DOWNLOAD PDF PLANT GROWTH SUBSTANCES

Chapter 1 : Plant growth substances - Biology-Online Dictionary | Biology-Online Dictionary

Plant hormones (also known as phytohormones) are signal molecules produced within plants, that occur in extremely low racedaydvl.com hormones control all aspects of growth and development, from embryogenesis, the regulation of organ size, pathogen defense, stress tolerance and through to reproductive development.

In contrast, animals have numerous different kinds of hormones, each with a specific function, and it works alone to induce a response. Recall that plants have an architectural design with a limited number of parts that are repeated. With a mechanical design and numerous separate parts, animals required unique chemical messengers to interact with each one. Plant hormones There are five major groups, based on chemical structure. With the exception of the latter two, each group represents a family of related compounds. In addition, there are a variety of other plant "hormones" including the brassinosteroids, oligosaccharides, polyamines, jasmonic acid, salicylic acid, systemin, and putative hormones like those involved in flowering florigen. How do we know a substance is a hormone? In the past, physiologists simply applied the substance to a plant or excised part to see if it caused a response. If there was a response, then we assumed that the substance was a hormone involved in the response. Exogenous application causes the response; Lowering endogenous levels prevents the response; Lowering endogenous levels followed by exogenous application restores the response; Endogenous levels should be related to the response i. Check out the case study concerning bolting in Agrostemma lithago Jones and Zeevart, , Planta Mechanism of hormone action Hormones act on target tissues to activate a receptor. The general mechanism is: Calcium is often involved and its interaction is mediated by the protein calmodulin; and the activated receptor initiates a physiological response VII. Techniques to study hormones A. Bioassays A bioassay examines the effect of a test substance on a plant tissue. To perform a hormone bioassay, a test plant is chosen that lacks the hormone for a response. To determine if a sample contains the hormone, the test plant is treated in a similar fashion. If present the hormone can be quantified by comparing its response to the samples of known concentration. For example, a variety of rice Tauginbozu lacks GA and is often used in bioassay studies. After treatment with various concentrations of GA, leaf length vs. Comparison of the advantages and disadvantages of bioassays Advantages.

Chapter 2 : Plant hormone - Wikipedia

Plant growth regulators (also called plant hormones) are numerous chemical substances that profoundly influence the growth and differentiation of plant cells, tissues and organs. Plant growth regulators function as chemical messengers for intercellular communication.

