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Determining the Planting Time for Burley Tobacco in Samsun Ecological Conditions

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Keywords

Air cured
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Quality
Yield

ABSTRACT

The aim of the present study was to provide reference to the planting time of Burley type tobacco, introduced to Samsun tobacco growing areas in Turkey after the legislative change. For this purpose, yield, quality, income, reducing sugar, nicotine and ammonia properties were examined in plants grown at four different planting times. TN90 variety, which is widely used in the region, was used as plant material. Planting was performed at a density of 40 ×100 cm, on April 15th (DT-1), April 25th (DT-2), May 5th (DT-3) and May 15th (DT-4) in the randomized complete blocks. The average values for yield, quality, income, reducing sugar, nicotine and ammonia were 4,160 kg ha-1, 58.6%, 11,023 $ ha-1, 1.09%, 3.30% and 0.256%, respectively. For all of the parameters examined, decreases were observed in late plantings. For all parameters except ammonia, the ranking was as DT-4<DT-3<DT-2<DT-1, while for ammonia it was as DT-4<DT-3<DT-1<DT-2. In burley tobacco production, which has no established production timing yet, the advantages of early planting in the region were obvious. Earlier plantings as long as the weather conditions allow will be an important opportunity to avoid possible losses and wastes.

1. Introduction

Planting time and fertilizer management, which affect the biophysical and chemical properties of tobacco plant, are direct sources of yield and quality differences [1, 2]. Tobacco can adapt to a wide variety of conditions but is highly sensitive to the environment. Grown in many tropical and subtropical regions of the world today, tobacco is an herbaceous plant from the Solanaceae family, with annual or perennial species [3]. The ecological basis for the development of high-quality tobacco leaves is the natural environment [4]. Tobacco also has an extraordinary ability to make up for early season losses. Tobacco can compensate for almost all of the 10-15% loss in the early season. A tobacco field with a 50% stand can achieve 80% of the performance of a field with a full stand [5].

Tobacco (Nicotiana tabacum L.) is an important industrial crop worldwide with its various types classified according to morphological traits, chemical content and intended use. The main types of tobacco include Virginia (flue-cured), Burley (air-cured), and Oriental (sun-cured). Each type differs in the environmental conditions in which it is grown, the method of curing, and its chemical composition [6]. Virginia type tobacco, for example, is known for its high sugar content and bright yellow color and is dried in ovens, while Burley's type is bright brown in color, low in sugar, high in nicotine, and is usually dried outdoors in the shade [7]. Both are high-yielding types of tobacco. Oriental tobaccos, on the other hand, are small-leaved, aromatic and low nicotine tobaccos, which stand out especially with their aroma. These tobaccos are generally low-yielding, which are grown under rainfed conditions [8]. In recent years, turning of producers' in Turkey to more profitable crops and legal restrictions have increased the interest in different types of tobacco instead of oriental tobacco.

After the amendment made in the legislation regulating tobacco production, it became mandatory to produce at least 30% of the tobacco used by tobacco manufacturers in their

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products aiming the domestic market in Turkey. This regulation was made with the amendment of Article 6 of the Law No. 4733 with the Law No. 7255 adopted on 28.10.2020 [9]. This situation has brought up the issue of increasing the current production amount and introduction of new tobacco types to the production areas. Instead of oriental tobacco, which has a higher cost than other types, the tendency towards tobacco types with higher yields and therefore higher return and low cost has increased. Therefore, Burley type tobacco production has gained importance and it has become necessary to determine the advantages in production methodologies.

In Samsun, where intensive oriental tobacco production has been carried out for a long time, Burley type tobacco production has come to the fore due to its suitability to the ecological conditions. Production of Burley tobacco in the region continues to increase every year. In any new ecology, the first step in the production process of a new type/variety is to determine the correct planting time, which is a critical procedure. For this purpose, the aim of the present study was to determine the correct planting time for better adaptation of Burley type tobacco, whose acreage has been increasing in Samsun ecology in line with the changing legislative producer demands.

