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CORRELATION AND PATH-ANALYSIS OF MORPHOLOGICAL TRAITS AND YIELD OF DRY TOBACCO IN COMPLEX RESISTANT TO VIRAL DISEASES VIRGINIA TOBACCO LINES

Neli KERANOVA[1], MARINA DRUMEVA-YONCHEVA[2], Yonko YONCHEV[2], Bistra MIHAILOVA[3]

[1] Agricultural University-Plovdiv, 12 Mendeleev Blvd., 4000, Plovdiv, Bulgaria
[2]Tabacco and Tabbaco Products Institute-Plovdiv, 4108 Markovo, Bulgaria
[3]Bulgarian Academy of Sciences, Institute of Plant Physiology and Genetics, 21 Academic Georgi Bonchev Street, 1113, Sofia, Bulgaria

Corresponding author email: nelikeranova@abv.bg

Abstract

*The aim of the study is to evaluate the impact of morphological traits on the yield of Virginia tobacco lines with consolidated complex resistance to economically important viral diseases, Tobacco mosaic virus and Potato virus Y. The effect of the change in the height of the plant, the number of leaves, the sizes of the sixth and twelfth leaves on the yield is studied. Correlation analysis, regression analysis and Path analysis were applied. The direct and indirect influence of the studied traits on the yields is determined. The calculated correlation coefficients show a very strong, positive correlation between the yield and the length of the sixth leaf (0.985 **), the width of the sixth leaf (0.949 **), the number of leaves (0.934 **), the length (0.970 **) and the width of the twelfth leaf (0.966 **). In L 5, the length of the sixth leaf and the width of the twelfth leaf have a very strong direct effect on the yield. In L 6.3.3, the number of leaves and the length of the sixth leaf have the highest direct effect on the yield.*

Key words*: tobacco, Virginia, stable lines, yield, correlations, regression analysis.*

INTRODUCTION

Tobacco is an industrial plant of great economic importance (Maleki et al., 2011) and is the main livelihood for part of the population of a significant number of countries in the world with diverse climates and soils (Dimanov, 2014; Bozukov, 2014). In the selection of this crop the creation of high-yielding and quality varieties resistant to biotic and abiotic stress is of particular importance. Studies of the relation between yield and other agronomic traits are essential for understanding the direction of expected changes during the selection process (Josm, 2005). Correlations can be used as criteria for selection effect by phenotype (Popova et al., 2013). The application of correlation and regression analyzes in tobacco studying is becoming more widespread in scientific research (Wang et al., 1997; Dospataliev et al., 2014; Ahmed and Mohammad, 2017; Georgieva and Kirkova, 2018). After correlation and Path analysis, a strong positive correlation was found between the number of leaves and the length of the largest leaves with the yield of the plant Wenping et al., (2009). A study of the relations between the yield of tobacco and plant height, number of leaves, leaf length and width, stem circumference, etc. shows that the yield is positively significantly correlated with all biometric traits (Maleki et al., 2011).

Kashif Ali Shah et al. (2016) study the phenotypic and genotypic correlation between yield elements and qualitative characteristics in Virginia tobacco. They found that there were significant positive correlations between yield and leaf area, number of leaves, weight of green leaves and grade index, which should be used for further evaluation in tobacco growing programs.

The aim of this study was to identify the morphological features that affect the productivity of complex resistant to potiviruses and tobamoviruses Virginia tobacco lines, as well as to analyze the direct and indirect links between them and tobacco yield.

MATERIALS AND METHODS

Two lines were studied: L 5 and L 6.3.3, having complex resistance to economically important viral diseases, Tobacco mosaic virus with tobamovirus agents and Sipaniza with potivirus agents (Yonchev, 2015). The experiment is set in four repetitions with the size of the harvest plot of 27 m^2 with a planting scheme of 110-40/45 cm according to the technology adopted for Virginia tobacco in Bulgaria. The biometric analysis was performed on a total of 80 plants per variant. Plant height, number of leaves, length and width of the sixth and twelfth leaves (cm), yield of dry tobacco (kg/da) were reported. The obtained data were processed with the statistical software product SPSS 24 through correlation, regression and Path-analysis (Cronck, 2012; Field, 2013; Weinberg and Abramowitz, 2016).

RESULTS AND DISCUSSIONS

As a result of the applied correlation analysis on the basis of experimental data at line L 5, a very strong, positive relation between plant height, number of leaves and sizes of the sixth and twelfth leaves on the yield was proved (Table 1). The calculated correlation coefficients show a significant positive relation between yield and plant height (0.794**), as well as a very strong, positive correlation with the number of leaves (0.934**), the length of the sixth leaf (0.985**), the width of the sixth leaf (0.949**), the length (0.970**) and the width of the twelfth sheet (0.966**).

Table 2 presents the results of the correlation analysis for line L 6.3.3. The yield is in a significant positive relation with the length of the sixth leaf (0.781**), moderate relation with the width of the sixth leaf (0.591*), as well as in a strong, positive relation with the length (0.914**) and the width of the twelfth leaf (0.818**).

The decomposed general correlation coefficients, respectively, between dry tobacco yield and morphological traits at line L 5 of direct and indirect coefficient are shown in Table 3. They show that the different traits affect the economic qualities specifically. The general conclusion that should be drawn from the attached analysis is that the yield on the complex stable line L 5 is most strongly influenced by the length of the sixth leaf (18.49%), followed by the length of the twelfth leaf (17.93%), the width of the twelfth leaf (17.78%), the width of the sixth leaf (17.16%), the number of leaves (16.61%) and to a lesser extent the height of the plant (12.01%).

