

CONTRIBUTII LA STUDIUL AGRO-BIOLOGIC AL SOIURILOR DE COACAZ NEGRU SI AFIN DIN RETEAUA EUROPEANA DE EVALUARE COMPARATIVĂ CONTRIBUTIONS TO THE AGRO-BIOLOGICAL STUDY OF THE BLACK CURRANT AND BLUEBERRY WITHIN THE CULTIVAR EVALUATION EUROPEAN NETWORK

Paulina Mladin¹, Mihail Coman¹, Audrius Sasnauskas², Emil Chițu¹, Gheorghe Mladin¹, Irina Ancu¹,
Claudia Nicola¹, Mihaela Sumedrea¹

¹Research Institute for Fruits Growing Pitești, Argeș, Romania

²Lithuanian Institute of Horticulture, Genetic and Biotechnology Department, Kauno 30, Babtai, Lithuania

Abstract

Studies were initiated within the European project COST ACTION 863-Euroberry-From Genomics to Sustainable Production, Quality and Health and PN 52-153/2008 project of the Romanian Partnership Program Number 4, belonging to the National Centre of the Management Programs and were carried on during 2006-2009. The main objectives of the COST 863 project -Working Group1 were as follow as: investigation of the berries genetic resources, building up an European network for the berry-fruits cultivars with the most valuable cultivars released by the breeding programs of the European countries, as well as, the most important ones, grown in U.S.A., Australia, South America, New Zealand. etc.; evaluation of the agronomical and biological properties under different ecological conditions; identification of the most valuable for each ecological areas by their quantitative and qualitative parameters and attractiveness for the local markets, finally, the rigorous and complete final characterization of the cultivars included in the European cultivars network. For the European cultivars evaluation network, 12 basic black currant cultivars obtained in Scotland, Sweden, Poland and Lithuania and 14 recommended at free choice cvs. produced by the breeding programs of Scotland, Poland, Romania and Finland were included. For the blueberry 12 basic cvs., and 8 at free choice, older and new cvs. obtained in Europe, U.S.A. and Australia were taken into account. For the black currant and blueberry cvs. evaluation, 22 descriptors and respectively, 28 descriptors on plant, berry, yield, biotical and non-biotical stress factors resistance were used. The paper deals with the variability of the agro-biological characteristics of the cultivars in the first four years after planting and will be emphasized those cvs. much more adapted to the ecological conditions of the Sub-Carpathians area and appropriate to compete on the European Community markets.

Cuvinte cheie: discriptori, proprietati fizico-chimice, rezistenta bolilor

Keywords: descriptors, berry physical and chemical properties, disease resistance, yield

1. Introductions

The black currants and blueberries are two important crops for the European fruits market. While the black currant growing is now recessive, the blueberry crop, lately, became of major interest for many countries of Europe and of the others continents. For the sustainable production of high berries quality under Romania climatic conditions, the selection of the most valuable foreign and autochthonous cultivars represents a major task. Along the years, in the world assortment of the black currant and blueberry many cultivars, new or older were introduced (Hancock, 2006; Libek and Kikas, 2002; Mladin et al., 2001; Mladin et al., 2008; Pluta and Zurawicz, 2002). In the last 15 years, with the black currant and blueberry breeding program developed at the Research Institute for Fruits Growing Pitești, 5 new black currant and 9 new high-bush blueberry cultivars were released. Some of these will be evaluated in our study together with other foreign cultivars. The purpose of the cultivars evaluation are as following as: screening and description of some cultivars belonging to the European Trial Network under ecological conditions of the South Sub-Carpathians area, contribution to the data basis of the European Trial Network and, and finally, the choice of the best cultivars for the Romanian assortment. The objectives of our study consist in high yield and berries quality for fresh and processed consumption and high biotic and non biotic stress factors resistance. These objectives are well matched together those of the European project-COST-863 and Romanian project No.52 - 153.

2. Material and Methods

For evaluation, 13 black currant and 16 high-bush blueberry cultivars of different geographic and genetic proveniences were established in 2006 in the field trials at the RIFG Pitești. The experiments were randomized block design with three replications and four plants per replication. The planting spaces

were 3,0 m between the rows and 1.0 m on the row. Soil type was an alluvial, with clay content ($\varnothing \angle 0.002 \text{ mm}$ (C) = 20.0% at 20-40 cm depth, low organic matter (H) = 1.72 %, pH H_2O = 5.8 .

Soil management practice was clean cultivation in blackcurrant and sawdust mulch in blueberry along the rows. For the black currant sprinkle irrigation and for the blueberry sprinkle irrigation during 2006-2007 and drip irrigation in 2008 and 2009 were applied.

