COVER CROPS FROM TRITICALE AND PEAS CULTIVATED IN PURE STANDS AND MIXTURES – SOIL AND WEED SUPPRESSION BENEFITS

Victor Petcu[1], Laurențiu Ciornei[2], Simona-Petruța Simion[2], Marga Grădilă[3], Simona Lavinia Burtan[4], Elena Partal[1]
[1]National Agricultural Research and Development Institute Fundulea, 915200 Fundulea, Călăraşi County, Romania
[2]Centre of Studies and Research of Agroforestry Biodiversity, 13 Calea 13 Septembrie, Academy House, West Wing, floor 7, District 5, Bucharest, Romania
[3]Institute of Research-Development for Plant Protection, 8 Ion Ionescu de la Brad Blvd, District 1, Bucharest, Romania
[4]National Research and Development Institute for Soil Science, Agrochemi

INTRODUCTION

The cover crops can sequester carbon, but the magnitude of their potential impact is debated (Zomer et al., 2017). Thus, this may vary with soil type, management, elevation, and soil climate (Poeplau and Don, 2015). The literature regarding the impacts of CCs on crop yields is also inconclusive, as there is considerable variability in results across studies, some studies have found that CCs positively affect subsequent crop yields (Maughan et al., 2009) while other studies have found no significant effect or even decreased yields (Acuna and Villamil, 2014). Weeds compete with crops for light, nutrients, and water. Cover crops are increasingly being used for weed management, and planting them as diverse mixtures has become an increasingly popular strategy for their implementation. While ecological theory suggests that cover crop mixtures should be more weed suppressive than cover crop monocultures, few experiments have explicitly tested this for more than a single temporal niche (Smith et al., 2014). The objectives of this study were to evaluate effects of cover crops consisting of winter peas (for fixing atmospheric nitrogen) and triticale (for recycling soil nutrients) in pure stands and mixtures on soil C sequestration, soil quality and weed suppression.

MATERIAL AND METHODS

The experiment was carried out at the experimental field of National Agricultural Research and Development Institute from Fundulea on cambic chernozem soil, during two vegetation periods (2019-2020 and 2020-2021). Three cover crops were studied, winter peas, triticale and a mixture of 50% triticale (Utrifun variety) and 50% winter pea (Spectral variety) and no cover crop as control. The sowing date was September 25 in both years and the sowing depth was 4-5 cm.

To quantify organic carbon sequestration, biomass was sampled in the end of spring, using 0.50 m2 quadrates combined in each plot. The soils samples were collected randomly from each replicated plot using a soil of 20 cm depth. Soil samples from each plot were then homogenized into a composite sample and sieved at 2 mm. Plant debris and roots were removed. Soil relative moisture was determined by drying 10 g of fresh soil at 105°C for 24 h. The physical and chemical soil characteristics were measured for all samples according to SR ISO 11464:1998. The following two methods were used for the chemical characterization of the soil: • organic matter: determined volumetrically by the wet oxidation method after Walkley Black modified by Gogoaşă - STAS 7184 / 21-82. The soil organic carbon content was obtained with the formula: SOC = organic matter/1.724, where 1.724 is the amount of humus, in g, corresponding to 1 g of organic carbon: • total nitrogen (N%): Kjeldahl method, disintegration with H_2SO_4 at 350°C. The effect of cover crop species on soil properties and weed suppression was determined by analysis of variance.

RESULTS

Winters were relatively mild, with temperatures above the multi-year average, while in the spring of 2021 April temperatures were below the multi-year average. The cover crops had passed well over the winter period in both years, as can be seen in the figure 1.

