LIÈGE université
Gembloux
Agro-Bio Tech

Le Corps professoral de

Gembloux Agro-Bio Tech - Université de Liège vous prie

de lui faire l'honneur d'assister à la défense publique de la dissertation originale que

Madame LE MIRE Géraldine,

Titulaire d'un diplôme d'ingénieur,

Titulaire d'un diplôme de master sciences, technologies, santé, mention biologie et écologie pour la forêt, l'agronomie et l'environnement, spécialité biologie des interactions plantes-environnement,

présentera en vue de l'obtention du grade et du diplôme de

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 4 mai 2018, à 13h30 précises (personne ne sera admis après cette heure),

en l'auditorium PhV (Physiologie végétale, bât. 48),

Avenue Maréchal Juin, 13 à 5030 GEMBLOUX.

Cette dissertation originale a pour titre :

« Identification of elicitors inducing resistance in wheat against *Zymoseptoria tritici* and characterization of the subsequent triggered defense-signaling pathways ».

Le jury est composé comme suit :

Présidente : Prof. M.-L. FAUCONNIER, Présidente du Département AGROBIOCHEM,
Membres : Prof. H. JIJAKLI (Promoteur), Dr M. DELEU, Prof. S. MASSART, Prof. F. LEBEAU, Prof. P. DELAPLACE, Dr A. SIAH (ISA, Lille - France), Pr P. HALAMA (ISA, Lille - France).
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Summary

The implementation of biocontrol products in integrated pest management strategies is a major challenge today in the transition to sustainable and environment-friendly agro-ecosystems. In particular, the use of natural elicitors, also called plant resistance inducers, represents an interesting alternative to conventional fungicides. Elicitors are natural immune-stimulating compounds which offer the advantage to indirectly target a broad spectrum of pathogens by enhancing the defensive state of the plant. Yet today, wheat is one of the most cultivated crops in the European Union and still requires fungicide protection every year for the control of a harmful disease: *Septoria tritici* Blotch (STB), caused by the fungal pathogen *Zymoseptoria tritici*. At a time when few elicitor products are available on the market for the sustainable management of crop diseases, the objective of this thesis project was to screen and identify innovative elicitors able to preventively protect wheat against the STB disease. Greenhouse trials successfully demonstrated the ability of λ-carrageenan, cytosine-phosphate-guanine oligodesoxynucleotide motifs (CpG-ODN), *Spirulina platensis*, glycine betaine and ergosterol to protect wheat by up to 70 % against the pathogen *Z. tritici*. These results are promising as previous research has indeed demonstrated the elicitor properties of these five compounds on other plant species and/or animals. Besides, no direct anti-fungal activity was recorded during *in vitro* experiments towards the disease. The risk of resistance development of the pathogen to these potential elicitors can thus be considered as low. Furthermore, the defense mechanisms of wheat were successfully demonstrated to be significantly induced following treatment with each of these formulated compounds. The relative expression of 23 plant defense genes was analyzed by qRT-PCR at 1, 2 and 3 days after plant treatment. Defense mechanisms involving the two hormones salicylic acid (SA) and jasmonic acid (JA) were triggered in treated wheat. These hormones play a key role in the transduction of defense signals throughout the plant. In addition, the protection efficacy of the two preferential candidates (λ-carrageenan and Spirulina) was investigated in the field during two successive years. Numerous parameters, among which environmental conditions, plant developmental stage, plant genotype and disease pressure, can indeed cause a variability of elicitor protection efficacy under practical conditions. Unfortunately, important contrasts in disease pressures and extreme weather conditions did not allow confirming the elicitor potential of the corresponding treatments on field. Finally, the potential effect of the formulation on the eliciting activity was characterized in order to rule out the possibility of interference by the selected adjuvants. Additional greenhouse experiments showed that a water solution containing only the adjuvants was as efficient to protect wheat against STB as plants treated with formulated or non-formulated λ-carrageenan. These last results highlighted the necessity of developing an appropriate formulation at an early stage before elicitor screening. Overall, the findings of this research study open the way to the development of new and interesting biocontrol products based on λ-carrageenan for sustainable wheat protection against *Zymoseptoria tritici*.