Organic seed treatment possibilities

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Abstract

In organic farming systems the focus is on prevention with regards to plant protection. To follow the rules of Good Agricultural Practice one is able to avoid serious yield losses; if it is not possible the use of allowed materials are permitted. Healthy and high quality propagation material plays a significant role from economic aspect, which places the propagation material production industry into the focus of improvement and research. In organic farming, propagation materials have to originate from organic production from 1. January 2004, which, in parallel, trigerred the need of their protection (1452/2003). Organic farmers have less material to protect their plants so it is necessary to find effective potential alternatives. Bacterial and fungal diseases of tomato and pepper can cause serious losses in yield. Different materials were tested against some plant pathogen bacterial (Clavibacter michiganensis subsp. michiganensis, Pseudomonas syringae pv. tomato, Xanthomonas campestris pv. vesicatoria and fungal (Phytophtora infestans, Rhizoctonia solani, Sclerotinia sclerotium) strains in order to find potential materials in the field of organic seed treatment. In vitro trials have shown that vinegar, cider vinegar, red wine vinegar, white wine vinegar, cinnamon and thyme oil have inhibiting effect against the causative agent of bacteria and fungi.

Introduction

Organic farming is a closed system in harmony with nature, therefore the demand for organic seeds has been escalated and its necessity was declared by European Seed Association as well. In traditional agriculture, numerous methods are known and used for seed treatment during the production process. However, organic seed treatment is so recent, that only insufficient number of methods for the examination of seeds and materials for treatment are available which can be applied in practice successfully. For filling this market and technological gap, appropriately tested and efficient materials are necessary, if we are to implement organic agriculture seriously and increasingly.

During the research the main aim was to find environmentally friendly, cheap and easily applicable materials for organic seed treatment with selecting appropriate materials for organic seed treatment according to scientific literature (*Borgen 2004*) and former examinations with in vitro microbiological examinations of perspective materials against previously chosen pathogenic microorganisms and defining the lowest, yet effective concentration of the materials which have been proven to be microbiologically effective to inhibit the reproduction of microorganisms safely.

The experiment is realized with the aim of TÁMOP-4.2.1/B-09/1/KMR-2010-0005 project with the title of “Fenntartható fejlődés – élhető régió – élhető települési táj”.

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Materials and methods

The materials for examination have been chosen on the grounds of scientific literature (*Borgen 2003*): materials applied in food conservation and of natural origin. Microbiological tests were implemented at Corvinus University of Budapest, Faculty of Food Science, Natural Collection of Agricultural an Industrial Microorganisms (NCAIM).
The following microorganisms were examined:
Clavibacter michiganensis subsp. michiganensis NCAIM B001778, NCAIM B001779
Pseudomonas syringae pv. tomato NCAIM B001277, NCAIM B001682, NCAIM B001538
Xanthomonas campestris pv. vesicatoria NCAIM B001771, NCAIM B001226
Sclerotinia sclerotium F00738
Rhizoctonia solani 268
Phytophtora infestans K39
Natrium-hydroxide, Kasumin 2L, Streptomycin-sulfate and destillated water were applied as controlls.
We examined several materials but here only effective or more important ones will be introduced; different essential oils: cinnamon essential oil (*Aetheroleum cinnamomi*), thyme essential oil (*Aetheroleum thymi*), vinegar, red wine vinegar, white wine vinegar, cider vinegar, baking soda (Natrium-hydrogencarbonicum), propolis etc.
Microbiological efficiency was tested by cup plate method, disk diffusion test (*Gavin 1957*), and poison agar assay (*Klement et al 1990*).
Handling and primary processing of data during the experiments was executed with Microsoft Excel 2003 programme. Statistical analysis of data was done by SPSS for Windows 14.0 statistical software and Ropstat programme package (*Vargha 2000*).

Results

In vitro bacteriological assays results are the followings: essential oils examined in 100% concentration had inhibition effect against all examined strains. Among oils cinnamon was the most effective as it had significantly bigger inhibition zone than 1,5% NaOH control. In lower concentration (25% and 50%) cinnamon oil has inhibition effect on the reproduction of all examined strains. Thyme oil was less effective but it had inhibition effect from 25% concentration.
In all examined materials 10% vinegar caused the highest inhibition.
Vinegar, cider vinegar, red vine vinegar and white vine vinegar have inhibiton effect from 0,5% concentration on examined Pseudomonas strains (B.01277, B.01682), on Xanthomonas strains (B.01807, B.01771, B.01226) and on Clavibacter strains (B.01778, B.01779).The effect of vinegar was the same in all strains. The examined highest concentration (10%) was the most effective; lower dose induce lower inhibition. Correlation was observed between concentrations and inhibition zones as all type of vinegars showed correlation.
During experiments the objective was to choose materials with the widest spectrum of activity, thus in further tests only bacteriologically efficient materials were examined. The results of tested materials on fungi are presented in Table 2.

