

# The Role of Gum Induced by *Fusarium oxysporum* Schlecht. Snyd. et Hans. f.sp. *tulipae* Apt. in Tulip Bulbs on Growth and Development of the Pathogen

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## Abstract

It was showed that gums induced by *Fusarium oxysporum* f.sp. *tulipae* in tulip bulbs applied to mineral Czapek-Dox Broth with Bacto Agar (CzDA) medium, containing sucrose substantially stimulated abundant growth of mycelium and sporulation of the pathogen. Addition of arabinose, xylose and their mixture, sugars occurring in tulip gum polysaccharide, to CzDA medium caused that mycelium was very sparse and sporulation was only slightly stimulated by arabinose. Mycelium growth on mineral CzDA medium without sucrose, was poor and sparse but addition of gum to the medium caused formation of abundant mycelium and increased sporulation of the pathogen. It is possible that polysaccharide of tulip gum may act mainly as elicitor and partially as substrate in regulation of mycelium growth and sporulation of *Fusarium oxysporum* f.sp. *tulipae*.

**Keywords:** tulip gums; arabinose; xylose; *Fusarium oxysporum* f.sp. *tulipae*; growth; sporulation *in vitro*

## INTRODUCTION

In tulip bulbs infected by *Fusarium oxysporum* f.sp. *tulipae*, and also in healthy bulbs stored together with bulbs with symptoms of fusariosis induction of gums take place. It is well known that *F. oxysporum* f.sp. *tulipae* produces considerable quantities of ethylene (KAMERBEEK & DE MUNK 1976). In healthy tulip bulbs treated with ethylene (ethephon) also high amounts of gums is formed. Polysaccharides of tulip gums are mainly consisted of xylose, arabinose and uronic acid(s) (SANIEWSKI *et al.* 2000). Physiological role of gums in plants is unknown. It is believed that gums have a function in limiting the spread of fungal and bacterial pathogens by isolating the infected tissues (BOOTHBY 1983). Addition of gums at concentration 5 mg/cm<sup>3</sup> to all used media [(Czapek-Dox Agar (CzDA), Malt-Extract Agar (MEA) and Potato-Dextrose Agar (PDA)] greatly stimulated mycelium growth of *F. oxysporum* f.sp. *tulipae* and sporulation of the pathogen (SANIEWSKA 2001). On the basis of these results is clear that tulip gums are not antifungal

substances but have evident stimulatory effect on the mycelium growth of *F. oxysporum* f.sp. *tulipae*.

The aim of the present work was to study the effect of tulip gums in mineral Czapek medium, with and without sucrose, on mycelium growth and sporulation of *F. oxysporum* f.sp. *tulipae* *in vitro*. Arabinose and xylose, sugars of the tulip gum polysaccharide, were supplied to the medium for comparison their effects to tulip gums for the pathogen growth and sporulation.

## MATERIALS AND METHODS

The gums induced by *Fusarium oxysporum* f.sp. *tulipae* in tulip bulbs but not contaminated with the pathogen (Figure 1), D(-)-arabinose and D(+)-xylose at final concentration 5 mg/cm<sup>3</sup> were dissolved in 5 cm<sup>3</sup> distilled and sterilized water and added to Czapek-Dox Broth with Bacto Agar – Difco (CzDA), and mineral compounds (without sucrose) of Czapek-Dox Broth with Bacto Agar – Difco (m-CzDA) before sterilization. Five mm diameter plugs taken from 7-day-old culture

Supported by the Committee for Scientific Research (KBN) Poland, Grant No. 0898 P06 2001 20.

of *Fusarium oxysporum* f.sp. *tulipae*, were placed in the middle of 90 mm Petri dishes containing above-mentioned media. Control plates constituted the culture growing on CzDA and m-CzDA without any supplemented compounds. The diameter of *Fusarium oxysporum* f.sp. *tulipae* colony, was measured within an 7-day-incubation at 25°C in darkness.

After 6, 8 and 12 days of mycelium incubation on CzDA supplemented with gums, D-(–)-arabinose and D-(+)-xylose, colonies of *Fusarium oxysporum* f.sp. *tulipae* were used for estimation of the effect of gums on sporulation of the pathogen. From mycelium colony of the pathogen, 12 cm<sup>2</sup> of colony fragments were cut out and transferred to clean Petri dishes containing 10 cm<sup>3</sup> sterilized water. These fragments of colony were smoothed by glass bagette for liberation of spores; after 30 min spores were separated from mycelium using filter paper. Density of spores in 1 cm<sup>3</sup> of suspension was determined under microscope using Bürker's camera. From each of Petri dishes there were analyzed 2 fragments of mycelium.

Five dishes were used for each treatment and the experiment was repeated 3 times.

The data were subjected to an analysis of variance and Duncan's multiple range test at 5% of significance was used for means separation.

