BIOLOGIA PLANTARUM (PRAHA)

16 (2) : 136—139, 1973

BRIEF COMMUNICATION

Rhythmic Changes in Ribonuclease Activity in Relation to Nucleic Acid Synthesis in Cotyledons of *Chenopodium rubrum* L. and to Floral Induction of the Plants

LOLA TELTSCHEROVÁ and DAGMAR PLESKOTOVÁ

Institute of Experimental Botany, Czechoslovak Academy of Sciences, Praha*

Received May 21, 1973

Abstract. Ribonuclease (RNAse) activity was investigated in cotyledons of *Chenopodium rubrum* plants subjected to various conditions of illumination (photoperiodic induction, continuous light, induction cancelled by interrupting the dark period by a light-break). At the end of the dark period of the single inductive cycles RNAse activity of induced plants was inferior to that of plants grown in continuous light. At the end of the first two cycles the activity was lowest after the interruption of the dark period by light. The investigation of the enzyme in 6h intervals showed rhythmic changes in activity to occur in induced plants. Enzyme activity followed a pattern opposed to this of nucleic acid (NA) synthesis in the cotyledons. In plants from continuous light the enzyme activity did not show any rhythm and in plants having obtained a light-break during the inductive period the rhythm was less distinct than in the induced ones. The period length of the endogenous rhythm of NA synthesis in the cotyledons is about half as long as this of flowering and the peaks of flowering coincide with the throughs of NA synthesis.

Additional key words: endogenous rhythm, photoperiodic regime.

In a previous paper (TELTSCHEROVÁ and PLESKOTOVÁ 1973) it has been shown that an endogenous rhythm of NA synthesis with a period length of about 18h can be initiated in the cotyledons of *Chenopodium rubrum* by subjecting the plants to one photoperiodic cycle (18h darkness, 8h light). In plants grown in continuous light NA synthesis does not proceed rhythmically. If the induction was cancelled by a light-break of $3^1/_2$h given in the middle of the dark period the amplitude of the first oscillation was reduced and the appearance of the second peak was delayed. If the plants are grown in 16 : 8h cycles of darkness and light, the period length of the rhythm is entrained to 24h. The aim of the present report was to ascertain whether the rhythm of NA synthesis is related to changes in RNAse activity during photoperiodic induction.

* *Address*: Ke dvoru 15, 160 30 Praha 6-Vokovice, Czechoslovakia.

The plants were cultivated in the same way as described previously (TELTSCHEROVÁ and PLESKOTOVÁ 1973). At the beginning of the experiment they were divided into three variants. The plants of the first variant were subjected to four photoperiodic cycles (16th darkness, 8h light). In the second variant the dark period was interrupted in the middle by $3^1/_2$h of light and the plants of the third variant were grown in continuous light for the whole duration of the experiment.

RNAse activity in the cotyledons was determined at the end of the dark period of each cycle, as well as in 6h intervals during the first three cycles. Cotyledons from 100 plants were used for each enzyme analysis. The extraction of the crude enzyme and determination of its activity were performed according to the method quoted by BEX (1972) with minor modifications based on the method of SCHRAUWEN and LINSKENS (1972). All experiments were repeated twice or more times.

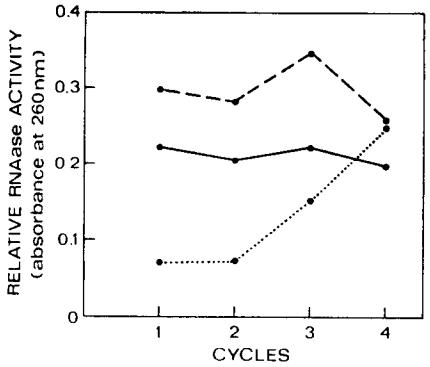

Fig. 1. Relative RNAse activity in cotyledons of *Chenopodium rubrum* in the single experimental variants at the end of the dark period of the 1st to 4th inductive cycle. Full line: Induction; Dashed line: Continuous light; Dotted line: Induction interrupted by light-break.

At the end of the dark period of each inductive cycle RNAse activity in the cotyledons of induced plants was always inferior to that of plants from continuous light. The lowest enzyme activity was found in plants submitted to inductive cycles interrupted by a light--break at the end of the first two cycles. At the end of the third and fourth cycle activity increased and reached the level of the non-induced variant from continuous light eventually (Fig. 1).

RNAse determinations, carried out in 6h intervals during three photoperiodic cycles, showed rhythmic changes of enzyme activity to occur in induced plants. The peaks of activity somewhat preceded the throughs of NA synthesis and the minima of activity preceded the peaks of NA synthesis (Fig. 2*A*).

In plants grown in continuous light, RNAse activity did not show rhythmicity. It increased during the first 18 hours of experiment and remained at approximately the same level afterwards. (Fig. 2*B*).

