

Sharka resistant plum hybrids and cultivars from the plum breeding programm at Hohenheim

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Importance of sharka.

- Sharka disease has spread from the European continent towards the most important *Prunus*-growing areas around the world.
- Losses in European plum-fruit production are estimated at 1.5 million metric t / year.



Tolerance to sharka

- More and more fruit growers are unsatisfied with the resistances or tolerance of today cultivated plum cultivars to PPV .
- An improvement of this situation is only possible by cultivation of immune or absolute resistant cultivars.

Resistance by hypersensitivity

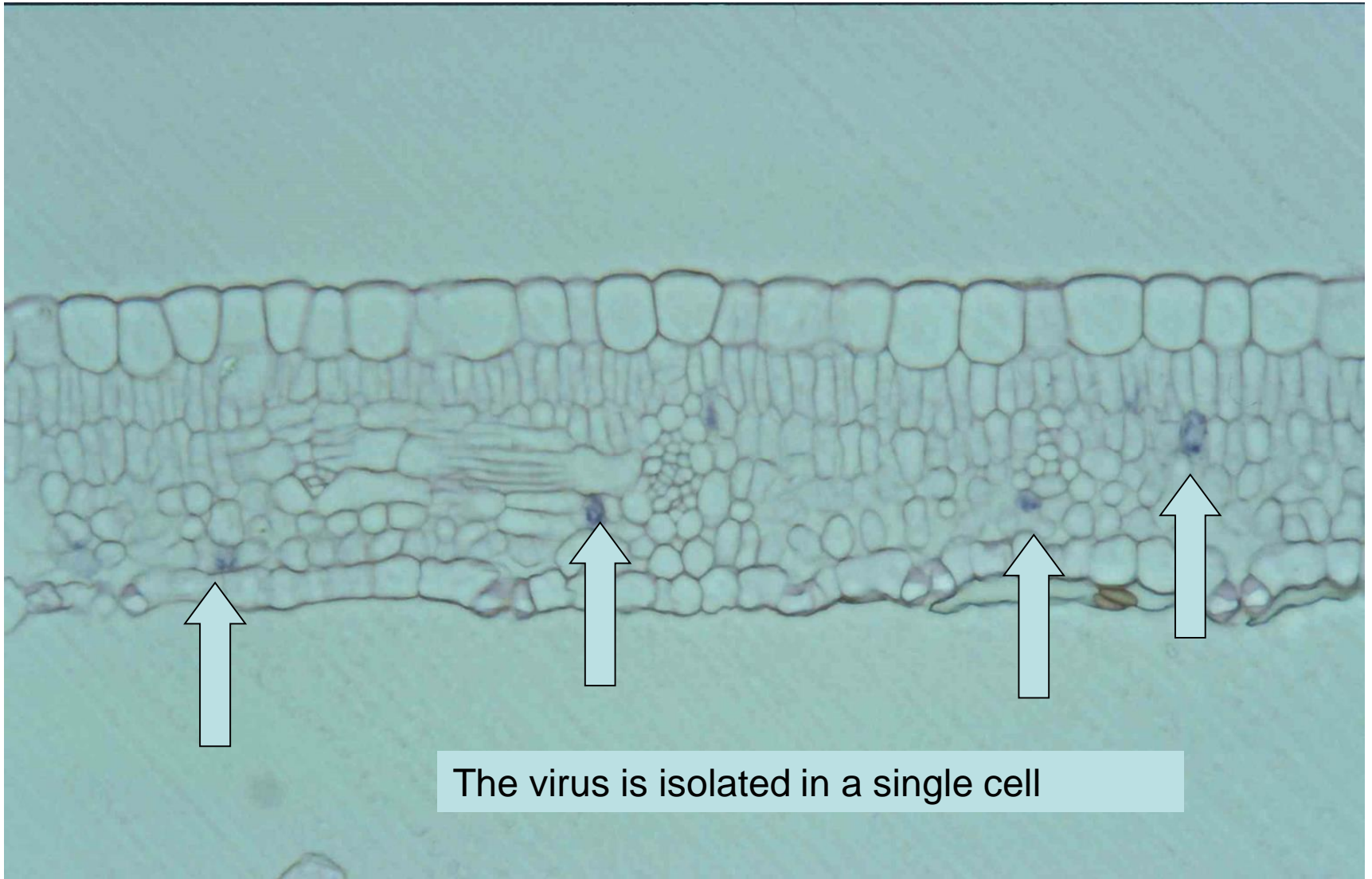
Hypersensitivity in plums was firstly found from H. Kegler in the K 4 - hybrid in the year 1986

