INVESTIGATIONS OF THE VARIABILITY OF QUANTITATIVE CHARACTERS IN TOBACCO VARIETIES AND THEIR F1 AND F2 HYBRIDS

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ABSTRACT

Six parental genotypes (P-23, MB-3, SM-1, YV 125/3, FL-5 and O-87) and their 15 diallel hybrids in F1 and F2 generations were investigated for two characters, stalk height without inflorescence and leaf number per stalk. Field trials were set up in Tobacco Institute-Prilep in 2008 and 2009 in a randomized block design with four replications. Standard agrotechnics was applied in tobacco growing.
The aim of investigations was to estimate the variability of characters using the basic statistical parameters standard deviation and degree of variability.
Parents and F1 generation showed a very low variability, which indicates a high level of uniformity. In F2 progeny high variability was estimated, indicating the existence of differences among individuals and higher possibility of choice for the breeders. The highest variability in F2 for these two characters in both investigating years was estimated in the hybrids P-23 x O-87 and P-23 x FL-5.

Keywords: Tobacco (*Nicotiana tanacumL.*), heredity, variability, standard deviation (σ), degree of variability (V).

ИСТРАЖУВАЊА ЗА ВАРИЈАБИЛНОСТА НА КВАНТИТАТИВНИТЕ СВОЈСТВА КАЈ ТУТУНСКИ СОРТИ И НИВНИТЕ F1 И F2 КРСТОСКИ

Проучувани се шест родителски генотипови тутун (П-23, МБ-3, SM-1, JV 125/3, FL-5 и О-87) и нивните 15 дијалелни хибриди во F1 и F2 генерациите за својствата: висина на стракот без соцветие и број на листови по страк. Опитот беше поставен во текот на 2008 и 2009 година на опитното поле при Научниот институт за тутун-Прилеп, по случаен блок-систем во четири повторувања. При одгледувањето на тутунот се користеа стандардни агротехнички мерки.
Целта на истражувањата беше да направиме проценка на варијабилноста на својствата со помош на основните статистички параметри: стандардна девијација и степен на варијабилност.
Родителите и потомството на F1 генерацијата покажаа многу ниска варијабилност, што значи дека се одликуваат со висок степен на униформност. Кај потомството на F2 генерацијата е пресметана висока варијабилност, што укажува на постоење на различни индивидуи и можност за избор според желбата населекционерот. Највисока варијабилност за двете својства во двете години на истражување кај F2 генерацијата покажаа крстоските: П-23 х О-87 и П-23 х FL-5.

Клучни зборови:тутун (*Nicotiana tanacumL.*), наследност, варијабилност, стандардна девијација (σ), степен на варијабилност (V).

INTRODUCTION

Quantitative characters, just as all other characters of the living organisms, are inheritable and changeable to a certain limit. Changeability of the characters is called variability. Carriers of the characters are the genomes and the reason for their variability are changes of the environment. The breeding activity is based on previous measurements of characters and determination of the mean values and variability.

The aim of the two-year investigations was to study the inheritance of stalk height and leaf number per stalk in six parental genotypes and their diallel progeny in F1 and F2 generations and to estimate the variability using the basic statistical parameters - standard deviation (σ) and variability coefficient (V)

MATERIAL AND METHODS

Investigations included six tobacco genotypes - four oriental (Prilep P-23, Basma MB-3, Samsun SM-1, Yaka YV 125/3) and two semi-oriental (Floria FL-5, Otlia O-87).

15 diallel crosses for F1 were made, from which seed material for F2 generation was obtained. The trial was carried out in 2008 and 2009 in the field of Tobacco Institute-Prilep in a randomized block design with four replications. During the vegetation period, adequate cultural practices were applied on tobacco.

During tobacco vegetation in field (May - September) in 2008, mean monthly temperature was 19.91^{0}C, number of rainy days was 39 and total precipitation amount was 235.44 mm. In the same period in 2009, mean monthly temperature was 19.89^{0}C, number of rainy days 42 and total precipitation amount 240.6 mm.

