SPONTANEOUS GREEN COVER AND COMPETITION: SYNTHESIS OF 5 YEARS OF STUDY IN THE RHONE VALLEY

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INTRODUCTION

The presence of green cover between rows of vines during winter months continues to be recommended since it does not compete with the vines. However the limitations imposed by green covering during the vegetative growth period of the vine [(3), (6), (7), (8)] have often lead vineyard managers to avoid this technique in less fertile vineyard plots. The limitations are linked to possible excessive competition for water resources [(1), (5)] but also to the difficulties associated with green cover management (4). This study has the objective of evaluating the relevance of spontaneous green cover, by considering the technical management as well as the competition between the vine and the green cover according to the amount of time it is present on the vineyard plot annually.

MATERIALS AND METHODS

The vineyard plots under study were selected where vineyard managers intuitively judged that the competition exerted by graminaceae green cover would be too high for their production objectives. The references for the 5 vineyard plots are as follows:

Departement	Vaucluse		Gard		Bouches du Rhône
Commune	St Cécile	Entrechaux	Valliguières	St Siffret	Rognes
Variety	Syrah	Grenache	Grenache	Syrah	Cabernet Sauvignon

The plots are all situated on calcareous soils of low to medium fertility, in Mediterranean zones with a plantation density close to 4000 vines/hectare.

The plots were followed from 2002 to 2007. The chose study design consisted of 4 blocks. Soil management was completed on all the rows. The methods tested were:
- Control (chemical removal of the winter flora starting from bud break)
- Natural permanent green cover
- Natural green cover chemically removed starting from flowering
- Natural green cover chemically removed starting from bunch closure

In the methods where chemical removal was used, the soil is maintained green cover free for the remainder of the season by using other chemical interventions (when necessary). The vine rows are also weeded.

The variables measured concerning the spontaneous flora and the vines:
Flora observation at four stages (bud break- flowering- bunch closure- harvest): Flora cover level, botanical identification of the main 5 species and eventual weed development stages.
Observation of growth arrest (apex fall): Counting the percentage of actively growing apices and growth arrested or dry/fallen apices by a simple visual method.
Harvest weight : Weight per vine, harvest weight and eventually the proportion of grapes affected by botrytis and number of grape bunches.
Weight of pruned wood : For each vine, shoot number count and weight of pruned wood

Petiole analysis at veraison: Dosage of principal elements (potassium, magnesium, phophorus) and weight of petioles
Must analysis at harvest: probable alcohol degree, total acidity, pH, assimilable nitrogen, anthocyanins and total polyphenols by classic maturity control methods
Biological characterization of soils (INRA Dijon methods- Rémi Chaussod): The variables measured were the soil organic matter characterization, the quantity and level of microbial biomass renewal as well as the carbon and nitrogen mineralization.

RESULTS AND DISCUSSION

Flora behaviour and Evolution

Spontaneous Flora Composition

The main species found are for the most part common across the vineyard plot network, however a greater diversity was initially expected. These vineyard plots are all located in Mediterranean zones on clay-calcareous soils. The dominant species are graminaceae species such as ray grass (*Lolium multiflorum* Lamarck.), crepis (*Crepis foetida* L.*, Crepis sancta* (L.) Bornm) or annual legumes such as medicago (*Medicago ploymorpha* L.) or melilotus (*Melilotus officinalis* L.). Table 1 listed the flora composition at the beginning of the trails on two vauclusian sites:

	Ste Cécile Syrah
Uncovered soil	18%
Ray-grass	71%
Senecio vulgaris	5%
Crepis foetida	2%
Veronica hederifolia	2%
Sonchus asper	1%
Other	1%

	Entrechaux Grenache
Uncovered soil	39%
Ray-grass	41%
Veronica hederifolia	7%
Crepis sancta	5%
Clover	3%
Capsella bursa-pastoris	2%
Other	3%

Table 1: Soil occupation repartition of two plots in March 2002

One of the fears that comes with spontaneous green cover is the development of summer crops (Canadian Horseweed – *Conyza canadensis L. Cronq.*, redroot pigweed – *Amaranthus retyroflexus L.*) or perennials (Bermuda grass -*Cynodon dactylon* (L.) Persoon) that will compete with the vines for resources. This fear is in particular for the treatment methods that are not weeded. Across the whole network of vineyard plots it was only seen on one plot, where *Cynodon dactylon* was already present at the beginning of the trials. On the other hand, on the St-Siffret plot where *Conyza canadensis* was already present at the start of the study, it disappeared with the development of spring species that dried out at the start of the summer.

