

TRANSMITEREA ÎN DESCENDENȚĂ A CARACTERISTICILOR „PRODUȚIA DE FRUCTE” ȘI „GREUTATEA FRUCTELOR” LA HIBRIZII F₁ DE PRUN INHERITANCE OF „FRUIT YIELD” AND „FRUIT WEIGHT” IN F₁ LINEAGE IN *PRUNUS DOMESTICA*

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Abstract

Genetic breeding of the plum cultivars has been a major concern for the Romanian researchers in fruit culture having in view the economic importance of this species which holds over 40% of the total Romanian's fruit yields. Growing demands on the fruit quantity and quality required to improve diversification and breeding and selection methods of varieties. During 2008 – 2010 period, have been investigated 230 seedling hybrids derived from 14 cross combinations made in 1997 and 1998, regarding the production and fruit weight. Analyzing this 14 hybrid families, from cross pollination between different cultivars, a very large difference between seedlings was observed, inside and between the families. Out from the total of 223 investigated seedlings, 83 have been assigned to the classes 3 and 4 – productive and very productive (between 10 and 20 kg/tree). Regarding the fruit size, 60 seedlings have been assigned to the class 7 – large fruit (41 – 55 g). So, taking into account these results, it can be concluded that differences between seedlings are of a genetic nature and the selection, even if difficult for these characteristics, is possible and recommended.

Key words: *Prunus domestica* L., fruit weight, production, inheritance, F₁ hybrid

Cuvinte cheie: *Prunus domestica* L., greutatea fruct, productie, descendenta, hibrid F₁

1. Introduction

Genetic breeding of the plum cultivars has been a major concern of the Romanian researchers in fruit culture having in view the economic importance of this species which holds over 40% of the total fruit yield of the our country (Dragoi, 2000).

Growing demands on the fruit quantity and quality required to improve the diversification and breeding and selection methods of varieties.

For traits „fruit yield” and „fruit weight”, the best genitors, the best hybrid families and progenies within the families were involved.

2. Material and methods

To screen the inheritance of „fruit yield” and „fruit weight” characteristics and the means of developing valuable cultivars with this character, the investigations either for families or within them (F₁ progenies, 1997, 1998 generations) were performed in the selection field of the Genetic and Breeding Lab. at RIFG Pitesti - Maracineni (Butac, 2009). Therefore, 223 F₁ hybrids resulted from 14 hybrid crosses were investigated, evaluating their production and fruit weight, rated on a 6 class scale, as follows:

- for yield capacity the genotypes were evaluated by a scale performed in the Genetics and Breeding Department: 0 – without production; 1 – low production (less than 5 kg/tree), 2 – medium production (5-10 kg/tree), 3 – productive (10 – 15 kg/tree), 4 – very productive (15 – 20 kg/tree), 5 – extremely productive (20 – 30 kg/tree).

- for fruit weight we used Descriptors according Genres 61 Project; EPDB) as follows: 1. very small - under 10 g (Mirabelle de Metz); 3. Small - 11-25 g (Early Rivers, Bonne de Bry); 5. Medium -26-40 g (Reine Claude Verte, Ruth Gerstetter); 7. Large - 41-55 g (California Blue, Reine Claude d'Oullins) ; 8. Very large - 56-70 g (Yakima, President); 9. Extremely large – over 70 g (Record).

To develop these hybrids, crosses were performed between different genotypes (tables 1 and 2), using the cross pollination employed in breeding (Cociu, 1989).

The data were statistically expressed, calculating the following statistical indexes: mathematic average, variation coefficient and genetic gain (Botu et al, 1997).

3. Results and discussions

The study of the progenies per each family, and within, was conducted in the selection field (Cociu et al., 1992).

During 2006-2008 period, 223 hybrids from 14 hybrid crosses were investigated assessing their production and fruit weight, on a 6 class variability scale. Analyzing the 14 hybrid families resulted from the crosses between low production ('Tuleu timpuriu', 'Early Rivers', 'Diana') and very productive ('Stanley', 'Carpatin', 'Centenar', 'Grase romanesti') genotypes, between small and medium fruit ('Tuleu gras', 'd'Agen', 'Grase romanesti') and large fruit ('Record', 'Diana', 'Carpatin', 'Tita'), genotypes – tables 1 and 2 – were noticed great differences between progenies, both between the families or within them.

