Effect of different temperature regimes on ethylene production and endogenous levels of IAA, ABA, ACC of tomato

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EFFECT OF DIFFERENT TEMPERATURE REGIMES ON ETHYLENE PRODUCTION AND ENDOGENOUS LEVELS OF IAA, ABA, ACC OF TOMATOES

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Abstract: Tomato plants (Lycopersicon esculentum Mill) var. Alicante, UC82, Cold set, floradel and castle long were transferred, after one month from seed sowing in greenhouse, to (5/10°C+1) (35/24°C+1) or (20/16°C+ 1) temperature regimes during day/night. Flowers were individually collected at the anthesis stage to determine the endogenous levels of IAA, ABA, and ACC. The high temperature regime (35/12°C) decreased the levels of IAA and ACC and increased the lever of ABA relative to 20/16°C regime. The low temperature regime (10/15°C) decreased the levels of IAA and ABA and increased that of ACC relative to the regime of 20116'C. Moreover, the ethylene production after such condition were differ and there was an increase of the production under high temperature compared to the optimum in different varieties. An indication of changes in the levels of such hormones due to varietal differences was observed. Results were discussed on the bases of possible role of endogenous hormones on fruit set.

INTRODUCTION

Plant hormones play an major role in flower formation and the transition of flowers to fruits (Muir, 1947; Phatak et al. , 1966; Crane and Hicks, 1968).

Environmental factor does effect and manipulate the normal course of growth and development possibly via changes in hormonal balance, (Lang and Reinhard, 1961; Hackett and Sachs, 1967; Lang, 1970).

Therefore, this work aims to study the effect of temperature on the levels of endogenous IAA, ABA, ACC and ethylene production at anthesis stage.

MATERIALS AND METHODS

Five tomato varieties namely Alicante, Cold-set, Floradel, UC82 and Castel-long were grown on 15th of July 1994 in the greenhouse. After one month from seed sewing seedlings were transplanted in 8-inch pots. Each pot was filled with air dried loamy soil mixed with 30% peat moss. After two days, five pots from each variety were transferred to controlled growth cabinets adjusted to (35/24°C), (20/16°C) or (10/5°C) during day/night. Cycle of 24 hours was used 12 hours light or dark. The cabinets were provided with provided with day light fluorescent tubes and incandescent bulb lamps. All sides of the cabinets were covered with aluminum foil. Places of the pots were interchanged daily to minimize differences in light intensity. Plants were planted daily and were fertilized every two days during irrigation using 10ml of liquid nutrient solution (Tomarite) per 10 liters of tape water. Flowers in the experiments were individually collected at the stage of anthesis and were immediately dropped in liquid nitrogen, freeze dried and stored at -20°C, to determine the endogenous levels of IAA, ABA and ACC.

Determination of IAA and ABA was carried out using the method described by Savidage (1981).

Matumba (1982) estimated ACC according to Lizada and Yang (1979) with modification.

The ethylene production was determined at the anthesis stage in the third leaf from the apex under different temperature regimes.

Ethylene production from 20cm proximal petiole sections (0.5-0.8gm) or pinnules from the same leaf (0.8-1.2gm) was measured by enclosing the sections in 10ml test tubes fitted with serum caps. The tubes were held at room temperature for 1 h and 1 ml samples of the gas phase were removed with a gas-tight hypodermic syringe. Ethylene content was analyzed by gas chromatography with a flame ionization detector (Jones and El-Abd, 1989).

RESULTS AND DISCUSSION

The effect of three temperature regimes (35/24°C, 20/16°C and 10/5°C) on endogenous levels of IAA in flowers of five tomato varieties (Alicante, UC82, Cold-set, Floradel and Castel-long) at the anthesis stage is presented in figure (1). Generally, the high temperature regime (35/24°C) decreased the level of IAA relative to the optimum temperature regime (20/16°C). On the other hand, low temperature regime (10/5°C) decreased the level of IAA in all varieties compared to optimum regime. There were small differences among the varieties under the same temperature regime where IAA level increased in the following orders Alicante, UC82, Cold-set, Floradel and Castel-long.

ACC has the same trend of IAA (fig. 2) where high temperature regime decreased the endogenous level compared to the optimum temperature regime. In contrast, low temperature regime increased the endogenous level of ACC compared to optimum temperature regime. variétal differences were similar to that observed for IAA endogenous level. ABA endogenous level is presented in figure (3). It is clear that the high temperature regime increased the endogenous level of ABA.