Among the dominant species, most end their biological cycle during the season or dry out when the rainfall conditions are not favourable. In fact, over the 5 years of study, the drying occurs often during the month of June (beginning June for 2005 and 2006), between flowering and bunch closure. The competition induced by the spontaneous flora could therefore only be exerted between bud break and drying out, if it occurs (Figure 1). Moreover the dry residual cover left by the spring cover reduces the presence of summer cover crops.

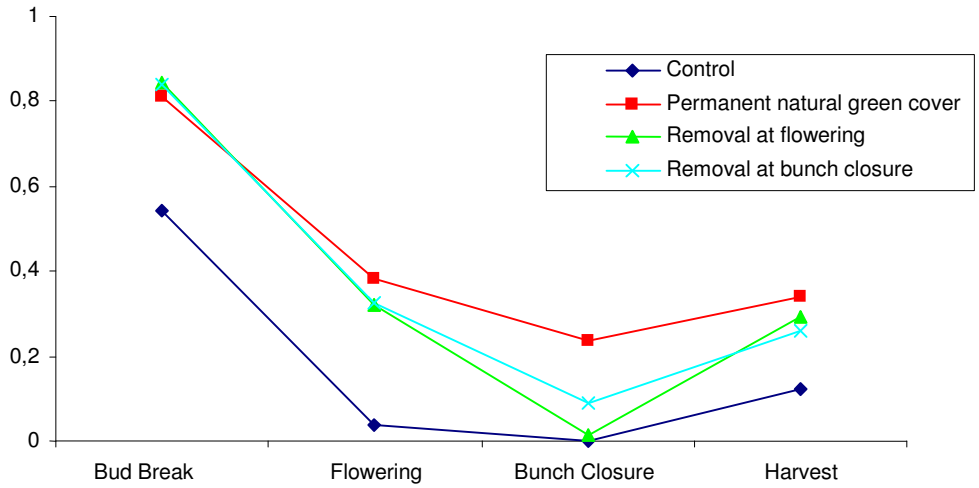


Figure 1: Green weed cover level – Sainte Cécile 2006

At bud break, the control after a few years normally has a lower green cover level than the other methods. The flora removal using chemicals starting from bud break (control) therefore leads to a gradual decrease in soil green cover in the following spring. In fact, the maintenance of uncovered soil during the whole vegetative season, even if the herbicides used only act at the foliar level, clearly limit the re-colonization of the soil starting in the fall. The fall and winter soil green cover level of the vineyard plots is therefore strongly dependant on spring time soil management. This observation is particularly of interest for protection against soil erosion during the spring and surprisingly also for the autumn-winter (improvements noted with delayed green cover removal).
Moreover, the species diversity encountered (at least at the threshold of 1%) is closely related to the when the herbicide treatment is applied. Generally, the earlier the removal is in the season, the lower is the number of species found during the counting (Table 2)

	Ste Cécile Syrah	St Siffret Syrah	Entrechaux Grenache	Valliguières Grenache	**Average**
Control	7	7	9	6	**7**
Natural permanent green cover	12	11	15	9	**12**
Removal at flowering	9	10	9	7	**9**
Removal at bunch closure	11	11	11	8	**10**

Table 2: Total number of species found during the counting at bud break 2006

In order to encourage biodiversity preservation, interventions aimed to remove green cover should be limited to periods where interventions are evidently needed (marked competition, development of invasive species…)

Do the different cover management programs applied induce a selection for certain species?
Statistical analyses (variance analyses) used to link the soil cover management program with a particular species did not show any net or stable relationship over time between these two parameters. However, locally, there can be species that are found often enough and well represented within a management program. Perennial species of such as bermuda grass (*Cynodon dactylon* (L.) Persoon.), rush skeletonweed (*Chondrilla juncea L.*) or field bindweed (*Convolvulus arvensis* L.) can often develop where there is permanent green cover or where only simple cutting is used. However, this was only observed in a significant manner on one of the five vineyard plots. On the other hand, the presence of no cover at spring **due to weeding at bud break** sometimes favours the appearance

