Thresholds for Net Blotch Infestation in Organic Barley Seed Production

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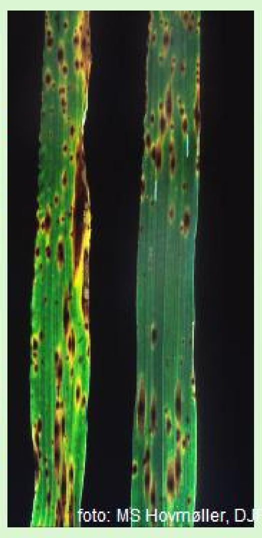
Background and objectives

Infestation levels of barley seed lots with net blotch (*Pyrenophora teres*, Pictures 1 – 3, Figure 1) can easily exceed the recommended 15% threshold in Denmark, especially in organically produced seeds. Seed lots having net blotch infestation levels above this threshold may not be sold. This threatens the supply of the Danish organic barley growers with organically produced healthy barley seeds (Nielsen & Kristensen, 2001). The ORGSEED project (http://www.foejo.dk/forskning/foejoii/vi1.html) aims at quantifying the links between initial seed infestation, primary seedling infection, disease severity during the growing season, yield parameters and new infestation of the harvested seeds to improve decision support for handling net blotch infestations in organically produced barley seeds.

Picture 1. Primary infection on the first leaf of a barley seedling (yellow arrow) due to seed born net blotch.

Picture 2. Net type symptoms of net blotch on barley at the grain filling phase.



Picture 3. Spot type symptoms of net blotch on barley leaves.

Materials & methods

An inoculated field trial employing the net blotch-susceptible varieties Lux and Madras and seed lots with various known levels of net blotch infestation was planted in 2003 at Flakkebjerg, Denmark in three replications. Seed infestation levels had been determined by means of the blotter method (incubation of seeds in petri dishes on wet filter paper). Treatments consisting of various application levels of net blotch-infected straw were included in this trial for seed lots infested with ca. 15% net blotch. The trial was irrigated (3 x 15 min. daily at 20:00, 0:00, 8:00 hrs) to provide opimum moisture for net blotch development. Net blotch development during the growing season was visually assessed (% infected seedlings = disease incidence, % diseased leaf area = disease severity) and yield parameters were determined.

Data and seed lots from a non-inoculated field trial subject to natural infection using several spring barley varieties planted in 3 locations, 2 years and 2 production systems (conventional and organic) were obtained from the BAR-OF project (http://www.foejo.dk/forskning/foejoii/vi2.html).
The data represented % net blotch severity visually assessed before and after flowering as well as yield parameters. Net blotch severity at the beginning of grain filling (growth stage 70) was estimated via linear interpolation of adjacent observations. Net blotch infestation levels in the harvested grains were assessed using the blotter method.