That fact demonstrates that the differences between the hybrids are genetically, and although the selection may be difficult it is still possible and recommended.

This within the hybrid population mode of 223 hybrids resulted from the 14 hybrid crosses (1997, 1998 series), the highest number of progenies with production over 10 kg/tree (VII years after planting), were given by the families Record x Stanley (11 hybrids of 84.62% respectively) and Record x Early Rivers (7 hybrids with production between 15 – 20 kg/tree) - table 3.a. It is noticed that a good percentage of productive hybrids will be obtained when at least one of the genitors has a high productivity.

The families which recorded the highest production (average per cross) were Record x Early Rivers (3.71 score) and Record x Stanley (3.00 score) and the lowest production was recorded with the families Tuleu gras x Silvia (0.77), d'Agen x Diana (1.27 score) and Tuleu gras x Grase romanesti, Minerva x d'Agen, Tuleu timpuriu x Stanley (1.33 score) (Tabel 3.b). The variability coefficient calculated per each hybrid family show a very high percentages ranging from 13.13% (Record x Early Rivers) up to 101.82% (Tuleu gras x Silvia) which means a great variability within the hybrid population and therefore a more difficult selection task (table 3.a).

The families which recorded the highest number of progenies without production in seven years after planting are Tuleu gras x Silvia, Tuleu timpuriu x Stanley.

The results of screening for the parental genotypes emphasized their different behavior related to the sex involved. So, there are female genitors who highly transmit the high productivity, such as: 'Record', 'Stanley', 'Tuleu gras', 'Centenar', 'Tita' and also male genitors like 'Stanley', 'Bluefree', 'Silvia', 'Early Rivers'.

The most productive hybrids were: H 20/30, H 20/36, H 20/45 (Record x Early Rivers) H 20/48, H 20/52, H 20/53, H 20/64, H 20 / 66 (Record x Stanley), H 19 / 1, H 19 / 4 (Tita x Stanley), which had yields between 15 and 20 kg / tree. Assuming the selection of the best family hybrid genetic gain was calculated. Thus, compared with the average hybrid population, could get a genetic gain of 116.96% (Record x Early Rivers) 75.44% (Record x Stanley) families, for the characteristic productivity (Table 3.b).

Regarding the fruit weight, in hybrid population of 223 hybrids resulted from 14 hybrid crosses (1997 and 1998 series), the highest number of progenies with large fruits (over 45 g) were given by the families Carpatin x Silvia (all hybrids are including in 7 class with fruit size between 41 and 55 g), Tita x Stanley (6 hybrids in 7 class), Record x Stanley (9 hybrids in 7 class and one in 8 class), Record x Early Rivers (all the hybrids in 7 class) (Table 4.a).

It is known that for the fruit weight the stronger influence on the progenies it is exercised by the female genitors and the cumulative effect of both maternal parents (Cociu et al., 1992, Dragoi, 2000). There are cases when the parents have a greater influence pattern. That is hybrid crosses d'Agen x Diana, Minerva x Bluefree.

It is remarked that in the hybrid progenies derived from families Tuleu gras x Stanley and Minerva x d'Agen, there are hybrids with large fruit, average fruit weight exceeded of both parents. The greatest number of hybrids with small fruit was recorded in hybrid families Tuleu gras x Silvia and Tuleu timpuriu x Stanley.

The families which recorded the largest fruit (average per cross) were Record x Early Rivers (class 7) and Carpatin x Silvia (class 7) and the smallest fruit was recorded with the families Tuleu gras x Silvia (4.46), Tuleu timpuriu x Stanley (4.90) (Table 4.b). The variability coefficient calculated per each hybrid family show a very high percentages ranging from 0.0% (Carpatin x Silvia) to 31.41% (Tuleu gras x Silvia) which means a medium variability within the hybrid population and therefore reduced opportunities of selection versus productivity features (table 4.a).

Analyzing the classes of the genitors and their progenies, there are genitors who highly transmit the characteristic fruit weight. So, were noted like female genitors for large and very large fruit the following cultivars: 'Carpatin', 'Silvia', 'Record', 'Tita', and also male genitors like 'Silvia' and 'Diana'. The best hybrids were: H 20/37, H 20/40 (Record x Early Rivers); H 20/50, H 20/52, H 20/53, H 20/55 (Record x Stanley); H 19/5, H 19/4, H 19/7 (Tita x Stanley), H 5/36 (Tuleu gras x Silvia), H 10/101 (Centenar x Silvia), which have fruits over 45g.

