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Manoj Kumar Gora
Ph.D. Scholar, Department of Agronomy, CCSHAU, Hisar, Haryana, India

Harikesh Jat
Ph.D. Scholar, Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan, India

Kailash Chand Jakhar
Ph.D. Scholar, Department of Extension Education, MPUAT, Udaipur, Rajasthan, India

Hemraj Jat
Ph.D. Scholar, Department of Agriculture Chemistry and Soil Science, MPUAT Udaipur, Rajasthan, India

Ashish Shivran
Assistant Professor Department of Agronomy, CCSHAU, Hisar, Haryana, India

Correspondence
Harikesh Jat
Ph.D. Scholar, Department of Agronomy, RCA, MPUAT, Udaipur, India

Potentiate the productivity of oilseed crops by plant hormon benzyladenine, (Synthetic cytokinin): A review

Manoj Kumar Gora, Harikesh Jat, Kailash Chand Jakhar, Hemraj Jat and Ashish Shivran

Abstract
Cytokinins are plant hormones that plants produce naturally and regulate plant growth including cell division and leaf senescence. Many chemical compounds have been synthesized and tested for cytokinin activity. Analysis of these compounds provides insight into the structural requirements for activity. Nearly all compounds active as cytokinins are N6- substituted aminopurines, such as benzyladenoe (BA). The beneficial effects of applied benzyladenine appear to be on account of formation of -SH compound and its cytokinin like activities and thus increased plant growth parameters *viz*., plant height, number of branches and dry matter accumulation. An application of benzyladenine increased the yield. Significant increase in seed yield of oilseed could be ascribed to cumulative effect of yield components *viz.*, number of fruit, number of seeds and test weight which increased seed yield and ultimately led to greater seed production per unit area. Benzyladenine application significantly improved the quality of oilseed crops assessed as protein and oil content. Cytokinin (BA) may stimulate protein synthesis by stimulating the recruitment of previously untranslated mRNA in to polysomes.

Keywords: cytokinins, benzyladenoe, plant growth parameters, yield

Introduction
Plant growth substance is biochemical produced in plant (endogenous) or synthetic substances applied to plant externally (exogenous) which cause modification in plant growth and development. Plant growth substances produced by plant are referred to as phytohormones or plant hormones the term 'phytohormone' was coined by Went and Thimann. Growth substance initiate biochemical processes which help in increased production of roots, shoots and flowers etc. Plant growth substances are mainly grouped into growth promoters (which enhance growth) and growth retardants (which reduce growth). There are five major group of endogenous growth substance present in plant *viz*. auxins, cytokinins, gibberellins, abscisic acid and ethylene are in single from (Spartz and Gray, 2008) [1].

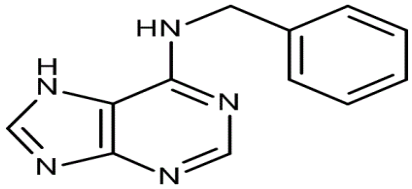
Cytokinins are plant hormones that plants produce naturally and regulate plant growth, including cell division and leaf senescence. There are several commercial plant growth regulators (PGRs) that contain benzyladenine, a synthetic cytokinin. The cytokinins were discovered in the search for factors that stimulate plant cells to divide (*i.e.*, undergo cytokinesis). Since their discovery, cytokinins have been shown to have effect on many other physiological and development processes, including leaf senescence, nutrient moblilzation, apical dominance, the formation and activity of shoot apical meristems, floral development, the breaking of bud dormancy, and seed germination. Cytokinins also appear to mediate many aspects of light-regulated development, including chloroplast differentiation, the development of autotrophic metabolism, and leaf and cotyledon expansion (Ikiba, L.K. 2017) [4].

Although cytokinins regulate many cellular processes, the control of cell division is central in plant growth and development and is considered diagnostic for this class of plant growth regulators. Mature plant cells stop dividing because they no longer receive a particular signal, possibly a hormone, That is necessary for the initiation of cell division. The idea that cell division may be initiated by a diffusible factor originated with the Austrian plant physiologist G. Haber landt, who, in about 1913, demonstrated that vascular tissue contains a water-soluble substance or substance that will stimulate the division of wounded potato tnber tissue. The effort to determine the nature of this factor (or factors) led to the discovery of the cytokinins in the 1950s (Kieber, J.J. 2002) [5].

