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PLANT BREEDING FOR CREATION OF LATE – MATURING ORIENTAL TOBACCO GENOTYPES

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ABSTRACT

Investigations were made with six oriental varieties of tobacco types Prilep, Djebel and Yaka (P-23, P-84, P10-3/2, P-76, Xanthi Djebel 1 and YV 125/3) and fifteen F1 hybrids for the characters flowering time and length of growing season from tobacco transplanting in field to the end of harvest. The field trial was set up in 2010 and 2011 in Tobacco Institute – Prilep in a randomized block design with four replications. All appropriate cultural practices were applied during the growing season. Statistical processing of data was performed by using the analysis of variance (ANOVA)

The aim of this work was to study the mode of inheritance and to detect possible heterotic effects for the above biological characters, which will allow a selection of lines with longer growing season, higher productivity and some other positive characters inherited from the early-maturing parent. They would be promising genotypes intended for arid regions with poorer soils and longer growing season.

The period from tobacco transplanting to 50% flowering in parental varieties ranged from 45 to 95 days in Xanthi Djebel-1 (XDj-1) and in P-76, respectively, while the period from transplanting to the end of leaf harvesting in these two genotypes ranged from 70 to 145 days. There were differences in inheritance of the two stages among hybrids. The most common types of inheritance were partial dominance and dominance. The early-maturing parent dominated in the first period, while the late-maturing parent dominated in the second period and there was also an appearance of heterosis.

Keywords: tobacco, diallel crosses, mode of inheritance, biological stages

СЕЛЕКЦИЈА ЗА КРЕИРАЊЕ НА ПОКАСНОСТАСНИ ГЕНОТИПОВИ ТУТУН

Испитувани беа шест ориенталски сорти од типовите прилеп, џебел и јака (П-23, П-84, П10-3/2, П-76, Ксанти Џебел-1 и ЈВ 125/3) и нивните 15 дијалелни F_1 хибриди за својствата време на цветање и должина на вегетациониот период од расадување на тутунот на нива до крајот на бербата. Опитот беше поставен во 2010 и 2011 година на опитното поле при Научниот институт за тутун - Прилеп по случаен блок - систем во четири повторувања. Во текот на вегетацијата беа применети соодветни агротехнички мерки. Податоците беа статистички обработени со анализа на варијансата (Anova).

Целта на овој труд беше да се проучи начинот на наследување и да се открие можен хетеротичен ефект за наведените биолошки својства, со што ќе се овозможи избор на линии со подолг вегетационен период, повисока продуктивност, но и со повеќе други позитивни особини наследени од раностасниот родител. Тоа би биле перспективни генотипови наменети за аридни подрачја, посиромашни почви и долга вегетација.

Периодот од расадување на тутунот до цветање на 50% од насадот кај родителските сорти се движеше од 45 (Ксанти Џебел-1) до 95 дена (П-76), додека периодот од расадување до завршување со бербата на листовите се движеше од 70 до 145 дена кај истите генотипови. Наследувањето на двете етапи кај

крстоските беше различно. Најчест начин на наследување бече парцијално-доминантниот и доминантниот. Во првиот период доминираше пораностасниот родител, додека во вториот период доминираше покасностасниот родител, а имаше и појава на хетерозис.

Клучни зборови: тутун, дијалелни крстоски, начин на наследување, биолошки фази

INTRODUCTION

The activity of breeders is directed toward increasing the yield, quality and resistance, but they also monitor the length of growth period in various genotypes and provide directives for their cultivation in different localities. Tobacco is a crop that can be grown at different altitudes and in areas with different soil and climate conditions, but the variety is the key factor which will give the maximum genetic potential in particular environment.

The aim of this paper comes from the necessity that varietal regionalization in the Republic of Macedonia should be followed by creation of tobacco genotypes with longer growth period, higher yield and better quality, suitable for arid areas, poor soils and longer vegetation.

MATERIAL AND METHOD

To study the mode of inheritance of the time of flowering and length of growth period from planting in field to the end of harvest, one-way diallel crossings were made between six oriental varieties of the types: Prilep (P-23, P-84, P 10-3/2, P 76/86), Djebel (Xanthi Djebel XDj-1) and Yaka (YV 125/3). The choice of parents was made on the basis of previous studies on tobacco varieties produced in R. Macedonia.

