

Comparison of relative abundance and diversity of coccinellids (Coleoptera: Coccinellidae) in blueberries (*Vaccinium corymbosum* L.), under two production systems in the La Araucanía Region, Chile

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Abstract

M. Vera, A. Aguilera, and R. Rebolledo. 2010. Comparative study of the relative abundance and diversity of coccinellids (Coleoptera: Coccinellidae) in blueberries (*Vaccinium corymbosum* L.) under two production systems in La Araucanía Region, Chile. Cien. Inv. Agr. 37(2):123-129. Coccinellids have been used, throughout the world, in biological control programs of agriculture pests. In Chile this family has been studied by various authors, which addresses issues such as biology, predatory activity and distribution in herbaceous species, shrubs and trees, but their situation in blueberries, where there is an abundance of species, is unknown Coccinellid beetles were counted visually on two blueberry orchards, under organic and conventional management. This study was conducted at the Maquehue Experiment Station, in the central valley of “La Araucanía Region” in southern Chile, from September 2007 through May 2008 and was divided into two periods: from September 2007 through February 2008 with visual counts only on the foliage of the plants, and from March through May 2008 counts were done on the foliage and on of the plant in the soil around the plants. The greatest number of species was recorded in the organic garden in both sampling periods, but species diversity was the same for both production systems. Specify results better.

Key words: Blueberries, coccinellids, *Eriopsis connexa*, *Eriopsis eschscholtzii*, *Hyperaspis sphaeridioides*.

Introduction

At world level, the number of coccinellid species in different environments, both tropical and temperate is estimated in six thousand (González, 2006); they are used in many countries in programs of biological control of aphids, phytophagous acari, scales, whiteflies and fungi (Richard and Davies, 1984; De Liñán, 1998; García *et al.*, 1994).

In Chile, this family was composed in 1989 by 33 genus and 76 species (Elgueta and Arriagada, 1989). González (2006) mentions that there are represented five Coccinellidae subfamilies in the country: Coccidulinae, Coccinellinae, Exoplectrinae, Scymninae and Sticholotidinae. There is currently a record of 93 coccinellid species in Chile (González, 2008).

The species of the Coccinellinae and Scymninae subfamilies feed mainly from Aphididae, while Sticholotidinae and Exoplectrinae feed more frequently from coccids. There is not sufficient information on Chilean Coccidulinae, although there are aphidophagous and coccidophagous species (González, 2006).

The ontogeny and ethology of this family has been studied in Chile by Rivera (1904), Montes (1970), Etchegaray (1982), Aguilera, (1995) and Aguilera *et al.* (2006a), who describe the Coccinellidae biology, postural habits, description and duration of larval stage, environmental conditions influencing development and hibernation cycle of the species in adult state. There are also outstanding works by Zúñiga (1967, 1985), González (1969), Carrillo *et al.*, (1974), Lamborot and Guerrero (1979), Zúñiga *et al.* (1986), Prado (1991), Aguilera and Pacheco (1995), Grez and Prado (2000), Grez and Villagrán (2000), Aguilera *et al.* (2006a, 2006b) who research aspects on the predatory activity of this family. Aguilera *et al.* (2005) and Rebolledo *et al.* (2007) refer specifically to the distribution of the species in the La Araucanía Region and the substrates they frequent. According to Rebolledo *et al.* (2007), coccinellids live on herbaceous plants, shrubs and trees, which are vegetal substrates where species of the Coccinellini tribe are abundant and with known diversity. Nevertheless, in fruit trees like blueberries (*Vaccinium corymbosum* L.), the relative abundance and diversity of these insects, as well as how these populations vary among different management systems of this fruit tree is unknown.

In regard to the aforementioned, this work had the objective to determine coccinellid species, their relative abundance and diversity associated to blueberries, in orchards under conventional management and organic in the La Araucanía Region, Chile.

Materials and methods

A sector under conventional management and another under organic management were chosen for the coccinellids sampling, both located in the Experimental Season Maquehue (38° 47' South and 73° 42' West), of Universidad de La Frontera, 14 km from Temuco, commune of Freire, La Araucanía Region, 100 M.S.L.

