

Desktop Solution for Farm Management and Planning

The agricultural industry is becoming increasingly tied to the rules that govern the economic market. This situation has made it necessary for farm owners to make use of new tools to aid them in the management, monitoring and planning of their farms in order to increase efficiency and productivity. This paper describes an application designed for the planning of vineyards, calculation of labor costs, generation of reports required for request of government aid and the creation of thematic cartography. The data utilized (cadastral cartography, satellite images, etc.) and their integration are described.

DESCRIPTION

Agriculture in the 21st century is increasingly tied to the rigid rules that govern the market. Some sectors of the agricultural industry in Italy like wine growers and producers have experienced major growth over the last several years due to growing demand and profitable opportunities provided by the growing popularity of wine in general and Italian wines in particular.

This situation has made it necessary for farmers and wine growers/producers to better manage their farms and vineyards. Through strategic planning and evaluation they must be able to renovate and create new areas for cultivation with the aim of maximising production without, however, sacrificing quality.

The current economic reality of this industry has also created the necessity for farmers and wine growers/producers to have a working knowledge of topics ranging from related legislation, to accounting, to tax regulations and government subsidy procedures, in order to manage a competitive agricultural enterprise.

This new way of doing business requires the manipulation of various types of data and information as well as tools capable of integrating this data to provide a support in the planning and decision-making process

Geographic Information Systems, for their ability to integrate various types of data in solutions for analysis, planning, management, etc. and for their ability to offer informative output in the form of maps and related reports, provide an obvious answer to the issues faces by today's farmers and wine growers/producers.

The development of solutions capable of carrying out analysis and planning procedures, calculating labor costs and government subsidies, simulating new vineyards, etc. opens the way to the introduction of new methods in farming. These applications aim to improve and simplify the management of farms and to act as support tools in strategic planning. They must be effective while at the same time easy to use as their operators will likely not be experts in GIS.

In order to create an instrument capable of answering to the real needs of farmers and wine growers/producers, our application was developed in co-operation with Marcello Bidini, co-owner and director of the Bidini Annita & C. Farm in Laterina (Tuscany, Italy). His farm operates in both the agricultural sector, cultivating grain, olives, etc. as well as in wine growing and production with 41 hectares of vineyards (among which are the acclaimed vineyards of Italy's former royal family) including Sangiovese, Cabernet Sauvignon, Merlot, Chardonnay and Syrah grapes. Roughly 2000 hectoliters of wine is produced yearly including Chardonnay, Sangiovese, Chianti and other high-quality wines.

Our application, called AgriGIS, has been developed as an ArcView 3.2 project using scripts and GUI customization (with the addition of buttons and menus). All code is written in the Avenue programming language.

AgriGIS is composed of two Views, one designed for the management of the farmland and one for the planning of the vineyards called respectively: Field/Vineyard Management ("Gestione Campi e Vigneti") and Vineyard Planning ("Pianificazione Vigneti").

Data

The following data was used in the development of the application:

- Cadastral cartography: This is the vector base acquired in paper form then digitalized and used to carry out searches on specific criteria (sheet number, parcel number etc.). Cadastral cartography is also necessary for the procedures used to calculate government farmland subsidies.
- Cadastral data base: This contains all information related to the parcels.
- Georeferenced Quickbird high resolution (1meter/pixel) multispectral satellite images: These were used as a raster base to obtain an up-to-date view of the farm's entire area and as a base for the digitalization of the existing fields and vineyards.<
- Farm database: This contains information related to the fields (Field ID, crops, labor costs, etc.).

The first step was to work on the initial data in order to be able to use it within a GIS and to integrate it.

To do this we:

- Digitalized and georeferenced the cadastral cartography
- Linked the data from the cadastral database
- Digitalized the fields and vineyards using the satellite images
- Linked the data on the fields derived from the farm database
- Overlapped the cadastral cartography and the digitalized map of the fields.

