

OPERATIONAL PHENOLOGICAL ACTIVITIES IN ITALY – AN OVERVIEW

STATO DELLE ATTIVITÀ FENOLOGICHE OPERATIVE IN ITALIA

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Abstract

This paper describes of operational phenological activities in Italy, on the base of the output of a census carried out in 2007 On behalf of the Italian Agrometeorological Association. An overview on crops monitored and observational standard adopted is given and some comments about results are also discussed; operational phenology is a vital sector with persistence of some regional and local activities but some critical elements are also evident and discussed.

Keywords: Crop phenology, agrometeorological services, phenological station, census

Riassunto

Questo lavoro fornisce una descrizione delle attività di fenologia operativa presenti sul territorio italiano così come emergono dal censimento svolto dagli autori nel 2007 su mandato dell'Associazione Italiana di Agrometeorologia. In particolare viene data una visione d'insieme delle colture monitorate e degli standard operativi. Da tale quadro la fenologia operativa in Italia appare come un settore ancora vitale e con alcune realtà regionali e locali consolidate; appaiono tuttavia evidenti alcuni elementi critici che vengono qui discussi.

Parole chiave: fenologia vegetale, servizi agrometeorologici, stazione fenologica, censimento

Introduction

Operational Crop Phenology (OCP) can be considered as a segment of operational activities carried out by agrometeorological services (WMO, 1982). As a consequence of this, OCP is not generally limited to phenological observations but gives many other observations useful for operational purposes (agro-techniques, biotic and abiotic hazards, crop protection, irrigation, etc.), with a practical approach useful for a range of aims, like:

- evaluation of the rate of development of crops and comparison with normal values
- definition of the needs of different species and varieties with reference to the different meteorological factors
- increase of the accuracy of agro-meteorological analysis and forecast
- real time monitoring of pests and diseases
- increase of the information base for the broadcast of agrometeorological services
- production of data sets useful for research activities in crop science
- production of data sets useful to define the agroclimatic characters of a given territory
- production of data sets useful for modeling of crop production, balance for water and nutrients, diffusion of pesticides

Furthermore phenological operational activities give a representative sample of the behavior of farmers useful to rationalize the choices of extension services (choices

of varieties, crop protection, soil science, ecc.) or planning / programming in agriculture.

Operational phenology is based on international standards defined by boards like the World Meteorological Organization (WMO), the FAO and the European and Mediterranean Plant Protection Organization (EPPO). At an Italian level a National standard were recently defined by the project PHENAGRI of CRA-Ucea, that was carried out with the participation of many organizations belonging to the world of research and operational services.

OPERATIONAL AGROMETEOROLOGY IN ITALY

Agrometeorological activities at regional scale are carried out by agrometeorological services and similar subjects (e.g.: unions for crop protection - consorzi di difesa); these services are generally organized following the scheme of fig. 1, which shows that phenological activities are a peculiar feature that distinguish agrometeorological services from general purpose meteorological services.

In fact, regional and local agrometeorological services can be considered as organizations which rule an information flow composed by physical data (guide variables of the agroecosystems) and biological data (phenological and agronomical). The birth of the first agrometeorological services begun in '70 years, with the first provincial initiatives (e.g.: Trento - Istituto Agrario di S.Michele all'Adige, Piacenza – Amministrazione Provinciale, Sondrio – Fondazione Fojanini; from '80 years to the

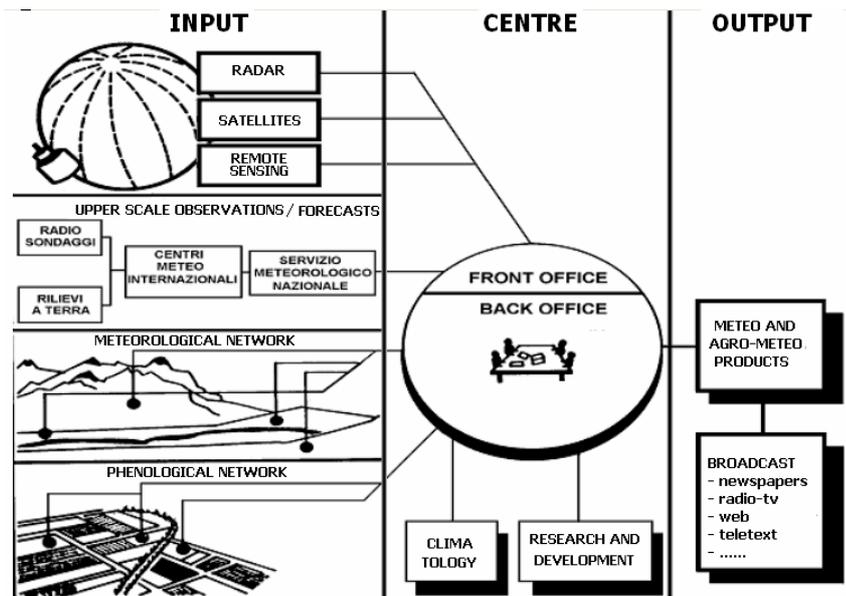


Fig. 1 – Scheme of an operational agrometeorological service.

