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Multi-annual comparisons demonstrate differences in the bunch rot susceptibility of nine *Vitis vinifera* L. 'Riesling' clones

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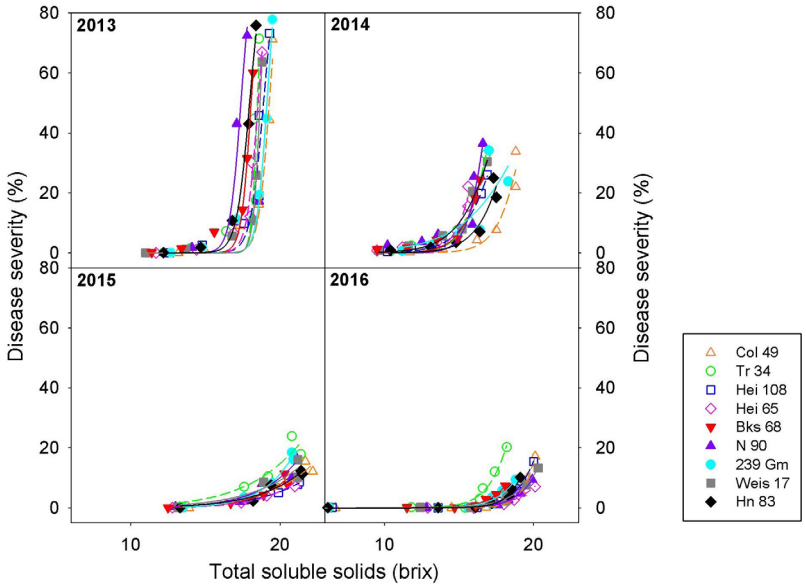

Supplementary Figure: Progress of the disease severity of *B. cinerea* in the different clones in the years 2013 to 2016 as functions of the total soluble solids (brix). Plot symbols represent the observed disease severities, the lines the calculated progress according to the sigmoidal equation type $y = 100 / (1 + e^{-((x-x_0)/b)})$.

Supplementary Table 1

Key annual and growing season (April – October) meteorological data as well as dates (expressed as day of the year (DOY)) of reaching key phenological stages BBCH (Lorenz et al., 1995) 09 (bud burst: green shoot tips clearly visible), BBCH 61 (beginning of flowering: 10% of flowerhoods fallen) BBCH 68 (80% of flowerhoods fallen), BBCH 77 (berries beginning to touch) and BBCH 81 (veraison; beginning of ripening: berries begin to develop variety-specific colour) in the years 2013 to 2016

Year	Mean annual temperature (°C)	Mean growing season temperature (°C)	Annual precipitation sum (mm)	Growing season precipitation sum (mm)	Riesling				
					BBCH 09 (DOY)	BBCH 61 (DOY)	BBCH 68 (DOY)	BBCH 77 (DOY)	BBCH 81 (DOY)
2013	10.2	15.2	799	616	125	172	181	207	242
2014	11.9	15.8	791	560	100	157	161	189	229
2015	11.3	15.3	587	360	115	162	167	191	232
2016	10.9	15.7	692	441	122	167	174	200	235
Average	11.1	15.5	717	494	116	165	171	197	235

Supplementary Table 2

Average values of the PIC (percentage of interior clusters) according to Point Quadrat Analysis (Smart and Robinson 1991) in the years 2013, 2014, 2015 and 2016 as well as average normalized PIC values (PIC of the respective clone in a specific year / average value of all clones in this year). No significant differences between the clones were observed

Clone	2013	2014	2015	2016	Average normalised PIC
Col 49	79.75	74.90	46.52	48.18	1.05
Tr 34	69.31	67.68	49.74	47.15	1.00
Hei 108	77.69	72.79	45.86	46.50	1.02
Hei 65	66.71	70.78	51.52	39.89	0.96
Bks 68	69.22	67.73	47.34	44.16	0.97
N 90	71.56	69.74	54.46	41.16	1.00
239 Gm	68.59	67.40	49.80	37.08	0.94
Weis 17	71.99	69.24	58.85	46.17	1.05
Hn 83	57.51	70.84	58.06	49.58	1.02
Average	70.26	70.12	51.35	44.43	1.00

Supplementary Table 3

Average values of the density index according to Ipach *et al.* (2005) in the years 2013, 2014, 2015 and 2016 as well as average normalized density index values (density index of the respective clone in a specific year/average value of all clones in this year). Density index values of different clones of the same year marked with the same letter did not differ significantly (according to Tukey's multiple comparison procedure ($P = 0.05$)). Average (2013 to 2016) normalized density index values did not differ significantly (according to pairwise comparisons following independent-samples Kruskal-Wallis test ($P = 0.05$))