Field/Vineyard Management View

Through the view related to the management of fields and vineyards, the following functions can be accessed:

- Searches on Cadastral Cartography

AGRIGIS

Comune : Superficie (mq):
Foglio : Coltura:
Particella: Proprietario:

Codice Campo:

Campo	Coltura_ca	Area_campo	Area
126	Vigna Cabernet	15591	966
140	Vigna Sangiovese	46028	37288
0		0	5416

- Searches and viewing of the data related to fields and vineyards through dialog boxes which allow the user to perform a simple search on a field or vineyard and to visualize all of the information related to it.

AGRIGIS

Comune : Superficie (mq):
Foglio : Coltura:
Particella: Proprietario:

Codice Campo: Coltura: Area Campo (mq):

Aratura:	<input type="text" value="168.54"/>	Semina (Combinata):	<input type="text" value="124.20"/>
Epicatura (Erpice Dischi):	<input type="text" value="62.10"/>	Semina (Singola):	<input type="text" value="62.10"/>
Epicatura (Erpice Strigliatore):	<input type="text" value="57.26"/>	Livellatura singola:	<input type="text" value="70.97"/>
Epicatura (Koskid):	<input type="text" value="57.65"/>	Rippatura:	<input type="text" value="115.32"/>
Epicatura (Combinata):	<input type="text" value="79.85"/>	Spanditura concime:	<input type="text" value="31.03"/>
Trinciatura con braccio:	<input type="text" value="51.53"/>	Trattamento diserbanti:	<input type="text" value="39.92"/>
Trebbiatura con Trinciapaglia:	<input type="text" value="150.81"/>	Trinciastocchi:	<input type="text" value="39.92"/>
Trebbiatura senza Trinciapaglia:	<input type="text" value="128.63"/>	Totale Lavorazioni:	<input type="text" value="1239.85"/>

AGRIGIS

Comune : TERRANUOVA BRACCIOLINI	Superficie (mq): 10320
Foglio : 73	Coltura: SEMIN.ARBOREO
Particella: 39	Proprietario: VITERETA
<input type="button" value="Seleziona"/>	<input type="button" value="Elenco Campi"/>

Codice Vigna: 214	Forma di allevamento: Cordone speronato
Descrizione: Vigneto Casa Rossa	Distanza sul filare (mt): 1.20
Anno Impianto: 2002	Distanza tra i filari (mt): 3.00
Vitigno: Chardonnay	Densità (Piante/Ha): 2773.00
Superficie Vitata: 27809.00	Numero Piantine: 7797.00
Giacitura (H.S.L.M.): 265	Esposizione: Sud Est
Destinazione Produttiva: Uva da vino	Note:
Pendenza: 10	
<input type="button" value="Scheda Campo"/>	<input type="button" value="Aggiorna"/>
<input type="button" value="Stampa"/>	
<input type="button" value="Cancella"/>	<input type="button" value="Chiudi"/>

- Creation and export of tables containing data required for the request of government subsidies.

