



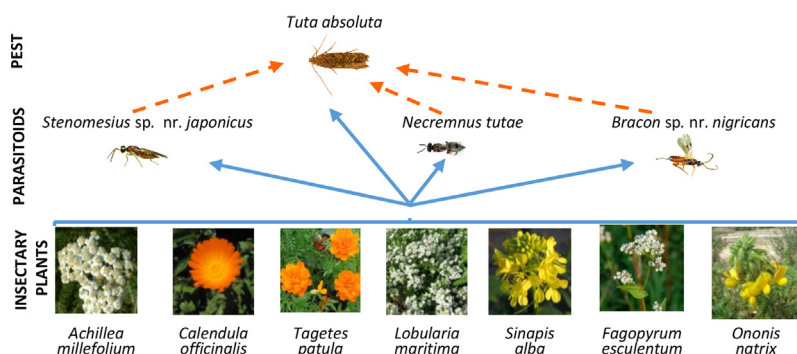
Selection of flowering plants to enhance the biological control of *Tuta absoluta* using parasitoids

Judit Arnó*, Marta F. Oveja, Rosa Gabarra

IRTA, Ctra. Cabrils km. 2, Cabrils, Spain



GRAPHICAL ABSTRACT



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ABSTRACT

The tomato moth *Tuta absoluta* is an important pest of tomato crops. To enhance biological control services, our study aims to ascertain the effect of potential insectary plants (*Achillea millefolium*, *Calendula officinalis*, *Fagopyrum esculentum*, *Lobularia maritima*, *Ononis natrix*, *Sinapis alba*, and *Tagetes patula*) as nutrient-providers to facilitate the installation of *T. absoluta* parasitoids (*Necremnus tutae*, *Stenomiesius nr. japonicus*, and *Bracon nr. nigricans*) without encouraging the pest. Our results showed that different flowers provide different benefits in terms of survival and egg load for different parasitoid species, and that the benefit of these flowers for *T. absoluta* females was low. Being *N. tutae* the most abundant and widespread parasitoid, selection of flowers might target this parasitoid. However, the provision of a flower mixture may be more advantageous than selecting only one species because they may contribute to enhance a broader guild of parasitoid wasps.

1. Introduction

The tomato moth *Tuta absoluta* Meyrick (Lepidoptera: Gelechiidae) was first detected in Spain in 2006 (Urbaneja et al., 2007) and from there, it spread quickly across Europe, the Mediterranean area, Asia and Africa causing major damage to tomato crops (Campos et al., 2017; Desneux et al., 2010, 2011; Urbaneja et al., 2013). Biological control of pests in tomato both in greenhouse and outdoor crops is based mainly

on the use of the predatory mirid bugs *Macrolophus pygmaeus* (Rambur) and *Nesidiocoris tenuis* Reuter (Hemiptera: Miridae) (Albajes et al., 2003; Gabarra et al., 2008; Jaworski et al., 2015; Shaltiel-Harpaz et al., 2016; Urbaneja et al., 2012). These predators are effective controlling *T. absoluta* by feeding on the eggs of the moth, but they have a poorer performance feeding on larvae (Arnó et al., 2009; Urbaneja et al., 2009). To complement the activity of these predators larval parasitoids may be of great help. In the Mediterranean area, numerous species of

* Corresponding author.

E-mail address: judit.arno@irta.cat (J. Arnó).

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