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Temperature Affects Vigour and Pollen Viability of Melon

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Abstract

Temperature is one of the most important factors influencing fruit and seed formation. Low or high temperature during reproductive stage of many crops causes sterility of pollen grains and reduced yield. Effects of different temperatures (20, 25, 30, 35, 40 and 45 °C) were studied on pollen germination and pollen tube growth of two melon cultivars (Green Tile and Chah Paliz). Field experiment was conducted during the summer season in Torbat-e-Jam. Male flowers of two native Iranian melon cultivars were collected and transported to the laboratory. Pollen grains were placed in medium culture in Petri dishes containing MS medium. The experiment was arranged in a completely randomized design with 3 replications. Maximum germination was obtained at 30 °C. Maximum pollen tube growth was recorded at 35 °C. The findings of this study showed, in vigour viability of pollens were decreased high temperatures and male reproduction organs at melon were sensitive to heat stress.

Keywords

Cucumis Melo, Germination, Pollen, Torbat-e-Jam, Tube Growth

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1. Introduction

Melon (*Cucumismelo* L.) belongs to the Cucurbitaceae family, which includes several important economic vegetables such as cucumber, watermelon, squash, and pumpkin. Iran is one of the most important centers of genetic variation (Nasrabadi *et al*., 2012). Different varieties of cucumis genus are cultivated in Iran. Ameri, Cantalupensis, Reticulatus, and Inodorus are the most important varieties respectively in Iran and Torbat-e-jam (Longitude: 60˚48´, latitude: 35˚ 31´, altitude: 928 meters, with semi-arid climate, hot summers and cold winters) is the biggest producer region in our country. Melon cultivated in dry region and desert fringes have good yield and quality (Nasrabadi *et al*., 2012). This is likely due to beneficial night temperature and reduced respiration leading to assimilate accumulation in fruit and increased fruit quality.

Temperature influences growth in plants at most stages. The reproductive stage in plants is more sensitive than the vegetative stage. Increasing temperature could damage reproductive organs at, or prior flowering. Kown *et al*. (2005) studied the effect of temperature on pollen germination and pollen tube growth in watermelon and reported that maximum and minimum pollen tube growths were obtained at 35 and 15°C respectively. Matlob and Kelly (1973) reported that as temperature increased from 10 to 32 °C, pollen tube growth rate also increased in snake melon. Chakrabarti *et al.* (2011) reported that Low temperature during reproductive stage of spring wheat causes sterility of pollen grains and reduced yield. Rang *et al.* (2011) studied effect of high temperature and water stress on pollen germination in five genotypes of rice and reported high

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temperature stress caused the highest sterility in all five genotypes. Fruit formation in pepper (Erickson & Markhart, 2002), beans (Porch & Jahn, 2001), corn (Herrevo & Johnson, 1980), cotton (Reddy *et al*., 1992), pea (Ahmed & Hall, 1993), groundnut (Prasad *et al*., 1999), soybean (Ferris *et al*., 1998), and tomato (Sato *et al*., 2004) proved sensitive to temperature and fruit and seed formation proved to decrease as temperature increase.

This study was undertaken to determine the best temperature for pollination to increase fruit yield and quality in melons.

2. Material and Methods

Effects of temperature on pollen viability of melon cultivars Green Tile and Chah Paliz were determined in July 2014 (Tab.1).

Tab. 1. Characteristic of melon used in this experiment.

Cultivar	Variety	From seed culture to flowering (days)	Time of sowing to harvest (days)	Description
Green Tile (V1)	Reticulatus	35-40	75-80	Very earliness
Chah Paliz (V2)	Inodorus	52-58	102-110	Very lateness

The 50 of Male flowers collected at 9-10 a.m were transported to the laboratory. Pollen grains were placed in medium culture in Petri dishes containing MS medium. The Petri dishes were exposed to temperatures of 20 (T1), 25 (T2), 30 (T3), 35 (T4), 40 (T5) and 45° C (T6) in a germinator for 2.5 hrs. Cultures were then fixed by addition of 2.5 cm^3 acetic acid (45%). To determine germination percent 200 pollen grains were randomly counted using a light microscope at 10x magnification. Pollen tube lengths were recorded using Camscop with IT proImage tracer software. The experiment was arranged in a completely randomized design with 3 replications. Analysis of variance was carried out with using Minitab software.

3. Result and Discussion

Cultivar did not, but temperature and the interaction affected germination percent, while the cultivar, temperature and the interaction proved to affect the tube length (Tab. 2).

Tab. 2. Mean squares from the analysis of variance of traits.

