



Technical note n°8

**Wine Quality relation book
Valagro Nutrition and Polyphenols**

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Technical Note n° 8 – May 2007

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NUTRITIONAL STRATEGIES AND PHENOLIC SITUATION.

THE VALAGRO EXPERIENCE IN SOME ITALIAN REGIONS.

Colugnati G., Crespan G., Cattarossi G.

The fertilization is a very important and delicate moment among all the horticultural applications in the vineyard management. A correct fertilization regulates plant productive capacity and its strength, achieving the right balance between leaf wall and grapes. In these conditions the vine can accomplish its potential and consequently can achieve high yield and also overcome adverse conditions and pathogenous.

Grape nutritional needs are easy to satisfy and the requirement of different fertilizers is due to phenological phases.

Besides the availability of nutrients necessary to the growth and the production is a consequence of soil physical-chemical and rootstock morpho-physiological characteristics, and also of climatic situations and nutrients mobility inside the plant. The nutrients effect on qualitative parameters of wine crops is still to be studied; despite it is already known the important role of macronutrients such as nitrogen, phosphorus, potassium on accumulation and degradation of sugars, organic acids and colouring matter, much is still to be discovered, especially about micronutrients, on the accumulation of high substances which mainly influence the perceived quality of wine (Conradie and Saayman, 1989).

Nitrogen happens to be the nutrient the most studied, taking into consideration its role in plant physiology and its influence once applied on physiologic balance (Ruhl et al., 1992; Webster et al., 1993; Rom 1996, Colugnati et al., 1997).

Nitrogenous fertilizations increase plant strengths moving along the plant-productive balance into a yield even excessive. When the sugar rates stay unchanged, the increase of plants' strength influences microclimatic conditions rising risks of high shading, slowing the degradation of malic acid (Porro et al., 1996) and reducing the enzymes activity of phenolic metabolism.

Phenols accumulation is determined by the presence of nitrogen (Colugnati et al., 2000).

The changes of phenolic content depend directly on protein synthesis and the accumulation of phenolic substances directly concurs with the protein synthesis, which is stimulated by the availability of nitrogen or of other factors such as water availability that improve growth activity (Kliewer, 1977).

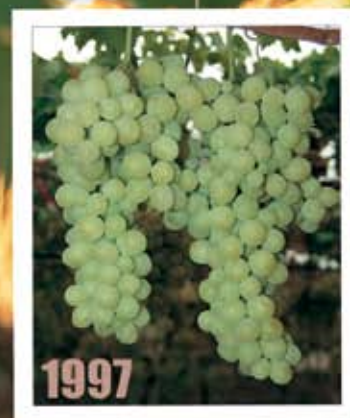
Nitrogen contribution lowers the content of phosphorus, potassium and boron, both in laminae and stalks, while it happens to improve calcium and magnesium absorption highlighting connections of antagonism and mutualism.

Also nitrogen influences the rate of aromatic pre-



cursors and aminoacids in must.

To grant a correct development is necessary to maintain the right balance between the plant and reproductive component, avoiding both plant nutritional deficiencies, which may reduce the potentiality and any excess, which often causes quality deficiencies due to the plant tips nutrients needs at a disadvantage of bunches of grapes and the microclimate favourable to cryptogams attack.



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Moderating the nitrogenous and fertilizers contributions, the qualitative standard of oenological productions increased.

The reduction of contributions and the application of purified mineral fertilizers effected, in medium-long term, the appearance of deficiency and/or sub-deficiency phenomenon on different elements, to which plants react with a contraction of metabolic activities, which concerns secondary metabolic ways and consequently the deposition of red colorants.

As well as the amount of fertilizer, the application time can effect in different ways plants behaviour. Usually in soil applications it is possible to choose the unique application in pre-flowering, considering the effect of nitrogen on plant-productive balance, or the fractionated distribution in two applications, one in post fruit set, the other in flowering. Fractioning further contributions may increase distribution costs, even if that can better satisfy plant needs, fitting the single nutrients availability with the real needs. Those considerations make the foliar fertilization the most common application in modern vinegrowing.

This kind of application presents many advantages:

- It provides plant with an adjusted nutrition even in adverse conditions;
- It is characterized by an improved efficacy and a readiness of action for resolving deficiency situations and for restoring normal metabolic activity;
- It reduces the dosage applied and soil losses;
- It can be associated with normal phytosanitary applications, highly reducing distribution costs;
- It improves plant-productive balance, accelerates ripening processes and achieves a higher extraction of berries phenolic substances.



