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Research Article

The Effect of Tebuconazole Applications on Melon (*Cucumis melo* L.) Seedling Quality and Development

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Abstract

In this study, the effects of different doses (0, 25, 50, 75, 100, 125, 150 and 175 ppm) of Tebuconazole substance on the quality and development of melon seedlings (seedling and stem length, stem diameter, number of leaves per plant, leaf, stem, and root dry matter contents and chlorophyll content) were investigated. According to statistical evaluations, it was determined that different dose applications cause a significant change in seedling characteristics. According to the data obtained, a reduction of 57.5% and 55.9% was achieved in seedling length and stem length, respectively, compared to the control application. Also the stem diameter increased by 9.95% after the application. The dose application also provided an increase in leaf chlorophyll content. In this study, applications of Tebuconazole at different doses were found to control the seedling height in melon and positively affect specific quality characteristics of seedlings.

Keywords: Cucumis melo, seedling, tebuconazole, quality

Tebuconazole Uygulamalarının Kavun (*Cucumis melo* L.)'da Fide Kalitesi ve Gelişimi Üzerine Etkisi

Öz

Çalışmada farklı dozlarda (0, 25, 50, 75, 100, 125, 150 ve 175 ppm) Tebuconazole maddesinin kavun fidelerinin kalitesi ve gelişimi (fide ve gövde boyu, gövde çapı, bitki başına yaprak sayısı, yaprak, gövde ve kök kuru madde oranları ile klorofil miktarı) üzerine etkileri araştırılmıştır. Yapılan istatiksel değerlendirmelere göre, farklı doz uygulamalarının fide özelliklerinde önemli derecede değişikliğe neden olduğu belirlenmiştir. Elde edilen verilere göre, kontrol uygulaması ile karşılaştırıldığında, fide boyu ve gövde boyunda sırası ile %57.5 ve %55.9'luk bir azalma sağlanmıştır. Gövde çapında ise uygulama sonrası %9.95'lik bir artış olmuştur. Ayrıca, doz uygulaması yaprak klorofil miktarında bir artış sağlamıştır. Bu çalışmada, farklı dozlarda Tebuconazole uygulamalarının kavun bitkisinde, fide boyunu kontrol altına aldığı ve bazı fide kalite özelliklerine olumlu yönde etki ettiği belirlenmiştir.

Anahtar Kelimeler: Cucumis melo, fide, tebuconazole, kalite

1. Introduction

Melon is an important vegetable species commonly grown in Turkey. According to the latest statistical data, it ranks 5th in terms of production quantity among the vegetable species (Anonymous, 2020). As in many vegetable species, the basis of successful production in melon cultivation is the use of quality seeds and quality seedlings (Demir et al., 2010). Using quality seedlings in cultivation directly affects both yield and crop quality (Sönmez, 2017). In vegetable seedling growing, low light intensity in winter and spring periods or high temperatures in summer cause of excessive growth of vegetable seedlings and thus it induces quality losses. In seedlings with low quality; the leaf area shrinks, the leaf chlorophyll content decreases and the leaf color lighten, the roots become small, weak, and open to stress factors as well (Çakırbay, 2013; Geboloğlu et al., 2016). In greenhouse vegetable cultivation, excessive growth in seedlings arises as an important problem. Therefore, the homogenous development of seedlings is an important matter in vegetable cultivation. Environmental factors such as low and high temperature, light intensity, plant thickness affect the growth of seedlings. Control of over-growing in seedlings can be achieved by controlling environmental factors well or by using certain chemicals that delay the growth. To control the seedling length and improve seedling quality in seedling growth, mechanical stress factors (Johjima et al., 1992; Garner and Björkman, 1996), various stress factors, ecological factors such as low and high light intensity (Melton and Dufault, 1991; Głowacka, 2004) and various plant nutrients were tested. However, these applications were not effective enough in improving seedling quality. Therefore, plant growth-retarding chemicals were applied to control the seedling size and improve the quality, and when the desired and expected effects were obtained, studies were conducted on these chemicals. Many pieces of research were conducted in which chemicals that slow down and retard the growth (chlormequat chloride, uniconazole, ethephon, flurprimidol, ancymidol, paclobutrazol) were effective in controlling seedling length in different vegetable species. One of the most preferred substances among these substances is Paclobutrazol, which is a chemical under the Triazole group. Another chemical in the triazole group is Tebuconazole. Tebuconazole is a broad effect fungicide used agriculturally for disease control in fruit, cereal and vegetable crops (Muñoz-Leoz et al., 2011). However, according to the literature review, there are not enough studies examining the effects of this substance on vegetable quality, and no studies have been conducted on *Cucumis* species.

