ABSTRACT OF HABILITATION THESIS

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CHANGES IN MICROBIAL COMMUNITIES COLONIZING LEAVES OF WINTER WHEAT TREATED WITH FUNGICIDES AND A PLANT DEFENSE ACTIVATOR

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Key words: epiphytes, bacteria, yeasts, filamentous fungi, winter wheat, fungicide, plant defense activator

The aim of a field experiment, conducted in 2001–2003 in Tomaszkowo near Olsztyn (NE Poland), was to determine the effect of fungicides and a plant defense activator on epiphytic microorganisms colonizing winter wheat, cv. 'Sakwa' and cv. 'Roma'. The experiment was established in a randomized sub-block design, with four replications. Protective treatment was applied twice, at tillering stage (GS 30) and ear formation stage (GS 55). The following fungicides were used: Bravo 500 SC (chlorotalonil), Penncozeb 80 WP (mancozeb), Mirage 450 EC (prochloraz), Karben 500 SC (carbendazim), Amistar 250 SC (azoxystrobin), Alert 375 SC (flusilazole, carbendazim) and Sportak Alpha 380 EC (prochloraz, carbendazim). The plant defense activator was Bion 50 WG (acibenzolar-S-methyl). Microbiological analyses were performed three times after each treatment, to determine quantitative changes in the communities of filamentous fungi, yeast-like fungi (including members of the genus *Sporobolomyces*) and epiphytic bacteria. Qualitative analysis of the community of filamentous fungi was also performed. The sensitivity of selected isolates of yeast-like fungi, filamentous fungi and bacteria to the applied fungicides and plant defense activator was evaluated under laboratory conditions.

The epiphytic microbial community in winter wheat was characterized by high variation over the growing season, and by relatively low diversity. Leaf surface was most frequently colonized by bacteria, often by yeast-like fungi, and much less commonly by filamentous fungi, among which potentially pathogenic species were encountered sporadically only. The effectiveness of fungicides against epiphytic microbial communities in the tested cultivars of winter wheat was significantly affected by leaf structure. All investigated microbial groups were present in great abundance on the leaves of winter wheat cv. 'Roma', while the inhibitory effect of some chemicals was more noticeable in the case of cv. 'Sakwa'.

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The majority of chemicals tested under field conditions, in particular fungicides containing carbendazim and flusilasole, exerted inhibitory effect on the growth of epiphytic bacteria. This effect was most pronounced 24 h after treatment, and it was often observed for several days. Under laboratory conditions bacterial isolates differed considerably in their response to the tested chemicals. Higher abundance of epiphytic bacteria was accompanied by lower abundance of fungi of the genus *Septoria* and – usually – by a higher yield of winter wheat.

Under field conditions the inhibitory effect of fungicides on the community of yeast-like fungi was generally short-lived and most probably selective, because a significant increase in the population size of the fungi was observed following some treatments. Amistar 250 SC, the fungicide containing azoxystrobin, exerted in most cases a long-term inhibitory effect on this group of microorganisms. Under *in vitro* conditions only some isolates of the genus *Rhodotorula* responded to the type and concentration of active substances.

The investigated eukaryotic organisms, except for a population of fungi of the genus *Sporobolomyces* forming white colonies, did not reduce the rates of leaf infection caused by fungi of the genus *Septoria.* In addition, they usually had a negative influence on winter wheat yield. The communities of fungi forming balistospores responded strongly to varying weather conditions as well as to the fungicides containing chlorotalonil, azoxystrobin and a combination of carbendazim and flusilasole.

The applied chemicals in most cases effectively controlled the growth of filamentous fungi on winter wheat leaves for 10 to 20 days after treatment, and the effect of the azoxystrobin containing fungicide lasted even longer. The investigated fungicides affected primarily species of the genus *Cladosporium,* and sometimes the newly-created niche was colonized by fungi of the genus *Fusarium*. The tested chemicals sporadically decreased the species biodiversity of filamentous fungi.

Under *in vivo* conditions, yeast-like fungi isolated from the roots of winter wheat contributed to a weaker infection of the seedlings by the species *Fusarium culmorum,* particularly at later inoculation dates. The epiphytic species *Rhodotorula glutinis* proved adapted for colonizing the bottom leaves of seedlings, particularly in cv. 'Roma'. Fungicides containing chlorotalonil, carbendazim and prochloraz exerted a direct inhibitory effect on the number of fungal colonies on the bottom leaves of winter wheat, and an indirect stimulating influence on the size of fungal populations on upper leaves.

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