The choice of this strategy necessitates a better knowledge about plant physiology and the effect of nutrients applied, indispensable to a proper distribution protocol.

For that reason it seems interesting to report the experience of aerial fertilization, on red berry varieties, both autochthonous as Montepulciano and Schioppettino and international as Merlot and Cabernet sauvignon. This experiment was performed in biennial 2005-2006 in four production plants (tab. 1) which are located in as many DOC areas of three regions which, because of their dislocation, are characterized by different climates such as cool temperate (Friuli Venezia Giulia), hot temperate (Abruzzo) and dry hot (Sicilia).

THE NEW REVOLUTIONARY IDEA BEHIND THE CONCEPT OF ABSORPTION

BREXIL, the well-established line of specific products to prevent and treat micronutrients deficiencies in foliar application, now benefit from an important innovation in addition to the LSA complex which:

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Location Capriva (GO)

Variety	Distance in rows	Training system	Load of buds (n/vine)	Soil management
Merlot	1,85 x 0,90	Guyot	6-8	Turfed

Location Ronchi di Cialla (UD)

Variety	Distance in rows	Training system	Load of buds (n/vine)	Soil management
Schioppettino	2,80 x 0,90	Guyot	6-8	Turfed

Location S. Clemente (PE)

Variety	Distance in rows	Training system	Load of buds (n/vine)	Soil management
Montepulciano	2,20 x 0,90	Rammed string	11-12	Processed

Location Mezzocorona (AG)

Variety	Distance in rows	Training system	Load of buds (n/vine)	Soil management
Cabernet sauvignon	2,20 x 1,00	Rammed string	12-14	Processed

Tab. 1 Main characteristics of experimental plants

The purpose of the experiment was to verify, on different varieties and environments, the effect of foliar fertilization of low dosage nutrients, with regular application depending on the phenological phases, comparing it with the soil distribution usually applied in farms.

In that order in every plant three parcels were identified per every kind of fertilization.

Then in every parcel five plants were identified considering the number of left and blossomed buds, the weight of the yield, the number of bunches and the bunch average weight.

At every grape harvest we examined a sample of grape taking in consideration the rate of sugar, pH, total acidity, Z/A index, concentration in potential and extractable anthocyanins, colour extractability, content in total polyphenols and grape pip percentage. In the vineyards in Friuli we



examined the ripening curve from post-ripening to the harvest. The characteristics of products and the protocol of foliar fertilization are illustrated on table 2 and 3.

Tab. 2 Main characteristics of products

Product	Composition	Characteristics
MC Cream	Mn (1,5%), Zn (0,5%)	Active phytoingredients in cream
Brexil Combi	B (0,9%), Cu (0,3%), Fe (6,8%), Mo (0,2%), Mn (2,6%), Zn(1,1%)	Specific to prevent and treat micronutrient deficiencies in foliar application
Kendal TE	Cu (23%), Zn (0,5%), Mn (0,5%)	Nourishes and strengthen plants
Kendal	N (3,5%), K ₂ O (15,5%), C (3,0%)	Improves yield quality
Boroplus	B (11,0%)	Prevents and treat boron deficiency
Brexil Mg	MgO (8,0%)	Micronutrients complexed with LSA
Brexil Ca	CaO (20%), B (0,5%)	Micronutrients complexed with LSA
Plantafol 5.15.45	NPK 5-15-45 + B(0,02%),Cu(0,05%), Fe(0,1%), Mn(0,05%), Zn(0,05%)	NPK foliar integrators with chelated micro-nutrients

Tab. 3 Products and dosage applied depending on phenological phase

Phenological Phase	Product and dosage			
Flowering	MC cream (2,0 l/ha)	Brexil Combi (2,5 kg/ha)	Kendal Te (2,5 l/ha)	
After 15 days	MC cream (2,0 l/ha)	Brexil Combi (2,5 kg/ha)		
Pre-flowering	MC cream (2,0 l/ha)	Boroplus (1,0 l/ha)		
Pre-fruit set	MC cream (2,0 l/ha)	Boroplus (1,0 l/ha)		
Post-fruit set	Kendal (3,0 l/ha)			
Post- fruit set	MC cream (2,0 l/ha)	Brexil Mg (2,0 kg/ha)		
After 15 days	MC cream (2,0 l/ha)	Brexil Ca (2,0 kg/ha)		
Pre-ripening	Kendal (2,5 l/ha)			
Post-ripening	MC cream (2,0 l/ha)	Plantafol 5.15.45 (3,0 Kg/ha)		
After 15 days	MC cream (2,0 l/ha)	Plantafol 5.15.45 (3,0 Kg/ha)		

