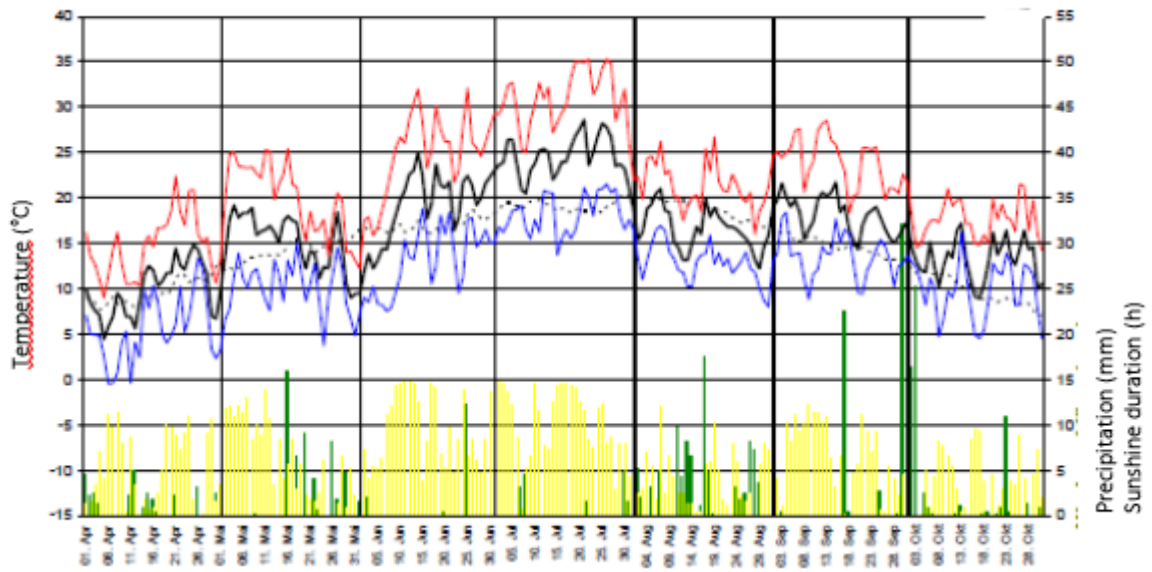


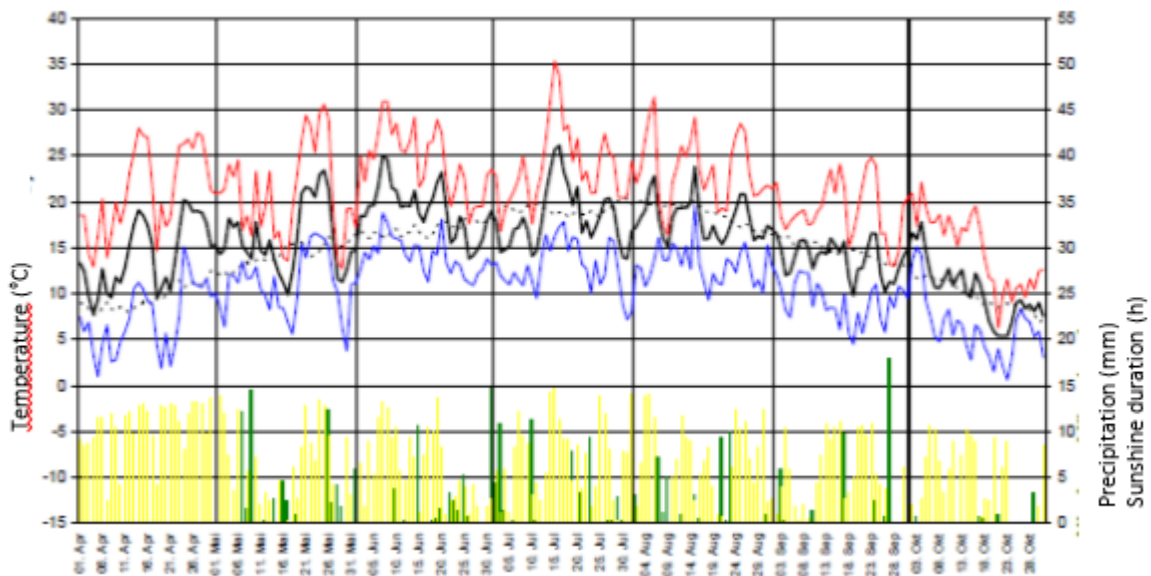
**Figure S1 – Experimental set-up for the field trial.**

x, Registered vines; o, missing vines; 1–40/41–80 (horizontal), row numbers; 1–49/1–42 (vertical), vine numbers. The present study concerned only treatments a1 (integrated management), a2 (organic management) and a3 (biodynamic management). For the results of treatments b1–b5 (different methods of horn silica application), see Fritz *et al.* (2017).



