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## **HYBRIDOLOGICAL ANALYSIS OF INHERITANCE THE CONTENT OF NICOTINE AND SUGARS IN BURLEY AND VIRGINIA TOBACCO CROSSES**

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### **Abstract**

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Manifestations of heterosis and transgression, inheritance, heritability, the number of genes involved in the formation of essential components of chemical composition of crosses Virginia and Burley large leaf tobaccos are studied. For that purpose are studied, the  $P_1$ ,  $P_2$ ,  $F_1$  and  $F_2$  populations of six crosses Burley and Virginia large leaf tobaccos. The results obtained suggest that inheritance of the nicotine content in Burley tobacco is svrahdominatno, incompletely dominant and additive, dominance, and in Virginia tobacco overdominatly and incompletely dominantly. Inheritance of the content of sugars in tobacco Burley and Virginia is overdominatly or incompletely dominantly. The number of genes determining the expression of the nicotine content in tobacco Virginia is lower than in Burley tobacco, and in the case of the sugars is opposite. The results obtained indicate that the use of heterosis in large leaf tobaccos to increase the nicotine content is an exploded, especially in Burley tobacco. The same applies to lower the content of soluble sugars. In Burley tobacco are established averages of the coefficient of heritability for the content of nicotine and negligible values of the heritability for the content of soluble sugars. For Virginia tobacco there are high values of coefficient of heritability in nicotine and middle ones on the content of sugars. On the content of nicotine and sugars in Burley tobacco and for sugars in Virginia tobacco the selection of desirable trait can begin in later hybrid generations, but in terms of nicotine content in tobacco Virginia in the early hybrid generations.

*Key words:* Burley tobacco; Virginia tobacco; inheritance; inheritability; nicotine; sugars

### **Introduction**

The chemical composition of tobacco determines its use value (Davis and Nielsen, 1999; Strellerv and Roth, 2013; Yeargin and Bicker, 2015). In large leaf tobacco by variety groups Burley and Virginia the most important indicators forming quality and type of raw material are nicotine and sugars (soluble carbohydrates) (Nikolov et al., 2004; Kocoska et al., 2011; Stoilova, 2009; Ritchey et al., 2014).

The literature is scanty data regarding succession and inheritance of chemical composition in tobacco (Matzinger and Wernsman, 1968; Korubin-Aleksoska, 2001; Dimitrieski et al., 2006; Pearce and Denton, 2013). Studies show that inheritance of nicotine is the most common direction of the parent with low-

er content as the main type is overdominantly and intermediately (Stankev and Trancheva, 1989; Dyulgerski and Dimanov, 2012). Overdominantly positive inheritance is observed less frequently (Manolov, 1979; Nikolov et al., 2004). For additively inheritance of nicotine mention Povilaitis (1971). Nikolov et al. (2004) and Bing-Guang et al. (2005) receive additively inheritance in sugars for in his research.

The purpose of this study is by applying hybridological analysis to determine the nature and extent of genetic interactions the inheritance and the number of genes which differ silk-worm forms, heritability coefficient and occurrence of heterosis, depression and a transgression with regard to the chemical composition of the large-leaved tobacco Burley and Virginia with a view to use in selection activity.

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## Material and Methods

For implementation the objective are studied populations  $P_1$ ,  $P_2$ ,  $F_1$  and  $F_2$  of six crosses Virginia and Burley tobacco. Burley tobacco are: Hybrid 1464 (L 1189 x Bt 102); Hybrid 1467 (B 1344 x Ky908); Hybrid 1468 (B 1317 x B 1344); Hybrid 1469 (B 1322 x 907 Ky); Hybrid 1470 (L 1145 x Tn 90) and Hybrid 1480 (Tn 86 x Ky 8959) and for Virginia tobacco: Hybrid 652 (L 607 x C 326); Hybrid 653 (L 607 x C 254); Hybrid 665 (V 250 x L 42); Hybrid 688 (L 842 x V 250); Hybrid 690 (L 843 x C 326) and Hybrid 694 (L 607 x V 250). An experimental work is performed in 2011 an educational-experimental field and laboratory of TTPI – Markovo. In the laboratory of TTPI is made chemical analysis of researches crosses regarding the content of nicotine and sugars (soluble carbohydrates) by standard methods, respectively: ISO 15152 and ISO 15154.

