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Research Article
(Araştırma Makalesi)

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Can pruning affect the growth of shallot (*Allium ascalonicum* L.) seedlings from seeds?

Budama tohum kaynaklı şalot soğanı (*Allium ascalonicum* L.) fidelerinin büyümesini etkileyebilir mi?

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ABSTRACT

Objective: This study aims to reveal whether pruning affects the growth of shallot seedlings from seeds, evaluated based on the use of several varieties and the frequency of pruning during nurseries.

Materials and Methods: This research was conducted at the Teaching Farm, Faculty of Agriculture, Hasanuddin University, from August to September 2023. This study was arranged in a randomized block design with two factors. The first factor is shallot varieties of Sanren F1, Lokananta, and Maserati. The second factor is the pruning frequency (days after sowing) consisting of one time (25 DAS), two times (25 and 30 DAS), and three times (25, 30, and 35 DAS).

Results: The Maserati variety had the highest average number of leaves and the highest average number of root tips, the Lokananta variety had the largest average pseudo stem diameter and the heaviest fresh and dry weight of seedlings, and the Sanren F1 variety had the most extended average root length. Pruning with a frequency of three times consistently increases the growth of shallot seedlings, such as number of leaves, pseudo stem diameter, root length, number of root tips, fresh and dry weight of seedlings.

Conclusion: Pruning frequency and varieties have an influence on the growth of shallot seedlings. Pruning three times can increase the growth of seedlings linearly.

ÖZ

Amaç: Bu çalışma, fidanlıklarda çeşitli çeşitlerin kullanımı ve budama sıklığına göre değerlendirilerek budamanın şalot soğanı fidelerinin tohumdan gelişimini etkileyip etkilemediğini ortaya çıkarmayı amaçlamaktadır.

Materyal ve Yöntem: Bu araştırma Hasanuddin Üniversitesi Ziraat Fakültesi Öğretim Çiftliği'nde Ağustos-Eylül 2023 tarihleri arasında gerçekleştirildi. Bu çalışma iki faktörlü tesadüf blokları tasarımında düzenlenmiştir. Birinci faktör Sanren F1, Lokananta ve Maserati'nin şalot soğanı çeşitleridir. İkinci faktör ise bir defa (25 DAS), iki defa (25 ve 30 DAS) ve üç defadan (25, 30 ve 35 DAS) oluşan budama sıklığıdır (ekimden sonraki gün).

Araştırma Bulguları: Maserati çeşidi en yüksek ortalama yaprak sayısına ve en yüksek ortalama kök ucu sayısına sahiptir, Lokananta çeşidi en büyük ortalama yalanci övde çapına ve en ağır fide taze ve kuru ağırlığına sahipti ve Sanren F1 çeşidi ise en geniş ortalama kök uzunluğuna sahiptir. Üç kat sıklıkta budama, şalot soğanı fidelerinin yaprak sayısı, yalanci gövde çapı, kök uzunluğu, kök ucu sayısı, fidenin taze ve kuru ağırlığı gibi büyümelerini tutarlı bir şekilde artırır

Sonuç: Budama sıklığı ve çeşitleri şalot soğanı fidelerinin büyümesine etki etmektedir. Üç kez budamak fidelerin büyümesini doğrusal olarak arttırabilir.

INTRODUCTION

Shallot (*Allium ascalonicum* L.) is a plant that is widely grown in Southeast Asia and several African countries. Shallots are an important horticultural product because they are consumed daily by every family. Furthermore, shallots contain multivitamins, minerals, and antioxidants. As a result, in addition to being used as a spice, this plant is used as a supplement to lower the risk of cancer, manage diabetes, improve heart health, boost immunity, and prevent obesity (Sun et al., 2019).

Shallot production must be maintained and needs to be increased every time. One of the efforts to increase shallot production is using botanical seeds as planting material. The growth and quality of seedlings is an essential factor in plant cultivation. True shallot seeds (TSS) are more efficient because they are only required in small quantities, specifically 4-6 kg ha^{-1}, as opposed to 1-1.5 t ha^{-1} for seeds from bulbs. Because TSS is free of diseases typically found in seed bulbs, using it as seeds in shallot production is more effective and healthier. Shallot seeds have an excellent yield potential when used as planting material. Numerous TSS studies have been conducted with varying degrees of success. TSS treated with various planting methods on sub-optimal land had productivity of 11.67 to 17.48 t ha^{-1}. Moreover, using various sowing methods, TSS can achieve productivity between 11.79 and 15.89 t ha^{-1} (Sopha et al., 2016, 2017).

