P-38

The effect of paclobutrazole on the rooting of azuki bean (*Vigna angularis*) cuttings

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1. Introduction

Triazole plant growth regulators, such as paclobutrazole (PB), are potent inhibitors of gibberellin biosynthesis (Davis et al.,1988). They include a variety of morphological and biochemical responses in plants, including retarded shoot elongation, stimulated rooting and protection from various environmental stresses (Kraus and Fletcher,1994). Most of these effects have been demonstrated for shoot tissues, but the effects of PB on roots have not received much attention, particularly the physiological and biochemical aspects (Wang and Lin,1992).

Rooting of cuttings is determined by a delicate balance between stimulatory and inhibitory endogenous factors. Auxius are well documented as dominating the rooting process of cuttings (Davis and Haissig,1990). It has been demonstrated that various retardants of the triazole group stimulate rooting of cuttings (Davis and Sankhla,1988) and are also effective in inducing adventitious root formation (Geneve,1990). The mechanism by which growth retardants stimulate adventitious root formation is still unclear, but several possibilities have been suggested. The interaction of PB and indole-3-butyric acid (IBA) has recently been reported to be very promotive to the rooting of cuttings (Pan and Zhao,1994). This interaction may be a clue to understanding of how PB improve rooting.

The present paper investigated the enhancing effect of PB on IBA stimulation of rooting of cuttings and attempted to characterize the interaction of PB and IBA to determine the involvement of PB in some sink-source processes which occur during rooting of azuki bean cuttings.

2. Materials and methods

Seeds of azuki bean (*Vigna augularis*) were soaked in aerated water for 24 h and then sown in moistened vermiculite. The swollen seeds were allowed to germinate for 3 days in darkness at 26℃. After germination, the seedlings were placed in growth chamber at 26℃ with an 18-h photoperiod at 200 μmol $m^{-2}s^{-1}$. Cuttings were made from 7-day-old seedlings. A cutting consisted of the terminal bud, the two primary leaves, epicotyl and 4 ㎝ of hypocotyl. Four cuttings were placed in a

25 ml vial containing 10 ml distilled water or test solution. Rooting was performed at 26℃ with an 18-h photoperiod and an irradiance of 200 μmol · m^{-2} · s^{-1}. The number of visible roots and the epocotyl growth were determined 7 days after the cutting were made. The cuttings were treated with 5 mg l^{-1} PB, alone or together with 20 mg l^{-1} IBA. After 6 h of treatment , the cuttings were transferred to distilled water. The cutting was excised into 4 sections and extracted according to the methods described by Wiesman et al. (1988).

3. Results and discussion

The application of PB to azuki bean seedlings increased the number of roots per cutting from about 8 in the control to 20, whereas GA_3 reduced it to 4 roots per cutting. Combined treatment of PB and IBA markedly increased the number of roots formed. Together with GA_3, IBA significantly reduced rooting at all tested concentrations.

PB is most promotive to root formation when applied together with IBA, immediately after the preparation of the cuttings and that it mainly affects the cell-division phase of the adventitious root meristem (Pan and Zhao, 1994). Sucrose application on rooting had no promotive effect, however, the addition of sucrose to LBA-treated cuttings significantly increased the number of roots per cutting. Sucrose plus IBA did not increase root formation more than PB alone. A combined treatment that included IBA, PB and sucrose gave similar results to IBA plus PB. The number of roots per cutting in defoliated cuttings was several times lower than in intact ones, however, the influence of all treatments on rooting was similar in both types of cuttings. PB stimulated rooting, whereas GA_3 inhibited it. The combined treatment of PB and IBA yielded the highest number of roots per cutting, while rooting in cuttings receiving IBA plus GA_3, was significantly reduced.

During rooting, epicotyl growth was significantly stimulated by GA_3. Application of PB alone, reduced epicotyl growth below that of water-treated control, in direct proportion to the concentrations applied and stimulated rooting. The results of the present study demonstrate the enhancing influence of PB on IBA stimulation of rooting of the cuttings. It is suggested that PB may affect the rate of metabolism of IBA during rooting (Wiesman and Riov, 1994). PB probably increase the sink capacity for assimulates in the base of cuttings, thus enhancing the root induction potential of IBA.

4. Abstract

PB only slightly the rooting of azuki bean cuttings but, interestingly, the number of adventitious roots formed was dramatically increased when PB was used together

with IBA. Application of PB in the first phase of root formation, when root initials were induced, caused the greatest enhancement of the promtive effect of IBA on rooting. Application of sucrose enhanced the effect of IBA. The patterns of the effects of PB and IBA, separately and together, on rooting were similar in defoliated and intact cuttings, however, the number of roots was much lower in the defoliated cuttings, which lacked a source of assimilates. The results demonstrated the enhancing influence of PB on IBA stimulation of the rooting of azuki bean cuttings and PB partially contribute to the enhancement of the rooting-promotive effect of IBA.

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