Participatory Cereals. Disease, varieties and seed treatments.
Jane Thomas and Rosemary Bayles (NIAB).

The Defra funded project "Cereal Varieties for Organic Production: Developing a Participatory Approach to Seed Production and Varietal Selection" has just completed its second of four years and led by EFRC in collaboration with NIAB, Middlesex University, University of Kingston, HDRA and around 20 organic farmers in the south and east of England.

The aim of the project is to develop a robust system for identifying, testing, multiplying and marketing cereal varieties, lines, mixtures and populations best suited to organic production in different parts of the country. It has eight objectives, which are;

1. To develop a participatory research and development methodology for UK organic farmers using variety trialling and the management of seed-borne disease as examples.
2. To collect information on the range of cereal varieties currently grown by organic farmers to help identify the major priorities and constraints among the varieties available.
3. To establish a pilot programme of cereal variety trials with organic farmers on organic farms using the methodology developed by Objective 1.
4. To obtain information on which seed-borne diseases, including ergot, may cause problems in the organic seed production chain of wheat, barley, oats and triticale, and to examine any relationship between organic husbandry conditions (seed rate, sowing date, rotation etc.) and incidence/severity of disease.
5. To determine whether cultivars with good potential for organic production are resistant to one or more of the seed-borne disease problems.
6. Working with farmers (Objective 1), review and identify a range of organically acceptable seed treatments and processes, considering both chemical and physical methods, and test these under organic conditions to determine efficacy.
7. To Formulate a code of best practice for the production of certified organic seed, and for the processing of seed on organic farms.
8. To evaluate the participatory research and development approach throughout the entire research process and produce guidelines and materials for best practice. Data will be collected throughout the duration of the project.

What follows is a report on the work undertaken by NIAB during the 2003/04 season as part of this project and addresses objectives 4, 5 and 6. A fuller report on the whole project will appear in the next bulletin.

Testing organic cereal seed for seed-borne disease

Tests have been completed on a total of 174 samples, predominantly wheat. Samples were obtained from organic seed producers, farm saved organic seed from growers, and seed harvested from organic variety trials. Levels of *Microdochium nivale* (seedling blight) were high on some samples of wheat. Levels of bunt (*Tilletia tritici*) were generally low, and below the threshold for treatment in conventional seed, though a small number of lots had higher levels, and in one case a seed bulk was considered unsuitable for further organic production. *Cochliobolus sativus* (foot rot) was recorded at high levels in a specific seed lot of barley, and *Pyrenophora avenae* (leaf blight) was seen in some organic oat samples.

Comparisons were made between results of samples of conventional seed sent to NIAB for commercial tests, and the organic seed. Though test numbers were very different (eg about 600 samples of conventional wheat seed), there did not appear to be any consistent trend for organic cereal seed to be healthier or less healthy than conventional seed (eg see Figure 1a and 1b). The predominant seed related problem was ergot in wheat, with very high numbers (up to 80) of sclerotia per kg of seed in some samples, but similar levels have been noted recently in conventional seed lots.

Fig 1a Percentage of samples infected with various seed-borne diseases, 2003, organic and conventional seed (W= wheat, O = oats)

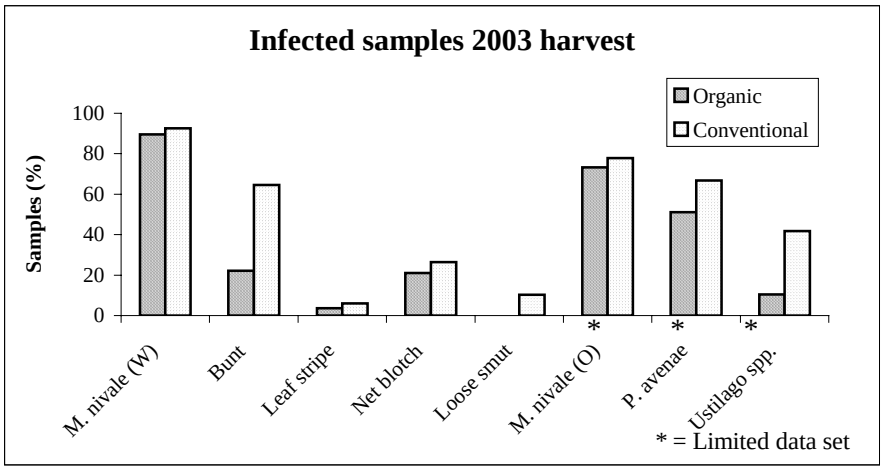
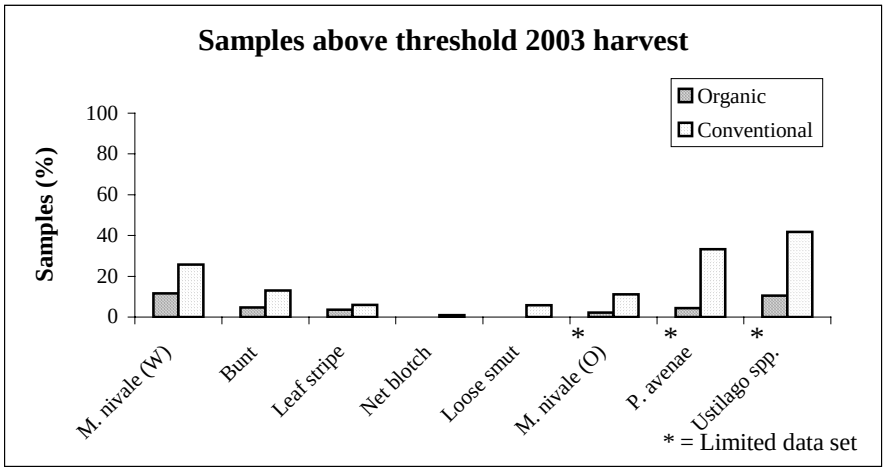