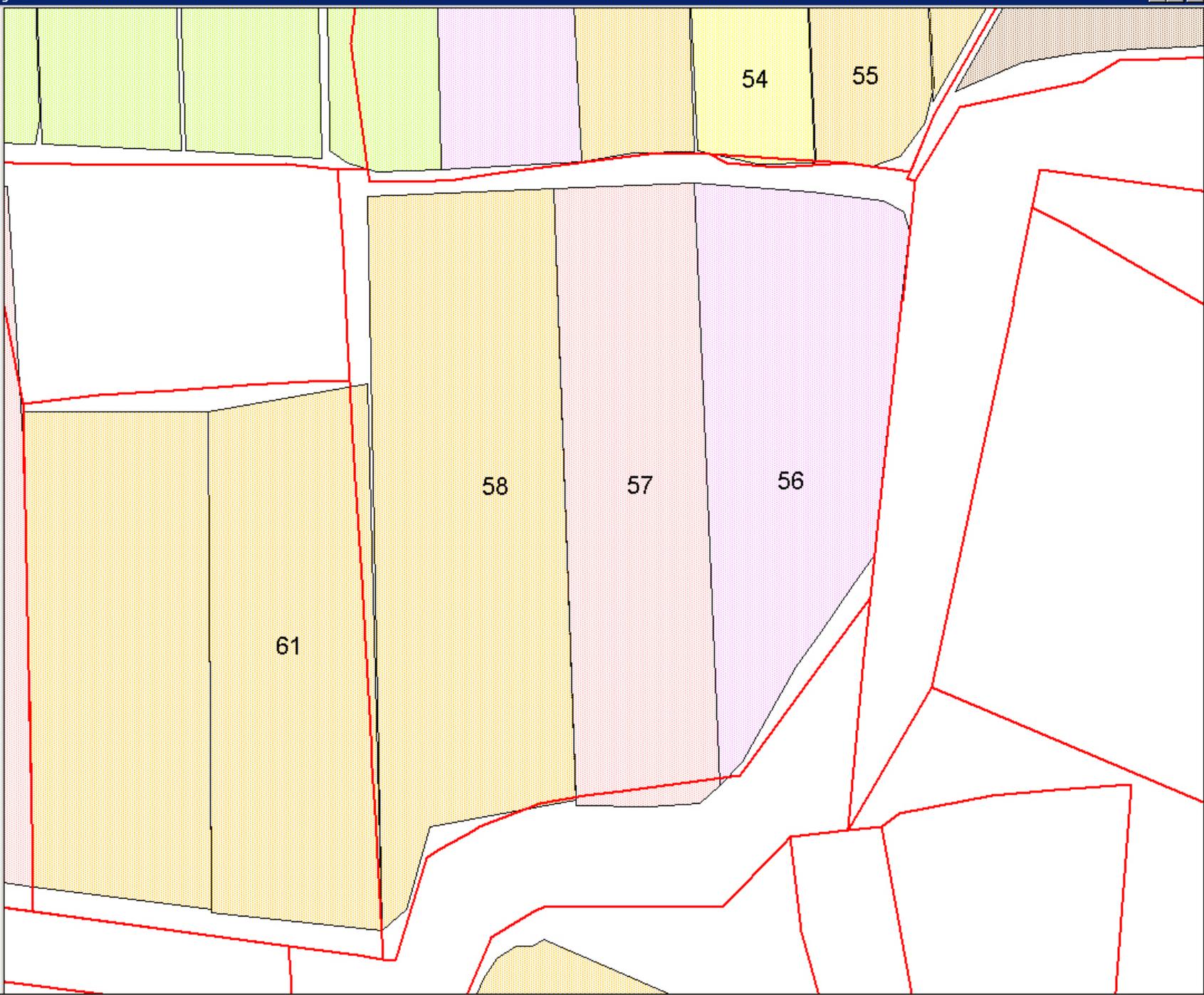
This function allows for the creation and export of tables containing the data required for applications for government subsidies. This data is derived from cadastral cartography and must be calculated based on precise specifications.

Each parcel can be part of more than one field and could also contain areas without crops (woods, paths, inter-farm roads, etc). The areas of the parcels must be sub-divided by the fields which they contain and the various crops present on the portion of the parcel indicated. This is because there are different specifications for subsidies for different crops.

The table must report the subdivision of each parcel area among the fields. The sum of the portions of a parcel and all of the non-crop areas within a parcel must be equal to the area of the parcel as defined by the cadastral database. Calculations are based on the area defined by the cadastral database in order to avoid introducing errors in parcel area (errors derived from digitalization).



