Rev. Chilena Ent.
2000, 26: 93 - 95

DO HOST PLANT TRAITS AND GALLING INSECTS AFFECT THE ABUNDANCE OF *ISSUS* SP. ON *COLLIGUAJA ODORIFERA* MOL. ALONG AN ALTITUDINAL GRADIENT?[1]

WILFREDO L. GONZÁLES[2] AND ROSARIO FERNÁNDEZ[3]

ABSTRACT

The association between the abundance of the jumping Hemiptera *Issus* sp. and host plant traits (fruits, flowers, buds, plant size and cover) and galling insects in *Colliguaja odorifera* Mol. along altitudinal gradient, was evaluated. Two contrasting sites were studied: low (850 m.a.s.l.) and high (1150 m.a.s.l.). At the low site, the number of fruits and buds, cover and plant size were larger (t-test, $P<0.05$, for each trait) than in the high site. The number of galling insects and isids was higher in the low site. The ratio of isids to galls was not significantly different in low and high sites. The ratio of fruits to isids was significantly larger in the low site (t- test, $P<0.05$) than in the high site. Using multivariate approaches in each site, in the low site plant cover was significantly ($F_{2,97}=4,89$, $P<0.01$) and positively associated with isid abundance. Whilst at the high site the number of fruits was significantly ($F_{3,36}= 3.18$, $P<0.05$) and positively associated with isid abundance.
Key words: *Colliguaja odorifera*, Issidae abundance, galling insects, altitudinal gradient.

RESUMEN

Se evaluó la asociación entre la abundancia de *Issus sp.* y el número de insectos agalladores y los atributos de la planta hospedera *Colliguaja odorifera* Mol. (frutos, flores, yemas, cobertura y dimensiones de la planta), a lo largo de un gradiente altitudinal. Se estudió dos zonas contrastantes: una baja (850 msnm) y otra alta (1150 msnm). En la zona baja, el número de frutos y yemas, y la cobertura y dimensiones de la planta fueron mayores (t-test, $P<0.05$ para cada carácter) que en la zona alta. El número de insectos agalladores e ísidos fue mayor en la zona baja. La proporción ísidos/agallas no fue significativamente diferente entre ambos lugares. La proporción frutos/ísidos fue significantemente mayor en la zona baja (t-test, $P<0.05$) con respecto a la alta. Utilizando regresiones múltiples en cada área, se observó que en la zona baja la cobertura de la planta estuvo asociada significativa ($F_{2,97}=4,89$, $P<0.01$) y positivamente con la abundancia de ísidos. Por otro lado, en la zona alta el número de frutos estuvo asociado significativa ($F_{3,36}=3.18$, $P<0.05$) y positivamente con la abundancia de ísidos.
Palabras claves: *Colliguaja odorifera,* abundancia de Issidae, insectos formadores de agallas, gradiente altitudinal.

INTRODUCTION

Herbivore-plant interactions may be affected in time and space by environmental conditions (Crawley, 1986; Thompson, 1988; Price, 1997). In particular, altitudinal range can affect the pattern of host plant distribution and consequently that of its closely related herbivores (Boecklen & Spellenberg, 1990; Aguilar & Boecklen, 1992). The common shrub *Colliguaja odorifera* Mol. shows an altitudinal distribution range between 600 to 1200 meters above sea level, is scarcely attacked by folivorous insects (Montenegro *et al.*, 1980), but strongly attacked by gall makers (Martínez *et al.*, 1992). Work in this system has focused on different aspects of the galling insect-*C. odorifera* relationship, emphasizing the relevance of plant traits such as specificity of attacked organs or plant phenology (Núñez & Sáiz, 1994; Sáiz *et al.*, 1999;

[1] This work was produced during the International Field Course on Insect-Plant Interactions held at Reserva Nacional Río Clarillo and Laboratorio de Química Ecológica, Departamento de Ciencias Ecológicas, Facultad de Ciencias, Universidad de Chile, from November 28 to December 14, 1999. The results presented are based on 6 days of field work.

[2] Laboratorio de Química Ecológica, Departamento de Ciencias Ecológicas, Facultad de Ciencias, Universidad de Chile, Casilla 653, Santiago, Chile, email: willy@abulafia.ciencias.uchile.cl.

