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Araştırma Makalesi / Research Article

The Effect of Different Planting Densities on Yield, Yield Components and Some Quality Characteristics of Virginia (Sun-Cured) Tobacco in Manisa Province

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Abstract

This study was conducted in 2023 under Manisa / Karayenice ecological conditions. The aim of the study was to determine the yield and yield components and some chemical properties of sun-cured virginia tobacco variety with different planting densities. Three different planting densities (40x70 cm, 50x70 cm and 60x70 cm) were applied in the study which was carried out with 3 replications according to randomized blocks experimental design. Plant height (cm), number of leaves (per plant^{-1}), leaf width (cm), leaf length (cm), yield (kg ha^{-1}), total alkaloid (nicotine) (%) and total reducing sugar (%) were analyzed. As a result of the results obtained from the experiment; plant height 184-190 cm; yield 409-434 kg da^{-1}; total alkaloid (nicotine) content 1.738-2.360%; total reducing sugar content 1.94-3.92%. It was concluded that it is suitable for sun-cured virginia tobacco cultivation in the region; when yield and yield components are considered, 50x70 cm planting density and when chemical properties are prioritized, 60x70 cm planting density can be recommended.

Keywords: Virginia tobacco, sun-cured, planting density, yield

1. Introduction

Tobacco, which has an important place in the agriculture and economy of our country, provides a wide range of employment opportunities from production to sale. However, tobacco farmers give up tobacco cultivation due to some reasons such as changes in legal regulations and the difficulty of cultivation. Tobacco sector and scientists have researched and tried to find solutions for this decrease in tobacco production in our country with tobacco types that can be substituted. Approximately 85% of the world tobacco production is composed of Virginia, burley and oriental tobacco types (Anonymous, 2022). Turkey is a country that has made a reputation and created a brand with oriental tobaccos in world tobacco production. Their small leaves are used to add aroma to cigarette blends with their unique color and smell (Şahin and Ekren; 2021). Due to the difficulties in agricultural production and the high average age of producers, inadequacies in price policies and legal regulations, there has been a significant decrease in tobacco production in our country in the last 20 years. Changes in the number of tobacco producers and the amount of production in Turkey are indicated by regions and tobacco types. When the years 2003 and 2023 are compared in terms of the number of producers, a decrease of 87.6% and 38.2% is observed in terms of the amount of production (Anonymous, 2023).

In the Aegean Region, the private sector started to grow Aegean tobacco in Hatay and Adıyaman provinces due to the fact that tobacco producers quit tobacco production over the years. After a while, Virginia tobacco production started in these provinces. The aim here is to compensate for the decline in production in the Aegean Region. Although, there are differences in terms of quality, a product that can be used in cigarette blends is obtained. However, when the amount of product to be obtained from unit area is compared in terms of virginia and oriental tobacco, it is seen that the yield value of virginia tobacco is higher. Another compensation for this decrease in production is provided through imports.

In recent years, the gap between tobacco import and export amounts has widened. While Turkey used to be a tobacco exporting country, it has become an importing country (Ekren et al., 2021). The information and data given above indicate that the rate of oriental tobacco use in cigarettes has decreased. There are cigarette companies that have invested in our country and have been operating for many years. These companies use imported tobacco as raw material in cigarettes rather than tobacco produced in Turkey. In Article 12 of the Official Gazette No. 31294 dated November 4, 2020, a paragraph was added to Article 6 of the Law No. 4733 (Anonymous, 2020). With this added paragraph, the private sector accelerated Virginia tobacco production. Due to the high drying costs of these tobaccos, they started to grow sun-cured Virginia (SCV) tobacco by drying in the sun instead of flue-cured Virginia (FCV) tobacco in Hatay, Adıyaman and then in the Aegean Region. The first Virginia tobacco production activities in Turkey started in 1938. However, the desired success was not fully achieved in the first stage (Küçüközden, 1995). Despite the economic policies implemented after this date, production continued intermittently. Later, with the amendment made to the Tobacco and Tobacco Monopoly Law No. 1177, domestic and foreign capital was granted the right to establish cigarette factories in the country. On the one hand, multinational companies started to establish cigarette factories in the country, and on the other hand, they tried to grow Virginia and burley tobaccos needed for the cigarettes they would produce in our country; they started the production of these tobaccos in Adapazarı, Düzce and its surroundings, Manyas and Gönen (Usturalı, 1995; Ekren, 2000; Çamaş et al., 2014). Due to the high drying costs of Virginia tobacco, it did not bring the desired success in production.

