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Supplementary datas – FIGURES

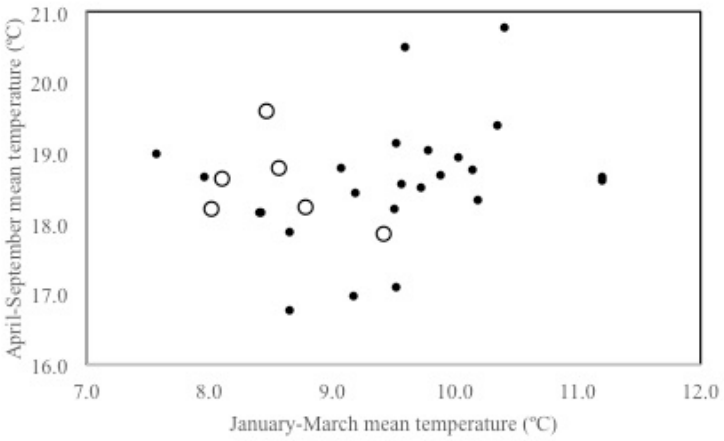

Figure S1. Scatterplots of January–March mean air temperature *vs.* April–September mean air temperature of each year between 1990 and 2019 of weather station of Viseu. The circles are the data-points correspondent the study period (2014–2019).

SUPPLEMENTARY DATA

Rodrigues, P., Pedroso, V., Henriques, C., Matos, A., Reis, S., & Santos, A. J. (2021). Modelling the phenological development of cv. Touriga Nacional and Encruzado in the Dão Wine Region, Portugal. *OENO One*, *55*(3). https://doi.org/10.20870/oeno-one.2021.55.3.4646

Supplementary datas – TABLES

Table S1. Descriptive statistics of observed dates for each phenological stage of Touriga Nacional and Encruzado varieties.

Phenological satges	Variety	n	Mean	Median	Std. Deviation	Interquartile Range	Minimum	Maximum	Range
EL4	EN	39	97	94	10.9	21	80	114	34
	TN	51	98	97	9.1	19	83	114	31
EL9	EN	40	108	106	10.9	22	93	127	35
	TN	51	107	104	9.2	17	91	127	36
EL12	EN	40	117	117	10.9	22	100	133	33
	TN	51	114	114	9.9	19	96	131	36
EF17	EN	37	140	138	13.5	26	114	158	44
	TN	51	135	135	11.9	21	111	163	52
EL19	EN	37	146	144	12.7	23	119	165	46
	TN	51	146	143	11.4	22	129	168	39
EL23	EN	37	149	148	11.1	20	132	169	37
	TN	51	151	149	11.2	15	134	178	44
EL27	EN	40	160	162	10.2	20	145	180	35
	TN	51	163	162	10.8	15	145	188	43
EL29	EN	40	168	169	8.7	17	149	184	35
	TN	51	170	169	9.5	15	156	193	37
EL31	EN	40	176	174	8.1	15	165	192	27
	TN	51	179	177	9.3	16	165	200	35
EL32	EN	40	181	177	8.6	17	172	198	27
	TN	51	184	180	10.4	18	168	205	37
EL35	EN	40	210	211	10.6	19	192	225	33
	TN	51	212	217	11.6	22	191	230	40
50V	EN	25	222	224	11.8	20	200	236	36
	TN	40	220	224	11.7	23	198	236	38

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Table S2. Efficiency coefficient (*EFF*) and the root-mean-squared-error (*RMSE*) of models calibrated for EL4 with different coefficient *e*, varying between 6 and 14, and five different onset dates for heat accumulation (1st January, 15 January, 1st February, 15 February and 1st March), for cv. Encruzado (EN) and Touriga Nacional (TN). For t_x = 1st March, the *d* coefficients fitted are also presented.

