# RESULTS AND DISCUSSION

# IV- RESULTS AND DISCUSSION

## 1- Effect of growth regulators foliar sprays on the vegetative growth of bearing Balady mandarin trees:

Data presented in Tables (1 and 2) show the periodical increments in both shoot length and number of leaves per shoot of Balady mandarin trees in response to growth regulators foliar sprays. All sprays were applied in November on trees bearing a rather heavy crop. Therefore, an "off-year" state was expected for all trees under study, during the two seasons of collecting the data for 1984 and 1985.

The obtained results show clearly that the spring flush of growth took place in all treatments and lasted until April 28, 1984 and May 5, 1985, in the first and second seasons, respectively. Generally, shoot length and number of leaves per shoot were increased rapidly through the first four to five weeks followed by a slower rate of growth till the end of the growth cycle, one to two weeks later. NAA sprays applied on November 7th resulted in higher increments in shoot length and leaves number per shoot over all other treatments and the control. This effect was highly significant during the early period of the growth cycle (March and early April). However, toward the end of the spring growth cycle, in both seasons, no appreciable differences were observed in either shoot length or number of leaves per shoot between the control trees and those sprayed in early November with NAA. On the other hand, NAA sprays on November 21st, caused an opposite trend to that showed by the early November 7th sprays, where significantly shorter shoots and less number of leaves per shoot were produced compared to the untreated trees (control). This was obvious throughout all the periodical measurements of both 1984 and 1985 seasons. Such differences in response to NAA sprays were indicated earlier by Ludders (1973); Ludder and Debor, (1975) and (1977) and Khamis, (1978) all reported that the effect of growth regulators on fruit trees depends on the concentration used, the date of application and the weather during and after application.

Regarding the effect of SADH (2000 PPm) sprays applied on 21st November, it is clear that shoots had grown at a significantly slower rate, in the spring flush of growth than the control. This is indicated by the periodical changes in shoot length and number of leaves per shoot (Table 1, 2).

Previous reports showed that shoot growth of apple trees were retarded by post bloom SADH applications (Greenhalgh and Edgerton, [1966]; Stembridge and Ferree

Table (2): Periodical changes in number of leaves per shoot of the spring flush of Balady mandarin trees* in two successive seasons in response to growth regulators foliar sprays.

| Treatments and date of spray | 1984 | | | | | | 1985 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | March | April | | | | May | April | | | | May | |
| | 31 | 7 | 14 | 21 | 28 | 5 | 7 | 14 | 21 | 28 | 5 | 12 |
| Control (Tap water spray) | 2.0 | 3.7 | 5.4 | 6.2 | 6.4 | 6.4 | 2.2 | 3.8 | 5.2 | 6.4 | 7.6 | 7.6 |
| NAA, 500 PPm-7/11 | 2.3 | 4.8 | 5.9 | 6.2 | 6.5 | 6.5 | 2.7 | 4.3 | 5.7 | 6.5 | 6.6 | 6.6 |
| NAA, 750 PPm-7/11 | 2.3 | 4.4 | 5.9 | 6.2 | 6.5 | 6.5 | 2.5 | 4.3 | 5.7 | 6.5 | 6.7 | 6.7 |
| NAA, 500 PPm-21/11 | 1.1 | 2.6 | 4.4 | 4.6 | 4.9 | 4.9 | 1.4 | 3.0 | 4.5 | 5.0 | 5.0 | 5.0 |
| NAA, 750 PPm-21/11 | 1.6 | 3.2 | 4.8 | 5.8 | 5.9 | 5.9 | 1.7 | 3.3 | 4.7 | 5.8 | 5.8 | 5.8 |
| SADH, 2000 PPm-21/11 | 1.4 | 2.8 | 4.3 | 4.7 | 4.9 | 4.9 | 1.2 | 2.5 | 3.6 | 4.4 | 4.8 | 4.8 |
| CCC, 2000 PPm-21/11 | 1.2 | 2.7 | 4.2 | 4.6 | 4.9 | 4.9 | 1.0 | 2.9 | 4.6 | 5.4 | 5.8 | 5.8 |
| L.S.D. at 5% | 0.19 | 0.34 | 0.35 | 0.32 | 0.37 | -- | 0.24 | 0.36 | 0.36 | 0.21 | 0.16 | -- |
| 1% | 0.27 | 0.47 | 0.48 | 0.44 | 0.51 | -- | 0.34 | 0.49 | 0.50 | 0.29 | 0.22 | -- |

* Sprayed in November 1983 and 1984 while the trees were considered in the "on-year" state (Data were recorded in the expected "off-year").

[1969]; Soczek and Zaziable [1971]; Ystaas [1971]; Stohr et al [1972]; Tromp [1972]; Veinbrants [1972]; Cartwright [1973] and Erasmus and Van [1974]). The latter disclosed that SADH at 1000-3000 PPm greatly reduced the rate of shoot elongation and shoot number. Ystaas (1973), working on sweet cherries mentioned also that an application of 2000 PPm Alar, 14 days after full bloom, reduced shoot extension growth by 33%.

CCC sprays at 2000 PPm applied on November 21st caused a highly significant retardation of shoot extension growth and number of leaves per shoot than the control treatment. This is in agreement with earlier reports by Marcelle (1966); Modlibowska (1966); Luckwill (1968) and Jaumien (1973). It was also noticed from the present study that CCC at 2000 PPm induced the most retardation of spring cycle shoot growth, in both seasons of study, followed by SADH at 2000 PPm then NAA at 500 PPM (all in the late November spray). However, NAA sprayed on the same date but at higher concentration (750 PPm) did not induce the strong degree of retardation showed by the lower NAA concentration (500 PPm). The obtained data cannot offer a suitable explanation to this trend.

## 2- Seasonal changes in dry matter, mineral elements content of leaves and shoots and total carbohydrates content of shoots of bearing Balady mandarin trees in response to growth regulator sprays:

### 2.1- Dry matter content of leaves and shoots

#### 2.1.a- Leaves:

Data presented in Table (3) and Figure (1) show the seasonal changes in leaf dry matter content as percentages for Balady mandarin trees sprayed with growth regulators NAA (500 and 750 PPm), 2000 PPm SADH and 2000 PPm CCC. Applications were performed on trees bearing a rather heavy crop (in "on-year" state) in November 1983 and 1984 seasons.

Trees sprayed on November 7th with either 500 PPm or 750 PPm. NAA, as well as the untreated (control) trees, showed generally the same trend for leaf dry matter percentage indicating a decrease from June till November followed by a gradual increase till March for both seasons. However, sprays on November 21st with 500 or 750 PPm NAA, 2000 PPm SADH and 2000 PPm CCC, all showed a slow and gradual increase in leaf dry matter content from June till the following March in both seasons of study. Such trend was interrupted by a slight drop in leaf dry matter content in November. The increase

Table (3): Seasonal changes in leaf dry matter of spring fulsh of Balady mandarin trees* in response to growth regulators foliar sprays.

| Treatments and dates of spray | Jun. | | Aug. | | Nov. | | Jan. | | Mar. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1985 | 1986 | 1985 | 1986 |
| | % dry matter in leaves | | | | | | | | | |
| Control (Tap water spray) | 33.87 | 35.82 | 33.57 | 35.81 | 32.22 | 31.44 | 39.08 | 40.11 | 50.30 | 52.80 |
| NAA, 500 PPm-7/11 | 33.81 | 35.44 | 33.36 | 35.77 | 31.76 | 31.08 | 39.00 | 40.00 | 49.65 | 51.95 |
| NAA, 750 PPm-7/11 | 34.28 | 35.52 | 33.48 | 35.56 | 32.34 | 32.28 | 40.30 | 40.16 | 49.69 | 44.33 |
| NAA, 500 PPm-21/11 | 31.92 | 34.50 | 37.75 | 39.46 | 36.51 | 38.65 | 39.82 | 41.92 | 45.62 | 46.87 |
| NAA, 750 PPm-21/11 | 31.01 | 33.17 | 38.31 | 40.33 | 38.79 | 39.09 | 40.75 | 41.79 | 45.93 | 47.54 |
| SADH, 2000 PPm-21/11 | 34.04 | 35.99 | 41.03 | 41.85 | 40.32 | 40.69 | 42.62 | 43.37 | 49.03 | 49.64 |
| CCC, 2000 PPm-21/11 | 33.57 | 34.99 | 39.90 | 41.40 | 39.66 | 39.01 | 41.96 | 41.83 | 48.92 | 48.25 |
| L.S.D. at 5% | 0.65 | 0.58 | 0.42 | 0.58 | 0.71 | 0.64 | 0.52 | 0.45 | 0.79 | 1.98 |
| 1% | 0.89 | 0.79 | 0.57 | 0.79 | 0.98 | 0.89 | 0.71 | 0.61 | 1.08 | 2.71 |

* Sprayed in November 1983 and 1984 seasons while the trees were considered in "on-year" state.

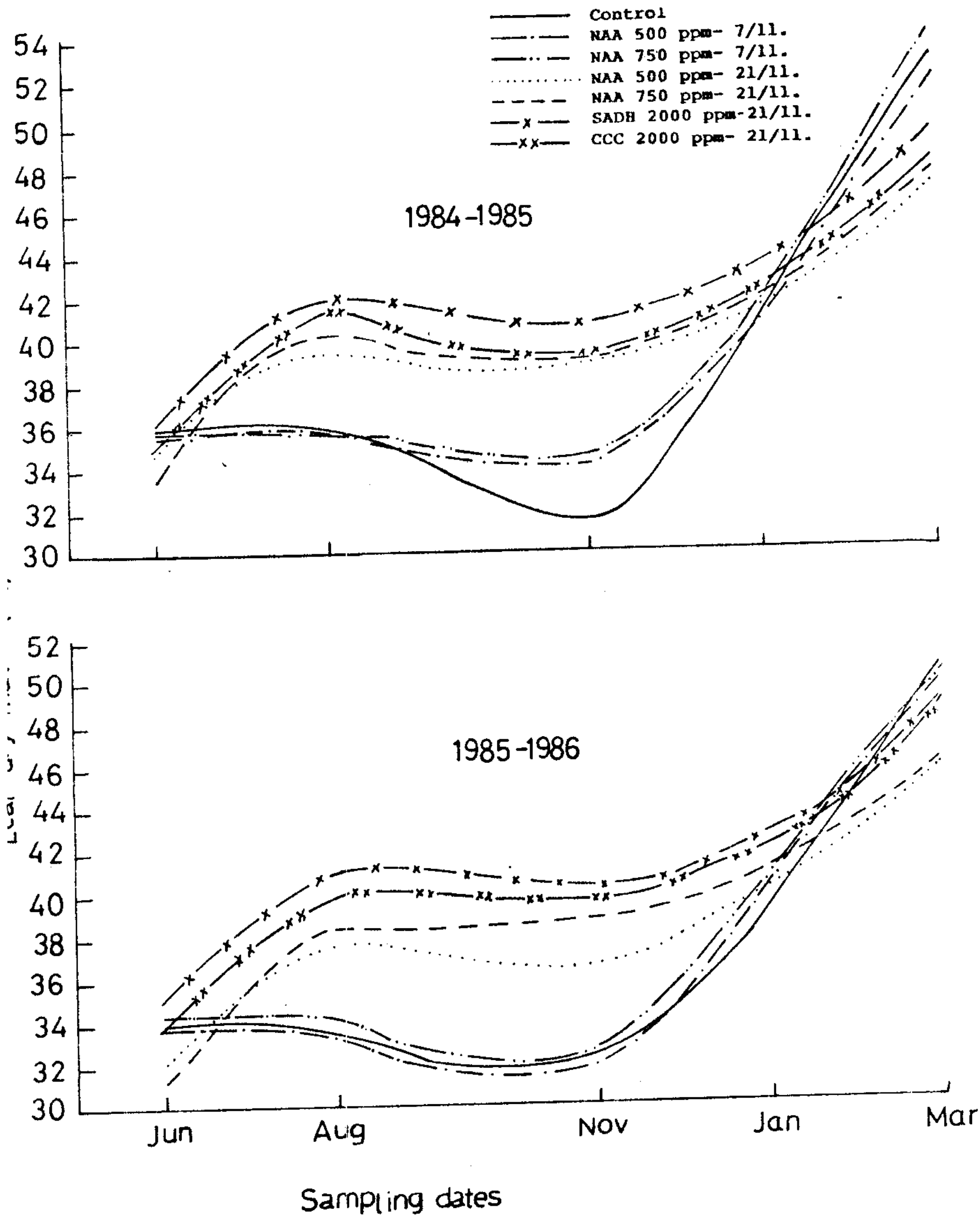


**Fig. (1):** Seasnonal changes in leaf dry matter of spring flush of Balady mandarin trees in response to growth regulators foliar sprays.

in dry matter percentages during summer may be due to the accumulation of photosynthates while the drop in leaf dry matter content in November, may be explained by the migration of food materials from the leaves to fruits and shoots. These results are in agreement with the findings of El-Gazzar (1961).

It was also clear that the range of seasonal fluctuations in leaf dry matter percentages was widest in the untreated trees between November and March but with the least fluctuations in leaf dry matter content under the 500 PPm NAA sprays on November 21st. All other treatments fell in between this two extremes.