Since the unit price spent on production was higher than imports, they again resorted to importing Virginia tobacco. In the light of this information, it is thought that sun-cured Virginia tobacco production will continue in our country today and in the coming years. This situation has made it a necessity for us to be successful in the field of Virginia tobacco production and to ensure the continuity of this situation.

This study was carried out to determine the effects of different planting densities on yield and yield components and some chemical properties of Virginia (Sun-cured) tobacco under Manisa / Karayenice ecological conditions. It is our greatest hope that the obtained findings and evaluations will guide the practitioners.

2. Materials and Methods

The research was conducted in Karayenice village of Manisa province during the tobacco production period of 2023. K326 Virginia tobacco variety was used as plant material in the experiment. It was determined that the soil of the land where the experiment was conducted was sandy clay loam, organic matter content was at medium levels, lime content was at medium levels, pH level was slightly alkaline, the amount of available Fe, K and N was sufficient, and the amount of available P was at medium levels. When the climatic data of the year in which the study was conducted were compared with the long years, it was observed that the temperature values were the same. The highest average temperature of 28.9 ºC was recorded in July and August. If a comparison is made in terms of total precipitation amount, the average precipitation amount for the year 2023 was approximately half of the average precipitation amount for many years. Based on the available data, almost no precipitation fell in Manisa in July and August (Figure 1). Lack of rainfall in the region is not a desirable situation for Virginia (Sun-cured) tobacco.

