Supplementary Material

Economic sustainability and riskiness of cover crop adoption for organic production of corn and soybean in northern Italy

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Table S1. Summary of the cover crop and cash crop agronomic management for organic corn and soybean grown in two years across different farms (three for corn, one for soybean) in northern Italy.

Cover crops	**Crimson clover**	**Hairy vetch**	**Rye**	**Triticale**
Sowing date	Late September in 2016-17; Early September in 2017-18	Late September in 2016-17; Early September in 2017-18	October 31, 2017; October 5, 2018	October 31, 2017; October 5, 2018
Sowing rate	40 kg/ha in 2016-17; 50 kg/ha in 2017-18	90 kg/ha	180 kg/ha	180 kg/ha
Sowing technique	Drill	Drill	Drill	Drill
Row distance	18.5 cm	18.5 cm	18.5 cm	18.5 cm
Termination technique	Roller-crimping in 2016-17; Roller-crimping or shredding in 2017-18	Roller-crimping in 2016-17; Roller-crimping or shredding in 2017-18	Roller-crimping	Roller-crimping
Termination date	April 20, 2017; May 31, 2018	April 20, 2017; May 31, 2018	May 17, 2017; May 31, 2018	May 17, 2017; May 31, 2018

Cash crops	**Corn**	**Soybean**
Sowing date	Mid-May 2017; June 2, 2018	May 19, 2017; June 2, 2018
Sowing rate	10 seeds/m^2	70 seeds/m^2
Sowing technique	Strip till + pneumatic drill	Strip till + pneumatic drill in 2017; Strip till + pneumatic drill, or direct sowing on rolled mulch in 2018
Row distance	70 cm	70 cm
Variety maturity	FAO Class 300	0+
Fertilization at sowing	40 kg/ha N	25 kg/ha P_2O_5
Irrigation applications	4	2
Harvest date	2nd half of September (both years)	Mid-October (both years)
Useful production	Grain yield (13% moisture)	Grain yield (13% moisture)

Table S2. Summary of the check and cover crop treatments, respective termination methods (rolling; shredding) and cash crop sowing techniques following cover crop termination, for organic corn and soybean grown in two years across different farms (three for corn, one for soybean) in northern Italy.

2017						2018					
Corn			Soybean			Corn			Soybean		
Treatment	Code	Notes	Treatment	Code	Notes	Treatment	Code	Notes	Treatment	Code	Notes
Inter-row weeding	IRW	Traditional weed management method (check)	Inter-row weeding	IRW	Traditional weed management method (check)	Inter-row weeding	IRW	Traditional weed management method (check)	Inter-row weeding	IRW	Traditional weed management method (check)
Rolled hairy vetch	VET	Cash crop sown after soil strip tilling	Triticale	TRI	Cash crop sown after soil strip tilling	Rolled hairy vetch	VET	Cash crop sown after soil strip tilling	Triticale	TRI	Cash crop sown after soil strip tilling
Rolled crimson clover	CLO	Cash crop sown after soil strip tilling	Rye	RYE	Cash crop sown after soil strip tilling	Shredded hairy vetch	VET SHR	Cash crop sown after soil strip tilling	Rye	RYE	Cash crop sown after soil strip tilling
						Rolled crimson clover	CLO	Cash crop sown after soil strip tilling	Triticale, sod seeding on mulch	TRI SOD	Cash crop sown directly on rolled cover crops
						Shredded crimson clover	CLO SHR	Cash crop sown after soil strip tilling			

Table S3. Costs of cover crop (CC) establishment and termination, inter-row weeding operations (IRW), cash crop sowing and additional operations. Average values across the harvesting years 2017 and 2018.

