

Impact of foliar diseases in organically grown barley: Influence of fertilization, nutrient content in leaves, varietal disease resistance characteristics and yield potential.

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Abstract

Significant increase in severity of powdery mildew, leaf rust and net blotch with increasing N content in plant leaves 30 days after germination (all years where the relevant diseases were present at a substantial level). This may explain most of the environmental main effects (field) on disease, and the effect of treatment. For instance, treatment 4 resulted in reduced N/increased K content in leaves, which coincided with reduced levels of disease. We observed no clear effect of P, Ca, S, and Zn content in leaves on disease. Micronutrients as Cu, Mo and Mn showed significant effects on powdery mildew in one year but not the other; further interpretation may not be possible due to inter-correlation among the effect of micronutrients.

The diseases had a significant grain yield reducing effect, in particular powdery mildew and net blotch, which occurred at highest severities. In addition, net blotch affected root development, resulting in significant shorter roots, whereas powdery mildew did not. The effect of disease on root length was of the same order of magnitude as the factor 'variety', but larger than the effect of 'year' and fertilization 'treatment'.

Introduction

The aim was to analyse the nature of foliar diseases in organically grown barley as influenced by fertilization (manure), nutrient content in the crop, varietal disease resistance characteristics and yield potential, and to quantify the impact of foliar disease on grain yield and root development.

Materials and Methods

Measurements

- Disease severity at GS 71-75, whole-plot-assessment based on top-three-leaves [at plot level in both years]: (additional assessment at GS 49-55 in 2004)
 - powdery mildew
 - leaf rust
 - scald
 - net blotch (net form)
 - net blotch (spot form)
 - general necrosis
- Spot form of net blotch was the least frequent and grouped with net blotch-net form in the analysis.
- History of plots
- Applied amounts manure (and nutrients) in plots
- Nutrient content (N, P, K, Ca, Mn, Zn, Mg, Cu, Mo, [S]) in plant biomass 30 days after emergence (at plot level)
- [Nutrient content (as above) in plant biomass 100 days after emergence and at harvest (at plot level) in 2004 – in 2003 at treatment*variety*field level] – this latter info will not be considered in detail because: 1) may be dependent on disease in trial and therefore not independent (covariate) variables, and 2) incomplete data on the plot level.

- Yield (biomass) 100 days after emergence
- Biomass of non-crop 100 days after emergence
- Yield (grain) at harvest
- Yield (straw) at harvest

Results

Preliminary analysis of nutrient content in crop:

- Poor correlation between nutrient content 30 days and 100 days after emergence (except for N-pct)
- Positive correlation between content of most nutrients at day 30 (except for K, which is negatively correlated with most others). Therefore, - may not be possible in detail to interpret the influence of individual nutrients on disease.

Summary of results - overall:

- Large differences in severity of individual diseases across year (leaf rust, net blotch-net form predominant in 2003, and powdery mildew predominant in 2004).
- Highly significant differences in disease severity between fields within year. Disease much more predominant 1st year after clover grass compared to 4th year after clover grass.
- Highly significant differences in individual disease severities on individual varieties.
- Highly significant interactions between variety and 'field within year'.
- Highly significant reduction of disease in mixtures as compared to average in pure stands, - valid for all environments and all prevalent diseases.
- Significant effect of treatment on prevalent diseases and necrosis:
 - Powdery mildew (2004). Significant effect of treatment, - and least powdery mildew in treatment 4 (farm yard manure FYM) compared to other treatments
 - Net blotch (2003). Close-to-significant effect of treatment, and least net blotch in treatment 4 (FYM), 1st year after clover grass (highest disease level).
 - Leaf necrosis (2003 & 2004). Significant effect of treatment in 3 out of 4 environments, - and least necrosis in treatment 4.
- Net blotch resulted in significantly shorter roots, whereas powdery mildew did not.
- Net blotch and powdery mildew was estimated to reduce grain yield up to 10 hkg/ha in the most susceptible varieties