

# Study On The Most Important Morphological And Agronomic Characteristics Of Oriental Tobacco Genotypes

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## **Abstract**

*From an experiment with 30 lines and varieties, five oriental tobacco genotypes (four newly created lines and one standard variety) were selected and examined for: stalk height with and without inflorescence, number of leaves per stalk, length, width and leaf area from the middle beld of the stalk and yield of dry leaf mass per stalk, dekar and hectare. The trial was set up in the Experimental Field of Scientific Tobacco Institute – Prilep in 2022 and 2023, in randomized block design with four replications, using traditional agricultural practices. Measurements of the morphological characteristics were made at the stage of butonization and beginning of flowering. The yield of dry leaf mass was determined during the treatment of cured tobacco. The results were statistically processed.*

*The aim of the research is to study the more important quantitative characteristics of the oriental genotypes, to determine the degree of uniformity of the populations through their variability and to emphasize the best among the selected assortment.*

*From the analysis of the results obtained from the comparative experiment, it can be concluded that the lines L-c and L-d are high-yielding, phenotypically and genotypically uniform and stable, thus granting a visa for their recognition as varieties by the Variety Commission from the Ministry of Agriculture, Forestry and Water management of the Republic of North Macedonia.*

**Keywords:** *Nicotiana tabacum L., oriental tobaccos, genotypes, quantitative characteristics, variability.*

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## **I. Introduction**

Tobacco (*Nicotiana tabacum L.*) is a strategic crop for the Republic of North Macedonia. The creation of new varieties, the breeding of existing, chemical and technological analyzes of tobacco leaves, as well as the production and sale of tobacco seeds are the competences of the Scientific Tobacco Institute - Prilep. About ten companies for the purchase of tobacco in the republic are obliged to purchase tobacco seeds only from the Institute. The scientific workers at the Institute are completely dedicated to the tobacco culture that has been cultivated in these areas for centuries. Every year, in the Department of Genetics, Selection and Seed Control, experiments related to the breeding of tobacco are set up, crossings are carried out and new lines are analyzed, all with the aim of obtaining more superior varieties, which is the main task and desire of everyone breeder.

A large number of works by breeders have been published on the topic of tobacco breeding. So for example: Mitreski (2012), studied height of the stalk with inflorescence in six oriental tobacco varieties of the type Prilep: P-23, P 12-2/1, NS-72, P 66-9/7, P-79-94 and Prilep Basma 82. The average values for the trait ranged from 59,3 cm in Prilep P 12-2/1 to 148,1 cm in Prilep Basma 82. The same author in co-authorship with Korubin-Aleksoska (2015) of the same varieties examined some morphological traits and announce that Prilep Basma 82 had the highest average leaf number, and the lowest length and width of the middle belt leaves. Dimitrieski and Miceska (2015), offer information about quantitative traits of new prospective variety of the oriental Yaka tobacco, and as the most perspective point out Yaka b 65 - 82/1. Korubin – Aleksoska and Ayaz (2016), investigated height of the stalk with inflorescence, leaf number, length of the middle belt leaves and dry mass yield per stalk in five autochthonous tobacco varieties of types: Prilep (P 10-3/2 and P 12-2/1), Djebel (Dj No 1) and Yaka tobaccos (YK 7-4/2 and KY), and five commercial oriental varieties of Prilep tobacco (P-23, P-84, NS-72, P-66-9/7 and P-79-94). Differences between the genotypes in the investigation period were highly significant, which is a sign of their mutual genotypic and phenotypic diversity. Korubin – Aleksoska and Ayaz (2016), studied ten oriental tobaccos of the types: Basmak (MK-1, MK-2, MB-2, MB-3, MS-8/1, MS-9/3 and YZ-7), Prilep (Prilep Basma-82), Djebel (Xanthi Djebel-1) and Yaka (YV 125/3), for some more important quantitative traits, and gave precise knowledge of the new type Basmak in Macedonia and the Balkans from