Variety	*e*	t_x										
		1st January		15 January		1st February		15 February		1st March		
		EFF	*RMSE*	*EFF*	*RMSE*	*EFF*	*RMSE*	*EFF*	*RMSE*	*EFF*	*RMSE*	*d*
EN	6	0.31	9.0	0.34	8.8	0.46	8.0	0.47	7.8	0.33	8.9	-0.26
	7	0.34	8.8	0.38	8.5	0.50	7.6	0.48	7.8	0.40	8.4	-0.33
	8	0.37	8.6	0.41	8.3	0.53	7.4	0.52	7.5	0.48	7.8	-0.43
	9	0.40	8.4	0.44	8.1	0.55	7.3	0.54	7.3	0.56	7.2	-0.54
	10	0.42	8.3	0.46	8.0	0.55	7.2	0.56	7.2	0.61	6.8	-0.51
	11	0.43	8.1	0.47	7.9	0.56	7.2	0.57	7.1	0.62	6.6	-0.41
	12	0.44	8.1	0.48	7.8	0.56	7.1	0.57	7.1	0.63	6.5	-0.35
	13	0.45	8.0	0.49	7.7	0.57	7.1	0.58	7.0	0.63	6.5	-0.33
	14	0.46	8.0	0.49	7.7	0.57	7.1	0.58	7.0	0.63	6.5	-0.28
TN	6	0.54	6.2	0.56	6.0	0.66	5.3	0.61	5.7	0.47	6.6	-0.27
	7	0.59	5.8	0.62	5.6	0.73	4.8	0.70	5.0	0.57	6.0	-0.37
	8	0.64	5.5	0.68	5.2	0.77	4.3	0.76	4.4	0.69	5.1	-0.53
	9	0.68	5.2	0.72	4.9	0.79	4.1	0.80	4.1	0.80	4.1	-0.72
	10	0.71	4.9	0.75	4.6	0.80	4.1	0.81	4.0	0.83	3.8	-0.55
	11	0.73	4.8	0.76	4.4	0.80	4.0	0.81	4.0	0.84	3.7	-0.4
	12	0.74	4.7	0.77	4.3	0.81	4.0	0.82	3.9	0.84	3.7	-0.33
	13	0.75	4.6	0.78	4.3	0.81	4.0	0.82	3.9	0.84	3.7	-0.29
	14	0.76	4.5	0.78	4.2	0.81	3.9	0.82	3.9	0.83	3.8	-0.26

The highest *EFF* values are shown in the grey box.

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Table S3. Efficiency coefficient (*EFF*), root-mean-squared-error (*RMSE*) and *F** of the best-fit model, model with *e* = 12 and adjusted d, model with *e* = 12 and *d* = -0.5, and model with *e* = 12 and *d* = -1 for all phenological stages, between budbreak and veraison, for cv. Encruzado (EN) and Touriga Nacional (TN).

Phenological phase	Variety	Phenological stage	Model	*e*	*d*	*F**	*EFF*	*RMSE*	*dEFF*	*dRMSE*
Budbreak-Flowering	Encruzado (EN)	EL9	best fit model	10	-0.67	9.4	0.87	3.94		
			model with *e* = 12 and *d* fitted	12	-0.30	6.7	0.86	4.02	-0.01	0.08
			model with *e* = 12 and *d* = -0.5		-0.50	7.1	0.86	4.03	-0.01	0.10
			model with *e* = 12 and *d* = -1		-1.00	7.2	0.85	4.12	-0.01	0.19
		EL12	best fit model	12	-39.58	13.9	0.88	3.67		
			model with *e* = 12 and *d* fitted	12	-39.58	13.9	0.88	3.67	0.00	0.00
			model with *e* = 12 and *d* = -0.5		-0.50	13.3	0.86	4.07	-0.03	0.40
			model with *e* = 12 and *d* = -1		-1.00	13.6	0.88	3.78	-0.01	0.11
		EL17	best fit model	11	-21.39	37.0	0.78	6.23		
			model with *e* = 12 and *d* fitted	12	-0.96	33.0	0.75	6.64	-0.03	0.41
			model with *e* = 12 and *d* = -0.5		-0.50	31.0	0.75	6.68	-0.03	0.45
			model with *e* = 12 and *d* = -1		-1.00	32.9	0.75	6.64	-0.03	0.41
		EL19	best fit model	11	-10.26	43.4	0.77	5.99		
			model with *e* = 12 and *d* fitted	12	-0.41	35.5	0.75	6.34	-0.03	0.35
			model with *e* = 12 and *d* = -0.5		-0.50	36.5	0.75	6.34	-0.03	0.36
			model with *e* = 12 and *d* = -1		-1.00	38.7	0.74	6.41	-0.03	0.42
		EL23	best fit model	12	-0.40	48.1	0.77	5.18		
			model with *e* = 12 and *d* fitted	12	-0.40	48.1	0.77	5.18	0.00	0.00
			model with *e* = 12 and *d* = -0.5		-0.50	40.7	0.77	5.19	0.00	0.01
			model with *e* = 12 and *d* = -1		-1.00	43.1	0.76	5.26	-0.01	0.08
		Mean	best fit model				0.82	5.00		
			model with *e* = 12 and *d* fitted				0.80	5.17	-0.01	0.17
			model with *e* = 12 and *d* = -0.5				0.80	5.26	-0.02	0.26
			model with *e* = 12 and *d* = -1				0.80	5.24	-0.02	0.24