Fig 1b Percentage of samples above advised seed treatment threshold disease levels, 2003, organic and conventional seed (W= wheat, O = oats)



Organic seed treatment evaluation

A number of seed treatments and processes which are either approved for organic use, or would be highly likely to achieve approval, were applied to diseased seed of wheat (*M. nivale* and *T. tritici*) and barley (*Pyrenophora graminea*, or *Ustilago nuda*). Products were selected to represent a) "chemical" b) physical, or c) biological applications. Treated seed was sown in replicated 12 m plots in autumn 2003, together with untreated seed and conventional product controls. Appropriate records of the occurrence of seed-borne disease expression, plant growth and yield were taken (wheat still to be harvested). The trial was carried out on non-organic land due to the problems associated with some products, and the introduction of

diseases such as bunt and loose smut onto organic holdings. Preliminary results indicate that the hot air treatment used as a physical process reduced bunt in wheat to some extent. This treatment clearly reduced establishment as well, though in the barley trial yield was not significantly reduced.

Controlling seed-borne disease with variety resistance

Trials in 2004 consisted of a second season of investigation for all diseases, and sowing out of seed infected in the previous year. The preliminary analyses of results are summarised below:

Bunt (*T. tritici*) . For winter wheat varieties, there was good consistency between 2003 & 2004 data, with Hereward and Solstice again showing good resistance and other varieties being fairly susceptible. As in 2003, all spring wheat varieties tested were susceptible to bunt. Winter triticale varieties were totally uninfected for the second successive year.

Ergot For winter wheat, there were some inconsistencies between 2003 and 2004 infection levels: in 2004, all varieties tested were susceptible, although Nijinsky (= Socrates) showed some resistance in both years. Spring wheat varieties were also all susceptible in 2004; Chablis appears to be slightly less susceptible, having no infection in 2003 and lower levels than other varieties in 2004. All four winter triticale varieties tested were very susceptible in both years. All winter and spring oat varieties tested showed no infection in either 2003 or 2004.

Barley leaf stripe It is difficult to draw any conclusions for this disease, as the method of spraying spore suspension onto ears produced little infection in harvested seed or resulting plants "grown-on" in 2004. There was a suggestion that the spring barley variety Dandy may be slightly more susceptible than others but this will require confirmation in 2005. It may be necessary to devise a more invasive ear infection method to test varieties for resistance to leaf stripe.

Loose smut The winter wheat varieties Exsept and Xi19 exhibited high levels of infection in both embryo and 2004 "growing-on" tests; Claire, Deben and Nijinsky appeared to be more resistant. For spring wheats, there was inconsistency between results of embryo tests and growing-on tests in the field and it is difficult to draw conclusions. All winter barley varieties tested were susceptible to loose smut; spring barley data is not yet complete, although Optic may be slightly more susceptible than other varieties.

M. nivale ear blight The winter wheat variety Exsept had low levels of ear blight in both years; Claire and Deben had lower infection than most other varieties in 2004 only. There was poor correlation between field assessment data and subsequent levels recorded on the seed in agar plate tests. All spring wheat varieties tested were moderately susceptible in both years and there was better correlation between ear and seed infection. Winter oat varieties ranked the same in both years, with Millenium showing the most infection and Kingfisher the least, although infection levels in the field and on the resulting seed were low. The spring oat Firth appeared to be more susceptible than other varieties in both years and had correspondingly higher seed infection.

Participatory procedures in NIAB work

(all objectives)

Participatory procedures have informed the planning and execution of the seed-related work at NIAB in a number of ways:-

1. Accessing organic seed samples – the majority of samples were provided through contacting organic seed producers and organic growers, and including samples from organic variety trials carried out by project collaborators and others
2. Selecting seed treatments – a number of commercial organisations and organic seed producers were contacted and asked to supply or identify products which may have potential in controlling seed-borne diseases. Representatives were asked for product data and application rates, and were invited to view the trials in June 2004 and suggest changes or additions to future work
3. Selecting varieties for resistance tests – Organic Seed Producers and EFRC collaborators were asked to nominate varieties for inclusion, concentrating on those either grown currently by organic farmers, or being trialled in organic conditions.

In addition, other activities to inform the participatory process were undertaken. These were

1. a demonstration of the seed treatment work in June 2004. Approximately 15 people attended this, including representatives of companies who provided products (see above), and organic grower groups/agronomists. As a result of this, changes to trial plans are being considered for 2004/5, in particular the inclusion of a suitable seed treatment trial on organic holdings, and the inclusion of a further physical seed treatment process (gravity separation to improve seed quality)
2. NIAB staff gave four talks for delegates at the Defra funded Organic Demonstration Project. Views of delegates on the importance of seed-borne diseases were sought. The most consistent view was that ergot and bunt were of concern, but there was also concern that poor germination experienced by some growers last season was due to Microdochium. Seed samples harvested from these trials will be sent to NIAB for testing since they represent a wide range of well documented growing situations in 2004.
3. Project staff at NIAB have been interviewed by a participatory research consultant so that the technical approaches described here can be reviewed and evaluated as part of the participatory process.