genetic, morphological and agronomic aspects. All Basmak varieties are characterized by stability and uniformity as a result of their homozygotness. Aleksoski and col. (2023), performed three-year studies for number of leaves per stalk and the length, width and area of the leaves from the middle part of the stalk – traits directly related to the yield in the offspring of the first generation, in four mother parent tobacco varieties of different types (three of the Prilep type and one of the Basmak type), one pollen donor parent Burley B-1-91, and their four F1 hybrids. The hybrids MS 8/1 x B-1/91 and P 18-50/4 x B-1/91 represent very interesting material for future tobacco breeding activities. Aleksoski and col. (2023), studied three oriental varieties (two of the type Prilep and one of the type Yaka), and 7 newly created genotypes, of which four are of the type Yaka and three of the type Prilep. The newly genotypes of the Prilep type have significantly longer leaves than the two control varieties. The highest yielding among the variants from the type Prilep is line L7. Lines L1, L3 and L4 have a significantly higher yield than standard variety type Yaka.

The aim of this paper is the analysis of the most important morphological and agronomic characteristics of five oriental tobacco genotypes placed in a comparative experiment in 2022 and 2023, at the Scientific Institute for Tobacco - Prilep and selection of the best lines for their recognition as varieties by the variety commission.

## **II. Material And Methods**

Four newly created oriental lines (L-a, L-b, L-c, L-d) and the standard variety P 66 9 7 (V-Ø) for comparison, were selected as working material.

The experiment was set up at the Experimental Field at the Scientific Tobacco Institute - Prilep, according to a random block system in four repetitions. Planting spacing was 45 cm between rows and 15 cm between plants.

The measurements of the morphological characteristics of tobacco were carried out in the phase of full growth and the beginning of flowering. Leaf area was calculated by multiplying the length and width of the leaves and the coefficient ( $k=0.6354$ ). Dry leaf mass yield was determined after tobacco manipulation and then the yield per stalk, dekar and hectare was calculated.

## **III. Results And Discussion**

### **1. Height of the stalk with and without inflorescence**

The height of the tobacco is a morphological characteristic that the breeder creates depending on the type of tobacco and the method of harvesting the leaves.

In our studies of the five oriental genotypes placed in a comparative experiment, the L-a line has the highest height of the stalk with inflorescence (127 cm - 2022 and 126.63 cm - 2023). The other lines and the control variety are characterized by approximately the same height, from 99 cm (L-d in 2023) to 105.25 cm (V-Ø in 2023). The standard deviation ranges from 2.7 cm for L-b (2022) to 5.72 cm for V-Ø (2023). The coefficient of variability is low and ranges from 2.03 % for L-b (2022) to 5.44 % for V-Ø (2023).

The L-a line has the highest height without inflorescence (114.38 cm - 2022 and 113.13 cm - 2023), similar to the height with inflorescence. The other genotypes have values ranging from 90.25 cm for L-d (2023) to 96 cm for V-Ø (2023). The standard deviation ranges from 2.8 cm for L-b (2022 and 2023) to 7.4 cm for L-d (2022 and 2023). The coefficient of variability ranges from 3.22 % for L-b (2022) to 8.12 % for L-d (2022). The low degree of variability is a sign of uniformity and stability of the new lines.

Table 1. shows the mean values, the standard deviation and the coefficient of variability for the height of the stalk with and without inflorescence in the investigated genotypes.

### **2. Number of leaves per stalk**

The number of leaves in a tobacco plant is directly related to the amount of yield and therefore causes great interest among breeders and is always present in programs for the creation of new varieties.

With the biggest number of leaves among the genotypes, in both years of investigations, is characterized L-c (55), while L-d is characterized by the lowest number of leaves (49 - 2022 and 48 - 2023). The standard deviation of the genotypes ranges from 1.5 (L-b and L-c in 2022), to 2.75 (L-a - 2023). The coefficient of variability ranges from 3.5 % (L-b and L-c) to 5 % in the standard variety. The low coefficient of variability in genotypes is an indicator of the homozygosity of individuals and the uniformity of the population.

Table 1 shows the mean values, the standard deviation and the coefficient of variability for the number of leaves per stalk in the genotypes.

