Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 04, Issue: 01 (JAN-FEB, 2024)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Plant Growth Regulators

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Plant Growth Regulators (PGRs) and growing media can significantly impact the germination of bael (Aegle marmelos) seedlings. Bael, also known as the Indian Bael or Wood Apple, is a fruit-bearing tree native to India and other parts of Southeast Asia.
To understand their impact on germination, let's explore how each factor affects bael seedlings separately:

Plant Growth Regulators (PGRs)

Plant Growth Regulators are substances that can influence plant growth and development. Different PGRs can have different effects on germination:

Gibberellic Acid (GA_3): Gibberellic acid is a PGR that is often used to promote seed germination. Applying GA_3 to bael seeds can break dormancy and enhance germination rates. GA_3 can play a significant role in breaking seed dormancy and enhancing germination rates. Here's how it works:
Breaking Seed Dormancy: Many plant seeds, including those of the bael tree (Aegle marmelos), have built-in dormancy mechanisms that prevent them from germinating under unfavorable conditions. GA_3 can effectively overcome this dormancy. It does so by stimulating the production of enzymes that break down inhibitors or barriers to germination within the seed. As a result, the embryo within the seed can begin to grow, leading to germination.
Enhancing Germination Rates: GA_3 not only breaks dormancy but also promotes more uniform and faster germination. It can lead to quicker and more synchronized seedling emergence, which is crucial for achieving a healthy and productive crop or plant stand. When using GA_3 for bael seed germination, it's essential to follow appropriate guidelines and recommendations:
Concentration: The concentration of GA_3 used should be within a specific range that is effective for breaking dormancy without causing harm to the seeds or seedlings. The optimal concentration can vary depending on the seed type and environmental conditions.
Application Method: GA_3 can be applied by soaking the bael seeds in a GA_3 solution before sowing or by incorporating it into the growing media. The choice of application method should consider the seed size and characteristics.
Timing: The timing of GA_3 application is crucial. It is typically applied before sowing, but the exact timing can depend on the specific requirements of bael seeds.
Environmental Conditions: Ensure that the growing conditions, such as temperature and moisture, are suitable for bael seed germination, as GA_3 alone won't compensate for inadequate environmental factors.

Gibberellic Acid (GA_3) is a valuable tool for promoting bael seed germination by breaking seed dormancy and enhancing germination rates. When used correctly, it can improve the success of germination and lead to healthier and more uniform bael seedlings.

Auxins: Auxins, such as indole-3-acetic acid (IAA), are hormones that regulate cell elongation and are involved in root development. They can also be used to encourage root formation in seedlings.

Auxins are a class of plant hormones that regulate various aspects of plant growth and development. One of their significant roles is in promoting cell elongation and controlling the direction of growth. In the context of seedlings, auxins play a critical role in root development and can be used to encourage root formation. Here's how this works:

Root Development: Auxins are primarily associated with promoting root growth. They are produced in the shoot apical meristems and transported downward to the root tips. In the root, auxins control cell elongation, allowing roots to penetrate the soil effectively and access water and nutrients.

Use in Root Formation: In the context of seedlings, applying exogenous auxins like IAA can be a valuable technique to encourage the formation of roots from stem or leaf cuttings. This is commonly used in horticulture for propagating plants vegetatively. By providing an external source of auxins, you can stimulate the growth of root primordia, leading to the development of a new root system.

When using auxins like IAA to promote root formation in seedlings, several factors should be considered:

Concentration: The concentration of IAA or other auxins should be carefully controlled, as excessive concentrations can have adverse effects, such as inhibiting root growth.

Application Method: Auxins can be applied as a rooting hormone in various forms, including powder, gel, or liquid solutions. The choice of application method depends on the plant species and the specific needs of the seedlings.

Environmental Conditions: Adequate environmental conditions, such as temperature and humidity, are essential to support the formation and growth of new roots.

Auxins like IAA are important hormones that regulate cell elongation and are involved in root development. When applied appropriately, they can be used to encourage root formation in seedlings, helping to establish healthy and robust root systems, which are essential for overall seedling growth and establishment.

