

Grape Breeding

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Dr. Michael Striem

Presentation content

1. What is breeding?
2. Grape breeding aims
3. Selection criteria
4. Grape breeding time-line
5. New selections
6. New trends



What is breeding?

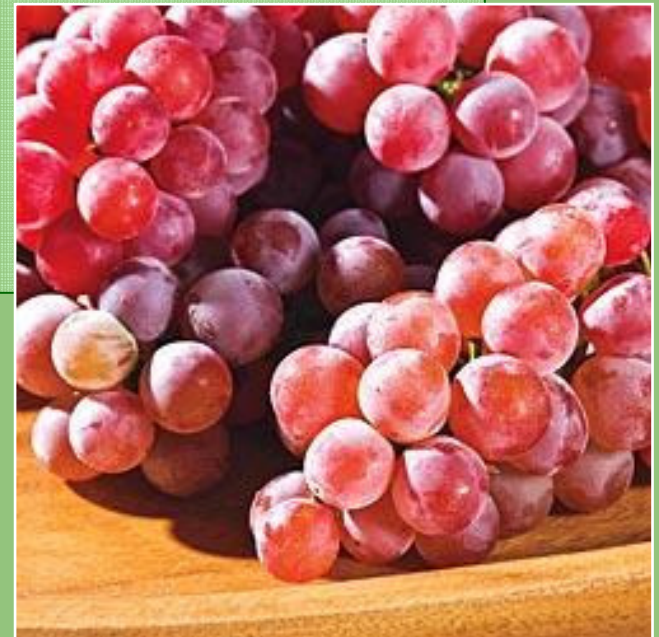
שקופית 3

- Creating new varieties
- Improving varieties
- Incorporating diversity
- Creating diversity



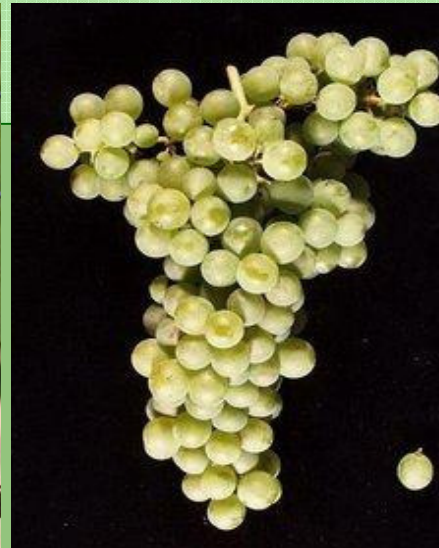
Breeding methods

- Traditional crosses and selection
- Clonal selection
- Mutagenesis
- Genetic engineering
- Introduction by import
- Germplasm collection



Grape breeding aims

- Fresh-market table grapes (Mainly seedless)
- Wine (Mainly for blending in generic wines)
- Raisin
- Juice



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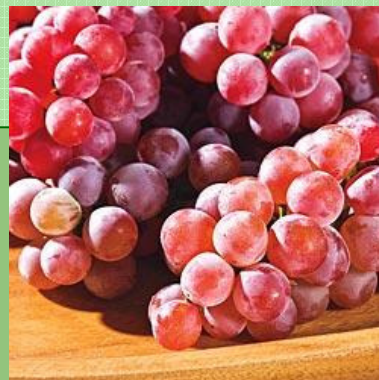


Grape breeding aims

שקופית 6



- **Improving quality** of grape & wine
- **Easy growing** – yield & vigor
- **Adaptation to climates** – heat, freezing
- **Resist pests** – fungi, insects, bacteria
- **Adaptation to environmental conditions** – salinity, drought



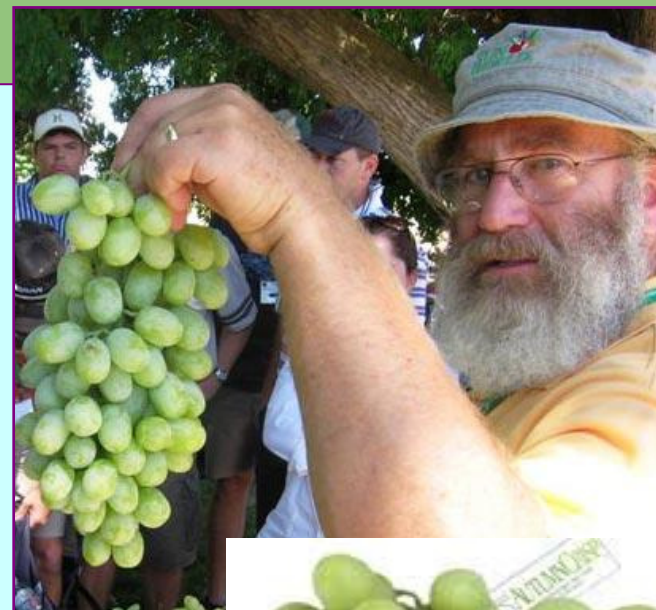
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Seedless table grape breeding aims

- Seedless grapes
- Large berries
- Loose cluster
- Good uniform color
- Good firm and strong skin
- Good firm and crunchy flesh
- Good taste
- Good post-harvest / shipping



Wine grape breeding aims

- Good sugar / acid ratio
- Good aromatic balance
- Medium size compact cluster
- Good uniform color
- Good firm and strong skin
- Easy harvest and processing



Wine & table grape breeding aims

- High yield vines – easy to grow
- Early / late ripening
- Resistance to diseases
- Tolerant to weather conditions



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Criteria for selection:

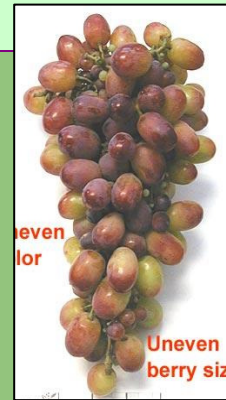
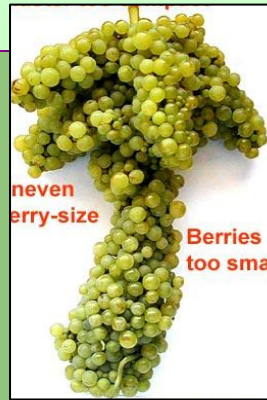
Wine grapes:

1. Chemical composition
2. Wine qualifications

Table grapes:

1. Berry
2. Cluster

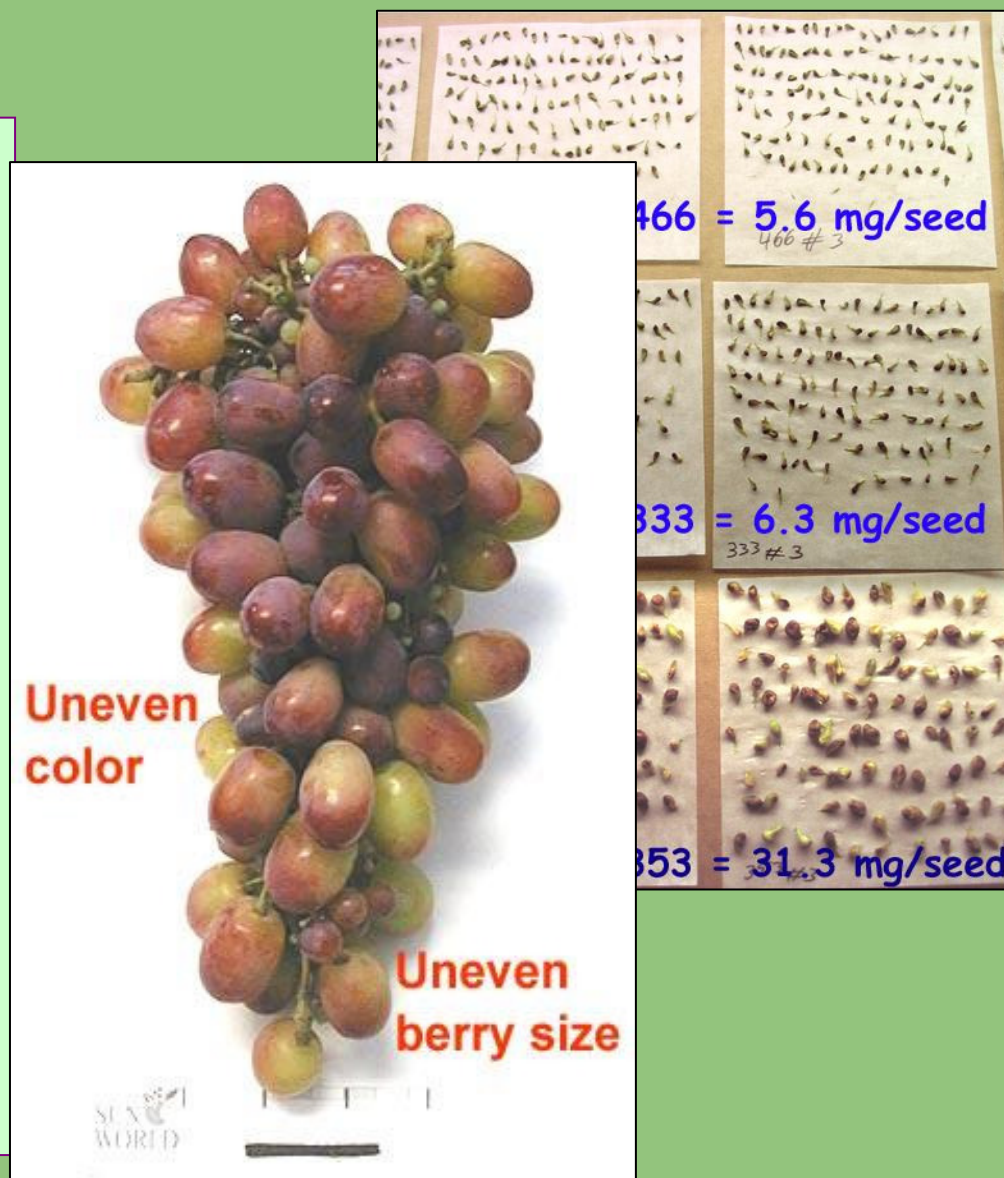
Agricultural practices



Criteria for selection:

Berry:

- **Seedless:** Seed traces should be small, soft and **undetectable**.
- Large berries, at least 19mm
- Firm, crispy, crunchy and juicy berries with medium to firm skin (but not tough).
- Uniform color.
No patches or bruising (rubbing) marks.



Criteria for selection:

Cluster:

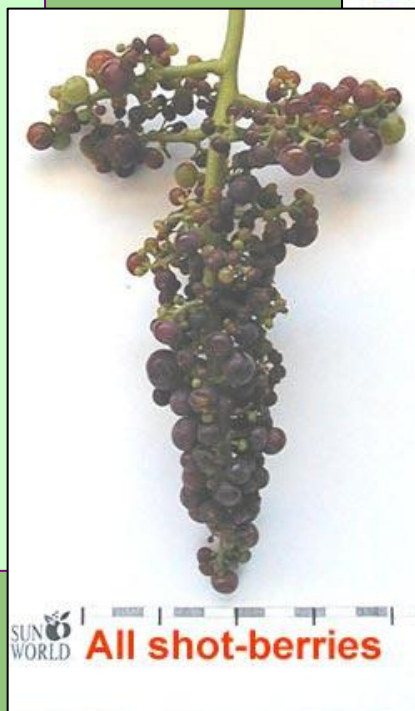
- Medium size (500gr), medium long, moderate shoulders (Africa shape).
- Loose to moderately compactness (not dense, not straggly).
- Rachis of reasonable thickness and good berry attachment (not brittle).

Cluster too compact

Uneven berry-size

Berries too small

Too straggly



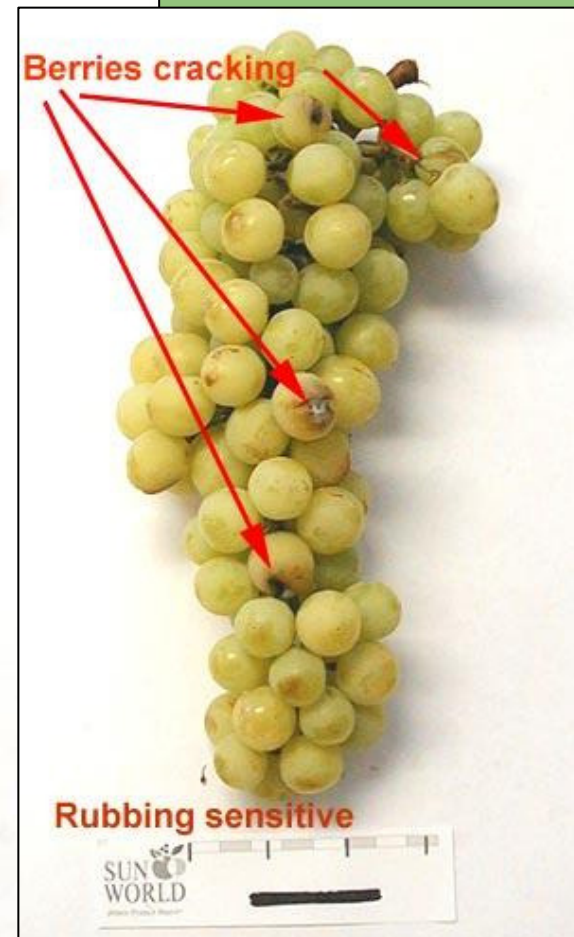
Criteria for selection:

Agricultural practices:

- High productivity
- Spur pruning
- No cracking and splitting.
- Good response to Gib (almost no need to thin and just a minor size increase)
- No negative rachis deformations.