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			best fit model	12	-39.92	6.2	0.77	4.40		
		EL9	model with e = 12 and d fitted	12	-39.92	6.7	0.77	4.40	0.00	0.00
			model with e = 12 and d = -0.5		-0.50	6.1	0.76	4.46	-0.01	0.07
			model with e = 12 and d = -1		-1.00	6.5	0.76	4.51	-0.01	0.11
			best fit model	12	-0.67	11.5	0.80	4.41		
		EL12	model with e = 12 and d fitted	12	-0.67	11.5	0.80	4.41	0.00	0.00
			model with e = 12 and d = -0.5		-0.50	11.4	0.79	4.48	-0.01	0.07
			model with e = 12 and d = -1		-1.00	11.9	0.80	4.43	0.00	0.02
			best fit model	13	-0.36	25.0	0.76	5.85		
		EL17	model with e = 12 and d fitted	12	-0.44	28.4	0.75	5.88	0.00	0.03
			model with e = 12 and d = -0.5		-0.50	28.9	0.75	5.88	0.00	0.03
			model with e = 12 and d = -1		-1.00	30.2	0.74	6.05	-0.02	0.19
	Touriga Nacional (TN)		best fit model	13	-0.14	27.7	0.84	4.53		
		EL19	model with e = 12 and d fitted	12	-0.17	30.1	0.84	4.56	0.00	0.03
			model with e = 12 and d = -0.5		-0.50	35.9	0.80	5.01	-0.04	0.47
			model with e = 12 and d = -1		-1.00	37.9	0.78	5.27	-0.06	0.73
			best fit model	13	-0.23	33.9	0.81	4.84		
		EL23	model with e = 12 and d fitted	12	-0.31	38.3	0.80	4.94	-0.01	0.10
			model with e = 12 and d = -0.5		-0.50	41.2	0.79	5.09	-0.02	0.25
			model with e = 12 and d = -1		-1.00	43.9	0.76	5.42	-0.05	0.58
			best fit model				0.80	4.81		
		Mean	model with e = 12 and d fitted				0.79	4.84	0.00	0.03
			model with e = 12 and d = -0.5				0.78	4.98	-0.01	0.18
			model with e = 12 and d = -1				0.77	5.13	-0.03	0.33
Flowering-Veraison	Encruzado (EN)	EL27	best fit model	14	-3.47	9.2	0.86	3.74		
			model with e = 12 and d fitted	12	-0.22	8.4	0.85	3.88	-0.01	0.14
			model with e = 12 and d = -0.5		-0.50	9.5	0.85	3.91	-0.01	0.17

