

# NEW TOOLS TO PUT THE DAMAGES FROM DISEASES UNDER CONTROL

*APPLE BREEDING PROGRAM OF AGROSCOPE*

# ABOUT ARTEVOS

*WHO WE ARE, WHAT WE DO*

- administration based in Freiburg (D)
- granting of the propagation right for nurseries,
- promotion and marketing of new fruit varieties
- but also active in breeding and testing of new varieties
- management of more than 120 fruit varieties
- These are produced in more than 220 nurseries worldwide



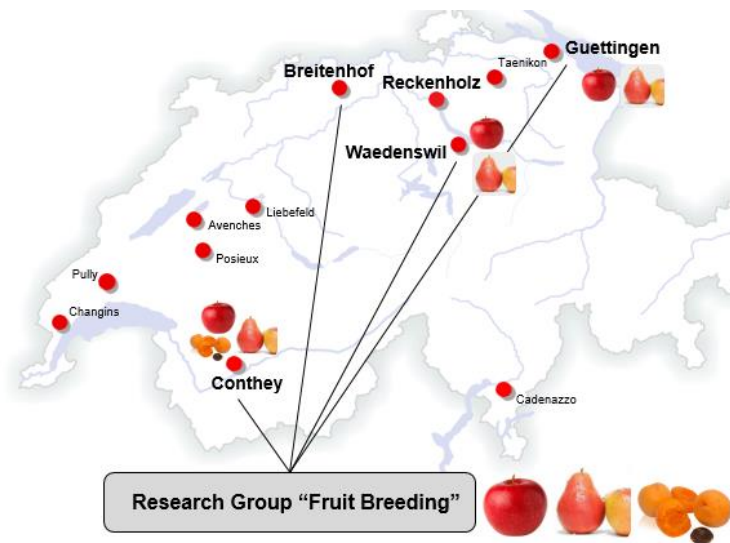
# ABOUT AGROSCOPE

*WHO THEY ARE, WHAT THEY DO*

- Swiss Confederation Centre for research and development
- in the agriculture, food and environmental sector
- With 7 different divisions
- Breeding programs for apple, apricot and now pear breeding



