

Latent infection rate of potato seed tubers with *Phytophthora infestans* (Mont.) de Bary

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SUMMARY

From 2007 to 2009 17 batches of certified potato seed tubers were tested for latent infections with late blight (*Phytophthora infestans*). Using PCR diagnosis it was possible to show that latent infestation is a common problem. Infection rates from 2% up to 38% were found while only 3 out of the 17 batches were free of *P. infestans*. The given data show no significant difference of infestation rates between seed tubers produced organically or conventionally.

KEYWORDS

Late blight, PCR-test, *Solanum tuberosum*, stem blight, tuber blight

INTRODUCTION

The oomycete *P. infestans* causes late blight in potatoes which still is one of the most important diseases in potato production worldwide (Shtienberg *et al.* 1990). In most cases the source of an infestation is the fungus overwintering in tubers on cull piles or in volunteers (Kadish and Cohen 1992) where the pathogen can grow and sporulate in the next growing season and can then spread to other plants by wind. Another nowadays more important possibility is the overwintering in tubers in storage (Zellner 2004). Today's optimal modern storage conditions prevent the pathogen from spreading within the tubers and so no visible symptoms appear. Once planted, at high soil humidity after rainfall sporangia can be produced on the infected tubers (Adler 2000, Bäßler *et al.* 2002 and 2004). These are spread via soil water and infect neighbouring tubers and plants leading to primary stem blight (figure 1). As no visible symptoms appear on the seed tubers the late blight infestation is not assessed during the official certification process. So seed tubers with a latent late blight infestation carry *P. infestans* right into new planting sites leading to early infestation.



Fig. 1. *Stem blight*

METHODS

From 2007 to 2009 a total of 17 batches of certified seed tubers were tested for latent infection with *P. infestans*. From each charge 47 tubers (respectively 94 in 2007) were randomly chosen and tested. Five batches were from organic and 12 from conventional production.

Samples were prepared and extraction of DNA was performed with the DNeasy Plant Mini Kit. The extracted DNA of the pathogen was amplified with a primer setting recommended by Judelson & Tooley (2000) with the primers 5'-GAAAGGCATAGAAGGTAGA-3' (forward primer 08-3) and 5'-TAACCGACCAAGTAGTAAA-3' (reverse primer 08-4). Concentration of the reaction-mixture was as following: 10ng DNA/μl, 10% PCR-Buffer y, 0.4μM of each primer, 2mM MgCl₂, 200μM deoxynucleotide triphosphates and 0.67 units TaqDNA polymerase. Amplification was performed in a MJ Research PTC-200 thermal cycler. The products were resolved by electrophoresis in 0.9% agarosis gels in Tris-Borate-EDTA buffer and stained with 0.005% ethidium bromide. Images were captured digitally (figure 2).



Fig. 2. Image of resolved amplification products on 0.9% agarosis gel stained with ethidium bromide. (L: Low range mass ruler DNA Ladder; +: positive standard e.g. DNA extracted from pure *P. infestans* mycelium)

RESULTS

In 2007 2 out of 5 tested batches showed latent infections on more than 10% of the seed tubers and one charge was without infection (figure 3). The mean infection rate was 11.2%, on average every ninth tuber was infected.

The average rate of latent late blight was 12.7% in 2008. No charge was free of infections and 4 out

of 6 showed infestation rates above 10% (figure 4).

In 2009 2 out of 6 tested batches were free of latent infections and the same number showed infestations rates above 10% (figure 5). The mean infection rate was 9.2%.

The overall average of infestation throughout all 17 tested seed tuber batches was 11% (figure 6). The highest rate of latent infestation was 38%. 17.6% (3 out of 17) were tested negative on *P. infestans*. The results from comparing organically and conventionally produced seed tubers showed no significant differences (t-test, $p < 0.05$) in the average percentage of latent infected seed tubers.