On the other hand, farmers do not use seeds as planting material because they require a long nursery time (40-45 days), and the percentage of seedlings that survive after transplanting is relatively low (Rosliani et al., 2022). In addition, the percentage of seedlings that grew after transplanting just ranged from 83% to 91% (Sumarno et al., 2021). Therefore, it is vital to increase the growth and quality of seedlings.

Improved seedling growth and quality reflect growth and production in the field. High-quality seedlings have characteristics such as healthy leaves, good morphology, optimal root growth, no shortage of nutrients, and being free from pests and diseases (Kubota et al., 2013). Good seedlings must also have balanced growth between shoots and roots, which is essential in vegetable production (Tuzel et al., 2015). One of the efforts to improve the growth and quality of shallot seedlings from seeds is pruning. Pruning is removing or removing some parts of plants that are not needed (Sukmawati et al., 2018). Pruning is a common thing to do on annual plants or trees. Pruning balances the vegetative and generative growth of plants and the distribution of nutrients and hormones in plants (Thakur et al., 2018; Zhang et al., 2018).

Several studies have linked the positive impact of pruning or leaf removal on crop growth and production. Research by Noviati & Setiawan (2018) revealed that pruning sweet potato plants can increase vegetative growth. Furthermore, Busri et al. (2018) showed that treatment by removing several plant leaves or leaf defoliation on cabbage plants could increase the weight and diameter of cabbage heads. Then, Adu-Yeboah et al. (2016) showed a positive effect of pruning on cashew nut (*Anacardium occidentale* L.) plants. Pruning leaves, shoots, and stems also influences the growth and production of tomato and cucumber plants (Mardhiana et al., 2017; Ayala-Tafoya et al., 2019; Lhamo et al., 2022).

In general, pruning shallot seedlings from seeds was done before transplanting. Pruning leaves aims to reduce water loss due to transpiration (Naidu & Jones, 2009). However, the effect of pruning on the growth of shallot seedlings in the nursery process is uncertain. Therefore, this study aims to reveal whether pruning affects the growth of shallot seedlings from seeds, evaluated based on the use of several varieties and the frequency of pruning during nurseries.

MATERIALS and METHODS

Study area

This research was conducted at the Teaching Farm, Faculty of Agriculture, Hasanuddin University. The nursery beds are made in a greenhouse with a 14% UV plastic roof. The research starts from August to September 2023.

Experimental design

This study was conducted in a randomized block design with two factors. The first factor is shallot varieties of Sanren F1, Lokananta, and Maserati. The second factor is the pruning frequency (the day after sowing) consisting of one time (25 DAS), two times (25 and 30 DAS), and three times (25, 30, and 35 DAS). The two treatment factors resulted in 9 treatment combinations repeated three times, so there were 27 observation units.

Bed preparation and sowing

Beds are made with a size of 1 × 1 meter, with a height of 30 cm. The beds were then applied with chicken manure equivalent to 10 t ha^{-1}. Then, a 0.9-meter-wide seedling furrow was made with a depth of 1 cm and 10 cm between furrows. A total of 0.5 g of seed is sown per furrow. The seeds that have been sown are then cared for until they are 45 days old.

Pruning techniques

Pruning is done by cutting 25% of the total length of the leaves. Pruning is done in the morning using scissors. The rest of the pruning is then cleaned and separated from the beds.

Data collection

Parameters observed in this study were the number of leaves, pseudo stem diameter (mm), root length (cm), number of root tips, seedling fresh weight, and seedling dry weight. The number of plants used as samples is five seedlings per treatment in each replication. Parameter measurements were carried out at the age of 45 DAS. Pseudo stem diameter was measured using a caliper, root length was measured with a ruler and fresh and dry weights of seedlings were measured with a digital scale. Dry weight was measured after the seedlings were dried in an oven at 120°C for 24 hours.

Data analysis

Data were analyzed with RStudio software. A two-way analysis of variance (ANOVA) was used to perform statistical analysis, with a p-value of 0.05 considered significant. The mean comparison was performed by Duncan multiple range test.