Crossings were made in 2009 and 2010, with manual castration and pollination. In 2010 and 2011, a trial was set up on the Experimental field of Tobacco Institute - Prilep with 6 parental genotypes and their 15 F1 hybrids, in randomized block design with four replications. The inter-row spacing was 45 cm, and plant spacing 15 cm. Variants in each replication were planted in four rows, i.e. 16 rows in the whole trial. Cultural practices applied during the growing period were as usual for production of oriental aromatic tobaccos.

General characteristics of parental genotypes

Prilep P-23 is characterized by ellipticalal - conical (fir-tree shaped) habitus, approximately 65 cm in height and with 45-50 sessile leaves (20 cm x 10.5 cm), densely distributed on stalk (Korubin - Aleksoska, 2004-a). Leaves are small, very gentle, with poorly defined nervation and intensive pleasant aroma. The dry mass yield is 2000-2500kg/ha (Ph. 1).

Prilep P-84 is characterized by cylindrical to elongated elliptical habitus, approximately 65 cm in height, with 38-42 sessile leaves (20 cm x 10 cm), evenly distributed on stalk (Korubin - Aleksoska, 2004-a). The leaves are gentle, with marked nervation and pleasant aroma. The dry mass yield is 2500-3200kg/ha (Ph. 2).

Prilep P 10-3/2 is characterized by cup-like habitus, approximately 50 cm high, with 30-36 sessile leaves (21.5 cm x 10 cm), densely distributed (Korubin - Aleksoska, 2004-a). The leaves are gentle, with marked nervation and intensive aroma. The dry mass yield is 1100-1300kg/ha (Ph. 3).

Prilep P 76/86 is characterized by elliptical - conical habitus, approximately 90 cm high, with 60 densely distributed sessile leaves (23 cm x 11.5 cm) and with pleasant aroma (Korubin - Aleksoska, 2004-a). The leaves are with strongly expressed nervation and dark green color. The dry mass yield is 3500-4000 kg / ha (Ph. 4).

Xanthi Djebel XDj - 1 is characterized by elliptical habitus (Korubin - Aleksoska & Aleksoski, 2011). The average stalk height is 65 cm, with approximately 17 sessile leaves (17cm x 8.4 cm), with pleasant aroma, oval shape and slightly curved tip. The dry mass yield is 500-700 kg/ha (Ph. 5).

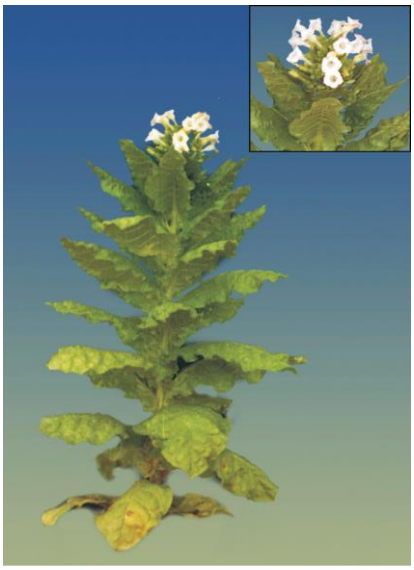
Yaka YV 125/3 is characterized by elliptical to cylindrical habitus . The average stalk height is 120 cm (Korubin - Aleksoska, 2004-b). It has approximately 40 sessile leaves (21.6 cm x 11.2 cm), with very pleasant aroma. The dry mass yield is 1500-1800 kg/ha (Ph. 6).

Processing of results

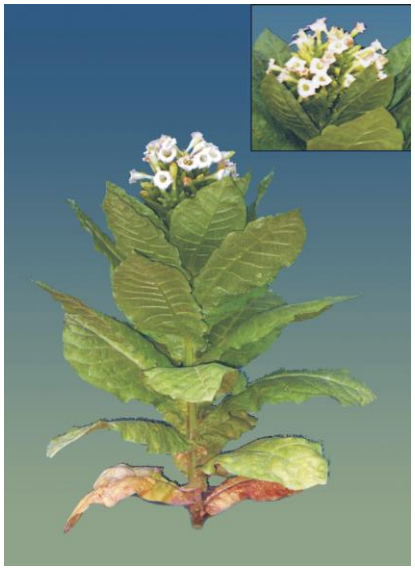
Data obtained for the traits time of flowering (from transplanting to beginning of flowering and to the stage when half of the plants are in blossom) and length of the growth period from transplanting tobacco in field to the end of harvest are processed statistically by the method of analysis of variance.

Mode of inheritance of investigated biological traits is evaluated on the basis of test - significance of the mean values of F1 progeny compared to parental average (Boroevic, 1981).

