with virtually no winter damage and produced desirable sugar, acid and pH must parameters. The vinifera cultivars 'White Riesling,' 'Chardonnay,' 'Muscat Blanc,' 'Cabernet Sauvignon,' 'Merlot,' 'Limberger' and 'Cabernet Franc' survived these winters with minimal damage and produced favorable yields with excellent sugar, acid and pH balances. The high elevation of this site is accompanied by dry climatic conditions, intense sunlight and large daily temperature fluctuations. These conditions favor high pigment concentration and high acid retention which may partially explain the excellent enological characteristics in certain areas of Colorado. Winters in Colorado can damage grapevines and the temperatures may not always be as moderate as the years observed during this study.

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40 Years of Plum Breeding in Romania

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Abstract

The plum (*Prunus domestica* L.) is an important fruit species in Romania. A breeding program aiming at improving the plum cultivars available in Romania was started in 1950 using traditional cultivars 'Tuleu gras' and 'Grase romanesti' as the initial parents. Forty years of research has resulted in the development of 20 new plum cultivars with high quality fruit, ripening season from July 1-5 to September 15-20 and resistance or tolerance to plum pox virus. The working stages and the main agronomical and technological characteristics of some of the cultivars already widely commercialized on the market are described.

This article will describe the historical progress of the breeding program as well as the characteristics of the major commercial cultivars developed.

The European plum *(Prunus domestica)* is widely spread (over 50% of the trees produced yearly in the nurseries and about 60% of the annual fruit production) throughout Romania. The native cultivars have always been prevalent and their main destination was the production of plum brandy although some very good cultivars for fresh market have been grown in Romania, e.g. 'Tuleu gras,' 'Grase romanesti,' etc.

Although some cultivars such as 'Anna Spath,' 'Agen,' 'Vinete de Italia' and more recently 'Stanley' have found

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a second native country in Romania, modernization of plum cultivars has primarily been achieved in the past 40 years as a result of our breeding research based on a program with clear, systemic and long term objectives.

Three phases of the breeding work are evident:

1. 1950-1960. The main objective was interbreeding of the old native cultivars: 'Tuleu gras' (deficiency: easy breaking of branches as a result of heavy crops), 'Grase romanesti' (deficiency: irregular bearing, clingstone), 'Vinete romanesti' (deficiency: low production, disease sensitivity).

It should be mentioned that the fruit of these varieties have a very good taste and commercial qualities. The work during this period resulted in the cultivars: 'Tuleu Timpuriu,' 'Superb,' and 'Gras ameliorat.'

2. 1960-1970. This phase emphasized the development of new cultivars that are early ripening and with good tasting fruit for the fresh market. In this respect, 'Tuleu gras,' 'Tuleu Timpuriu,' 'Renclod Althan' (for high yields and fruit quality), 'Early Rivers,' 'Pêche,' 'Wilhelmina Späth,' varieties had induced to their offsprings such characters as fruit size, flesh firmness, small stone and nice color. During this stage, 10 cultivars have been selected and released which supplied the market with high quality plums from July 5-10 to August 15-20.

3. Since 1970, the breeding has been continued to develop varieties resistant to plum pox virus, late ripening genotypes and specific qualities for fruit processing (dehydration). Seven new varieties have been selected and named and a number of high quality selections are under study.

A short description of the best Romanian varieties released during 1967-1989 is given below:

'Diana.' Parents: 'Renclod Althan' x 'Early Rivers.' Released in 1981. Author: V. Cociu. The fruit is like 'Renclod Althan' in its shape and size (60 g/fruit mean weight) and has blue skin covered with grey pruin; 12.5% dry matter, yellow flesh, small free stone. Its ripening season is early July.

Figure 1. 'Silvia' plum released in 1978 tolerant to Sharka.

Figure 2. 'Pescarus' plum a new release.

It is the earliest high quality variety for the temperate zone.