- Particelle
- Campi
 - Bosco Nuovo
 - Cava di Ghiaia
 - Erba Medica
 - Favino
 - Girasole
 - Grano Duro
 - Grano Tenero
 - Lago
 - Mais
 - Oliveto
 - Pioppeto
 - Prati e Pascoli
 - Sodo
 - Sorgo
 - Vigna Cabernet
 - Vigna Chardonnay
 - Vigna Merlot
 - Vigna Sangiovese
- Satellitare 2003
- Ortofoto Vitereta
- Ortofoto Civitella
- Ortofoto Mugliano



AGRIGIS

Comune : Superficie (mq):

Foglio : Coltura:

Particella: Proprietario:

Codice Campo:

Campo	Coltura_ca	Area_campo	Area
54	Girasole	6409	31
55	Girasole	5676	1
56	Sorgo	5997	5994
57	Sodo	6014	5849
58	Girasole	8368	8358
61	Girasole	5864	314
0		0	2038

The figure above shows the table resulting from this procedure. In this case, notice that the area of parcel 28 is divided by six fields (54-55-56-57-58-61) with different crops and that a portion of the parcel measuring 2,308 sq meters is a non-crop area.

The result is a table that can be exported in Excel format (.dbf).

Campo	Coltura_ca	Area_campo	Comune	Foglio	Particella	Sup_catast	Proprieta	Area
54	Girasole	6409	LATERINA	5	28	22585	VITERETA	31
55	Girasole	5676	LATERINA	5	28	22585	VITERETA	1
56	Sorgo	5997	LATERINA	5	28	22585	VITERETA	5994
57	Sodo	6014	LATERINA	5	28	22585	VITERETA	5849
58	Girasole	8368	LATERINA	5	28	22585	VITERETA	8358
61	Girasole	5864	LATERINA	5	28	22585	VITERETA	314
0		0	LATERINA	5	28	22585	VITERETA	2038
1	Favino	7796	LATERINA	5	266	628	IST.DIOCESANO	641
1	Favino	7796	LATERINA	5	22	6225	VITERETA	493
2	Sorgo	10055	LATERINA	5	19	3910	VITERETA	2454
2	Sorgo	10055	LATERINA	5	269	8308	VITERETA	262
2	Sorgo	10055	LATERINA	5	273	1079	VITERETA	4572
2	Sorgo	10055	LATERINA	5	20	14771	VITERETA	2766
3	Grano Duro	20974	LATERINA	5	10	21333	VITERETA	19786
3	Grano Duro	20974	LATERINA	5	269	8308	VITERETA	1188
4	Sorgo	4345	LATERINA	5	218	470	IST.DIOCESANO	101

- Calculation and visualization of labor costs

The calculation of labor costs is based on fixed costs per hectare contained in a table (these costs can be up-dated).

Lavorazioni Campi

CAMPI

Descrizione	Tipo	In	Iva%	Totale
ARATURA PROFONDITA' MEDIA CM 40		98.12	20.00	117.74
ERPICATURA CON ERPICE A DISCHI	A	36.15	20.00	43.38
ERPICATURA CON ERPICE STRIGILATORE X TOGLIERE INFESTANTI	D	30.98	20.00	40.00
ERPICATURA CON KOSKID	C	33.56	20.00	40.27
ERPICATURA IN COMBINATA CON FRANGIZZOLLE ED ESTIRPATORE	B	46.48	20.00	55.78
LIVELLATURA SINGOLA	A	41.32	20.00	49.58
RIPPATURA		67.13	20.00	80.56

Descrizione Lavorazione
 ERPICATURA CON KOSKID

Totale (lordo)
 40.27

Salva

- Creation and printing of thematic cartography for the various crops

- Creation of printable reports for each field or vineyard

The project allows the user to report all the information related to a field (or vineyard) on an html page complete with an extract from the cartography.

- Digitalization of new fields and vineyards and updating of their related information

By means of ArcView Editing tools it is possible to draw new fields and vineyards and update their related information.

