ORC Factsheet no. 2 - January 2021

CROP DIVERSITY & AGRONOMY

Farm-based organic variety trials

A collective experiment with an organic farmers network

AUTHOR
Ambrogio Costanzo

CONTACT
Ambrogio Costanzo

ORC ACKNOWLEDGEMENTS
Dominic Amos, Charlotte Bickler

YEAR
2017-Present

FUNDING - PROJECT
EU Horizon 2020
- LIVESEED

ABSTRACT

Varietal choice is the major crop specific management decision organic farmers can make to manage crop performance. However, with official varietal evaluation mostly carried out in conventionally managed environments, there has been widespread difficulty in identifying varieties suitable for organic and low-input systems. This has been especially difficult in wheat, which is the most important arable crop in England, yet with a very small and shrinking organic acreage.

In 2017/18 we started a collective experiment in which wheat varieties were tested by organic farmers at a commercial field scale. In the first two years, besides providing useful information on the tested varieties, this work has paved the way to better understand winter wheat production and thereby build decision support frameworks and feedback to breeders on useful traits.

Collective experiments can be a powerful tool for co-learning between researchers, farmers and supply chain stakeholders. By working together, the industry, and any farmer engaged in a journey towards a more sustainable production with reduced use of chemicals, can be empowered to independently generate the evidence needed for on-farm decision making.

Figure 1 Different weed suppressive ability by a modern (left) and a historic (right) wheat variety grown in the same field Credit: Mark Lea

INTRODUCTION

Crop performance in organic farming is in part limited by use of inappropriate varieties. As a matter of fact, varietal evaluation is critical to match the most appropriate variety to a farm's conditions and needs, yet it requires complex and resource-intensive organisation. Organic farming adds further difficulties to the task for three reasons. First, different varieties perform differently whether they are grown in a conventional or in an organic farm[1]. Second, with minimal or no use of external inputs (herbicides, mineral fertilisers, pesticides), organic farms tend to differ from one another more than conventional farms do[2]. Third, observations from experimental plots can be less reliable in organic than in conventional farming to predict how a crop performs at a field-scale[3]. With the whole of agriculture aiming to reduce the use of external inputs, understanding varietal performance in organic farming can be of high strategic importance well beyond the organic sector.

WHAT WE DID AND WHAT WE HAVE LEARNED

ORC started testing winter wheat varieties at a field-scale in 2017/18, with a network of seven farmers from Dorset to Lincolnshire, which grew to 13 farms in 2018/19 and tested 12 varieties. These included commercial varieties, as well as the historic cv. Maris Widgeon and the Yield-Quality Composite Cross Population (YQCCP) aka "ORC Wakelyns Population". Also see: Factsheet no. 3 "(R)evolutionary wheat populations".

At least three varieties were drilled as strips in each farm's main wheat field, according to an experimental design which allows robust statistical comparisons. Crop cover, height, ear density, severity of foliar diseases, weed abundance and community composition were measured during the growing season. Farmers measured the yield of their strips and provided a grain sample for quality analysis, after which they used the harvest for sale or for on-farm feed use.

Varieties tended to cluster in two groups: one with a high yield potential (4-5 t/ha) but low protein content, and one with high protein potential (10-11.5 %) and slightly lower yields (3-4 t/ha) (**Figure 2**). The historic variety Maris Widgeon and the ORC Wakelyns Population, which are not officially classified in end-use categories, positioned themselves in the high-protein group, suggesting their suitability for the milling market.

Two weed management strategies emerged across the participating farms: one based on spring-tine harrowing on wheat sown in 10-15 cm distant rows; and one, more intensive, relying on power hoeing on wheat sown in 20-25 cm distant rows. The second showed less abundant, but less diverse, weed communities than the first. This evidence, coupled with observed varietal effects on weed abundance, can inform integrated weed management strategies.

Lastly, integrating such a real-farm crop performance dataset with climatic data over several years, will provide precious information to improve resilience to climatic unpredictability. For example, data from the 2017/18 growing season, which had a dry and hot spring and summer, can be a snapshot of the more drought-prone climate that is forecasted for the second half of the century[4].

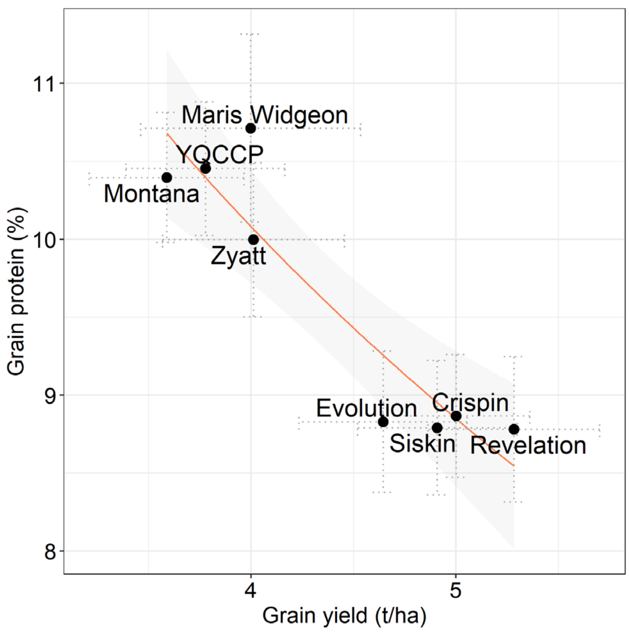

Figure 2 Grain yield and protein content measured across a network of farms in 2017/18 for eight selected winter wheat varieties, averaged over farm and year

Conclusion

As of the 2020/21 growing season, the collective experiment is continuing and expanding, with more varieties tested and more farmers involved, including non-organic farms. We aim to build a comprehensive dataset of wheat performance that will inform farmers, breeders and scientists on the interactions between genetics (the varieties), environment (climate, soil) and management. Moreover, the work on varieties can be a starting point to shed light on bigger, highly strategic questions such as crop adaptation and resilience to climate change, dynamics and assembly of weed communities and their effects on cropping system performance and sustainability.

So far, this work is a successful proof of concept of how farmers, in collaboration with research, can generate the evidence they need to support their decision making. In fact, with some attention to experimental design, participatory research can generate robust data whilst being easily accessible to farmers and ultimately empowering them to improve their adaptive capacity and consequently foster the transition towards more sustainable food systems.

Figure 3 Measuring ear density in a wheat crop

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The Organic Research Centre

Trent Lodge, Stroud Road, Cirencester GL7 6JN - United Kingdom

Company Registration: 1513190 | Registered Charity: 281276

organicresearchcentre.com