DETERMINATION OF YIELD AND KERNEL PERCENTAGE IN SOME HAZELNUT CULTIVARS (*CORYLUS AVELLANA* L.)

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Abstract

This study aims to evaluate the effect of nut weight on kernel percentage and yield of three hazelnut varieties (*Corylus avellana* L.), namely *Tonda Gentile Romana, Ennis*, and *Halski Dzik*. The data were analyzed using descriptive statistics, correlation analysis, and linear regression in the SPSS program.
The results show that there is a strong positive relationship between nut weight and yield ($r = 0.876$), suggesting that increasing nut size significantly contributes to increasing production per hectare. Meanwhile, the relationship between nut weight and kernel percentage is weak ($r = 0.253$), indicating that kernel percentage is influenced by other structural and genetic factors of the varieties. Linear regression analysis confirms these trends; however, the results are not statistically significant ($p > 0.05$), mainly due to the limited number of samples. In conclusion, nut weight is an important indicator for yield, while improving kernel percentage requires a more detailed analysis of other factors. Further studies with a larger number of samples are recommended to increase the reliability and generalization of the results.

Keywords: hazelnut, varieties, nut weight, kernel percentage, yield, Corylus avellana.

Introduction

Hazelnut is a Mediterranean crop and a distinctly heliophilous plant. It is a fruit tree from the group of nut-bearing species and is very unusual because, unlike other trees that bloom in spring, it blooms in winter, from December to March. Its root grows and develops very superficially, in a layer of about 30 cm. The lifespan of a hazelnut tree is from 70 to 100 years, and it bears fruit from 50 to 70 years. It begins to bear fruit in the third or fourth year, while full fruiting is achieved in the seventh or eighth year, depending on the cultivar and cultivation conditions. In full production, one tree yields from 8 to 12 kg of production, of which about 50% is shell. Depending on the cultivation form, planting density, age, and other agrotechnical measures, yields vary from 2.5 to 3.6 t/ha.
The global annual production of hazelnuts in shell averages over 800,000 tons (Fideghelli and De Salvador, 2009). This production is mainly achieved by four countries: Turkey, about 563,000 tons (68%), Italy, about 120,244 tons (15%), far behind them are the USA (mainly Oregon) with 31,631 tons, and Spain with 29,709 tons. Hazelnut kernels are a source of a large number of very useful compounds, such as fats 55–72%, proteins 12–22%, carbohydrates 14%, sugar 2–10%, minerals 1.8–3%, vitamin E (24–40.40 mg/100 g), β-sitosterol (134.05 mg/100 g), cellulose 2.42%, water 5.8%. Numerous phenolic compounds have been identified in hazelnuts: gallic, caffeic, p-coumaric, ferulic, and sinapic acid, myricetin 3-rhamnoside, quercetin 3-glucoside, quercetin 3-rhamnoside, and kaempferol 3-rhamnoside. The shell and leaves are a source of catechin tannin.

Research Objective

This research aimed to investigate the participation of the kernel in the nut weight in some hazelnut cultivars with different nut weights, as well as the yield per hectare depending on nut size, and to recommend for wider cultivation the cultivar with a higher kernel percentage and higher yield adapted to the climatic and soil conditions of the Pollog Region, North Macedonia.

Materials and Methods

As material, a total of 150 hazelnuts (50 nuts for each variant) with different sizes were used, where from each variant, 10 nuts were measured in five replications. The experimental material was taken after harvest in the localities of Kamjan and Sellarcë e Epërme-Bogovinë. The average fruit weight, kernel percentage, and yield were compared for the three cultivars.

Results

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
%	3	43.96	46.72	45.3433	1.38001
t\ha	3	2590.00	3110.00	2813.3333	267.64404
G	3	3.01	4.51	3.8767	.77675
Valid N (listwise)	3				

The descriptive results show that kernel percentage (%) varies from 43.96% to 46.72%, with a mean of 45.34% and a standard deviation of 1.38, indicating relatively low variability among the varieties. Yield (t/ha) shows values from 2590 to 3110 t/ha, with a mean of 2813.33 t/ha and a standard deviation of 267.64, indicating more pronounced differences among the varieties.