Subject of the investigations were the characters stalk height without inflorescence and leaf number per stalk.

Determination of the mode of inheritance was based on test-significance of the mean values in F1 progeny compared to the parental average (Borojevic, 1981).

Standard deviation (σ) is an indicator of the variability of quantitative characters. It indicates the mean square deviation from the arithmetic mean and is a result obtained from the square root of the variance. It is calculated by the following formula:

$$\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n}} \qquad \sigma = \pm \sqrt{\sigma^2}$$

If the representative sample consists of lower number of individuals, the following formula is used:

$$\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$$

Standard deviation is expressed with the same measurement with which the investigated character is measured.

The degree of variability of characters is calculated from the standard deviation by the following formula:

$$V(\%) = \frac{\sigma \cdot 100}{\bar{x}}$$

The above formulas for calculation of standard deviation and variability coefficient were used by Najceska (2002).

RESULTS AND DISCUSSION

The two-year biometric investigations of parental genotypes for the characters stalk height without inflorescence and leaf number per stalk showed low standard deviation and low degree of variability, which is an indication of stability and uniformity as a result of their homozygotness. In both years of investigation, the lowest values for stalk height were recorded in YV 125/3, while for leaf number per stalk in SM-1 followed by O-87 in 2008 and O-87 followed by SM-1 in 2009 (Table 1).

Table 1. Mean value and variability of the characters stalk height and leaf number

Parentales	2008						2009					
	Stalk height (cm)			Leaf number per stalk			Stalk height (cm)			Leaf number per stalk		
	$\bar{x} \pm s\bar{x}$	σ	V (%)	$\bar{x} \pm s\bar{x}$	σ	V (%)	$\bar{x} \pm s\bar{x}$	σ	V (%)	$\bar{x} \pm s\bar{x}$	σ	V (%)
P1	78 ± 0,2	3,32	4,25	50 ± 0,1	2,10	4,19	79 ± 0,2	3,48	4,40	51 ± 0,1	2,15	4,22
P2	88 ± 0,3	4,00	4,54	32 ± 0,1	1,73	5,41	89 ± 0,3	4,34	4,88	32 ± 0,1	1,82	5,69
P3	91 ± 0,2	4,36	4,79	30 ± 0,1	1,02	3,40	90 ± 0,3	4,21	4,68	30 ± 0,1	1,28	4,27
P4	120 ± 0,3	3,16	2,63	42 ± 0,1	1,58	3,76	122 ± 0,3	3,27	2,68	44 ± 0,1	1,90	4,32
P5	125 ± 0,1	4,47	3,58	31 ± 0,1	1,48	4,78	126 ± 0,2	4,30	3,41	31 ± 0,1	1,54	4,97
P6	138 ± 0,2	4,00	2,90	33 ± 0,1	1,23	3,73	140 ± 0,2	3,95	2,82	32 ± 0,1	1,25	3,91

Legend:
$\bar{x}$ - Mean value
$s\bar{x}$ - Error of mean value (±)
σ - Standard deviation
V - Coefficient of variability (%).
P1 - Prilep P-23

P2 - Basma MB-3
P3 - Samsun SM-1
P4 - Yaka YV 125/3
P5 - Floria FL - 5
P6 - Otlia O-87

In F1 progeny obtained from homozygous parents, variability parameters of stalk height without inflorescence are very low. The most frequent way of inheritance of this character in both investigating years was partial dominance. Occurence of positive heterosis was observed in hybrids MB-3 x FL-5, YV 125/3 x FL-5 and FL-5 x O-87.

In F2 progenies segregation of characters appears, as a result of which there are differences among the individuals. Therefore, their standard deviation and degree of variability are higher as compared with F1. For breeders, higher variability also means higher possibility of choice. The highest variability for this character was observed in the hybrid P-23 x O-87. In F2 progeny, inheritance of this character was most frequently intermediate or partially dominant, which indicates its secure and fast stabilization in further selection (Tables 2 and 3).

