

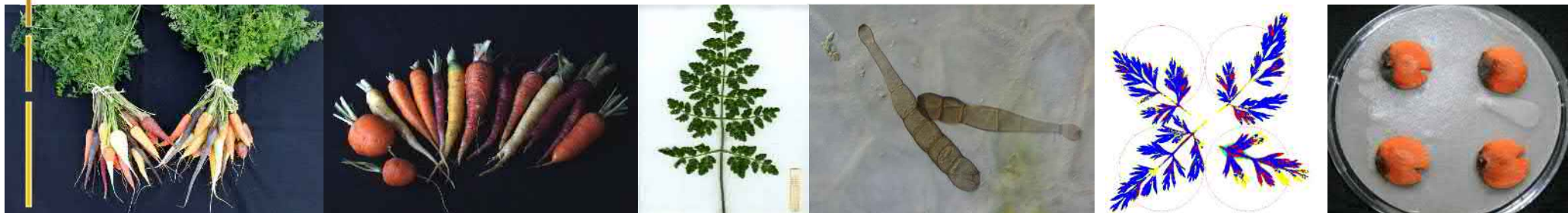


EVA Carrot

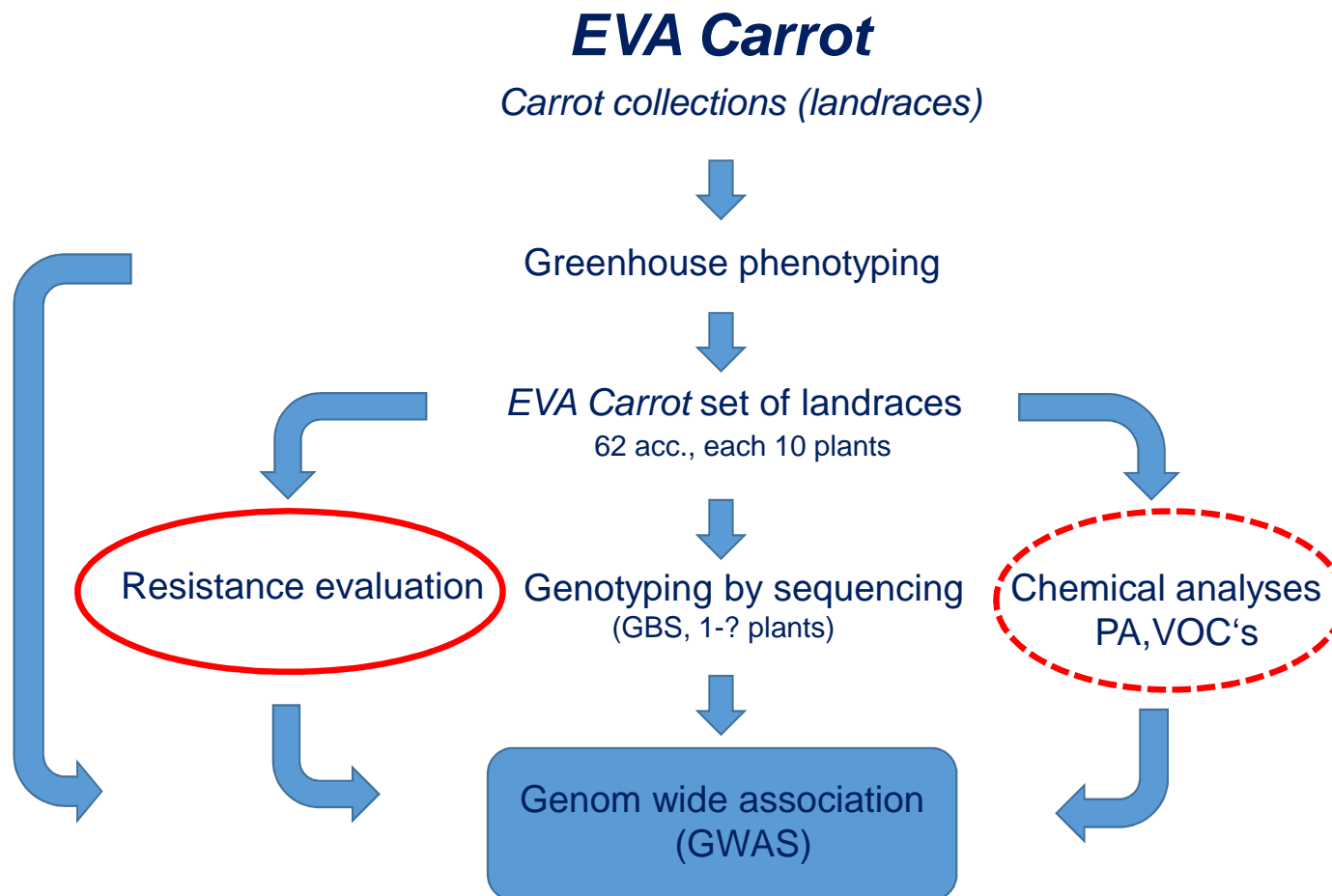
Activities at the Julius Kuehn-Institute