Clone	2013	2014	2015	2016	Average normalised density index
Col 49	2.83 ab	3.28	3.32 b	3.35 ab	1.03
Tr 34	2.97 b	3.53	3.10 ab	3.36 b	1.04
Hei 108	3.00 b	3.49	3.02 ab	3.34 ab	1.03
Hei 65	3.07 b	3.21	3.10 ab	3.23 ab	1.02
Bks 68	3.02 b	3.21	2.84 a	2.98 ab	0.97
N 90	2.78 ab	3.76	2.95 ab	2.72 ab	0.98
239 Gm	2.87 ab	3.32	2.9 ab	3.16 ab	0.99
Weis 17	3.00 b	3.66	3.27 ab	3.00 ab	1.04
Hn 83	2.51 a	3.33	2.82 a	2.72 a	0.91
Average	2.89	3.42	3.04	3.10	1.00

Supplementary Table 4

Average values of the berry firmness (in g·mm^{-1}) in the years 2013, 2014, 2015 and 2016 as well as average normalized berry firmness values (berry firmness of the respective clone in a specific year/ average value of all clones in this year). Berry firmness values of different clones of the same year marked with the same letter did not differ significantly (according to Tukey's multiple comparison procedure ($P = 0.05$)). Average (2013 to 2016) normalized berry firmness values did not differ significantly (according to pairwise comparisons following independent-samples Kruskal-Wallis test ($P = 0.05$))

Clone	2013	2014	2015	2016	Average normalised berry firmness
Col 49	142.36 ab	164.92 b	143.55 ab	136.95	1.00
Tr 34	141.02 a	162.90 b	146.23 ab	129.14	0.99
Hei 108	143.38 ab	160.40 b	141.70 ab	139.26	1.00
Hei 65	144.03 ab	167.97 b	139.81 ab	135.80	1.00
Bks 68	149.87 ab	161.48 b	147.19 b	136.76	1.01
N 90	152.54 b	162.58 b	141.73 ab	138.22	1.01
239 Gm	144.29 ab	163.53 b	145.63 ab	135.69	1.00
Weis 17	152.63 b	162.21 b	146.23 ab	140.11	1.02
Hn 83	148.43 ab	139.94 a	137.96 a	139.05	0.97
Average	146.51	160.66	143.34	136.78	1.00

Supplementary Table 5

Mean relative impedance (Z_{rel}) of berry cuticle (including epicuticular waxes) of investigated berries in the year 2016. Z_{rel} values and total soluble solids of different clones marked with the same letter did not differ significantly (according to Tukey's multiple comparison procedure ($P = 0.05$)). No significant differences were observed

Clone	Z_{rel}
Col 49	459
Tr 34	409
Hei 108	433
Hei 65	464
Bks 68	402
N 90	440
239 Gm	460
Weis 17	462
Hn 83	411

Supplementary Table 6

Average values of the yield (tons·ha^{-1}) in the years 2013, 2015 and 2016 as well as average normalized yield values (yield of the respective clone in a specific year / average yield of all clones in this year). Yield was not recorded in 2014. The harvest was done according to commercial standards; all grapes of each clone were pooled each year such that no replicates were available in this case

Clone	2013	2014	2015	2016	Average normalised yield
Col 49	4.7		5.5	5.7	0.96
Tr 34	5.0		6.2	5.5	1.02
Hei 108	6.2		5.1	7.0	1.10
Hei 65	6.9		6.0	4.8	1.06
Bks 68	8.7		5.4	6.5	1.22
N 90	5.1		3.9	4.3	0.80
239 Gm	5.3		4.1	5.5	0.90
Weis 17	8.3		4.2	5.6	1.07
Hn 83	4.9		4.7	4.8	0.87
Average	6.1		5.0	5.5	1.00

Supplementary Table 7

Parameters describing the disease progress plotted against the time according to the sigmoidal equation type $y = 100 / (1 + e^{-((x-x_0)/b)})$. Independent variable: DOY. R^2 = coefficient of determination, *P* = significance, b = slope factor of the curve, x_0 = inflection point of the curve

