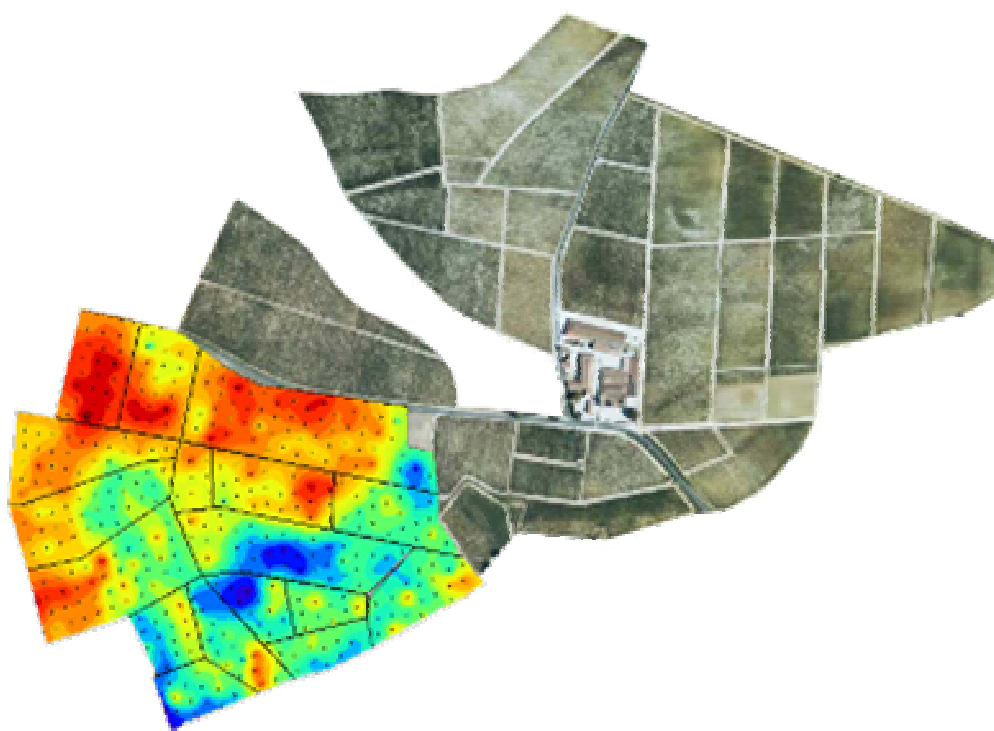


## *SOVIVINS' approach of « terroir »*



## Introduction

Linking products to their terroirs, expressing their very essence: here are the aims of SOVIVINS.

The notion of terroir refers to the interaction of natural environmental factors (geology, topography, pedology and climate), biological factors (grape variety and rootstock) and human factors (wine growing and oenological practices).

The “soil effect” is particularly dependent on water status which varies according to the features of both soil and vintage year. The occurrence of water deficit is the main qualitative factor. However, a serious water stress leads to the deterioration of leaf area and can involve prejudicial blocks during ripening process. Thus, the water status monitoring is essential to optimize soil and vine management. Most often, we need an intra-plot scale monitoring.

## Available instruments to assess water deficit

Beforehand, it's fundamental to highlight the importance of pedology. Setting up an accurate soil map contributes to evaluate viticultural and oenological potentialities of soils and their spatial spreading (*Figure 1*). Physical parameters (soil and subsoil's texture and structure, porosity, compactness, hydromorphism) provide data about soil ability to retain water and vine possibilities to absorb it. Therefore, it directly affects vine's water feeding. These soil studies and maps should be done before planting in order to chose rootstocks, grape varieties, clones, drainage system, fertilizers types and amount, pre-plantation cover crops, trellising system (*Figure 2*)...