RESULTS and DİSCUSSİON

Aerial Parts

Based on the analysis of variance, it was shown that there was no interaction between varieties and the frequency of pruning on the average number of leaves and pseudostem diameter of shallot seedlings. However, each treatment factor significantly affected both parameters (Table 1). The Maserati variety recorded the highest average number of leaves (3.87) compared to the Lokananta and Sanren F1 varieties. Then, the Lokananta variety recorded the widest average pseudo stem diameter (4.24 mm) compared to the other two varieties. The pruning treatment showed that pruning shallot seedlings with a frequency of three times (25, 30, and 35 DAS) recorded the highest average number of leaves (4.11) and the broadest pseudo stem diameter (4.69 mm) compared to one and two pruning frequencies times.

There is a difference in the average number of leaves and pseudo stem diameter of shallot seedlings because of the different varieties used. In general, the three varieties have different characters. The Maserati variety has the highest average number of leaves, while the Lokananta variety has the widest average diameter of the pseudo stem. This difference is, of course, caused by the genetic factors of each variety. Alemu et al. (2022) found different effects on onion varieties regarding growth characteristics such as plant height and number of leaves.

Table 1. The effect of variety and pruning frequency on mean number of leaves and pseudo stem diameter (cm)

Çizelge 1. *Çeşit ve budama sıklığının ortalama yaprak sayısı ve yalancı gövde çapına (cm) etkisi*

Variety	Number of Leaves	Pseudo Stem Diameter (mm)
Sanren F1	3.38±0.14[b]	3.49±0.46[b]
Lokananta	3.76±0.32[a]	4.24±0.56[a]
Maserati	3.87±0.34[a]	3.78±0.50[b]
Pruning Frequency	Number of Leaves	Pseudo Stem Diameter (mm)
One time (25 DAS)	3.22±0.02[c]	2.93±0.13[c]
Two times (25 and 30 DAS)	3.67±0.25[b]	3.90±0.28[b]
Three times (25, 30, and 35 DAS)	4.11±0.22[a]	4.69±0.23[a]

* Means followed by the same letter are not significantly different for $p \leq 0.05$ according to Duncan multiple range test. (DAS) days after sowing.

Three times of pruning, they significantly affected the average number of leaves and stem diameter of shallot seedlings. Pruning part of the leaves stimulates the growth of new leaves, so the more often they are pruned, the potential for new leaves to emerge increases. Then, the increase in the diameter of the pseudo stem is also due to the reduced allocation of assimilates in the leaves, so that the pseudo stem, which will become the forerunner of bulbs, gets bigger. Aragle et al. (2023) stated that the age of the shallot seedlings significantly affected plant performance in the field. Seedlings with optimal vigor are certainly influenced by active growth, including the growth of the pseudo stems of the seedlings. In addition, an increase in the number of leaves certainly increases the capacity of plants to form and assimilate so that the potential for forming new leaves can occur.

Aboveground Parts

Based on the analysis of variance, it was shown that there was no interaction between varieties and pruning frequency on the average root length and number of root tips in shallot seedlings. However, each treatment factor significantly affected both parameters (Table 2). The Sanren F1 variety recorded the most extended average root length (3.69 cm) compared to the Lokananta and Maserati varieties. Then, the Maserati variety recorded the highest average number of root tips (11.20) compared to the other two varieties. The pruning treatment showed that pruning shallot seedlings with a frequency of three times (25, 30, and 35 DAS) recorded the most extended root length (4.35 cm) and the highest number of root tips (12.31) compared to one and two pruning frequencies time.

Table 2. The effect of variety and pruning frequency on mean root length (cm) and number of root tips

Çizelge 2. *Çeşit ve budama sıklığının ortalama kök uzunluğu (cm) ve kök ucu sayısına etkisi*

Variety	Root Length (cm)	Number of Root Tips
Sanren F1	3.69±0.62[a]	11.04±1.00[a]
Lokananta	3.57±0.58[a]	10.73±0.63[a]
Maserati	2.78±0.39[b]	11.20±1.13[a]
Pruning Frequencies	Root Length (cm)	Number of Root Tips
One time (25 DAS)	2.51±0.19[c]	9.62±0.44[c]
Two times (25 and 30 DAS)	3.20±0.25[b]	11.04±0.73[b]
Three times (25, 30, and 35 DAS)	4.35±0.42[a]	12.31±0.44[a]

* Means followed by the same letter are not significantly different for $p \leq 0.05$ according to Duncan multiple range test. (DAS) days after sowing.

