# FOLIAR EFFECT OF INDOLE -3-ACETIC ACID AND JASMONIC ACID (JA) ON DIFFERENT PLANT: A REVIEW

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***Abstract:*** The term phytohormone was synonymous with auxin, the existence of other phytohormones. Plant hormone are "Organic compounds which regulate plant physiological process regardless of whether these compounds are naturally occurring synthetic: stimulating and inhibitory: local activators or substances which act a distance from the place where they are formed." The application of plant growth regulators in agriculture has started in 1930 in United States, a naturally occurring substance, is one of the first plant growths being discovered and used successfully for enhancing flower production in pineapple. The word Auxin is derived from the Greek word, "Auxin" which mean "to enlarge or to grow''. Charles Darwin was the first scientist who performed auxin experiments on canary grass (*Phalaris canariensis*) coleoptiles. It is plays in a number of plant activities, including phototropism, gravitropism, apical dominance, fruit development. Jasmonic acid (JA) is endogenous plant growth regulators widely distributed in higher plants. The synthesis of Jasmonic acid takes place via the octadecanoid pathway. The precursor of Jasmonic acid is α-linolenic acid. Jasmonic acid is volatility and presence in essential oils of *Jasminum grandiflorum* L. and *Rosmarinus officinalis* L. During the last many years, the many research and inventions have showed that Auxin (IAA, IBA and NAA etc.) and JA foliar application on different ppm and µl solution of high concentration and low concentration effects on different plants.
***Keywords:*** **Plant growth regulators, Indole 3- Acetic Acid, Jasmonic Acid, Other Plant Growth Regulators**

## 1. INTRODUCTION

It is 60 years since Went and Thimann in 1937 published their classic book Phytohormones. At that time, the term phytohormone was synonymous with auxin, the existence of other phytohormones. Phytohormone main role their cell division factors, was on the basis of physiological experiments. The structure of auxin, many of the phenomena of auxin physiology were already known that time. It is equally impressive that much auxin biology including the Cholodny Went hypothesis (Went and Thimann, 1937).

Since 1937, Gibberellin (GA), Ethylene, Cytokinin, and Abscisic acid (ABA) have auxin as phytohormone; they are regarded as the "Classical five". These groups are expected to grow as the hormonal functions of other compound are recognized and as new hormones are discovered (Creelman and mullet, 1997, in this issue).

### *1.1 Plant Hormone*

The endogenous compound is synthesized at one site and transported to another physiological effect in very low concentration (G.Sharma, 2015). A defined of plant hormones given by Johannes van Overbeek (1950). According to him defined as "Organic compounds which regulate plant physiological process-regardless of whether these compounds are naturally occurring synthetic: stimulating and inhibitory: local activators or substances which act a distance from the place where they are formed."

### *1.2 Plant Growth Regulators*

Defined the natural or synthetic compounds are applied directly to a target plant to alter its life processes or its structure to improve quality, increase yields, or facilitate harvesting (G.Sharma, 2015). The application of plant growth regulators in agriculture has started in 1930 in United States, a naturally occurring substance, is one of the first plant growths being discovered and used successfully for enhancing flower production in pineapple (F. M. Fishel, 2006).

## 2. AUXIN

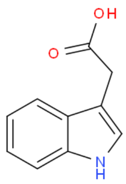
### *2.1 Indole 3-Acetic Acid (IAA)*

The most important Auxin produced by plants is indole 3- acetic acid. It is plays in a number of plant activities, including phototropism, gravitropism, apical dominance, fruit development.

IAA plays main role on regulating plant growth. For example, it controls vascular tissue development, cell elongation, and apical dominance (Wang *et al*., 2001). IAA also responds to salinity in crop plants. The variations in IAA content under stress conditions appeared to be similar to abscisic acid (Ribaut and Pilet, 1991).

Charles Darwin was the first scientist who performed auxin experiments on canary grass (*Phalaris canariensis*) coleoptiles. He observed the effect of a hypothetical substance modulating plant shoot elongation to allow tropic growth toward light. It was discovered by Salkowski in 1885 in fermentation media.

