PRODUCTIVITY, QUALITY, AND THERMAL NEEDS OF THE PIEDIROSSO VINE: FOUR YEARS OF OBSERVATIONS.

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Abstract

The effects of temperature on cv Piedirosso, indigenous of the Campania region (South of Italy), were tested in order to study its possible influence on grapevine and to discover how to optimize the qualitative expression of the cultivar. Relationships between evolution of the main must components, berry weight, and heat requirement of the cv Piedirosso were studied. The cv Piedirosso showed itself to be suitable to the area tested. We evidenced a reasonable agreement of the model of Amerine and Winkler's estimation as to the thermal needs of cv Piedirosso. The heat requirement of the cultivar was determined in 1750-1850 degrees/day (DD) to obtain a sugar content of 21-22 °Brix, a pH of 3.10-3.20 and a titratable acidity of 8-9 g/l; to obtain a higher sugar content of musts (23-24 °Brix, pH of 3.2-3.3, titratable acidity of 8-9 g/l) the thermal needs is 1800-1900 DD.

1. Introduction

The viticulture of the Campania region (South of Italy) is rich in accession and unfortunately, unknown for the most part. About 70 accessions can currently be counted. Among these, an important place is occupied by the Piedirosso vine. Well known since antiquity, it competes with various DOC (Vesuvio rosso, Campi Flegrei) and DOCG (Taurasi) wines, nevertheless it hasn't been studied in relation to its environmental adaptation, or more precisely, in relation to kinetics of degradation and of accumulation of the berry components. Studies of grapevine adaptability are very important in order to evaluate environmental influences on production and quality. These studies, through the estimation of the heat requirement of a grapevine, suggest the optimal placing of the cultivar into a data *terroir*, in order to reach the best genotype-environment ratio and to improve the qualitative expression of the cultivar. Another objective of these studies is to verify the response of the model utilised to estimate the heat requirement of a data cultivar in a data *terroir*: to reach this objective it's necessary to study the adaptation of a cultivar during an adequate number of years: in the case of Piedirosso, 4 years of observations were necessary. For all the reasons just expressed, it seemed right to undertake the present study that completes the results obtained by a phenological study of the accession (Scaglione et. al., 1998 a) and to follow previous trials concerning other grapevines (Scaglione, 1996; Scaglione et al., 1998 b, c, d; Scaglione et al., 2000 a, b), put it in a long standing program, to estimate the environmental adaptation of the most interesting grapevine authoctons of the Campania region.

2. Materials and methods

Observations were carried out in the four-year period 1993-'96, on seven-year-old plants of the Piedirosso/420A grapevine grown at the Radici vineyard (owned by Mastroberardino), situated at Lapio (province of Avellino) (lat. north: 40° 59', long. east: 14° 57' Greenwich) at 590 m a.s.l. In the month of December of each year, the same bud-load was left on 20 plants, arranged according to the rectangular plan of 2,50 x1,20 m, trellis trained and Guyot pruned, leaving with winter pruning 10 buds on the cane and 2 buds on the spur. The 20 plants were subdivided into two groups of 10, the first being used for periodical analyses conducted on samples of clusters while the plants of the second group were left undisturbed up to complete ripening, so as to carry out customary yield analyses at harvest. To determine the phenological stages of veraison and ripening, reference was made to the refractometric dry residue, setting them at 9 (Boselli et al., 1996) and 21 °Brix (Intrieri et al., 1988) the respectively reference for the veraison and maturation phases (settled according to the destination of product, considering a determinate equilibrium between the must components).

>From fruit-set to ripening in each year, 3-4 clusters were sampled at weekly intervals and used for the following determinations: 100-berry weight, refractometric content (°Brix); pH; titratable acidity (g/l). At harvest the yield, the number and the weight of the clusters and the berry weight was recorded. In December of each year, the pruning wood was weighted. The air temperature was monitored in the period from 1st April to the 31st October of each year, using an instument shelter positioned in the vineyard. To quantify the thermal needs of the Piedirosso, the temperatures were converted into thermal-units according to the model of active thermal summations of Amerine and Winkler (1994).