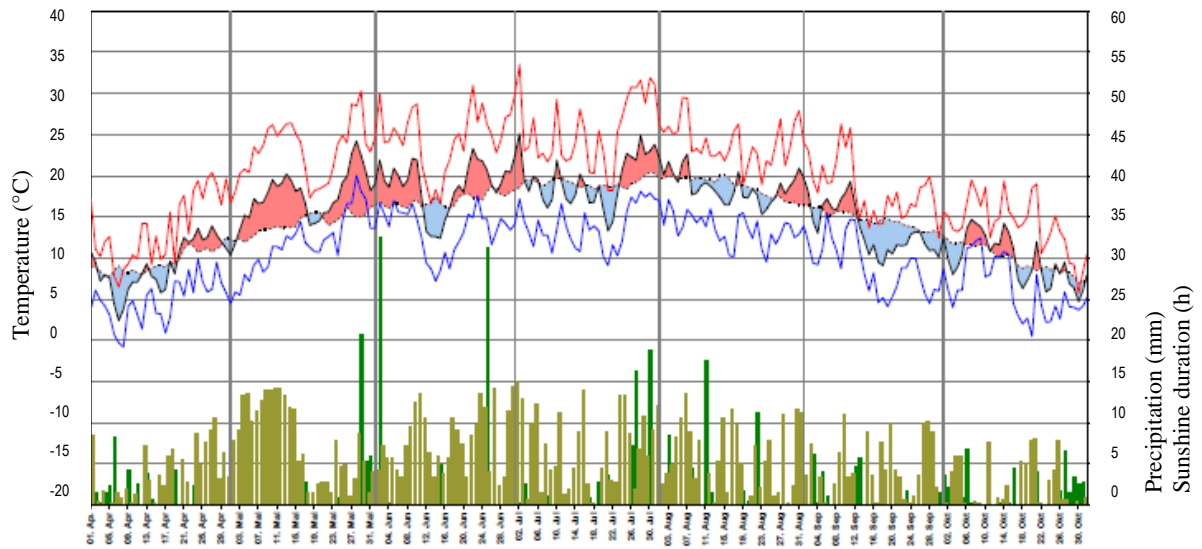
**Figure S2 – Climate data for April to October 2006 (German Weather Service, Geisenheim station).**

Green bars, precipitation; yellow bars, duration of sunshine; red line, maximum temperature; blue line, minimum temperature; black line, daily mean temperature; dashed line, long-term mean temperature, 1971–2000.



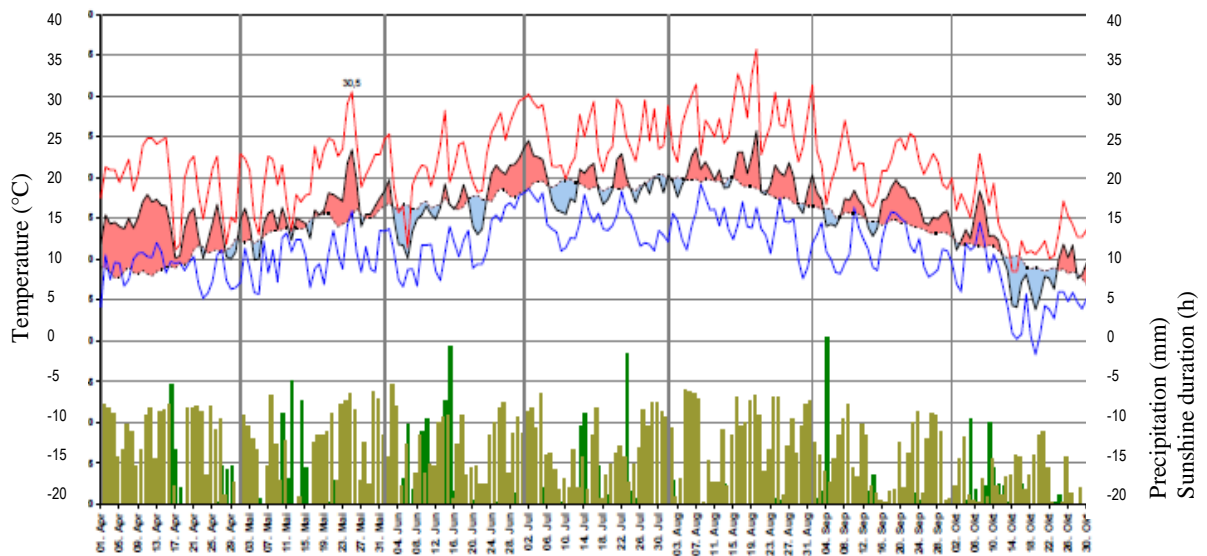
**Figure S3 – Climate data for April to October 2007 (German Weather Service, Geisenheim station).**

Green bars, precipitation; yellow bars, duration of sunshine; red line, maximum temperature; blue line, minimum temperature; black line, daily mean temperature; dashed line, long-term mean temperature, 1971–2000.



**Figure S4 – Climate data for April to October 2008 (German Weather Service, Geisenheim station).**

Dark green bars, precipitation; light green bars, duration of sunshine; red line, maximum temperature; blue line, minimum temperature; black line, daily mean temperature; dashed line, long-term mean temperature, 1971–2000.



**Figure S5 – Climate data for April to October 2009 (German Weather Service, Geisenheim station).**

Dark green bars, precipitation; light green bars, duration of sunshine; red line, maximum temperature; blue line, minimum temperature; black line, daily mean temperature; dashed line, long-term mean temperature, 1971–2000.