2. Material and Method

2.1 Plant material

As plant material in the study, Nicotiana tabacum L., TN90, an air-cured burley-type tobacco variety introduced in 1990, was used. TN90 is a variety that has become popular due to its good resistance to blue mold, root and stem rot and common viral diseases. TN90 has a moderately high yield (333.4 kg da-1), medium-maturing, small stalk diameter, upright growth (ease of handling), and good cured-leaf color [10].

2.2 Experimental procedures

The research was carried out in 2023 in Samsun province, at 41º34'13"N, 35º51'53"E coordinates and at an altitude of 21 meters, under farmer conditions. The climatic characteristics of the vegetation period are given in Fig.1. Compared to long-term averages, rainfall in 2023 decreased by 57% while the mean monthly temperature increased by 12% during the vegetation periods. Soil characteristics of the experimental land with sandy-loamy soil structure are given in Table 1.

Table 1. Soil characteristics of the experimental land

Characteristics	Results	
pH	7.82	Slightly alkaline
EC	765 dS cm^{-1}	Normal
$CaCO_3$	9.3%	Limed
Organic matter	1.45%	Low
P_2O_5	0.32 t ha^{-1}	Excessive
K_2O	1.098 t ha^{-1}	Low
Mg	472 mg kg^{-1}	Excessive
Fe	6.27 mg kg^{-1}	Excessive
Cu	1.76 mg kg^{-1}	Sufficient
Zn	1.26 mg kg^{-1}	Sufficient
Mn	8.01 mg kg^{-1}	Low
B	0.18 mg kg^{-1}	Low

Seedlings were grown in a float system. The seedlings, which became mature, were transplanted at a density of 40×100 cm into plots consisting of four rows of 4 m long. N, P and K was applied at the rates of 120, 90 and 160 kg ha-1, respectively, before the transplanting. A 30 kg ha-1 N application was performed after the first hoe. During the vegetation periods, maintenance operations such as hoeing, bottom stripping, listering and disease and pest control were carried out.

Plantings were carried out on April 15th, 2023 (DT-1), April 25th, 2023 (DT-2), May 5th, 2023 (DT-3) and May 15th, 2023 (DT-4). At the beginning of flowering, topping was carried out manually at a depth of 22 leaves. Harvesting was done as a one-time harvest of stems during the delayed period in the lower hands, full maturity in the main hands and early maturity in the upper leaves, and left in the field for wilting for a day. Then, the drying of the plants taken to the drying area under air cured conditions was completed. The dried leaf tobacco was separated from the stems and weighed. Yield (YLD) was calculated on the fixed 15% moisture level. Organoleptic observations (quality grade index, QGI) were made by tobacco experts according to the American Grading method. Gross revenue (GRI) generated by yield×price calculation is determined on the basis of a price of $2.64 kg-1. Samples were taken from the weighed tobacco for chemical content analysis, which were then ground at zero moisture. Nicotine [11] and reducing sugar contents [12] of the samples were determined according to the continuous flow analysis method while ammonia ratios [13] were determined according to the ion chromatographic method in the analysis laboratory of OZ-EGE Tobacco Industry and Trade Inc.