3. Results

3.1 *Soil characteristic and thermal units accumulations*

The trial was conducted on a clay-limous-subalkaline-calcareous-soil (Table 1). The soil was characterized by a low dry-matter, N, Fe, Mn, content and a normal P content; it was very rich in K, Mg, Ca, and Cu. During the year 1994 the thermal availability (Picture 1,2,3 and 4) was higher than the other years: from 1st April until 31st October, the active thermal summation was 1996 degrees-day (hereafter shown as DD). In 1993, the thermal availability of 1981 DD was about the same as that of '94. During '95 1834 DD were registered; in '96, 1648 DD.

In 1994, the maximum accumulation in a 10-day-period, of 160 DD, occurred between 32th until 34th week. In 1993 the maximum accumulation of 175 DD, occurred from the 31st until the 32th week.

Table 1 - Chemical-physical soil analysis in which the trial was conducted.

Sand	%	0,38
Lime	%	0,26
Clay	%	0,36
pH	%	7,8
Carbonates	%	15,87
CaCO3	%	6,4
Organic matter	%	1,55
C/N ratio		10
C.E.C.	meq/100 g	28,66
Mg/K ratio		3,88
N	%	0,9
P	ppm P205	66
K	ppm K20	482
Mg	ppm MgO	806
Ca	ppm CaO	6588
Na	ppm Na	27,5
Fe	ppm Fe	9,05
Mn	ppm Mn	1,77
Zn	ppm Zn	1,75
Cu	ppm Cu	6,07
B	ppm B	1,14

Table 2 - Yield, quality, vegetative parameters, thermal needs, measured at harvest for the Piedirosso vine, during the period from '93-'96. for the Piedirosso vine, during the period from 1993-1996

Year	1993	1994	1995	1996

Day of vintage				
Day of vintage	26-oct	26-oct	23-oct	22-oct
Julian day	299	299	296	296
Bud fertility (clusters/bud)	1,06±0,11	1,25±0,09	1,09±0,08	1,18±0,13
Yield/vine (Kg)	2,07±0,24	1,99±0,21	1,75±0,25	1,78±0,28
Clusters/vine (numbers)	12,7±1,14	15,0±1,39	13,1±1,11	14,2±1,34
Cluster weight (g)	163±34	126±31	125±29	125±34
Berry weight (g)	2,35±0,11	2,31±0,09	1,87±0,06	2,18±0,07
Sugars (°Brix)	23,84±0,41	24,29±0,44	24,05±0,56	24,92±0,06
pH	3,50±0,04	3,41±0,03	3,12±0,02	3,00±0,03
Titratable acidity (g/l)	6,95±0,31	8,30±0,46	10,01±0,47	9,00±0,39
Pruning wood (Kg/vine)	1,12±0,11	1,16±0,14	1,26±0,11	1,3±0,09
Ravaz index	1,85±0,16	1,71±0,09	1,30±0,14	1,37±0,15
Thermal needs (DD)	1974	1956	1778	1634

During the years '95 and '96 with lesser thermal accumulation than the previous years the ten-day-period maximum accumulation was respectively of 170 and 150 DD; in both years it was reached between the 29th and 31st week (data not reported).

3.2 *Seasonal variation of sugar and thermal accumulation*

The mass of sugar in the berries of Piedirosso starts to increase when heat accumulation is about 700 DD (Picture 1). The sugar content showed a slow increase during a first period, with a similar evolution at the variations observed in the Fiano and Aglianico grapevines, previously studied in the same place (Scaglione et al., 1998 a, op.cit.; Scaglione et al., 1998 b op. cit.); in the following period up to the ripening (21° Brix) and beyond, the mass of sugar increased rapidly. The rapid increase of sugar began the 34th (years '93, '94, '95), and the 36th week (year'96). The phase of the rapid increase in the mass of sugar began when the thermal accumulation was about 1250 DD (Picture 1). The duration of the period before the rapid mass of sugar was from 34 (years '93 and '94) to 48 (year '95) days, extending therefore considerably in the years with a lower thermal availability. The phase of veraison (9° Brix) happened during the 34th-36th weeks with a thermal availability of 1300-1400 DD. The phase of ripening (21° Brix) happened from the 40th until 42nd week with a thermal accumulation of 1750-1850 DD.