**2.1.b- Shoots:**

Table (4) and Figure (2) show that trees sprayed on November 7th with either 500 or 750 PPm NAA followed the same trend as the control in the seasonal changes in dry matter content of shoots indicating a gradual increase from June to August followed by a slight decrease till November followed by a rise in shoot dry matter content till next March. This trend was similar for both seasons. However, sprays of November 21st with 500 PPm or 750 PPm NAA, 2000 PPm SADH or 2000 PPm CCC all showed a different trend than the control where a steady gradual increase in shoot dry matter content

Table (4): Seasonal changes in shoot dry matter of spring fulsh of Balady mandarin trees* in response to growth regulators foliar sprays.

| Treatments and dates | Jun. | | Aug. | | Nov. | | Jan. | | Mar. | |
|---|---|---|---|---|---|---|---|---|---|---|
| of spray | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1985 | 1986 | 1985 | 1986 |
| | % dry matter in leaves | | | | | | | | | |
| Control (Tap water spray) | 40.86 | 43.55 | 44.43 | 43.27 | 42.63 | 42.63 | 48.66 | 50.72 | 57.75 | 61.81 |
| NAA, 500 PPm-7/11 | 41.05 | 43.37 | 43.66 | 43.19 | 41.98 | 42.00 | 43.03 | 49.79 | 57.16 | 61.76 |
| NAA, 750 PPm-7/11 | 40.25 | 43.22 | 44.92 | 42.96 | 42.18 | 41.79 | 48.21 | 48.63 | 57.35 | 61.55 |
| NAA, 500 PPm-21/11 | 38.81 | 42.10 | 43.04 | 42.55 | 44.16 | 45.53 | 47.03 | 48.45 | 52.88 | 58.29 |
| NAA, 750 PPm-21/11 | 39.29 | 40.20 | 41.50 | 42.40 | 42.63 | 45.27 | 46.08 | 49.33 | 54.54 | 59.70 |
| SADH, 2000 PPm-21/11 | 40.91 | 42.97 | 43.06 | 42.60 | 45.79 | 46.19 | 48.10 | 50.55 | 56.69 | 60.87 |
| CCC, 2000 PPm-21/11 | 39.85 | 41.85 | 43.14 | 42.76 | 46.71 | 48.08 | 46.84 | 49.69 | 55.79 | 60.73 |
| L.S.D. at 5% | 0.56 | 0.71 | 1.03 | 0.51 | 0.79 | 0.58 | 0.55 | 0.61 | 0.77 | 0.93 |
| 1% | 0.78 | 0.97 | 1.41 | 0.70 | 1.08 | 0.79 | 0.75 | 0.84 | 1.06 | 1.27 |

* Sprayed in November 1983 and 1984 seasons while the trees were considered in "on-year" state.

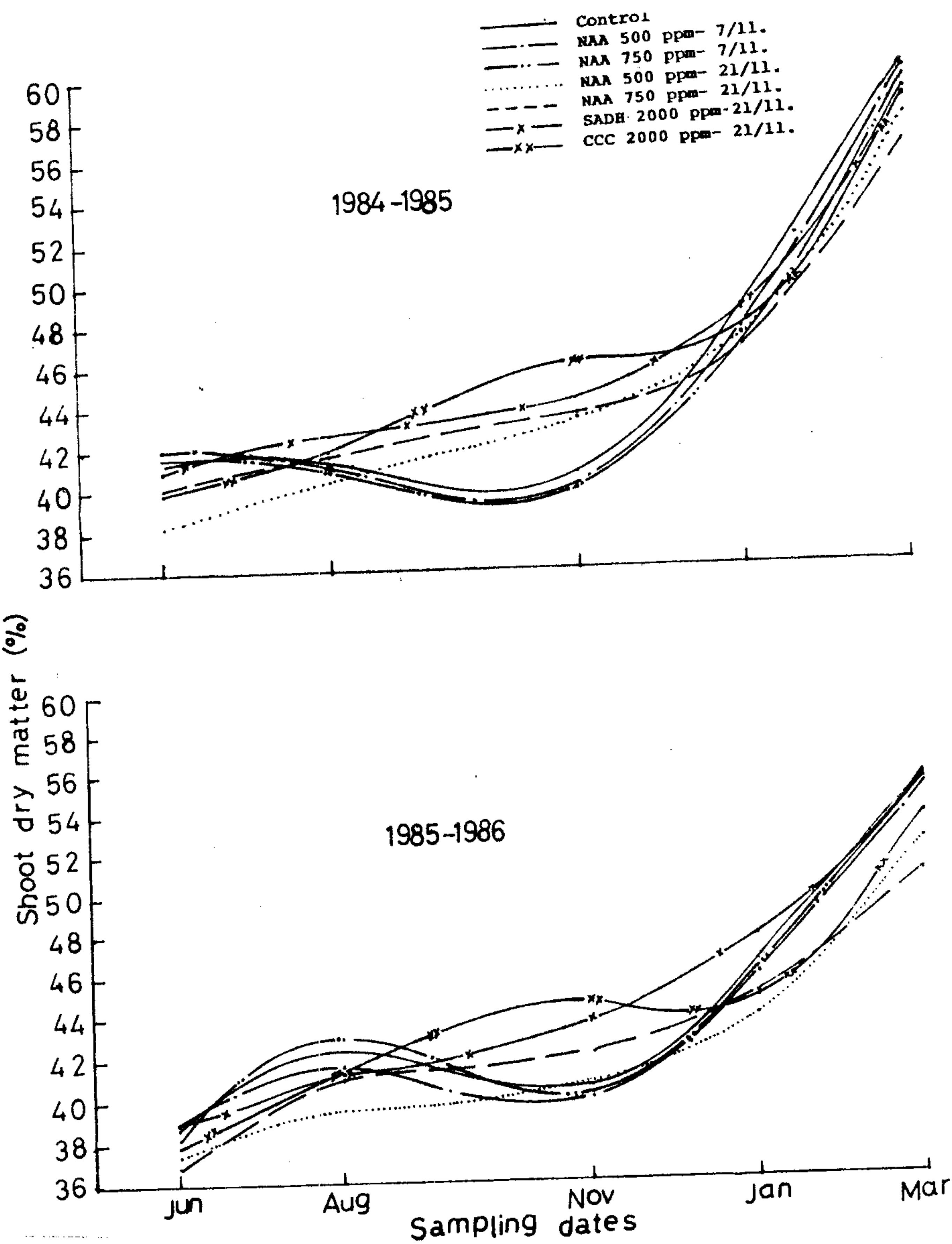


**Fig. (2):** Seasonal changes in shoot dry matter of spring flush of Balady mandarin trees in response to growth regulators foliar sprays.

took place from June to the following March for both seasons. The general increase in dry matter content of shoots by aging may be due to the accumulation of photosynthates and maturation of these shoots.

**2.2- Mineral elements content:**

**2.2.1- Nitrogen content of leaves and shoots:**

**2.2.1.a- Leaf nitrogen content:**

Table (5) and Fig. (3) show the seasonal changes in leaf nitrogen content of Balady mandarin trees in response to growth regulators foliar sprays in November. It is clear that, in both treated trees and the untreated ones leaf nitrogen percentages dropped gradually from June till August followed by a sudden but limited rise in nitrogen level till November in the leaves of control trees only, followed by a gradual decrease in Nitrogen level till March. Under the different spray treatments used, leaf nitrogen content differed significantly in values and trend during the season than the control. Leaf nitrogen levels decreased at a faster rate than the control, under all treatments, then continued to decrease till November. A sudden rise in leaf nitrogen content started in November till January indicating an opposite trend to that shown by the control trees.

Table (5): Seasonal changes in leaf nitrogen content of the spring flush of Balady mandarin trees* in 1984 and 1985 seasons in response to growth regulators foliar sprays.

| Treatments and dates of spray | Jun. 1984 | Jun. 1985 | Aug. 1984 | Aug. 1985 | Nov. 1984 | Nov. 1985 | Jan. 1985 | Jan. 1986 | Mar. 1985 | Mar. 1986 |
|---|---|---|---|---|---|---|---|---|---|---|
| | % N in dry leaves | | | | | | | | | |
| Control ( water spray) | 3.07 | 3.13 | 2.70 | 2.80 | 2.90 | 3.03 | 2.59 | 2.47 | 2.41 | 2.31 |
| NAA, 500 PPm-7/11 | 3.19 | 3.15 | 2.79 | 2.68 | 2.73 | 2.63 | 2.69 | 2.58 | 2.47 | 2.35 |
| NAA, 750 PPm-7/11 | 3.25 | 3.22 | 2.72 | 2.61 | 2.68 | 2.54 | 2.79 | 2.69 | 2.51 | 2.60 |
| NAA, 500 PPm-21/11 | 3.26 | 3.30 | 2.59 | 2.57 | 2.61 | 2.49 | 2.94 | 2.87 | 2.59 | 2.72 |
| MAA, 750 PPm-21/11 | 3.31 | 3.42 | 2.56 | 2.51 | 2.55 | 2.43 | 3.10 | 3.02 | 2.66 | 2.84 |
| SADH, 2000 PPm-21/11 | 3.40 | 3.31 | 2.50 | 2.35 | 2.39 | 2.30 | 3.11 | 3.25 | 2.91 | 2.97 |
| CCC, 2000 PPm-21/11 | 3.33 | 3.21 | 2.59 | 2.44 | 2.49 | 2.36 | 3.11 | 3.16 | 2.69 | 2.93 |
| L.S.D. at 5% | 0.05 | 0.07 | 0.10 | 0.05 | 0.11 | 0.05 | 0.07 | 0.05 | 0.10 | 0.05 |
| 1% | 0.07 | 0.10 | 0.14 | 0.07 | 0.16 | 0.07 | 0.10 | 0.07 | 0.14 | 0.07 |

* Sprayed in November 1983 and 1984 seasons while the trees were considered in "on-year" state.

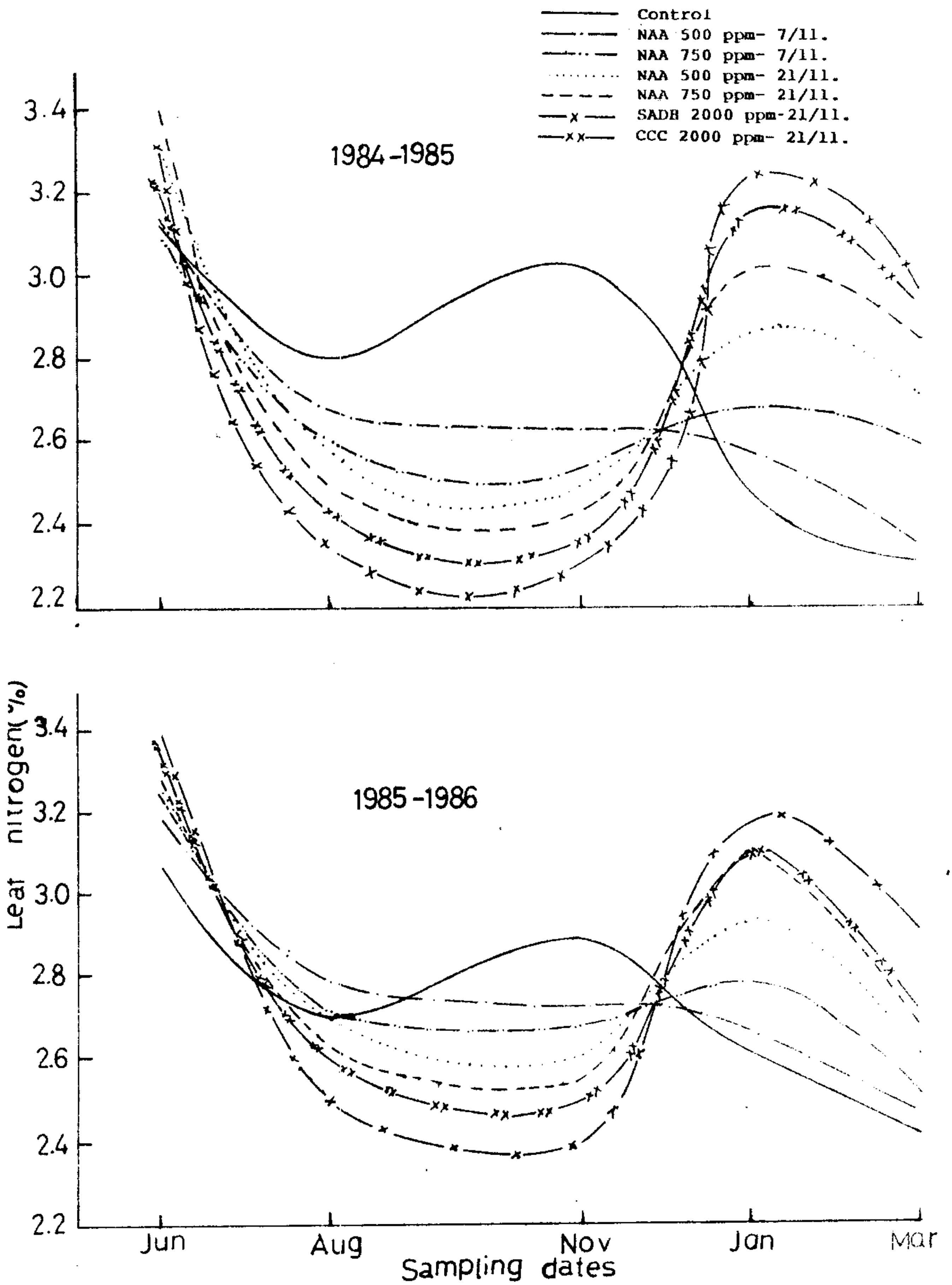


**Fig. (3):** Seasonal changes in leaf nitrogen content of the spring flush of Balady mandarin trees in 1984-1985 and (1985-1986) seasons in response to growth regulators foliar sprays.