Depends from:

1. Way of infection
2. Infection dose

For example: Young trees of Jojo can be infected by massive inoculation with grafting but not by aphids

Virus infection by aphids



The virus is isolated in a single cell

First absolute resistant variety

- In the breeding material at Hohenheim was found some hybrids, derived from 'Ortenauer', with hypersensitive reaction and field resistance .
- Many extensive tests resulted in the introduction of the first absolute PPV-resistant variety '**Jojo**' in 1999.



Sharka symptoms on `Ortenauer`

**because the virus is not isolated,
the hypersensitivity is too weak**

**The variety Ortenauer was the
donator of hypersensitive genes
for Jojo**

Hypersensitivity

a new kind of resistance

- Test by double grafting by using infected interstems



Durable resistance

- Jojo is in the meantime growing in more than 30 years in heavy infected orchards and allways free of PPV.
- This is the conclusive proof of the effectiviness of hypersensitivity.
- Similar results were found in Poland (Malinowski et. al., 2013), in Slovenia (Moja Virscek Marn et. al. 2014,) and in many other European countries.

Hypersensitive reaction

- The resistance of the variety depends from the infection dose.
- The plant is infected by aphids
- The virus dose with such an infection is low.
- We have another situation when succers of the rootstock are infected.
- It can be that such an infection **breakthroughs** the resistance

sharka infection of succers and possible reaction of hypersensitive varieties



What can we do in such a situation ?

- The **only possibility** is to take
- **hypersensitive rootstocks**
- The virus will be isolated in succers and is dying

Hypersensitive rootstocks

- Was generated by crossing of:
 1. *Prunus cerasifera* with hyp. Clone
 2. *Prunus spinosa* with hyp. Clone

started at University of Hohenheim
in the year 2007

New rootstocks

- The work was continued by
- **Michael Neumüller** at the University Munich –Weihenstephan
- **Two rootstocks are on the market**
- Docera 6
- Dospina 235

New hypersensitive varieties

- Breeding for hypersensitivity cultivars was continued
- In the meantime we have four hypersensitive cultivars, named:
 - **‘Jojo’**,
 - **‘Jofela’**,
 - **‘Joganta’**
 - **‘Jolina’**
- and a lot of promising clones in test.
- These clones are the reason I am still working with a age of 75 years, because at the university plum breeding was finished.

Jofela



32- 40 g , 20-25 % Brix

Data of Jofela 2009 - 2017

Year/ Harvesting		Yield 1-9	Fruit weighth g	Brix %	Taste 1- 9	Stone 1-9	Overall score
2009	31.08.	4	34	20,5	8	7	7
2010	08.09.	8-9	32	21,5	9	8	8
2011	30.08.	6	40	23,3	9	8	9
2012	17.09.	8	35	23,1	8	8	8
2013	25.09.	5	44	22,3	9	7	8
2014	04.09.	7	44	22,8	9	7	9
2015	15.09.	7	33	25,3	9	9	9
2017	07.09.	5-7	38	25,6	9	8	9

