DESSERT-TYPE CULTIVARS of BLACKCURRANT

NEW BREEDING AIM at the RIPF, POLAND

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RIBES SEMINAR – Drammen, Norway – 24 March, 2010

SHORT INFORMATION ABOUT POLAND


ICELAND
Reykjavik
NORWEGIAN SEA
BARENTS SEA
Naryan Mar
Murmansk
SCANDINAVIAN PENINSULA
NORWAY
SWEDEN
FINLAND
Ladoga Lake
Sukhona
Helsinki
Stockholm
SCOTLAND
Glasgow
Belfast
NORTH SEA
IRE
Dublin
ESTONIA
Nizhniy Novgorod
Moscow
DENMARK
Copenhagen
LATVIA
LITHUANIA
Dnepr
Tula
U K
ENGLAND
London
Amsterdam
Berlin
Vilnius
Minsk
NETH.
POLAND
Brussels
GERMANY
Warsaw
BELARUS
Paris
Kiev
Kharkho
Loire
Rhine
Danube
CZECH REPUBLIC
Vistula
Lviv
FRANCE
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UKRAINE
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SWITZ.
AUSTRIA
HUNGARY
Turin
Milan
Chisinau
SEA OF AZOV
Slovenija
PORTUGAL
SPAIN
ITALY
Belgrade
ROMANIA
Lisbon
Madrid
Barcelona
Sarajevo
BULGARIA
BLACK SEA
Rome
Sofia
Naples
Tirana
Istanbul
MEDITERRANEAN SEA
Ankara
Oran
Algiers
Bursa
Palermo
GREECE
Izmir
TURK
MOROCCO
Tunis
Mount Etna
Athens
Adana
ALGERIA

GENERAL INFORMATION ABOUT POLAND

- An area - 313 000 km^2
- Population – almoust 39 million inhabitants
- Mean yearly temperature ranges from 6,0 ^oC 8,5^oC
- Warmest month is July, the temp. reaches + 30 ^oC more
- Coldest month is January, the temp. drops below - 30 ^oC
- Late spring frosts in May are quite frequent
- Average yearly precipitation is 500 - 600 mm
- About 60 % of the agric. land are rather poor podsolic soils
- Soils consisting of clayey sand and boulder clay

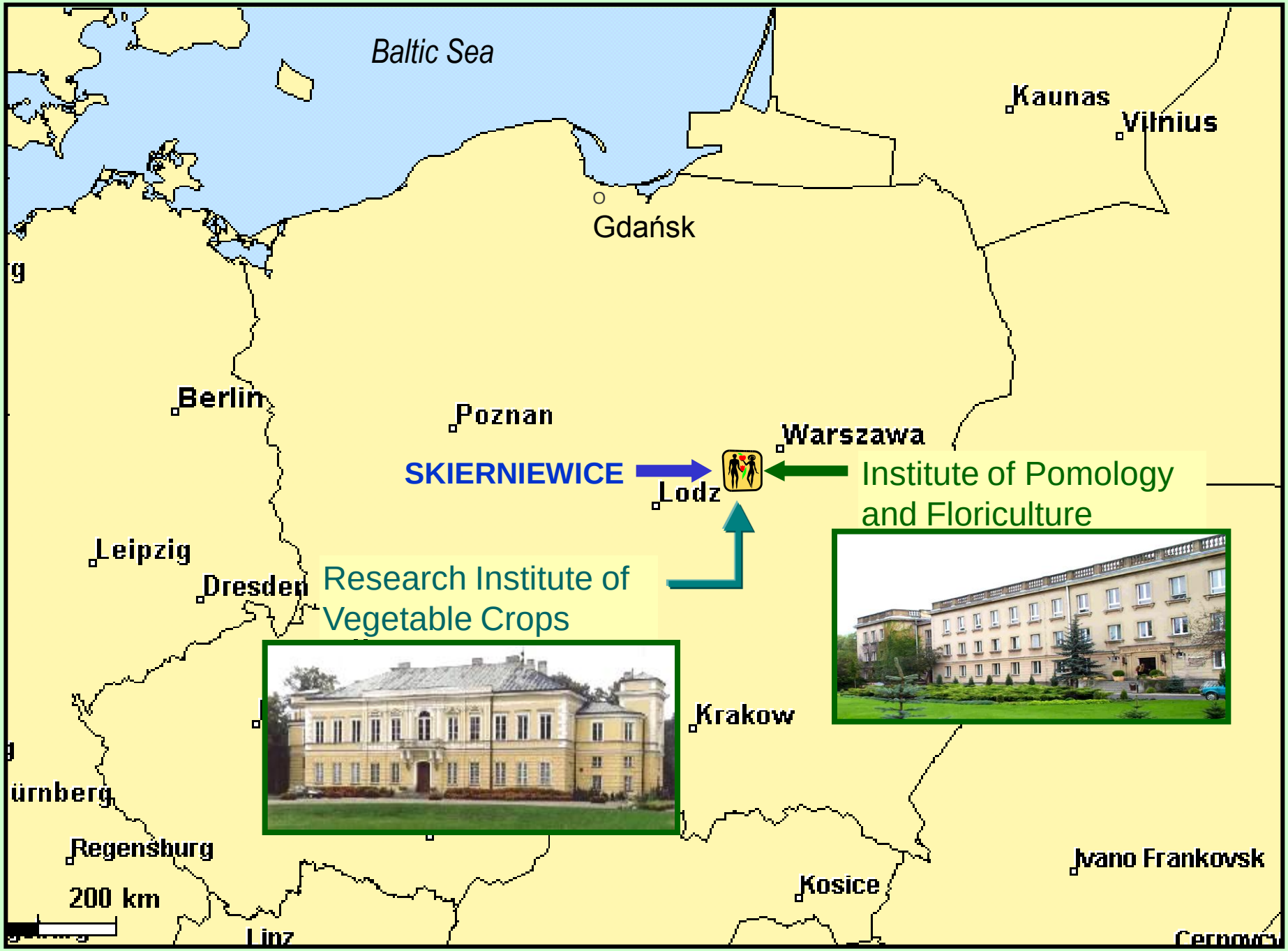
ADMINISTRATIVE DIVISION OF POLAND

SHORT INFORMATION ABOUT SKIERNIEWICE AND THE RESEARCH INSTITUTE OF POMOLOGY AND FLORICULTURE


Baltic Sea
Kaunas
Vilnius
Gdańsk
POLAND
MAZOVIA
Berlin
Poznan
Warszawa
SKIERNIEWICE
Lodz
Institute of Pomology and Floriculture
Leipzig
Dresden
Wroclaw
Praha
Krakow
ürnberg
Brno
Regensburg
Ivano Frankovsk
Kosice
200 km
Linz

