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IN VITRO ANTIFUNGAL EXAMINATION OF POTASSIUM SORBATE TOWARDS SOME PHYTOPATHOGENS

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Abstract

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Potassium sorbate, a common food preservative, was tested under *in vitro* conditions according to its inhibitory activity towards economically important for Bulgaria phytopathogens. Conidial (germ tube inhibition) and Thornberry (radial growth assays) tests were conducted in order to be determine such activity. The received results showed that potassium sorbate has a potential to be a developed as a protective fungicide against *Monilia fructigena, Botrytis cinerea, Rhizoctonia solani, Phytophthora capsici and Alternaria solani*.

Key words: potassium sorbate, antifungal activity, phytopathogens

Introduction

Potassium sorbate is the potassium salt of ascorbate acid. The acid and its salt were discovered in France in 1850 and their activity–during 1930 and 1940. These two substances are widely used in food industry as food preservatives under names: E 201, E 202, E 203. Several research show that potassium sorbate can be used and as an effective remedy for the post–harvest treatment of potato tubers against *Helminthosporium solani* (Hervieux et al., 2002; Olivier, 1999) against *Penicillium digitatum* causing post-harvest decay of citrus fruits (Smilanick et al., 2008). A combination of benomyl and potassium sorbate successfully suppresses the development of *Fusarium moniliforme, Rhizopus stolonifer, Alternaria* sp. (Obenauf et al., 1982). Application of 0.2 M potassium sorbate inhibited completely the mycelia growth and spore germination against another important post-harvest potato pathogen *Fusarium sambucinum* (Mecteau et al., 2002) and cowpea root rot disease caused by *Rhizoctonia solani* and *Fusarium solani* (El-Mogly et al., 2004). In the present investigation we tested the inhibitory activity of this salt against *Monilia fructigena, Botrytis cinerea, Rhizoctonia solani, Phytophthora capsici and Alternaria solani*

Materials and Methods

Phytopathogen cultures of *Monilia fructigena* were isolated from infected fruits quince tree (*Cydonia vulgaris*); from grapes fruits for Botrytis cinerea; from potato tubers for *Rhizoctonia solani*, and from tomato leafs for *Alternaria solani*. Potassium sorbate was received from food industry (trade mark “E 201”). The initial starting concentration was different for every pathogen. According to common practice for preliminary tests of antifungal activity it was 1.0% (Rai and Carpinella, 2006). However, in some cases, it was 0.5% or 0.7%. According to the effectiveness achieved by the initial concentration, in next tests concentration was increased or decreased.

Germ tube inhibition tests were conducted in order to be determined a possible protective activity of the tested salts. Fresh infected with inspected pathogen plant parts were collected and were incubated in a humid chamber for the purpose of stimulation the conidial sporulation of the phytopathogens. Conidial suspensions were prepared with the density $3*10^4$ spores/ml. Microscopic slides kind "handing drop" were sprayed with potassium sorbate solution and after drying, 20 µl of conidial suspension was applied. The slides were incubated in a humid chamber, in thermostat and after 24-48 h. the number of germinated conidia was counted with a light microscope. The effectiveness was determined with formula of Abbott (Abbott, 1925).

The effect of the inspected salt to inhibit the development of the mycelium of the tested phytopathogens was determined according to Thornberry methods (Thornberry, 1950; Rai and Carpinella, 2006). For this purpose a potato dextrose agar (PDA) was used. The observation of mycelium growth was conducted on the 3rd, 7th, 10h and 14th day. The area under disease progressive curve (AUDPC) was calculated by using Python Program Language script created by Donyo Ganchev and on base of it was calculated effectiveness by using formula of Abbott. Statistical manipulation of the results (one-way ANOVA) was made with R Program Language for Statistical Computing (R Development Core Team, 2008).

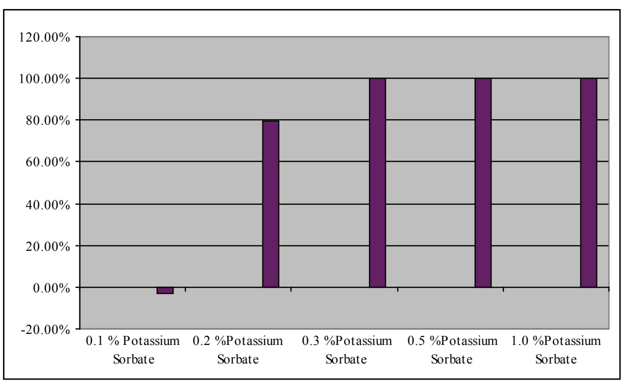

Fig. 1. *In vitro* conidia tests with potassium sorbate with *Monilia fructigena*

Results and Discussion

The tests showed that potassium sorbate can be effective against germination of conidiospores of *Monilia fructigena* in 0.3% concentration and against *Botrytis cinerea* at 3.0% (Figures 1 and 2).

The experiments showed that according to conidiospores of *Alternaria solani*, the tested salt was not effective - at 1.0% concentration, the effectiveness was 16.3%; at 3.0% - it was 25.6 %; at 5.0 % - it was 32.47 %.

