THE CONTROL OF STEM BLIGHT AND THE SPREAD OF POTATO LATE BLIGHT BY COPPER SEED TREATMENT

KEIL S.[1)], BENKER M.[2)] & ZELLNER M.[1)]

[1)] Bavarian State research Centre for Agriculture, Lange Point 10, 85354 Freising, Germany

[2)] Chamber of Agriculture North Rhine Westphalia, Nevinghoff 40, 48147 Münster, Germany
email: Michael.Zellner@lfl.bayern.de

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Abstract

Late blight still is an unsolved problem in organic potato farming. Up to now the most effective way to control this disease is the use of copper fungicides. Transferring results from regular farming, seed treatments with copper fungicides shall postpone the beginning of the blight epidemic and decrease the spread of the disease with soil water. Thus stem blight, which can't be prevented otherwise, shall be reduced. In field trials, conducted 2005-2007, copper fungicide treatments reduced primary stem infections (stem blight) and the spreading of the pathogen from infected seed tubers.

Introduction

Potato late blight caused by the oomycete *Phytophthora infestans* is one of the most important yield-limiting factors in organic potato farming. The most effective way to control this pathogen is by the protective foliar application of copper fungicides. This can prevent secondary infections on the leaves, which are caused by wind-spread sporangia. Sources for this inoculum are volunteers and/or infected cull piles (HOFFMANN & SCHMUTTERER, 1999), especially after a mild winter. However latent infected tubers in storage resemble the main inoculum source (ANDRIVON, 1997). During storage these tubers don't show any symptoms, and are used as seed tubers, bringing the inoculum direct into the field (ADLER, 2000). At high soil moisture after rainfall (20mm) the pathogen expands it's growth into the stem, causing stem blight (ZELLNER, 2006). This happens either by direct intercellular growth from the tuber into the stem (ADLER, 2000; APPEL et al., 2001), or by reinfection of the stem after sporulation on the surface of the tuber. Thus under suitable conditions early stem blight occurs, which can not be prevented by foliar application of fungicides. The produced sporangia can be spread via soil water to neighbouring plants (BAIN & MÖLLER, 1998), causing stem infections on them as well. It has been showed in regular farming, that the use of fungicide seed treatments can postpone primary infections for 8-20 day and slow down the course of the blight epidemic (BÄßLER et al., 2002). These findings shall be transferred as a new approach into organic farming within the project Öko-Simphyt. Copper seed treatment shall prevent healthy tubers from being infected by inoculum in the soil and also inhibit latent infected tubers directly from producing sporangia (BENKER et al., 2006).

Materials and methods

In the years 2005 –2007 field trials where conducted at two sites in Bavaria on heavy and light soil. Seed tubers were artificially inoculated by injection of zoospores of *P. infestans* to produce latent infected tubers, which where treated with copper fungicides (Copperhydroxide, trade name: Cuprozin flüssig; 120g Cu/ha) before planting.

Two seed tubers were planted closely adjacent to each other. One of them (variety Quarta) was inoculated with 200 zoospores and the other one (variety Agria) remained healthy. Copper seed treatment was either applied to the infected tuber or the healthy one. For control both tubers remained untreated. The frequency of stem blight was measured weekly and confirmed by PCR detection (JUDELSON & TOOLEY, 2000). In this way the effect of the copper seed treatment on the spreading of inoculum from diseased to healthy plants was tested.

Results

If both tubers where not treated with copper, the latent infected Quarta was able to infect the neighbouring plant, causing stem blight at a frequency of 45% (figure 1). A copper seed treatment on the infected Quarta stopped the pathogen from spreading to a certain degree, reducing the frequency of stem infections on the adjacent Agria for 10%. The best result was achieved by a copper seed treatment of the healthy Agria, significantly preventing the infected Quarta from infecting the neighbouring plants by released sporangia (25% frequency of stem blight).

