CO-FREE: four crops, three years – where are we now?

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INTRODUCTION

The aim of CO-FREE is to find potent strategies to replace copper in organic, integrated and conventional farming. The project is constructed as a modular system (Figure 5). The 4 main topics: CO-FREE alternative test products (CTPs), decision support systems (DSS), varieties / innovative breeding goals and cropping systems will be integrated into management strategies. A brief overview on results from 2012 to 2014 is given below.

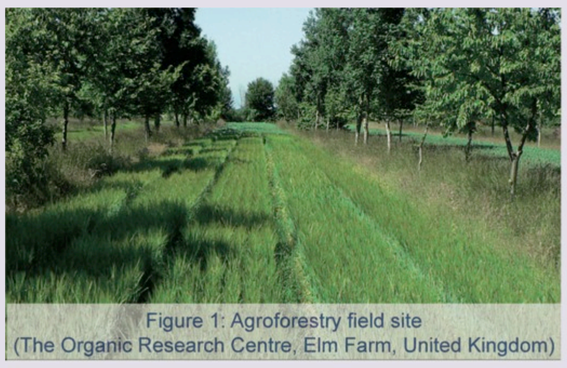

Figure 1: Agroforestry field site (The Organic Research Centre, Elm Farm, United Kingdom)

Figure 2: Leaf fall caused by Marssonia coronaria (Centro di Sperimentazione Agraria e Forestale Laimburg Azienda, Italy)

Figure 3: Trial site tomato (Benaki Phytopathological Institute, Greece)

Figure 4: Trial site grapevine (Fondazione Edmund Mach, Italy)

RESULTS

CO-FREE test products (CTPs):

In CO-FREE alternative test products (CTPs) (*Trichoderma atroviride* SC1 and protein extract SCNB, *Lysobacter* spp., yeast-based derivatives, *Cladosporium cladosporioides* H39, oligosaccharidic complex COS-OGA, *Aneurinibacillus migulanus* and *Xenorhabdus bovienii,* sage extract, liquorice extract, PLEX and seaweed extract) are tested and their modes of action are further characterized.

- Trichoderma-induced resistance is strongly affected by grapevine genotype and by exposure of plants to abiotic stresses
- Active ingredients of several CTPs were identified
- No toxicity of tested CTPs was found on 8 arthropod indicator species and non-target aquatic indicator organisms

Field Trials

The aim of CO-Free is the development of strategies including CTPs, DSS and varieties to avoid/reduce copper treatments. In 2012/13 single compounds were tested in the field, whilst first combined strategies (improved CTPs with DSS and tolerant varieties etc.) were tested in the field in 2014 (Table 1).

- Combined strategies (with or without low doses of copper) provided better results, compared to stand alone treatment with CTPs
- Other crucial factors: Variety/ideotype, rain fastness and UV stability
- Useful side effects on beneficial mites and non-target disease

Effects of CTPs	Disease reduction leaves	Disease reduction on fruit / yield	Side effects
Apple / *V. inaequalis*	Effective „stop-treatment“ Overal strategy very successful	Agroforestry: > 50% disease reduction in fruit; Varietal diversity important	Reduction in leaf fall caused by *Marssonina coronaria*
Grape / *P. viticola*	up to 40 %	During vegetation up to 40% disease reduction in fruit	Higher abundance of predatory mites
Tomato/ *P. infestans*	up to 58 %	no reduction in yield when frequently applied	
Potato/ *P. infestans*	Retarded disease development / influence of variety	Up to 35% yield increase	Enhanced tuber firmness; Effect of resistance inducers does not correlate with suceptibility of the variety

Table 1: Overview of results of CO-FREE test products (CTPs) in the field 2012 - 2014

Decision support systems (DSS):

In grape and potato DSS were adapted and improved, with respect to cultivar (grape) and determination of the necessity of copper sprays and adaption for application timing (potato).

- Grape: Adaption of model RIMpro
- Potato: Development of a growth model for integration into DSS Oeko-SIMPHYT (http:// www.zepp.info/ackerbau/75-kartoffel/61--oeko-simphyt)

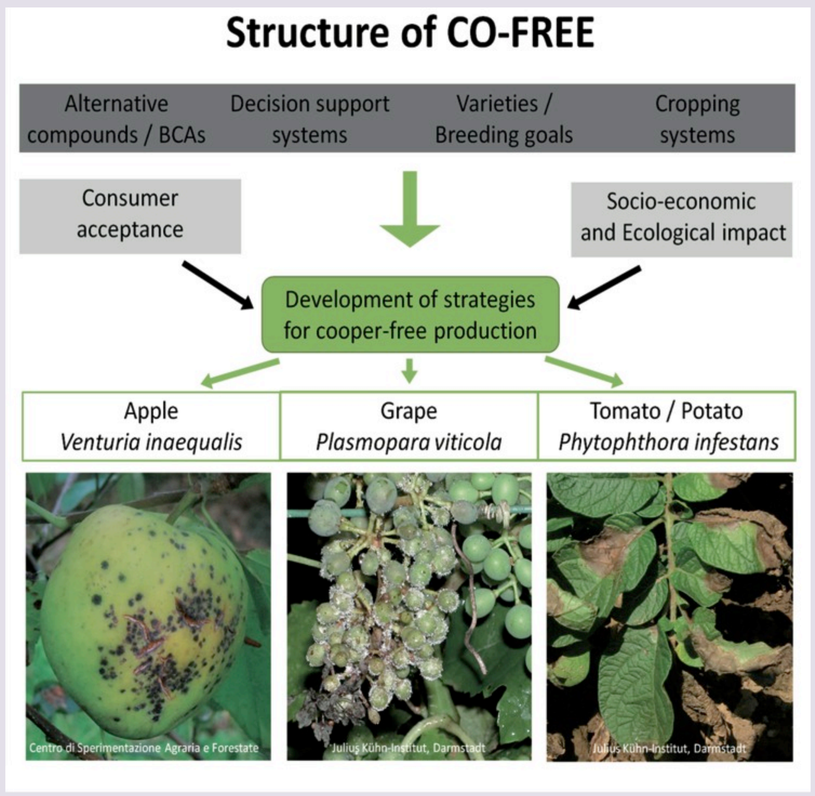

Figure 5: Overview of structure and content of CO-FREE

OUTLOOK

- In 2015 combined strategies with the most promising CTPs are currently tested in the field

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