كلية العلوم

القسم : علم الحياة

السنة : الرابعة

المادة : البيولوجيا النباتية

المحاضرة : الخامسة/نظري/د . ميسون

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Mechanisms of Plant Growth- Hormones

Plants exhibit a wide variety of sizes.

When a plant is exhibiting primary growth, it is building more cells to make it taller or longer. So primary growth makes the grass in your lawn grow higher, it makes trees grow taller، it makes roots grow deeper, and it makes vines grow longer.

Many plants can also grow in another way, called secondary growth.

In secondary growth, the plant gets broader or thicker due to the lateral or sideways activity of meristem cells.

These meristematic cells exist in the cambium, a special layer in between the xylem and the phloem in a plant's stem.

When lateral meristem cells divide, they create more girth for the plant, so the stem increases in diameter.

The best example of secondary growth is the annual growth rings of a tree trunk.

If you look at the rings, you can see each growing season represented by a broad band of expansion in the tree's trunk. This is secondary growth.

So how does a plant know when to start growing, when to switch modes of growth, or even which way is up so that it grows out of the soil into the sunlight؟ Just like animals, plants have a series of hormones that trigger and regulate their growth.**Hormones** are chemicals that affect processes occurring inside a living organism.

It is this similarity in function, rather than their chemical structure, that causes hormones to be grouped together.

1.Auxin

The most important plant growth hormone is auxin.

Auxin is responsible for most of the primary growth in a plant, including the lengthening and differentiation of cells from the meristem.

Auxin is also responsible for much of a plant's "sense of direction".

Gravitropism, also known as geotropism, is growth in relation to gravit.

The distribution of auxin within a plant's cells changes with the relationship between the direction of growth and gravity, helping the plant to grow correctly.

Roots demonstrate positive geotropism, or growth toward the pull of gravity, while stems experience negative geotropism, growing away from the direction of gravitational pull.

If you tip a potted plant on its side, and a few days later the stem has become bent and is growing straight up again, that's auxin at work.

Auxin is also responsible for phototropism, or a plant's ability to sense and grow towards or away from light.

2.cytokinin

The next important plant growth hormone is cytokinin, named for its role in regulating

cytokinesis, which is a process that occurs at the end of cell division.

Cytokinin is responsible for stimulating mitosis for growth, regulating how cells differentiate from the meristem, and how quickly or slowly plant tissues senesce, or age..

3. The gibberellins

Another group of plant hormones**, the gibberellins**, is primarily responsible for the reproductive parts of a plant.

Production and distribution of gibberellins is what causes flowers to mature, stimulates pollinated flowers to turn into fruits, and causes seeds to mature and be ready for planting.

Scientists have discovered that preventing the normal activities of gibberellin hormones can cause fruits to be "seedless," so that's how we get things like seedless grapes.

We can also use a spray of gibberellin hormones on crops to cause their fruits to grow bigger than they would in the wild.

4.abscisic acid

Next, abscisic acid can be thought of as a plant stress hormone, because it accumulates when plants are exposed to stressful conditions like a lack of water, cold air temperatures، or shorter amounts of sunlight each day, also called a photoperiod.

When a plant or seed begins to experience these conditions, abscisic acid puts the brakes on a lot of the plant's growth functions in order to conserve its resources.

Abscisic acid is important for signaling tree branches to stop growing in fall and winter،and the same hormone causes seeds to go dormant in the soil until spring, when warm temperatures return.

5.Ethylene

Like gibberellins, ethylene, the last important plant growth hormone, is responsible for regulating flowers and fruits.

What makes ethylene different from the other hormones we've covered is that it's actually released by maturing and senescing parts of a plant, but the gas also stimulates other nearby flowers and fruits to mature and age.

If you've ever used the trick of putting ripe and unripe fruit together in a paper bag to help the unripe fruit ripen faster, then you've used ethylene.

Commercially, farmers spray ethylene on fruit crops so that all of the fruits ripen at approximately the same time, so as to make the harvesting process more efficient.

We should also note that many of these plant growth hormones can also be used as herbicides، or chemicals that target and kill plants, especially undesirable plants like weeds.

Messing with the balance of a plant's hormones can cause a weed plant to grow too fast or too slow, or cause it to not produce seeds, any of which could seriously damage or kill the plant.

pigments

We just learned about plant hormones, which means we are beginning to discuss specific chemicals that carry out important functions in plants. So let's look at some other plant chemicals called pigments.
First, we should know what a pigment is.

Pigments are organic compounds that give living things their color and may also serve some other sort of function.

