

Supplementary materials

Table S1. Climatic conditions during summer and winter trials. Sum of rainfall (mm), minimum (Tmin), mean (Tmean) and maximum temperatures (Tmax) were averaged for each trial.

Trials	Duration (days)	Rainfall (mm month⁻¹)	Tmin (°C)	Tmean (°C)	Tmax (°C)
Summer	109	147	22,0	25,6	30,2
Winter	106	33	16,5	20,1	25,2

Table S2. Main soil characteristics measured in the site (same site for both trials) in two soil layers.

	pH	Organic C	Organic N	C/N	P	K	Ca	Mg	Na	CEC
Units		g kg ⁻¹	g kg ⁻¹	cmol kg ⁻¹	mg kg ⁻¹	cmol kg ⁻¹	cmol kg ⁻¹	cmol kg ⁻¹	cmol kg ⁻¹	cmol kg ⁻¹
0-15 cm	6.53	19.08	1.83	10.42	56.51	1.53	6.06	3.62	0.18	13.06
15-30 cm	6.46	19.08	1.76	10.84	44.08	1.26	5.82	3.79	0.14	12.42

Table S3. Dominant weed flora in the in the two trials (Summer and Winter). The weed species frequency was calculated with the number of observations per plot and date of measurements.

Family	Species	EPO	Frequency (%)	
			Summer	Winter
Amaranthaceae	<i>Amaranthus viridis.</i>	AMAVI	48	0
Asteraceae	<i>Bidens pilosa</i>	BIDPI	21	86
Poaceae	<i>Urochloa eminii</i>	BRARU	2	1
Sapindaceae	<i>Cardiospermum microcarpum</i>	CRIMI	16	6
Cyperaceae	<i>Cyperus rotundus</i>	CYPRO	14	2
Euphorbiaceae	<i>Euphorbia heterophylla</i>	EPHHL	31	2
Convolvulaceae	<i>Ipomoea eriocarpa</i>	IPOER	3	0
Convolvulaceae	<i>Ipomoea obscura</i>	IPOOB	12	0
Solanaceae	<i>Nicandra physalodes</i>	NICPH	37	87
Plantaginaceae	<i>Plantago lanceolata</i>	PLALA	0	21
Malvaceae	<i>Sida spinosa</i>	SIDSP	5	0

Table S4. Cover crop sowing density depending on plot and number of species (sp.). The species identification is indicated in Table 1.

Trial	Plot	Treatment	Species				Sowing density (kg ha ⁻¹)			
Summer	1	1 sp.	Ga				20			
	2		Vr				10			
	3		Ce				50			
	4		Pg				20			
	5	2 sp.	Ga	Ce			10	25		
	6		Ga	Pg			10	10		
	7		Vr	Ce			5	25		
	8		Vr	Pg			5	10		
	9	3 sp.	Ga	Vr	Ce		6.7	3.3	16.7	
	10		Ga	Vr	Pg		6.7	3.3	6.7	
	11		Ga	Ce	Pg		6.7	16.7	6.7	
	12		Vr	Ce	Pg		3.3	16.7	6.7	
	13	4 sp.	Vr	Ce	Pg	Ga	2.5	12.5	5	5
Winter	1	1 sp.	As				90			
	2		Bc				10			
	3		Ga				20			
	4		Vv				60			
	5	2 sp.	As	Ga			45	10		
	6		As	Vv			45	30		
	7		Bc	Ga			5	10		
	8		Bc	Vv			5	30		
	9	3 sp.	As	Bc	Ga		30	3.3	6.7	
	10		As	Bc	Vv		30	3.3	20	
	11		As	Ga	Vv		30	6.7	20	
	12		Bc	Ga	Vv		3.3	6.7	20	
	13	4 sp.	As	Bc	Ga	Vv	22.5	2.5	5	15