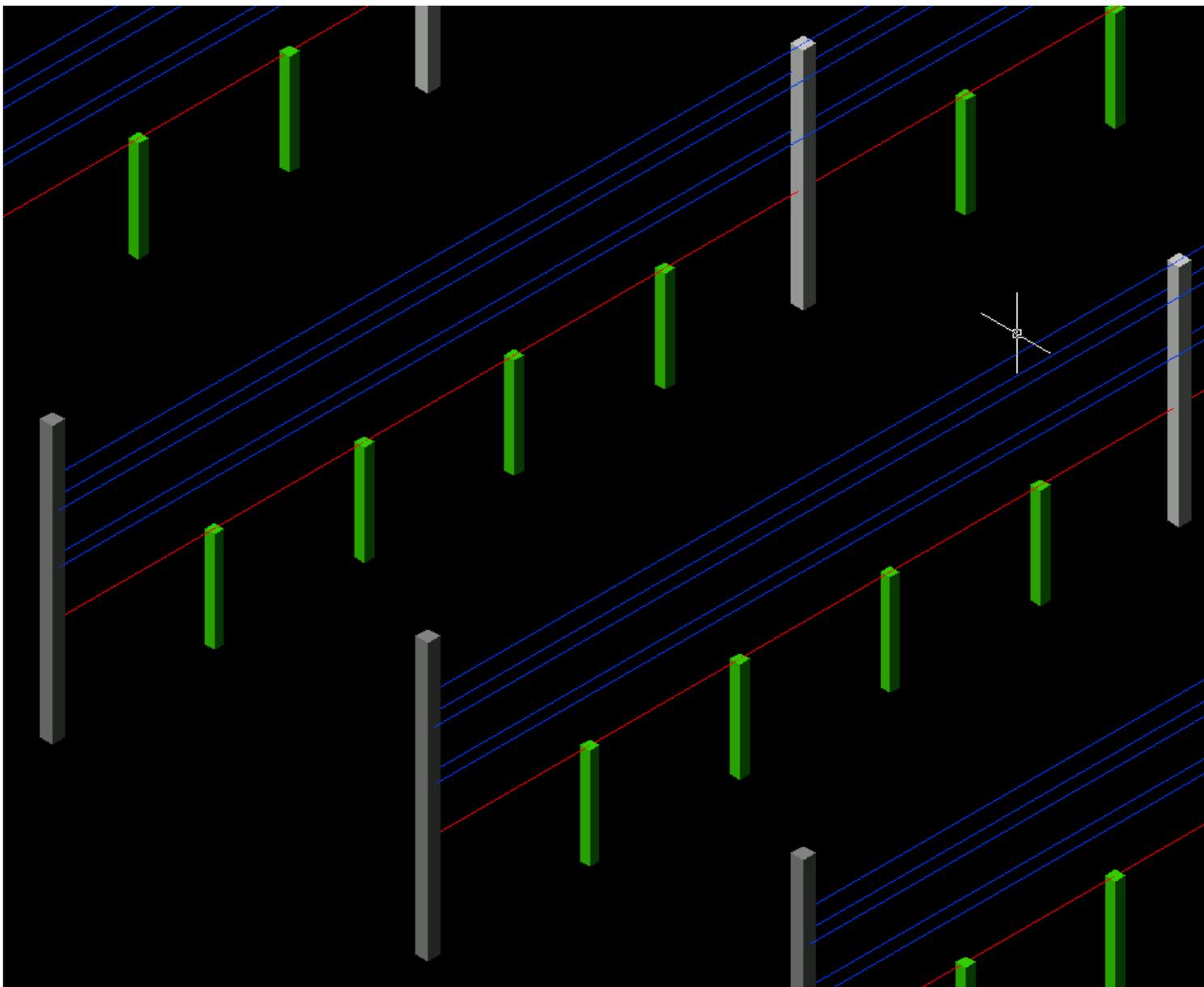
Vineyard Planning View

The considerable contribution of capital necessary to establish new vineyards requires that these choices be evaluated very carefully as they can greatly influence the economic life of the wine-growing operation. The choice of materials, the various technical and agricultural solutions necessary to allow for the use of machinery, the distance between the rows, the growing method, etc are all important aspects in the planning of new vineyards or in the renovation of existing vineyards.

From the Vineyard Planning View it is possible to access all the planning functions and simulations developed to supply the user with an effective support tool for strategic planning.

