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EFFECT OF TWO TEMPERATURE REGIMES ON GROWTH, FLOWERING AND FRUITING OF TWO TOMATO VARIETIES

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Abstract: Tomato plants (*Lycopersicon esculentum* Mill.) var. Alicante and UC 82 were transferred after 35 days from seed sowing to either (35/24° C± 1) or (20/16°C ± 1) temperature regimes in controlled growth cabinets. The effect of these two different temperature regimes on plant height, number of leaves, branches, total number of clusters, double clusters, total flowers, abscised flowers and fruit-set together with percentage of flower abscission and fruit set were recorded. Under high temperature regime, increases in number of leaves, number of branches, leaf area, flower abscission and enhancement of fruit repening, puffiness or decrease in the number of flowers, fruit set were evident. These findings were relative to the other regime (20/16°C). Differences were obtained between the two varieties in the response to temperature regimes.

INTRODUCTION

High temperature reduces effectively fruit production of tomato during hot summer in Egypt. Such effectiveness of high temperature is mainly due to the decrease in flower production (Lewis, 1953; Charles and Harris, 1972; Aung, 1976; El-Ahmadi and Stevens, 1979a) and /or to bud and flower drop (Smith, 1935; Abdalla and Verkerk, 1968; Levy et al., 1978). However, differences between varieties in fruit set under high temperatures have been reported (Went, 1944; Charls and Harris, 1972; El-Ahmadi and Stevens, 1979 a and b; FAO, 1990). The importance of temperature in fruit set was clearly evident. Wents (1944) assured that fruit set was abundant only when night temperature was between 15°C and 20°C, which might over-simplify the issue. The fact that Curme (1962) reported fruit set in certain varieties with temperature as low as 45°F (7.2°C) and Schaible (1962) with temperature as high as 80°F (26.6°C) had created more flexible situation in respect of the variety temperature interactions other than those gathered from Went's conclusions. Obviously more work needs to be done on the temperature effects especially in relation to varieties. This work was undertaken to study the effect of two temperature regimes (35/24°C and 20/16°C) on the growth and development of two varieties (Alicante and UC 82). The temperature regimes selected to tentatively match natural temperature regime in a given time of the year in Egypt. Therefore, any possible practical results can be readily used.

MATERIALS AND METHODS:

Two tomato varieties namely Alicante and UC 82 were sown on the 20th of April, 1995 in the greenhouse at 25/18°C during day and night with 16hr light period. After 35 days from seed sowing, seedlings were transplanted in 8-inch pots. Each pot was filled with air dried loamy soil mixed with 30% peatmoss. After two days, five pots from each variety were transferred to controlled growth cabinets adjusted to either (35/24°C ± 1) or (20/16°C ±1) during day/night. A cycle of 24 hrs was used with 12 hrs. of lightness or darkness. The cabintes were provided with day light fluorescent tubes

and incandescent bulb lamps. All sides of cabinets were covered with aluminum foil. Places of pots were interchanged daily to minimize differences in light intensity.

Plants were watered daily and were fertilized every two days during irrigation using 10 ml of liquid nutrient solution (Tomarite) per 10 liters of tap water.

Plants height, number of branches, leaves, total clusters, branched clusters, flowers, dropped flowers and fruit set were recorded every week.

RESULTS

Effect of two temperature regimes on some vegetative characteristics

1. Effect on plant height

High temperature regime (35/24°C) significantly increased plant height of the two varieties relative to 20/16°C regime during the early periods of exposure i.e. after 6 days in variety UC 82 and after 6 and/or 13 days in variety Alicante (Fig.1). Thereafter, the high temperature regime, while it has not significantly affected plant height of variety UC 82, it significantly reduced plant height of variety Alicante. At each temperature regime, the variety Alicante was taller than UC 82.

