

CHEMICAL AND MORPHOLOGICAL PROPERTIES OF THE PLANTS FROM SOLANACEAE FAMILY

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Abstract

Tobacco is a plant from the Solanaceae family, characterized by specific chemical and morphological properties that vary based on the species and type of tobacco. Nicotine, one of the significant alkaloids present in the *Nicotiana tabacum* species, notably sets this plant apart as an industrial crop from others within the same family.

Eight wild tobacco species were examined: *N. rustica*, *N. alata*, *N. longiflora*, *N. petunia hybrida*, *N. repanda*, *N. glutinosa*, *N. miersii*, and *N. undulate*. Their values were compared with the cultivated species *N. tabacum* (P 23 variety).

The goal of the study was to analyze the chemical and morphological characteristics of wild tobacco species compared with the cultivated species *N. tabacum* (P 23 variety). The obtained data will contribute to the further selection. The acquired findings concerning the levels of nicotine, proteins, and soluble sugars are as follows: ranging from 1.53% nicotine, 8.77% proteins, and 25.72% soluble sugars in the cultivated *N. tabacum* species (P 23 variety) to 0.01% nicotine in the *N. petunia hybrida* species, along with 11.44% proteins and 1.59% soluble sugars in the *N. repanda* species.

The data from morphological measurements were statistically methods with the following parameters: standard error of the mean (σ_x), standard deviation (σ) and coefficient of variation (CV%).

Chemical property analyses of tobacco were conducted in the accredited laboratory in the Department of Technology and Chemistry of Tobacco and Tobacco Products, following internationally recognized methods.

Keywords: family, genus, species, tobacco, wild species.

Introduction

The species *Nicotiana tabacum* belongs to the Solanaceae family. This species encompasses a large number of tobacco types and varieties, with each type of tobacco distinguished by its characteristic chemical and morphological properties. Among the chemical properties, nicotine stands out as one of the important alkaloids present in tobacco of the *Nicotiana tabacum* species. This alkaloid sets tobacco apart as an industrial plant from other plants belonging to this family.

Unlike the cultivated tobacco species *N. tabacum*, which is characterized by a haploid number of chromosomes [2], wild tobacco species have different numbers of chromosomes and exhibit various morphological and chemical traits in the plants Rudolph G [3]. Some wild tobacco species have the same chromosome number as the cultivated tobacco species and can be easily used for cross breeding. This should be emphasized because one of the most important reasons for cross breeding in selection is the property of disease resistance in plants, inheritance of certain chemical and morphological traits such as a greater number of leaves, obtaining plants with a shorter vegetative period, etc.

Materials and Methods

The trial was set up in the experimental field of the STIP, in metodrandomized block design with 3 replications. Seven wild species were used as working material (*N. rustica*, *N. alata*, *N. longiflora*, *N. petunija hybrida*, *N. repanda*, *N. glutinosa*, *N. miersii*, *N. undulata*) and the cultivated tobacco variety (P-23 Ø).

The harvesting of the leaves was carried out at their technological maturity in 5-6 harvests and drying was done in the shade. Morphological measurements were made in the stage of full flowering. Selected tobacco was stringed, yellowed and then sundried.

Following chemical properties were analyzed: nicotine content in %, protein content in % and soluble sugars content in%. Nicotine in the raw material was determined spectrophotometrically using the CORESTA method. Total nitrogen content was determined according to the Foster method, proteins by the J. Moor method and soluble sugars by the Bertrand method. Morphological measurements were conducted during the full flowering phase of the plants on five stalks of each wild species and the control. Data from the morphological measurements were statistically analyzed using basic statistical parameters: standard error of the mean (σ_x), standard deviation (σ) and coefficient of variation (cV%), calculated according to Filiposki K. [6]

Results and Discussion

Chemical and morphological properties are among the most important characteristics of plants for identifying different types and varieties of tobacco; this also applies to other types of plants.

Table 1. Chemical properties of the raw material of *Nicotiana tabacum* type

VARIETY	Chemical analysis		
	Nicotine%	Proteins%	Soluble , Sugars%
<i>N. tabacum P-23</i>	1.53	8.77	25.72
<i>N. rustica</i>	0.40	9.11	4.25
<i>N. alata</i>	0.37	9.97	3.86
<i>N. longiflora</i>	0.50	10.69	2.15
<i>N. petunia hybrida</i>	0.01	9.15	3.10
<i>N. repanda</i>	0.09	11.44	1.59
<i>N. glutinosa</i>	0.55	8.89	3.73
<i>N. miersii</i>	/	/	/
<i>N. undulata</i>	0.69	8.50	4.20

Table 1 displays data for the chemical composition of dry tobacco from the tested wild species. It shows: %of nicotine, %of proteins and %of soluble sugars.

Nicotine Content

Uzunovski M. (5), climate conditions have a significant influence on nicotine content. In Table 1 nicotine content varies from 1.53% in the *N. tabacum* variety (P-23) to 0.01% in the *N. petunia hybrida* variety, where the presence of nicotine is almost in traces. Lazaroski T. (1984) has observed that irrigation, as an agricultural practice, significantly influences the reduction of nicotine content in tobacco. Depending on the irrigation variant, nicotine ranged from 0.80% to 1.14%. According to Mitreski M. [4], the average nicotine content in 2009 ranged from 1.18% in P 12-2/1 variety to 1.96% in P 23 variety.

Soluble Sugar Content

Soluble sugars are considered primary for the formation of other organic compounds in photosynthesis. The soluble sugars in the tested species range from 25.72% in the cultivated variety *N. tabacum* (P-23) to 1.59% in the wild species *N. repanda*, whose percentage is significantly lower compared to the P -23 varieties. Other wild tobacco species also exhibit low content of soluble sugars. The highest content was observed in the wild species *N. rustica* (4.25%). Mitreski M. [5], the average nicotine content ranges from 1.18% in P 12-2/1 variety to 1.96% in P 23 variety.