The Sanren F1 variety has the longest roots, while the Maserati has the greatest number of root tips. The growth of plant roots becomes dominant due to the pruning of leaves. The more often it is pruned, the more significant root growth will be. Pruning leaves on scallions can stimulate the growth of new shoots and roots (Kahar et al., 2022). This, of course, will improve the ratio of plant shoots and roots. This was also stated by Carrilo et al. (2011), who stated that pruning of plants will affect the ratio of shoots and roots. Takoutsing et al. (2013) also pointed out the importance of the ratio of shoots and roots. If leaf growth is more dominant than roots, the potential for plant seedlings to survive in the field is lower.

Seedling Biomass

Based on the analysis of variance, it was shown that there was no interaction between varieties and pruning frequency on the average of fresh and dry weight on shallot seedlings. However, each treatment factor significantly affected both parameters (Table 3). The Lokananta variety recorded the heaviest fresh and dry seed weights, namely 1.50 g and 0.61 g respectively, which was not significantly different from Maserati. Pruning with a frequency of three times recorded the heaviest fresh and dry weights of seedlings, namely 2.12 g and 0.88 g respectively, which was significantly different from pruning twice and once.

Table 3. The effect of variety and pruning frequency on fresh and dry weight of seedlings

Çizelge 3. *Çeşit ve budama sıklığının fide yaş ve kuru ağırlığına etkisi*

Variety	Fresh Weight of Seedling (g)	Dry Weight of Seedling (g)
Sanren F1	1,15±0.27^{b}	0.52±0.11^{a}
Lokananta	1,50±0.43^{a}	0.61±0.18^{a}
Maserati	1,38±0.50^{a}	0.58±0.17^{a}
Pruning Frequencies	Fresh Weight of Seedling (g)	Dry Weight of Seedling (g)
One time (25 DAS)	0.80±0.04^{c}	0.36±0.01^{c}
Two times (25 and 30 DAS)	1.11±0.04^{b}	0.48±0.02^{b}
Three times (25, 30, and 35 DAS)	2.12±0.25^{a}	0.88±0.07^{a}

* Means followed by the same letter are not significantly different for $p \leq 0.05$ according to Duncan multiple range test. (DAS) days after sowing.

Pruning is vital in accumulating assimilates in all parts of the plant. Several previous researchers also found increased plant biomass. Research conducted by Partey (2010) also found a significant effect of pruning on increasing biomass in *Tithonia diversifolia* plants. However, different results were found by Makhubedu et al. (2022), who showed that pruning with a high frequency would reduce the capacity of the *Sesbania sesban* plant to form assimilates, which would result in a decrease in plant biomass.

Relation Between Pruning Frequency and Parameters

Pruning frequency generally affected all observed parameters, including the number of leaves, diameter of pseudo stems, root length, number of root tips, and fresh and dry weight of seedlings (Figure 1). The coefficient of determination (R^2) between pruning frequency and these parameters ranges from 0.91 to 1.00. This shows that there is a close relationship between the two variables. Pruning affected stomatal conductivity, quantum yield values, leaf chlorophyll content (a, b and total), net photosynthesis (Saifuddin et al., 2010; Maurin & DesRochers, 2013).