Preliminary status 2020-05-11 (online meeting)

Thomas Nothnagel



● *Project strategy 2020 at JKI*



- - - optional by JKI



EVA carrot collection 2020

Material

Genebank	EVA Carrot landraces
Agrocampus Ouest INHP (Angers, France)	15
BGHZ-CITA (Zaragoza, Spain)	13
NGB (Alnarp , Sweden)	9
UKVGB (Wellesbourne, Warwick, UK)	25
Sum	62

Control: *Daucus carota* ssp. *sativus*
cvs. Yukon (Syngenta), Maestro (Vilmorin), Rotin (Sperli), BL 101 (RZ)

EVAcarrot - JKI Experiment 2020-1

Sowing: 25.03.2020

EVAcarrot no.	man	Code	Accession name	Country of origin	% germination	Genebank
EVA-20-01	1	HRIGRU 3935	AMSTERDAMMER BAK	NLD	90	Warwick GRU-UK
EVA-20-02	2	HRIGRU 7262	LUNGA DI ALBENGA	ITA	98	Warwick GRU-UK
EVA-20-03	3	HRIGRU 8058	BERLICUM ROSAL	NLD	93	Warwick GRU-UK
EVA-20-04	21	24337	Bjurholm	SE	90	NordGen-Schweden
EVA-20-05	2	453	Chantenay à cœur rouge 2	FRA	81	France
EVA-20-06	3	911	Royal Chantenay 3	FRA	91	France
EVA-20-07	10	1683	de Colmar à cœur rouge race Caillard	FRA	98	France
EVA-20-08	11	857	De Meaux	FRA	94	France
EVA-20-09	12	471	Saint Valery	FRA	93	France
EVA-20-10	18	13955	Regulus Imperial	SE	96	NordGen-Schweden
EVA-20-11	5	509	Nantaise à forcer	FRA	94	France
EVA-20-12	6	935	Nantaise améliorée 2 race TipTop	FRA	99	France
EVA-20-13	7	923	Nantaise améliorée 3	FRA	89	France
EVA-20-14	8	1462	Nantaise améliorée 7 race Aubagne	FRA	96	France
EVA-20-15	9	607	de Palaiseau	Fra	88	France
EVA-20-16		958	Nantaise améliorée race Fancy	NLD	94	France
EVA-20-17	16	13970	Nana W561	SE	90	NordGen-Schweden
EVA-20-18	17	13967	Nantes SW64/93130	SE	98	NordGen-Schweden
EVA-20-19	19	13942	Koloss	SE	50	NordGen-Schweden
EVA-20-20	23	573	Nantes Apollo (<i>rk: Nantes 5</i>)	DK	82	NordGen-Schweden
EVA-20-21	49	HRIGRU 7254	MARKETGARTNER	DEU	97	Warwick GRU-UK
EVA-20-22	53	HRIGRU 7125	DELTA A CUORE ROSSO	ITA	89	Warwick GRU-UK
EVA-20-23	22	1843	Feonia Dana	DK	92	NordGen-Schweden
EVA-20-24	60	HRI 9534 (2037 BPGV)	Cenoura	PRT	85	Warwick GRU-UK
EVA-20-25	1	534	de Guérande	FRA	82	France
EVA-20-26	4	548	de Carentan	FRA	100	France
EVA-20-27	26	NC042521	Zanahoria carota	ESP	83	BGHZ-CITA-Spain
EVA-20-28	31	NC020629	Zanahoria	ESP	88	BGHZ-CITA-Spain
EVA-20-29	32	NC077752	Zanahoria amarilla (yellow carrot)	ESP	100	BGHZ-CITA-Spain
EVA-20-30	33	NC054873	Zanahoria del terreno	ESP	95	BGHZ-CITA-Spain
EVA-20-31	34	NC052590	Zanahoria negra	ESP	100	BGHZ-CITA-Spain
EVA-20-32	35	NC071892	Zanahoria nantesa	ESP	100	BGHZ-CITA-Spain
EVA-20-33	38	10626	STRATOVA	CSK	100	Warwick GRU-UK
EVA-20-34	40	12400	ALTRINGHAM	GBR	100	Warwick GRU-UK
EVA-20-35	41	6100	JAMES SCARLET INTERMEDIATE	GBR	72	Warwick GRU-UK
EVA-20-36	42	6102	LONG RED SURREY	GBR	66	Warwick GRU-UK
EVA-20-37	43	3842	NORFOLK GIANT	GBR	93	Warwick GRU-UK
EVA-20-38	44	8054	EARLY HORN	GBR	100	Warwick GRU-UK
EVA-20-39	46	HRIGRU 10241	RED GIANT OBTUSE OF FLAKKEE	BEL	97	Warwick GRU-UK
EVA-20-40	51	HRIGRU 5780	NAGYKALLO	HUN	97	Warwick GRU-UK