In this study, it was aimed to determine the effects of different doses of Tebuconazole on seedling length control and seedling quality of melon, and the most appropriate dose(s) that can be practiced in seedling production.

2. Material and Methods

The study was conducted between March-May 2020 in the seedling greenhouse operated by Erzincan Horticultural Research Institute. Zümra F1 variety of melon was used as plant material in the experiment. Seedlings were grown in 128-compartment viols, each of which is 40 x 40 mm. A mixture of peat:perlite (3:2) was used as seedling growing medium. As the source of Tebuconazole, a commercial preparation 'Folicur' containing 25% Tebuconazole (developed by Bayer Company) was used. In

this randomized-block-design study, seven different application doses of Tebuconazole (0, 25, 50, 75, 100, 125, 150 and 175 ppm) were applied to cotyledon leaf plants. Seedlings to which Tebuconazole will be applied in different doses are given in Figure 1. According to randomized block design, the study is planned with 3 replicates and 21 plants in each replicate. Tebuconazole solutions prepared at different doses in the laboratory were applied by spraying to the cotyledon leaves of the plants 20 days after sowing, with two applications at 14-day intervals, and after the final application, the seedlings were grown under the greenhouse conditions until the planted period (2 weeks later). The necessary measurements, observation and analysis were made in the seedling.

Measurements and weighing for seedling development

Seedling height (cm), stem height (cm), stem diameter (mm), number of leaf (number plant-1) leaf dry matter content (%), stem dry matter content (%), root dry matter content (%) and leaf chlorophyll content (SPAD value) were measured to determine the seedling development. Seedling height (cm) and stem height (cm) were measured with tape measure and stem diameter (mm) was measured with a digital caliper. Leaf chlorophyll content was measured using SPAD (Chlorophyll Meter SPAD-502Plus, Konica Minolta). The number of leaves per plant was calculated by counting the leaves of the plants. In order to determine the dry matter contents in seedlings, ten seedlings were taken randomly, and leaves, stems and roots were room temperature for one week after the wet weight was determined. They were then dried at 105 oC in an oven for 24 hours and weighed (A.O.A.C., 1980). The wet and dry weights were determined using a scale with 0.01 g sensitive and dry matter content (%) was determined with the formula: Dry Matter Content (%) = Dry Weight x100 / Wet Weight (Kılıç et al., 1991). SPSS 22.0 statistical program was used for statistical analysis of the data.

3. Research Findings

Seedling height (cm)

In the study, Tebuconazole applications had a significant effect on seedling length. It was determined that the seedling length in the 0 ppm (control) application was 7.58 cm, the seedling length decreased depending on the doses after application, and the lowest value (5,08 cm) was obtained in 150 ppm application. According to the post-application control application, an average reduction of 32.98% occurred in the seedling length (Table 1; Figure 1).

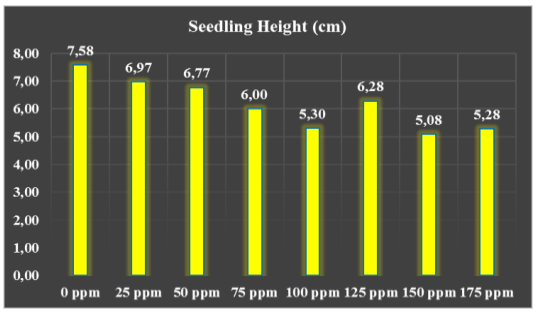

Figure 1. The effect of the application of Tebuconazole on seedling height

Stem height (cm)

It was determined that dose applications had a statistically significant effect on stem length. In the study, while the stem length value measured in the control (0 ppm) application was 8.1 mm, as a result of the application of Tebuconazole, the stem height varied depending on the doses and the lowest stem length was found at a dose application

of 50 ppm as 2.43 mm. According to the control application, as a result of dosing, a 19.83% reduction was determined in stem height (Table 1; Figure 2).

