

Breeding of the highbush blueberry (*Vaccinium corymbosum* L.) - the main limitations of releasing Northern-type cultivars



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Agenda

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2. Main limitations in breeding of highbush blueberry cultivars of northern types

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- 2.2. environmental – climate limitations
- 2.3. genetic barriers
- 2.4. public & private breeding programs
- 2.5. breeding strategy & the use of new cultivars

3. Summary

1. Introduction

BLUEBERRY TYPES IN CULTIVATION

1. LOW BUSH

2. HIGHBUSH Northern type

3. HIGHBUSH Southern type

4. HALF-HIGH

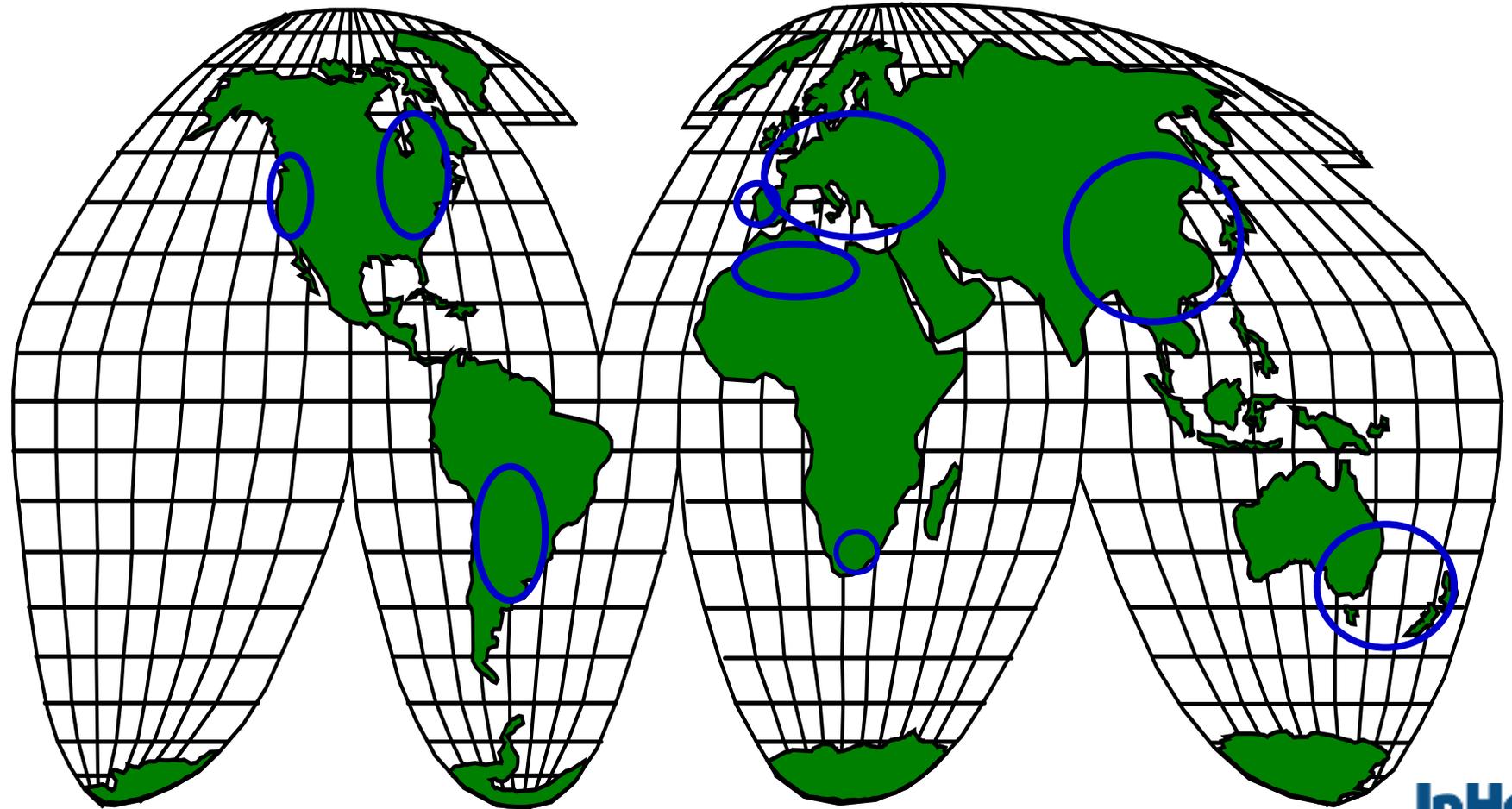
5. RABBITEYE

} >70%



1. Introduction

Highbush blueberry is a popular cultivated species in North, Central and South America, Asia, Europe, Africa, Australia and New Zealand.



