

## Breeding Evaluation of Plum Elites

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### Abstract

The breeding programme of the Fruit-Growing Institute in Bulgaria for the improvement of plum cultivars started in 1987. The main objectives of this program were the development of new plum cultivars resistant or tolerant to Plum pox virus (PPV), with good sensory characteristics and economic indicators. First F1 hybrid population was obtained mainly by open pollination of the parental cultivars 'Stanley', 'Pacific', 'President', 'Green gage' and 'Scoldush' belonging to the species *Prunus domestica* L., but controlled crosses were also carried out. After two vegetative cycles, 37 elites were selected among 3,850 hybrid plants on the basis of their good results demonstrated under high pressure of natural PPV infection and they were propagated on 'Zhalta dzhanak' (myrobalan) rootstock. A minimum of 10 trees from each elite were planted in the plantation. Their phenological (flowering and ripening time) and pomological characteristics (fruit and stone weight, fruit skin and flesh colour), productivity, susceptibility to drought and to Plum pox virus, were evaluated. Elite 5-77 is of perspective and 13 other are partially of perspective and they need further studies with the aim of using them as donors of concrete characteristics at next stages of the plum breeding programme. Three of the elites have been registered as new plum cultivars: 'Plovdivska renkloda' (E 6-5), 'Sineva' (E 6-51) and 'Ulipya' (E 5-174).

### INTRODUCTION

Plum is one of the major fruit species grown in Bulgaria. The diversity of cultivars in the plum orchards is not quite rich. The major cultivar is 'Stanley', mainly because of its tolerance to Plum pox virus and its ecological plasticity. Other popular cultivars are 'Cacanska Lepotica', 'Cacanska Najbolja', 'Tuleu timpuriu', 'Altan's gage' and lately 'Hartmann, 2001). Due to the endemic character of Plum pox virus (PPV) in a lot of countries of Balkan Peninsula, the major aim of Bulgarian plum breeding is the establishment of new cultivars resistant or tolerant to Sharka disease (Butac et al., 2007; Iliev, 1990; Iliev and Stoev, 2001). The first plum breeding programme of the Fruit-Growing Institute in Plovdiv started in 1987. Initially the hybrid fund was established based on controlled crossings and from populations obtained by open pollination of tolerant cultivars like 'Stanley', 'President', 'Green gage' and 'Scoldush'. (Zhivondov and Djouvinov, 2001) After two selections 37 elites were chosen among 3,850 hybrid plants, propagated and studied during the period 2002-2010. In 2009 three of the elites were officially registered as new Bulgarian cultivars. Those are 'Plovdivska renkloda' (E 6-5), 'Sineva' (E 6-51) and 'Ulipya' (E 5-174).

### MATERIALS AND METHODS

The investigations were carried out in the period 2002-2010 and they included 37 elites selected from three different populations. Elites numbered from 5-30 to 5-207 were selected from a population obtained by open pollination of 'President' cultivar. Elites numbered from 6-25 to 6-202 and E 12-4 were selected from a population obtained by open pollination of 'Stanley' cultivar and those numbered from 7-24 to 7-38 were

obtained by crossing 'Serdika' × 'Stanley'. Observations were made on 10 trees per elite, planted in 1999 in a collection orchard at a distance of 6 x 4 m. The collection was grown on humus carbonate soil under non-irrigation conditions. The average altitude above sea level is 170 m. Climate is humid continental with considerable humid subtropical influences. The total precipitation was 540mm. The studies were conducted using numerical scale of the IBPGR descriptors.

Descriptors for evaluation of the elite collection were:

**Blooming period:** 1 – extremely early, 2 – very early, 3 – early, 5 – intermediate, 7 – late, 9 – extremely late; **Harvest maturity:** 1 – extremely early, 2 – very early, 3 – early, 5 – mid-season, 7 – late, 9 – extremely late; **Fruit: shape frontal view:** 1 – rounded flat, 2 – rounded, 3 – elliptic, 4 – ovate, 5 – heart shaped, 6 – oblong; **Stone shape:** 1 – rounded flat, 2 – rounded, 5 – ovate, 9 – elongated; **Fruit over skin colour:** 1 – pink, 2 – red, 3 – red-violet, 4 – violet, 5 – dark violet, 6 – blue, 7 – dark blue, 8 – black; **Fruit flesh colour:** 1 – green, 2 – light green, 3 – yellow-green, 4 – light yellow, 5 – yellow, 6 – amber, 7 – light orange, 8 – orange, 9 – red; **Yield per unit area:** 1 – extremely low, 3 – low, 5 – intermediate, 7 – high, 8 – very high, 9 – extremely high; **Plum pox virus susceptibility:** 1 – none, 2 – high tolerance, 3 – tolerant, 6 – susceptible, 7 – high susceptibility, 9 – extremely high susceptibility; **Drought susceptibility:** 1 – extremely low susceptibility, 3 – low susceptibility, 5 – moderate susceptibility, 7 – high susceptibility, 9 – extremely high susceptibility.

