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Effect of foliar nutrition in major horticultural crops

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Abstract
Foliar applications are often timed to meet the demand of nutrients at specific vegetative or fruiting stages of growth, and the fertilizer formula is adjusted accordingly. Applications may also be used to aid plants recovering from transplant shock, hail damage, and other damaging environmental conditions. Comparing them with current research trends and to indicate future benefits of foliar nutrient spray investigations and their importance for agronomic science and practice. The application of foliar sprays is an important crop management strategy, which may help maximizing crop yield and quality. Foliar fertilization is used as a means of supplying supplemental doses of macro-and micro-nutrients, plant hormones, stimulants, and other beneficial substances. Observed effects of foliar fertilization have included yield increases, resistance to diseases and insect pests, improved drought tolerance, and enhanced crop quality. Plant response is dependent on species, fertilizer form, concentration, and frequency of application, as well as the stage of plant growth. It is proposed that this treatment should be recommended in integrated plant production, because it is more environmentally friendly and may increase productivity and quality of crops. It is concluded that foliar fertilization has a definite place in vegetable crop production and that foliar nutrient sprays will be widely used in the future.

Keywords: foliar nutrition, major horticultural, vegetative

Introduction
Plant growth regulators also known as plant hormones or phytohormones are chemicals used to alter the growth of a plant or plant part and development as well. Hormones are substances those are either naturally produced by plants or artificial synthesized substances in lab that control normal plant functions, such as root growth, fruit set and drop, growth another developmental processes. The growth and development of plant is a complex process and is under the control of three main factors *viz*., genetics, environment and endogenous growth substances. Plant growth regulators include auxins, gibberellins, cytokinins, ethylene, brosinostoriods, morphoactins, growth retardants, growth promoters and growth inhibitors *etc*. The production of poor quality fruits is a matter of common experience now- a- days. It would be therefore worthwhile to improve the yield and quality of fruit crops by foliar application of plant growth regulators. The enhanced productivity of fruit crop through physiological approaches i.e. foliar spray of PGR's is chiefly achieved by coordinating plant processes to synthesize maximum dry matter production and partitioning major quantum to increased dry matter into effective yield contributing factors. The effect of various growth regulators on physiological response *viz*., plant height, number of branches, days to flower initiation and 50 per cent flowering, bud formation, thinning, retard pre harvest drop of flower and fruits, improve fruit firmness, improve fruit shape, vegetative growth control, increase fruit set, increase sprouts and improve stress tolerance *etc*. The enhance potential horticultural crops yield, quality and avoiding the fruit losses by proper and right time foliar spray of plant regulators in horticultural crops is needed. By this end users can get good yields and quality fruits over the year.

Material and Methods
Physiological basis of growth manipulation
- Plant growth substances are chemicals that are central to plant growth and development.
- They regulate the rate by which the individual part of a plant grow and integrate growth of those parts to form the whole organism and control reproduction.
- Plant hormones also allow mature plant to respond to changes in their environment
- Physiology plant growth substances regulates the cell division, elongation and enlargement.

- Apical dominance is controlled by cytokinin like substances. Assimilation and translocation can also be increased by growth regulating substances.
- Root system may be promoted or less impeded and hence shoot / root ratio is lowered.
- The effect of fruit thinning on fruit size is related to the leaf / fruit ratio. As this ratio is reduced below 30/1, fruit size is reduced as well.

Impact of altered physiology
- Increased yield and quality of fruits
- Overcoming apical dominance
- Early ripening and improved surface colour
- Delayed senescence
- Prevent seediness (Poovan)
- Suppress the excessive vegetative growth
- Prevent abscission

Practical uses of PGR'S in various horticultural crops

1. Propagation

Growth regulators are applied in the form of paste and solution for various fruits.

E.g. IAA, IBA and NAA are used to induce rooting of cuttings.

2. Fruit Thinning

The NAA applications at post bloom for thinning in apple and with help of DNOC (Sodium 4, 6-dinitro-o-cresol) in stone fruits. Pre-bloom application of GA for optimum fruit set and loose and attractive clusters in grapes.