**Table 1. Stalk height with and without inflorescence and number of leaves per stalk in oriental tobacco genotypes (2022 and 2023)**

| Ord. no. | Genotypes  | Height of the stalk with inflorescence (cm) |                    |        | Height of the stalk without inflorescence (cm) |                    |        | Number of leaves per stalk |                    |        |
|----------|------------|---|--------------------|--------|--|--------------------|--------|----------------------------|--------------------|--------|
|          |            | $\bar{x}$                                   | $\sigma$ ( $\pm$ ) | CV (%) | $\bar{x}$                                      | $\sigma$ ( $\pm$ ) | CV (%) | $\bar{x}$                  | $\Sigma$ ( $\pm$ ) | CV (%) |
| 2022     |            |   |                    |        |  |                    |        |                            |                    |        |
| 1.       | L-a        | 127.00**                                    | 4.03               | 3.16   | 114.38**                                       | 4.15               | 3.77   | 51                         | 2.70               | 4.86   |
| 2.       | L-b        | 102.00                                      | 2.07               | 2.03   | 92.00  | 2.80               | 3.22   | 52                         | 1.50               | 3.54   |
| 3.       | L-c        | 100.93                                      | 3.53               | 3.50   | 92.75  | 5.00               | 6.25   | 55                         | 1.50               | 3.54   |
| 4.       | L-d        | 101.25                                      | 3.67               | 3.61   | 91.25  | 7.39               | 8.12   | 49                         | 2.47               | 4.41   |
| 5.       | V-Ø        | 104.75                                      | 4.10               | 3.92   | 94.75  | 6.03               | 7.35   | 54                         | 2.30               | 5.00   |
|          | LSD 0.05 = | 2.38  |                    |        | 5.25   |                    |        | 1.66                       |                    |        |
|          | 0.01 =     | 3.34  |                    |        | 7.37   |                    |        | 2.32                       |                    |        |
| 2023     |            |   |                    |        |  |                    |        |                            |                    |        |
| 1.       | L-a        | 126.63                                      | 4.44               | 3.51   | 113.13   | 4.12               | 3.72   | 50                         | 2.75               | 4.84   |
| 2.       | L-b        | 102.23                                      | 3.56               | 3.49   | 92.00  | 2.82               | 3.25   | 53                         | 1.52               | 3.50   |
| 3.       | L-c        | 103.13                                      | 3.56               | 3.46   | 94.00  | 5.01               | 6.25   | 55                         | 1.51               | 3.50   |
| 4.       | L-d        | 99.00                                       | 4.12               | 4.16   | 90.25  | 7.37               | 7.42   | 48                         | 2.45               | 4.45   |
| 5.       | V-Ø        | 105.25                                      | 5.72               | 5.44   | 96.00  | 6.05               | 8.05   | 54                         | 2.30               | 5.02   |
|          | LSD 0.05 = | 3.00  |                    |        | 2.70   |                    |        | 2.32                       |                    |        |
|          | 0.01 =     | 4.22  |                    |        | 3.79   |                    |        | 3.26                       |                    |        |

Legend: L-line, V- variety, Ø-control,  $\bar{x}$ -mean value,  $\sigma$ -standard deviation, CV-coefficient of variability.

**3. Dimensions of the leaves from the middle belt of the stalk**

**- Length of the leaves**

The length of the leaves is a varietal characteristic and one of the most important criteria for classifying tobacco. That is why the breeder gives great attention and effort in the process of breeding the tobacco.

L-b is distinguished by the longest leaves (31.54 cm – 2022 and 32.35 cm – 2023), which represents the F<sub>9</sub> generation of a cross of two oriental varieties, one of which has narrow and long leaves. L-c and L-d (23 cm) have the smallest length of leaves from the middle belt, in both years of investigation. The standard deviation ranges from 1.2 cm for L-c (2022) to 2.55 cm (2023) for the standard variety V-Ø. The coefficient of variability ranges from 5.3 % for L-b to 10.29 % for L-d (2022). All CV values are less than 10, with the exception of L-d at 2022 (but also close to the limit), which is a sign of a uniform population.

**- Width of the leaves**

The widest leaves of the middle belt of the stalk have L-a (16 cm). The lines L-c, L-b and the standard variety are distinguished by the smallest width (from 12.35 cm – 2022 in L-c to 12.73 cm – 2023 in L-d). The standard deviation ranges from 0.34 cm for L-c (2022) to 0.83 cm for L-a (2022). The coefficient of variability varies from 2.7 % in L-c and L-d in 2022 to 6.43 in L-b in 2023. The CV percentage value is less than 10.

