From the list of publications of Anders Borgen

Borgen, A. 2005: Removal of bunt spores from wheat seed lots by brush cleaning. ICARDA Seed Info. no. 29, July 2005

Abstract

A brush cleaner can be used to remove spores of common bunt from wheat seed lots. It is demonstrated that a combined cleaning by a conventional air-sreen cleaning and a brush cleaning removes 99.8% of the spores in a seed lot. Hence, the efficacy of this treatment to prevent seed borne transmission is comparable with the best chemical treatments available on the market.

Introduction/Problem

Common bunt caused by *Tilletia tritici* (syn.: *T. caries*) or *T. foetida* is the most prevalent seed-borne disease of wheat world-wide. The pathogen is infecting wheat seedlings just after sowing in the heterotrophic phase before plant emergence. The wheat seed *per se* could be healthy at the time of sowing, but gets infected from spores resting on the seed surface or in the soil. However, seed contamination is by far found to be the most significant source of infection (Borgen 2000).

The control of common bunt in infected seed lots is possible by killing the spores with chemicals or heat treatment, by preventing infection using different agronomic techniques (resistant varieties, sowing time) or by removing the spores from the seed lot through cleaning (Borgen 2004).

Bechel *et al.* 1998 has shown that only a minor fraction of the spores of the closely related bunt species *T. contraversa* in a seed lot end up in the flour, while the majority are removed during the cleaning of the seed before or during milling. However, little is known about the fate of the spores during the cleaning process of seed for sowing. This article reports the results of an investigation that deals with cleaning of seed contaminated with common bunt spores.

Methodology

A field with one plant per square meter infected with common bunt (*T.tritici*) was harvested with a combine harvester. After harvest the seed lot was cleaned in a brush cleaner (ø=400mm) (Anonymous 2005) with and without cleaning using an air-screen cleaner prior to brushing. After the air-screen cleaning, the seed lot still contained some weed seed and inert matter. Hence, the seed cleaning could have been improved by a second air screen- or gravity-cleaning. The air-stream in the brush-cleaner was modified during the experiment compared with the standard equipment, and the presented data shows the optimal adjustment. The contamination of bunt spores was estimated by spore counting in a the haemocytometer, a method described by Keitrieber (1984). The effect on seed vigour was estimated by counting the emergence of 200 seeds, germinated in sand at 10 C°. The emergence was assessed the 13th day after sowing.

Results and discussion

After harvest, the contamination of bunt spores in the seed lot was assessed to 230,000 spores/g. The air-screen cleaning reduced the number of spores to 60,200 spores/g (69.4%). Compared with this, the brush cleaner without air-screen cleaning prior to brushing reduced the number of spores by up to 83.9%. However, if the seed lot was first cleaned by air-screen cleaner, and then cleaned in the brush the effect was considerably improved.

Figure 1 and 2 shows the results of an experiment, where the seed is treated in a batch, where the treatment duration can be controlled precisely. Figure 1 shows that the longer the seed is treated, the higher the effect of the treatment on reducing the spore contamination. It also shows that the more seed is present inside the brush, the lower the efficacy. Figure 2 shows that the effect of the treatment on seed vigour mainly depend on the treatment duration, but not on the amount of seed in the brush. Therefore, seed should be treated with in short time with a low load of seed in the brush.

Figure 3 shows the result of an experiment, where the seed lots were treated in continuous flow. The Figure shows that 97% of the spores in the seed lot was removed by most treatments, but if the capacity of this cleaner passes 750 kg h^{-1}, the effect decreases. Performing the brush-cleaning after the air-screen cleaning reduces the number of spores in the raw seed lot by 99.5%. None of the treatments with continuous flow significantly affected the vigour of the seed (data not presented).

Brush cleaners are normally placed in the beginning of the cleaning line in seed plans, as the normal function of the brushes are to release the true seed from husk and stalk. Bunt spores are present in the seed lot both as free spores and assembled in bunt balls (sori), each containing millions of spores. These bunt balls can be gently removed by air-screen cleaning as the density is lower than true seed. Without cleaning, the bunt balls will brake in the brush cleaner, releasing myriad's of spores in the seed lot, which also have to be removed by the brush. This is the likely explanation that the efficacy of the brush-cleaner increases considerable after air-screen cleaning. Hence, it is essential that the brush is included at the end of the cleaning line, when the purpose is to remove spores from the seed lot.

In Denmark the current threshold for bunt contamination in untreated seed lots is 10 spores/g (~0,5 spore/seed), which is quite low compared to other European countries. In the experiment presented in Figure 1, the number of spores was reduced from 230,000/g in the raw seed lot to 1,356-2,067 spores/g by air-screening and additional brush-cleaning. Hence, the current Danish threshold for bunt contamination were still exceeded for the treated seed. The efficacy of the cleaning is difficult to assess at low contamination rates, as the threshold is close the to detection level. If the cleaning efficacy of 99.8% by air-screen cleaning and brush-cleaning is assumed to be independent of contamination level, it means theoretically that seed lots with a contamination levels less than 5,000 spores/g can be expected to meet the current Danish threshold level after celaning, while seed lots above 5,000 spores/g is likely still to exceed the threshold after treatment. However, the same principle goes for other seed treatments, and the cleaning seems to have the same or better efficacy than most chemical treatments. In Sweden e.g., seed lots exceeding 1,000 spores/g can not be certified for sowing, even with a chemical treatment.