This test is known as the avena curvature test. Kogl and Haagen-Smit purified the compound auxentriolic acid (auxin A) from human urin in 1931. After Kogl isolated other compound from urine, which was IAA, the same was primarily discovered by Salkowski in 1885. Finally in 1954 plant physiologists committee was set up to characterize the group auxin.




Indole 3-Acetic Acid Chemical structure, Formula: $C_{10}H_9NO_2$

### *2.2 Functions of Auxin*

The following are some of the responses that auxin is known to cause,

- Stimulates cell loosening, expansion and elongation
- Initiation of adventitious roots on stem cuttings
- Lateral root development in tissue culture
- Stimulates differentiation of phloem and xylem
- Stimulation of abscission (young fruits) or delay of abscission
- Stimulates cell division in tissue culture in combination with cytokinins
- Mediates the tropistic response of bending in response to gravity and light

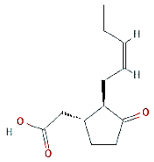
## 3. JASMONIC ACID

Jasmonic acid (JA) is endogenous plant growth regulators widely distributed in higher plants (Tizio 1996). The synthesis of Jasmonic acid takes place via the octadecanoid pathway. The precursor of Jasmonic acid is linolenic acid (www.planthormones.info/auxins.htm)

There are two ways to induced resistance, the acquired systemic resistance (ASR) and induced systemic resistance (ISR), which can be differentiated by the nature and regulatory paths of the inductor (also called elicitor) (Kunkel *et al*., 2002). Jasmonic acid is effective against viral, bacterial and fungal diseases, dependent on JA signalling and the plant roots are colonized by some non-pathogenic rhizobacteria or herbivores insect damage (Clarke *et al*., 2000)

In plants JA is synthesized from linolenic acid released from lipid membranes and converted into JA. JA synthesis can be also activated by herbivores, (tissues and leaves damages), injuries caused by mechanical damage. JA induces trichomes formation on leaves, which confer protection to the leaf, another essential role of in the immunity activation against pathogens that feed on dead tissues, such as some necrotrophic fungi or bacteria (Gutjahr C. and Paszkowski U. 2009).

In plants, the resistance against pathogenic infection can be improved by biotic and abiotic treatments, also called inductors. The biotic inductors include: *necrotrophs* and *rizobacteria* infection, such as *Bacillus, Streptomyces, Pseudomonas, Burkholderia and Agrobacterium*, non-pathogenic microorganisms (Alizadeh H. *et al*., and Akram W. *et al*., 2013). The abiotic inductors include chemical products or molecules as responsible of disease resistance signalling (Walters D. *et al*., 2005).



Jasmonic acid Chemical structure Formula: $C_{12}H_{18}O_3$

Jasmonic acid is structurally of α-linolenic acid. It includes group of oxygenated fatty acids called oxylipins. These occur in the plant kingdom along with some reports about production by fungi also. Its derivative, methyl jasmonate was first of all derived from jasmine oil (Demole *et al*. 1962).

***3.1 Functions of Jasmonic acid***

The following are some of the responses that Jasmonic acid is known to cause,

- They regulate induced defence mechanisms in plants insect attack and wounding
- Most of the Jasmonic acid induced proteins (JIPs) (Vandenborre *et al*., 2009) have direct defence function against insects.
- Jasmonic acid is signalling molecules the play role against abiotic and biotic stresses as well as in the plant development (War *et al*., 2012).
- And other JA substances have physiological effects, like growth inhibition in rice seedling, promotion of senescence in detached oat leaves, and inhibition of pollen germination.

## 4. ROLE OF AUXIN

Patel *et al*., 2012 revealed that application NAA increases the fruit diameter in **tomato.** Verma *et al*., 2014 revealed that fruit set in tomato was successfully improved by application of NAA. Mukharji and Roy (1966) found that application of IAA had protected the flower and premature fruit drop and increased length size fruit in tomato plant. Upadhyaya (1967) studied the effect of IAA and NAA on tomato and reported that the regulators induce parthenocarpic fruit.