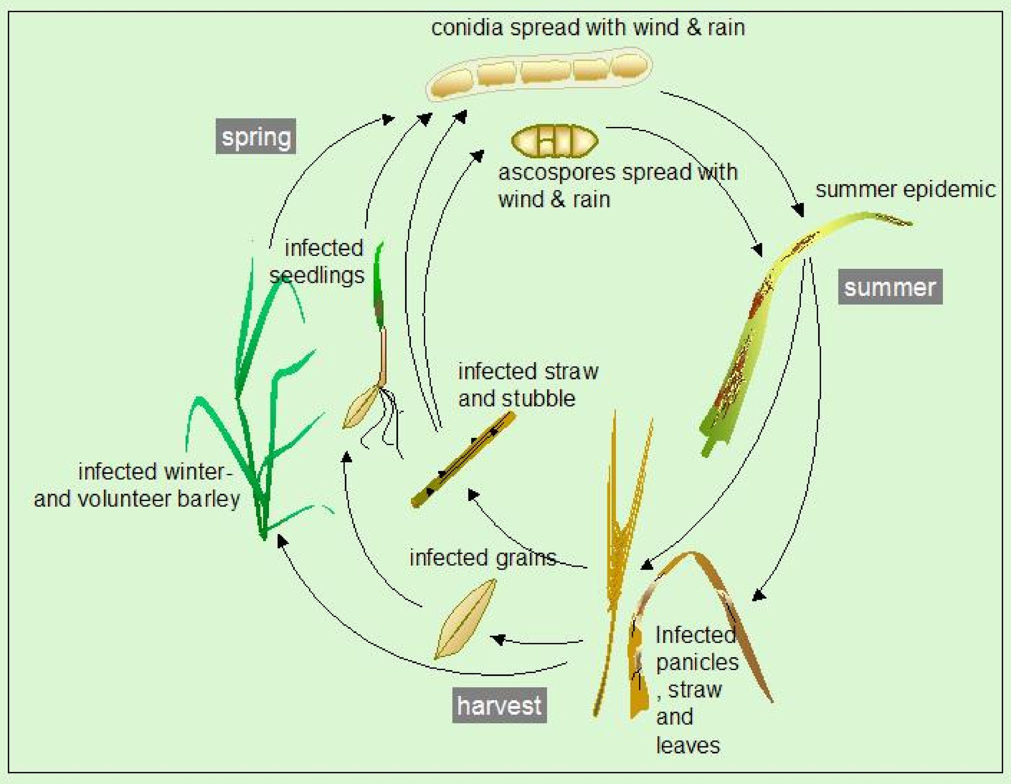


Figure 1. Life cycle of net blotch (*Pyrenophora teres*). Transmission from infected leaves to grains via air- and splashborn spores and from infected grains to seedlings are important infection pathways in organic production systems. From: Jørgensen *et al.*, 2004.

Results

In the inoculated trials, the net blotch seed infestation level was highly positively correlated with the frequency of primary seedling infection and disease severity at flowering and explained ca. 90 and 50% of the variation of these variables, respectively (Figure 2). The seed infestation level was negatively correlated with 1000 grain weight. However, all the a. m. relationships were very "flat", i. e. much lower than proportional. Net blotch severity levels at tillering increased with increasing levels of application of infected straw (Figure 3). However, this effect was no longer apparent after heading (Figure 4).

In the non-inoculated trials, the disease severity of net blotch at early grain filling was highly positively correlated with the level of net blotch infestation of the harvested grains (Figure 5). Disease severity and seed infestation were much higher in very susceptible varieties (e. g. Cork, Lux, Pongo) than in more resistant ones (e. g. Alliot, Mentor). All of the a. m. variables were negatively correlated with 1000 grain weight, fraction of large grains and total yield (Figure 6, shown for the relationship between net blotch severity at beginning of grain filling and 1000 grain weight).

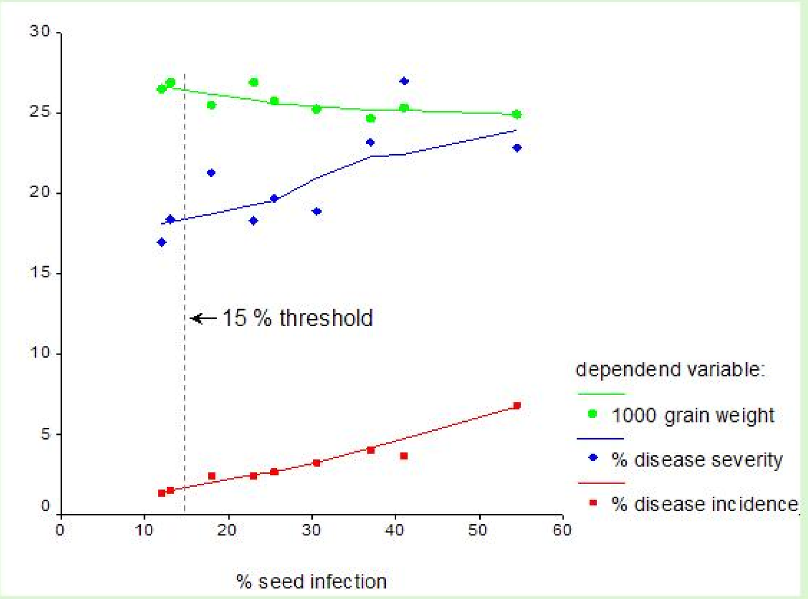


Figure 2. Relationship between % infected seeds and primary disease incidence on seedlings, disease severity at flowering and 1000 grain weight. Inoculated trial with variety Lux in 2003.