Of studied indicators are calculated arithmetic mean ( $\bar{x}$ ), degree of dominance ( $d/a$ ) by the formula of Mather (1949), the manifestations of heterosis (HP) and the dispersion  $a/c$  by Omarov (1975). By the method of Sobolev are identified (1976): the events of transgression (Tn), the number of genes that differ in the parental forms (N), the coefficient for the heritability of the trait ( $H^2$ ).

## Results and Discussion

Inheritance the content of nicotine in the crosses Burley tobacco is overdominantly, incompletely dominantly and additive dominantly depending on the crossing, prevailing first (Table 1). The Direction of inheritance is regarding to the parent with higher values, with the exception of the hybrid combination Hybrid 1468 (B 1317 x B 1344), wherein the direction is regarding to the parent with the lower values. The number of genes determining the expression of the trait in all crosses varies in narrow range – from 6 to 8.

Heterosis events on the content of nicotine in tobacco Burley crosses are well expressed. Is observed positive heterosis

effect of significant figures in four of the six examined crosses. Especially strongly manifested in Hybrid 1480 (Tn 86 x Ky 8959), where the value exceeds 50%. Apparent positive depression are relatively well expressed in all hybrid combinations, indicating that in the next hybrid generations observed significant decrease in the content of nicotine.

Coefficients of transgression depend on the manifestations of heterosis. In following hybrid generations in Hybrid 1480 available homozygous genotype may be selected plants that will exceed the rate of nicotine of 1.5% in comparison to the parental forms.

There are averages of the coefficient of heritability, and the results of different hybrid combinations are too close. In this feature of deterministic decisive influence of the environment and the manifestation of the genotype is less pronounced. In this case the selection of the desirable trait can begin in the later hybrid generations ( $F_4 - F_5$ ).

Inheritance the content of nicotine in Virginia tobacco is overdominantly in three crosses and a dominant part in the other three (Table 2). The direction of inheritance is regarding parent with higher values, with the exception of the hybrid combination Hybrid 1,468 (B 1317 1344 B x), wherein the direction is regards to the parent with the lower levels of nicotine. The number of genes determining the expression of the nicotine content in Virginia tobacco is lower than in Burley tobacco – 3 or 4, which facilitates the selection for this trait.

Heterosis events are various kinds and are depending on the crossing. Is observed significant positive heterosis in crosses Hybrid 652 (L 607 x C 326), Hybrid 653 (L 607 x C 254), Hybrid 690 (L 843 x C 326) and especially Hybrid 694 (L 607 x V 250). In crosses Hybrid 665 (V 250 x L42) and Hybrid 688 (L 842 x 250 V) are present negative heterosis, while the first is of significant figures. Depression on the content of nicotine in Virginia is tobacco greater manifested in less than Burley tobacco, with two of the crosses is negative, which indicates increase of signs in the next generations. Transgression coefficients depend on the manifestations of heterosis and show that following gen-

**Table 1**  
**Data on the content and inheritance of nicotine in Burley tobacco**

Parents / Crosses/Indexes	$P_1$	$P_2$	$F_1$	$F_2$	$d/a$	HP, %	$a/c$ , %	Tn	N	$H^2$
Hybrid 1464 (L 1189 x Bt 102)	2.42	2.81	2.86	2.49	0.05	1.78	12.93	0.07	8.46	0.35
Hybrid 1467 (B 1344 x Ky 908)	3.26	2.55	3.83	3.37	2.6	17.48	12.01	0.44	7.78	0.42
Hybrid 1468 (B 1317 x B 1344)	2.20	3.26	3.78	3.24	-0.01	15.95	14.29	0.38	6.38	0.32
Hybrid 1469 (B 1322 x Ky 907)	2.37	1.84	2.77	2.52	1.09	16.88	9.03	0.42	7.25	0.44
Hybrid 1470 (L 1145 x Tn 90)	2.51	2.02	2.63	2.16	1.46	4.78	17.87	0.17	8.11	0.39
Hybrid 1480 (Tn 86 x Ky 8959)	2.13	1.97	3.34	2.90	16.1	56.81	13.17	1.52	6.43	0.37

