Studies on Neotropical Fauna and Environment
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/nnfe20

Voltinism in the melanopline grasshopper *Dichroplus elongatus* Giglio-Tos (Orthoptera: Acrididae: Melanoplinae)

Christian Bardi [a] & Carlos E. Lange [1 a]
[a] Centro de Estudios Parasitológicos y de Vectores (CEPAVE), CCT La Plata - CONICET - UNLP, La Plata, Argentina

Available online: 02 Aug 2011

To cite this article: Christian Bardi & Carlos E. Lange [1] (2011): Voltinism in the melanopline grasshopper *Dichroplus elongatus* Giglio-Tos (Orthoptera: Acrididae: Melanoplinae), Studies on Neotropical Fauna and Environment, 46:2, 143-145

To link to this article: http://dx.doi.org/10.1080/01650521.2011.562685

Studies on Neotropical Fauna and Environment
Vol. 46, No. 2, August 2011, 143–145

Taylor & Francis
Taylor & Francis Group

SHORT COMMUNICATION

Voltinism in the melanopline grasshopper *Dichroplus elongatus* Giglio-Tos (Orthoptera: Acrididae: Melanoplinae)

Christian Bardi & Carlos E. Lange*[1]

Centro de Estudios Parasitológicos y de Vectores (CEPAVE), CCT La Plata – CONICET – UNLP, La Plata, Argentina

(Received 22 March 2010; accepted 10 February 2011)

Although *Dichroplus elongatus* is a common grasshopper of wide distribution and economic importance in southern South America, contradictory information still existed regarding its voltinism. Through captive rearing of individuals from an area where bivoltinism was recently postulated (Rafaela, Santa Fe province, Argentina) and either immediate subsequent incubation or incubation after refrigeration (4°C) of the resulting egg-pods, we determined that *D. elongatus* has obligatory embryonic diapause and one generation a year. Some previous reports of facultative diapause and bivoltinism may be attributed to other *Dichroplus* species that can be easily confused with *D. elongatus*.

Aunque *Dichroplus elongatus* es un acridio común de amplia distribución e importancia económica en el Sur de Sudamérica, aún existe información contradictoria respecto de su voltinismo. Mediante la crianza en cautiverio de individuos colectados en un área donde recientemente se postuló la ocurrencia de bivoltinismo (Rafaela, Santa Fe, Argentina) y la incubación inmediata o incubación con refrigeración previa (4°C) de posturas, determinamos que *D. elongatus* posee diapausa embrionaria obligatoria y una generación anual. Algunos registros previos de diapausa facultativa y bivoltinismo pueden ser atribuidos a otras especies de *Dichroplus* fácilmente confundibles con *D. elongatus* en condiciones de campo.

Keywords: Argentina; bivoltinism; *Dichroplus exilis*; embryonic diapause; univoltinism

Introduction

Dichroplus elongatus is the most widely distributed species of the genus, occurring in the south of Brazil (Rio Grande do Sul), central Chile, Uruguay, and all of Argentina except Tierra del Fuego (Carbonell et al. 2006). In Argentina, *D. elongatus* is an economically deleterious grasshopper, affecting pastures and several crops (Cigliano & Lange 1999). In recent years, an increase in grasshopper populations occurred in some areas of the country, and *D. elongatus* was usually one of the involved species (Cigliano et al. forthcoming).

One of the main biological features of grasshoppers that need to be known for management of their populations is the type of embryonic diapause. In the genus *Dichroplus*, as with most grasshoppers (Joern & Gaines 1990), two types of diapause are recognized, obligatory and facultative (Turk & Barrera 1979). The number of generations per year (voltinism) correlates with the type of diapause that a species exhibits. Obligatory diapause leads to univoltinism while facultative diapause permits bivoltinism or multivoltinism if favorable environmental conditions occur. Information on the voltinism of *D. elongatus* is contradictory. Facultative diapause and two generations per year were reported by Campodónico (1966), Barrera & Paganini (1975) and Luiselli et al. (2002). Other researchers observed the presence of obligatory diapause and one generation annually (Liebermann 1949; Turk & Barrera 1979; Sisler 1981; Lange 1986; de Wysiecki et al. 1997). This study addresses the voltinism issue of *D. elongatus* by determining its type of embryonic diapause, and explores what might have been one cause of the contradiction. From an applied perspective, the issue is relevant because those grasshopper species with the capability of developing more than one generation per year tend to require more sustained (i.e. prolonged in time) control efforts than univoltine species.

