SUMMARY

Postharvest green mold, caused by *Penicillium digitatum* (Pers.:Fr.) Sacc., and postharvest blue mold, caused by *Penicillium italicum* Wehmer, are the most economically important postharvest diseases of citrus worldwide. In Spain, fruit postharvest losses due to molds may reach up to 10% under normal environmental conditions. However, under climatic conditions favorable to mold development, these losses might exceed 50%. Currently, these diseases are primarily controlled by application of synthetic fungicides. However, the use of these fungicides can lead to important problems such as chemical residues accumulation on/in fruit, the development of *P. digitatum* and *P. italicum* strains resistant to these fungicides and environmental pollution because of inadequate management of fungicide disposal.

An adequate control of postharvest diseases without the use of conventional fungicides does not rely on only one control strategy and should consider all factors that are influencing decay incidence. Therefore, the non-contaminant integrated management of postharvest diseases is a global strategy, which takes into account disease epidemiology, and all preharvest, harvest and postharvest factors determining disease to take action on each of them at the right moment in order to reduce economic losses. In this context, the general goal of this doctoral thesis was to increase the knowledge on some of these factors and search for non-polluting alternative strategies to control citrus postharvest green and blue molds.

The effect of commercial degreening with ethylene gas under Spanish conditions on fruit susceptibility and quality and on the development of postharvest green and blue molds on early-season 'Clemenpons', 'Clemenules' and 'Nova' mandarins and 'Navelina' oranges was determined (chapter 1). Commercial degreening with 2 $\mu L\ L^{-1}$ ethylene at 21ºC and 95-100% RH for 3 days had no significant effect on fruit susceptibility to both green and blue molds on citrus cultivars degreened, inoculated 2 h later with *P. digitatum* or *P. italicum* and incubated at 20°C and 90% RH for 7 days. Also, no significant effect was observed on disease incidence on citrus cultivars inoculated 2 h before degreening and stored at either 20°C for 7 days or 5°C for 14 days. In contrast, commercial degreening significantly increased the severity of the molds on fruit with higher initial rind color index (CI). On the other hand, besides rind color, commercial degreening did not significantly affect external and internal quality attributes of citrus cultivars.

Postharvest preventive and curative treatments with chemical inducers selected for their general capability to induce disease resistance in plants were evaluated as alternatives to conventional chemical control (chapter 2). In *in vivo* primary tests, different concentrations of sodium silicate (SSi), 2,6-dichloroisonicotinic acid (INA), β-aminobutyric acid (BABA), benzothiadiazole (BTH), salicylic acid (SA), acetylsalicylic acid (ASA) and harpin protein were assayed. Among these seven compounds, only the first four at respective concentrations of 1000, 0.03, 0.3, and 0.9 mM significantly reduced the incidence of green and blue molds on 'Valencia' or 'Lanelate' oranges inoculated 2 h after treatment and incubated at 20°C for 7 days. SSi at 1000 mM was the best treatment to reduce both molds, but it was discarded because of potential phytotoxicity. Chemical elicitors did not show any curative activity when the fruit were inoculated with the pathogens about 24 h before their application.

Preventive and curative antifungal activities of postharvest treatments with potassium silicate (PSi) against green and blue molds were evaluated on oranges (chapter 3). In *in vivo* primary tests, preventive treatments with PSi at 90 mM significantly reduced the incidence of green and blue molds up to 52% on oranges stored at 20°C for 6 days. PSi applied about 2 h before inoculation with *P. digitatum* showed higher preventive activity than applied before 24, 48 or 96 h. In preventive tests, no systemic activity was observed because no disease reduction was noticed when the distance between treatment and inoculation sites was 10, 20 or 30 mm. Dips with PSi at 90 mM at 20°C for 60 s were selected and subsequently applied on inoculated 'Valencia' oranges incubated at 20°C and 90% RH. These dips significantly reduced the incidence and severity of green and blue molds up to 50%. A temperature of 50°C and a dip time of 150 s did not improve the effectiveness of this dip treatment. Selected dips also reduced significantly the molds on oranges stored at 5°C for 6 weeks.

Finally, the control ability of postharvest treatments with sodium salts of parabens, which are classified as GRAS compounds, and included sodium methylparaben (SMP) (chapter 4), sodium ethylparaben (SEP) (chapter 5) and sodium propylparaben (SPP) (chapter 6) were evaluated in citrus species and cultivars of commercial significance. SMP at 200 mM, SEP at 80 mM and SPP at 100 mM were selected in *in vivo* primary screenings as the most effective concentrations (reduction of incidence up to 100%) against green and blue molds on fruits inoculated 24 h before treatment. A temperature of 20°C and an immersion time of 60 s were selected as the best dip treatment conditions. Dip treatments at 50°C did not improve the effectiveness of treatments at 20°C. These dip treatments were compatible with imazalil applied at doses as low as 25 $\mu L\ L^{-1}$ (IMZ 25) and consistently improved its performance, irrespective of citrus cultivars and storage conditions. The combination of SMP, SEP, or SPP with IMZ 25 reduced up to 90% the incidence of green and blue molds in 'Valencia' oranges incubated for 7 days at 20°C. Also, these combined treatments were effective to control the molds on 'Valencia' oranges stored at 5°C during 8 weeks.