The Shoot Plays an Important Role in Potassium Deficiency-induced Senescence in Cotton (*Gossypium hirsutum* L.) Seedlings

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Introduction

Premature senescence induced by potassium (K) deficiency has become a major restriction in cotton (*Gossypium hirsutum* L.) production recent years. Despite the large number of reports indicated that root is more important than shoot in regulating leaf senescence (Dong et al., 2008), there have been some literatures stated that leaf senescence was mainly controlled by shoot (Ookawa et al., 2005). The objectives of this study are to investigate the effects of shoot and root on K-induced senescence in cotton seedlings by grafting and to explore the underlying mechanisms involved cytokinins (CTKs) and abscisic acid (ABA).

Methods

Plant material and culture conditions

Experiment was conducted in growth chamber, early-senescence cultivar CCRI41 and late-senescence cultivar SCRC22 were used as material. Surface sterilized seeds were germinated on sand bed for 3 d and then transferred to plastic pots filled with modified Hoagland's solution. Seedling senescence was induced by K deficiency (0.03 mM). Plants were harvested at 6-7 leaf stage (about 35 d after transferring).

Grafting

I-type Grafts: one scion (at cotyledonary stage) grafted onto one rootstock (at 1-leaf stage) at cotyledonary node by wedge-grafting technique, denoted as scion /rootstock.

Y-type Grafts: two wedge-cut scions (cotyledonary stage) grafted onto one rootstock (at 1-leaf stage) at cotyledonary node, denoted as (scion-scion)/rootstock

A-type Grafts: one scion (at 1-leaf stage) grafted onto two rootstocks (at 1-leaf stage) at hypocotyl, denoted as scion/(rootstock- rootstock).

Results

Preliminary study indicated that grafting does not influence the development and senescence of cotton seedlings.

It was observed that CCRI41 scions maintained early senescence property (despite improved by SCRC22 rootstock to a less extent) in I-, A- and Y-type grafts, with lower level of chlorophyll, soluble protein and photosynthetic rate in the youngest fully-expanded leaf (Fig. 1), regardless of rootstock genotypes. Also, SCRC22 scions maintained late senescence property (despite impacted by CCRI41 rootstock to a less extent) in all I-, A- and Y-type grafts.

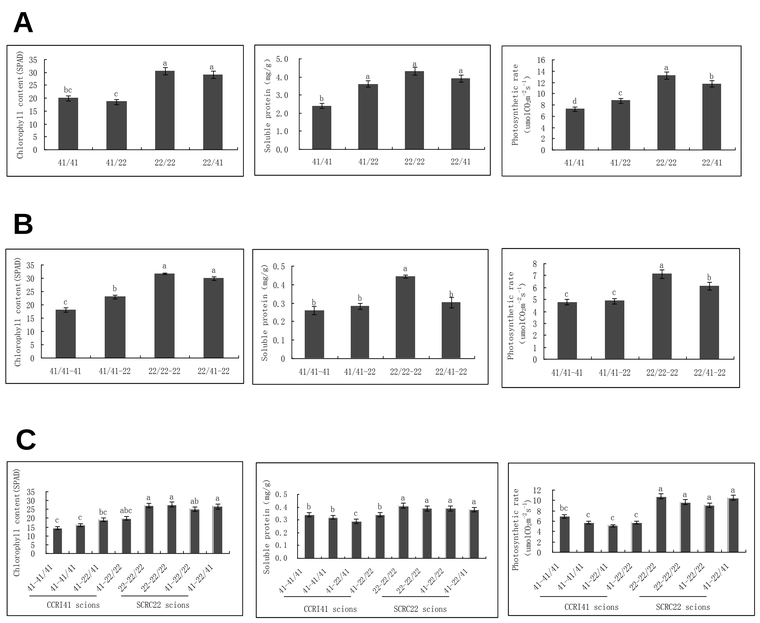

Fig. 1. Chlorophyll content, soluble protein and photosynthetic rate of the youngest fully-expanded leaf in (A) I-, (B) A- and (C) Y-type grafted plant. Different letters at the top of each bars indicate significant differences (Duncan's significant difference test, P <0.05).

Furthermore, cytokinins (zeatin + zeatin riboside, dihydrozeatin + dihydrozeatin riboside，and isopentenyl + isopentenyl adenine) and abscisic acid (ABA) in the youngest fully-expanded leaves and xylem exudate collected either under or over graft union were determined. The results indicated that cytokinins concentration in CCRI41 leaves were always lower than those in SCRC22 leaves, independent of rootstock genotypes and grafts type (Fig. 2). In contrast, ABA concentration in CCRI41 leaves were higher than those in SCRC22 leaves (Fig.3).

Discussion

The present study suggested that shoot plays an important role in K deficiency-induced senescence in cotton seedlings, which was probably owed to long-distance feedback signals from shoot to regulate synthesis and transport of cytokinins and ABA in root.

Additionally, when cytokinins and ABA level were compared between leaves and xylem exudate (both under and over graft union), it appears that the site for feedback regulation located above the graft union (data not shown).

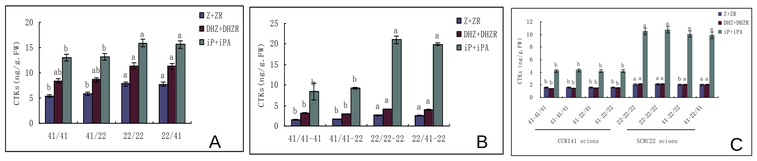

Fig. 2. Cytokinins (Z + ZR, DHZ + DHZR, iP + iPA) contents in the youngest fully-expanded leaf of (A) I-, (B) A- and (C) Y-type grafted plant. Different letters at the top of each same colour bars indicate significant differences (Duncan's significant difference test, P <0.05).

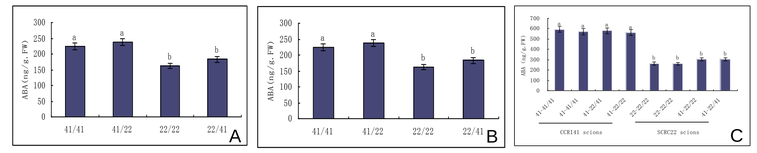

Fig. 3. ABA contents in the youngest fully-expanded leaf of (A) I-, (B) A- and (C) Y-type grafted plants. Different letters at the top of each bars indicate significant differences (Duncan's significant difference test, P <0.05).

Acknowledgements

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