

## EFFECT OF LUPIN CYCLITOLS ON PEA APHID PROBING BEHAVIOUR

Bożena Kordan<sup>1\*</sup>, Lesław B. Lahuta<sup>2</sup>, Katarzyna Dancewicz<sup>3</sup>, Wojciech Sądej<sup>1</sup>, Beata Gabrys<sup>3\*</sup>

<sup>1</sup>Department of Phytopathology and Entomology, University of Warmia and Mazury in Olsztyn  
Prawocheńskiego 17, 10-718 Olsztyn, Poland

<sup>2</sup>Department of Plant Physiology and Biotechnology, University of Warmia and Mazury in Olsztyn  
Oczapowskiego 1A, 10-718 Olsztyn, Poland

<sup>3</sup>Department of Botany and Ecology, University of Zielona Góra, Szafrana 1, 65-516 Zielona Góra, Poland

Received: November 4, 2010

Accepted: March 2, 2011

**Abstract:** The cyclitols: D-pinitol, D-chiro-inositol are naturally present in the tissues of *Lupinus angustifolius*. The effect of these cyclitols on the behaviour of the pea associated clone of *Acyrtosiphon pisum* during various stages of probing was studied. The main stage of probing studied was the stylet penetration in mesophyll and vascular bundle. D-pinitol, D-chiro-inositol and their mixture were exogenously applied to pea *Pisum sativum* explants and the aphid probing behaviour was evaluated using the Electrical Penetration Graph technique (EPG). Feeding of peas with cyclitols at a concentration of 10 mM, caused a selective accumulation of D-pinitol and D-chiro-inositol in stems, leaf petioles, and leaf blades. In aphid bodies, both cyclitols were traced, respectively, to the host plant treatment. The new cyclitols in pea tissues did not significantly affect the total duration and frequency of aphid activities during probing in peripheral as well as vascular tissues. However, the aphid behaviour on cyclitol-treated plants as compared to their behaviour on the control was slightly altered. Non-probing and probing in mesophyll prevailed among aphid activities during the initial period of stylet penetration. Aphids on D-pinitol+D-chiro-inositol-treated plants reached phloem vessels relatively later than aphids on the control and D-chiro-inositol plants. There were recurrent switches between E1 (salivation) and E2 (sap ingestion) patterns in some aphids during the phloem phase on D-pinitol and D-pinitol+D-chiro-inositol – treated plants. This may reflect difficulties in the uptake of the phloem sap, and point to lupin cyclitols as being responsible, at least in part, for the rejection of *L. angustifolius* as a host plant by the pea clone of *A. pisum*.

**Key words:** D-pinitol, D-chiro-inositol, *Pisum sativum*, *Lupinus angustifolius*, *Acyrtosiphon pisum*, chemical ecology, Electrical Penetration Graph Technique (EPG)

## INTRODUCTION

Cyclitols, the hydroxylated cycloalkanes biosynthetically derived from glucose, occur in all living cells and express a broad spectrum of biological activity. They participate in many cellular processes including membrane biogenesis and dynamics, signal transduction, ion channel physiology, osmoregulation, and antioxidation (Bieleski 1994; Loewus and Murthy 2000; Merchant *et al.* 2006; Michell 2008) as well as in environmental interactions, *e.g.*, in conferring salt tolerance in plants and plant response to water stress (Arndt *et al.* 2004; Das-Chatterjee *et al.* 2006; Merchant *et al.* 2006). Cyclitols may also be involved in plant-insect relationships. However, this aspect of their biological activity has rarely been studied. Glendinning *et al.* (2000) found that myo-inositol was vital in regulating feeding in tobacco hornworm *Manduca sexta* caterpillars by counteracting the inhibitory effects of caffeine. Dreyer *et al.* (1979) demonstrated that pinitol was a larval growth inhibitor for *Helicoverpa zea* (Boddie) in soybeans *Glycine max* (L.) Merr.

Leguminous plants (Fabaceae) contain an exceptionally high amount of cyclitols compared to the majority of plant species: in some seeds, these sugar alcohols may make up to 30% of the total content of soluble carbohydrates (Szczeciński *et al.* 2000). Among a variety of herbivores that feed on legumes, the pea aphid *Acyrtosiphon pisum* (Harris 1776) (Homoptera: Aphididae) is of special character and importance. It is a well-known almost worldwide oligophagous species that infests leguminous plants and transmits over 30 virus diseases (Blackman and Eastop 1985). Interestingly, *A. pisum* is a complex of subspecies, races, and clones with different host preferences and different abilities to transmit viruses (Blackman and Eastop 2007; Katis *et al.* 2007). Moreover, the pea aphid races that live sympatrically on closely related host plants are reproductively isolated from one another (Via 1999). In Poland, the pea aphid populations are the most abundant on the pea *Pisum sativum* L., broad bean *Vicia faba* L., lentils *Lens culinaris* Medik., lucerne *Medicago sativa* L. and clover *Trifolium* spp. Due to the rising economic importance of lupins *Lupinus* spp., *A. pisum* is becoming a threat

\*Corresponding address:

b.gabrys@wnb.uz.zgora.pl, bozena.kordan@uwm.edu.pl