The agroclimatic area to which the site under study belongs corresponds to the agroecologi-

cal unit called Central Valley, with an annual pluviometric fall of 1328, with prevailing soils derived from recent volcanic ashes, also known as trumaos (Rouanet *et al.*, 1988).

Sector under conventional management

The blueberries coordinates were 18H 0699878; UTM 5698450, determined with a GPS mod. III Plus, Garmin.

The blueberries orchard has an approximate surface of 0.2 ha, with the cultivars Elliot, Bluecrop, Brigitta and O'Neill. The plants are arranged in lines, at a distance of 1 m over the line and 2 m between lines.

During the season and period of study, the products applied in this orchard: glyphosate (750 cc/ha, in July), paraquat (600 g/ha in September), and boscalid + pyraclostrobin (188 g + 96 g/ha, in October) (Dilman Boero. 2007. Agricultural engineer. Manager Experimental Field Maquehue. Personal communication).

Sector under organic management

The coordinates of the blueberries under organic management were 18H 0699658; UTM 5698270, measured with GPS. There is currently an associated complex of cultivations in this sector, planted at a sufficient spatial closeness to lead to complementation, in order to improve the yields (Altieri, 2008).

In the site of sampling, the cultivations are arranged in a plot composed by nine ridges and intercultivations (-blueberries-green manure-vegetables -potato -blueberries-green manure-vegetables-potato-blueberries). In each ridge header there were aromatic plants (wormwood, *Artemisia absinthium* L., aliso, *Alyssum* sp. L., oregan, *Origanum vulgare* L., thyme, *Thymus vulgaris* L., and lemon balm, *Melissa officinalis* L.), to attract plague species. The blueberries in this sector covered a approximate surface of 0.6 ha, where 1 L of liquid foliar fertilizer, prepared in the same farm (compost/plant) Supermagro

in September, every 15 days, in October, November and December, and piretro every 15 days, in January and February.

The samplings were made from September 2007 to May 2008. only the aerial part of the plant was sampled in both sectors, between September 2007 and February 2008, and the foliage and the soil around the plants were sampled from March to May 2008, because in that date the coccinellids prepare to hibernate and were habitually in the soil. The visual revision of the blueberries plants was carried out from 14 to 17 H, in different and consecutive days, for each sampling season, in a completely randomized sampling with 10 repetitions.

Additionally, some specimens were collected manually, which were taken to the Laboratory of Applied Entomology of the Faculty of Agropequarian and forest Sciences of Universidad de La Frontera for determination.

The specific richness (S), total abundance (N) and relative abundance (AB%) species diversity (H), diversity in maximum conditions (H' max) and evenness of Pielou (J) were determined. The results were analyzed by the U Man-Whitney non parametric test, because they did not fulfil the requirements of normality and homocedasticity, using the software SPSS 11.0.

Results and discussion

The captures from September 2007 to May 2008 resulted in the presence of three coccinellid species, belonging to the Coccinellinae subfamilies: *Eriopsis connexa chilensis* Hoffmann, *Eriopsis eschscholtzii* Mulsant and Scymninae *Hyperaspis sphaeridioides* (Mulsant).

A total of 711 specimens of *Eriopsis connexa chilensis* Hofmann (91%), 62 de *Eriopsis eschscholtzii* Mulsant (8%) and 1 of *Hyperaspis sphaeridioides* (Mulsant) (1%) (Figure 1) were found during the sampling season.

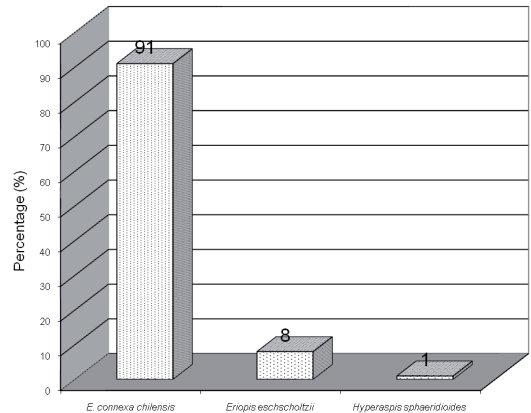


Figure 1. Total percentage of each coccinellid found on both orchards, from September 2007 through May 2008.