Auxins Nature of Auxins The term auxin is derived from the Greek word auxein which means to grow. Compounds are generally considered auxins if they can be characterized by their ability to induce cell elongation in stems and otherwise resemble indoleacetic acid the first auxin isolated in physiological activity. Auxins usually affect other processes in addition to cell elongation of stem cells but this characteristic is considered critical of all auxins and thus "helps" define the hormone Arteca, ; Mauseth, ; Raven, ; Salisbury and Ross, History of Auxins and Pioneering Experiments Auxins were the first plant hormones discovered. Charles Darwin was among the first scientists to dabble in plant hormone research. In his book "The Power of Movement in Plants" presented in , he first describes the effects of light on movement of canary grass Phalaris canariensis coleoptiles. The coleoptile is a specialized leaf originating from the first node which sheaths the epicotyl in the plants seedling stage protecting it until it emerges from the ground. When unidirectional light shines on the coleoptile, it bends in the direction of the light. If the tip of the coleoptile was covered with aluminum foil, no bending would occur towards the unidirectional light. However if the tip of the coleoptile was left uncovered but the portion just below the tip was covered, exposure to unidirectional light resulted in curvature toward the light. He then cut off the tip of the coleoptile and exposed the rest of the coleoptile to unidirectional light to see if curving occurred. Curvature did not occur confirming the results of his first experiment Darwin, It was in that Salkowski discovered indoleacetic acid IAA in fermentation media Salkowski, The isolation of the same product from plant tissues would not be found in plant tissues for almost 50 years. IAA is the major auxin involved in many of the physiological processes in plants Arteca, In , Fitting studied the effect of making incisions on either the light or dark side of the plant. His results were aimed at understanding if translocation of the signal occurred on a particular side of the plant but his results were inconclusive because the signal was capable of crossing or going around the incision Fitting, Results showed that whichever side was exposed to the coleoptile, curvature occurred toward the other side Paal, He showed that if tips were cut off there was a reduction in growth but if they were cut off and then replaced growth continued to occur Soding, In , a graduate student from Holland by the name of Fritz Went published a report describing how he isolated a plant growth substance by placing agar blocks under coleoptile tips for a period of time then removing them and placing them on decapitated Avena stems Went, After placement of the agar, the stems resumed growth see below. In , Went developed a method of quantifying this plant growth substance. His results suggested that the curvatures of stems were proportional to the amount of growth substance in the agar Went, This test was called the avena curvature test. Much of our current knowledge of auxin was obtained from its applications. He is often credited with dubbing the term auxin but it was actually Kogl and Haagen-Smit who purified the compound auxentriolic acid auxin A from human urine in Kogl and Haagen-Smit, Later Kogl isolated other compounds from urine which were similar in structure and function to auxin A, one of which was indole-3 acetic acid IAA initially discovered by Salkowski in In a committee of plant physiologists was set up to characterize the group auxins. The term comes from the Greek auxein meaning "to grow. Biosynthesis and Metabolism of Auxin IAA is chemically similar to the amino acid tryptophan which is generally accepted to be the molecule from which IAA is derived. Three mechanisms have been suggested to explain this conversion: Tryptophan is converted to indolepyruvic acid through a transamination reaction. Indolepyruvic acid is then converted to indoleacetaldehyde by a decarboxylation reaction. The final step involves oxidation of indoleacetaldehyde resulting in indoleacetic acid. Tryptophan undergoes decarboxylation resulting in tryptamine. Tryptamine is then oxidized and deaminated to produce indoleacetaldehyde. This molecule is further oxidized to produce indoleacetic acid. As recently as , this 3rd mechanism has evolved. IAA can be produced via a tryptophan-independent mechanism. This mechanism is poorly understood, but has been proven using trp - mutants. Other experiments have shown that, in some plants, this mechanism is actually the preferred mechanism of IAA biosynthesis. The enzymes responsible for the biosynthesis of IAA are most active in young tissues such as shoot apical meristems and growing leaves and fruits. The same tissues are the locations where the highest concentrations of IAA are found. One way plants can control the amount of IAA present in tissues at a particular time is by controlling the biosynthesis of the hormone. Another control mechanism involves the production of conjugates which are, in simple terms, molecules which resemble the hormone but are inactive. The formation of conjugates may be a mechanism of storing and transporting the active hormone. Conjugates can be formed from IAA via hydrolase enzymes. Conjugates can be rapidly activated by environmental stimuli signaling a quick hormonal response. Degradation of auxin is the final method of controlling auxin levels. This process also has two proposed mechanisms outlined below: The oxidation of IAA by oxygen resulting in the loss of the carboxyl group and 3-methyleneoxindole as the major breakdown product. IAA oxidase is the enzyme which catalyzes this activity. Conjugates of IAA and synthetic auxins such as 2,4-D can not be destroyed by this activity. C-2 of the heterocyclic ring may be oxidized resulting in oxindoleacetic acid. C-3 may be oxidized in addition to C-2 resulting in dioxindoleacetic acid. The mechanisms by which biosynthesis and degradation of auxin molecules occur are important to future agricultural applications. Information regarding auxin metabolism will most likely lead to genetic and chemical manipulation of endogenous hormone levels resulting in desirable growth and differentiation of important crop species. Ultimately, the possibility exists to regulate plant growth without the use of hazardous herbicides and fertilizers Davies, ; Salisbury and Ross, Functions of Auxin The following are some of the responses that auxin is known to cause Davies, ; Mauseth, ; Raven, ; Salisbury and Ross, Stimulates cell elongation Stimulates cell division in the cambium and, in combination with cytokinins in tissue culture Stimulates differentiation of phloem and xylem Stimulates root initiation on stem cuttings and lateral root development in tissue culture Stimulates root initiation on stem cuttings and lateral root development in tissue culture Mediates the tropistic response of bending in response to gravity and light The auxin supply from the apical bud suppresses growth of lateral buds Delays leaf senescence Can inhibit or promote via ethylene stimulation leaf and fruit abscission Can induce fruit setting and growth in some plants Involved in assimilate movement toward auxin possibly by an effect on phloem transport Delays fruit ripening Stimulates growth of flower parts Promotes via ethylene production femaleness in dioecious flowers Stimulates the production of ethylene at high concentrations References Arteca, R. A new name for abscisin II dormin ". Physiology, Biochemistry and Molecular Biology. The Power of Movement in Plants. La Physique des arbres. An Introduction to Plant Biology. Pflanzen Beitrage und Botanik Zentralblatt Molecular and Cellular Biology.