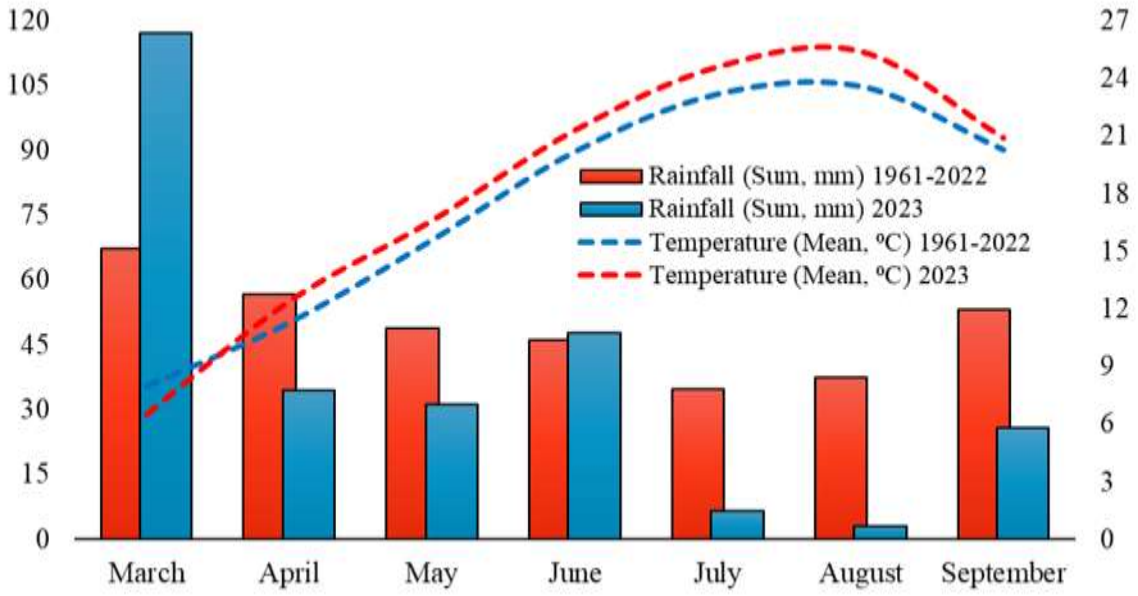

Figure 1. Meteorological data for experimental year and long-term averages

In the study, which was carried out in randomized complete block design with three replications, arcsin transformation was applied to the quality grade index data. The data were subjected to analysis of variance (ANOVA) with JMP 13.0 software and the differences between the means were grouped using the LSD multiple comparison test [8].

3. Results and Discussion

Differences in planting date in the ecological conditions of the Central Black Sea Region significantly affected burley tobacco yield, quality, income and chemical structure ($p<0.01$) (Table 2). The average leaf yield was 4,160 kg ha-1. The highest leaf yield was obtained as 4,918 kg ha-1 from DT-1 (which was April 15th) which statistically constituted the first group. In terms of yield, the ranking was as DT-4<DT-3<DT-2<DT-1. Yield loss following the delay of the planting schedule was found to be 10.6% in DT-2, 22.0% in DT-3 and 49.3% in DT-4 compared to DT-1 (Table 2, Fig. 2).

For the QGI value with an experimental average of 58.6%, the first two planting dates and the last two planting dates formed different groups, and the delaying planting date caused a decline in quality (DT-4<DT-3<DT-2<DT-1). The decrease was 5.1% for DT-2, 44.9% for DT-3 and 92.8% for DT-4 compared to DT-1, which had the highest QGI value.

In terms of the GRI value calculated by yield and QGI, the average was 11,023 $ ha-1, and the ranking did not change. The highest value was obtained in DT-1 and the lowest in DT-4. The decrease in income was 10.6% in DT-2, 22.0% in DT-3 and 49.3% in DT-4 compared to DT-1 (Table 2, Figs. 2 and 3).

Table 2. The ANOVA table for the significance of day of transplanting randomized complete blocks for burley tobacco characteristics.

		Yield (kg ha^{-1})		Quality grade index (%)		Gross Income ($ ha^{-1})		Reducing sugars (%)		Nicotine (%)		Ammonia (%)	
DT-1 (April 15th)		4918	a	74.2	a	13034	a	1.49	a	3.70	a	0.244	b
DT-2 (April 25th)		4396	ab	70.4	a	11649	ab	1.55	a	3.98	a	0.343	a
DT-3 (May 5th)		4030	b	51.2	b	10680	b	0.74	b	3.18	b	0.221	b
DT-4 (May 15th)		3295	c	38.5	b	8732	c	0.62	c	2.35	c	0.217	b
	DF	Mean Square and Significance											
Block	2	195953	ns	152.92	ns	1378111	ns	0.014	*	0.1476	ns	0.0008	ns
DT	3	1396223	**	841.86	**	9801867	**	0.709	**	1.5329	**	0.0311	**
Error	6	80096		66094		561547		0.002		0.0349		0.0002	
CV%		6.8		13.9		6.8		4.3		5.7		5.4	
$LSD_{0.05}$		565		16.24		1497		0.094		0.373		0.027	

(**), (*), ns: significant at 1%, 5%, and non-significant, respectively, DF: Degree freedom, DT: Date of transplanting,

