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Effect of plant growth regulators (PGRs) on fruits: An overview

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Abstract

Use of plant growth regulators have become an important part in agricultural activities. Plant growth hormones in accordance to their surrounding are created and regulated. When applied in passable concentrations it affects or regulates the plant. They have very specific impacts on plants. Their usage and impact is discussed in this overview.

Keywords: Propagation, application, phytohormones

Introduction

Phytohormones or plant growth regulators (PGRs) are organic compounds produced in a plant which supports many physiological functions and growth. The term 'phytohormone' was given by Thimmann (Suman *et al.*, 2017) ^[26]. Different types of plant growth regulators include auxins, gibberellins, cytokinins, abscissic acid and ethylene (Small *et al.*, 2018) ^[25]. Auxins, gibberellins and cytokinins come under plant growth promoter while abscissic acid comes under plant growth inhibitor (Khan *et al.*, 2020) ^[13]. Auxin is one of the first plant hormone to be discovered (Kumari *et al.*, 2018) ^[17]. PGRs play an important role in improving the quality and yield of fruits. It also serves as an aid in time of propagation. The hormones have their own specific functions (Naqvi, 2001) ^[20]. The categorized plant growth promoters support cell division, cell enlargement, flowering, fruiting and seed formation. Plant growth inhibitor or bioinhibitors are involved in dormancy and abscission (Chaudhary *et al.*, 2006) ^[5]. Exogenous application of PGRs is done to different agricultural responses (Gaba, 2005) ^[10].

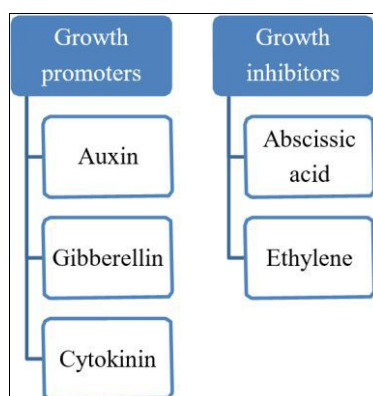


Fig 1: Plant growth regulators

Auxin

Auxin is primarily involved in cell expansion and cell elongation. They are formed in the root and shoot apices of plants and moves in acropetal manner (Kogl and Haagen – Smith, 1931) ^[14]. One such auxin is naphthaleneacetic acid (NAA). It is commonly used in propagation of stem cuttings. Fruit drop is also said to be managed by use of NAA (Kumari *et al.*, 2018) ^[17]. Other effective uses of auxin are for sprouting purposes by xylem and phloem differentiation along with lignifications process (Ughareja *et al.*, 2022) ^[28].

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Gibberelin

Kurosawa a Japanese farmer observed some rice plants were larger in size, pale, with long and narrow leaves and fruitless. After investigating, gibberellin was discovered. Gibberellins help in the regulation of fruit development. A study conducted by Garner *et al.*, (2011) ^[33] showed that, foliar application of GA3 in 'Hass' variety of avocado increased yield and fruit size.

Cytokinin

Dating back to Folke Skoog's laboratory cytokinin was discovered in the 1940s. It mainly encourages cell division. Term 'cytokinin' was given by Letham in 1963 (Letham, 1963) ^[18]. Cytokinin regulates a variety of physiological and biochemical processes like axillary shoot branches, root meristematic cell, apical dominance and lateral roots formation (Koprna *et al.*, 2016) ^[15]. A study conducted by Huang *et al.*, (2014) ^[12] showed inhibition of ripening in

bananas at 10 mg/L CPPU.

Abscissic acid (ABA)

Abscissic acid is found in many plant organs and tissues. Due to the presence of ABA a lot of leaves and fruits are forced to abscise in different plant species. Buds of woody plants of temperate regions are affected by ABA that causes dormancy. Exogenous applications of ABA have effect on endogenous ABA causing ripening in certain fruits like raspberry, kiwi, strawberry etc (Zaharah *et al.*, 2012) ^[30].

Ethylene

Ethylene is a natural hormone which affects the storage stability of various fruits and vegetables. The effectiveness of ethylene is influenced by both endogenous and exogenous sources (Suman *et al.*, 2017) ^[26]. Another use of ethylene besides ripening is the use of ethephon treatment for flower bud development in pineapple (Onaha *et al.*, 2001) ^[21].

Table 1: Effect of different PGRs on fruit propagation

Crop	Propagation	PGR	Concentration	Reference
Mango	Shoot tip	IBA	1000 ppm	Yang and Luders, 1992 ^[29]
Pomegranate	Cuttings	IBA	500 ppm	Sharma <i>et al.</i> , 2009 ^[24]
Guava	Cuttings	IBA, NAA	1000 ppm, 1000 ppm	Debnath and Maiti, 1990 ^[8]
Grapes	Shoot apical meistem	IBA	1000 ppm	Aazami, 2010 ^[1]
Citrus	Nodal explants	IBA	100 ppm	Fadli <i>et al.</i> , 2017 ^[9]
Litchi	Air layers	IBA	5000 ppm	Das and Prasad, 2014 ^[7]
Apricot	Cuttings	IBA	2000 ppm	Suriyapananont, 1987 ^[27]
Apple	Rootstocks	IBA	1.5 mgL ⁻¹	Ghanbari, 2014 ^[11]
Peach	Cuttings	IBA	50 ppm	Chauhan and Maheshwari, 1970 ^[6]
Dragon fruit	Cuttings	IBA	7000 ppm	Ayesha and Thippesha, 2018 ^[3]
Jackfruit	Air layers	IBA	1.5 mgL ⁻¹	Mukherjee and Chatterjee, 1978 ^[19]
Almond	Apical shoot tips	IAA	0.5 mgL ⁻¹	Akbas <i>et al.</i> , 2009 ^[2]
Walnut	Applied during stooling	IAA NAA	100 ppm 500 ppm	Rashid, 1978 ^[22]
Strawberry	Runners development	GA3	80 ppm	Kumar <i>et al.</i> , 2012 ^[16]
Sweet cherry	Fruit size	CPPU	100 mg/L	Zhang <i>et al.</i> , 2011 ^[31]
Mango	Fruit size	Ethrel	200 ppm	Karuna <i>et al.</i> , 2007 ^[32]

Conclusion

In conclusion, phytohormones or plant growth regulators (PGRs) are essential for regulating plant growth and development. These organic compounds, including auxins, gibberellins, cytokinins, abscisic acid, and ethylene, each play distinct roles in promoting or inhibiting various physiological processes. Auxins, such as naphthaleneacetic acid, facilitate cell expansion and propagation. Gibberellins, discovered from rice anomalies, are pivotal in fruit development and yield enhancement. Cytokinins are crucial for cell division and plant growth regulation, while abscisic acid manages dormancy and abscission. Ethylene, influential in fruit ripening and storage, also aids in flower bud development. Understanding and applying these PGRs can significantly enhance agricultural practices, optimizing plant growth, fruit quality, and overall yield.

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