Nut weight (g) varies from 3.01 g to 4.51 g, with a mean of 3.88 g and a standard deviation of 0.78, reflecting noticeable differences in nut size among the varieties.

Correlations

		g	%	t\ha
G	Pearson Correlation	1	.253	.876
	Sig. (2-tailed)		.837	.320
	N	3	3	3
%	Pearson Correlation	.253	1	.688
	Sig. (2-tailed)	.837		.517
	N	3	3	3
t\ha	Pearson Correlation	.876	.688	1
	Sig. (2-tailed)	.320	.517	
	N	3	3	3

Pearson correlation analysis shows a positive relationship between nut weight and yield (r = 0.876), suggesting that an increase in weight is associated with an increase in production.
Meanwhile, the relationship between weight and kernel percentage is weak (r = 0.253), indicating that weight does not have a strong effect on kernel percentage.
Also, kernel percentage and yield have a moderate positive relationship (r = 0.688).
However, due to the limited number of samples (n = 3), these results are not statistically significant (p > 0.05) and should be interpreted only as indicative.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	43.598	6.751		6.458	.098
	g	.450	1.719	.253	.262	.837

a. Dependent Variable: %

Linear regression analysis between nut weight and kernel percentage shows a weak positive relationship (β = 0.253). The regression coefficient (B = 0.450) indicates that an increase of 1 g in nut weight is associated with an increase of 0.45% in kernel percentage. However, the model is not statistically significant (p = 0.837), indicating that weight is not a dominant factor in determining kernel percentage in this dataset.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1642.837	652.192		2.519	.241
	g	301.934	166.028	.876	1.819	.320

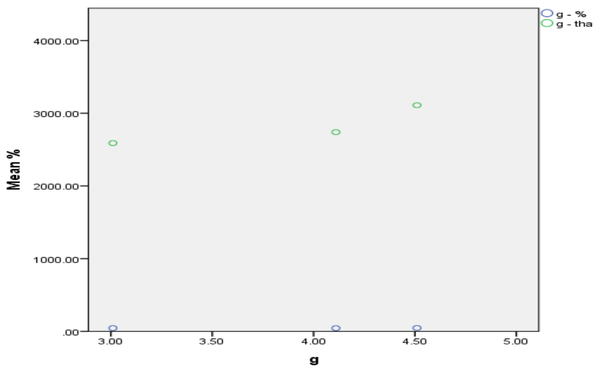
a. Dependent Variable: t\ha

Linear regression between nut weight and yield shows a strong positive relationship (β = 0.876). The coefficient (B = 301.934) indicates that each increase of 1 g in nut weight is associated with an increase of about 302 t/ha in yield. However, this model is also not statistically significant (p = 0.320), due to the small number of data points.

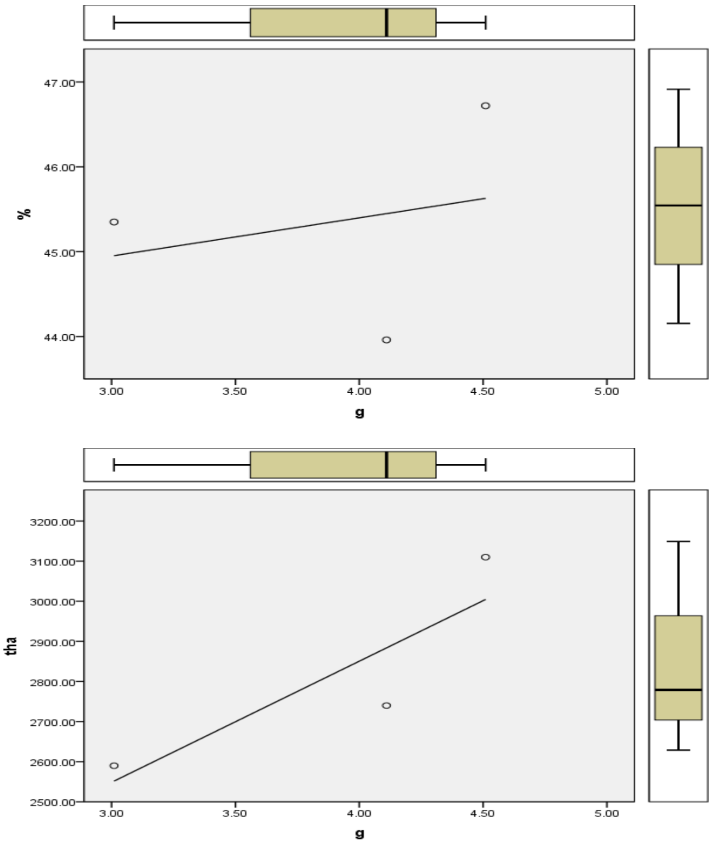
Discussion (very important)

