Regulation of pod growth in soybean by light signaling

Nobuvuki Ario[1], Andressa C. S. Nakagawa[1], Yuki Tomita[1], Seiya Tanaka[1], Chiaki Mizuta[2], Naoki Murayama[2], Yushi Ishibashi[1, 2], and Mari Iwaya-Inoue[1, 2]

[1] *Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University,*
[2] *School of Agriculture, Kyushu University.*
Hakozaki 6-10-1, Higashi-ku, Fukuoka city 812-8581, Japan

Crop Science Lab.

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Introduction

The yield of the soybean (*Glycine max* L.) was comprised of the number of the pods, the number of seeds in a pod, 100-seed weight. It has been reported that soybean seeds taken out of a pod and cultured in well water and a complete nutrient medium containing sucrose was bigger than the seed which continued growing up in a pod (Egli 1990).

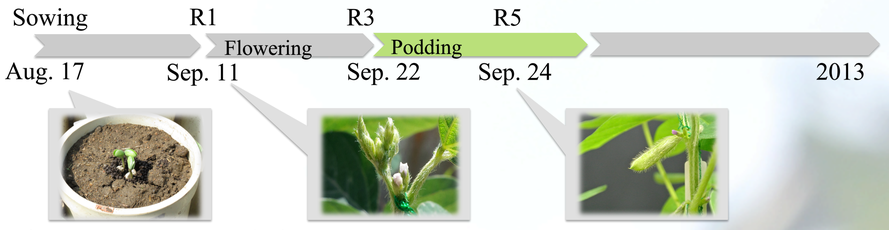
In rice, some genes like *GRAIN SIZE (GS3)* are identified as determinant of seed size (Takano-Kai et al. 2013). This seed size regulation by *GS3* was shown to be mediated by controlling cell number in the upper epidermis of the glume (Takano-Kai et al. 2013). Therefore, we hypothesized that the pod limits seeds growth in soybean and focus on pod growth. .

Materials and Methods

＜**Materials**＞ •Soybean *Glycine max* (L.) Merr. 'Fukuyutaka'

＜**Cultivation**＞ •1/5000aWagner pot

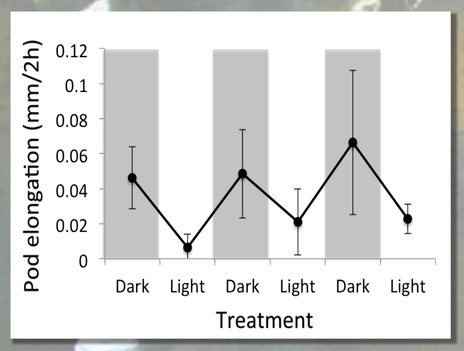
•sampling : soybean pod (R3-R4 stages) every 2h until 28h



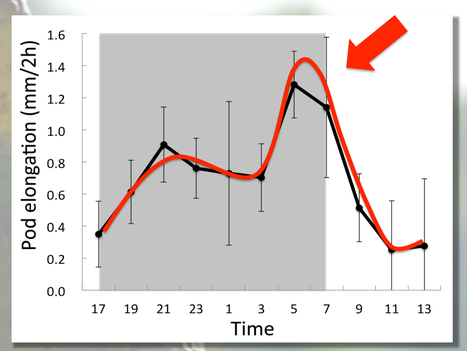
＜**Methods**＞ •RT-PCR, Real-time PCR

Results

Soybean Pods elongated at the dawn in dark period



(14h Dark/ 10h Light)



(14h Dark/ 10h Light)

Soybean pods elongated in dark period rather than light period.

In dark period, soybean pods elongated at the dawn.

