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Topic 4 - Innovation in Organic farming: "thinking out of the Box"

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STRAWBERRY LIVING MULCH IN ORGANIC VINEYARDS

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Abstract: A living mulch system can improve soil nutrient status and structure, provide beneficial habitat for biodiversified coenoses and spatial competition against weed infestation, and support a rhizosphere-enhanced diversity in microbial populations that can suppress soilborne pathogens. Strawberry living mulch in vineyards has been evaluated for two years through a participative approach involving researchers and producers. From the results of the experimental work, it appears that living mulch obtained with wild strawberry combined with a horizontal blade weeder reduces the need for further soil management, starting from the second year after vines planting, and assures a full soil cover during winter, thus reducing soil erosion and weed competition. It maintains a diversified coenosis and represents a source of potential second income. Several advantages, as well as some weak points of the technique, have been shown, and some technical tips have been issued from the practical activities. Low input weed management is the first advantage derived from introducing living mulches. Such service is especially relevant for the area surrounding the trunk, where management is particularly complex and requires frequent manual interventions. Furthermore, installing a permanent mulch guaranteed a constant soil cover, and especially in hilly regions can drastically reduce the risk of erosion and leaching during rainy periods, compared to mechanical tillage. Mulching species could also provide an accessory for agroecological services and contribute in creating resilient biological communities; biodiverse populations able to dynamically evolve, matching the changes on environmental conditions.

Introduction: A major priority of our project is to break the paradigm of monoculture with the introduction of new intercropping strategies using multifunctional cover crops to increase the sustainability and profitability of organic fruit orchards (Leary and De Frank, 2000). Farming systems using intercropping, which mimic nature (Scherr and McNeely, 2008), can increase the on-farm biodiversity and the provision of eco-services (Malézieux et al., 2009). However, such systems often lead to new challenges: constraints for efficient weed control; increased energy and water consumption in living mulch

management, potential competition between main and cover crops (Wezel et al., 2009). Our project is considering these challenges and evaluate the proposed systems with a multi-stakeholder approach, adjusting them to improve the economic and ecological sustainability (Neri et al., 2019). Intercropping with a cash crop, a living mulch in the row, will combine an increase of soil fertility and an improvement of biological diversity leading to a reduction of the risk of pest infestation and soil borne diseases when replanting intensive orchards (Polverigiani et al., 2016). The choice of species with different rooting depths, inducing a weaker competition for water and nutrients, is key to the system. Such rich communities provide organic residues to the soil, thus improving its chemical, physical and biological fertility which conversely can be hinder by the organic residues of a single crop (Neri et al., 2005) as it is documented for other fruit species (Endeshaw et al., 2015; Polverigiani et al., 2018). For apple, the replant problems are recognized in several fruiting areas in Europe (Polverigiani et al., 2014). They could also attract beneficial insects for the main crop. Several species could also have a positive aesthetic impact, particularly relevant where there is a direct relationship with consumers. Some of the species suitable for mulching are edible and could have a productive function providing a secondary income (Malézieux et al., 2009; Scherr and McNeely, 2008). The selection of promising species should be based on some relevant characteristics: vegetative aptitude, high adaptability to local pedoclimatic conditions, stoloniferous species (with offshoots/runners) possess several desired characteristics. They can be issued from the local flora: i.e. several subspecies of *Potentilla* are particularly promising. The goal of the living mulch by wild strawberries was to create a stable and weakly competitive community (cenosis) within the grapevine agro-ecosystem as a sustainable solution for weed management. Such technique is particularly suitable in situations where soil tillage is otherwise unavoidable. Among the horticultural species, the strawberries, when local ecotypes are selected, represents an interesting option, also for the secondary income potentially provided.