Table 2. Mode of inheritance and variability of the character stalk height in F1 and F2 progenies in 2008

Hybrids	F1				F2			
	$\overline{x} \pm s\overline{x}$ (cm)		σ	V (%)	$\overline{x} \pm s\overline{x}$ (cm)		σ	V (%)
1. P-1 x P2	88,00 ± 1,02	+d	4,58	5,21	84,97 ± 1,14	pd	5,12	6,03
2. P-1 x P3	85,00 ± 0,87	i	3,87	4,56	85,55 ± 1,69	i	7,57	8,85
3. P-1 x P4	81,00 ± 0,91	-d	4,06	5,01	90,66 ± 1,55	pd	6,92	7,63
4. P-1 x P5	93,50 ± 1,12	pd	5,02	5,37	98,83 ± 3,48	i	15,57	15,76
5. P-1 x P6	85,50 ± 0,78	pd	3,50	4,09	96,45 ± 4,39	pd	19,62	20,34
6. P-2 x P3	90,25 ± 0,90	pd	4,02	4,46	89,35 ± 1,17	i	5,26	5,88
7. P-2 x P4	106,50 ± 0,94	i	4,21	3,96	105,05 ± 3,00	i	13,44	12,79
8. P-2 x P5	138,25 ± 0,89	+h	3,96	2,86	122,82 ± 1,86	+d	8,30	6,76
9. P-2 x P6	122,25 ± 0,90	pd	4,02	3,29	117,11 ± 3,50	i	15,67	13,38
10. P-3 x P4	100,00 ± 0,87	pd	3,87	3,87	103,64 ± 2,69	i	12,05	11,63
11. P-3 x P5	123,75 ± 0,48	+d	2,16	1,75	117,23 ± 3,11	pd	13,91	11,87
12. P-3 x P6	105,25 ± 0,90	pd	4,02	3,82	111,29 ± 3,06	i	13,68	12,29
13. P-4 x P5	130,75 ± 0,81	+h	3,63	2,78	128,35 ± 1,38	+h	6,19	4,82
14. P-4 x P6	125,50 ± 0,78	pd	3,50	2,79	127,41 ± 1,57	i	7,01	5,50
15. P-5 x P6	139,99 ± 0,91	+h	4,06	2,90	135,78 ± 1,81	pd	8,11	5,97

Table 3. Mode of inheritance and variability of the character stalk height in F1 and F2 progenies in 2009

Hybrids	F1				F2			
	$\overline{x} \pm s\overline{x}$ (cm)		σ	V (%)	$\overline{x} \pm s\overline{x}$ (cm)		σ	V (%)
1. P-1 x P2	89,14 ± 1,03	+d	4,42	4,96	85,82 ± 1,17	pd	6,95	8,10
2. P-1 x P3	85,27 ± 0,82	i	3,83	4,49	85,77 ± 1,57	i	7,84	9,14
3. P-1 x P4	81,68 ± 0,94	-d	4,26	5,22	92,43 ± 1,59	pd	7,46	8,07
4. P-1 x P5	94,36 ± 1,10	pd	5,00	5,30	97,99 ± 3,56	i	17,15	17,50
5. P-1 x P6	87,02 ± 0,75	pd	3,97	4,56	98,25 ± 4,47	pd	19,94	20,30
6. P-2 x P3	89,72 ± 0,92	pd	4,18	4,66	89,87 ± 1,22	pd	5,91	6,58
7. P-2 x P4	107,33 ± 0,91	i	4,25	3,96	107,14 ± 3,05	i	14,62	13,65
8. P-2 x P5	139,45 ± 0,83	+h	4,85	3,48	123,51 ± 1,93	+d	8,59	6,95
9. P-2 x P6	123,51 ± 0,90	pd	4,19	3,39	118,35 ± 3,41	i	15,87	13,41
10. P-3 x P4	99,97 ± 0,85	pd	3,93	3,93	104,52 ± 2,72	i	12,73	12,18
11. P-3 x P5	123,92 ± 0,45	+d	2,45	1,98	116,73 ± 3,28	pd	14,36	12,30
12. P-3 x P6	106,08 ± 0,94	pd	4,19	3,95	112,05 ± 3,15	i	14,52	12,96
13. P-4 x P5	133,48 ± 0,87	+h	3,84	2,88	126,08 ± 1,68	+d	6,99	5,54
14. P-4 x P6	126,21 ± 0,75	pd	3,48	2,76	127,57 ± 1,59	pd	7,28	5,71
15. P-5 x P6	142,55 ± 0,90	+h	3,22	2,26	136,86 ± 1,88	pd	8,03	6,87