EVA-20-41	55	HRIGRU 8132	AUTUMN KING FLAKEE RED CORED	NLD	99	Warwick GRU-UK
EVA-20-42	57	HRIGRU 10375	PERFEKCA	POL	92	Warwick GRU-UK
EVA-20-43	58	HRIGRU 10432	LOSINOOSTROVSKAJA 13	RUS	95	Warwick GRU-UK
EVA-20-44	13	442	Blanche demi-longue des Vosges	FRA	90	France
EVA-20-45	30	NC020023	Zanahoria blanca (White carrot)	ESP	93	BGHZ-CITA-Spain
EVA-20-46	37	9808	KUETTIGER	CHE	100	Warwick GRU-UK
EVA-20-47	48	HRIGRU 3920	LANGWEISSE GRUNKOPFIGE	DEU	93	Warwick GRU-UK
EVA-20-48	50	HRIGRU 3921	GELBE RHEINISCHE	DEU	79	Warwick GRU-UK
EVA-20-49	14	595	Jaune obtuse du Doubs	FRA	90	France
EVA-20-50	27	NC110467	Zanahoria amarilla (yellow carrot)	ESP	86	BGHZ-CITA-Spain
EVA-20-51	29	NC020331	Zanahoria	ESP	85	BGHZ-CITA-Spain
EVA-20-52	25	NC082224	Zanahoria forrajera (Fodder carrot)	ESP	89	BGHZ-CITA-Spain
EVA-20-53	36	NC056993	Zanahoria roja para vinagre (red carrot for vinegar)	ESP	100	BGHZ-CITA-Spain
EVA-20-54	39	5833	JOHNS PURPLE	GBR	85	Warwick GRU-UK
EVA-20-55	15	13975	Gul Jätte Weibulls	SE	96	NordGen-Schweden
EVA-20-56	28	NC040161	Zanahoria morada (Purple carrot)	ESP	85	BGHZ-CITA-Spain
EVA-20-57	24	NC083735	Zanahoria negra (black carrot)	ESP	100	BGHZ-CITA-Spain
EVA-20-58	45	13455	ARMENIAN CARROT	NLD	97	Warwick GRU-UK
EVA-20-59	47	HRIGRU 7889	NESRAVIMENNAJA	CSK	83	Warwick GRU-UK
EVA-20-60	59	HRIGRU 6683	JADJK LOCAL	TJK	75	Warwick GRU-UK
EVA-20-61		Standard (susceptible)	Yukon	?		Syngenta
EVA-20-62		Standard (resistant)	Maestro	FRA		Vilmorin
EVA-20-63		HRIGRU 7803	Benifuku 625	NLD	95	Warwick GRU-UK
EVA-20-64		NGB 24558	50805 (Fancy)	SE	44	NordGen-Schweden
EVA-20-65		JKI-internal standard	Rotin	DEU		
EVA-20-66		JKI-internal standard	BL 101	NLD		

! The JKI-internal standards are important for the comparability of the GBS-studies (CarrotDivers/EVAcarrot)

Plant cultivation

- Seeds were sown on 25.03.2020 directly in sandy-humus soil filled plastic pots (Ø20 x H 30 cm) and grow recently under optimized greenhouse conditions (16/8h D/N, PAR 10.000 lm/m²; 20/15°C).
The plants will be drop irrigated and all two weeks fertilized with 100 mL of a 0.2% *Wuxal Super* solution (N 8%/P 8%/ K 6%; Wilhelm Haug GmbH and Co.KG Düsseldorf, Germany)