## RESULTS AND DISCUSSION

Tulip gums added to CzDA medium containing sucrose substantially stimulated mycelium growth of *Fusarium oxysporum* f.sp. *tulipae*, and the all surface of mycelium was similar abundant (Figure 2). Addition to CzDA medium arabinose, xylose or their mixture greatly inhibited formation of abundant mycelium; xylose in highest degree limited growth of abundant mycelium. However, the total surface of mycelium growth was not inhibited by arabinose, xylose and their mixture but the higher part of surface of mycelium was very sparse (Figure 2). On CzDA medium supplemented with tulip gums was highest sporulation (Figure 3), as was previously documented (SANIEWSKA 2001). Arabinose added to CzDA medium only slightly stimulated sporulation, but xylose and mixture did not affect sporulation in comparison to CzDA medium only.

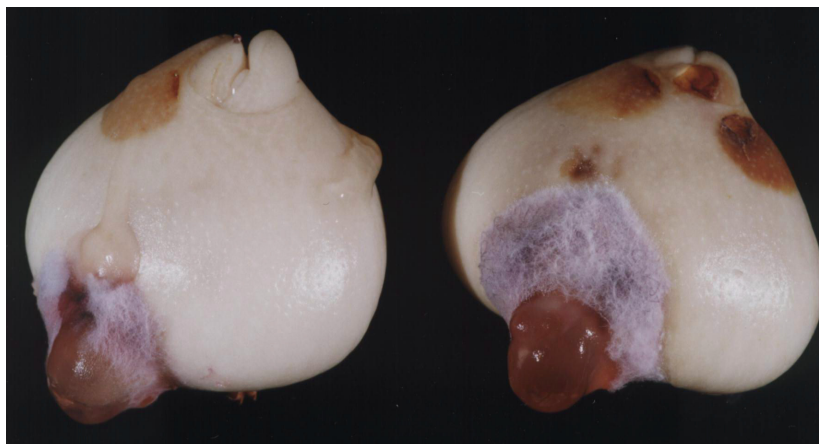


Figure 1. Gums induced in tulip bulbs by *Fusarium oxysporum* f.sp. *tulipae*

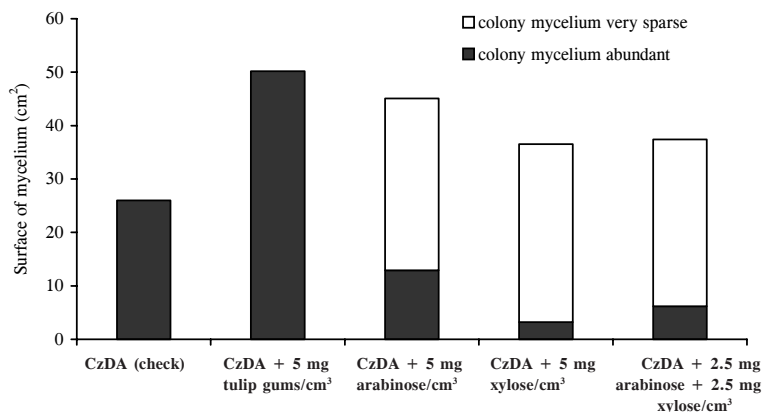


Figure 2. *In vitro* growth of *Fusarium oxysporum* f.sp. *tulipae* cultured on Czapek-Dox Broth with Bacto Agar, supplemented with tulip gums, arabinose, xylose and their mixture (sugars of the tulip gum polysaccharide); observation after six days of incubation