SKIERNIEWICE – HISTORICAL CITY

- **1136** - the oldest mentions about Skierniewice as rural settelment belonging to the vast estates of Gniezno archbishops
- **1457** - official fundation of the town;
- **50.000** – recent population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SKIERNIEWICE
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Leipzig
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Research Institute of Vegetable Crops
Krakow
Regensburg
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Kosice
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CAPITAL OF THE HORTICULTURAL SCIENCES


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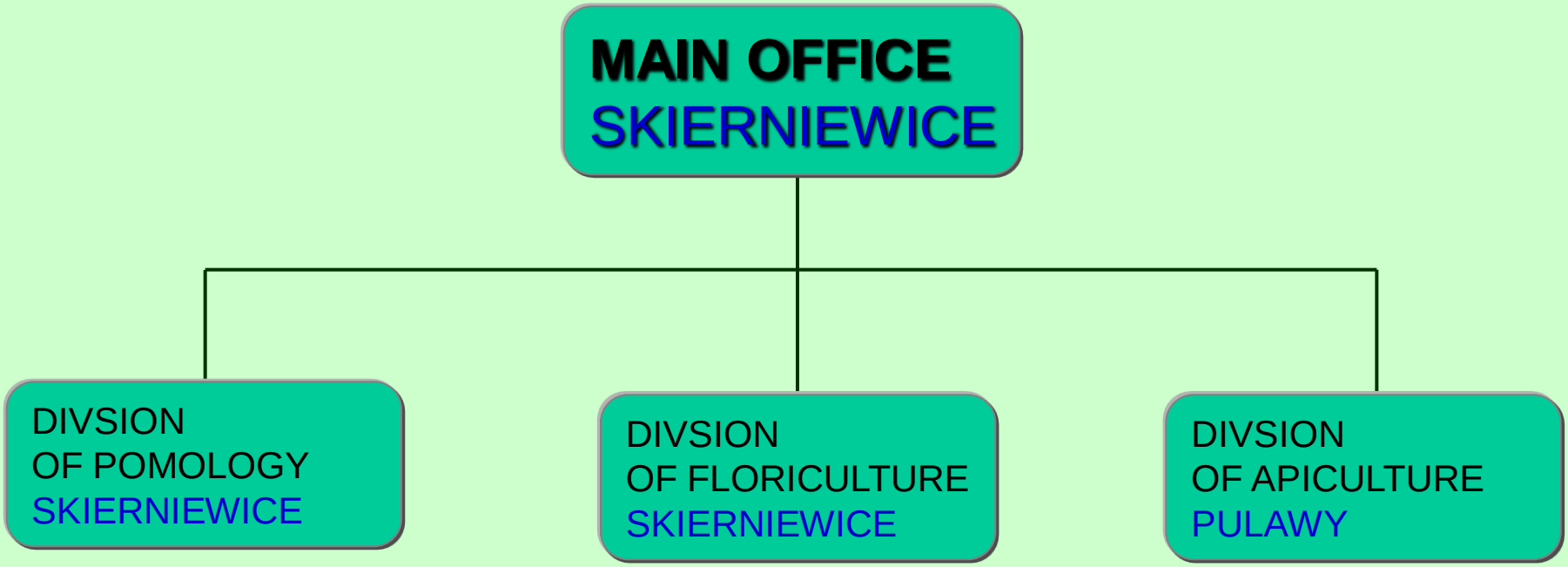
CAPITAL OF THE HORTICULTURAL SCIENCES

SHORT HISTORY OF THE INSTITUTE

- The RIPF was established in 1951 under the patronage of the Ministry of Agriculture and Food Economy.

- RIPF concentrates on research in fruit growing, ornamental plants and beekeeping.