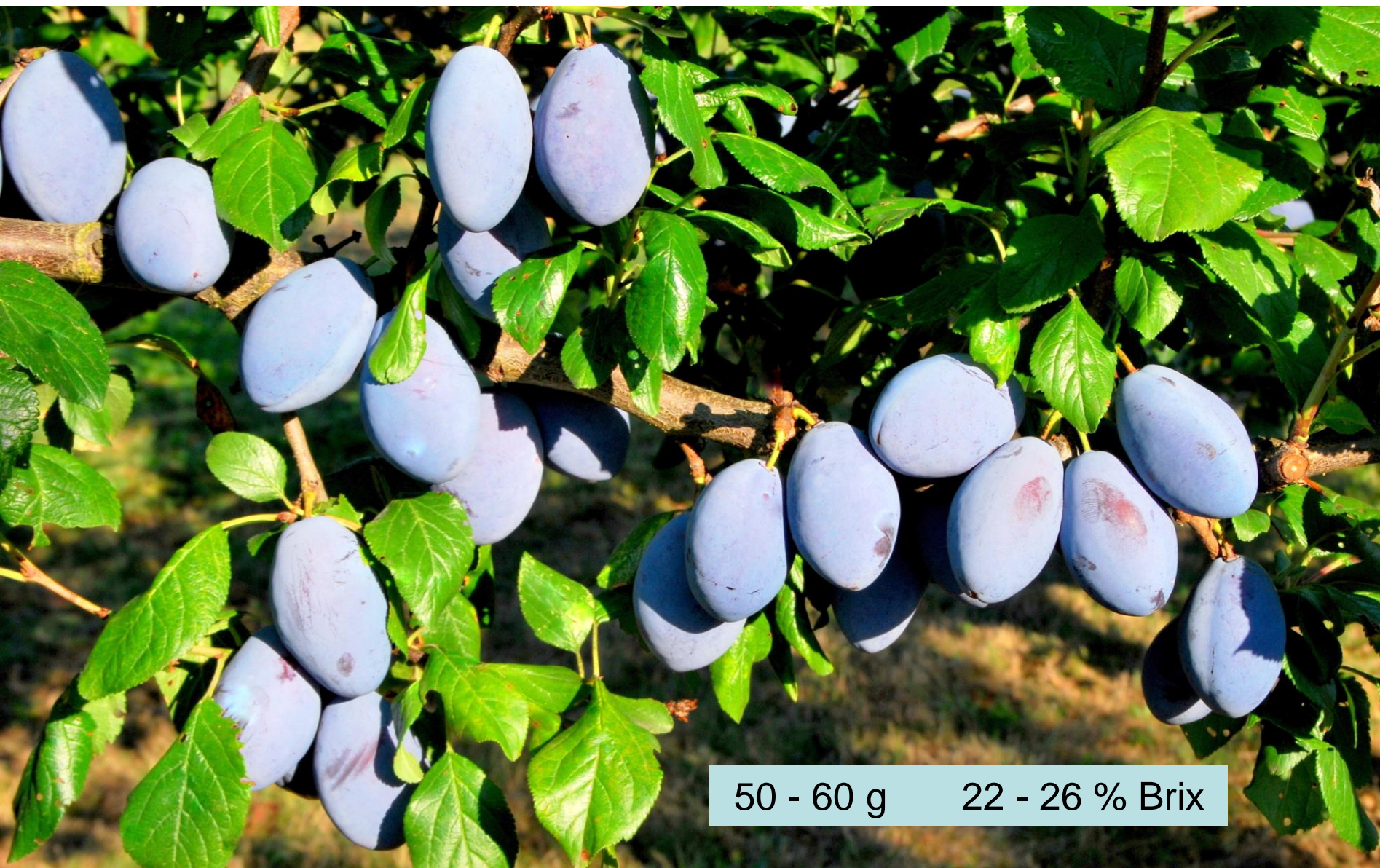
Joganta



70 - 90 g

20 – 24% Brix

Jolina



50 - 60 g

22 - 26 % Brix

New breeding programme

- Most of interest in our plum breeding were the improvement of the sharka resistant varieties, especially in three points:
 - **1. Enlargement of ripening**
 - **2- Better fruit size**
 - **3. High fruit quality**

Inheritance of hypersensitivity

combination	Number of seedlings	% Hypers. HK3
Jojo × Jojo	129	55
Jojo × Fellenberg	128	45
Jojo × Haganta	105	29
HZ Wolff × Jojo	133	22
Jojo × HZ Schüfer	55	22
Jojo × HZ Gunser	20	40
Jojo × Harbella	87	36
Jojo × 1468	106	15
Jojo x Nr. 4465	119	78

Enlargement of ripening

- The growers want resistant cultivars with good fruit quality over the whole season

To achieve hypersensitive plums with **Early ripening** is not so easy.