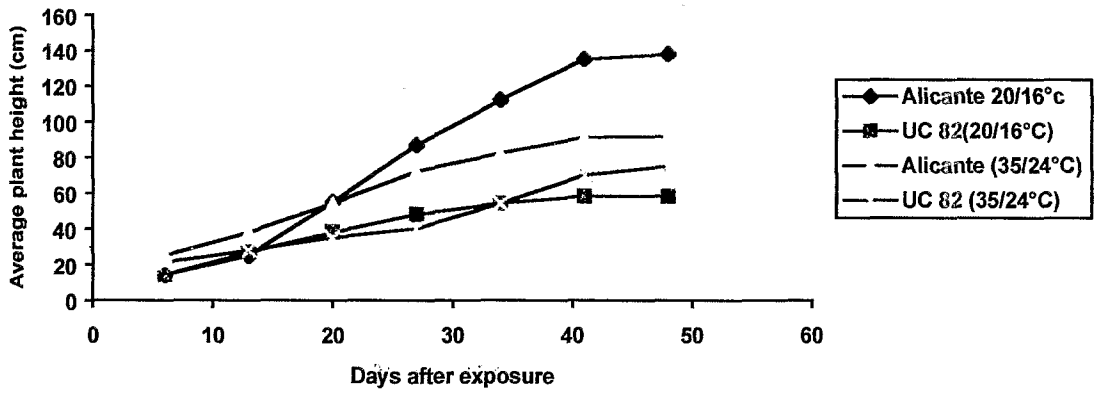

Figure 1. Effect of two temperature regimes on plant height of two tomato varieties

2. Effect on number of leaves

High temperature regime gave significant increase in the number of leaves relative to 20/16°C regime in the two varieties (fig. 2). Such effect was evident after 13 days from exposure, in the variety Alicante. The UC 82 gave similar response after 27 days from exposure. However, in the two temperature regimes the number of leaves of variety Alicante was significantly indifferent at the end of the experiment. Meanwhile, variety UC 82 showed significant increase in number of leaves under high temperature compared with that of (20/16°C) at the end of the experiment. Furthermore, variety Alicante produced significantly a higher number of leaves relative to UC 82 in each temperature regime. Such effect was evident after 13 days from exposure to the higher temperatures while it occurred after 27 days from exposure to lower temperatures.

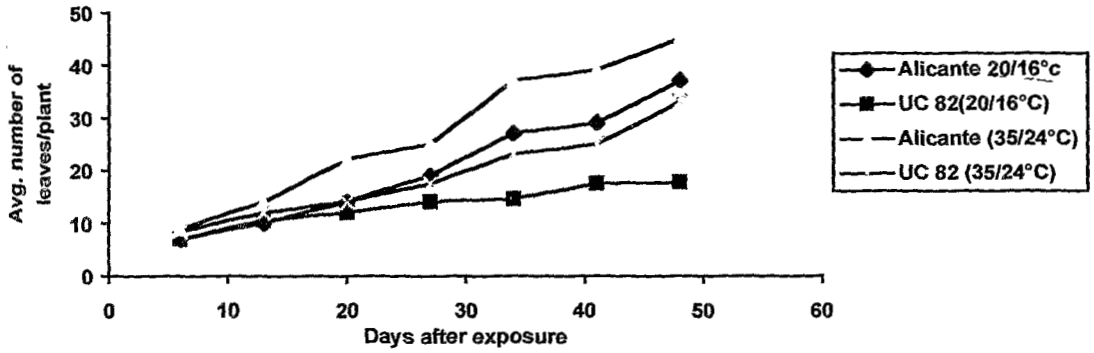

Figure 2. Effect of two temperature regimes on leaf number of two tomato varieties.

3. Effect on number of branches

High temperature regime significantly increased the number of branches in the two varieties relative to 20/16°C regime (fig. 3). Such effect was evident in all the dates of measurements starting from 20 days after exposure to different temperature regimes.

However, at the high temperature regime, the number of branches was significantly increased in variety Alicante relative to variety UC 82. Such effect was evident after 34 days from exposure to different regimes. However, no significant differences in the number of branches were observed between the two varieties at the 20/16°C-temperature regime.

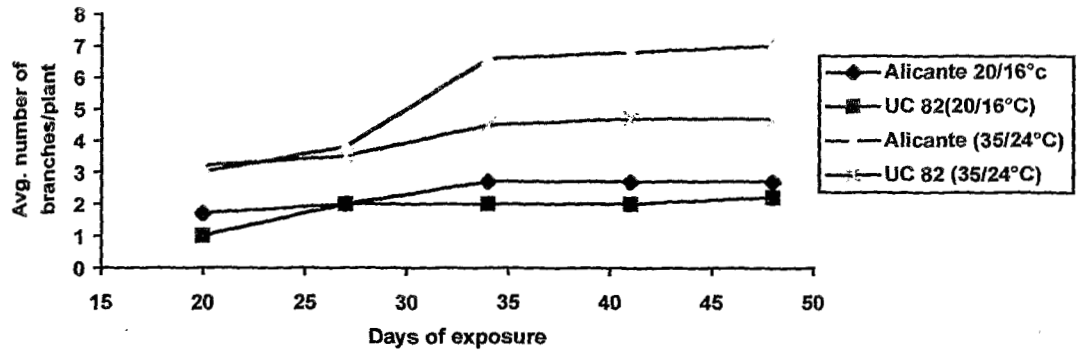

Figure 3. Effect of two temperature regimes on number of branches/plant of two tomato varieties

