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# Importance of Plant Growth Regulators in Fruit Breeding

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Some endogenous (i.e., naturally occurring) compounds in plant tissues play regulatory rather than nutritive roles in growth and development. These molecules are referred to as plant hormones (or plant growth substances), and they are often active at very low quantities. Plant growth regulators are typically synthetic chemicals with physiological properties resembling those of agents used to promote plant development or substances with the capacity to influence plant growth in other ways, such as polyamines. When these chemicals have been added to plant tissue culture media, they are termed plant growth regulators in this book, to indicate the fact that they have been applied from outside the tissues (i.e., exogenously).

There are several recognized classes of plant growth substance. Until relatively recently only five groups were recognized namely: Auxins, cytokinin, gibberellins, ethylene and abscisic acid.

Plant growth regulators are organic chemicals that alter the way that plants develop, as opposed to nutrients, which are only minimally necessary. PGR plays a crucial role in fruit breeding and is utilized in every aspect of crop improvement, including the asexual or micropropagation of hybrids or selections, the breaking of seed dormancy, the control of growth, the regulation of flowering and fruiting, the induction of sterility in reproductive organs, etc. ***(Dhatt, 1985).***

## The various uses of plant growth regulators are given as under:

**1. Multiplication of hybrids/selections.**

- **Root initiation:** Beginning root cutting and layering is a crucial stage for the plant growth regulator, auxin. Two artificial auxins, IBA and NAA, are particularly effective at triggering root initiation.

| Name of the fruit crop | Method of propagation | Name of the PGR and its concentration |
|---|---|---|
| **Mango** | Air layering | IBA/NAA 2500 to 5000 ppm |
| | Cutting | IBA 5000-10000 ppm |
| | Stooling | IBA 500 ppm |
| **Guava** | Cutting | IBA 5000 ppm + Benzoic acid 200 ppm |
| | Air layering | IBA 5000 ppm |
| | Stooling | IBA 5000 ppm |
| **Custard apple** | Stooling | IBA 20000 ppm |
| **Grape** | Cutting | IBA 3000 ppm |
| **Litchi** | Layering | Pre-treatment of stock plants with etherel 250 ppm + treatment 200 ppm with IBA 5000 ppm + hydroxy benzoic acid. |

- **Seed germination/overcoming seed dormancy:** In order to generate a significant population for testing, excellent hybrid seed germination is the primary necessity in fruit breeding operations. After ripening, some fruits seeds require a specific period of time. In order to promote appropriate germination and seedling growth, stratification involves storing seeds at low temperatures for a predefined period of time. Growth regulators have been tried as a full or partial replacement for stratification. Gibberellic acid has been found to be the best chemical for inducing germination e.g., Padmanabhaiah and Satyanarayana (1969); Chadha (1965) recommended the use of 100 to 500 ppm GA, in grape. Further, Kachru et al. (1972), Uppal et al. (1972) and Randhawa and Negi (1964) observed that GA, not only substituted stratification for 40 days but also stimulated the growth of seedlings in grape. Pandey and Singh (1988) found that seeds extracted from immature berries (5 to 6 week after anthesis) were capable of germinating with 1500 to 2500 ppm GA, and 1500 to 2000 ppm Kinetin treatments.
- **Substitution for chilling requirement:** Dormancy of the resting buds is controlled by environmental factors affecting levels of phytohormones. Breaking of bud dormancy in fruit trees, use of GA, has been reported by many workers (Donoho and Walker, 1957, Chauhan et al., 1961). In peach, only leaf buds are GA, inducible and flower buds were unaffected or had a very week response (Hatch and Walker, 1969). The dormant pear buds showed very week response to GA, Brown et al., 1960), however, apple buds did not show any response (Walker, 1970). Further, Biggs et al. (1974) and Mc Eachern and Storey (1974) reported that the GA, and thiourea sprays break the dormancy of leaf as well as flower buds in peach, pecan and grapes.
- **Induction of male sterility:** Male sterile line can be used to do away with the tedious process of emasculation. Pollen sterility can also be induced by chemicals which do not cause ovule sterility. Iyer and Randhawa (1965 and 1966) reported that aqueous solutions of maleic hydrazide (MH) at 500 to 750 ppm, Tri-iodo-benzoic acid (TIBA) at 400 to 500 ppm and 1,2 Dichloro-iso-butyrate (FW-450) at 0.30% applied twice to 13-15 days old inflorescence of grape, induced pollen sterility. Similar reports were made by Singh (1967), Dhillon and Singh (1970) and Randhawa (1971).
- **Shortening of breeding cycle in fruit crops:** The efforts to shorten the breeding cycle in order to enhance the breeding efficiency are an integrated approach. It would facilitate a quicker evaluation of genotypes. Further, "fruiting cutting" (Mullins, 1966) and conversion of tendril into inflorescence by use of plant growth regulators can help in this regard (Srinivasan and Mullins,1976).
- **Influence on reproductive growth:** In some fruit crops, flowering has been controlled using chemical techniques. Since the juvenile stage of some fruit plants can last from three to twelve years in seedling descendants. As a result, it is impossible to evaluate hybrid/selection early. It seems preferable to reduce both the juvenile period and the transition period in order to achieve early flowering. The seedling should be grown in a greenhouse for two to five months to hasten its growth, and during this time, it should be checked for disease and pest resistance. Then promising type should be shifted to the field for the induction of flowering through growth regulators. There are some examples that growth regulators like paclobutrazol in mango and SADH (Bruinsma, 1966, Dennis, 1968) TIBA (Dayton, 1966) CEPA (Kender 1971 and 1974) have been reported to induce flowering in apple and pear seedlings. Application of paclobutrazol promoted flowering in mango, citrus and cherry. Application of NAA and 2.4D were reported beneficial in pineapple, papaya, and litchi. Application of ethylene promoted flowering in pineapple.
- **Control of fruit drop:** To prevent the dropping of fruits from the tree, PGR has important role. The important fruit crops in which fruit drop can be minimized by the use of plant growth regulators are as under

| Name of the fruit crops | Variety | Name of PGR and their concentration |
|---|---|---|
| **Mango** | Alphonso | NAA 25 ppm<br>2,4-D 25 ppm |
| | Neelam | 2,4-D 30 ppm |
| | Dashehari | 2,4-D 20 ppm |
| | Langra | 2,4-D 20 ppm |
| | Chausa | 2,4-D 20 ppm |
| | Bombay green | 2,4-D 20 ppm |
| **Citrus** | Naval orange | 2,4-D 20 ppm |
| | Valencia orange | 2,4-D 4-40 ppm |
| | Pineapple orange | 2,4,5-T 10-23 ppm |
| | Mosambi | 2,4, S-T 30 ppm |
| | Jaffa | 2,4-D 20 ppm |
| | Sathgudi | 2,4-D 5-10 ppm |
| **Cashewnut** | | 2,4-D 10 ppm, NAA 10 PPM |

- **Making distant crosses:** Sometimes an embryo will deteriorate when travelling long distances. The employment of the embryo rescue procedure can solve this issue. PGR plays a significant function in this method for the development of the embryo and organogenesis.

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