INTRODUCTION

*Inula viscosa* (L.) Aiton (Compositae) is a perennial plant native of the Mediterranean Basin. In folklore medicine it is used for therapeutic purposes (LEV & AMAR 2000). Water extracts of *I. viscosa* were shown to exhibit antifungal activity in vitro (QASEM et al. 1995; MAOZ & NEEMAN 1998) and organic solvent extracts were shown to be antibacterial (DEBAT 1981). *Inula viscosa* leaf powder and costic acid derived from it were reported to be antihelmintic (OKA et al. 2001).

The purpose of this study was to examine the protective properties of *I. viscosa* extracts against foliar fungal plant diseases and to produce formulations suitable for application in the field.

MATERIAL AND METHODS

Shoots (stem and leaves) of 0.3–0.4 m long were harvested from naturally-grown plants in July. They were allowed to dry in the open air for several days and then crushed and extracted for 30 min at room temperature by shaking in various solvents of increasing polarity (water to n-hexane) at a ratio of 1:10 (w/w, plant/solvent). The plant material was then discarded by filtration and the extract was vacuum-dried at 37°C. The obtained residue was weighed and dissolved in acetone. Acetone solutions (0.4% w/v) of the various extracts were sprayed onto the leaf surfaces of test plants. Pure acetone was applied to control plants (acetone caused no damage to plants due to its instant evaporation). The protective effects of the extracts were tested in several pathosystems (see Results). Plants were incubated in growth cabinets (usually 20–22°C, 12 h light/day) and disease was recorded at 7–10 days post inoculations.

Concentrated extracts were applied to TLC plates (Kissegel-60, Merck) and ran in chloroform:methanol (9:1, v/v). Plates were developed with iodine vapor or sprayed with spore suspension of *Colletotrichum lagenarium* to reveal the presence of antifungal compounds.

For field experiments, crushed dry shoots were extracted in acetone: n-hexane (10:1, w/w) mixture. After evaporation of the solvents the paste residue was emulsified with the aid of surfactants so that a stable emulsion was obtained. The EC formulation contained 37.5% *I. viscosa* paste. The formulated product was tested in the field against late blight in potato and tomato and downy mildew in grapes.

RESULTS AND DISCUSSION

Water extracts were found to poorly protect plants against fungal diseases, whereas extracts made with organic solvents were highly effective (Table 1). Thus,
extracts made with *n*-hexane, chloroform, acetone, ethylacetate, ethanol or methanol were effective in protecting potato against *Phytophthora infestans*, cucurbits against *Pseudoperonospora cubensis*, *Sphaerotheca fulinginea* and *Botrytis cinerea*, wheat against *Erysiphe graminis* f.sp. *tritici*, grape against *Plasmopara viticola* and sunflower against *Puccinia helianthi*. It thus appeared that *I. viscosa* extracts were effective against oomycetes, *Ascomycetes* and *Basidiomycetes*.

TLC studies revealed the presence of at least 11 compounds in e.g. acetone extract, of which at least 7 compounds were antifungal (Figure 1). Cosmetic acid and iso-cosmetic acid, which were reported to control root-knot nematodes (OKA et al. 2001) were amongst these 7 compounds.

EC (emulsion concentrate) formulations were effective in controlling these diseases in the field: late blight in potato, late blight in tomato and downy mildew in grapes.

Our data suggest that *Inula viscosa* is a useful source for antifungal products. Extracts made with organic solvents were successfully formulated into EC products. These EC products exhibited effective disease control under field conditions.

**References**


