

Seed science supplies organic farmers with high quality seeds



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"It is my pleasure to give some ideas on the role of seed science in providing organic farmers with high quality seeds. I will present some of the work done at our institute, Plant Research International, which forms part of Wageningen University and Research Centre.

In Europe regulation is in effect prescribing the requirements for seeds that can be used for organic farming. A first requirement is that the seeds must be produced under organic farming conditions. A second requirement is that no synthetic chemicals may be used to disinfect the seeds.

For some crops such as potato and tomato this works quite well, but for a number of vegetable and arable crops it is very difficult to produce organic seeds of sufficiently high quality. Especially in biennial crops such as cabbage, onion, and carrot, the two seasons needed for seed production increase the risk of contamination and development of diseases.

Temporary exemptions ('derogations') are being made for the use of conventionally produced seeds, only in those species for which not sufficient organic seed is available.

Seed quality

When talking of organic seeds, some additional criteria for seed quality have to be considered. Trueness to variety comes in a different light when we realize that genetic modified crops are not allowed in organic farming. Also, the production conditions have

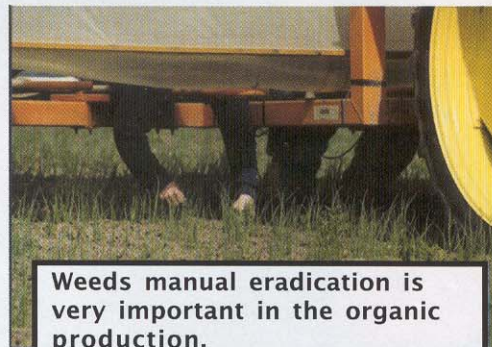
to meet the criteria of organic farming and the buyer of the seed should have some proof of this. But organic farming also relates to the other quality issues like analytical purity, germination and vigour, and seed health.

An important sales item for organic produce is that it is GMO-free. Therefore,

presence of GMO-seeds in organically produced seeds must be avoided. However, occasional contaminations are unavoidable and there is a need for a definition of how free is free. Threshold levels have to be developed. This closely links with the work of ISTA's GMO Task Force.

Weed problems

Because of the impossibility to use chemical herbicides, weeds form a serious problem in organic farming. As a result of this, the classical analytical purity and number count tests become even more relevant. Improved sorting techniques may be necessary and new methods for weed removal need to be developed.



Weeds manual eradication is very important in the organic production.

In organic farming the slow mineralization in springtime impedes rapid establishment of the crop. In order to outgrow weeds we need

vigorous crops. Unfortunately, the organic manure used in organic farming has a slow mineralization under cold conditions, which impedes rapid establishment, thus disfavours the crops in their competition with weeds.

Seed health

Now we come to the most important concern of the organic farmer. While he or she can try to assist the crop physically in its

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early establishment and with its competition with weeds, most farmers are at a loss when their crop shows infestation with fungi or bacteria. Infection must be avoided with a strategy comprising of a number of measures.

We can avoid crop diseases by a number of approaches: resistance of the crop; production of healthy seeds; sorting of seeds; eradication of pathogens; improved detection methods; the buffering effect of the soil.

Resistance breeding lies outside our field of influence as seed technologists, except when trying to stimulate or induce resistance by certain applications. We are no soil scientists either, except that we can try to add substances or antagonists to the seed or to the soil to positively influence the processes in the soil.

Production of healthy seeds, a case with carrot - *Alternaria radicina*.

We did extensive research on the development of crown rot, a disease in carrots caused by the fungus *Alternaria radicina*. Crown rot is a disease that affects all stages

of the plant, and can cause great losses of the harvested carrots that are being kept in cool storage for a number of months.

Heavy seed infections lead to damping off, where seed treatment with hot water have a positive effect. Slight seed infections may lead to latent infections where the disease remains latently in the plant and the harvested carrots look perfectly healthy. The disease is only revealed after some months during winter storage, when crown rot appears and renders the roots useless.

The hot water treatment is one of the few effective methods available for organic seed production until now. The effect of the hot water treatment is quite clear, but what is important is to realize that there seems to be a strong link between the original seed infection and the infection with *Alternaria* of the seeds produced in the second season.

Sorting

After production in the field, sorting may further improve the seed. We have developed chlorophyll fluorescence techniques to determine the ripeness of the seed, initially for research purposes, but machines for large scale sorting are now also commercially available.

