

## The biological clock

Daily life is influenced by the Sun. Every living being on Earth feels its effect. When you pass through several time zones travelling on an aeroplane, you become very aware of these effects on your day/night rhythm. Plants use the sunlight to produce sugars. They grow in the direction of the light and so can see it. Besides that they can also measure the length of light and dark periods.



1] Plants will sometimes shrink in their surface area by letting the leaves hang limply. By doing this, they draw their moisture inwards and because the pores close, transpiration cannot take place. In photo A, you can see a plant in full sun and in photo B you can see one in the shade.

2] Plants can work with the different information they receive from the light. The actual and periodical light information is compared with itself as well as the biological clock.

Plants have eyes everywhere! Throughout an entire plant, small eyelets are to be found whose purpose is not for absorbing the energy but for measuring the light intensity. Plants absorb a light image that dictates the direction and strength of their growth. Plants possess two sorts of eyelets, the Phyto-chromosome, which sees red light and eyelets that see the blue light in the UV spectrum.

### Red eyes

Phyto-chromosomes work like a switch between important reactions. Phyto-chromosomes are stimulated by red light and activate specific processes, germinating the seed being one of those. Some plant types will not germinate in the dark, lettuce, to give an example. The working of the phyto-chromosomes can be seen through a simple experiment. (See the table: germinating lettuce seeds) Expose a saucer of seeds to pure red light (660nm) for one minute and the reaction will be the germination of the seeds. Should you then expose the seeds to another minute of extreme red light (730nm) then the reaction does not occur and the seeds will not germinate. However, with another minute of pure red (660nm) the seeds will germinate. So in a sequence of a minute red, followed by a minute of extreme red, followed by another minute of red will still allow the seeds to germinate. You will see from the table that a connection exists between the light and the percentage of germinated seeds. That it is a connection and not a light dependant action of metabolism is to be seen in the short amount of the exposure time to the light.

Phyto-chromosomes are partly responsible for the production of the legendary Florigen, the flowering hormone that prompts the plant to flower when the light signals that the ideal light/dark period has been reached. With marijuana plants, that time period is 12 hours of night rest.

In the previous issue, I mentioned that the flowering phase would be delayed if the night rest were to be disturbed. The interruption need not be long or intensive either. A weak light (red 25watt is already enough) for half an hour will completely negate the tendency to start the flowering phase and the plants will remain in the growth phase. (See the previous articles comments on chrysanthemum cultivation) With hemp cultivation, an eighteen-hour light cycle will keep the plants in the growth phase. With longer hours of light, the growth will continue without a problem. It is possible to actually use the effects of light disturbances should you wish to put your plants in an outdoor greenhouse in February already, whilst blooming conditions are raging. This only makes sense if you have radiators in your greenhouse or live in a warmer part of Europe or elsewhere.

### Light blue eyes

Plants possess a multitude of receptors that react not only to the blue light but also the purples found in the UV spectrum. The previous article explained the functioning of the blue light receptors or eyelets, namely that of growing in the direction of the light source. All the green parts of the plant are

covered in these blue eyes and they direct the plant to grow in the direction of the strongest light source. Even the roots possess these blue light eyelets although they use it to grow away from the light in the opposite direction from the source. This allows the plant maximum stability whereby the roots and the stems grow away from each other.

#### **UV light can be divided into two categories, UV-A and UV-B.**

UV-B is a harsh and highly energetic ultraviolet light. We use sun block cremes to protect our skin against the presence of UV-B rays. UV-A is less dangerous and it can tan and age the skin without the fear of long term damage like cancer and pigmentation changes that can occur with intensive exposure to UV-B.

