

Seed size separation to control loose smut (*Ustilago nuda*) in barley

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Barley loose smut (*Ustilago nuda*) is an obligate seed borne disease that infects the barley flower before fertilization. The infected flower develops a normal seed, but this seed is infected in the embryo by the smut mycelium.

The main control of loose smut is the selection of varieties that flower with a closed flower. This disables the fungus to come in contact with the stamen (androecium), and the plant will avoid infection. The degree of flower opening is depended not only by the variety, but also by the climatic conditions during flowering. There exist also specific resistance genes, but less focus has been put on these in most breeding programs. Seed infected by loose smut can be treated with fungicides, and this is regularly used in conventional agriculture in case of infection.

In organic farming pesticides cannot be used. In this cropping system the seed companies therefore depend on non-chemical control measures. Hot water treatment is a possible control measure (Nielsen *et al.* 2000), and the technique was regularly used until the development of fungicides in the 1960ties. The technique has not been reintroduced in commercial seed production for organic farming in control of this disease.

The flowers in the top of the head normally flower more openly than the flowers in the centre or the bottom of the head (Stölen og Sands 1974), and the seed developed in these flowers are statistically smaller. It is also possible that the infection of the flower reduces the filling of the seed. In general, seed infected by loose smut will therefore be smaller than healthy seed (Henning 1913, Krull *et al.* 1966, Pedersen 1967). Similar effect is seen for loose smut in wheat (Neergaard 1977). Removal of the smallest fraction of the barley seed from a seed lot will hence reduce the infection level of loose smut.

Previous studies on the effect of seed separation on the infection level of loose smut have only investigated the effect of seed size in terms of the width of the seed. However, it is possible that other characters of the seed development are affected, eg. the density of the seed.

The aim of this experiment is to investigate the effect of different seed separation techniques on the infection level of loose smut in infected seed lots.

Materials and methods

Seed samples of barley were collected from fields, where loose smut was observed in the growing season. The seed sample was cleaned by the standard procedure used by most commercial seed companies. This include 1) air stream separator (Damas LASTI) to remove dust and empty seed, 2) seed screen separation (Damas LASOL), and an Indented cylinder (Damas LACYL). The smallest seed fraction (<2.2mm) was discarded. The larger seeds (>2.2mm) were then cleaned in either by a Table Separator (Damas LASOR) or a Gravity Separator (Damas LAKTA).

After treatment, 2000 seeds from each seed fractions was analysed by the Embryo-method defined by ISTA (ISTA 2002).

Results and Discussion

The results from the seed cleanings are presented in Figure 1, 2 and 3. The experiment confirms that conventional seed cleaning affects the infection level of loose smut in a seed lot. When the seed lot was separated on only by the seed size, only the largest seed fraction had significantly lower the frequency of smut infection. As only 2% of the seeds in the seed lot fell into this category and more than 90% of the seeds fell into the category between 2.5-2.8mm, the potential of control by discarding the most infected categories is minimal.

The fraction with the smallest seed cleaned by the Table Separator only represent only 15.7% of the seed lot, but by discarding this fraction, the infection level of the seed lot can be reduced significantly.

The two fractions with the smallest seed cleaned by the gravity separator only represent only 17.3% and 8.7% respectively, and by discarding these fractions, the infection level of the seed lot could also be reduced significantly.

The result emphasise that the infection level of loose smut in a seed lot can be reduced by seed separation. Most effective is Table Separation and Gravity Separation, whereas seed size separation only has a limited potential, as the major part of the seed fall into fractions with a high infection level. The experiment also emphasises that it is of major importance whether seed samples taken from a seed lot for seed health analysis is taken before or after commercial seed cleaning.

Literature

ISTA 2000: International Rules for Seed Testing, Annexe to Chapter 7 Seed Health

Testing. Seed Health Testing Method No. 7-013: Detection of *Ustilago nuda* on *Hordeum vulgare* (Barley). The International Seed Testing Association (ISTA).

Henning, E. 1913: Några småforsök med kornets flygsot (*Ustilago nuda*). Sveriges utsädesförenings Tidskrift, **23**:137-141

Krull, C.F., G. Robayo, L.A. Valbuena, G. Rico, L.E. Castiblanco, L.E. Bravo 1966: Influence of seedsize on the incidence of loose smut in Funza barley. Plant Disease Reporter **50**:101-103.

Lavery, P. 1965: The relationship between seed size and infection with leaf stripe disease. Proc. Indiana Acad. Sci. **74**:155-164.

Neergaard, P. 1977: Seed Pathology vol I og II. The MicMillan PressLtd. London Basingstoke 1187 p.

- Nielsen, B. J., A. Borgen og L. Kristensen 2000:** Control of seed borne diseases in production of organic cereals. The Brighton conference - Pest and Diseases pp 171-176. BCPC, Farnham
- Pedersen, P.N. 1967:** On the relation between the placement of the flower in ears of barley and its susceptibility to attacks of loose smut (*Ustilago nuda*). Acta Agricultura Scandinavica **17**:39-42
- Stölen, O og H.L. Sands 1974:** Flower opening in response to plant density and nitrogen application. KVLs Årsskrift, side 150-159.

