Generating adaptable diversified modern genetic resources for on-farm selection and participative breeding of wheat

Maria R. Finckh[1] and Philipp Steffan[2]

[1] Ecological Plant Protection Group, Faculty of Organic Agricultural Sciences, Univ. Kassel, Nordbahnhofstr. 1a, D-37213 Witzenhausen

[2]Keyserlingk-Institut, Rimpertsweiler 3, D - 88682 Salem, psteffan @saatgut-forschung.de

Introduction

The overall aim of "evolutionary breeding" is to produce high yielding and high quality but genetically diverse crop populations able to respond to changing biotic and abiotic environmental conditions

Three winter wheat composite crosses (CC) were produced in the UK in 2001 (Wolfe et al, 2006) and are currently maintained at different sites in Europe. The three CC populations are composed of 9 high yielding (Y), 12 high quality (Q), or 20 (A) parents, respectively.

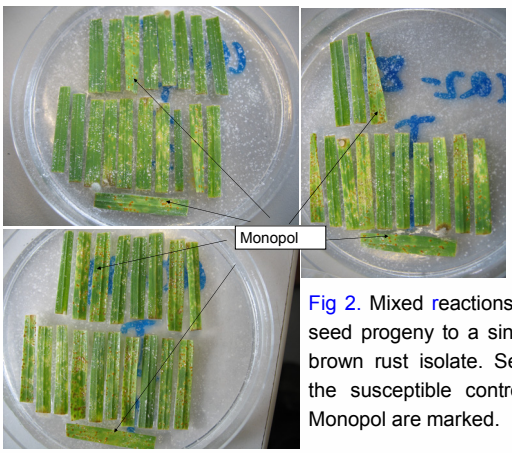

Fig 2. Mixed reactions of single seed progeny to a single spore brown rust isolate. Sections of the susceptible control variety Monopol are marked.

Results

- Variation within the populations for morphological traits was still large in the F_7 (Fig. 1).
- Out of 23 tested single seed progenies of the $F_{5,}$ 22 segregated for resistance to brown rust (Fig. 2). One of the progenies was in gametic equilibrium for its reaction to two rust races suggesting recent outcrossing.
- Due to climatic conditions, yields were considerably higher in 2006 and 2008 than in 2007 (Fig. 3). The low performance under conventional conditions in 2007 and 2008 was due to fertiliser errors. No statistical comparison can be made between growing systems as different fields were used, however.
- In 2006 and 2008, local disease pressure was low. Although in 2007, rust pressure was up to 20% severity at milk stage in neighbouring varieties, almost no rust was observed in the CC populations.

Methods

At the University of Kassel, the populations are maintained since the F_5. They are grown in neighbouring sites under conventional (without the use of fungicides) and organic conditions in two replicate plots of at least 100m^2 each.

Single seed progenies of the F_5 were tested for genetic uniformity in rust resistance (Fig. 2).

Fig. 1. Morphological variability in the F_7 grown in 2007-2008 under organic conditions.

Aims

The aims of the work at University of Kassel are to:

- Determine if, what, and how much heterogeneity will persist in the populations over time.
- Determine the effect of the farming system on the evolution of the populations
- Generate and provide materials for interested farmers for the development of locally adapted populations.

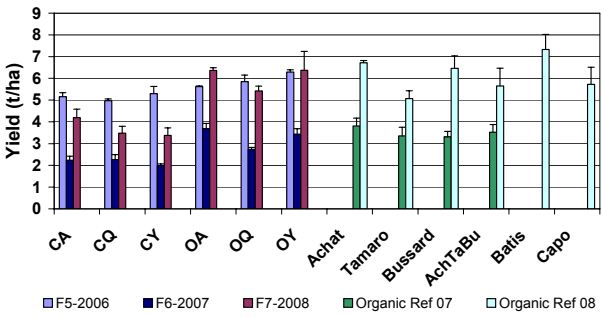

Fig 3. Yields and standard deviations of the F_5 to F_7 of three CC populations (A, Q, and Y, see Introduction) under conventional (C) and organic (O) conditions and yields of reference varieties and one mixture (AchTaBu) under organic conditions.

Discussion and outlook

The segregation in the F_5 for resistance and gamatic equilibrium in a single seed progeny show that outcrossing is taking place and that there is continuous potential of new genotypes arising. As male sterility was still observed at 1% in the F_5, outcrossing beyond the ‚normal' level should still have been occurring.

In the future it will be possible to study adaptation processes to the management system with respect to nutrient use, resistances and weed suppressiveness.

Exposure of the populations to additional selective pressures (pathogens, weeds, soil managment) either experimentally or within exisiting farms would be very desirable.

Literature:

Wolfe, M. S., et al. 2006. Evolutionary breeding of wheat , p. 77-80. *In*: H. Ostergaard and L. Fontaine (eds.), Proceedings of the COST SUSVAR workshop on Cereal Crop Diversity: Implications for Production and Products, 13-14 June 2006, La Besse, France. ITAB (Institut Technique de l'Agriculture Biologique), Paris, France.