

The effect of soil disinfection with chemical and alternative methods on fungal and bacterial populations

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Abstract

The study was carried out in 2010-2012 on 4 farms. Soil was disinfested by chemical fumigation, biofumigation and active steam. Chemical fumigation was carried out during fall 2010 and 2011 with dazomet 30 and 40 g·m⁻², metam sodium 90 and 60 ml·m⁻², chloropicrin +1,3D 35 and 50 ml·m⁻². During spring 2011 and 2012 the treatment with active steam (steam additioned with CaO, maintaining soil temperature of about 70°C for 3-4 h, Bioflash system) or with meal of *Brassica carinata* seeds was performed at 2 locations. The soil was sampled 4 weeks after the treatments to assess quantitatively and qualitatively bacteria and fungi populations.

All chemical treatments provoked a significant decrease of the number of fungi. Depending on the year, location and the active substance applied, the fungi populations were decreased by 2.3 to 3500-fold in comparison to control. Metam sodium and chloropicrin+1,3D resulted in almost a entire elimination of the fungi from the soil environment. All fumigants completely eliminated *Verticillium dahliae* and *Phytophthora cactorum* propagules and appeared to be very highly effective against *Fusarium oxysporum, F. culmorum, F. solani, Botrytis cinerea* and *Rhizoctonia* spp. even at lower doses. The total number of bacteria was significantly increased by the chemical fumigation with all active substances. Interestingly, dramatic changes appeared in the population of fluorescent Pseudomonads. The number of these bacteria in all fumigated plots increased from 2- to 150-fold in comparison to not fumigated soil. On the other hand, the number of *Bacillus* bacteria generally did not change or were slightly decreased after some treatments.

Active steam treatment caused about a 5-fold decrease of fungi and totally eliminated harmful fungi such as *Fusarium* and *Rhizoctonia*. The size of the bacteria population was not changed by the active steam treatment. However, the structure of their population was modified: while the number of Pseudomonads decreased about 5-fold, the number of *Bacillus* spp. increased by about 50%. Application of biofumigation resulted in an increase of *Penicillium* and *Mucorales* population, but eliminated other fungi, including pathogens. This treatment induced a 3-fold decrease of the bacteria populations, without affecting the number of Pseudomonads and *Bacillus* spp.