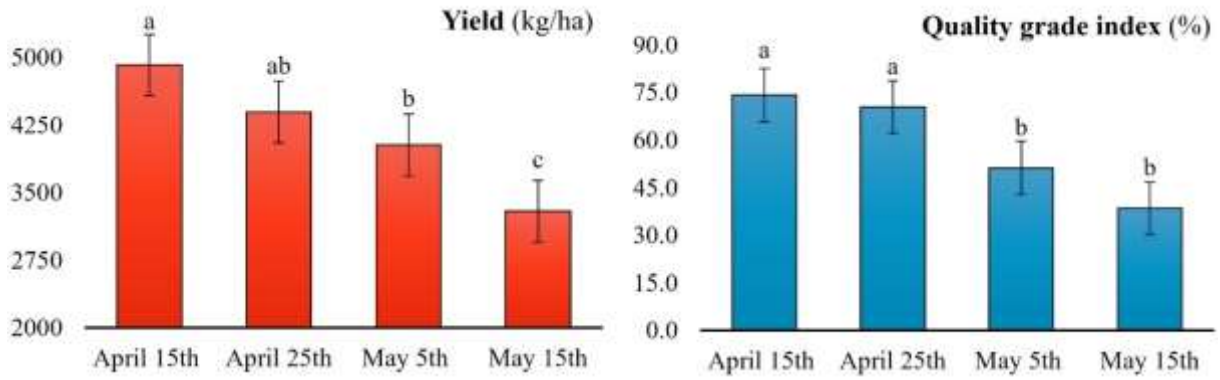

Figure 2. Effect of transplanting date on tobacco yield and quality grade index

Although it varied proportionally, chemical content of the leaves can be stated to be negatively affected by the delayed planting. Compared to DT-1, RES values (mean=1.09%) were similar in DT-2, while there were significant decreases of 101.9% in DT-3 and 137.9% in DT-4. The most striking effect of the change in planting dates was observed in the amount of RES. NIC was another parameter negatively affected by delayed planting, especially in DT-3 and DT-4 with decreases of 16.4% and 57.5% compared to DT-1, respectively. While AMM values also decreased with delayed planting, unlike the others, they reached their highest value at the second planting, with a 40.5% increase in DT-2 compared to DT-1. The decreases in ammonia values at DT-3 and DT-4 were 55.1% and 57.9% compared to DT-2, respectively. The mean ammonia value was 0.256% (Table 2, Figs. 3 and 4).

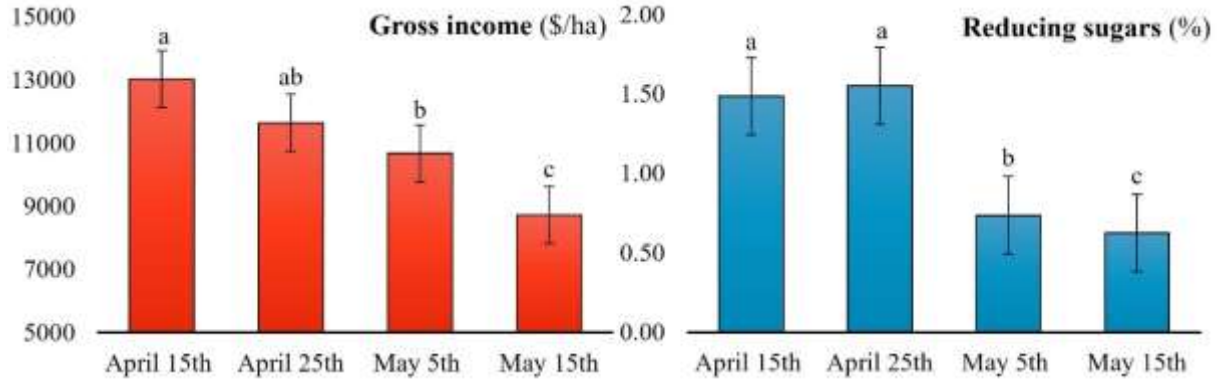

Figure 3. Effect of transplanting date on tobacco gross income and reducing sugars

Prolonged vegetation period increases tobacco yields as in all other plants [14]. Due to more intense stress conditions in delayed planting conditions, plants may not be able to meet their requirements. Harsher stress conditions push tobacco to protect itself with its defense mechanism, which causes yield losses [15]. The advantage of early planting was mentioned in basma type tobacco [14]. For the aforementioned reasons, a similar situation was experienced in all parameters examined in the study, and especially the reducing sugar ratios decreased significantly in parallel with the delay (Fig. 3). The advantages obtained in earlier planting conditions were obvious. These results suggested that the nutrients given before planting are better utilized.