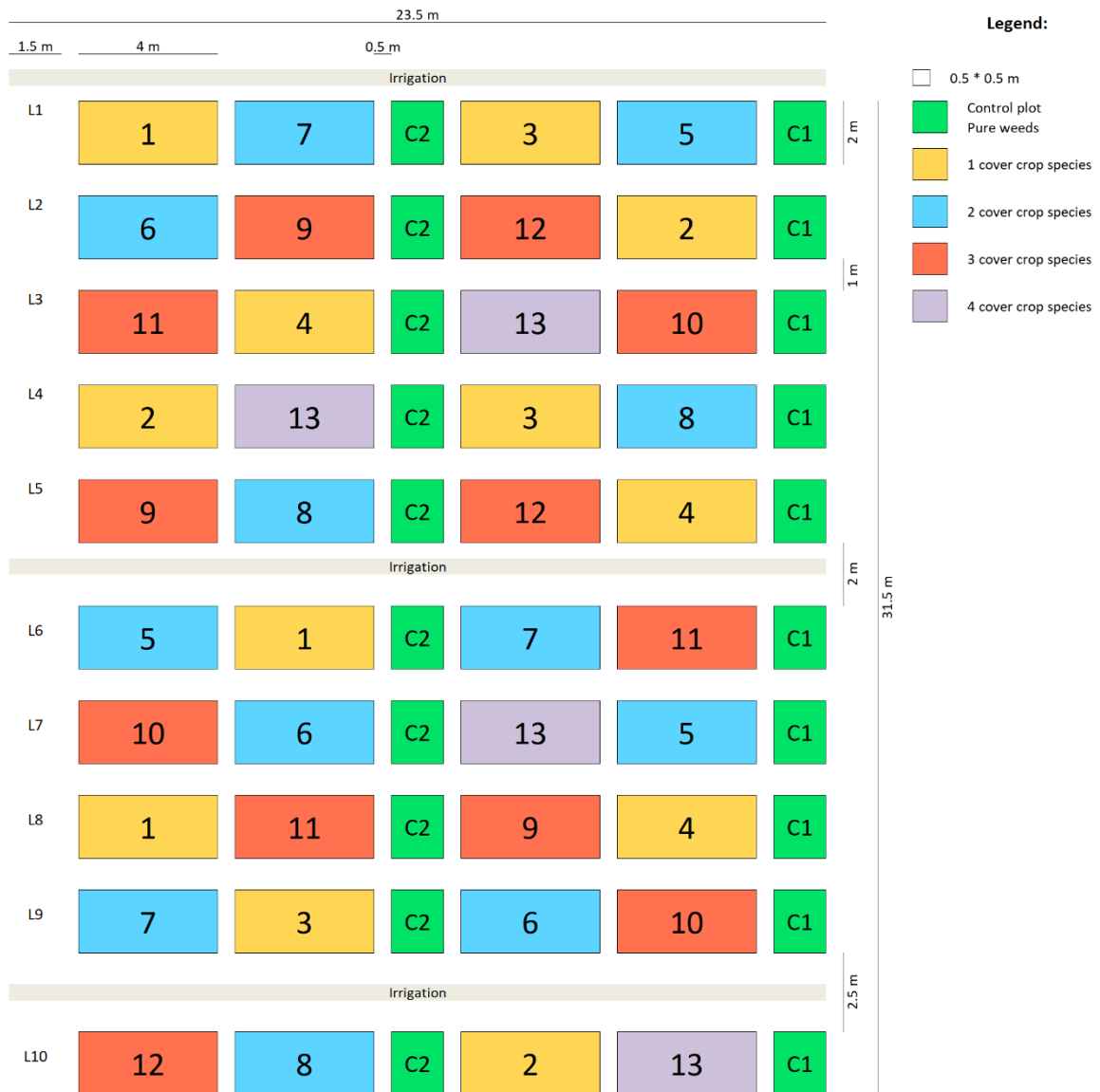


Figure S1. Experimental design in both summer and winter trials. Plot identification (1-13) is described in Table 3. C1 & C2 indicated control plot.

Table S5. Notation method used to assess ground cover by plants (weeds or cover crops). The choice of notation was made by following a multi-step decision tree. At each step, the decision has to be taken if we estimate it to be above or below a value (e.g. 50% cover in the first step, at least one individual per m² in the second step, etc).

