

Table S1. Initial physico-chemical characteristics of the studied soils at a depth of 0–25 cm in two growing seasons.

Two growing seasons.			
Properties		2018/2019 season	2019/2020 season
Particle size distribution			
Sand		9.6±0.5	9.5±0.6
Silt	%	20.1± 0.9	20.1±1.2
Clay		70.3±2.4	70.4±3.0
Texture class		Clay	
Physico-chemical properties			
HC	cm ³ h ⁻¹	0.03±0.00	0.03±0.00
FC		34.3±2.12	34.6±2.24
WP	%	19.7±1.40	19.8±1.52
AW		14.6±0.82	14.7±0.77
ECe	dS m ⁻¹	1.91±0.12	1.94±0.11
pH (1:2.5 soil/water extract)		7.52±0.31	7.54±0.40
OM		1.11±0.01	1.12±0.01
CaCO ₃	%	3.87±0.11	3.75±0.15
N		17.6±1.28	18.7±1.33
P		6.11±0.29	6.32±0.31
K		51.5±3.83	52.4±4.02
Fe	mg kg ⁻¹	4.73±0.15	4.95±0.21
Zn		0.89±0.05	0.97±0.06
Mg		0.37±0.01	0.39±0.01
Mn		2.87±0.16	2.89±0.20

The data are means±SE ECe= Electrical conductivity, OM= Organic matter content, HC= Hydraulic conductivity, FC= Field capacity, WP= Wilting point, and AW= Available water.

Table S2. Monthly average of meteorological data of the experimental farm during 2018/ 2019 and 2019/2020 seasons.

Month	2018/2019 season				2019/2020 season			
	Air temperature (°C)			ARH (%)	Air temperature (°C)			ARH (%)
	Maximum	Minimum	Average		Maximum	Minimum	Average	
October	30.0	16.4	23.2	45.9	32.4	15.6	24.0	45.0
November	26.0	10.7	18.4	52.8	27.2	11.5	19.4	51.3
December	20.0	8.71	14.4	56.4	23.5	7.89	15.7	60.3
January	19.0	6.25	12.6	55.5	21.0	6.14	13.6	55.2
February	21.8	11.1	16.5	43.8	23.4	6.97	15.2	53.3
March	23.6	14.0	18.8	37.2	26.5	8.00	17.2	45.6
April	29.0	16.4	22.7	37.7	32.5	12.1	22.3	38.8
May	37.5	21.5	29.5	29.6	36.3	15.3	25.8	30.2

ARH= Relative humidity average.

Table S3. A preliminary study to identify the optimal sowing date, seed soaking period, foliar spray times, and ascorbic acid (AsA) concentrations for parsley.

