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EFI© information system: interest in using growers' on-field data to evaluate cropping systems and to propose indicator dashboards for peach orchard management

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The improvement of agronomic performances of peach (*Prunus persica* L. Batsch) orchards requires effective control of many technical interventions such as dormant pruning, summer pruning, hand-thinning and harvest management operations. These interventions must be well adapted to the behaviour of each cultivar to attain maximum genetic potential, to produce fruits with the most highly desired commercial and organoleptic qualities and to control production costs because manual operations are highly labour-intensive, representing the main costs in orchards. Because of ripening schedule management in order to adjust the fruit supply to consumer demand throughout the summer season (June until September in France), one plot often corresponds to one cultivar on many horticultural farms. Thus, the grower does not have a possible point of comparison at the farm scale to evaluate if each plot is training at its agronomic and technical optimum. The objective of EFI internet database is to collect information from the greatest number of growers' plots to elaborate performance indicators of peach-nectarine cultivars, particularly the efficiency of labour (EFI database name for efficiency). In return, the growers can request the database in order to audit the performance of each plot or cultivar by comparison with all of the data observed on other farms, thanks to dashboard and graph presentations of agro-economic performance indicators. By collecting a large quantity of on-field data, EFI also acts as an observatory of the cropping systems of fruit-bearing trees, making it possible to conduct a large-scale analysis of the influence of training systems on orchard performances.

Materials and Methods

The voluntary growers record their orchard data (homogeneous plot according to traceability criteria: same cultivar, same year of plantation and similar cultural practices) in EFI database. The recorded variables correspond to the location and description of orchards (cultivar, maturity period, year of plantation, rootstock, planting density, tree form, tree height), annual results of harvested fruits and working time of technical operations. Six indicators were calculated: gross yield (Yield, t ha⁻¹), percentage of fruit size above or equal to grade A (GradesA, fruit diameter × 67 mm), fresh marketable yield in grades A (MYieldA), total working time (Hours in h ha⁻¹), total working time per gross yield (HoursYield) and total working time per fresh marketable yield in GradesA (HoursMYieldA). References based on the median and the 20th and 80th percentiles were developed for the most commonly-grown cultivars.

The EFI information system (database, programmed request and graphic visualisation) was built by a team composed of scientists, peach tree experts and technicians to design a tool effectively adapted for use by growers and their technical advisers so that they can make better choices for orchard management.

The database contained 3 000 to 5 000 plots per year from 2000 to 2008, representing nearly 25 to 30% of the French peach-nectarine production (<http://www.fruits-et-legumes.net/efi>).

Results and discussion

The central point of the EFI information system is to allow each grower to audit the performance level of each peach-nectarine plot on Internet by comparison with data collected in the plot network and reference values calculated by the information system for each cultivar. Fig. 1 presents an example of results observed on a farm in the year 2004 for mid-season cultivars. For the performance indicators, an index is calculated allowing standardized comparisons between cultivar-plots. These references are considered by growers as more realistic and representative of their cropping systems than the economic data coming from experimental plots. Especially since these references, in particular working time, are determining factors in the farmer's choices for orchard management. Audits are generally carried out in close relationship with the farm's technical advisor. This analysis makes it possible to pinpoint the particular aspects to be improved on

specific plots. Nevertheless, the assessment of plot performance from the EFI database might be supplemented by other orchard observations (tree vigour, canopy volume, crop load, etc.).

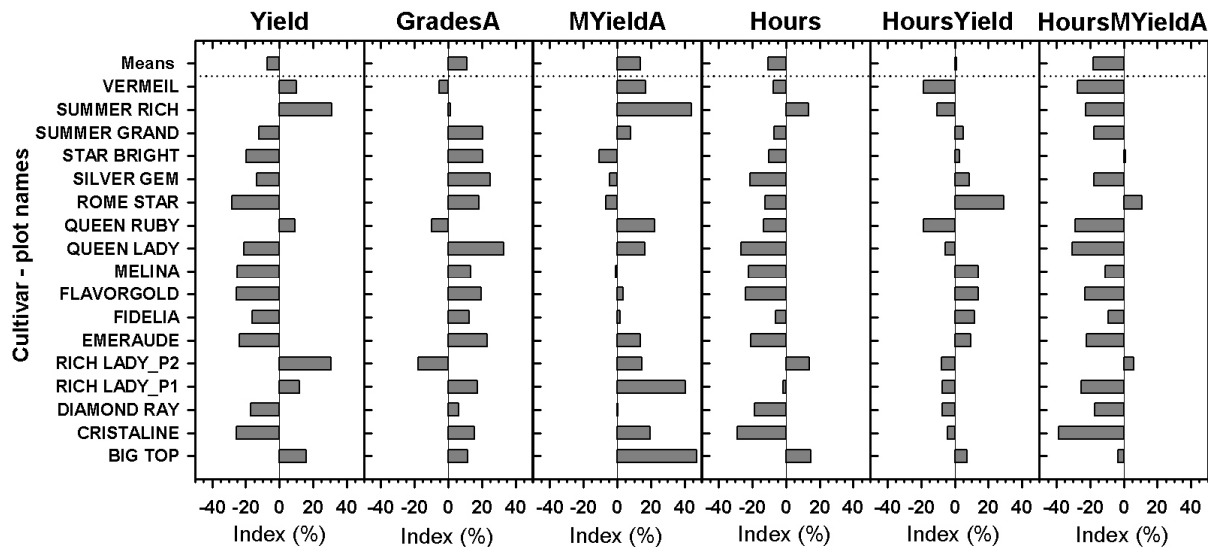


Figure 1. Management charts to visualise the performance of all peach-nectarine plots for mid-season maturity on one farm for the year 2004 (means corresponding to the average of all plots, index (%) are calculated according to median value for each cultivar).

The second interest of EFI database is the interaction between view points of scientists, technical advisers and growers to develop a decision support system (DSS). This integration of their knowledge allowed that the database field has been restricted. Recording information on a data-processing support is still a constraint for many farmers who may be discouraged if they are asked to record too much information. The participatory process is an important ingredient for the DSS adoption and technical advisers have played an essential role in EFI use. The availability of updated formalised knowledge and references via Internet is also very important for the economic decision support tools.

The third point is the interest in using growers' on-field data to evaluate cropping systems on a large scale. In particular we characterize the influence of genetic traits associated to tree or fruit characters (maturity periods, flesh colour and peach-nectarine groups) and the performance variability resulting from year-effect, geographic regions and tree training systems (Plénet et al., 2009). The maturity period was the main factor which strongly affected agronomic performances and labour efficiency ratios, but not the total working times. Nectarine genetic traits reduced only fruit size. Working times for the main manual operations were very significantly affected by region factor partly because orchard height differed according to regions. Tree height strongly influenced the performances. Low trees decreased yield (-4.9 t ha^{-1}) and high trees increased total working time about 190 h ha^{-1} compared to mid-high trees which seem the best compromise between productivity and labour efficiency in peach-nectarine training systems in France.

The development of the EFI information system is iterative to integrate advisers' expectations. Recently, we have developed plot economic analyses in terms of production costs and gross margins.

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