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Canopy Management in Fruit Crops through Plant Growth Retardant and Regulator

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INTRODUCTION

Canopy in a fruit tree refers to its physical composition comprising of the stem, branches, shoot and leaves also the number and size of the leaves, determining the density. Canopy management in fruiting trees has been practiced over the years for increasing the productivity and quality of the fruits. Management of canopy architecture is one of the predominant technologies by which huge and unmanageable trees are properly managed to make them more productive. Canopy management is the manipulation of tree canopies to optimize its production potential with excellent quality fruits. Canopy management deals in fruit crops deals with the development and maintenance of their structure in relation to their size and shape for maximizing productivity with quality fruits. To optimize the utilization of light for increased yield of quality fruits, canopy management deserves greater attention by exploiting the various available techniques like training, pruning (dormant, summer and root pruning), branch orientation (bending), scoring, girdling, selection of proper rootstock, use of plant growth regulators, appropriate use of fertilizer, deficit irrigation, use of genetically engineered plants with altered architectural characters would help in maintaining the ideal canopies of trees. The basic objective of canopy management is to maximize light interception to optimize light distribution within canopy and to maintain proper airflow. Canopy management enhances productivity, improves fruit quality, facilitates cultural practices and help in management of pest and disease. In new plantations initial training and pruning is given to develop strong framework of the tree whereas in old plantation the aim of canopy management is to reduce tree height and make provision of solar radiation inside the canopy by thinning excessive biomass.

Features of ideal canopy:

- Strong frame of primary branches.
- Wider crotches in scaffold branches.
- Healthy and well distributed secondary and tertiary branches.
- Sufficient fruiting terminals in most productive areas.
- Healthy foliage with high photosynthetic efficiency to maximize the solar radiation use efficiency.
- Enough space for air circulation inside canopy.
- Should support adequate shade to protect the fruits from sunburn.

Plant growth retardants:

The group of the bio-regulators that modify a plant in its growth and developmental behaviour without including phytotoxic or malformative effects includes synthetic substances known as growth retardants. When used in appropriate concentration, these compounds influence the plant architecture in a typical fashion, such as a. Inhibition of shoot growth (plant height, internode elongation, leaf area) with unchanged number of internodes and leaves and with intensified green leaf pigmentation and Maintained or slightly promoted root growth (main roots often longer and thicker). In both cases the root – shoot ratio is changed in favour of the root. There are at least 3 basic methods as how plant height is controlled by chemicals:

- By killing the terminal buds or branches or severely inhibiting apical meristematic activity.
- By inhibiting internode elongation without disrupting apical meristematic function.
- Reduced apical control.

Terminal bud destruction:

Some of the most effective inhibitors, Maleic Hydrazide (MH), Triidobenzoic Acid (TIBA) fatty acids, ethylene and ethylene releasing compounds such as ethephon and ethyl hydrogen propyl phosphate act by killing the terminal bud or by causing severe disruption in apical meristematic functions. In some species ethylene, TIBA, Napthylpthalamic Acid (NPA) and others have been shown to inhibit polar auxin transport. Hence the inhibition of stem elongation observed may reflect reduced auxin level in tissues below the apical meristem, too. These compounds usually alter geotropic responses, cause auxiliary bud break, or induce early leaf abscission as well as reduced stem elongation.

Internode elongation inhibition:

The effect of retardants on stem growth occurs on the subapical region of the shoot tip where cell division and, to a lesser extent, cell elongation is inhibited. Thus, internodes of retardant-treated plants are shorter primarily because they possess fewer cells. Many growth retardants like Succinic Acid, 2, 2-dimethylhydrazide (SADH) and 2-Chloroethyl Trimethyl Ammonium chloride (CCC or Chlormequat) act by inhibiting a specific step in the synthesis of naturally-occuring gibberellins, which is necessary for the maintenance of subapical meristem activity. When such retardants are used, it is possible to reverse the inhibitory effect in intact plants by the application of an appropriate dose of GA_3.

Reduced Apical Control:

Reduction in plants height can also be achieved by stimulating the growth of auxiliary buds and branches which will compete for minerals, nutrients, hormones and other metabolites thus reducing the growth of main stem. In general, branched plants are shorter than those with a single axis. Application of 6-benzylamino purine and Gibberellin A4 +7 and Promalin (6-benzlamino purine plus gibberellins A4 +A7) increased spur and lateral shoot development. The cytokinins apparently promote growth directly in the auxiliary buds rather than by inhibiting terminal meristematic activity or by inhibiting auxin transport.

Use of growth regulators in fruit crops:

Significant reduction in shoot length was observed with three sprays of Maleic

Hydrazide (MH 500 ppm at leaf stage followed by 1000 ppm at leaf stage and 1500ppm at 15 leaf stage) when compared to control. Shoot length was not significantly reduced by any of the 2-Chloroethyl Trimethyl Ammonium Chloride (CCC) treatments. None of the treatments reduced the intermodal length measured between 5th and 6th 10th and 11th and 15th and 16th nodes significantly when compared to control. However application of CCC at 5 leaf stage was more effective than other treatments in reducing the internodal length between 5th and 6th 10th and 11th and between 15th and 16th nodes.

Maleic Hydrazide (MH) seemed to be more effective than CCC in increasing the cane diameter in Thompson Seedless grape application of Cultar (25% Paclobutrazol) significantly inhibited the annual shoot growth and improves photosynthetic activity which may increase yield in cherry. Application of Paclobutrazol 10 g / tree in mango resulted reduced tree height (21.20%), tree volume (33.1%) and mean shoot length (48.2%). This response was attributed to GA_3 inhibitory activity of Paclobutrazol application of 1500 ppm CCC increased the number of fruiting buds in grape.

In red raspberries cv. 'Autumn Bliss' Ghora *et al.* (2000) conducted an experiment on effect of growth retardants (CCC, Daminozide and Paclobutrazol) on growth and development under plastic greenhouse condition and found that application of 500 ppm CCC enhanced anthesis and fruit ripening by about 10 days. In an experiment on effect of growth substances on flowering and fruiting characters of 'Sardar' guava. Brahmachari *et al.* (1995) 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 /panical.

Turn bull et al. (1999) studied routes of ethephon uptake in pineapple and reasons for failure of flower induction and found that ethylene releasing agents such as ethephon are used widely to induce flowering in pineapple. Likewise, Similarly, Ramburn (2001) reported that foliar application of 0.5 gm. PBZ + 0.4 gm. ethephon / l promoted flowering in litchi with erratic fruiting. The use of growth retardants have an important impact on the economic production of fruit crops by incorporating more trees in a given area of land because of their reduced tree height, canopy size and spread. This has resulted in increase in the fruit yield at the expense of only cost of chemical and its cost of application. Thus, the increase in final production is at no extra purchasing of land, no extra tilling of land, no addition of extra fertilizers, no extra weed control or other pest control measures. However, judicious use of growth retardants which have been properly registered and experimented with no harmful effects on humans and environment are only to be allowed for commercial use in fruit plants.

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