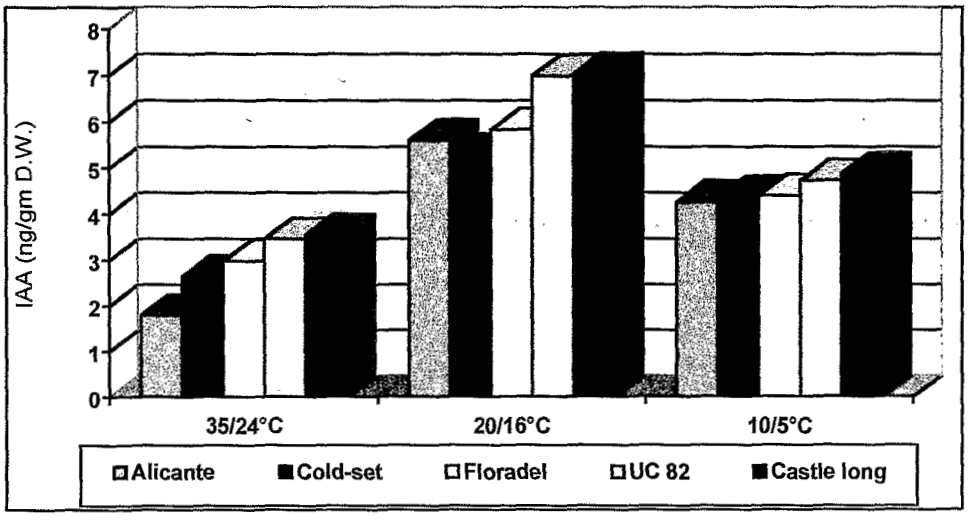

Figure 1. Effect of three temperature regimes on the endogenous level of IAA in five tomato varieties

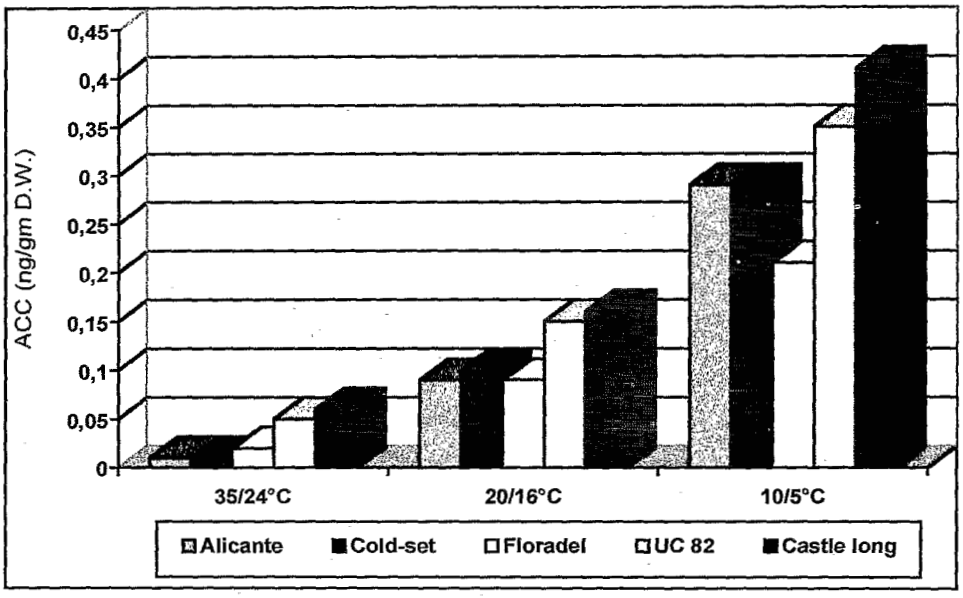

Figure 2. Effect of three temperature regimes on the endogenous level of ACC in five tomato varieties

On the other hand, low temperature regime decreased the endogenous level of ABA compared to the optimum temperature regime. Concerning the differences among the varieties in the three temperature regimes it may be evident that Alicante, Cold set and Floradel varieties contained higher levels of ABA relative to the other varieties.