J. K. Kushwah *et al*., (2015) was experiment on **cabbage (*Brassica oleracea var. capitata L.*)** effect of auxin (IAA 50ppm, 100ppm, 150ppm) and (IBA 100ppm, 150 ppm on two varieties Golden Acre ($V_1$), Pride of India ($V_2$). The maximum cabbage head yield with (IAA 150ppm V2 treatment. Highest net return and benefit: cost ratio (1:3:74) have been estimated by IBA 50ppm treatment with variety Golden Acre IAA 50ppm) was found.

M. Okao *et al*., 2016 was experiment on Effect of mode of auxin application on rooting and Bud Break of **Shea Tree (*Vitellaria paradoxa*)** cutting. Treatment of Extended sock (24 h) (60ppm,80ppm, 100ppm, 40ppm), Foliar spray (60ppm, 80ppm,2500ppm, Quick dip method (3500ppm, 4500ppm, 2500ppm), Delayed IBA application (3500ppm, 4500ppm). Result gets the root length increased with IBA concentration. Stem cutting extended soak at 100ppm rooted best (59.5% ± 8.33%), foliar spray stem cutting rooting success (11.9 ± 3.06 – 23.8 % ± 4.16%). Bud break decrease with increasing IBA concentration and delaying IBA application enhanced rooting of the quick dip method by 7.1%, 9.5% and 11.9% at 2500ppm, 3500ppm and 4500ppm. The extended sock method of IBA application at 80 ppm shows potential for large scale production of *V. paradoxa* through stem cuttings.

Dr. SS Kulkarni *et al*., 2017 were experiment on **mango (*Mangifera indica L.*)** effect of plant growth regulators on yield and quality. Result the improvement in fruit retention and yield of mango. Application of PGRs (NAA and CPPU) was found to be increasing yield of mango cv. Keshar. Application of PGRs at mustard + Pea stage were found effective in increasing number of fruit and weight of fruit than single application, CPPU 10ppm at mustard + pea stage recorded maximum fruit yield 107.00 kg/tree and 10.70t/ha of mango cv. Keshar.

## 5. ROLE OF JASMONIC ACID

B. Hamedi *et al*., in 2014 he was experiment on effect of foliar application of Jasmonic acid on Hypericin content of **St. John'S Wort (*Hypericum perforatum L.*).St. John's Wort is one of important medicinal plants in the world.** This herb has used in traditional folk medicine treatment of various ailments. Experimental treatment included 1) water foliar application (control), 2) water + acetone foliar application (as a solvent, 3-4) 50, 100, 200 and 400 µL/L JA. The result indicated the different level of foliar application of JA highly significant impacts on Hypericin content. Highest amount of hypericin is 200 µL/L. JA with 0.8% (w/w). JA foliar application for rapid and increased production of hypericin. It also important secondary metabolite in *H. perforatum* with a wide range of biologically active.

T. Jahanbazi *et al*., 2014 were experiment on **rose (cv. 'Angelina') flowers** on impacts of Jasmonic acid on keeping quality. Result get in the Jasmonic acid (JA) foliar application best dosage of each material was 50ppm.

M. Yadegari and A. Shakerian 2014 were experiment on the effect of Salicylic acid and Jasmonic acid foliar applications on Essence and Essential Oil of **Salvia (*Salvia officinalis* L.)**. In 1mM SA led to the same total production of many essential oils like β-pinene, camphor, thymol, thujone-cis, carvacrol, α-humulene and caryophyllene were less produced in JA(50µl); only α-pinene, β-pinene, camphene, 1,8-cineole, veridiflorol were produced better in JA (50 and 100 µl).

E. Sewedan *et al*., 2018 were experiment on Effect of methyl Jasmonic acid and salicylic acid on production of ***Gladiolus grandifloras* L**. last obtained results it was concluded that treating *Gladiolus* plants with combination of SA at 150ppm and methyl jasmonate at 75 ppm improve the vegetative growth, flowering characteristics, Corm Production and the contents of total chlorophyll in the laves of *Gladiolus* plants.

A. G. Pirbalouti *et al*., 2013 these study concluded in a CRD with three replications and in experimental greenhouse, Experimental treatment included in (3-4) 50, 100 and 200 JA µL. result of foliar application of 200 µL JA on some of secondary metabolite production in ***Hyssopus officinalis L***. oil could be partially changed.

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