Effect of two temperature regimes on some flowering and fruiting characteristics

1. Effect on number of clusters

Generally, difference in temperature did not significantly affect the number of the total clusters in both varieties (fig. 4). However, number of total clusters was significantly higher in Alicante relative to UC82 at 6 days from exposure to each temperature regime, this response vanished later.

Under different temperature regimes, the formation of single and double cluster was observed (fig.5). Higher temperature regime increased the number of double cluster only in variety UC 82. Nevertheless, the number of the double clusters was significantly higher in variety UC 82 relative to Alicante at 20 days after exposure to temperature regimes, such difference was vanished thereafter. Meanwhile, at the end of the experiment, Alicante variety produced significantly a higher number of double clusters relative to the UC 82 when both varieties were subjected to the 20/16°C regime.

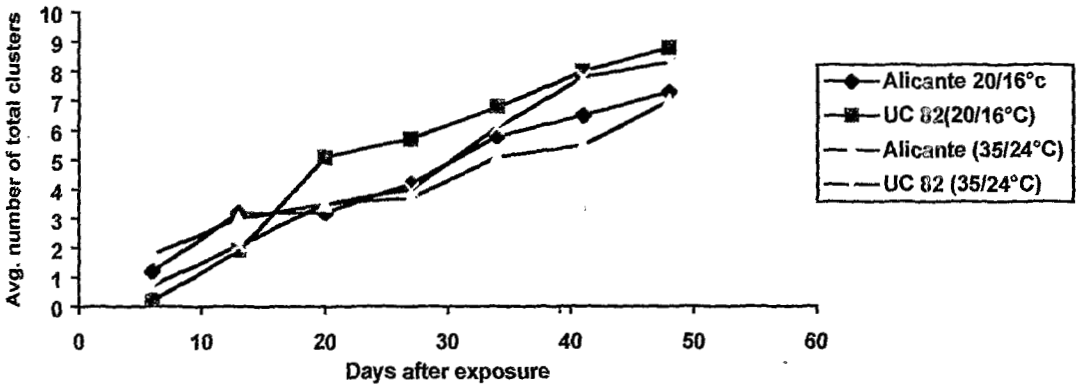

Figure 4. Effect of two temperature regimes on number of total clusters of two tomato varieties.

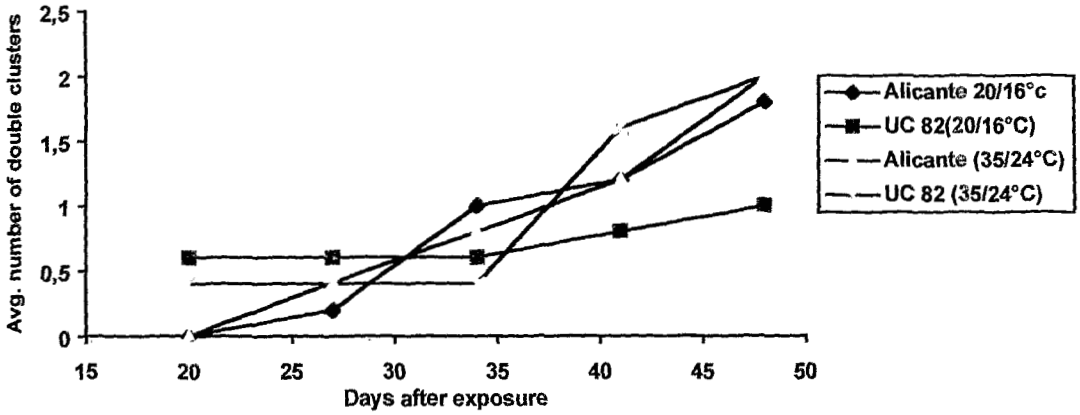

Figure 5. Effect of two temperature regimes on number of double clusters of two tomato varieties

2. Effect on number of produced flowers

In general, high temperature regime significantly decreased the number of flowers produced in both varieties (fig. 6). Such effect was more pronounced in variety UC 82 relative to Alicante.

