# PLANT GROWTH SUBSTANCES IN AGRICULTURE

*by*

CHANDRA SAMARANAYAKE

The growth of a plant is a dynamic and complex, yet strictly controlled, process. The growth in different parts of the plant must be integrated and co-ordinated. As a result of intensive studies extending over many years, it is now known that certain chemical substances, produced by the plant, play a very vital role in the control of growth. These chemical substances, which are produced in plants and are involved in the control of growth and development are called plant hormones. There are at least four major classes of hormones in plants *viz* auxins, gibberellins, cytokinins and inhibitors. Ethylene gas is also included as a fifth class. These plant hormones can be extracted from one plant and applied to another to affect the latter plant's growth and development. There is a large number of synthetic chemical substances possessing growth regulating properties are commonly termed plant growth substances. The mechanism of plant growth hormone action is not clearly understood, but this has not prevented many of these substances becoming very important tools in modern day agriculture. A few of them are used in the cultivation and exploitation of the tree for latex, in rubber. There is possibility for many more to be used, for the advantage of the industry. This article discusses the use of plant growth substances in agriculture with special reference to their use and possible uses for the future in rubber.

The earliest commercial use of a plant hormone was the exposure of fruits to ethylene gas to accelerate ripening, a practice which is still common today. Another commercial use has been to initiate or accelerate the rooting of cuttings or both. The best chemicals for this purpose are synthetic auxins. Growth substances stimulate rooting of easy to root species most effectively but may not induce rooting on species that normally fail to root. Difficult to root cuttings may respond to growth regulator treatment when combined with an intermittent mist spray. Rubber falls into this group of difficult to root plants and combination of growth regulator treatment with a mist spray has improved rooting of rubber cuttings. Growth substances can be used in transplanting of nursery grown trees. Improvement of field establishment of nursery grown rubber budded stumps and stumped buddings has been achieved with the use of growth substances.

The capacity to induce flowering on command or the ability to prevent flowering is necessary in many horticultural crops. Treatment with certain growth substances has been found to induce certain plants to flower at pre-determined times. In the early 1930s, ethylene was known to accelerate flowering in pineapple, a few years later acetylene was used, at present, the haloethane phosphonic acids are found to be very effective for this purpose.

In many temperate fruit trees especially apple, pear and peach, the extent of flower induction is increased by spraying them with inhibitors. Many annual vegetables that normally flower only when days are long *e.g.* raddish, lettuce, mustard and dill can be made to flower early, by treatment with gibberellins. Many biannual vegetables *e.g.* carrot, beet and cabbage that require low temperatures to flower, can be made to flower on treatment with gibberellins.

In certain crops, delaying the onset of flowering is of economic importance to avoid adverse weather conditions. The appropriate delays can also bring the plant varieties with different flowering dates into synchronization for breeding purposes. This can be achieved with suitable growth regulators. The sex expression can also be regulated in certain plant families, with the use of growth substances. The application of auxins, shifts the balance of sex expression from maleness to femaleness in cucumber. Gibberellin application causes maleness in certain cultivars. Ethephon also has been found to increase maleness in cucumbers.

Certain grape varieties develop fruit from the stimulus provided by the presence of pollen without fertilization of the ovule, presumably because of its secretion of hormonal substances. Synthetic growth substances have been used to increase fruit set and development in many crops. Use of growth regulators to induce flowering and improve podset is one of the fields of study, which has not been given much attention in rubber. Use of appropriate growth regulators may help in increasing podset in hand pollination of rubber for breeding purposes.

A reduction of fruit set is desirable in certain situations *e.g.* thinning of grapes and apples to enhance fruit size. Fruit size and colour are important determinants of marketability in developed countries. Growth substances are used to get larger, more attractive fruits.

In rubber, a reduction in podset can be used to control secondary leaf fall, a serious conditions which results due to infection with a fungus. The pods form the ideal base for the growth of the causal fungus of this disease, and reducing podset has helped in the control of leaf fall. In fruit crops by hastening or delaying maturation, growers can utilize peak demand of fruit and earlier ripening may avoid unfavourable environmental conditions and extend the market period. All these can be achieved with the use of appropriate growth substances.

In most plants, the outstanding effect of gibberellins is to cause elongation of the stem. It can also affect the extent to which the plant develops side branches. Gibberellins are used in stimulating the growth of sugarcane. Treatment with a very low concentration of gibberellins has been found to increase the yield of cane, to more than 11.2 metric tons per hectare. The most important commercial application of gibberellin however is in the malting industry. Gibberellins have a stimulatory effect on enzymes that help in the conversion of starches to sugar in barley seedsGibberellinshave not found much use in rubber culture so far.

Reducing the size of the plant, can be desirable in certain situations. In many countries, wheat is treated with growth substances to prevent lodging and certain growth retardants are used to reduce the frequency of moving turf grass. Growth retardants are also used to improve branching of plants where only a few branches are formed normally. Rubber tree should have an unbranched stem upto 8 - 9 feet for the tapping panels. The prevention of branching in the initial stages induction of branching and the control of the tree form later to get a short, sturdy tree may be possible with the use of appropriate growth substances.

The control of abscission, the separation or shedding of a plant part such as leaf, flower, fruit or stem is important in many crops *e.g.* to simplify mechanical harvesting of cotton, it is desirable to have the leaves removed. A number of chemical defoliants have been tried out for this purpose and in the United States the largest single market for plant growth substances is as harvest aids for defoliating cotton. Artificial defoliation of trees is important in rubber to get all trees to defoliate and refoliate at the same time at the beginning of the year, when the tree "winters" naturally. If wintering is uniform, then, it is easier to control leaf diseases. Many chemical defoliants have been tested in rubber growing countries, these defoliants have to be applied by aerial spraying. If vast extents of land is planted without any village settlements dispersed among them, aerial spraying can be done. The situation is quite different in Sri Lanka and the use of chemical defoliants available at present cannot be safely used, where rubber lands are intermingled with villages.

Controlling the internal metabolisum of a given crop should make it produce more sugar, more proteins, more oil, more latex or better quality in fruit, than it would under the best conditions without treatment. The application of Ethephon, a haloethane phosphonic acid on tapping panels can increase yields almost by about 200%, in the short run. The continuous use of high concentrations of Ethephon, as a yield stimulant, has been found to result in reduction of the crop and drying up of tapping panels. The RRI recommends the use of a lower concentration to obtain 25 - 30% increase in yield, sustained over a long period. Ethephon increases the length of time of the flow of latex between tappings, by delaying the plugging of latex vessels. In many countries where there is a shortage of labour, Ethephon is used very successfully with low frequency tapping systems to reduce the labour costs, and to extract the same crop which can be obtained by normal, high frequency tapping systems. This in turn extends the life of the tree.

A characteristic feature of auxins is that, above a certain concentration, their effect is to inhibit growth. This property is made use of, in their success as weedicides. Of course many chemicals other than auxins have a toxic effect on plants and can be used as weed killers. The special merits of synthetic auxins are that, they will kill plants when applied at relatively low concentrations they are comparatively harmless to animals, they are non-corrosive, translocated within the plant to kill parts such as the roots, not reached by sprays and, most important, some auxins are selective and can therefore be used, to kill weeds without damaging sorrounding crop plants. The harm done to soil by scraping tool is so heavy in rubber plantations, that hormone type weedicides should be used to control weeds wherever this is economically feasible.

Growth substances have not been extensively used in rubber cultivation except for its use as a yield stimulant. They can be used much more to the advantage of the industry and the day may not be too far when tailor made trees are produced by controlling different phases of growth of the tree, by the use of growth regulators.