**Table 2**  
**Data on the content and inheritance of nicotine in Virginia tobacco**

Parents / Crosses/Indexes	P <sub>1</sub>	P <sub>2</sub>	F <sub>1</sub>	F <sub>2</sub>	d/a	HP, %	a/c, %	Tn	N	H <sup>2</sup>
Hybrid 652 (L 607 x C 326)	2.57	2.34	2.92	2.63	4.04	13.62	9.93	0.46	4.31	0.62
(Hybrid 653) (L 607 x C 254)	2.57	2.25	3.08	2.89	4.19	19.84	6.17	0.33	4.05	0.58
Hybrid 665 (V 250 x L42)	2.73	2.11	2.58	2.51	0.51	-5.49	2.71	-0.13	3.40	0.67
Hybrid 688 (L 842 x V 250)	2.41	2.73	2.63	2.67	-0.06	-3.66	-1.52	-0.08	3.27	0.54
Hybrid 690 (L 843 x C 326)	2.24	2.34	2.46	2.65	0.12	5.13	-7.7	0.25	4.22	0.64
Hybrid 694 (L 607 x V 250)	2.57	2.20	3.14	2.94	4.08	22.18	6.37	1.14	3.74	0.59

erations in Hybrid 694 available homozygous genotypes can be selected plants which would exceed the percentage of nicotine in parents with more than 1%.

These results indicate that the use of heterosis in large leave tobacco to increase the nicotine content is perspective, especially in Burley tobacco.

Exist are medium to high values of the coefficient of heritability. For deterministic of this sign decisive is the genotype and the environmental impact is less pronounced. In this case the desirable trait of the selection can be started in the earlier generations

Inheritance of sugar content in the studied hybrid combinations Burley tobacco is monogenic overdominantly or incomplete dominantly, prevailing second (Table 3). The direction of inheritance is always in respect of the parent with the lower values, which in this case is favorable.

Significant negative heterosis effect on the sugar content, which is desirable in Burley tobacco is observed in Hybrid 1467 (B 1344 x Ky 908), Hybrid 1470 (L 1145 x Tn 90) and especially

in Hybrid 1469 (B 1322 x Ky 907) and Hybrid 1480 (Tn 86 x Ky 8959). In Hybrid 1464 (L 1189 x Bt 102) is a significant positive heterosis, which in this case is undesirable. Manifestations of depression are mild to moderate, depending on the hybrid combination, indicating that the next hybrid generations observed a significant increase in sugar content, which is unfavorable.

Coefficients of transgression are negative, which is desirable in Burley tobacco. They show that in following generations in all studied hybrids generations available homozygous genotype may be selected plants will have a lower percentage of sugars when compared to the parental forms.

Available are very low values of the coefficient of heritability. Environmental influences is crucial for deterministic of this feature. In this case the selection of sugars content can begin in late hybrid generations (F<sub>4</sub> – F<sub>5</sub>).