Phenotyping



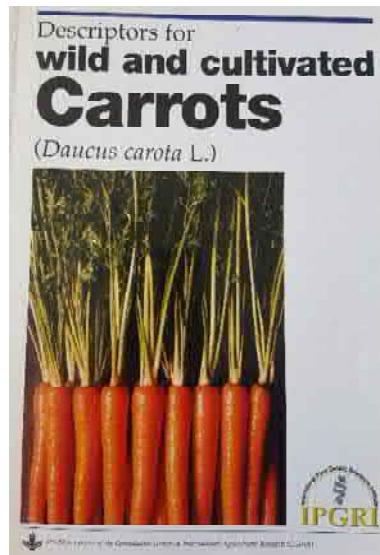
Kerstin Schmidt (TA)

Alina Rumpa (Master student from Bangladesh at the
Justus-Liebig-University Gießen, Germany)



Phenotyping

- Phenotyping by using the IPGRI guideline (1998).
- 14 carrot minimum descriptors Umbellifer WG (validated in Zaragoza 2018, document elaboration E. Geoffriau).
- Data documentation in Excel files



Descriptor	Descriptor values						
1. 1.1.1.1 Leaf shape: base position	1	2	3	4	5		
2. 2.1.1.1 Curvature	1	2	3	4	5		
3. 3.1.1.1 Curvature	1	2	3	4	5		
4. 4.1.1.1 Rooting habitus	1	2	3	4	5		
5. 5.1.1.2 Root shape: root end	1	2	3	4	5		
6. 6.1.1.1 Root length	1	2	3	4	5		
7. 7.1.1.1 Root tapering	1	2	3	4	5		
8. 8.1.1.1 Root shape	1	2	3	4	5		

9. 9.1.1.1 Root diameter: shape	1	2	3	4	5	6	7	8		
10. 10.1.1.1 Color of skin on shoulder (Modified)	1	2	3	4	5	6	7	8	9	
11. 11.1.1.1 Root shape: crown	1	2	3	4	5	6	7	8	9	
12. 12.1.1.1 Root skin pigmentation: color	1	2	3	4	5	6	7	8	9	10
13. 13.1.1.1 Core pigmentation: color (Microscopic analysis based)	1	2	3	4	5	6	7	8	9	10
14. 14.1.1.1 Core color pigmentation: color (Microscopic analysis based)	1	2	3	4	5	6	7	8	9	10

Resistance screening (Bioassay)



Alternaria dauci (Kühn, Groves & Skolko)



- **Leaf blight**
- Necrotic lesions, die back of leaves
- Losses in yield, quality and marketability
- Transmission by seed
- No resistant carrot cultivars

Alternaria radicina (Meier, Drechs. & Eddy)



- **Black rot**
- Storage: dry, black lesions
- Losses in yield, quality and marketability
- No resistant carrot cultivars

Alternaria alternata (Fries) Keissler



- Leaves: **Leaf blight**
- Storage: dry, black lesions
- Losses in yield, quality and marketability
- Transmission by seed
- No resistant carrot cultivars

Mycocentrospora acerina (Harting) Deighton



- **Liquorice rot**
- Storage pathogen in carrot
- Infest all organs (leaves, petioles, roots)
- No resistant carrot cultivars

Pathogen*	Plant age	Plant tissue	Inoculation concentration	Inoculation amount	Incubation
<i>Alternaria alternata</i>	~92 d	Leaflets	3.0×10^5	5 drops x 1 μ l	7 d
<i>Alternaria dauci</i>	~100 d	Leaflets	3.0×10^5	5 drops x 1 μ l	9 d
<i>Alternaria radicina</i>	~110 d	Root slices	1.0×10^6	1 drop x 1 μ l	9 d
<i>Mycocentrospora acerina</i>	~110 d	Root slices	1.0×10^6	1 drop x 1 μ l	14 d