Year	Clone	R^2	P-value	b	x_0
	Col 49	0.9963	0.0001	5.8	285.6
	Tr 34	0.9989	0.0001	5.8	285.5
	Hei 108	0.9979	0.0001	6.0	285.1
	Hei 65	0.9932	0.0001	5.1	287.7
2013	Bks 68	0.9979	0.0001	6.4	288.6
	N 90	0.9957	0.0001	5.9	285.5
	239 Gm	0.9933	0.0001	5.6	284.7
	Weis 17	0.9917	0.0001	4.9	288.5
	Hn 83	0.9921	0.0001	5.4	285.3
	Col 49	0.9864	0.0001	8.7	288.5
	Tr 34	0.9959	0.0001	10.6	290.6
	Hei 108	0.9690	0.0004	10.6	293.3
	Hei 65	0.9855	0.0001	11.3	296.7
2014	Bks 68	0.9505	0.0009	10.2	294.0
	N 90	0.9771	0.0002	9.8	288.0
	239 Gm	0.9759	0.0002	9.4	288.7
	Weis 17	0.9854	0.0001	10.1	291.0
	Hn 83	0.9705	0.0003	10.7	294.1
	Col 49	0.9677	0.0025	13.5	304.1
	Tr 34	0.9814	0.0011	14.8	298.7
	Hei 108	0.9394	0.0064	19.3	325.7
	Hei 65	0.9901	0.0004	13.4	310.5
2015	Bks 68	0.9874	0.0006	12.8	307.8
	N 90	0.9803	0.0012	12.6	301.4
	239 Gm	0.9474	0.0052	14.5	302.2
	Weis 17	0.9731	0.0019	15.2	307.0
	Hn 83	0.9160	0.0106	17.2	313.6
	Col 49	0.9949	0.0001	9.9	305.4
	Tr 34	0.9944	0.0001	10.2	303.8
	Hei 108	0.9911	0.0001	10.7	308.1
	Hei 65	0.9856	0.0001	11.9	320.4
2016	Bks 68	0.9835	0.0001	11.5	318.8
	N 90	0.9958	0.0001	9.6	311.7
	239 Gm	0.9881	0.0001	11.2	315.1
	Weis 17	0.9952	0.0001	10.8	310.2
	Hn 83	0.9904	0.0001	11.5	314.8

Supplementary Table 8

Parameters describing the maturation progress plotted against the time according to the sigmoidal equation type $y = a / (1 + e^{-((x-x_0)/b)})$. Independent variable: DOY. R^2 = coefficient of determination, *P* = significance, a = maximum value, b = slope factor of the curve, x_0 = inflection point of the curve

Year	Clone	R^2	P-value	a	b	x_0
	Col 49	0.9744	0.0041	21.2	4.1	245.3
	Tr 34	0.9568	0.0090	20.0	3.7	247.0
	Hei 108	0.9671	0.0060	20.0	3.1	246.6
	Hei 65	0.9851	0.0018	19.4	2.9	248.2
2013	Bks 68	0.9769	0.0035	19.7	3.7	249.0
	N 90	0.8876	0.0377	18.4	2.5	246.3
	239 Gm	0.9847	0.0019	21.1	3.9	246.6
	Weis 17	0.9766	0.0036	19.7	2.8	250.7
	Hn 83	0.9198	0.0227	19.1	2.7	247.1
	Col 49	0.9914	0.0008	21.4	5.0	237.6
	Tr 34	0.9698	0.0053	18.7	4.7	237.8
	Hei 108	0.9918	0.0007	22.0	6.9	246.3
	Hei 65	0.9819	0.0024	17.6	4.5	238.7
2014	Bks 68	0.9942	0.0004	19.8	5.6	243.4
	N 90	0.9757	0.0038	18.8	5.1	237.5
	239 Gm	0.9360	0.0162	19.6	4.9	235.8
	Weis 17	0.9963	0.0002	20.3	5.7	243.8
	Hn 83	0.9864	0.0016	19.2	4.3	238.1
	Col 49	0.9686	0.0314	26.2	5.9	238.4
	Tr 34	0.9759	0.0241	23.1	4.5	235.6
	Hei 108	0.9937	0.0063	23.4	4.4	235.6
	Hei 65	0.9916	0.0084	23.8	4.7	238.0
2015	Bks 68	0.9881	0.0119	22.6	4.4	237.3
	N 90	0.9895	0.0105	24.1	5.3	237.5
	239 Gm	0.9914	0.0086	22.9	4.5	234.0
	Weis 17	0.9790	0.0210	23.3	4.6	235.5
	Hn 83	0.9848	0.0152	23.2	4.2	235.7
	Col 49	0.9886	0.0001	19.6	1.9	242.8
	Tr 34	0.9895	0.0001	17.7	2.2	243.3
	Hei 108	0.9916	0.0001	19.6	2.2	243.7
	Hei 65	0.9926	0.0001	19.5	2.1	245.0
2016	Bks 68	0.9959	0.0001	17.8	2.3	244.6
	N 90	0.9917	0.0001	19.3	2.1	244.9
	239 Gm	0.9860	0.0002	18.0	1.8	242.4
	Weis 17	0.9919	0.0001	19.8	2.2	246.0
	Hn 83	0.9901	0.0001	18.6	1.9	243.0