Treatments	2016/2017			2017/2018		
	Emergence (%)	Dry weight (g plant ⁻¹)	Seed weight (g plant ⁻¹)	Emergence (%)	Dry weight (g plant ⁻¹)	Seed weight (g plant ⁻¹)
Sowing dates:						
September	81.7 ^b ±7.4	16.1 ^b ±1.3	8.0 ^b ±0.6	81.2 ^b ±8.0	15.1 ^b ±1.1	8.9 ^b ±0.7
October	89.6 ^a ±8.2	18.2 ^a ±1.5	9.8 ^a ±0.7	91.2 ^a ±8.9	19.1 ^a ±1.5	10.4 ^a ±0.9
November	81.3 ^b ±7.6	14.3 ^c ±1.2	7.6 ^b ±0.6	80.9 ^b ±7.7	14.8 ^b ±1.1	8.1 ^c ±0.6
December	64.2 ^c ±5.6	8.7 ^d ±0.7	5.8 ^c ±0.4	65.0 ^c ±6.1	9.2 ^c ±0.8	6.2 ^d ±0.5
LSD _(0.05)	5.4	1.2	0.5	6.1	1.1	0.6
Seed soaking periods:						
0 h (Control)	71.0 ^c ±6.0	13.4 ^c ±1.1	7.0 ^c ±0.6	72.2 ^b ±5.8	13.6 ^c ±1.2	7.1 ^c ±0.5
4 h	78.5 ^b ±7.4	14.4 ^b ±1.3	8.7 ^b ±0.7	77.2 ^b ±6.3	15.2 ^b ±1.5	8.9 ^b ±0.6
8 h	84.1 ^a ±7.9	17.2 ^a ±1.7	9.8 ^a ±0.8	84.1 ^a ±7.0	16.9 ^a ±1.7	9.9 ^a ±0.7
12 h	65.2 ^d ±5.2	11.8 ^d ±0.8	6.4 ^d ±0.5	59.6 ^c ±4.0	11.1 ^d ±1.0	6.5 ^d ±0.4
LSD _(0.05)	5.2	1.1	0.5	5.4	1.0	0.5
Times of foliar spray of AsA at 2 mM:						
0 (Control)	72.4 ^c ±6.0	13.0 ^d ±1.1	7.1 ^d ±0.4	73.1 ^c ±6.1	13.2 ^d ±0.9	7.4 ^d ±0.5
1 spray	73.9 ^{bc} ±6.2	14.1 ^c ±1.2	7.7 ^c ±0.6	74.3 ^{bc} ±6.3	14.7 ^c ±1.1	8.1 ^c ±0.5
2 sprays	77.7 ^b ±7.1	15.4 ^b ±1.4	8.5 ^b ±0.6	79.2 ^{ab} ±6.9	16.4 ^b ±1.4	9.2 ^b ±0.6
3 sprays	83.0 ^a ±7.4	17.4 ^a ±1.6	9.6 ^a ±0.7	83.2 ^a ±7.4	17.8 ^a ±1.8	10.4 ^a ±0.8
4 sprays	77.5 ^b ±7.2	15.8 ^b ±1.3	8.4 ^b ±0.6	79.2 ^{ab} ±6.8	16.1 ^b ±1.3	9.5 ^d ±0.7
LSD _(0.05)	5.0	1.1	0.5	6.0	1.2	0.6
AsA levels (seed soaking for 4 h and foliar spray for 3 times):						
0 mM	79.2 ^c ±6.7	14.3 ^d ±1.0	7.8 ^d ±0.5	79.6 ^c ±6.5	14.6 ^d ±0.9	8.1 ^d ±0.6
0.5 mM	81.2 ^{bc} ±6.9	15.9 ^c ±1.3	8.5 ^c ±0.7	80.9 ^{bc} ±6.8	16.0 ^c ±1.2	8.9 ^c ±0.6
1.0 mM	84.2 ^b ±7.4	17.6 ^b ±1.5	9.6 ^b ±0.8	86.3 ^{ab} ±7.0	17.8 ^b ±1.2	10.1 ^b ±0.8
2.0 mM	89.9 ^a ±7.9	18.9 ^a ±1.6	10.4 ^a ±0.8	90.4 ^a ±7.1	19.2 ^a ±1.4	11.2 ^a ±0.8
3.0 mM	64.7 ^d ±5.2	12.8 ^e ±0.9	7.4 ^d ±0.5	71.0 ^d ±5.8	13.1 ^e ±0.9	7.5 ^d ±0.5
LSD _(0.05)	5.5	1.3	0.6	6.5	1.4	0.7

Values (means±SE) with similar letters are not significantly different at $p \leq 0.05$.

Notes: Emergence (%) was determined based on only seed soaking in AsA concentrations before sowing, however, the other traits (dry weight and seed weight plant⁻¹) were determined based on seed soaking plus foliar spraying with AsA concentrations. The sowing dates were the first week of each month.

Table S4. Fractionation of essential volatile oil of the produced parsley seeds (identified by Gas Chromatography-Mass Spectroscopy)

