

Effects of Different Plant Density and Cutting Times on Yield of *Stevia* under the Çukurova Conditions

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Abstract: *Stevia* (*Stevia rebaudiana* Bertoni) is perennial shrub form plant belonging to Asteraceae. It is indigenous to Paraguay and Brazil. *Stevia* is a natural sweetening and it has using potential to diets of obesity patients with non-caloric specialty and treatment of diabetes with insulin secretagogue specialty. In this study, the effects of different planting spaces and two cutting times on yields of two-year old *Stevia* plant were investigated. The highest dry leaf yield (515.96 kg/da) was obtained from blooming stage, cuttings in spring and 30x60 cm planting density.

Keywords: *Stevia rebaudiana*, planting space, cutting times.

1. INTRODUCTION

Stevia rebaudiana (Bert.) Bertoni is a herbaceous perennial native to the high lands of Paraguay [1]. Four major glycosides such as stevioside A, rebaudioside A, rebaudioside C and dulcoside were the most important ones among eight glycosidic diterpenes found as sweetness in the leaves of wild *Stevia* [2]. *Stevia* is use wich as a wild commercial sweetener. It is also called as the sweet herb for these substances are 300 times sweeter than sucrose, used as calorie-free sweeteners [6, 8]. Therefore, it has been used for the therapy such as diabetes, obesity and various diseases. Adaptation experiment of *Stevia rebaudiana* was started in recent years, although it was not found as wild plant in Turkey. The yield and quality of *Stevia* leaf were significantly affected by plant density and cutting time [4]. Also, growing and flowering of *Stevia* were affected day length, temperature, soil moisture and wind [6]. Therefore, in this research, the effect on yield of *Stevia rebaudiana* was studied different plant density and cutting time under the Çukurova conditions.

2. MATERIAL and METHODS

Seed material of stevia (*Stevia rebaudiana*) was provided from Paraguay. This study has been performed at the experimental area of Field Crops Department, Çukurova University Agriculture Faculty in 2013. Field trials were organized in the Complete Split-Plot Design with three replications. Effects of three different plant densities as mainplots (30×60, 45×60 and

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60×60 cm, intra plant and row spacings) and ontogenetic variability as split-plot (such as pre and flowering stages) on yield and quality characteristics were investigated. Each plot has 7 rows, and each middle two rows were harvested at pre and flowering stages in May 12nd and July 8th, 2014, respectively, the remaining edge rows were untouched to remove the side effects. Young seedlings were transplanted into field on April, 29th, 2013. Because the new plants have not grown sufficiently. The first year was adopted as the establishment period, so, data were excluded. The following year, new shots from the 1 year-old plants carefully managed and cuttings were performed and, necessary data were collected. Statistical analyses were performed by using MSTAT-C Statistical software [7].

3. RESULTS and DISCUSSIONS

While plant heights were significantly affected by both plant densities and cutting times number of stem values were significantly affected by plant densities. The highest plant values (61.20 cm) and number of stems (31.47 number plant⁻¹) were obtained from the plant density with 30x60 spacing. Our findings were similar to [3] indicating narrow plant spacing's increased the both plant height (71.11 cm) and drug yields (Table 1). Considering the cutting times, the highest plant height was on cutting during the flowering. There were no significant differences among the number of stem depending on the cutting times

Table 1. The value of plant height and number of branches for plant density and cutting time under the Çukurova conditions.

Cutting times	Plant height (cm)				Number of branches (numberplant ⁻¹)			
	Plant density			Mean	Plant density			Mean
30x60	45x60	60x60	30x60		45x60	60x60		
Pre-flowering	45.74	40.98	36.82	41.20b	29.83	26.75	20.83	25.81
Full-flowering	78.09	70.45	64.80	71.11 a	33.10	23.57	18.77	25.14
Mean	61.20 a	55.7 ab	50.80b		31.47 a	25.16 ab	19.80 b	
LSD(%5)	LSD _{pd} 7.52			LSD _{ct} 5.44	LSD _{pd} 8.39			

In *Stevia* plants, according to the statistical analyses, main effects of plant densities and cutting times, and plant densities x cutting times interactions for fresh and dry herb, leaf yields were significant. The highest fresh herb yield (3002.48 kg da⁻¹) and dry herb yield (1028.76 kg da⁻¹) were obtained from the plant density with 30x60 cm spacing at the harvest during the flowering (Table 2). The highest fresh leaf yield (1623.96 kg da⁻¹) and dry leaf yield (515.96 kg da⁻¹) were obtained from the plant density with 30x60 cm spacing's at the spring harvest during the flowering (Table 3).

Table 2. The Yields of Fresh Herb and Dry Herb of *Stevia rebaudiana* for plant density and cutting time under the Çukurova conditions.

Cutting times	Fresh herb yield (kg da ⁻¹)				Dry herb yield (kg da ⁻¹)			
	Plant density				Plant density			
	30x60	5x60	60x60	Mean	30x60	45x60	60x60	Mean
Pre-flowering	1316.89 c	656.77 e	373.94 e	782.54b	273.07 c	128.51 d	81.87 d	161.15 b
Full-flowering	3002.48 a	1658.96 b	1003.9 d	1888.45 a	1028.76 a	543.39 b	343.63 c	638.59 a
Mean	2159.69a	1157.87 b	688.92 c		650.92 a	335.95 b	212.75 b	
LSD (%5)	LSD _{pd} 367.91 LSD _{ct} 167.87 LSD _{pdxcct} 290.77				LSD _{pd} 140.013 LSD _{ct} 81.147 LSD _{pdxcct} 140.55			

Table 3. The Yields of Fresh Leaf and Dried Leaf of *Stevia rebaudiana* for plant density and cutting time under the Çukurova conditions.

Cutting times	Fresh leaf yield (kg da ⁻¹)				Dry leaf yield (kg da ⁻¹)			
	Plant density				Plant density			
	30x60	45x60	60x60	Mean	30x60	45x60	60x60	Mean
Pre-flowering	829.05 b	366.24 cd	250.35 d	481.88 b	184.65 c	84.17 d	56.47 d	108.43 b
Full-flowering	1623.96 a	938.43 b	562.07 c	1041.49 a	515.96 a	297.56 b	190.69 c	334.74 a
Mean	1226.51 a	652.34 c	812.42 b		350.31 a	190.87 b	123.58 c	
LSD (%5)	LSD _{pd} 148.91 LSD _{ct} 114.38 LSD _{pdxcct} 198.12				LSD _{pd} 56.087 LSD _{ct} 35.94 LSD _{pdxcct} 62.25			

4. CONCLUSION

Because the plants showed best performance in the second year due to good adaptation to environmental condition the better yields were obtained at the plots with narrow plants spacing in the both harvests done in spring and summer season. Leaf yield were higher during flowering. As the plant continue to grow from vegetative to generative stage. According to the result obtained from the research, it has been indicated that stevia plants can be successfully grown. Also, there were morphological difference among the seedling from seeds directly. Further research is need to select the best seedlings and to determine the yield and quality characteristics.

Conflict of Interests

Authors declare that there is no conflict of interests.

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