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LOCALIZED EFFECT OF 1, 3-DIAMINOPROPANE AND BENZYLADENINE ON CHLOROPHYLL LOSS IN SOYBEAN PRIMARY LEAVES

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Abstract

The effect of polyamines, 1, 3-diaminopropane and benzyladenine on the chlorophyll loss of soybean primary leaves was compared. Polyamines, 1, 3-diaminopropane and benzyladenine all retarded the chlorophyll loss at specific areas in primary leaves, though in different patterns. The differential patterns in retarding chlorophyll loss by polyamines, 1, 3-diaminopropane and benzyladenine were discussed in terms of transport capacity. Similar to benzyladenine, both polyamines and 1, 3-diaminopropane showed mobilization effect in primary leaves.

Key words: Benzyladenine; chlorophyll loss; 1, 3-diaminopropane; localized effect; mobilization effect; polyamines.

Introduction

Polyamines have been reported to retard leaf senescence (Altman, 1982; Cheng and Kao 1983; Cheng *et al.*, 1984; Cohen *et al.*, 1979; Kaur-Sawhney and Galston 1979). Endogenous 1, 3-diaminopropane (DAP)[2], an oxidation product of polyamines, was found to decrease in attached oat leaves with increasing age of seedlings and in excised leaves with increasing time of dark incubation, suggesting that DAP, like polyamines, may be involved in the control of senescence (Kaur-Sawhney *et al.*, 1982). Recent work of Shih *et al.* (1982) and Cheng *et al.* (1984) demonstrated that exogenous application of DAP also retarded senescence of excised leaves. Previous work of this laboratory showed that the retardation of chlorophyll (Chl) loss by polyamines was mainly localized around the cut edges of detached leaves or near large veins of soybean primary leaves (Cheng and Kao, 1983). Therefore, it was of

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[2] Abbreviations: BA, benzyladenine; Chl, chlorophyll; DAP, 1, 3-diaminopropane; Sd, spermidine; Sm, spermine.

interest to know whether the retardation of Chl loss by DAP also shows localized effect. Our previous work showed that those parts of leaves received polyamines accelerated the senescence of those parts of leaves received no polyamines in soybean primary leaves (Cheng and Kao, 1983). We suggested that the polyamine effect was quite similar to that of cytokinins. Therefore, the comparison between the effect of cytokinins and polyamines on senescence in soybean primary leaves was also included in this communication.

Materials and Methods

Soybean (*Glycine max* Merr. cv. Tainung 4) seeds were grown in pot (2 dm^2) containing sandy loam in a greenhouse controlled at 30°C for day and 25°C for night. At 12 days after planting, the primary leaves were fully grown and excised. The petiole of excised primary leaf was immersed in cotton ball moistened with distilled water or test solution. Chl loss in primary leaf was judged by visual observation at 66 h of dark incubation at 30°C.

Results

Figure 1 shows the effect of Sd, Sm and DAP on Chl loss in soybean primary leaves. Significant Chl loss in water-treated soybean primary leaves was clearly shown along the vein (light areas in Fig. 1). In Sd-, Sm- and DAP-treated primary leaves, Chl became more green (dark area in Fig. 1) along large veins and leaf margin. It seems that DAP, like polyamines, shows localized effect in the retardation of Chl loss in soybean primary leaves. From Fig. 1, it was also found that those areas away from large veins and leaf margin usually became more yellow (light areas in Fig. 1) as compared with the control.

For BA-treated leaves, those areas along and around large veins clearly showed

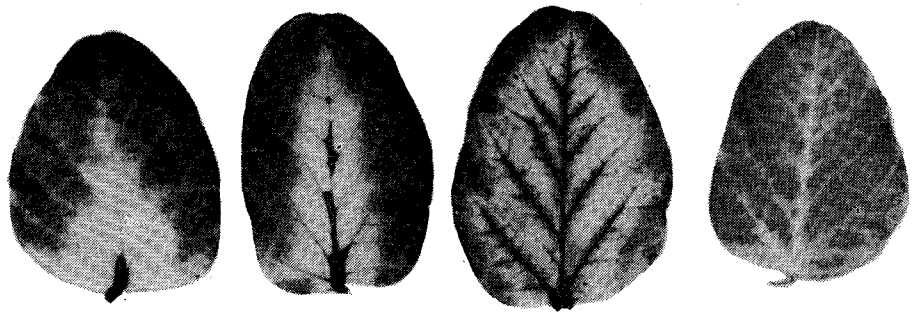

Fig. 1. The effect of Sd, Sm and DAP on the Chl loss of soybean leaves. The concentration of Sd, Sm or DAP was 10 mM.