Chapter 3 : The International Plant Growth Substances Association

The object of the Association is to promote the development of the study of plant growth substances at the international level. The IPGSA organizes International Conferences on plant growth substances. It also organizes sections devoted to plant growth substances and related disciplines at International Congresses.

Characteristics[edit] Phyllody on a purple coneflower Echinacea purpurea , a plant development abnormality where leaf-like structures replace flower organs. It can be caused by hormonal imbalance, among other reasons. The word hormone is derived from Greek, meaning set in motion. Plant hormones affect gene expression and transcription levels, cellular division, and growth. They are naturally produced within plants, though very similar chemicals are produced by fungi and bacteria that can also affect plant growth. They are used to regulate the growth of cultivated plants, weeds , and in vitro -grown plants and plant cells; these manmade compounds are called plant growth regulators or PGRs for short. Early in the study of plant hormones, "phytohormone" was the commonly used term, but its use is less widely applied now. Plant hormones are not nutrients , but chemicals that in small amounts promote and influence the growth, [8] development, and differentiation of cells and tissues. The biosynthesis of plant hormones within plant tissues is often diffuse and not always localized. Plants lack glands to produce and store hormones, because, unlike animalsâ€"which have two circulatory systems lymphatic and cardiovascular powered by a heart that moves fluids around the bodyâ€"plants use more passive means to move chemicals around their bodies. Plants utilize simple chemicals as hormones, which move more easily through their tissues. They are often produced and used on a local basis within the plant body. Plant cells produce hormones that affect even different regions of the cell producing the hormone. Hormones are transported within the plant by utilizing four types of movements. For localized movement, cytoplasmic streaming within cells and slow diffusion of ions and molecules between cells are utilized. Vascular tissues are used to move hormones from one part of the plant to another; these include sieve tubes or phloem that move sugars from the leaves to the roots and flowers, and xylem that moves water and mineral solutes from the roots to the foliage. Not all plant cells respond to hormones, but those cells that do are programmed to respond at specific points in their growth cycle. Plants need hormones at very specific times during plant growth and at specific locations. They also need to disengage the effects that hormones have when they are no longer needed. The production of hormones occurs very often at sites of active growth within the meristems , before cells have fully differentiated. After production, they are sometimes moved to other parts of the plant, where they cause an immediate effect; or they can be stored in cells to be released later. Plants use different pathways to regulate internal hormone quantities and moderate their effects; they can regulate the amount of chemicals used to biosynthesize hormones. They can store them in cells, inactivate them, or cannibalise already-formed hormones by conjugating them with carbohydrates , amino acids , or peptides. Plants can also break down hormones chemically, effectively destroying them. Plant hormones frequently regulate the concentrations of other plant hormones. Because of these low concentrations, it has been very difficult to study plant hormones, and only since the late s have scientists been able to start piecing together their effects and relationships to plant physiology. The earliest scientific observation and study dates to the s; the determination and observation of plant hormones and their identification was spread-out over the next 70 years. Classes[edit] Different hormones can be sorted into different classes, depending on their chemical structures. Within each class of hormone the exact structures vary, but they have similar physiological effects. Initial research into plant hormones identified five major classes: Additionally there are also several other compounds that fulfill a similar function to the major hormones, but their status as bone fide hormones is still debated. Abscisic acid[edit] Abscisic acid Abscisic acid also called ABA is one of the most important plant growth regulators. It was discovered and researched under two different names before its chemical properties were fully known, it was called dormin and abscicin II. Once it was determined that the two compounds are the same, it was named abscisic acid. The name "abscisic acid" was given because it was found in high concentrations in newly abscissed or freshly fallen leaves. This class of PGR is composed of one chemical compound normally produced in the leaves of plants, originating from chloroplasts , especially when plants are under stress. In general, it acts as an inhibitory chemical compound that affects bud growth, and seed and bud dormancy. It mediates changes within the apical meristem, causing bud dormancy and the alteration of the last set of leaves into protective bud covers. Since it was found in freshly abscissed leaves, it was thought to play a role in the processes of natural leaf drop, but further research has disproven this. In plant species from temperate parts of the world, it plays a role in leaf and seed dormancy by inhibiting growth, but, as it is dissipated from seeds or buds, growth begins. In other plants, as ABA levels decrease, growth then commences as gibberellin levels increase. Without ABA, buds and seeds would start to grow during warm periods in winter and be killed when it froze again. Since ABA dissipates slowly from the tissues and its effects take time to be offset by other plant hormones, there is a delay in physiological pathways that provide some protection from premature growth. It accumulates within seeds during fruit maturation, preventing seed germination within the fruit, or seed germination before winter. Soon after plants are water-stressed and the roots are deficient in water, a signal moves up to the leaves, causing the formation of ABA precursors there, which then move to the roots. The roots then release ABA, which is translocated to the foliage through the vascular system [13] and modulates the potassium and sodium uptake within the guard cells , which then lose turgidity , closing the stomata. Just before the seed germinates, ABA levels decrease; during germination and early growth of the seedling, ABA levels decrease