This application allows for the planning of new vineyards beginning with a simulation of the proposed vineyard. This particular application was developed for the planning of vineyards which utilize the "cordone speronato" method, one of the most widely used methods as it allows for the use of machinery to carry out much of the labor involved in wine-growing.

The "cordone speronato" growing method with is structured as shown below.



Simulations of new vineyard installations can be carried out by choosing the distance between the rows, the distance between the seedlings, the distance between the posts, the minimum length of the rows and the non-cultivated distance at the margins of the vineyards (used for the passage of machinery).

AGRIGIS

Inserisci i parametri per la pianificazione del vigneto:

Distanza tra i filari

Distanza tra le barbatelle

Distanza tra i pali

Lunghezza minima dei filari

Then a function allows the user to choose the direction of the rows in two different ways:

- By placing the rows parallel to one side of the vineyard
- or
- By drawing a vector that indicates the direction.

After having inserted all of the requested parameters, the application draws the vineyard, inserting the main elements for the planning, in other words the external posts, the internal posts and the seedlings. The system also automatically eliminates rows under a certain length and is able to draw vineyards even in the presence of complex geometrical forms.

It was particularly important that the system be programmed in such a way that it could draw the rows taking maximum advantage of the available space. It was also important that the integrity of the initial data (distance between rows, minimum length of rows, etc.) and the general prerequisites (every row has two external posts - one at the beginning and one at the end, etc.) be maintained.

This is particularly important in vineyards with complex geometrical forms.

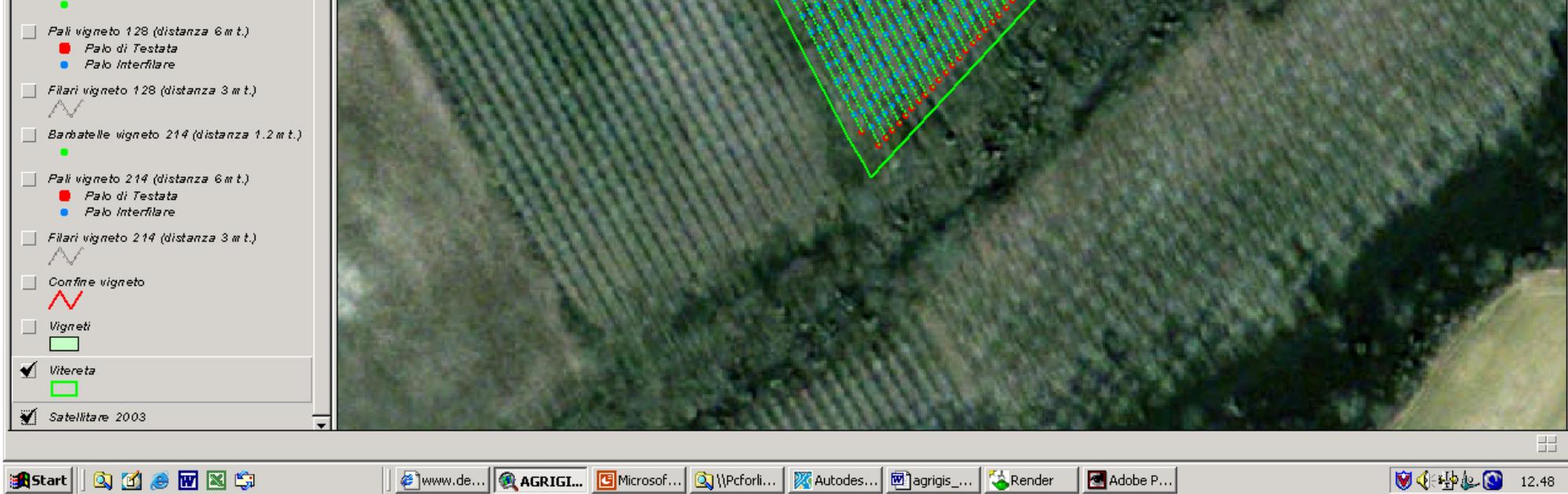
AGRIGIS - Azienda Agricola di Bidini Annita & C. s.s. Laterina (AR) Loc. VITERETA Powered by G.I.S. 2000