Notation	Equivalence in percentage	coverage
1	1	Species present but rare
2	7	Less than one individual per m ²
3	15	At least one individual per m ²
4	30	30 % of coverage
5	50	50 % of coverage
6	70	70 % of coverage
7	85	High coverage
8	93	Very little apparent soil
9	100	Full coverage

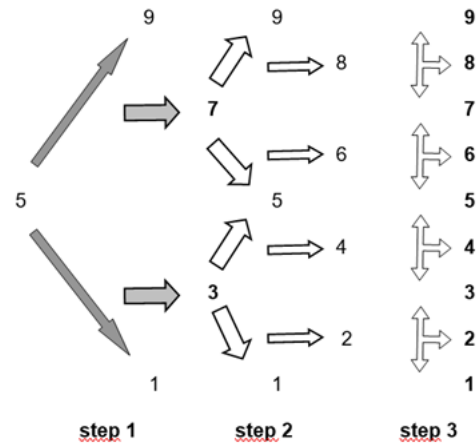


Table S6. Mixt linear variance analysis on ground cover by weeds with the presence or absence of cover crop (pres vs. abs CC), the number of days after sowing (DAS) and their interaction as fixed effect and the plot identification as random effect, in the summer and winter trial. F statistics and p.value are provided.

	Trial	DAS	Pres vs. abs CC	CC x DAS
Ground cover by weeds	Summer	F _{10,580} =161.3 ; p<0.0001	F _{1,58} =66.1 ; p<0.0001	F _{10,580} =31.4 ; p<0.0001
	Winter	F _{8,544} =554.6; p<0.0001	F _{1,68} =30.1 ; p<0.0001	F _{8,544} =35.4 ; p<0.0001

Table S7. Linear variance analysis on WCE_{COV}, WCE_{ADM}, ADM, COV_{RATE}, LAI and LMF response to the number of cover crop species in the summer and winter trial. F statistics and p value are provided.

	Number of cover crop species	
	Summer	Winter
WCE _{COV}	F _{3,36} =0.89 ; p=0.45	F _{3,36} =1.70 ; p=0.18
WCE _{ADM}	F _{3,36} =0.91 ; p=0.45	F _{3,36} =0.86 ; p=0.47
ADM	F _{3,36} =1.40 ; p=0.26	F _{3,36} =2.69 ; p=0.06
COV _{RATE}	F _{3,36} =1.23 ; p=0.35	F _{3,36} =0.56 ; p=0.64
LAI	F _{3,36} =1.72 ; p=0.18	F _{3,36} =2.57 ; p=0.07
LMF	F _{3,36} =0.49 ; p=0.69	F _{3,36} =0.67 ; p=0.58

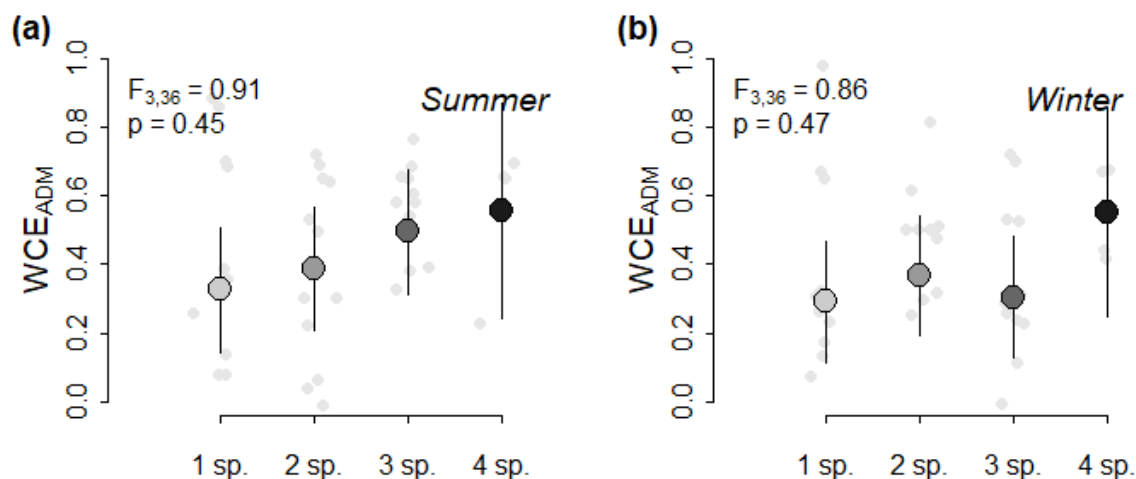


Figure S2. Weed control efficiency in terms of weed dry mass (WCE_{ADM}) depending on the number of cover crop species (sp.) in the mixture. WCE_{ADM} are presented in the summer (a) and winter (b) trials. Small points represented observed values. Mean (big points), and 95% confidence intervals (bars) predicted by the linear analysis of variance are represented. F statistics, degree of freedom, and p value were indicated.