even more. As plants begin to produce shoots with fully functional leaves, ABA levels begin to increase, slowing down cellular growth in more "mature" areas of the plant. Stress from water or predation affects ABA production and catabolism rates, mediating another cascade of effects that trigger specific responses from targeted cells. Scientists are still piecing together the complex interactions and effects of this and other phytohormones. Auxins[edit] The auxin, indoleacetic acid Auxins are compounds that positively influence cell enlargement, bud formation and root initiation. They also promote the production of other hormones and in conjunction with cytokinins , they control the growth of stems, roots, and fruits, and convert stems into flowers. They stimulate cambium , a subtype of meristem cells, to divide and in stems cause secondary xylem to differentiate. Auxins act to inhibit the growth of buds lower down the stems apical dominance , and also to promote lateral and adventitious root development and growth. Leaf abscission is initiated by the growing point of a plant ceasing to produce auxins. Auxins in seeds regulate specific protein synthesis, [19] as they develop within the flower after pollination , causing the flower to develop a fruit to contain the developing seeds. Auxins are toxic to plants in large concentrations; they are most toxic to dicots and less so to monocots. Because of this property, synthetic auxin herbicides including 2,4-D 2,4-dichlorophenoxyacetic and 2,4,5-T have been developed and used for weed control. Auxins, especially 1-Naphthaleneacetic acid NAA and Indolebutyric acid IBA , are also commonly applied to stimulate root growth when taking cuttings of plants. The most common auxin found in plants is indoleacetic acid or IAA. Brassinosteroids[edit] Brassinolide, a major brassinosteroid Brassinosteroids are a class of polyhydroxysteroids, the only example of steroid based hormones in plants. Brassinosteroids control cell elongation and division, gravitropism , resistance to stress, and xylem differentiation. They inhibit root growth and leaf abscission. Brassinolide was the first identified brassinosteroid and was isolated from extracts of rapeseed Brassica napus pollen in They were called kinins in the past when the first cytokinins were isolated from yeast cells. They also help delay senescence of tissues, are responsible for mediating auxin transport throughout the plant, and affect internodal length and leaf growth. Cytokinins counter the apical dominance induced by auxins; they in conjunction with ethylene promote abscission of leaves, flower parts, and fruits. Ethylene has very limited solubility in water and does not accumulate within the cell but diffuses out of the cell and escapes out of the plant. Its effectiveness as a plant hormone is dependent on its rate of production versus its rate of escaping into the atmosphere. Ethylene is produced at a faster rate in rapidly growing and dividing cells, especially in darkness. New growth and newly germinated seedlings produce more ethylene than can escape the plant, which leads to elevated amounts of ethylene, inhibiting leaf expansion see Hyponastic response. Ethylene affects cell growth and cell shape; when a growing shoot hits an obstacle while underground, ethylene production greatly increases, preventing cell elongation and causing the stem to swell. The resulting thicker stem can exert more pressure against the object impeding its path to the surface. Studies seem to indicate that ethylene affects stem diameter and height: When stems of trees are subjected to wind, causing lateral stress, greater ethylene production occurs, resulting in thicker, more sturdy tree trunks and branches. Normally, when the seeds are mature, ethylene production increases and builds-up within the fruit, resulting in a climacteric event just before seed dispersal. The nuclear protein Ethylene Insensitive2 EIN2 is regulated by ethylene production, and, in turn, regulates other hormones including ABA and stress hormones. They were first discovered when Japanese researchers, including Eiichi Kurosawa, noticed a chemical produced by a fungus called Gibberella fujikuroi that produced abnormal growth in rice plants. The synthesis of GA is strongly upregulated in seeds at germination and its presence is required for germination to occur. In seedlings and adults, GAs strongly promote cell elongation. GAs also promote the transition between vegetative and reproductive growth and are also required for pollen function during fertilization. Jasmonic acid can be further metabolized into methyl-JA, which is a volatile organic compound. This unusual property means that methyl-JA can act as an airborne signal to communicate herbivore attack to other distant leaves within one plant and even as a signal to neighboring plants. It was originally isolated from an extract of white willow bark Salix alba and is of great interest to human medicine, as it is the precursor of the painkiller, aspirin. In plants, SA plays a critical role in the defense against biotrophic pathogens. In a similar manner to JA, SA can also become methylated. Like methyl-JA, methyl-SA is volatile and can act as a long distance signal to neighboring plants to warn of pathogen attack. In addition to its role in defense, SA is also involved in the response of plants to abiotic stress particularly drought, temperature, heavy metal and osmotic stress. It was found that the germination of Striga species was stimulated by the presence of a compound exuded by the roots of its host plant. Plant peptide hormones â€" encompasses all small secreted peptides that are involved in cell-to-cell signaling. These small peptide hormones play crucial roles in plant growth and development, including defense mechanisms, the control of cell division and expansion, and pollen self-incompatibility. They are essential for plant growth and development and affect the process of mitosis and meiosis. Nitric oxide NO â€" serves as signal in hormonal and defense responses e. ATP synthesis in chloroplasts and mitochondria. Karrikins can promote seed germination in many species. The cellular karrikin signalling pathway shares many components with the strigolactone signalling pathway. Potential medical applications[edit] Plant stress hormones activate cellular responses, including cell death, to diverse stress situations in plants. Researchers have found that some plant stress hormones share the ability to adversely affect human cancer cells. For example, sodium salicylate has been found to suppress proliferation of lymphoblastic leukemia, prostate, breast, and melanoma human cancer cells.