'Minerva.' Parents: 'Tuleu Timpuriu' x 'Early Rivers.' Released in 1984. Authors: V. Cociu, Ecaterina Bumbac, R. Roman, N. Minoiu. The fruits of medium size (40 g) have oval shape, violet skin color covered with much bluish pruin; yellow-greenish, firm and juicy flesh, containing 14-16% dry matter and 10.47 mg% acid ascorbic. Small free stone (3.5% of the fruit weight). Its ripening season is mid July. Tolerant to plum pox (Sharka).

'Ialomita.' Parents: 'Renclod Althan' x 'Early Rivers.' Released in 1981. Authors: V. Cociu, Ecaterina Bumbac. The fruit is of medium size (40 g) and has a globulous shape; dark violet skin covered with grey pruin, green-yellowish flesh, rather firm and juicy containing 12.5% dry matter and 15.2% C vitamin; free stone (4.8% of the fruit weight). Its ripening season is late July. Tolerant to Sharka.

'Pitestean.' Parents: 'Tuleu gras' x 'Early Rivers.' Released in 1981. Authors: V. Cociu, R. Roman. The fruit is large (50 g), oval shape and slightly asymetric; it has dark violet skin covered with blue pruin; yellow-greenish, juicy flesh, containing 15% dry matter and 14.8% mg C vitamin; free stone (3.8% of the fruit weight). Its ripening season at the very end of July or the beginning of August. Tolerant to Sharka.

'Carpatin.' Parents: 'Tuleu gras' x 'Early Rivers.' Released in 1981. Authors: V. Cociu, R. Roman. The fruit is of medium size (40-45 g) and has a globulous shape with slightly elongated end, dark blue skin covered with grey pruin; firm and juicy yellow-greenish flesh, containing 13% dry matter and 10.12 mg% C vitamin. Small free stone (3%). Its ripening season is early August. Tolerant to Sharka.

'Silvia.' Parents: 'Renclod Althan' x 'Early Rivers.' Released in 1978. Authors: V. Cociu, N. Minoiu. The fruit is big (50-60 g) like 'Renclod Althan,' it has an elipsoidal shape, dark violet skin covered with much bluish pruin; white-yellowish, juicy flesh containing 15% dry matter and 6.16 mg% C vitamin; small and free stone. Its ripening season is early August. Tolerant to Sharka (Fig. 1).

'Centenar.' Parents: 'Tuleu gras' x 'Early Rivers.' Released in 1978. Author: V. Cociu. The fruit is large (45-50 g) and has a reversed ovoidal shape, dark blue skin covered with much grey pruin; firm, juicy white-greenish flesh containing 14-17% dry matter and 8.80 mg% C vitamin; small free stone (3.5% of the fruit weight). Its ripening season is August 10-15. Tolerant to Sharka.

'Tuleu Timpuriu.' Parents: 'Tuleu gras' x 'Early Rivers.' Released in 1967. Author: V. Cociu. The fruit is over medium sized, ovoidal shape, slightly asymetric; dark violet-yellowish skin containing 13-16% dry matter and 12-15 mg% C vitamin. Free stone (3.5% of the fruit weight). Its ripening season is August 10-15, e.g. 10-15 days earlier than 'Tuleu gras.' Tolerant to Sharka.

'Flora.' Parents: 'Tuleu gras' x 'Renclod violet.' Released in 1989. Author: V. Cociu. The fruit is large (60 g) and has an ovoidal-globulous shape; dark blue skin covered with grey pruin; white-greenish flesh containing 15% dry matter. Very small free stone (1-2% of the fruit weight). The most resistant cultivar to Sharka.

'Gras ameliorat.' Parents: 'Gras romanesc' x 'Gras Romanesc.' Released in 1970. Author: V. Cociu. The fruit is overmedium sized (45 g), has a globulous shape and violet-reddish skin; mean firm, juicy, yellow-greenish flesh containing 17% dry matter, and 15 mg% C vitamin. Its ripening season is the first half of September. Resistant to Sharka.

