

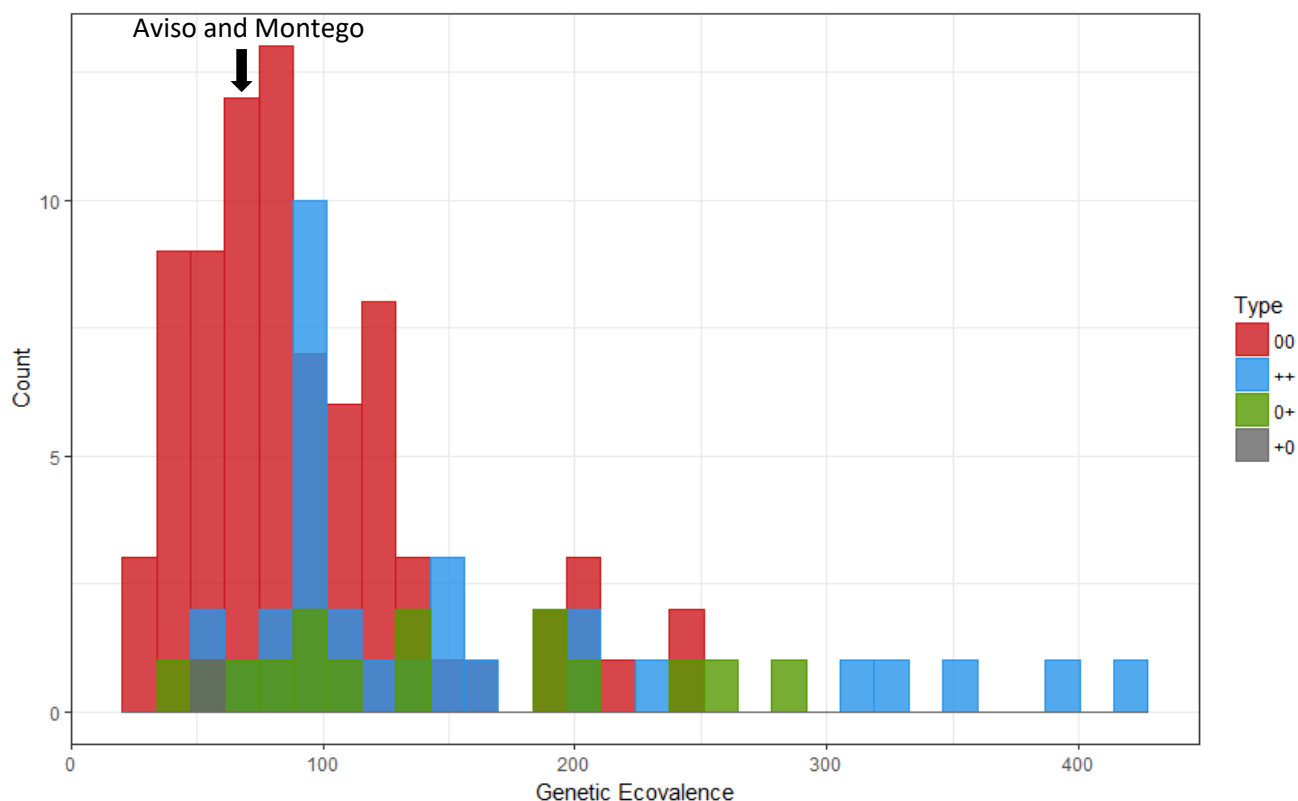


Figure S1. Description of the DS127 set based on the ecovalence calculated for each genotype. The ecovalence is defined as: $W_g^2 = \sum_{e=1}^E (Y_{ge} - \bar{Y}_g - \bar{Y}_e + \bar{Y}_{..})^2$ where g stands for the number of genotype, e stands for the number of environments and Y stands for the seed yield [1]. The ecovalence gives information about the stability of a genotype across environments. A high ecovalence means that the genotype is not stable across environments. The different accession types of the accessions are as following: 00 for low in erucic acid and glucosinolates, ++ for high in erucic acid and glucosinolates, 0+ low in erucic acid and high in glucosinolates, +0 high in erucic acid and low in glucosinolates.