Low variability of the character leaf number per stalk in F1 progeny was observed during the two-year investigations. Modes of inheritance differed, but the most frequently represented was partial dominance. Positive heterozis was observed in MB-3 x SM-1 and negative heterosis in P-23 x MB-3, MB-3 x O-87 and SM-1 x O-87. As a result of previously presented reasons, the progeny of this generation is uniform.

Variability parameters in F2 generation were higher, which indicaes inequality of individuals in relation to this character. Higher variability also denotes higher possibilities for selection. In both years of investigation, the highest values were achieved in the hybrids P-23 x SM-1, P-23 x YV 125/3, P-23 x FL-5 and P-23 x O-87. The most represented inheritance is partial dominance, followed by the intermediate mode (Tables 4 and 5).

Data presented in the tables show that mean values of the investigated characters with their statistical errors in 2008 are approximately the same with those of 2009. Variability parameters are almost identical in both investigating years. Meteorological reports also reveal that 2008 and 2009 were very similar in relation to their mean monthly temperatures and precipitation amounts from May to September. This points out to precise estimations and good performance of the trial.

Table 4. Mode of inheritance and variability of the character leaf number per stalk in F1 and F2 progenies in 2008

Hybrids	F1				F2			
	$\overline{x} \pm s\overline{x}$ (cm)		σ	V (%)	$\overline{x} \pm s\overline{x}$ (cm)		σ	V (%)
1. P-1 x P2	27,60 ± 0,19	-h	0,86	3,12	33,25 ± 0,79	-d	3,53	10,63
2. P-1 x P3	33,50 ± 0,29	pd	1,28	3,83	37,54 ± 1,23	i	5,50	14,65
3. P-1 x P4	41,75 ± 0,34	-d	1,51	3,62	43,87 ± 1,40	pd	6,27	14,29
4. P-1 x P5	36,70 ± 0,22	pd	1,00	2,74	39,62 ± 1,24	i	5,55	14,02
5. P-1 x P6	36,95 ± 0,22	pd	0,97	2,63	40,11 ± 1,21	i	5,43	13,54
6. P-2 x P3	32,30 ± 0,26	+h	1,19	3,68	30,40 ± 0,40	pd	1,79	5,90
7. P-2 x P4	32,70 ± 0,28	-d	1,27	3,88	34,79 ± 0,40	pd	1,80	5,19
8. P-2 x P5	31,10 ± 0,31	-d	1,41	4,54	30,96 ± 0,36	-d	1,63	5,26
9. P-2 x P6	29,50 ± 0,33	-h	1,50	5,08	31,93 ± 0,37	-d	1,65	5,17
10. P-3 x P4	34,85 ± 0,21	i	0,96	2,76	35,17 ± 0,60	i	2,67	7,59
11. P-3 x P5	30,20 ± 0,36	pd	1,63	5,40	30,18 ± 0,80	pd	3,59	11,89
12. P-3 x P6	29,45 ± 0,30	-h	1,32	4,49	31,21 ± 0,95	i	4,25	13,61
13. P-4 x P5	33,15 ± 0,26	pd	1,15	3,48	34,00 ± 0,94	pd	4,22	12,41
14. P-4 x P6	35,05 ± 0,23	pd	1,02	2,92	36,78 ± 0,89	i	3,96	10,78
15. P-5 x P6	31,55 ± 0,22	pd	0,97	3,08	31,30 ± 0,55	pd	2,45	7,83