3.3 *Seasonal variation of titratable acidity and thermal accumulation*

The degradation of titratable acidity (picture 2) started from the 30th until 34th week when the temperature availabilities were of 900-1200 DD. The value of 8 g/l, according to the opinion of wine makers considered suitable for obtaining a good wine using Piedirosso, was obtained when the thermal accumulation was of 1800-1900 DD.

3.4 *Seasonal variation of pH and thermal accumulation*

The pH levels reached at vintage time, probably due to higher values of air temperature, similar to that found for Fiano (Scaglione et al., 1998 b, op. cit.), were higher in the years '93-'94 with higher thermal availability: a value of 3,2 was reached on the 39th– 40th week when the thermal accumulation was of 1750-1850 DD; values of 3,4-3,5 were obtained on the 43rd week with a thermal availability of 1950-2050 DD. In the years '95 and '96, with lower thermal availability, the pH values obtained were lower: the value of 3,0 was obtained on the 41st -43rd week, when the thermal availability was of 1600-1700 DD.

3.5 *Seasonal variation of the berries weight and thermal active summations*

In ’93 and ’94 the best weight of the berries was 264g and 231g respectively began both on the 43rd week when the thermal active summation was 1900-2000 DD. In’95 and ’96 the best weight of berries was 220g and 207g respectively: it began both on the 43rd week when the respective thermal active summation was 1750-1850 DD and 1600-1700 DD.

3.6 *Yield and qualitative parameters recorded at vintage*

The vintage time occurred in each year on the 43rd week. The heat active summations, registered at vintage time vintage were 1974, 1956, 1778, 1634 DD respectively for ’93,’94,’95 and ’96 years. The bud fertility in each year was more than 1; it assumed the highest value in ’94 (1,25), in ’93 the lowest (1,06). The number of clusters showed few variations among ’94,’95, ’96 years in which were respectively registered 12,7g, 15,0g, 13,1g, 14,2g. In ’93 cluster weight, probably on account of a particular temperature/rainfall combination was higher than other years reaching a value of 163g. The berry weight ranged from 2,35g (’93) to 1,87g (’96).The sugar content, showed homogeneous values between the different years: the highest value (24,29 °Brix) was registered in ’94; the lowest (23,84°Brix) in ’93.The pH of the must assumed higher values in ’93 and ’94 years in which we registered respectively the values of 3,50 and 3,41. In ’95 and ’96 we registered respectively a value of 3,12 and 3,00. The titratable acidity ranged from 10,01g/l (’95) to 6,95g/l (’93). The pruning wood showed few variation among years, ranging from 1,30kg (’96) to 1,12kg (’93). The Ravaz’s index assumed generally low values, showing few variations among years: the highest value (1,85) was registered in ’93; the lowest (1,30) in ’95.

4.Discussion

It’s well known that the yield/quality of a grapevine is closely linked to its geographical location and to climate in its widest sense (Asselin, 1999). Among the climatic factors, air temperature is of primary importance. It can affect the behavior of the plant in many ways; for example, it can condition the germinability of the pollen (Di Lorenzo et al., 1998), influence the phenological behavior of the plant (Scaglione et al., 2000 a, b, c, d, opus cited). Calò, (1972) proved that the date of bud burst is closely connected to the temperature during the month of March. Thermal factors can also condition the lenght of the bud burstflowering (Alleweldt et al., 1975), flowering-veraison (Barbagallo et al., 1993) intervals, whereas does’nt influence the veraisonmaturation period (Scaglione, 1996, op. cit.). The microclimate plays an important role in the physology of the gases exchange and the accumulation of the anthocyanins in the black-berries varietes (Porro et al., 2000). High day and night temperatures during the growth of the berry increase the amount of the sugars in the fruit (Kliewer, 1973; Buttrose et al., 1971). The sugar evolution can be closely linked to total seasonal thermal activity (Scaglione et al., 1998 l.c.). The study of the adaptability of the Piedirosso cultivar to the considered environment, has permitted the evaluation of the thermal needs of the grapevine and the thermal potential of the environment (Huglin, 1986). The tested area can be classified as belonging to "zone 3" that includes "temperate-hot areas", with a thermal active summations during the development of the grape, from 1671 until 1950 DD (Amerine and Winkler, 1944, op.cit.). The thermal characteristics of the area classify it as "high vocation": according to Boubals (1990); in fact it belongs to class 1 meaning areas suitable for the cultivation of grapevine in which are accumulated thermal active summations above 1390 DD. The qualitative response of the grapevine in the considerate environment has underlined that, as for Fiano (Scaglione et al.,1998 op.cit), Aglianico (Scaglione et al., 1998) Sciascinoso (Scaglione, 1996), the grapevine is relatively ansensitive to climatic conditions.

