecular size of synthesized xyloglucans were investigated in the upper growing regions of epicotyls. The amounts of radioactivity incorporated into xyloglucan fraction increased during incubation, irrespective of the gravity conditions. ^{3}H-Xyloglucans were eluted in the higher molecular mass regions than xyloglucans already present in the cell wall, which were detected by the iodine method. Hypergravity at 300 g did not influence the molecular size of newly deposited xyloglucans. Thus, the process of xyloglucan synthesis was not modified by the gravitational force. ^{3}H-Xyloglucans obtained from epicotyls grown at 1 g were shifted to the low molecular mass regions during the incubation period, which was inhibited by hypergravity. These results indicate that xyloglucans were deposited into the cell wall as large molecules but they were then depolymerized in the cell wall, and that the inhibition of the depolymerization is involved in the increase in the molecular size of xyloglucans under hypergravity conditions.