Improvement of the quality of propagation material for organic farming systems

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***Abstract* – The use of organic propagation material is obligatory according to the current EU regulations for organic production. However, frequently difficulties are encountered regarding the availability, the costs or the quality. In the Netherlands a national research program aims at developing solutions, needed for improving the production of high quality organic propagation material. The main emphasis in the program is on the model crops cabbage, onion, wheat and potato. Individual projects within the program include epidemiological studies of seed borne diseases to develop disease prevention strategies, methods to improve resistance of seeds and seedlings towards pathogens and methods to control silver scurf in seed potatoes, development of multi-spectral analysis and sorting techniques and methods for analysis and improvement of seed vigour. Active involvement of producers and users of the seeds or seed potatoes ensures that the results will be implemented in practice. The program also aims at strengthening the international collaboration, amongst others through involvement in international research projects.** [1]

Introduction

In organic farming, the use of organic propagation material is obligatory according to the current EU regulations 2092/91. However, sufficient material of high quality is not available for all crops, and in those cases farmers still rely on conventionally produced seeds, tubers, bulbs or young plants. In the Netherlands a national research program of 3 years started in 2005 and aims at developing solutions, needed for improving the production of high quality propagation material. Although the main emphasis of the program is toward improvement of organic seed production, spin-off of the results toward a more sustainable conventional production is expected.

Epidemiology and detection

To enable disease prevention it is important to start with healthy propagation material. For most crops, emphasis is needed for prevention of infection during production of the seeds, tubers, bulbs or young plants. It is important to determine the critical control points during production process and to decide what measures can be taken when action is needed. To get a better understanding on what these critical control points are, epidemiological studies are performed on the transmission of fungal and bacterial pathogens. Transmission of the fungus *Alternaria brassicicola* and the bacteria *Xanthomonas campestris* pv. *campestris* during Brassica seed production is analysed. Results on these studies are reported elsewhere on the congress and in these proceedings.

Fruit tree canker (*Nectria galligena*) is a serious problem in organic apple production and grafted young trees used as planting material are potentially an important source of infection. To test this, a practical method is in development to determine the frequency of infected plants. The first results show that in a climate chamber within 3-6 weeks visible symptoms on artificially inoculated plants can be induced. Further studies will be done in order to determine the critical threshold levels of infection in the field.

Treatments

When seed infection cannot be prevented disinfection of the seeds might be needed. Hot water treatments are frequently used, but may harm the vitality of the seeds. There is a need for additional treatments with natural components that can be used for seed sanitation. Combination of milder physical treatments with natural components might be more effective, while preventing harm to the vitality of the seeds or other planting material. These components should be acceptable according to EU regulation 2092/91 (regulation on organic production methods) as well to EU or national regulations regarding crop protectants. Essential oils fulfil both regulatory criteria and for instance thyme oil is shown to be a potent anti-fungal and antibacterial component for seed treatments. Certain organic acids also exhibit sanitising effects, but for these compounds application is still hampered by EU regulation 2092/91, which allows their use only as food preservative, but not for treatment of organic plant material. The planned revision of the EU regulation, may aid in increasing the possibilities for using a broader range of natural components, without interfering with the organic principles.

Silver scurf is a fungal disease that adversely affects the appearance of potato tubers and may enhance water loss from the tubers. The main primary

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infection source for newly harvested tubers is the mother tuber planted in spring. Research is done aimed at developing methods that can control silver scurf on the seed potatoes or reduce spore survival and transmission in the soil. Thyme oil seems to have potential for treatment of seed potatoes.

ENHANCING NATURAL TOLERANCE

One of the principles of organic farming is to use the endogenous self regulating strength of plants in relation to a vital eco system. Although farming itself is rather artificial, it is important to understand how plants react and how organic agricultural practices can aid in optimising this endogenous strength. In the program it is studied how treatments of seeds or seedlings can stimulate the expression of natural tolerance of the plants to pathogens. The reaction of young cabbage plants to *Peronospora parasitica* infection functions as a model system.