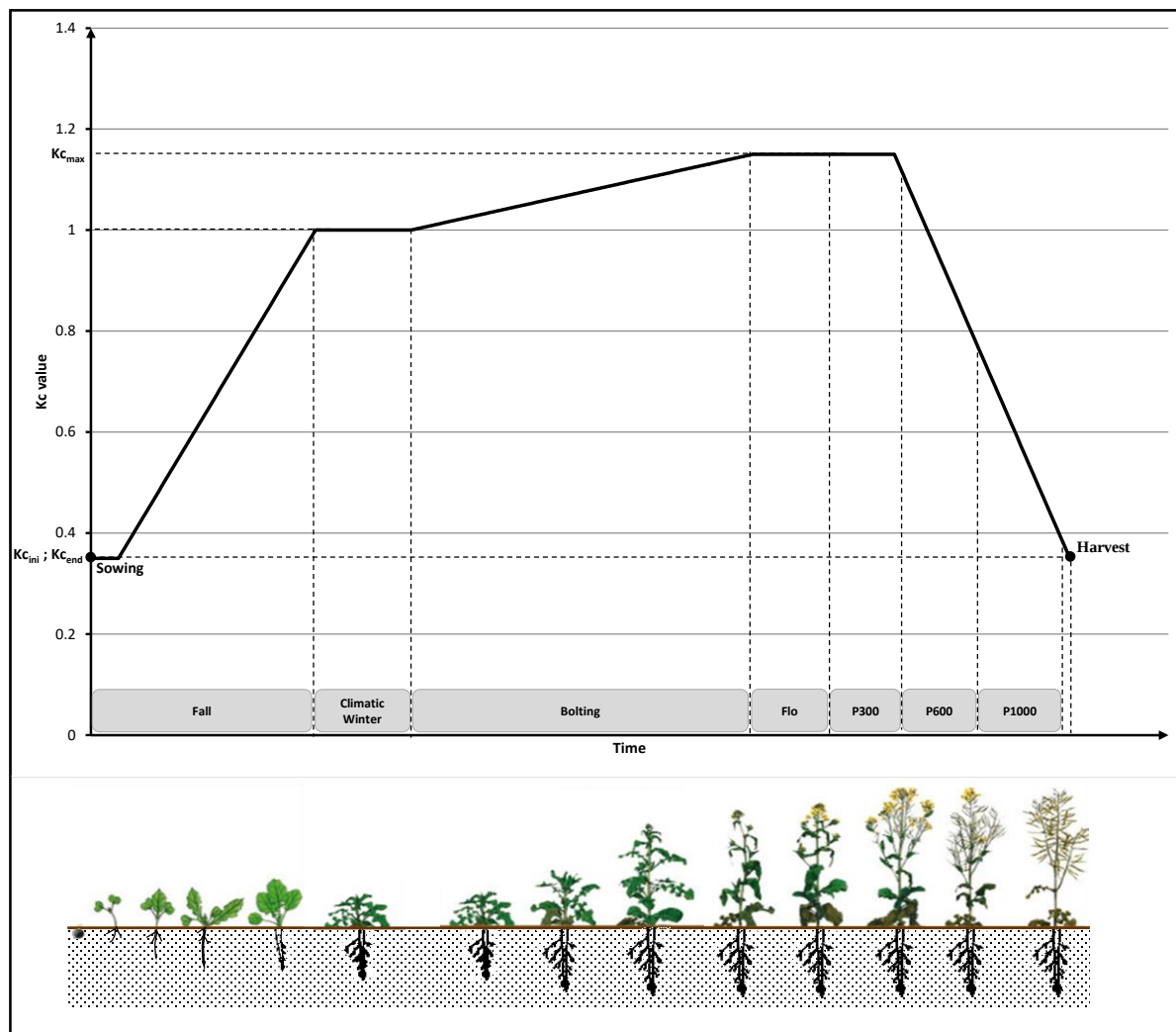


Figure S2. Adaptation of crop coefficient (K_c) dynamics for winter oilseed rape to perform soil water content estimation across the crop cycle (adapted from Allen et al. [28]). K_c takes different values during the cycle. The seven periods are represented (Fall, Climatic Winter, Bolting, Flo, P300, P600 and P1000). Four values are fixed for the K_c . The minimal and maximal values for K_c (K_{c_ini} , K_{c_max}) and the K_{c_end} were chosen according to Allen et al. [28]. We adapted the dynamics of K_c to reflect the climatic winter period: the K_c was fixed to 0.35 at sowing and during the first 150 GDD, from 150 GDD post sowing up to the beginning of the climatic winter, the K_c followed a linear dynamic and reached the value of 1 (K_{c_cw}). During the climatic winter period, the K_c remained fixed to 1 to mimic the absence of biomass accumulation during the vegetative break. Another linear kinetics was fit to predict the K_c value from the end of winter up to flowering, where the K_c reached its maximal value of 1.15 (K_{c_max}). During the FLO and P300 periods, the K_c is fixed to 1.15. Finally, from the P300 up to the harvest, the K_c followed a linear dynamic and decreased to the value of 0.35 (K_{c_end}).

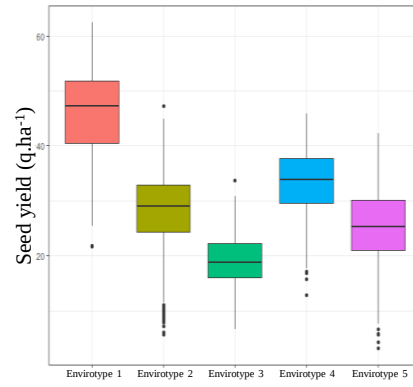


Figure S3. Boxplots of seed yield distribution of the DS127 set following the envirotypes defined for Aviso and Montego.