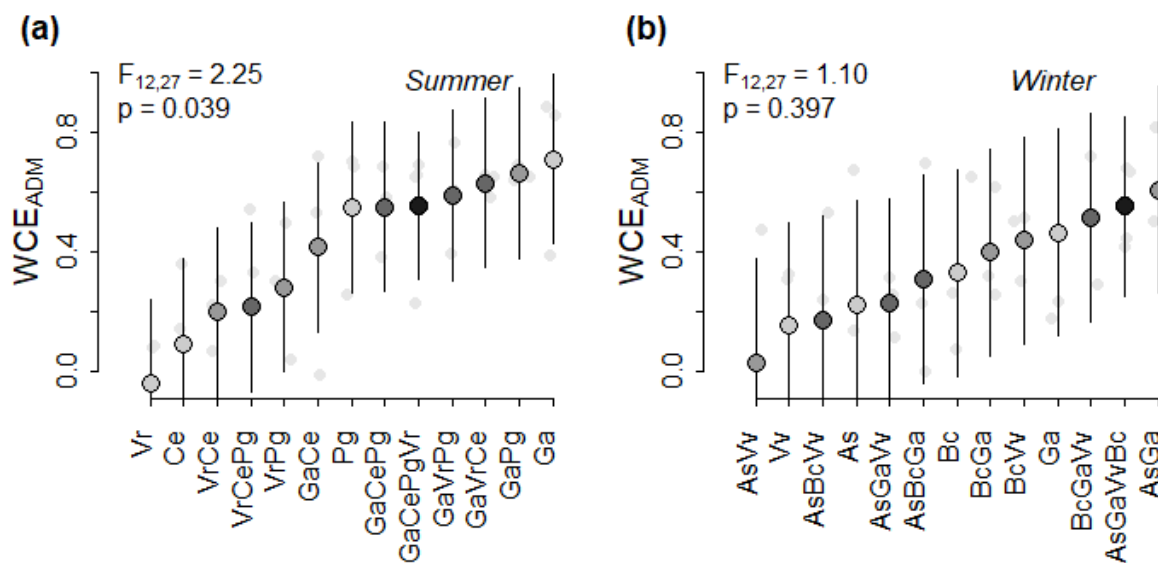


Figure S3. Weed control efficiency in terms of weed dry mass (WCE_{ADM}) depending on cover crop mixture. WCE_{ADM} are presented in the summer (a) and winter trials (b). Small points represented observed values. Mean (big points), and 95% confidence intervals (bars) predicted by the linear analysis of variance are represented. F statistics, degree of freedom, and p value were indicated.

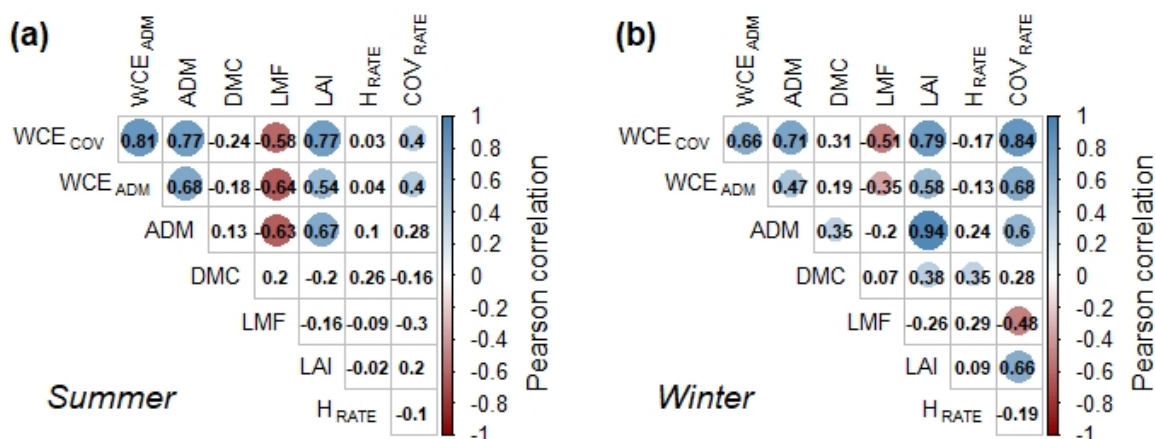


Figure S4. Pearson correlation between cover crop traits and weed control efficiency indices in the summer (a) and winter (b) trials. Significant positive and negative correlations were presented with blue and red circle, respectively. No p value adjustment methods were applied for multiple comparisons.

