UTR sequence also differed in only two nucleotides (nt) in both of these isolates. Alternately, the capsid sequences of PVY^N isolates from various countries showed differences ranging from 0 to 12 aa. Similarly, the differences in 3′ UTR sequences ranged from 1 to 49 nt. Y^N-138 was closely related to N-27 based on 3′ UTR, and the basis of capsid sequences. The minimal nt and aa differences in both N-27 and Y^N-138 isolates resulted in different secondary structures of respective RNAs and capsid proteins and may be responsible for the differential symptom expression.

The complete nucleotide sequence of a common strain of potato virus Y (PVY^O). Mathuresh Singh and Rudra P. Singh. *Agriculture and Agri-Food Canada, Research Centre, P.O. Box 20280, Fredericton, New Brunswick E3B 4Z7.*
The complete nucleotide sequence of the common strain PVY^O (isolate PVY^O-139) from Eastern Canada was determined since it has not been previously characterized. It consists of 9698 nucleotides (nt). The sequence contains one large open reading frame of 3061 amino acids (aa), an untranslated region (UTR) of 184 nt at the 5′ end and an UTR of 331 nt at the 3′ end. The nt sequence and the predicted aa sequence of the polyprotein of PVY^O-139 were compared with partial and complete sequences of other PVY^O and PVY^N strains. The overall sequence identity of PVY^O-139 ranged from 96–97% with all PVY^O strains and to a previously identified PVY^N strain. This provides support that the latter isolate is actually a PVY^O isolate. The sequence identity with true PVY^N strain (Hungarian isolate) was less than 88%. PVY^O-139 has identical proteolytic cleavage sequences to previously described partial sequences of PVY^O strains.

Changes in the plant endomembrane system associated with callose deposition during the infection of cowpea (*Vigna unguiculata*) by the cowpea rust fungus (*Uromyces vignae*). D. Škalamera and M.C. Heath. *Department of Botany, University of Toronto, Toronto, Ontario M5S 3B2.*
Electron microscopy and stereological analysis of cowpea (*Vigna unguiculata*) leaf tissue infected with the cowpea rust fungus (*Uromyces vignae*) was used in combination with inhibitor treatments to evaluate changes in plant membranes associated with callose synthesis that typifies an unusual form of rust resistance. An increase in surface of plant endomembranes was observed in cells containing fungal haustoria regardless of whether they were synthesizing callose or not. In callose-synthesizing cells, the surface density of smooth membranes was increased compared to both uninfected and infected cells that were not synthesizing callose. Cytoplasmic regions adjacent to the haustorium in callose nonsynthesizing cells had an increase in rough endoplasmic reticulum (ER). This increase was more pronounced in the susceptible cultivar than in the resistant cultivar in which callose synthesis was inhibited by treatment with tunicamycin. Inhibiting callose deposition in the resistant cultivar did not effect ultrastructural signs of incompatibility but did allow formation of the haustorial neckband. Our data suggest that both callose synthesis and fungal presence are associated with de novo synthesis of membranes and that callose deposition may require an increase in smooth membrane surface of uncertain origin, while the establishment of a haustorium may be dependent on increased synthesis of rough ER in the plant cell.

* **Differentiation of *Sphaeropsis sapinea* morphotypes based on genetics and host response.** G.R. Stanosz, D.R. Smith, and J. Blodgett. *Department of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706, USA.*
Sphaeropsis sapinea (Fr.:Fr.) Dyko & Sutton in Sutton (syn. *Diplodia pinea*) causes shoot blight and cankers on conifers throughout the world, including *Pinus* spp. grown in the north-central United States and Canada. **A** and **B** morphotypes previously have been differentiated by culture morphology and spore size, although differences are not consistent. These morphotypes also have been suggested to vary in virulence and geographic distribution. Random amplified polymorphic DNA markers (RAPDs) were obtained for 16 **A** and 16 **B** morphotype isolates of *S. sapinea* collected in Michigan, Minnesota, and Wisconsin from *Pinus banksiana, P. nigra, P. resinosa, P. strobus, and P. sylvestris.* Relationships among isolates were determined using both cluster analyses and parsimony methods. All analyses placed the **A** morphotype isolates in one group and the **B** morphotype isolates in another group. Multiple isolates of each morphotype were screened for virulence by inoculation into wounded shoots of potted *P. banksiana* and *P. resinosa* seedlings. Both host species tended to be more severely affected by **A** isolates than by **B** isolates, and this difference was very pronounced for red pine. These results indicate that the morphotypes comprise two genetically distinct populations with differences in virulence. Accurate identification of the isolates present on particular hosts or in a given geographic area will aid in the assessment of risk of severe damage and selection of appropriate management strategies.

Epiphytic growth and survival of *Tilletiopsis pallescens*, a potential biological control agent of *Sphaerotheca fuliginea*, on cucumber leaves. E.J. Urquhart and Z.K. Punja. *Centre for Pest Management, Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia V5A 1S6.*
Powdery mildew of cucumber, caused by *Sphaerotheca fuliginea*, is a major disease in greenhouses throughout Canada. A yeast-like fungus, *Tilletiopsis pallescens*, exhibits strong antagonism towards *S. fuliginea* sporulation under commercial greenhouse conditions. A blastospore suspension of the yeast was applied to healthy cucumber leaves and maintained in a growth chamber at 70% or 90% relative humidity (R.H.) and 25°C. The effect of the two R.H. on growth and survival of *T. pallescens* was studied using S.E.M. and leaf plating. Following application, *Tilletiopsis* colonies developed as mycelium within 3 days and ballistospores were produced after 7 days at 90% R.H. At 70% R.H., development of mycelium following spore germination was sparse, with very small colonies at 3 days and no further growth after longer incubation times. Population density of the yeast was assayed at 1 and 5 days following application. *Tilletiopsis* colonies declined rapidly from 3250 to 15 colonies/leaf when maintained at 70% R.H.; at 90% R.H., the population density was 9900 and 4700 colonies/leaf at 1 and 5 days. Formulations of blastospore suspensions with oil-emulsifier combinations were tested to improve survival at reduced R.H. The addition of light paraffin oil-lecithin (1%-0.1%, v/v) enhanced *Tilletiopsis* survival; at 60% R.H., the density was 6800 and 285 colonies/leaf at 1 and 5 days. Addition of light paraffin oil-Tween 80 was found to be less effective.

Potential and problems of developing bacterial biocontrol agents. R.S. Utkhede. *Agriculture and Agri-Food Canada, Research Centre, Summerland, British Columbia V0H 1Z0.*
A few plant pathogens have been controlled successfully by commercial formulations of biological agents, but many attempts to develop biocontrol formulations have met with problems in practice. Problems in the development of bacterial biological control agents for plant pathogens can be identified as research or regulatory. Problems created by regulatory agencies involve lengthy procedures to obtain permits for shipments/importation of cultures, research permits to test bio-