Each cultivar was assessed by 22 descriptors for black currant and by 28 descriptors for blueberry, on plant, fruits, diseases, pests, drought and sunburn resistance, blooming and ripening time. In addition, 30 measurements and determinations in 3 replications for each following characteristics: berries size, weight, firmness, black currant cluster weight, berries number on the strig, rachis length, caliceal cavity and pedicel scar size, soluble solids and pH, were recorded. For black currant, total acidity, total sugars and ascorbic acid by common laboratory analyses were determined. Presence of the disease on leaves and shoots was noted by notes: 1= undamaged (resistant) 0 %; 2= very small < 5%; 3 = small 5-25 %; 5 = medium 26-50 %; 7 = strong 51-75 %; 9= very strong (susceptible) 76-100 %. Also, the yield in the first 4th years after planting of the blueberry cultivars was recorded.

This paper includes the results of some of these measurements and determinations in the first four years after planting.

3. Results and discussions

The black currant cultivars were different with the weight of strigs, 'Deea' and 'Abanos' having the largest strigs and Ben Gairn and Ores the smallest ones (Table 1). The cultivars with large strigs had also, the largest number of berries on the strig: 'Deea', 'Abanos', 'Tisel', 'E-124/3'. Other cultivars numbered only 3.0-3.3 berries on the strig: 'Ores', 'Ben Gairn'. The shortest rachis had cultivars 'Ben Gairn', 'Ruben' and 'Bona', these cvs. being recommended by machine harvesting, comparing with cultivars 'Deea' or 'E-124/3', 'Tines', 'Abanos' and 'Tiben' with longer strigs, and thus, more suitable for hand picking. The largest berries were produced by 'Ruben', 'E-124/3', 'Bona', followed by 'Deea', 'Abanos' and 'Titania', with more than 1.0 g (Table 2). The berry firmness, an notable characteristic for transport and manipulation of the black currants ranged from 66.85 gf up to 163.73 gf (Table 3). The firmest berries were produced by 'Bona', 'Tiben' and 'Ruben' and the softened ones by 'Tisel'. Some of cultivars were remarkable for high soluble solids content, such as: 'Tisel', 'Ben Gairn', 'Tines', 'E-124/3'. The more sweet berries were produced by 'E-124/3', 'Titania', 'Tiben', 'Ores' and 'Ben Gairn'. 'Tiben' and 'Deea' were the richest in organic acids, while Bona and E-124/3 the poorest (Table 4). Also, 'Tisel' and 'Tines' accumulated the highest sugars, more than 12.0% , while 'Titania', 'Ruben', 'E-124/3', 'Bona', 'Abanos', and 'Deea' medium sugar content. The poorest in sugar was 'Ores', followed by 'Ben Hope'. The berry highest content in vitamin C were recorded with 'Ores' (228.8 mg /100g fresh fruits), than with 'Abanos', 'Tisel' and 'Titania', while the smallest one with 'Tiben' and 'Bona' (44.0-52.8 mg/100 g). Regarding the behaviour of the black currant cultivars versus powdery mildew, rust and anthracnose diseases, of the Table 5, we can appreciate the mildew resistance of all cultivars, excepting 'Tiben' which was only tolerant to the fungi *Spaerothecca mors-uvae*. Versus fungi *Pseudopeziza ribis*, only 'Ruben' was resistant, while other cvs. were tolerant ('Abanos', 'Ben Gairn', 'Tisel', 'Tiben' and 'Tines'), intermediate ('Ores', 'Ben Hope', 'Ben Lomond') or susceptible ('Bona' and 'Titania'). Also, resistance or tolerance to *Cronartium ribicola* showed most of cultivars.

The blueberry cultivars which were remarkable by their berry weight and size were 'Delicia', 'Azur', 'Bonifacy', 'Lax' and 'Simultan' in 2008, and 'Bonifacy', 'Sunrise', 'Azur', 'Delicia', 'Brigitta Blue', 'Darrow' and 'Spartan' (with 3.0-4.15 g) in 2009 (Table 6). 'Darrow' cv. had the largest calix cavity and 'Ozarkblue', 'Simultan', 'Bluetta' and 'Bluehaven' cvs. the smallest ones. The smallest pedicel scar were recorded with 'Simultan', 'Bluehaven', 'Ozarkblue' and 'Brigitta Blue' cvs.. On the other hand, 'Bonifacy', 'Bluetta' and 'Delicia' cvs. produced large pedicel scar, exposing oneself to the alteration.

