RESULTS

1.5. RESULTS

Table 1.2 shows varietal differences of *Sechium edule* growing in various altitudes of Darjeeling hills. Altogether 10 varietal types have been established on the basis of morphological characters of mature fruits viz., length, breadth, girth, weight and colour of fruits as well as on the basis of density, length and mode of distribution of hairs on the surface of fruits. Among the categories the types A,B and J produce hairless fruits and the type H produce fruits with scanty hairs. Other varietal types yield fruits with hairs of specific nature and they show specific mode of distribution on fruit surface.

Important events during the life cycle of the experimental chayote plant (type C in table 1.2) have been depicted in table 1.3. The leafy above ground part of chayote is monocarpic in nature and the data reveal that the plant survives more than 5 months with prolonged duration of log phase and stationaay phase of growth. The under ground tuberous part is perennial and survives for several years. Meteorological data at the experimental station (Darjeeling) during the experimental years of 1992, 1993 and 1994 (monthwise) are represented in table 1.4, 1.5 and 1.6 respectively. As planting of chayote starts from late February, maximum vegetative growth takes place during the months of April, May and June, and harvesting of fruits is completed by October each year, it seems apparent that during plantation comparatively low temperature, low relative humidity and low rainfall are ideal climatic factors. Vigorous plant growth and fruit maturation takes place during the monsoon months of June and July when maximum rainfall, fairly high relative humidity and moderate temperature are recorded.

5.1 Whole fruit treatment at sprouting stage

5.1.1. Changes in chlorophyll and protein levels (Table 1.7)

Data revealed that whole fruit treatment with Na-dikegulàc (1000 and 2000 μg/ml) chlormequat (2000 and 4000 μg/ml) and maleic hydrazide (250 and 500 μg/ml), irrespective of their concentrations, resulted in significant increase of both chlorophyll and protein levels in leaves of chayote plant when data were recorded at the seedling and sapling stages of plant development. However, the chemical-induced enhancement of the level of these two biochemical parameters were not found during the subsequent analyses at preflowering, fruiting and senile stages. All the changes recorded beyond sapling stage failed to attain statistical significance and thus the initial promotive effect seemed to be transient and nonpersistent.

5.1.2. Changes in soluble and insoluble carbohydrate levels (Table 1.8)

As regards the chemical-induced changes of soluble and insoluble carbohydrate levels in leaves of chayote plant almost an identical trend of result was obtained. All the three growth retardants at both their concentrations caused to enhance soluble and insoluble carbohydrate contents in leaves at least up to the sapling stage of 40 days of plant age, although in case of maleic hydrazide the increse of insoluble carbohydrate level was insignificant at seedling stage. Subsequent changes of soluble and insoluble carbohydrate levels recorded at preflowering, fruiting and senile stages were statistically insignificant. Thus, whole fruit treatment with Na-dikegulac, CCC and maleic hydrazide resulted in a temporary increase of the two carbohydrate levels.

5.1.3. Changes in RNA and DNA levels (Table 1.9) :

Whole fruit treatment with Na-dikegulac, chlormequat and maleic hydrazide also enhanced the nucleic acid levels at the two initial stages of analyses i.e. at seedling stage and sapling stage. However, the changes of DNA level remained insignificant even at the sapling stage. In preflowering, fruiting and senile stages the chemical-induced changes of both RNA and DNA levels were statistically identical with that of the control ones.

5.1.4. Changes in peroxidase and catalase activities (Table 1.10) :

Concomitant with the changes of chlorophyll, protein, soluble carbohydrate, insoluble carbohydrate, RNA and DNA contents in leaves during different developmental stages of chayote plant, the chemicals, regardless of their concentrations, enhanced the activities of both peroxidase and catalase enzymes when data were analysed at seedling and sapling stages. The chemical-induced enhanced activities of these two enzymes were not found at the subsequent periods of observations i.e. at preflowering, fruiting and senile stages.

5.1.5. Changes in IAA-oxidase and RNase activities (Table 1.11)

Unlike the stimulatory action of the chemicals on peroxidase and catalase activities at the seedling and sapling stages, RNase and IAA-oxidase activities in leaves of chayote plant were significantly reduced at the initial observation period i.e. at seedling stage only. Such inhibitory effect was clearly nullified thereafter and the chemicals failed to induce any significant change in the activities of the enzymes during the subsequent analyses recorded at sapling, preflowering, fruiting and senile stages.