<b>Preparation</b>	<b>Material</b>	<b>Animal organ</b>	<b>Treatment</b>	<b>Method of application</b>	<b>Dose</b>
Field sprays					
Horn manure (500)	Cow manure	Cow horn	Buried in soil during winter	Sprayed in drops on the soil after stirring in water for 1 h	50–300 g/ha
Horn silica (501)	Quartz meal	Cow horn	Buried in soil during summer	Sprayed on the plants after stirring in water for 1 h	2.5–5.0 g in 50 L water/ha
Compost preparations					
<i>Achillea millefolia</i> (502)	Flowers	Stag's bladder	Kept in a dry place outside during summer and buried in soil during winter	Buried about 10 cm deep into the compost	1–2 cm <sup>3</sup> per 10 m <sup>3</sup> of compost
<i>Chamomilla recutita</i> (503)	Flowers	Bovine intestine	Buried in soil during winter	Buried about 10 cm deep into the compost	1–2 cm <sup>3</sup> per 10 m <sup>3</sup> of compost
<i>Urtica dioica</i> (504)	Whole plant	None	Buried in soil during winter and summer (June to June)	Buried about 10 cm deep into the compost	1–2 cm <sup>3</sup> per 10 m <sup>3</sup> of compost
<i>Quercus robur</i> (505)	Bark	Skull from cows, pigs or horses	Buried in soil during winter	Buried about 10 cm deep into the compost	1–2 cm <sup>3</sup> per 10 m <sup>3</sup> of compost
<i>Taraxacum officinale</i> (506)	Flowers	Bovine peritoneum	Buried in soil during winter	Buried about 10 cm deep into the compost	1–2 cm <sup>3</sup> per 10 m <sup>3</sup> of compost
<i>Valeriana officinalis</i> (507)	Flower extract	None	Fermented	Poured over whole compost after stirring in water for 15 min	2–5 mL in 10 L of water

**Table S1 – Content, production and application of the biodynamic preparations used in the present study.**

Variable	Year	Integrated management	Organic management	Biodynamic management
Starch (mg/g of dry matter)	2006	53.38	52.35	48.88
	2007	59.06	61.77	58.40
	2008	47.64	51.93	51.51
	2009	34.56	34.12	32.25
Glucose (mg/g of dry matter)	2006	17.45	16.55	16.67
	2007	16.80	17.98	18.35
	2008	26.06	26.64	26.63
	2009	33.00	33.79	33.23
Fructose (mg/g of dry matter)	2006	20.66	19.74	19.98
	2007	23.52	25.05	25.01
	2008	31.41	32.91	32.85
	2009	41.64	41.69	40.83
Sucrose (mg/g of dry matter)	2006	26.68 a	25.68 b	26.89 ab
	2007	17.64	19.98	18.25
	2008	24.28 ab	24.66 a	23.38 b
	2009	30.98 a	31.10 a	29.27 b
Nitrogen (%)	2006	0.68 a	0.62 b	0.62 b
	2007	0.64	0.62	0.62
Phosphorus (%)	2006	0.11	0.11	0.12
	2007	0.12	0.12	0.12
Potassium (%)	2006	0.72	0.71	0.72
	2007	0.77	0.76	0.79
Calcium (%)	2006	0.64	0.6	0.63
	2007	0.69	0.61	0.65
Magnesium (%)	2006	0.08	0.08	0.07
	2007	0.09	0.08	0.08
Copper (p.p.m.)	2006	11.08 b	17.67 a	17.23 a
	2007	8.70 b	11.66 a	12.63 a
Zinc (p.p.m.)	2006	35.12	34.90	36.08
	2007	38.94	25.87	33.88
Iron (p.p.m.)	2006	40.05	28.45	35.41
	2007	29.54	56.06	35.94
Manganese (p.p.m.)	2006	17.63	15.37	15.79
	2007	16.53	16.09	15.35

**Table S2 – Composition of wood in vines under integrated, organic and biodynamic management (means,  $n = 4$ ).**

The 2006 data for starch, glucose, fructose and sucrose have been reported previously (Fritz *et al.*, 2017). Different letters indicate significant differences between treatments in the given year (Tukey's test,  $\alpha = 0.05$ ).

Variable	Year	Date	Integrated	Organic	Biodynamic	
N (%)	2006	28 Jun	2.84	2.74	2.73	
		29 Aug	1.90	1.89	1.93	
		26 Sep	1.78	1.79	1.86	
		19 Oct	0.96	1.06	1.03	
		23 May	3.79 a	3.61 a	3.23 a	
	2007	21 Jun	2.71	2.59	2.64	
		17 Jul	2.48	2.40	2.47	
		28 Aug	2.10	2.00	1.96	
	2008	11 Jun	3.08	2.97	3.05	
		7 Jul	2.55	2.41	2.49	
		31 Jul	2.23	2.10	2.28	
		31 Aug	1.86	1.80	1.81	
	P (%)	2006	28 Jun	0.44 a	0.37 ab	0.32 b
			29 Aug	0.24	0.25	0.21
			26 Sep	0.24	0.20	0.18
19 Oct			0.22	0.19	0.14	
23 May			0.54 a	0.53 a	0.47 b	
2007		21 Jun	0.36	0.38	0.32	
		17 Jul	0.31	0.35	0.32	
		28 Aug	0.35	0.37	0.28	
2008		11 Jun	0.39	0.36	0.32	
		7 Jul	0.29	0.25	0.21	
		31 Jul	0.28	0.24	0.20	
		31 Aug	0.22	0.18	0.15	
K (%)	2006	28 Jun	1.17	1.18	1.14	
		29 Aug	1.02 b	1.19 a	1.17 a	
		26 Sep	1.05	1.11	1.09	
		19 Oct	0.92	1.01	0.96	
	2007	23 May	1.36 b	1.69 a	1.35 b	
		21 Jun	1.22	1.25	1.31	
		17 Jul	1.16	1.21	1.25	
		28 Aug	1.05 ab	1.18 a	0.99 b	
	2008	11 Jun	1.28	1.19	1.17	
		7 Jul	1.07	0.98	1.01	
		31 Jul	1.07	1.09	1.15	
31 Aug	0.99	0.95	0.96			
<b>Variable</b>	<b>Year</b>	<b>Date</b>	<b>Integrated</b>	<b>Organic</b>	<b>Biodynamic</b>	
Ca (%)	2006	28 Jun	2.02 a	1.83 b	1.94 ab	
		29 Aug	2.39	2.33	2.51	
		26 Sep	3.11	2.92	3.06	
		19 Oct	3.57	3.44	3.30	
	2007	23 May	1.54 a	0.99 b	1.11 b	
		21 Jun	2.42	2.26	2.19	