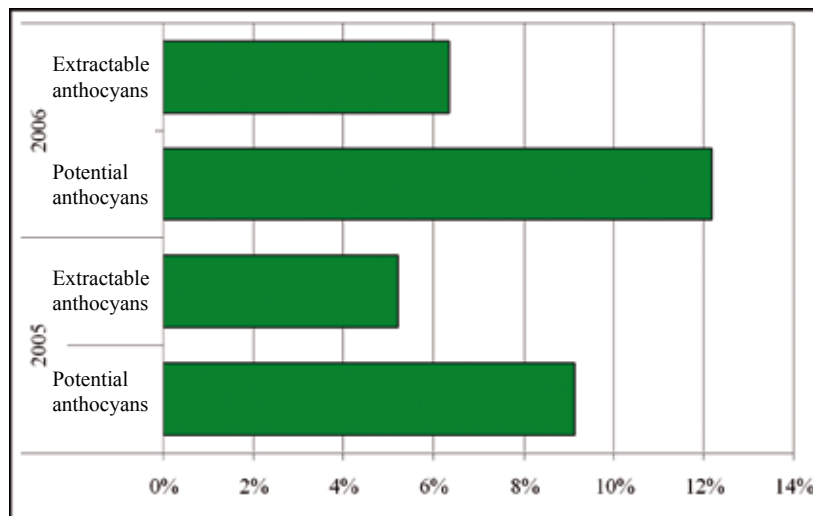
Please note that in 2005 in the grape harvest time the climate was cool and rainy; in 2006 we had higher temperature and less rainfall.



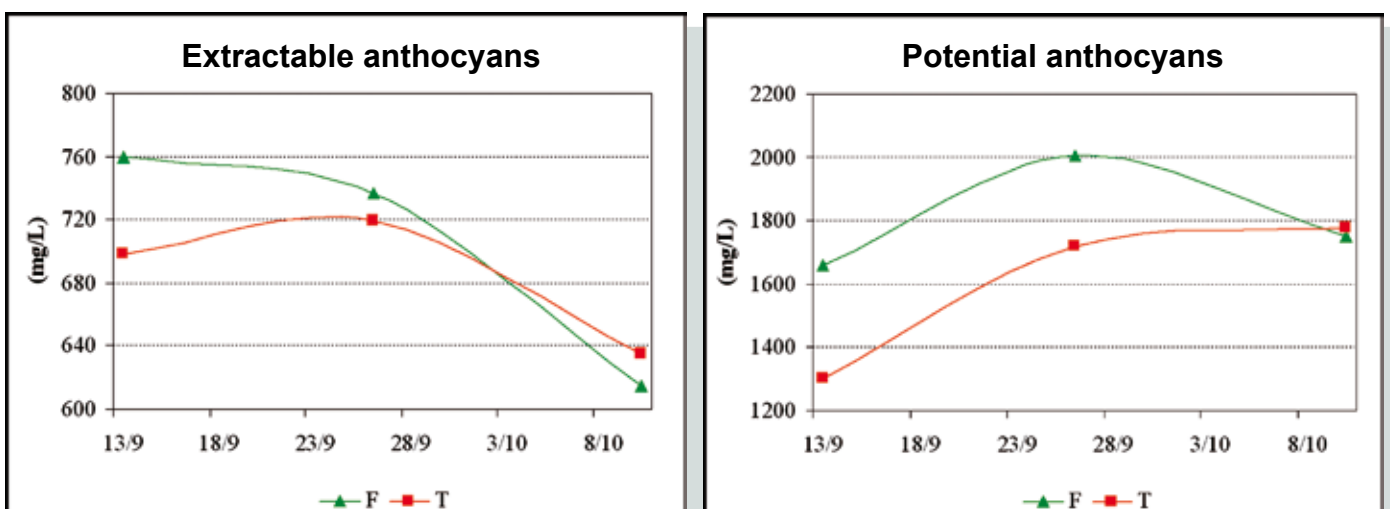
First experimental results

Following we report the first experimental checking obtained in single plant, starting from the cool climate of Friuli Venezia Giulia. Merlot plant-productive behaviour in the vineyard in Capriva does not show any significant differences due to the fertilization strategy. The statistic analysis evidences a substantial homogeneity regarding the fertility of buds, the quantity of product, and the bunch and grapes average weight. Also the para-

