Innovative Concepts for Traceability Software of Orchard Production

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Abstract
The requirements of traceability applications are function of the level of detail requested by traceability protocols (mandatory requirements, GlobalGap, Nature Choice's) and of the needs to communicate the data along the fruit supply-chain, in electronic format. Some applications are available on-line. Three of them have been subjected to trials. The following defect were common among them: the application is built to satisfy all users, so it is quite complex for small farmers or for mandatory level of information tracing; the chemical database is not updated when needed, so farmers cannot load into the application the state-of-the-art, newly formulation even if allowed on the specific orchard; the user interface is sometime difficult to use for farmers, that are often reluctant to the use of software in general; too many controls during the insertion do not allow to insert partial data and delay the information recording. Specifically, some operation often carried out by the farmer (e.g. spraying of fungicides, insecticides) are difficult to insert because have to be carried on a single parcel for the software. The defects often prevent farmers to do the traceability task while carrying out the real activities. Instead, they prefer to do it at the end of the campaign. In this way the information is not available when the product is harvested. These considerations lead the authors to develop during two year project a stand-alone software for traceability, with focus on spraying operations. Among the peculiar features of the software the spraying on groups of parcels that allows to greatly reduce the data recording, the post-data control that allows partial data to be inserted into the application.
In this way, the farmer can easily use the software and control the storage of chemical, load the product into the system even after chemical application. The paper present the main features of the application being developed and an example of application.

Keywords: traceability, software, orchard, spraying

Introduction

From the comparison of different management solutions on the market for traceability, we assessed those most in use in the Piedmont Region. The applications have proved very similar to each other and the main differences are referred to: how to define the batch production/lot size, the database of pesticides/fungicides, the refresh rate of the database and the presence of custom specifications that gradually have been requested by customers.

Almost all computer programs for the traceability of the market provide centralized management of several databases that are normally given for hire by paying an annual fee. The main limitation to their diffusion is given by the unwillingness of farmers to invest time in recording the data in electronic format. Very interesting is the opinion of users who wonder how the first condition is the operation usefulness, in terms of ease of insertion and retrieval of data.

The update of data on allowed pesticide use is often slow and dot timely to meet the needs of farmers and this greatly limits the spread of certain applications. The level of computerization in agriculture stands as an important aspect in the diffusion of application traceability, particularly in proper use of modern management systems in the traceability chain of fruit. The difficulty of access to fast Internet connections or the need for special hardware are today still limiting to the dissemination of management systems and computerized tracking and tracing fully managed via web.
The computer approach is therefore more restrained in terms of distribution of the application among the farmers; To fill this gap, DEIAFA has created a stand-alone Access ®-based registration application for fast data log that comply also with certain requirements of the GLOBALGAP Protocol. The project's objective is to develop an integrated application for managing the activities of the orchard production, with the inclusion of information relating to compliance law (e.g. logbook), but that is also used as an aid in drawing up the plan of fertilization and water balance of fruit orchards and irrigation management.

Methods
The database was created in Microsoft Access ®. The database is designed to handle a single user at a time and then a single farm, as it was designed for use by individual companies. Since managing a single company, the database does not require password authentication.

The main menu includes the following groups of procedures:

Minimum Lot: small lots are inserted, i.e. the single field portion on which is cultivated the same with the same year of planting. This means that in a single field we can register more than one minimum lot. For treatments, fertilization and harvesting operations, the small lots are grouped into homogeneous entities referred below as groups. The group includes small lots homogeneous by species or varieties, or parcels located in a certain defined area of the farm.

Figure 1. Form for the insertion of the single parcel
Create / delete group: you can group minimum lots in homogeneous classes related to species, varieties and location specification, in order to simplify the implementation of treatments and fertilization. The procedures developed allow you to create automatically with the use of set operations AND / OR / NOT any grouping of small lots and encode it for later use while performing spraying, irrigation or fertilization. It is also allowed the construction of a group with the manual insertion of minimum lots. The application refers to these groups while registering information on spraying or fertilization.