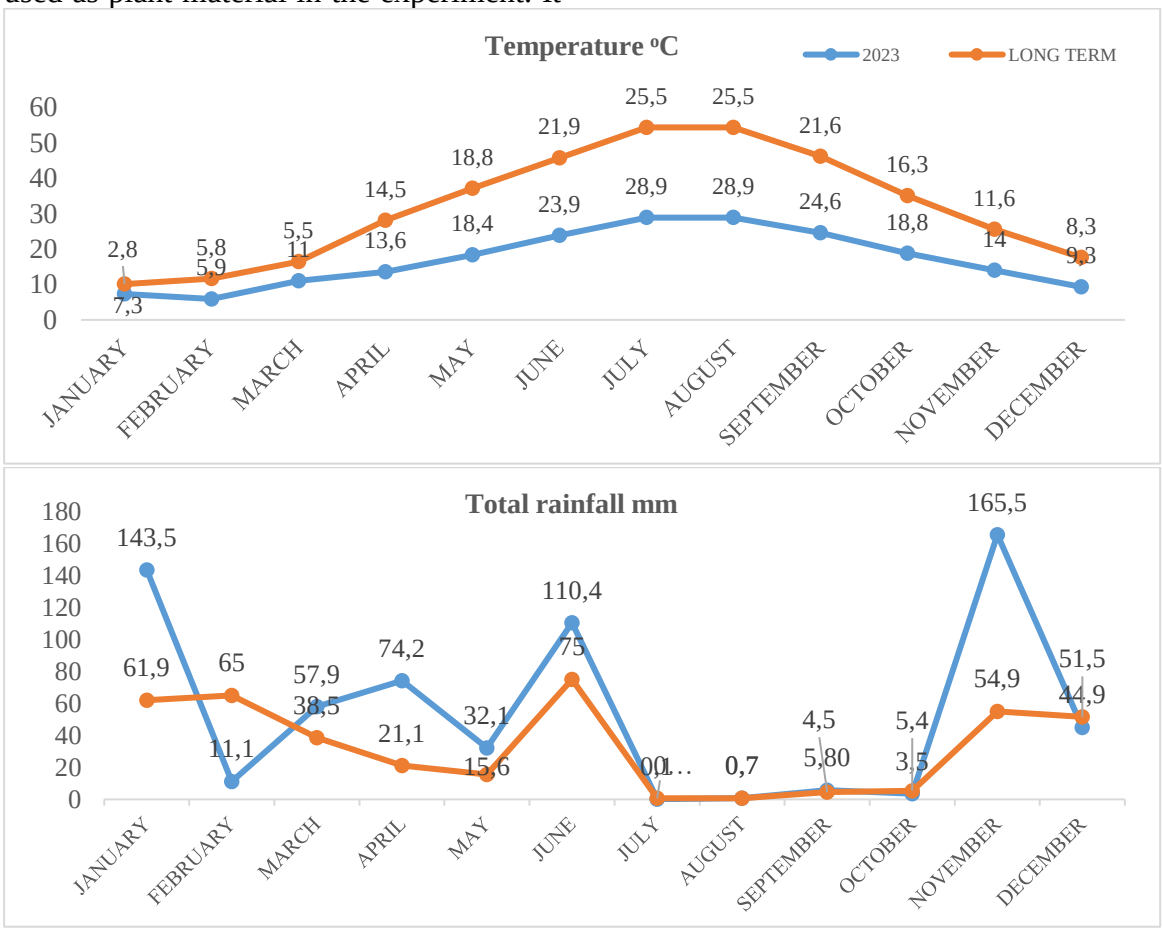


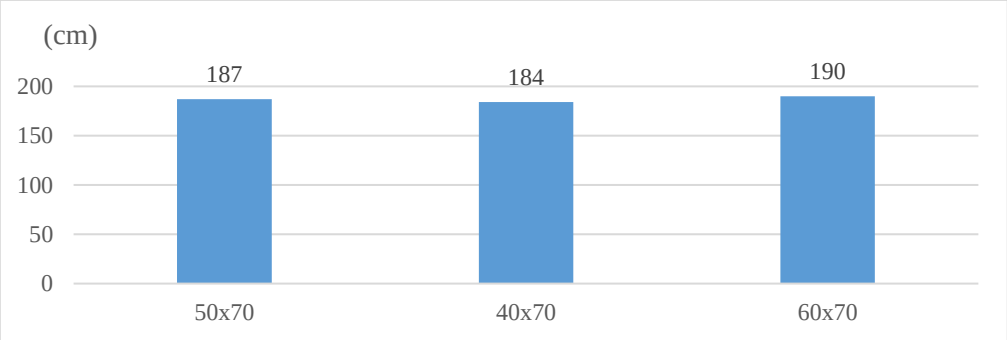
Figure 1. Climate data of Manisa province where the research was conducted (2023 and long years) (Anonymous, 2023b)

Since the tobacco seeds were very small, they were sown on March 1 to obtain seedlings. The experimental land was deep plowed with a plow in the fall and tillage was done with a disc harrow and cultivator in the spring. On April 18, 2023, 15-15-15 compound fertilizer was applied at 50 kg/ha. The healthy seedlings obtained were planted in the field on May 18, 2023 and life water was given after planting. Three different planting densities were applied to tobacco seedlings: 40x70 cm, 50x70 cm and 60x70 cm. The research was carried out in a total area of 1500 m^2 with 3 replications according to the randomized blocks experimental design. After planting, hoeing was done 2 times (June 8th and 22 th, 2023) and drip irrigation was done seven times (June 2th, July 3th, July 8th, July 13th, July 18th, July 20th, August 3th, 2023). Tobacco was not subjected to top-cutting. Harvesting was done in five hands on July 29th, August 7th, August 31th, September 20th and October 21th, 2023. The crushed tobacco leaves were arranged in the machine and kept in the shade for one day and dried by sun curing method. Plant height (cm), leaf width (cm), leaf length (cm), number of leaves (per/plant), yield(kg/ha^{-1}) (Anonymous, 2006), total alkaloid nicotine (%) (Anonymous, 1969) (Lindsay, 1973) and total reducing sugar (%) (Sekin, 1979) were analyzed. The statistical analysis of the data obtained was subjected to analysis of variance with the help of Totem Stat statistical program (Açıkgöz et al., 2004).