5.Conclusion

Studies using bioclimatic indexes on the suitability of grapevines to various environments are widely used in viticulture. Since it is important to check the quality of wines it is hoped that

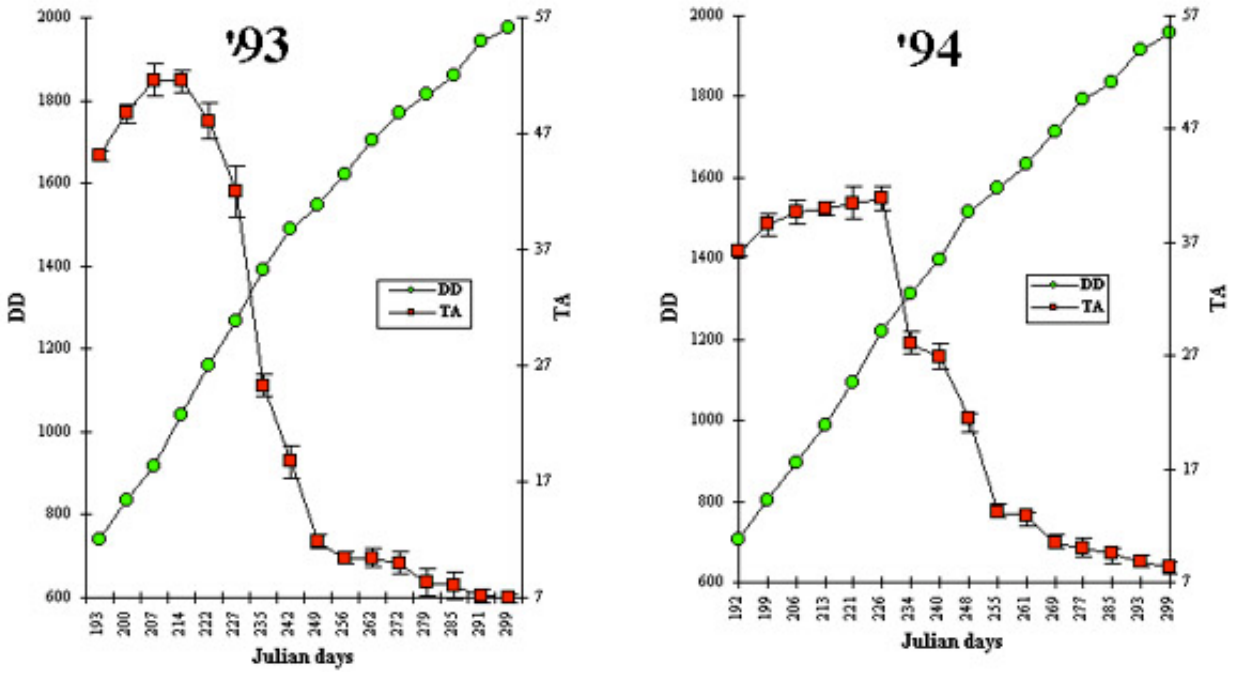
the indices will be developed and used (Fregoni, 1998).

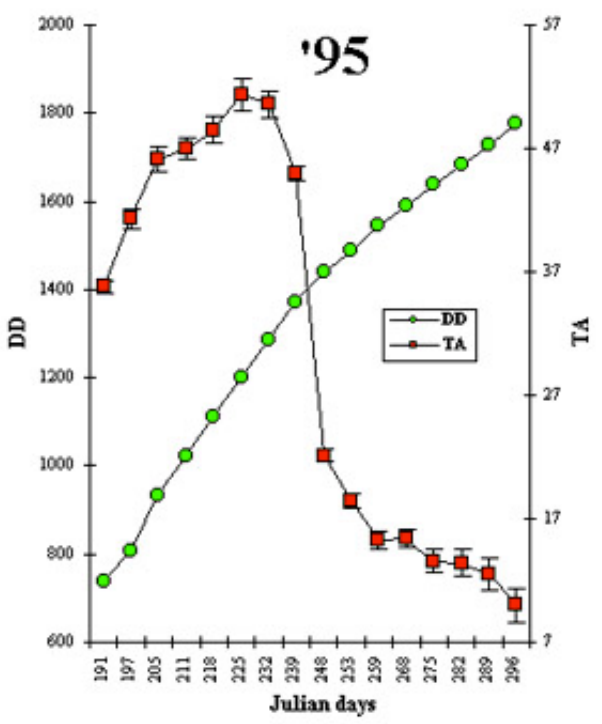
Obtained results are so synthetically:

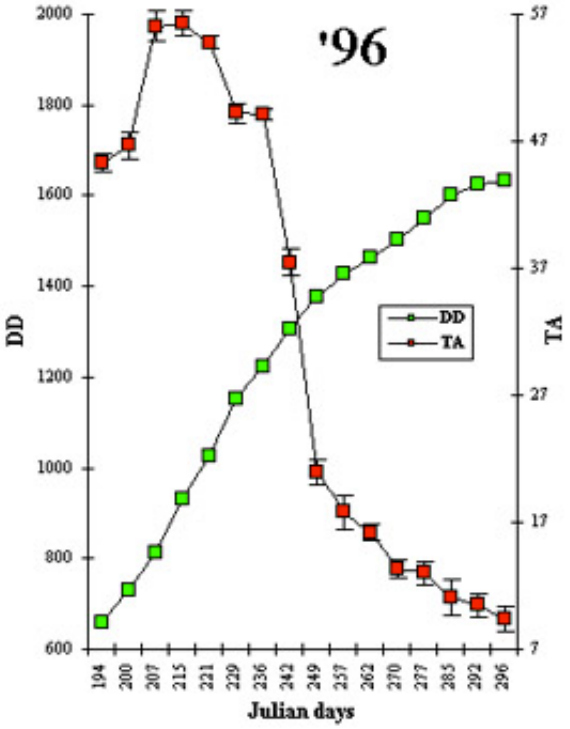
- fairly agreement of the Amerine and Winkler's model to estimate of the thermal need's cultivar Piedirosso;
- thermal necessary availability to obtain must of 21-22 °Brix , pH of 3.10-3.20, titratatable acidity of 9 g/l: about 1750- 1850 degree day; to obtain must more mellow (23-24 °Brix , pH 3.2-3.3, titratable acidity of 9 g/l) are required about 1800-1900 degree day;
- good adaptation of the genotype to environment tested.

It regards, therefore that similar *terroirs* under agronomical- pedological aspects and characterized by thermal indicated avalabilities, satisfying thermal needs of the cultivar can allow the best qualitative expression.

Fig. 2 - Seasonal variation of the titratable acidity (TA g/l), thermal active summations (degrees day, DD), julian days registered during the 4-years-period '93-'96.







Bibliography

Alleweldt G. und Hofacker W., 1975 - Einflub von Umweltfacktoren auf Austrieb, Blute, Fruchtbarkeit und Triebwachstum bei der Rebe. Vitis (14): 103-115.

Amerine M.A. , Winkler A. J., 1944 - Composition and quality of must and wines of California grapes. Hilgardia, 15: 493-675.

Asselin C., 1998 - Territoires et zones viticoles. Aspects climatiques, pedologiques, agronomiques. Caractérisation des terroires viticoles: une étude systémique. Atti Simposio Internazionale Territorio e vino. Siena, 19-24 Maggio 1998, 57-70.

Barbagallo M.G.,Di Lorenzo R., Iannolino G., Sottile I. 1993 - Indagini preliminari sull'influenza di alcuni parametri climatici sulla fenologia e sula produttività della vite. Nota presentata al convegno conclusivo del sub-progetto "Studio degli Ambienti" facente parte del P.F. M.A.F. "Miglioramento qualitativo della viticoltura" tenutosi ad Asti il 14 e 15 luglio 1993. Atti del Convegno, 265-280.

Boselli M., Scaglione G., Oriana Silvestroni, Intrieri C. 1996 - Valutazione delle capacità adattative di due varietà di *Vitis vinifera* L. allevate a tendone in un ambiente temperato-caldo. Vignevini,(4):25-30.