However, no significant differences in the average number of accumulated flowers was observed between the two varieties in each temperature regime with the exception of the early measurement (20 days after exposure) at the 20/16°C regime during which UC82 retained significantly a higher number

of flowers. Moreover, Alicante retained a significant higher number of flowers relative to UC 82 after 34 days of exposure to the 35/24°C regime.

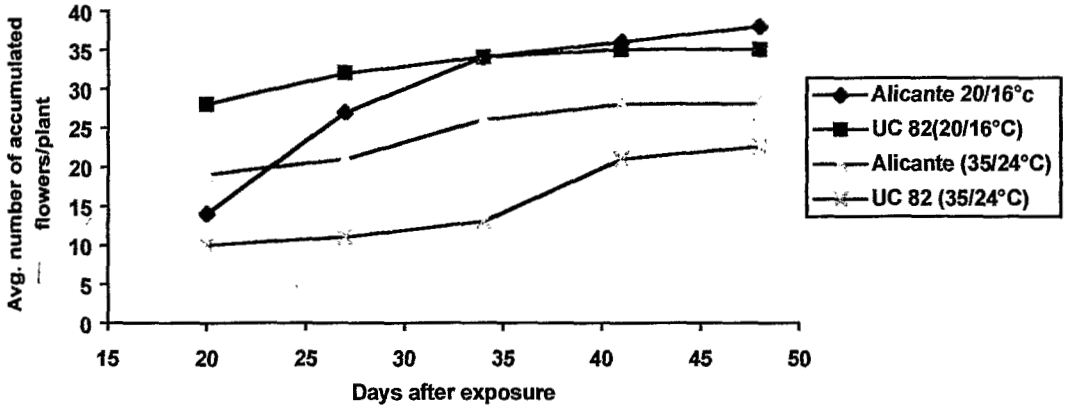

Figure 6. Effect of two temperature regimes on number of total flowers/plant of two tomato varieties.

3. Effect on number of abscissed flowers

Difference in temperature regime did not significantly affect the number of abscised flowers in each variety except in UC 82 during the early periods, as the 35/24°C regime significantly induced higher number of abscised flowers (fig. 7).

During the late periods, the number of abscised flowers was significantly higher for UC 82 relative to Alicante at each temperature regime.

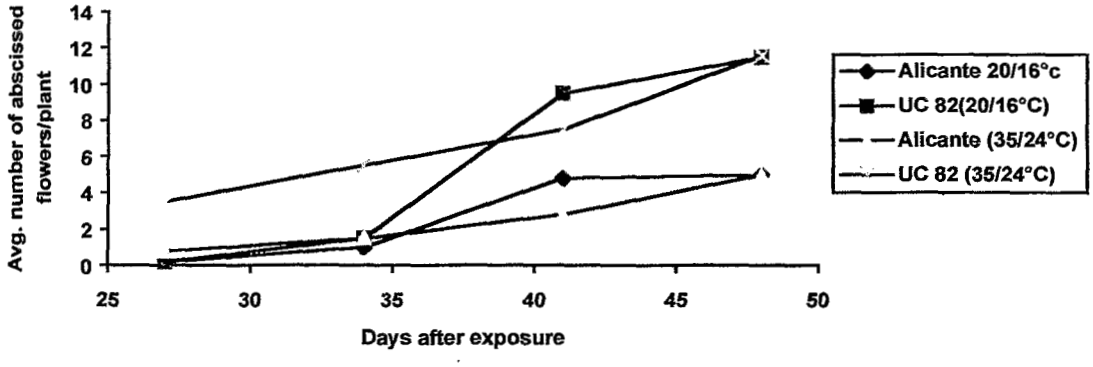

Figure 7. Effect of two temperature regimes on number of abscised flowers/plant of two tomato varieties

4. Effect on number of fruit set

High temperature regime significantly decreased the number of fruit set in both varieties relative to 20/16°C regime. Such effect was evident earlier in variety UC82 (after 34 days from exposure to different temperatures) relative to Alicante (after 41 days from exposure) (fig. 8).