Virological surveys included visual inspections and enzyme-linked immunosorbent assay (ELISA). The results concerning this part of the study are published (Milusheva et al., 2009).

## RESULTS AND DISCUSSION

Out of the studied 37 plum elites, 6 are early flowering, 4 are late and the prevailing part are intermediate (Table 1). The greatest variation in the blooming period was established in the elite group selected from a population obtained by open pollination of 'Stanley'. Most homogeneous concerning that characteristic were the elites of the group originating from the crossing 'Serdika' × 'Stanley'. The variation of the characteristic is moderate in the elite group originating from populations obtained by open pollination of 'President' cultivar. Fruits of most of the elites mature in mid August, i.e., they are characterized by a mid ripening season. Only those of elite 12-4 mature earlier – after 20 July and two elites mature in the end of August, like 'Stanley'. Data show that the variation concerning that characteristic is slight. Fruit shape is predominantly ovate or elliptic. Oblong fruit shape have E 5-70, E 5-178 and E 7-24 and rounded E 6-5 and E 7-38. Stone shape is ovate or near to it. Six elites, originated from all three mentioned populations have rounded or almost rounded stone shape. Fruit skin coloration is typical of common plum. Only E 6-5 has red-violet skin colour, while in the other elites fruit skin is from violet to dark blue. More attractive are fruits with dark colouration (Vandal et al., 2007; Rusterholz and Krebs, 2001). Fruit flesh is not characterized by great colour diversity. Elite 5-184 has light green fruit flesh and the fruit flesh of the rest of the elites is from yellow-green to yellow. Three of the elites (E 6-51, E 6-52 and E 6-85) have a fruit weight over 45 g and 20 elites – over 30 g. Stone weight is acceptable because do not exceed 2.6 g. That characteristic is important for the next stages of selection, depending on the envisaged usage of the fruits. The studied elites have medium large stone, easily detached from the fruit flesh.

The plantation where the studied elites were grown was under non-irrigation conditions that provided the opportunity to evaluate their response to drought. The years 2008 and 2009 were very favourable for that. In 2008 the total precipitation sum in June, July and August was 77 l m<sup>-2</sup> and in 2009 119 l m<sup>-2</sup>, the maximum air temperatures in the hottest months July and August varied between 30 and 39°C in 2008 and 29 and 40.8 C in 2009. Some of the elites did not respond to drought, while in others symptoms such as leaf drooping, mass yellowing and leaf fall, bearing fruits of a smaller size, loss of fruit turgor, browning of the fruit flesh and fruit abscission were observed. The investigations

conducted on the susceptibility of the elites to drought allowed to group them into the following groups:

- Very low susceptibility to drought – E 5-30, E 5-49, E 5-50, E 5-66, E 5-67, E 5-70, E 5-77, E 5-159, E 5-171, E 5-174, E 5-204, E 6-40, E 6-5, E 6-51, E 6-52, E 7-27, (1<sup>st</sup> and 2<sup>nd</sup> clusters);
- Low susceptibility – E 5-52, E 5-93, E 5-177, E 5-178, E 5-180, E 5-184, E 5-207, E 6-25, E 6-41, E 6-43, E 12-4 (3<sup>rd</sup> and 4<sup>th</sup> cluster);
- Medium susceptibility – E 6-85, E 5-33, E 5-53, E 5-182, E 5-202, E 7-30, E 7-38 (5<sup>th</sup> and 6<sup>th</sup> cluster);
- High susceptibility – E 5-51, E 5-169, E 7-24 (7<sup>th</sup> cluster).

In areas where PPV infection is endemic, the evaluation of breeding materials will not be complete without assessment of their resistance to the virus (Butac et al., 2007). On the basis of the results of PPV study (Milusheva et al., 2009), observed elites could be classified as follows:

- High tolerant – E 6-5, E 5-77 (1<sup>st</sup> and 2<sup>nd</sup> cluster);
- Tolerant – E 5-30, E 5-33, E 5-51, E 5-52, E 5-53, E 5-66, E 5-70, E 5-93, E 5-159, E 5-169, E 5-174, E 5-178, E 5-180, E 5-184, E 5-204, E 6-25, E 6-40, E 6-41, E 6-43, E 6-51, E 6-52, E 12-4, E 7-24, E 7-30, E 7-38 (3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> clusters);
- Susceptible – E 5-50, E 5-177, E 5-182, E 6-85, E 6-202, E 7-27 (6<sup>th</sup> cluster);
- High susceptible – E 5-49, E 5-67, E 5-171, E 5-207 (7<sup>th</sup> and 8<sup>th</sup> clusters).