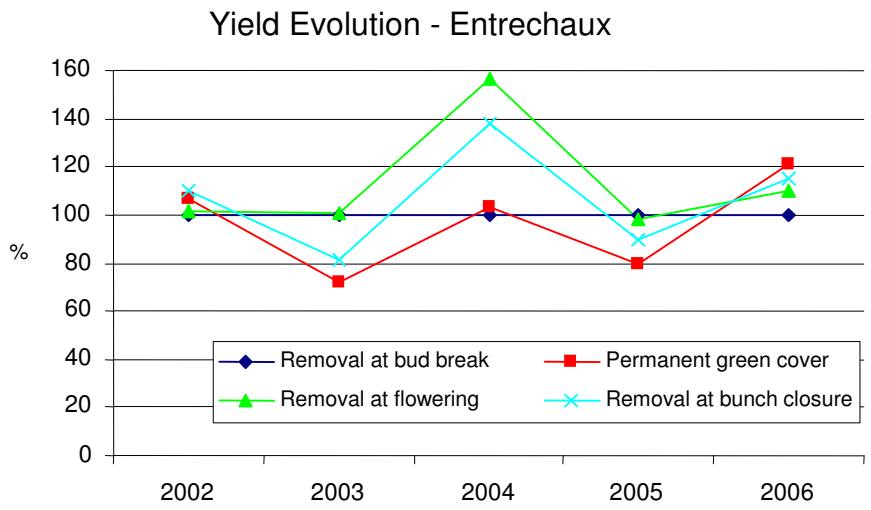
of a particular flora: green foxtail (*Setaria viridis (*L.) P. Beauvois.), Wild radish (*Raphanus raphanistrum* L.), redroot pigweed (*Amaranthus retroflexus* L.)… These species absolutely call for a second removal passage since they are very likely to induce strong competition with the vine if they are not removed.

What are the consequences on the soil?
The soil analyses completed at the beginning of the study and three or five years later showed that the presence of permanent green cover (and to a lesser extent cover removal at bunch closure) allows for an increase in organic matter in the soil. However, the quantity of microbial biomass in the soil and the carbon and nitrogen mineralization are not systematically modified.

Evaluation of the competition generated by green cover presence

Consequences on the growth and vigour of the plant
In the situations studied, the halt of vegetative growth is lightly or not influenced at all by the green cover duration. When differences are observed, they are too small to induce different vine behaviours. The presence of green cover, even permanently, does not accentuate the water restriction: if vine defoliation did occur, visually it was identical everywhere.
It was also found that the mineral supply, measured by petiole analyses at veraison, was identical across all the treatment methods.
However, a prolonged presence of spontaneous flora clearly reduces the vegetative expression and the average vigour of the vines. These differences are regular for the permanent green cover method but are less systematic in the green cover removal methods at flowering or bunch closure. The differences observed during the weighing are also clearly visible by simply observing the vineyard plots.

Consequences on the yield and harvest quality
In terms of technological and phenolic maturity, the analyses did not show notable or reproducible differences between the treatments.
The effects on yield are variable between vineyard plots. These results are presented on the following graphs:



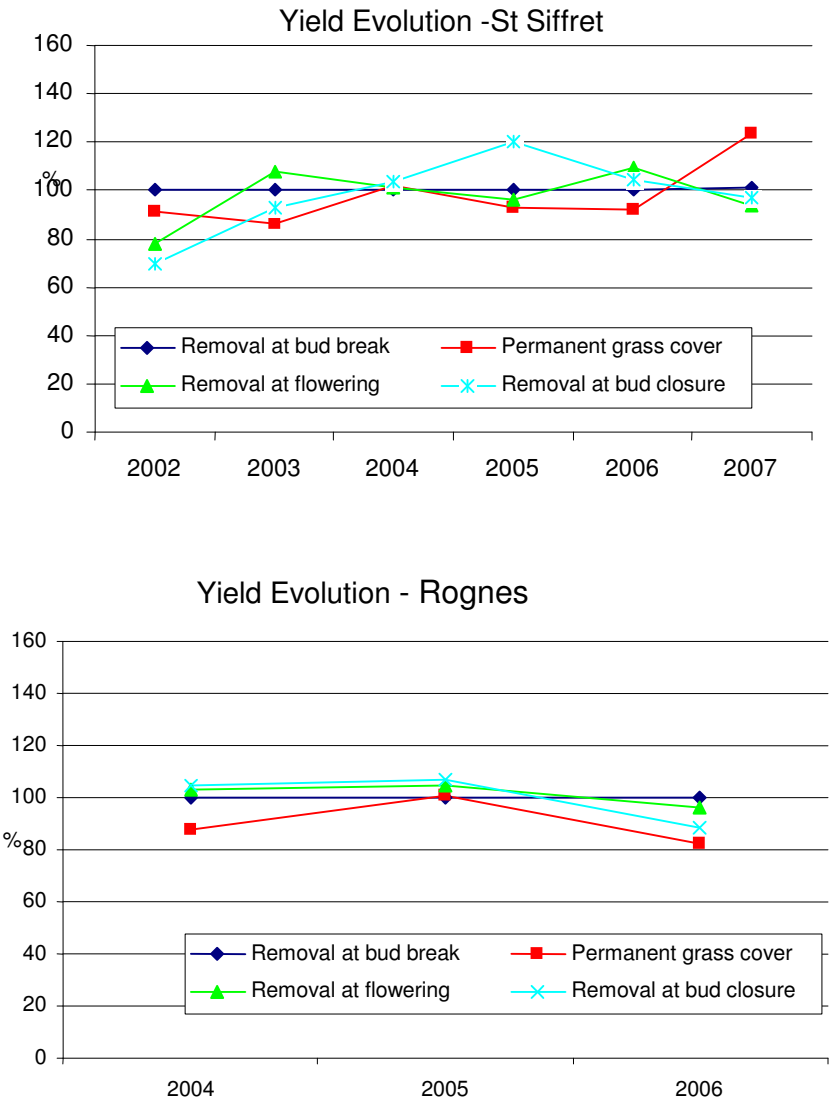
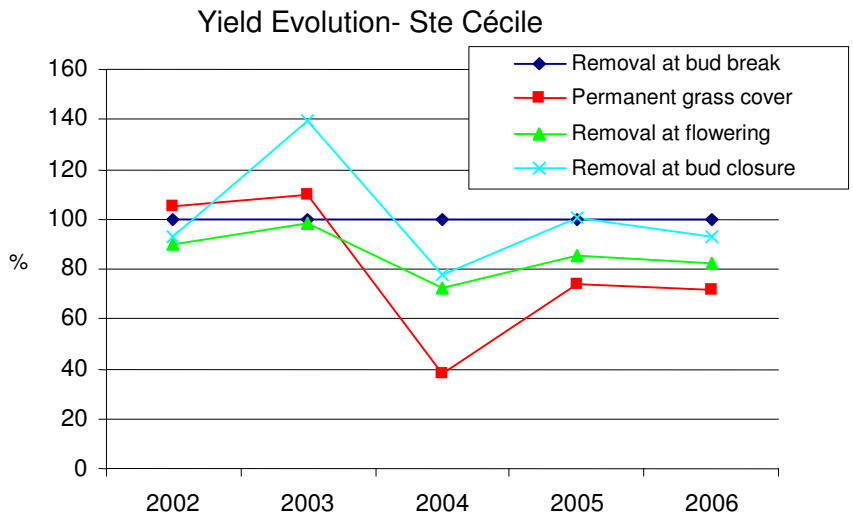


Figure 2, 3 and 4: Yield Evolution - Plot little or not affected by a decrease in yield

For Entrechaux, St- Siffret and Rognes, the presence of green cover has no or little effect on the quantity of grapes produced; independent of the date of green cover removal.