File Modifica Vista Digitalizza Visualizza Impostazione costi Finestra Info

Scale 1:1.500 718,352.65
4,824,250.30

AGRIGIS - Pianificazione Vigneti

- Barbatelle vigneto 127 (distanza 1.2 m t.)
- Pali vigneto 127 (distanza 6 m t.)
 - Palo di Testata
 - Palo Interfilare
- Filari vigneto 127 (distanza 3 m t.)
- Barbatelle vigneto 140 (distanza 1.2 m t.)
- Pali vigneto 140 (distanza 6 m t.)
 - Palo di Testata
 - Palo Interfilare
- Filari vigneto 140 (distanza 3 m t.)
- Barbatelle vigneto 126 (distanza 1.2 m t.)
- Pali vigneto 126 (distanza 6 m t.)
 - Palo di Testata
 - Palo Interfilare
- Filari vigneto 126 (distanza 3 m t.)
- Barbatelle vigneto 200 (distanza 1.2 m t.)
- Pali vigneto 200 (distanza 6 m t.)
 - Palo di Testata
 - Palo Interfilare
- Filari vigneto 200 (distanza 3 m t.)
- Barbatelle vigneto 128 (distanza 1.2 m t.)



When the design has been completed, a dialog box displays the main values of the new vineyard.

Preventivo Impianto Vigneto 197 - AGRIGIS

Sesto d'Impianto:	Parametri preventivo:
Superficie vitata: 12453 Mq.	Vitigno: Cabernet
Distanza tra i filari: 3 Mt.	Portinnesto: Kober 5BB
Numero di filari: 50	Pali di testata: Valente C. prec. 9x9
Lunghezza dei filari: 4020 Mt.	Pali di mezzeria: Valente C. prec. 5,5x5
Lunghezza minima tra i filari 24 Mt.	Filo portante: Trefil Arbed cal.16 (mm2.7) triplo zinc
Distanza tra i pali: 6 Mt.	Filo in acciaio: AISI304 mm1.2 (cal13)
Totale pali: 720	Tutore: canna PVC rinf. tonda mm18
Pali di testata: 100	
Pali di mezzeria: 620	
Distanza tra le barbatelle: 1.2 Mt.	
Totale delle barbatelle: 3400	
Densità: 2730 barbatelle/Ha	

Calcola preventivo

Through a dialog box, it is possible at this point to choose the materials necessary for the installation of the vineyard. Based on these choices and considering the characteristics of the cordone speronato growing method (positioning of the seedlings, distribution of the steel wires, etc.) the system will provide an estimate of the cost of the installation.

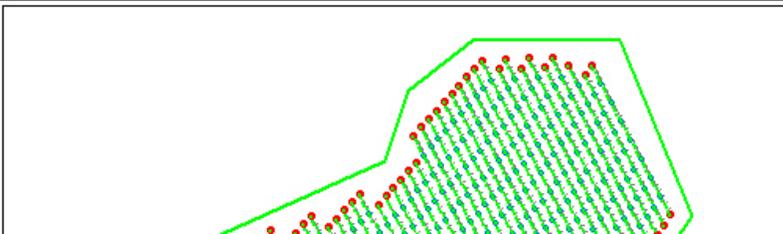
Preventivo Impianto Vigneto 140 - AGRIGIS