So far we got only one interesting hybrid (Nr. 8404) resulted from a crossing 'Tegera' with the hypersensitive clone Nr. 6482 .

Data of Nr.8404 compared with Katinka

Clone Nr. 8404	Harves. time	Yield 1-9	Fruit weigh g	Brix %	Taste 1- 9	Stone 1-9	Over all score
2009	27.07	6	21	15,7	7	7	7
2011	14.07.	4	22	19,4	7	9	7
2012	20.07	7	29	15,5	7	9	7
2016	27.7	4	30	17,4	7	7	7
2018	20.7	8	22	19,8	7	8	7
Katinka 2012	15.7.	7	26	15,2	7	7	7

Fruits of Nr. 8404



Medium to late ripening hypersensitive plums

Variety/ clone	Ripe month	Yield 1 - 9	Fruit weigh g	Brix %	Taste 1 - 9	Stone 1 - 9	Overall score
Jojo	E 8	6-8	45	18	6	7	7
6621	M-E 8	5-7	32	23,2	8	7	8
7344	M- E 8	5-7	34	20,7	7	9	8
7533	E 8	6-7	34	21.1	7	7	8
8630	E 8	6-8	53	23,1	8	9	8

Nr.8630



53 g,23,1% Brix

Fruits of Nr. 6621

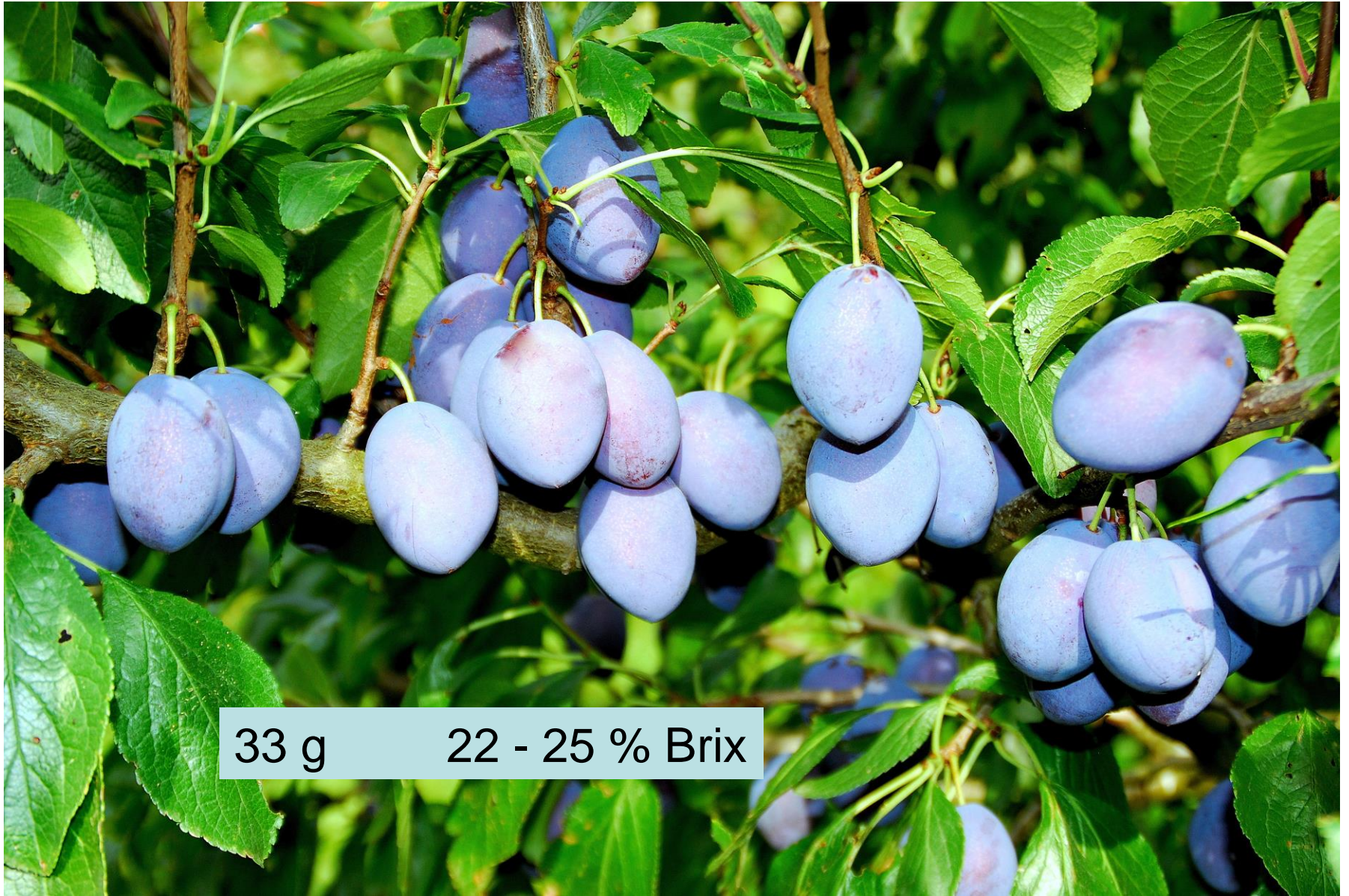


32g. 23,2 % Brix.

Late ripening clones

Clone Nr.	Harvest. time	Yield 1 - 9	Fruit weight	Brix %	Taste 1 - 9	Stone 1 - 9	Overall score
6364	6.9.	6 - 7	54	23,8	9	7	8
7245	6.9.	6 - 7	38	25,5	9	6	8
7410	7.9.	6 - 7	33	23,8	9	7	8
Jofela	7.9.	6 - 8	38	25,1	9	7	8

Clone Nr.7410



33 g

22 - 25 % Brix

Very late clones with high fruit quality

Clone	Harvest. time	Yield 1-9	Fruit weight g	Brix %	Taste 1-9	Stone 1-9	Total 1-9
8616	26.9.	6 - 8	42	24,9	8	7	8
8626	19.9.	6 - 7	45	27,9	9	7	8
8627	21.9.	5 - 7	55	26,8	9	9	8
8709	23.9.	6 - 7	44	24,9	8	7	8

Clone Nr.8627



50 - 60 g 26 - 27 % Brix