SORTING

Sorting and grading is used to increase the quality of seed lots and other plant material. Less mature seeds often have reduced vigour and are more frequently infected with pathogens. For those seeds which are green during development and the chlorophyll is broken down during maturation, the less mature seeds can be removed through chlorophyll fluorescence sorting. In addition, innovative methods are being developed that can analyse and sort seeds based on spectral differences. In contrast to traditional colour sorters, which in general measure only three broad spectral area's, the new method analyses spectral differences for hundreds of spectral area's varying from one till four nm in width. Software has been written that facilitates the data analyses to determine the area's of wavelength in which poor quality seeds may differ from high quality seeds. This system is applied in discriminating infected from healthy seeds and in discriminating seeds differing in vigour. The analysis is performed within milliseconds and will allow incorporation in seed sorting equipment.

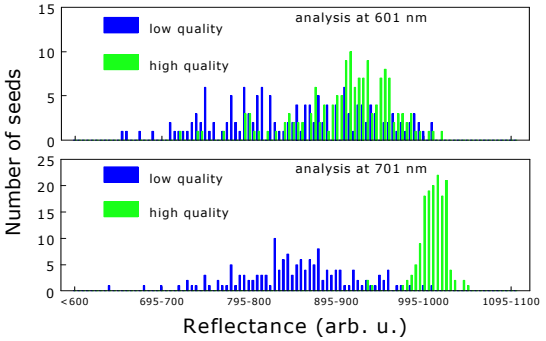

Figure 1. Spectral analysis of low and high quality seeds.

SEED VIGOUR

Vigour of seeds and planting material can be defined as the potential to provide a good start of a crop under sub-optimal conditions. Production of propagation material under organic farming conditions is more restricted in quality management compared to conventional production systems. For instance, field conditions for organic farming require a strong seed vigour in relation to competition with weeds.

Moreover, high seed vigour is also needed for tolerance against seed sanitation treatments such as with hot water. Seed producers need methods for prediction of the sensitivity of the seeds, as well as methods for a relative quick determination of potential damage after sanitation treatments. Gene-expression, protein profiles, enzyme activities and protein oxidation are studied in relation to stress tolerance to determine their potential as markers for damage after treatments.

Seeds of different physiological properties have been compared with respect to their level of stress tolerance. Less mature seeds and seeds that have started their germination process were shown to be more vulnerable to a hot water treatment or treatments with aerated steam, but do not differ in sensitivity towards an electron beam sanitation treatment. For hot water or aerated steam treatments seed companies are advised to use only mature seeds and if needed sort their seeds first, e.g. with chlorophyll fluorescence sorting equipment.

Moist conditions at the end of seed development may under certain conditions initiate the onset of germination processes, even without visible signs of sprouting. In general, this pre-sprouting increases the sensitivity of the seeds towards hot water treatments. However, incubation of onion seeds for one day at 100% RH increased their tolerance towards an aerated steam treatment.

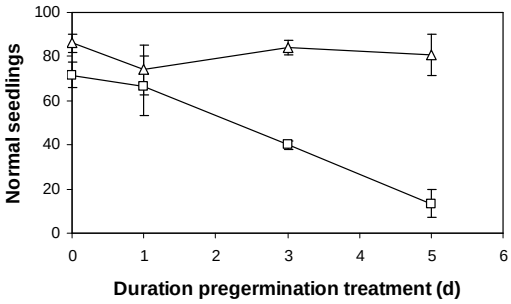

Figure 2. Increased sensitivity of pre-germinated cabbage seeds demonstrated by the frequency of normal seedlings(Δ no treatment, □ 30 minutes hot water (50 ℃).

INVOLVEMENT OF THE ORGANIC SECTOR

To involve the end-users in the implementation of the research results into practice, project teams were established in which researchers from both the research organisations and from the seed industry are involved, whereas in some teams also organic growers participate. The seed industry provides characterised seed samples and experimental fields for use in experiments in the setting of practical organic seed production conditions. The seed companies are also involved in implementing e.g. seed treatments in their industrial practice. The close interaction between public research and the organic seed industry is very stimulating in both directions.

ACKNOWLEDGEMENT

This work is funded by the Dutch Ministry of Agriculture, Nature and Food Quality and in part by the EU in the frame of the STOVE project.