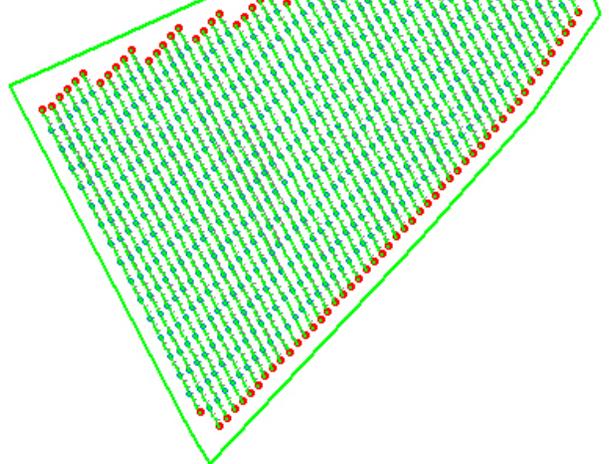
Impianto barbatelle: Vitigno: Cabernet Portinnesto: Kober 5BB Costo unitario: 3 euro/cad. Quantità: 3400 Costo Totale: 10200,00 euro	Tutori per barbatelle: Modello: canna PVC rinf.tonda mm18 Costo unitario: 0.2 euro/cad. Quantità: 2680 Costo Totale Tutori: 536,00 euro
Pali di testata: Modello: Valente C. prec. 9x9 Costo unitario: 1.8 euro/cad. Quantità: 100 Costo Totale Pali di Testata: 180,00 euro	Cordone: Modello Trefil Arbed cal.16 (mm2.7) triplo zinc Costo unitario: 0.75 euro/Kg. Quantità: 182.727 Kg Costo Totale Cordone: 137,05 euro
Pali di mezzera: Modello: Valente C. prec. 5,5x5 Costo unitario: 1 euro/cad. Quantità: 620 Costo Totale Pali di Mezzera: 620,00 euro	Cavo d'Acciaio: Modello: AISI304 mm1.2 (cal13) Costo unitario: 3 euro/Kg. Quantità: 143.571 Kg. Costo Totale Cavo d'Acciaio: 430,71 euro

Costo Totale impianto: 12103,76 euro

The results of the simulation can then be summarized in an html page containing a report with the calculated values and the design of the vineyard, useful in proposing various options for the installation of the new vineyard.

Preventivo Impianto Vigneto 140 - AGRIGIS			
Sesto d'impianto Superficie vitata: 12453 Mq. Distanza tra i filari: 3 Mt. Numero di filari: 50 Lunghezza dei filari: 4020 Mt. Lunghezza minima tra i filari 24 Mt. Distanza tra i pali: 6 Mt. Totale pali: 720 Pali di testata: 100 Pali di mezzera: 620 Distanza tra le barbatelle: 1.2 Mt. Totale delle barbatelle: 3400 Densità: 2730 barbatelle/Ha	Impianto barbatelle Vitigno: Cabernet Portinnesto: Kober 5BB Costo unitario: 3 euro/cad. Quantità: 3400 Costo Totale: 10200,00 euro	Tutori per barbatelle Modello: canna PVC rinf.tonda mm18 Costo unitario: 0.2 euro/cad. Quantità: 2680 Costo Totale Tutori: 536,00 euro	
	Pali di testata Modello: Valente C. prec. 9x9 Costo unitario: 1.8 euro/cad. Quantità: 100 Costo Totale Pali di Testata: 180,00 euro	Cordone Modello Trefil Arbed cal.16 (mm2.7) triplo zinc Costo unitario: 0.75 euro/Kg. Quantità: 182.727 Kg Costo Totale Cordone: 137,05 euro	
	Pali di mezzera Modello: Valente C. prec. 5,5x5 Costo unitario: 1 euro/cad. Quantità: 620 Costo Totale Pali di Mezzera: 620,00 euro	Cavo d'acciaio Modello: AISI304 mm1.2 (cal13) Costo unitario: 3 euro/Kg. Quantità: 143.571 Kg. Costo Totale Cavo d'Acciaio: 430,71 euro	
Costo Totale impianto: 12103,76 euro			





Naturally the system calculates the price quote based on the costs of materials inserted in a table. These costs can be updated or changed for different currencies. It should be noted that this application, by changing a few specific parameters and materials, can be adapted for other types of cultivation (for example certain kinds of fruit) where the growing method used is the “cordone speronato”.

ACKNOWLEDGMENTS

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