Materials and methods

In early February 2009, adults of *D. elongatus* ($n = 25$; 11 ♀, 14 ♂) were collected alive with nets in grasslands near Rafaela (31°15′25.29″S, 61°29′14.48″W), Santa Fe, northeastern Argentina, an area where a second generation of the species was postulated through field observations (Luiselli et al. 2002). The individuals were indentified by characters of the phallic complex

*Corresponding author. Email: carlosl@cepave.edu.ar

ISSN 0165-0521 print/ISSN 1744-5140 online

DOI: 10.1080/01650521.2011.562685
http://www.informaworld.com

Table 1. Hatching of egg-pods of *Dichroplus elongatus* incubated (30°C) with or without a two-month period of refrigeration (4°C).

Treatment	Substrates with 4–6 egg-pods each	Hatching occurrence	Number of egg-pods hatched per substrate
30°C 9 months	3	No	0
4°C 2 months, 30°C	4	Yes	3–4
30°C 5 months, 4°C 2 months, 30°C	2	Yes	2–3

following Ronderos et al. (1968). Otherwise, when identified solely by its external morphology, *D. elongatus* can be easily confused with other species of the genus (Centre for Overseas Pest Research 1982). In the laboratory, the insects were maintained following general procedures employed by Henry (1985) and Lange (1986) for grasshoppers. The individuals were placed in a wire-screened, aluminium cage (20 × 20 × 30 cm) and reared under controlled conditions (30°C, 14 h light: 10 h dark, 40% relative humidity; Henry 1985; Hinks & Erlandson 1994). The insects were fed with fresh leaves of a variety of grasses, lettuce, cabbage, and wheat bran. Substrates for egg-pod laying consisted of containers (10 cm deep) filled with sterilized sand. Thermoregulation, mating, and egg-laying were stimulated with a 75 W bulb suspended 15 cm above the cage. Substrates were replaced every 10 days. After removal from the cage, the substrates with four to six egg-pods each were kept in the rearing room under controlled conditions for two weeks, and then received one of three treatments. Four substrates were kept at 4°C for two months, a procedure used for breaking the obligatory diapause in grasshoppers (Breije & Blickenstaff 1974; Oma et al. 1990), followed by incubation at 30°C until hatching. Three substrates were directly incubated at 30°C for nine months. Two substrates were directly incubated at 30° for five months, then kept at 4°C for two months, and further incubated at 30°C until hatching. When under incubation, substrates were checked twice a day for hatchings. The number of egg-pods from which larvae hatched was estimated based on the mean number of 24 eggs per egg-pod (de Wysiecki et al. 1997; Cigliano & Lange 1999).

Results

Hatchings did not occur in substrates that were not exposed to refrigeration (Table 1). On the contrary, numerous hatchings occurred in substrates subjected to refrigeration, corresponding to several cohorts (all hatchings coming from a same egg-pod) that hatched almost simultaneously or within a few days in each substrate (Table 1). After hatching, nymphal development proceeded normally until adulthood.

Discussion

Our results strongly support the notion that *D. elongatus* has obligatory embryonic diapause and one generation a year throughout northeastern Argentina. They thereby contradict the findings of two generations by Campodónico (1966), Barrera & Paganini (1975) and Luiselli et al. (2002). Since intraspecific variability may exist in the type of embryonic diapause, particularly in grasshopper species with wide geographic distribution (Centre for Overseas Pest Research 1982; Joern & Gaines 1990), the possibility that some populations of *D. elongatus* may exhibit facultative diapause cannot be ruled out.