3. Research Results and Discussion

3.1.Plant height

The effect of different planting densities on plant height is shown in Figure 2. Plant height varied between 184-190 cm and the highest plant height was obtained with a row spacing of 60x70 cm. The number of plants per unit area and the distribution of plants per unit area, the distance between rows and above rows, are determined by planting density. As the row spacing of the plants decreases, they form a taller structure due to the lack of sufficient light and the decrease in plant nutrients (Bukan et al., 2010, Tepecik and Ongun, 2020). It was found that plant height of virginia tobacco varied between 89.1-123.2 cm with different planting densities in Adıyaman province (Vural and Ekren, 2021). They determined plant heights as 104.7 cm, 106.3 cm and 107.3 cm in 120x55 cm, 107x55 cm and 90x60 cm planting desity, respectively (Usman et al., 2017). In our study, it was observed that the results obtained regarding plant height were higher than the mentioned literatures. It is thought that this may be due to the cultivated region and cultural treatments applied.

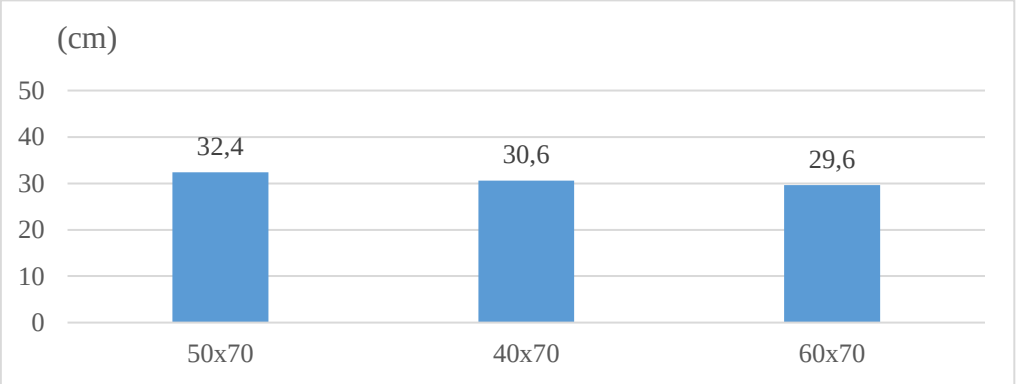


LSD: not significant

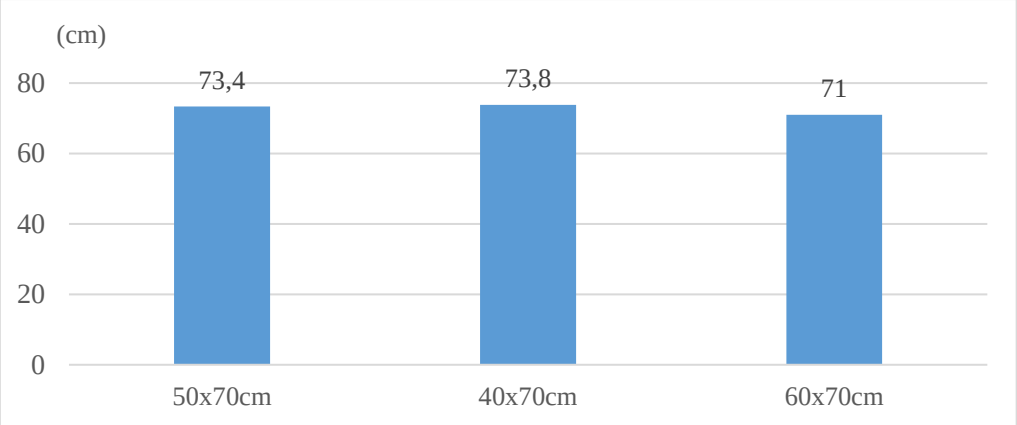
Figure 2. Effect of different planting densities on plant height (cm)

3.2.Leaf width and length

As shown in Figures 3 and 4, the highest leaf width and length were obtained at 50x70 cm with 32.4 cm and 40x70 cm planting density with 73.8 cm. It was determined that the leaf length and leaf width of virginia tobaccos varied between 53.8-67.1 cm and 21.4-30.3 cm, respectively, in Erbaa, Tokat conditions (Ayan, 1994). In a study conducted with 6 different virginia tobacco varieties under Manyas conditions, the lowest leaf length (61.0 cm) and width (25.9 cm) were obtained in 117x46 cm planting density and the highest leaf length (70.5 cm) and width (34.3 cm) were obtained in 112x51 cm planting density (Küçüközden, 1995). It is seen that the results obtained in our study regarding leaf dimensions are not very compatible with the literature values mentioned above. The seedling quality applied (Karabulut and Ekren, 2024) and also the differences arising from the ecological characteristics of the land where the experiment was conducted are important in determining the leaf width and length.