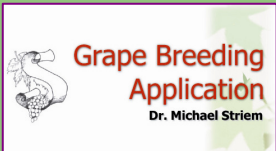


Bad Gib response
Stiff rachis
Weak berry attachment



Rubbing sensitive

Breeding timeline



1. Design the crosses – choose the parents.
2. Create the cross between two chosen selections.
3. Harvest clusters, extract seeds from berries, germinate seeds (using embryo rescue procedures for seedless varieties).
4. Acclimate seedlings in greenhouse during the winter and plant in the field in the spring.
5. Seedlings start bearing fruit. Make new selections – propagate in the winter.
6. Most of the seedlings were bearing fruit. Plant new selections in test-block.
7. Selection at semi-commercial blocks

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Design the crosses program

January 2011

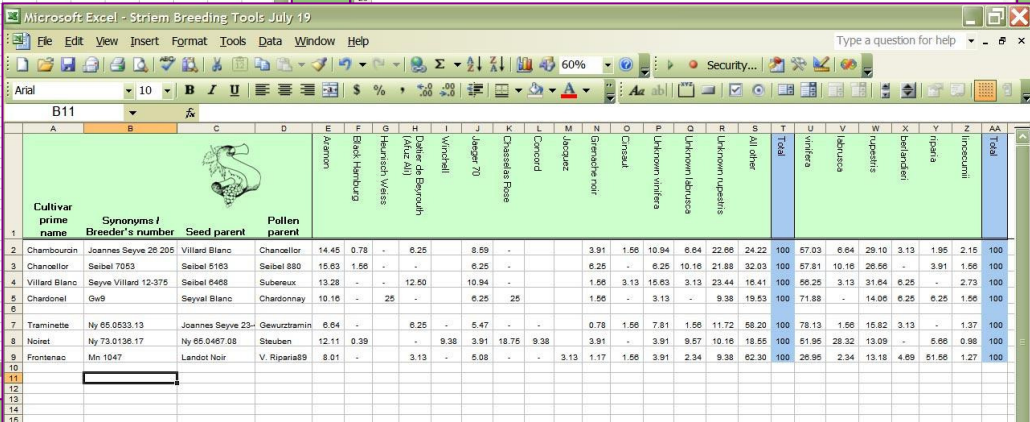
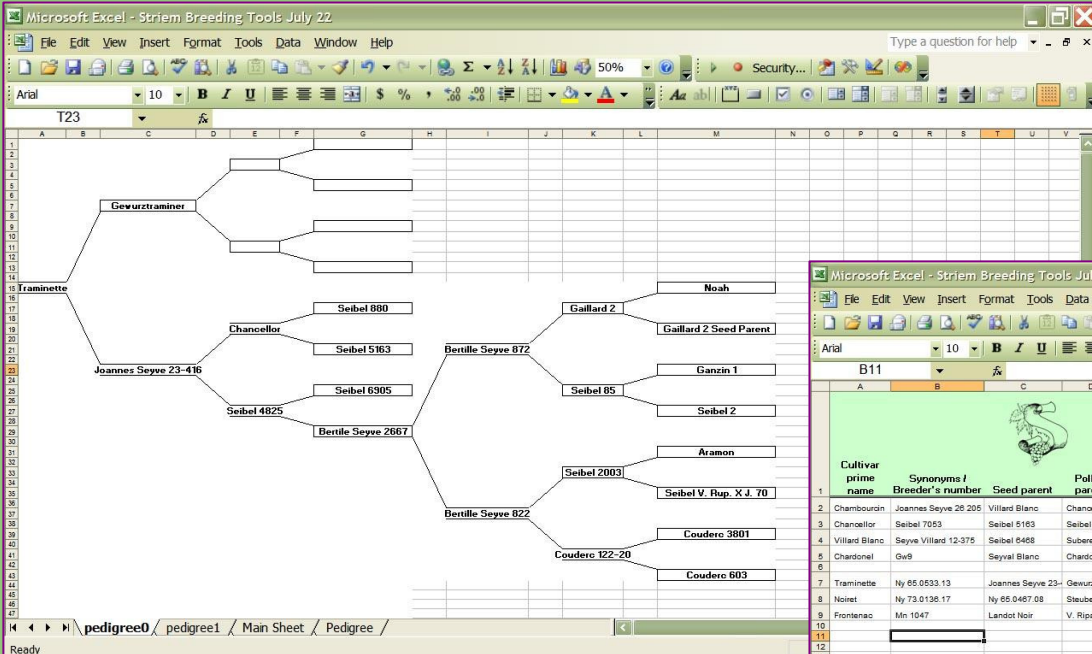
1. Have target in mind
2. Design crosses: choose parents
3. Check availability of plant material

שקופית 15



Grape Breeding Application

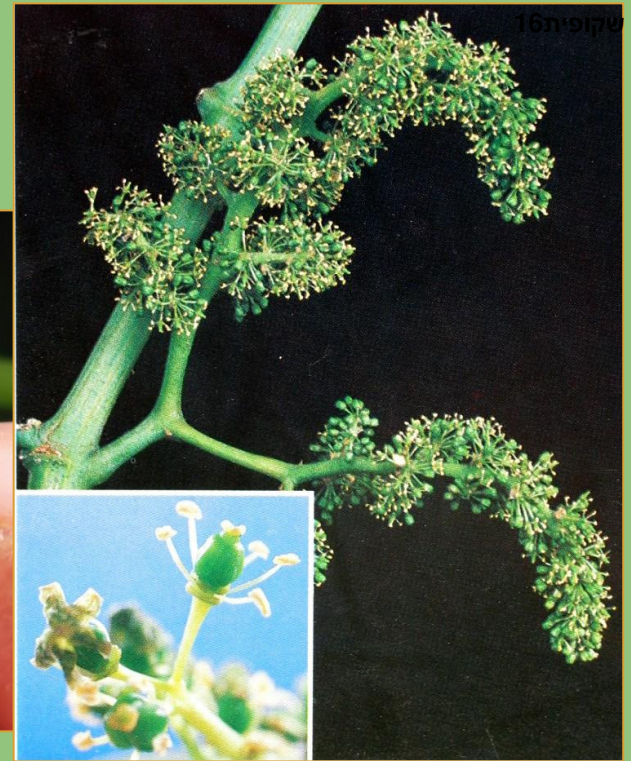
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Create the cross between two chosen selections

May 2011



- Parents are chosen to produce a combination of their traits.
- Flowering time may affect cross ability.
- Heritability of traits affects efficiency of selection.

Cultivar A X Cultivar B



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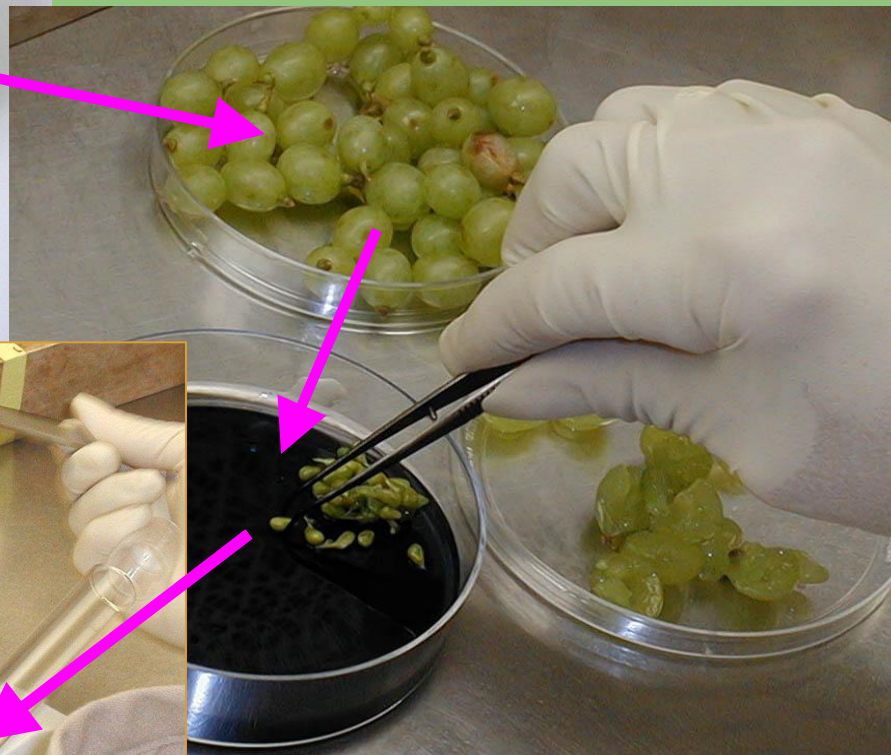
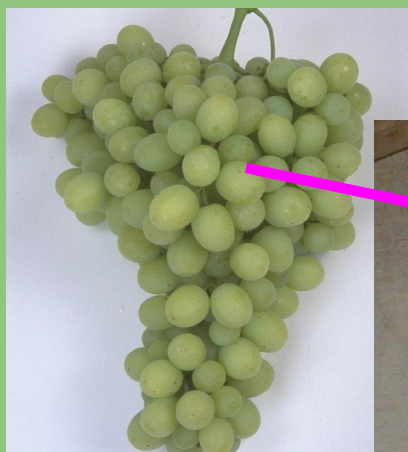
Extract seeds using embryo rescue procedures for seedless varieties