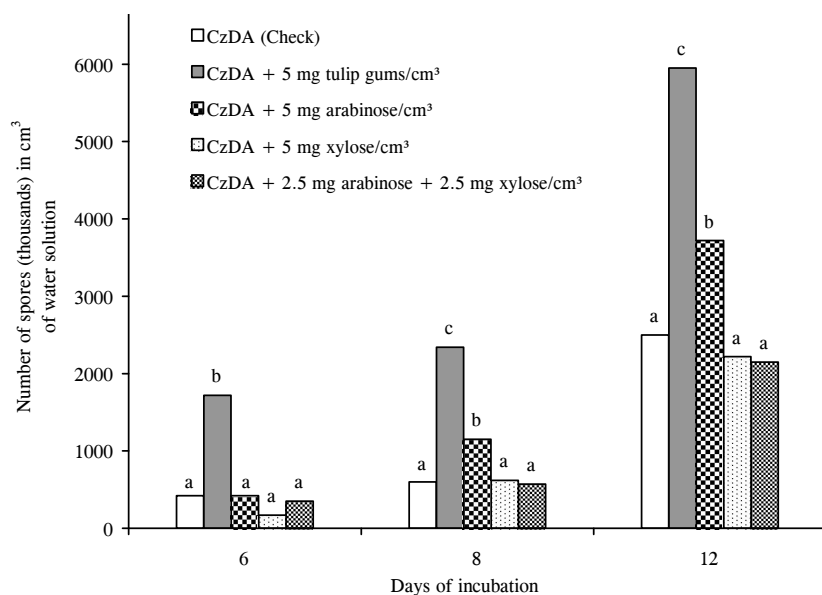
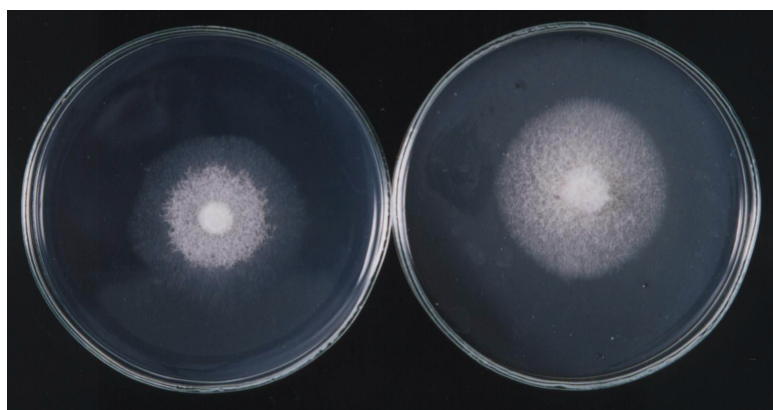


Figure 3. The effect of tulip gums, arabinose, xylose and their mixture on sporulation of *Fusarium oxysporum* f.sp. *tulipae* cultured on Czapek-Dox Broth with Bacto Agar



left – control m-CzDA only  
right – m-CzDA supplemented with gums at a concentration of 5 mg/cm³

Figure 4. Influence of tulip gums on the *in vitro* growth of *Fusarium oxysporum* f.sp. *tulipae* cultured on mineral compounds of Czapek-Dox Broth with Bacto Agar (m-CzDA)

It is interesting that arabinose and xylose, sugar occurring in polysaccharide of tulip gums, did not stimulate mycelium growth and sporulation of *F. oxysporum* f.sp. *tulipae*, in opposite to tulip gums.

Also OCAMB and KOMMEDAHL (1994) showed that dry weights for *F. graminearum*, *F. oxysporum* and *F. proliferatum* were significantly greater on xylan (Sigma oat spelts) than on D-(+)-xylose. Sporulation by either *F. oxysporum* or *F. proliferatum* was great on xylan, whereas sporulation was sparse with xylose substrate. Sporulation by *F. graminearum* was almost nonexistent both on xylans and xylose.

The mycelium growth of *F. oxysporum* f.sp. *tulipae* on mineral CzDA without sucrose, was very poor; but mycelium growing near plugs was abundant and next layers of the mycelium was sparse (Figure 4). However, addition of tulip gums to m-CzDA caused that mycelium surface was similar to m-CzDA but total surface of mycelium was abundant (Figure 4).

Tulip gums also stimulated sporulation of mycelium on m-CzDA in comparison to m-CzDA only (Figure 5).

On the basis of these results can be suggested that polysaccharide of tulip gums which is a glucuronoara-

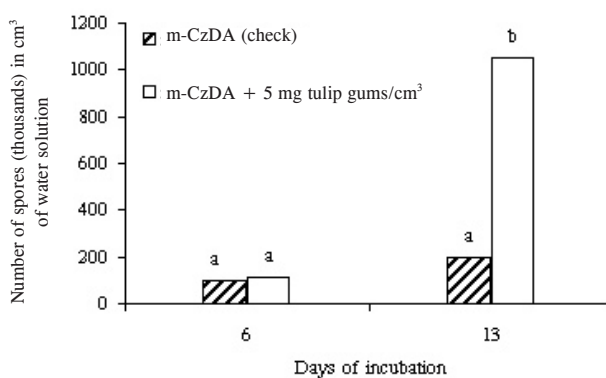


Figure 5. The effect of tulip gums on sporulation of *Fusarium oxysporum* f.sp. *tulipae* cultured on mineral compounds of Czapek-Dox Broth with Bacto Agar

binoxylan may act mainly as elicitor which regulate some processes connected or responsible for mycelium growth and sporulation of *F. oxysporum* f.sp. *tulipae*.

It is well known that different kind of oligosaccharides can function in plants as molecular signals (elicitors) that regulate growth, development and survival in the environment, through elicitation of various physiological and biochemical processes (EBEL & MITHÖFER 1998; CÔTE & HAHN 1994; ALDINGTON *et al.* 1991; DARVILL *et al.* 1992).

The stimulatory role of polysaccharide of tulip gums as substrate on mycelium growth of the pathogen is also probable. Tulip gums contain also many other unidentified compounds which may have stimulatory effect on mycelium growth and sporulation of *F. oxysporum* f.sp. *tulipae*.

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