		SD vs. Oct.	Oct. (24.0 °C)			Nov. (19.4 °C)			Dec. (15.7 °C)			Jan. (13.6 °C)		
		AsA level	0 mM	1 mM	2 mM	0 mM	1 mM	2 mM	0 mM	1 mM	2 mM	0 mM	1 mM	2 mM
No.	RT Min.	Oil fractions	Area sum (%)											
1	4.71	α -Pinene	1.22	0.92	1.83	2.30	1.30	1.24	0.21	0.54	1.01	0.57	0.58	0.56
2	4.93	Limonene	1.43	1.57	0.58	0.57	1.06	0.62	0.87	0.57	0.57	0.34	0.33	0.35
3	5.03	Camphene	1.01	1.66	2.12	1.24	1.42	2.54	0.36	0.76	0.59	5.32	5.37	5.35
4	5.17	β -Pinene	0.61	0.57	2.47	0.94	1.60	1.67	0.87	1.14	1.16	0.35	0.31	0.32
5	5.52	β -Myrcene	1.13	2.81	0.63	1.31	1.34	1	2.96	1.18	0.65	2.82	2.82	2.82
6	5.70	p-Cymenene	1.40	0.79	0.96	1.42	1.03	1.68	2.73	1.34	1.90	1.27	1.27	1.28
7	5.84	D-Limonene	3.01	0.34	1.14	0.88	1.70	0.72	2.08	1.03	1.27	1.62	1.66	1.64
8	5.89	γ -Terpinene	6.60	2.11	4.75	1.54	0.82	1.1	1.83	0.97	1.2	1.48	1.41	1.43
9	6.01	Farnesole	3.06	7.76	0.33	1.67	0.74	0.64	0.55	0.97	0.84	0.82	0.87	0.85
10	6.31	α -Fenchene	6.15	0.65	0.37	0.56	0.75	1.49	0.80	1.58	1.30	0.73	0.73	0.71
11	6.35	3-Carene	3.37	0.81	0.44	1.96	0.78	0.53	1.92	1.36	0.73	1.51	1.51	1.52
12	6.50	α -Asarone	2.00	0.36	0.63	0.43	0.76	1.07	4.13	1.09	0.80	0.72	0.71	0.72
13	7.51	α -Terpinolene	0.90	0.61	0.36	0.42	1.67	3.45	2.04	0.66	1.71	1.51	1.51	1.54
14	7.82	Cis-Verbenone	6.10	0.99	1.21	0.53	1.11	0.69	1.62	2.13	1.60	1.01	1.01	1.04
15	8.27	(-)-Verbenone	2.33	3.81	0.55	3.99	1.49	0.82	2.65	1.76	0.91	4.07	4.01	4.04
16	8.80	D-Verbenone	1.54	0.56	0.93	0.84	1.08	0.54	0.77	2.75	1.57	1.44	1.46	1.41
17	9.07	p-Thymol	2.96	0.54	0.37	0.56	0.82	0.79	1.79	0.43	1.76	1.11	1.16	1.14
18	9.46	Terpenolene	1.14	0.37	0.60	0.53	1.13	0.71	1.49	3.85	1.14	0.41	0.41	0.40
19	9.87	Eremophilene	0.57	0.51	0.40	0.78	0.92	0.58	0.89	1.57	0.76	0.61	0.65	0.60
20	10.36	Caryophyllene	1.06	0.39	0.53	0.52	0.82	0.88	1.51	0.65	0.94	1.46	1.44	1.48