5.1.6. Changes in vine length and stem circumference (Table 1.12)

Biochemical changes in leaves were found to be associated with the changes of growth parameters like vine length and stem circumference of chayote plant as a result of treatment of the whole fruits with Na-dikegulac, chlormequat and maleic hydrazide. Results showed that vine length was significantly reduced at seeding and sapling stages by all the chemicals irrespective of their concentrations used. On the other hand, stem circumference was increased by the pretreating chemicals and this increasing trend was maintained up to the sapling stage only. Changes in vine length and stem circumference, recorded at the subsequent stages of plant development i.e. at preflowering, fruiting and senile stages, were found statistically insignificant.

5.1.7. Changes in number of days required for inception of plant senescence, fruit number, fruit weight and root weight per plant (Table 1.13)

The chemical-induced transient changes of growth and biochemical parameters did not alter yield attributes, recorded in terms of total fruit number, fruit weight and tuberous root weight per plant and the time (days) for onset of plant senescence, determined by observing the yellowing of leaves. All the changes were insignificant.

Thus, the summarized result of whole fruit treatment with the growth retardants stands as such :

The chemicals could induce a transient effect on the growth and biochemical parameters analysed. Crop yield was not at all affected and onset of plant senesence (days of plant age) remained unaltered.

5.2. Foliar treatment at sapling stage

5.2.1. Changes in chlorophyll and protein levels (Table 1.14)

Foliar application with Na-dikegulac (1000 and 2000 µg/ml), CCC (2000 and 4000 µg/ml) and MH(250 and 500 µg/ml) for three consecutive days at the sapling stage of chayote plant resulted in a significant reduction of chlorophyll and protein levels in leaves of all the samples analysed at sapling stage only. However, this retardant-induced inhibitory effect was not only found to overcome subsequently, but the chlorophyll and protein contents were high in comparison to the control values. Unlike whole fruit treatment this increase was not merely transient but this was maintained during the subsequent analyses at preflowering, fruiting and senile stages of plant development. However, relative efficacy of the three growth retardants on changing these two parameters was not apparent from the result although higher concentratinos of Na-dikegulac and CCC rendered a strong inhibitory effect at the sapling stage as evident from much higher reduction of chlorophyll content.

5.2.2. Changes in soluble and insoluble carbobydrate levels (Table 1.15)

The growth retardants, irrespective of their concentrations, increased soluble carbohydrate levels in leaves when data were recorded at the sapling stage. However, in subsequent analyses at preflowering, fruiting and senile stages the changes of soluble carbohydrate contents were found to be insignificant. It is noteworthy that during fruiting stage of 80-day-old plants the levels were low in all the samples analysed. On the other hand, insoluble carbohydrate contents in leaves were found significantly low in all the chemical-treated plants at the observation period of sapling stage only. During preflowering stage, the chemical-induced inhibitory effect was overcome in all the samples analysed, and at fruiting and senile stages the insoluble carbohydrate contents were found much higher than the control values. Results also revealed that with the progress of plant ageing insoluble carbohydrate levels started declining right from the sapling stage.

5.2.3. Changes in RNA and DNA levels (Table 1.16)

Results of this table revealed that the growth retardants, regardless of their concentrations used, significantly reduced the level of RNA at the sapling stage only. During the subsequent observation periods at the preflowering, fruiting and senile stages RNA content was remarkably increased in leaves of all the chemical-treated plants and the chemicals were found to be almost equally efficient in this regard.

As regards the changes of DNA content it was found that the chemicals caused to reduce the level of DNA at the initial observation period of sapling stage only. Subsequent chemical-induced changes recorded at the preflowering, fruiting and senile stages failed to attain statistical significance. Data of this table thus showed that the effect of growth retardants was merely transient in case of DNA but perpetuating in case of RNA.

5.2.4. Changes in peroxidase and catalase activities (Table 1.17)

The chemical-induced changes of chlorophyll, protein, carbohydrate fractions and nucleic acids were associated with the changes in the activities of the enzymes peroxidase and catalase in leaves. Activities of both the enzymes were suppressed by all the concentrations of the chemicals used when data were recorded at the sapling stage. This retardation effect was erased quickly as subsequent analyses at the preflowering, fruiting and senile stages revealed significantly higher activities of these two enzymes when compared with the enzyme activities in leaves of distilled water treated control plants.