Chapter 4 : PPT - Plant Growth Substances PowerPoint Presentation - ID

These are called plant growth substances. Regulation of plant growth through chemical mechanisms frequently involves certain molecules known as hormones. Based on the origin and biological activities plant growth substances are grouped into three - growth regulators, phytohormones and growth inhibitors.

Chapter 5 : plant growth substances - English-French Dictionary - Glosbe

of growth substances to plants depends not only on the species of plant, its stage of development, and the rate at which the substance is applied, but also on the part of the plant to which.

Chapter 6 : Plant Growth Substances: Principles and Applications - Richard N. Arteca - Google Books

plant growth substances (Science: plant biology) substances that, at low concentration, influence plant growth and differentiation. Formerly referred to as plant hormones or phytohormones, these terms are now suspect because some aspects of the hormone concept, notably action at a distance from the site of synthesis, do not necessarily apply in plants.

Chapter 7 : Plant Physiology

Plant growth substances (plant hormones), the auxins, kinins, gibberellins, abscisins and ethylene, are a group of metabolically-active substances in plants concerned with development.

Chapter 8 : Auxins | The International Plant Growth Substances Association

In a convenient, single-source reference, this book examines plant growth substances and their relationship to a wide range of physiological processes, ranging from seed germination through the death of the plant.

Chapter 9 : Plant Growth Substance | Definition of Plant Growth Substance by Merriam-Webster

Plant Growth Substances/Hormones. I. Plant Hormones - do they exist? You betcha. In class we will provide some case studies, including early experiments by Darwin (), Boysen-Jensen (), Paal () and Went () involving phototropic curvature in canary grass coleoptiles and more recent work concerning fruit set in soybean.