

SERVICE CROP EFFECTS ON GRAPEVINE WATER AND NITROGEN STATUS AND YIELD UNDER MEDITERRANEAN CLIMATE

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Abstract:

Context and purpose of the study – Service crops in vineyard can provide multiple ecosystem services but they can also lead to competition with the grapevine for soil resources in the Mediterranean region due to potential severe droughts (Garcia et al., 2018). One of the levers of action to manage this competition is the choice of species adapted in terms of growth dynamics and water and nutrients' needs. The objectives of this study were to determine the effect of temporary service crops on grapevine water and nitrogen status and grapevine yield and yield components in a Mediterranean vineyard.

Material and methods – The experiment was carried out for two consecutive years in a vineyard located in the south of France on a calcareous cambisol under a Mediterranean climate (468 and 487 mm of rainfall for 2016-17 and 2017-18 winters respectively). Grapevines (Mourvèdre) were planted in 2008 at a density of 4000 vines per hectare. For the two consecutive years, 9 species (*Achillea millefolium*, *Avena sativa*, *Dactylis glomerata*, *Medicago lupulina*, *Medicago sativa*, *Plantago coronopus*, *Poterium sanguisorba*, *Trifolium fragiferum* and *Vicia villosa*) were sown after harvest and destroyed after budburst. Predawn leaf water potential and leaf chlorophyll content were measured using a pressure chamber and a SPAD® chlorophyll-meter device for all treatments (9 service crops, spontaneous vegetation and bare soil) on 10 plants at grapevine's fruit set to assess early water and nitrogen status of the vine. At harvest, the yield and yield components' grapevine were measured for all treatments on the same plants. All treatments were compared with tilled and spontaneous cover systems using ANOVA and post-hoc Tukey tests for multiple comparison of means ($p < 0.05$).

Results – At fruit set, the leaf water potentials indicated an absent to low stress depending on the treatment: *Plantago coronopus* ($-1.6 \cdot 10^5$ Pa) and *Poterium sanguisorba* ($2.8 \cdot 10^5$ Pa) were the least and the most constrained treatments respectively. The range of SPAD values between 34 and 39 indicated that nitrogen needs are met (higher values for *Vicia sativa* and lower values for *Dactylis glomerata* and *Poterium sanguisorba*). At harvest, the mean yields and the mean number of bunches per plant ranged from 2.8 to 4.4 kg of grapes and from 12.8 to 17.3 respectively, without any significant difference between the treatments. The only significant difference was observed for bunch fresh weight (*Avena sativa* (288 g) significantly higher than *Poterium Sanguisorba* (156 g)). In conclusion, after two years of temporary service crop, no significant reduction in yield was noticed, but the treatments were differentiated for their water and nitrogen status, and for the fresh mass of a bunch depending on the chosen species. Our results reinforce the need for long-term monitoring of service crop trials in vineyards.

Keywords: Grapevine, Service Crop, Yield, Predawn Leaf Water Potential, Nitrogen, Competition

1. Introduction.

Service Crop Effects on Grapevine Water and Nitrogen Status and Yield under Mediterranean Climate

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Context

Service crops in vineyard can provide multiple ecosystem services but they can also lead to competition with the grapevine for soil resources in the Mediterranean region due to potential severe droughts (Garcia et al., 2018). One of the levers of action to manage this competition is the choice of species adapted in terms of growth dynamics and water and nutrients' needs.

Objective: to determine the effect of temporary service crops on grapevine water and nitrogen status and grapevine yield and yield components in a Mediterranean vineyard.



