

Contribution to organic breeding programmes of wheat variety testing in organic farming in France

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Abstract

Bread winter wheat is one of the most important cash crops for French organic farmers. Nevertheless, most of varieties available on the market were bred for conventional farming systems (with high inputs of mineral fertilizers and chemicals for crop defense). In order to obtain correct levels of yield and quality, it is important i) to screen current varieties to find the best suited for organic conditions, and ii) to rapidly obtain suitable varieties that are specifically bred for organic farming conditions. Bread wheat variety trials under organic conditions have been coordinated since the year 2001, to centralize and evaluate results at national level. The ringtest not only aims to compare varieties, but also to support organic breeding, as it provides an opportunity to evaluate the ability of advanced lines bred for organic farming to meet the needs of farmers and millers for agronomic and quality traits. Trials are also used to study specific traits required for organic farming (such as weed competitiveness), so that they can become selection criteria in specific breeding programmes. In addition, protocols and results obtained in variety trials in organic farming give information to discuss about possibility of low input VCU testing (Value for Cultivation or Use).

Introduction

The acreage of bread wheat is considerable in French organic agriculture (about 30 000 ha in 2006). As bread wheat is the most important cash crop, the type of varieties organic farmers should be using is very important. That is why it is essential to assess wheat varieties in terms of their productivity and quality, and to assess stability across years and sites under French organic conditions. Varieties that are compared encompass modern varieties that are available on the seed market, but also new cultivars that are supposed to be more suitable for organic production, including lines from organic breeding. The coordination of wheat variety testing at national level has two main objectives: i) To determine relative performance of cereal varieties grown under organic conditions. This should improve productivity and quality of organic cereal production by identifying cultivars that are best suited to organic farming systems. ii) To provide information for organic breeding programmes in order to support them, as these trials give opportunity to evaluate the relative performance of advanced lines bred for organic farming, and to study specific traits (such as weed competitiveness) usually not used as selection criteria.

Materials and methods

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Considering that numerous wheat variety trials were conducted independently with no connection and only local evaluation of results, Technical Institute for Organic Farming (ITAB) proposed in 2001 to centralise results and evaluate them at national level, in order to coordinate methods and reduce costs. The first step was to apply the same protocol and to have common varieties in each trial. Furthermore, as very few baking tests were locally processed because of cost, they have been centralized and taken in charge by ITAB for the last three years. All trials, run on organic farms, use a randomised block design with either 3 or 4 replicates. Where possible, organically certified seed is used, otherwise conventionally produced untreated seed is used. The basic principle is to have diverse environmental conditions that reflect reality (farmers standard practises are generally applied⁴), in order to assess the ability of varieties to adapt to different constraints. Varieties assessed in the ringtest are conventional varieties with traits that are supposed to best fit organic constraints (i.e. a good response to low level of nutrients, a good competitive ability against weeds), foreign varieties (with priority to those specifically bred for organic agriculture), and advanced lines from French breeding programmes specifically for organic agriculture. Agronomic and quality parameters that are currently centralized at are: yield (t/ha) and proteins content (% -NIR method-) for all trials, and if available: specific weight (kg/hl), height (cm), ground cover, diseases notations, quality/bread-making data. As a result, for the last 5 years data of 20 to 30 wheat variety trials per year have been combined for yield and proteins content. As a large range of soil types and climatic conditions are concerned; these results are processed by large geographical areas (roughly: north, south, centre and west). Since last year, results on important traits such as height, diseases, test weight, and baking quality have also begun to be combined and evaluated at national level.

Results

Figure 1 gives an example of annual results for the Southern area: yield versus protein content. Besides, stability across sites is observed. The variety Saturnus, which has clearly higher protein content, has low and very variable yields across sites, whereas the variety Orpic, in the average for both yield and protein, appears to be very stable across all five sites.

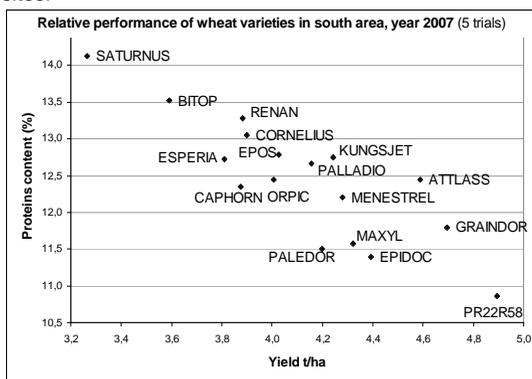


Figure 1. Relative performance of winter wheat varieties in south area, year 2007

⁴ For fertilisation: N provided through crop rotation or manure, 30 to 60 kg/ha if direct fertilisers.