Fig. 1 Pod elongation in light-dark change Fig. 2 Time course of Pod elongation of soybean

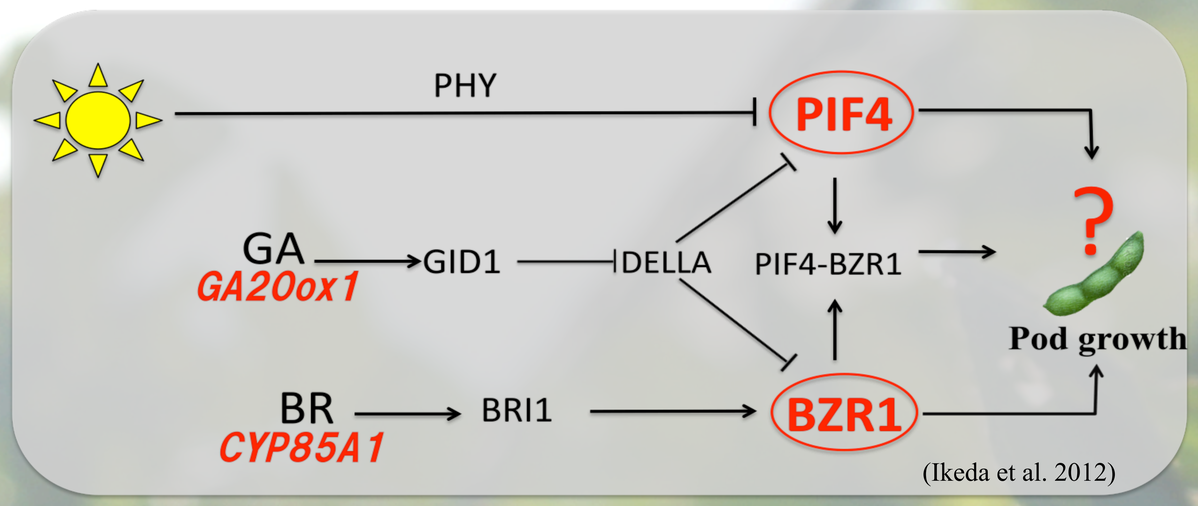


Fig. 3 Hypothesis mechanism of pod elongation of soybean

GmPIF4 regulated light signal more than GA signal

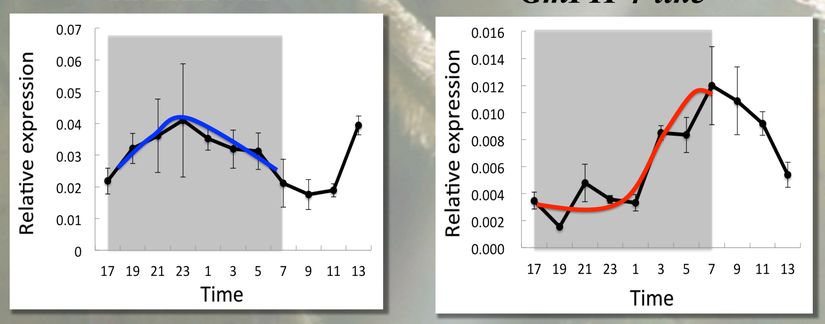


Fig. 4 Gene expression analysis of *GmGA20ox1* and *GmPIF4-like* (/EF1b)

The expression of *GmPIF4* increased at the dawn. However, the expression rhythm of *GA20ox1,* which is related to GA synthesis did not express such as pod elongation pattern. These data suggested that *GmPIF4* was regulated by light signal rather than GA in pod elongation.

BR signal related to Pod elongation

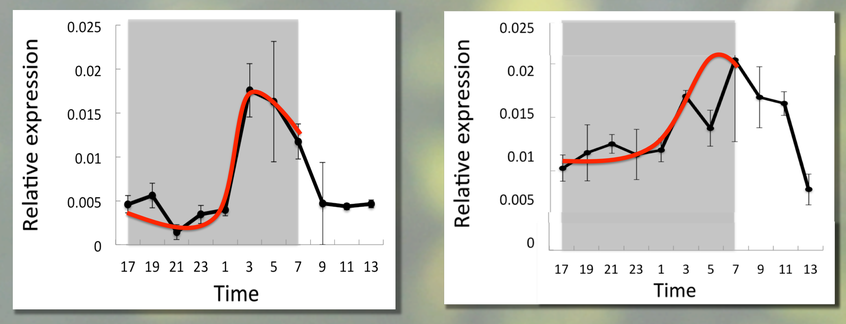


Fig. 5 Gene expression analysis of *GmCYP85A1* and *GmBZR1* (/EF1b)

The expression of *GmCYP85A1*, which is involved in BR synthesis and *GmBZR1,* which is transcription factor regulated by BR(brassinosteroid) increased at the daw as observed in expression profile of *GmPIF4*.