21	10.54	Isocaryophyllene	0.98	0.63	0.59	0.73	1.26	0.91	0.35	0.90	1.52	0.46	0.52	0.44
22	11.30	Myristicine	22.78	31.76	32.43	39.44	37.11	37.41	11.82	33.81	48.05	9.19	10.31	10.41
23	11.91	o-PyCt A	1.74	0.57	1.2	1.58	1.21	0.85	2.61	3.77	1.03	2.41	1.44	1.45
24	12.60	Apiol	19.13	22.24	29.11	13.16	22.46	25.39	9.50	7.08	12.93	9.26	10.04	10.07
25	13.52	Glycer-Lin	0.66	0.54	0.66	1.23	1.00	1.13	2.21	5.73	1.42	1.94	0.95	0.92
26	13.60	Orientin	0.32	0.71	6.98	1.36	2.96	1.02	3.39	1.28	0.66	1.27	1.22	1.23
27	13.66	Farnesole	0.56	0.51	1.99	3.65	0.58	0.74	5.66	0.67	0.75	4.36	4.38	4.37
28	14.02	Ger-Iso	0.31	0.42	0.33	1.06	0.54	0.72	0.61	2.31	0.53	0.66	0.69	0.68
29	14.31	GlyMonoOl	0.45	1.23	0.44	0.48	0.51	0.61	4.01	0.54	1.01	2.66	2.63	2.61
30	14.70	Hexad.A	0.63	0.93	0.49	1.89	5.13	0.74	8.87	4.73	0.58	4.77	4.73	4.72
31	15.30	Schaftoside	0.65	0.72	0.34	0.51	0.51	0.58	0.79	0.92	2.17	5.25	5.28	5.29
32	15.81	9-OctaDA(Z)	0.62	0.93	0.36	1.01	0.48	0.48	4.15	4.71	0.56	8.69	8.66	8.65
33	16.09	Quercetin	0.42	1.16	0.38	0.52	0.50	0.45	0.53	0.42	0.58	1.11	1.13	1.14
34	16.31	2-Hyd-Trimeth	0.40	0.68	0.42	0.67	0.65	0.46	1.85	1.95	0.75	1.87	1.82	1.88
35	17.25	3-Hyd-trimeth	0.36	0.48	0.40	0.81	0.41	0.45	1.04	0.50	0.62	0.71	0.76	0.70
36	17.81	E.dienoic, ME	0.39	0.94	0.37	0.77	0.39	0.65	1.48	0.71	0.62	0.95	0.92	0.94
37	18.34	Epimedin B	0.33	1.04	0.45	1.19	1.05	0.52	1.14	0.85	0.50	2.31	2.34	2.32
38	18.50	Epimedin C	0.31	3.12	0.38	1.59	0.58	0.86	0.86	0.56	0.52	3.51	3.52	3.54
39	18.89	Epimedin A	0.32	0.85	0.40	1.55	0.37	0.78	1.32	0.43	0.58	2.43	2.42	2.40
40	19.52	Icariin	0.37	0.56	0.35	1.15	0.67	1.01	1.36	0.50	0.49	2.84	2.82	2.82
41	20.24	Trihydro-TetrFl	0.40	0.44	0.36	1.45	0.52	0.57	2.61	0.86	0.83	1.91	1.92	1.93
42	21.09	Phytanic acid	0.31	0.46	0.33	1.25	0.77	0.87	1.74	0.39	0.90	2.27	2.28	2.27