May 2011

July 2011

Surface sterilizing with bleach and ethanol prevent contamination of seed-trace cultures.

- Each berry may have 1-4 seed-traces.
- Each seed-trace is a result of a different fertilization event.
- Seed-traces bear viable but not fully-developed embryos.



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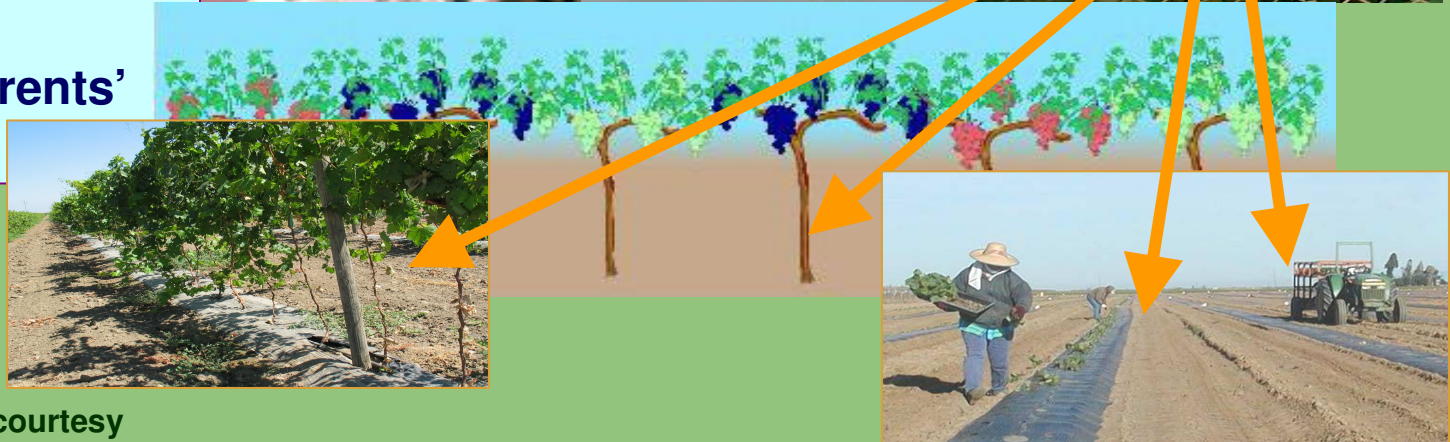
Acclimate seedlings in the greenhouse during the winter. Plant to the vineyard in the spring.

May 2011

April 2012

High density planting – low canopy volume available for each vine.

- Each vine is a unique individual.
- 20% of the embryos make their way to the field.
- Planting by families enables genetic evaluation of parents' performance.



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Seedlings start bearing fruit

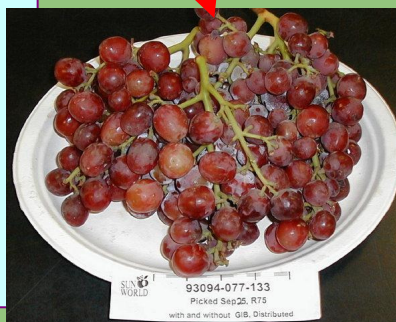
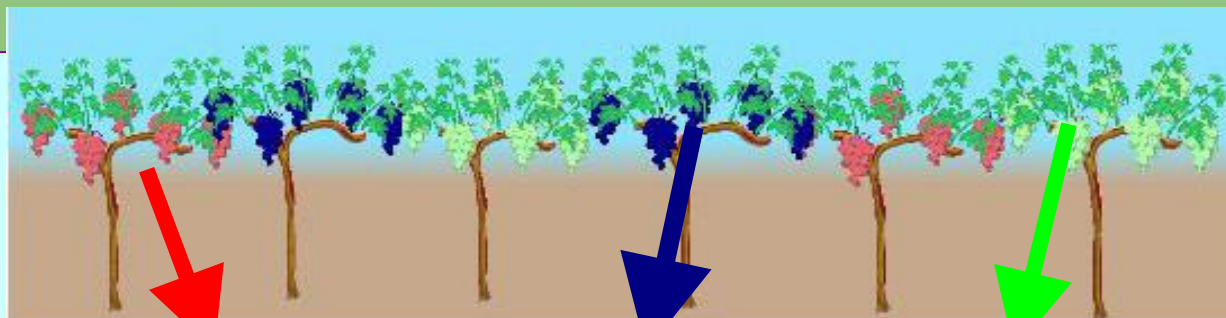
May 2011

June 2013

Most seedlings are discarded due to unfavorable traits.
Seedlings with desired and outstanding traits are selected.



- Each vine is evaluated for at most- three years.
- Selections are propagated to test-blocks.
- Agricultural practices and environmental conditions have affect on fruit and vine.



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Most seedlings were observed and evaluated

May 2011

June 2015



Selections with commercial potential are propagated to test-blocks.

Other selections are used as genetic germplasm for crosses.

- Agricultural practices and environmental conditions are evaluated.
- Selections which fail to maintain superior qualifications are removed from test.
- Selections with best performance are further propagated.