Boubals D., 1990 - Sur l'atlas des regions les mieux adapteés a à la culture de la vigne dans les vallées de l'Oakanagan et de Similkameen (Colombie britannique). Progres Agricole et viticole,107, (19): 423-424.

Branas J., 1974 - Viticulture. Imprimerie Dehan, Montpellier (France), pagg. 991.

Buttrose M.S., Hale C. R., Kliewer W.M., 1971 - Effect of temperature on development of grapevine inflorescence after bud burst. Am. J. Enol. Vitic., 24, (1): 14-16.

Calò A., 1972 - Ricerche sulla variabilità di alcune caratteristiche fenologiche nella *Vitis vinifera L.*,

1° contributo. Atti Acc. It. Vite. Vino.vol. XXII:37-51.

Di Lorenzo R., Scaglione G., Carafa A., Barbagallo G., 1998 - Effetto della temperatura sulla fioritura e sulla germinabilità del polline in diverse cultivar di uva da tavola. Atti IV Giornate Scientifiche S.O.I.; Sanremo, 1-3 aprile, 459-460.

Di Lorenzo R., Giuffrida S., Ferrante S., Collesano G., 1999 - Study on vegetative and productive behaviour of table grape cv"Matilde" under greenhouse. Atti XI Giornate GESCO, Sicilia, 6-12 giugno, 744-750.

Fregoni, 1998 - Viticoltura di qualità pp 705. Edizioni l'Informatore Agrario, Verona.

Gladstones, 1992 - Viticulture and Environment. Winetitles, Adelaide (Australia), pp.310.

Huglin P., 1986 - Biologie et ecologie de la vigne. Editions Payot Lausanne, technique & documentation, Paris, pp. 371.

Intrieri C.,Turri S.,Volpelli P.,Magnanini E., Zanotti A., 1988 - Rapporti tra clima e fenologia nel vitigno "Albana". Vignevini, (6): 53-60.

Kliewer W.M., 1973 - Berry composition of Vitis vinifera cultivars as influenced by photo - and nycto temperatures during maturation. J. Am., Soc. Hort. Sci., 95: 766-769.

Porro D., Mattivi F., Pitacco A., Facini O., Loreti S., Rossi F., Iacono F., 2000 - Microclima termico e scambi gassosi in vite: influenza sugli aspetti qualitativi del Pinot Nero. Atti V giornate scientifiche SOI, Sirmione, 28-30 marzo. (II): 333-334.

Scaglione G. 1996 - Studio della fenologia del vitigno Sciascinoso. Atti III Giornate Scientifiche S.O.I. - Erice (Tp), 10-14 marzo.

Scaglione G., Pasquarella C., Boselli M., 1998 a - Indagini sul fabbisogno termico del vitigno Piedirosso. Atti IV Giornate Scientifiche S.O.I.,Sanremo, 1-3 aprile, 449-450.

Scaglione G., Pasquarella C., Boselli M., 1998 b - Indagini sul fabbisogno termico del vitigno Fiano nell'ambiente campano. Atti IV Giornate Scientifiche S.O.I., Sanremo, 1-3 aprile, 447-448.

Scaglione G., Pasquarella C., Boselli M. 1998 c - Valutazione del comportamento fenologico dei vitigni "Aglianico e "Fiano" in due combinazioni d'innesto. Italus Hortus,4 (6): 12-19.

Scaglione G., Pasquarella C., Boselli M., 1998 d - Evoluzione stagionale delle temperature ed andamento della maturazione nel vitigno Aglianico: risultati di un quadriennio di osservazioni in Campania. Atti Simposio Internazionale "Territorio e Vino", Siena, 19-24 maggio, 503-508.

Scaglione G., Pasquarella C.,Dente A., Santitoro A., Giaquinto G., 2000 - Caratterizzazione fenologica dei vitigni Falanghina e Coda di cavallo. Atti V giornate scientifiche SOI, Sirmione, 28-30 marzo. (II): 459-460.

Scaglione G., Pasquarella C.,Santitoro A., Dente A., Stumpo C., 2000 - Determinazione delle esigenze termiche di dieci vitigni autoctoni Campani a bacca bianca. Atti V giornate scientifiche SOI, Sirmione, 28-30 marzo. (II): 461-462.