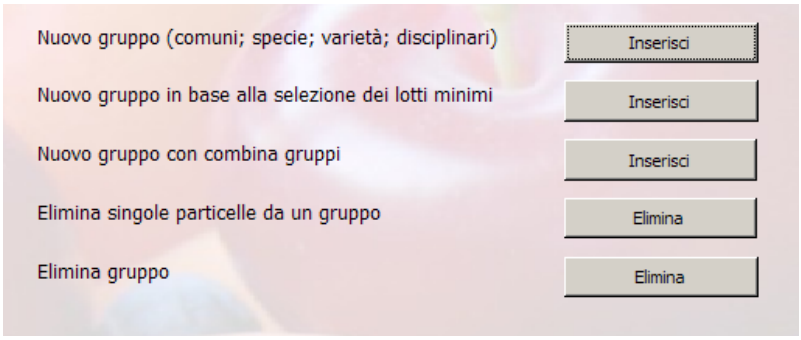

Figure 2. Operations that can be carried on the group management menu

Treatment: you can load the treatments, indicating the products (pesticide/fungicide) used, the total amount of active ingredient used and the group or groups on which the treatment was performed. The registration of a treatment on different groups is done in one step.

Harvest/picking: Defines when the intervention was made, the product types (apples. Peaches, nectarines), the lots / groups on which the collection was made

Fertilizer: this procedure allowed to register the fertilizer used like for the spraying.

Storage of pesticides/fertilizers: the user can register movements such as loading, unloading and the initial stock. Fertilization and spraying and inserted automatically as unloading of the products, when the user insert the treatment or the fertilization.

Views: this procedure allows to access to reports where treatments are shown on each plot, sorted by date, by particles and small lots that constitute a single group. Also the stock movements and products with negative stock are presented.

Peculiarities related to group management
The management of homogeneous groups of particles, called minimum lots, it is essential to speed up the records of treatments and fertilization, which can be executed on the group, not on the individual lot. The group is a set of minimum lots, homogeneous on some characteristics, created on purpose by the user. What differentiates the tool developed is the ease in the composition of groups with operators as intersection, union and negation of sets.

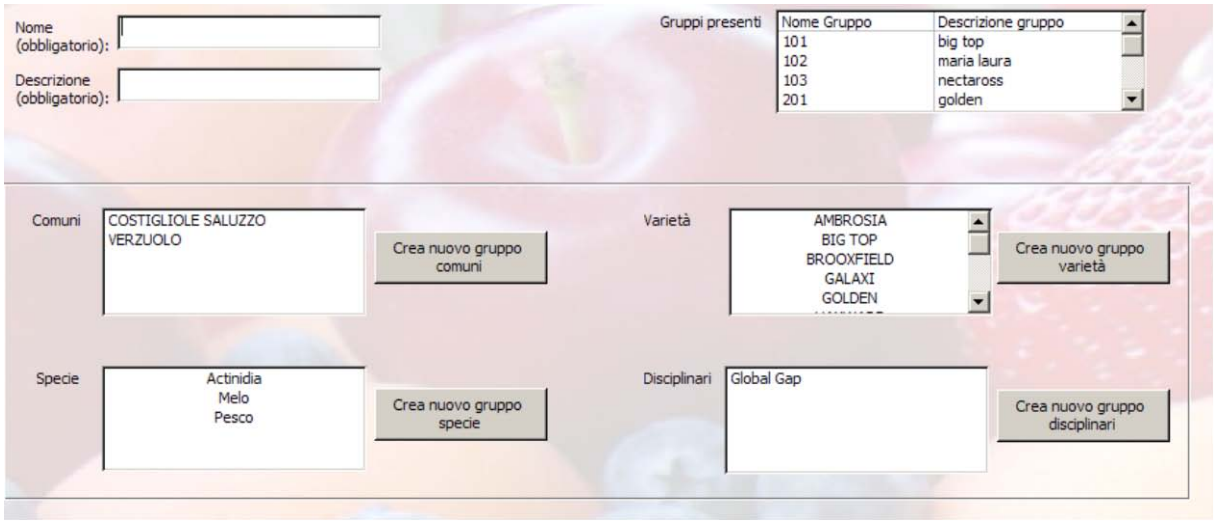

Figure 3. Operations that can be carried on the new group form

With the new option group by selecting the minimum lots you can manually create a group by choosing which small lots are part of it. This is the classic option, which many procedures on the market have, and allows to form groups by selecting among all the particles of the farm.
With the "groups combination" the user can combine groups created with previous options. In this form are requested the name and a brief description of the group, and two windows, displays all the groups already present. You must select a group on the right screen, a group on the left screen, and highlight the option you want to use for combining the two groups:

- an intersection of sets, which will result as all the particles present in the first and second group. Just an example, if you choose apples left the group and right group golden apples, the result will still be the set of particles containing the group golden apples, as a subset of the apples;
- the of union of sets, which will have all the resulting particles is the first group, and in the second group, without duplicates. The union operation applied to the previous case will generate a group containing all the apples, as the group golden apples is already completely contained in the group apples;
- a subtraction operation, which will generate results in all particles present in the first group that are not present in the second. Applied to the previous case, the new group will include all particles with apples except those that are planted with golden apples.

The Figure 4 present the form visualized to combine the groups.

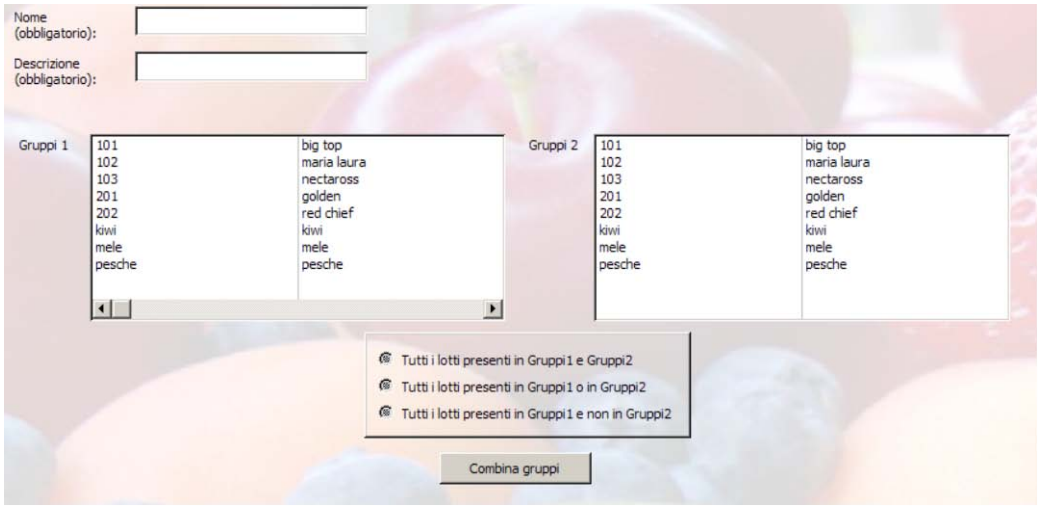

Figure 4. Operations that can be carried on the combine group form.

The combination of the groups mentioned above with the operations of intersection, union, and subtraction to generate all the groups needed to register the spraying and fertilization in one step. It is convenient to generate all groups before starting to enter treatment, and is convenient to generate homogeneous groups by type of treatment in order to expedite the placing of the treatments. Groups can represent the union of simple groups, or groups of second and third level without limit to the number of levels.
For example if a user creates a group for each variety of nectarines, he can then combines them into a single group that contains nectarines using these options, creating a single group of nectarines used for treatments. Instead, when he register the harvest, he will use the single variety of nectarine group.