Cytokinins: Cytokinins promote cell division and are useful in tissue culture and micropropagation, but their role in seed germination may be limited.

Cytokinins play a significant role in promoting cell division and differentiation. They are often used in tissue culture and micropropagation techniques to stimulate the formation of shoots and roots from plant explants. In this context, cytokinins are crucial for generating numerous new plantlets from small sections of a parent plant.

When it comes to seed germination, cytokinins typically have a more limited role for several reasons:

Seed Germination Mechanism: The primary stages of seed germination are primarily regulated by other hormones, such as gibberellins and abscisic acid. Gibberellins break seed dormancy, while abscisic acid inhibits it. Cytokinins do not directly address these processes, making them less involved in the early stages of germination.

Embryo Growth: In seed germination, the embryo within the seed grows, leading to the emergence of a seedling. While cytokinins can stimulate cell division and growth in mature plants, they are less critical during the initial stages of embryo growth within a seed.

Excess Stimulation: Overapplication of cytokinins during seed germination can sometimes lead to abnormal growth, which may not be desirable in many cases. Excessive cell division could lead to the production of abnormal or unviable seedlings.
In summary, cytokinins are indeed essential for promoting cell division and growth in mature plants and are extensively used in tissue culture and micropropagation. However, their role in seed germination is more limited compared to other plant growth regulators, and their application in this context should be carefully considered to avoid potential adverse effects on the germination process.

Abscisic Acid (ABA): ABA is a hormone that inhibits germination and promotes seed dormancy. Reducing ABA levels in the seed may improve germination.
Inhibiting Germination: ABA is primarily associated with maintaining seed dormancy, a state in which seeds do not germinate even when placed in favorable environmental conditions. This dormancy mechanism prevents premature germination when conditions might not be suitable for seedling survival. ABA inhibits the growth of the embryonic plant within the seed, specifically by preventing cell elongation in the radicle (embryonic root) and coleoptile (protective sheath).
Breaking Seed Dormancy: When seeds are exposed to appropriate conditions, such as moisture, light, or specific temperatures, ABA levels decrease. This reduction in ABA is a signal for the seed to end dormancy and initiate germination. Other hormones, like gibberellins, often work in conjunction with reduced ABA levels to stimulate germination.
Improving Germination: In some cases, to improve germination rates, it may be necessary to reduce the levels of ABA in seeds artificially. This can be achieved through techniques like scarification, stratification, or chemical treatments. Chemical treatments might involve the use of gibberellins to counteract the inhibitory effects of ABA or using other substances that promote ABA degradation.
In summary, ABA is a hormone that inhibits germination and promotes seed dormancy. Reducing ABA levels within the seed, either naturally through exposure to suitable environmental conditions or artificially through treatments, is an effective way to improve germination rates and initiate seedling growth when conditions are favorable for the plant's survival.
The choice of PGR and its concentration should be carefully considered based on the specific requirements of bael seed germination. Experimentation with different PGR treatments may be necessary to optimize germination rates.

Growing Media

The choice of growing media can also impact bael seed germination. Here are some factors to consider:
Substrate Composition: The growing medium should have good aeration and water-holding capacity. A well-draining, sterile, and lightweight medium is ideal for bael seed germination. A mixture of peat, perlite, and vermiculite is commonly used.
pH Level: The pH of the growing medium should be within the optimal range for bael seed germination, which is typically slightly acidic to neutral (pH 6-7).
Moisture Content: Adequate moisture is essential for germination. Ensure that the growing medium is consistently moist but not waterlogged. Avoid drying out or overwatering, as this can inhibit germination.
Temperature and Light: Bael seeds usually germinate well in warm temperatures. Providing the appropriate temperature and light conditions in your growing environment is important for successful germination.
In summary, the choice of PGRs and growing media can impact the germination of bael seedlings. Proper experimentation and observation are essential to determine the most

effective combination of PGRs and growing media for your specific bael seed germination needs. Additionally, it's crucial to monitor the environmental conditions, such as temperature and light, to ensure optimal germination.

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