The results show that nut weight has a more pronounced effect on yield than on kernel percentage. Varieties with larger nuts tend to produce higher yields per hectare, which is consistent with the principles of crop production.
On the other hand, kernel percentage is not significantly affected by weight, suggesting that other factors, such as nut structure or composition, may play a more important role.

However, due to the very limited number of data (n = 3), the results should be considered indicative and require verification with larger samples in order to draw statistically reliable conclusions.



"The scatter plot graph visually confirms the positive relationship between nut weight and yield, while for kernel percentage, this relationship appears weaker."



"The scatter plot graph visually confirms the positive relationship between nut weight and yield, while for kernel percentage, this relationship appears weaker."

Discussion of Results

The results of this study show that there are differences among hazelnut varieties in terms of nut weight, kernel percentage, and yield. Descriptive analysis highlights relatively low variability for kernel percentage, while yield and nut weight show more pronounced differences among the varieties. Pearson correlation shows that nut weight has a strong positive relationship with yield ($r = 0.876$), suggesting that increasing nut size directly influences the increase in production per hectare. This result is logical from an agronomic perspective, as larger nuts contribute more to the total production mass.

On the other hand, the relationship between nut weight and kernel percentage is weak ($r = 0.253$), indicating that kernel percentage does not depend directly on weight, but may be influenced by other factors such as the internal composition of the nut, the kernel/shell ratio, and the genetic characteristics of the varieties. Linear regression results reinforce these findings. Nut weight has a more pronounced effect on yield ($\beta = 0.876$) than on kernel percentage ($\beta = 0.253$). However, the lack of statistical significance ($p > 0.05$) for both models indicates that these relationships cannot be considered statistically confirmed, but only as trends.

An important factor influencing these results is the limited number of data ($n = 3$), which reduces the statistical power of the analysis and limits the possibility of drawing generalized conclusions.

In general, the results suggest that the selection of varieties with larger nuts may be an appropriate strategy for increasing yield, while improving kernel percentage requires analysis of other factors beyond nut weight.

Conclusions

[1] The analyzed varieties show differences in nut weight, kernel percentage, and yield.
[2] Nut weight has a strong positive effect on yield, appearing as an important factor for increasing production.
[3] The effect of weight on kernel percentage is weak, suggesting that kernel percentage is determined by other structural and genetic factors.
[4] Statistical analyses show clear trends, but they are not statistically significant due to the small number of samples ($n = 3$).
[5] The results provide valuable indications for the selection of hazelnut varieties in agricultural practice.

Recommendations

[1.] Further studies should be conducted with a larger number of samples to increase the statistical reliability of the results.
[2.] Other factors affecting kernel percentage, such as nut structure and kernel/shell ratio, should be taken into consideration.
[3.] In agricultural practice, the selection of varieties with larger nut weight is recommended to increase yield per hectare.
[4.] More advanced analyses should be used in the future (ANOVA, more extended models) with individual data for each nut.

[5.] Statistical analyses should be combined with agrotechnical factors (irrigation, soil, fertilization) for a more comprehensive evaluation of production.

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