

Supplementary materials

Table S1: The 16 treatments in the OSCAR experiment (Osinaike, [37])

Treatment	Tillage	CC Cover crop / 1m Living mulch	Organic amendment
	Factor I	Factor II	Factor III
1	Plowing	Oilseed radish/lopsided oat (cc)	compost
2	Plowing	Oilseed radish/lopsided oat (cc)	None
3	Plowing	Summer vetch (cc)	Compost
4	Plowing	Summer vetch (cc)	None
5	Plowing	Subterranean clover (lm)	Compost
6	Plowing	Subterranean clover (lm)	None
7	Plowing	White clover (lm)	Compost
8	Plowing	White clover (lm)	None
9	Reduced tillage	Oilseed radish/lopsided oat (cc)	Compost
10	Reduced tillage	Oilseed radish/lopsided oat (cc)	None
11	Reduced tillage	Summer vetch (cc)	Compost
12	Reduced tillage	Summer vetch (cc)	None
13	Reduced tillage	Subterranean clover (lm)	Compost
14	Reduced tillage	Subterranean clover (lm)	None
15	Reduced tillage	White clover (lm)	Compost
16	Reduced tillage	White clover (lm)	none

Table S2: Soil-management practices applied in the Long-Term field trial from September 2012 to July 2020

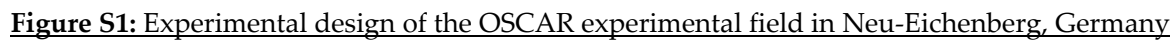
Year	Date	Crop	Field operation	Differential operation in RT
Since 2010		Clover grass		
2012	14.09.2012	Clover grass	Mulching	
2012	14.09.2012		Cultivating	
2012	17.09.2012		Cultivating	
2012	02.10.2012		Plowing	Chisel plow 5 cm
2012	04.10.2012		5 t DM ha ⁻¹ Compost application or fertilization with K and P equivalent amounts of potash sulfate and rock phosphate.	

Year	Date	Crop	Field operation	Differential operation in RT
2012	12.10.2012	W-Wheat	Sowing	
2013	25.04.2013	W-Wheat	Hoeing	
2013	06.05.2013	W-Wheat	Oversowing white clover 10 kg ha ⁻¹ with harrow half of the plots	
2013	15.08.2013	W-Wheat	Harvest	
2013	06.09.2013	Cover crop (CC)	1. ryegrass/oil radish and 2. winter vetch after shallow tillage	
2014	14.03.2014		Undercutting with chisel plow	
2014	07.04.2014		Chisel plowing	
2014	22.04.2014		Plowing	Chisel plowing 15 cm
2014	24.04.2014		10 t DM ha ⁻¹ Compost application or fertilization with K and P equivalent amounts of potash sulfate and rock phosphate.	
2014	25.04.2014		Power harrow	
2014	26.04.2014	Potatoes	Planting	
2014	12.05.2014	Potatoes	Rotary hiller	
2014	20.05.2014	Potatoes	Rotary hiller	
2014	21.05.2014	Potatoes	Harrow	
2014	22.05.2014	Potatoes	Hilling	
2014	26.05.2014	Potatoes		18 t ha ⁻¹ DM rye-pea mulch
2014	04.06.2014	Potatoes	Hilling	
2014	12.06.2014	Potatoes	Hilling	
2014	10.09.2014	Potatoes	Harvest	
2014	04.10.2014		Cultivating	
2014	16.10.2014	CC Triticale	Cultivating	
2014	21.10.2014	CC Triticale	Sowing	
2015	19.05.2015	CC Triticale	mulching	
2015	21.05.2015		Cultivating	
2015	28.05.2015		Cultivating	
2015	29.05.2015		Potash sulfate 400 kg ha ⁻¹	
2015	10.06.2015		Chisel Plow	
2015	12.06.2015		Rock phosphate 300 kg ha ⁻¹ 27 %	
2015	12.06.2015		Liming 500 kg ha ⁻¹	
2015	12.06.2015	CC Berseem clover	Sowing 29 kg ha ⁻¹	
2015	12.06.2015	CC Berseem clover	Seedbed finishing by roller	
2015	17.06.2015	CC Berseem clover	Irrigation 25 mm	