	2008	17 Jul	2.74	2.67	2.63	
		28 Aug	3.35	3.13	3.46	
		11 Jun	2.09	2.10	2.06	
		7 Jul	3.01	2.92	2.85	
		31 Jul	3.31	3.15	3.02	
		31 Aug	3.49	3.62	3.60	
	Mg (%)	2006	28 Jun	0.20	0.19	0.19
			29 Aug	0.21	0.19	0.20
			26 Sep	0.21	0.20	0.19
			19 Oct	0.22	0.21	0.19
23 May			0.15 a	0.16 a	0.13 b	
2007		21 Jun	0.20	0.19	0.19	
		17 Jul	0.20	0.19	0.18	
		28 Aug	0.18	0.16	0.18	
		11 Jun	0.21	0.22	0.21	
		7 Jul	0.25	0.26	0.24	
Cu (p.p.m.)	2006	31 Jul	0.28	0.27	0.26	
		31 Aug	0.22	0.23	0.23	
		28 Jun	7.88 b	49.50 a	46.50 a	
		29 Aug	11.25 b	146.63 a	159.50 a	
		26 Sep	11.13 b	132.38 a	151.88 a	
	2007	19 Oct	13.13 b	185.25 a	198.88 a	
		23 May	8.25 ab	10.25 a	7.00 b	
		21 Jun	7.00 b	65.50 a	59.50 a	
		17 Jul	6.75 b	182.00 a	198.50 a	
		28 Aug	11.00 b	323.75 a	270.63 a	
2008	11 Jun	11.00 b	323.75 a	270.63 a		
	7 Jul	9.79 b	175.60 a	149.23 a		
	31 Jul	11.55 b	422.93 a	418.53 a		
	31 Aug	11.92 b	313.08 a	314.33 a		
	<b>Variable</b>	<b>Year</b>	<b>Date</b>	<b>Integrated</b>	<b>Organic</b>	<b>Biodynamic</b>
Zn (p.p.m.)	2006	28 Jun	36.63 a	17.63 b	18.25 b	
		29 Aug	36.25 a	14.75 b	15.88 b	
		26 Sep	45.25 a	16.00 b	15.75 b	
		19 Oct	69.50 a	20.75 b	21.25 b	
		23 May	43.50 a	34.50 ab	19.25 b	
	2007	21 Jun	38.50 a	19.00 b	18.00 b	
		17 Jul	52.75 a	24.00 b	24.25 b	
		28 Aug	69.00 a	26.50 b	29.50 b	
		11 Jun	45.04 a	15.86 b	14.43 b	
		7 Jul	34.04 a	13.68 b	12.28 b	
2008	31 Jul	41.16 a	21.78 b	19.32 b		
	31 Aug	30.57 a	17.56 b	16.10 b		
	28 Jun	55.50	58.00	55.38		
Fe (p.p.m.)	2006	28 Jun	55.50	58.00	55.38	

Mn (p.p.m.)	2007	29 Aug	62.88	56.25	57.38
		26 Sep	71.13	67.50	71.38
		19 Oct	65.88 b	79.38 a	82.63 a
		23 May	57.75 a	45.25 c	51.25 b
		21 Jun	62.75	64.75	61.75
		17 Jul	58.50	63.25	65.50
	2008	28 Aug	59.00	69.75	65.13
		11 Jun	83.50	78.80	81.75
		7 Jul	81.82	72.41	69.97
		31 Jul	110.26	112.64	97.17
		31 Aug	91.79	75.39	79.25
	2006	28 Jun	47.50	42.38	39.38
		29 Aug	63.50	66.88	64.38
		26 Sep	80.75	81.00	81.63
		19 Oct	103.25	96.50	90.38
23 May		46.75	39.00	39.25	
21 Jun		77.00	90.75	76.75	
17 Jul		102.50	103.50	102.00	
28 Aug		113.50	110.00	111.00	
11 Jun		41.05	40.23	39.81	
7 Jul		79.20	73.82	68.06	
31 Jul	105.44	98.89	90.15		
31 Aug	122.98	118.98	117.28		

**Table S3 – Composition of leaves in vines under integrated, organic and biodynamic management (means,  $n = 4$ ).**

Different letters indicate significant differences between treatments on the given date (Tukey's test,  $\alpha = 0.05$ ).

