HOST RESPONSE TO INTRODUCTION OF ANTAGONISTIC YEASTS USED FOR CONTROL OF POSTHARVEST DECAY

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INTRODUCTION

Increasing public concern about the extensive use of synthetic chemicals for the control of plant diseases has led to intensified research efforts world-wide to develop alternative control methods that are safe for humans and the environment. Following the realisation of the risks involved in long term use of pesticides in agriculture, many countries have adapted a policy aimed at minimising the use of synthetic chemical pesticides by establishing vigorous research programs aimed at the development of environmentally sound control measures.

Losses from postharvest spoilage of fruits and vegetables have been managed primarily by applying fungicides. This practice has proved to be the most effective in maintaining a low rate of decay and extending the postharvest life of produce. Consumer concerns about fungicide residues in their food, however, have resulted in pressure to restrict or ban the use of some fungicides on freshly harvested fruits and vegetables. Some countries that import fruits and vegetables do not allow residues of certain fungicides, such as N-[trichloromethyl]thio]-4-cyclohexene-1, 2-dicarboximide (captan). Other countries, such as Japan, allow no residues of any postharvest fungicide on fruits. As a result, most major fungicides used for postharvest diseases control have been forced off the market, withdrawn voluntarily or identified to undergo critical (and costly) recertification.

Even greater impetus has been given to the removal of pesticides (particularly fungicides) from our food chain by a recent American National Academy of Science report
entitled, "Pesticides in the Diets of Infants and Children". This report emphasised that children are at particularly greater risk from synthetic pesticides on our fruits and vegetables because: (a) they consume greater quantities of those commodities containing the greatest amounts of pesticides, and (b) their cellular activity and metabolism makes them more susceptible than adults to synthetic pesticide carcinogenicity (National Research Council, 1993).

In addition to risks associated to human health and the environment, many of the fungicides widely used for the control of postharvest decay have limited effectiveness because of the development of resistance in the pathogens, particularly to benzimidazoles (Eckert and Ogawa, 1985; Eckert and Ogawa, 1988). Thus, their is clearly an urgent need to develop new control methods which are effective, safer than fungicides to human health, and perceived to be so by the public. Physical means have a potential to answer part of this need. The application of various sanitation techniques to reduce inoculum pressure, the use of heat treatments, cold storage, irradiation and controlled and modified atmospheres are some examples. In addition, natural plant products and nonselective fungicides (sodium carbonate, sodium bicarbonate, active chlorine and sorbic acid) are among the approaches currently being evaluated for the control of postharvest diseases (Eckert, 1991). Harvesting and handling techniques that minimise injury to the commodity, along with storage conditions that are optimum for maintaining host resistance (Sommer, 1982; Sommer, 1985), can also aid in suppressing disease development after harvest.

Biological control of postharvest diseases is a relatively new research area. The potential of this approach as a measure of postharvest decay control has been discussed in several reviews (Wilson and Pusey, 1985; Wilson and Wisniewski, 1989; Jeffries and Jeger, 1990; Droby et al., 1991b; Wilson, et al., 1991; Wisniewski and Wilson, 1992; Wilson and Wisniewski, 1994). In the past five years, substantial progress has been made in identifying and developing potential biological alternatives to synthetic fungicides for the control of postharvest diseases of fruits and vegetables (Wilson and Wisniewski, 1994). A number of antagonistic micro-organisms have been discovered which have the potential to effectively control postharvest diseases (Droby and Chalutz, 1994a). Some of this technology has been patented and commercial products such as Aspire™ (Ecogen Corporation, Langhorne, PA, USA), Biosave 10 and Biosave 11 (Ecoscience Inc., Worcester, MA, USA) have been registered for commercial use.

In this review, recent findings regarding the use of epiphytic, naturally occurring yeasts for control ofpostharvest diseases of fruits and vegetables will be discussed. Special emphasis is given to the interactions taking place at surface wounds - the site of infection and interaction between the antagonist, the host tissue and the pathogen. The importance of these interactions in the mechanism of action of yeast antagonists is also discussed.

THE ROLE OF EPIPHYTIC MICROFLORA IN FRUIT RESISTANCE TO PATHOGENS

It is assumed that biocontrol of plant diseases occurs naturally on aerial plant surfaces and is the main reason why crops are not entirely destroyed during their cultivation. This assumption is supported by work with epiphytic populations on leaf surfaces (Blakeman and Fokkema, 1982; Andrews, 1990; Andrews, 1992; Fokkema, 1992).

We are accustomed to thinking of fruit resistance to pathogen infection and development in terms of the presence of various resistance mechanisms such as pre-formed antifungal compounds, phytoalexins, lignin formation and deposition of cell wall materials (Brown and Barmore, 1983; Brown, 1989; Hahlbrock and Scheel, 1989; Sequeira, 1990).