[3] Laboratorio de Ecofisiología, Area de Biodiversidad Animal, Facultad de Ciencias Naturales y Matemáticas, Universidad Nacional Federico Villareal, Lima-Perú, email: rosariofi@hotmail.com.

(Recibido: 3 de diciembre de 1999. Aceptado: 5 de enero de 2000)

Martinez *et al.*,1992), and the influence of altitudinal gradient (Fuentes-Contreras *et al.*, 1999). A common insect found associated to *C. odorifera* is the jumping Hemiptera, *Issus* sp. (Fulgoromorpha: Issidae), but it has been poorly studied. In this work, the pattern of abundance of *Issus* sp. on *C. odorifera* growing at two sites of different altitude was evaluated in relation to plant traits and galling insect abundance.

METHODS AND MATERIALS

C. odorifera occurs at the Río Clarillo National Reserve (33° 51´ S- 70° 29´W, 45 km southeast of Santiago, Chile) mostly on equatorial facing slopes. Two sites of different altitude (850 and 1150 m above sea level) were chosen. Modular plants separated by at least 5 m were selected at each site (n = 100 in low site, and n = 40 in high site). The size of each plant (breath and length) and approximate area covered by it were recorded. A representative volume (40cm x 40cm x 40cm) of each plant was chosen and the number of fruits, flowers, buds and galls present in this volume was determined. Only the galls corresponding to the last season were considered, i.e. galls which were either completely green or at least green at their base. A beating trap (0.5m x 0.8 m) was placed under the representative plant volume chosen and the canopy was shaken to collect and determine the number of isids fallen.

For comparisons between low and high sites, a t- test was used for plant traits, herbivore abundance (galling insects and isids), and the ratios of fruits to isids and isids to galls. Multiple regression analyses considering plant traits and galling insects as variables affecting isid abundance, were used for both sampling areas.

RESULTS

At the low site, the number of fruits and buds, and the cover and dimension of the plants were significantly (t-test, $P< 0.005$, for each plant trait evaluated) greater than at the high site. The number of flowers was not significantly different (t-test, $P> 0.1$) between low and high sites (Figure 1).

At the low site, the number of galling insects and isids were significantly higher (t-test, $P< 0.005$, for each herbivore evaluated) than at the high site. Multiple regressions showed that at the low site only the cover of the plant was positively associated ($F_{2,97} = 4.899$, $P<0.01$) with isid abundance. At the high site, the number of fruits was positively associated

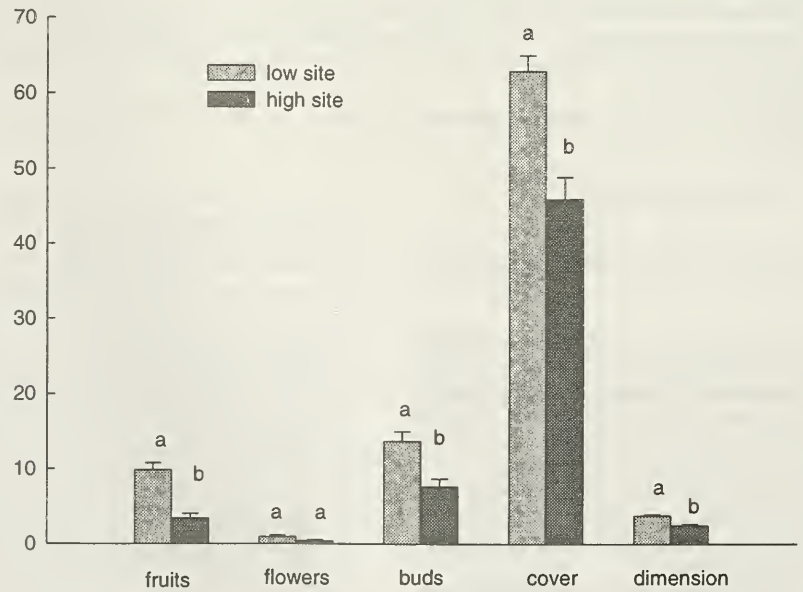

Figura 1. Comparison of plant traits in *Colliguaja odorifera* growing at low and high altitudes. Different letters mean significant differences (t-test, $P<0.05$). Fruits, flowers and buds are represented as number; cover as porcentage of total plant area, and total dimension as square meters.