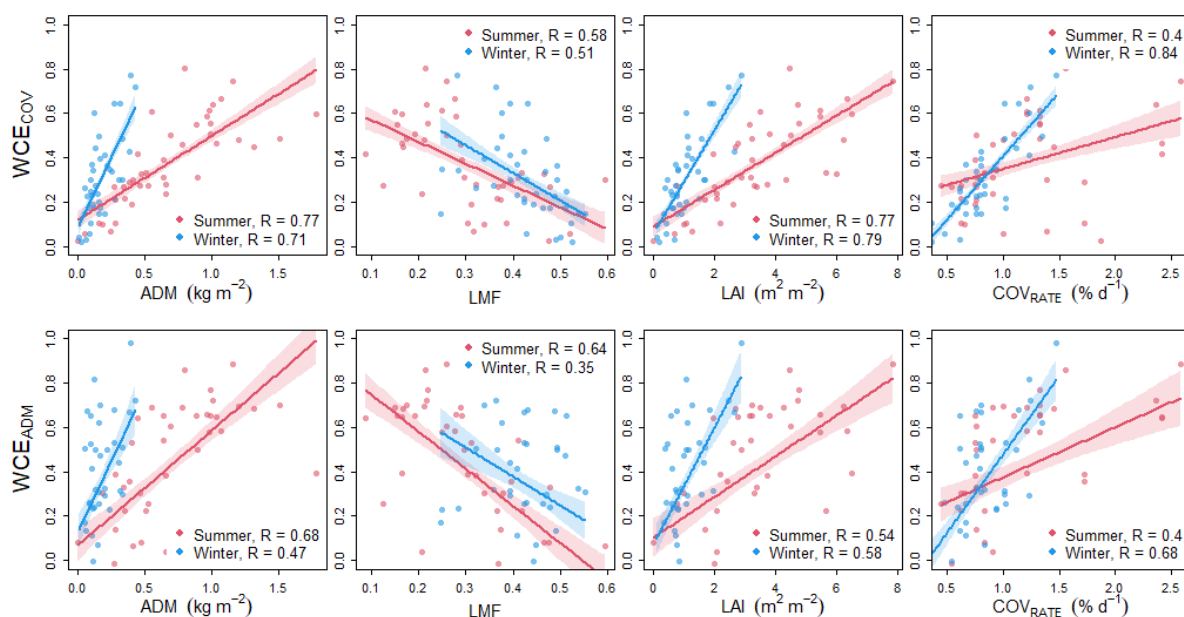


Figure S5. Relation between weed control efficiency in terms of ground cover (WCE_{COV}) and dry mass (WCE_{ADM}) and cover crop traits: aboveground dry mass (ADM), leaf to aboveground mass ratio (LMF), leaf area index (LAI) and growth rate in coverage (COV_{RATE}). Linear regression and Pearson correlation (R) are indicated for summer (red) and winter (blue) trials. Shaded areas represent the confidence interval of linear regressions.