There are also some other valuable varieties such as 'Vilcean,' 'Renclod de stepa,' 'Sarmatic,' 'Baragan 17,' 'Albatros,' 'Pescarus' following to be extended (Fig. 2). The new plum varie-

New Plum Varieties Registered During 1967-1991.

No.	Variety	Genitors	Year of registration	Authors	Main characteristics
1.	Tuleu Timpuriu	Tuleu gras x Peche	1967	V. Cociu	Earliness, resistance to branches breaking
2.	Superb	Tuleu gras x Abbaye d'Arton	1968	V. Cociu	Productivity, commercial aspect
3.	Gras ameliorat	Gras rom. x Gras rom.	1968	V. Cociu	Large fruit, free stone
4.	Flora	Tuleu gras x Renclod violet	1989	V. Cociu	Earliness, virus tolerance, fruit quality
5.	Sarmatic	Tuleu Timpuriu x Rivers timpuriu	1989	V. Cociu Ec. Bumbac C. Marica N. Mutascu N. Bancila	Productivity, virus tolerance
6.	Centenar (Bucurie)	Tuleu gras x Rivers timpuriu	1978	V. Cociu Ec. Bumbac	Productivity, earliness, tolerance to plum-pox
7.	Silvia (Dor)	Renclod Althan x Rivers timpuriu	1978	V. Cociu N. Minoiu	Idem
8.	Albatros	Tuleu gras p.l.	1979	V. Cociu T. Gozob	Productivity, fruit quality
9.	Pescarus	Renclod Althan x Wilhelmina Spath	1979	V. Cociu R. Roman	High fruit quality, productivity
10.	Ialomita	Renclod Althan x Rivers timpuriu	1981	V. Cociu Ec. Bumbac R. Roman	Earliness, superior fruit quality, disease resistance
11.	Dimbovita	Tuleu gras y Anna Spath	1981	V. Cociu R. Roman	Productivity, high fruit quality, disease resistance
12.	Pitestean	Tuleu Timpuriu x Rivers timpuriu	1981	V. Cociu R. Roman	High fruit quality, earliness, virus tolerance
13.	Diana	Renclod Althan x Rivers timpuriu	1981	V. Cociu	Earliness, high fruit quality
14.	Carpatin	Tuleu gras x Rivers timpuriu	1981	V. Cociu R. Roman	Earliness, high fruit quality, disease tolerance
15.	Record	Renclod violet p.n.	1982	Gh. Stanciu Gh. Petre N. Mateescu St. Nica	Lateness, high yields
16.	Minerva	Tuleu Timpuriu x Rivers timpuriu	1984	V. Cociu Ec. Bumbac R. Roman N. Minoiu	Earliness, high fruit quality, virus tolerance
17.	Vilcean	H.8/12 x H.5/23	1991	V. Cociu R. Roman I. Botu El. Turcu	Earliness, high fruit quality
18.	Baragan 17	Tuleu gras x Rivers timpuriu	1991	V. Cociu N. Mutascu N. Bancila T. Gozob	Productivity, virus tolerance, high fruit quality
19.	Renclod de stepa	Wilhelmina Spath x Renclod Althan	1991	V. Cociu E. Bumbac N. Mutascu N. Bancila	Productivity, virus tolerance
20.	Tita	Tuleu gras, seminte iradiate zu X 2o14R	1991	V. Cociu E. Bumbac D. Stroe R. Roman	Excellent taste quality
21.	Alina	Seminte Tuleu gras iradiate zu X 2o14	1991	V. Cociu E. Bumbac M. Nicolaescu R. Roman M. Bancila	Excellent taste quality, productivity

ties play an important role in the annual nursery programs. Thus, during 1979-1990, the percentage of the new cultivars used for nursery grafting was raised from 6.2 to 23.7; in 1990, 301,800 'Centenar' trees, 298,6000 'Silvia' trees, 100,000 'Minerva' trees and 86,000 'Record' trees were grafted.

Conclusion

As a result of the plum breeding in Romania, 20 new varieties were obtained meeting two main requirements: earliness and tolerance/resistance to Sharka.

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