LSD (%1): 3.873*
Figure 3. Effect of different planting densities on leaf width (cm)

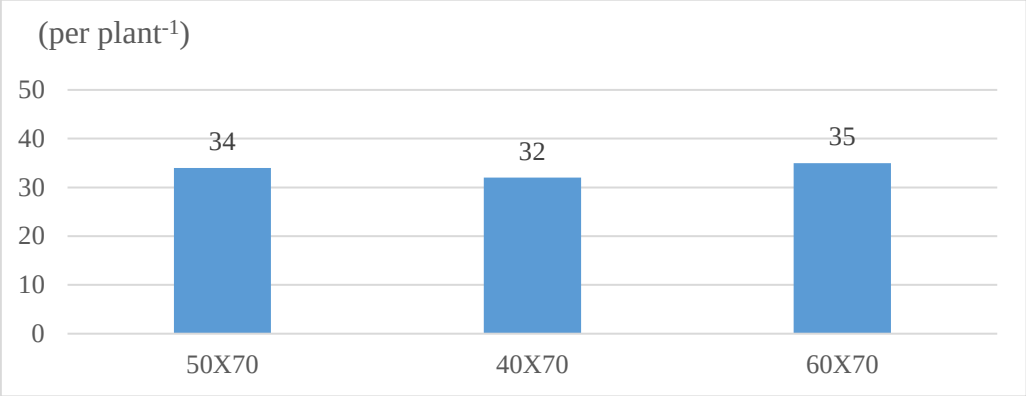


LSD (%1): 6.538*
Figure 4. Effect of different planting densities on leaf length (cm)

3.3.Number of leaves

It was observed that the number of leaves varied between 32-35 leaves plant^{-1} and the highest number of leaves was reached at 60x70 cm planting norm (Figure 5). It was determined that dry leaf yield increased as

the number of leaves per plant decreased (Patel et al., 1986). As the distance between and above the rows increases, more daylight can be utilized and the number of leaves per plant increases and leaves with thicker leaf texture (heavy bodied) are obtained. On the contrary, fewer and thinner leaves (light bodied) are formed (Mantesa et al., 2019). The number of leaves in virginia tobacco grown under Manyas conditions was found to be 20.06-36.6 per plant^{-1} (Keskiner, 1993; Küçüközden, 1995). In Adıyaman ecological conditions, the number of leaves of Virginia tobacco was found to be 25.5-32.9 per/plant (Vural and Ekren, 2021). It can be said that the findings obtained in our study are compatible with the information and findings mentioned above.

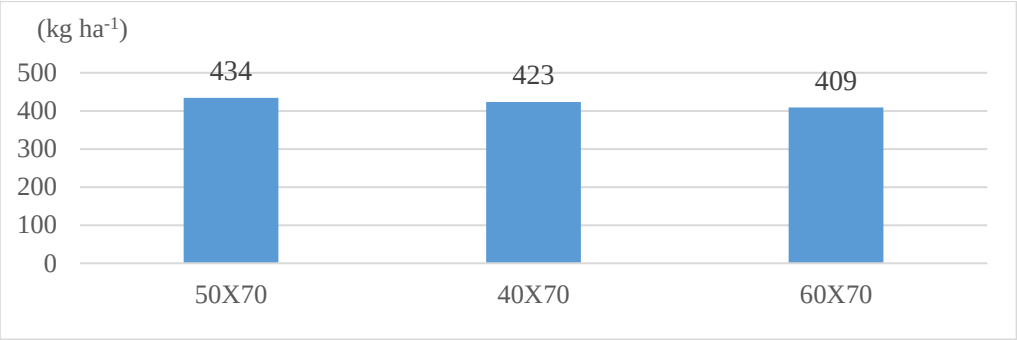


LSD: not significant

Figure 5. Effect of different planting densities on the number of leaves (per/plant)