	Corn					Soybean			
	IRW	VET	CLO	VET SHR	CLO SHR	IRW	RYE	TRI	TRI SOD
	€/ha					€/ha			
CC costs									
Sowing	-	63	63	63	63	-	63	63	63
Seed cost	-	162	95	162	95	-	117	126	129
Rolling	-	33	33	90	90	-	33	33	33
Strip tilling	-	135	135	135	135	-	135	135	0
IRW operations									
Harrowing	135	-	-	-	-	135	-	-	-
Inter-row weeding	60	-	-	-	-	60	-	-	-
Cash crop costs									
Sowing	75	75	75	75	75	85.5	85.5	85.5	180
Seed cost	224	224	224	224	224	210	210	210	210
Other Operations									
Soil preparation	300	300	300	300	300	300	300	300	300
Irrigation and harvesting	627	627	627	627	627	430	430	430	430
Total costs	1421	1619	1552	1676	1609	1220.5	1373.5	1382.5	1345
Additional costs with CC (compared to IRW):									
€/ha	-	198	131	255	188	-	153	162	124.5
Δ%	-	+13.9	+9.2	+17.9	+13.2	-	+12.5	+13.2	+10.2

For treatment abbreviations, see Table A2.
Source: Own calculation from field experiments data and A.P.I.M.A. (2018).

Table S4. Corn crop revenues (€/ha) with the traditional weed control technique (inter-row weeding) and with the cover crop techniques. Harvesting years 2017 and 2018.

	Roverbella		Nuvolera		Malagnino	
	2017	2018	2017	2018	2017	2018
Inter-row weeding	1975	2074	2356	1845	1432	2497
Rolled hairy vetch	1262	1591	2628	-	2134	1878
Rolled crimson clover	1240	-	2194	-	2428	1053
Shredded hairy vetch	-	1387	-	1788	-	1181
Shredded crimson clover	-	1301	-	1168	-	878

Source: Own calculation from field experiments data and Associazione Granaria di Milano (2018).

Table S5. Soybean crop revenues (€/ha) with the traditional weed control technique (inter-row weeding) and with the cover crop techniques. Harvesting years 2017 and 2018.

	Roverbella	
	2017	2018
Inter-row weeding	1716	2166
Triticale[a]	1940	1919
Rye[a]	1832	2261
Triticale, soybean sod seeding on mulch	-	2503

Source: Own calculation from field experiments data and Associazione Granaria di Milano (2018).

[a] Soybean sown after strip tilling on terminated cover crops.

Table S6. Mean nitrogen (N) uptake in the total above-ground biomass (kg N/ha) at the vegetative stage V7 and at harvest of corn sown and grown on autumn-sown, spring-terminated cover crop treatments (hairy vetch or crimson clover) as compared to corn sown on tilled soil and subject to post-emergence mechanical inter-row weeding (check treatment) in three organic farms of northern Italy in the second evaluation year (2018).

Vegetative stage V7 (seven unfolded leaves)					
Malagnino		Nuvolera		Roverbella	
Rolled hairy vetch	12 b	Shredded hairy vetch	18 b	Rolled hairy vetch	55 a
Shredded hairy vetch	17 b	Shredded crimson clover	18 b	Shredded hairy vetch	58 a
Rolled crimson clover	8 b	Inter-row weeding	32 a	Shredded crimson clover	33 b
Shredded crimson clover	15 b			Inter-row weeding	36 b
Inter-row weeding	32 a				
Reproductive stage R6 (harvest)					
Malagnino		Nuvolera		Roverbella	
Rolled hairy vetch	154 a	Shredded hairy vetch	151 a	Rolled hairy vetch	172 a
Shredded hairy vetch	113 ab	Shredded crimson clover	120 b	Shredded hairy vetch	126 ab
Rolled crimson clover	124 ab	Inter-row weeding	151 a	Shredded crimson clover	87 b
Shredded crimson clover	86 b			Inter-row weeding	140 ab
Inter-row weeding	153 a				

In each site and stage, the variation among treatments was significant at $P \leq 0.05$ according to F test of ANOVA, and mean values followed by different letters were different at $P \leq 0.05$ according to Tukey's studentized range (HSD) test.