UNIT - I
PLANT GROWTH REGULATORS ON GROWTH, METABOLISM AND YIELD

SUMMARY

1.0 SUMMARY

Chayote (*Sechium edule* Sw., Cucurbitaceae), a lesser-known member of the gourd family, is gaining popularity and importance as a promising vegetable crop worldwide. In Darjeeling hills of Eastern India this plant species is profusely grown without proper care and scientific management. In this investigation, a detailed study was carried out on some physiological aspects of the crop but emphasis was laid on analysing the negative yield attributing characters of the plant and on improvement of crop yield.

Different germplasms of chayote were collected and ten varietal types (named alphabetically A to J) were recorded after a thorough exploration of different chayote growing altitudinal regions of Darjeeling hills. Varietal type C producing yellow green fruits with evenly distributed hairs, was found to be highly productive and superior variety over others and this was used as the experimental plant material for detailed investigation. Unlike other cucurbits the above ground leafy plant is annual and underground tuberous part of the plant is perennial and all parts e.g. tuberous roots, fruits and tender shoots are used as human food. Phenological studies showed that the leafy plant survives around 160 days and within its life span it shows some distinct developmental phases which include : field emergence phase, first leaf emergence phase, seedling phase, sapling phase, flower initiation phase, fruit formation phase, senescence phase and death phase. Each phase is clearly distinguished by a few key features. Plantation of different varietal types of chayote starts from February, vigorous vegetative growth and fruiting takes place during the monsoon months of June and July and harvesting of fruits is completed by October each year.

Three plant growth retardants namely, Na-dikegulac (2,3:4,6-di-O-ispropylidene-α-L-xylo-2 hexulofuranosate), chlormequat [(2-chloroethyl) trimethylammonium chloride] and maleic hydrazide were applied at three different stages of chayote plant viz., at sprouting stage of fruits (whole fruit treatment), at sapling stage and at preflowering stage. The chemical-induced changes on growth, metabolism and yield were analysed at different developmental stages of the plant.

Whole fruit treatment at sprouting stage : Treatment of sprouting fruits with Na-

dikegulac (1000 and 2000 μg/ml), chlormequat (2000 and 4000 μg/ml) and maleic hydrazide (250 and 500 μg/ml) resulted in significant increase of chlorophyll and protein contents in leaves at the seedling and sapling stages only, and subsequent changes recorded at preflowering,fruiting and senile stages were statistically insignificant. Almost an identical trend of changes were noted when soluble carbohydrate, insoluble carbohydrate, RNA and DNA levels in leaves were analysed at different developmental stages. Corresponding changes in the activities of peroxidase and catalase enzymes in leaves were recorded. The growth retardants, irrespective of their concentrations, enhanced the activities of these two enzymes at the two initial observation periods i.e., at seedling and sapling stages, and thereafter the chemical effect was nullified. Conversely, activities of IAA-oxidase and RNase enzymes were inhibited by the retardants at the seedling stage only, and this inhibitory action did not persist at subsequent analyses done at sapling, preflowering, fruiting and senile stages.

Retardant-induced biochemical changes in leaves were associated with the changes of growth parameters like vine length and stem circumference. Regardless of their concentrations Na-dikegulac, chlormequat and maleic hydrazide retarded vine length and increased stem circumference, and the effects were found significant up to sapling stage only.

Yield attributes recorded in terms of fruit number, fruit weight and tuberous root weight as well as days to onset of plant senescence remained unchanged by retardant treatment at the sprouting stage of fruits.

Thus, in case of whole fruit treatment the retardants could render only a transient effect on the growth and metabolism of chayote plants and such changes were not reflected in yield attributes.

Foliar treatment at sapling stage : Foliar application with the same concentrations of growth retardants at the sapling stage (30-day-old plants) caused significant reduction of chlorophyll, protein, insoluble carbohydrate and RNA levels in leaves at the initial observation period of sapling stage on 40-day-old plant. The inhibitory effects were found transient and the chemicals subsequently augmented the levels of these cellular

components. Soluble carbohydrate level was increased and DNA level was decreased in retardant treated leaf samples analysed at sapling stage only; all subsequent changes were found insignificant.

Activities of the enzymes peroxidase and catalase were declined shortly after foliar application of the retardants but this retardation effect was not only alleviated quickly but the activities were found even higher at all the chemical-treated samples analysed at preflowering, fruiting and senile stages. A reverse change in the activities of IAA-oxidase and RNase was recorded where a transient retardant-induced increase in the enzyme activities were followed by a consistent decrease till senile stage. Unlike the retardant-induced differential biochemical changes with respect to growth stages of the plant, vine length was retarded and stem circumference was increased by the chemicals and such retardation or enhancement effects were found to be maintained throughout the observation periods.

Growth retardants showed a tendency towards deferring senescence of chayote plants but among all the treatments, only Na-dikegulac (2000 μg/ml) showed a significant senescence deferral effect. Again a significant increase of yield components like fruit number, fruit weight and tuberous root weight per plant was recorded in Na-dikegulac and chlormequat-treated plants.

Thus, unlike whole fruit treatment, effect of foliar treatment with the growth retardants was found to fairly persist till senile stage and the changes of the growth and biochemical parameters were associated with a substantial increase of yield components at least in treatments with Na-dikegulac and chlormequat.

Foliar treatments with growth retardants at preflowering stage and retardant followed by hormone treatment at flowering stage : Growth retardants, irrespective of their concentrations, resulted in increase of chlorophyll, protein, soluble carbohydrate insoluble carbohydrate, RNA and DNA levels in leaves of chayote plants at both fruiting and senile stages. Except the changes of DNA level by Na-dikegulac and chlormequat (2000 μg/ml) recorded at the fruiting stage all other changes attained statistical significance. However, retardant-induced increases were further augmented by IAA and kinetin treatments at flowering stage.

Like the changes of the above biochemial parameters, almost identical changes were recorded in peroxidase and catalase activities, and IAA-as well as kinetin-induced additive effect was found to be very prominent. Changes of IAA-oxidase and RNase activities were found to be reverse to that of peroxidase and catalase. Here, retardant-induced decrease of IAA-oxidase and RNase activities were reduced to a further extent in supplementary treatments with IAA and kinetin.

Retardant-induced reduction of vine length was overcome to some extent by the second treatment with IAA and kinetin but still the vine lengths at all the treatments (single or combined) were found significantly less than control value. On the other hand, retardants increased stem circumference and the effect was found additive in supplementary treatments with IAA and kinetin. The retardants showed a tendency towards deferring of leaf senescence but senescence deferral effect was found significant in the single treatment with Na-dikegulac (2000 μg/ml) and in all combined treatments. Yield attributes like fruit number, fruit weight and tuberous root weight were augmented by all the retardant treatments and this augmentation was much more remarkable in combined treatments with IAA and kinetin. The retardants, however, failed to increase the number of female and male flowers per plant while combined treatments with IAA, kinetin and GA_3 remarkably increased both female and male flowers. Again, the combined treatment with retardants and GA_3 exerted the best respone on increasing female flowers.

Regulatory action of the growth retarding chemicals and their promising role on augmentation of crop yield are discussed.