		model with *e* = 12 and *d* = -1		-1.00	9.9	0.84	3.99	-0.02	0.26
	EL29	best fit model	10	-0.19	14.3	0.73	4.53		
		model with *e* = 12 and *d* fitted	12	-0.46	15.0	0.72	4.56	0.00	0.03
		model with *e* = 12 and *d* = -0.5		-0.50	16.3	0.72	4.58	-0.01	0.05
		model with *e* = 12 and *d* = -1		-1.00	17.2	0.72	4.58	-0.01	0.05
	EL31	best fit model	10	-34.80	26.3	0.68	4.52		
		model with *e* = 12 and *d* fitted	12	-39.59	26.0	0.66	4.70	-0.03	0.19
		model with *e* = 12 and *d* = -0.5		-0.50	24.3	0.63	4.90	-0.06	0.38
		model with *e* = 12 and *d* = -1		-1.00	25.5	0.65	4.77	-0.04	0.25
	EL32	best fit model	10	-36.28	30.7	0.66	4.94		
		model with *e* = 12 and *d* fitted	12	-8.70	30.3	0.63	5.20	-0.04	0.26
		model with *e* = 12 and *d* = -0.5		-0.50	28.6	0.58	5.54	-0.09	0.60
		model with *e* = 12 and *d* = -1		-1.00	29.9	0.61	5.30	-0.05	0.36
	EL35	best fit model	10	-35.79	60.1	0.62	6.51		
		model with *e* = 12 and *d* fitted	12	-39.83	59.7	0.60	6.68	-0.02	0.17
		model with *e* = 12 and *d* = -0.5		-0.50	57.5	0.58	6.84	-0.04	0.32
		model with *e* = 12 and *d* = -1		-1.00	59.2	0.58	6.78	-0.03	0.27
	50V	best fit model	10	-37.84	69.6	0.89	3.90		
		model with *e* = 12 and *d* fitted	12	-39.74	69.1	0.88	4.01	-0.01	0.11
		model with *e* = 12 and *d* = -0.5		-0.50	66.6	0.86	4.35	-0.03	0.45
		model with *e* = 12 and *d* = -1		-1.00	68.5	0.87	4.18	-0.02	0.29
	Mean	best fit model				0.74	4.69		
		model with *e* = 12 and *d* fitted				0.72	4.84	-0.02	0.15
		model with *e* = 12 and *d* = -0.5				0.70	5.02	-0.04	0.33
		model with *e* = 12 and *d* = -1				0.71	4.93	-0.03	0.25
Touriga Nacional (TN)	EL27	best fit model	14	-39.60	10.3	0.91	3.18		
		model with *e* = 12 and *d* fitted	12	-0.32	9.9	0.91	3.22	0.00	0.04

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	model with e = 12 and d = -0.5		-0.50	10.5	0.91	3.23	0.00	0.06
	model with e = 12 and d = -1		-1.00	11.0	0.91	3.30	-0.01	0.12
EL29	best fit model	12	-0.19	14.2	0.78	4.44		
	model with e = 12 and d fitted		-0.19	14.2	0.78	4.44	0.00	0.00
	model with e = 12 and d = -0.5	12	-0.50	16.9	0.78	4.50	-0.01	0.06
	model with e = 12 and d = -1		-1.00	17.7	0.77	4.57	-0.01	0.13
EL31	best fit model	13	-0.22	20.8	0.73	4.79		
	model with e = 12 and d fitted		-0.23	22.2	0.73	4.81	0.00	0.02
	model with e = 12 and d = -0.5	12	-0.50	25.5	0.72	4.93	-0.02	0.14
	model with e = 12 and d = -1		-1.00	26.7	0.71	5.04	-0.03	0.25
EL32	best fit model	10	-0.26	29.5	0.72	5.45		
	model with e = 12 and d fitted		-0.40	29.9	0.72	5.49	0.00	0.04
	model with e = 12 and d = -0.5	12	-0.50	30.8	0.72	5.50	-0.01	0.05
	model with e = 12 and d = -1		-1.00	32.2	0.71	5.57	-0.01	0.12
EL35	best fit model	15	-0.68	54.8	0.76	5.66		
	model with e = 12 and d fitted		-0.23	51.9	0.73	5.98	-0.03	0.32
	model with e = 12 and d = -0.5	12	-0.50	58.4	0.71	6.23	-0.05	0.57
	model with e = 12 and d = -1		-1.00	60.2	0.67	6.58	-0.08	0.92
50V	best fit model	15	-0.97	63.0	0.87	4.16		
	model with e = 12 and d fitted		-0.31	61.1	0.83	4.77	-0.04	0.61
	model with e = 12 and d = -0.5	12	-0.50	65.0	0.82	4.98	-0.06	0.82
	model with e = 12 and d = -1		-1.00	66.8	0.78	5.40	-0.09	1.24
Mean	best fit model				0.80	4.61		
	model with e = 12 and d fitted				0.78	4.78	-0.01	0.17
	model with e = 12 and d = -0.5				0.77	4.89	-0.02	0.28
	model with e = 12 and d = -1				0.76	5.07	-0.04	0.46

dEFF represents the difference between the EFF of each model and the best fit model.
dRMSE represents the difference between the RMSE of each model and the best fit model.