($F_{3,36}$ = 3.18, P< 0.05) with isid abundance. The ratio of isids to galls was not significantly different (t- test, P>0.2) between the low and high sites. The ratio of fruits to isids was significantly larger (t-test, P<0.05) at the low site than at the high site.

DISCUSSION

Environmental conditions may affect some host plant traits and act directly or indirectly on herbivores. Plant traits showed significant differences between sites of different altitudes: number of fruits and buds, and plant cover and dimension were greater at low altitude (Figure 1). These traits suggest that *C. odorifera* represents a resource of poorer quality at the high site than at the low site. Hence, fewer herbivores (galling insects and isids) were expected at the high site than at the low one. The multivariate approach which considered both plant traits and number of galling insects at each site (low and high) as independent variables, showed that these variables were relevant to explain isid abundance.

At the low site, cover of the plant explained the number of isids at this site. This suggests that for this jumping insect, the host plant with larger cover will be a better habitat (microclimatic advantage or refuge zone, etc.) than that with smaller cover.

On the other hand, at the high site the number of fruits showed a positive association with isid abundance, but cover was not relevant. At this site, some plant traits were significantly smaller than at the low site, in particular the number of fruits (Figure 1). Given the lower host plant quality and the lower fruits to isids ratio, the resource could well be limiting, and hence the number of fruits is a relevant plant trait affecting isid abundance. The lack of significance of number of fruits in the multiple regression for the low site where the fruits to isids ratio is higher, may be explained by a time lag between the insect population dynamics and the availability of the resource. Interestingly, most females in the low site were gravid; hence, it is expected that later on the season the isid population would increase, and the number of fruits would explain isid abundance.

On the other hand, the abundance of galling insects was not relevant to explain the pattern of isid abundance (low and high site). Possibly, galling insects and isids have different patterns of host plant use, thus avoiding possible negative interactions. However, at high density of isids the pattern could change.

ACKNOWLEDGEMENTS

We thank all participants to the course for their enthusiastic and helpful criticism of the manuscript, specially Christer Björkman, Mattias Jonsson, Ernesto Gianoli, Richard J. Hopkins, and Claudio C. Ramírez. We gratefully acknowledge the financial support of MISTRA/IFS for our participation in the course, and the help and advice received from staff at CONAF.

REFERENCES

Aguilar, J.M. & Boecklen, W.J. 1992. Patterns of herbivory in the *Quercus grisea* x *Quercus gambelii* species complex. Oikos *64*: 498-504.

Boecklen, W.J. & Spellenberg, R. 1990. Structure of herbivore communities in two oak (*Quercus* spp.) hybrid zones. Oecologia *85*: 92-100.

Crawley, M.J. 1986. Plant Ecology. Second edition. Blackwell, Oxford.

Fuentes-Contreras, E. Gianoli, E., Caballero, P.P. & Niemeyer, H.M. 1999. Influence of altitude and host-plant species on gall distribution in *Colliguaja* spp. (Euphorbiaceae) in Central Chile. Revista Chilena de Historia Natural *72*: 305-313.

Martínez, E., Montenegro, G. & Elgueta, M. 1992. Distribution and abundance of two gallmakers on the euphorbiaceous shrub *Colliguaja odorifera*. Revista Chilena de Historia Natural *65*: 75-82.

Montenegro, G., Jordan, M. & Alfaro, M.E. 1980. Interactions between chilean matorral shrubs and phytophagous insects. Oecologia *45*: 346-349.

Núñez, C. & Sáiz, F. 1994. Cecidios en vegetación autoctona de Chile de clima mediterráneo. Anales del Museo de Historia Natural de Valparaiso *22*: 57-80.

Price, P.W. 1997. Insect Ecology . Third edition.Wiley, New York

Sáiz, F., Morales, A. & Olivares, M. (in press). Sobre el complejo de cecidios de *Colliguaja odorifera* Mol. (Euphorbiaceae). Anales del Museo de Historia Natural de Valparaíso.

Thompson, J. N. 1988. Variation in interspecific interactions. Annual Review of Ecology and Systematics *19*: 65-87.