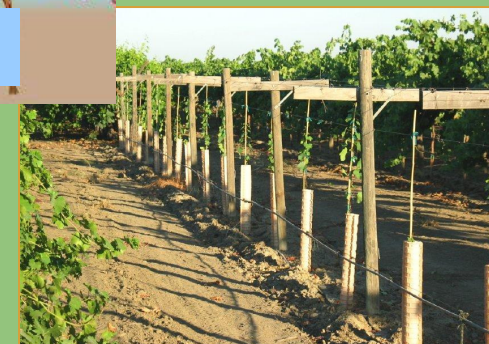
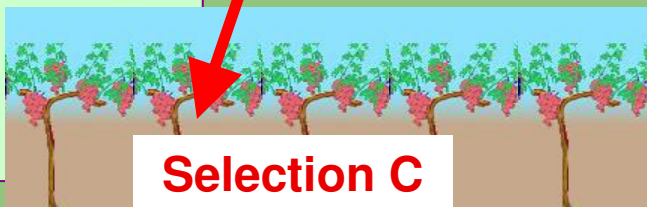
Selection A



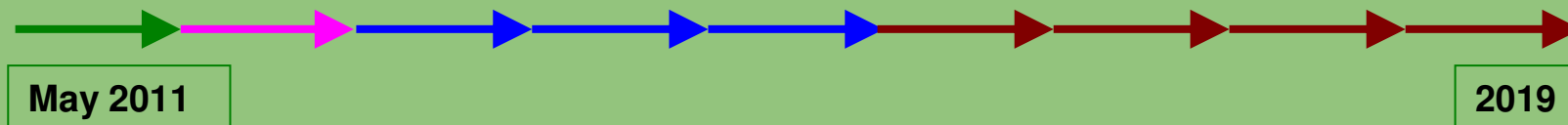
Selection B



Selection C



New selection planted in semi-commercial test block

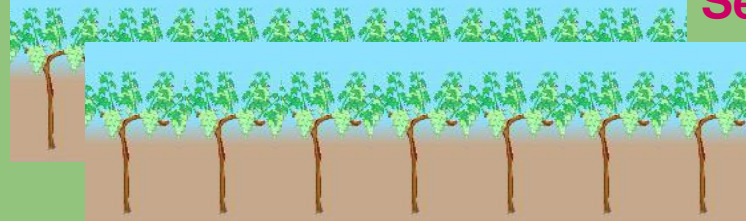


Selections planted at commercial blocks receive commercial treatments. Yield is evaluated for cold-storage, shipment and marketing.

- Training and practices are re-evaluated on large scale.
- Selections are distributed to licensees.
- Quarantine period delays commercial plantings abroad.



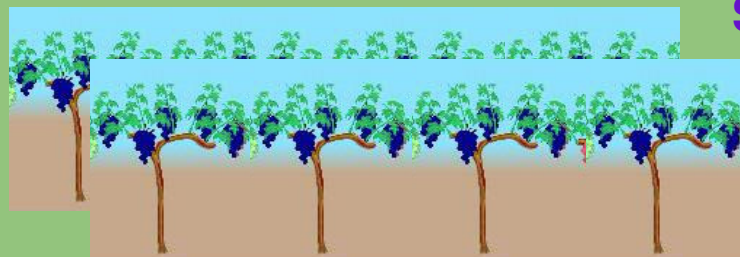
Selection A



Selection B



Selection C

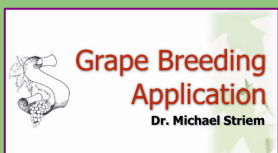


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Breeding timeline



January
2011

1. Design the crosses – choose the parents.



May 2011

2. Create the cross between two chosen selections.



July 2011

3. Harvest clusters, extract seeds from berries, germinate seeds (using embryo rescue procedures for seedless varieties).



April 2012

4. Acclimate seedlings in greenhouse during the winter and plant in the field in the spring.

June 2013

5. Seedlings start bearing fruit. Make new selections – propagate in the winter.



2016

6. Most of the seedlings were bearing fruit. Plant new selections in test-block.



2019

7. Selection at semi-commercial blocks

New wine grape varieties



- **Pinotage** – Pinot Noir x Cinsaut (Hermitage), 1920's, Stellenbosch University, South Africa
- **Emerald Riesling** – Riesling x Muscadelle (O.P. Heunisch Weiss) 1936, Harold Olmo, California, USA
- **Ruby-Cabernet** – (Cabernet Sauvignon x Carignan) 1940's by Dr. Harold Olmo, UC Davis, California, USA
- **Cayuga White** – (Seyval Blanc x Schuyler) 1945, NYSAES, Geneva, NY, USA
- **Chardone** - (Seyval Blanc x Chardonnay) 1953, NYSAES, Geneva, NY, USA
- **Dornfelder** - (Helfensteiner x Heroldrebe) 1955, today >2200 ha in Germany
- **Rubired** – (Tinto Cão x Alicante Ganzin) 1958 release, UC Davis, USA

Newest wine grape varieties

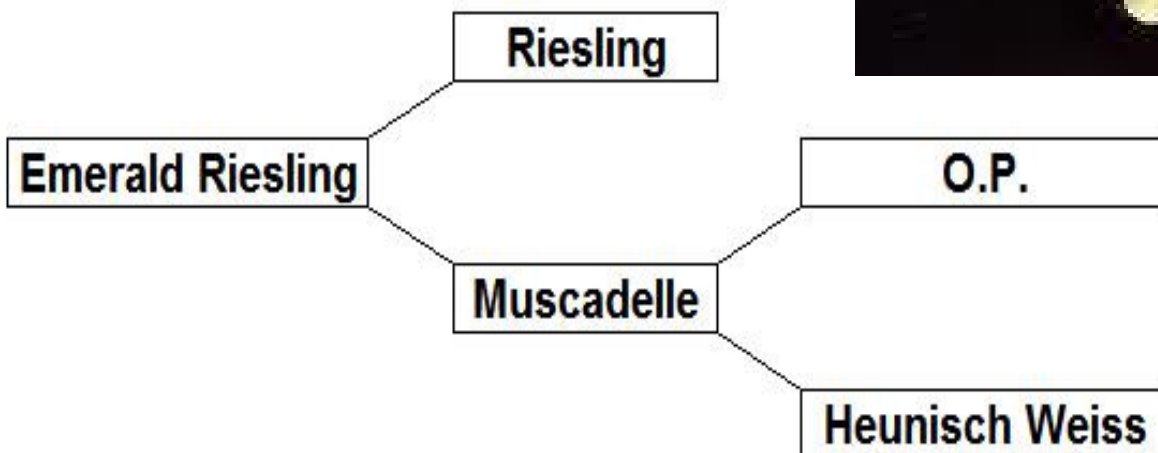


- **Traminette** – (Joannes Seyve 23.416 x Gewurztraminer) 1965, Professor Bruce Reisch, NYSAES, Geneva, NY, USA
- **Regent** – (Diana x Chambourcin) 1967, by Professor Alleweldt at the Geilweilerhof Institute, Germany
- **Argaman** – (Souzao x Carignan) 1972 release, Professor Spiegel-Roy, ARO Volcani Center,
- **Roy-Muscat** – (Dabouki x Muscat Frontignan) 1972 release, Professor Spiegel-Roy, ARO Volcani Center,
- **Noiret** - (NY65.0467.08 x Steuben) 1973, Professor Bruce Reisch, NYSAES, Geneva, NY, USA

