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RESEARCH ARTICLE

New Approach in Obtaining the Ideal Watermelon (*Citrullus lanatus*) Seedling: Tebuconazole

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ABSTRACT

The study was conducted in March-May 2020 in greenhouse in Erzincan Horticultural Research Institute. Sahra F1 variety of watermelon (*Citrulus lanatus*) was used as plant material in the experiment. 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 watermelon seedlings were investigated. It was determined that different dose applications caused a significant change in seedling characteristics According to the data obtained, a average reduction of 38.45% and 17.81% was achieved in seedling length and stem length, respectively, compared to the control application. Also, the stem diameter increased in 3.03% after the applications. The all doses applications also provided an increase in leaf chlorophyll content (SPAD). In this study, applications of Tebuconazole at different doses were found to control the seedling height in watermelon and positively affected on specific quality characteristics of seedlings.

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Introduction

Watermelon agriculture in the world and in Turkey is grown in a wide area. As in many vegetable species, the basis of successful production in watermelon cultivation is the use of quality seed and seedling (Demir et al., 2010). Using quality seedlings in agricultural production are directly affecting on both yield and crop quality (Sönmez, 2017). In vegetable seedling growing, various environmental factors low light intensity, high temperatures etc. cause excessive growth of seedlings and thus it is causing quality losses. In seedlings with low quality; the leaf area shrinks, the leaf chlorophyll content decreases and the leaf color lightens, 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 effect on 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. Various chemicals (chlormequat chloride, uniconazole, ethephon, flurprimidol, ancymidol, paclobutrazol) were applied to different vegetable species to control the seedling length. One of the most

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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 substance commonly used against to fungal diseases. 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 Cucurbitaceae family.

In this study, it was aimed to determine the effects of tebuconazole application on seedling growth characteristics and quality of watermelon, and the most appropriate dose(s) that can be practiced in seedling production.

Materials and Methods

Plant Material and Growth Conditions

The study was conducted in 2020 in greenhouse in Erzincan Horticultural Research Institute. Sahra F1 variety of watermelon (*Citrulus lanatus* L.) was used as plant material in the experiment. Seedlings were grown in 128- celled, each of which is 40 x 40 mm. A mixture of peat:perlite (3:2, v:v) was used as seedling growing medium. As the source of Tebuconazole, a commercial preparation 'Folicur' containing 25% Tebuconazole (developed by Bayer) was used. Seven different application doses of Tebuconazole (0, 25, 50, 75, 100, 125, 150 and 175 ppm) were applied to cotyledon leaf plants with a hand sprayer. According to randomized block design there were 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 30 days after sowing, with two applications at 14-day intervals. The seedlings were grown under the greenhouse conditions (during 2 weeks). The greenhouse is set at 26 ºC and relative humidity at 60%. The measurements, observation and analysis were made in the seedling.

Harvest and Growth Parameters

Seedlings were harvested 14 days after. 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). In order to determine the dry matter contents in seedlings, ten seedlings were taken from randomly, and leaves, stems and roots were kept under were waited room temperature for one week after the fresh weight was determined. They were then dried at 105 ºC in an oven for 24 hours and weighed (AOAC., 1980). The fresh and dry weights were determined using a scale with 0.01 g sensitive and dry matter content (%) was determined with the formula: $\text{Dry Matter Content } (\%) = \frac{\text{Dry Weight} \times 100}{Fresh\ Weight}$ (Kılıç et al., 1991). SPSS 22 statistical program was used for statistical analysis of the data.

Results

Seedling Height (cm)

In the study, tebuconazole applications had a significant effect on seedling height. It was determined that the seedling height in the 0 ppm (control) application was 9,18 cm, the seedling height decreased depending on the doses after application, and the lowest value (5.65 cm) was obtained from 175 ppm application. The seedlings applied with tebuconazole had an average of 38.45% reduction in seedling height compared to the control group (Table 1; Figure 1).