Protein Content

The optimal range for proteins is 5-10%. In the examinations, the protein content in the cultivated variety *N. tabacum* (P-23) is 8.77%, whereas in the wild species, it ranges from 11.44% in *N. repanda* to 8.50% in *N. undulata*. From the data presented in Table 1, we conclude that most wild species have an optimal protein content. Arsov Z. et al. [1] emphasize that protein content below 5.5% of the dry matter is an indication of a monotonoustaste, while a content higher than 7% is a sign of a deteriorated taste of the smoke and the quality of the tobacco.

Length and width of the leaves from the middle belt (cm)

In Table 2 the control variety P-23 stands out with the greatest average length of the middle leaf (26.6 ± 0.64) and it also has the smallest standard deviation (0.64). Its coefficient of variation is insignificant - 5.71%, indicating the stability of this variety. The wild species *N. miersii* is characterized by the smallest length of the leaves from the middle belt (2.3 ± 0.12), with a coefficient of variation of 11.90%, thus we conclude that the variability in length of the middle leaf is medium. The wild species *N. repanda* stands out for the property length of the leaves from the middle belt with the largest standard deviation of 2.17 and a coefficient of variation of 17.77%.

Table 2. Average values of length and width of leaves from the middle belt (cm)

VARIETY	Length of leaves (cm)			Width of leaves (cm)		
	$\bar{x} \pm c \bar{x}$	σ	cV%	$\bar{x} \pm c \bar{x}$	σ	cV%
<i>N. tabacum P-23</i>	26.6 ± 0.64	0.64	5.71	10.5 ± 0.57	0.65	12.27
<i>N. rustica</i>	14.4 ± 0.21	0.47	3.29	11.3 ± 0.46	1.04	9.18
<i>N. alata</i>	19.2 ± 0.58	1.30	6.79	8.5 ± 0.63	1.41	16.64
<i>N. longiflora</i>	19.2 ± 0.58	1.30	6.79	8.5 ± 0.63	1.41	16.63
<i>N. petunia hybrida</i>	13.5 ± 0.35	0.79	5.85	8.6 ± 0.19	0.42	4.86
<i>N. repanda</i>	12.2 ± 0.97	2.17	17.77	10.0 ± 0.67	1.50	15.00
<i>N. glutinosa</i>	8.9 ± 0.37	0.82	9.23	7.6 ± 0.19	0.42	5.50
<i>N. miersii</i>	2.3 ± 0.12	0.27	11.90	1.1 ± 0.10	0.22	20.33
<i>N. undulata</i>	19.2 ± 0.58	1.30	6.79	8.5 ± 0.63	1.41	16.64

The wild species *N. rustica* (11.3 ± 0.46) is characterized by the largest average width of the leaves, whose standard deviation is 1.04 and the coefficient of variation is 9.18%. The wild species *N. miersii* is characterized by the smallest leaf width (2.3 ± 0.12), the smallest standard deviation (0.22) and the largest variation coefficient of 20.33%. According to the obtained data, the standard deviation is low, from which it can be concluded that the tested wild species are stable.

Conclusions

Nicotine content among the examined wild species varies from 1.53% in the *N. tabacum* variety (P-23) to 0.01% in *N. petunia*. Protein content in the cultivated *N. tabacum* variety (P-23) is 8.77%, while in wild species, it ranges from 11.44% in *N. repanda* to 8.50% in *N. undulata*.

Soluble sugars in the examined species range from 25.72% in the cultivated *N. tabacum* variety (P-23) to 1.59% in the wild *N. repanda*.

The length of the middle leaf is highest in the control variety P-23 (26.6 ± 0.64) with a coefficient of variation of 5.71%, while the wild species *N. miersii* has the shortest length of leaves in the middle belt (2.3 ± 0.12) with a coefficient of variation of 11.90%.

N. repanda having the highest standard deviation of 2.17 and a coefficient of variation of 17.77%. *N. miersii* has the lowest standard deviation (0.22), and *N. rustica* has the lowest coefficient of variation, at 3.29%.

Wild species *N. rustica* stands out with the greatest average width of leaves (11.3 ± 0.46), with a standard deviation of 1.04 and a coefficient of variation of 9.18%. *N. miersii* exhibits the smallest leaf width (2.3 ± 0.12), the lowest standard deviation (0.22) and the highest coefficient of variation, 20.33%.

Based on the data obtained, we conclude that the wild species exhibit variability ranging from insignificant to moderate.

References

- [1] Arsov Z., Kabranova R.. Knowledge and processing of tobacco raw materials-practicum. University of St. Cyril and Methodius-Skopje. Faculty of Agricultural Sciences and Food-Skopje, 2011
- [2] Lazaroski T.Effect of irrigation on yield and technological properties of the oriental aromatic tobacco variety Prilep. Doctoral dissertation. Agricultural Faculty, Belgrade-Zemun, 1984
- [3] Rudolph G. Refinement of tobacco. Adhere. 1973
- [4] Mitreski M. Comparative studies of the most important production, technological and quality properties in some varieties of Prilep tobacco. Doctoral dissertation, Scientific Institute for Tobacco-Prilep, 2012.
- [5] Uzunoski M. Tobacco production. Business Journal, Skopje 1985.
- [6] Filiposki K.Statistical methods in agricultural research - Selected chapters. Scientific Institute for Tobacco – Prilep, Maxten Graphics – Skopje, 2011.