Generally, no significant differences in the number of the set fruits were observed between the two varieties in each temperature regime.

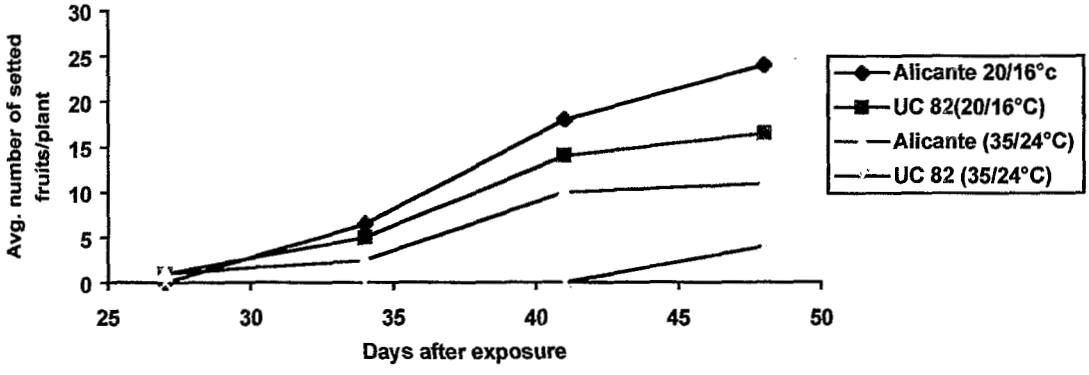

Figure 8. Effect of two temperature regimes on number of setted fruits/plant of two tomato varieties.

5. Effect on percentage of fruit set

High temperature regime (35/24°C) decreased fruit set percentage in each variety relative to 20/16°C regime (fig. 9). On the other hand, in both temperature regimes, fruit set percentage was higher in variety Alicante relative to UC 82.

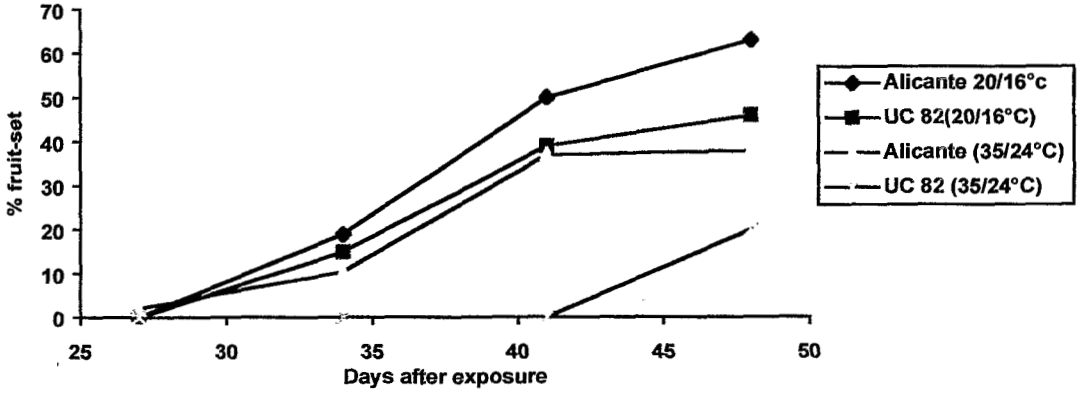

Figure 9. Effect of two temperature regimes on fruit-set percentage of two tomato varieties

6. Effect on percent flower abscission

Flower abscission was increased in the variety UC 82 maintained at high temperature regime. Nevertheless, such effect was not evident in variety Alicante (fig. 10). Values of flower abscission percentage were higher in variety UC 82 relative to Alicante.