The firmest berries were produced with 'Simultan' cv., followed by 'Sunrise', 'Brigitta Blue', 'Delicia', 'Azur' and 'Blueray' cvs., while the soft one with 'Duke' and 'Lax' cvs. (Table 7). 'Darrow' cv. accumulated the largest amount of soluble solids, then 'Sunrise', 'Bluetta', 'Nelson' and 'Simultan' cvs.. 'Blueray' cv. was the poorest in this component. 'Simultan', 'Azur', 'Brigitta Blue', 'Bluetta', 'Delicia' cvs. were characterised by an intense pruinose layer and Lax and Nelson cvs. by the poor one.

Regarding the productivity of the blueberry cvs., in Table 8, it can be seen that in the second year after planting some cvs. yielded between 0,500 up to 0, 750 g/ bush ('Delicia', 'Lax', 'Azur', 'Brigitta Blue', 'Simultan'). In the second year the highest yield were produced with 'Spartan', 'Lax', 'Simultan', 'Brigitta Blue', 'Delicia' cvs. In the third year the most productive were 'Bluetta', 'Azur', 'Simultan', 'Delicia', 'Brigitta Blue', 'Sunrise', 'Lax', 'Spartan' cvs. (2,01-2,65 kg /bush). The most productive in the first year after planting were: 'Delicia', 'Simultan', 'Lax', 'Azur', 'Brigitta Blue' cvs., followed by 'Spartan', 'Blueray' and 'Bluetta' cvs..

4. Conclusions

By the totalizing of all those major agronomic characteristics we could conclude that after the first four years of growing under ecological conditions of Pitești, some cultivars exhibited a good adaptability, owing so high precocity in bearing, good yield, diseases resistance and high berry quality. In spite of these, for the final decision on the suitability of the cvs. to our market, and their adaptability to local ecological conditions, more information needed on yield, diseases, pests, and spring frosts resistance, fruit set, easy of picking, berries shelf life. So, the most promising black currant cvs. proved to be the foreign cvs. 'Ruben', 'Bona', 'Ceres', 'Titania' and Romanian cvs. 'Deea', 'Abanos' and advanced selection 'E-124/3'. For blueberry, the most promising ones proved to be the following foreign cvs.: 'Bonifacy', 'Brigitta Blue', 'Darrow', 'Spartan', 'Bluetta', 'Sunrise' and Romanian cvs. 'Delicia', 'Azur' and 'Simultan'.

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Tables and Figures

Table 1. Strig characteristics of the black currant cultivars, at the RIFG Pitești

| No. Crt. | Cultivar-elite | Strig weight(g) | Berries number on strig | Strig length (cm) |
|--------------|----------------|------------------|-------------------------|-------------------|
| 1 | Ben Gairn | 2.4 | 3.3 | 1.5 |
| 2 | Ben Hope | 3.4 | 4.1 | 4.3 |
| 3 | Ben Lomond | 3.2 | 3.5 | 7.9 |
| 4 | Bona | 4.0 | 3.5 | 2.8 |
| 5 | Ores | 2.9 | 3.0 | 3.7 |
| 6 | Tiben | 3.0 | 4.1 | 4.5 |
| 7 | Tines | 5.4 | 5.5 | 5.6 |
| 8 | Tisel | 5.3 | 6.0 | 3.7 |
| 9 | Titania | 3.9 | 3.8 | 3.1 |
| 10 | Ruben | 4.9 | 4.3 | 1.9 |
| 11 | Abanos | 6.2 | | 4.4 |
| 12 | Deea | 6.4 | | 7.0 |
| 13 | E-124/3 | 5.5 | | 5.6 |
| DL 5% | | 0.5 | 1.9 | 1.03 |

Table 2. Berry weight and size of the black currant cultivars

| No. crt | Cultivar-elite | Berry weight (g) | Berry height (mm) | Berry diameter (mm) |
|---------------|----------------|-------------------|--------------------|----------------------|
| 1 | Ben Gairn | 0.74 | 10.70 | 11.0 |
| 2 | Ben Hope | 0.88 | 10.48 | 11.63 |
| 3 | Ben Lomond | 0.88 | 11.06 | 12.00 |
| 4 | Bona | 1.14 | 11.93 | 12.83 |
| 5 | Ores | 0.95 | 11.30 | 11.93 |
| 6 | Tiben | 0.74 | 9.96 | 10.60 |
| 7 | Tines | 0.98 | 19.40 | 11.76 |
| 8 | Tisel | 0.88 | 10.32 | 10.49 |
| 9 | Titania | 1.02 | 10.86 | 12.23 |
| 10 | Ruben | 1.14 | 11.96 | 12.86 |
| 11 | Abanos | 1.05 | 10.31 | 11.43 |
| 12 | Deea | 1.10 | 11.43 | 12.0 |
| 13 | E-124/3 | 1.14 | 11.34 | 12.32 |
| DL 5 % | | 0.18 | 1.12 | 6.09 |