Fig. 1 – Schema di un servizio agrometeorologico operativo.

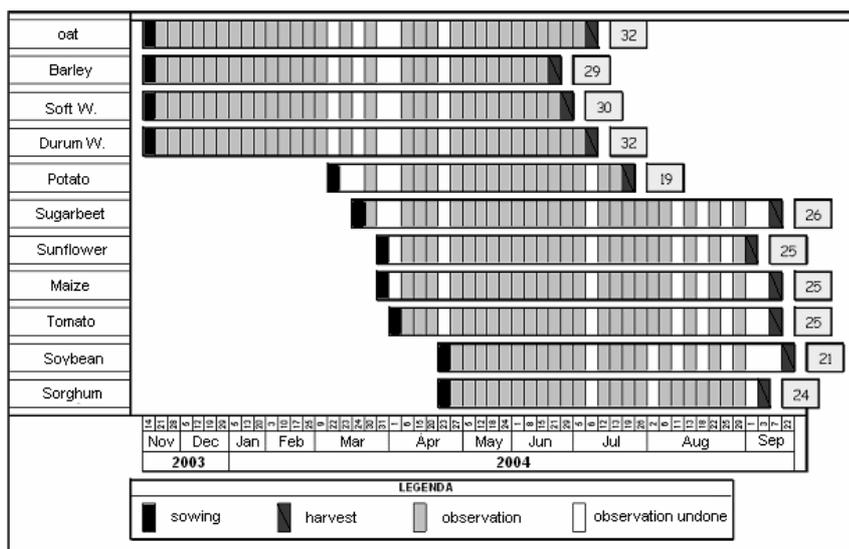


Fig. 2 – Scheme of observations carried out in the phenological station of Cadriano of the Università degli Studi di Bologna (F. Ventura, personal communication).

Fig. 2 – Schema che illustra i rilevamenti fenologici eseguiti presso la stazione fenologica di Cadriano dell'Università degli Studi di Bologna (F. Ventura, comunicazione personale).

first half of '90s specific services were activated by regions or regional boards for agricultural development - Enti regionali di sviluppo agricolo (Emilia Romagna - Ersr, Veneto - Esav then region, Lombardia - Ersal, Piemonte - Esap then region, Friuli V.G. - Ersr, Toscana - Etsaf, Lazio - region, Marche - Assam, Abruzzo - Ersr, Umbria - Esau, Puglia - Regione, Calabria - Ersr, Basilicata - Alsia, Sicilia - Esa then region, etc.). From the second half of '90 years, with the birth of Regional Environmental Agencies (ARPA) the progressive

transition of regional meteorological services from agriculture to Environmental Agencies was observed, which in some cases produced a marginalization of agrometeorological component.

Operational phenology of services is prevalently founded on field observations carried out on areas which are representative in terms of soil characters and cropping systems. Furthermore in most recent years the need of observations carried out in dedicated sites (phenological stations), where standard varieties and cropping techniques are adopted, is emerging. The reference example of this kind of approach is given by the phenological station of Cadriano of University of Bologna, which data are used for operational activities by the regional agrometeorological service of ARPA - Emilia Romagna. This station is working from 2003 and observations on different herbaceous crops (oat, sugar beet, soft and durum wheat, sunflower, maize, barley, potato, tomato, soybean, sorghum and pumpkin) are carried out (Fig. 2).

Furthermore it is important to highlight that data produced by phenological networks in Italy are not only useful for immediate needs of agrometeorological assistance but can also be useful for agroclimatic evaluations. As examples of this (i) in Fig. 3 are presented the average dates of appearance of some phenological phases in grapevine variety Gaglioppo in Calabria region, which correlation with 10°C growing degree days was studied by Caterisano et al (2007) and (ii) in

Fig. 4 a macroscale phenomenon (the climatic change observed at the end of '80 in Europe (Sneyers et al., 1993; Werner et al., 2000) and its effect on regime of maximum temperatures and by consequence on grapevine phenology in Veneto region is shown.