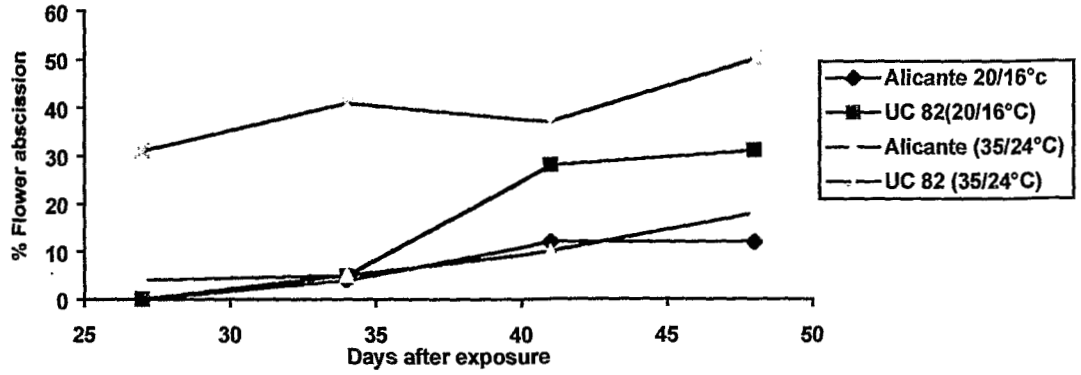

Figure 10. Effect of two temperature regimes on percentage of flower abscission of two tomato varieties.

7. Effect on fruit ripening and puffiness

The high temperature regime (35/24°C) stimulated the formation of red colour as well as the degredation of the green colour (enhance ripening) in comparison with light green fruits under 20/16° temperature. Moreover, such high temperature regime resulted in the production of puffy fruits.

DISCUSSION AND CONCLUSION

The increase in plant height during the early periods of growth at the high temperature regime was in accordance with the findings of several investigators. Moreover, Abdel-Rahman and Bierhuizen (1959) demonstrated that the height of plant was very sensitive to changes in temperature, the height decrement was associated with the decrease in temperature. Abdalla and Verkerk (1968) stated that the growth rate of the stem in mm per day at high temperature was about double the value of that at normal temperature resulting in long and thin stems.

High temperature significantly increased the number of leaves in both varieties in all intervals except variety Alicante at the end of the experiment. Abdel-Rahman and Bierhizen (1959) also obtained such stimulation of high temperature to leaf production; Abdel-Hafeez and Verkerk (1969).

Although our result indicated that difference in temperature has not significantly affect the number of total clusters in both varieties, Abdalla and Verkerk (1968) indicated that high temperature (35/25°C) gave many trusses relative to 22/18°C regime.

Although several investigations showed that low temperatures increased the number of double trusses (Calvert, 1965; 1966; 1967), in our experiment high temperature increased the number of double trusses in the variety UC82 while such effect was not evident in the variety Alicante.

High temperature regime decreased the number of total flowers produced in both varieties. Similar results have been obtained by Abdelhafeez and Verkerk (1969); Cherles and Harris (1972); El-Ahmadi and Stevens (1979a) and Rylski (1979a).

The decrease in flower number due to high temperature was more pronounced in variety UC82 relative to Alicante. Such variétal response in this respect was obtained by Aung (1976).

There were no significant differences in the average number of accumulated flowers between the two varieties in each temperature regime. The UC82 variety retained a significantly higher number of flowers during early measurement at 20/16°C-temperature regime. Nevertheless, El-Ahmadi and Stevens (1979b) showed a variation in the number of flowers among parents and F1 at two different temperature regimes (42-37°C day and 30-27°C night).

During early periods, the number of abscised flowers of variety UC82 was increased due to high temperature regime. Similar findings were obtained as the number of buds and/or flowers calculated in either the first or second truss (Abdalla and Verkerk, 1968; 1970) or every first three clusters (Abdelhafeez and Verkerk, 1969) or the first three inflorescences (Levy et al., 1978). Nevertheless, during the late periods, the number of abscised flowers was insignificant in the two temperature regimes for the two varieties. However, at each temperature regime the number of abscised flowers at the end of the experiment was significantly higher for UC 82 relative to Alicante.

Several investigators observed that high temperature reduced fruit set in tomato (Iwahori et al. 1963; Abdall and Verkerk, 1968; 1970; Levy et al., 1978). Such reduction ranged from 94% to 10 % (Shelby et al., 1978) or 77-16% (Levy et al., 1978). Our results confirmed such findings. Neverthless, correlation in fruit set between high and normal temperatures was not significant (El-Ahmadi and Stevens, 1979b).

The difference in response of fruit set to high temperature between varieties which has been obtained in other investigation (Levy et al., 1978; Shelby et al., 1978) was also found in the present work.

Apparently, both temperature and Auxin affect fruit quality as judged by shape, puffiness and jelly color.

Generally, it can be concluded from the obtained results that the differences may be due to unbalance in hormones especially IAA, ABA, ACC and ethylene.

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