In plants having received

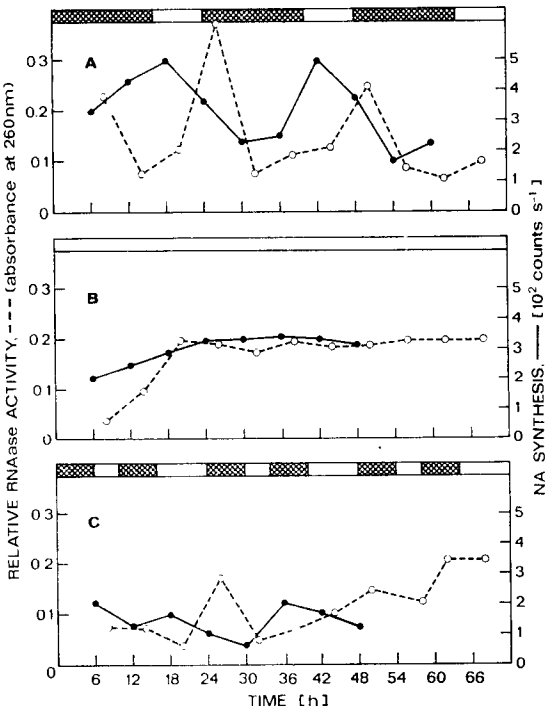

Fig. 2. Relative RNAse activity in cotyledons of *Chenopodium rubrum* plants grown under different conditions of illumination. *A*: Photoperiodic induction. *B*: Continuous light. *C*: Dark periods of inductive cycles interrupted by light-break. The light regime is indicated above each graph.

a light-break in the middle of the dark period, rhythmicity of RNAse activity was less distinct than in induced ones. The first peak of enzyme activity was considerably reduced and the second one was delayed. Starting from the end of the light period of the second cycle enzyme activity exhibited a rising tendency (Fig. 2*C*).

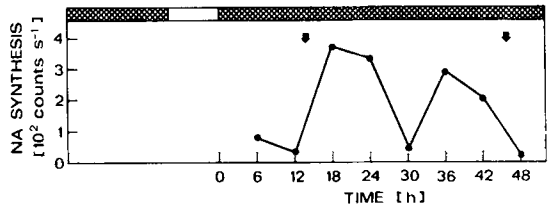

Fig. 3. Endogenous rhythm of NA synthesis in cotyledons of *Chenopodium rubrum*. The arrows indicate the peaks of the rhythm of flowering. The light regime is indicated above the graph.

It follows from the results mentioned above that the changes in RNAse activity during photoperiodic induction represent at least one factor responsible for the rhythm of NA synthesis found in the cotyledons at this time. The question arises whether the observed rhythmicity in NA synthesis and RNAse activity is related to floral induction. According to STÄRK and JAENICKE (1971) RNAse coordinates RNA synthesis and degradation with the growth conditions of an organism. The rhythms of NA synthesis and RNAse activity observed in the cotyledons of *Chenopodium rubrum* might be linked with rhythmicity of growth brought about by the photoperiodic regime. This would be in line with the findings of CHIA-LOOI and CUMMING (1972) who have shown circadian rhythms of some other indicators of growth to be initiated by a dark period interrupting continuous light in *Chenopodium rubrum*.

On the other hand GRESSEL *et al.* (1970) who have found in the shoot meristem of *Pharbitis nil* similar relations between the changes in NA synthesis and in RNAse activity as reported in this paper assume cotyledonary RNA synthesis to be necessary for the production of floral hormone. In so far unpublished experiments it was shown that in *Chenopodium rubrum* plants subjected to one photoperiodic cycle prior to the transfer to permanent darkness the period length of the endogenous rhythm of flowering determined in 2h intervals is about 32h, which is approximately twice the period length of the rhythm of NA synthesis in the cotyledons (if allowance is made for the less accurate determination of the course of this latter rhythm — in 6h intervals). According to Fig. 3 the peaks of flowering approximately coincide with the minima of NA synthesis, two peaks of NA synthesis occuring between each peak of flowering. These findings do not exclude a closer relation between the rhythms of NA synthesis and of flowering and require further investigation.

References

BEX, J. H. M.: Effects of abscisic acid on nucleic acid metabolism in maize coleoptiles. — Planta **103** : 1—10, 1972.

CHIA-LOOI, A., CUMMING, B. G.: Circadian rhythms of dark respiration, flowering, net photosynthesis, chlorophyll content, and dry weight changes in *Chenopodium rubrum*. — Can. J. Bot. **55** : 2219—2226, 1972.

GRESSEL, J., ZILBERSTEIN, A., ARZEE, T.: Burst of incorporation into RNA and ribonuclease activities associated with induction of morphogenesis in *Pharbitis*. — Developmental Biol. **22** : 31—42, 1970.

SCHRAUWEN, J., LINSKENS, H. F.: Ribonuclease in styles. — Planta **102** : 277—285, 1972.

STÄRK, G. F., JAENICKE, L.: Das Ribonukleinsäure-Ribonuklease-System von *Saccharomyces cerevisiae*: Zur Stoffwechselregulation bei Eukaryoten. — Z. Naturforsch. **26b** : 328—336, 1971.

TELTSCHEROVÁ, L., PLESKOTOVÁ, D.: Nucleic acid synthesis in *Chenopodium rubrum* L. during photoperiodic induction and its relation to endogenous rhythmicity. — Biol. Plant. **15** : 419 to 426, 1973.