Agroscope



# APPLE BREEDING PROGRAMS

*AROUND THE WORLD*

**ARTEVOS**<sup>®</sup>  
FLAVOUR FIRST





# FRUIT GROWERS ARE FACED

*WITH COMPLEX CHALLENGES*



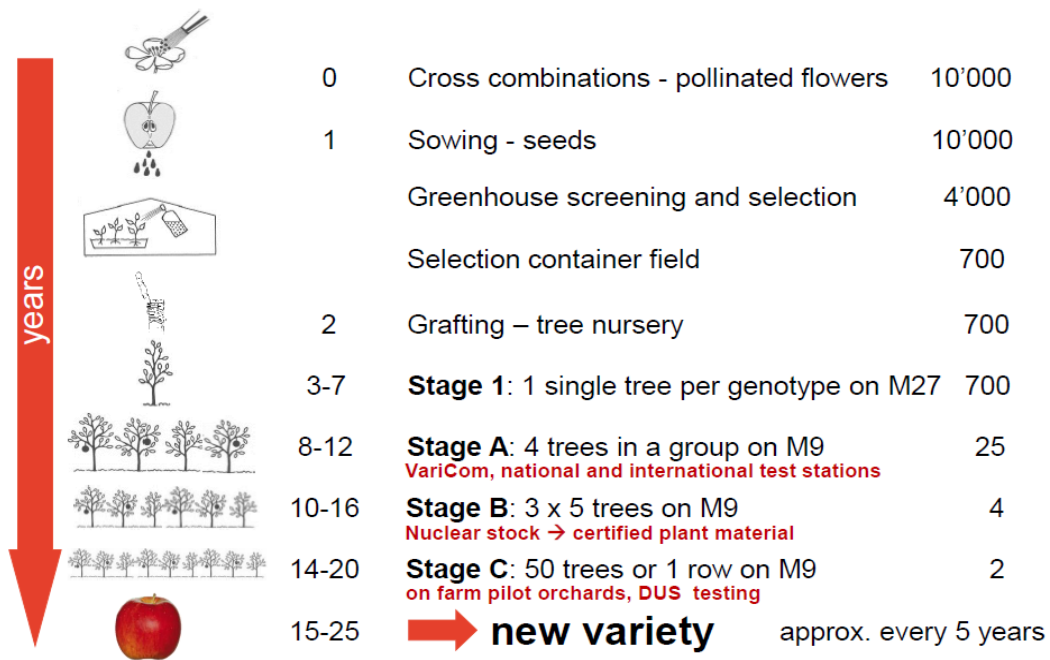
# APPLE BREEDING

BY AGROSCOPE



## Timeline in Apple Breeding at AGROSCOPE

Agroscope



selection number / seedling

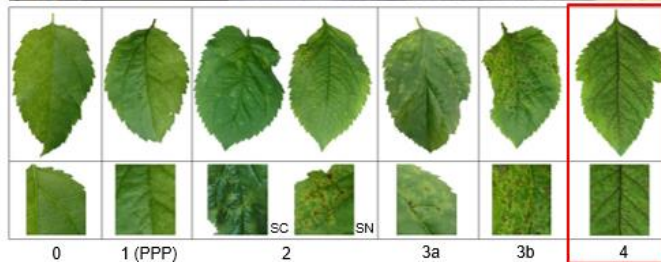
# APPLE BREEDING

BY AGROSCOPE



## Phenotyping – artificial inoculation

- First strong selection step
- Well established apple scab resistance screening in the greenhouse
  - Four week old seedlings
  - *V. inaequalis* conidial suspension including no *R*-gene breaking strains ( $3.5$  to  $4.0 \times 10^5$  conidia/ml)
  - Greenhouse conditions: approx.  $15^\circ$  to  $17^\circ\text{C}$  + high humidity of 75 to 95 % RH
  - Symptoms are evaluated 14 days after inoculation according to the adapted scale from Chevalier *et al.* (1991) as reported by Baumgartner *et al.* (2015)
  - Class 4 seedlings are considered as susceptible and are removed



Scale adapted from Chevalier *et al.* (1991) as reported by Baumgartner *et al.* (2015)

# APPLE BREEDING

BY AGROSCOPE



## Marker assisted selection

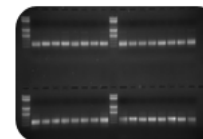
- When possible at least two markers flanking the R-gene are used
- SSR or SCAR markers ► Ecogenics GmbH (CH, [www.ecogenics.ch](http://www.ecogenics.ch))
- SNP markers ► LGC Genomics Ltd. (UK, [www.lgcgroup.com](http://www.lgcgroup.com))

R-gene	LG <sup>a</sup>	Marker name	Marker type	Allele in coupling	Reference
Rvi2	2	CH05e03	SSR	173 (179/190) <sup>b</sup>	Bus et al., 2005
Rvi2	2	OPL19	SCAR	438 (-) <sup>b</sup>	Bus et al., 2005
Rvi4	2	CH02C02a	SSR	182 (148/184) <sup>b</sup>	Bus et al., 2005
Rvi4	2	Hi22d06	SSR	132 (132/138) <sup>b</sup>	Silfverberg-Dilworth et al., 2006
Rvi6	1	CH-Vf1	SSR	164 (146/146) <sup>b</sup>	Vinatzer et al., 2004
Rvi2	2	FBsnRvi2.7_W242	SNP	A <sup>c</sup>	Jansch et al., 2015
Rvi2	2	FbsnRvi2.1_M417	SNP	A <sup>c</sup>	Jansch et al., 2015
Rvi4	2	FBsnRvi4.1_K146	SNP	T <sup>c</sup>	Jansch et al., 2015
Rvi4	2	TNL1_Rvi4_R131	SNP	G <sup>c</sup>	Jansch et al., 2015
Rvi6	1	M8S_Rvi6_Y124	SNP	T <sup>c</sup>	Jansch et al., 2015
Rvi6	1	M18_Rvi6_Y32	SNP	T <sup>c</sup>	Jansch et al., 2015

<sup>a</sup>Linkage group

<sup>b</sup>Allele in coupling with resistance and reference alleles of 'Gala' in brackets