Breeding for fruit size - results

Variety / Clone	Harv. time	Yield 1-9	Fruith weight	Brix %	Taste 1-9	Stone 1-9	Overa. score
Joganta	05.9.	7- 8	76	21,0	7	7	7
8630	06.9.	6 - 8	53	21,2	9	9	8
6364	06.9.	6 - 7	54	23,8	8	7	8
8627	21.9.	5 - 7	55	26,8	9	9	8
Jolina	22.9.	6 - 7	52	26,1	7	7	7

Nr. 6364



50 - 60 g 22 - 24 % Brix

The Problem in breeding

- **To find the right parents as donators:**
- For resistance
- For yield
- For fruit size
- and for excellent fruit quality
- And some points more
- All combined in the same variety

Interest. Clones from Cross. Nr. 4517 x Haganta

Clone Nr.	Harvest. time	Fruit weight	% Brix	Overall score
8626	26.9	46	27,0	8
8627	21.9	42	27,2	8
8630	06.9.	55	23,8	8
8709	23.9.	44	24,9	8

Nr.8630



Nr.8630



53 g , 23,1 % Brix

Data of clone Nr. 8709

(2010 and 2011 data from seedling)

Clone-Nr.	Harvesting time	Yield 1-9	Fruit weight	Brix %	Taste 1- 9	Stone 1-9	Overall score
2010	23.09.	6	39,4	96	7	9	8
2012	08.10.	7	50,3	140	9	7	8
2015	03.10	9	41	92	7	7	8
2016	27.09	8	42	21,2	8	9	8
2017	17.09	3	39	95	7	7	8
2018		7					

Nr. 8709



44 g, 24,9 % Brix

Evaluation of Hypersensitivity

- With the utilisation of hypersensitivity in breeding the problem of sharka in Plum growing can be solved, by:
- planting of hypersensitive cultivars
- and planting of hypersensitive rootstocks
- Let us remember to **Hartmut Kegler** for detection of hypersensitivity in plums.

Hartmut Kegler