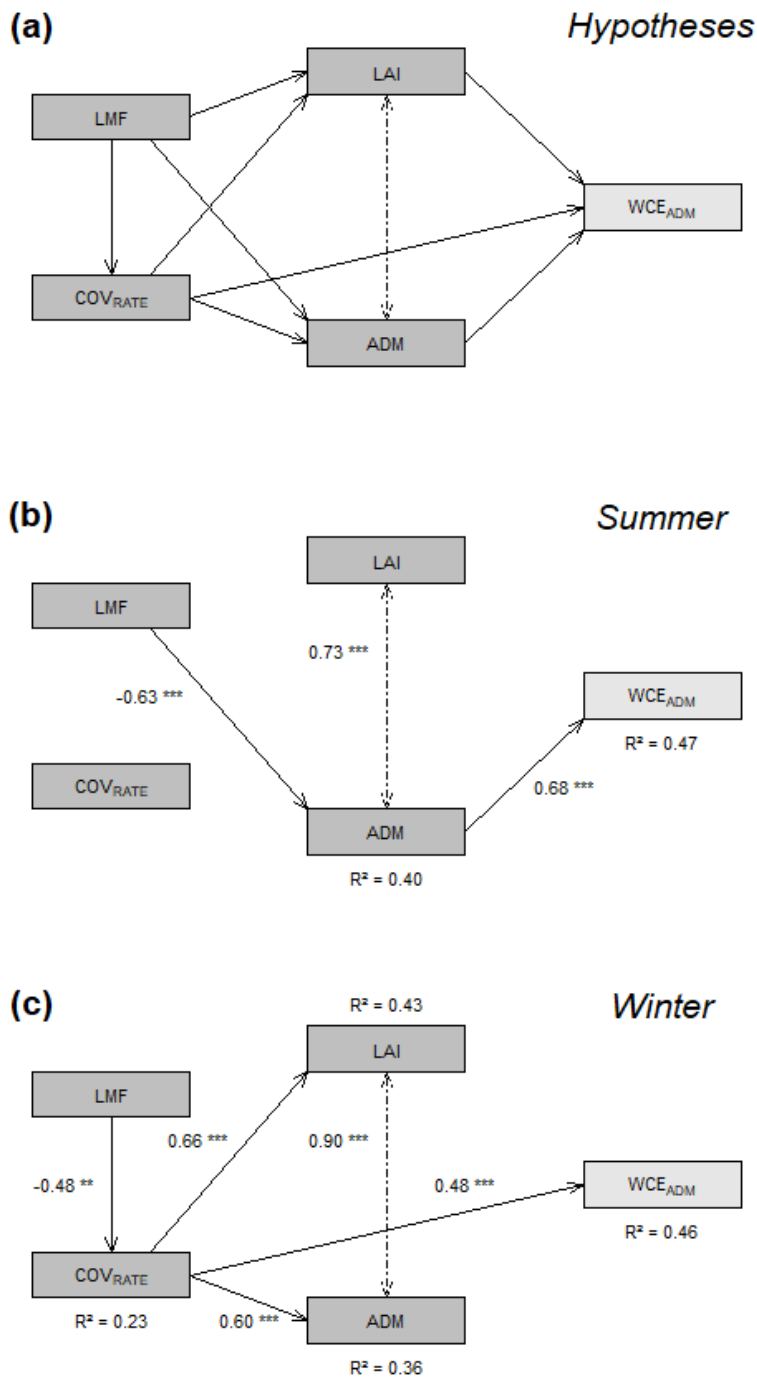


Figure S6. Structural equation model showing direct and indirect effects of cover crop traits on weed control efficiency in weed dry mass (WCE_{ADM}). Arrows in (a) represents the hypothesized structural equation with variables: crop rate of increase in ground cover (COV_{RATE} , % d^{-1}), leaf area index (LAI , $m^2 m^{-2}$), aboveground dry mass (ADM , $kg m^{-2}$) and leaf to aboveground mass fraction (LMF). The dashed arrow between LAI and ADM represents the correlation between these two variables without causal relationship. The arrows in (b) and (c) represent the significant result of the analysis using R package piecewiseSEM in summer and winter, respectively. The asterisks relate the significance levels of the coefficients ($* < 0.05$, $** < 0.01$, $*** < 0.0001$) and R^2 per predicted variables are given. The model standardized estimates were given to compare the relative strengths of predictors.

Table S8. Mean cover crop trait within the mixture depending on cover crop treatment (number of species, sp.).

Trial	Treatment	ADM (kg m ⁻²)	COV _{RATE} (% d ⁻¹)	LAI (m ² m ⁻²)	LMF
Summer	1 sp.	0.58 (± 0.50)	1.39 (± 0.58)	2.78 (± 2.30)	0.32 (± 0.13)
	2 sp.	0.56 (± 0.26)	1.15 (± 0.64)	3.11 (± 1.32)	0.29 (± 0.14)
	3 sp.	0.81 (± 0.41)	0.99 (± 0.27)	4.32 (± 1.53)	0.30 (± 0.09)
	4 sp.	0.90 (± 0.38)	1.28 (± 0.78)	3.72 (± 1.82)	0.23 (± 0.09)
Winter	1 sp.	0.13 (± 0.10)	0.72 (± 0.31)	0.81 (± 0.69)	0.44 (± 0.11)
	2 sp.	0.15 (± 0.10)	0.84 (± 0.34)	0.91 (± 0.49)	0.44 (± 0.07)
	3 sp.	0.21 (± 0.10)	0.85 (± 0.23)	1.21 (± 0.58)	0.40 (± 0.06)
	4 sp.	0.27 (± 0.12)	0.85 (± 0.20)	1.70 (± 0.83)	0.41 (± 0.02)

Table S9. Cover crop mean traits depending on cover crop treatment (number of species, sp.) and mixture.