* Each one high aggressive pathogen isolate will be used

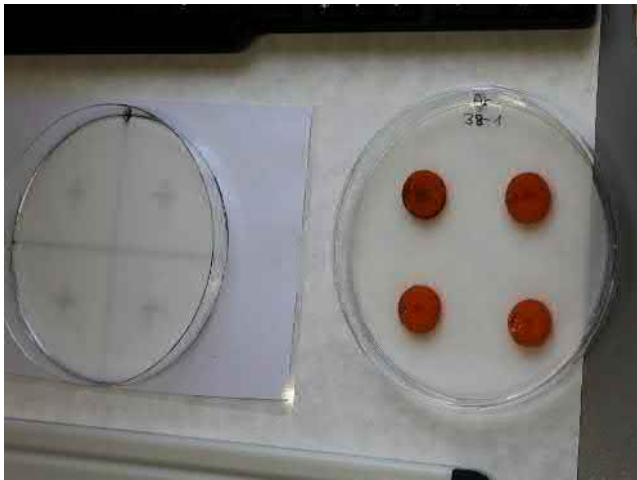
➔ Resistance tests will be carried out between July and August 2020 !



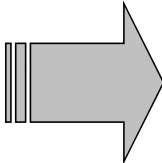
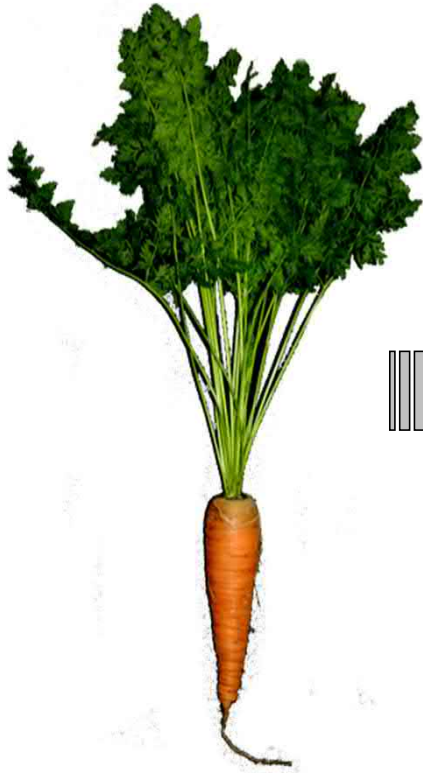
Petri dish with four leaflets and the inoculation process



Lemnatec system (l.) digital picture with disease symptoms (m.) and color classification (r.) by the Lemnatec software







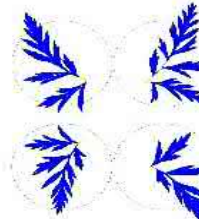
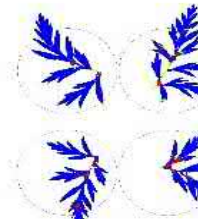
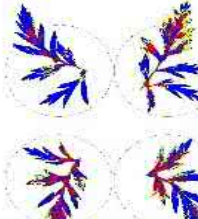
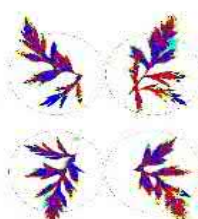
DIAS - Lemnatec



The software interface consists of several overlapping windows. The top-left window shows two original images of carrot leaves. Below it, another window shows the same leaves with red and blue segmentation. To the right, a window displays a color calibration chart with various color swatches. Below that, a window shows segmented carrot roots. Further down, a window displays four circular color calibration targets. To the right of these, another window shows a segmented carrot leaf. The bottom-right window shows three carrot roots with red and blue segmentation, accompanied by a detailed color calibration chart and control buttons like 'Zurücksetzen', 'Speichern', and 'Abbrechen'.