Generally the drop in leaf nitrogen content occur during periods of growth flushes where great consumption of nitrogen takes place. This was explained previously by Wallace et al. (1954), who found that 25-30% of the nitrogen in orange leaves was lost during new growth flushes. Similar results were obtained by, Smith and Reuther (1950); Zidan and Maximos (1962) and El-Naggar (1964). The difference in trend of leaf nitrogen level between teated and untreated control trees may be due to the shift occurred in growth flushes due to treatments. The trend was similar in both 1984-1985 and 1985-1986 seasons.

Generally no much stress could be put on the differences ocurring between treated trees and the untreated contorl at specific dates since no logical explanation could be given for each date. However, the general trend for nitrogen leaf content was beleived to be of importance because it may reflect the shift in nitrogen consumption in growth activities in response to the treatments used.

**2.2.1.b- Shoot nitrogen content:**

Data of the two seasons of study as shown in Table (6) and Figure (4) show that shoot nitrogen contents for trees sprayed on November 21st were significantly higher than the control in June and August of both seasons

Table (6): Seasonal changes in shoot nitrogen content of the spring fulsh of Balady mandarin trees* in response to growth regulators foliar sprays.

| Treatments and dates of spray | Jun. | | Aug. | | Nov. | | Jan. | | Mar. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1985 | 1986 | 1985 | 1986 |
| | % N in dry shoots | | | | | | | | | |
| Control ( water spray) | 1.19 | 1.22 | 1.50 | 1.39 | 1.43 | 1.36 | 1.39 | 1.43 | 1.60 | 1.60 |
| NAA, 500 PPm-7/11 | 1.24 | 1.25 | 1.54 | 1.47 | 1.47 | 1.49 | 1.43 | 1.46 | 1.53 | 1.51 |
| NAA, 750 PPm-7/11 | 1.35 | 1.32 | 1.55 | 1.41 | 1.47 | 1.43 | 1.49 | 1.55 | 1.50 | 1.51 |
| NAA, 500 PPm-21/11 | 1.37 | 1.34 | 1.68 | 1.64 | 1.38 | 1.32 | 1.56 | 1.67 | 1.50 | 1.49 |
| NAA, 750 PPm-21/11 | 1.43 | 1.40 | 1.80 | 1.66 | 1.35 | 1.33 | 1.62 | 1.58 | 1.39 | 1.42 |
| SADH, 2000 PPm-21/11 | 1.48 | 1.43 | 1.88 | 1.80 | 1.32 | 1.31 | 1.64 | 1.83 | 1.24 | 1.27 |
| CCC, 2000 PPm-21/11 | 1.39 | 1.36 | 1.74 | 1.71 | 1.35 | 1.40 | 1.69 | 1.72 | 1.30 | 1.30 |
| L.S.D. at 5% | 0.14 | 0.10 | 0.13 | 0.10 | 0.13 | 0.08 | 0.11 | 0.13 | 0.11 | 0.10 |
| 1% | 0.19 | 0.14 | 0.18 | 0.14 | 0.18 | 0.11 | 0.16 | 0.18 | 0.16 | 0.14 |

* Sprayed in November 1983 and 1984 seasons while the trees were considered in "on-year" state.

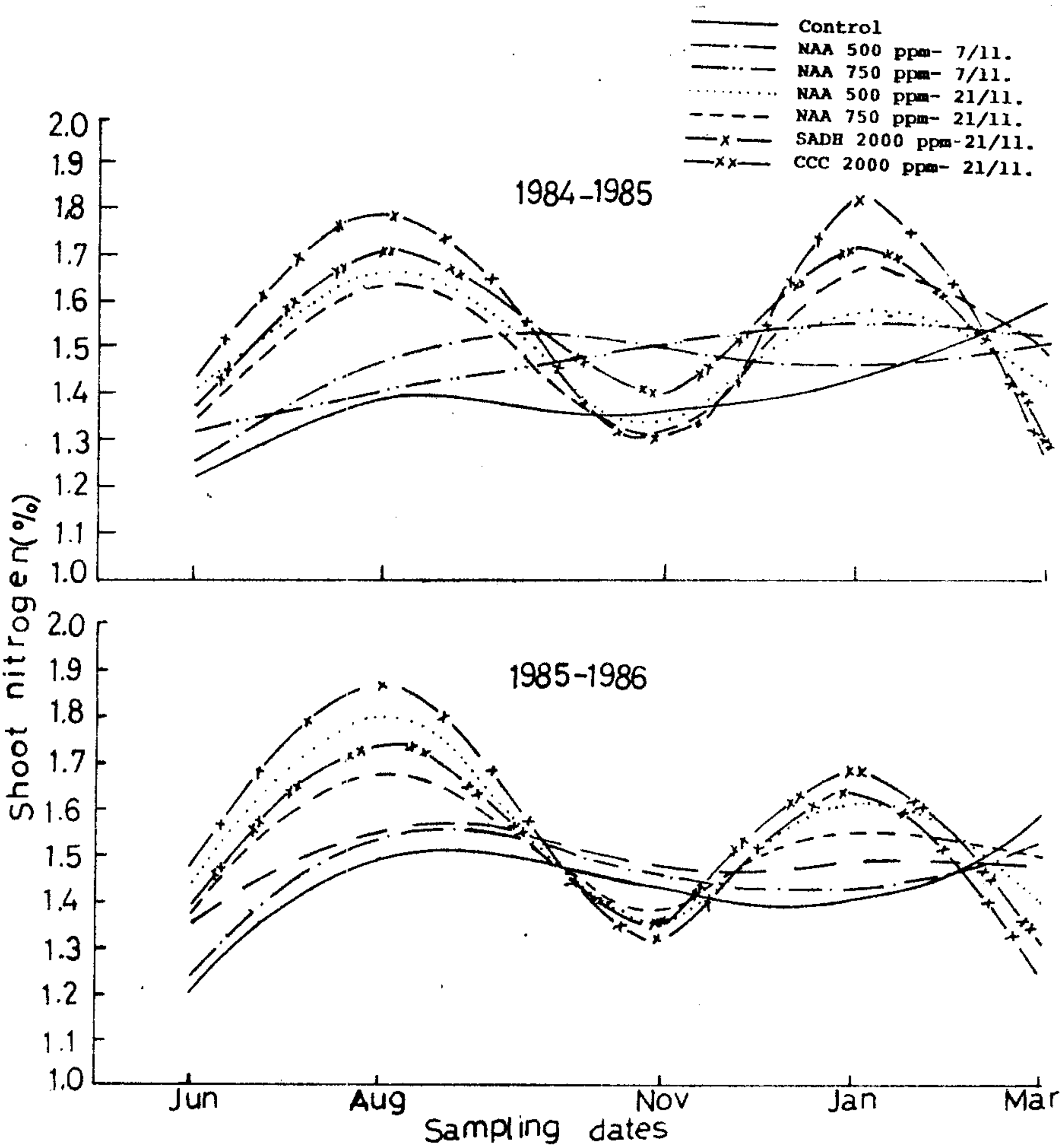


**Fig. (4):** Seasonal changes in shoot nitrogen content of the spring flush of Balady mandarin trees in response to growth regulators foliar sprays.

of study. NAA sprays on November 7th showed a similar trend to that of the control throughout both seasons. SADH, CCC and NAA sprays on November 21st showed a different trend indicating two peaks of shoot nitrogen content reached in August and January for both seasons of study.

From the results of leaf and shoot nitrogen content we can notice a significant differences in trend and control percentages of nitrogen between the control trees and those sprayed on November 21st. Such differences were highly significant for the SADH and CCC treatments, but not significant for NAA sprays on November 7th. Such differences may reflect the shift in vegetative growth and or fruiting in response to treatment as will be shown in the data of yield for different treatments.

### 2.2.2- Leaf phosphorus content:

Seasonal changes in leaf phosphorus content are shown in Table (7) and Figure (5). The data show that NAA sprays on November 7th at 500 and 750 PPm showed a similar trend to the control with regard to leaf phosphorus content, with insignificant differences in its actual values. However, in June phosphorus level was significantly higher in leaves of the control trees than those of trees sprayed with 2000 PPm SADH, 2000

Table (7): Seasonal changes in leaf phosphorus content of spring fulsh of Balady mandarin trees* as affected by different growth regulators sprays.

| Treatments and dates of spray | Jun. | | Aug. | | Nov. | | Jan. | | Mar. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1985 | 1986 | 1985 | 1986 |
| | % P in dry leaves | | | | | | | | | |
| Control (Tap water spray) | 0.16 | 0.17 | 0.18 | 0.18 | 0.16 | 0.17 | 0.14 | 0.14 | 0.10 | 10.10 |
| NAA, 500 PPm-7/11 | 0.15 | 0.15 | 0.17 | 0.18 | 0.15 | 0.17 | 0.13 | 0.14 | 0.11 | 0.11 |
| NAA, 750 PPm-7/11 | 0.15 | 0.15 | 0.17 | 0.16 | 0.16 | 0.17 | 0.14 | 0.14 | 0.11 | 0.12 |
| NAA, 500 PPm-21/11 | 0.14 | 0.14 | 0.16 | 0.15 | 0.16 | 0.17 | 0.12 | 0.13 | 0.12 | 0.13 |
| NAA, 750 PPm-21/11 | 0.13 | 0.13 | 0.16 | 0.13 | 0.16 | 0.17 | 0.12 | 0.12 | 0.14 | 0.18 |
| SADH, 2000 PPm-21/11 | 0.10 | 0.09 | 0.13 | 0.11 | 0.18 | 0.14 | 0.11 | 0.09 | 0.16 | 0.18 |
| CCC, 2000 PPm-21/11 | 0.11 | 0.11 | 0.15 | 0.12 | 0.15 | 0.15 | 0.11 | 0.11 | 0.15 | 0.17 |
| L.S.D. at 5% | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 |
| 1% | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 |

* Sprayed in November 1983 and 1984 seasons while the trees were considered in "on-year" state.

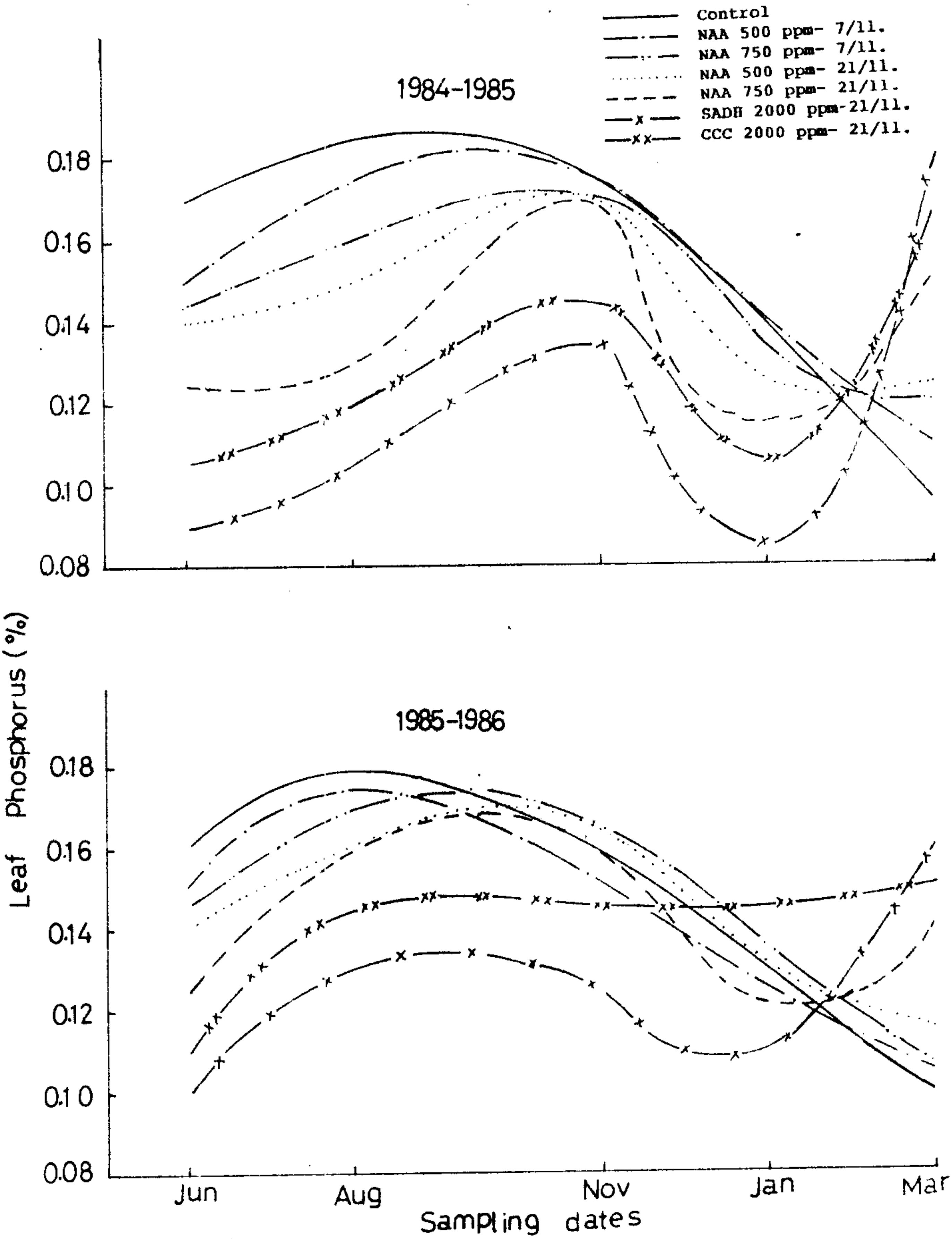


**Fig. (5):** Seasonal changes in leaf phosphorus content of the spring flush of Balady mandarin trees in response to growth regulators foliar sprays.