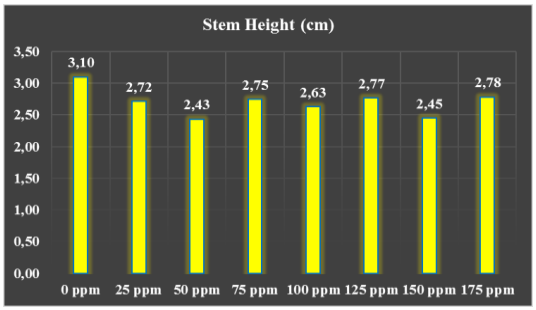

Figure 2. The effect of the application of Tebuconazole on stem height

Stem diameter (mm)

Significant differences were found between the applications in terms of stem diameter. It was determined that after the application, 25 and 50 ppm doses increased the stem diameter and other doses caused a decrease. The biggest stem diameter (3.65 mm) was detected at a dose of 50 ppm. An increase of 10.61% occurred in the stem diameter with 50 ppm (Table 1; Figure 3).

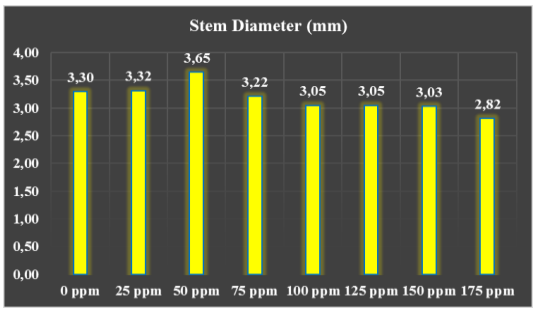

Figure 3. The effect of the application of Tebuconazole on stem diameter

Number of leaves per plant (number/plant)

The effect of different doses on the number of leaves per plant was found significant according to statistical evaluations. It was determined that the number of leaves per plant was 7 in the seedlings without application, and after application, the number of leaves increased in applications other than the 175 ppm dose (Table 1; Figure 4).

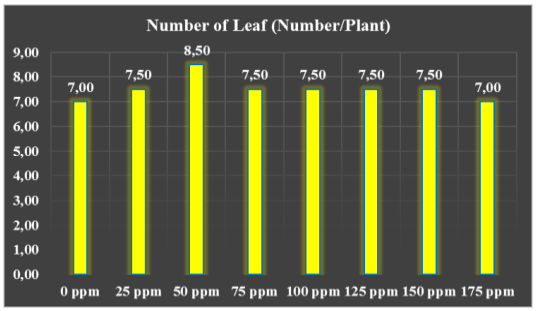

Figure 4. The effect of the application of Tebuconazole on number of leaf

Leaf dry matter content (%)

Doses were found to have a statistically highly significant effect on leaf dry matter content. In the plants in a control application, the content of leaf dry matter was 13.14%, and after the application of Tebuconazole, there was a general decrease in the dry matter leaf content at all application doses compared to the control group. Apart from the control group, the highest dry matter content was obtained from 100, 175 and 25 ppm doses, respectively (Table 2; Figure 5).

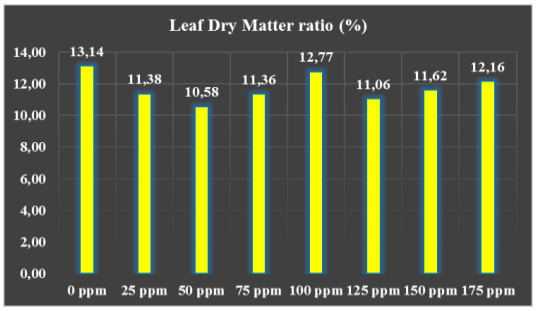

Figure 5. The effect of the application of Tebuconazole on leaf dry matter ratio

Stem dry matter content (%)

While the dry matter content obtained with the control group application in the study was 10.37%, after the application, the dry matter content decreased at all doses compared to the control group. Among the doses applied, the highest dry matter content was obtained from the application of 100 ppm with a 9.78% content (Table 2; Figure 6).

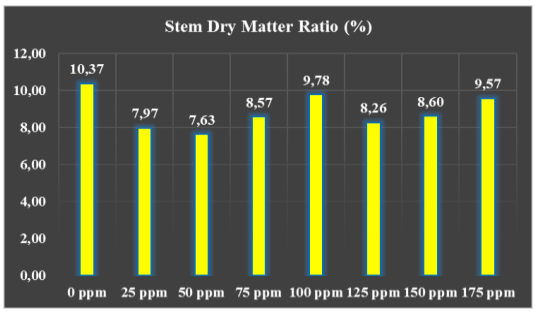

Figure 6. The effect of the application of Tebuconazole on stem dry matter ratio

Root dry matter content (%)

In the study, the stem dry matter content obtained from the control group (0 ppm) was found to be 4.01%. As a result of the application of Tebuconazole, it was determined that the stem dry matter content increased at the doses of 100 and 175 ppm compared to the 0 ppm (control) dose, and decreased at the other doses. The highest content (4.25%) was obtained from the 175 ppm dose (Table 2; Figure 7).