Table 1. Average temperature (°C) and monthly distribution of rainfall (mm) during the experimental years

Month	X	XI	XII	I	II	III	IV
Temperature 2019-2020	12.8	10.2	4	0.9	5.2	8.3	12.3
Temperature 2020-2021	14.7	6.1	3.9	1.6	3.2	5.1	9.7
Multianual average	11.7	5.8	0.1	-1.8	0.8	5.8	11.6
Rainfall 2019-2020	38.0	33.2	16.2	2.0	16.6	29.8	14.0
Rainfall 2020-2021	28.6	20.0	77.6	77.0	16.2	59.0	31.0
Multianual average	42.4	41.7	48.4	32.7	26.5	38.8	44.9

Figure 1. Aspect with cover crops (spring 2021)

Table 2. Contribution of cover crops to organic carbon sequestration

Experimental variants	Biomass (g fresh matter/m²)	
	2020	2021
Triticale + pea	2840	4260
Triticale	1540	2400
Winter pea	1020	1650

Table 3. Analysis of variance for organic carbon sequestration

Source of variance	DF	Mean square	F value
A Factor: Year	1	4370939	5011.26***
Error A	2	0.022872	
B Factor: cover crops	3	7671606	529.85***
Interaction AxB	3	259505	8.79***
Error B	12	29522	

The cover crop consisting of triticale and peas contributed to the increase of the organic carbon content in the soil through aerial biomass with values of 4260 g FM/m2 in 2021 compared to only 2840 FM/m2 (Table 2). Effects of cover crop on biomass accumulations were analysed using the analysis of variance which showed the very significant effect of both the analysed factors and their interaction (Table 3).

Soil analyses carried out to see if the cover crop contributes to the improvement of the organic carbon content of the soil showed the positive effect of the mixture of peas and triticale on it, which was 1.96% compared to 1.75% carbon content in no cover field under the conditions of 2021. The contribution brought by winter pea was higher than that made by triticale, where the values of the carbon content were lower or equal than those from the no cover field (Table 4).

The results obtained by us on the influence of cover crops on the evolution of diseases, pests and weed suppression highlighted the beneficial effect of the cover crop consisting of the mixture of two species, which confirms the data in the literature presented above, (Table 5). It is obvious that the mixture of triticale and winter peas had the effect of reducing the weeding. Only the ephemeral species of *Veronica* was present, compared to the species of *Apera spica venti*, *Papaver rhoeas* and *Cirsium arvensae* present in the cultivation of triticale, respectively, winter peas

Table 4. The effect of different cover crops on organic carbon and soil C/N ratio

Experimental variants	Soil depth (cm)	Organic carbon (%)		C/N ratio	
		2020	2021	2020	2021
Triticale + pea	0-20	1.59	1.96	9.69	11.95
Triticale	0-20	1.10	1.75	6.70	10.62
Winter pea	0-20	1.46	1.86	9.24	12.63
No cover	0-20	1.30	1.75	8.38	11.23

Table 5. The diseases, pests and weed species in the years of experimentation

Experimental variants	Diseases		Pest		Weed species and weed suppression (1-10 scale; 10 = best)	
	2020	2021	2020	2021	2020	2021
Triticale + pea	Zero	Zero	Zero	Zero	Veronica spp. 8	Veronica spp. 9
Winter pea	Pea rust	Pea rust (Puccinia)	Zero	Zero	Veronica spp. Polygonum convolvulus Cirsium arvensae 4	Veronica spp. Cirsium arvensae 5
Triticale		Erisiphe graminis	Zero	Zero	Veronica spp. Apera spica venti Papaver rhoeas 5	Veronica spp. Apera sica venti 6

CONCLUSIONS

The results obtained highlighted the importance of the component of the cover crop and the climatic conditions on the carbon sequestration and the organic carbon content of the soil. Thus, the cover crop consisting of a mixture of 2 species (triticale and peas) and higher rainfall have been shown to have a beneficial effect on the accumulation of biomass and organic carbon content in the soil. While the carbon-nitrogen ratio is more influenced by climatic conditions. The floristic composition and weed infestation were different in the years of experimentation and the cover crops studied. In the cover crop consisting of a mixture of triticale and peas, weed species and weeding were lower compared to the individual cover crops studied.

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