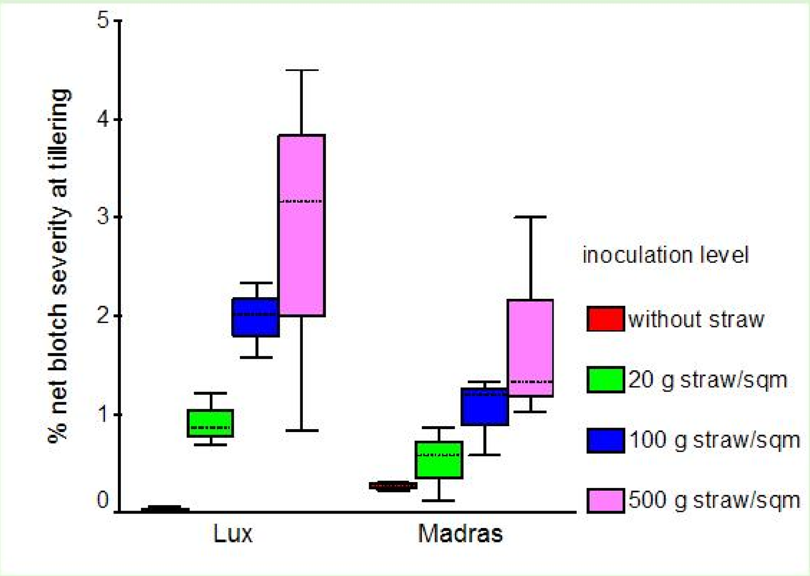


Figure 3. Boxplots of net blotch severity at tillering as related to the straw inoculation level and variety. Inoculated trial with varieties Lux and Madras in 2003. Note: seeds with ca. 15% net blotch infestation were used in all plots.

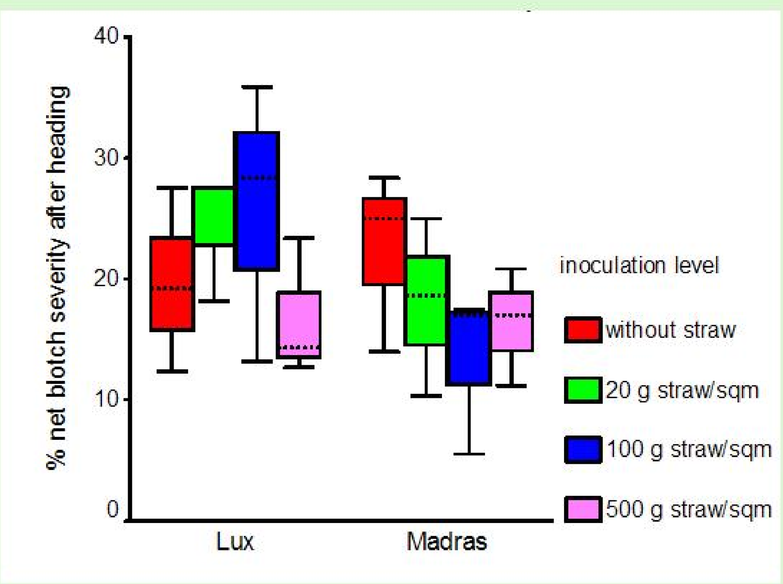


Figure 4. Boxplots of net blotch severity after heading as related to the straw inoculation level and variety. Inoculated trial with varieties Lux and Madras in 2003. Note: seeds with ca. 15% net blotch infestation were used in all plots.