ORGANIZATION OF RIPF



Research Institute of Pomology and Floriculture

Baltic Sea
Kaunas
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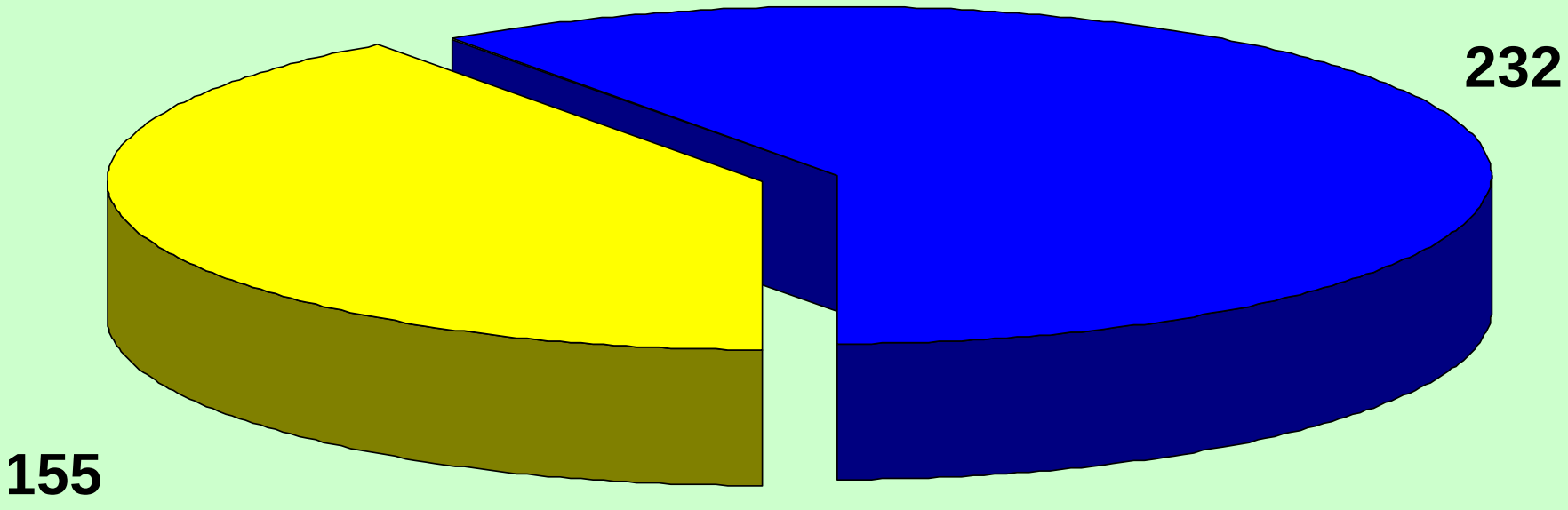
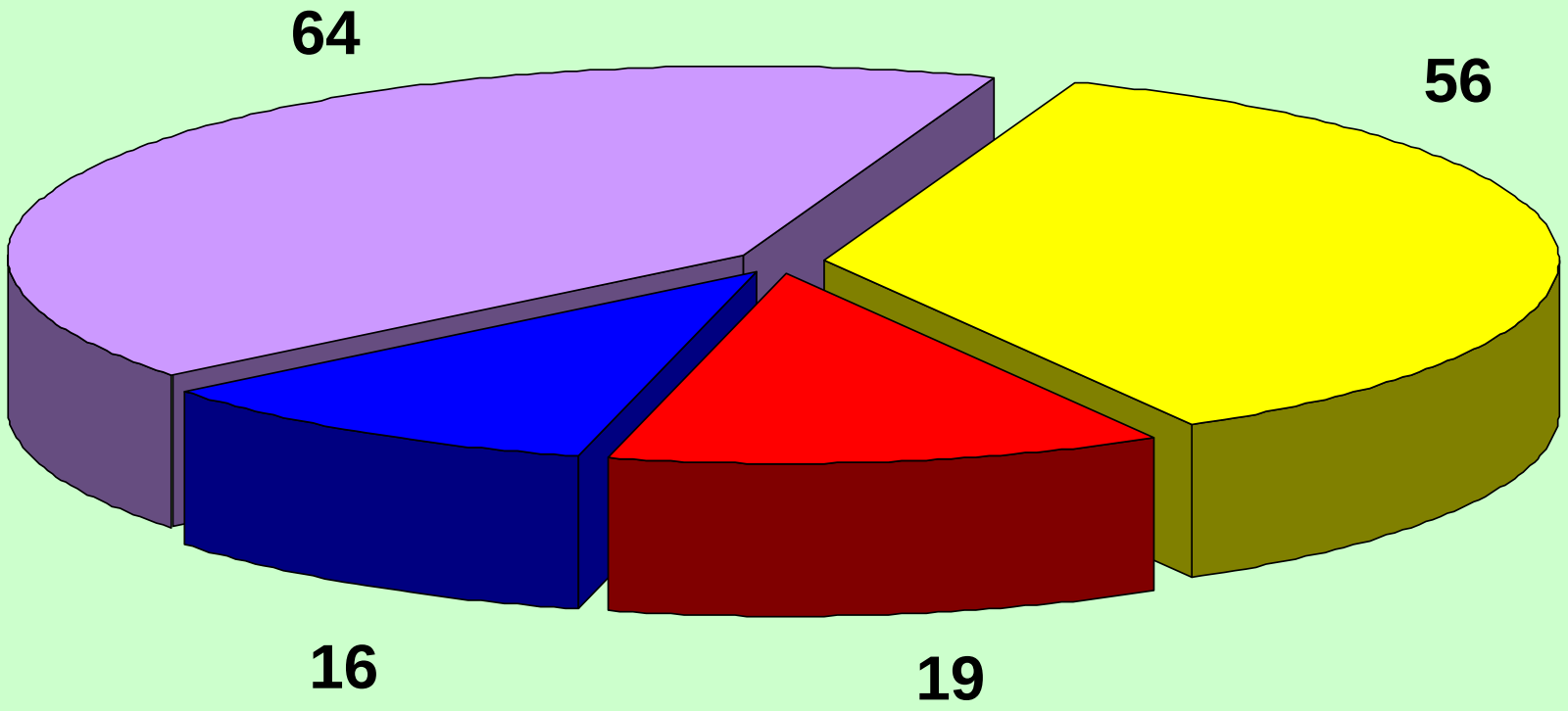
Poznan
SKIERNIEWICE
Warszawa
Lodz
Leipzig
Dresden
Pulawy
Praha
Krakow
Brno
Regensburg
Kosice
Ivano Frankovsk
200 km