Compared with average hybrid population, a high genetic gain was recorded at the following hybrid crosses: Record x Early Rivers (21.32%), Carpatin x Silvia (21.32%) and Record x Stanley (14.74%) (Table 4.b).

Regarding the fruit yield and fruit weight, the following hybrids demonstrate to be the best: H 19/4 = Stanley x Tita; H 20/36 = Record x Early Rivers and H 20/52 = Record x Stanley. These promising selections were grafted on myrobalan rootstock and promoted in the microfield trials for the test of productivity and stability for positive characters.

4. Conclusions

For traits „fruit yield” and „fruit size”, the best genitors, the best hybrid families and progenies within the families were involved.

So, for productivity, the best genitors were ‘Stanley’, ‘Tuleu gras’, ‘Centenar’, ‘Tita’ – as female genitors; ‘Stanley’, ‘Bluefree’, ‘Silvia’, ‘Early Rivers’ – as male genitors. The best hybrid families were: Record x Early Rivers and Record x Stanley. The best hybrids were: H 20/30, H 20/36, H 20/45 (Record x Early Rivers); H 20/48, H 20/52, H 20/53, H 20/64, H 20/66 (Record x Stanley); H 19/1, H 19/4 (Tita x Stanley), which have production between 15 up to 20 kg/tree.

For fruit weight the best genitors were: ‘Carpatin’, ‘Tita’, ‘Record’ – like female genitors; ‘Silvia’, ‘Diana’ – like male genitors. The best hybrid families were: Carpatin x Silvia, Tita x Stanley, Record x Early Rivers and Record x Stanley. The best hybrids were: H 20/36, H 20/40 (Record x Early Rivers); H 20/50, H 20/52, H 20/53, H 20/55 (Record x Stanley); H 19/5, H 19/4, H 19/7 (Tita x Stanley), H 5/36 (Tuleu gras x Silvia), H 10/101 (Centenar x Silvia), which have fruits over 45g.

Regarding the fruit yield and fruit weight, the following hybrids demonstrate to be the best: H 19/4 = Stanley x Tita; H 20/36 = Record x Early Rivers and H 20/52 = Record x Stanley. These promising selections were grafted on myrobalan rootstock and promoted in the microfield trials

5. References

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Tables and figures

Table 1. Distribution per productivity classes of the genitors used in breeding

No.	Cultivar	Distribution per homogeneous classes				
		1	2	3	4	5
1	Tuleu timpuriu	*				
2	Stanley					*
3	Carpatin					*
4	Tuleu gras				*	
5	Tita				*	
6	Minerva				*	
7	Record				*	
8	Centenar					*
9	Early Rivers			*		
10	Ruth Gerstetter			*		
11	Agen				*	
12	Silvia				*	
13	Diana		*			
14	Grase romanesti					*
15	Bluefree			*		

Table 2. Distribution per fruit size classes of the genitors used in breeding

No.	Cultivar	Distribution per homogeneous classes					
		1	3	5	7	8	9
1	Tuleu timpuriu			*			
2	Stanley			*			
3	Carpatin				*		
4	Tuleu gras		*				
5	Tita				*		
6	Minerva			*			
7	Record						*
8	Centenar			*			
9	Early Rivers			*			
10	Ruth Gerstetter			*			
11	Agen		*				
12	Silvia				*		
13	Diana					*	
14	Grase romanesti		*		*		
15	Bluefree					*	

Table 3.a. Distribution per productivity classes of progenies under study (1997 and 1998 series)