The real condition of operational phenological networks in Italy was the subject of a specific census carried out by the writers of this paper during the last Italian Agrometeorological Association National Meeting. This census follows the similar works carried out by Mariani

(1998) and Spanna (Personnel communication about census data presented at 2005 Meeting on crop phenology, Ucea, Rome, 15 december 2005).

Census results are resumed in tab. 1 and annex 1. It is necessary to say that in 2006 started the IPHEN project, a co-operative effort for the production and broadcast of phenological maps for Italian area that involves several regional agro-meteorological services, university

departments and research institutions. The final aim of IPHEN activity is the collection of the phenological observations carried out in Italy to produce and broadcast some national phenological maps. The main product of IPHEN is represented by maps in BBCH scale of two grapevine varieties (Cabernet Sauvignon and Chardonnay Fig. 5) and a wild shrub (Sambucus nigra) broadcasted by Cra-Ucea web site (www.ucea.it).

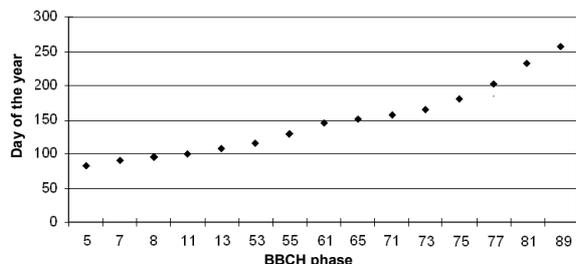


Fig. 3 – Average date of phenological phases (BBCH scale) for Gaglioppo grapevine variety in Calabria - Average of 2000-2006 observations carried out in 7 sites. (Caterisano *et al.*, 2007)

Fig. 3 – *Data media di comparsa delle fasi fenologiche (scala BBCH) sulla varietà di vite Gaglioppo in Calabria - media per il periodo 2000-2006 dei dati rilevati in 7 siti distribuiti sul territorio regionale. (Caterisano et al., 2007)*

Conclusions

This summary picture of the operational phenological activities in Italy highlight some positive elements like (i) the persistence of some regional and local activities in spite of the rapid changes of the sector of the extension services for agriculture, (ii) the presence of a national service (Cra-Ucea) which co-ordinates operational activities and (iii) the seminal co-operation activated by the IPHEN project.

Therefore it's useful to underline a series of critical aspect and in particular: (i) the underground (“carsic”) character of many phenological service activities, shown for example by the interruption of regional observations in Piedmont and Tuscany, (ii) the low level of information exchange or co-operation among services, (iii) the difficult access of potential users to phenological data, which in many cases are inhomogeneous and (iv) the fact that services show a very low level of knowledge about