Table S1. Field network and crop management strategies

Trial information								Cultural practices						Phenotypic value
Environment ID	Crop season	Location	Latitude	Longitude	Maximal Water Soil Content (mm) ¹	Experimental design ²	Population ³	Sowing date	Total N fertilization (U = kg.ha ⁻¹)	First N fertilization (date)	Second N fertilization (date)	Third N fertilization (date)	Harvest date	Seed yield (t.ha ⁻¹) ⁴
Ch14	2013-2014	Châteauroux	46.914158	1.756584	122.1	2 replicates	Probes/DS127	09/03/2013	140 U	70 U (02/17/2014)	70 U (03/15/2014)	none	07/02/2014	2.94 (± 0.27)
Dij13	2012-2013	Dijon	47.230468	5.10036	122.1	3 replicates	Probes	09/12/2012	180 U	60 U (02/14/2013)	70 U (03/14/2013)	50 U (04/19/2013)	08/05/2013	4.70 (± 0.393)
Dij15	2014-2015				122.1	2 replicates	Probes/DS127	09/04/2014	140 U	60 U (02/19/2015)	80 U (03/13/2015)	none	07/08/2015	4.43 (± 0.781)
Liv16	2015-2016	Liverdy	48.7048247	2.7564469	197.4	3 replicates	Probes	03/09/2015	140 U	NA	NA	NA	07/17/2016	2.72 (± 0.257)
LR11	2010-2011	Le Rheu	48.13916	-1.799776	197.4	3 replicates	Probes	09/14/2010	130 U	40 U (02/08/2011)	90 U (03/10/2011)	none	06/28/2011	4.28 (± 0.631)
LR12	2011-2012				197.4	4 replicates	Probes	09/14/2011	80 U	40 U (02/21/2012)	40 U (03/14/2012)	none	07/16/2012	3.34 (± 0.406)
LR13	2012-2013				197.4	4 replicates	Probes	09/05/2012	80 U	40 U (02/25/2013)	40 U (03/28/2013)	none	07/15/2013	3.36 (± 0.186)
LR15	2014-2015				197.4	3 replicates	Probes/DS127	09/10/2014	40 U	40 U (02/27/2015)	none	none	07/01/2015	3.21 (± 0.336)
LR16	2015-2016				197.4	2 replicates	Probes	09/09/2015	70 U	70 U (02/29/2016)	none	none	07/11/2016	3.27 (± 0.428)
Md11	2010-2011	Mondonville	43.7825	1.341389	122.1	2 replicates	Probes	09/08/2010	120 U	40 U (02/16/2011)	80 U (03/10/2011)	none	06/09/2011	2.92 (± 0.276)
Md14	2013-2014				122.1	2 replicates	Probes	09/19/2013	190 U	50 U (02/25/2014)	70 U (03/14/2014)	70 U (04/02/2014)	06/19/2014	2.70 (± 0.656)
Md15	2014-2015				122.1	2 replicates	Probes/DS127	09/02/2014	120 U	120 U (03/10/2015)	none	none	06/27/2015	2.92 (± 0.436)
Pre14	2013-2014	Prémesques	50.66556	2.926667	153.6	2 replicates	Probes/DS127	09/05/2013	170 U	50 U (03/07/2014)	120 U (03/31/2014)	none	08/01/2014	2.44 (± 0.292)
Pre15	2014-2015				153.6	2 replicates	Probes/DS127	09/10/2014	175 U	75 U (03/27/2015)	100 U (04/15/2015)	none	07/23/2015	4.02 (± 0.315)
Pre16	2015-2016				153.6	3 replicates	Probes	09/10/2015	160 U	60 U (03/11/2016)	100 U (04/01/2016)	none	07/27/2016	3.73 (± 0.443)
Sel14	2013-2014	Selommes	47.44324	1.14943	138.9	2 replicates	Probes/DS127	09/04/2013	160 U	50 U (02/27/2014)	50 U (03/07/2014)	60 U (03/15/2014)	07/17/2014	3.44 (± 0.411)
Sel15	2014-2015				138.9	2 replicates	Probes/DS127	09/09/2014	160 U	80 U (02/17/2015)	50 U (02/27/2015)	30 U (03/12/2015)	07/06/2015	2.74 (± 0.483)
Ver14	2013-2014	Verpillères	49.663611	2.834444	189.6	2 replicates	Probes/DS127	09/04/2013	90 U	40 U (02/27/2014)	50 U (03/13/2014)	none	07/18/2014	3.57 (± 0.231)
Ver15	2014-2015				189.6	2 replicates	Probes/DS127	09/02/2014	130 U	50 U (02/20/2015)	80 U (03/13/2015)	none	07/27/2015	3.60 (± 0.11)
Yeb15	2014-2015	Yèbles	48.62417	2.7641667	197.4	2 replicates	Probes/DS127	09/03/2014	150 U	90 U (02/12/2015)	60 U (03/09/2015)	none	07/19/2015	3.78 (± 0.147)

NA, not available.

All the dates are given as MM/DD/YYYY.

¹Maximal Water soil content defined according to the soil texture and without consideration of the density accordind to Bruand et al [25]

²All the trials were designed as randomized complete block design.

³Genotypes used in the present study consisted of a set of two probe genotypes (namely Aviso and Montego - trialed in 20 environments) or a set of 127 winter oilseed rape genotypes (DS127 - trialed in 11 environments). All the genotypes are describes in Table S2.

⁴Seed yield is given as the mean seed yield values from the two probe genotypes.