<b>Integrated management</b>	<b>Organic and biodynamic management</b>
30% <i>Festuca ovina</i>	20% <i>Vicia villosa</i>
20% <i>Agrostis capillaris</i>	15% <i>Onobrychis viciifolia</i>
20% <i>Festuca nigrescens</i>	7.5% <i>Medicago sativa</i>
20% <i>Poa pratensis</i>	7.5% <i>Melilotus albus</i>
10% <i>Festuca rubra</i>	7.5% <i>Trifolium alexandrinum</i>
	7.5% <i>Trifolium incarnatum</i>
	5% <i>Medicago lupulina</i>
	5% <i>Trifolium resupinatum</i>
	2.5% <i>Trifolium hybridum</i>
	2.5% <i>Phacelia tanacetifolia</i>
	10% bee pasture mixture ( <i>Anethum graveolens</i> , <i>Borago officinalis</i> , <i>Calendula officinalis</i> , <i>Coriandrum sativum</i> , <i>Fagopyrum esculentum</i> , <i>Helianthus annuus</i> , <i>Malva sylvestris</i> , <i>Nigella sativa</i> , <i>Phacelia tanacetifolia</i> , <i>Raphanus sativus</i> var. <i>oleiformes</i> )
	10% herb mixture ( <i>Achillea millefolium</i> , <i>Carum carvi</i> , <i>Chicorium intybus</i> , <i>Daucus carota</i> , <i>Foeniculum vulgare</i> , <i>Lotus corniculatus</i> , <i>Pastinaca sativa</i> , <i>Petroselinum crispum</i> , <i>Plantago lanceolata</i> , <i>Sanguisorba minor</i> )

**Table S4 – Perennial cover crop mixtures used in integrated, organic and biodynamic management, 2006–2009.**



<b>Year</b>	<b>Integrated management</b>	<b>Organic and biodynamic management</b>
2006–2007	80% <i>Secale cereale</i> 20% <i>Vicia villosa</i>	26% <i>Secale cereale</i> 25% <i>Vicia villosa</i> 20% <i>Pisum sativum</i> 16% <i>Raphanus sativus</i> var. <i>oleiformes</i> 10% <i>Brassica napus</i> 2% <i>Phacelia tanacetifolia</i>
2007–2008	77% <i>Secale cereale</i> 23% <i>Vicia villosa</i>	23% <i>Brassica napus</i> 18% <i>Malva sylvestris</i> 18% <i>Raphanus sativus</i> var. <i>oleiformes</i> 18% <i>Sinapis alba</i> 7% <i>Phacelia tanacetifolia</i> 5% <i>Fagopyrum esculentum</i> 4% <i>Secale cereale</i> 3% <i>Vicia villosa</i> 2% <i>Pisum sativum</i> 1% <i>Lupinus albus</i> 1% <i>Lupinus angustifolius</i>
2008–2009	77% <i>Secale cereale</i> 23% <i>Vicia villosa</i>	50% <i>Vicia faba</i> 13% <i>Raphanus sativus</i> var. <i>oleiformes</i> 11% <i>Phacelia tanacetifolia</i> 10% <i>Fagopyrum esculentum</i> 7% <i>Pisum sativum</i> 6% <i>Vicia villosa</i> 3% <i>Helianthus annuus</i>

**Table S5 – Annual cover crop mixtures used in integrated, organic and biodynamic management, 2006–2009.**

Cover crops	Agronomic practice	Integrated management	Organic management	Biodynamic management
Summer cover crops, 2006	Seedbed preparation	28 April 2006: herbicide	28 April 2006: weed control with blade	
	Sowing	10 May 2006: rotary harrow 10 May 2006		
Winter cover crops, 2006–2007	Seedbed preparation	15 May 2006: digging machine 4 September 2006: milling cutter and cultivator		
	Sowing	6 September 2006		
Summer cover crops, 2007	Seedbed preparation	14 March 2007: digging machine 27 March 2007: rotary harrow	11 November 2006 and 14 March 2007: digging machine 14 March 2007: rotary harrow	
	Sowing	4 April 2007	28 March 2007	
	Mulching or rolling	20 June 2007: mulching	20 June 2007: rolling 6 July 2007: mulching	
Winter cover crops, 2007–2008	Seedbed preparation	30 April 2007: mulching 22 May 2007: herbicide	30 April 2007: rolling 22 May 2007: weed control with blade 11 June 2007: mulching, vine cuttings chopped and applied as soil cover	
		20 June 2007: cultivator		
		6 July 2007: herbicide		
		6 July 2007: mulching	19 July 2007: weed control with blade	
		25 October 2007: seedbed preparation		
	Sowing	30 October 2007		
Summer cover crops, 2008	Seedbed preparation	31 March 2008: vine cuttings chopped and applied as soil cover		
		24 April 2008: herbicide	25 April 2008: milling cutter, weed control with blades 28 April 2008: rotary harrow	
		9 May 2008: cultivator		
		13 May 2008: milling cutter		
		28 April 2008		
	Mulching or rolling	24 July 2008: mulching 24 September 2008: mulching		
Winter cover crops, 2008–2009	Seedbed preparation	16 May 2008: mulching	19 May 2008: rolling, weed control with blade under vines 18 June 2008: rolling, weed control with blades	
		24 June 2008: mulching		
		23 July 2008: ploughing		
		23 July 2008: weed control with blades		
		24 July 2008: herbicide		
		Sowing	9 September 2008	11 August 2008
	Summer cover crops, 2009	Seedbed preparation	20 March 2009: vine cuttings chopped and applied as soil cover 7 April 2009: disc plough under vines	
Sowing		8 April 2009		
Mulching or rolling		16 April 2009: herbicide		
		18 May 2009: rolling 19 June 2009: rolling		
		15 July 2009: mulching	31 July 2009: rolling	