3. Induction of Flowering

Plant growth regulators like NAA @10 to 50 ppm induces early flowering in pine apple. 2, 4 D at 6 to 10 ppm has induced flowering in pine apple. Flowering can be delayed by 1 to 2 weeks by NAA @ 200 to 800 ppm application in apple, cherries, pears, peaches, and plums.

4. Flowering

Ethylene was responsible for flowering in pineapple. Acetylene, calcium carbide, ethephon and NAA (10-15 ppm) used to induce flowering in pineapple. Soil application of paclobutrzol (cultar) @ 5 g per tree is effective in regulating fruiting in mango. In litchi, NAA replaces girdling for improved flowering. SADH promotes flowering in apple, pear, peach and blueberry. Grapes and lemon respond to CCC with increased flowering.

5. Flower and fruit thinning

Many fruit trees produce heavy flowering and fruit in one year and few in next year. By using growth regulators the normal bearing can be maintained. Spraying of NAA at 5 to 10 ppm and NAA at 5 to 7 ppm which helps to thinning of apple, peaches and grapes.

6. **Fruit ripening**

Ethrel application in apple for uniform ripening and early fruit maturity. Ethephon in citrus prior to storing ensures post harvests degreening. In lemons, dipping in 1000 ppm ethephon for attaining marketable yellow colour which is ripening of banana, mango *etc.*

Summary and conclusion
- The effect of various growth regulators on physiological responses *viz*., plant height, number of branches, days to flower initiation and 50 % flowering, bud formation, thinning, retard pre-harvest drop of flower and fruits, improve fruit firmness, improve fruit shape, vegetative growth control, increase fruit set, increase fruit red colour, advance fruit ripening, delay of fruit ripening, enhance rooting, suppress growth of sprouts and improve stress tolerance *etc.*
- The exogenous application of plant growth regulators might, therefore, act as a powerful tool not only for enhancing the growth, productivity, quality of fruits but also in combating the ill effects generated by various biotic and abiotic factors in fruits plants.
- There by aiding to enhance potential fruits crop yield, quality and avoiding the fruit crop losses by proper and right time foliar spray of plant regulators in fruits crop is needed. By this end users can get good yields and quality fruits over the years.

Results of research studies

Brahmachari *et al.* (1995) [2] reported that application of *ethrel* at 25 or 50 ppm in guava enhanced fruit set percentage, weight, quality of fruit while, reduced number and weight of seeds thereby increased pulp / seed ratio. In a study on induction flowering in off year mango cv. "Alphonso" as influenced by chemicals and growth regulators, the foliar spray of *ethrel* @ 200 ppm has increased number of flowers / panicle.

Nath and Baruah (1999) [6] conducted an experiment on regulation of flowering time, plant growth and yield in 'Assam' lemon with the help of pruning and growth regulators. They reported that spray of 3000 ppm CCC in lemon gave the highest yield. Which leads to the maximum net returns and benefit cost ratio.

Ingle *et al.* (2001) [3] revealed that foliar application of GA_3 @ 25 ppm increased the fruit weight, volume, TSS, ascorbic acid, peel and yield over control in 'Nagpur' mandarin.

Lichev *et al.* (2001) [4] found that application of cultar (25 % paclobutrazol) significantly inhibited the annual shoot growth and improves photosynthetic activity which may increase yield in cherry.

Baghel and Tiwari (2003) [1] concluded that spray of 6 per cent urea and 150 ppm NAA in mango found superior for increasing the total number of flowers/panicle and percentage of hermaphrodite flowers. However, maximum flowering and fruiting and number of fruits/tree was recorded under combined application of 4 per cent urea and 150 ppm NAA.

Stern *et al.* (2007) [5] observed that application of 25 ppm 2,4-D plus 30 ppm NAA at the beginning of pit-hardening in cherry caused appreciable and significant increases in fruit size, total yield and fruit quality and also found that spray of 0.5 per cent triacontanol resulted in the highest value for vine length, number of leaves and 100 leaf weights in betel vine.

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