<sup>c</sup>Allele in coupling with resistance





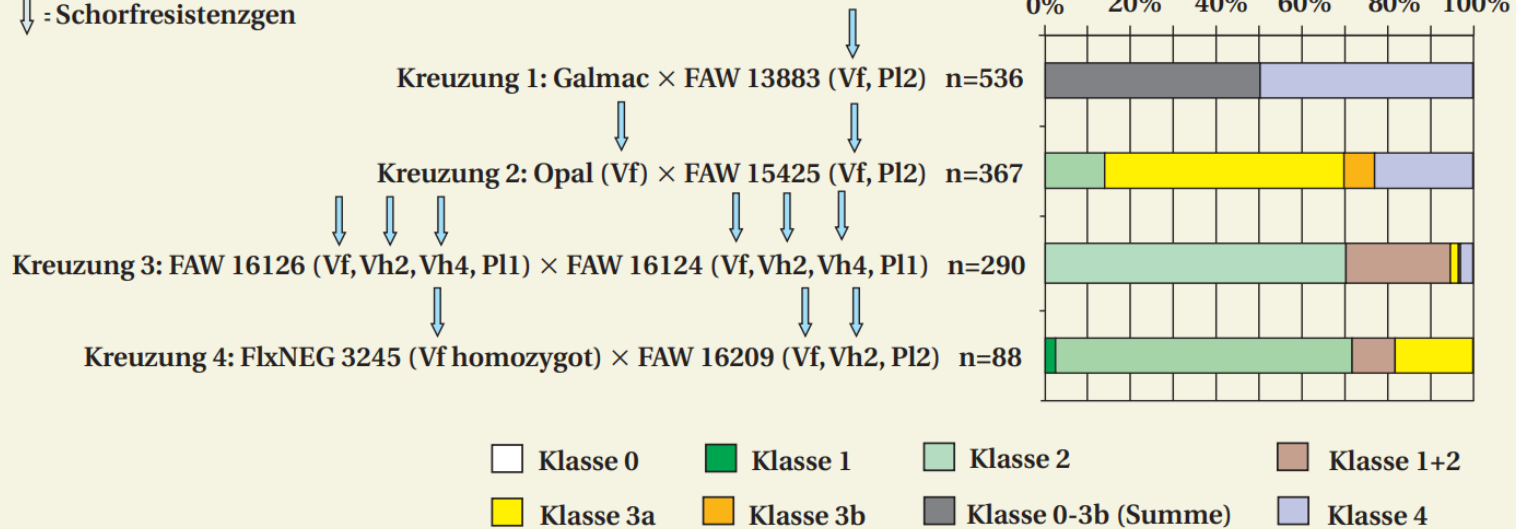
# APPLE BREEDING

BY AGROSCOPE



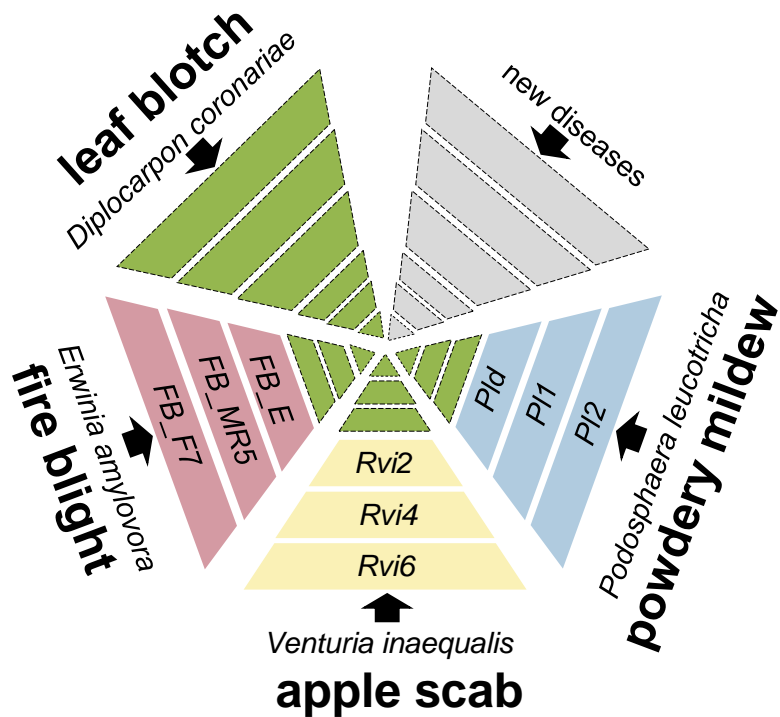
Anteile der Schorfbefallsklassen nach Chevalier in %