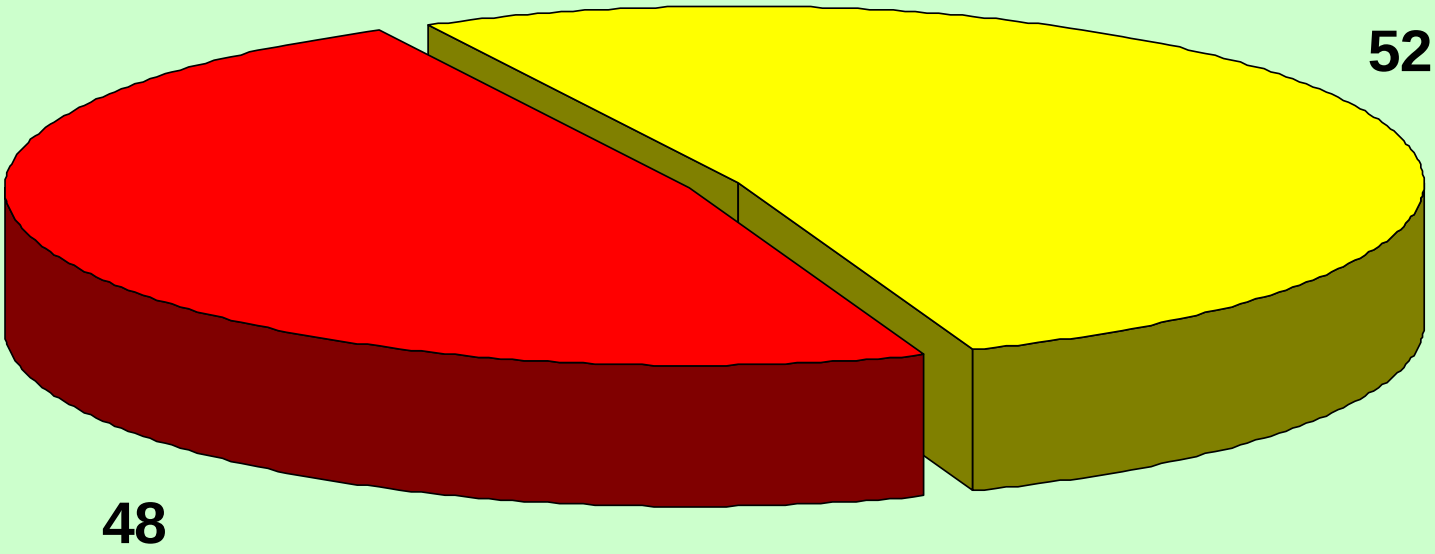
STAFF OF RIPF – 01.01.2009
(total 387 persons)



STRUCTURE OF SCIENTIFIC PERSONEL OF RIPF – 01.01.2009



FUNDING OF RIPF (%)



BRIEF HISTORY OF THE POLISH BLACKCURRANT BREEDING PROGRAM

1954 – 1967 – Dr. Kazimierz Somorowski – 6 cultivars

1968 – 1985 – Dr. Józef Gwozdecki – 2 cultivars

From 1986 – Dr. Stanisław Pluta – 6 cultivars

ACHIEVEMENTS OF THE POLISH BLACKCURRANT BREEDING PROGRAM

BONA

CERES

ACHIEVEMENTS OF THE POLISH BLACKCURRANT BREEDING PROGRAM


TIBEN

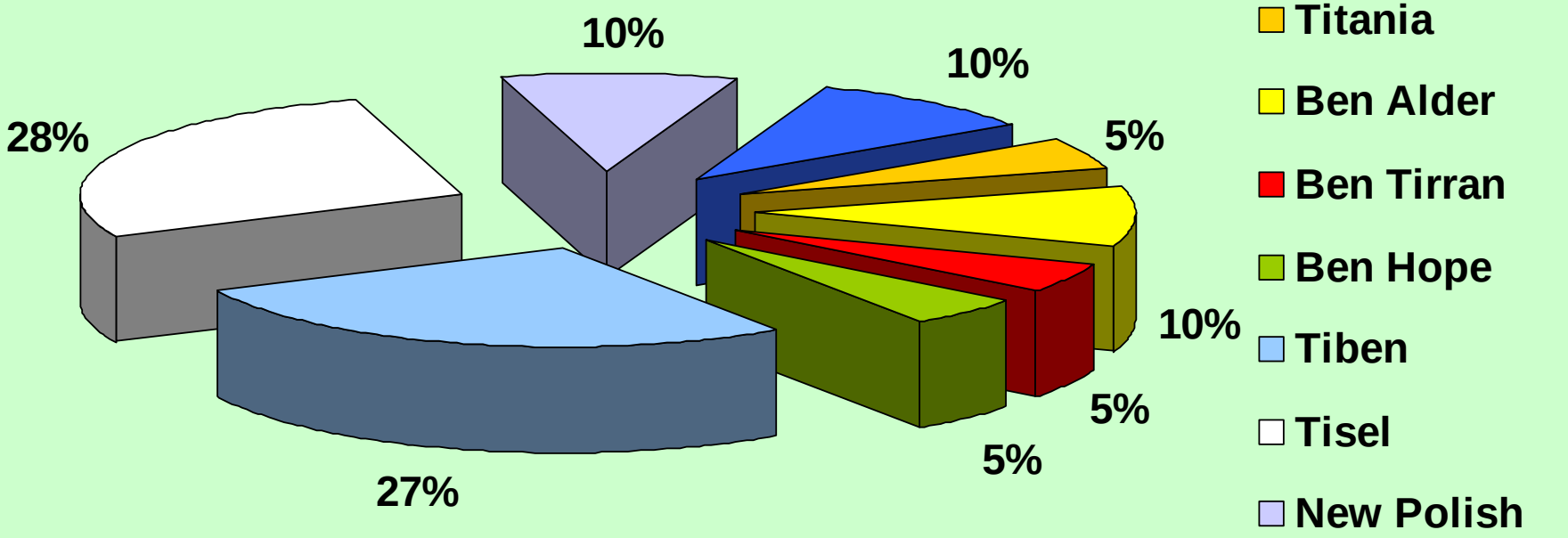

TISEL


ORES


RUBEN


TINES

STRUCTURE OF BLACKURRANT CULTIVARS PLANTED IN POLAND (2007-2009)



WHY DESSERT-TYPE CULTIVARS OF BLACKCURRANT?