Delay in planting date results in low yields due to rapid growth and flowering and production of thinner leaves in older plants [16]. Better results were achieved in early planting due to higher survival rate of seedlings, improved agronomic properties, leaf appearance quality, suitability of chemical composition of leaf and economic indices of leaves [17]. Similarly, Su et al. [18] reported that yield, income, grade A tobacco ratio, reducing sugar, sugar/nicotine ratio, aroma level and quality and total sensory quality score first increased and then decreased as the transition from early to late planting as a result of the effects of ecological variables. In the study conducted on Virginia type tobaccos, it was reported that a maximum of two weeks could be delayed after the normal planting time and significant yield losses would be experienced in plantings delayed by four and five weeks [5]. Nine different planting and harvesting time combinations were tried in Virginia tobaccos [19]. As very similar to our findings, the highest performance in all examined parameters was obtained in plantings realized 14 day earlier.

Wilkinson et al. [5] reported that the yield loss was 8% per week on average as of the third week after the normal planting date, and in a location where the growing season is quite short, the

yield loss increased from 8% to 36% in the planting that was delayed by four weeks. It was also mentioned that yield loss was exacerbated due to increased insect damage in delayed planting [16]. In FCV type tobaccos, better drying quality was obtained in early planting, while undesired browning increased in delayed planting conditions [20]. Thus, realizing the plantings of burley type tobaccos as earlier as the climate conditions allow and planning the seedling cultivation timing accordingly could be important strategies for successful production.

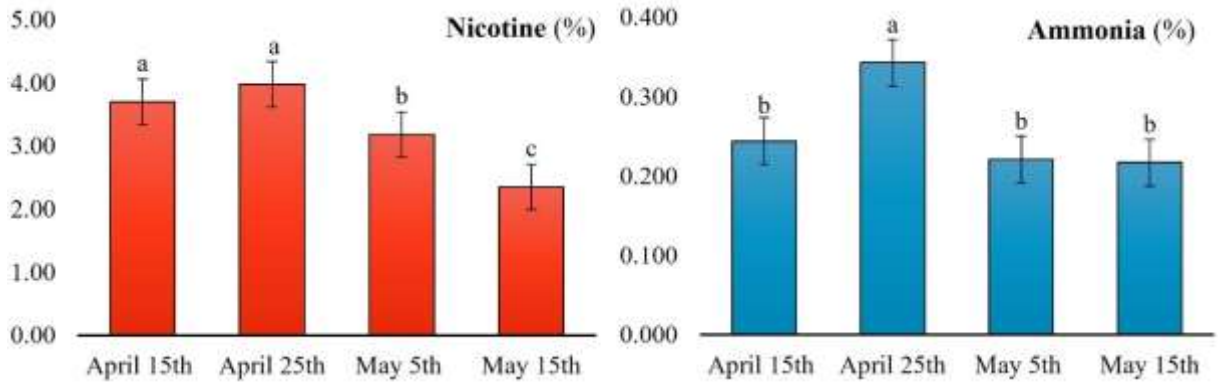

Figure 4. Effect of transplanting date on tobacco nicotine and ammonia

4. Conclusion

After the changing legislation, tobacco types with higher leaf yields and lower production cost are becoming widespread in different areas of Turkey with the expectation that it could reduce the raw material cost. Burley tobacco type is being popular in Samsun region. This study aimed to evaluate the changes that would occur in tobacco parameters as a result of the planting time changes in Burley type tobaccos and to determine of the appropriate planting time. In the ecological conditions where the study was carried out, realizing earlier planting was found to prevent yield, quality and income losses. The advantage of early planting was clear. In delayed planting conditions forced by weather conditions, planting should be carried out as early as possible.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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