3.4.Yield

One of the most important parameters determining the yield is the number of plants per decare and in our study, it was found that yields varied between 409-434 kg ha^{-1}. The highest yield was obtained at 50x70 cm planting norm (Figure 6). Papenfuz and Quin (1984) stated that dense planting increases leaf tobacco yield as it increases the number of plants per decare. Eğilmez (1984) stated that dense planting did not increase the yield at the expected level. Chaplin et al. (1968) found that yield increased as the distance between rows increased. Küçüközden (1995) determined dry leaf tobacco yield as 314.1 kg ha^{-1}at a planting density of 112x51 cm and 327.6 kg ha^{-1}at a planting density of 117x46 cm in his research conducted with different planting densities. Usturalı (1995) found that virginia tobacco yield varied between 156.0-353.6 kg ha^{-1}and average leaf tobacco yield was 254.2 kg ha^{-1} in his study conducted in Düzce region. Ayan (1994) obtained the highest yield value as 263.63 kg ha^{-1} in his study conducted in Karakaya town of Erbaa district of Tokat province. In a study on different planting densities in Adıyaman province, the highest yield was obtained from 110x38 cm planting norm with 500.9 kg ha^{-1}and the lowest yield was obtained from 80x35 cm with 336 kg/ha^{-1} (Vural and Ekren, 2021). It is seen that the yield values we obtained in our study are compatible with the findings of the researchers mentioned above.

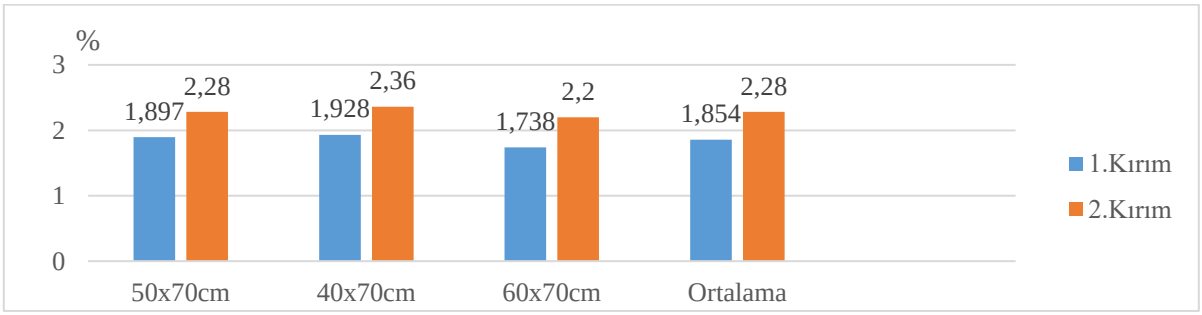


LSD (%1): 18.321*

Figure 6. Effect of different planting densities on yield (kg/ha^{-1})

3.5.Total alkaloid (nicotine) content

The harvests obtained in our research were combined in two hand groups and chemical analyzes were evaluated in this way. In the 1st harvest, nicotine content was 1.738-1.928%; in the 2nd harvest it was 2.20-2.36%. In both harvests, the lowest nicotine content was obtained from 60x70 cm and the highest was obtained from 40x70 cm planting density (Figure 7). Nicotine accumulation in virginia tobacco starts after planting and continues at an increasing rate until the leaves mature. It is especially higher after the top break stage than before the top break stage (Mumba and Banda, 1990; Hu et al., 1999, 2000; Cao et al., 1989; JU Xiao-Tang, 2004). As the planting distance increases, the proportion of nitrogenous compounds in the plant and therefore nicotine amounts increase. In dense plantings, it is known that nicotine ratio decreases as a result of decreased competition between plants for nitrogen (Bilalis, 2015). In a study conducted with different row spacing and nitrogen doses, the lowest nicotine content was found in the control treatment at 40 cm row spacing with 1.21% and the highest was found in the 80 kg N/ha treatment at 55 cm row spacing with 1.85% (Menteşe et al., 2019). Usturalı (1995) found that the average nicotine content in Virginia tobaccos grown in Düzce region was 1.79% and the nicotine content in Virginia tobaccos grown in Adıyaman varied between 0.79-2.36% (Vural and Ekren, 2024). Some researchers found that the amount of nicotine in virginia tobacco varied between 1.5-3.5% (Collins and Hawks, 1993; Keskiner, 1993; Ekren, 2000). It is seen that the results we obtained are compatible with the literature findings.