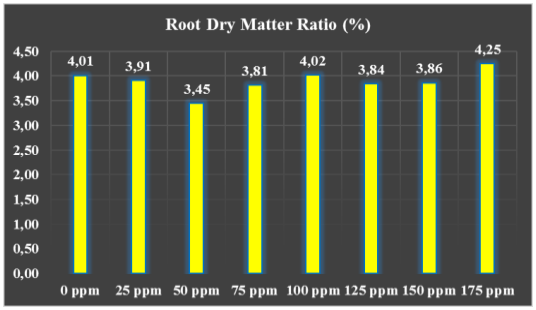

Figure 7. The effect of the application of Tebuconazole on root dry matter ratio

Chlorophyll content (SPAD value)

Statistical analysis revealed that the applications of Tebuconazole had a substantial effect on the leaf chlorophyll content (SPAD value). In the study, the chlorophyll content obtained in the control application was measured as 50.63 and this value increased in all other applications compared to the control group (0 ppm). The highest SPAD values were obtained from 100 (SPAD value=57.43), 175 (SPAD value=56.37) and 150 (SPAD value=54.75) ppm doses, respectively (Table 2; Figure 8).

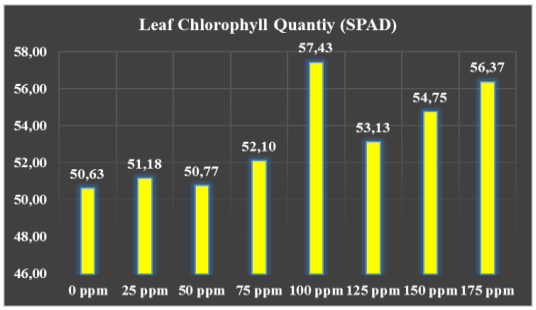

Figure 8. The effect of the application of Tebuconazole on chlorophyll content

Table 1. Effects of Tebuconazole applications on some seedling quality characteristics

Doses	Seedling Height (cm)	Stem Height (cm)	Stem Diameter (mm)	Number of Leaf (Number/ Plant)
0 ppm	7,58a	3,10a	3,30b	7,00b
25 ppm	6,97b	2,72b	3,32	7,50b
50 ppm	6,77b	2,43c	3,65a	8,50a
75 ppm	6,00d	2,75b	3,22b	7,50b
100 ppm	5,30e	2,63bc	3,05c	7,50b
125 ppm	6,28c	2,77b	3,05c	7,50b
150 ppm	5,08e	2,45c	3,03c	7,50b
175 ppm	5,28e	2,78b	2,82d	7,00b
	***	***	***	***

***: $p<0.001$

Table 2. Effects of Tebuconazole applications on some seedling quality characteristics

Doses	Leaf Dry Matter Ratio (%)	Stem Dry Matter Ratio (%)	Root Dry Matter Ratio (%)	Leaf Chlorophyll Quantiy (SPAD)
0 ppm	13,14a	10,37a	4,01b	50,63e
25 ppm	11,38c	7,97e	3,91bc	51,18de
50 ppm	10,58d	7,63f	3,45d	50,77e
75 ppm	11,36c	8,57cd	3,81c	52,10de
100 ppm	12,77a	9,78b	4,02b	57,43a
125 ppm	11,06cd	8,26de	3,84c	53,13cd
150 ppm	11,62bc	8,60c	3,86bc	54,75bc
175 ppm	12,16b	9,57b	4,25a	56,37ab
	***	***	***	***

***: $p<0.001$

The correlation analysis between quality characteristics of seedlings

According to the correlation analyzes, the dose was found to have a negative effect on the seedling length and stem length, and a significantly positive effect on the chlorophyll content. In addition, it was determined that seedling length showed a statistically significant positive correlation with stem length and diameter and a negative correlation with chlorophyll content. However, it was determined that the leaf dry matter content showed a significant positive correlation with the stem and root dry matter content at a 1% significance level (Table 3).