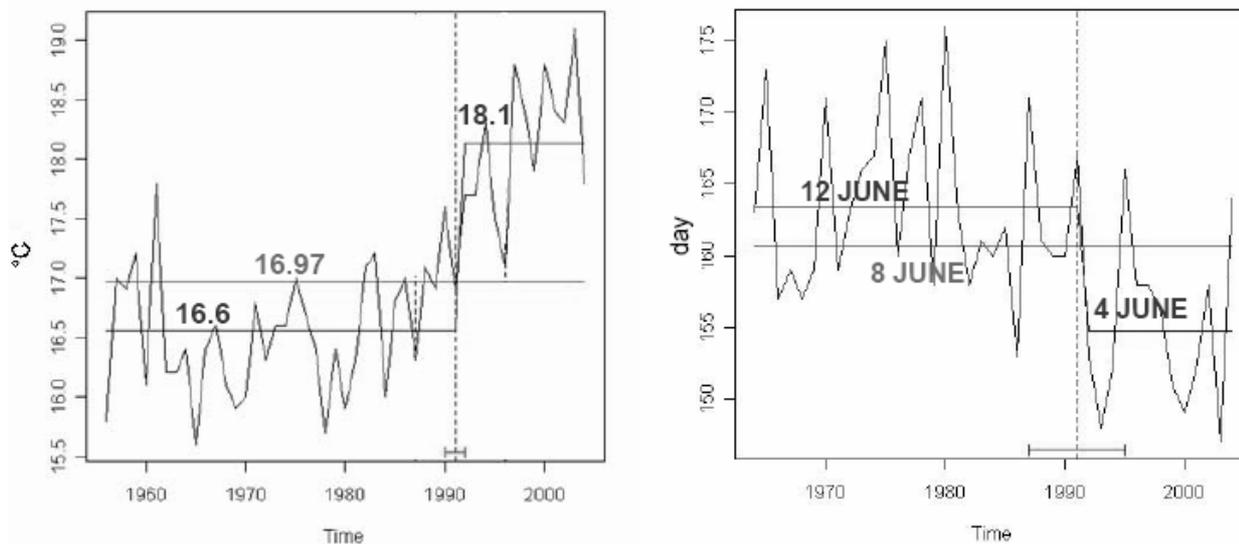


Fig. 4 - Climatic change in Europa at the end of '80 (change of regime of westerlies) and abrupt effect (shift) on maximum temperatures and and grapevine phenology. The right figure show the breakpoint in maximum temperatures which show a shift of the yearly mean value from 16.6 to 18.1°C; the left one show the breakpoint in the flowering date of Merlot which show a shift of the yearly mean value from 12 June to 4 June. (source: Chiaudani *et al.* 2006). Data for Merlot are referred to Conegliano Veneto (CRA – Istituto Sperimentale per la Viticoltura). [The breakpoint analysis carried out with Strucchange libray of R software; the vertical dotted line shows the most probable breakpoint year and the horizontal line shows the 95% confidence interval.

Fig. 4 – *La figura illustra come il cambiamento climatico che ha avuto luogo in Europa intorno alla fine degli anni '80 del 900 per effetto di un brusco cambiamento (breakpoint) a macroscale nella circolazione (regime delle grandi correnti occidentali) abbia avuto una ripercussione rapidissima sulle temperature massime e di conseguenza sulla fenologia della vite. A destra si mostra il breakpoint delle temperature massime del Veneto, con brusco passaggio da 16.6 a 18.1°C di media annua) e a destra l'analogo breakpoint nella data (giorno dell'anno) di fioritura del Merlot , con brusco passaggio della data media dal 12 giugno al 4 giugno (fonte: Chiaudani et al. 2006).I dati di fioritura del Merlot sono riferiti a Conegliano Veneto e provengono d CRA – Istituto Sperimentale per la Viticoltura). (Analisi di breaskpoint eseguita con la libreria Strucchange di R; la linea tratteggiata verticale indica l'anno i più probabile breakpoint mentre l'intervallo di confidenza del 95% è indicato dalla banda orizzontale, in basso nel grafico.*

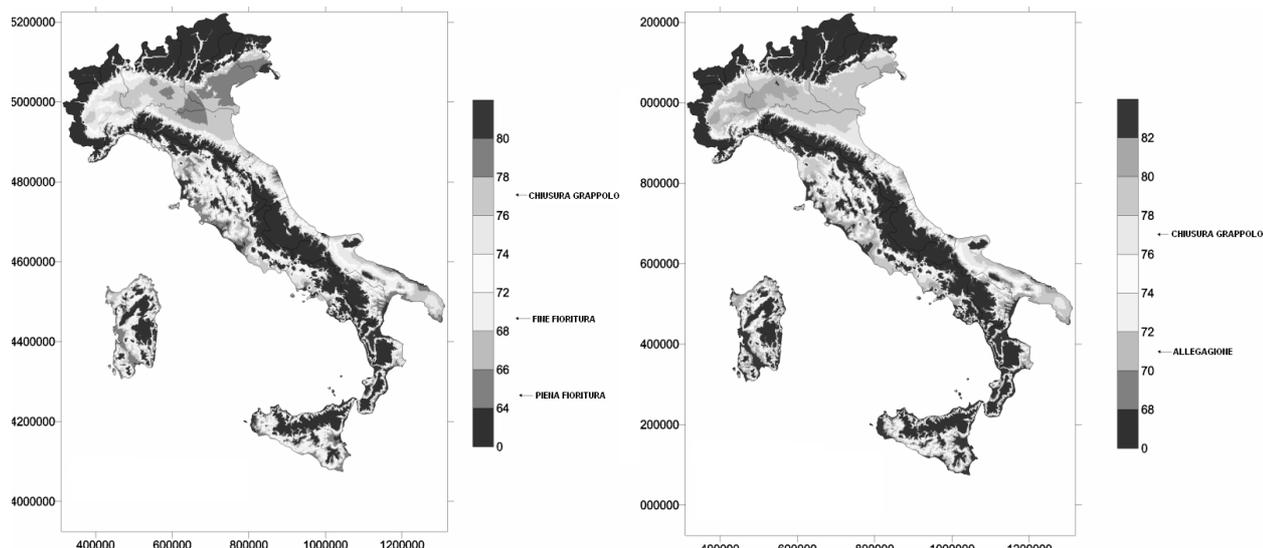


Fig. 5 –Phenological maps of IPHEN project for 14 June 2007 referred to grapevine varieties Cabernet sauvignon (on the left) and Chardonnay (on the right) (source: www.ucea.it)