- **Blackcurrant** is one of the small fruit crops commonly grown in Poland
- **Blackcurrant fruits** are regarded as very healthy fruits, due to the high content of vit. C, mineral compaunds, poliphenols including flavonoids such as anthocyanins and other compounds. Till now they have been consumed as processed
- **Cultivation of dessert-type blackurrants** in Great Britain, Germany Switzerland, Belgium and Netherlands has been under developement for many years
- In Poland there is also a growing interest in production of **dessert-type blackurrant cultivars**
- Breeding technology and gentetic resources allow to receive new **blackcurrant** cultivars producing high quality **fruits for fresh consumption**
- We believe that **dessert-type blackurrant fruits** will become soon „**the fruit of tomorrow"** suitable for fresh consumption

VITAMIN C CONTENT IN MOST COMMON FRUITS

(mg/100g)

Apple	- 4,6
Pear	- 4,2
Peach	- 6,6
Sweet cherry	- 7,0
Banans	- 8,7
Plum	- 9,5
Sour cherry	- 10,0
Apricot	- 10,0
Grapes	- 10,8
Blackberry	- 21,0
Raspberry	- 26,2
Grapefruit	- 34,4
Lemon	- 53,0
Orange	- 53,2
Strawberry	- 58,8
Blackcurrant	- 181,0

ANTIOXIDANT PROPERTIES OF DIFFERENT FRUITS

(umol TEAC/gram - Trolox Equivalent Antioxidant Capacity)

Blackcurrants	**-**	**14.0 – 50.0**
Highbush blueberries	**-**	**20.0 – 45.0**
Raspberries	**-**	**13.0 – 22.0**
Strawberries	**-**	**9.0 – 18.0**
Plums	**-**	**9.5**
Oranges	**-**	**7.5**
Grapes	**-**	**7.4 – 18.0**
Apples	**-**	**2.2**
Red wine	**-**	**10.0 – 18.0**
White wine	**-**	**2.0 – 5.0**

Source: Deighton D. *et al.* - 2002)

FRUIT QUALITY PARAMETERS

- **Ascorbic acid** (vit. C)
- **Anthocyanins and other phenolics**
- **Sensory components** (appearance, size/weight, taste, flavor, aroma, smell, ect.)

High content of anthocyanins and other phenolics as well as ascorbic acid in fresh blackcurrant fruit
=
HIGH ANTIOXIDANT CAPACITY

GREENMARKET IN NEW YORK - AUGUST, 2008

ADVENTAGES OF BLACKURRANT FRESH FRUITS PRODUCTION

CONSUMERS

- Enhance the fresh fruit market
- Enrich the human diet in a very healthy fresh fruit

FRUIT GROWERS

- Increase profitability of blackurrent production
- Allow the growers to introduce innovative technology of blackurrant production (open field, protected cultivation, out of season production)

ADVENTAGES OF BLACKURRANT FRESH FRUITS PRODUCTION

POTENTIALLY VERY GOOD FRUIT FOR ORGANIC PRODUCTION

IS IT POSSIBLE TO OBTAIN GOOD DESSERT TYPE BLACKCURRANT CULTIVARS?

We believe it is possible !

As a good example of blackcurrant cultivars fulfilling partly the requirements of dessert fruits can be Scottish - 'Ben Sarek'; Polish - 'Bona' as well as few Ukrainian cultivars such as 'Chereshnieva', 'Sjuta Kyevskaja' or 'Sanjuta'

BREEDING STRATEGY

First step

Exploring the existing genetic resources of blackurrant

Fruit of some cultivars - 'Bona' (PL), Big Ben' (UK), 'Chereshnieva', 'Sjuta Kyevskaja', 'Sanjuta' (UA) and 'Storklas' (S) have a good taste and are attractive in apperance

Second step

Studies on suitability of above mentioned genotypes for breeding of new desser-type cultivars

Estimation of breeding value (GCA-General Combining Ability and SCA-Specific Combining Ability)

REQUIREMENTS FOR BLACKCURRANT FRESH FRUITS

- Big fruit (1,5 g and more)
- Good fruit taste and aroma
- High fruit quality (vit. C and anthocyanins)
- Fruit apperrance and firmness
- Long strigs
- Uniform ripening
- Green strigs preferred
- Hand picking (all strigs)

BREEDING STUDIES

EXPERIMENT I

PLANT MATERIAL

Seedlings resulting from 6 x 6 half-diallel complete design Griffing's method 4, (15 F_1 full-sib families — 720 seedlings)

♀ \ ♂	BONA	BEN SAREK	LENTAJ	STORKLAS	BIG BEN	CHERESHNIEVA
BONA		X	X	X	X	X
BEN SAREK			X	X	X	X
LENTAJ				X	X	X
BIG BEN					X	X
CHERESHNIEVA						X

GENOTYPES CROSSED

(Six cultivars were crossed)

1. BONA
(PL)

2. BEN SAREK
(U.K.)

16. LENTAJ
(RUS)

GENOTYPES CROSSED

(Six cultivars were crossed)

4. STORKLAS
(S)

5. ‘BIG BEN’
(UK)

6. CHERESHNIEVA
(UA)

CROSSING PROGRAM - PLASTIC TUNNEL

(SPRING - 1996)

CROSSING OF PARENTAL FORMS

BONA

X

BIG BEN

PRODUCTION OF SEEDLINGS IN GLASHOUSE

(January 15 - May 30, 1997)

COLLECTING RESULTS – FRUIT HARVESTING

15 July, 2001

INVESTIGATED TRAITS – 2000 - 2003

- Fruit yield *[kg/plant]*
- Fruit size *[weight of 100 berries in g]*
- Field resistance to American powdery mildew *(Sphareotheca mors-uvae)* *[ranking scale 1-5]*
- Field resistance to leaf spot *(Drapenopezizia ribis)* *[ranking scale 1-5]*
- Field resistance to white pine blister rust *(Cronatrium ribicola)* *[ranking scale 1-5]*

Ranking scale *1-5; 1 –no symptoms, 5 – very severe symptoms*

Taste and aroma (only on the selected clones with good productive value) – evaluated by 5 persons