**Table S6 – Cover crop management used in integrated, organic and biodynamic management, 2006–2009.**

Growing season 2006							
Integrated management				Organic and biodynamic management			
Date	Developmental stage	Product	kg/ha or L/ha	Date	Developmental stage	Product	kg/ha or L/ha
23 May	1st before flowering	Wettable sulphur Polyram WG®	3.6 1.2	23 May	1st before flowering	Mycosin Vin® Wettable sulphur	3 3.6
6 Jun	2nd before flowering	Wettable sulphur Polyram WG®	3.6 1.2	1 Jun	2nd before flowering	Mycosin Vin® Wettable sulphur	3 3.6
19 Jun	Just after flowering	Forum Star® Vivando®	1.2 0.2	13 Jun	3rd before flowering	Mycosin Vin® Wettable sulphur	5 4.8
4 Jul	1st after flowering	Cabrio Star® Urea Bitter salts	2.4 5.0 10	22 Jun	Just after flowering	Funguran® Wettable sulphur Vitsan®	0.9 2.4 5.0
17 Jul	2nd after flowering	Folpan 80 WDG® Vento® Bitter salts	1.4 0.35 10	3 Jul	1st after flowering	Funguran® Wettable sulphur Vitsan®	0.7 2.4 5.0
1 Aug	3rd after flowering	Folpan 80 WDG® Systane 20EW® Bitter salts	1.6 0.24 10	12 Jul	2nd after flowering	Funguran® Wettable sulphur Vitsan®	0.7 2.8 5.0
14 Aug	4th after flowering	Cabrio Top® Forum Star® Systhane 20EW®	3.2 1.92 0.24	21 Jul	3rd after flowering	Wettable sulphur Vitsan®	2.8 2.5
				1 Aug	4th after flowering	Vitsan®	12
				14 Aug	5th after flowering	Funguran® Vitsan®	0.7 12
Growing season 2007							
Integrated management				Organic and biodynamic management			
Date	Developmental stage	Product	kg/ha or L/ha	Date	Developmental stage	Product	kg/ha or L/ha
14 May	1st before flowering	Wettable sulphur Polyram WG®	3.6 1.2	10 May	1st before flowering	Mycosin Vin® Wettable sulphur	5 3.6
23 May	2nd before flowering	Wettable sulphur Cabrio Top®	4.8 1.6	23 May	2nd before flowering	Mycosin Vin® Wettable sulphur	5 3.6
4 Jun	Just after flowering	Forum Star® Flint®	1.2 0.15	4 Jun	Just after flowering	Funguran® Wettable sulphur	0.9 4.8
13 Jun	1st after flowering	Folpan 80 WDG® Vento®	1.4 0.35	14 Jun	1st after flowering	Funguran® Wettable sulphur Vitsan®	0.9 2.4 5.0
27 Jun	2nd after flowering	Polyram WG® Vivando®	2.8 0.28	27 Jun	2nd after flowering	Wettable sulphur Vitsan®	2.8 5.0
9 Jul	3rd after flowering	Folpan 80 WDG® Systane 20EW®	1.6 0.24	7 Jul	3rd after flowering	Funguran® Wettable sulphur Vitsan®	1.1 2.8 5.0