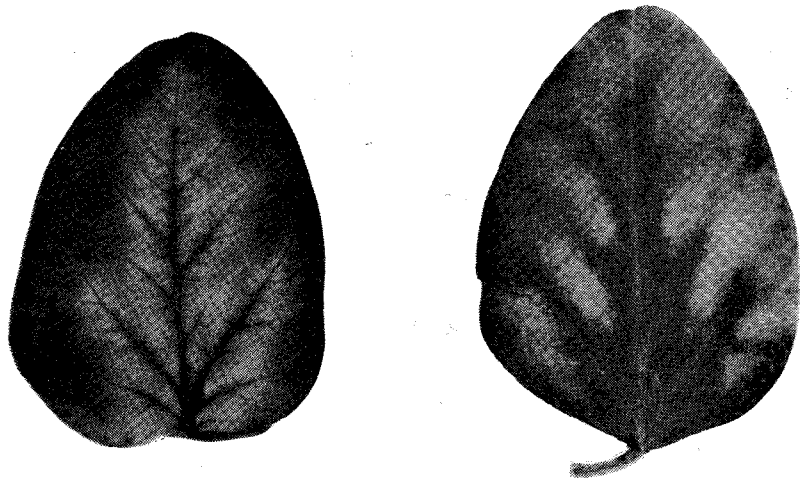

Fig. 2. Comparison of the effect of BA and Sm on the Chl loss of soybean primary leaves. The concentrations of BA and Sm were 0.1 mM and 10 mM, respectively.

the retardation effect of Chl loss (dark areas in Fig. 2) and those areas away from large veins showed the acceleration effect of Chl loss (light areas in Fig. 2).

Discussion

Polyamines have been reported to retard leaf senescence (Altman, 1982; Cohen *et al.*, 1979; Kaur-Sawhney and Galston, 1979; Kaur-Sawhney *et al.*, 1982). The present work showed that the retardation effect of Chl loss by polyamines and DAP occurred mainly at specific areas in primary leaves, though in different patterns. The localized effect might be caused mainly by the different transport capacity of polyamines and DAP in leaf cells. Recently, Young and Galston (1983) investigated the possible transport of polyamines in etiolated pea plants. They found that polyamines were not transported *in vivo*. From our results, it seems that both polyamines and DAP can be transported in large veins and Sm is poorly transported in leaf cells when compared with Sd and DAP. This would explain why Sm retarded Chl loss mainly at large veins, whereas both Sd and DAP retarded Chl loss mainly at leaf margin. The differential transport capacity of polyamines and DAP is not unexpected if the cation nature is considered. DAP and Sd are able to form divalent cation and trivalent cation, respectively, whereas Sm is able to form tetravalent cation at physiological pH (Kaur-Sawhney and Galtson, 1979). The localized effect of BA in retarding Chl loss is also evident though in a different pattern as in polyamines and DAP, suggesting that the transport capacity of BA is also restricted in leaf cells.

Leopold and Kawase (1964) found that treatment of one leaf with cytokinin

hastened the senescence of other untreated bean leaves. The present results showed that those areas away from large veins and leaf margin usually showed an acceleration effect of Chl loss when compared with the control. This seems to suggest that those areas receiving polyamines, DAP or BA cause mobilization of substances, which are presumably essential to retard Chl loss, from those areas away from large veins and leaf margin. In other words, polyamines, DAP and BA appear to creat a new source-sink relationship.

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1,3-Diaminopropane 與 Benzyladenine 對大豆初生葉葉綠素消失之局部效應

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本研究主要係比較 polyamines, 1,3-diaminopropane 與 benzyladenine 對大豆初生葉葉綠素消失之效應。Polyamines, 1,3-diaminopropane 與 benzyladenine 都可延緩大豆初葉特定部位葉綠素之消失，但這三類物質對葉綠素消失之型式不同。文中以這三類物質在葉片中運移之能力來討論爲什麼會有不類反應型式。Polyamines 與 1,3-diaminopropane 類似 benzyladenine 都具有移動效應 (mobilization effect)。