Table 3. Berry firmness, soluble solids and pH of black currant cultivars.

| No. Crt. | Cultivar-elite | Berry firmness (gf) | Soluble solids °Brix | Berry pH |
|----------|----------------|---------------------|----------------------|----------|
| 1 | Ben Gairn | 136.55 | 19.16 | 3.01 |
| 2 | Ben Hope | 130.34 | 15.76 | 2.96 |
| 3 | Ben Lomond | 128.08 | 16.00 | 2.80 |
| 4 | Bona | 162.73 | 16.66 | 3.29 |
| 5 | Ores | 117.75 | 15.33 | 3.10 |
| 6 | Tiben | 162.21 | 17.93 | 3.12 |
| 7 | Tines | 114.13 | 18.86 | 2.94 |
| 8 | Tisel | 66.85 | 20.06 | 2.99 |
| 9 | Titania | 114.28 | 16.63 | 3.62 |
| 10 | Ruben | 149.92 | 16.33 | 2.84 |
| 11 | Abanos | 94.41 | 17.73 | 2.91 |
| 12 | Deea | 100.12 | 17.34 | 2.87 |
| 13 | E-124/3 | 95.11 | 18.12 | 3.32 |
| DL 5% | | 43.82 | 0.96 | 0.10 |

Table 4. Berry chemical content of the black currant cultivars under ecological conditions of Pitești.

| No. Crt. | Cultivar | Titrateable acidity % | Total sugars % | Vitamin C mg/100 g fresh fruit |
|----------|------------|-----------------------|----------------|--------------------------------|
| 1 | Ben Gairn | 2.64 | 8.12 | 98.2 |
| 2 | Ben Hope | 2.97 | 7.33 | 140.8 |
| 3 | Ben Lomond | 2.83 | 7.92 | 121.1 |
| 4 | Bona | 1.53 | 10.54 | 52.8 |
| 5 | Ores | 2.73 | 6.97 | 228.8 |
| 6 | Tiben | 3.43 | 8.31 | 44.0 |
| 7 | Tines | 2.58 | 12.35 | 132.1 |
| 8 | Tisel | 2.43 | 12.72 | 158.4 |
| 9 | Titania | 2.89 | 10.81 | 154.0 |
| 10 | Ruben | 2.93 | 10.81 | 127.6 |
| 11 | Abanos | 2.93 | 10.33 | 179.4 |
| 12 | Deea | 3.18 | 10.20 | 148.1 |
| 13 | E-124/3 | 1.61 | 10.81 | 132.0 |

Table 5. Fungi damages of the black currant cultivars during 2008 and 2009, climatic conditions of Pitești.

| No. Crt. | Cultivar | <i>Sphaerotheca Mors-uvae</i> | <i>Pseudopeziza ribis</i> | <i>Cronartium ribicola</i> |
|----------|------------|-------------------------------|---------------------------|----------------------------|
| 1 | Ben Gairn | 1 | 3 | 1 |
| 2 | Ben Hope | 1 | 5 | 1 |
| 3 | Ben Lomond | 1 | 5 | 1 |
| 4 | Bona | 1 | 9 | 1 |
| 5 | Ores | 1 | 5 | 3 |
| 6 | Tiben | 3 | 3 | 1 |
| 7 | Tines | 1 | 3 | 1 |
| 8 | Tisel | 1 | 3 | 1 |
| 9 | Titania | 1 | 9 | 1 |
| 10 | Ruben | 1 | 1 | 1 |
| 11 | Abanos | 1 | 3 | 2 |
| 12 | Deea | 1 | 2 | 2 |
| 13 | E-124/3 | 1 | 2 | 2 |

Table 6. Berries weight in 2008 and 2009 years, berry calix cavity and pedicel scar size of the blueberry cultivars.

