BIОLOGICAL CONTROL OF БOTRYTIS CINEREA

James J. Marois
Department of Plant Pathology
University of California
Davis, California 95616, U.S.A.

INTRODUCTION

Botrytis cinerea is a ubiquitous pathogen effecting a wide range of crops whenever the environmental conditions are conducive for disease development. The major factors limiting the epidemic are the requirements of water and nutrients for germination of the conidia. Through cultural practices, it is possible to increase the evaporative potential of the plant surface so that the period of moisture is reduced (Thomas et al., 1988). One way to reduce exogenous nutrients is to increase the competition by modifying the microbial community on the plant surface.

Microbial communities appear to develop succession and stability functions similar to those described for terrestrial ecosystems. Andrews and Rouse (1982) applied the concept of r- and K-selected species to microbial plant pathogens. Botrytis cinerea, due to its rapid life cycle, broad host range, and growth usually limited by abiotic factors, functions as an r-selected species.

Usually, r-selected species are associated with low diversity systems; they often rapidly colonize habitat after a perturbation has disturbed the original microbial community. With B. cinerea, the perturbations are often related to wounds, ripening fruit, or new plant tissue which is not yet colonized. This limited ability to grow on plant parts which are already colonized is typical of many saprophytic and pathogenic microbes.

It was hypothesized that biological control of B. cinerea could be achieved by establishing saprophytic microbial populations on plant surfaces which inhibit the activity of the pathogen by increasing the competition for available nutrients and possibly for infection sights.

MATERIALS AND METHODS

The first pathosystem studied was Botrytis blight of rose. The disease is a major limiting factor in rose production, especially in the newer, higher-energy efficient glasshouses in which air exchange is minimized. It is also a severe post-harvest disease and a major limiting factor affecting vase life of long-stem roses.
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Disease Incidence</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Petals</td>
<td>Flowers</td>
<td></td>
</tr>
<tr>
<td>B. cinerea alone</td>
<td>19.6% a</td>
<td>82.6% a</td>
<td></td>
</tr>
<tr>
<td>Coryneform bacterium and B. cinerea</td>
<td>6.4% b</td>
<td>73.7% a</td>
<td></td>
</tr>
<tr>
<td>Exophiala jeanselmei and B. cinerea</td>
<td>3.6% b</td>
<td>44.0% b</td>
<td></td>
</tr>
</tbody>
</table>

* Percentages in same column with the same letter are not significantly different by Duncan's Multiple Range Test.

Isolations of the potential biological control agents, made from several rose varieties (Redmond et al., 1987), resulted in a collection of several hundred fungi and bacterial isolates which could become established on rose petals. The 80 most common yeast and bacterial isolates were tested for their ability to reduce disease. As with all initial biological control investigations, the objective was to develop a screening procedure which was realistic in time and cost but also simulated the actual disease conditions. Individual rose petals were treated with both the potential control agent and the pathogen. The petals were then kept at 95% relative humidity in closed containers at 20°C. After 2 days the number of lesions per petal and the area of the petal diseased were determined. The two most promising isolates, a black yeast Exophiala jeanselmei and a coryneform bacterium controlled disease as well as the standard chemical application of iprodione. These isolates were further tested for their ability to reduce disease under greenhouse conditions. Population studies were also conducted to determine the ability of the control agents to colonize the rose petals in either the presence or absence of the pathogen.

RESULTS

Roses treated with the antagonists had fewer petals with lesions than roses treated with the pathogen alone. The application of E. jeanselmei reduced the incidence of diseased flowers significantly, from 82.6% to 44.0%. Both the coryneform bacterium and E. jeanselmei reduced the incidence of diseased petals (Table 1). Severity of disease, measured as the percentage of petal area covered by lesions, was not affected significantly by the treatments, and ranged from 13% to 31%.

In the second series of experiments, the number of lesions that occurred on rose petals was reduced significantly with applications of E. jeanselmei at $10^6$ spores/ml (Table 2). The population density of E. jeanselmei increased when applied alone and in combination with the pathogen.

DISCUSSION

The biological control of B. cinerea is dependent upon the ability of the antagonist to outcompete the pathogen before interaction takes place. However, the effect is two-sided, in that not only does the antagonist reduce the population of the pathogen, but the presence of the pathogen also reduces the population of the antagonist.