Emerald Riesling

**Developed (1936) in California
to fit hot climate**

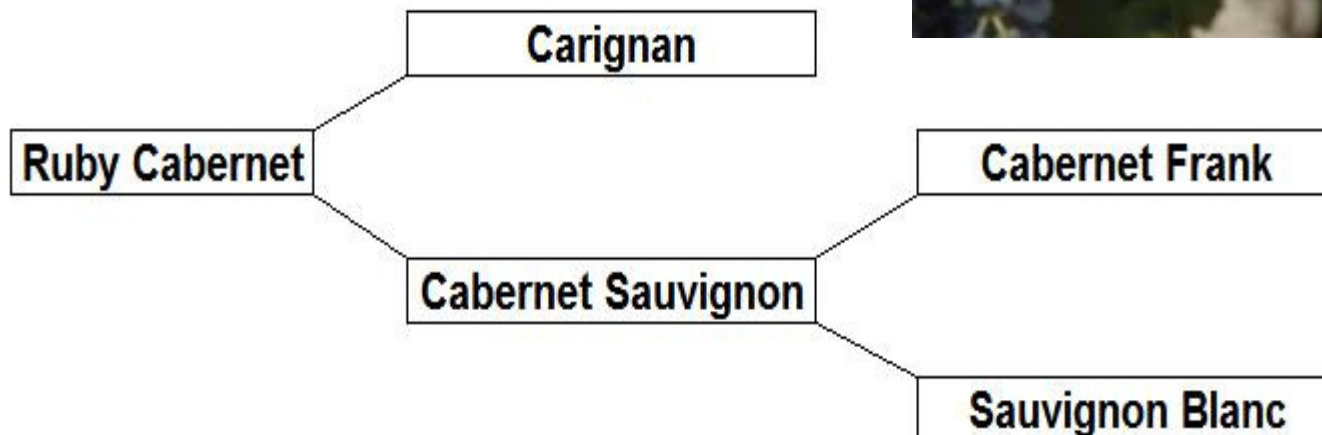
- Flavors and aroma from Riesling
- Acidity and muscat from Muscadelle



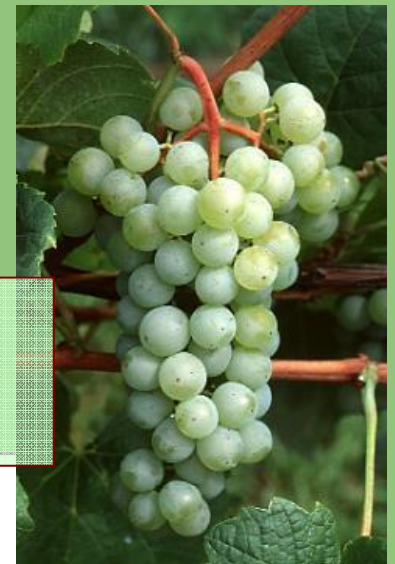
Ruby Cabernet

Developed (1940) in California to fit hot climate

- Flavors and aroma from Cabernet Sauvignon
- Productivity and adaptability of Carignan



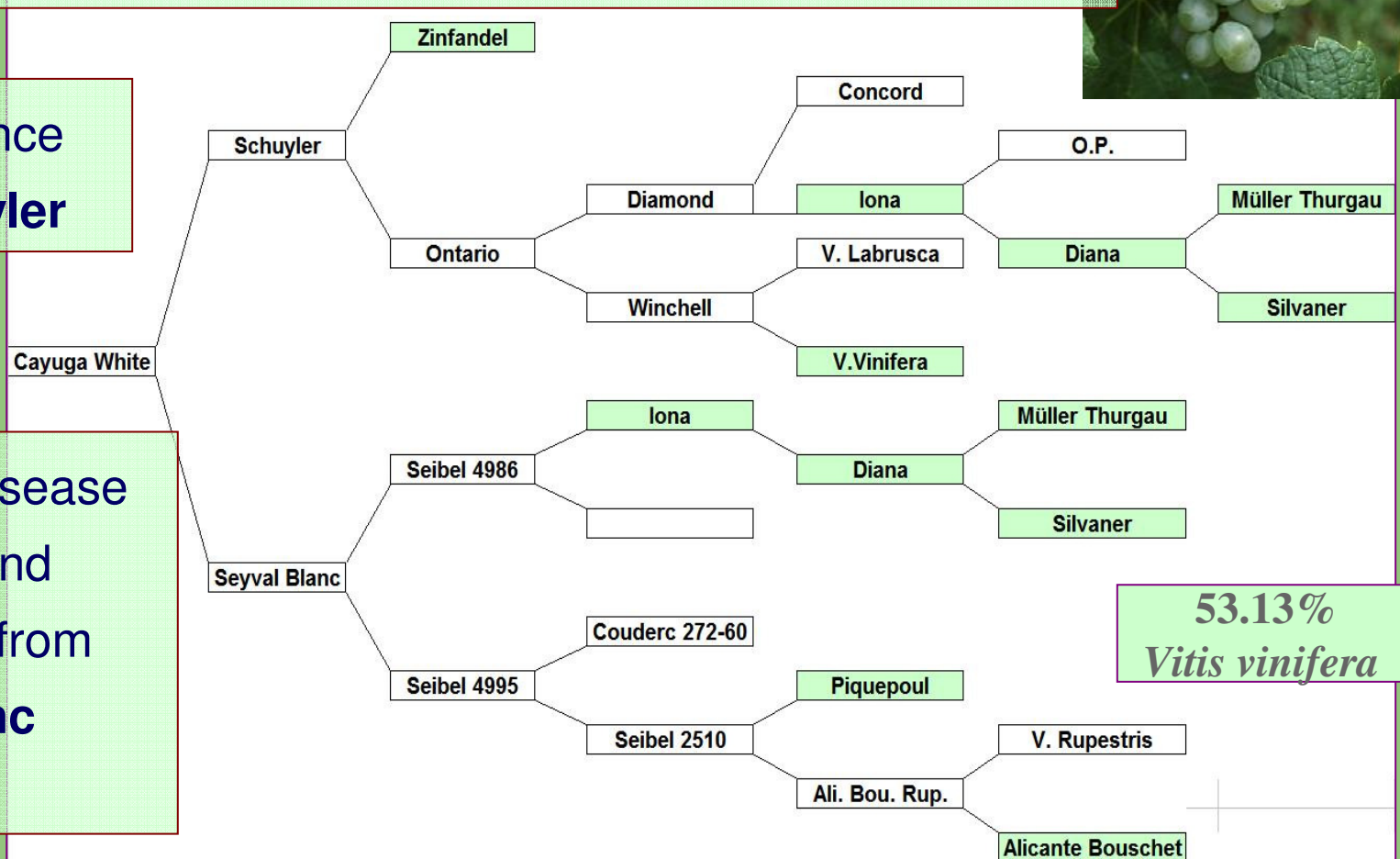
Cayuga White



Developed (1945) in upstate New York to fit cold climate, freezing winter conditions -29°C