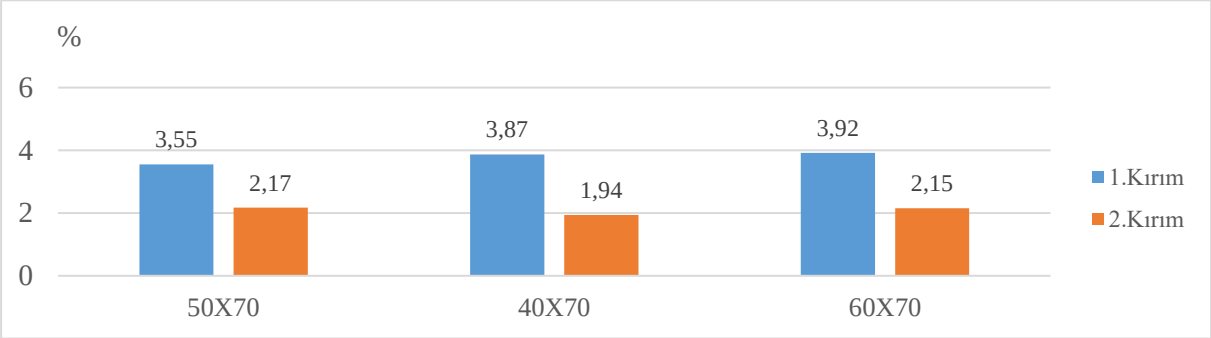
LSD (%1): 0.218*

Figure 7. Effect of different planting densities on total alkaloid (nicotine) content (%)

3.6.Total reducing sugar

As in the total alkaloid content, the harvests were combined in two hand groups in total reducing sugar content and the chemical analyses were evaluated in this way. The highest content was obtained from 40x70 cm planting norms with 3.87% in the first harvest and from 50x70 cm planting

norms with 2.17% in the second harvest (Figure 8). Soluble carbohydrates have a positive effect on tobacco quality in virginia tobacco (Akehurst, 1981) and it was reported that tobacco quality is good when the reducing sugars are between 12-25% (Collins and Hawks, 1993), whereas the amount of sugars decreases as it goes towards poor quality (Aksu, 1967; Sekin, 1979). It was also found that the soil structure of the region had a significant effect on sugar content (Tuncay et al., 1985). As the planting density decreased, the amount of reducing sugars increased (Elliot, 1976). In studies on different planting densities, it was observed that the highest sugar content was in the middle hand group with 7.56%, followed by the lower hand group with 6.64% and the upper hand group with 4.57% (Vural and Ekren, 2021). The sugar amounts obtained in our study were lower than the rates mentioned above. It can be said that the main factor that makes the difference here may be due to the drying method, as the variety, cultural processes, climate and soil characteristics of the region affect the amount of sugar. Because virginia tobacco is dried in ovens under controlled temperature and humidity conditions with flue-curing drying method. Starch turns into sugars without being completely broken down. When we dry the same tobacco with the sun curing drying method, since the drying time is longer than the flue-curing method, the starch breaks down and turns into sugar.



LSD (%1): 1.150*

Figure 8. Effect of different planting densities on total reducing sugar content (%)

4. Conclusion and Recommendations

✓ As a result of the data obtained from our research, it is seen that Manisa province, which is an important production center in Turkish tobacco cultivation, is a promising production region for sun-cured virginia tobacco cultivation.

✓ It was concluded that the results obtained in terms of yield and yield components were at acceptable values for sun-cured virginia tobacco.

✓ It was determined that the data obtained in terms of the analyzed chemical properties are values that can be used in cigarette blends.

✓ The obtained data lead to the belief that it would be useful to test sun-cured virginia tobacco in other tobacco production centers of the Aegean Region and interpret the results.

Declaration of Author Contributions

The authors declare that they have contributed equally to the article. All authors declare that they have seen/read and approved the final version of the article ready for publication.

Declaration of Conflicts of Interest

All authors declare that there is no conflict of interest related to this article.

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