Article ID 240204025

Growth Inhibitors - Their Application in Flower Crops

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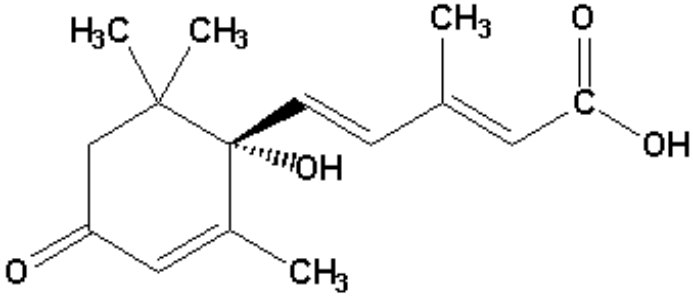
Growth inhibitors are the group of plant growth substances, they inhibit or retard a physiological or biochemical process in plants. Main effect of growth inhibitor is that it will cause malformation of leaves and stems, completely supresses the plant growth, cause yellowing and abscission of leaves, affects the vigour and rate of organ development and they inhibit the auxin transport. These are available in both synthetic and natural forms. Natural growth inhibitors are ABA, ethylene, coumarin, cinnamic acid, ferulic acid and whereas Synthetic growth inhibitors are TIBA, dichloroanisol.

Natural growth inhibitors

I. Abscissic acid

Abscisic acid (**ABA**), also known as **Dormin, Dormic acid (DMA)**, is best known as a plant hormone. It is degraded by the enzyme (+)-abscisic acid 8'-hydroxylase into phaseic acid. It also acts as stress hormone helping the plants to cope with adverse environmental conditions.



Abscisic Acid

A) Translocation of ABA

ABA is manufactured in mature leaves and moves up to the shoot apex. Analytical studies revealed that ABA moves through phloem and perhaps xylem as well. All plant parts are known to synthesize it.

B) Effects of ABA

1. ABA applied to hypocotyls, epicotyls, coleoptiles and leaves generally results in growth inhibition.
2. Application to roots can either inhibit or promote growth.
3. Application of ABA causes very fast abscission of leaves and flowers.
4. ABA induces flowering in short day plants and inhibits flowering in long day plants. In short day plants, it inhibits vegetative growth & cause apical bud dormancy. In such plants onset of dormancy precedes flowering. But ABA does not induced flowers in xanthium, another short-day plant.

C). Application of ABA in flower crops

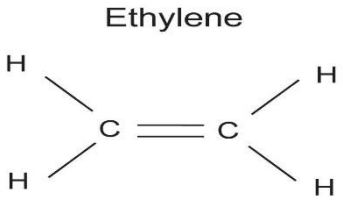
(i) Gladiolus: Dormancy is due to accumulation of growth inhibitory substances i.e. ABA in the tissue and scales encapsulating them. Cold storage causes decrease in the ABA level in tissues. Therefore, cold treatment (4 - 5˚C) for 3 - 4 months is used to break corm and cormel dormancy. Abscisic acid (100 and 150 µM) is involved in the induction of senescence-related events in gladiolus flowers, such as high loss of membrane stability and abnormal flower opening.

(ii) Daffodil (*Narcissus pseudonarcissus* L. 'Dutch Master'): The flowers detached at the base of their ovaries and held with their cut ends in 10–100 mM abscisic acid (ABA) senesced prematurely.

(iii) Lily: Bulbs treated with ABA @ 200 ppm delayed sprouting.

Ethylene

Ethylene is produced by *flowers, leaves, stems, roots, tubers and seeds*, often as a response to stress such as drought, flooding, mechanical pressure, injury or infection. Ethylene production is often stimulated by auxin. (Auxins increased ethylene level in plants and many of auxin actions are attributed through ethylene such as increased % of female flowers, apical bud dominance and leaf epinasty). It causes chlorophyll destruction and yellowing.



A) Application of Ethylene in flower crops

(i) Bougainvillea

Ethephon was applied at four developmental stages of shoots to observe the stage-specific effect of ethylene on bougainvillea flower formation. According to the results, when bougainvillea is in the vegetative growth stage, its ACC content is relatively low. Additionally, spraying ethephon increases endogenous ethylene production, subsequently accelerating maturation of the shoots. When the shoots are in the reproductive growth stage, the increasing ACC content causes the sprayed ethephon to adversely impact shoot development because excessive ethylene leads to serious leaf and flower drop. The above observation indicates ethylene's bi-directional movement in adjusting bougainvillea's flowering.

(ii) Dahlia: Ethrel @ 500-2000 ppm increase number and weight of tuber roots.

(iii) Bird of paradise: 24 hours soaking of seeds in 500 ppm ethephon improves germination.

(iv) Tuberose: Ethrel @ 200 ppm gave early flowering.

(v) Gladiolus: Treatment of corms with ethrel at 100ppm when they are stored at high temp or stored period at 5° C enhance sprouting. But this increase cause corm splitting, delay flowering and slightly reduced length of spike. Application of ethrel (500,1000 & 2000 ppm) as foliar application increased flower diameter.

(vi) Rose: Chemical pinching is done by ethephon and whereas treatment of rose plants with ethylene (0 to 1 ppm) caused defoliation, yellowing of leaves, and "blasting" of flowers.

(vii) Freesia: Pre planting dip of corms in ethrel (1000 ppm) for 24 hr reduces the number of days for flowering.

(viii) Jasmine: Spraying of ethrel @1000 ppm enhance maximum growth retardation.

(ix) J. Sambac: Ethrel delayed the onset of flowering and reduced essential oil content. Accumulation of ethylene in storage will cause senescence & abscission of flowers is also seen.

(x) Carnation: Sleepiness of carnations, premature wilting of petals before the flowers even open, was known to be the result of gas leaks in greenhouses long before the active principle was shown to be ethylene (Crocker 1913)

(xi) Iris (Elphinstone & Rees, 1985; Schipper, 1982) and **Narcissus** (Imanishi, 1983), ethylene treatment shown to induce flowering of bulbs of non-flowering size.

B) Rise in ethylene production in flowers

Ethylene triggers the process of ageing. Ethylene evolution was low in flowers at & immediately after harvest. Rapid ethylene production started on 3rd day in carnation and 8th day in orchid.

Synthetic growth inhibitors:

Triiodobenzoic acid

- In the presence of 2,3,5-triiodobenzoic acid (TIBA), an auxin polar transport inhibitor, embryo formation from embryogenic cells are suppressed, while cell division are not affected.
- In abnormal embryos induced by TIBA, further development of shoot and root apical meristems and vascular differentiation is also suppressed. Thus, abnormal development of embryos induced by inhibition of triiodobenzoic acid results in plantlets without shoots and roots.

(i) Rose: TIBA @ 4000 ppm is found to significantly increase the number of basal shoots / per plant.

(ii) Crossandra: Treatment of TIBA suppress stem elongation.

(iii) Jasmine: Spraying of TIBA @ 100-300ppm, ethrel @ 100-500ppm reduces shoot length.

(iv) Lily: Bulb formation was accelerated by treating with TIBA @ 500ppm.

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