Trial	Treatment	Mixture	ADM (kg m ⁻²)	COV _{RATE} (%) d ⁻¹)	LAI (m ² m ⁻²)	LMF
Summer	1 sp.	Ce	0.30 (± 0.07)	1.29 (± 0.49)	1.80 (± 0.59)	0.36 (± 0.04)
		Ga	0.74 (± 0.44)	1.96 (± 0.55)	4.83 (± 2.82)	0.26 (± 0.05)
		Pg	1.12 (± 0.52)	1.08 (± 0.55)	2.24 (± 1.27)	0.16 (± 0.03)
		Vr	0.17 (± 0.26)	1.24 (± 0.56)	2.25 (± 3.27)	0.49 (± 0.03)
	2 sp.	Ga + Ce	0.56 (± 0.39)	0.96 (± 0.93)	3.12 (± 1.43)	0.30 (± 0.08)
		Ga + Pg	0.63 (± 0.23)	1.33 (± 0.16)	2.87 (± 0.81)	0.13 (± 0.04)
		Vr + Ce	0.37 (± 0.17)	0.82 (± 0.34)	3.67 (± 2.38)	0.45 (± 0.13)
		Vr + Pg	0.67 (± 0.22)	0.68 (± 0.14)	2.77 (± 0.63)	0.29 (± 0.09)
	3 sp.	Ga + Ce + Pg	0.81 (± 0.17)	0.75 (± 0.19)	4.48 (± 0.88)	0.29 (± 0.04)
		Ga + Vr + Ce	0.89 (± 0.22)	0.85 (± 0.19)	5.01 (± 1.61)	0.28 (± 0.01)
		Ga + Vr + Pg	1.16 (± 0.56)	0.99 (± 0.28)	5.24 (± 1.09)	0.21 (± 0.05)
		Vr + Ce + Pg	0.38 (± 0.24)	0.46 (± 0.09)	2.55 (± 1.27)	0.42 (± 0.05)
4 sp.	Ga + Vr + Ce + Pg	0.90 (± 0.38)	0.87 (± 0.41)	3.72 (± 1.82)	0.23 (± 0.09)	
Winter	1 sp.	As	0.05 (± 0.03)	0.56 (± 0.23)	0.54 (± 0.37)	0.49 (± 0.01)
		Bc	0.11 (± 0.03)	0.64 (± 0.18)	0.60 (± 0.16)	0.46 (± 0.04)
		Ga	0.19 (± 0.18)	1.03 (± 0.41)	1.35 (± 1.34)	0.27 (± 0.02)
		Vv	0.15 (± 0.05)	0.64 (± 0.25)	0.72 (± 0.25)	0.54 (± 0.01)
	2 sp.	As + Ga	0.10 (± 0.04)	0.77 (± 0.19)	0.89 (± 0.41)	0.35 (± 0.03)
		As + Vv	0.07 (± 0.08)	0.36 (± 0.22)	0.47 (± 0.47)	0.52 (± 0.01)
		Bc + Ga	0.13 (± 0.03)	0.74 (± 0.30)	0.84 (± 0.27)	0.40 (± 0.06)
		Bc + Vv	0.30 (± 0.06)	0.75 (± 0.10)	1.46 (± 0.32)	0.48 (± 0.01)
	3 sp.	As + Bc + Ga	0.17 (± 0.06)	0.51 (± 0.13)	0.99 (± 0.26)	0.34 (± 0.10)
		As + Bc + Vv	0.22 (± 0.08)	0.52 (± 0.11)	1.22 (± 0.49)	0.46 (± 0.03)
		As + Ga + Vv	0.19 (± 0.11)	0.61 (± 0.25)	1.27 (± 0.64)	0.41 (± 0.02)
		Bc + Ga + Vv	0.25 (± 0.17)	0.72 (± 0.22)	1.35 (± 1.02)	0.40 (± 0.03)
4 sp.	As + Bc + Ga + Vv	0.27 (± 0.12)	0.55 (± 0.19)	1.70 (± 0.83)	0.41 (± 0.02)	