Supplementary Table 9

Parameters describing the disease progress plotted against the maturation progress according to the sigmoidal equation type $y = 100/(1 + e^{-((x-x_0)/b)})$. Independent variable: total soluble solids (brix). R^2 = coefficient of determination, *P* = significance, b = slope factor of the curve, x_0 = inflection point of the curve

Year	Clone	R^2	P-value	b	x_0
	Col 49	0.9519	0.0009	0.3	19.3
	Tr 34	0.8374	0.0105	0.2	18.5
	Hei 108	0.8836	0.0053	0.4	18.9
	Hei 65	0.9715	0.0003	0.4	18.5
2013	Bks 68	0.9815	0.0001	0.3	18.1
	N 90	0.3450	0.2203	0.4	17.2
	239 Gm	0.9721	0.0003	0.4	19.1
	Weis 17	0.9844	0.0001	0.3	18.7
	Hn 83	0.9933	0.0002	0.5	18.0
	Col 49	0.9304	0.0019	0.9	19.6
	Tr 34	0.9795	0.0002	0.9	17.4
	Hei 108	0.9970	0.0001	1.3	18.2
	Hei 65	0.9340	0.0017	0.7	16.6
2014	Bks 68	0.9715	0.0003	1.0	17.6
	N 90	0.8566	0.0081	0.7	17.1
	239 Gm	0.6338	0.0581	2.3	20.3
	Weis 17	0.9649	0.0005	1.4	18.1
	Hn 83	0.8824	0.0054	1.2	19.1
	Col 49	0.8982	0.0142	2.7	27.0
	Tr 34	0.8711	0.0205	2.9	25.0
	Hei 108	0.9886	0.0005	2.8	27.9
	Hei 65	0.9507	0.0047	2.2	26.1
2015	Bks 68	0.8899	0.0161	2.0	24.9
	N 90	0.8641	0.0222	2.3	25.0
	239 Gm	0.9830	0.0009	1.8	23.6
	Weis 17	0.8425	0.0279	2.9	26.5
	Hn 83	0.9476	0.0052	2.6	26.6
	Col 49	0.9958	0.0001	0.7	21.3
	Tr 34	0.9707	0.0001	1.1	19.7
	Hei 108	0.9939	0.0001	1.0	21.7
	Hei 65	0.9609	0.0001	1.4	23.8
2016	Bks 68	0.9899	0.0001	1.1	20.7
	N 90	0.9959	0.0001	1.1	22.4
	239 Gm	0.9418	0.0003	1.1	21.3
	Weis 17	0.9884	0.0001	1.4	22.9
	Hn 83	0.9759	0.0001	0.9	21.1

Supplementary Table 10

Calculated soluble solids (brix) at the moment of reaching a bunch rot disease severity of 5 % in the years 2013, 2014, 2015 and 2016 as well as deviations (Δ) between the calculated must densities in a clone in a specific year and the average must densities at the moment of reaching a bunch rot disease severity of 5 % of all clones in this year. Average (2013 to 2016) deviations did not differ significantly (according to pairwise comparisons following independent-samples Kruskal-Wallis test ($P = 0.05$))

Clone	2013	Δ	2014	Δ	2015	Δ	2016	Δ	Average Δ
Col 49	18.24	0.7	17.07	2.2	19.03	0.4	19.10	0.7	1.0
Tr 34	17.94	0.4	14.85	0.0	16.57	-2.1	16.50	-1.9	-0.9
Hei 108	17.61	0.1	14.50	-0.3	19.78	1.1	18.71	0.3	0.3
Hei 65	17.40	-0.1	14.62	-0.2	19.75	1.1	19.54	1.1	0.5
Bks 68	17.18	-0.3	14.64	-0.2	19.03	0.4	17.60	-0.8	-0.2
N 90	16.84	-0.7	14.88	0.0	18.27	-0.4	19.12	0.7	-0.1
239 Gm	18.06	0.5	13.62	-1.2	18.44	-0.2	17.95	-0.5	-0.3
Weis 17	17.88	0.4	13.90	-0.9	18.11	-0.6	18.82	0.4	-0.2
Hn 83	16.56	-1.0	15.44	0.6	18.96	0.3	18.42	0.0	0.0
Average	17.52	0.0	14.84	0.0	18.66	0.0	18.42	0.0	0.0