## CONCLUSIONS

On the basis of a complex evaluation, three out of the 37 studied plum elites were registered as new cultivars: E 5-174 ('Ulpia'), E 6-5 ('Plovdivska renkloda') and E 6-51 ('Sineva').

Elite 5-77 is of perspective and 8 other are partially of perspective and they need further studies with the aim of using them as donors of concrete characteristics at next stages of the plum breeding programme.

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Table 1. Evaluation of plum elites (selected results).

Elite No	Blooming period	Harvest maturity	Fruit shape	Stone shape	Fruit colour	Flesh colour	Stone weight* (g)	Susceptibility to drought	Susceptibility to PPV	Yield	Perspectiveness
E 6-25	5	6	3	5	5	5	39.01 a	4	5	6-7	-
E 6-40	5	6	4	7	7	5	31.59 b	1	5	7	+
E 6-41	5	6	3	6	7	5	30.56 b	3	5	7	-
E 6-43	5	6	4	6	7	3	37.72 b	4	8	6-7	-
E 6-5	7	6	2	2	3	5	32.56 b	1	2	7-8	RNC
E 6-51	5	5	4	5	5	5	45.85 a	1	3	7-8	RNC
E 6-52	6	5	3	3	7	5	46.76 a	1	5	6	+
E 6-85	4	6	4	6	5	3	48.02 a	5	6	6-7	-
E 6-202	5	6	4	6	7	5	23.88 bc	6	6	7	-
E 12-4	5	4	4	7	5	5	29.41 b	4	4	6-7	+
E 7-24	5	5	6	7	5	5	38.40 b	7	5	6-7	-
E 7-27	5	6	4	7	7	5	27.58 bc	1	6	6-7	-
E 7-30	4	6	4	6	5	5	31.74 b	6	3	6-7	-
E 7-38	4	5	2	6	7	5	26.71 bc	6	5	8	+
E 5-30	5	6	4	7	7	3	33.17 b	1	5	6	-
E 5-33	5	6	4	5	7	3	26.27 bc	6	5	6-7	-
E 5-49	6	6	3	5	5	5	24.77 bc	9	7	6-7	-
E 5-50	5	5	3	5	5	5	24.71 bc	1	6	7	-
E 5-51	5	6	3	6	7	3	25.08 bc	7	3	7	-
E 5-52	5	6	4	3	6	3	27.33 bc	4	4	7	-

Table 1. (Continued).

Elite No	Blooming period	Harvest maturity	Fruit shape	Stone shape	Fruit colour	Flesh colour	Fruit weight * (g)	Stone weight* (g)	Susceptibility to drought	Susceptibility to PPV	Yield	Perspectiveness
E 5-53	5	6	4	7	5	3	35.49 b	1.9 b	6	5	6	-
E 5-66	6	6	3	7	7	5	31.62 b	1.4 d	1	3	6-7	+
E 5-67	4	7	3	2	5	3	31.03 b	1.8 bc	1	7	7	-
E 5-70	5	5	6	8	6	5	30.12 b	1.5 cd	1	5	7	+
E 5-77	5	5	3	6	5	5	33.52 b	1.3 d	1	2	7	++
E 5-93	4	6	4	6	7	5	24.10 bc	1.4 d	4	3	7	-
E 5-159	5	6	4	2	7	5	30.06 b	1.5 cd	1	5	7	+
E 5-169	6	5	3	5	5	3	26.76 bc	1.8 bc	7	5	7	-
E 5-171	4	6	3	5	5	5	29.03 b	1.5 d	1	7	6-7	-
E 5-174	5	6	4	6	5	3	39.37 a	1.8 bc	1	7	8	-
E 5-177	5	7	4	6	5	3	29.02 b	1.3 e	1	3	7-8	RNC
E 5-178	5	6	6	7	7	3	22.80 bc	1.4 e	3	6	6-7	-
E 5-180	5	6	3	6	7	5	33.00 b	2.6 a	4	5	7	-
E 5-182	5	6	4	6	5	5	35.30 b	2.1 b	4	3	7	-
E 5-184	5	6	4	7	5	2	33.43 b	2.0 b	6	6	6-7	-
E 5-204	5	6	3	5	7	3	33.54 b	2.0 b	4	4	7	-
E 5-207	5	6	4	6	4	3	33.36 b	1.8 bc	1	3	7	+
									3	8	6	-

\*Means followed by the same letter do not differ at 5% level of significance; Duncan's multiple range test.

Notice: - non-perspective  
 +-partially perspective  
 ++ -perspective  
 RNC - registered as a new cultivar