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Role of Ethylene inhibitors in tissue culture

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Ethylene is a plant hormone which controls growth and senescence of plants. It is also produced by plant tissues developed *in vitro*. At times ethylene accumulates in large amount in the cultures, especially in suspension cultures or rapidly growing non-differentiated callus, thus it probably affects the growth and development in various plant systems. This review exhibits the role of agents which inhibits accumulation of ethylene in the different types of tissue culture systems. Although in some cases its influence seems negligible but in many types of tissue culture ethylene may act either as a promoter or inhibitor depending on the type of culture. Ethylene plays an important role in *in vitro* regeneration of plants.

Introduction

Profitable shoot organogenesis technique for plant regeneration is based on proper establishment of medium components, an appropriate explant and regulation of the physical environment (Brown *et al*., 1986). Ethylene (C2H4) is the main factors of physical environment in plant tissue culture which is a gaseous plant hormone. It plays an important role in plant growth and development(Kende *et al*., 1993). Similar researches has been done in the previous years using ethylene inhibitors, like cobalt chloride (CoCl2), aminoethoxyvinylglycine (AVG), silver nitrate (AgNO3), benzyl isothiocyanate (BITC), 1-methylcyclopropene (1-MCP), aminocarboxypropionic acid, polyamines, 3,4,5-trichlorophenol, silver thiosulphate (STS) and salicylic acid (2-hydroxybenzoic acid) for instigating shoot organogenesis in different plant species (Bai *et al*., 2013). Recently some *in vitro* plant regeneration studies were conducted in various plants has been reported (Ruduś *et al*., 2013; Siddikee *et al*., 2012; Luo *et al*.,2014).

Ethylene biosynthesis

Biosynthesis of ethylene needs intensive study. The biosynthesis of ethylene begin with conversion of the amino acid methionine to *S*-adenosyl-Lmethionine by the enzyme Met Adenosyltransferase. SAM is consequently converted to 1- aminocyclopropane-1-carboxylic-acid (ACC) by the enzyme ACC synthase (ACS). The action of ACS is the rate-limiting step in ethylene synthesis. The closing step involves oxygen and enzyme action of ACC-oxidase (ACO), also known as the ethylene forming enzyme (EFE) (Pech *et al*., 2010). Establishment of S-adenosylmethionine (SAdoMet) and ACC as the precursors of ethylene becomes a major breakthrough in the ethylene synthesis pathway. Based on this fact, the enzymes catalyzing these reactions were characterized and purified. The molecular cloning of the ACC (Jafari *et al*., 2013) and ACO (Shi *et al*., 2012) genes results in demonstration of these enzymes that fit in to a multi-gene family and are controlled by a complex network of developmental and environmental signals responding to both internal and external stimuli. Over and above being an indispensable building protein synthesis block, almost 80% of cellular methionine is converted to S-AdoMet by S-AdoMet synthetase at the rate of utilization of ATP (Osborne *et al*., 1996). S-AdoMet being the foremost methyl donor in plants, is used as a substrate for numerous biochemical pathways going on in plants simultaneously, including polyamines and ethylene biosynthesis (Ravanel et al. 1998).

Mechanisms of action of ethylene inhibitor on inhibition of ethylene production

Active elements of ethylene inhibitor compounds are capable of producing ethylene insensitivity in plants (Wang et al. 2004). Ethylene-insensitive mutations (Stepanova *et al*., 2005) interrupt with the ethylene binding sites (Sisler *et al.*, 2003). ETR1, ethylene receptor, have one ethylene-binding site per homodimer and binding is intervened by a single copper ion present in the ethylene-binding site. The replacement of the copper co-factor by inhibitor element also functions in locking the receptor into such a conformation where it continuously represses ethylene responses (Sisler *et al.*, 2003).

Conclusion

In this review, an attempt has been made to discuss the role of ethylene, its biosynthesis and the mechnanism how ethylene inhibitors interact and inhibit the action of ethylene on the plant cells. Although a lot of studies require the complete process. Current communication exhibits new dimensions in understanding plant morphogenesis. Thus, it is essential to explicate the physiological mechanisms at the gene regulation level to find out the definite role of ethylene inhibitors in signaling and to get to know how they influence regulation of ethylene action in plants.

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