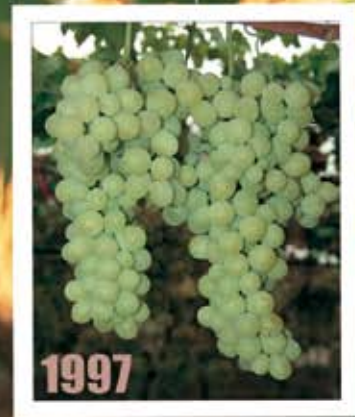
meters relating to post-ripening at grape harvest technologic ripening are approximately the same. On the other way around, the concentration of potential and extractable anthocyanins in buds highlights since the first year, a higher superiority of foliar fertilization compared to the test, both in ripening and grape harvest. This trend was confirmed in 2006 with a differential increase in comparison with the first experimental year (tab. 1).



Tab. 1 Effect of foliar fertilization on concentration of potential and extractable anthocyanins, on Merlot, in the area of Capriva (GO), in 2005 and 2006 (rates compared to the test).



Tab. 2 Accumulation of potential and extractable anthocyanins during the ripening (Schioppettino 2005) (F) = foliar application (T) = test



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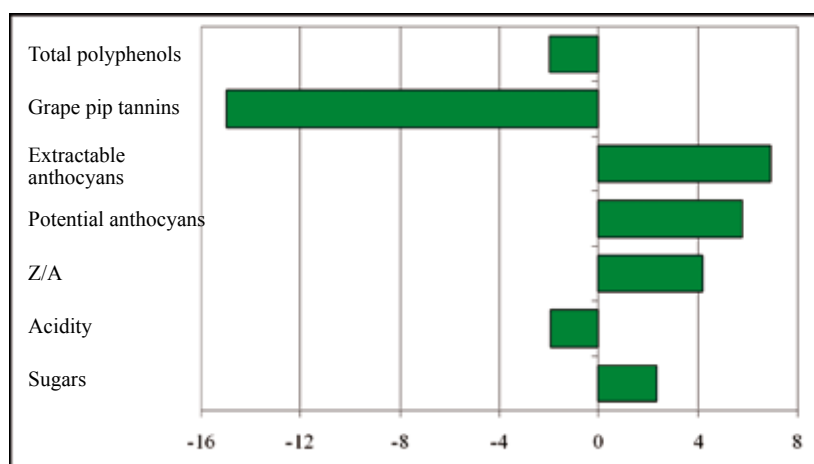
Concerning the plant in Ronchi di Cialla, the situation is more complex: considering that any influence was shown on parameters of plant-productive behaviour in the biennial, technological, phenolic and cellular dynamics of ripening showed differences depending on the strategy of fertilization.

Specifically in 2005 we reported an evident superiority concerning the accumulation of polyphenols and particularly of potential and extractable anthocyanins during the ripening which decreased

until the disappearance at grape harvest time (tab. 2).

In 2006 those differences were reported also at grape harvest time concerning potential (+ 6%) and extractable (+7%) anthocyanins and grape pip tannins (-14,9%).

Besides we reported, although not supported by statistics, an interesting increase compared to the test concerning sugars deposit (+2,3%) and the index of Z/A technologic ripening (+4,2%) (tab. 3).



Tab. 3 Effect on foliar fertilization on the ripening level of buds of Schioppettino, grown in the area of Cividale, Ronchi di Cialla, in 2006 (rates compared to the test).



The behaviour of Montepulciano in Abruzzo was more or less homogeneous in the biennial. There were not reported differences at plant-productive level (fertility, yield, bunch weight and grape weight) nor regarding technologic ripening (sugars/ acidity ratio).

On the contrary the phenolic situation showed the influence of fertilization strategy, specifically the parcels at foliar application had a better yield, both in single years and the biennial average.