5.2.5. Changes in IAA-oxidase and RNase activities (Table 1.18)

Unlike the changes in the activities of peroxidase and catalase enzymes, a reverse trend of changes in that of IAA-oxidase and RNase were recorded. Data of this table clearly revealed that the growth retardants significantly increased the activities of both IAA-oxidase and RNase enzymes at the sapling stage only and this increasing trend was not found perpetuating. When the chemical-induced changes were recorded during the sampling periods at the preflowering, fruiting and senile stages a consistent decrease in the activities of these two enzymes were found.

5.2.6. Changes in vine length and stem circumference (Table 1.19)

Concomitant with the biochemical changes in leaves of chayote plant, the growth retarding chemicals affected the vegetative growth of the plants, simply measured in terms of vine length and stem circumference. Results showed that the chemicals significantly reduced the length of vine at all the concentrations. And this inhibitory effect of the chemicals was found throughout the observation periods at the sapling, preflowering, fruiting and senile stages. On the other hand, stem circumference was found to increase in all the plants treated with the growth retarding chemicals, regardless of their concentrations used and developmental stages of the plant.

5.2.7. Changes in number of days required for inception of plant senescence, fruit number, fruit weight and root weight per plant (Table 1.20)

Results of this table revealed the senescence delaying effect and changes of yield attributes of chayote plants by the growth retarding chemicals. Na-dikegulac, CCC and MH, regardless of their concentrations, tended to increase the number of days (plant age) required for inception of plant senescence but the senescence delaying effect was found to be marginally significant only in case of Na-dikegulac (2000 μg/ml) and the effect was insignificant in other treatments.

As regards the changes of yield attributes, measured in terms of fruit number, fruit weight and tuberous root weight per plant, it was found that the chemicals, particularly Na-dikegulac and CCC increased fruit number, total fruit and tuberous root weight per plant, although this increasing effect was not found to be fairly significant. On the other hand, MH-induced increase of the three yield attributes failed to attain statistical significance. The results of this table, thus, showed that the growth retardants tended to delay plant senescence and increase crop yield.

Thus, the precised result of the sapling treatment with growth retardants stands as such :

The retardant-induced changes in chlorophyll, protein, insoluble carbohydrate, RNA, peroxidase and catalase levels were inhibitory at the initial observation period (sapling stage). Subsequent changes were promotive after a quick revival, and the effect persisted up to senile stage. Retardants reduced vine length and increased stem circumference throughout the observation periods. Increase in crop yield by the retardants was marginally significant or insignificant in MH and their senescence delaying effect was insignificant except in Na-dikegulac (2000 μg/ml) treated plants.

5.3. Foliar treatment with growth retardants at preflowering stage and retardant followed by hormone treatment at flowering stage

5.3.1. Changes in chlorophyll and protein levels (Table 1.21)

Foliar treatment with Na-dikegulac, CCC and MH at preflowering stage resulted in significant increase of chlorophyll and protein levels when observation was made at the fruiting and senile stages of plant development. However, the retardant-induced increase of chlorophyll and protein contents were found to be enhanced to a further extent when the retardant-treated plants experienced foliar treatment with growth promoters like IAA and kinetin. And this supplemented stimulatory action of IAA and kinetin over the retardant-induced increase of the macromolecules was found in all the combined doses analysed at both the developmental stages.

5.3.2. Changes in soluble and insoluble carbohydrate levels (Table 1.22)

All the growth retardants, regardless of their concentrations, significantly increased both soluble and insoluble carbohydrate levels at the fruiting and senile stages of chayote plant. In this case also, foliar application of IAA and kinetin on the retardant-pretreated plants showed an additive action as evident from the much higher soluble and insoluble carbohydrate levels in the leaves of the plants which underwent hormone treatment at flowering stage in addition to retardant treatment at preflowering stage.

5.3.3 Changes in RNA and DNA levels (Table 1.23)

Results of this table revealed that foliar application of growth retardants significantly increased RNA levels in leaves irrespective of their concentrations used and plant stages analysed. Here also, a second treatment with IAA and kinetin at the flowering stage, on the retardant pretreated plants further enhanced the RNA contents over the retardant-induced increase of RNA levels, and this effect was true at both fruiting and senile stages of plant development.