These data suggested that BR signal was mainly involved in pod elongation of soybean.

GmBRU1 might be a target of *GmPIF4* and *GmBZR1*

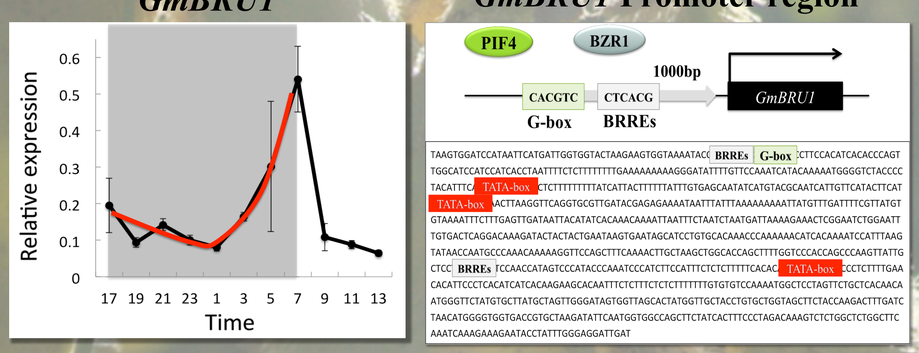


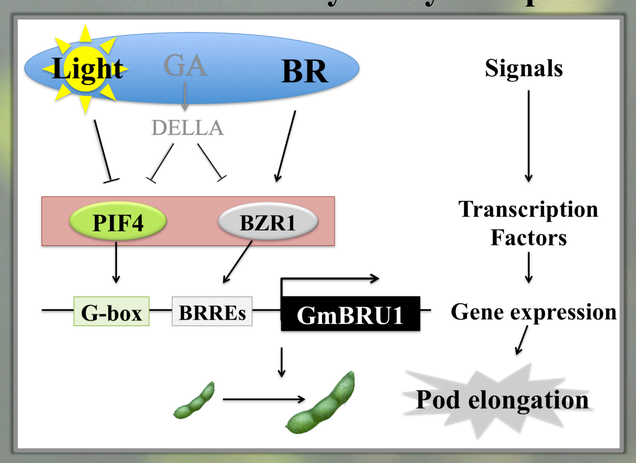
Fig. 6 Analysis of target gene of *GmPIF4-like* and *GmBZR1* (/EF1b) and its promoter region

The expression rhythm of *GmBRU1,* which enhances plant growth through cell extension is similar to that of *GmPIF4* and *GmBZR1*.

Additionally, the promoter region has G-box and BRREs, which can be bonded by PIF4 and BZR1 respectively.

Conclusion

Indicated Pathway in soybean pod



Soybean pod elongated at the dawn, and the elongation rhythm is consistent with that of hypocotyl in *Arabidopsis thaliana*.

From gene expression analysis, the mechanism of this elongation rhythm might be involved in BRU1, which enhances plant growth through cell division and extension.

Additionally, it was regulated by two transcription factors, PIF4 and involved in light and phytohormone signaling, respectively.

These results indicate that soybean pod elongation might be regulated by light signaling.

References

Egli (1990) Seed water relations and the regulation of the duration of seed growth in soybean. *J. Exp. Bot.* 41: 243-248.

Ikeda et al. (2012) A triantagonistic basic helix-loop-helix system regulates cell elongation in Arabidopsis. *Plant Cell* 24: 4483-4497