Table 5. Mode of inheritance and variability of the character leaf number per stalk in F1 and F2 progenies in 2009

Hybrids	F1				F2			
	$\bar{x} \pm s\bar{x}$ (cm)		σ	V (%)	$\bar{x} \pm s\bar{x}$ (cm)		σ	V (%)
1. P-1 x P2	28,54 ± 0,21	-h	0,95	3,33	33,35 ± 1,09	-d	3,93	11,78
2. P-1 x P3	34,36 ± 0,31	pd	1,28	3,72	38,87 ± 1,13	i	5,42	13,94
3. P-1 x P4	43,58 ± 0,35	-d	1,44	3,30	44,91 ± 1,54	pd	6,76	15,05
4. P-1 x P5	37,75 ± 0,38	pd	1,27	3,36	40,89 ± 1,15	i	6,04	14,77
5. P-1 x P6	37,15 ± 0,33	pd	1,07	2,88	40,25 ± 1,37	i	5,92	14,71
6. P-2 x P3	34,84 ± 0,18	+h	1,26	3,62	31,24 ± 0,58	i	2,08	6,66
7. P-2 x P4	31,98 ± 0,19	-d	1,35	4,22	35,57 ± 0,67	pd	2,14	6,02
8. P-2 x P5	31,49 ± 0,27	i	1,54	4,89	31,86 ± 0,35	pd	2,18	6,84
9. P-2 x P6	30,05 ± 0,29	-h	1,68	5,59	31,32 ± 0,45	-h	1,99	6,35
10. P-3 x P4	35,65 ± 0,21	i	1,09	3,06	34,97 ± 0,86	pd	2,85	8,15
11. P-3 x P5	31,01 ± 0,36	-d	1,54	4,97	29,87 ± 0,92	-d	3,95	13,22
12. P-3 x P6	28,93 ± 0,30	-h	1,42	4,91	31,32 ± 1,00	pd	4,06	12,96
13. P-4 x P5	33,58 ± 0,25	pd	1,27	3,78	35,84 ± 0,82	pd	4,58	12,78
14. P-4 x P6	35,62 ± 0,25	pd	1,19	3,34	36,24 ± 0,79	pd	3,81	10,51
15. P-5 x P6	31,42 ± 0,20	i	1,08	3,44	31,83 ± 0,78	pd	2,62	8,23

CONCLUSIONS

Based on the results of investigation, the following statements can be drawn:

- Inheritance of the characters stalk height without inflorescence and leaf number per stalk in six parental genotypes with their 15 F1 and 15 F2 hybrids is performed in different ways, but partial dominance and intermediate mode are dominating. Positive heterosis in F1 progeny for stalk height appears in MB-3 x FL-5, YV 125/3 x FL-5 and FL-5 x O-87, and for leaf number per stalk in MB-3 x SM-1. Negative heterotic effect appears only for leaf number per stalk in P-23 x MB-3, MB-3 x O-87 and SM-1 x O-87.

- Parental genotypes have a low standard deviation and variability of the investigated characters, which indicates high genetic homogeneity.

- Low variability of the characters in F1 progeny indicates high uniformity.

- Standard deviation and degree of variance for F2 progeny are significantly higher as compared with F1, which denotes that this generation offers a possibility for selection of individuals and improving the characters in further selection work. The highest variability for the two characters in F2 generation in both investigating years was estimated in the hybrids : P-23 x O-87 and P-23 x FL-5.

REFERENCES

- Borojević S., 1981. Principi i metode oplemenivanja bilja. Ćirpanov, Novi Sad.

- Najčevska C., 2002. Eksperimentalna statistika primeneta vo zemjodelskite i biološkite istražuvanja. Bona, Skopje.