In addition, there is an analysis of stability of results across years for both yield and protein content: for the 2 or 3 last years for most varieties, for the last 5 years for three of them. Results are similarly analyzed for the five main areas of France. Complemented by baking quality results (example in figure 3), these analyses are the base used to elaborate list of recommendations to organic farmers: the results are published each year, including long-term results over the years.

Within the ringtest, we include advanced lines bred for organic farming (cultivars from Lemaire-Deffontaines and INRA), in order to assess in different organic conditions their performances and compare them to current varieties. Two lines bred by INRA appear to be promising: both have yields among the more productive (see figure 2, lines are underlined), while their response to baking test is good (figure 3) and a nutrient analysis indicates good level of magnesium. In addition, measures of height and ground cover show good weed competitiveness. For this criteria, it is interesting to add that the network of organic wheat variety trials is used to study how to improve measurement of weed competitiveness, as it offers a large range of weed species found under different conditions of climate and soil.

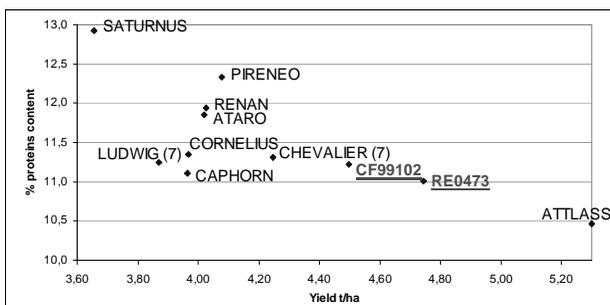


Figure 2. Relative performance (yield and proteins content) of 2 winter wheat lines bred for organic farming (results of 8 trials across France, year 2007).

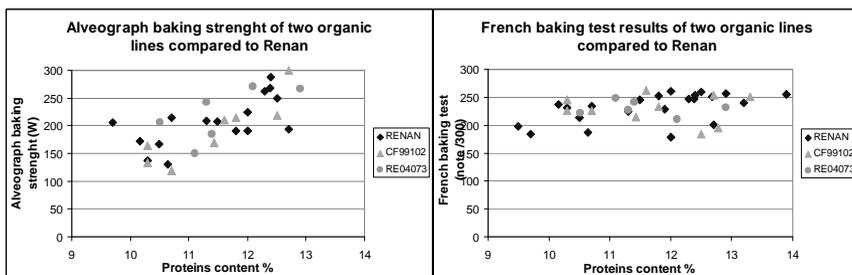


Figure 3. Baking quality results of 2 winter wheat lines bred for organic farming (samples from year 2004 to 2007).

Discussion

Currently, referent varieties such as Renan (a compromise between yield and proteins, with good baking quality), Atlass (for yield) or Saturnus (for proteins) perform relatively well from North to South. The results demonstrate that advanced lines bred

for organic farming CF99102 and RE04073 perform well compared to current varieties with good levels of yield and ground cover; baking quality data are good up till now, but have yet to be completed for RE04073. According to those results, a proposition for official registration may be done next year.

In addition, it is important to underline that network gives large information to discuss about the possibility of low input VCU testing. As official VCU in France is conducted under conventional conditions, the network of variety trials in organic farming provides knowledge on i) reference varieties cultivated in organic farming and ii) assessment of weed competitiveness and specific baking quality required for organic bread making.

Conclusions

Organic farmers need bread wheat varieties suitable for both organic conditions (agronomic traits) and organic market demand (quality traits). Already in France some initiatives exist to set up specific organic breeding programs to meet the requirements for adapted genotypes. Besides screening of conventional varieties, a national network of variety trials in organic farming complements those breeding programs, as the network provides data on the performance of advanced lines and help to improve selection criteria. A problematic issue which needs more attention is the registration system, not being adapted to lines for very low input and organic conditions. Therefore another value of the national network could be to transform some of the trials into official VCU trials, or to be recognized as post-registration system for organic agriculture if VCU trials are eliminated. This still has to be discussed.

Acknowledgments

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