The discovery, identification and properties of cytokinins

A great many substances were tested in an effort to initiate and sustain the proliferation of normal stem tissues in culture. Materials ranging from yeast extract to tomato juice were found to have a positive effect, at least with some tissue. However, culture growth was stimulated most dramatically when the liquid endosperm of coconut, also known as coconut milk, was added to the culture medium. Philip White s nutrient medium, supplemented with an auxin and 10 to 20 % coconut milk, will support the continued cell division of mature, differentiated cells from a wide variety of tissues and species, leading to the formation of callus tissue (Caplin and Steward 1948) [2]. This finding indicated that coconut milk contains a substance or substances that stimulate mature cells to enter and remain in the cell division cycle. Eventually coconut milk was shown to contain the cytokinins *zeatin*, but this finding was not obtained until several years after the discovery of the cytokinins (Letham, 1974) [7]. The first cytokinin to be discovered was the synthetic analog kinetin.

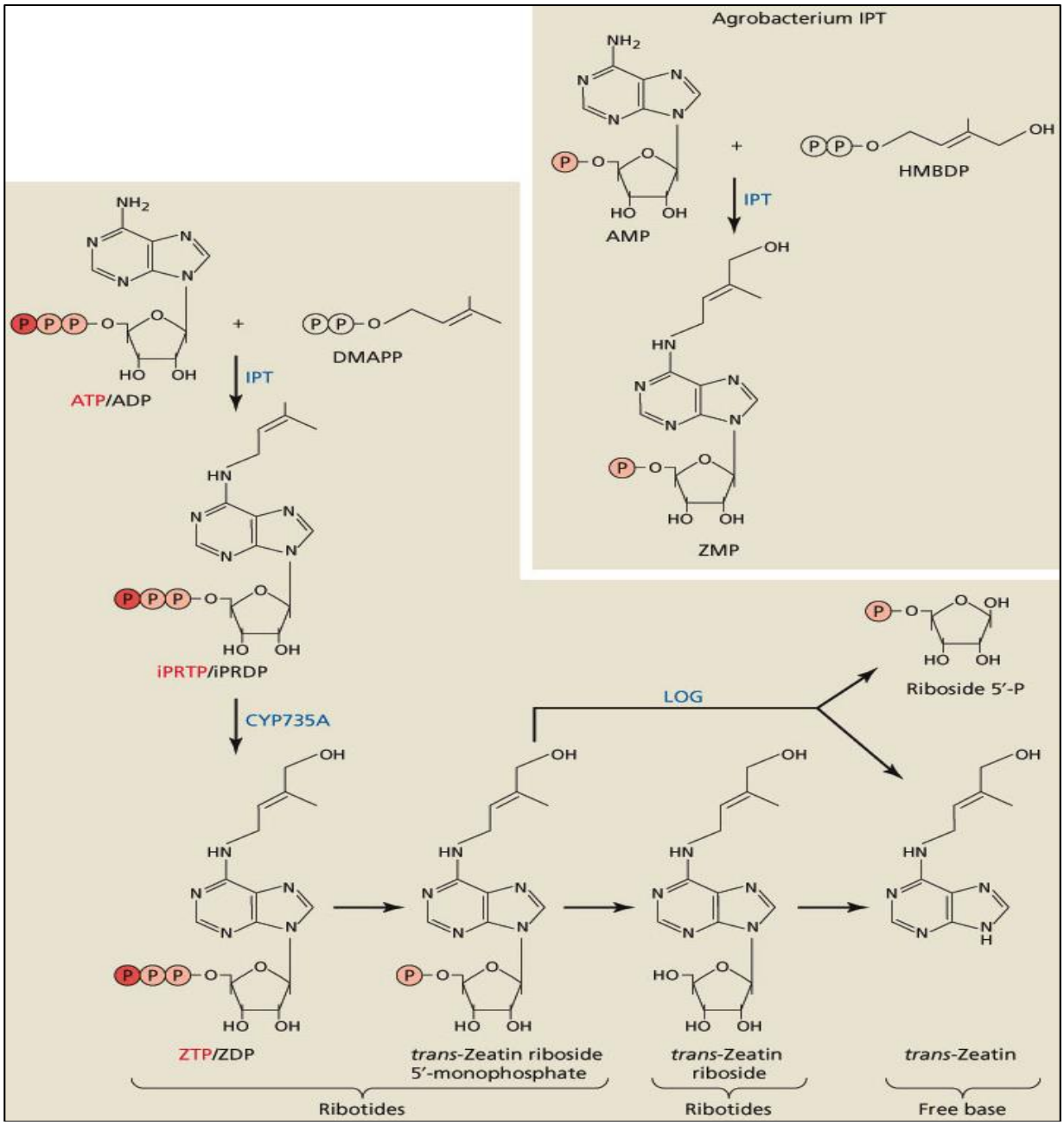
Many chemical compounds have been synthesized and tested for cytokinin activity. Analysis of these compounds provides insight into the structural requirements for activity. Nearly all compounds active as cytokinins are N6- substituted aminopurines, such as benzyladenoe (BA):