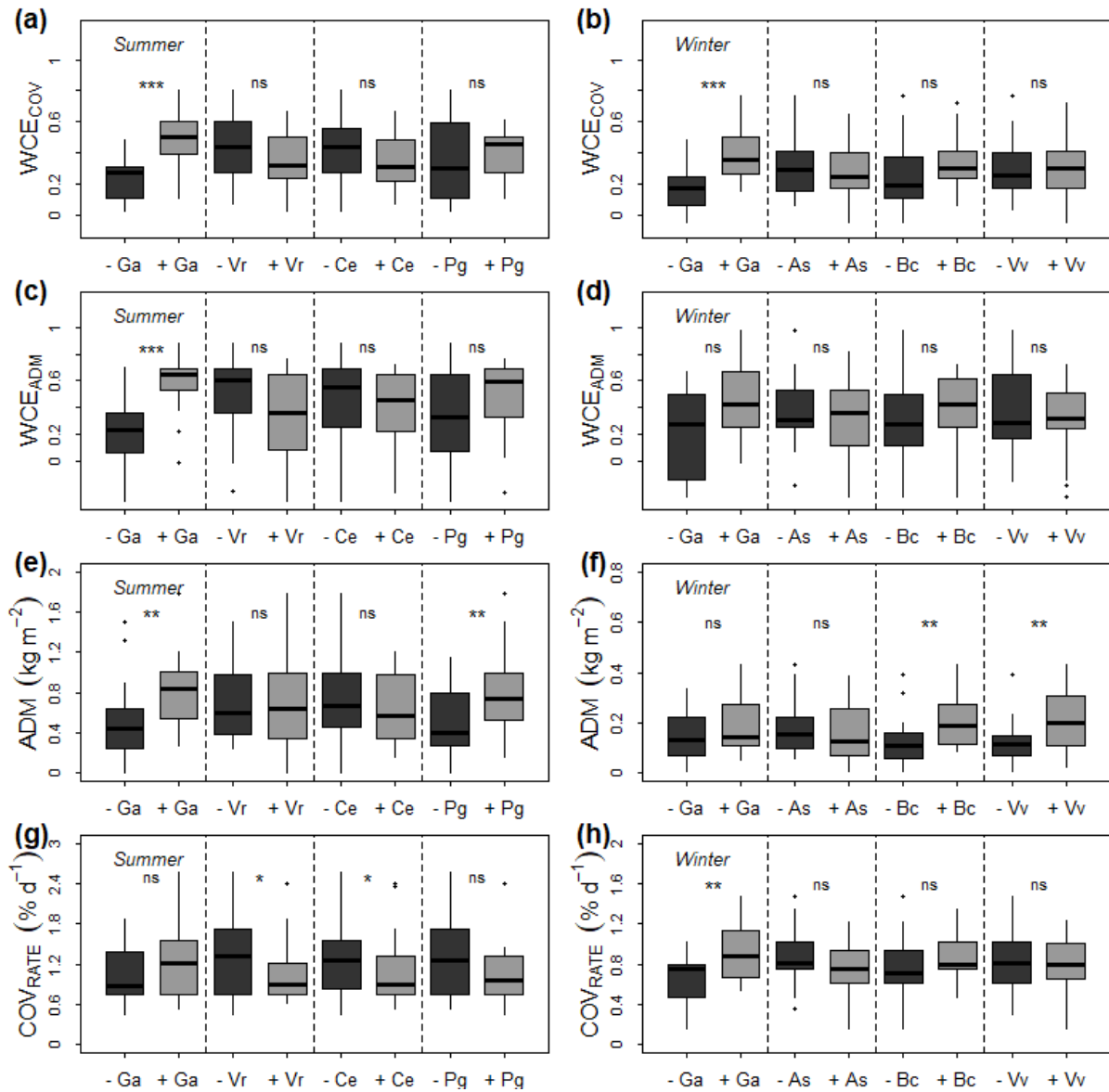


Figure S7. Weed control efficiency in terms of weed cover (WCE_{COV} , a-b) and weed dry mass (WCE_{ADM} , c-d), cover crop aboveground dry mass (ADM , e-f) and rate of increase in ground cover (COV_{RATE} , g-h) depending of the absence (“-”) or presence (“+”) on each crop species in the crop mixture during the summer and winter trials. Differences were tested using a non-parametric Wilcoxon test and indicated by “*”, “**” and “***” when p value was lower than 0.05, 0.01 and 0.001 respectively or “ns” when non-significant.