Table 1. Effects of tebuconazole applications on seedling growth and quality characteristics

Doses	Seedling Height (cm)	Stem Height (cm)	Stem Diameter (mm)	Number of Leaf (Number/Plant)	Leaf Dry Matter Ratio (%)	Stem Dry Matter Ratio (%)	Root Dry Matter Ratio (%)	Leaf Chlorophyll reading value (SPAD)
0 ppm	9.18a	3.20a	5.27ab	4.00ab	16.51ab	14.75c	4.51a	53.52d
25 ppm	7.18c	2.88b	5.08bc	4.60a	15.86c	13.88d	4.51a	57.66bc
50 ppm	8.03b	3.13a	4.83d	4.00ab	15.89c	14.72c	4.71d	60.00ab
75 ppm	7.10c	2.90b	4.93cd	3.40bc	16.81a	16.19a	5.16b	61.25a
100 ppm	6.02e	2.70c	5.35a	3.40bc	15.84c	14.75c	4.81c	56.65c
125 ppm	6.73d	2.77bc	5.43a	3.20bc	14.83d	13.67e	5.72a	61.05a
150 ppm	6.05e	2.70c	5.35a	3.00c	14.60d	13.79f	4.81c	57.97bc
175 ppm	5.65f	2.63c	4.55e	3.00c	16.29b	15.87b	5.67a	59.69ab
	***	***	***	**	***	***	***	***

**p<0.005 ***p<0.001. There is no difference at the level of 0.005 between averages shown with the same letter in the same column.

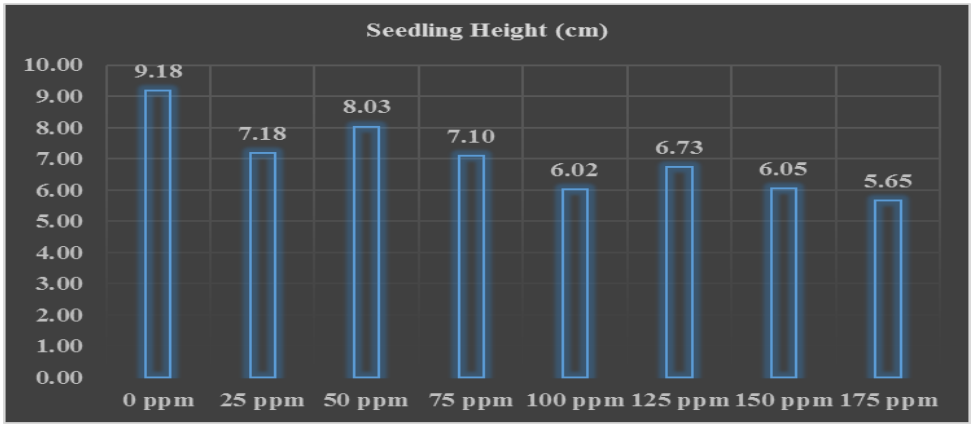

Figure 1. The effect of the application of tebuconazole on seedling height

Stem Height (cm)

That dose applications had a statistically significant effect on stem length. In the study, while the stem height value measured in the control (0 ppm) application was 3.2 cm, as a result of the application of Tebuconazole, the stem height varied depending on the doses and the lowest stem height was found at a dose application of 175 ppm as 2.63 mm (Table 1; Figure 2).