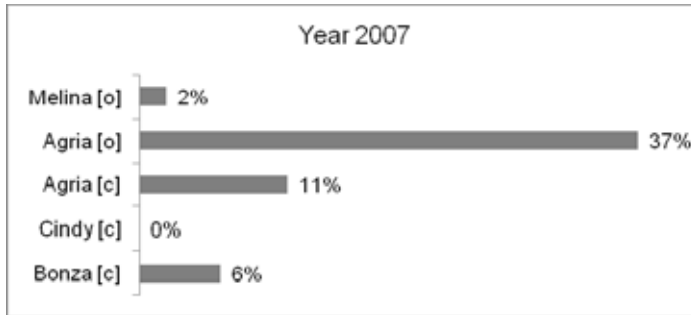


Fig. 3. Latently infected seed tubers in %, 2007 ($n=94$); [o] organically [c] conventionally produced seed tubers

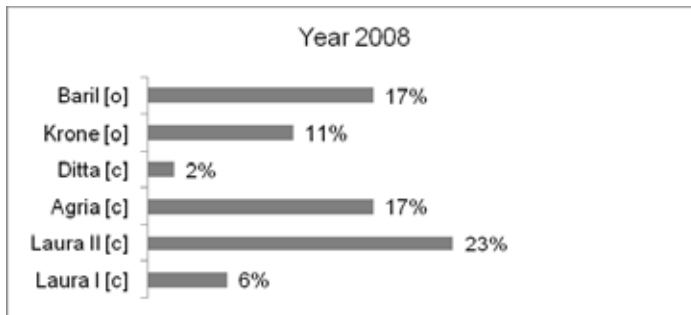


Fig. 4. Latently infected seed tubers in %, 2008 ($n=47$); [o] organically [c] conventionally produced seed tubers

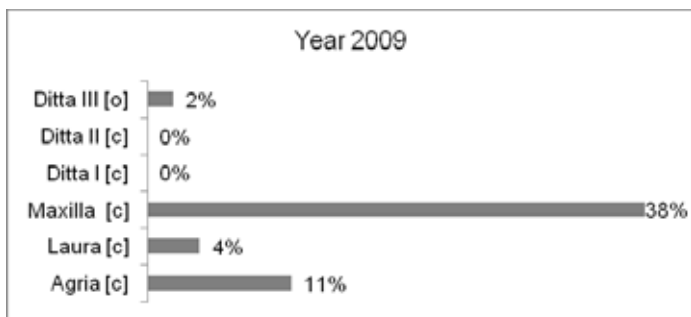


Fig. 5. Latently infected seed tubers in %, 2009 ($n=47$); [o] organically [c] conventionally produced seed tubers

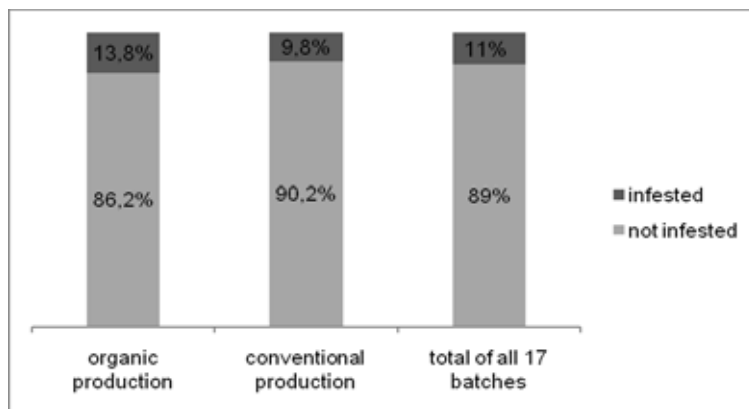


Fig. 6. Mean infestation rate of seed tubers with *P. infestans*

DISCUSSION

The given data illustrates that there is a considerable risk of bringing *Phytophthora infestans* into the field with seed tubers even when using certified and symptomless tubers. Latent infections with *Phytophthora infestans* seem to be a general problem since the data shows no significant difference between tubers from organic and conventional production. As a result seed tubers may look healthy, but can still be infested, thus lead to an early primary outbreak of this disease (stem blight). Because of the high risk of infected seed tubers a timely usage of protective fungicides is recommended. This type of infection can only be treated with curative fungicides and the aim of the first treatment is to contain the growth of the fungus from the tuber through the stem of the potato plant. Systemic products spread into the plant tissue and seize the fungus when it grows upwards. Therefore in conventional potato farming infections can be reduced by systemic fungicides. Thus latent infected seed tubers are a more serious problem in organic farming since no curative fungicides are available. For organic as well as for conventional seed potato production it is important to reduce the latent infection rate.

Further research should deal with the question of how to clearly reduce tuber infections with *P. infestans*. Especially for seed tubers overwintering in storage the aim is to have an infection rate as low as possible as they initiate new infections in the field the following year.

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