Table S2. Description of the D5127 diversity set of winter oilseed rape

ACCESSION NAME	TYPE
Alsace 1360	++
Askari	++
Blagodatnyi	++
Cetmeki	++
Debruder Dippes	++
Fertodi Elit	++
Gaspard	++
Gesunder	++
Goldgelber Zarter Butter	++
Hochzucht Repole	++
Kormovoi Skrivskiyi	++
Lembke B	++
Lembke R	++
Major	++
Mansholts	++
Markus	++
Matador	++
Moldavia	++
Nain de Hambourg	++
Oleski	++
Olquell Gulzover	++
Orleans	++
Polux	++
Prerouska	++
Quedlinburger Platzfester	++
Rangi	++
Rapol	++
Regal2	++
Sarepta	++
Titus	++
Tonus	++
Aztec	0+
Belinda	0+
Beryl	0+
Bienvenu	0+
Brink	0+
Constable	0+
Doral	0+
Emil	0+
Jupiter	0+
Kurander	0+
Lesira	0+
Mikado	0+
Rafal	0+
Ramses	0+
Valdor	0+
Zeruca	+0
Adriana	00
Akamar	00
Alesi	00
Aligator	00
Amber	00
Ariana	00
Astrid	00
Atlantic	00
Aurum	00
Aviso	00
Bellini	00
Bolko	00
Boston	00
Campala	00
Canberra	00
Cancan	00
Capitol	00
Capricorn	00
Capvert	00
Ceres	00
Chelsi	00
Cheops	00
Colvert	00
Contact	00
Courage	00
Darmor	00
Doublol	00
Ecrin	00
Eleonore	00
Escort	00
Evri	00
Expander	00
Express	00
Frederic	00
Goeland	00
Ibex	00
Idol	00
Inca	00
Jetton	00
Kadore	00
Kosto	00
Lewis	00
Liberator	00
Licorne	00
Lioness	00
Liporta	00
Lirabon	00
Lirajet	00
Madora2	00
Madora3	00
Madrigal	00
Makila	00
Mar	00
Milena	00
Mohican	00
Montego	00
Navajo	00
NSL 96-25	00
Oase	00
Olymp	00
Pacific	00
Payrol	00
Pollen	00
Potomac	00
Prince	00
Recital	00
Remy	00
Rocket	00
Roxet	00
Sahara	00
Salomont	00
Shogun	00
Start	00
SW Gospel	00
Tarox	00
Tenor	00
Tor	00
Tradition	00
Twister	00
Zorro	00

The accession type (++, +0, 0+ or 00) is indicated with:
++, varieties rich in erucic acid (C22:1) and glucosinolates (GSL)
+0, varieties rich in C22:1 and poor in GSL
0+, varieties poor in C22:1 and rich in GSL
00, varieties poor in C22:1 and in GSL

