

Application of methyl jasmonate reduces growth but increases chemical defence and resistance against *Hylobius abietis* in Scots pine seedlings

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Abstract

Scots pine (*Pinus sylvestris* L., Pinaceae) produces a terpenoid resin which consists of monoterpenes and resin acids that offer protection against herbivores and pathogen attacks. Methyl jasmonate (MJ) is a potential plant elicitor which induces a wide range of chemical and anatomical defence reactions in conifers and might be used to increase resistance against biotic damage. Different amounts of MJ (control, 10 mM, and 100 mM) were applied to Scots pine to examine the vigour, physiology, herbivory performance, and induction of secondary compound production in needles, bark, and xylem of 2-year-old Scots pine seedlings. Growth decreased significantly in both MJ treated plants, and photosynthesis decreased in the 100 mM MJ treated plants, when compared to 10 mM MJ or control plants. The large pine weevil (*Hylobius abietis* L.) (Coleoptera: Curculionidae) gnawed a significantly smaller area of stem bark in the 100 mM treated plants than in the control or 10 mM treated plants. The 100 mM MJ treatment increased the resin acid concentration in the needles and xylem but not in the bark. Furthermore, both MJ treatments increased the number of resin ducts in newly developing xylem. The changes in plant growth and chemical parameters after the MJ treatments indicate shifts in carbon allocation, but MJ also affects plant physiology and xylem development. Terpenoid resin production was tissue-specific, but generally increased after MJ treatments, which means that this compound may offer potential protection of conifers against herbivores.

Introduction

Large pine weevil (*Hylobius abietis* L.) (Coleoptera: Curculionidae) adults emerge from tree stumps and feed on the stem phloem and bark of young seedlings, causing severe problems in cultivated clear-cut areas of Scots pine and Norway spruce (Örlander & Nilsson, 1999). Heavy infestations of this insect can result in the widespread loss of young seedlings for several years after planting. Both sexes of large pine weevil beetles are attracted by volatile compounds, such as the α -pinene and β -pinene emitted by fresh conifer stumps left during clear felling (Zagatti

et al., 1997). In Europe, insecticides are commonly used to limit large pine weevil damage. There is a need for alternative chemical or mechanical methods to prevent *H. abietis* damage, as the commonly used insecticide, permethrin, was prohibited in the European authorities on 31 December 2003.

Conifers possess chemical defences, such as the production of terpenoid resins or phenols, that help to reduce attacks by insects and pathogens (Mattson et al., 1988). Resins are thought to be toxic or repellent compounds to herbivores, but they can also act as attractants and feeding stimulants (Gershenzon & Croteau, 1991). Methyl jasmonate (MJ) has been found to be a potential plant elicitor which induces wide plant defence reactions in conifers, such as the formation of traumatic resin ducts, the accumulation of mono- and diterpenes, induction of enzyme activities of terpene synthases, or the formation of additional

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