ECOLOGICAL FACTORS AFFECTING THE ESTABLISHMENT OF THE BIOLOGICAL CONTROL AGENT *Gargaphia decoris* DRAKE (HEMIPTERA: TINGIDAE)

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ABSTRACT

The Brazilian lace bug (*Gargaphia decoris* Drake (Hemiptera:Tingidae)) was released in New Zealand in 2010 for the biological control of the invasive weed woolly nightshade (*Solanum mauritianum* Scopoli (Solanaceae)). Currently there is scarce information about the potential effect of ecological factors on the establishment of this biological control agent. This study investigated: 1) the effect of maternal care and aggregation on nymphal survival and development; 2) the effect of temperature, photoperiod and humidity on *G. decoris* performance; and 3) the effect of light intensity on *S. mauritianum* and *G. decoris* performance.

Maternal care and aggregation are characteristic behaviours of *G. decoris*. These behaviours have an adaptive significance for the offspring and are key determinants for the survival of the species under natural conditions. Maternal care is reported to increase the survival and development of offspring under field conditions, and higher aggregations to increase the survival of the offspring. However, in this study, maternal care negatively affected the survival and development of the offspring, and higher aggregations had no significant impact on offspring survival. The availability of host plants under laboratory conditions may have influenced the expression of these behaviours.

Climate is a factor that constrains insect development and therefore establishment. In this study, temperature affected the survival, nymphal development, life cycle, adult longevity, female reproductive success (i.e. total number of eggs, number of eggs laid per female, number of egg batches, number of eggs per batch, pre-oviposition period, percent females that oviposited successfully, number of eggs in the first batch and percentage of eggs that hatched from the first batch) and population growth parameters (i.e. life table). Temperatures between 20 – 25 °C were the optimal temperatures for *G. decoris* establishment. Photoperiod affected the mean percentage of egg hatch (i.e. emergence of nymphs in egg batch collected from colony) and total nymphal survival (i.e. egg to adult emergence), adult longevity and population growth parameters. The photoperiod 16L:8D was the optimal photoperiod for insect establishment. Humidity affected the mean percentage of egg hatch, adult longevity and population growth parameters. *G. decoris*

population growth was highest at 70 ± 10% RH but the population growth was faster at 50 ± 10%.

The CLIMEX model predicted that *G. decoris* could occupy broader regions not only on its native range (i.e. Brazil and Argentina) but also other regions where *S. mauritianum* is considered invasive (i.e. New Zealand and South Africa). *G. decoris* is predicted to be able to establish optimally in most of New Zealand North Island, except in regions with altitudes higher than 1300 meters above sea level. Most of the South Island is considered unsuitable for *G. decoris* establishment, except parts of the West Coast, Nelson and the Tasman region, which are predicted to be moderately to marginally suitable.

Light intensity and plant age (i.e. day of harvest) affected host plant quality and had an indirect impact on insect establishment. Light intensity and plant age affected key physiological, morphological and defensive traits of *S. mauritianum.* Three compounds appeared to be involved, and were positively identified as glycoalkaloids: α-solamargine/β-solamarine, solauricine/solasonine, and unknown-954. The reproductive performance of *G. decoris* was affected because females avoided ovipositing on unshaded plants. The presence of trichomes and an increase in concentration of glycoalkaloids in the second harvest affected the nymphal performance and was reflected in adults, which had smaller bodies and wings.

The results of my study have implications for using the Brazilian lace bug *G. decoris* in biological control programmes. The ecological factors included in this study work synergistically rather than independently and are important to consider when deciding the best locations in which the insect could be liberated.

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