PPm CCC and 500, 750 PPm NAA all sprayed on November 21st. However, as the season progressed, differences between treatments and the control started to decrease gradually till January, where the differences between treatments and the control were the least. After wards the differences started to increase but with a reverse trend where phosphorus level in the control treatment continued to decrease. On the other hand, 2000 PPm SADH, 2000 PPm CCC and 500, 750 PPm NAA sprayed on November 21st showed an increase in phosphorus level from January through March.

These data are in partial agreement with the reports of Smith and Reuther (1950) and El-Naggar (1964). They pointed out that leaf phosphorus content of Washington navel oranges increased, gradually, early in the season, then it decreased during the summer cycle, then it increased again till the start of the next spring cycle. Differences between November 21st growth regulator sprays and the control in the trend of the sesonal changes in phosphorus level may reflect a difference in consumption activities of these nutrients due to shifts in vegetative growth and fruiting than the control. This was indicated in earlier discussion by a more vigorous vegetative growth during the spring flush in the untreated control trees over those sprayed with SADH, CCC and NAA on November 21st.

**2.2.3- Leaf potassium content:**

The seasonal changes in leaf potassium content in Balady mandarin trees in response to growth regulator sprays are shown in Table (8) and Figure (6). In June, potassium level was significantly higher in leaves of the control trees than trees sprayed on the later November 21st with SADH 2000 PPm, CCC 2000 PPm and NAA (500 and 750 PPm). However, trees sprayed on November 7th with NAA did not show significant differences between them and the control with regard to leaf potassium content. Furthermore, the trend of their seasonal changes in potassium level was similar to that of the control trees. It showed a gradual increase in potassium level starting from August till January followed by a gradual drop in the potassium content in March. Growth regulator sprays on November 21st induced a change in trend and actual values of leaf potassium content of Balady mandarin trees in the two seasons of study, than the control trees as well as the November 7th sprays. Such differences were highly significant throughout the season except that on March of both 1985 and 1986 seasons where differe-nces between all treatments were limited. The results of both seasons of study were very much similar. The general trend of leaf potassium obtained in these results agree with the findings of many earlier investigators;

Table (8): Seasonal changes in leaf Potassium content of spring flush of Balady mandarin trees* in response to growth regulators foliar sprays.

| Treatments and dates of spray | Jun. | | Aug. | | Nov. | | Jan. | | Mar. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1985 | 1986 | 1985 | 1986 |
| | % K in dry leaves | | | | | | | | | |
| Control (Tap water spray) | 1.42 | 1.45 | 0.45 | 1.51 | 1.72 | 1.76 | 1.81 | 1.90 | 1.57 | 1.67 |
| NAA, 500 PPm-7/11 | 1.50 | 1.60 | 1.54 | 1.59 | 1.60 | 1.61 | 1.87 | 1.96 | 1.59 | 1.69 |
| NAA, 750 PPm-7/11 | 1.45 | 1.59 | 1.55 | 1.58 | 1.76 | 1.79 | 1.85 | 1.92 | 1.59 | 1.69 |
| NAA, 500 PPm-21/11 | 1.27 | 1.28 | 1.34 | 1.37 | 1.47 | 1.45 | 1.58 | 1.61 | 1.47 | 1.51 |
| NAA, 750 PPm-21/11 | 1.25 | 1.33 | 1.27 | 1.34 | 1.40 | 1.44 | 1.49 | 1.50 | 1.51 | 1.63 |
| SADH, 2000 PPm-21/11 | 1.21 | 1.32 | 1.22 | 1.36 | 1.27 | 1.29 | 1.31 | 1.31 | 1.54 | 1.64 |
| CCC, 2000 PPm-21/11 | 1.26 | 1.21 | 1.27 | 1.22 | 1.39 | 1.33 | 1.46 | 1.36 | 1.54 | 1.64 |
| L.S.D. at 5% | 0.10 | 1.13 | 0.09 | 0.10 | 0.09 | 0.07 | 0.16 | 0.09 | 0.09 | 0.09 |
| 1% | 0.14 | 0.18 | 0.12 | 0.14 | 0.12 | 0.10 | 0.23 | 0.12 | 0.12 | 0.12 |

* Sprayed in November 1983 and 1984 seasons while the trees were considered in the "on-year" state.

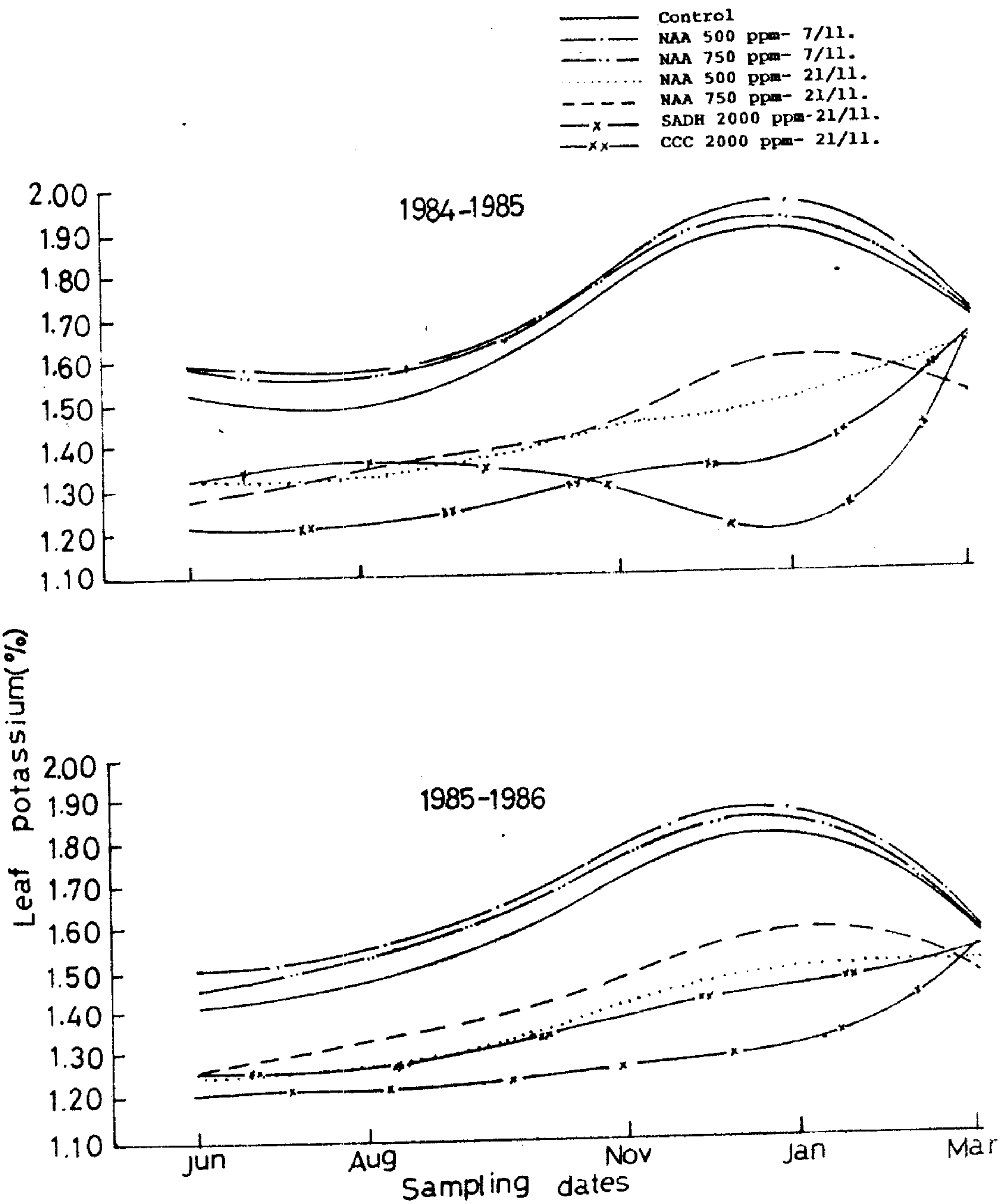


**Fig. (6):** Seansonal changes in leaf potassium content of the spring flush of Balady mandarin trees in response to growth regulators foliar sprays.

Zidan and Maximos (1962), working on mango, El-Naggar (1964) and Deidda and Virdis (1969), working on Washington navel orange, Kamis (1974), working on guava.

The observed shifs in the trend and concentrations of leaf potassium in response to sprays of November 21st with 2000 PPm SADH, 2000 PPm CCC, 750 PPm NAA and to some extent 500 PPm NAA could be attributed to the changes induced by these growth regulators in vegetative growth as shown earlier and the reflections occurred on flowering and fruiting of treated mandarin trees.

**2.3- Seasonal changes in total carbohydrates content and carbohydrate Nitrogen ratio in shoots of Baladi mandarin trees in response to growth regulator sprays:**

Data presented in Table (9) and Figure (7) show the changes in total carbohydrates of Baladi mandarin shoots, during the two seasons of study as influenced by foliar sprays with NAA on either November 7th or November 21st, SADH and CCC on November 21st. Trees were sprayed while they were bearing a rather heavy crop (an off-year was expected in the following season). Shoot total carbohydrates, in June, were at rather low level in all trees. However, the untreated control trees showed a significantly higher level of shoot carbohydrates

Table (9): Seasonal changes in shoot total carbohydrates content of spring flush of Balady mandarin trees* in response to growth regulators foliar sprays.

| Treatments and dates of spray | Jun. | | Aug. | | Nov. | | Jan. | | Mar. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1985 | 1986 | 1985 | 1986 |
| | g. glucose/100 g dry weight | | | | | | | | | |
| Control (Tap water spray) | 16.50 | 14.26 | 21.02 | 20.17 | 15.87 | 11.62 | 23.52 | 21.85 | 30.71 | 29.79 |
| NAA, 500 PPm-7/11 | 14.65 | 13.76 | 20.66 | 19.87 | 13.96 | 11.25 | 22.93 | 20.86 | 30.59 | 29.30 |
| NAA, 750 PPm-7/11 | 14.21 | 13.45 | 20.36 | 19.83 | 13.77 | 10.67 | 22.58 | 21.55 | 29.84 | 29.39 |
| NAA, 500 PPm-21/11 | 14.19 | 12.63 | 20.01 | 19.31 | 13.69 | 10.67 | 22.47 | 21.45 | 29.97 | 29.41 |
| NAA, 750 PPm-21/11 | 14.14 | 11.07 | 18.79 | 17.20 | 13.57 | 10.34 | 21.00 | 18.17 | 28.44 | 27.07 |
| SADH, 2000 PPm-21/11 | 13.65 | 9.75 | 17.90 | 16.83 | 13.09 | 9.81 | 20.95 | 17.36 | 27.38 | 26.65 |
| CCC, 2000 PPm-21/11 | 13.89 | 10.37 | 18.89 | 17.80 | 13.42 | 10.40 | 21.03 | 18.22 | 26.91 | 27.48 |
| L.S.D. at 5% | 1.63 | 0.27 | 1.62 | 0.39 | 1.36 | 0.16 | 1.67 | 0.48 | 1.49 | 0.42 |
| 1% | 2.29 | 0.39 | 2.27 | 0.55 | 1.91 | 0.23 | 2.34 | 0.67 | 2.09 | 0.58 |

* Sprayed in November 1983 and 1984 seasons while trees were considered in the "on-year" state. Data were recorded in the expected "off-year".

