

## S1. Supplementary material to materials and methods

Table S1.1. Soil chemical and physical properties in the four experiments. Total carbon (C), mineral nitrogen (N), phosphorus (P) and potassium (K) are reported in mg kg<sup>-1</sup> dried soil\*. Clay, silt and sand content are reported in % of air dried soil

Experiment	Depth	Total C	N	P	K	pH**	Clay	Silt	Sand
SK1	0-30	0.11	4.5	68	110	6.9	21	32	47
	30-60	0.04	6.3	17	110	7.7	31	30	39
	60-100			46	91		24	33	43
SK2	0-30	0.15	2.8	52	98	7.0	29	42	29
	30-60	0.03	1.6	44	120	7.8	43	41	16
	60-100			86	120		48	40	12
OG1	0-30	0.17	6	67	150	7.1	34	56	10
	30-60	0.05	10	110	73	7.4	31	61	8
	60-100		4.6***	160	160		72	27	1
OG2	0-30	0.25	-	36	130	6.8	41	49	10
	30-60	0.07	-	80	140	7.23	69	29	2
	60-100		-	170	110		49	31	20

\*N was extracted with 2 M KCl and determined on a FIAstar 5000 Analyzer (Foss Tecator, Hilleröd, Denmark) and P and K was measured with the ammonium lactate extraction method, and analysed with ICP/OES (Avio200, Perkin Elmer, USA)

\*\*analysed with MeterLab®, Radiometer Analytical SAS, Lyon, France

\*\*\*taken from 60-90 cm.

Table S1.2. Sowing densities of the different legume species in the three mixtures tested

Mixture	Legume species (variety)	Sowing density kg ha <sup>-1</sup>	
		SK	OG
Summer annuals	<i>Trifolium squarrosum</i> (?)	10.3	10.3
	<i>T. resupinatum</i> (Maral)	3.7	3.7
Perennials	<i>T. repens</i> (Klondike)	1.2	0.7
	<i>T. pratense</i> (Taifun)	3.5	2
	<i>Medicago lupulina</i> (Virgo Pajberg)	2.8	1.6
Winter annuals	<i>T. incarnatum</i> (Kardinal)	-	9.5
	<i>Vicia villosa</i> (Villana)	-	15

Table S1.3. Timing and details on field operations, in chronological order, in the four experiments. Abbreviations: SK and OG stands for the two experimental regions, 1 = starting 2017, 2 = starting 2018

Field operation	SK1	SK2	OG1	OG2
Soil cultivation	2017-04-27	2018-04-03	2017-05-02	2017-05-08
Fertiliser*, oats	2017-04-22	2018-04-03	2017-04-05	2018-05-18
	80 kg N ha <sup>-1</sup> (Biofer) 10-3-1 (% N, P and K)	130 kg N ha <sup>-1</sup> chicken manure	60 kg N ha <sup>-1</sup> (Ekoväx) 8-3-5-3 (% N, P, K and S)	60 kg N ha <sup>-1</sup> (Ekoväx) 8-3-5-3 (% N, P, K and S)
Roller	-	2018-04-10	2017-05-07	2017-05-21
Sowing, oats	2017-04-28	2018-04-14	2017-05-05	2018-05-21
Sowing density, cultivar	160 kg ha <sup>-1</sup> , Nike	180 kg ha <sup>-1</sup> , Haga	131 kg ha <sup>-1</sup> , Galant (SW 051020)	200 kg ha <sup>-1</sup> , Galant (SW 051020)
Sowing, SC in oat rows	2017-04-28	2018-04-14	2017-05-05	2018-05-21
Sowing, SC between and adjacent to oat rows	2017-06-02	2018-05-23	2017-06-19	2018-06-02
Row hoeing 1	2017-06-02	2018-05-23	2017-06-19	2018-06-02
Row hoeing 2	2017-06-27	..**	2017-07-07	2018-06-29
Harvest, oats	2017-09-03	2018-07-26	2017-08-24	2018-08-21
Straw removal	2017-09-06	-	2017-08-26	-
Mowing of SC	2017-09-25	2018-09-16	-	Just before harvest
Sowing, winter wheat, row hoeing 3	2017-09-28	2018-09-17	***	2018-09-21
	220 kg ha <sup>-1</sup> , Stava	220 kg ha <sup>-1</sup> , Stava		221 kg ha <sup>-1</sup> , Stava
Sowing density, cultivar				
Mechanical termination of SC, row hoeing 4	2018-05-09	2019-04-15		2019-04-30
Fertiliser, winter wheat	2018-04-28	2019-04-15		2019-04-26
	130 kg N ha <sup>-1</sup> Pig manure, liquid	70 kg N ha <sup>-1</sup> (Biofer) 10-3-1 (%N, P and K)		100 kg N ha <sup>-1</sup> Ekoväx, 8-3-5-3 (% N, P, K and S)
Row hoeing 5	..**	2019-05-07		2019-05-31
Row hoeing 6	..**	2019-05-29		-
Harvest, winter wheat	2018-07-31	2019-08-26		2019-08-26

\*Biofer: pelleted chicken manure and meat flour, Ekoväx: meat flour and yeast residues

\*\*In 2018 the second row hoeing was excluded due to high risk of affecting the main crop negatively and very few weeds.

\*\*\*In 2017 it was too wet in autumn to sow winter wheat in no-till plots, instead spring wheat was sown in 2018.

Table S1.4. Dates for collection of data in the four field experiments. Abbreviations: SK and OG stands for the two experimental regions, 1 = starting 2017, 2 = starting 2018

<b>Data collected</b>	<b>SK1</b>	<b>SK2</b>	<b>OG1</b>	<b>OG2</b>
Plant counts oats				
<i>Plants</i>	2017-05-19	2018-05-11	2017-06-01	2018-06-18
<i>Tillers</i>	2017-06-15	2018-05-30	-	2018-06-29
<i>Heads</i>	2017-07-27	2018-06-18	2017-07-25	2018-07-27
Weed and SC <sup>±</sup> counts	2017-05-22/23	2018-05-15/16	2017-06-05/06	2018-06-04/06
	2017-05-17/19 <sup>±</sup>	2018-07-25 <sup>±</sup>	2017-08-09/10 <sup>±</sup>	2018-08-08 <sup>±</sup>
Biomass harvest 1*	2017-07-17/19	2018-07-25	2017-08-09/10	2018-08-08
Oat harvest	2017-09-03	2018-07-26	2017-08-23	2018-08-21
δ <sup>15</sup> N sampling	2017-10-31	2018-10-28	2017-11-05/08	2018-10-22/23
SC soil cover	2017-10-31	2018-10-28	2017-11-05/08	2018-10-22/23
Soil mineral nitrogen				
<i>Autumn</i>	2017-11-22	2018-10-31	2017-11-08	2018-12-18
<i>Spring</i>	-	2019-04-12	-	2019-04-29
Plant counts wheat				
<i>Plants</i>	2017-10-19	2018-10-02	2018-06-05	2018-11-23
<i>Tillers</i>	2018-05-02	2019-05-02	2018-06-30	2019-05-20
<i>Heads</i>	2018-06-04	2019-07-01	2018-07-13	2019-05-20
Weed counts	2018-07-26	2019-07-29	2018-08-07/08	2019-08-05
Biomass harvest 2**	2018-07-26	2019-07-29	2018-08-07 – 2018-08-08	2019-08-05
Wheat harvest	2018-07-31	2019-08-26	10-08-2018	2019-08-26

\*Main crop, service crop and weeds

\*\*Main crop and weeds