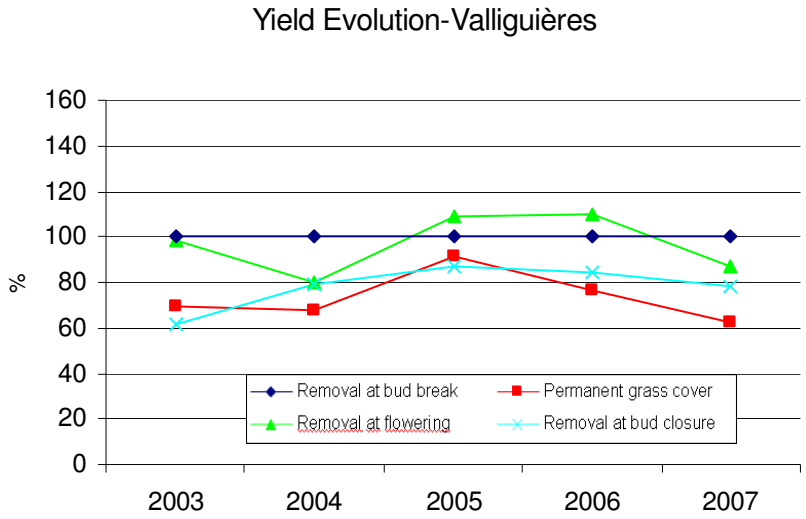


Figure 5 et 6: Yield Evolution - Plots affected by a decrease in yield

On the St-Cécile vineyard plot, the effects are irregular across the vintages. When a decrease in yield is observed, it is correlated with the duration of the green cover. This decrease is due to a lower bunch weight; the number of bunches/vine were similar. A notable and continuous effect of the green cover on the weight per vine was observed only on one vineyard plot of the five. Not surprisingly it was the Valliguières vineyard plot, the only plot with a significant presence of Bermuda grass in both the permanent green cover and removal at bunch closure treatments (Figure 6). The average difference in yield is around 30%, therefore a significant difference. We state that the removal of Bermuda grass at bunch closure (beginning of july) is too late to avoid its competitive effect on the production.

Take Note

In the spontaneous green cover trial conditions, a large part of the green cover dries out between flowering and bunch closure (during June). The flora diversity as well as the amount of organic matter increase with an increased duration of green cover on the plot. Green cover removal at flowering or at bunch closure of an already well-developed green cover usually eliminates the need to complete a second intervention. This also favours the maintenance of a mulch layer of dry residues which is particularly interesting to limit erosion risks and to avoid the proliferation of summer perennials.

The presence of green cover during all or part of the vine cycle causes only limited or no competition with the vine in most of the cases observed. This competition mainly affects the vine vigour and often yield and maturity is equivalent. Only the cases where there was cramping with perennials caused significant decreases in yield that did not allow for the production objectives to be met. In these cases it is necessary to remove the green cover starting from the beginning of June. These cases are less frequent than we initially expected and easy enough to identify and to therefore intervene and control.

The presence of green cover (even permanent) does not accentuate water restriction: the vine defoliation is comparable across all the treatments when it occurs.

Spontaneous green cover can therefore be implanted in a large number of situations and managed using simple observations in key periods of the season (flowering, bunch closure)

The maintenance of uncovered soil during the whole vegetative season remains the method of choice only for soils that are particularly infertile and on those where production objectives are not attained.

Spontaneous green cover with weeding on the vine rows is actually one of the least costly technical treatment methods available to the vineyard manager. This method should therefore be privileged as soon as possible.

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Abstract :
Spontaneous grass cover and competition: Synthesis of 5 years of study in Rhône Valley
This study concerned Mediterranean limestone soils and was conducted on a five plots network where soil conditions would not theoretically support grass cover sown in between rows (due to possible excessive competition).
Different spontaneous grass cover methods were tested to evaluate the competition in the vineyard for vigour, yield, grape berry maturation and also the flora evolution linked to these management practices. The results from 2002 to 2007 are presented here.
The flora species is normally more important in the technical itineraries where grass cover is present for a longer amount of time. The presence of grass cover also favours an increase in organic matter, however the other organic components of soil are only partly affected. Between 2002 and 2007, the grass cover dried in June. It induces limited competition on the vines. A decrease of vigour is observed, but not a regular and frank decrease of yield.
Keys words: *Spontaneous grass cover, competition, yield, vigour, spontaneous flora*

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