S.V	DF	Germination %	Tube length
Variety (A)	1	13.44^{ns}	7378.81^{**}
Temperature (B)	5	2520.84^{**}	303723.21^{**}
A×B	5	72.04^{**}	4259.88^{**}
Error	24	12.75	66.00

** Significant at 1% level and ns no significant.

4. Germination Percentage

Maximum (64.33%) and minimum (11.5%) germination percent were recorded at 30° C and 45° C respectively (Fig. 1). The highest and lowest germination percents occurred at 30 °C with 'Chah Paliz' and 45°C with 'Green Tile' respectively (Fig. 1).

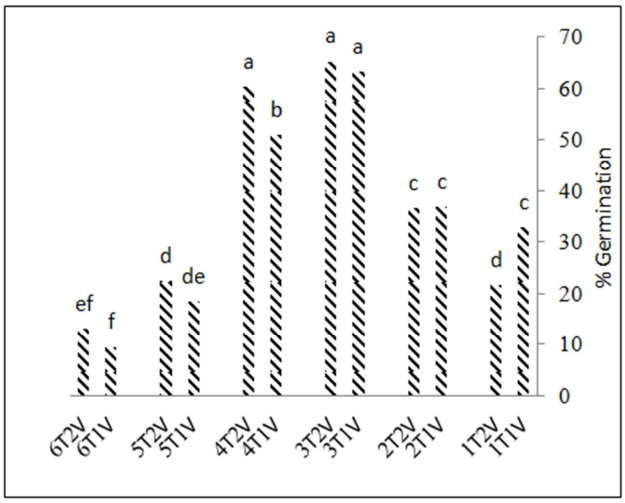

Fig. 1. Interaction between variety and temperature on germination percentage. Different letters differ significantly at 0.05 probability level according Duncan's multiple range test and columns with same letters are statistically similar. (V1= Green Tile and V2= Chah Paliz. T1 (20 °C), T2 (25 °C), T3 (30 °C), T4 (35 °C), T5 (40 °C) and T6 (45 °C) are different temperatures).

Germination decreased along as temperature increased. The germination decrease at high temperatures is probably due to denaturation of the molecular structure of proteins and enzymes (Najafi and Nadvar, 2006). 'Chah Paliz' had high germination percent at 35 °C than did 'Green Tile' (Fig. 1). Flowering for 'Chah Paliz' occurred 20 days later than for 'Green Tile', and may be due to exposure to higher temperature. The nature and structure of proteins and enzymes in late ripening melons are probably different than in early ripening melons. Further study is required to determine the biochemistry of this occurrence.

5. Pollen Tube Growth

The longest pollen tubes were recorded at 35 °C in both cultivars (Fig. 2). Minimum tube length was recorded at 45 °C with 'Green Tile' (Fig. 2).

As temperature increased up to 35°C, pollen tube length increased and germination decreased. Temperatures over 35°C caused reductions in pollen tube lengths and germination. There were differences in pollen tube growth due to cultivar with ‘Green Tile’ was more affected than ‘Chah Paliz’. Since there is high genetic variation in melon Iran, this experiment can contribute to identification of cultivars resistant to high temperatures for breeding and to increase fruit yield and quality.

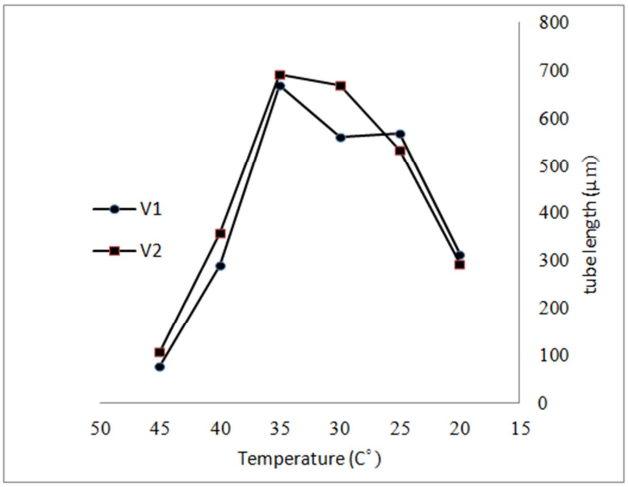

Fig. 2. Interaction between variety and temperature on tube length.

Results showed that there is a significant difference between two melon cultivars. It seems first genetic factors control vigour and pollen viability. Second environmental conditions such as temperature effect on pollen germination and pollen tube growth. Of course it is suggested that more cultivars of melon should be studied so that the results could be generalized to this genus.

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