↓ : Schorfresistenzgen



# APPLE BREEDING BY AGROSCOPE

WILD APPLES WITH STRONG RESISTANCE



'Evereste'  
Fb\_E



*Malus x robusta 5*  
FB\_MR5



*Malus fusca*  
Fb\_Mfu10



*Malus baccata*



# Ladina

Very juicy – Exotic taste

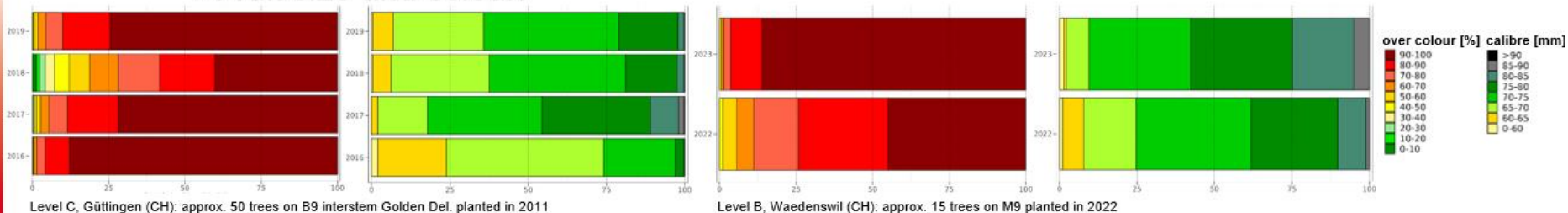
- Cross (Topaz x Fuji) made in 1999 by Agroscope
- *Rvi6/Vf* scab resistance, tolerant to fire blight, little susceptible to powdery mildew
- EU, GB, Marco, South Africa, Australia, Chile, New Zealand and Swiss Plant Breeder's Rights
- Owned by *Vari Com*
- Rootstock: M9 tested, G11 under examination
- Tree: medium vigor with good branching and ramified, bears regularly
- Flowering time: approx. with "Gala Galaxy"
- Pollinators: "SQ159", "Topaz", "Scifresh", "Evereste", "Golden Gem"





# Ladina

## ▪ Fruit size and colour:



## ▪ Fruit maturity and harvesting time: approx. 1 week before “Golden Del.”

Level C, Güttingen (CH): approx. 50 trees on G11 planted in 2011, values after harvest

year	acidity [g/L]	firmness [kg/cm <sup>2</sup> ]	sugar [°Brix]	fruit weight [g]
2015	8.75	8.93	12.75	157
2017	8.00	8.99	12.63	162
2018	7.20	8.64	12.40	162
2019	8.25	9.48	14.68	145

Level B, Waedenswil (CH): approx. 15 trees on M9 planted in 2022, values after harvest

year	acidity [g/L]	firmness [kg/cm <sup>2</sup> ]	sugar [°Brix]	fruit weight [g]
2023	5.60	6.50	12.23	177

## ▪ Storage: 1°C CA or DCA and MCP not longer than 4 month







# Rusticana

## Rustic look – Great taste

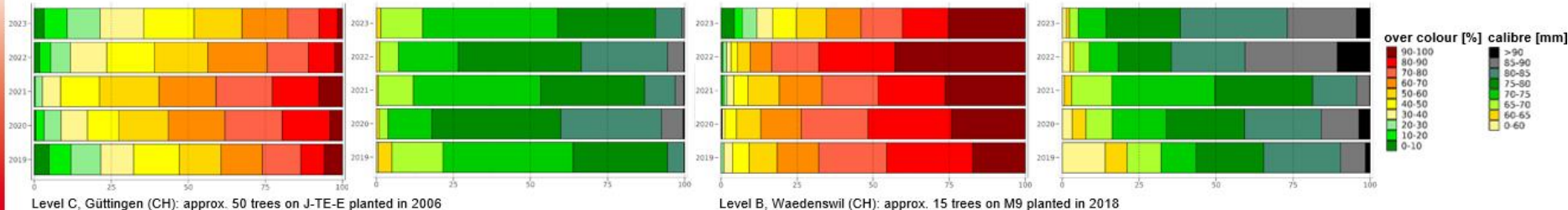
- Cross (La Flamboyante x H 23-10) made in 1994 by Agroscope
- *Rvi6/Vf* scab resistance, little susceptible to powdery mildew
- EU and Swiss Plant Breeder's Rights
- Owned by *Vari Com*
- Rootstock: M9 tested
- Tree: slightly drooping, well ramified, relatively good self-thinning
- Flowering time: short before "Gala Galaxy"
- Pollinators: "SQ159", "Topaz", "Bonita"