Table 3. Correlation analysis between seedling characteristics

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	1								
2	-0,88**	1							
3	-0,33	0,47*	1						
4	-0,77**	0,70**	-0,12	1					
5	-0,17	0,12	-0,64**	0,63**	1				
6	-0,09	-0,03	0,52*	-0,38	-,623**	1			
7	0,02	-0,08	-0,55**	-0,46*	-,641**	0,91**	1		
8	0,34	-0,30	0,45*	-0,78**	-,754**	0,63**	0,70**	1	
9	0,75**	-0,82**	-0,16	-0,80**	-,259	0,38	0,48*	0,55**	1

**: p<0.001 *: p<0.05; 1-Doses;2-Seedling Height; 3-Stem Height; 4-Stem Diameter; 5-Number of Leaf ; 6-Leaf Dry Matter Ratio; 7-Stem Dry Matter Ratio ; 8-Root Dry Matter Ratio; 9-SPAD Value

4. Results and Discussion

As a result of the literature review, the only study on the application of Tebuconazole on seedling quality in vegetables was found to be made for eggplant (Öztürk and Dursun, 2020). There are certain studies investigating the effects of Paclobutrazol and similar substances, which are under the Triazole group similar to Tebuconazole, on vegetable seedling characteristics and quality (Brigard et al., 2006; Çopur and Sarı, 2011; Gebologlu et al., 2015; Gebologlu et al., 2016; Uçan, 2019). In a study conducted on eggplant, it was determined that the Tebuconazole substance applied at significantly decreased the seedling height and stem length. (Öztürk ve Dursun, 2020). In a study on seedling quality of melon, 25 ppm paclobutrazol application was determined to suppress seedling length (Florez et al., 2018). In another study, the characteristics of tomato seedlings were investigated by applying paclobutrazol from the soil (1 ppm) and through foliar spray (25 ppm) at the stage where 2-4 true leaves were formed in tomato seedlings. As a result of the measurements, researchers found that the spray applications from the soil and through foliar spray decreased the plant height by 20% and 16%, respectively (Berova and Zlatev, 2000). In a similar study, it was observed that the PP333 and CCC retarders applied to the eggplants during the period when they had six leaves decreased the stem length (Xue et al., 2008). Similarly, in this study, as a result of the application of Tebuconazole, significant decreases in seedling and stem length were detected. According to the data obtained and measurement results, it was determined that 25 and 50 ppm applications increased the stem diameter.

And the biggest stem diameter was obtained from the 50-ppm application. In several studies, where similar substances were applied, increases were found in stem diameter compared to the control application (Berova and Zlatev, 2000; Zandstra et al., 2007; Teto et al., 2016). It was determined that leaf, stem, and root dry matter contents also varied significantly after application. In the comparisons made with the seedlings in the control group, it was found that the leaf and stem dry matter contents decreased, and the root dry matter content increased at 175 and 100 ppm doses. In a similar study, the control applications showed decreases at 7% and 6% in dry weights of tomato seedlings (Berova and Zlatev, 2000). In zucchini seedlings, 25 ppm paclobutrazol application was found to decrease the dry matter content in the aboveground parts of the seedlings and increase in root dry matter content (Florez et al., 2018). The changes in the plant dry matter content are considered to affect the synthesis and transport of gibberellic acid by Tebuconazole and can be caused by the regression in the growth. As a result of the measurements on the leaves of the seedlings, it was determined that the chlorophyll content increased in the seedlings in the application group compared to the control group. In similar studies, it was found that paclobutrazol applied with foliar spray on melon seedlings increased in the chlorophyll content in the leaves (Florez et al., 2018); besides, similar results were obtained for several species such as watermelon (Baninasab, 2009), Potato (Tsegaw et al., 2005) and lettuce (Akdemir, 2018). It was found that almost all of the different doses of Tebuconazole in melon seedling cultivation prevented excessive and unnecessary growth in seedling and stem lengths. As a result; although the seedlings in the control application reached the planting size, it was observed that the duration of reaching planting size for the seedlings with applied substance was extended.

Suggestions

In conclusion, Tebuconazole was determined to achieve length control in melon seedlings and had positive effects on seedling quality. According to the data obtained in the study, it is considered that the application doses can be applied in practice as well and that the seedlings applications in the future studies can be more beneficial by means of evaluating the land performances.

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