SENSORY EVALUATION of BLACKCURRANT FRUIT of the BEST DESSETRT CLONES

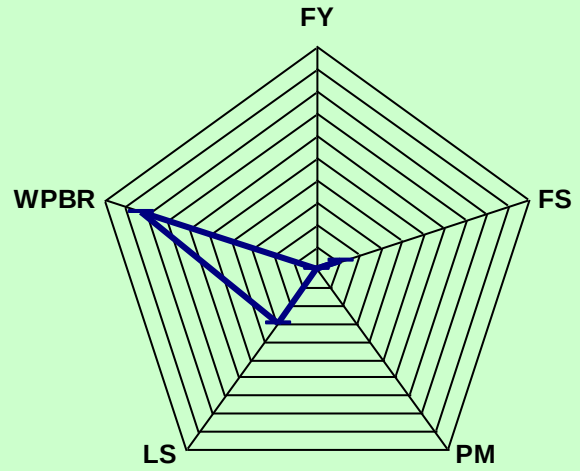
ANALYSIS OF VARIANCE OF COMBINING ABILITY OF SELECTED TRAITS IN BLACKCURRANT DIALLEL-CROSS DESIGN (*averaged 2000-2003*)

Source of variation	df	Mean squares (S^2)				
		Fruit yield	Fruit size	Field resistance to fungal diseases		
				Powdery mildew	*Leaf spot*	*WPBR*
GCA	5	0,368**	449,9**	0,058**	0,320**	0, 676**
SCA	9	0,298**	181,6**	0,076**	0,128**	0,576**
Error	42	0,080	42,8	0,006	0,024	0,005
$\frac{S^2_{GCA}}{S^2_{SCA}}$		*0,55*	*0,71*	*0,43*	*0,71*	*0,54*

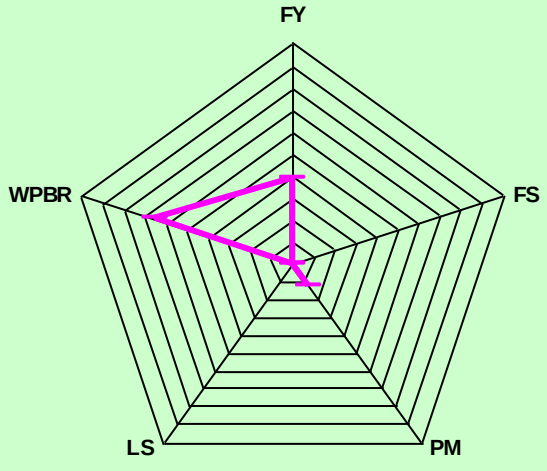
** - significant at the level α=0,05

ESTIMATES of GCA EFFECTS of SIX BLACKCURRANT CULTIVARS for SELECTED TRAITS

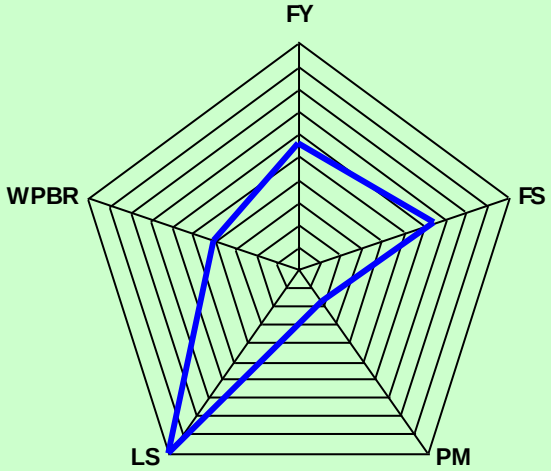
(averaged 2000-2003)



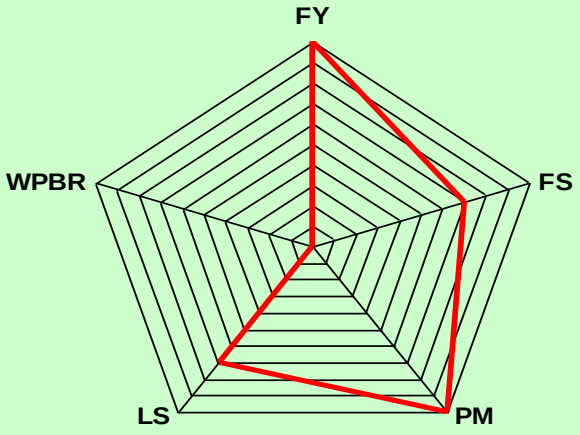
BONA



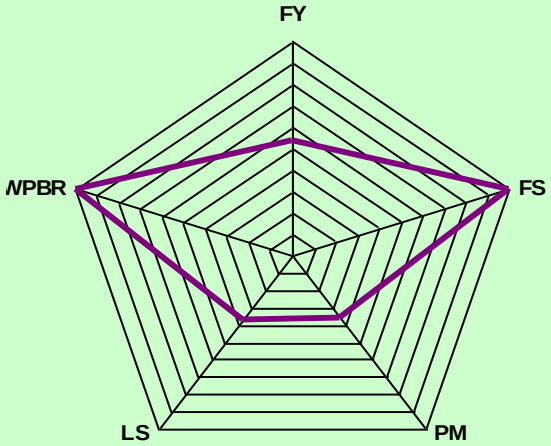
BEN SAREK



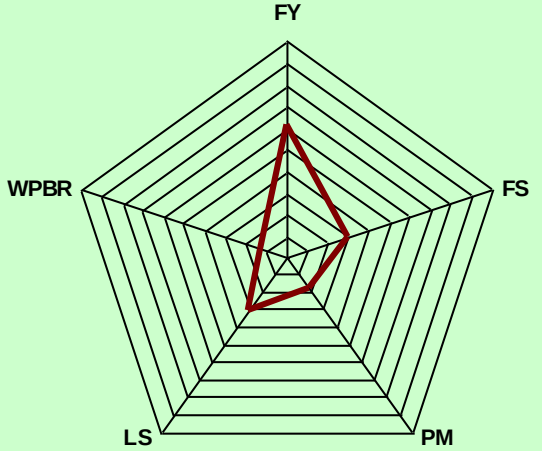
LENTAJ



STORKLAS



BIG BEN



CZERESZNIEWA

Legend: FY - Fruit Yield, FS - Fruit Size, PM - Powdery mildew, LS - Leaf Spot, WPBR - White Pine Blister Rust