Cold tolerance from **Schuyler**

Bunch-rot disease resistance and productivity from **Seyval Blanc**



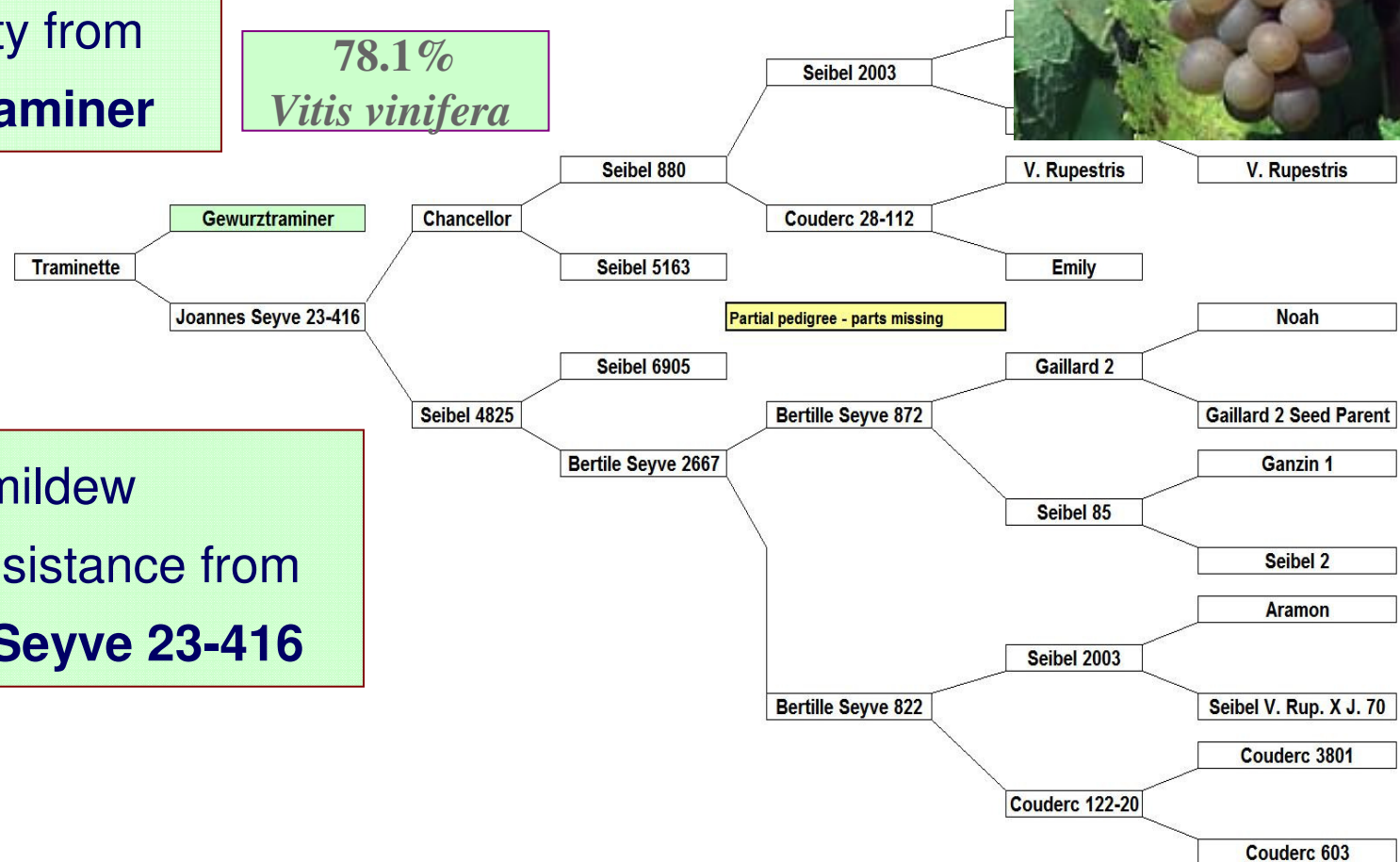
53.13%
Vitis vinifera

Traminette

Developed (1965) in upstate New York to fit cold climate, freezing winter conditions -26°C

Wine quality from
Gewürtztraminer

78.1%
Vitis vinifera

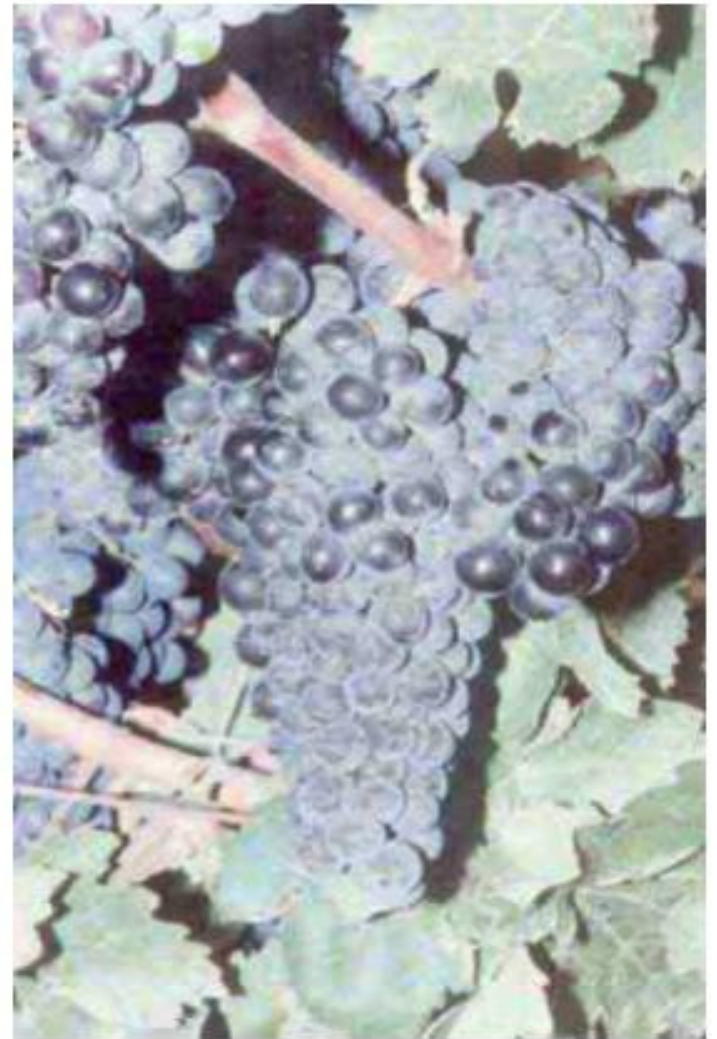
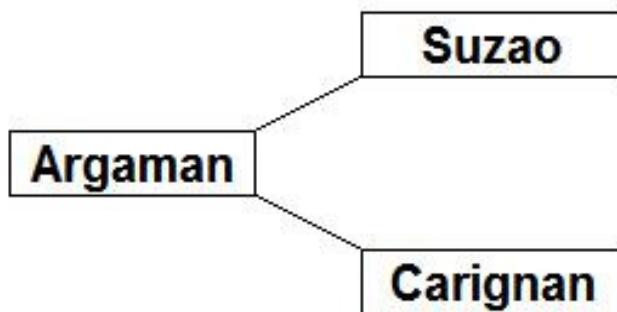


Powdery mildew
disease resistance from
Joannes Seyve 23-416

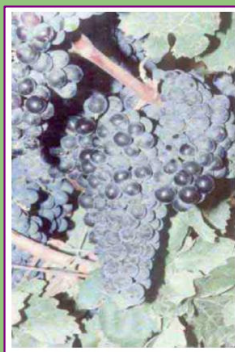
Argaman

**Developed (1972) in Israel to
fit hot climate**

- Color from Suzao
- Productivity and adaptability of Carignan



Next generation!



Argaman

Suzao

Carignan

Developed (1983) in Israel
to fit hot climate

- Color from Argaman
- Quality of Cabernet Sauvignon



Cabernet Sauvignon

Cabernet Frank

Sauvignon Blanc

Breeding early seedless for hot climate

The problems are:

- Heat
- Sunburn
- Dry air and soil
- Early frost



How early can a variety be?