No.	Hybrid cross	No. of trees	No. of hybrids per homogenous classes						S%
			0	1	2	3	4	5	
1	Tuleu timpuriu x Ruth Gerstetter	7	-	4	1	2	-	-	53.63
2	Stanley x d'Agen	25	-	19	3	3	-	-	51.47
3	Carpatin x Silvia	15	-	9	5	1	-	-	43.63
4	Tuleu gras x Stanley	8	-	4	2	2	-	-	50.65
5	d'Agen x Diana	30	-	23	6	1	-	-	41.12
6	Tuleu gras x Grase romanesti	6	1	3	2	-	-	-	38.73
7	Tita x Stanley	9	-	5	2	2	-	-	51.96
8	Minerva x d'Agen	6	1	3	2	-	-	-	38.73
9	Minerva x Bluefree	6	1	2	3	-	-	-	36.51
10	Record x Early Rivers	7	-	-	-	2	5	-	13.13
11	Record x Stanley	13	-	-	2	9	2	-	19.25
12	Centenar x Silvia	7	-	4	1	2	-	-	55.48
13	Tuleu gras x Silvia	63	26	27	8	2	-	-	101.82
14	Tuleu timpuriu x Stanley	21	5	9	2	5	-	-	83.29
	TOTAL	223	34	112	39	31	7	-	48.53

Table 3.b. Statistical indexes on yielding capacity at the hybrid crosses performed in 1997 and 1998

No.	Hybrid cross	Average per cross	Genetic gain (%)
1	Record x Early Rivers	3.71	116.96
2	Record x Stanley	3.00	75.44
3	Tuleu timpuriu x Ruth Gerstetter	1.83	7.02
4	Tuleu gras x Stanley	1.75	
5	Centenar x Silvia	1.71	
6	Tita x Stanley	1.66	
7	Minerva x Bluefree	1.50	
8	Carpatin x Silvia	1.47	
9	Stanley x d'Agen	1.36	
10	Tuleu gras x Grase romanesti	1.33	
11	Minerva x d'Agen	1.33	
12	Tuleu timpuriu x Stanley	1.33	
13	d'Agen x Diana	1.27	
14	Tuleu gras x Silvia	0.77	
	Average per hybrid population	1.71	

Table 4.a. Distribution per fruit size classes of progenies under study (1997 and 1998 series)

No.	Hybrid cross	No. of trees	No. of hybrids per homogenous classes						S %
			1	3	5	7	8	9	
1	Tuleu timpuriu x Ruth Gerstetter	7	-	-	4	3	-	-	18.25
2	Stanley x d'Agen	25	-	-	22	3	-	-	12.66
3	Carpatin x Silvia	15	-	-	-	15	-	-	0.00
4	Tuleu gras x Stanley	8	-	-	7	1	-	-	13.47
5	d'Agen x Diana	30	-	-	26	4	-	-	13.13
6	Tuleu gras x Grase romanesti	6	-	-	4	2	-	-	18.22
7	Tita x Stanley	9	-	-	3	6	-	-	15.78
8	Minerva x d'Agen	6	-	-	5	1	-	-	15.31
9	Minerva x Bluefree	6	-	-	2	4	-	-	16.31
10	Record x Early Rivers	7	-	-	-	7	-	-	0.00
11	Record x Stanley	13	-	-	3	9	1	-	14.52
12	Centenar x Silvia	7	-	-	5	2	-	-	17.52
13	Tuleu gras x Silvia	63	-	26	28	9	-	-	31.40
14	Tuleu timpuriu x Stanley	21	-	5	12	4	-	-	27.28
	TOTAL	223		31	121	70	1		15.27

Table 4.b. Statistical indexes on fruit size at the hybrid crosses performed in 1997 and 1998

No.	Hybrid cross	Average per cross (note)	Genetic gain %
1	Record x Early Rivers	7.00	21.32
2	Carpatin x Silvia	7.00	21.32
3	Record x Stanley	6.62	14.74
4	Tita x Stanley	6.33	9.71
5	Minerva x Bluefree	6.33	9.71
6	Tuleu timpuriu x Ruth Gerstetter	5.85	
7	Tuleu gras x Grase romanesti	5.66	
8	Centenar x Silvia	5.57	
9	Minerva x d'Agen	5.33	
10	d'Agen x Diana	5.27	
11	Tuleu gras x Stanley	5.25	
12	Stanley x d'Agen	5.24	
13	Tuleu timpuriu x Stanley	4.90	
14	Tuleu gras x Silvia	4.46	
	Average per hybrid population	5.77	

Table 5. Promising selections for microfield trials

No.	Promising selections	Hybrid cross	Fruit mean yield (kg/tree)	Fruit mean weight (g)
1	H 19/4	Tita x Stanley	18	50
2	H 20/36	Record x Early Rivers	20	55
3	H 20/52	Record x Stanley	25	60