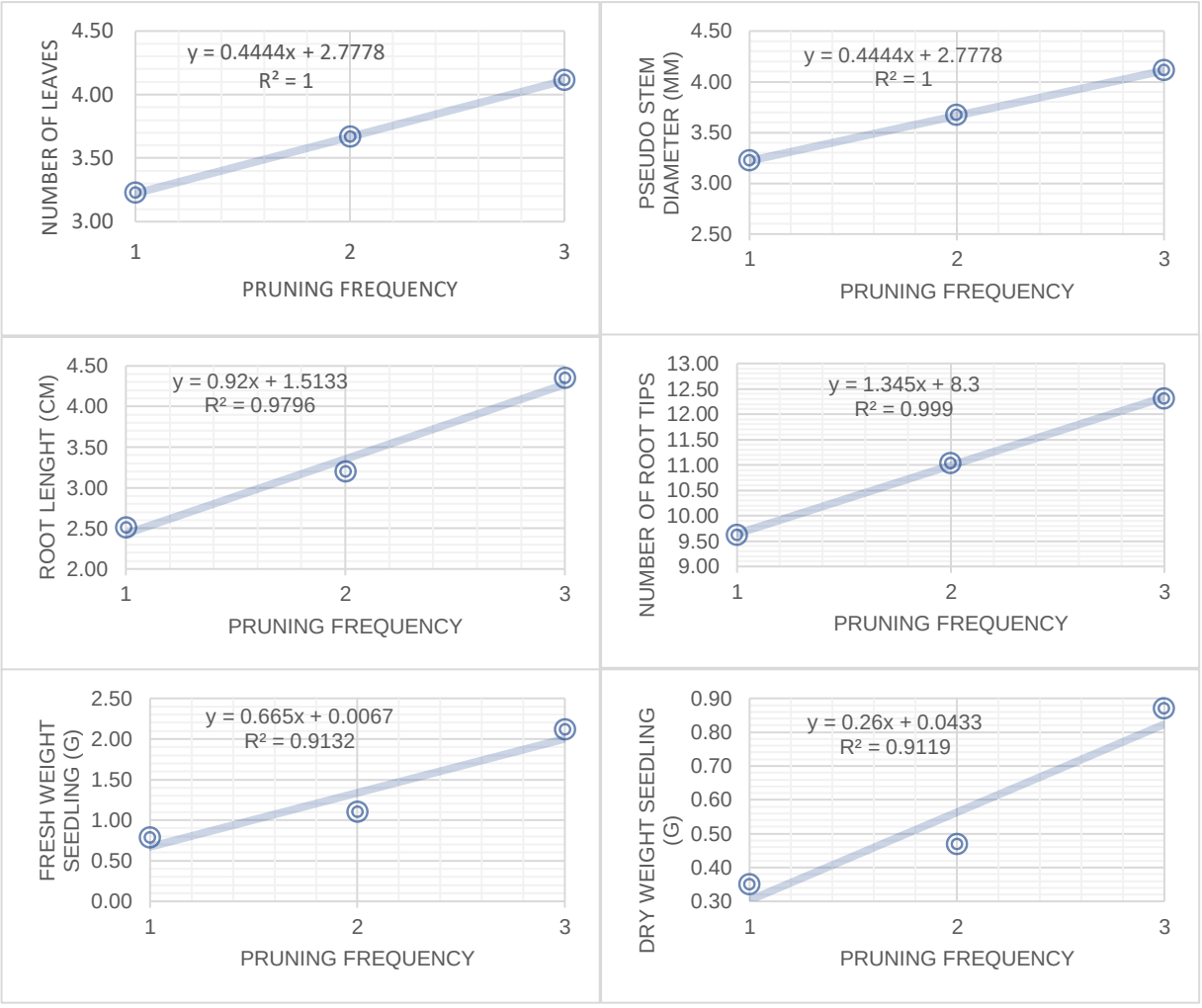

Figure 1. Linear regression equation between pruning frequency and parameters. Number of leaves (A), pseudo stem diameter (B), root length (C), number of root tips (D), fresh weight seedling (E), and dry weight seedling (F).

Şekil 1. *Budama sıklığı ve parametreler arasındaki doğrusal regresyon denklemi. Yaprak sayısı (A), yalancı gövde gövde çapı (B), kök uzunluğu (C), kök ucu sayısı (D), fidenin taze ağırlığı (E) ve fidenin kuru ağırlığı (F).*

The difference in performance between the seedlings of the three shallot varieties with the frequency of pruning can be seen in Figure 2. The Lokananta variety with three pruning times had the most remarkable performance compared to the seeds of the other varieties and pruning frequencies. There is also a tendency for the seedlings to get bigger with an increase in pruning frequency.

