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Use of subterranean clover and burr medic as cover crops in vineyards

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Summary - A three-year experiment was carried out to compare four treatments: traditional tillage, natural herbage covering, subterranean clover (*T. yanninicum* cv Trikkala) and burr medic (*M. polymorpha* cv Anglona) cover crops. A randomised complete design with three replicates was utilised. Data on emergence, herbage covering rate, weeds presence, canopy height, length of vegetative cycle, dry matter production, seed bank dynamics and re-establishment were collected. Grape yield and branches weight of vine were determined. Sugar content, acidity and pH of must were measured. Natural covering affected grape yield negatively. No negative effect on grape yield and must quality was observed using the annual self-reseeding legumes compared to the tillage treatment. Subterranean clover was found to be more adapted than burr medic to control the growth of weeds and on average increased grape yield significantly.

Key-words: vineyard ground cover, annual self-reseeding legumes, *Trifolium yanninicum, Medicago polymorpha*, grape production

Résumé - *Ce papier présente les résultats d'un essai sur 3 ans où 4 traitements ont été comparé: travail traditionnel, enherbement spontané, trèfle souterrain (*T. yanninicum *cv Trikkala) et luzerne annuelle (*M. polymorpha *cv Anglona). On a utilisé un dispositif avec tirage au hasard et 3 répétitions. La date de germination, le pourcentage de recouvrement, la présence d'adventices, la production de matière sèche, la présence des graines et le réensemencement ont été déterminé. La quantité de raisin et le poids des sarments ont également été mesuré, de même que la teneur en sucre, l'acidité et le pH du moût. L'enherbement spontané influence négativement la production de raisin. On n'a observé aucun effet négatif sur la production de raisin et sur la qualité des moûts en comparant le travail traditionnel et les traitements avec légumineuses. Le trèfle souterrain semble être plus indiqué que la luzerne pour contrôler les adventices et augmente de façon significative la production de raisin.*

Mots-clés: *enherbement du vignoble,* Trifolium yanninicum, Medicago polymorpha, *production de raisin*

Introduction

In the last decade farmers and researchers have taken a renewed interest in cover crops because of their potential role in reducing chemical inputs, water erosion and improving soil fertility. The main constraint on using the cover crop in vineyards under Mediterranean climate receiving less than 600 mm of annual rainfall, mainly concentrated in autumn and winter, is the water competition between vines and green cover during late spring. Resident vegetation can be inexpensively managed for ground cover, although it can be highly variable. Winter annual self-reseeding forage legumes seemed to fit these requirements. The plants initiate growth in late summer or early fall, grow vegetatively until the following spring when they flower, produce the burrs and seeds and then die from mid-May to mid-June. In summer there is a dense mulch of dead herbage. In September the seeds produced in spring begin to germinate and by early October a green cover is again produced. The use of self-reseeding annual cover crops can reduce or eliminate the costs associated with purchasing and sowing seed each year. Proper choice and management of cover crops are important in maximising the benefits and reducing potential problems (Ingels *et al.*, 1994).

Some experimental results shown that subterranean clover can permit a good covering and weed control without high water competition on the vine (Masson, 1991; Campiglia and Caporali, 1995). This paper presents data collected over three years to evaluate self-reseeding cover crops and to determine the effect of different soil management systems on vine vigour, grape yield and must quality.