In plants, pigments give the leaves, flowers, and fruits their colors, but they're also responsible for things like food production. Let's go through the different types of plant pigments now.

1.chlorophyll

The first and most important plant pigment you will hear about is chlorophyll.

There are actually three types of chlorophyll that may appear in organisms which are capable of photosynthesis, those being chlorophyll a, b, and c. Chlorophylls are large molecules with a cyclic portion that binds to a metal ion.

This is extremely similar to another cyclic biomolecule found in our bloodstream called hemoglobin, except that where the heme in hemoglobin involves iron, chlorophyll contains a magnesium ion instead.

Chlorophyll pigments reflect green light, which makes plants look green, and they absorb red, yellow, and blue light. The light energy absorbed by chlorophyll pigments excites electrons in the porphyrin ring, which provides the energy required to initiate the process of photosynthesis.

Now to be clear, chlorophyll doesn't facilitate photosynthesis all on its own.

2.carotenoids

Another set of pigments, called carotenoids, assist with the function of photosynthesis.

You might notice that carotenoid sounds a bit like a certain orange vegetable, and you'd be correct to associate the two.

Carotenoid pigments give plant parts red, yellow, or orange coloration. But beyond this, carotenoids are known as accessory pigments because they assist chlorophyll in the collection and absorption of light energy.

Beyond red and orange vegetables like peppers and carrots, carotenoid pigments are also responsible for the beautiful colors you see in autumn leaves, once all of the chlorophyll has degraded.

3.flavonoids

The next group of plant pigments we will discuss is called flavonoids.

These are usually found in the vacuoles of plant cells. As we recall, the vacuole is a large water-filled compartment within each plant cell, which contains organic and inorganic substances that are important for the cell.

The most common flavonoids are the anthocyanins, which often produce bright red coloration in plants.

Anthocyanin pigments are usually found in the petals of flowers and in the flesh of fruits, but they can also color the stems of plants.

Trees with especially vibrant red autumn leaves are expressing anthocyanins as well.

4.Phytochrome

The last important plant pigment is a little different from the others that we've covered.

Phytochrome is a plant pigment that isn't visible unless we separate it from the rest of the plant.

This pigment is less about creating visible color in a plant and more about triggering certain events in a plant's growth and development.

Phytochrome absorbs light just like all of the other pigments, but in this case the light absorbed acts like the flip of a switch to start a new process, such as seed germination, stem and leaf growth, or bud flowering.

Vocabulary - Lecture 5

مفردات المحاضرة الخامسة

يتراكم	accumulates	آليات عمل	Mechanisms
يتعرّض	exposed	نمو	Growth
ظروف مرهقة	stressful conditions	يُظهر –يُبدي	exhibit
نقص المياه	lack of water	النمو الأولي	primary growth
يوقف	brakes on	النمو الثانوي	secondary growth
يعطي الإشارة	signaling	الجانبي	lateral or sideways
السكون	dormant	محيط - مقاس	girth
يُطلق – يتحرر	released	يزداد	increases
ناضجة وغير ناضجة	ripe and unripe	قطر الدائرة	diameter
عملية الحصاد	harvesting process	حلقات النمو السنوية	annual growth rings
أكثر فعالية	more efficient	الجذع	trunk
مبيدات الأعشاب	herbicides	تظهر – تتمثّل	represented
تستهدف	target	نطاق واسع	broad band
غير المرغوب بها	undesirable	التمدد	expansion
الأعشاب الضّارّة	weeds	التبديل بين الأوضاع	to switch modes of
العبث	Messing	سلسلة	series
تتلف - تخرّب	damage	تبدأ – تُسبّب	trigger
الأصباغ	pigments	تُنظّم	regulate
قادرة	capable	العمليات	processes
جزيئات	molecules	الشعور بالاتجاه	sense of direction
جزء دوري	cyclic portion	التّوجه بفعل الجاذبية	geotropism
يرتبط	binds	توزيع	distribution
يعكس	reflect	تُظهر	demonstrate
يُحفّز	excites	شدّ الجاذبية	pull of gravity
البدء	initiate	التّوجّه الضّوئي	phototropism
تدهور	degraded	ينحني	bend
كما نتذكر	As we recall	تنشيط	stimulating
حجرة	compartment	تتقدم بالعمر	senesce
مرئي	visible	تنضج	mature
البدء بعملية جديدة (عكس قاطع تبديل)	flip of a switch	هرمون الإجهاد	stress hormone

Wishing you the best of luck

Engr. Maissoun Ziadeh