However, the retardant-induced increase of DNA level was not significant at least in treatments with Na-dikegulac and CCC (2000 μg/ml) at the fruiting stage. But combined treatments with retardants followed by hormones significantly increased the level of DNA in all the samples analysed at both fruiting and senile stages of plant development.

5.3.4. Changes in peroxidase and catalase activities (Table 1.24)

Like sapling treatments, treatment of plants with growth retardants at the preflowering stage resulted in parallel changes in the activities of peroxidase and catalase enzymes. Data revealed that all the chemicals at both their concentrations significantly increased the activities of these two enzymes at the fruiting and senile stages. The retardant-induced increase in the activities of the enzymes were found to be stimulated further by foliar application of IAA and kinetin on the retardant pretreated plants at preflowering stage.

5.3.5. Changes in IAA-oxidase and RNase activities (Table 1.25)

A reverse picture was noted when the changes in the activities of IAA-oxidase and RNase enzymes were compared with that of peroxidase and catalase enzymes. Here the activities of both IAA-oxidase and RNase enzymes were found to be reduced significantly in the leaves of plants which received foliar application of the growth retardants at the preflowering stage. The chemical-induced reduction in the activities of these two enzymes in leaves of chayote plant were found to be reduced to a further degree when IAA and kinetin were sprayed foliarly at flowering stage of the plants which received prior treatment with the growth retardants at the preflowering stage.

5.3.6. Changes in vine length and stem circumference (Table 1.26)

Results of this table showed that the chemical-induced biochemical changes in leaves were associated with the changes of two growth parameters recorded in this study. The growth retarding chemicals reduced the length of vine irrespective of their concentrations used and growth stages analysed. However, retardant-induced inhibition of vine length was overcome by foliar treatment with IAA and kinetin on the chayote plants which underwent prior treatment with the growth retardants at the preflowering stage. On the other hand, stem circumference was found to increase significantly as a result of foliar application with the growth retardants. The growth promoters IAA and kinetin showed additive effect, with respect to increase of stem circumference of the plants, with the growth retarding chemicals as the retardant-induced increase of stem circumference was further increased when plants were subsequently treated with the growth promoters.

5.3.7. Changes in number of days required for inception of plant senescence, fruit number, fruit weight and root weight per plant (Table 1.27)

Results presented in the table 1.27 clearly showed that Na-dikegulac, CCC and MH at all their concentrations tended to delay senescence of the chayote plants but the effect was found insignificant at all the treatments with growth the retardants except at Na-dikegulac (2000 μg/ml). On the other hand, all combined treatments with growth retardants at the preflowering stage and hormonal (IAA and Kinetin) treatment at the flowering stage significantly delayed the onset of plant senescence. A corresponding change in fruit number, fruit weight and root weight per plant was recorded alongwith the chemical-induced deferment of leaf senescence. Yield data showed that all the treatments (single or combined) increased total fruit number, fruit weight and tuberous root weight per plant. However, combined treatments with retardant followed by hormone were found to be much more efficient in this regard. Again, foliar application of chayote plant with Na-dikegulac at preflowering stage followed by application of IAA and kinetin at the flowering stage exerted the best response particularly on increasing fruit number per plant.

5.3.8. Changes in the number of female and male flowers per plant (Table 1.28)

Results on the effect of single treatment with growth retardants as well as combined treatment with retardants and hormones (IAA, kinetin and GA_3) in successive manner on changes in the number of female and male flowers per plant were recorded in this experiment. Growth retardants, irrespective of their concentrations, failed to induce any significant effect on the changes in the total number of female and male flowers per plant. But when retardant-treated plants experienced a second treatment with IAA, kinetin and GA_3 at the flowering stage, number of female flowers were significantly increased. Interestingly, combined treatment with all the three retardants plus GA_3 was found to be most effective among all the samples analysed. Concomitant with this, number of male flowers were also increased in the combined treatments only. However, in treatments like CCC 2000+IAA100, CCC4000+ kinetin 100 and MH 250+kinetin 100 the increasing effect was found to be statistically insignificant.

Thus, the summary result of the combined treatment with retardants followed by hormones at preflowering and flowering stages respectively, stands as such :

The retardant and hormone (single or combined doses)-induced changes perpetuated till senile phase. The chemicals applied in combined doses were much more effective on changing the growth and biochemical parameters analysed. Retardant-induced increase in crop yield was supplemented by the hormone treatments, and concomitantly deferment of plant senescence was more remarkable in combined doses of retardants followed by hormone applications.