o-PyCt.A= o-Pyrocatechuic acid, GlyMonoOl= Glyceryl Monooleate, Glycer-Lin= Glyceryl linolenate, Ger-Iso= Geranyl isovalerate, Hexad.A= Hexadecanoic acid, 9-OctaDA(Z)= 9-Octadecenoic acid (Z)-, 2-Hyd-Trimeth= 2-Hydroxy-3,4,5-trimethoxychalcone, 3-Hyd-trimeth= 3-Hydroxy-7,8,3-trimethoxyflavone, E.dienoic, ME= 11,14-Eicosadienoic acid, methyl ester, and Trihydro-TetrFl= 4,5,7- trihydroxy 3,3,6,8-tetramethoxyflavone.

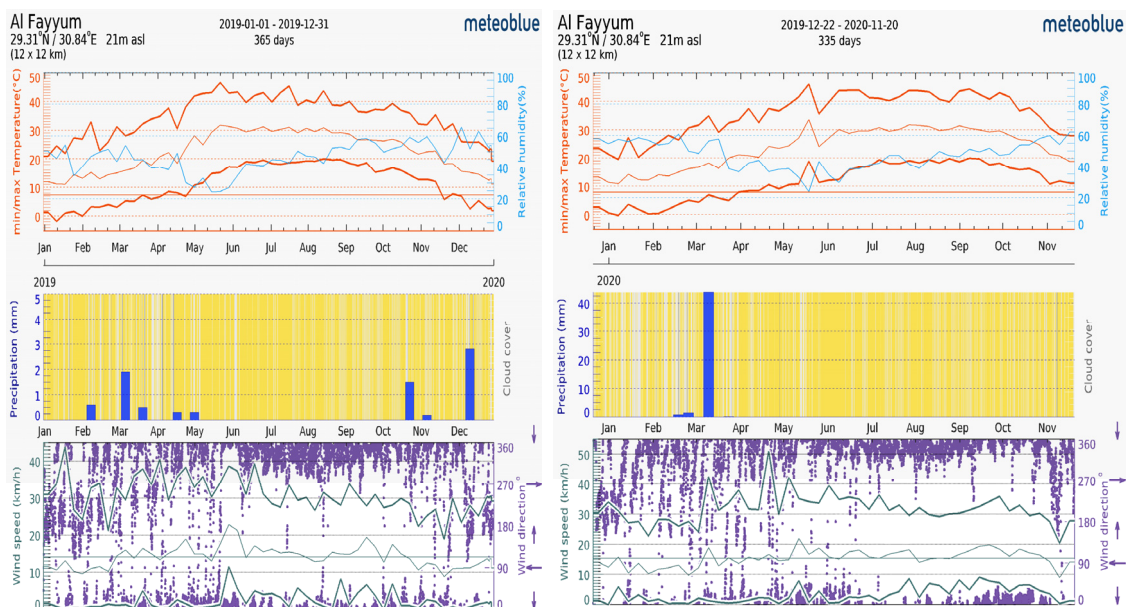
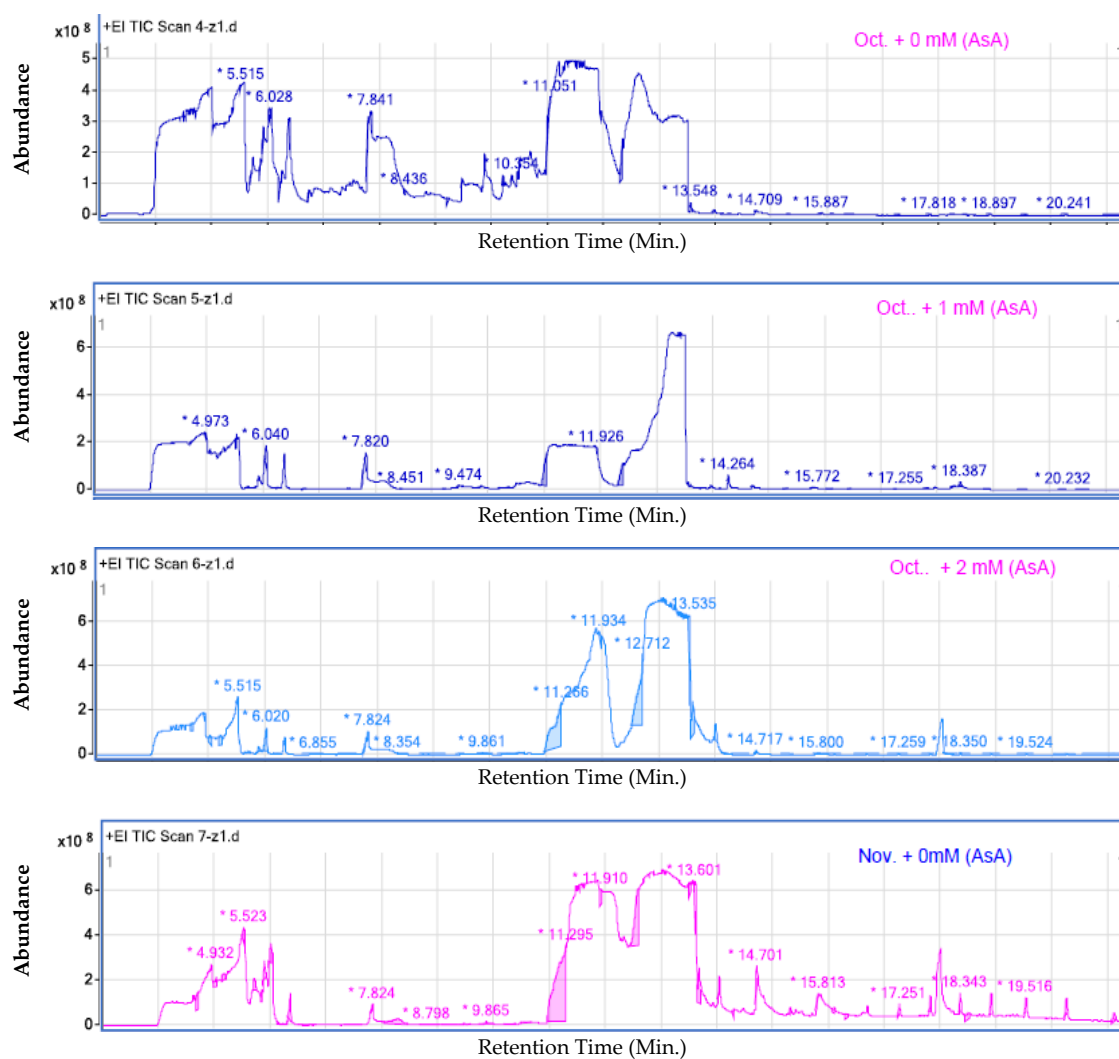


Figure S1. Monthly average of meteorological data of the experimental farm.



