

The network of hormones

Hormones of human beings and animals are substances that cause big reactions in small amounts. Mostly they are made in special glands but work in another place.

Examples we know are male and female sex hormones (estrogen, androgen) or the thyroid hormone. Our hormones not only control physical reactions, but also influence the mind, the well being and very subtle also our social behavior.

Plants also have hormones.

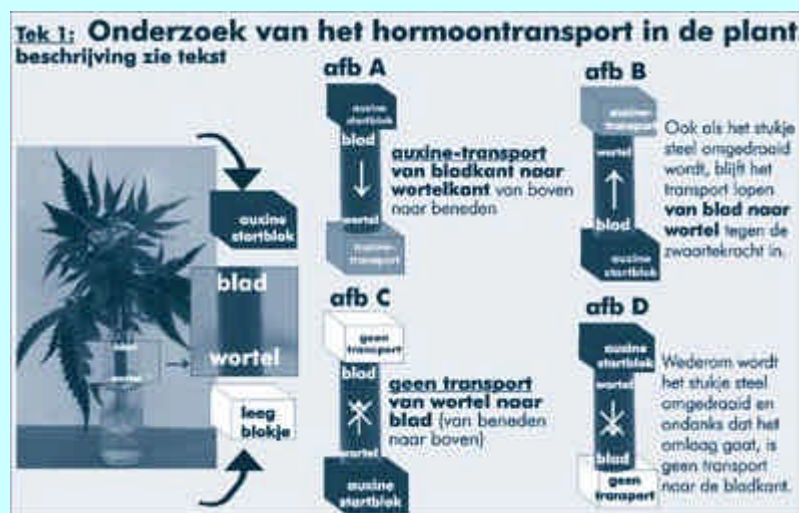
Most of us know plant hormones that are in cutting powder.

Plant and animal hormones differ in many things, but the way it works is corresponding in such a way that the word hormone is well chosen.

A clear difference is for instance the place where the hormones are produced. Animal hormones are made in special glands, the production place of plant hormones can be indicated only generally (in roots and leaves).

Plant hormones can use all possible lanes of transport through the plant.

Depending on the task they have to do, they choose the way. They use the stream in the central cylinder, the highway up and also the sugary energy lanes that are going in all directions. Plant hormones use other ways of transport that we get to know here.



As far as we know, there are five different groups of hormones. These are:

1. the auxines
2. the gibberellenes
3. cytoquinine
4. abscising acid
5. ethylene

all difficult words but very interesting compounds that regulate the whole growth of the plant.

All plant hormones have several functions. It is not possible to describe a plant hormone with only one task. All plant hormones work together, they stimulate or slow down the other plant hormones. By combination and variation of the concentrations very complex and specific functions are possible. The working of a plant hormone depends on its concentration. In low concentrations they can stimulate growth, in high concentrations they can slow down growth.

Auxine:

Auxine is a growing hormone that we know as a root stimulator and use to stimulate the development of the roots of a cutting.

The natural auxine (indolyl acetic acid) is produced in young leaves and is working for instance in the

roots. Auxine stimulates the growth of side roots. To come from the leaves to the roots they use a transport way that is going right through the cells and through the whole plant. They don't follow a pipe stream on their way to the cells and stream goal-oriented to the roots.

In the first two articles of transport and logistic in the plants (Highlife February and April 1999) we got to know a similar transport. Water with nutrition salt streaming from the plant's substrate to the hair root. To come into the central cylinder the water has to go in straight through the root cells.

How does auxine know in what direction it has to move?

To understand this new transport way of auxine, we do the next experiment. A piece of root or stem is cut from the plant. At the upper side a piece of gelatin or agar, treated with auxine, is put. At the other side we put the same piece without auxine. After a while we measure if in the piece at the bottom growing hormone has come.

The piece of stem has an upside (direction leaves) and a downside (direction root). The piece of gelatin is made on the leaf side and the root side. And the different results are:

(compare to the drawing)

- A. Is the prepared gelatin with auxine placed on the original upper side, the auxine can be measured at the bottom. Transport is taking place.
- B. If we put it all upside down, the transport from leaf to root is taking place, independent of the fact that the hormone now must stream upwards.
- C. If we put the auxine piece on the side of the stem that used to point at the root, then no auxine can be measured at the other side. Transport from root to leaf has not taken place.
- D. If we turn around the example in front of this (C), no auxine goes from the root to the leaf (in spite of transport downward).

Every cell in the plant knows exactly where the roots and the leaves are and have senses for orientation. They have a south pole and a north pole. The answer to the question is: not the auxine finds its way but the cells direct it in the right direction.

The stream of auxine is only possible from leaf to root, unesteemed if the transport is going up or down. Every cell works like a kind of pump for auxine and if auxine is in the cell, it is immediately brought to the right side of the cell and advanced to the neighbor cell.

Logistic insight of the plant

Auxines in the active grown plant stimulates the growth of the side roots. They give the signal to make more roots if the biologic factors in the upper side of the leaves are all right. When it is going worse at the upper side, for instance by light disturbance or vermin, the leaves will send less auxine to the roots. So the plant knows: fewer roots have to be grown. This message is a matter of life and death for the plant, because if disturbances in the photosynthesis appear, too less energy is produced. The making of the new roots is not guaranteed. Without the auxine signal the plant would starve.

Auxine for industry:

Cutting powder contains matter that look like natural auxine (have the same keys), but have a chemical different body. So the plant is deceived by it, because the key for stimulating the root is working, but the matter is not seen by the changed structure. The plant does not know the artificial auxine and cannot decompose it. So the synthetic auxine stays longer in the plant and works very intensive in small concentrations. Because the synthetic auxine stays longer in the plant, you better not use artificial grow stimulators at older plants, because they will stay in the chain of food (or in the pipe).

Auxine look-alike matters are also used as herbicides, especially to protect grains. The fast growing broad leaved weeds absorb more herbicide than the grains and die. All these active herbicides are not easily decomposed so they will heap in the chain of food.

The big defoliates of bush in wartime (like in Vietnam) were done with these auxines and known as Agent Orange. The 'treated' grounds are unfruitful for years and still a high percentage of disfigured children are born there.

This shows that an overdose of root hormone achieves the contrary of a low dose. If we put a cutting too deep into the cutting powder, the making of roots will be decreased. Important is that as less as possible working matter must stick to the outside of the stems, because then a signal will be given to restrain the growth of the roots. Right is to treat a freshly cut slip only at the bottom, so the auxine will penetrate the plant and will not be sticking at the outside.