

Contribution to the development of a biological control method against crown rot of bananas



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Introduction



Figure 1: External symptom

Crown rot of bananas is one of the most important post-harvest disease of bananas (Cavendish cv. Grande-Naine). It affects tissues joining fruits with each other, called the crown (Figure 1). This disease develops during fruit transport, conservation and ripening. First superficial, the fungal infection develops internally affecting the pedicel (Figure 2) and ultimately, the banana pulp. Crown rot is caused by a complex of fungi, with one main pathogen: *Colletotrichum musae*. The aim of this study was to evaluate the antagonistic activity of two yeast strains against the parasitic complex.



Figure 2: Internal symptom

Materials and methods



Figure 3: Pathogen inoculation

Pichia anomala strain K and *Candida oleophila* strain O were isolated, from apple fruits, in the Plant Pathology Unit (Gembloux Agricultural University, Belgium). The antagonistic activity of both strains, applied at three different concentrations (10^6 , 10^7 , 10^8 cfu/ml), was evaluated against *Colletotrichum musae* (10^3 conidia/ml), *Fusarium moniliforme* (10^4 conidia/ml), *Cephalosporium sp.* (10^4 conidia/ml), and against a parasitic complex formed by the association of the three fungi. The green bananas (*Musa acuminata*, AAA, subgroup Cavendish, cv. Grande-Naine) were harvested in banana plantations as described by Chillet and de Lapeyre de Bellaire (1996). 100 µl of suspension of each conidial suspension were deposited on the surface of the crown of a cluster consisting of four bananas (Figure 3). Six replicates were carried out. After an incubation period of 15 min, banana crowns were immersed during 10 sec into a suspension of strain K or strain O (Figure 4). Fruits from different batches were packed in punched polyfilms, placed in commercial boxes and stored at 13°C for 10 days long to simulate the shipment. Bananas were then exposed to ethylene 1000 ppm for 24 h at 20°C, and stored 2 days at 20°C for ripening. The Percentage of Crown Necrosed Surface (PCNS) was then evaluated as: (internal crown rot surface/ total crown

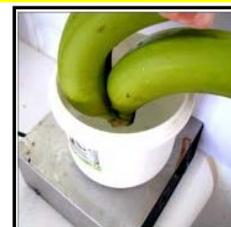


Figure 4: Yeast treatment

surface) x 100. The influence of banana incubation period between strain O (10^8 ufc/ml) treatment and the inoculation of the banana crowns with the fungal complex was also studied. Strain O was applied 24 h before the complex, but also 15 min or 3 h after its inoculation. The statistical interpretation of the results is based on ANOVA (three ways) and mean separations were calculated by Newman and Keuls test at a 5% probability level.

Results and discussion

Evaluation of the antagonistic activity of two yeast strains against fungi implicated into the parasitic complex

Significative antagonistic effects of strain K and strain O were observed against *C. musae* and *F. moniliforme*, and against the fungal complex, but not against *Cephalosporium sp.* The fungal complex had an intermediate pathogenicity between *C. musae* and the two other fungi (Figure 5). Among the various treatments, the application of strain O applied at (10^8 cfu/ml) showed the highest protective level (56%) against the complex. This observation suggests that there are some antagonistic activities between the three fungi.

Influence of the banana incubation period, between strain O and fungal complex inoculation, on the protective level

The protective effect of strain O, applied at 10^8 cfu/ml was remarkably reinforced (more than twice) when the strain was added 24 h before inoculation of the fungal complex (Figure 6).

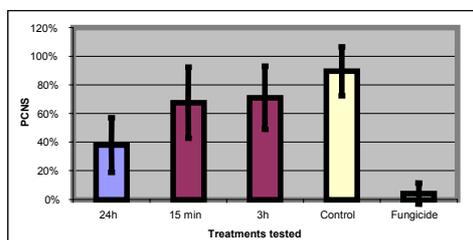


Figure 6: PCNS on banana clusters inoculated with the fungal complex and treated with *C. oleophila* strain O (10^8 ufc/ml). Statistically similar values of PCNS are represented in the same color. PCNS mean is the result of 6 replicates, and standard-errors are represented by vertical bars. 24h: strain O applied 24h before the fungal complex inoculation; 15 min and 3 h: strain O respectively applied 15 min and 3 h after the fungal complex inoculation; control: no treatment; fungicide: bananas dipped in thiabendazole (500mg/L) for 1 minute.

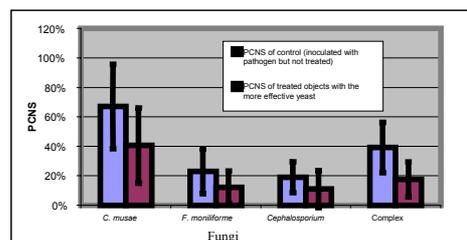


Figure 5: PCNS on banana clusters inoculated with one pathogen or with a complex of them, treated or untreated with the most effective yeast according to the pathogen. PCNS mean is the result of 6 replicates, and standard-errors are represented by vertical bars.

Relationship between the severity of the disease and the protective level by strain O

A strict correlation between the severity of the disease and the protective level by strain O at a concentration of 10^8 cfu/ml was observed. The higher the severity of the disease increased, the lower the protective level by strain O (Figure 7).

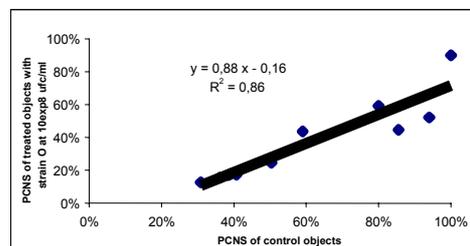


Figure 7: Relationship between the PCNS of banana clusters inoculated with the fungal complex and untreated with strain O (PCNS control), and the PCNS of banana clusters inoculated with the fungal complex of fungi and treated with strain O at 10^8 ufc/ml.

Conclusions

These results show that *P. anomala* strain K and *C. oleophila* strain O have both antagonistic effects against the parasitic complex formed by the association of *C. musae*, *F. moniliforme* and *Cephalosporium sp.* Strain O was more effective than strain K. The antagonism was not enough to prevent rots caused by the complex, but it decrease them noticeably. The protective level being limited and variable, combination of this protective effect with other crown rot control methods will be assessed.

Acknowledgments and references

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•Chillet M and de Lapeyre de Bellaire L. 1996. Conditionnement en polybag pour le contrôle de l'antracnose de blessures des bananes. Fruits 51:163-172.