# Rusticana

## ▪ Fruit size and colour:



## ▪ Fruit maturity and harvesting time: approx. 2 weeks after “Golden Del.”

Level C, Güttingen (CH): approx. 50 trees on J-TE-E planted in 2006, values after harvest

year	acidity [g/L]	firmness [kg/cm <sup>2</sup> ]	sugar [°Brix]	fruit weight [g]
2020	7.20	9.99	12.70	225
2021	8.00	11.12	11.87	179
2022	7.20	9.45	12.94	189
2023	6.09	9.03	13.58	173

Level B, Waedenswil (CH): approx. 15 trees on M9 planted in 2018, values after harvest

year	acidity [g/L]	firmness [kg/cm <sup>2</sup> ]	sugar [°Brix]	fruit weight [g]
2020	7.75	10.12	16.16	186
2021	9.50	10.65	12.89	177
2022	9.20	9.80	13.53	236
2023	6.20	7.71	12.32	190

- Storage: under examination  
→ till now storage at 3° C DCA is recommended





# Iori

## Pretty Fruit – Unique Taste

- Cross (Topaz x Fuji) made in 1999 by Agroscope
- *Rvi6/Vf* scab resistance
- EU and Swiss Plant Breeder's Rights
- Owned by *Vari Com*
- Rootstock: M9 tested, G11 under examination
- Tree: vigorous tree with good stability, rejuvenation of frutting wood
- Flowering time: approx. with "Gala Galaxy"
- Pollinators: "Bonita", "Gala Galaxy", "Wurtwinning", "WA 38"

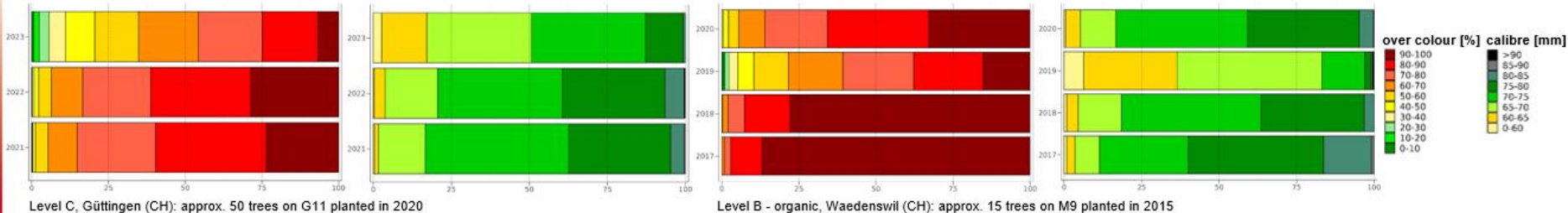






# lori

## ▪ Fruit size and colour:



## ▪ Fruit maturity and harvesting time: approx. 3 weeks after “Golden Del.”

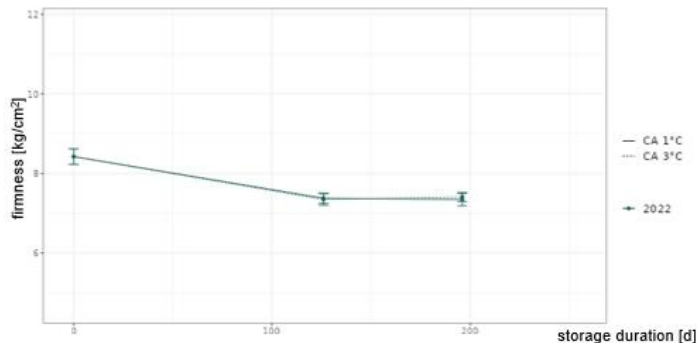
Level C, Güttingen (CH): approx. 50 trees on G11 planted in 2020, values after harvest

year	acidity [g/L]	firmness [kg/cm <sup>2</sup> ]	sugar [°Brix]	fruit weight [g]
2021	6.75	9.09	11.00	189
2022	7.05	8.42	13.57	191
2023	7.00	8.47	10.07	176

Level B - organic, Waedenswil (CH): approx. 15 trees on M9 planted in 2015, values after harvest

year	acidity [g/L]	firmness [kg/cm <sup>2</sup> ]	sugar [°Brix]	fruit weight [g]
2017	9.15	8.15	14.64	188
2018	7.50	9.01	12.69	175
2019	6.75	8.81	12.04	138
2020	8.30	8.94	14.69	187

- Storage: under examination  
→ till now storage at 1°C CA is recommended







**THANKS FOR YOUR ATTENTION!**

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