ESTIMATES of GCA EFFECTS for SIX BLACKCURRANT CULTIVARS for SELECTED TRAITS

(averaged 2000-2003)

Cultivar	Fruit yield	Fruit size	Field resistance to fungal diseases		
			Powdery mildew	*Leaf spot*	*WPBR*
Bona	**-0,24***	**-4,92***	**0,05***	**0,06**	**-0,17***
Ben Sarek	**-0,06**	**-6,68***	**0,03**	**0,18***	**0,18***
Lentaj	**0,02**	**2,70**	**0,02**	**-0,22***	**-0,22***
Storklas	**0,23***	**3,45***	**-0,12***	**-0,10***	**-0,10***
Big Ben	**0,01**	**7,74***	**-0,01**	**0,03**	**0,03**
Chereshnieva	**0,05**	**-2,30**	**0,02**	**0,06**	**0,06**
$SE(\hat{g}_i)$ x 2,77	*0, 17*	*5,01*	*0,06*	*0,11*	*0,06*
$SE(\hat{g}_i - g_j)$ x 3,11	*0,31*	*8,74*	*0,09*	*0,16*	*0,09*
General mean	***0,75***	***97,4***	***1,32***	***3,39***	***2,28***

PRACTICAL RESULTS OF EXPERIMENT I

FIRST RESULTS of BREEDING PROGRAM

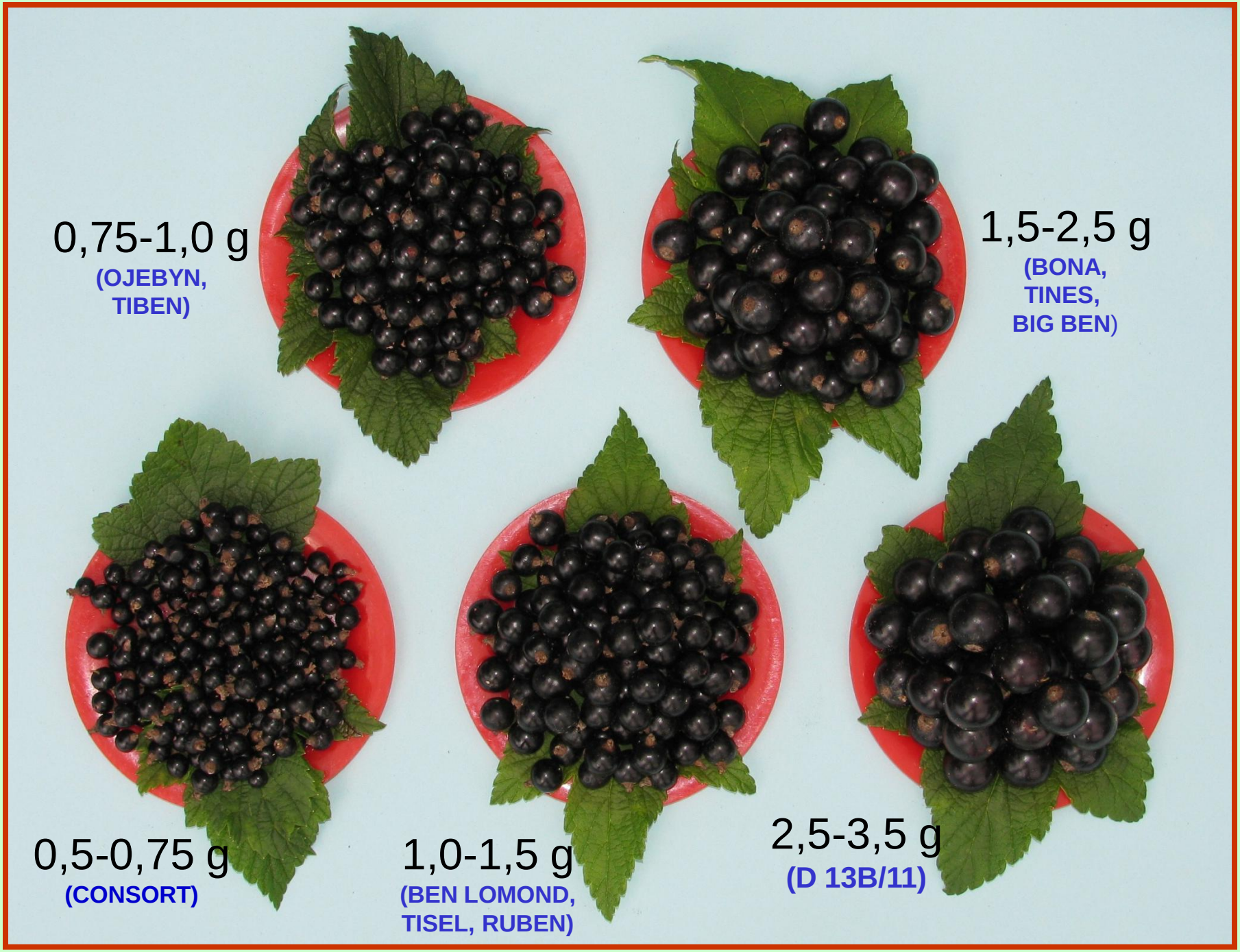
Best desert advanced selectiones *(average 2008-2009):*

D 4A/10 (Bona x Lentaj)
D 7C/3 (Storklas x Bona)
D 9B/5 (Storklas x Lentaj)
D 13A/9 (Big Ben x Lentaj)
D 13B/11 (Big Ben x Lentaj)
D 13C/6 (Big Ben x Lentaj)
D 14D/10 (Big Ben x Storklas)
D 20D/3 (Chereshnieva x Big Ben)