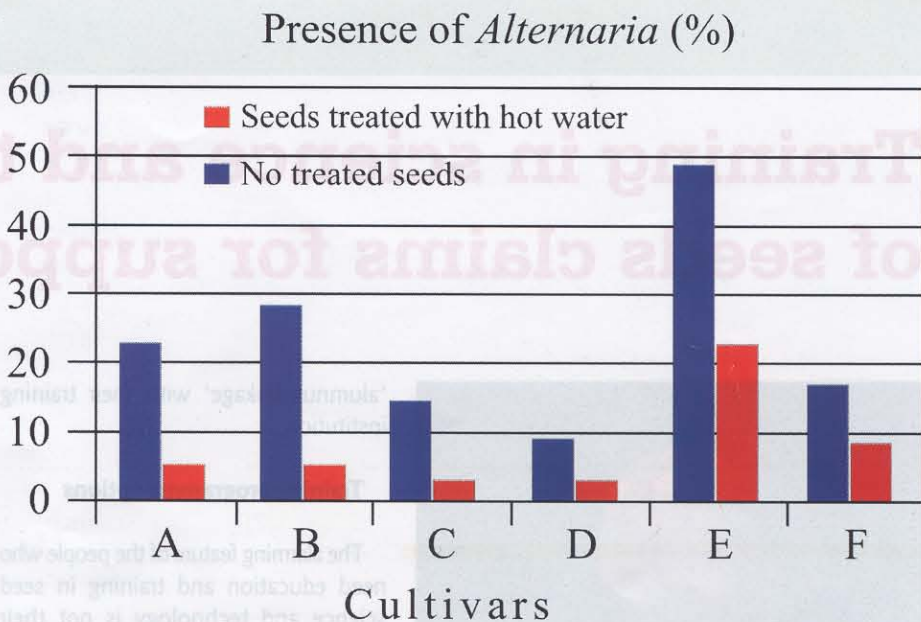
Using this technique we can sort seeds individually into different maturity classes. All seeds are mature and normally contained in highly graded seed lots, but some seeds are always more mature than others.

Treatment

Sorting does have some influence on seed contamination generally, but there always remain many infected seeds in the lot. These can not be removed physically by any means, so we are forced to eradicate the pathogen on the seed.

Basically, three sets of treatments can be recognised. 1. Biological treatments involving micro-organisms, phages, etc as antagonist or predator; 2. Green Chemicals.; and 3. Physical treatments including the mentioned hot water treatment, hot vapours, various forms of irradiation, either enhancing vigour or reducing the pathogen.

For organic farming only 'green chemicals' can be used. Chemicals treatments for organic farming can only be applied if the active compound is of natural origin and not chemically processed. Only minimal purifications are allowed. The groups of green



chemicals are: Plant (and animal) extracts (onion, garlic, citrus, Bt); Essential oils (neem oil, thyme oil); Anti-microbial proteins (nisin, lactoferrin); Other natural agents (chelators, detergents, elicitors). These and many other substances are currently under study worldwide.

We try them all, but I would like to focus on essential oils. We consider them most promising, because of a number of characteristics.

- Many of them have a proven activity against fungi and bacteria;
- They are environmentally friendly, because they have a low persistence;

on 4 pathogens: *Xanthomonas campestris*, *Clavibacter michiganense*, *Alternaria dauci*, and *Botrytis aclada*. Oregano and thyme oils both are very efficient antimicrobials, cinnamon is a good third. Often green chemicals are not entirely effective on their own. Combinations with other active ingredients, like chelators and detergents, are needed for the proper administration and maximum effect.

Detection

Finally I would like to stress the importance of detection methods. In many techniques applied to eradicate pathogens on seeds, the pathogens are not physically removed, but only killed. Therefore, of particular relevance are methods that can distinguish between viable and non-viable pathogens. We do so with flow cytometry. This technique that you may well know, analyses, and if desired even sorts, small particles on basis of fluorescence. We use specific labels that have been developed for vital staining.

Summarizing, it may now be clear that in order to produce viable and healthy organic seeds, all resources that we have, need to be utilized. From production, through frequent analysis and research, intelligent sorting of the seed and with proper treatments, we may achieve our goal.

I hope to have shown that seed science holds many of the clues and solutions for a successful organic agriculture."



Umbel of carrot attacked by *Alternaria*

- They are relatively cheap;
- They are often applied in food already and
- They are generally considered as safe;

This renders registration much easier and they are, therefore, cheaper than many members of the other compound groups.

In the framework of the Eu-stove project, we tested the effect of numerous compounds

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