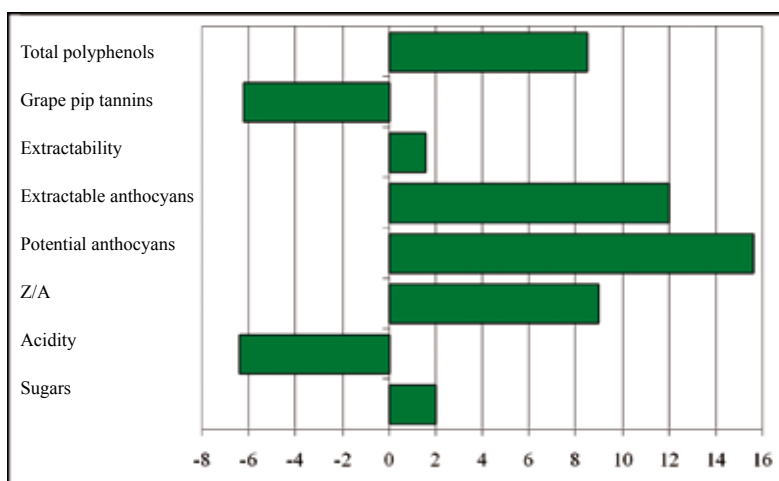
The higher concentration of potential (+15,6%) and extractable (+12%) anthocyanins, associated with a lower contribution of astringent tannins (-6,2%) and a higher polyphenolic contribution (+8,5%) reported in foliar fertilization, show a richer presence of sweet tannins and red colorants which improve the fullness and persistence of taste and also the longevity of wine (tab. 4).

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Tab. 4 Effect of foliar fertilization on technological ripening grade and on phenolic situation of buds of Montepulciano d'Abruzzo in the area of Bolognano, S. Clemente (average 2005-2006) (rates compared to the test).

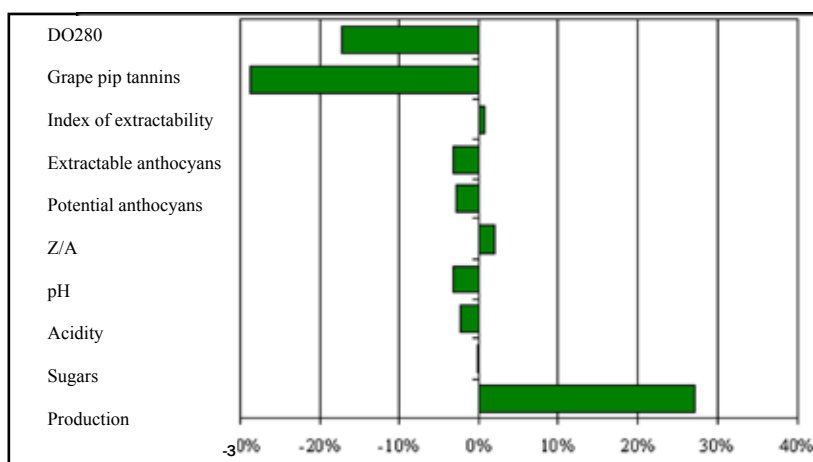
The Cabernet sauvignon in Sicilia reported peculiar characteristics, in comparison with the other areas and between the two years compared. In 2005 we reported a relevant yield increase (over 25% in weight) on parcels in foliar fertilization, without any decrease in quality due to the same phenological situation and to the higher amount of total polyphenols (+17%) consequence of a bigger amount of grape pip aggressive tannins (+29%) (tab. 5).

The followed year the yield was very similar to the previous. We reported though an increase of concentration of total polyphenols (+11%) and of both potential (+14%) and extractable (+12%)

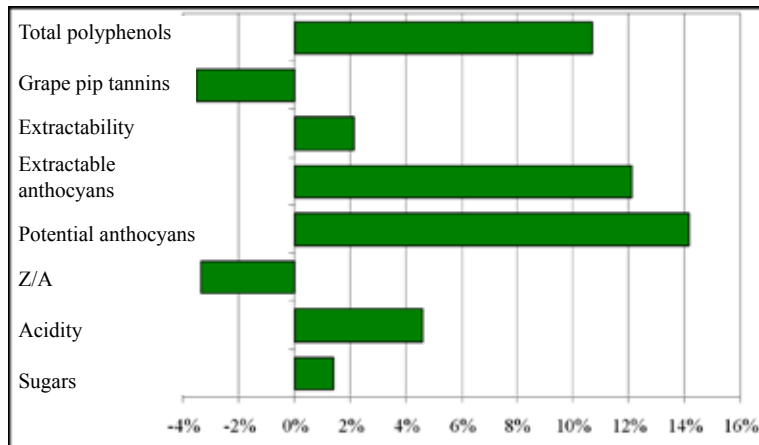
anthocyanins in the phenolic situation.