Chemical structure N-Benzyl-9H-purin-6-amine

Biosyntheis, metabolism and transport of cytokinins

The side chain of naturally occurring cytokinins are chemically related to rubber, carotenoid pigments, the plant hormones gibberellins and abscisic acid and some of the plant defense compounds are constructed, at least in part, from isoprene units.



Biosynthetic pathway for cytokinin biosynthesis

Isoprene is similar in structure to the side chain of zeatin and ip. These cytokinin side chains are synthesized from an isoprene derivative. Large molecules of rubber and the carotenoids are constructed by the polymerization of many isoprene units; cytokinins contain just one of these units. The precursor(s) for the formation of these isoprene structures are either mevalonic acid or pyruvate plus 3-phosphoglycerate, depending on which pathway is involved. These precursors are converted to the biological isoprene unit dimethylally diphosphate (DMAPP).

Effect of regulator benzyladenine on oilseed crops

Growth parameters

It is generally accepted that cytokinin group of hormones is directly involved in large number of physiological and metabolic processes like auxin. The beneficial effects of applied benzyladenine appear to be on account of formation of -SH compound and its cytokinin like activities and thus increased plant growth parameters *viz*., plant height, number of branches and dry matter accumulation (Samuel *et al.*, 2000) [9]. The profound beneficial effect might be a result of regulation of all organization of plant in the presence of cytokinin (BA). The increase in dry matter and leaves were associated with increase in chlorophyll content and photosynthetic activity in leaves. This view is in cognizance with the findings of Williams and Cartwright (1980) [11], Krishnan *et al.* (1999) [6] and Samuel *et al.* (2000) [9] who recorded increase in sink capacity, CGR, RGR and dry matter production with the application of benzyladenine.

Yield attributes and yield

An application of benzyladenine increased the yield. Significant increase in seed yield of oilseed could be ascribed to cumulative effect of yield components *viz.*, number of fruit, number of seeds and test weight which increased seed yield and ultimately led to greater seed production per unit area. These results are cognizance with the findings of Williams and Cartwright (1980) [11], Crosby *et al.* (1981), Krishnan *et al.* (1999) [6] and Samuel *et al.* (2000) [9] who reported higher yield attributes and yield with application of benzyladenine in different crops. Further, part of benevolence on oilseeds yield perhaps resulted on account of delicate interaction of auxin and cytokinin (BA) might have led to increased mobilization of metabolites and it's partitioning towards seed development. This contention appears to be quite logical, as applied benzyladenine brought about significant increase in number of fruit**,** number of seeds and test weigh. This view is in close cognizance with the findings of Williams and Cartwright (1980) [11], Krishnan *et al.*(1999) [6], Samuel *et al.* (2000) [9] and Patil *et al.* (2002) [8] who recorded increase in sink capacity, seed set, yield attributing characters and seed filling percentage as the source was not limiting factor. The increased vegetative growth and higher assimilate partitioning towards sink was also noticed by Patil *et al.* (2002) [8].

Quality parameters and nutrient uptake

Benzyladenine application significantly improved the quality of oilseed crops assessed as protein and oil content. Cytokinin (BA) may stimulate protein synthesis by stimulating the recruitment of previously untranslated mRNA in to polysomes. This finding is in close association with Patil *et al.* (2002) [8] who recorded a remarkable improvement in protein content of seed.

Further, significant improvement in oil content of seed might have due to increased transformation of stored translocated metabolites under the influence of favourable enzymatic activity created by BA application. While, oil yield increased due to increase in seed yield. These results are in close conformity with Samuel *et al.* (2000) [9], Patil *et al.* (2002) [8] and Vani *et al.* (2004) [10]. Patil *et al.* (2002) [8] also reported that benzyladenine increased nutrient uptake with concomitant increase in dry matter production.

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