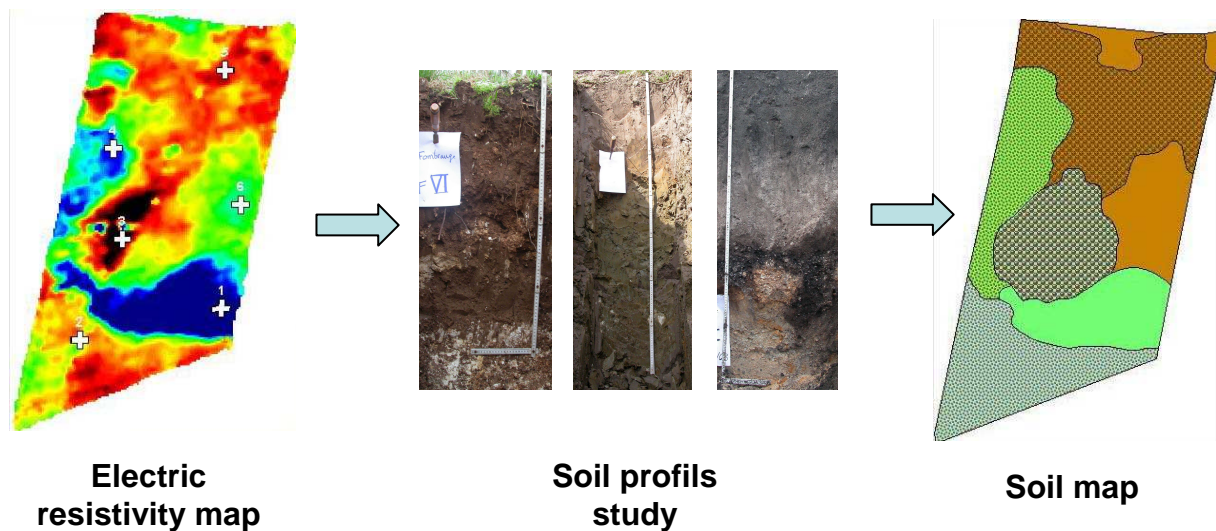


Figure 1 : Soil mapping methodology

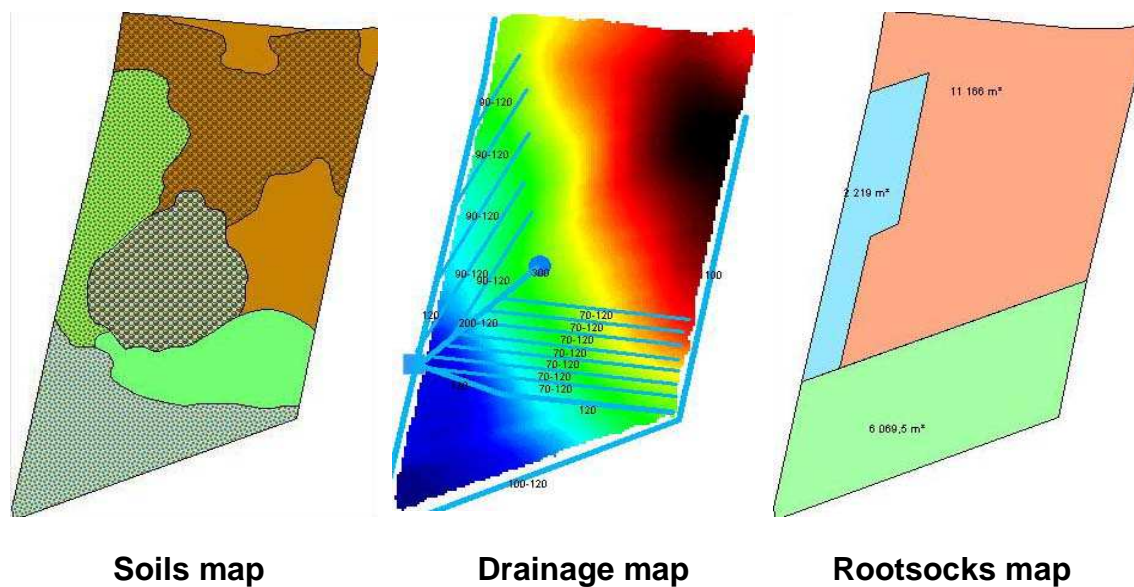


Figure 2 : Several soil map applications

Such studies are not only useful before planting but also to manage plots of fully-grown vines as regards organic matter and mineral salts sustainment, cover-cropping... On the other hand, they are not sufficient to assess and adapt vine hydric behaviour for each vintage.