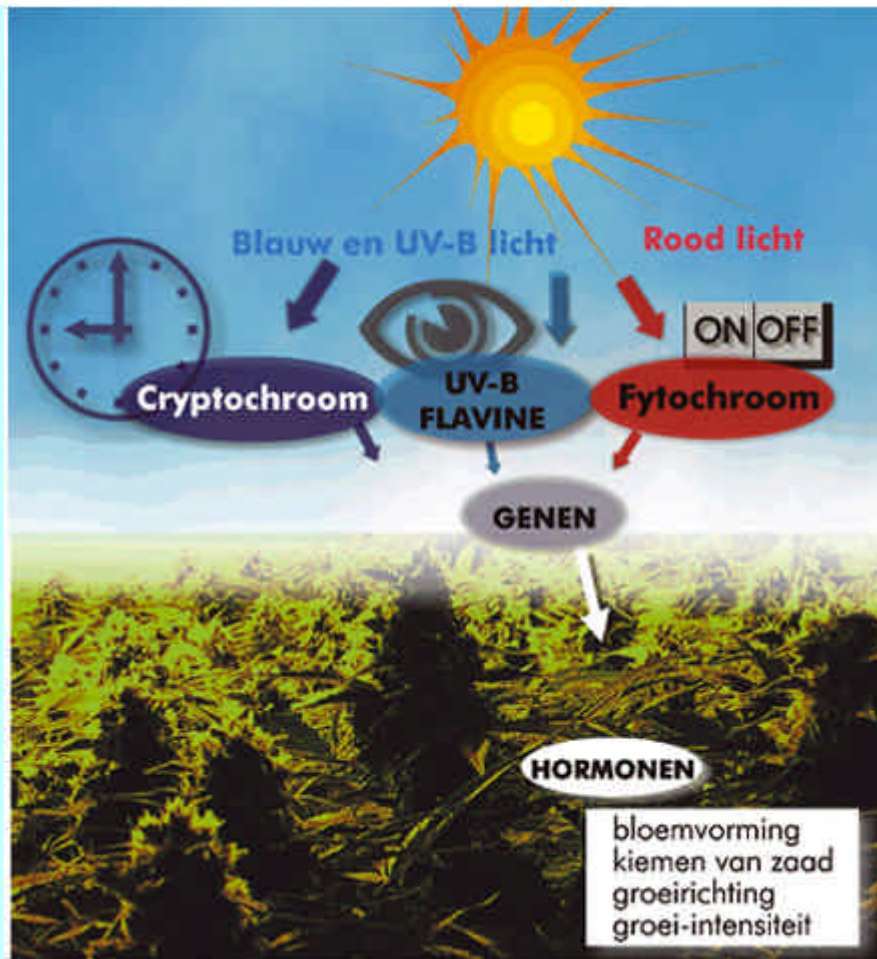
Plants are able to see and measure the UV-B rays. If the intensity gets too much, the leaf pores will close and photosynthesis stops. Just in case you forgot, photosynthesis is an automatic process and can only be halted by the closing of the leaf pores where there is sufficient light and air available. CO<sub>2</sub> is then not absorbed.

With too much intense light, overproduction of sugars because of the photosynthesis leads to water lost through transpiration and damage by exposure to the UV-B rays. This often happens daily during the midday hours when the sun is at it's peak on hot days and especially at higher altitudes where the UV rays are already more intense. Plants will sometimes shrink in their surface area by letting the leaf hang limply. By doing this, they draw their moisture inwards and because the pores close, transpiration cannot take place. In photo A, you can see a plant in full sun and in photo B you can see one in the shade.

So now we know that plants can see the light but how they measure the duration of the light phases is still a question. Is it possible, for example, to train a plant to an eighteen-hour cycle rather than the usual 24? What happens when a hemp plant is left in the dark for ten hours followed by an eight hour light period? Will the plant begin to flower? Not at all! The ratio between daylight and night hours is important with the period of night time being absolute. This has to last a minimum of 12 hours which means that even plants cultivated indoor are subject to a 24 hours rhythm.

#### **Biological clock**

All animals plants and bacteria are calibrated to the daily return of the Sun. It was not so long ago that the switch was discovered that governs the mechanism of this biological clock. It is known as the Crypto-chromosome. We have been aware of this chromosome for sometime now, but it was only in 1998 that it was discovered to function as the organism for time recognition.



The Crypto-chromosome is the controller of the biological clock and it keeps to a circadian biological rhythm. Circadian means; approximately one day (circa = about and dia = day) and everything on Earth follows a circadian rhythm. That is a cycle between 23,5 and 24,5 hours.

Blue light rays reach a peak twice a day, namely at sunrise and at sunset. The Crypto-chromosome measures the light radiation and relates it to the biological clock that then calibrates to the cycle.

#### For those who want to know

The biological clock functions roughly as follows:

Two proteins form the core of the clock, one 'timeless', the other marks 'period' and these two interact with each other. The concentration of these proteins rises during the twelve-hour period (just like the ebb and flow of high and low tides). Once the maximum concentration of these proteins have been produced for the clock, production is blocked and the level starts to drop again until the minimum level is reached where production starts again.

The concentration of clock molecules is the lowest in the morning and increases throughout the day until the peak is reached and the blockage sets in. With a maximum exposure to blue light rays, the Crypto-chromosome is activated and holds the 'timeless' protein arrested so that the clock (the protein production) starts at null. The plant corrects the levels every morning and evening so that a 24-hour rhythm is achieved. The circadian rhythm also works without the presence of daylight but can be brought out of balance and will either run ahead or behind, but will continue to turn. Even a watch that is telling the wrong time still keeps to a 24-hour cycle.

Plants can work with the different information they receive from the light. The actual and periodical light information is compared with itself as well as the biological clock. The start of the flowering phase has been genetically pre-programmed and the direction and strength of the growth determine the appearance and energy levels of the plants. If there are changes in the light period, the biological clock has to recalibrate while the circadian rhythm is continued. It is logical that every disturbance of

the biological rhythm costs the plants time and energy to adapt to and so they will briefly stop with their growth while clock and rhythm readjust.