Fig. 5 –Mappe fenologiche del progetto IPHEN per il 14 Giugno 2007; le mappe sono riferite alla cultivar di vite Cabernet sauvignon (sinistra) e Chardonnay (destra) (fonte: www.ucea.it)

Tab. 1 – Phenological operational activities in Italy (2007 data).

Tab. 1 – Attività fenologiche operative in Italia (dati 2007).

Region / Province	Crops
Emilia Romagna – Piacenza	grapevine, apple, pear, cereals
Sardegna	grapevine
Puglia – Brindisi	grapevine
Lombardia	maize, barley, soft wheat
Emilia Romagna – University of Bologna	Phenological station (see into the text for other details)
Abruzzo	grapevine, olive, peach
Basilicata	grapevine
Trentino	grapevine, apple
Calabria	grapevine, olive, citrus fruits, e peach
Liguria	grapevine, olive
Veneto	Soft wheat, maize, barley, grapevine
Marche	durum wheat, sorghum, olive, soft wheat, sunflower, prune, grapevine, barley, sugar beet, peach, maize, olive, tomato, apple and some vegetable crops (e.g.: salad crops, spinach)
Umbria	grapevine, olive, vegetable crops

the potential applications of crop phenology which principal (and often unique) aim is the production of weekly agrometeorological reports.

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Bibliography

Caterisano R., Cirone P., Mariani L., 2007. Aspetti fenologici della vite in Calabria. Atti del convegno nazionale di agrometeorologia AIAM 2007, Isola di Capo Rizzuto.

Chiaudani A., Barbi A., Delillo I., Cacciatori G., Tridello G., Bonamano A., Borin M., Cola G., L. Mariani L., 1998. Censimento rilevamenti agrofienologici italiani, in Atti di AIAM98, 101-106.
 Mariani L., 2006. Analysis of a 49 years long agrometeorological historical data-sets for short term programming and multi-year planning of regional and local irrigation, Atti del 6th EMS/ECAC Meeting, Ljubljana, Slovenia.
 Sneyers R., Palmieri S., Siani A.M., 1993. Characterizing trends in climatological time series. An application to Brera observatory (Milan) rainfall series, Proceedings of international conference on applications of time series analysis to astronomy and meteorology, Università di Padova, 6-10 settembre 1993, pp. 321-328.
 Werner, P. C., Gerstengarbe F.W., Fraedrich K, Oesterle K. Recent climate change in the North Atlantic/European sector, International Journal of Climatology, Vol. 20, Issue 5, 2000: 463-471.

annex 1 – Census of phenological operational activities in Italy (2007)

Region/Province	Piacenza	Sardegna	Piemonte	Puglia
Compiler	Ivano Faccini	Paolo Capece	Federico Spanna	Nicola Scarano - Codivabri
Organization	Provincia di Piacenza - Rete Agrometeorologica	Servizio Agrometeorologico Regionale for la Sardegna	Regione Piemonte – Servizio Fitosanitario	CO.DI.VA.BRI (Consorzio di Difesa e Valorizzazione delle Produzioni Agricole della Provincia di Brindisi)
Seat	Via Colombo 33 Piacenza	Viale Porto Torres, 119 Sassari	Torino	Brindisi
Crops	grapevine, apple, pear and cereals	grapevine (other observations for production of periodical reports on Olive, cereals, forage crops, vegetable crops)	Only single point observations (e.g.: Tenuta Cannona for grapevine) or extemporaneous observations are carried out	grapevine
Number of varieties	5 for grapevine, 6 for apple-pear e 3 for Cereals	6 – 8 (variable)		Negroamaro and other 10 varieties
Sites	Val Tidone (grapevine), Basso Arda (apple-pear), Pianura piacentina (Cereals)	S.M. La Palma (Alghero)		10
Data availability (years)	20 for grapevine, 15 for apple-pear e 20 for cereals	grapevine S.M. La Palma (2002 – 2007) agrofenological archive of SAR (1996 – 2002) with observations phenological ERSAT su grapevine, Olive and other crops		20 years for Negroamaro; 2 years for 10 varieties
Phenological scale	BBCH for grapevine and apple-pear, Zadoks for cereals	Phenagri, dal 2006 for Iphen BBCH		BBCH
Frequency if observation	weekly	Weekly or each ten days		weekly
Observation of other crop data	Presence of pathogens	Following the Phenagri standard		Yes
Data management	On paper and electronic	Phenological sheets		PC
File format	DB 4 and Excel	Text format or .xls		Excel
Meteorological data	from 1980	Yes		Yes, from 1984
Co- operation with other organizations	ARPA SIM	Università degli studi di Milano, Departement of Crop Science		
Participation to other projects (inter-regional, national, or international)	Phenagri	Iphen		
Other organizations which carried out phenological observations in the selected region	Unions of producers	ERSAT and other organizations.		
Phenological gardens in the selected region				
Botanic gardens in the selected region		Cagliari, Sassari		

