

**Title** Efficacy assessment of *Pichia guilliermondii* strain Z1, a new biocontrol agent, against citrus blue mould in Morocco under the influence of temperature and relative humidity

**Author** Rachid Lahlali, Younes Hamadi, M. El guilli and M. Haissam Jijakli

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### Abstract

The interactions of *Penicillium italicum*, which causes blue mould, and antagonistic yeast *Pichia guilliermondii* strain Z1 were examined in controlled environments, to determine the influence of relative humidity (RH) (45%, 75%, 85%, 98%, and 100%) and temperature ( $T$ ) (5, 10, 15, 20, and 25 °C). All main effects and interactions were significant ( $P \leq 0.05$ ), with the exception of interactions RH $\times$  $T$  and strain Z1 (BCA) $\times$ RH $\times$  $T$ . In the pathogen control, the lesion diameter of blue mould developed under all environmental conditions but was the largest at a RH range between 98% and 100%, independent of the temperature. The efficacy of strain Z1 appeared to be independent of the environment and reduced disease incidence by more than 85% in all environmental conditions. Rapid colonization of the antagonistic yeast strain Z1 on citrus wounded sites was recorded during the first week at 5 °C. Colonization then stabilized at  $\pm 6.9 \times 10^6$  CFU/ml for 30 days. This indicates that *P. guilliermondii* is able to adapt itself and colonize the wound sites prior to the arrival of the pathogen, displaying greater efficiency than when colonizing wounds after pathogen. The antagonist was capable of growing in low concentrations of orange juice (0.1–5%), with greatest growth at 5%. Applying strain Z1 ( $1 \times 10^8$  CFU/ml) as a formulated product significantly reduced the incidence of infected fruits and the percentage of infected wounds relative to the pathogen control. Disease control with formulated product (45%) was slightly lower than that obtained with thiabendazole (20%) or strain Z1 culturable cells (25%). These results suggest that strain Z1 may be a useful BCA for control of blue mould under varying environmental conditions, and control may be enhanced by combining with other eco-friendly post-harvest treatments or improved formulation.