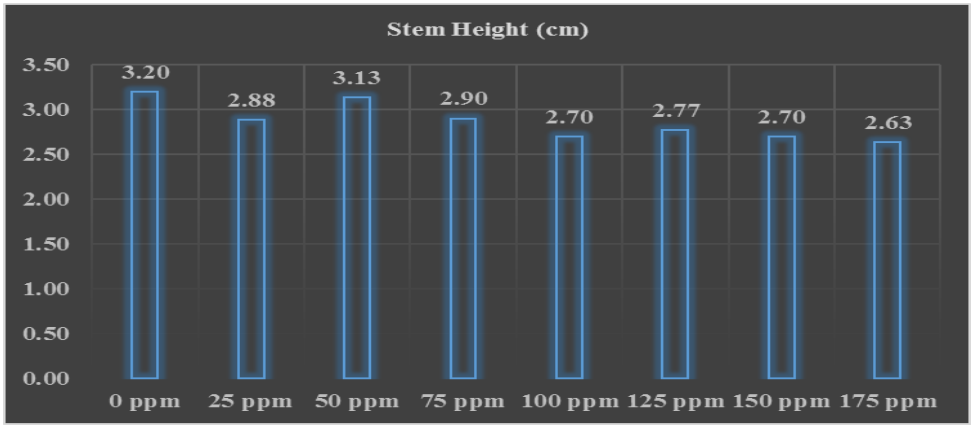

Figure 2. The effect of the application of tebuconazole on stem height

Stem Diameter (mm)

Significant differences were found among the applications in terms of stem diameter. It was determined that 100, 125 and 150 ppm doses increased the stem diameter and other doses caused a decrease. The biggest stem diameter (5.43 mm) was detected at dose of 125 ppm. It was determined that the sap diameter of the seedlings dosed with 125 ppm increased 3.03% when compared with the control group seedlings. (Table 1; Figure 3).

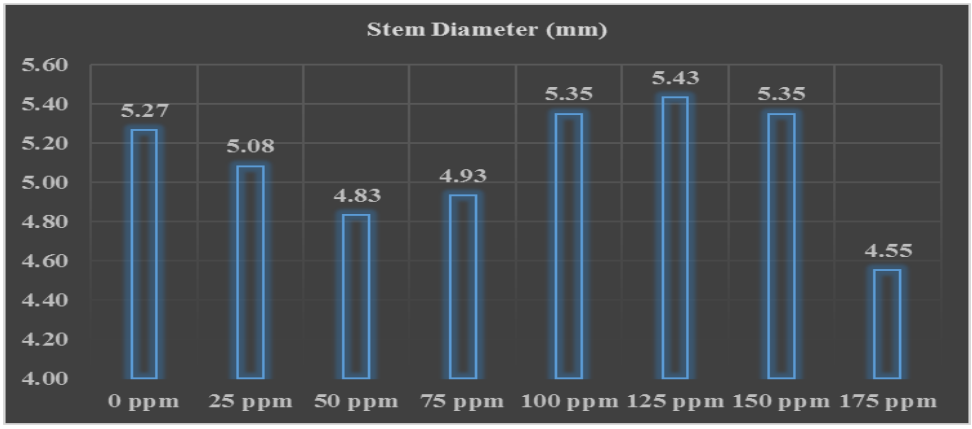

Figure 3. The effect of the application of tebuconazole on stem diameter

Leaf Number (number per plant)

The effect of different doses on the number of leaves per plant was found significant according to statistical evaluation. The number of leaves per plant was 4 in the seedlings without application, and after application, the number of leaves decreased in applications other than the 25 and 50 ppm dose (Table 1; Figure 4).

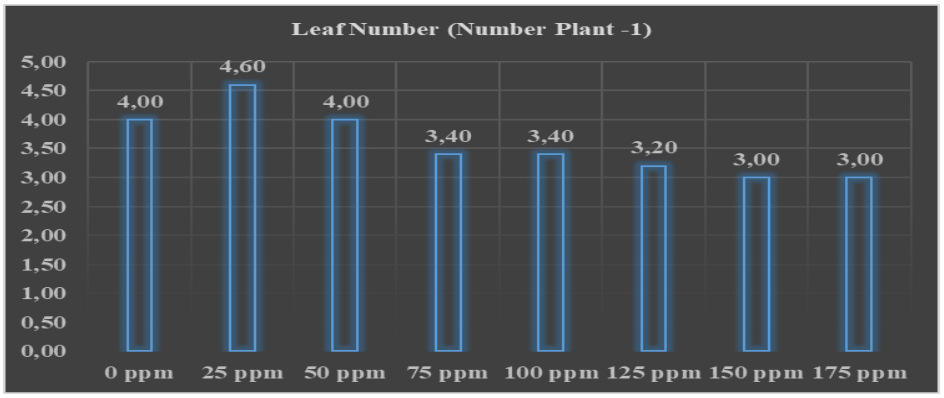

Figure 4. The effect of the application of tebuconazole on leaf number

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 16.51%, and after the application of Tebuconazole, there was a general decrease in the dry matter leaf content at all application doses except 75 ppm compared to the control group (Table 1; Figure 5).