Figure 1: Sown service crops (source: www.telabotanica.org)

Material and methods

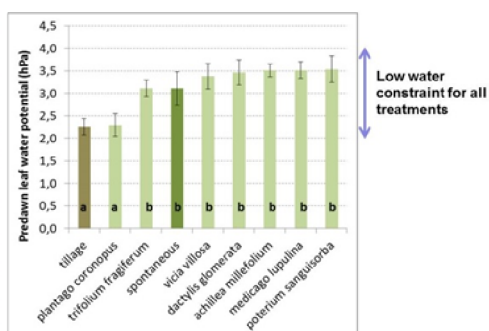
- Vineyard located in the South of France, calcareous cambisol with 30% clay and 40% silt
- Mediterranean climate (468 and 487 mm of rainfall for 2016-17 and 2017-18 winters respectively).
- Grapevines (Mourvèdre) were planted in 2008 at a density of 4000 vines per hectare.
- For the two consecutive years, 9 species (fig.1) were sown after grapevine harvest and destroyed after grapevine budburst on different inter-rows.



- Measurements of predawn leaf water potential using a pressure chamber and leaf chlorophyll content using a SPAD® chlorophyll-meter device for all treatments (9 service crops, spontaneous vegetation and bare soil) on 10 plants at grapevine's fruit set to assess early water and nitrogen status of the vine.
- At harvest, measurements of the yield and yield components' grapevine for all treatments on the same plants.
- ANOVA and post-hoc Tukey tests form multiple comparison of means ($p < 0.05$) to compare all treatments

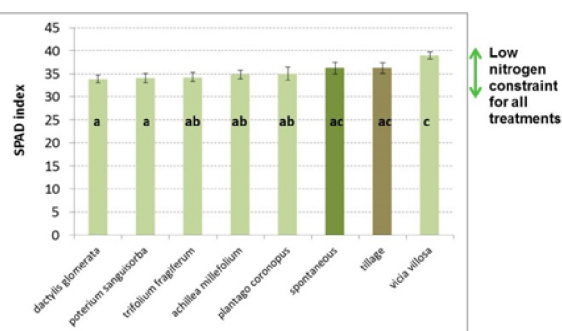
Results and highlights

1. Service Crop Effects on Grapevine Water Status



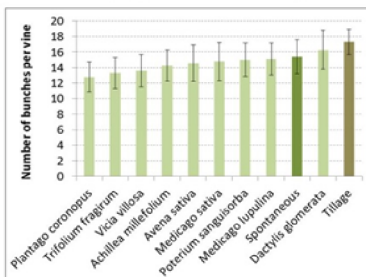
At fruit set, the leaf water potentials indicated an absent to low stress depending on the treatment: *Plantago coronopus* ($-1.6 \cdot 10^5$ Pa) and *Potentilla sanguisorba* ($2.8 \cdot 10^5$ Pa) were the least and the most constrained treatments respectively.

2. Service Crop Effects on Grapevine Nitrogen Status

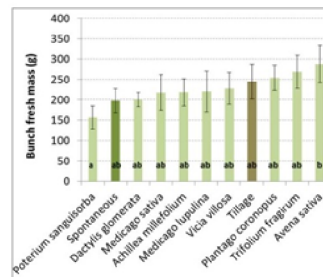
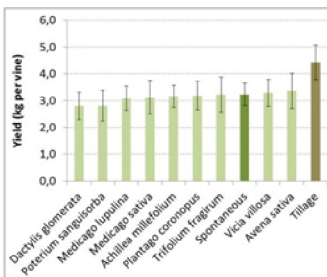


The range of SPAD values between 34 and 39 indicated that nitrogen needs are met (higher values for *Vicia sativa* and lower values for *Dactylis glomerata* and *Potentilla sanguisorba*).

3. Service Crop Effects on Yield after 2 years



At harvest, the mean yields and the mean number of bunches per plant ranged from 2,8 to 4,4 kg of grapes and from 12,8 to 17,3 respectively, without any significant difference between the treatments.



The bunch fresh weight of *Avena sativa* (288 g) was significantly higher than that of *Potentilla Sanguisorba* (156 g)

Conclusion

In conclusion, after two years of temporary service crop, no significant reduction in yield was noticed, but the treatments were differentiated for their water and nitrogen status, and for the fresh mass of a bunch depending on the chosen species. Our results reinforce the need for long-term monitoring of service crop trials in vineyards.

References

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