Light reduction affected agronomic performance and nutritive value of temporary grassland swards in a Mediterranean rainfed plot trial

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Corresponding Author:

lorenzogabriele.tramacere@phd.unipi.it

Lorenzo Gabriele Tramacere[1], Alberto Mantino[2], Massimo Sbrana[3], Marco Mazzoncini[1 3], Marcello Mele[1 3], Giorgio Ragaglini[4], Daniele Antichi[1 3]

[1]*Department of Agriculture, Food and Environment, University of Pisa, Italy*
lorenzogabriele.tramacere@phd.unipi.it, daniele.antichi@unipi.it,
[2] *Institute of Life Sciences, Scuola Superiore S. Anna di Pisa, Italy*
[3] *Centre for Agri-environmental Research "Enrico Avanzi", Pisa, Italy*
[4] *Dipartimento di Scienze Agrarie e Ambientali-Produzione, Territorio, Agroenergia, Università degli Studi di Milano, Via Celoria 2, 20133 Milano, Italy*

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Abstract

In Italy, traditional olive orchards are characterised by low tree density (100-300 ha^{-1}) allowing the cultivation of forage and crops under the tree canopy (Paris et al., 2019). Eichhorn et al. (2006), reported that in Central Italy there are 20000 ha of farmland identified as a silvoarable olive orchard. The intercropping of perennial legumes and trees is a key strategy to improve nutrient cycle of silvoarable systems, due to the higher amount of nitrogen (N) accumulated in stable forms in soil due by biological nitrogen-fixation (Hernandez-Esteban et al., 2019; Sanna et al., 2019), leading to a request for reduction of inorganic N fertilisation. Perennial legumes can also provide a continuous soil cover during the entire year reducing soil loss risk (Vallebona et al., 2016). In the Mediterranean basin, the most important perennial legume is alfalfa (*Medicago sativa* L.). Previous studies reported that alfalfa nutritive value was not negatively affected by tree presence (Mantino et al., 2021), whereas legume production was reduced due the competition for resources such as water (Nasielski et al., 2015), nutrients (Isaac et al., 2014) and light (Mantino et al., 2021). In Tuscany, sulla (*Hedysarum coronarium* L.) an autochthonous biennial legume is appreciated for its rusticity, productivity, and quality and it is intercropped with Italian ryegrass (*Lolium multiflorum* Lam.) for a better utilisation as pasture.

In 2019, a rainfed field plot trial was established to evaluate agronomic performance and nutritive value of different perennial forage species grown under different levels of light reduction, aiming to start a selection of shade tolerant forage crops. In October, the plot trial was established in Pisa, on a clay-loam soil with pH of 8.1 and 2.5 % w/w of organic matter content in the topsoil (0-0.3 m). Before sowing, 100 kg ha^{-1} of P_2O_5 were applied. The experimental layout complies with a two-factor randomized complete

block design with four replicates (18 m^2 sizing each plot). The first factor included five different swards: i) sulla cv. Silvan, (ii) ryegrass cv. Teanna, (iii) mix of sulla cv. Silvan and ryegrass, 50:50 (iv) mix of sulla cv. Silvan, sulla cv. Chiara Stella and sulla cv. Bellante 33:33:33 and (v) alfalfa cv. Messe. The second factor included three increasing shading levels: S0) the control representing full light availability, S25) and S50), corresponding to a reduction of potential light availability of 25 and 50% respectively. As previously tested by Varella et al. (2011), shading was provided by woody slats, N-S oriented, 2.0 m long and 0.10 m wide, with a distance between each slat of 0.10 m for *S50* and 0.20 m for *S25*, covering a total surface of 4 m^2. After sowing, slats were placed at 0.8 m above ground level. Yield and nutritive value of herbage mass and N^2 fixation were evaluated for two consecutive years. Herbage biomass was not affected by the reduction of the 50% of light in ryegrass and ryegrass-sulla mixture while it was negatively affected in alfalfa and sulla. Conversely, the 25% of shade level had no effect on legume yield.

Figure 1. Picture of the experimental site (from L.G. Tramacere, 2020)

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