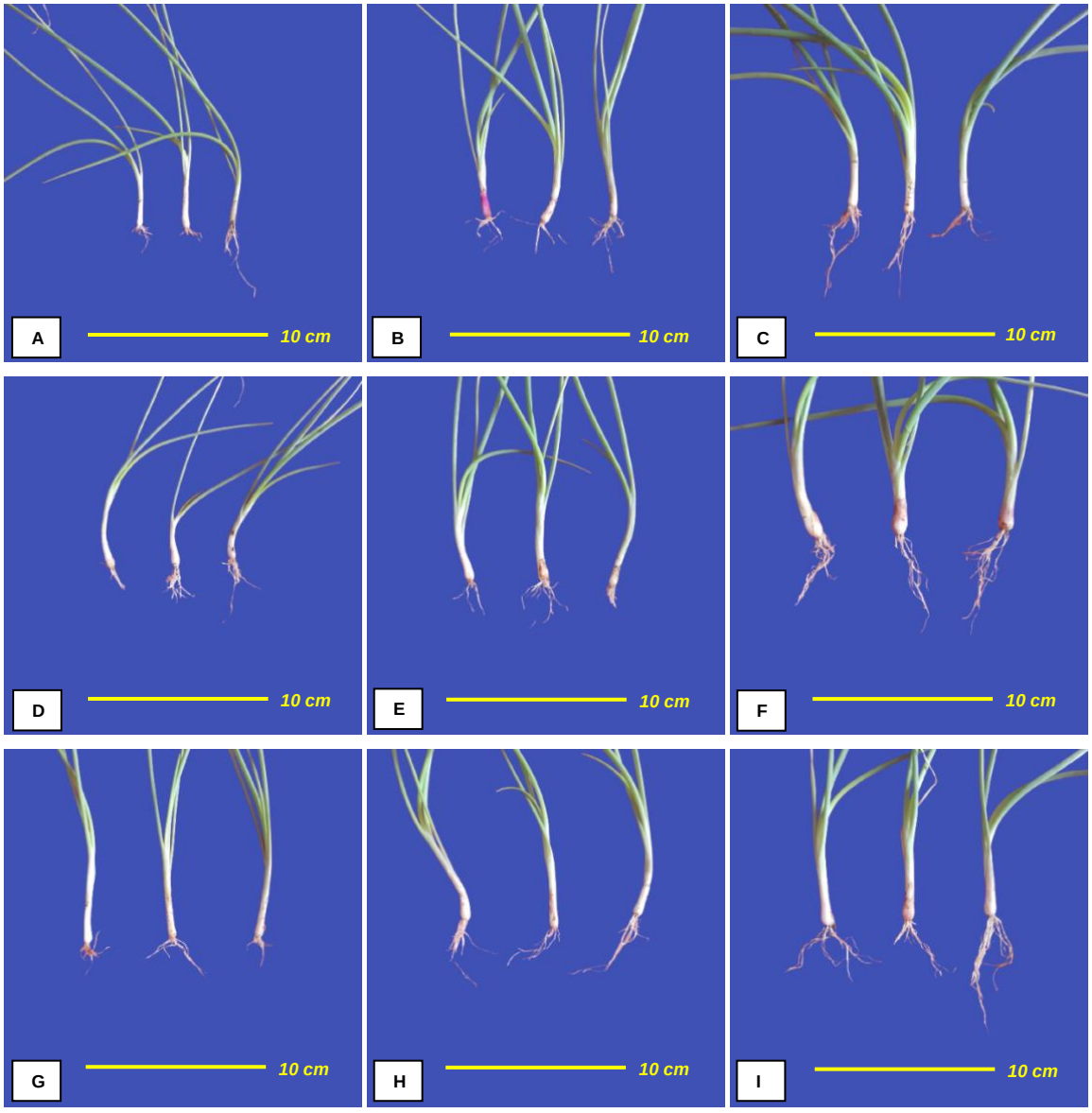

Figure 2. Performance of shallot seedlings by pruning. Sanren F1 + one time (A), Sanren F1 + two times (B), Sanren F1 + three times (C), Lokananta + one time (D), Lokananta + two times (E), Lokananta + three times (F), Maserati + one time (G), Maserati + two times (H), Maserati + three times (I).

Şekil 2. *Şalot soğanı fidelerinin budama ile performansı. Sanren F1 + bir kez (A), Sanren F1 + iki kez (B), Sanren F1 + üç kez (C), Lokananta + bir kez (D), Lokananta + iki kez (E), Lokananta + üç kez (F) , Maserati + bir kez (G), Maserati + iki kez (H), Maserati + üç kez (I).*

Correlation (based on color) between observation parameters can be seen in Figure 3. Correlation values for these various parameters range from 0.50 to 0.98, which shows a moderately correlated relationship to a very strong correlation (Schober et al., 2018). A very strong correlation was shown in the parameters of fresh weight with the dry weight of seedlings (0.98). The correlation between the number of leaves with the diameter of the pseudo stem (0.87), the number of leaves with the number of root tips (0.77), the number of leaves with fresh weight (0.85), the number of leaves with dry weight (0.80), the pseudo stem diameter with root length (0.78), pseudo stem diameter with number of root tips (0.72), pseudo stem diameter with fresh weight (0.85), pseudo stem diameter with dry weight (0.88), and root

length with weight dry (0.79) classified into a strong correlation. Correlation value between the number of leaves and root length (0.50), root length and number of root tips (0.63), root length and fresh weight (0.68), number of root tips and fresh weight (0.66), and number of tips roots with dry weight (0.64) were classified to a moderate correlation.