Material and methods: A local wild strawberry clone from Sibillini mountain (Central Italy) was propagated by stolons to obtain small plantlets easily uprooted after the summer. In a young organic vineyard (planted in 2016, Castelraimondo, MC, Central Italy), the strawberry plantlets were planted near the trunk of each vine, with two densities (2 and 4 plants per trunk), in autumn 2017. The experimental layout included the two strawberry planting densities and a control without living mulch in a randomized block design. Each treatment was applied to a plot of 20 vines per block. The soil management in all the treatments consisted in horizontal blade weeder in-row and green manure with leguminous species between the rows.
The vegetal coverage of 1 x 0,5m of soil in the row, the discrimination between strawberry and weed were recorded in July 2018, November 2018, June 2019 and August 2019. The production per vine was weighted at harvest 2019, and the pruned wood per vine in February 2020. Chemical composition of the grape “must” was evaluated at three different times during the 20 days before the harvest. Statistical data analysis consisted in ANOVA and Tukey’s HSD test.

Results: Analysed data showed that strawberry plants used as living mulch were effective to control weeds development in the vineyard. In fact, percentage of soil coverage by weeds was significantly reduced in the area managed with living mulch plant. Strawberry planting density influenced the rate of soil coverage during the two years of experimental work. For example, installing four strawberry plants per vine brought to a highly significant increase of soil coverage by strawberry (fig. 1).

The treatments, on the other end, didn't influence pruned wood per plant, grape production and grape "must" chemical composition.

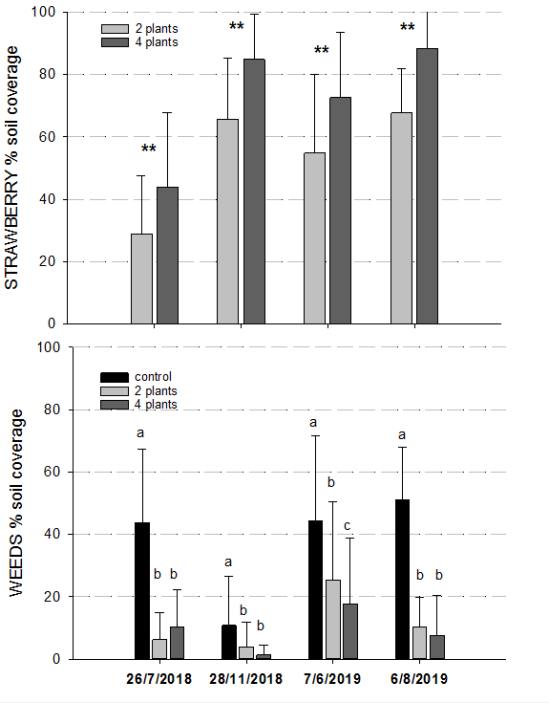

Figure 1. Percentage (%) of soil coverage by straberry (top) and weeds (bottom). ** indicates highly significative difference (ANOVA). Different letters indicates significative difference (Tukey's HSD test)

Discussion: Selected species has a limited summer growth (a sort of stasis or summer dormancy). In mild winter climates (like Central Italy) strawberry plants must be transplanted in autumn (the rainy season) to avoid drought stress for the young strawberry plants. Transplant should be done after soil tillage under the rows of trees or vines, to favour the competition of living mulch against weed at the initial stage. Shallow tillage with the horizontal blade favours the growth of strawberry which has a very superficial fasciculate root system and stolon propagation, but strongly damages the tap root of several weeds, so it promotes the spreading of the strawberries over the row.

From the results of the experimental work, it appears that living mulch combined with a horizontal blade weeder reduces the need for further soil management, starting from the second year after vines or trees planting, and assures a full soil cover during winter, thus reducing soil erosion and weed competition without negatively affecting the vine vigour and the grape quality. It maintains a diversified coenosis and represents a source of potential second income.

Figure 2. Weed growth at the end of the growing season. Control (left : horizontal blade weeder) vs strawberry (right : horizontal blade weeder + strawberry living mulch)

Figure 3. Strawberry living mulch in January 2020

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Disclosure of Interest: None Declared

Keywords: Fragaria vesca, mixed crops, system design, weed control, multifunctionality

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