SOVIVINS advises two complementary instruments for measuring vine water deficit.

## *Water potential measurements*

The water stem potential (WSP) represents the capacity of vine to drive soil water until atmosphere. These measurements, made with a pressure chamber (*Figure 3b*), are contingent upon the difference between potential water loss (due to the air temperature and hygrometry, and to the wind speed) and real water loss (due to the potential water loss, the sun-exposed leaf area, and the availability of water in contact with roots). In most of the case, it appears as the most accurate water potential measurement among the different possible uses of a pressure chamber. It enables to specify a hydric “itinerary” for each plot by following water deficit throughout the season (*Figure 3c*). For many vintages, we have used WSP to assess water deficit on some of the best terroirs. Today we have a precise idea of the best water deficit evolution, followed by the WSP, to obtain grapes with high oenological potentialities.

To optimize the number of measurements and when to make them, we regularly study the climatic water balance in many weather stations located at estates we work with. This assessment is also a very useful and objective tool to compare vintage years together (*Figure 3a*).

As part of irrigation monitoring, the follow-up of water stem potential helps to plan out amounts and dates of watering for an optimal water status.

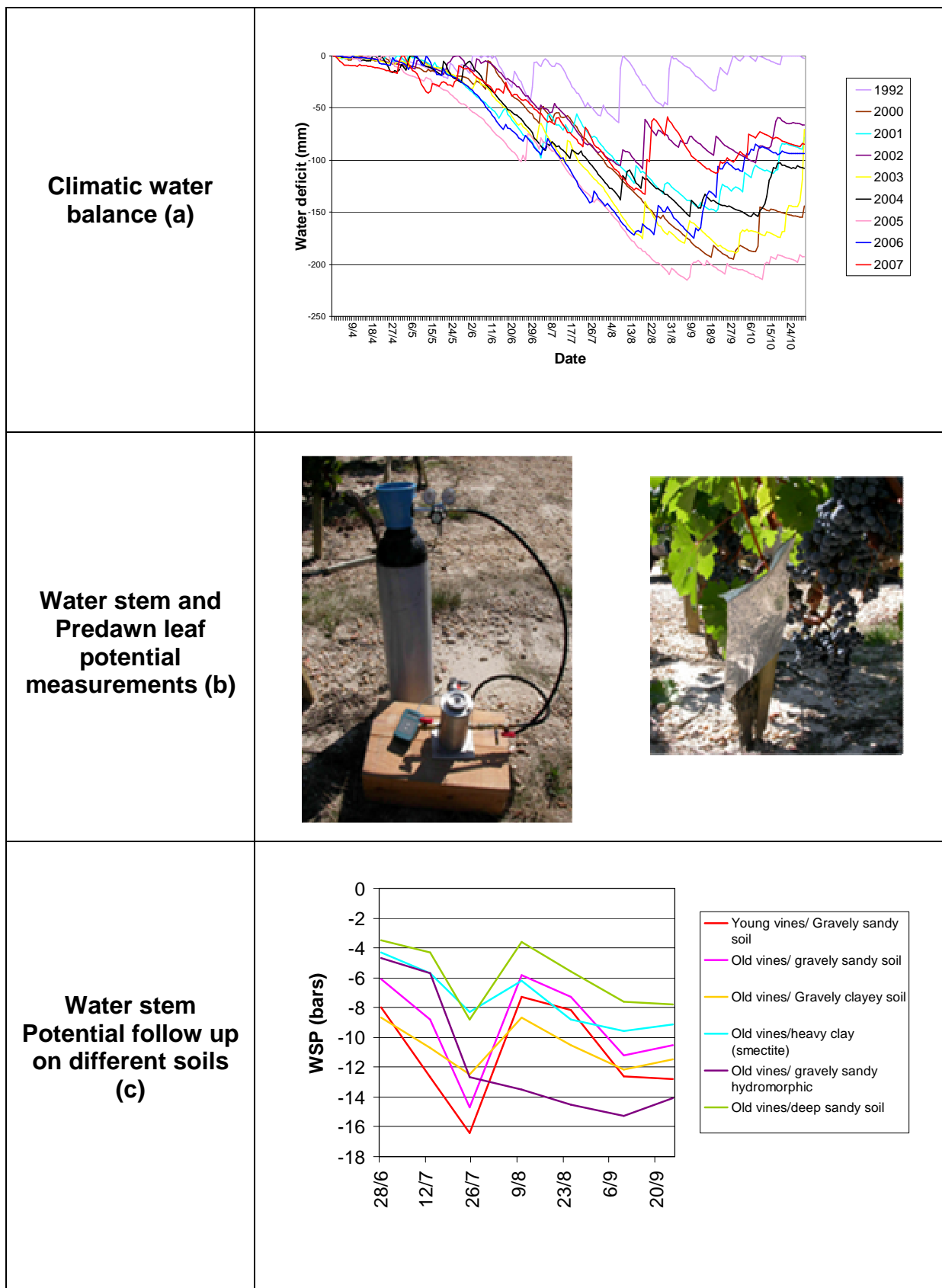


Figure 3 a), b) and c): Water Stem Potential - method and results

Nevertheless, water stem potential shows some limits:

- In case of serious water stress, in a substantial evaporative demand, the water stem potential might be completed with predawn leaf water potential (water potential measured at the end of the night), in order to differentiate the vines according to their nocturnal ability to recover a water status which enables them to work
- The time necessary to carry out the measurements does not enable to know precisely the water deficit distribution on an intra-plot scale. (intra plot monitoring during grape harvest, answer to irrigation and leaf area adaptation).
- It is a destructive testing: only a limited number of measurements can be done on each vine.

### *Delta C13 measurement, a further instrument*

Compared to water potential measurements, Delta C13 measurement is really easier and much faster too.

#### **General principle**

Earthbound atmosphere contains 98,9 % of  $^{12}\text{C}$  and 1,1 % of  $^{13}\text{C}$ . The photosynthesis enzymes, especially RUBISCO, have a better affinity with the lighter one ( $^{12}\text{C}$ ). When the stomata are opened, the carboxylation of biphosphate ribulose thanks to RUBISCO generates a high amount of organic molecules integrating  $^{12}\text{C}$ . When stomata opposition increases, isotopic discrimination is lower. Enzymes continue to use  $^{12}\text{C}$  until it is unavailable, then they use  $^{13}\text{C}$ . Delta C13 measurement before harvest quantifies this discrimination integrated since the organic acid synthesis (organic acid will become sugar...) up to ripened grapes. Delta C13 values are spaced out -28 ‰ to -20 ‰, the latter value representing a serious water deficit. A moderate water deficit, beneficial for quality, corresponds to values between -24 ‰ and -22 ‰.

Secure links are established between Delta C13 and the quality of harvest, which represents the first advantage (*Figure 4*).