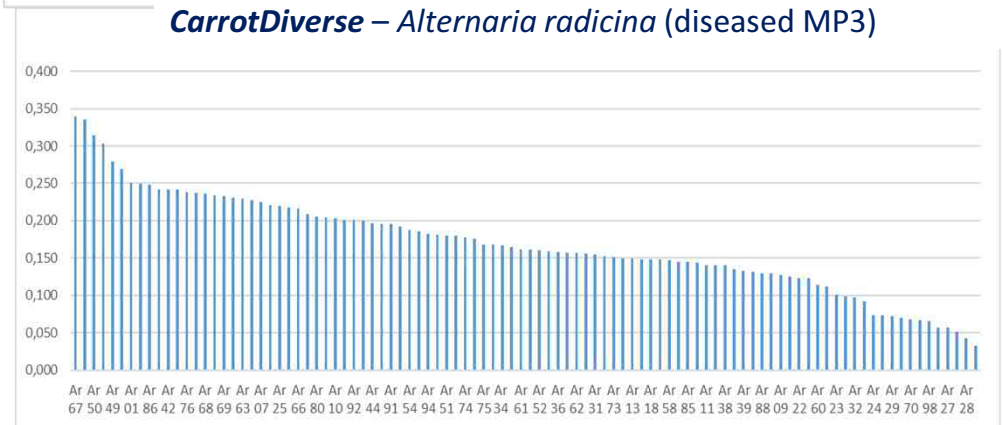
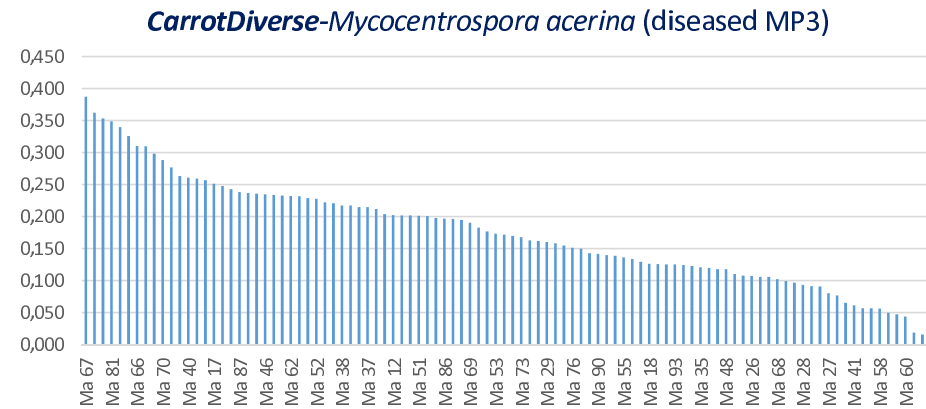
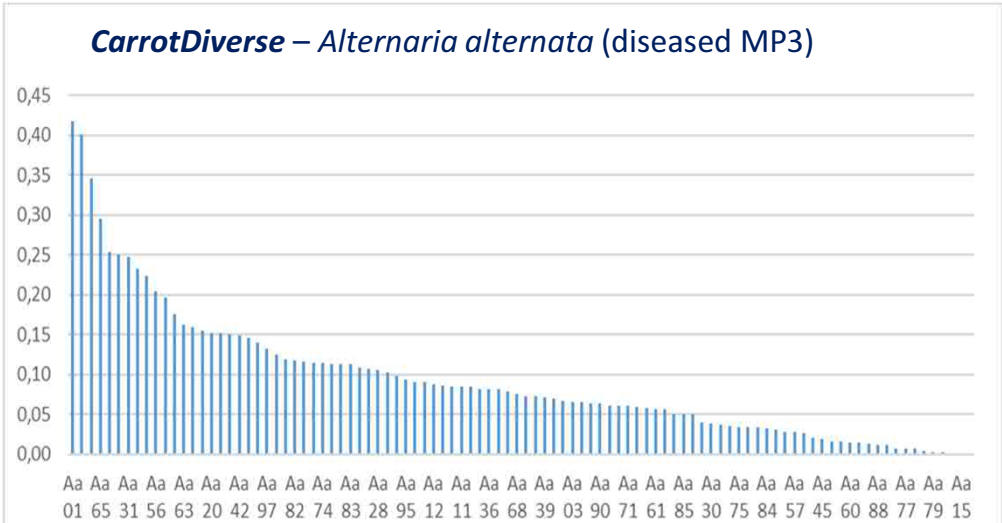
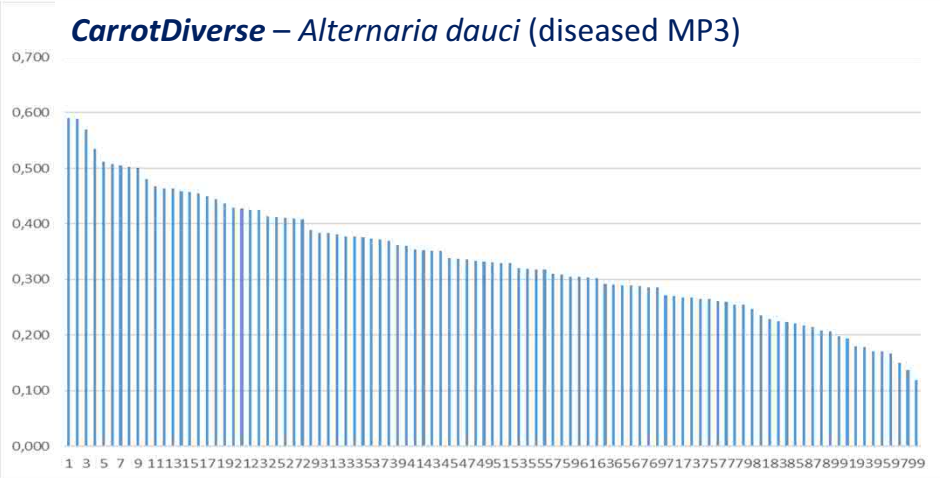
Leaf assay