A few things that we need to have:

- Break of dormancy
- Bud-break
- Bloom (short)
- Good fruit development conditions
- Good ripening conditions
- Good harvest



Summary for early seedless breeding

To get early ripening we need to:

- **Start early with early bud break**
- **Genetic tolerance to high temperatures and high photosynthesis optimum**
- **Genetically large berry**

Early ripening regions

- Mexico – Sonora
- California – Coachella
- Morocco –
- Israel – Jordan River
- Greece –
- **South Africa – Orange River + Namibia**
- **Chile – Copiapo**



Early ripening regions



SATI
South African Table
Grape Industry

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Nuutste nuus

Vroeë Chileense druiwe-oes 65 laer
Inligtingsdiensverskaffer Decofruit se vooruitskatting is dat oesvolumes van pitlose druiwe in Atacamaand Coquimbo 17K MT laer as in die vorige jaar sal wees
[Lees meer...](#)

SH TAFELDRUIF KALENDER

Please click on the fields below to learn more about the particular grape species.

	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY
Prime							
Flame Seedless							
Sugraone							

Early ripening regions



- South Africa – Orange River + Namibia

	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY
Prime							
Flame Seedless							
Sugraone							
Thompson Seedless							
Sunred Seedless							
Red Globe							
Alphonse Lavallee							
La Rochelle							
Crimson Seedless							
Bonheur							
Dauphine							
Barlinka							

Developing new varieties

4

New table grape varieties

In 2004 Dole South Africa purchased the rights to seven table grape varieties from a small farm in the North West. The first season of production was the third season for the varieties, which are promising.



The varieties are: Desert Seedless (red seedless), Alpha Red (black seedless), Alpha Red (red seeded), Nightshade (black seedless), and Moonballs (white seeded).

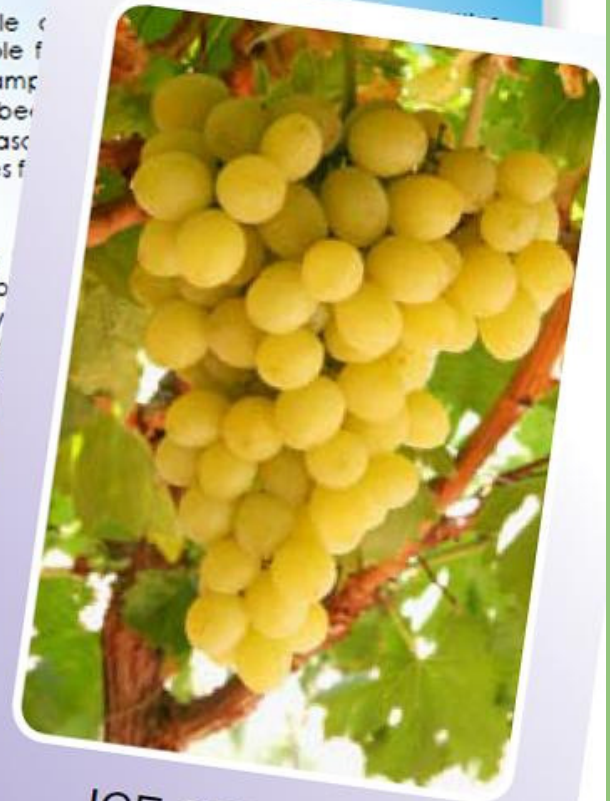
"We are following a strict evaluation process for these varieties, testing them in all South Africa's production regions for suitability," says Leon Van Biljon, Dole South Africa's business manager for grapes. "The coming season is likely to show which of these varieties Dole will continue to develop."

The two most promising varieties are Moonballs and Desert Seedless. Moonballs is a dramatic white seeded variety similar in berry size to Red Globe. Desert Seedless is a black seedless variety with a similar taste to the Sunworld variety Midnight Beauty.

These new varieties were developed in the North West for early production and are able to produce good yields in difficult growing conditions, where summer temperatures sometimes soar to 40°. Indications are that these varieties are set to produce earlier than similar varieties in the other South African production regions.

"Although Dole has a lot of fruit available for export some sample feedback has been positive. The production season for various varieties is still in progress," says Leon.

Dole plans to test the varieties in grower club systems. African export markets and Sunworld varieties are also under search for new markets.



ICE SEEDLESS



ICE SEEDLESS

Developing new varieties



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Product Availability Calendar

Sun World offers produce year-round, specializing in early and late season fruit. For more information about our product availability, [click here](#).

Good:  Peak: 



Sales & Marketing Services

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- [Nutrition Facts](#)
- [International Licensees](#)
- [News](#)
- [Growing & Shipping](#)
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- [Marketing Services and Programs](#)

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Good:  Peak: 



Early seedless varieties

- Black Emerald
- Perlette
- Prime
- Early Sweet
- Sugraone
- Sugrathirteen
- Ice Seedless



ICE SEEDLESS

Modern methods to advance breeding

Molecular markers are already used to:

- Develop DNA fingerprints for identification & enforcement of Intellectual Property Rights
- Identify parentage of cultivars
- Accelerate breeding



For example:

Prof. Andy Walker at UC-Davis and by Dr. David Ramming at the USDA to identify seedlings with resistance to:

- nematodes
- powdery mildew
- **Pierce's Disease**



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of Sun World Int. LLC

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Modern methods to advance breeding

Genetic transformations:

- Insertion of genes, chromosome segments, to incorporate new traits



For example:

Prof. Bruce Reisch at Cornell University, Geneva, NY , using Gene transfer technology – the biolistic process for Genetic Engineering, of Grapevines for Improved Disease Resistance to powdery mildew

Philosophy of commercial breeding

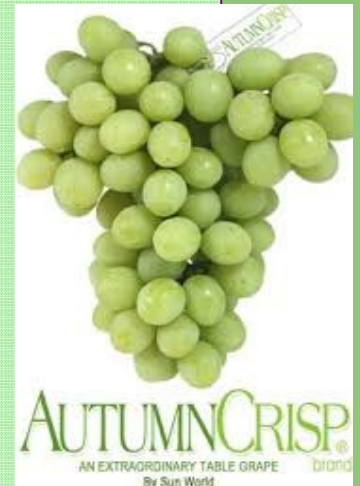
- First class quality of produce
- Protection of Intellectual Property rights
- International fit of varieties
- Grower friendliness
- Value of universally-used brands

®
TM

**SUPERIOR
SEEDLESS**
A SENSATIONAL GREEN GRAPE
By Sun World



**SABLE
SEEDLESS**
AN EXCEPTIONAL BLACK GRAPE
By Sun World



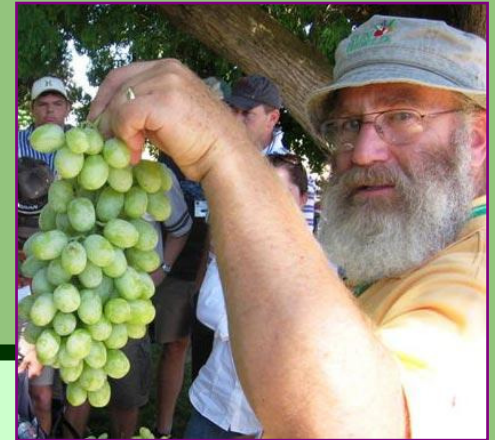
AUTUMNCRISP
AN EXTRAORDINARY TABLE GRAPE
By Sun World

**SCARLOTTA
SEEDLESS**
A SENSATIONAL RED GRAPE
By Sun World



Pictures by the courtesy
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Thank you!



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**Grape Breeding
Application**

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