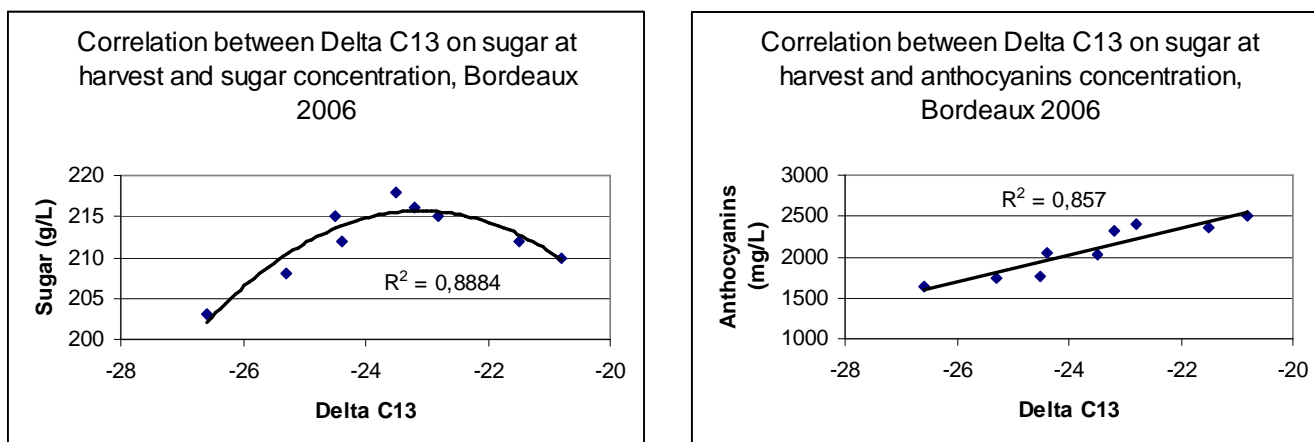


Figure 4 : Relations between Delta C13 on must sugar and several grapes qualitative parameters

The second one is that you can easily make many spots to have a subtle knowledge of the vineyard.

It allows to obtain a map integrating vine water deficit with only one sampling date, 15 days before harvest (but there is no need to sample at a precise date). We only need 5  $\mu$ L of must per sample for the analysis but we pick up 50 berries to have a representative sample.

### Methodology : Water state mapping with Delta C13

- Grapes sampling and GPS reading
- Delta C13 analysis
- Geostatistics processing and map creation

As a result, we can design a water status map which is a sustainable and powerful instrument for vineyard management (*Figure 5*).