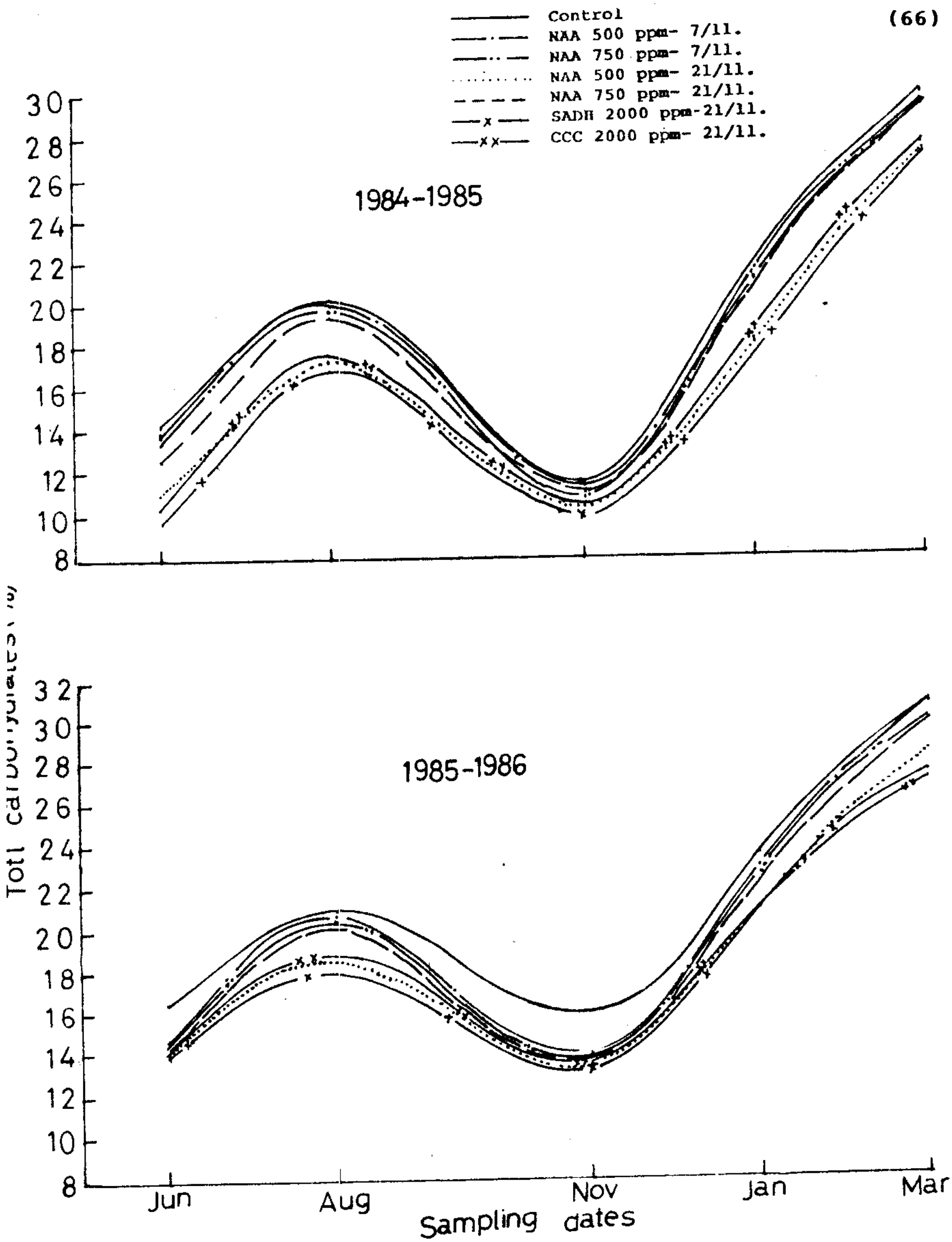


**Fig. (7):** Seasonal changes in shoot total carbohydrates content of the spring flush of Balady mandarin trees in response to growth regulators foliar sprays.

over all sprayed trees. Such higher level continued throughout the season in both seasons of study indicating the same trend but with variable degrees of significance. 2000 PPm SADH foliar sprays induced the lowest level of shoot carbohydrates in June followed by 2000 PPm CCC sprays, with no significant differences between them. This trend continued throughout the season. NAA sprays induced less influence on shoot carbohydrates content than SADH or CCC showing higher values but still significantly lower than the control. These results indicate some influence of the regulators used on the consumptive use of stored carbohydrates in shoots.

Regarding the seasonal changes in shoot total carbohydrates, it is clear that carbohydrates level was generally low in June then started to rise to reach a peak in August followed by a drop in shoot carbohydrates content to reach a minimum in November followed by a second rise that continued until the following March. This trend was true for all treatments under study for both seasons. This general trend agree with the finding of Hussain (1979), working on Amoun orange. It could be stated that accumulation of carbohydrates in shoots may take place during periods of arrested growth activities while rapid consumption and depletion of shoot carbohydrates may take place during fluches of growth as well as during flowering and fruiting activities.

The highly significant differences indicated between trees sprayed on November 21st by 2000 PPm SADH or 2000 PPm CCC in shoot total carbohydrates could be a reflection of the shift occurred in growth and fruiting activities in these trees.

With respect to the C/N ratio in shoots data of the two seasons of study as shown in Table (10) and Figure (8) indicate that shoots of the control trees had the highest C/N ratio while those sprayed with SADH had the least C/N ratio followed by trees sprayed with CCC. Generally, NAA sprays induced a response in between the above spray treatments and the control, November 21st sprays being more effective than November 7th sprays. As the season progressed the differences between treatments and the control started to decrease gradually until November where differences between all treatments and the control were very limited but, control trees stayed at a higher C/N ratio in shoots over all other treatments. After November, the C/N ratio started to increase gradually in all trees but at a higher rate for trees sprayed with SADH and CCC to show, in the following March, higher C/N ratios than the control.

The trend of sasonal changes in C/N ratio presented in this study confirm earlier results by Hussain (1979), on Amoun orange trees. However, he indicated that Alar

Table (10): Seasonal changes in shoot C/N ratio of the spring flush of Balady mandarin trees* in response to growth regulators foliar sprays.

| Treatments and dates of spray | Jun. | | Aug. | | Nov. | | Jan. | | Mar. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1985 | 1986 | 1985 | 1986 |
| | | | | | C/N ratio | | | | | |
| Control (Tap water spray) | 13.90 | 11.68 | 14.01 | 14.51 | 11.12 | 8.58 | 16.84 | 15.31 | 19.19 | 18.67 |
| NAA, 500 PPm-7/11 | 11.61 | 10.19 | 13.43 | 13.51 | 9.49 | 7.55 | 16.01 | 14.16 | 19.95 | 19.40 |
| NAA, 750 PPm-7/11 | 10.52 | 10.18 | 13.14 | 14.06 | 9.37 | 7.03 | 15.15 | 13.90 | 20.21 | 19.46 |
| NAA, 500 PPm-21/11 | 10.35 | 9.41 | 11.91 | 11.77 | 9.92 | 7.01 | 13.41 | 12.84 | 19.98 | 19.73 |
| NAA, 750 PPm-21/11 | 9.69 | 7.91 | 10.44 | 10.23 | 10.05 | 7.60 | 12.96 | 11.48 | 20.46 | 19.07 |
| SADH, 2000 PPm-21/11 | 9.35 | 6.65 | 9.52 | 9.36 | 9.89 | 7.48 | 12.77 | 9.48 | 22.02 | 20.99 |
| CCC, 2000 PPm-21/11 | 9.99 | 7.50 | 10.56 | 10.27 | 9.94 | 7.42 | 12.44 | 10.62 | 20.80 | 21.10 |

* Sprayed in November 1983 and 1984 seasons while trees were considered in the "on-year" state.

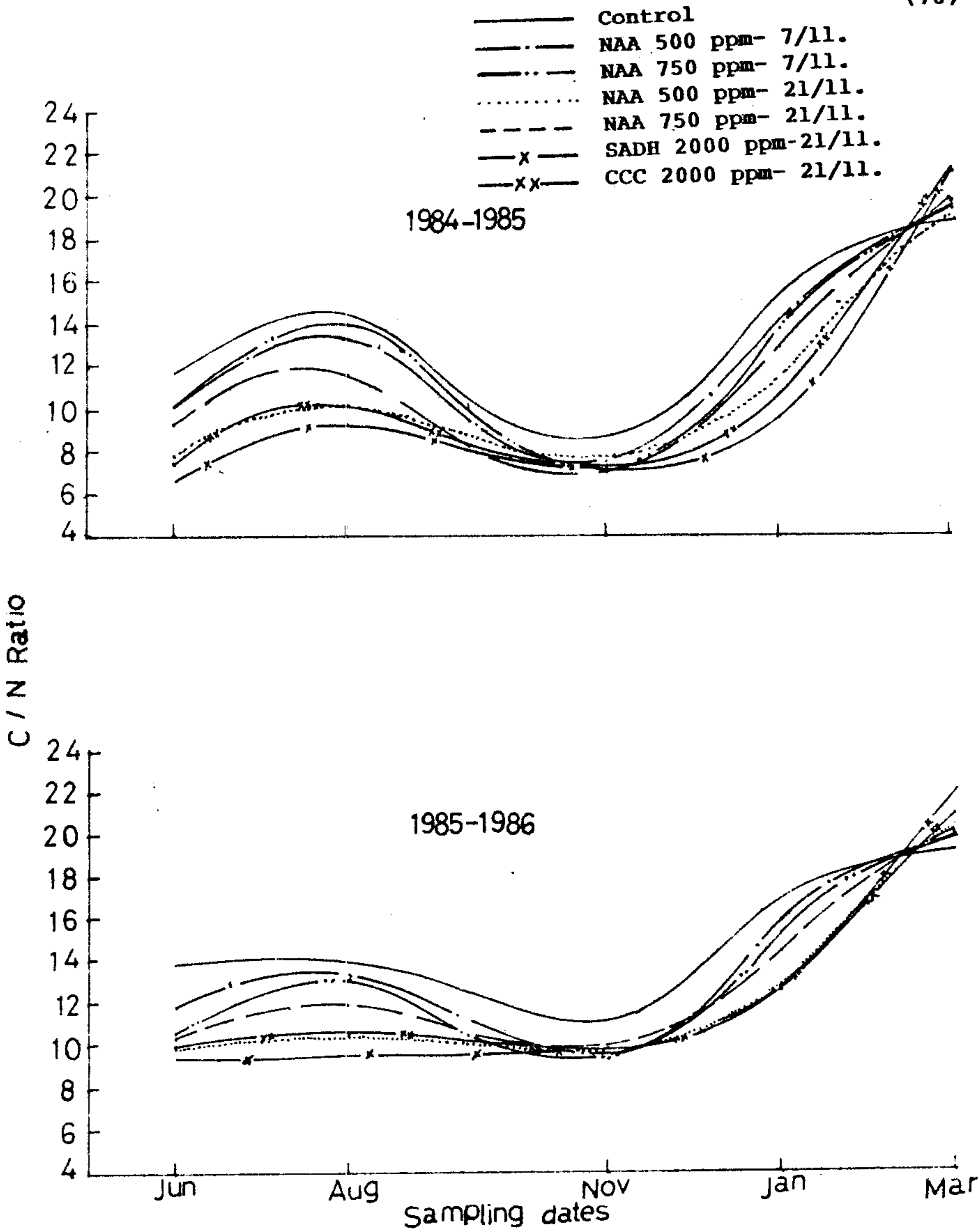


**Fig. (8):** Seasonal changes in shoot C/N ratio of the spring flush of Balady mandarin trees in response to growth regulators foliar sprays.

treatments did not greatly influence C/N ratio of Amoun orange shoots, leaves and flowers.

## 3- Effect of growth regulators sprays on flowering and fruiting of Balady mandarin trees:

### 3.1- Number of flowers, fruit set and yield:

Data of number of flowers, fruit set and yield are shown in Table (11). It is quite evident that NAA sprays either at the rate of 500 PPm or 750 PPm on 7th November had no effect on the number of flowers since differences between these treatments and the control trees were so small to reach the significant level. The picture was changed when trees were sprayed with NAA on 21st November where treated trees significantly surpassed the untreated ones in this respect. However, in both seasons high level of NAA (750 PPm) decreased significantly the number of flowers per tree than the low level (500 PPm).

Regarding SADH sprays it is clear that trees sprayed with 2000 PPm developed higher number of flowers than the control. Such treatment was still higher stastistically than 750 PPm NAA treatment in the same date of spraying.

Moreover, in both seasons trees sprayed with 2000 PPm CCC had higher number of flowers than the control.

Table (11): No. of flowers, fruit set and yield of Balady mandarin trees* in two successive seasons as affected by different growth regulators foliar spray.

| Treatments and dates of spray | No. of tagged flowers | | Fruit set (%) | | Yield/tree Wt. in (Kg) | | No. of fruits/tree | |
|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 |
| Control (water spray) | 197.00 | 227.30 | 30.28 | 20.32 | 13.50 | 12.80 | 83.50 | 76.30 |
| NAA, 500 PPm- 7/11 | 203.00 | 239.00 | 30.60 | 30.13 | 20.50 | 19.50 | 43.50 | 137.30 |
| NAA, 750 PPm- 7/11 | 213.30 | 248.30 | 31.08 | 29.82 | 22.00 | 21.80 | 161.30 | 151.80 |
| NAA, 500 PPm- 21/11 | 1953.50 | 1891.30 | 49.96 | 50.07 | 30.00 | 30.80 | 210.80 | 215.50 |
| NAA, 750 PPm- 21/11 | 1293.50 | 1254.50 | 40.07 | 55.09 | 37.00 | 35.80 | 267.80 | 258.30 |
| SADH, 2000 PPm- 21/11 | 1365.50 | 1644.00 | 59.10 | 60.15 | 50.30 | 48.30 | 409.50 | 367.00 |
| CCC, 2000 PPm- 21/11 | 1052.50 | 2105.30 | 43.43 | 39.78 | 38.30 | 38.80 | 309.00 | 308.80 |
| **L.S.D. at 5%** | **88.43** | **60.08** | **2.16** | **2.14** | **2.96** | **3.50** | **21.63** | **22.23** |
| **1%** | **121.28** | **82.40** | **2.96** | **2.93** | **4.05** | **4.80** | **29.67** | **30.48** |

* Sprayed in November 1983 and 1984 seasons while trees were considered in the "on-year" state (Data were recorded in the expected "off-year".