Year	Date	Crop	Field operation	Differential operation in RT
2015	03.07.2015	CC Berseem clover	Irrigation 25 mm	
2015	01.08.2015	CC Berseem clover	Mulching	
2015	26.10.2015	CC Berseem clover	Mulching	
2015	26.10.2015		Plowing (20 cm)	Cultivating
2015	27.10.2015		Liming 600 kg ha ⁻¹	
2015	27.10.2015		Cultivating	
2015	27.10.2015	Triticale	Sowing 200 kg ha ⁻¹ , 25 cm row spacing, mixture of four varieties	
2016	24.03.2016	Triticale	Hoeing	
2016	09.08.2016	Triticale	Harvest	
2016	15.08.2016		Straw swathing	
2016	17.08.2016		Straw baling and removal	
2016	30.08.2016		Cultivating, shallow	
2016	06.09.2016		Plowing 21 cm	Chisel plow 5 cm
2016	07.09.2016		Cultivating	Chisel plow 5 cm
2016	07.09.2016		Liming 500 kg ha ⁻¹	
2016	07.09.2016		Power harrow	
2016	15.09.2016	Mustard CC	Sowing	
2016	28.09.2016		Cultivating	
2016	29.09.2016		Seedbed finishing by roller	
2016	10.10.2016		Cultivating	
2016	15.10.2016		Seedbed preparation	
2016	17.10.2016	W-Wheat	Sowing, half the ploits undersown with white clover with harrow 7 kg ha ⁻¹ (failed)	
2017	29.03.2017	W-Wheat	Cambridge roller 3 m	
2017	27.04.2017	W-Wheat	Hoeing and harrow	
2017	10.05.2017	W-Wheat	White clover undersowing with harrow 7.5 kg ha ⁻¹ , half of the plots (failed)	
2017	04.08.2017	W-Wheat	Harvest	
2017	07.08.2017	W-Wheat	Straw swathing	
2017	08.08.2017	W-Wheat	Baling straw	
2017	09.08.2017	W-Wheat	Cultivating	
2017	18.09.2017		Cultivating	Cultivating
2017	22.09.2017		Plowing (15 cm)	
2017	23.09.2017			Shallow rotary hoe ca. 5 cm
2017	26.09.2017		Liming 500 kg ha ⁻¹	

Year	Date	Crop	Field operation	Differential operation in RT
2017	26.09.2017		Cultivating (7-10 cm)	
2017	29.09.2017		5 t DM ha ⁻¹ Compost application or fertilization with K and P equivalent amounts of potash sulfate and rock phosphate.	
2017	17.10.2017		Cultivating	
2017	18.10.2017	Vetch triticales CC	Sowing, 210 kg ha ⁻¹ 30 % Vetch, 70 % Triticale	
2018	27.04.2018		termination with Rotary hoe ca.5 cm	
2018	27.04.2018		Shallow cultivating ca.7 cm	
2018	28.04.2018		5 t DM ha ⁻¹ Compost application or fertilization with K and P equivalent amounts of potash sulfate and rock phosphate.	
2018	28.04.2018		Shallow cultivating ca.7 cm	
2018	28.04.2018	Potatoes	Planting	
2018	14.05.2018	Potatoes	Fertilization 100 kg ha ⁻¹ N as Phytoperls	
2018	15.05.2018	Potatoes	Potatoes hilling	
2018	18.05.2018	Potatoes	11 t ha ⁻¹ DM triticales-vetch mulch on half of the plowed and half of the RT plots	
2018	26.05.2018	Potatoes	Harrow in unmulched plots	
2018	06.06.2018	Potatoes	Hilling in unmulched plots	
2018	30.08.2018	Potatoes	Irrigation to enable harvesting 15 mm	
2018	31.08.2018	Potatoes	Irrigation to enable harvesting 15 mm	
2018	03.09.2018	Potatoes	Harvest potatoes	
2018	10.09.2018		Disc harrow	
2018	27.09.2018		Deep plowing	
2018	28.09.2018		Liming 500 kg ha ⁻¹	
2018	28.09.2018		Plowing 20 cm	Cultivating 10 cm
2018	01.10.2018	Brassica rapa CC	Sowing Brassica rapa 50 cm row	
2018	14.11.2018		Turnover of rapeseed (due to poor emergence) Cabbage flea damage	
2018	15.11.2018	Winter rye CC	Sowing 200 kg ha ⁻¹	
2019	17.04.2019	termination of cover crop	termination with Rotary hoe ca.5 cm	

Year	Date	Crop	Field operation	Differential operation in RT
2019	18.04.2019		Fertilizing sulphur 100 kg ha ⁻¹	
2019	19.04.2019		Cultivating	
2019	23.04.2019	Spring wheat	Sowing 180 kg ha ⁻¹ + 1kg Berseem clover and 10 kg Green Carbon fix ha ⁻¹	
2019	23.04.2019	Spring wheat	Prisma roller	
2019	17.07.2019	Spring wheat	Mulching (wheat failure due to drought)	
2019	01.08.2019		Plowing 25 cm	Cultivating
2019	04.08.2019		Cultivating	Cultivating
2019	05.08.2019		Liming 2000 kg ha ⁻¹	
2019	06.08.2019	Alfalfa clover grass CC	Sowing	
2019	06.08.2019	Alfalfa clover grass CC	Prisma roller	
2019	14.10.2019	Alfalfa clover grass CC	Mulching	
2020	06.05.2020	Alfalfa clover grass CC	Mulching	
2020	06.05.2020		Termination with rotary hoe	
2020	16.05.2020		Chisel plow 5 cm	
2020	20.05.2020		Shallow and rapid rotary hoe	
2020	26.08.2020		Plowing 25 cm	



OSCAR field setup. Plow tillage, Wenz= Reduced tillage, SC subsidiary crop, CC cover crop, LM living mulch, WW and WS winter-wheat and white clover or subterranean clover, WV and WB winter-wheat and vetch or *Brassica*, + with compost, - no compost.