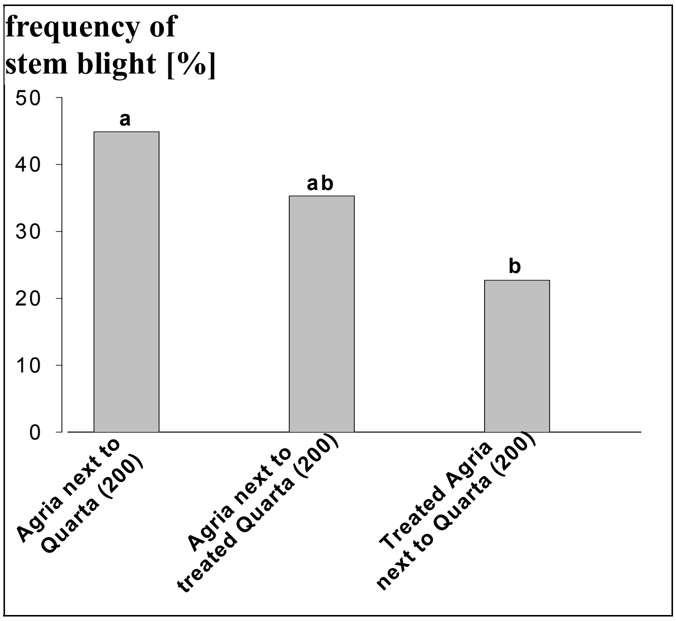

Figure 1: Effect of copper seed treatment (120g Cu/ha) on stem blight; different letters indicate significant ($p<0.05$) differences; variety Quarta was artificially inoculated with 200 zoospores.

Throughout the 3 years data from 56 experiments with copper seed treatments was collected. Figure 2 shows the overall effect. In 47% of the experiments a reduction of stem infections of less than 10% was achieved. The effectiveness of a copper seed treatment was 10-50% in 35% of the experiments. A high effectiveness above 50% was achieved in 18% of all experiments.

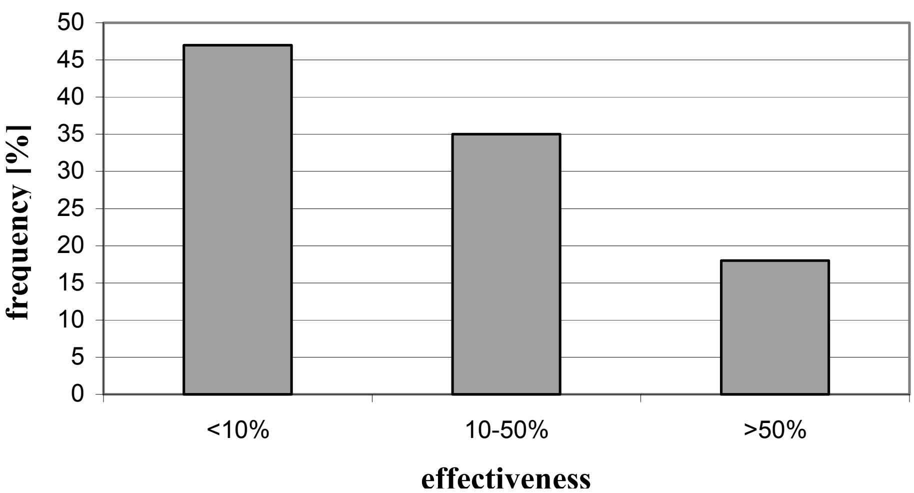

Figure 2: Effectiveness of a copper seed treatment against stem blight in 56 experiments.

Discussion

Other than secondary infections, stem blight (primary infections) can not be prevented by the protective foliar application of copper fungicides. And since the source of inoculum is brought into the field with latent infected seed tubers, crop rotation doesn't work. Up to now the only way to prevent stem blight and the spread of the pathogen caused by infected seed tubers is the usage of copper seed treatment. The applied dosage of the copper is as low as 48g/t (120g/ha), enabling also foliar applications of copper against secondary infections to the maximum allowed amount of copper (3000g/ha per year in Germany).

Conclusions

Copper seed treatments are a promising way to reduce stem blight and decrease the spread of inoculum to neighbouring plants. This new method of applying copper can prevent the early outbreak and fast course of the epidemic.

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