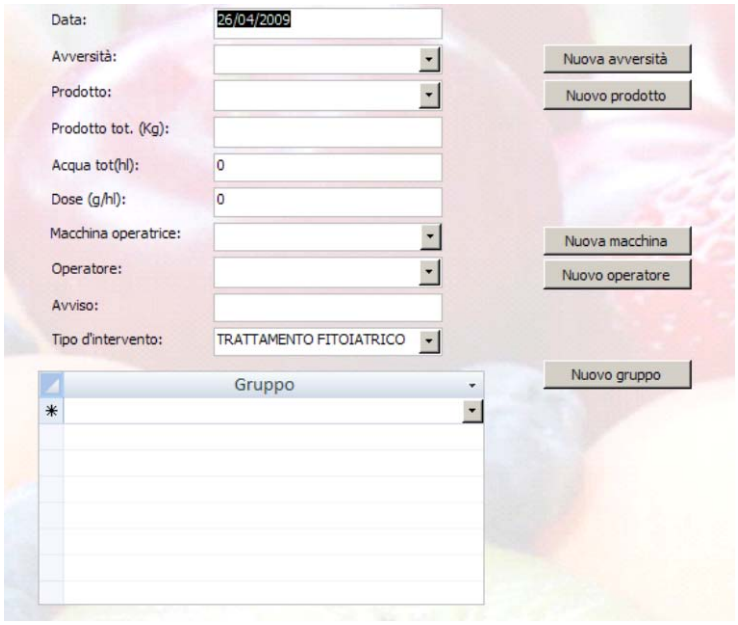

Figure 5. Insertion of new spraying intervention form

Defined these data, the user could register the treatment or the fertilization. When the user enters the groups on which treatment was performed, he can push the new button group, if a group missing and define it immediately. In this case it will appear the screen for defining groups.
The user can freely select multiple groups for each treatment. The total doses of product and water will be distributed evenly among all small lots that are part of the groups selected for treatment, in a completely automatic way.
The application allows the inclusion of a treatment even if the user has not yet uploaded to the active inventory the product, to ensure the partial information storage, which can be completed later.
The application is provided with control application to verify proper data input and control inventory in stock to avoid drawing erroneous records.
With the report referred to the Figure 6, the user gets the view of inventory of products with negative stock, which require a load of product at a date less than that in which they were used.

Controllo prodotti e giacenze

Ragione sociale: AZIENDA BRUNETTI PAOLO **Indirizzo:** Via Ronconi 31 **Comune:** SAN MAURO TORINESE

Nome commerciale	Principio attivo	Numero di registrazione	Data	Disponibilità	Intervento	Check data control
OLEOTER	Olio Minerale	3102	02/03/2007	-260,00	TRATTAMENTO FITOIATRICO	Effettuare il carico entro la data 02/03/2007
TRISCABOL DG	Ziram	3486	02/03/2007	-12,00	TRATTAMENTO FITOIATRICO	Effettuare il carico entro la data 02/03/2007
OLEOTER	Olio Minerale	3102	02/03/2007	-360,00	TRATTAMENTO FITOIATRICO	Effettuare il carico entro la data 02/03/2007
MAVRIK 20 EW	Fluvalinate	9800	08/03/2007	-1,50	TRATTAMENTO FITOIATRICO	Effettuare il carico entro la data 08/03/2007
NITRATO AMMONICC	26% N		04/08/2010	-850,00	CONCIMAZIONE MINERALE	Effettuare il carico entro la data 04/08/2010

Figure 6. Report to control product with negative storage

Conclusions

The application requirements are tracking the level of detail required by specifications and protocols for traceability, and the need to communicate such data to downstream production in electronic format.
Often the requests and customizations for individual users are not implemented by software developers, so the addition of amendments to existing applications is often with a certain slowness. Even the registration of new pesticides on the database required too much time compared to the needs of the farmers.
When the famer follow the minimum, mandatory traceability protocols his goal is to minimize data entry so the use of simpler, fast applications may be ideal.
To fill this gap DEIAFA created a stand-alone based Access ® for fast data recording logbook and to comply with certain requirements of the Protocol GLOBALGAP. The application is currently used on eight pilot farmers. This application has all the advantages of a purpose-built application, with simple graphical interface, with no redundant data request.
The feedback from farmers will help to improve the application in the future.
At present the application is single user and runs a company at a time. This simplifies a lot the data management by the farmer or technician responsible for entering data for traceability. This application, however, does not allow grouped analysis of different farmers, as it could be done in the future with applications that use a single central database (Agritracer, Image Line and the CCSC-Bluarancio Coldiretti).
The purpose of traceability for many farmers has the only function of ensuring the aspects of traceability and food safety thereof. It would be interesting to go on to examine the use of traceability data or to assess the costs of production from one side, or to enhance the product in the eyes of the consumer on the other side.
This second objective, however, requires a tracking system integrated along the supply chain so that information entered along the supply chain are available to the consumer. This could be interesting to implement a new research with the integration of traceability from producer to consumer.

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