Meanwhile, in 1985 this treatment surpassed all other used treatments including the SADH treatment in the number of flowers.

Generally, it is safe to conclude that the 21st November CCC treatment as an average of two seasons gave the highest values of flowers number followed by SADH, 500 PPm NAA and 750 PPm NAA treatments in descending order Table (11). The aforementioned results on SADH sprays agreed with the findings of Batjer et al. (1964), on apple and pear, Monselise et al. (1966), on lemon trees, Maiti and Sen (1968), on mango, Costa and filiti (1971), Soczek and Zogiable (1971) and Ystaas (1971), on apples. They all found that Alar (SADH) sprays increased flowering of trees in the following season.

Moreover, the effect of CCC sprays on flowering of fruit trees was previously studied by many investigators and their findings coincided with the present results. In this respect, Monselise and Halevy (1962); Dedolf (1962); Batjer et al. (1964) and Kamis et al. (1985), found that spraying lemons, papaya, apple, and Balady lime trees, respectively with CCC increased number of flowers.

Regarding fruit set percentage, it is obvious from Table (11) that neither 500 PPm nor 750 PPm NAA sprays on early November had statistically any effect on fruit set as compared with the control since significant differences were lacking. As trees were sprayed on late November the picture was changed to the positive effect. In other wards, NAA sprays in this date encouraged fruit set significantly.

Higher level of NAA, as an average of two seasons, decreased fruit set as compared with the lower concentration.

Concerning SADH sprays, it is clear that, in both seasons, it stimulated fruit set markedly and surpassed all other used growth regulators in this concern.

Spraying trees with CCC caused significant increase over the control. However, this treatment gave the least values of fruit set among the other growth substances used in this study.

The obtained data of fruit set of Balady mandarin trees as affected by NAA, SADH and CCC growth substances behaved the same as findings of verious previous workers.

In this respect, El-Ashram at al. (1985), found that NAA sprays improved fruit set of peach trees. Moreover, Southwick et al. (1971), on Mc-Intoch apple and Ali (1977), on valencia orange reported that SADH sprays increased fruit set of these crops. On the other hand, Khamis et al. (1985), on Balady lime trees obtained the same findings with CCC as reported in this study.

Concerning the yield of Balady mandarin trees, expressed either as Kgs. or number of fruits per tree, data presented in Table (11) and Figure (8) clearly showed that all trees were in the off-year state. Nevertheless in both seasons all treatments of growth substances increased statistically the yield of treees over the untreated ones (control). In this concern, NAA sprays either at the rate of 500 PPm or 750 PPm on 7th November increased the yield of trees visually. However, no appreciable difference was observed between high level and low level of NAA on 7th November. The opposite was true when NAA was sprayed on 21st November where 750 PPm concentration developed higher yield than the 500 PPm level. On the other hand, SADH treatment surpassed all other treatments where it gave the highest yield either as Kgs. or number of fruits per tree. Spraying trees with 2000 PPm CCC on late November caused a high increase in yield over the corresponding ones sprayed with 750 PPm NAA on the same spraying date, hence no significant difference was observed between these treatments. Accordingly, it is easy to notice from Table (11) that the highest yield was born on trees sprayed on 21st November with 2000 PPm SADH followed by 2000 PPm CCC, 750 PPm NAA and 500 PPm NAA in a descending order. The obtained results of NAA sprays were supported by the findings of El-Masry (1982), on mango trees. Moreover, Khamis results (1978), on peach trees go in line with the present data in this study on SADH and CCC sprays.

### 3.2- Number of remaining fruits:

Data as shown in Table (12) and Figure (9) disclosed the number of remaining fruits per tree at intervals started from early May up to mid-December in response to growth regulator foliar sprays while trees were expected to be in the off-year state following a heavy crop born in the previous season.

It is clear that number of remained fruits on trees sprayed with NAA, SADH and CCC on late November decreased sharply till July then decreased smoothly afterwards. However, trees sprayed with NAA on early November or unsprayed trees had few number of remained fruits in early May as compared with other treatments and maintained a small number of remaining fruits till the last count in mid-December.

Concerning growth regulator treatments in this respect it is quite evident that trees sprayed with either 500 PPm or 750 PPm NAA on early November did not show any significant increase in number of remaining fruits in different dates over the unsprayed trees.

Table (12): Number of remaining fruits of Balady mandarin trees* as affected by different growth regulators foliar sprays.

| Treatments and dates of spray | No. of remaining fruits/tagged branches. Early May 1984 | Early May 1985 | mid-Jun. 1984 | mid-Jun. 1985 | mid-Jul. 1984 | mid-Jul. 1985 | mid-Aug. 1985 | mid-Aug. 1986 | mid-Dec. 1985 | mid-Dec. 1986 |
|---|---|---|---|---|---|---|---|---|---|---|
| Control (Tap water spray) | 59.8 | 67.8 | 18.5 | 22.5 | 11.5 | 13.3 | 11.3 | 12.8 | 4.3 | 4.8 |
| NAA, 500 PPm-7/11 | 60.0 | 105.0 | 20.8 | 34.5 | 11.8 | 23.0 | 11.3 | 22.5 | 4.5 | 10.3 |
| NAA, 750 PPm-7/11 | 66.3 | 95.3 | 22.3 | 24.3 | 12.8 | 23.8 | 12.0 | 23.3 | 4.8 | 10.3 |
| NAA, 500 PPm-21/11 | 975.8 | 944.3 | 585.3 | 588.0 | 193.0 | 190.3 | 191.8 | 189.0 | 154.3 | 150.8 |
| NAA, 750 PPm-21/11 | 518.3 | 691.0 | 452.3 | 439.8 | 226.3 | 186.3 | 225.0 | 185.3 | 157.5 | 148.8 |
| SADH, 2000 PPm-21/11 | 805.8 | 938.8 | 654.3 | 819.8 | 300.5 | 361.5 | 299.8 | 361.3 | 233.5 | 278.0 |
| CCC, 2000 PPm-21/11 | 456.5 | 837.5 | 263.3 | 524.3 | 157.3 | 208.3 | 106.3 | 207.3 | 79.8 | 166.3 |
| L.S.D. at 5% | 41.11 | 70.28 | 44.39 | 55.14 | 25.31 | 20.91 | 25.85 | 21.04 | 12.67 | 16.83 |
| 1% | 56.38 | 96.38 | 60.88 | 75.63 | 34.72 | 28.68 | 3.46 | 28.85 | 17.38 | 23.08 |

* Sprayed in November 1983 and 1984 while trees were considered in the "on-year" state. (Data were recorded in the expected "off-year".

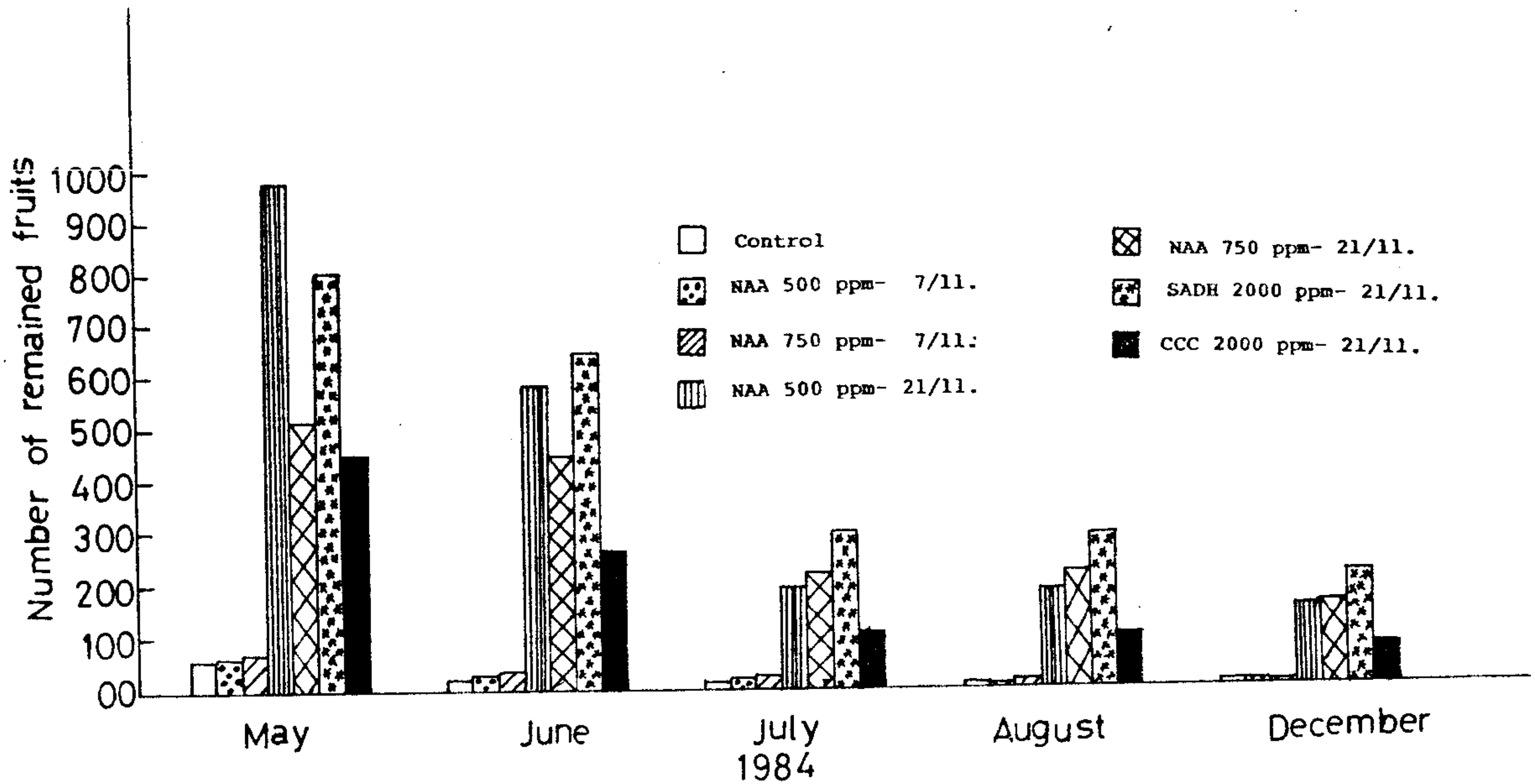


**Fig. (9-a):** Number of remaining fruits of Balady mandarin trees as affected by different growth regulators foliar sprays.

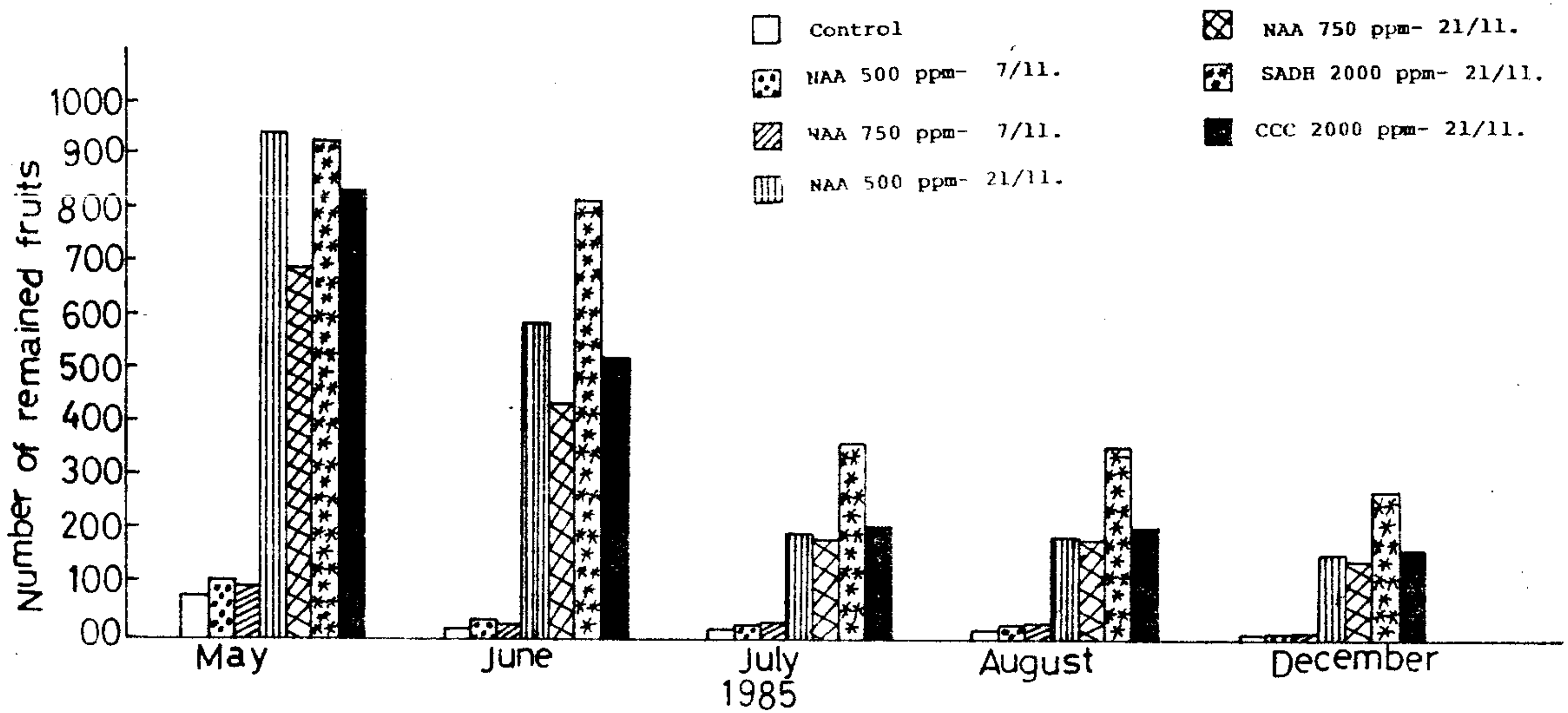


**Fig. (9-b):** Number of remaining fruits of Balady mandarin trees as affected by different growth regulators foliar sprays.