Region/Province	Lombardia	Friuli V.G.	Emilia Romagna	Sicilia
Compiler	Lorenzo Craveri	Andrea Cicogna	Francesca Ventura	Antonino Drago
Organization	ERSAF	ARPA FVG	University of Bologna	
Seat	Via Copernico, 38 – Milano		Via Fanin, 44 Bologna	
Crops	maize, barley e wheat		4 winter cereals + 8 spring crops + 2 cv of grapevine + 4 fruit trees	phenological observations weren't carried out during the last years
Number of varieties	20 for maize, 5 for barley e 10 for wheat			
Sites	4 for maize, 4 for barley e 4 for wheat		Only one site (phenological station of Cadriano)	
Data availability (years)	2005-2007		From 2003 for winter cereals; from 2004 for spring crops; from 2007 for grapevine; from 2006 for fruit trees	
Phenological scale	BBCH		BBCH	
Frequency if observation	One or two times each week		weekly	
Observation of other crop data	Height of plants, etc.		Biometrics e productive observations	
Data management			Electronic e on paper	
File format	Excel		Access	
Meteorological data	In areas near sites of phenological observations		Yes	
Co- operation with other organizations	CRA – Istituto Sperimentale for la Cerealicoltura (Bergamo, S. Angelo e Fiorenzuola)		ARPA Sim Emilia Romagna	
Participation to other projects (inter-regional, national, or international)	National and regional		IPHEN – IPG	
Other organizations which carried out phenological observations in the selected region		Only some “consorzi doc” gather some phenological data on grapevine, for crop protection aims. The adopted scale is the BBCH	Università – Botanica; ARPA – Sim	
Phenological gardens in the selected region				
Botanic gardens in the selected region				

Region/Province	Abruzzo	Basilicata	Trentino	Calabria
Compiler	Rocco Antonio Zinni	Emanuele Scalcione	Emanuele Eccel	Cirone Paola
Organization	ARSSA	ALSIA	IASMA	ARSSA
Seat	Avezzano	Lavello, Melfi and Aliano	S.Michele all'Adige	Crotone
Crops	grapevine, Olive e peach	grapevine	grapevine, Sambucus nigra, apple	grapevine, Olive, citrus fruits and peach
Number of varieties	3 for grapevine, 3 for Olive e 3 for peach	10	Various	30 for grapevine, 16 for Olive, 9 for citrus fruits and 6 for peach
Sites		3	Various	60 for grapevine, 50 for Olive, 30 for citrus fruits and 10 for peach
Data availability (years)	1990-2006		About 20 years on grapevine; from 2006 Sambucus nigra; from 1984 apple	From 1996
Phenological scale	Baggiolini modified	BBCH	BBCH + Baggiolini for grapevine; BBCH for Sambucus nigra; Fleckinger for apple	Baggiolini for grapevine.
Frequency if observation	weekly during vegetative period	weekly	Weekly	Weekly
Observation of other crop data		Yes		Yes
Data management	Sistema Agroambientale Abruzzo	On paper	Electronic and on paper	Electronic
File format	xls, text format, ecc.	Excel	Phenagri – Iphen	Excel
Meteorological data	Yes	Yes	Yes	Yes
Co- operation with other organizations		IPHEN – CRA Conegliano Veneto	Iphen	Iphen
Participation to other projects (inter-regional, national, or international)			Iphen	Iphen
Other organizations which carried out phenological observations in the selected region				
Phenological gardens in the selected region			1	
Botanic gardens in the selected region			2	
			Are only available some observations on grapevine carried out around 2000 with some hundreds of sheets	