DESIGNING COVER CROP MIXTURES TO ENHANCE POTENTIAL WEED SUPPRESSION IN ORGANIC NO-TILL VEGETABLE SYSTEMS

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Introduction

No-tillage in vegetable systems can provide several benefits, but it can be realized only if there is a powerful strategy to control weeds (Morse, 1999). Cover crops are an essential part of an integrated weed management strategy in no-till organic and low input vegetable systems (Altieri et al., 2011). However, few studies focus on no-tillage practices in organic vegetable systems in European environments, particularly in Mediterranean contexts (Isik et al., 2009). Cover crop effectiveness in weed control, depend on crop traits linked with weed suppressive ability. Mixtures have been used to improve effectiveness of cover crops (Wortman et al., 2012, Smith et al. 2014, Finney et al., 2016). Nonetheless, to our knowledge, this is the first study adopting a functional approach to the design of cover crop mixtures. Our objective was to investigate the effect of functional diversity and composition of cover crops in controlling weeds before aubergine (*Solanum melongena* L.) transplanting, highlighting the relationship between functional traits and weed suppression.

Materials and Methods

A field trial was performed in an organic field located at CIRAA, University of Pisa, Italy, according to a randomized complete block design with 3 replicates and 18 treatments. We selected 8 cover crop species clustered into 4 functional groups as follows: i) large seeded legumes (*Pisum sativum* L., *Vicia sativa* L.) characterized by a major development in height; ii) small seeded legumes (*Trifolium incarnatum* L., *T. squarrosum* L.), that tend to fast cover the soil; iii) grasses (*Hordeum vulgare* L., *Avena sativa* L.) characterized by a strong competitive ability and iv) crucifers (*Raphanus sativus* L., *Brassica nigra* L.) with allelopathic potential. We designed the mixtures to create a gradient of functional diversity. We included 8 monocrop treatments, 4 two-species mixtures; 4 four-species mixtures including co-presence of 2, 3 and 4 functional groups; an eight-species mixture characterized by the highest level of species and functional diversity, and a no cover crop control. Cover crop plots (3 x 12 m) were broadcast sown on 27th October 2014 and devitalized on 6th May 2015 with a roller crimper followed by flame weeding. Throughout the experiment, density and height of component cover crop species was regularly recorded. Organically certified aubergine plants (cv “Dalia F1”) were transplanted 5 days after cover crop devitalization. Before devitalization, three above-ground biomass samples of 0.5 m^2 per plot were collected. We separated cover crop from weed biomass, and cover crop biomass in the mixtures was further partitioned into component species.

Results and Discussion

We found no strong correlation between cover crop height and biomass at the time of devitalization. Instead, we found a significant negative relationship between cover crop biomass and weed biomass. This relationship was significantly influenced by treatments. The highest weed biomass was recorded for vetch, although it was significantly lower than in the control. The effect of cover crop biomass on weeds was significant for the small seeded legumes and for pea within the large seeded legumes functional group. We found no significant effect for vetch, as its development was particularly low due to poor establishment in 2014. As for grasses, the effect of cover crop biomass over weeds was not significant. In this functional group, alternative mechanisms, as allelopathy, might have overcome the biomass effect on weeds. A clear functional differentiation between cover crop species emerges.

Conclusions

Cover crop mixtures showed a strong potential for weed infestation reduction, given the high amount of biomass produced (Teasdale and Abdul-Baki, 1998). As pointed out by previous research (Mirsky et al., 2013; Mohler and Teasdale 1993), a high quantity of cover crop biomass will ensure good weed suppression during subsequent cash crop cultivation. However, choice and combination of different cover crop functional groups can provide a stronger effect on weeds suppression, through mechanisms not necessarily related to higher biomass production. Our results show that functional characterization of cover crop species and the use of mixtures can be powerful tools in an integrated weed management strategy in organic or low input no-till vegetable systems.

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