The reverse was true when trees were sprayed with NAA, SADH or CCC on late November. In this concern, trees sprayed with SADH gave the highest values in most dates whereas trees sprayed with either 750 PPm NAA or 2000 PPm CCC produced the lowest values in most dates. However, 500 PPm NAA treatment was in between in this respect. Thus, it is safe to conclude that spraying trees with 2000 PPm SADH in late November maintained a higher number of remaining fruits and was the most promising in this respect.

Such result may be attributed to the depressing effect of SADH on fruit dropping. The same findings were previously obtained by Costa and Filiti (1971), Lord and Cromack (1971) and Jawanda and SIngh (1974). On the other hand, Batjer et al. (1948), pointed out that NAA applied 2 weeks before harvest controlled the preharvest drop of Bartlette pear.

**4- Effect of growth regulators on fruit quality of Balady mandarin:**

**4.1- Fruit physical properties:**

Data in Table (13) and Figure (10) show the physical proparties of Balady mandarin fruits in response to spraying with 500 PPm and 750 PPm NAA on both 7th and 21st November, 2000 PPm SADH and 2000 PPm CCC on 21st

Table (13): Physical characteristics of Balady mandarin fruits in response to growth regulators foliar sprays.

| Treatments and dates of spray | Fruit Wt. (g) | | Fruit vol. (ml) | | Fruit height (cm) | | Fruit diameter (cm) | | Fruit index (cm) | | Juice vol./ Fruit (ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 |
| Control (water spray) | 169.00 | 168.00 | 178.50 | 172.80 | 6.10 | 6.10 | 6.40 | 6.40 | 1.00 | 1.00 | 39.30 | 39.80 |
| NAA, 500 PPm- 7/11 | 139.80 | 138.80 | 144.30 | 143.80 | 6.10 | 6.00 | 6.40 | 6.40 | 1.00 | 0.90 | 38.30 | 38.70 |
| NAA, 750 PPm- 7/11 | 140.50 | 142.50 | 145.00 | 151.80 | 5.90 | 5.70 | 6.20 | 5.60 | 0.90 | 1.00 | 39.00 | 39.30 |
| NAA, 500 PPm- 21/11 | 139.80 | 136.30 | 143.30 | 140.00 | 5.10 | 5.00 | 5.40 | 5.30 | 1.00 | 0.90 | 34.80 | 34.50 |
| NAA, 750 PPm- 21/11 | 124.30 | 123.50 | 133.30 | 131.30 | 5.30 | 5.10 | 5.60 | 5.40 | 1.00 | 0.90 | 35.30 | 35.30 |
| SADH, 2000 PPm- 21/11 | 125.30 | 124.30 | 136.00 | 130.30 | 5.30 | 5.30 | 5.60 | 5.50 | 0.90 | 1.00 | 36.80 | 36.80 |
| CCC, 2000 PPm- 21/11 | 122.30 | 125.00 | 135.30 | 130.80 | 5.10 | 5.30 | 5.40 | 5.40 | 0.90 | 1.00 | 35.80 | 35.00 |
| L.S.D. at 5% | 3.22 | 4.15 | 2.40 | 3.52 | 0.25 | 0.16 | 0.19 | 0.17 | -- | -- | 1.52 | 1.60 |
| 1% | 4.41 | 5.69 | 3.29 | 4.82 | 0.34 | 0.22 | 0.26 | 0.24 | -- | -- | 2.09 | 2.20 |

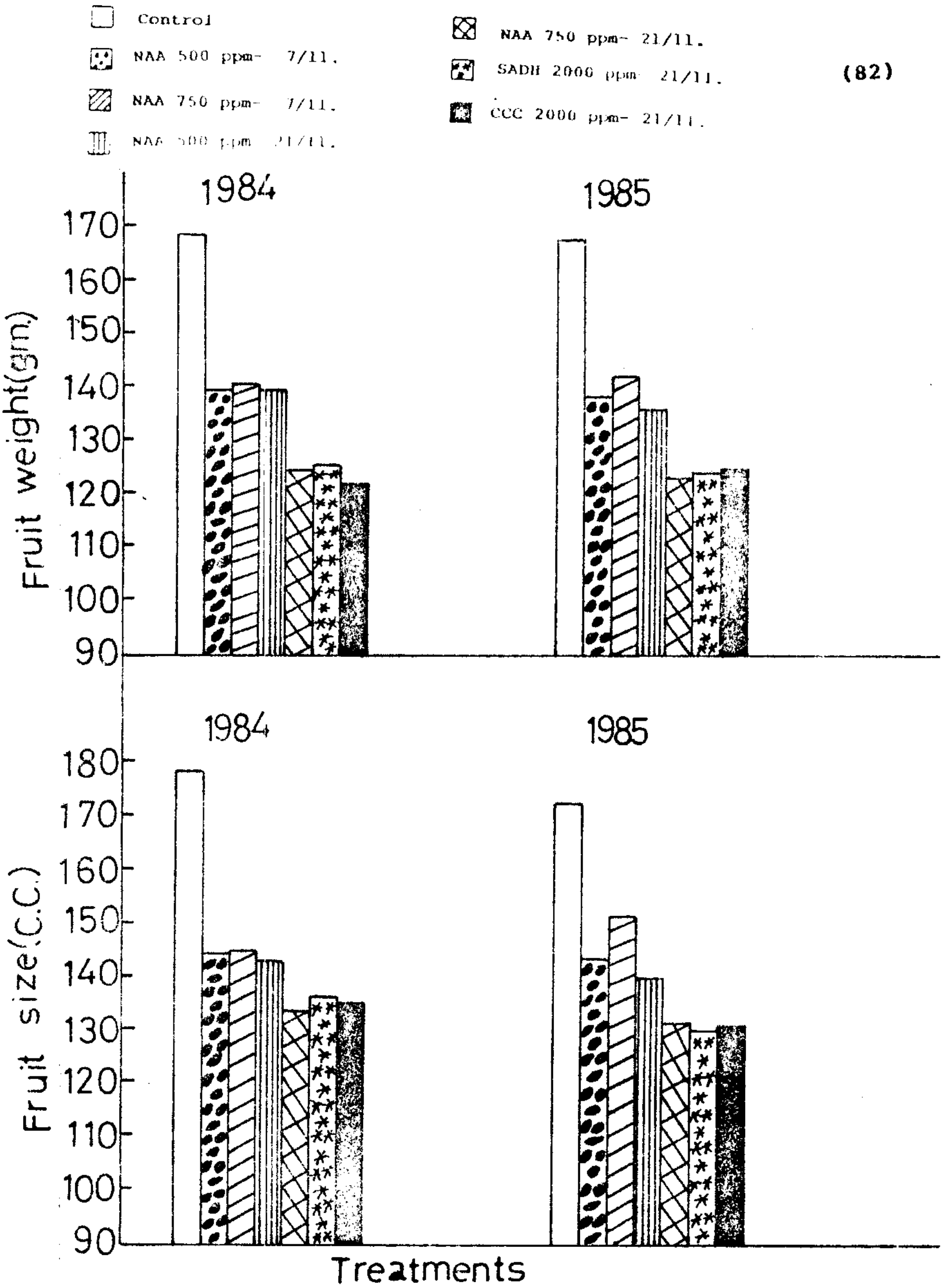


**Fig. (10-a):** Physical characteristics of Balady mandarin fruits in response to growth regulators foliar sprays.

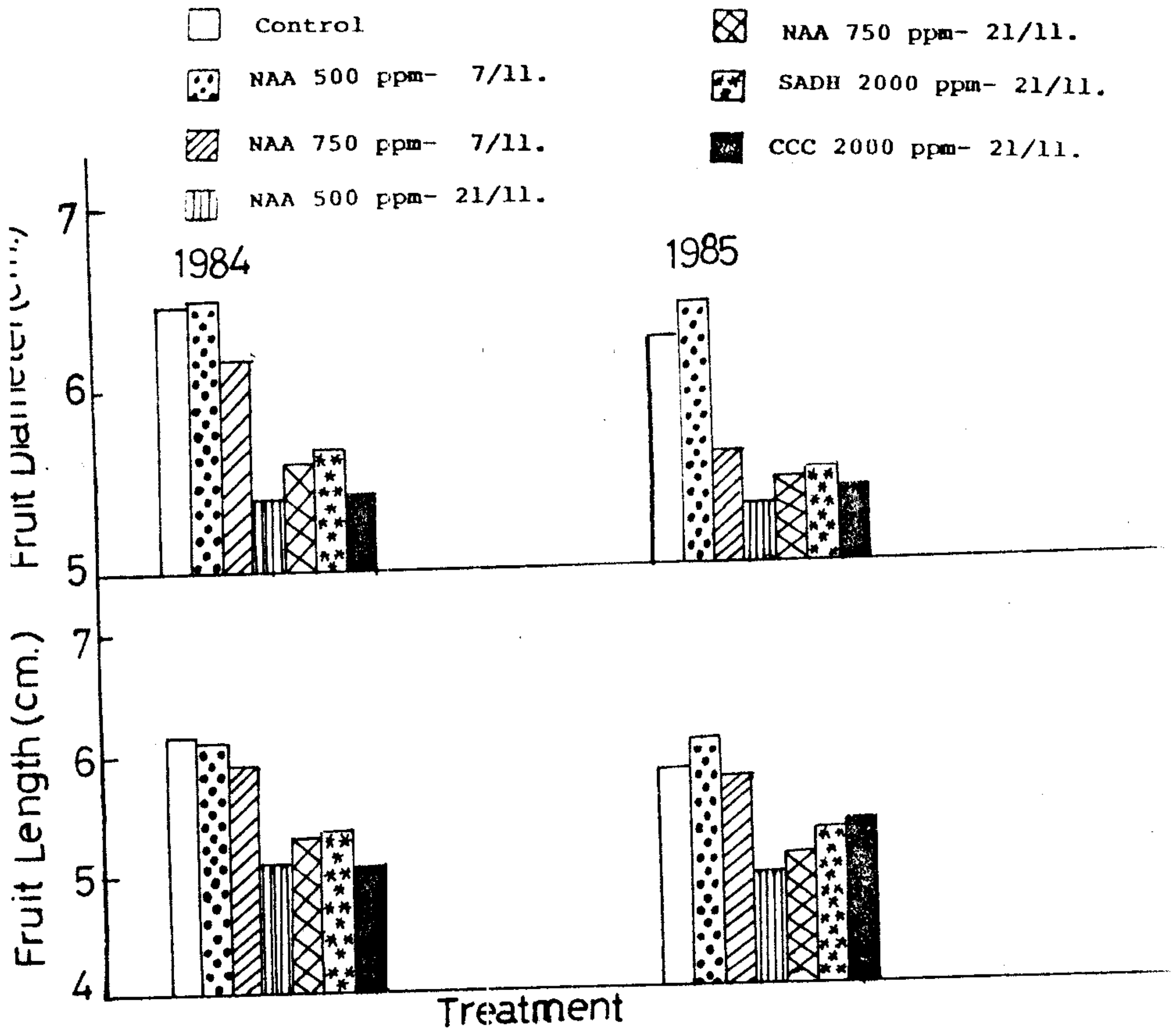


Fig. (10-b): Physical characteristics of Balady mandarin fruits in response to growth regulators foliar sprays.