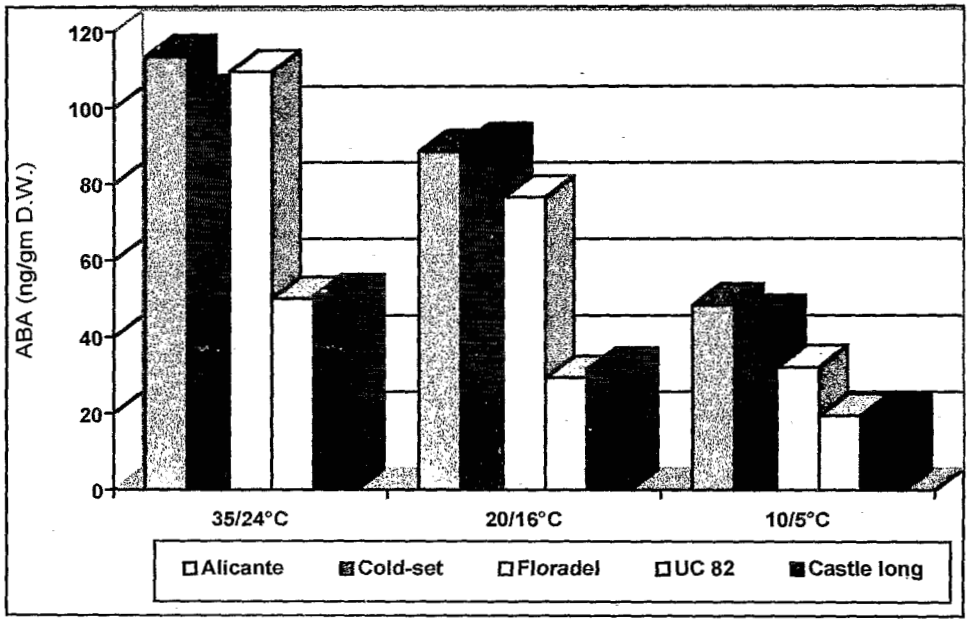

Figure 3. Effect of three temperature regimes on the endogenous level of ABA in five tomato varieties

The same trend was observed for ethylene production (fig. 4) where high temperature regime increased the production of ethylene meanwhile, there was no big difference in the low temperature regime compared to the optimum temperature regime. Also, varietal differences were similar to that observed for ABA level.

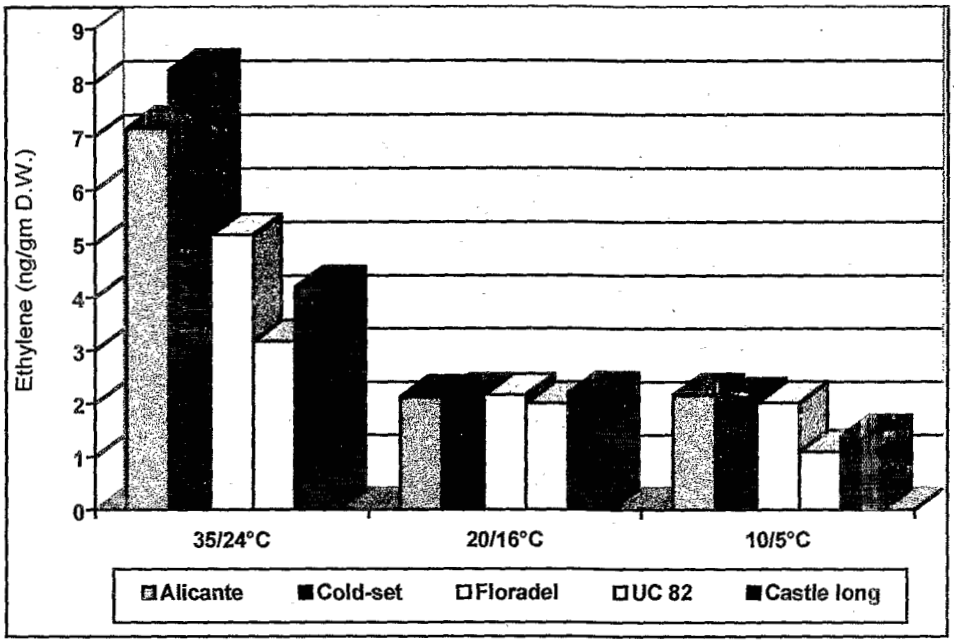

Figure 4. Effect of three temperature regimes on the endogenous level of Ethylene in five tomato varieties

Changes in hormone levels in plant tissue can be attributed to changes in synthesis, transport and/or degradation. It is true that scattered information is available concerning the effect of temperature on Auxin transport. Temperature does effect transport of C14 IAA with a minimum of (2-7°C) and an increase near 44°C. Further increase resulted in complete cessation of transport, suggesting a breakdown of Auxin transport system (Morris, 1979). An indication of decreased level of endogenous Auxin in tomato fruit in response to high temperature up to 40°C given 0-3 days after anthesis were reported (Iwahori, 1967).

In present work an indication of a decrease in the level of IAA was correlated with increase the temperature (high level). Although data are available concerning the effect of temperature stress on endogenous ABA (Daie et al., 1981), in top portion of several plants. It should be mentioned before no data is available concerning the effect of high temperature on endogenous growth regulators other than Auxines as related to fruit set (Kuo et al., 1978).

With increased temperature rapid conversion of ACC to ethylene was observed (Apelaum et al., 1981). Wang and Adams, (1980; 1982) studied chilling-induced ethylene production by cucumber fruits and found that ACC level, ACC synthase activity, and ethylene production rate all remained low while the cucumber fruits were held at chilling temperature but increased rapidly upon transfer to warm temperature. Opposites result were recorded in this present work may reflect a difference related to the level of ACC in a given organ which vary with transport and synthesis and degradation of such component in a given organ. An interaction between the three groups of endogenous hormone under study (IAA, ABA and ACC) may have an effect i.e. ethylene regulated Auxin biosynthesis, abscisic acid was found to enhance ethylene induced production of cellulose (Abeles, 1973).

These results formed premenarly bases for a deeper understanding of the status and balance of endogenous plant hormone during anthesis stage. It will be interested, therefore, to further study the hormonal status in pollinated and unpollinated flower under different temperature regime.

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