# STOVE: Seed treatments for organic vegetable production

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***Abstract* – Production of pathogen-free seeds is a major goal in organic farming. In the framework of the EU-funded project "STOVE" ("Seed Treatments for Organic Vegetable Production") physical and biological methods of seed treatment (alone and in combination) were investigated in different vegetable / pathogen systems.**

**Overall, the physical treatments (hot water, hot air and electron treatment) resulted in a moderate to good control of the respective diseases. Also, from all biological treatment groups (microorganisms, plant extracts and inducers of resistance) candidates with promising control properties could be identified. The influence of the biological methods on emergence was often more prominent under greenhouse than under field conditions.**

**The efficacy of given single and combined treatments depended strongly on the host / pathogen system investigated. Moreover, it turned out that the cultivar and also the seed lot differed to a large extent with respect to their sensitivity, so that selection of treatment parameters need to be considered thoroughly for each vegetable species and seed lot .[1]**

## INTRODUCTION

In organic farming, the availability of pathogen-free seeds in most crops is often hampered by a lack of effective non-chemical methods for sanitation of infested seed lots. In the framework of the EU-funded project STOVE "Seed Treatments for Organic Vegetable Production" (QLK5-2002-02239) currently available methods for control of seed-borne vegetable pathogens are investigated with the aim of further improvement, while in parallel new methods, which are acceptable to organic farming are developed.

Besides three physical methods (hot water, hot air and electron treatment), the potential of micro-organisms and different agents of natural origin acceptable to organic farming are investigated.

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## OUTLINE OF THE PROJECT

The project consists of three major steps, which build on each other. In the first step, the physical treatment methods are optimised, while the potential alternative seed treatments (microorganisms, plant extracts and inducers of resistance) are screened against the different seed-borne pathogens (e.g. *Alternaria radicina /A. dauci*, *Septoria petroselini*, *Xanthomonas campestris*, *Phoma valerianellae*, *Colletotrichum lindemuthianum*) in different hosts, such as carrot, parsley, brassicas, lambs lettuce and bean. In the second step, the efficacy of the different methods is compared in glasshouse and field trials, leading to the selection of the most effective single methods among the physical and biological treatments. In the last step, suitable combinations of the most efficient different alternative and physical methods are identified and again evaluated in glasshouse and field trials.

## OPTIMISATION OF PHYSICAL METHODS

Seeds of different physiological conditions have been compared with respect to their level of tolerance to physical treatments. Less mature seeds and seeds that have started germination have proved to be more vulnerable to a hot water treatment or treatments with hot air, but did not differ in sensitivity towards an electron beam sanitation treatment. For hot water or hot air treatments, seed companies are advised to use only mature seeds, and, if needed sort their seeds first.

## SINGLE TREATMENTS

In transmission experiments in the greenhouse with *Xanthomonas campestris* pv. *campestris* in

brassica, seed treatment with all three physical methods, as well as treatment with a laboratory based *Bacillus* strain and the commercial product MBI 600® (active ingredient: *Bacillus subtilis*) resulted in a clear reduction in percent infected seedlings compared to untreated. The resistance inducer Milsana® and thyme oil showed no positive effects, and resulted in at least the same level of infection as observed in the untreated control.

In field trials with parsley infected with *S. petroselini*, all three physical methods and treatment with Cedomon® (active ingredient: *Pseudomonas chlororaphis* strain MA 342) resulted in a clear reduction of *Septoria* leaf spot. Furthermore, treatments with Mycostop Mix® (based on *Streptomyces griseoviridis*) and thyme oil, also resulted in reduction of the disease. In agreement with the results in the field, in trials performed under controlled conditions, all three physical methods and thyme oil treatment increased the number of germinated seedlings significantly compared to the untreated control.

In greenhouse trials with bean / *C. lindemuthianum* untreated seeds showed emergence of 65%, with 10% infected seedlings. All tested resistance inducers reduced the infection significantly to levels between 2 and 0%. Emergence, however, was in all cases below 60%, except after treatment with Milsana® (active ingredient: extract *from Reynoutria sachalinensis*). Treatment with all microorganism-based products resulted in an emergence of bean seedlings of approximately 90% with the exception of Cedomon®, which in turn together with Serenade® was the only treatment which led to disease control similar to thiram.

Overall, results indicated that in all investigated vegetable / pathogen systems the physical treatments resulted in a moderate to good control of the respective diseases. Interestingly, also from all biological treatment groups (microorganisms, plant extracts and inducers of resistance) candidates with control properties could be identified. The effects and efficacy, however, depended strongly on the investigated host / pathogen system.

## COMBINED TREATMENTS

After the most effective single treatments had been identified in greenhouse and field trials, combinations of physical and biological treatments were selected and investigated under greenhouse and field conditions.

Greenhouse trials with lambs lettuce / *P. valerianellae* revealed that the treatments selected for a certain seed lot of a given cultivar resulted in reduction in the number of infested seedlings from around 10% in the control down to 0% in treated seeds, while emergence of seedlings was as high or higher compared to the untreated control. The same treatments were applied to a second seed lot of the same cultivar, which showed a slightly lower overall emergence rate. In this lot, some of the biological and physical treatments led to signifcantly reduced germination rates compared to the control, indicating a higher sensitivity of that seed lot.

Under field conditions, the overall differences in seedling emergence were much more prominent than under controlled conditions. In the first lambs lettuce seed lot around 60 plants / meter row emerged while in the second seed lot only around 40 plants / meter row emerged. In agreement with the results from the greenhouse, the negative effects of some of the treatments were also visible in tendency in the field, while none of the treatments in either seed lot led to increased emergence rates. Moreover, the differences between treatments and the control and among treatments were in no case significant. Disease symptoms could not be observed until the end of the trial in mid-October.

In greenhouse trials, the percentage healthy seedlings emerging from carrot seeds highly infested with *A. dauci* and *A. radicina* reached around 10% when untreated. Treatment with all three physical methods, hot water, hot air and electrons, significantly increased the percentage of healthy seedlings up to 65%, while selected biological treatments also significantly enhanced emergence, but to a lesser extent. Interestingly, the combination of hot water with an isolate of *Pseudomonas putida* resulted in an additive effect (61% emergence of healthy seedlings) compared to treatment with the single methods (appoximately 42% for hot water and appoximately 24% for the bacteria).

When these treatments were evaluated with the same seed in the field, overall results showed the same tendency as in the greenhouse. However, the obvious additive effect of the combination treatment of hot water and *P. putida* could not be observed. Although there appeared to be an increase in the absolute number of plants / per meter row for most treatments, the only significant difference to untreated was observed when carrot seeds were treated with hot air. Disease symptoms on carrot leaves due to *A. dauci* were in all treatments below 0.2%.

Field trials with carrot / *A. dauci* and *A. radicina* will be repeated in 2006 in different European countries and final conclusions will be drawn after that.

However, a comparison of the different results gained in the frame of the project so far show that in general the physical treatments lead to good protection against the different diseases under greenhouse and field conditions, while the biological treatments in many cases show clear effects only under controlled conditions. Significant differences between treatments are easier to observe in the greenhouse than in the field.