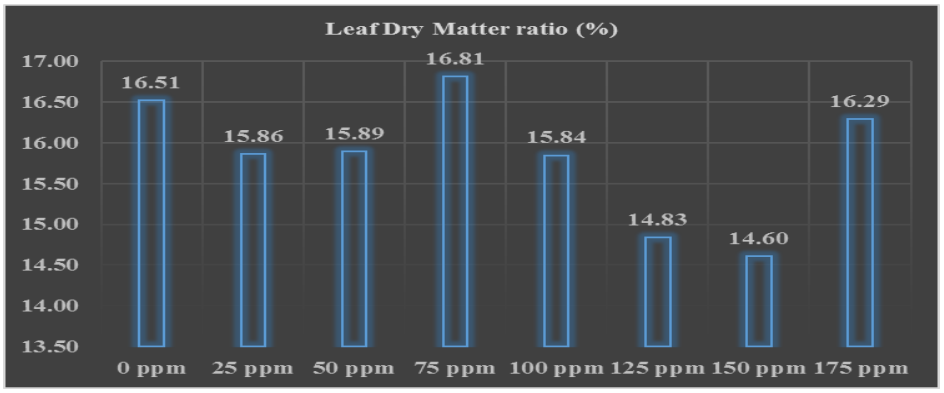

Figure 5. The effect of the application of tebuconazole on leaf dry matter ratio

Stem Dry Matter Content (%)

While the dry matter content obtained from the control group application in the study was 14.75%, after the application, the stem dry matter content decreased at all doses except 75 ppm and 175 ppm compared to the control group. Among the doses applied, the highest dry matter content was obtained from the application of 75 ppm with a 16.19% content (Table 1; Figure 6).

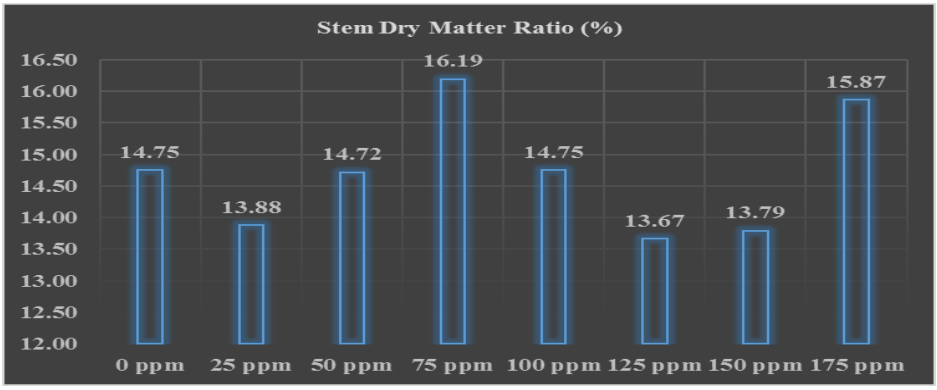

Figure 6. The effect of the application of tebuconazole on stem dry matter ratio

Root Dry Matter Content (%)

In the study, the stem dry matter content obtained from the control group (0 ppm) was found to be 4.51%. As a result of the application of Tebuconazole, there was a general decrease in the root dry matter content at all application doses compared to the control group. Among the doses applied, the highest dry matter content was obtained from the application of 125 ppm with a 5.72% content (Table 1; Figure 7).