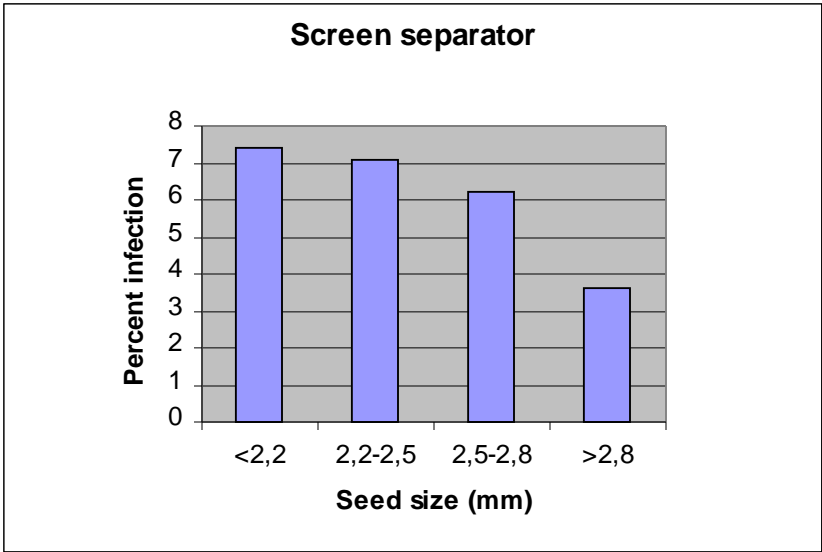


Table 1: Barley seeds lot separated by seed size.

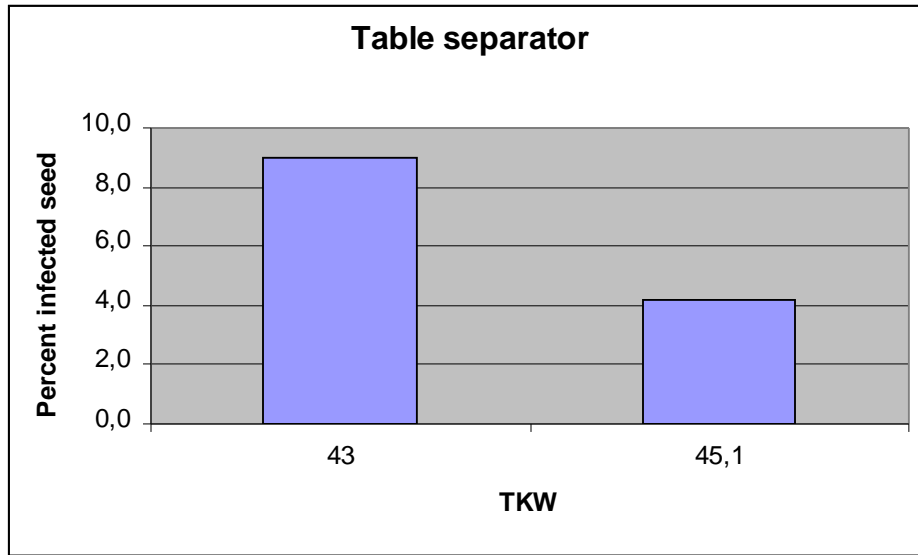


Table 2: Infection of barley loose smut as affected by separation on a Table Separator. The minor seed fraction (TKW=43) represented 17.5% of the seed lot by weight.

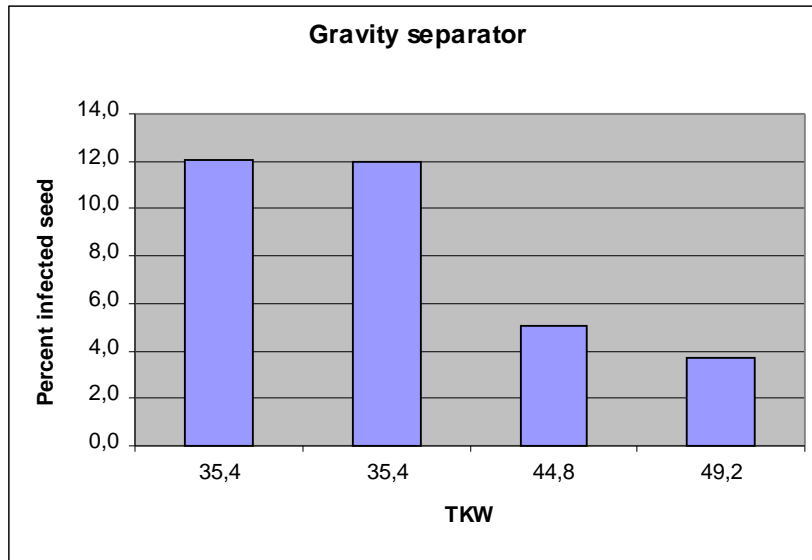


Table 3: Infection of barley loose smut as affected by separation on a Gravity Separator. The minor seed fractions represented 1.2% (TKW=35,4), 5.7% (TKW=35,4) (TKW=35,4) of the seed lot by weight, and the larger seed fractions represented 91.6% (TKW=44,8) and 49.2% (TKW=1.6%) respectively.