23 Jul	4th after flowering	Mildicut® Systhane 20EW®	4.0 0.24	18 Jul	4th after flowering	Funguran® Vitsan®	0.9 12
6 Aug	5th after flowering	Switch®	0.39	23 Jul	5th after flowering	Funguran® Vitsan®	0.9 12
<b>Growing season 2008</b>							
<b>Integrated management</b>				<b>Organic and biodynamic management</b>			
Date	Developmental stage	Product	kg/ha or L/ha	Date	Developmental stage	Product	kg/ha or L/ha
27 May	1st before flowering	Wettable sulphur Polyram WG®	3.6 1.2	27 May	1st before flowering	Mycosin Vin® Wettable sulphur	3 3.6
4 Jun	2nd before flowering	Wettable sulphur Vento Power® Forum Star®	1.6 6.8 0.69	4 Jun	2nd before flowering	Funguran® Wettable sulphur	1.17 4.8
11 Jun	3rd before flowering	Cabrio Top®	2.0	11 Jun	3rd before flowering	Funguran® Wettable sulphur	0.89 3.0
23 Jun	Just after flowering	Vento Power® Equation Pro®	1.2 0.48	20 Jun	Just after flowering	Funguran® Wettable sulphur	0.7 3.13
1 Jul	1st after flowering	Scala®	0.7	07/01	1st after flowering	Funguran® Wettable sulphur Salukarb®	0.45 3.2 5.0
7 Jul	2nd after flowering	Mildicut® Vivando®	3.5 0.28	10 Jul	2nd after flowering	Funguran® Wettable sulphur Salukarb®	0.67 3.0 8.0
22 Jul	3rd after flowering	Folpan 80WDG® Prosper/Impuls®	1.6 0.8	21 Jul	3rd after flowering	Funguran® Salukarb®	0.44 12
30 Jul	4th after flowering	Vento Power® Mildicut®	1.6 4.0	30 Jul	4th after flowering	Funguran® Salukarb®	0.46 12
13 Aug	5th after flowering	Systhane 20EW® Mildicut® Switch®	0.24 4.0 0.96	11 Aug	5th after flowering	Funguran® Salukarb®	0.46 12.33
<b>Growing season 2009</b>							
<b>Integrated management</b>				<b>Organic and biodynamic management</b>			
Date	Developmental stage	Product	kg/ha or L/ha	Date	Developmental stage	Product	kg/ha or L/ha
25 May	1st before flowering	Vivando® Forum Star® Wettable sulphur	0.16 0.96 4.8	8 May	1st before flowering	Wettable sulphur	3.6
4 Jun	2nd before flowering	Wettable sulphur Prosper/Impulse® Melody Combi®	2.0 0.5 1.5	13 May	2nd before flowering	Mycosin Vin® Wettable sulphur	4.0 3.6
17 Jun	3rd before flowering	Wettable sulphur Cabrio Top®	2.0 2.0	20 May	3rd before flowering	Mycosin Vin® Wettable sulphur	4.0 3.6
30 Jun	Just after flowering	Forum Star® Flint® Wettable sulphur	1.44 0.18 2.4	29 May	4th before flowering	Mycosin Vin® Wettable sulphur	5.0 4.8
7 Jul	1st after flowering	Teldor®	0.6	8 Jun	5th before flowering	Funguran® Wettable sulphur	0.89 4.8
10 Jul	2nd after flowering	Melody Combi® Vento Power®	2.25 1.5	18 Jun	6th before flowering	Wettable sulphur Funguran® Salukarb®	2.4 0.89 5.0

21 Jul	3rd after flowering	Sythane 20EW® Folpan 80WDG® Bitter Salt	0.24 1.6 10	30 Jun	Just after flowering	Wettable sulphur Funguran® Salukarb®	2.4 0.89 5.0
5 Aug	4th after flowering	Mildicut® Sythane 20EW® Bitter salt	4.0 0.24 10	10 Jul	1st after flowering	Funguran® Wettable sulphur Sodium silicate Aminio Vital®	0.89 3.2 2.5 2.5
19 Aug	5th after flowering	Scala®	0.8	16 Jul	2nd after flowering	Funguran® Wettable sulphur Sodium silicate Aminio Vital®	0.89 3.2 2.5 2.5
				27 Jul	3rd after flowering	Funguran® Wettable sulphur Salukarb®	0.89 3.2 8.0
				3 Aug	4th after flowering	Salukarb®	8.0

**Table S7 – Plant protection used in integrated, organic and biodynamic management, 2006–2009.**

<b>Preparation</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>
Compost preparation	14 August	24 October	NA	NA
Horn manure	11 May 23 June	29 March 2 May	15 April 26 May	8 April 6 May
Horn silica	14 June 16 August 21 September	25 May 6 August 17 September	6 June 14 August 26 September	4 June 18 August 17 September

NA, not applied.

**Table S8 – Dates of application of the preparations used in biodynamic management, 2006–2009.**

Principal component	Factor	1	2
Explained variance (%)		41.9	19.9
Earthworms	Abundance 2007	-0.536	-0.071
	Abundance 2008	-0.518	-0.231
	Abundance 2009	-0.498	-0.414
	Biomass 2007	0.007	0.371
	Biomass 2008	-0.347	-0.012
	Biomass 2009	-0.169	-0.587
Enzyme activity	Betaglucosidase 2007	-0.307	0.712
	Betaglucosidase 2008	-0.305	0.444
	Dehydrogenase 2007	-0.233	0.055
	Dehydrogenase 2008	-0.320	0.414
	Neutral phosphatase 2007	-0.485	0.641
	Neutral phosphatase 2008	-0.293	0.408
	Urease 2007	0.202	0.263
	Urease 2008	-0.033	0.307
Grape yield	hL/ha 2006	0.603	-0.581
	hL/ha 2007	0.598	-0.366
	hL/ha 2008	0.653	-0.079
	hL/ha 2009	0.933	-0.100
Grape composition	Must weight 2006	-0.855	-0.230
	Must weight 2007	-0.209	-0.472
	Must weight 2008	-0.652	-0.328
	Must weight 2009	0.370	-0.238
	Total acid 2006	0.551	0.725
	Total acid 2007	0.431	0.505
	Total acid 2008	0.338	0.473
	Total acid 2009	0.605	0.209
	pH 2006	-0.011	-0.699
	pH 2007	0.319	0.564
	pH 2008	0.188	0.505
	pH 2009	-0.395	0.133
	NOPA 2006	0.378	0.242
	NOPA 2007	0.650	0.521
	NOPA 2008	0.029	0.383
	NOPA 2009	-0.347	-0.427
Leaf composition	Nitrogen 2006	0.356	0.240
	Nitrogen 2007	0.471	0.330
	Nitrogen 2008	0.347	0.296
	Calcium 2006	0.484	-0.437
	Calcium 2007	0.663	0.041
	Calcium 2008	0.019	0.450
	Copper 2006	-0.919	0.073
	Copper 2007	-0.888	0.005
	Copper 2008	-0.884	-0.055
	Iron 2006	-0.112	-0.269
	Iron 2007	0.096	0.500
	Iron 2008	0.079	-0.041