- Documentation and classification by Digital Image Analyzing System (LemnaTec)
- Inoculum: *Alternaria dauci*

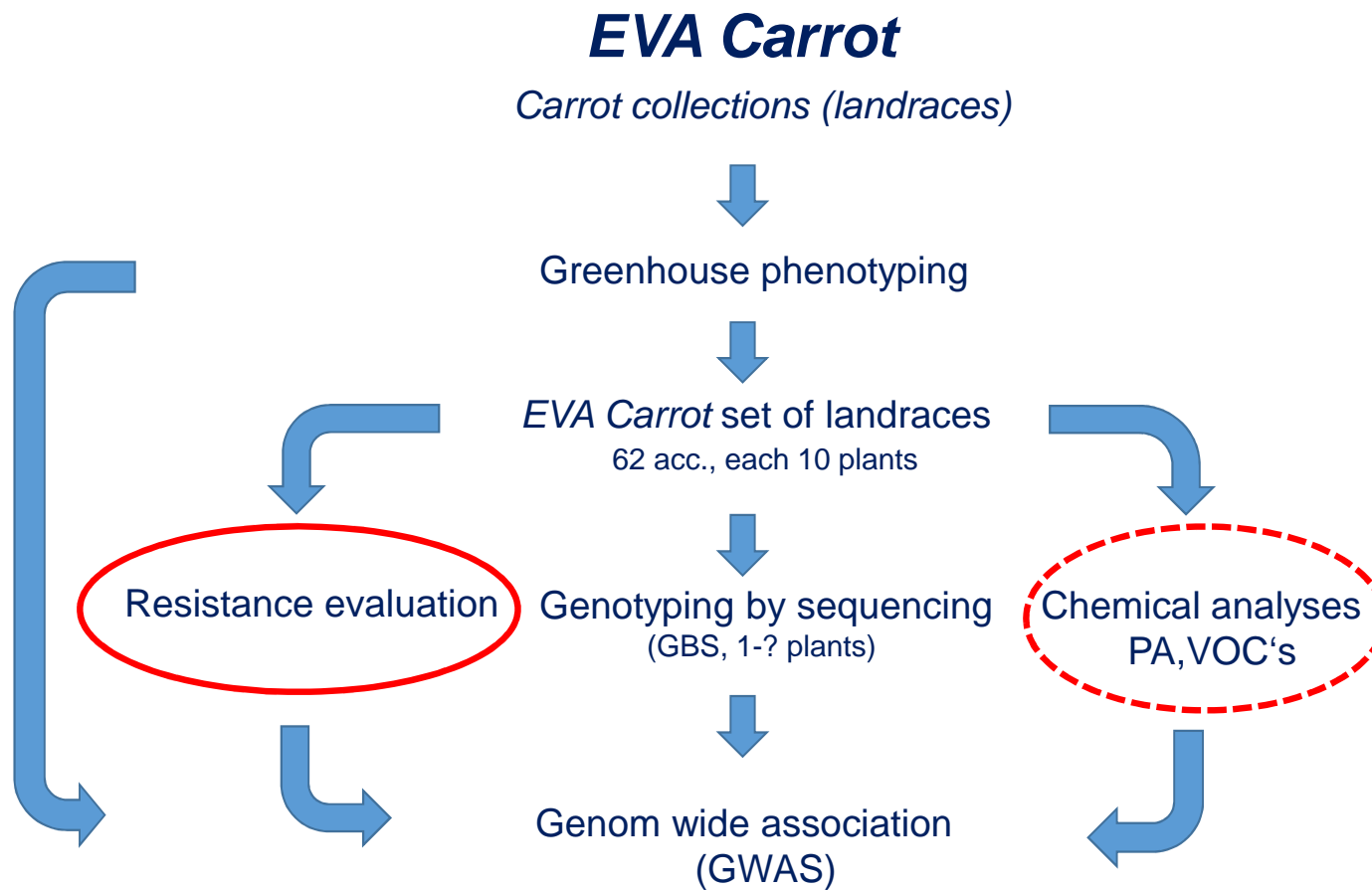
	0 dpi	6 dpi	9 dpi	12 dpi
Original				
Calibrated				

Leaves of Rotin, incubated at room temperature.

