

TENTATIVE BIOLOGICAL CONTROL OF CONIFER SEED INSECTS USING PARASITOIDS

CASE STUDY OF THE DOUGLAS-FIR SEED CHALCID, *MEGASTIGMUS SPERMOTROPHUS* WACHTL, INVASIVE IN WESTERN EUROPE

The Douglas-fir seed chalcid, *Megastigmus spermotrophus* Wachtl (Hymenoptera: Torymidae), was probably introduced during the last part of the 19th century from Western North America to Europe along with seeds of its host, Douglas-fir (*Pseudotsuga menziesii*). At present, the chalcid is widespread throughout the plantations and seed orchards of Douglas-fir in Europe, and severely impacts seed orchards. Because the use of pesticides is less and less accepted in Europe, two European teams from France (INRA Orléans, Dr. A. Roques) and Belgium (Université Libre de Bruxelles; Drs. A.C. Mailleux and J.C. Grégoire) in collaboration with Canadian Forestry (J.J. Turgeon, Sault Ste Marie) and , are considering the possibilities of a classical biological control, by using parasitoids originating from the chalcid's native range.

In the native range of Western North America, only few data existed about possible parasitoids due to both the minor impact of seed chalcids compared to that of other cone insects attacking Douglas-fir and to the way of collecting seeds from ripe cones. In Europe, a pteromalid, *Mesopolobus spermotrophus* Hussey (Hymenoptera: Pteromalidae), has been recorded since the 1950s, but it seemed to have a limited impact on the chalcid populations. Because no parasitoids were previously observed over billions of chalcid-infested seeds collected when the cones are still closed we hypothesized that the parasitoids may attack the chalcid larvae only when the cones begin to open and the seeds become easily accessible. Cone collections were thus carried out during autumn and winter throughout the native American range of the Douglas-fir seed chalcid during 1998-2003. A total of 132 natural stands of Douglas-fir were sampled in British Columbia, Washington, Oregon, Utah, California, Colorado and New Mexico, and additional collections were obtained from seed orchards of British Columbia by the way of Robb Bennett (B.C. Ministry of Forests, Victoria B.C.). In addition, seed traps were also designed to offer large numbers of chalcid-infested seeds to parasitoids in native stands in Oregon, California and Utah. Finally, all seeds were submitted to X-ray analysis, and about 23000 chalcid-infested seeds could be individually reared in France.

A total of 4 chalcid species emerged from these seeds. Apart *Mes. spermotrophus*, they corresponded to an other *Mesopolobus* species, new for science, which is currently in the process of description as *M. americanus* Dzhakomnen and Roques, an eupelmid, *Brasema* nr. *brevicauda*, and an eurytomid, *Eurytoma* sp. Laboratory rearings proved that *Mes. americanus* is a primary parasitoid of *M. spermotrophus* whilst the status of the two other species remained uncertain. A few specimens of the three species were observed in Belgian plantations but not in France suggesting possible accidental introductions in the former country. All these species are capable of prolonged diapause over 2 years at least such as *Megastigmus*.

During summer 2002, 240 specimens of *Mes. americanus* (120 males, 120 females) originating from British Columbia were released in four plantations surrounding a Douglas-fir seed orchard of south-western France, which is every year heavily infested by *Megastigmus spermotrophus* arriving from the close-by plantations. The parasitoids were not released within the orchard because all the cones are collected every year in that place and no resident population of parasitoid could thus develop. A mathematical model has been previously designed to select the plantations which are the most contributing ones to the annual invasion of the orchard by *Megastigmus* (Jarry et al., Can. Entomol. 1997). The release was apparently successful because we found by winter 2003 that 8 up to 15% of the chalcids were parasitized by *Mes. americanus* in the four plantations used for release. However, the parasitoid dispersal yet remained limited because *Mes. americanus* was found in only two additional plantations, including the seed orchard (1% of parasitism) over a total of 40 surveyed. It has not been possible to carry out a new release in 2003 because parasitoid rearings were affected by the severe heat which occurred in central France during summer 2003 but 160 *Mes. americanus* from the same Canadian origin as these of 2002 could be released in summer 2004 in the same four plantations. The cone collections planned during autumn 2005 will tell whether the released parasitoids could contribute or not to decrease the population density of *Megastigmus* in the seed orchard.

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