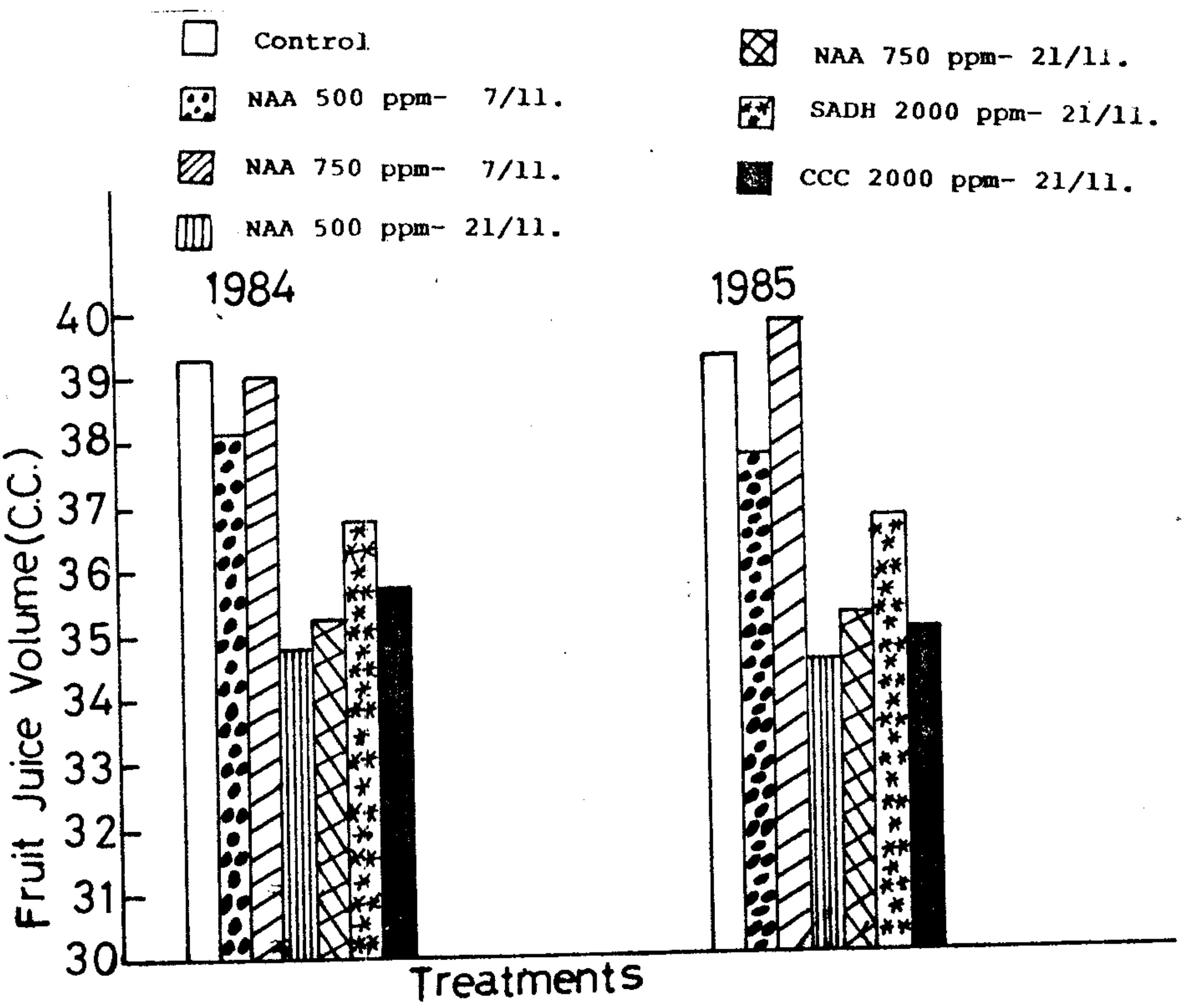


Fig. (10-c): Physical characteristics of Balady mandarin fruits in response to growth regulators foliar sprays.

November. Trees were sprayed while they were in the on-year state in November 1983 and 1984 seasons. It is clear that all used treatments decreased individual fruit weight below the control. Differences were so high to be statistically significant. In this respect, trees sprayed with 750 PPm NAA, 2000 PPm SADH and 2000 PPm CCC all on 21st November born the lightest fruits. Nevertheless, no significant differences were observed between these treatments. Moreover, trees receiving 500 PPm and 750 PPm NAA sprays in early November had heavier fruits than the corresponding ones on 21st November. On the other hand, high level of NAA sprays on late November resulted in smaller fruits as compared with the low level on the same spraying date. Such difference was appreciable in both seasons. NAA sprays in early November had no effect on fruit weight, hence no significant difference was noticed between the two levels of NAA.

The previous results of NAA sprays are in contradiction with the findings of Ohlers (1960), who found that 12-20 PPm NAA sprays increased fruit weight when sprayed druing the period from petal-fall to one week later. He added that spraying NAA at later stages was less effective. Such contradiction could be attributed to the difference in the date of application.

Regarding fruit volume, it is obvious that growth regulator treatments gave the same effect on fruit weight. Marsh et al. (1960), found the same findings on NAA at petal fall of apple. They concluded that NAA sprays depressed fruit size.

Furthermore, Greenhalgh and Edgerton (1966); Lord and Cromac (1971) and Costa and Filiti (1973), all supported the findings of SADH sprays in this study. In addition, Looney (1969), stated that application of SADH at the rate of 500, 1000 and 2000 PPm, and 2 weeks after full bloom of Mc-Intoch and spartan apple trees reduced fruit size. Beside, Khamis et al. (1981), on Washington navel orange reached the same findings regarding CCC sprays in this study.

Generally, one can conclude that trees sprayed with various growth regulators used developed fruits with less values of fruit weight and size as compared with the control. These results may be attributed to the increase in number of fruits developed on the sprayed trees over the unsprayed ones (Table 11).

Referring to fruit dimensions, it is obvious from Table (13) and Figure (10) that all treatments generally decreased fruit dimensions as compared with the control. Such findings were statistically true in all treatments except 500 PPm NAA sprays on early November treatment.

Table (14): Chemical properties of Balady mandarin fruits as affected by various treatments with growth regulators.

| Treatments and dates of spray | Ascorbic acid mg/100 ml | | T.S.S. (%) | | Total acidity gm/100 ml | | T.S.S./acid ratio | |
|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 |
| Control (water spray) | 50.32 | 45.51 | 12.09 | 11.07 | 0.99 | 0.93 | 12.21 | 11.95 |
| NAA, 500 PPm- 7/11 | 51.39 | 47.13 | 11.32 | 10.45 | 1.06 | 1.03 | 10.87 | 10.19 |
| NAA, 750 PPm- 7/11 | 52.39 | 50.42 | 11.47 | 10.41 | 1.05 | 1.03 | 11.18 | 10.11 |
| NAA, 500 PPm- 21/11 | 54.77 | 52.98 | 11.62 | 10.62 | 1.24 | 1.22 | 9.45 | 8.70 |
| NAA, 750 PPm- 21/11 | 55.59 | 54.71 | 11.64 | 10.27 | 1.24 | 1.19 | 9.41 | 8.67 |
| SADH, 2000 PPm- 21/11 | 56.81 | 56.13 | 11.29 | 10.23 | 1.07 | 1.01 | 10.53 | 10.16 |
| CCC, 2000 PPm- 21/11 | 53.92 | 53.24 | 11.41 | 10.04 | 0.94 | 0.89 | 12.14 | 11.26 |
| L.S.D. at 5% | 0.63 | 0.67 | 0.24 | 0.31 | 0.06 | 0.06 | | |
| 1% | 0.86 | 0.91 | 0.34 | 0.43 | 0.08 | 0.08 | | |

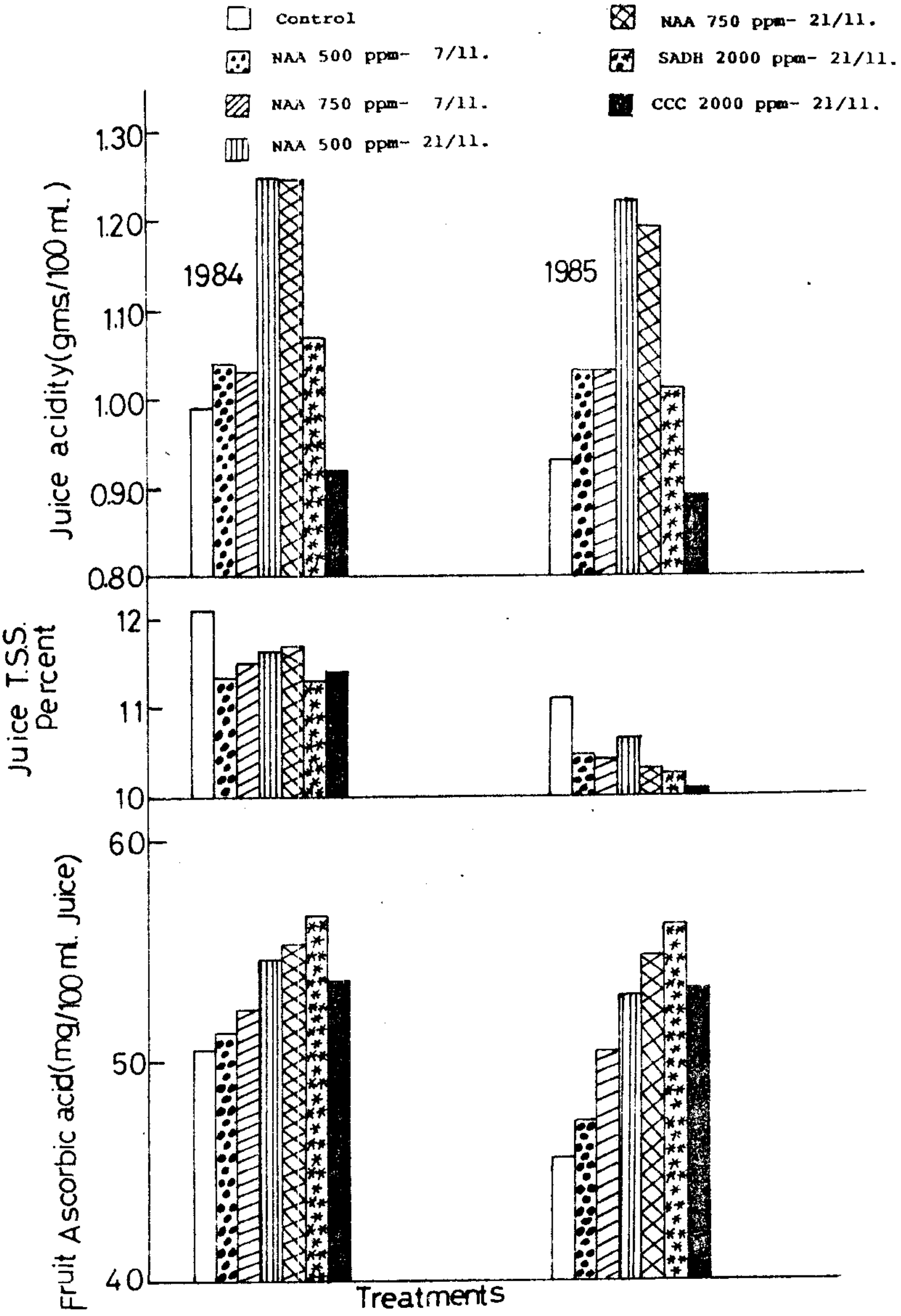


**Fig. (11):** Chemical properties of Balady mandarin fruits as affected by various treatments of growth regulators.

Meanwhile, no significant difference was noticed between high and low level of NAA on either 7th November or 21st November spraying dates.

Considering total acidity in fruit juice, it is quite evident that in the first season trees sprayed with the different concentrations used of NAA on late November produced fruits with highest values of juice acidity as compared with the control. Other treatments were nearly statistically the same, hence they do not change from the control. In the second season, the same effect of the first one was observed. Generally, in both seasons all treatments except 2000 PPm CCC treatment were higher in fruit juice acidity content than the control.

Regarding T.S.S./acid ratio, it is clear from Table (14) and Figure (13) that fruits of all used treatments were lower in their values of T.S.S./acid ratio than the control. Such effect was not statistically noticed when 2000 PPm CCC treatment was concerned. Moreover, trees sprayed with NAA on late November had fruits with the lowest values among the other treatments, hence these trees produced late maturing fruits. On the contrary, 2000 PPm CCC treatment gave fruits earlier in maturity.

Considering fruit juice ascorbic acid content, it is found that all treatments were higher significantly in their values than the control. This was more obvious in trees treated with 2000 PPm SADH. Moreover, trees sprayed with NAA in late November gave higher values than CCC sprays in this respect. Meanwhile, high level of NAA produced fruits with higher values of ascorbic acid content than the corresponding ones of low level. Beside, trees sprayed with NAA on late November born fruits with higher ascorbic acid content than the corresponding ones sprayed on early November.

Anyhow, the effect of growth regulators on fruit juice T.S.S. content was previously studied. Sullivan and Widmoyer (1970), pointed out that SADH sprays at 2000 PPm applied in early July to stayman Winesap apple trees decreased the percentage of soluble solids in fruits. Such finding support the obtained result in this study in this respect.

On the other hand, the present results of fruit juice acid content is in contradiction with that obtained by Lal and Thakur (1978). They found that NAA sprays at concentrations of 50 or 75 PPm at petal-fall on Santa Rosa plum trees reduced fruit acidity while the lower concentration had no effect. Furthermore, Mishra (1969), on found that NAA sprays decreased T.S.S./acid ratio in fruit juice.