Ph. 1. Prilep P23



Ph. 2. Prilep P-84



Ph. 3. Prilep P 10-3/2

Ph. 4. Prilep P 76/86

Ph. 5. Xanthi Djebel XDj-1

Ph. 6. Yaka YV 125/3

Meteorological data

From May to September 2010, during the growth period of tobacco, the mean monthly temperature was 18.9 ^{0} C, mean monthly relative humidity was 56 % and rainfall amount in 35 days was 298 l/m².

In the same period in 2011, the mean monthly temperature was 19.04 ^{0} C, mean monthly relative humidity was 48.6 % and rainfall amount in 32 days was 180 l/m².

The above data on weather parameters were obtained from the Meteorological station located in the Experimental field of Tobacco Institute – Prilep.

RESULTS AND DISCUSSION

Parents and their F1 hybrids were transplanted on June 10 and June 15 in 2010 and 2011, respectively, but their further development was different (Table 1).

XDj - 1 variety is characterized by the shortest growth period. It begins to flower 43 days after planting and 50% of plants in plots blossom in four days. The period from planting to the end of harvest is 70 days. Variety P 76/86 has the longest growth period. Beginning of flowering stage in this variety occurs 90 days after planting and 50% of plants blossom in five days. Number of days from planting to the end of harvest is 145.

Hybrids with the shortest period to the beginning of flowering are: P-23 x XDj-1 (2010-45 days, 2011 - 46 days), P 10-3/2 x XDj-1 (2010 and 2011-45 days), XDj-1 x YV 125/3 (2010-45 days, 2011 - 44 days) and P-84 x XDj-1 (2010-46 days, 2011 – 43 days). In all of them, one parent is the early maturing variety XDj - 1. The longest period to the beginning of flowering was recorded in P 76/86 x YV 125/3 (2010-70 days, 2011-68 days).

The shortest period from planting to 50% flowering was observed in P-23 x XDj-1 (2010-48 days, 2011-47 days), in P 10-3/2 x XDj - 1 (2010 - 49 days, 2011 - 48 days) and XDj-1 x YV 125/3 (2010 and 2011-49 days). This period was the longest in P 76/86 x YV 125/3 (2010-75 days, 2011 - 73 days).

Period from planting to the end of harvest was the shortest in P-23 x XDj - 1 (2010 and 2011-100 days) and longest in P 76/86 x YV 125/3 (2010-150 days, 2011-148 days).

The most common mode of inheritance of biological traits in both years of investigations is partial dominance. Inheritance of the time to flowering (from planting to the beginning of flowering and from planting to 50 % flowering) does not coincide with inheritance of the time from planting to the end of harvest. For the time of flowering, dominant parent is the one with shorter vegetation, while for the time from planting to the end of harvest it is the late maturing parent. Negative heterosis with poor heterotic effect for the time of flowering was observed in P-84 x P 10-3/2, while for the time from planting to the end of harvest positive heterosis with poor heterotic effect occurs in P-23 x YV 125/3, P-84 x YV 125/3 and P 76/86 x YV 125/3 in both years of investigation. In all three hybrids where heterosis is present, variety YV 125/3 is one of the parents.

Numerous authors point out that the use of heterosis for yield increase in hybrids obtained from oriental tobacco is economically unjustified. Our investigations are related to the negative (for early maturation) and positive heterosis (for late maturation) which, due to their poor heterotic effect, supports the above statement.

The aim of our investigation was to create lines with longer growth period than the early-maturing parent, higher yield and better quality. For realization of this aim, the following hybrids should be pointed out: P-23 x XDj-1, P-84 x XDj-1, P 10-3/2 x XDj-1, P 76/86 x XDj-1 and XDj-1 x JV 125/3. In all these combinations, one of the parents is XDj-1, distinguished by a very pleasant aroma, low yield and shortest growth period (70 days from planting to the end of harvest). The inheritance of the length of growth period is partially dominant and positively dominant, and is dominated by the parent with longer growth period. This mode of inheritance ensures fast stabilization of the trait in future successive selection, aiming at the same time at yield and quality improvement. Such breeding activity will finally result in creation of prospective tobacco genotypes, suitable for arid area, poor soils and longer growth period.

