Control of floral transition in maize

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Introduction

Maize (*Zea mays* L.) is a quantitative short-day plant, but breeding programs have selected genotypes whose flowering is largely autonomous and occurs in response to developmental cues. An outstanding observation is that - in given growing conditions - the apical meristem produces a predictable total leaf number (TLN) before floral transition occurs (1). This led to the hypothesis that leaf counting is the basis of flowering time measurement in maize. In this rationale, a change in leaf initiation rate should directly delay or accelerate flowering while the TLN should remain unchanged. On the opposite, if floral transition and TLN are not correlated, a change in leaf initiation rate should modify the TLN without affecting flowering time.
We used hormonal treatments to test these hypotheses.

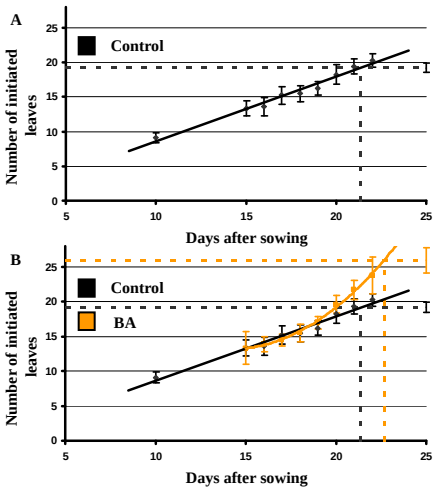

Figure 1 : Leaf initiation rate of control plants (A) and BA treated plants (B).
TLN is shown by the horizontal dotted lines. Intersection of the horizontal line with the leaf initiation curve allows to estimate time of floral transition (vertical dotted lines).

Material and Methods

Plants of inbred B were grown in phytotronic cabinets at 400 µE m^{-2} s^{-1}, 16h photoperiod and 24/18°C day/night temperature. Hormones - 10^{-3} M benzyladenine (BA), 10^{-3} M gibberellic acid (GA_3) or 2.10^{-5} M 2,4-dichlorophenoxyacetic acid (2,4-D) - were applied in the centre of the leaf roll (1 ml) when plants were 15-day old. Hormonal treatments were repeated daily during three days. Plants were regularly dissected in order to determine the leaf initiation rate (Fig. 1A) and TLN was counted at the end of the experiment.

Results

As shown in table 1, we observed that :
- BA increased leaf initiation rate and TLN but delayed floral transition (Fig. 1B) ;
- GA_3 increased leaf initiation rate but decreased TLN and advanced floral transition ;
- 2,4-D decreased leaf initiation rate and TLN but florewing time remained unchanged.

In addition to its effect on flowering time, BA affected severely the morphology of the plants (Fig. 2) : plants were smaller than control, phyllotaxy was altered and number of ear per plants was increased. GA_3 and 2,4-D treated plants were similar to controls.

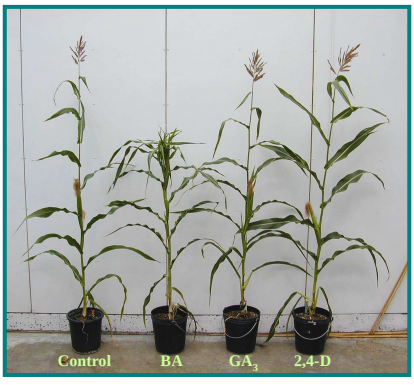

Figure 2 : Effect of BA, GA_3 and 2,4-D on plant morphology

Table 1 : Effect of BA, GA_3 and 2,4-D on TLN and floral transition

Treatments		TLN	Floral transition (days after sowing)
BA	Control	19,2 ± 0,7	21,4
	Treated	25,9 ± 1,8	22,7
GA_3	Control	19,1 ± 0,6	21
	Treated	18,1 ± 0,9	19,2
2,4-D	Control	19,9 ± 1,2	23
	Treated	18,9 ± 0,8	23,3

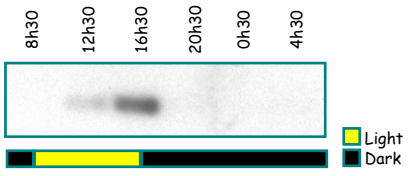

Figure 3 : Isolation of a candidate *Hd3a* homolog by RT-PCR analysis.
RT-PCR was performed on maize cDNA prepared from short-day grown plants. Primers specific to the rice *Hd3a* gene was used and the PCR product was hybridized with an *Hd3a* probe.

Conclusion and future prospects

Our results indicate that there is no simple correlation between leaf initiation rate and flowering time in maize.
We are thus interested to study the involvement of the photoperiodic pathway. It has been shown indeed that genetical control of flowering disclosed in *Arabidopsis* is also at work in rice which is, as maize, a quantitative short-day plant (2). Taking advantage of the synteny between cereal genomes, an RT-PCR approach is being used to clone candidate genes in maize. Up to now, a cDNA fragment showing very high similarity with the rice *Heading date 3a* gene (*Hd3a*, orthologous to *AtFT*) has been cloned from short-day grown plants (Fig. 3) and will be used for further analyses.

References :
(1) Irish E. and Jegla D., 1997. Regulation of extent of vegetative development of the maize shoot meristem. *The Plant Journal*, 11 : 63-71.
(2) Hayama R., Yokoi S., Tamaki S., Yano M. and Shimamoto K., 2003. Adaptation of photoperiodic control pathways produces short-day flowering in rice. *Nature*, 422 : 719-722.
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