According to mycelium of the above mentioned phytopathogen *Alternaria solani*, potassium sorbate could not achieve a satisfactory level of control – at 3.0% concentration effectiveness was 54.10% although higher than in conidial tests (Figure 3).

Towards to the mycelium of *Monilia fructigena*, activity of the potassium sorbate was higher than in germ tube inhibition tests. Even at 0.1% concentra-

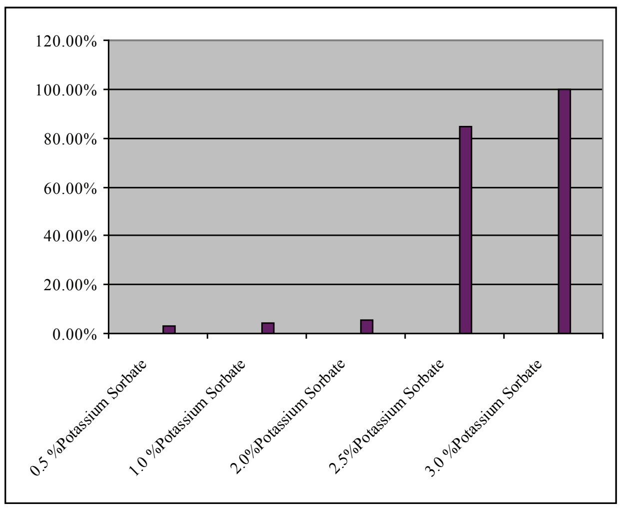

Fig. 2. *In vitro* conidial tests with potassium sorbate with *Botrytis cinerea*

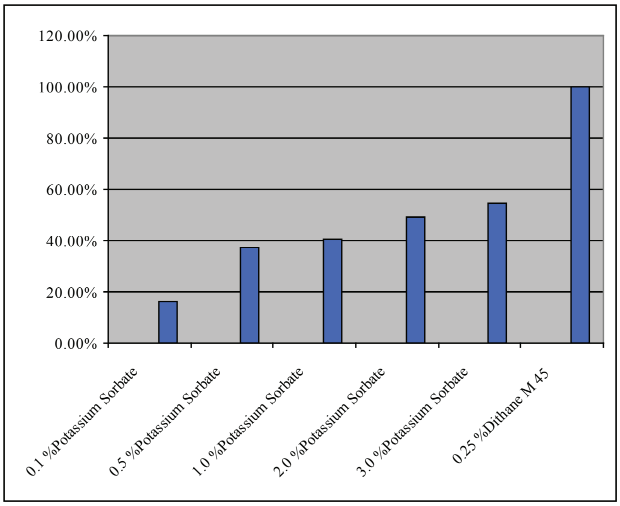

Fig. 3. Thornberry *in vitro* tests with *Alternaria solani*

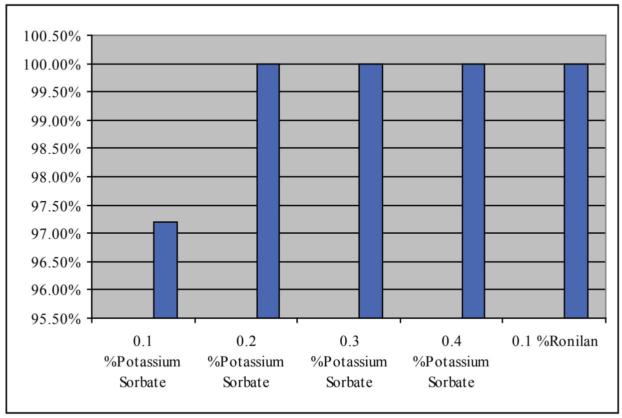

Fig. 4. Thornberry *in vitro* tests with *Monilia fructigena*

tion effectiveness was 97.2 % (Figure 4).

The same tendency as above mentioned was observed and according to *Botrytis cinerea*. The minimal concentration in which the tested salt was able to inhibit development of the mycelium was 0.5% compared to conidial tests, where inhibition of germination of conidia was achieved at 3.0%. A very good effectiveness *in vitro* showed potassium sorbate towards to mycelium of *Rhizoctonia solani* with minimum inhibition concentration at 0.1%. Towards to mycelium of the oomycete fungi *Phytophthora capsici* the satisfactory level of effectiveness (over 90 %) was achieved at 0.2% concentration.

Additionally potassium sorbate was tested *in vitro* against mycelium and conidiospores of Fusarium *oxysporum,* but the activity was very low – 2.0% effectiveness in germ tube inhibition tests, 3.0% effectiveness in Thornberry tests at 2.0% concentration.

Conclusions

The present investigation reveal the possibility and potential of potassium sorbate to be developed in the future as effective preventive fungicide against several plant pathogens causing considerable loss of yields of culture plants like *Monilia fructigena, Phytophthora capsici, Botrytis cinerea* and *Rhizoctonia solani*. According to the *Monilia fructigena,* and *Phytophthora capsici* this is the first time scientific notation about antifungal action of the potassium sorbate on this phytopathogens. The salt, however, showed very low antifungal activity against *Alternaria solani* and *Fusarium oxysporum.* The presented results gave considerable reasons for the future *in vivo* plot and filed trials with the potassium sorbate in this area.

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