The high correlation coefficient between plant height and yield is largely due to the strong indirect influence between them. The result is similar for the number of leaves, width of the sixth leaf, length of the twelfth leaf. The length of the sixth leaf and the width of the twelfth leaf have a very strong direct effect on the yield, which determines the high correlation coefficient. Here the indirect influence is very weak and is fully compensated by the direct one.

Table 1. Correlation coefficients for economic and biometric indicators of a stable line L 5

	Yield da (kg)	Height of the plant (cm)	Number of leaves	Length of 6th leaf (cm)	Width of 6th leaf (cm)	Length of 12th leaf (cm)	Width of 12th leaf (cm)
Yield of dry tobacco da (kg)	1	0.794**	0.934**	0.985**	0.949**	0.970**	0.966**
Height of the plant (cm)		1	0.899**	0.850**	0.633*	0.754**	0.758**
Number of leaves			1	0.970**	0.881**	0.949**	0.956**
Length of 6th leaf. (cm)				1	0.940**	0.976**	0.971**
Width of 6th leaf (cm)					1	0.979**	0.973**
Length of 12th leaf (cm)						1	0.996**
Width of 12th leaf (cm)							1

*, ** Correlation coefficient at level of proof, 0.01 and 0.05, respectively

Table 2. Correlation coefficients for economic and biometric indicators of a stable line L 6.3.3

	Yield	Height of the plant (cm)	Number of leaves	Length of 6th leaf (cm)	Width of 6th leaf (cm)	Length of 12th leaf (cm)	Width of 12th leaf (cm)
Yield	1	0.513	0.288	0.781*	0.591*	0.914**	0.818**
Height of the plant (cm)		1	0.941**	-0.004	-0.306	0.678*	0.774**
Number of leaves			1	-0.254	-0.531	0.461	0.613*
Length of 6th leaf (cm)				1	0.949**	0.680**	0.516
Length of 6th leaf (cm)					1	0.451	0.274
Length of 6th leaf (cm)						1	0.955**
Length of 6th leaf (cm)							1

*, ** Correlation coefficient at level of proof, 0.01 and 0.05, respectively

Table 3. Direct and indirect influences of the studied traits on the yield from line L 5

Trait	Direct coefficient (Beta)	Indirect (Path) coefficient	Correlation coefficient (R)
Height (x_1)	-0.035	0.829	0.794
Number of leaves (x_2)	-0.695	1.629	0.934
Length of the 6th leaf (x_3)	1.481	-0.496	0.985
Width of the 6th leaf (x_4)	-0.274	1.223	0.949
Length of the 12th leaf (x_5)	-0.6	1.570	0.97
Width of the 12th leaf (x_6)	1.083	-0.117	0.966

The mathematical model, presenting in analytical form, the influence of the six biometric indicators on the economic qualities of line L5, is of the type:

$y=28.967-0.035x_1-13.061x_2+9.54x_3-2.748x_4-3.352x_5+9.422x_6$.

The compiled model is statistically significant at a significance level of $\alpha \leq 0.05$.

Table 4 presents information related to the decomposition of the correlation coefficients, representing the relations between yield and morphological traits, into direct and indirect in the complex stable line L 6.3.3. It was found that the length of the twelfth leaf (29.73%) had the strongest overall positive effect on the yield, followed by the width of the twelfth leaf (23.81%), the length of the sixth leaf (21.71%). The high correlation coefficient between the length of the twelfth leaf and the yield is largely due to the strong indirect influence between them. The negative indirect effect of the length of the sixth leaf is weak and it is largely compensated by the direct effect of this feature.

The presence of statistically proven correlation coefficients is a prerequisite for the application of multiple regression analysis in order to model the relationships between yield and some morphological features. The obtained statistically reliable model is:

$y = -170.631+4.733x_3-2.350x_4+7.275x_5-3.727x_6$.

Table 4. Direct and indirect influences of the studied traits on the yield from line L 6.3.3

Trait	Direct coefficient (Beta)	Indirect(Path) coefficient	Correlation coefficient (R)
Height (x_1)	-0.574	1.087	0.513
Number of leaves (x_2)	1.248	-0.960	0.288
Length of the 6th leaf (x_3)	0.916	-0.135	0.781
Width of the 6th leaf (x_4)	-0.635	1.226	0.591
Length of the 12th leaf (x_5)	0.306	0.698	0.914
Width of the 12th leaf (x_6)	0.484	0.334	0.818

CONCLUSIONS

The study of the traits influencing the productive potential of complex sustainable to both viral diseases tobacco lines is essential for the further correct and effective planning of the experimental work and the selection programs. As a result of the applied correlation analysis at line L 5, a significant positive relation between the yield and the height of the plant is established, as well as a very strong, positive correlation with the number of leaves, the sizes of the sixth and twelfth leaves. For line L 6.3.3, the yield is in a significant positive relation with the length of the sixth leaf, moderate relation with the width of the sixth leaf and in a strong, positive relation with the length and width of the twelfth leaf. In L 6.3.3, the number of leaves and the length of the sixth leaf have the highest direct effect on yield.

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