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Disordered Distribution of Amynoplasts and High Ga Content Related To Negative Gravitropic Growth of Peanut Gynophore in MLO-Infected Plants

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Abstract

Peanut, *Arachis hypogaea* L., is well known as 'Aerial Flowers and Subterranean Fruit' (Smith 1950). Due to the subterranean fructification, after flowering, the gravitropic gynophore elongation and penetration into the soil are essential for the fruiting in peanut. During the event, gravity is related to the orientation of gynophore growth. Recently, however, we found the gynophore grows upward in mycoplasma-like organisms (MLO) infected peanut plants. Previous studies suggested that amyloplasts and plant endogenous hormones were involved in plant gravitropism. To explain the negative gravitropism of the MLO-infected gynophores, anatomical structure and hormones (IAA, GA and ABA) were analyzed for the gynophores from infected and uninfected peanut plants. Our results show that MLO-infected gynophores showed no amyloplast sedimentation, decrease in number and mass of amyloplasts and a higher GA content than uninfected gynophores. The abnormal amyloplast location in statocytes might be the reason to keep the MLO-infected gynophores straight. Results obtained in this study hint that high GA content promoted the expression of the α-amylases gene, which resulted in the degradation of starch, contributing to decrease the amyloplast number. The decreased number and random displacement of amyloplasts lead to the gynophores growing upward vertically. Taken all together, starch might acts as the booster of amyloplasts sedimentation and GA mediated gravity response in plants by regulating the expression of α-amylases.

Keywords: Peanut; Gynophore; Gravitropicsm; Amynoplasts; Sediment gibberellin

Introduction

Peanut produces aerial flowers but buries its developing seeds into the ground by means of a specialized organ, the gynophore. Gravitropism is the unusual character of gynophore as reproductive organ. Recently, we found the gynophores grow directly upward in mycoplasma-like organisms (MLO) infected peanut plants. To explain the negative gravitropism of the MLO-infected gynophores, gynophores from both infected and uninfected peanut plants were collected; anatomical structure and auxins content of these gynophores were analyzed. This study will also provide an additional data to research of the gynophores gravitropicsm [1].

Experiment

About 500 young gynophores tips from MLO infected (treatment) and un-infected plants (control) were collected, sterilized and then *in vitro* planted with tip point upward in MS medium (no hormone) respectively. The gynophore of both treatment and control group were obtained after 0, 6 and 12h cultured *in vitro* and subjected to anatomical analysis according to Moctezuma and Feldman method and anxins analysis by HPLC according to Yin's method.

Results

As shown in figure 1, tips of gynophore from un-infected plants (control) started to curve down at 6 h, and the curvature increased and progressed to 90°C at 12 h. but the gynophore from MLO-infected plants showed negative gravitropic growth, kept upward growth direction. To compare distribution of amynoplasts, the curve part (gravitational set point angle parts) of control gynophores and the corresponding parts of MLO-infected gynophore were dissected for microscope observation respectively. The results showed that there were distinguished differences of amyloplast arrangement between the longitudinal sections of control gynophores MLO-infected gynophore (Figure 2). The amyloplast grains of control gynophore moved to side surface of the starch sheath cells in the direction of bending down and sediment to the lowermost surface of the starch sheath cell in the direction of the gravity vector, but amyloplast grains of MLO-infected showed disordered distribution. The content of GA, IAA and ABA were compared. The results (Table 1) showed that there are not significantly differences in IAA and ABA between control gynophores and MLO-infected gynophores. But GA content showed significantly difference. GA content (79172.9 μg/g) in MLO-infected gynophores were significantly higher than that of un-infected gynophores, (2102.1 μg/ g). The GA content of un-infected gynophores *in vitro* culture is 2102.1g/ g, increased 65% at 6 h, and decreased to 2669.1 μg/ g at 12 h. While in MLO-infected gynophores, the GA content decreased

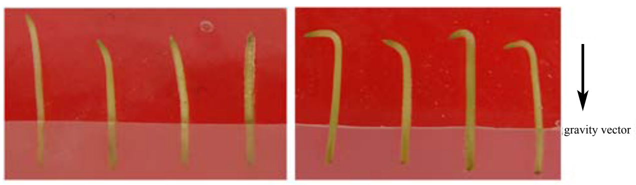

Figure 1: Gynophore from MLO-infected plants showed negative gravitropic growth, kept upward growth direction (A) but the gynophore from un-infected plants (control) curved down and progressed to 90°C at 12 h (B).

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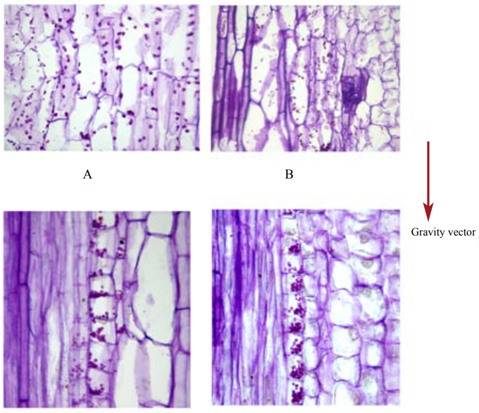

Figure 2: Anatomical analysis of amyloplasts in the starch sheath cells of gynophore from MLO-infected plants and un-infected plants (control). A and B: Longitudinal section of gynophore tip from MLO-infected plants at 0 h and 12 h respectively. C and D: Longitudinal section of gynophore tip from un-infected plants at 0 and 12 h respectively Bar=100 µm.

Auxins	MLO-infected gynophores (µg/ g)			Un-infected gynophores(µg/ g)		
	0h	6h	12h	0h	6h	12h
GA	79172.9	6279.5	4533.4	2102.1	3468.5	2669.1
IAA	30.95	35.7	25.0	12.0	15.2	10. 8
ABA	16.0	26.9	17.6	19.0	24.3	13.1

Table 1: Content of GA, IAA and A BA in gynophores.

sharply, from 79172.9 µg/ g (0 h) to 6279.5 µg/ g within 6 h and then decrease slowly to 4533.4 within another 6 h.

Discussion

Previous experiments had demonstrated that amyloplasts sedimentation was associated with the onset of the gravitropic response of peanut gynophores. In our study, the distribution of amyloplast in MLO-infected gynophores showed disordered distribution and no sedimentation, in the lowermost surface of the starch sheath cell. The results were consistent with Moctezuma and Feldman's [2] observation. Abnormal distribution of mynoplasts was one of the reasons why the gynophores in MLO-infected peanut plant showed negative gravitropic growth.

GA is known to be mediator regulating gravity response in plants, but the mechanism is known fewer yet [3]. GA also was reported as regulator that activated expression of α-amylases [4]. In our study, MLO-infected gynophores has significantly higher GA content and less of amyloplasts in number and mass than un-infected gynophores, suggested that amynoplasts disorderedly distributed in MLO-infected gynophores is because GA activated over-expression of α-amylases genes and decomposed the starchs in amyloplasts rapidly, resulted in the number and specific gravity of amyloplasts decreased radically, therefore ,these amyloplasts were not sufficient in density to sediment to the cell bottom, as a result, the gynophores grow upward vertically. In conclusion, the data presented here suggested that t capsule of amyloplasts is the sensor site of gravistimulation, starch might act as the booster of amyloplasts sedimentation. GA mediated gravity response in plants by regulating the expression of α-amylases.

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