CHERESHNIEVA
1,4 g


BONA
1,8 g


D 13B/11
2,3 g


0,75-1,0 g
(OJEBYN, TIBEN)
1,5-2,5 g
(BONA, TINES, BIG BEN)
0,5-0,75 g
(CONSORT)
1,0-1,5 g
(BEN LOMOND, TISEL, RUBEN)
2,5-3,5 g
(D 13B/11)

CONCLUSIONS (Experiment I)

➢ Of the tested six genotypes the highest significantly positive GCA effects posses the following cultivars (based on the averaged values for 2000-2003):

- ‘Storklas’ – fruit yield
- ‘Big Ben’ (SCRI C2/15/40) and ‘Storklas’ – fruit size
- ‘Storklas’ – resistance to American powdery mildew
- ‘Lentaj’ and ‘Storklas’ – resistance to leaf spot
- ‘Big Ben’, ‘Bona’ and ‘Ben Sarek’ – resistance to WPBR

➢ For the practical breeding oriented on the studied traits ‘Big Ben’, ‘Storklas’ and ‘Lentaj’ are the best parental forms.

EXPERIMENT II

NEW CROSSING PROGRAM – 2008

(factorial crossing design)

PARENTAL FORMS	1. CERES	2. FOXENDOWN	3. SANJUTA
1. BONA (PL)	X	X	X
2. BIG BEN (UK)	X	X	X
3. CZERESZNIEWA (UA)	X	X	X
4. KUPLINIAI (LT)	X	X	X
5. GOFERT (PL)	X	X	X
6. DLINNOKISTNAJA (RUS)	X	X	X
7. LENTAJ (LT)	X	X	X
8. TINES (PL)	X	X	X
9. TISEL (PL)	X	X	X
10. SOFIJEWSKAJA (UA)	X	X	X
11. PC-425 (PL)	X	X	X
12. D 13B/11 (PL)	X	X	X
13. ORES (PL)	X	X	X
14. RUBEN (PL)	X	X	X
15. TITANIA (S)	X	X	X

DESSERT TYPE CULTIVARS

KUPOLINIAI

VYCIAI

LENTAJ

DESSERT TYPE CULTIVARS

(new Polish cultivars)

TISEL

TINES

GOFERT

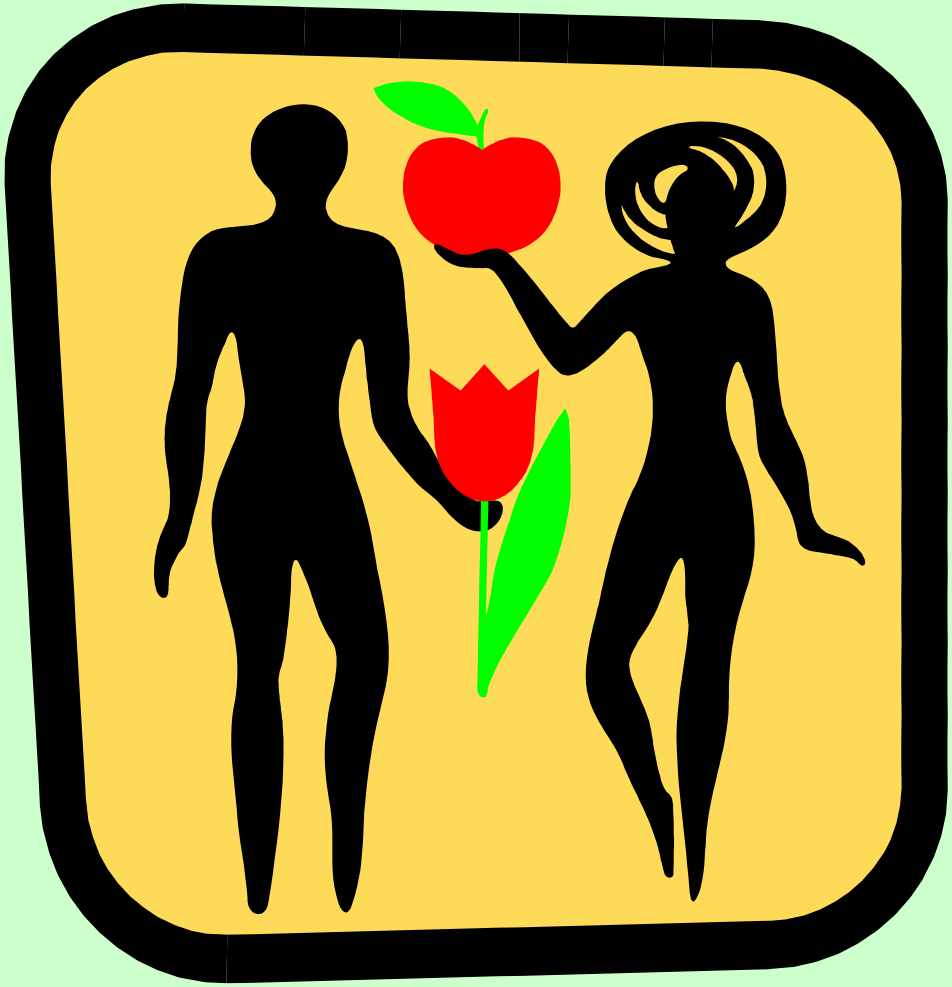
FURTHER SELECTION WORKS

STAGE I. (2008-2013)

- Selection of the best individuals with large fruits and good productive value

STAGE II. (2012-2013)

- Sensory evaluation and chemical analysis of fruit of the best breeding clones selected in the stage I.



THANK YOU

DESIRED TRAITS OF BLACKCURRANTS FOR FRESH MARKET

- **Cultural practices:**

  open field and protected cultivation on wires etc.

- **Desired fruit traits:**

  - Large berries preferred (1,5 g or more) on long strings,
  - Green strings preferred
  - High fruit quality (ascorbic acid, anthocyanins, others)
  - Uniform fruit ripening
  - Easy hand picked on string

METHODOLOGY APPROACH

Obtain information on breeding value based on General Combing Ability (*GCA*) effects of six genotypes which could be used in the efficient breeding program aimed at developing **dessert type of blackcurrant cultivars.**