Materials and methods

The experiment was conduced in the period 1995-1998 at the Lizzos Station of the Consorzio Provinciale per la Frutticoltura, 15 km North of Sassari (Sardinia), and 50 m above sea level. The climate at Lizzos is typical of central Mediterranean area with a mild winter and an average annual rainfall of 540 mm. The soil is of a calcareous sandy type with pH (water) = 8.0. The vineyard was 15 years old, the vine growth system was a traditional espalier of the 'Vermentino' variety under rainfed conditions. The field was fertilised with 46 kg ha^{-1} $year^{-1}$ P_2O_5 and 50 kg ha^{-1} $year^{-1}$ K_2O. Four treatments were compared: A = early mid-season subterranean clover (*T. yanninicum* Katzn. et Morley cv Trikkala) cover crop; B = mid-season burr medic (*M. polymorpha* L. cv Anglona) cover crop; C = spontaneous cover by resident vegetation; D = traditional soil tillage (in March). Treatment A and B were fertilised with 18 kg ha^{-1} N and 46 kg ha^{-1} P_2O_5 before sowing. The experiment was designed as a randomised block with three replicates giving a total of 12 plots (15 vine plants, 5 m x 22.5 m in size). A and B plots were fully sown on 20 November 1995 at rates of 20 and 40 kg seed ha^{-1} respectively. No herbicide was used and weeds were also mowed and chopped along the rows. The number of seedlings and regenerating seedlings were counted in six quadrats of 0.12 m^2 randomly placed in each plot. Herbage covering rate and weeds presence was scored (min=1, max=9) monthly. Sward surface height was also measured monthly: plots were cut when legumes height reached to *c.*10-15 cm. Dry matter yields (DMY) were estimated in three quadrats of 1 m^2 in each plot. The percentage of *T. yanninicum* and *M. polymorpha* was estimated by botanical separation. Seeds were harvested in late June or July when pods were fully mature. Seed from six subsamples (25 x 25 cm) of each plot were collected. The number of seeds per pod and 1000-seed weight were then calculated. Grape yield and branches weight on 12 plants per plot was determined. Sugar content, acidity and pH of must were measured.

Results and discussion

Total rainfall was similar although it differed from year by year in its distribution: 502 mm, 525 mm and 446 mm in the 1995/96, 1996/97 and 1997/98 seasons, respectively. Rainfall was evenly distributed in 1995/96 with unusual rains in late spring that caused some damage to vines due to the development of *Plasmopara viticola*. In the second year there was a period of severe drought and high temperatures in February and March. A dry winter and rainy spring occurred in 1997/98. Seedlings re-establishment was always before the end of October. Flowering started between mid-February (second year) and mid-March (third year) without differences between cv Anglona and cv Trikkala. Seed ripening started around late April and the beginning of May. Full plant senescence took place in late May or at the maximum in mid-June (1995/96). The cv Anglona cycle was found to be a week longer than cv Trikkala in two years out of three. Vine budding started in late March while flowering occurred from late May to early June. The overlap between the end of the legume cycle and the beginning of a higher water demand period for the vine was limited. Burr medic established rapidly and covered the soil better than subterranean clover in the first year while the opposite was observed in the second year due to the large amount of hard seeds in *M.*

polymorpha which reduced the number of regenerating seedlings. In the third year Anglona re-established well and soil covering was similar in both legumes, ranging from 50 % to 75%. Spontaneous covering in treatment C was high and represented by annual species. More than 20 different native species were identified, with the presence of both long cycle winter and summer species. The main weeds were *Calendula officinalis* L. and *Stellaria media* Cyr., the latter was very aggressive on burr medic plots during the second year. Canopy height of Anglona was higher than Trikkala, 18 cm and 10 cm, respectively. Cover crop DMY was influenced by seasonal meteorological trends: two mowing were made in the first and second year while there were four cutting in the third. Three-year total DMY was quite low but higher in treatment A (5.7 t ha^{-1}) than in treatment B (3.9 t ha^{-1}) and C (3.3 t ha^{-1}). With regard to botanical composition, burr medic represented up to 50-60% of the total DMY in 1995/96 and 1997/98 while only 25% in 1996/97. The contribution of subterranean clover was always below 30% because of the accumulation of biomass below the mowing height (3 cm). Seed production of cv Anglona was very high in the first year, reaching almost 50,000 seeds m^{-2} but the soil seed bank decreased rapidly in the two following years (tab 1). The yield of cv Trikkala was much lower than cv Anglona but the seed bank and seed yield components were stable.

Tab. 1 – Introduced cover crops: seed bank and seed yield components.

