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Cover crops as green mulching for weed management in rice

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Introduction

In Italy, rice (*Oryza sativa* L.) is cultivated in a relatively small territory, in the North-West, often as monocrop and weeds are one of the main issues and their control is mainly based on the use of herbicides. These characteristics have made weed management challenging, with the development of highly specialized weed flora and the spread of herbicide-resistant weeds, which demands for finding more sustainable integrated weed management strategies (Vidotto et al., 2020). In this context, cover crops can play a key role as they can cover the ground with a considerable amount of biomass, suppressing weeds (Didon et al., 2014). A new technique that has been recently introduced is green mulching, which consists of growing cover crop species during autumn and winter and flooding the field after their termination (by shredding or roller-crimping) in order to start the degradation of the biomass and the potential production of phytotoxic compounds.

The objective of the study was to evaluate the effectiveness of green mulching with three different cover crops, *Lolium multiflorum* (Italian ryegrass), *Vicia villosa* (hairy vetch) and a mixture of the two, on weed development and on rice yield. The study also aimed at defining which cover crop termination technique (shredding or roller crimping) resulted more effective for weed control.

Materials and Methods

The experiment was conducted in 2017 and 2018 in two rice farms located at Livorno Ferraris and Rovasenda (Piemonte region). At each site, three fields were sown after rice harvest with either *V. villosa*, *L. multiflorum* (50 kg ha^{-1}), or a mixture of both (with 60 kg ha^{-1}: *V. villosa* 40% + *L. multiflorum* 60%); at Rovasenda a small percentage of *Brassica napus* and Triticale was also present in the mixture. At both site, another field without cover crop was considered as a control reference. Rice was broadcasted sown within the cover crop in May and, after few days, the cover crop was terminated in half of each field using a roller-crimper, while in the other half it was terminated by shredding. Each field was also divided crosswise in three zones to obtain three pseudo-replicates in which assessments were carried out. Within ten days, the fields were flooded for about a week to promote the degradation of the cover crop biomass. Then, the fields were cultivated in flooding conditions without further weed control. Cover crop biomass at both sites was determined just before the termination of the cover crops by randomly cutting the biomass in three areas of 0.5 m^2 in each zone; afterward, the plants were oven dried until constant weight. Weed density was evaluated thrice during the growing season by counting individuals of each weed species present within a square metal frame, randomly launched 18 times per field. The weed cover over the soil surface was also visually estimated within each frame. At harvest, rice yield was also determined. For each site and assessment, different mixed nested ANOVAs were performed to determine the effect of cover crop species, termination technique, and the interaction between cover crop and year.

Results

Higher values of cover crop biomass before termination were recorded for *L. multiflorum*, especially at Rovasenda in 2018, with values of dry matter of about 5.6 t ha^{-1}, while *V. villosa* had a more variable development. At Rovasenda, *V. villosa* growth was limited, with values of dry biomass lower than 1 t ha^{-1} because of the combination of scarce emergence due to sod-seeding and frost damage.

In general, green mulching significantly affected weed density as the control plot often recorded higher weed densities than the plots with cover crops. At Livorno Ferraris, higher weed densities were observed in *L. multiflorum* and mixture only in July 2017 with values higher than 300 plants m^{-2} (Table 1). At Rovasenda weed density was not affected by cover crop in 2017, while an effect of the cover crop species was visible in 2018, in which *V. villosa* recorded the highest weed density values (200 plants m^{-2}) in July

assessment. At this site, the best weed suppression was observed with *L. multiflorum* and mixture, with values of weed density of about 31 and 54 plants m^{-2} for the two cover crops, respectively.
In the majority of the assessments on weeds, the termination technique did not affect weed density; only in the assessment of July 2017, at both sites, lower weed densities were recorded in shredded field portion of mixture at Rovasenda and of *L. multiflorum* at Livorno Ferraris compared to the same cover crop crimped. The weeds most frequently encountered were: *Oryza sativa* (weedy rice) and *Lindernia dubia* at Rovasenda and *Alopecurus geniculatus* and *Cyperus difformis* at Livorno Ferraris, while *Heteranthera reniformis* was abundantly found at both sites.

Table 1. Weed density (plants m^{-2}) in the different cover crops at Livorno Ferraris in July 2017 and at Rovasenda in July 2018. Same letters represent non-significant differences between values according to Tukey test ($p \leq 0.05$).

		Livorno Ferraris July 2017				**Rovasenda July 2018**			
Cover crop	**termination**	**Weed density cover crop** (plants m^{-2})		**Weed density termination** (plants m^{-2})		**Weed density cover crop** (plants m^{-2})		**Weed density termination** (plants m^{-2})	
L. multiflorum	shredded	348.4	a	218.7	b	30.8	b	41.3	a
	crimped			478.2	a			20.3	a
V. sativa	shredded	91.5	b	87.1	a	205.0	a	239.1	a
	crimped			96.0	a			171.0	a
Mixture	shredded	487.1	a	627.5	a	53.9	b	61.2	a
	crimped			346.7	a			46.7	a
Control		78.2	b	-		148.6	a	-	

Rice yield was variable in the two years at both sites. The highest rice yield (>5 t ha^{-1}) was observed in 2018 in the shredded mixture at Rovasenda and in *V. villosa* at Livorno Ferraris in 2017 (about 3.5 t ha^{-1}). Generally, control fields showed lower yields (1-3 t ha^{-1}) at both sites. The termination methods did not significantly affect rice yield.

Conclusions

The cover crop species showed a variable behavior in terms of weed suppression in the two sites. *V. villosa* recorded high weed density and low rice yield at Rovasenda as it showed poor establishment because of the combination of scarce emergence, due to sod-seeding, and low temperatures. Generally, *L. multiflorum* was more tolerant to low temperatures and showed a good cover that contained weed growth, especially at Rovasenda. Cover crop mixture showed variable results with higher suppression probably related to the number of cover crop species present in the mixture. The results highlighted that green mulching could reduce weed infestations, even though alone is not able to completely limit weed development. The termination method only rarely affected weed density but no effects were observed on rice yieds. Some critical issues of the technique were observed, such as the need of a good cover crop establishment, that eventually results in abundant biomass production and significant weed suppression.

Literature

Didon UME et al. 2014. Cover Crop Residues—Effects on Germination and Early Growth of Annual Weeds. Weed Sci. 62: 294–302.
Vidotto F. et al. 2020. Rapid increase of herbicide resistance in *Echinochloa* spp. consequent to repeated applications of the same herbicides over time. Arch. Agron. Soil Sci.:1–13.