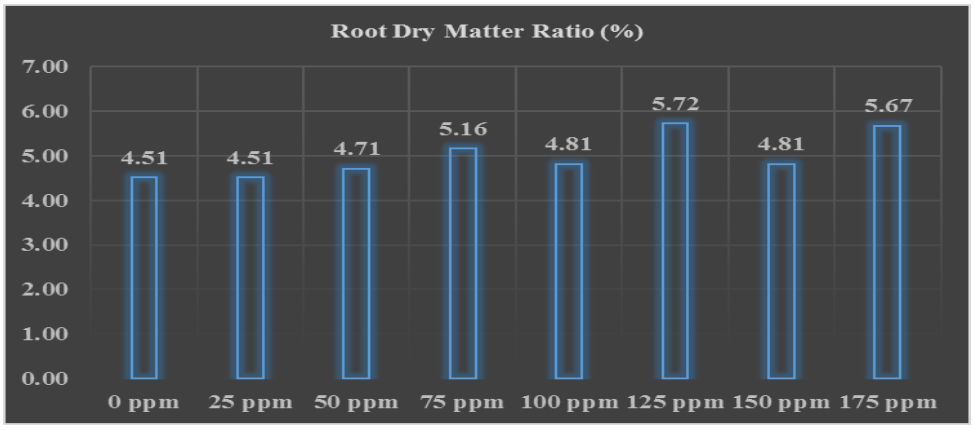

Figure 7. The effect of the application of tebuconazole on root dry matter ratio

Leaf Chlorophyll Reading Value (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 from the control application was measured as 53.52 and this value increased in all other applications compared to the control group (0 ppm). The highest leaf chlorophyll content were obtained from 75 (SPAD value=61.25), 125 (SPAD value=61.05) and 175 (SPAD value=59.69) ppm doses, respectively (Table 1; Figure 8).

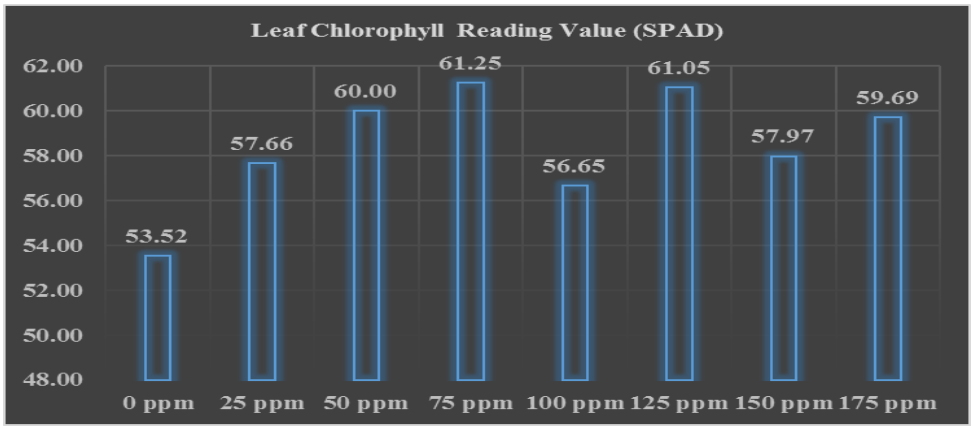

Figure 8. The effect of the application of tebuconazole on leaf chlorophyll reading value

Discussion

There are studies investigating the effects of Paclobutrazol and similar substances, which belong to the Triazole group similar to tebuconazole, on vegetable seedling characteristics and quality (Brigard et al., 2006; Çopur and Sarı, 2011; Geboloğlu et al., 2015; Geboloğlu et al., 2016; Uçan, 2019). In a study conducted on eggplant, the tebuconazole applied at different doses significantly decreased the seedling length and stem length (Öztürk and Dursun, 2020). In a study on seedling quality of melon, 25 ppm paclobutrazol application was determined to suppress seedling length (Flores 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 leaf 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 100,125 and 150 ppm applications increased in the stem diameter. And the biggest stem diameter was obtained from the 125 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 applications (Table 1). In the comparisons with the seedlings in the control group, it was found that the leaf dry matter contents decreased, stem dry matter content decreased at all doses except 75 ppm and 175 ppm and in 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 the root dry matter content (Flores 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 in 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 the chlorophyll content in the leaves (Flores et al., 2018); besides, similar results were obtained from 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.

Conclusion

In conclusion, Tebuconazole had positive effects on seedling quality. According to the data obtained in the study, it is can be suggested 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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