Tab. 2: Results of tests on fungi (P=0,05)

Strains	Rhizoctonia solani R268			Sclerotinia sclerotium F 00738			Phytophtora infestans K39
Methods	a	b	c	a	b	c	a
Tested agents, concentrations							
control	100%	100%	100%	100%	100%	100%	100%
NaOH 1,5%	81%		52%	100%		0%	0%
material with kasugamycin	100%		100%	95%		83%	
vinegar 10%	0%	0%		0%			0%
vinegar 5%	56%	0%	48%	44%	0%	0%	100%
vinegar 4%			63%			32%	
vinegar 2,5%	80%		76%	100%		31%	100%
vinegar 0,5%	82%		86%	100%			
red wine vinegar 6%	84%		48%	100%	0%	0%	100%
white wine vinegar 6%	88%		45%	50%	0%	0%	
cider vinegar 6%	85%		56%	73%	0%	0%	
cinnamon oil 100%	100%			0%			9%
thyme oil 100%	75%			51%			100%
propolis 100%	95%			100%			

Key to symbols:
a: poison agar assay, b: further test on cid effect , c: direct contact method

Discussion

The objective of my experiments was to find materials suitable for organic seed treatment. Vinegars in 0,5% concentration inhibit reproduction and by increasing concentration this effect can be multiplied. Inhibiting effect of vinegar in 10% concentration exceeds that of 50 ppm Streptomycin-sulfate. Hydrogen ion on pH 3-6 has bacteriostatic, while on pH <3 has bactericid effect, which was proven in case of tested bacteria strains. Alkalis, however, have much lower effect on propagation of bacteria. Alkaline medium does not present such an extent of inhibition on the propagation of bacteria as those of acids. Baking soda did not have any effect, while 1,5% NaOH solution, with pH 13, only showed little effect on the growth of strains.
The effect of 0,5% vinegars had the same effect as 1,5% NaOH, while in higher than 2,5% concentration it has proved to be more efficient.
Cinnamon and thyme essential oils have to be applied in at least 25% concentration to perform inhibition on the propagation of bacteria. 25% concentration compared to 50% showed efficiency and did not present significant difference, however from ecological point of view lower concentration is reasonable. These oils inhibited the growth of all three bacteria from 25% concentration.
In case of tested fungi strains it is considered to be a good result if the material decelerates their growth, thus providing vantage for the germination of seeds. The Chosen materials generally decelerate the growth of fungi (static effect), however not many of them could have cid effect. In the case of *R. solani* and *S. sclerotium* the majority of tested agents in higher concentrations (> 6%) had cid effect, while in case of *P. infestans* only 1,5% NaOH, vinegar in 10% concentration and undiluted cinnamon essential oil inhibited growth. These materials also inhibited the growth of

other fungi strains. In case of mildews, natural acids under pH 3 did not have any inhibition effect. On the basis of my experiments antimicrobial effect of vinegar, cider vinegar, white and red wine vinegar can be established.

Conclusions

The above mentioned compounds in higher concentration have cid effect on bacteria, while stronger acids have the same effect on fungi as well. Microbiological efficiency of vinegars is directly proportional to their concentration. Tested vinegars are efficient in lower dose; therefore their application is to be implemented in such, for they decelerate the speed of the growth of microbes, which might be a key factor of prevention and plant protection in organic farming. With their better performance, plants are able to reach a level in their development for the unfavourable period, so that pathogenic microbes cannot infect them in healthier and better condition. Vinegars, red and white wine vinegars, cider vinegars in 0,5% concentration have presented complex spectrum of activity, for they have been efficient against both the tested bacteria and mildews. As for expenses, NaOH 1,5% is the cheapest, followed by vinegar 0,5%, cider vinegar 0,5%, red wine vinegar 0,5% white vine vinegar 0,5%, and the agent with kasugamycin content. Tested agents can be utilized in organic plant protection, where other means of application have to be considered as well. In such use, concentration does not have limiting role, for the surface of plants is less sensitive than seeds, thus treatments cannot be so harmful. Developing agents with appropriate effect at fields beyond seed treatment can be researched further on. Results have to be applied and their use in practice can be tested widely in the future.
The significance of further research lies in the fact, that the tools of plant protection are to be broadened not just in organic but also in conventional farming, and as long as it is possible to provide more environmentally friendly and cheaper agents, than presently available ones, all members of the consumer chain might benefit both from the aspect of environmental protection and economy.

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