Foliage samplings of the plants

In the period September 2007 to February 2008, only *Eriopsis connexa chilensis* was found with a total of 436 specimens (153 in the conventional orchard and 283 in the orchard under organic management) (Table 1), this is, with a relative abundance of 35.1% for the conventional orchard and 64.9% for the organic orchard (Figure 2).

Table 1. Population parameters of Coccinellidae in blueberry orchards under two production systems, during two periods.

Population indexes	Orchard	
	Conventional	Organic
September 2007 to February 2008		
S (Species richness)	1	1
N (Number of individuals)	153.0	283.0
AB% (Relative abundante)	35.1	64.9
H' (Diversity)	0.0	0.0
H' máx. (Diversity in maximum conditions)	0.0	0.0
J (Equity)	0.0	0.0
March to May 2008		
S (Species richness)	3	3
N (Number of individuals)	164.0	181.0
AB% (Relative abundante)	47.5	52.5
H' (Diversity)	0.53	0.61
H' máx (Diversity in maximum conditions)	1.09	1.09
J (Equity)	0.48	0.56

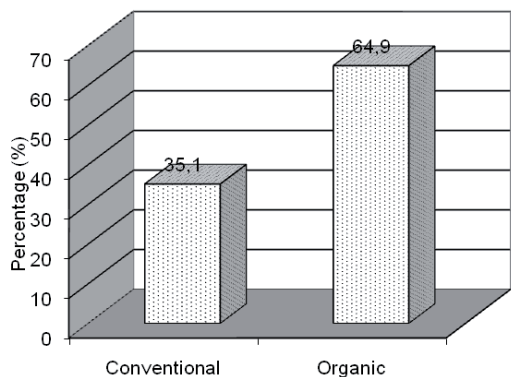


Figure 2. Relative abundance of coccinellids on blueberry orchards under to production systems, from September 2007 through February 2008.

For *Eriopsis connexa chilensis*, the U Man-Whitney test resulted that for the period September de 2007 to February 2008, the populations from the conventional orchard and the organic orchard presented significant differences in their population means, with a P value fo 0.03 (≤ 0.05). The specific richness for this period with only one taxon could occur because the blueberries cultivation in that period was not highly attractive for other coccinellid species, by the low presence of Aphididae observed. In addition, this coccinellid has good adaptability to different agroecosystems and has the capacity to multiply even in conditions of low feeding conditions (Bertolaccini *et al.*, 1994), which might explain their abundance in the foliage of blueberry plants.

The different abundance of species between the orchards was significant, and could result because the organic orchard had a surface of 0.6 ha versus 0.2 ha of the conventional orchard, thus, the first orchard would have shown better conditions for *E. connexa chilensis*, for the higher amount of vegetation associated that acts as habitat for coccinellids, adding the fact that there was absence of herbicide management that might result toxic for the insects. According to Asteraki *et al.* (2004), Wackers (2004) and Rebolledo *et al.* (2007), the herbicides used to protect the weeds cultivations in fields under conventional management diminish the diversity of plants in the borders, with a loss in the number of shelters, alternative hosts and food resources for adult entomophagus. Additionally, the use

of herbicides and fungicides may affect the coccinellid populations, because coccinellids are more sensitive than their preys to those products (Langhof *et al.*, 2003; Symington, 2003).

The population parameters H (Diversity), H' max (Diversity in maximum conditions) and J (Evenness) were null in both orchards, which indicates that, as in the cultivation of organic blueberries as in the conventional blueberries, there were not any differences in the diversity of coccinellid species (Table1).

Foliage and soil samplings around the plants

In the samplings from March to May 2008, a total population of 345 specimens was obtained in both orchards, arranged in 47.5% in the conventional orchard and 52.5% in the organic orchard (Table 1).