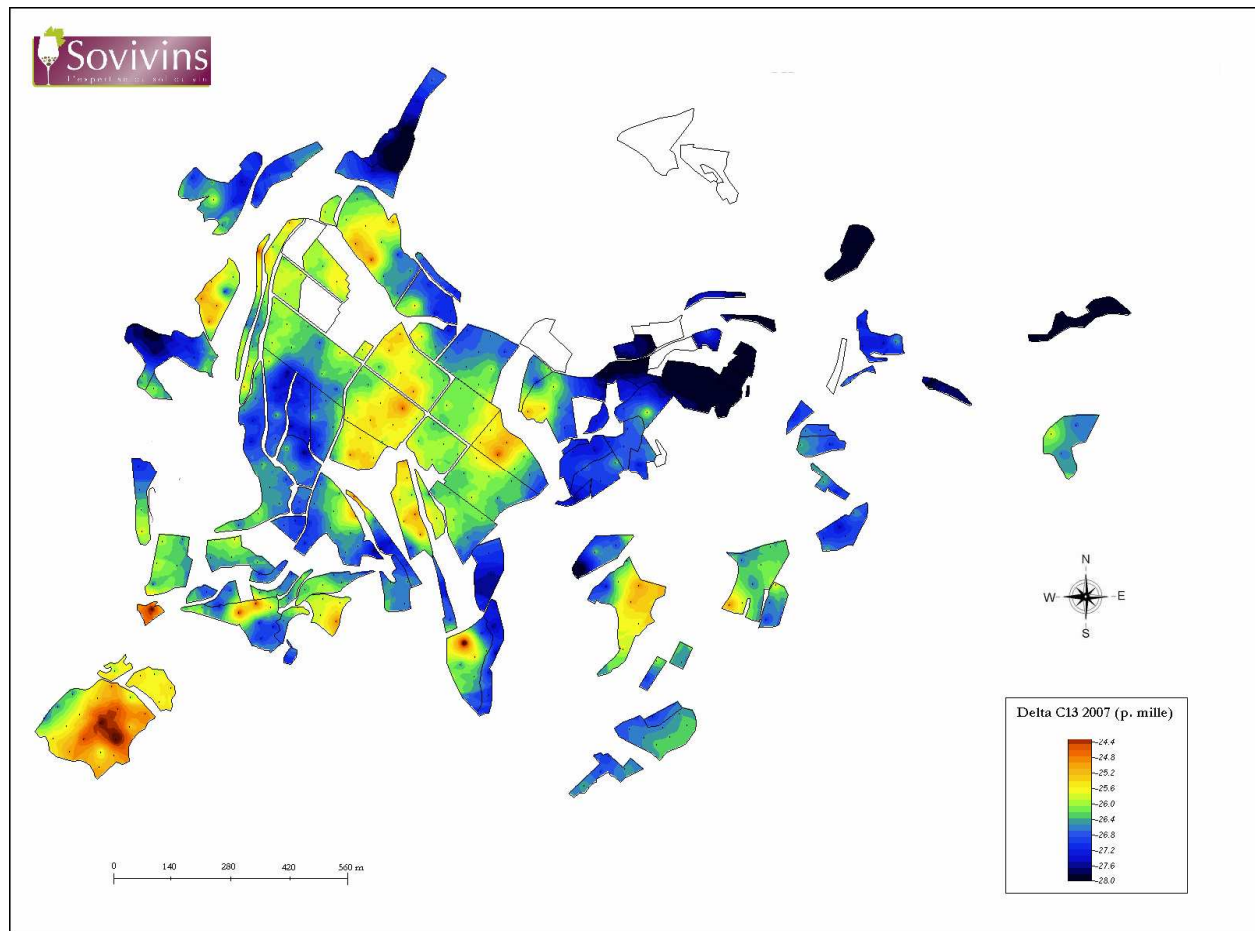


Figure 5 Example of water status mapping by Delta C13 and geostatistic processing (Spain, 2007)

### Various applications can be forecasted

- Qualitative zoning in order to make intra plot selection during grape harvest
- Definition of green work priorities (green harvest, lateral bots removal)
- Crossing watering map (Delta C13) and nitrogen status map in order to adapt soil up keeping modalities: temporary or permanent green cover, more or less competitive green cover, scrapping and ploughing deepness and time...(Figure 6)
- Leaf areas adaptation for each plot depending on water status