		F										CW										B										FLO										P300										P600										P1000									
		WSC_MAX	VERN_OPT	TMIN	TMAX	TMN	FR	HT	LT	GGDD	WD	WS	WSC_MN	SSR	LSR	TMIN	TMAX	TMN	FR	LT	GGDD	WSC_MN	SSR	LSR	TMIN	TMAX	TMN	FR	LT	GGDD	WSC_MN	SSR	LSR	TMIN	TMAX	TMN	LT	GGDD	WSC_MN	SSR	QPT	SR	TMIN	TMAX	TMN	HT	LT	WS	WSC_MN	SSR	LSR	TMIN	TMAX	TMN	HT	WD	WS	WSC_MN	SSR	LSR	TMIN	TMAX	TMN	HT	WD	WS	WSC_MN	SSR	LSR		
		-0.02	0.06	-0.24	-0.40	-0.06	-0.44	0.10	0.22	-0.52	0.33	-0.17	-0.03	0.44	0.08	-0.19	0.04	-0.14	-0.05	-0.02	0.00	-0.10	-0.09	0.13	-0.24	-0.35	0.07	-0.18	-0.25	0.12	-0.51	-0.13	-0.21	-0.11	-0.42	0.39	-0.42	0.41	-0.09	0.36	0.27	-0.47	-0.03	-0.39	-0.30	LT	WS	WSC_MN	SSR	LSR	0.14	-0.44	-0.11	-0.43	-0.36	-0.49	-0.34	0.48	0.08	0.45	-0.33	0.10	-0.55	-0.56	-0.34	-0.28	0.36	0.40	0.53		
F	VERN_OPT	-	-	0.12	-0.13	-0.12	0.09	-0.36	-0.24	-0.51	-0.25	-0.35	0.15	-0.38	-0.22	-0.09	-0.06	-0.19	0.47	0.72	0.51	0.33	0.40	0.67	-0.28	0.35	-0.15	0.30	-0.07	-0.19	0.18	0.06	-0.22	0.15	0.27	0.25	-0.53	0.26	0.02	-0.01	-0.28	0.08	0.27	0.34	0.16	0.44	-0.30	0.04	-0.06	0.33	-0.44	0.06	0.41	0.19	0.26	-0.02	0.36	-0.27	0.09	-0.25	-0.47	0.26	0.16	0.27	0.06	0.39	-0.27	0.16	-0.28		
	TMIN	-	-	-	0.09	0.64	-0.82	0.06	-0.81	-0.08	-0.21	0.33	-0.60	0.00	-0.53	0.21	-0.01	0.34	-0.03	0.41	0.39	-0.18	0.17	0.29	0.38	0.03	0.33	-0.17	0.11	0.09	-0.08	0.17	0.02	0.13	-0.06	0.12	0.03	0.12	-0.44	0.22	0.06	-0.22	0.37	-0.12	0.15	-0.27	0.13	0.16	-0.32	0.26	-0.51	0.03	0.06	-0.04	-0.11	0.17	0.38	-0.43	0.26	-0.08	0.01	0.37	0.14	0.05	0.37	0.43	-0.52	-0.01	-0.16		
	TMAX	-	-	-	-	0.54	-0.11	0.38	-0.35	-0.31	0.36	0.28	-0.32	-0.13	-0.52	0.18	-0.03	0.24	-0.06	-0.02	0.00	-0.32	0.04	0.37	0.11	0.26	-0.16	0.38	0.45	-0.17	0.29	0.37	-0.05	0.13	0.24	0.08	0.25	-0.62	0.16	-0.10	-0.24	0.19	-0.43	-0.16	-0.33	-0.15	0.52	-0.47	-0.23	0.21	-0.11	-0.13	0.14	0.36	-0.43	0.50	-0.51	-0.08	-0.08	0.05	0.00	0.21	0.25	-0.46	0.44	-0.36					
	TMN	-	-	**	*	-	-0.70	0.61	-0.79	-0.05	0.41	0.34	-0.69	0.25	-0.80	0.14	0.17	0.47	-0.05	0.17	0.27	-0.42	0.19	0.13	0.52	-0.14	0.39	-0.21	0.22	0.32	-0.15	0.37	0.19	0.02	0.14	0.41	-0.09	0.41	-0.69	0.44	0.02	-0.48	0.47	-0.24	0.39	-0.31	-0.25	0.59	-0.68	-0.14	-0.39	0.08	-0.14	-0.02	-0.06	0.47	0.51	-0.74	0.48	-0.47	0.15	0.37	0.30	0.64	0.41	-0.74	0.41	-0.51			
	NBDR	-	-	***	-	***	-	-0.14	0.82	-0.02	0.18	-0.28	0.58	-0.06	0.48	-0.18	0.14	-0.58	0.26	-0.11	-0.22	0.18	0.07	-0.03	-0.53	0.29	-0.13	0.09	-0.25	-0.23	0.10	-0.20	-0.21	0.06	0.13	-0.05	-0.13	-0.05	-0.54	-0.30	-0.24	0.35	-0.26	0.21	-0.24	0.32	0.07	-0.22	0.43	-0.09	0.38	0.11	0.20	0.14	0.27	-0.19	-0.29	0.39	-0.12												

Indicators are grouped by periods, Fall (F); Climatic Winter (CW); Bolting (B); Flowering (FLO); P300; P600 and P1000

***, $p < 0.001$; **, $p < 0.01$; *, $p < 0.05$; -, not-significant