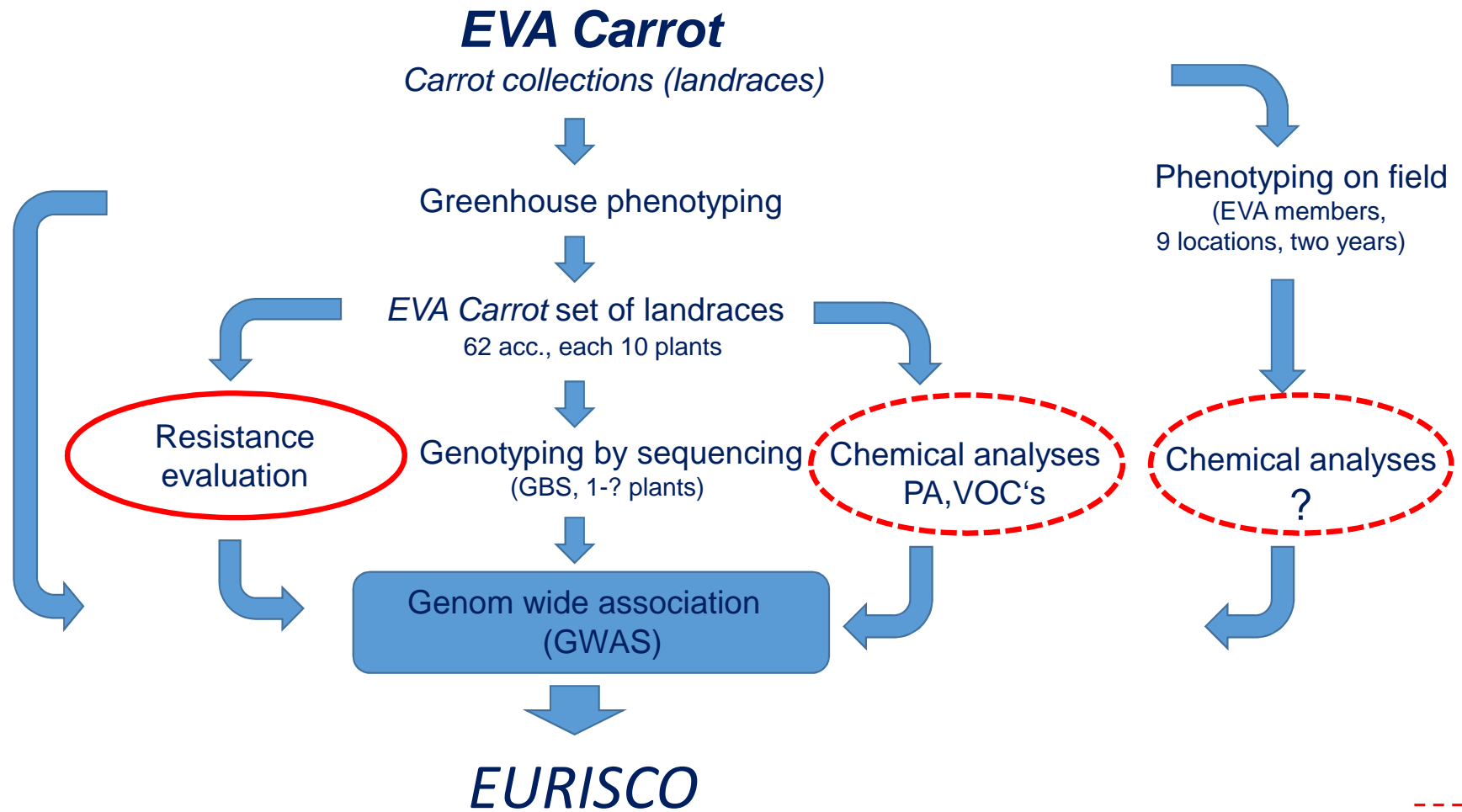
Example: Resistance screening in the **CarrotDivers-Project** 2018 (n=86 CWR, n=10 CC control)



● *Project strategy 2020 at JKI*



● *EVA Carrot Project strategy*





- *EVA Carrot* - project group at JKI

Institute for Breeding Research on Horticultural Crops

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