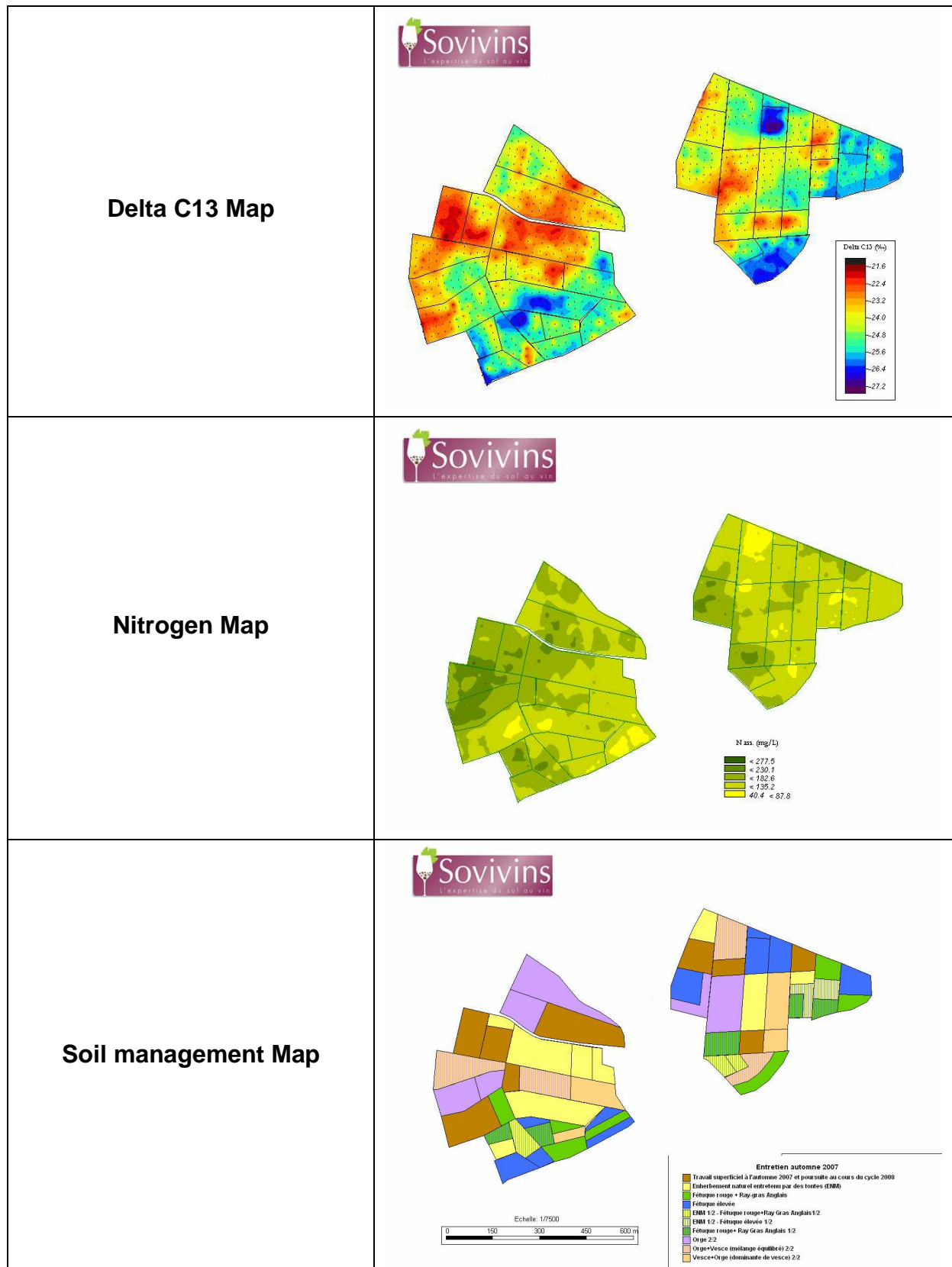
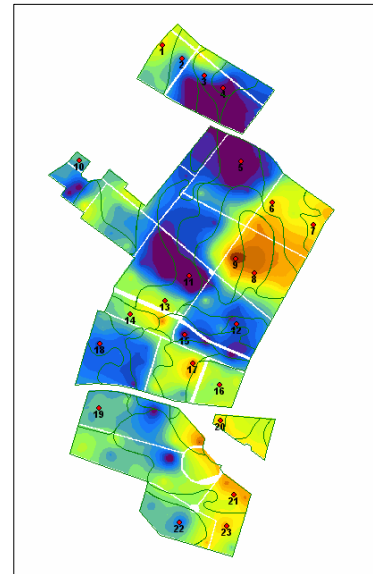


Figure 6 Soil management based on crossing water and nitrogen data

## Interest in irrigation monitoring

Water status map established thanks to Delta C13 measurements increases the precision of irrigation monitoring in different ways:

- Vine positioning for water stem potential monitoring (Figure 7)
- Definition of representativeness area for each water stem potential measurement
- Check the validity of irrigation strategy and its relevance
- Water amount adaptation in an intra plot scale



**Figure 7 Water Stem Potential monitoring based on a water status map**

## Conclusion

Water stem potential assessment and delta C13 measurement must not be opposed; both of them have their specific and quite complementary advantages:

→ **WSP** enables to highlight the occurrence of qualitative, moderate, early water deficit, when delta C13 cannot be measured yet. More generally, WSP reveals the evolution of water deficit. **It is a sensitive, dynamic indicator, which must be carried out several times a year.**

→ **Delta C13** “records” water stress throughout the ripening. It enables to set out a perennial hierarchy of qualitative potentials, thus helps to define a range of products according to their phenolic constitution. It eases and optimizes irrigation management by means of WSP while it reveals homogeneous water-stressed areas. **It is an integrating indicator, carried out once and for all** to design a water status map, but it can sure be used punctually afterwards to check the cumulated water stress, especially when watering.