The technology is believed to have similar effect against other seed pathogens contaminating the seed surface. These include smut diseases like dwarf bunt (*T. contraversa*), covered smut (*Ustilago hordei*), and stem smut in rye (*Urocystis occulta*), and also contamination's of witch weed (*Striga hermonthica*). However this needs to be confirmed by future investigations.

Conclusions

Brush cleaning proceeding a air-screen cleaning can reduce the number of bunt spores in a seed lot by 99,8% without reducing the seed vigour. In this way, seed lots contaminated with a limited number of bunt spores can be used without chemical treatment and still produce a healthy crop. This will have special interest in organic farming and other systems where chemical treatment is not possible due to legal, environmental or economical reasons.

Acknowledgement

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References

Anonymous 2005: Illustration of Westrup brush cleaner.

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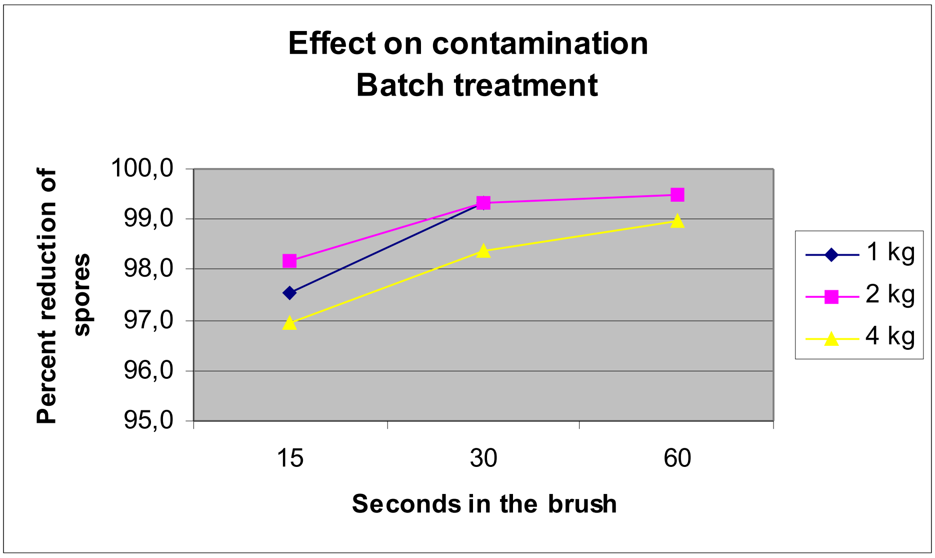

Figure 1: Effect of brush cleaning on bunt spore contamination as affected by batch size and treatment duration .

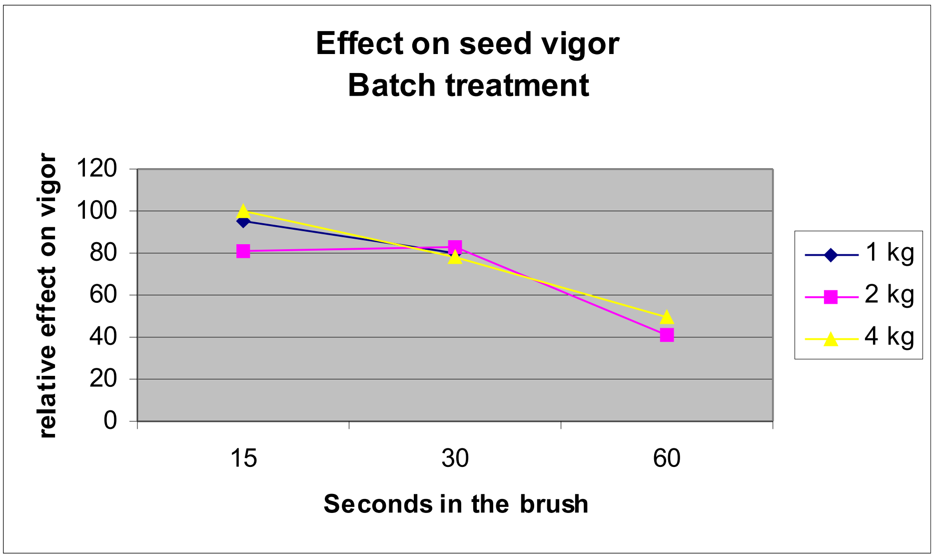

Figure 2: The relative effect of brush cleaning on seed vigour in term of germination speed at 10 C° as affected by batch size and treatment duration compared with untreated seed.

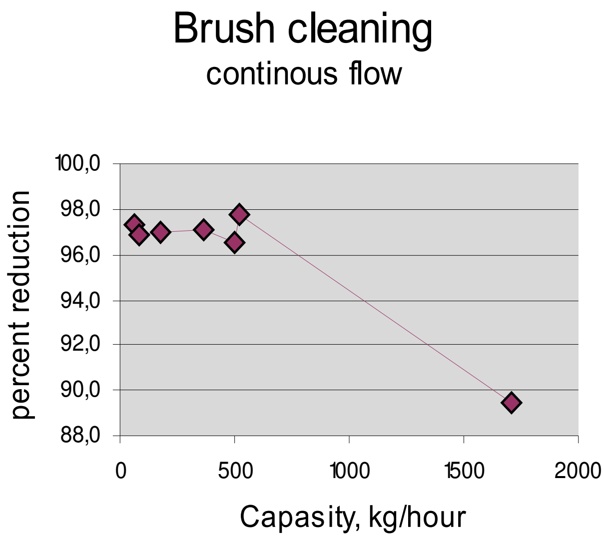

Figure 3: Effect on spore contamination of common bunt in wheat as affected by flow volume in a brush cleaner. No effect on seed vigour was observed.