Balancing the production we reported a considerable improvement concerning the accumulation of red colorants and in general of phenolic substances, but it did not happen with grape pip tannins which showed a similar concentration.

In sum, with the aerial application in 2005 we had a significant yield increase and consequently a slight decrease of total polyphenols content on disadvantage of grape pip tannins, in 2006 at the same average yield we obtained richer, more concentrated and complexed musts able to produce wines susceptible to a prolonged ageing (tab. 6).



Tab. 5 Effect of fertilization strategy on Cabernet sauvignon cultivated in Sicilia (Melfi Mezzocorona) in 2005 (rates compared to the test).



Tab. 6 Effect of foliar fertilization on qualitative level of buds of Cabernet Sauvignon cultivated in Sicilia (Melfi Mezzo-corona) in 2006. (Rates compared to the test).

Final conclusions

At the end of this biennial we can report indications about the use of the protocol of the distribution of nutrients based on low aerial dosage in comparison with soil distribution.

Foliar fertilization did not effect much plant-productive parameters and bud technologic ripening: on the contrary it significantly effected dynamics of red colorants accumulation.

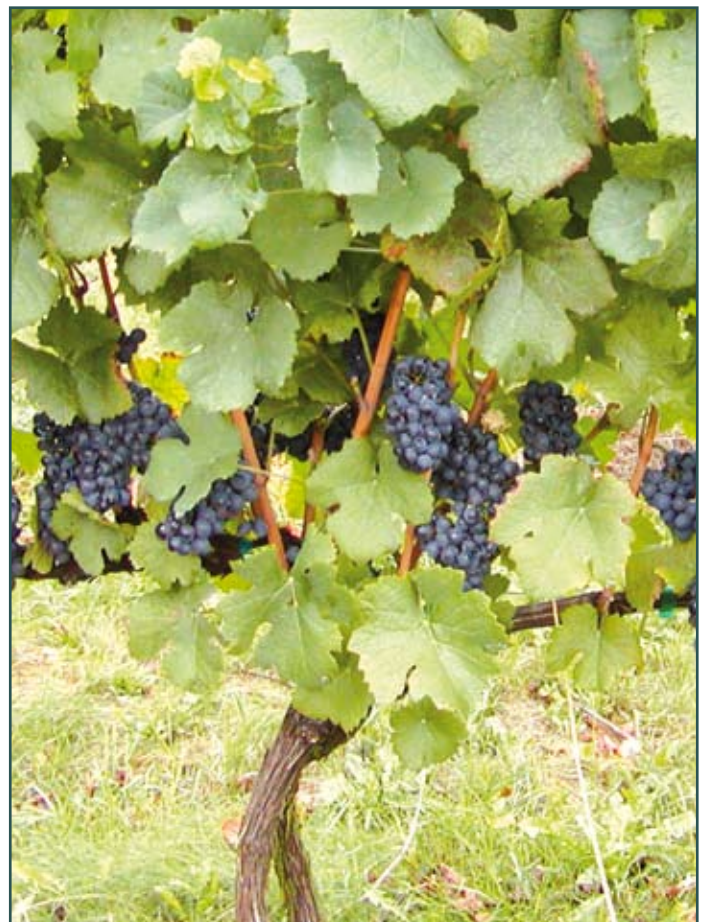
Likely the used protocol achieved to overcome all the sub-deficiency phenomenon, which negatively interferes with metabolic secondary ways, decreasing the deposit of polyphenols and a higher number of both potential and extractable anthocyanins.

Also the aerial application showed encouraging results of different varieties concerning the origin, the harvest time and the length of plant-productive cycle; on the other side due to the use of the applications according to the phenological phases the application naturally conforms to the variety with the consequential balance of the stream of nutrients independently from the precocity of the vineyard and the climatic situation.