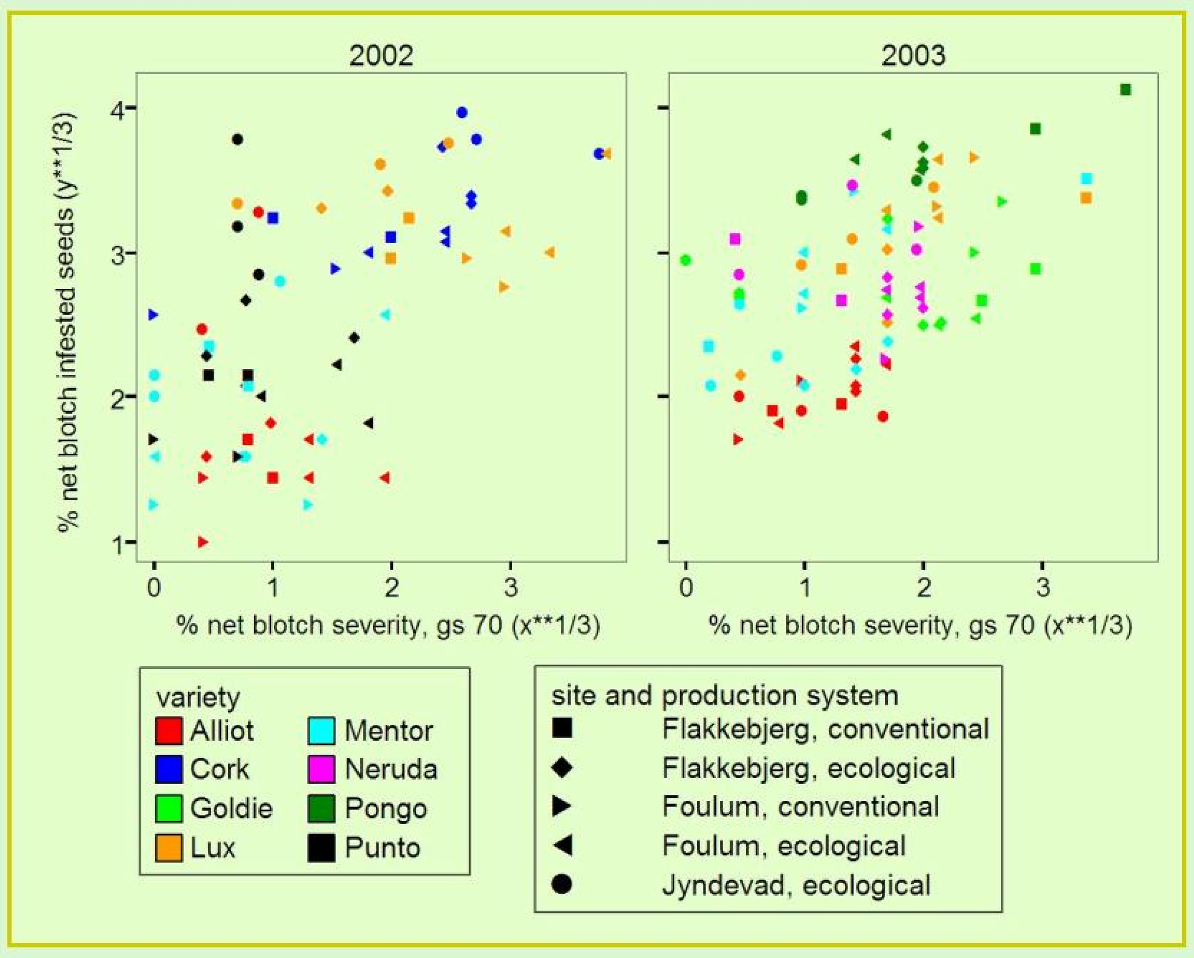


Figure 5. Relationship between net blotch severity at beginning of grain filling (growth stage 70) and % grains infested by net blotch at harvesting. Data from non-inoculated surveys in two years, three sites and two production systems (BAR-OF project). Note: all variables transformed to the 3rd root.