**- Area of the leaves**

The leaves of the middle band of the stalk at the L-a line have the biggest area (303 cm<sup>2</sup> - 2022 and 128 cm<sup>2</sup> - 2023), and the smallest L-b (162 cm<sup>2</sup>). The standard deviation ranges from 7.77 cm<sup>2</sup> for L-d (2023) to 26.74 cm<sup>2</sup> for L-a (2022). The coefficient of variability ranges from 4.13 % at L-b (2023) to 9.26 % at L-b (2023). All CV values are less than 10, which is a sign of a uniform leaves in the populations.

The mean values, standard deviation, and coefficient of variability for dimensions of the leaves in the studied genotypes are shown in Table 2.

**Table 2. Dimensions of leaves from the middle belt of the stalk in oriental tobacco genotypes (2022 and 2023)**

| Ord. no. | Genotypes  | Leaves from the middle belt of the stalk |                    |        |            |                    |        |                         |                    |        |
|----------|------------|--|--------------------|--------|------------|--------------------|--------|-------------------------|--------------------|--------|
|          |            | Length (cm)                              |                    |        | Width (cm) |                    |        | Area (cm <sup>2</sup> ) |                    |        |
|          |            | $\bar{x}$                                | $\sigma$ ( $\pm$ ) | CV (%) | $\bar{x}$  | $\sigma$ ( $\pm$ ) | CV (%) | $\bar{x}$               | $\Sigma$ ( $\pm$ ) | CV (%) |
| 2022     |            |  |                    |        |            |                    |        |                         |                    |        |
| 1.       | L-a        | 29.40                                    | 1.84               | 6.51   | 16.23**    | 0.83               | 5.10   | 303.29**                | 26.74              | 8.81   |
| 2.       | L-b        | 31.54                                    | 1.65               | 5.28   | 8.10       | 0.37               | 4.50   | 162.20                  | 13.04              | 8.03   |
| 3.       | L-c        | 23.09                                    | 1.20               | 5.67   | 12.35      | 0.34               | 2.70   | 181.36                  | 8.69               | 4.80   |
| 4.       | L-d        | 23.05                                    | 2.15               | 10.29  | 12.68      | 0.35               | 2.70   | 186.05                  | 9.16               | 4.90   |
| 5.       | V-Ø        | 24.90                                    | 2.52               | 8.98   | 12.49      | 0.47               | 3.78   | 197.66                  | 11.99              | 6.07   |
|          | LSD 0.05 = | 1.46                                     |                    |        | 0.75       |                    |        | 16.21                   |                    |        |

|      |            |         |      |      |         |      |      |          |       |      |
|------|------------|---------|------|------|---------|------|------|----------|-------|------|
|      | 0.01 =     | 2.05    |      |      | 1.05    |      |      | 22.75    |       |      |
| 2023 |            |         |      |      |         |      |      |          |       |      |
| 1.   | L-a        | 29.10** | 1.84 | 6.50 | 16.10** | 0.77 | 4.78 | 297.69** | 24.49 | 8.23 |
| 2.   | L-b        | 32.35** | 1.63 | 5.29 | 8.14    | 0.52 | 6.43 | 162.14   | 15.48 | 9.26 |
| 3.   | L-c        | 23.00   | 1.22 | 5.65 | 12.56   | 0.36 | 2.85 | 183.72   | 7.90  | 4.31 |
| 4.   | L-d        | 23.25   | 2.15 | 9.89 | 12.73   | 0.37 | 2.90 | 190.17   | 7.77  | 4.13 |
| 5.   | V-Ø        | 24.90   | 2.55 | 8.97 | 12.42   | 0.48 | 3.89 | 196.45   | 13.68 | 6.96 |
|      | LSD 0.05 = | 1.57    |      |      | 0.55    |      |      | 10.99    |       |      |
|      | 0.01 =     | 2.21    |      |      | 0.77    |      |      | 15.42    |       |      |

Legend: L-line, V- variety, Ø-control,  $\bar{x}$ -mean value,  $\sigma$ -standard deviation, CV-coefficient of variability.