Despite all the efficacy of the fertilization strategy was influenced by the climatic situation, which accentuated or hid the effect: in sum if the climate does not improve the nutrients absorption by the soil which can happen in drier years, an oportune protocol of aerial fertilization achieves a

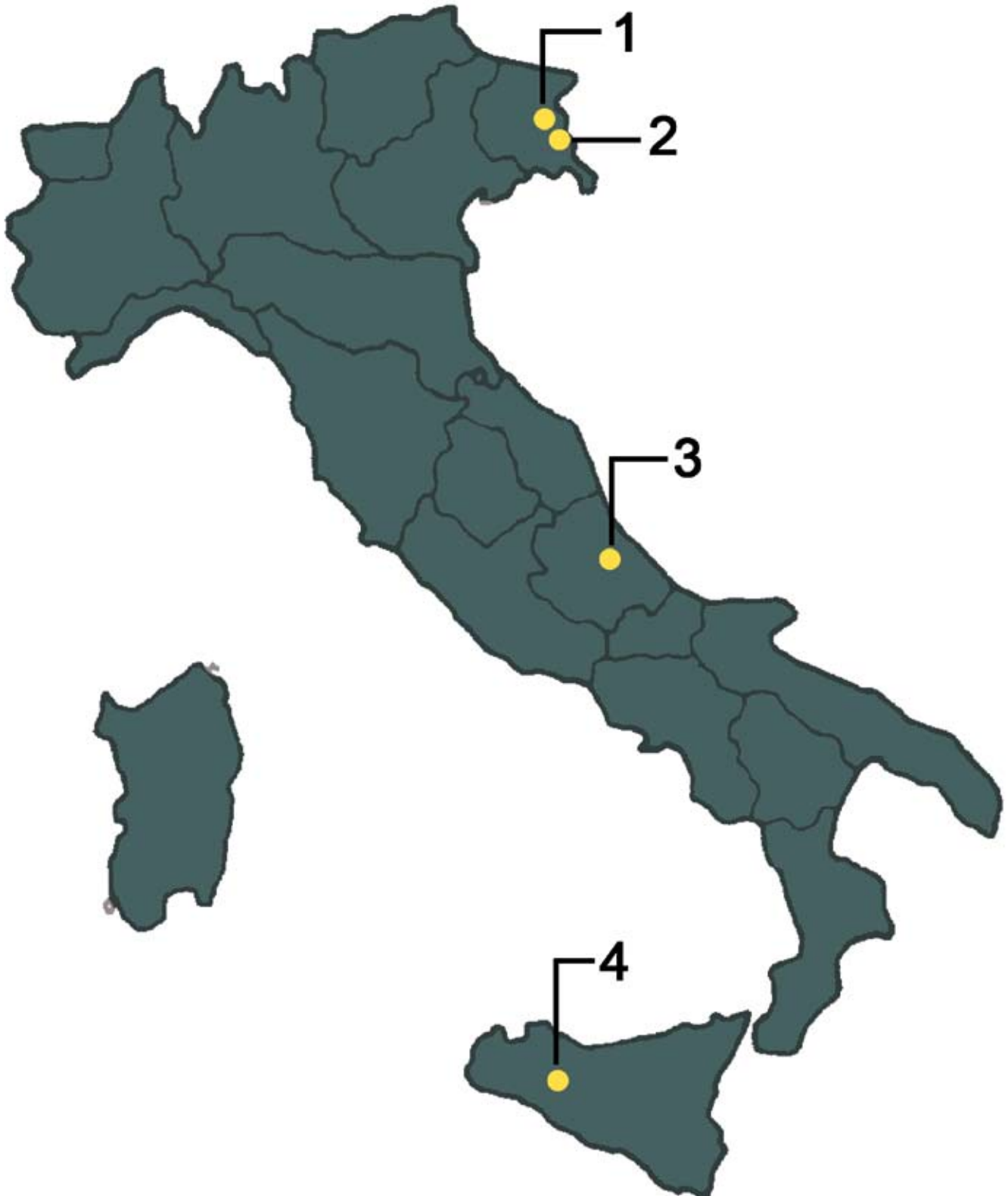
higher qualitative differential compared to humid and rainy years.

During this experimental activity we decided to verify the possibility of drastically reducing the number of applications, with the purpose of limiting the company costs and designing suitable foliar applications which can boost the differential obtaining musts with higher quality.



Vineyard experimental areas

1. Ronchi di Cialla (UD) DOC "Colli orientali del Friuli"
2. Capriva (GO) DOC "Collio"
3. Bolognano (PE) DOC "Montepulciano d'Abruzzo"
4. Mezzocorona (AG) DOC "Sambuca di Sicilia"



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