Inheritance of the sugars content in the study crosses Virginia tobacco is incompletely dominantly, with exceptional of Hybrid 694 (L 607 x V 250) where it is o overdominantly (Table 4). The

**Table 3**  
**Data on the content and inheritance of sugars in Burley tobacco**

Parents / Crosses/Indexes	P <sub>1</sub>	P <sub>2</sub>	F <sub>1</sub>	F <sub>2</sub>	d/a	HP, %	a/c, %	Tn	N	H <sup>2</sup>
Hybrid 1464 (L 1189 x Bt 102)	1.23	0.82	0.87	0.97	-0.76	6.1	-11.5	-0.11	0.57	0,14
Hybrid 1467 (B 1344 x Ky 908)	0.68	1.07	0.62	0.70	-0.45	-8.82	-12.9	-0.14	0.64	0,21
Hybrid 1468 (B 1317 x B 1344)	1.12	0.68	0.66	0.68	-1.09	-2.94	-3.03	-0.02	0.68	0,17
Hybrid 1469 (B 1322 x Ky 907)	0.96	1.28	0.73	0.94	-0.55	-24.0	-28.8	-0.28	0.54	0,12
Hybrid 1470 (L 1145 x Tn 90)	1.01	0.90	0.84	0.89	-2.09	-6.67	-5.95	-0.07	0.58	0,19
Hybrid 1480 (Tn 86 x Ky 8959)	1.15	1.31	0.88	1.05	-0.43	-23.5	-19.3	-0.26	0.61	0,16

**Table 4**  
**Data on the content and inheritance of sugars in Virginia tobacco**

Parents / Crosses/Indexes	P <sub>1</sub>	P <sub>2</sub>	F <sub>1</sub>	F <sub>2</sub>	d/a	HP, %	a/c, %	Tn	N	H <sup>2</sup>
Hybrid 652 (L 607 x C 326)	16.24	14.31	15.53	15.14	0.26	-4.37	2.51	-0.38	2.24	0,38
(Hybrid 653) (L 607 x C 254)	16.24	14.83	15.35	15.28	-0.26	-5.48	0.46	-0.48	2.72	0,28
Hybrid 665 (V 250 x L42)	16.07	13.95	15.86	15.67	0.80	-1.31	1.21	0.06	1.97	0,31
Hybrid 688 (L 842 x V 250)	15.76	16.07	15.34	15.10	-0.73	-4.54	1.56	0.32	2.36	0,34
Hybrid 690 (L 843 x C 326)	14.62	14.31	14.44	14.41	-0.16	-13.1	0.21	-1.40	2.66	0,37
Hybrid 694 (L 607 x V 250)	16.24	16.07	16.31	15.76	3	0.43	3.37	0.03	2.19	0,26

direction of inheritance is as in respect of the parent with the higher values, and the one with the lower ones. The number of genes that are involved in deterministic sugars content in researches hybrid combinations is two or three.

Except Hybrid 694 where almost not observed heterosis in other hybrid combinations is there a negative one. Significant heterosis effect is observed in (Hybrid 653) and especially Hybrid 690 (L 843 x C 326).

Coefficients of transgression are both positive and negative depending on the crossing. In following generations in Hybrid 690 available homozygous genotype may be selected plants that will have a content of more than 1% rate of sugars less as compared to the parental forms.

Observed are relatively low values of the heritability of the content of sugars. For determination of this feature more important is the influence of the environment. In this case the selection by signs sugars content can begin in the later hybrid generations ( $F_4 - F_5$ ).

## Conclusion

➤ Inheritance the content of nicotine in the studied hybrid combinations in Burley tobacco is overdominantly, incomplete dominantly and additive-dominantly, while Virginia tobacco is overdominantly and incomplete dominantly. Inheritance of sugar content in Virginia and Burley tobacco is monogenic overdominantly or incompletely dominantly.

➤ The number of genes determining the expression of the nicotine content in Virginia tobacco is lower than in Burley tobacco, and as regards of the sugars content is opposite.

➤ Are established manifestations of heterosis and transgression of significant figures in terms of both studied chemical indicators on both types of tobacco. They are of a more importance in the Burley tobacco.

➤ As regards the content of nicotine and sugars for Burley tobacco and in respect of sugars in Virginia tobacco, the selection by desirable trait can begin in the later hybrid generations, but in terms of nicotine content in Virginia tobacco in early hybrid generations.

➤ Character of inheritance of the content of nicotine and sugar is more complicated in Burley tobacco, which hinders the selection on these indicators.

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