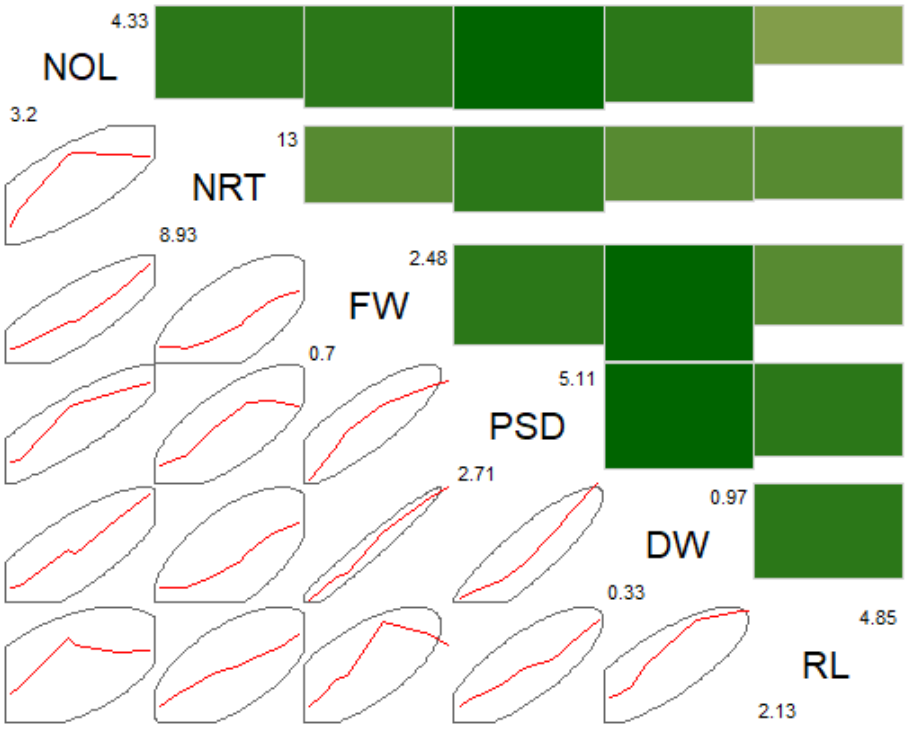

Figure 3. Correlation graph among parameters. (NOL) number of leaves, (NRT) number of root tips, (FW) fresh weight, (PSD) pseudo stem diameter, (DW) dry weight, and (RL) root length.

Şekil 3. *Parametreler arasındaki korelasyon haritaları. (NOL) yaprak sayısı, (NRT) kök ucu sayısı, (FW) taze ağırlık, (PSD) sahte gövde çapı, (DW) kuru ağırlık ve (RL) kök uzunluğu.*

CONCLUSIONS

Based on the research that has been done, it can be concluded that pruning affects the growth of shallot seedlings from seeds. The three varieties have different responses to pruning. The Maserati variety had the highest average number of leaves and the highest average number of root tips, the Lokananta variety had the largest average pseudo-stem diameter and the heaviest fresh and dry weight of seedlings, and the Sanren F1 variety had the most extended average root length. Pruning with a frequency of three times consistently increases the growth of shallot seedlings, such as number of leaves, pseudo stem diameter, root length, number of root tips, fresh and dry weight of seedlings.

Data Availability

Data will be made available upon reasonable request.

Author Contributions

Conception and design of the study: MF, ES; sample collection: PW, CC; analysis and interpretation of data: AJ, RWP; statistical analysis: AJ, RWP; visualization: MF, CC; writing manuscript, reviewing, and revising: MF, ES.

Conflict of Interest

There is no conflict of interest between the authors in this study.

Ethical Statement

We declare that there is no need for an ethics committee for this research.

Article Description

This article was edited by Section Editor Dr. Emrah ZEYBEKOĞLU.

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