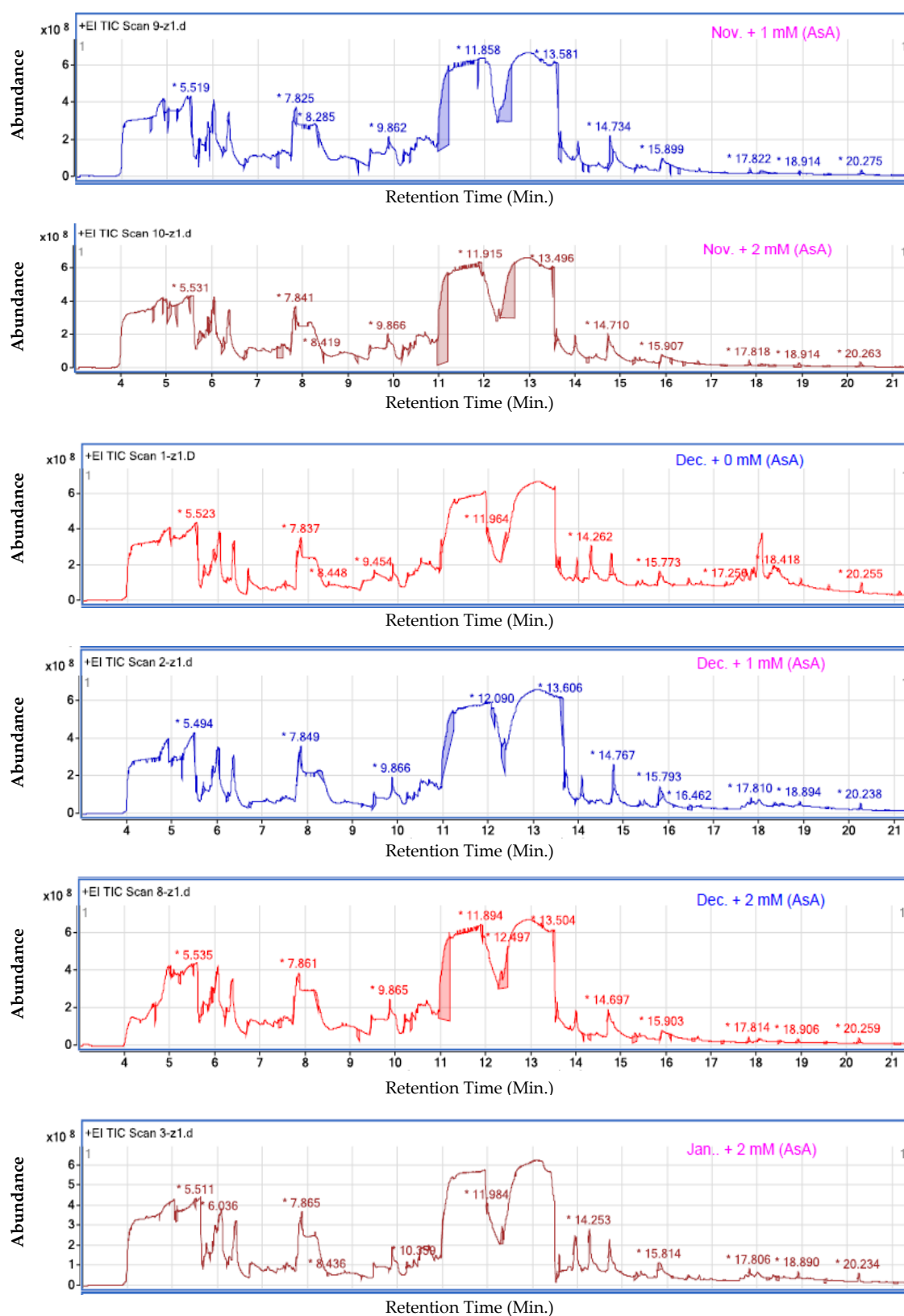


Figure S2. GC-MS chromatograms of parsley seed oil as affected by AsA treatments and low-temperature stress.