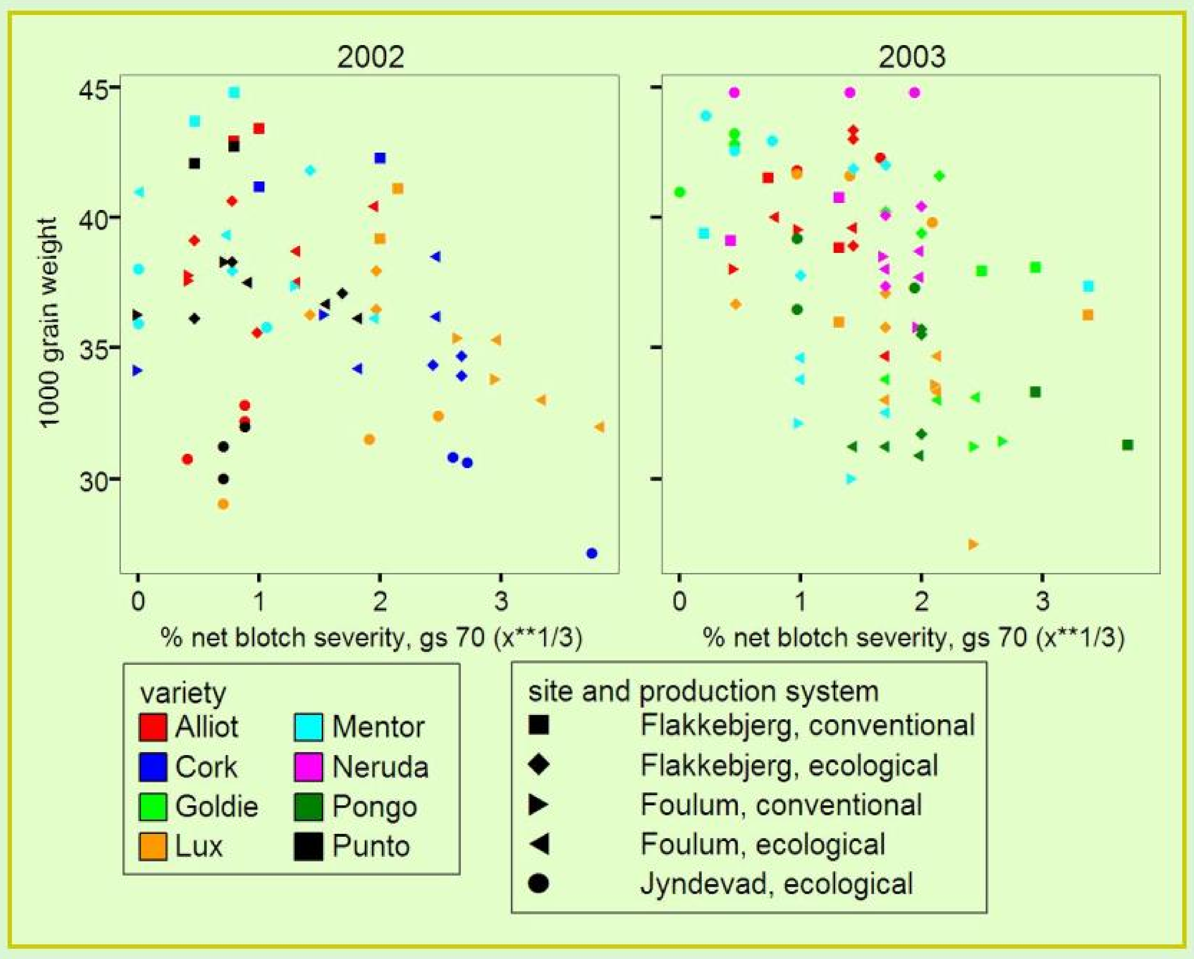


Figure 6. Relationship between net blotch severity at beginning of grain filling (growth stage 70) and 1000-grain weight at harvesting. Data from non-inoculated surveys in two years, three sites and two production systems (BAR-OF project). Note: % net blotch transformed to the 3rd root.

Conclusions and outlook

Net blotch-infested seeds can be as important as initial inoculum source for net blotch epidemics as other inoculum sources such as infected straw. Our results underline the importance of varietal resistance for seed health. Employing resistant varieties results in low net blotch severity levels in the field which in turn reduces the risk of seed infestation. The results give reason to assume that the present threshold recommendations for seed born barley net blotch could be raised for normal growing conditions and/or for varieties having a reasonable level of net blotch resistance.
Supplemental results are expected from ongoing field trials and more detailed analyses will follow to improve our understanding of quantitative relationships among epidemiological key variables to develop decision support tools for handling net blotch infestations in organic barley seed production.

References

Nielsen, B. J. & Kristensen, L. (eds.), 2001: Forædling af korn og bælgsæd samt produktion af såsæd i økologisk jordbrug (Breeding of cereals and pulses including seed production in ecological land use). FØJO report nr. 14, Research Center for Ecological Land Use (FØJO), Denmark, 168 p.

Jørgensen, L. N., Pinnschmidt, H. O., Nielsen, B. J. & Nielsen G. C., 2004: Bygbladplet, biologi og bekæmpelse (Barley net blotch, biology and control). Grøn Viden (Green Knowledge), Markbrug nr. 289, 12p.