	Potassium 2006	0.180	0.212
	Potassium 2007	-0.487	0.236
	Potassium 2008	0.459	0.164
	Magnesium 2006	0.204	0.618
	Magnesium 2007	0.406	-0.099
	Magnesium 2008	0.055	0.308
	Manganese 2006	0.412	0.304
	Manganese 2007	-0.096	-0.335
	Manganese 2008	0.142	0.301
	Zinc 2006	0.901	-0.202
	Zinc 2007	0.965	-0.120
	Zinc 2008	0.816	-0.251
	Phosphorus 2006	0.692	-0.466
	Phosphorus 2007	0.274	0.478
	Phosphorus 2008	0.567	0.463
Wood composition	Starch 2006	0.397	-0.298
	Starch 2007	-0.095	-0.488
	Starch 2008	-0.524	0.235
	Starch 2009	0.342	0.292
	Glucose 2006	0.270	-0.747
	Glucose 2007	-0.441	-0.661
	Glucose 2008	-0.207	0.593
	Glucose 2009	-0.217	0.269
	Fructose 2006	0.267	-0.721
	Fructose 2007	-0.415	-0.567
	Fructose 2008	-0.496	0.471
	Fructose 2009	0.399	-0.001
	Sucrose 2006	0.009	0.285
	Sucrose 2007	-0.396	0.284
	Sucrose 2008	0.166	0.405
	Sucrose 2009	0.460	-0.055
	Calcium 2006	0.117	-0.658
	Calcium 2007	0.411	0.707
	Copper 2006	-0.821	0.036
	Copper 2007	-0.903	0.099
	Iron 2006	0.421	-0.482
	Iron 2007	-0.225	0.214
	Potassium 2006	0.220	-0.407
	Potassium 2007	-0.152	0.631
	Magnesium 2006	0.166	-0.510
	Magnesium 2007	0.502	0.691
	Manganese 2006	0.311	-0.600
	Manganese 2007	0.261	0.695
	Zinc 2006	-0.002	-0.450
	Zinc 2007	0.426	0.650
	Phosphorus 2006	-0.002	0.630
	Phosphorus 2007	0.327	0.602
Field assessment: vegetative development	Stem length 2007	0.650	-0.144



	Stem length 2008	0.676	0.016
	Stem length 2009	0.727	0.224
	Prune weight 2006	0.804	-0.022
	Prune weight 2007	0.907	0.277
	Prune weight 2008	0.789	0.139
	Prune weight 2009	0.936	-0.140
	Leaf chlorophyll 2007	0.708	0.053
	Leaf chlorophyll 2008	0.653	-0.014
	No. of internodes 2008	-0.435	0.444
	No. of side shoots 2008	0.816	0.437
	No. of leaves main shoot 2008	-0.363	0.550
	No. of leaves side shoots 2008	0.686	-0.410
	Total leaf number 2008	0.686	-0.396
	No. of grapes 2008	0.582	0.014
	Leaf layer number 2008	0.724	-0.231
	Leaf layer number 2009	0.811	-0.384
	Gaps in the canopy 2008	-0.724	0.439
	Gaps in the canopy 2009	-0.519	-0.036
	% inner leaves 2008	0.862	-0.122
	% inner leaves 2009	0.853	-0.327
	Exposed grapes 2008	-0.045	0.216
	Exposed grapes 2009	-0.798	0.068
Field assessment: generative development	Grape cluster compactness 2007	0.935	-0.013
	Grape cluster compactness 2008	0.937	-0.033
	Grape cluster compactness 2009	0.867	-0.146
	Single-grape weight 2006	0.681	0.372
	Single-grape weight 2007	0.478	-0.011
	Single-grape weight 2008	0.428	0.384
	Single-grape weight 2009	0.674	0.112
Diseases	<i>Botrytis</i> infection degree 2006	0.219	0.245
	<i>Botrytis</i> infection frequency 2006	-0.234	-0.467
	<i>Botrytis</i> infection degree 2007	-0.508	0.244
	<i>Botrytis</i> infection frequency 2007	-0.723	-0.124
	<i>Botrytis</i> infection degree 2008	0.381	-0.011
	<i>Botrytis</i> infection frequency 2008	-0.515	-0.661
	<i>Botrytis</i> infection degree 2009	0.913	0.104
	<i>Botrytis</i> infection frequency 2009	0.857	-0.058
	Acetic acid rot infection degree 2008	0.851	0.243
	Acetic acid rot infection frequency 2008	0.810	-0.185
	Acetic acid rot infection degree 2009	0.803	-0.303
	Acetic acid rot infection frequency 2009	0.920	-0.169

**Table S9 – Full list of principal components and corresponding factor loads.**

Light grey, positive factor loads > 0.5; dark grey, negative factor loads < -0.5.

NOPA, nitrogen by the orthophthaldialdehyde method.

