DISEASE SEVERITY AND GRAIN YIELD OF SPRING BARLEY VARIETY MIXTURES GROWN UNDER ORGANIC OR CONVENTIONAL CONDITIONS

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INTRODUCTION

Modern spring barley varieties have been developed with the aim of combining high productivity and standardized product quality under high-input conditions. The organic growing system is a system where pesticides and synthetic fertilizers are generally not allowed. Hence, biotic and abiotic stresses have to be overcome by growing appropriate varieties and by practicing good farm management. An important question is whether modern spring barley varieties possess the right combinations of characteristics, e.g. disease resistance and tolerance, to ensure a stable and acceptable yield of good quality when grown under different organic growing conditions.

Despite quite intensive testing of varieties, predictions of future performance of varieties, when grown on specific locations, are known to be nearly impossible; this especially within organic growing systems, where no pesticides and fertilizers can help stabilize yield. Therefore, using mixtures of appropriate varieties might be a way to obtain more stable and acceptable yields. Variety mixtures have so far been studied mostly under conventional farming conditions and focus has often been to

characterize disease progress of one pathogen. Here we consider simultaneously four important foliar diseases on spring barley grown in organic as well as conventional growing systems. Further, we study the changes in disease severity of variety mixtures when adapting to local growing conditions ('farm saved seeds' or 'farm varieties'). The work is part of a Danish project on organic spring barley (BAR-OF) as well a European Network on varietal characteristics and crop diversity (COST 860) (see Østergård 2002 and 2004).

MATERIALS AND METHODS

In 2002 six three-component variety mixtures were constructed. The mixtures consisted mostly of high yielding varieties based on 2001 official variety testing data. The mixtures were made according to official certification requirements: 1:1:1 mixture, medium to high predicted grain yield, high predicted average disease resistance and little difference between harvest dates. However, the varieties were chosen to show larger differences in culm length than required according to the rules. These mixtures as well as their components have been included in trials in three years. Further, seeds harvested from mixtures have been sown the following years resembling farm saved seed. This gave the opportunity to study the natural processes based on competition between the varieties in the mixture taking place during the growth of the crop.

Field trials have been conducted on experimental research fields at three Danish locations: Jyndevad, Foulum and Flakkebjerg. At each location different growing conditions were considered: either being organic-like (i.e. no pesticides, weed harrowing and low input of organic fertiliser (e.g. slurry)) or being conventional-like (use of herbicides and

synthetic fertiliser according to local standards, however, without use of fungicides). All together, in 2002 data were collected in six different environments, in 2003 in five environments and in 2004 in three environments. The following characteristics will be considered: disease severity of powdery mildew, barley leaf rust, scald and net blotch assessed 2-3 times during the season; grain yield; kernel size and culm length. The potential disease load in an environment was calculated as the average of the five most susceptible varieties in that environment.

RESULTS AND DISCUSSION

Despite what generally is assumed, the potential disease loads of the different diseases were of the same magnitude in the different systems at the same locality and year. In the three years studied, powdery mildew as well as net blotch was dominant.

The mixtures performed differently with three of them ranking above the standard and one of them among the ten best varieties in both 2002 and 2003 (1). The grain yield of the mixtures was in most cases higher than the average of the components. The total disease severity was less in the mixtures than in the averages of the components; especially the powdery mildew severity was reduced.

The yield stability of the mixtures over these very different environments was not much different from that of their components. This may be due to the fact that these mixtures were designed to enhance competition between the components of the mixtures. As a consequence, mixtures for stabilizing yield in very variable environments may need to be designed differently.

When using the 'farm saved seed'-mixtures the yield decreased. Again this effect may be a result of the chosen mixtures.

The final result of competition between the components of the mixtures will be evaluated when DNA markers are established to estimate changes in the proportions of different components in each mixture.

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