#### 4. Yield of dry leaf mass

L-c is characterized by the highest dry leaf yield (36.03 g/stalk – 2022 and 36.65 g/stalk – 2023, i.e. 538.3 kg/da – 2022 and 547.6 kg/da – 2023, i.e. 5.3591 t/ha – 2022 and 5.4514 t/ha – 2023). After it comes the L-d line (35.70 g/stalk – 2022 and 34.95 g/stalk – 2023, i.e. 533.4 kg/da – 2022 and 522.2 kg/da – 2023, i.e. 5.3100 t/ha – 2022 and 5.1985 t/ha – 2023). Compared to the control variety, the differences in yield per stalk are highly significant, which also indicates high significance in yield per dekar and yield per hectare.

The mean values for the yield of dry leaf mass per stalk, per dekar and per hectare in the genotypes are shown in Table 3.

**Table 3. Yield of dry leaf mass from oriental tobacco genotypes (2022 and 2023)**

| Ord. no.    | Genotypes  | Yield of dry leaf mass per stalk (g) |       |       |       | $\bar{x}$ (g) | Yield of dry leaf mass per dekar (kg) | Yield of dry leaf mass per hectare (t) |
|-------------|------------|--------------------------------------|-------|-------|-------|---------------|---------------------------------------|--|
|             |            | Repetitions                          |       |       |       |               |                                       |  |
|             |            | I                                    | II    | III   | IV    |               |                                       |  |
| <b>2022</b> |            |                                      |       |       |       |               |                                       |  |
| 1.          | L-a        | 25.60                                | 26.60 | 25.70 | 27.40 | 26.30         | 392.90                                | 3.9119                                 |
| 2.          | L-b        | 26.30                                | 26.80 | 26.60 | 25.70 | 26.40         | 394.40                                | 3.9268                                 |
| 3.          | L-c        | 36.60                                | 36.70 | 34.60 | 36.20 | 36.03**       | 538.30                                | 5.3591                                 |
| 4.          | L-d        | 33.10                                | 37.10 | 38.50 | 34.00 | 35.70**       | 533.40                                | 5.3100                                 |
| 5.          | V-Ø        | 30.0                                 | 32.00 | 33.30 | 26.40 | 30.40         | 454.20                                | 4.5217                                 |
|             | LSD 0.05 = | 2.75                                 |       |       |       |               |                                       |  |
|             | 0.01 =     | 3.85                                 |       |       |       |               |                                       |  |
| <b>2923</b> |            |                                      |       |       |       |               |                                       |  |
| 1.          | L-a        | 26.50                                | 27.20 | 25.70 | 27.80 | 26.80         | 400.40                                | 3.9863                                 |
| 2.          | L-b        | 28.60                                | 27.70 | 29.90 | 27.80 | 28.50         | 425.80                                | 4.2391                                 |
| 3.          | L-c        | 37.40                                | 36.70 | 36.60 | 35.90 | 36.65**       | 547.60                                | 5.4514                                 |
| 4.          | L-d        | 33.10                                | 35.10 | 36.40 | 35.20 | 34.95**       | 522.20                                | 5.1985                                 |
| 5.          | V-Ø        | 29.80                                | 32.80 | 31.70 | 27.70 | 30.05         | 449.00                                | 4.4697                                 |
|             | LSD 0.05 = | 2.10                                 |       |       |       |               |                                       |  |
|             | 0.01 =     | 2.94                                 |       |       |       |               |                                       |  |

Legend: L-line, V- variety, Ø-control,  $\bar{x}$ -mean value, 1 dekar = 1000 m<sup>2</sup>, 1 hectare = 10000 m<sup>2</sup>.

#### IV. Conclusion

The following can be concluded from the presented analysis of the most important morphological and agronomic characteristics:

- The L-a line has the highest stalk height (with and without inflorescence), L-c has the biggest number of leaves, and L-b has the smallest leaves from the middle belt of the stalk (smaller than the standard variety).
- All morphological characteristics in the two years of investigation have a coefficient of variability less than 10% (with the exception of L-d in 2022 whose coefficient of variability is approximately 10), which means that the new lines are stable and uniform.
- Lines L-c and L-d gave the highest yield of dry leaf mass. Compared to the control variety, both lines have a significantly higher yield.
- From the analysis of the results obtained from the Comparative Experiment, it can be concluded that the lines L-c and L-d are high-yielding, phenotypically and genotypically uniform and stable, thus granting a visa for their recognition as varieties by the Varietal Commission at the Ministry of Agriculture, Forestry and Water Management from Republic of North Macedonia.

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