Table 1. Inheritance of the time from transplanting to flowering and the length of growth period from transplanting to the end of harvest in some tobacco varieties and their diallel F1 hybrids

Parents and diallel F1 hybrids	Transplanting date: 10.06.2010			Transplanting date: 15.06.2011		
	Days to the beginning of flowering	Days to 50% flowering	Days to the end of flowering	Days to the beginning of flowering	Days to 50% flowering	Days to the end of flowering
P-23	50	53	115	48	51	110
P-84	59	64	135	60	64	135
P 10-3/2	54	58	110	50	55	105
P 76/86	90	95	145	87	92	143
XDj-1	43	47	70	40	45	70
YV 125/3	57	62	120	55	60	117
P-23 x P-84	50 -d	55 pd	133 +d	48 -d	52 -d	132 +d
P-23 x P 10-3/2	50 -d	53 -d	115 +d	48 -d	51 -d	110 +d
P-23 x P 76/86	60 pd	63 pd	135 pd	58 pd	62 pd	135 pd
P-23 x XDj-1	45 pd	48 pd	100 pd	46 pd	47 pd	100 pd
P-23 x YV 125/3	51 pd	55 pd	125 +h	50 pd	55 i	123 +h
P-84 x P 10-3/2	53 -h	57 -h	125 i	48 -h	56 -d	122 i
P-84 x P 76/86	60 -d	65 -d	143 pd	58 -d	63 -d	140 i
P-84 x XDj-1	46 pd	50 pd	120 pd	43 pd	49 pd	120 pd
P-84 x YV 125/3	57 -d	61 -d	140 +h	55 -d	60 -d	138 +h
P 10-3/2 x P 76/86	60 pd	65 pd	141 +d	60 pd	64 pd	139 +d
P 10-3/2 x XDj-1	45 pd	49 pd	105 +d	45 i	48 pd	105 +d
P 10-3/2 x YV 125/3	54 -d	59 pd	118 pd	54 pd	58 i	115 pd
P 76/86 x XDj-1	60 pd	65 i	120 pd	58 i	62 pd	118 pd
P 76/86 x YV 125/3	70 i	75 i	150 +h	68 i	73 i	148 +h
XDj-1 x YV 125/3	45 pd	49 pd	125 +d	44 pd	49 pd	122 +d

CONCLUSIONS

Based on the results of two-year investigations on the mode of inheritance of the time from planting to flowering of tobacco (beginning stage and 50 % flowering) and length of the growth period from planting to the end of harvest in six oriental varieties and their fifteen F1 diallel hybrids, the following conclusions can be drown:

- Parental genotypes P-23, P-84, P 10-3/2, P 76/86, XDj-1 and YV 125/3 are characterized by genetic homogeneity and significant differences among them, while in

their diallel F1 progeny a high degree of uniformity was observed.

- The period from transplanting the seedlings in the field to the beginning of flowering in parents ranged from 40 days (2011) in the early-maturing variety XDj-1 to 90 days (2010) in the late-maturing P 76/86. In hybrids this period ranges from 43 days (2011) in P-84 x XDj-1 to 70 days (2010) in P 76/86 x YV 125/3. The period from planting to 50% flowering in parents ranges from 45 days (2011) in XDj-1 to 95 days (2010) in P 76/86 and in hybrids it is 47 days (2011) in P-23 x XDj-1 to 75 days (2010) in P 76/86 x YV 125/3. The period from planting the seedlings in the field to the end of harvest in parents ranges from 70 days (2010 and 2011) in XDj-1 to 145 days (2010) in P 76/86, and in hybrids it is 100 days (2010 and 2011) in P-23 x XDj-1 to 150 days (2010) in P 76/86 x YV 125/3.
- The mode of inheritance of biological stages in F1 progeny differs, but partial dominance is the most common. Inheritance of the time of flowering is dominated by the early-maturing parent, and the period from transplanting to the end of harvest is dominated by the late-maturing parent. Negative heterosis with poor heterotic effect on the time of flowering was recorded in P-84 x P 10-3/2. Positive heterosis with weak heterotic effect for the time from planting to the end of harvest in both years of investigation was recorded in hybrids where one of the parent was YV 125/3 (P-23 x YV 125/3, P-84 x YV 125/3 and P 76/86 x YV 125/3). The use of heterosis is economically unjustified, due to the poor heterotic effect and to the fact that our subject of investigation were oriental, small-leaf tobacco hybrids.
- For realization of the aim of our investigation we would point out to the hybrids where one of the parents is XDj-1, which has the shortest growth period, very pleasant aroma and low yield. Their F1 progeny has much longer growth period than the early-maturing parent. The inheritance is partial-dominant and dominant (dominated by the late-maturing parent), and it ensures rapid stabilization of the trait in future successive selection, aiming at the same time at increasing the yield and quality.

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