| No. Crt. | Cultivar | Berry weight 2008 (g) | Berry weight 2009 (g) | Mean berry weight (g) | Calix cavity size (mm) | Pedicel Scar size (mm) |
|----------|-----------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|
| 1 | Azur | 2.61 | 3.71 | 3.16 | 7.42 | 2.36 |
| 2 | Bonifacy | 2.23 | 4.15 | 3.19 | 7.32 | 2.95 |
| 3 | Brigitta Blue | 1.37 | 3.23 | 2.30 | 7.50 | 1.93 |
| 4 | Bluetta | 0.93 | 2.00 | 1.46 | 6.30 | 2.61 |
| 5 | Bluehaven | 1.69 | 2.71 | 2.20 | 6.33 | 1.73 |
| 6 | Darrow | 1.92 | 3.18 | 2.55 | 9.64 | 2.32 |
| 7 | Delicia | 2.72 | 3.48 | 3.10 | 6.30 | 2.69 |
| 8 | Duke | 1.67 | 2.35 | 2.01 | 6.72 | 2.24 |
| 9 | Lax | 2.31 | 2.84 | 2.57 | 7.50 | 2.30 |
| 10 | Nelson | 1.39 | 2.78 | 2.08 | 6.87 | 2.31 |
| 11 | Ozarkblue | 1.02 | 2.71 | 1.86 | 6.21 | 1.78 |
| 12 | Patriot | 1.80 | 2.72 | 2.26 | 6.72 | 2.34 |
| 13 | Simultan | 2.03 | 2.86 | 2.45 | 6.31 | 1.65 |
| 14 | Spartan | 1.77 | 3.05 | 2.41 | 7.45 | 2.24 |
| 15 | Sunrise | 1.07 | 4.04 | 2.55 | 7.58 | 2.39 |
| 16 | Blueray-control | 1.24 | 2.63 | 1.94 | 7.14 | 2.32 |

Table 7. Berries firmness, soluble solids and intensity of pruline of the blueberry cultivars.

| No. Crt. | Cultivar | Berry firmness (gf) | Soluble solids °Brix |
|----------|-----------------|---------------------|----------------------|
| 1 | Azur | 122.1 | 13.12 |
| 2 | Bonifacy | 100.2 | 12.31 |
| 3 | Brigitta Blue | 125.3 | 13.86 |
| 4 | Bluetta | 119.5 | 14.50 |
| 5 | Bluehaven | 119.9 | 13.56 |
| 6 | Darrow | 107.6 | 16.13 |
| 7 | Delicia | 125.2 | 14.21 |
| 8 | Duke | 97.9 | 14.00 |
| 9 | Lax | 98.2 | 12.34 |
| 10 | Nelson | 102.3 | 14.30 |
| 11 | Ozarkblue | 118.3 | 12.24 |
| 12 | Patriot | 113.7 | 13.60 |
| 13 | Simultan | 146.1 | 14.22 |
| 14 | Spartan | 106.6 | 12.63 |
| 15 | Sunrise | 128.6 | 14.50 |
| 16 | Blueray-control | 122.00 | 10.20 |

Table 8. The yield of the blueberry cultivars in the 2 th – 4 th years after planting.

| No. crt. | Cultivar | 2007 Kg/bush | 2008 Kg/bush | 2009 Kg/bush | Mean yield Kg/ bush |
|----------|-----------------|--------------|--------------|--------------|---------------------|
| 1. | Azur | 0.62 | 1.12 | 2.52 | 1.42 * |
| 2. | Bonifacy | 0.34 | 0.72 | 1.23 | 0.78 |
| 3. | Brigitta Blue | 0.55 | 1.45 | 2.22 | 1.41 * |
| 4. | Bluetta | 0.18 | 0.75 | 2.65 | 1.19 |
| 5. | Bluehaven | 0.30 | 0.57 | 0.97 | 0.61 |
| 6. | Darrow | 0.41 | 0.86 | 1.55 | 0.94 |
| 7. | Delicia | 0.75 | 1.42 | 2.24 | 1.47 * |
| 8. | Duke | 0.35 | 1.12 | 1.85 | 1.11 |
| 9. | Lax | 0.65 | 1.56 | 2.12 | 1.44 * |
| 10. | Nelson | 0.13 | 1.21 | 1.62 | 0.98 |
| 11. | Ozarkblue | 0.15 | 0.95 | 1.42 | 0.84 |
| 12. | Patriot | 0.23 | 0.76 | 1.95 | 0.98 |
| 13. | Simultan | 0.55 | 1.48 | 2.33 | 1.45 * |
| 14. | Spartan | 0.35 | 1.67 | 2.01 | 1.34 |
| 15. | Sunrise | 0.31 | 0.72 | 2.15 | 1.06 |
| 16. | Blueray-control | 0.45 | 1.10 | 2.10 | 1.21 |