	M. polymorpha			*T. yanninicum*		
Variable	1996	1997	1998	1996	1997	1998
Seeds m^{-2} (x 1,000)	49.7 (±4.4)	25.3 (±4.1)	9.3 (±1.6)	3.3 (±0.9)	5.4 (±0.5)	4.7 (±1.0)
Pods m^{-2} (x 1,000)	11.5 (±0.7)	7.0 (±1.2)	3.6 (±0.5)	1.3 (±0.3)	2.1 (±0.2)	1.8 (±0.4)
Seeds per pod	4.3 (±0.2)	3.6 (±0.1)	2.5 (±0.2)	2.5 (±0.1)	2.5 (±0.1)	2.1 (±0.2)
1000-seed weight (g)	4.1 (±0.1)	3.9 (±0.2)	3.2 (±0.2)	7.7 (±0.3)	7.2 (±0.3)	8.6 (±0.4)

the Standard Errors are reported in brackets

The emergence and establishment of cv Anglona was more regular than cv Trikkala (tab 2). Annual fluctuations were observed in burr medic in terms of re-establishment while the regeneration of subterranean clover was more than satisfactory in both autumn 1996 and 1997.

Tab. 2 - Introduced cover crops: establishment and re-establishment (no. seedlings m^{-2}).

Cover crop	29/12/1995	14/10/1996	04/11/1997	22/10/1998
M. polymorpha	465 (±51)	670 (±84)	2,942 (±259)	45 (±15)
T. yanninicum	154 (±22)	1,571 (±149)	1,185 (±110)	561 (±89)

the Standard Errors are reported in brackets

Despite the high seed production of cv Anglona, in the first year less than 2 % of seeds was estimated soft against about 46% in cv Trikkala. Re-establishment in autumn 1998 was unsatisfactory mainly for burr medic.

The effects of the treatments on grape production are reported in table 3. Natural covering affected grape yield negatively (-30% in comparison to traditional soil tillage). No negative effect on grape yield was observed using the annual self-reseeding legumes. By contrast subterranean clover increased vine yield mainly due to the significantly higher production in 1997/98.

Tab. 3 - Vine yield (t ha^{-1}) as influenced by cover crops and spontaneous cover.

Treatments	1995-96	1996-97	1997-98	Average
M. polymorpha	5.49	5.00	4.75	5.07
T. yanninicum	6.16	5.83	9.67	7.22
Spontaneous cover	4.91	3.71	3.16	4.00
Soil tillage	4.28	5.45	7.73	5.82
LSD P≤0.05	n.s.	1.34	2.08	0.82
Average	5.21	5.00	6.32	5.52

Average vine branches weight ranged from 656 g $plant^{-1}$ in treatment C to 972 g $plant^{-1}$ in treatment D, intermediate values were recorded for both cover crops without significant differences between treatments. The sugar content, acidity and pH of must were not significantly influenced by the treatments.

Conclusions

The results showed that appropriate varieties of annual self-reseeding legumes can be used efficiently as cover crops in vineyard under rainfed conditions. Subterranean clover and burr medic did not have negative effects on grape production, vine vigour and must quality but the use of resident vegetation was extremely unsuccessful. This means that cover cropping may be sustainable, particularly in hilly Mediterranean areas and thus reduce soil erosion (Piemontese *et al.*, 1995). In many situations, and also in Sardinia where agropastoral systems based on dairy sheep are widespread, autumn-winter mowing can be substituted by sheep grazing, making the sward management easier and more economical. Although subterranean clover and burr medic competed quite effectively with weeds it seems necessary to resow the cover crop in 3 to 5 years to ensure the dominance by these species. To improve the persistence of the cover, mainly for the annual medics, more suitable varieties must be selected and in particular the number of hard seeds must be reduced. Further studies are necessary to evaluate whether mixtures of self-reseeding legumes increase the chances of a long persistent stand.

References

Campiglia, E., Caporali, F. (1995). Confronto fra diverse tecniche di inerbimento negli arboreti specializzati dell'Alto Lazio. *Riv. di Frutticoltura*, 3, 57-61.

Ingles, C., Horn, M.V., Bugg, R.L., Miller, P.R. (1994). Selecting the right cover crop gives multiple benefits. *California Agriculture* 48(5), 43-48.

Masson, P. (1991). Enherbement des vignobles méditerranéens avec trèfle souterrain: bilan de 5 années d'expérimentation. In: *Proc. of Third International Symposium on "No-tillage and other soil management techniques in vines"*, Montpellier, France.

Piemontese, S., Pazzi, G., Argenti, G., Pardini, A, Talamucci, P. (1995). Alcuni dati sull'impiego di leguminose annuali autoriseminanti nella protezione dei territori declivi a elevata intensità viticola. *Riv. di Agronomia*, 29,3, 273-280.