World production
- 2023

Total planted
– 262,427 ha

Global production
– 1,796 million MT

1. Introduction

Blueberry production in the world

- The high global production of blueberries is, among others, the result of biological progress, in the form of new cultivars obtained in breeding programs.
- Applied breeding of highbush blueberries has currently been conducted in various countries of the world - public, mainly private breeding programs.
- **However, the cultivation of the northern highbush blueberry has some limitations.**

2. Main limitations in breeding of highbush blueberry cultivars of northern types

2.1. Long breeding cycle (procedure)

HIGHBUSH BLUEBERRY BREEDING – crossing program

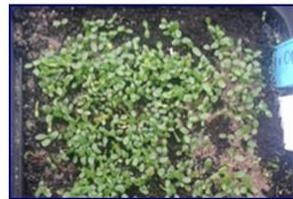


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Forma mateczna

Forma ojcowska



- **Stage I** - crossing program; - 1 year
- **Stage II** - Seedling population; 1-2 years
- **Stage III** - Selection (1-2%); 2-3 years
- **Stage IV** - Advanced Selection (1-2%); 3-4 years
- **Stage V** - Assessment of clones in a trail experiment (5-10 clones); 3-4 years
- **Stage VI** - Application for registry research (DUS and VCU studies) - (1-3 clones); 3-4 years
- **Stage VII** - New cultivar, registration; 1-2 years

TOTAL – 12-15 years

2.2. Environmental – climate limitations

CULTIVATION TYPE	WINTERHARDINESS (°C)	CHILLING requirements (hrs.)
LOW BUSH	-30°C	>1000
HIGHBUSH Northern type	-25°C	>800
HIGHBUSH Southern type	-5°C	<600
HALF-HIGH	-25°C	800
RABBITEYE	0°C	<600

Northern type cultivars have to be much winterhardy and have higher chilling requirements and adaptation to harsh climatic conditions.

2.3. Genetic barriers

Different ploidy levels

1. LOW BUSH - *V. angustifolium* Aiton.

($2n=4x=48$) – tetraploid

2. Highbush Northern type *V. corymbosum* L.

($2n=4x=48$) - tetraploid

3. Highbush Southern type Interspecific hybrids of *V. corymbosum* with other species, as *V. darrowii* *V. tenellum* ($2n=2x=24$) - diploid; *V. virgatum* (syn. *V. ashei* - Rabbiteye) $2n=6x=72$ – heksaploid; $2n=4x=48$) – tetraploid

Interspecific *hybrids* between different *Vaccinium* species incl. diploid ($2n=2x=24$), tetraploid ($2n=4x=48$) and hexaploid ($2n=6x=72$).

4. HALF-HIGH = Highbush x Low Bush *V. corymbosum* x *V. angustifolium*

($2n=4x=48$) – tetraploid

5. RABBITEYE: *V. virgatum* , syn. *V. ashei*

($2n=6x=72$) – **hexaploid**

Short genetic information

- Different ploidy levels of parental forms: diploid, the most common - **tetraploid** and hexaploid, cause crossing barriers and obtaining fruit and seeds from pollination.
- Highbush blueberry cultivars with a very complex origin /pedigree were obtained – **A. Draper** (USA)

'Legacy'

73% *V. corymbosum* (4x)
25% *V. darrowii* ((2x)
2% *V. angustifolium* (4x)



'Sierra'

50% *V. corymbosum* (4x)
20% *V. darrowii* (2x)
15% *V. ashei* (6x)
13% *V. constablaei* (6x)
2% *V. angustifolium* (4x)

In practice, not all species can be effectively used in the applied breeding of new cultivars of the Northern type, as many of them are thermophilic.

2.4. Public & private breeding programs

❖ **Almost 40 programs (public + private) of highbush blueberry breeding have currently been conducted in different countries around the world.**

1. North, Central and South America - approx. 20 programs in total.
2. Europe – 12 programs
3. Asia / Pacific + Australia and New Zealand - 7-8 programs

Lp.	Country	Number	Lp.	Country	Number
1	Australia	2	13	Chile	3
2	New Zealand	2	14	Canada - BC	1
3	China	2	15	Canada - Nova Scotia	1
4	Japan	1	16	Mexico	1
5	Byelorussia	2	17	USA - Arkansas*	1
6	Spain	2	18	USA - California	1
7	Germany	1	19	USA - Florida	1
8	Poland	4	20	USA - Georgia	2
9	Romania	1	21	USA - Michigan	2
10	Italy	1	22	USA - Minnesota*	1
11	UK	1	23	USA - Mississippi	1
12	Ukraine	1	24	USA - New Jersey	1
Total		20	25	USA - North Carolina	1
			26	USA - Oregon	2
			Total		19

- In the last decade, public/state highbush blueberry breeding programs in the USA and Canada have been restricted or even completely stopped.
- It was related to the retirement of an experienced breeders or the sudden tragic death of a breeder, such as Dr. Chad Finn.
- On the other hand, young breeders takeover of these work and activities.

2.5. Breeding strategy & the use of new cultivars

- A different breeding strategy and the use of new highbush blueberry cultivars are applied by public/state and private programs.

Public/state programs

- Cultivars bred in the USA are often available to American growers unrestrictedly under a purchased of license.
- For those interested in new cultivars from outside of North America, exclusive licenses for one company are often sold.

Private programs

- Some breeding companies donate cultivars only to their producers of these fruits (so-called "club varieties")
- Other firms sign exclusive contracts only with a few partners (nurserymen or growers)
- Still others allow everyone to grow their cultivars under a simple license contract.

The first public-private agreements have also recently been developed that allow the use of parental forms in breeding programs on the basis of a shared royalty profit ("royalty").

3. SUMMARY



- ✓ **Applied breeding of highbush blueberry cultivars of Northern type faces various limitations related to:**
 - the long cycle of obtaining new cultivars,
 - environmental requirements and winterhardiness of plants,
 - genetics of *Vaccinium* species, including their ploidy level
 - the source of funding,
 - the licensing policy of public/state and private programs.



THANK YOU VERY MUCH

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