The most numerous taxa in the samplings, in both the organic orchard and the conventional orchard was *E. connexa chilensis*, with a total of 275 specimens (80%), followed by *Eriopsis eschscholtzii* with 62 specimens (18%) and then *Hyperaspis sphaeridioides* with eight specimens (2%) (Figure 3).

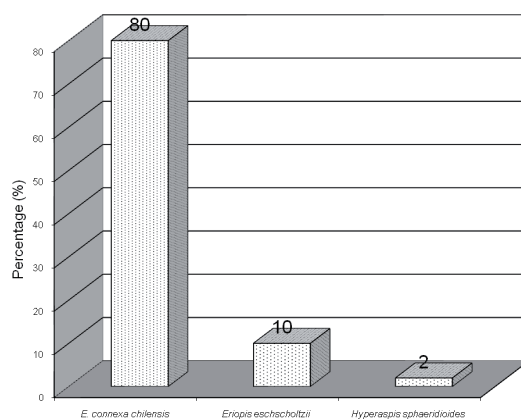


Figure 3. Percentages of species of coccinellids, considering both orchards, from March through May 2008.

The U Man-Whitney test determined that both *Eriopsis* species did not present significant differences in their mean populations between both

orchards, with a P value of 0.67, for *E. connexa chilensis* and 0.29, for *E. eschscholtzii* (≥ 0.05), therefore, the null hypothesis is accepted, which determines that both distributions are equivalent and without significant differences. *Hyperaspis sphaeridioides* could not be analyzed because only a few specimens were found.

The specific richness of three taxa in both orchards could be attributed because in both orchards there was a diversity of other close vegetal species, in addition to blueberries plants.

There was not any significant difference in the abundance of ladybugs in the orchards, which could occur because there were several plant species associated to blueberries in the organic orchard that might be more attractive for coccinellids; this occurs because there is a polycultural agroecosystem in the organic orchard, which according to Altieri and Nicholls (1999) produces an increased abundance of predators and parasitoids, result of a better availability of alternative preys, nectar sources and an appropriate microhabitat.

The results obtained indicate that the organic blueberries orchard presented a higher relative abundance of coccinellids than the conventional orchard, possibly because there was absence of a phytosanitarian management with herbicides and fungicides in the first orchard, which also presented a larger surface than the conventional orchard. *Eriopis connexa chilensis* presented the highest relative abundance, which could be due to the good adaptability to different agroecosystems and a high rate of reproduction. In addition, there were different blueberry cultivars in both the organic and conventional orchards, with only the O'Neill variety in common in both sectors, which could have influenced the results obtained.

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Resumen

M. Vera, A. Aguilera y R. Rebolledo. 2010. Comparación de la abundancia relativa y diversidad de coccinélidos (Coleoptera: Coccinellidae) en arándano (*Vaccinium corymbosum* L.) bajo dos modalidades de cultivo en la Región de La Araucanía, Chile. Cien. Inv. Agr. 37(2): 123-129. En todo el mundo, los coccinélidos se han utilizado en programas de control biológico de plagas agrícolas. En Chile esta familia ha sido estudiada por diversos autores, que tratan aspectos de biología, actividad depredadora y distribución de las especies en substratos herbáceos, arbustivos y arbóreos, pero en arándano se desconoce la diversidad y abundancia de especies de esta familia. Se hizo un estudio mediante recuentos visuales en la Estación Experimental Maquehue de la Universidad de La Frontera, en la región de La Araucanía de los coccinélidos presentes en dos huertos de arándano, uno bajo manejo orgánico y otro bajo manejo convencional, desde septiembre de 2007 a mayo de 2008, dividido en dos periodos, de septiembre de 2007 a febrero de 2008, con recuentos sólo en el follaje de las plantas, y de marzo a mayo de 2008 tanto en el follaje como en el suelo alrededor de ellas. La mayor cantidad de especies se contabilizó en el huerto orgánico, en ambos periodos de muestreo, y la diversidad fue la misma para ambos huertos.

Palabras clave: Arándano, coccinélidos, *Eriopis connexa*, *Eriopis eschscholtzii*, *Hyperaspis sphaeridioides*.

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