It is also conceivable that the conflicting results by Luiselli et al. (2002) and us are rooted in an identification issue. In fact it is possible that *D. elongatus*, relatively scarce in Rafaela, was confused with *D. exilis*, which has a facultative diapause and multivoltine capacity (Barrera & Turk 1977; Turk & Barrera 1979) and was abundant there (personal observation). If *D. exilis* was studied instead of *D. elongatus* this could explain the observation of two generations per year as well as the surprising lack of *D. exilis* from grasshopper species lists for the area in several publications (Salto & Beltrame 1999; Zequín et al. 1999; Beltrame et al. 2002).

Acknowledgements

This research was supported in part by "Fondo para la Investigación Científica y Tecnológica" (FONCYT, project PICT2006/679).

Note

1. Researcher, Comisión de Investigaciones Científicas (CIC) de la provincia de Buenos Aires.

References

Barrera M, Paganini IH. 1975. Acridios de Tucumán. Notas bioecológicas. A Zool Lill. 31(11):107–123.

Barrera M, Turk SZ. 1977. Acridios del NOA II: contribución al conocimiento de huevos, desove y hábitos de postura de algunas especies de tucuras (Orthoptera: Acrididae) de la provincia de Tucumán. A Zool Lill. 32(9):167–188.

Beltrame RS, Luiselli L, Zequin S, Simioni S, Salto C. 2002. Dinámica poblacional de tucuras (Orthoptera: Acridoidea) en agroecosistemas del centro oeste de Santa Fe y centro este de Córdoba. Natura Neotrop. 33(1–2):47–54.

Breije NN, Blickenstaff CC. 1974. Refrigeration of egg pods of a nondiapausing strain of the migratory grasshopper. Econ Entomol. 67(1):134–135.

Campodónico MJ. 1966. Comprobación de una segunda generación en tucuras de importancia económica. Inst Pat Veg INTA Hoja Inform 2:1–2.

Carbonell C, Cigliano MM, Lange CE. 2006. Acridomorph (Orthoptera) species of Argentina and Uruguay. La Plata (Argentina): The Orthopterists Society, Museo de La Plata. CD ROM.

Centre for Overseas Pest Research. 1982. The locust and grasshopper agricultural manual. London: Centre for Overseas Pest Research. 690 p.

Cigliano MM, Lange CE. 1999. Global crop protection compendium. Module 1, *Dichroplus elongatus*. Wallingford (UK): Centre for Agriculture and Biosciences International (CABI).9 p.

de Wysiecki ML, Cigliano MM, Lange CE. 1997. Fecundidad y longevidad de adultos de *Dichroplus elongatus* (Orthoptera: Acrididae) bajo condiciones controladas. Rev Soc Entomol Argent. 56(1–4): 101–104.

Henry JE. 1985. Handbook of insect rearing. Vol. I, *Melanoplus* spp. Amsterdam: Elsevier. p. 451–464.

Hinks CF, Erlandson MA. 1994. Rearing grasshoppers and locust: review, rationale and update. J Orthop Res. 3:1–10.

Joern A, Gaines SB. 1990. Population dynamics and regulation in grasshoppers. In: Chapman RF, Joern A, editors. Biology of grasshoppers. New York: John Wiley & Sons. p.415–482.

Lange CE. 1986. Crianza en cautiverio de *Dichroplus elongatus* (Orthoptera: Acrididae: Melanoplinae). Neotrópica. 32(88): 147–148.

Lange CE, Cigliano MM, de Wisiecki ML. 2005. Los acridoideos (Orthoptera: Aeridoidea) de importancia económica en la Argentina. In: Barrientos Lozano L, Almaguer Sierra P, editors. Manejo integrado de la langosta centroamericana (Schistocerca piceifrons piceifrons, Walker) y acridoideos plaga en América Latina. Instituto Tecnológico de Ciudad Victoria, Tamaulipas, México. p. 93–95.

Liebermann J. 1949. Los acridios de la zona subandina de Neuquén, Río Negro y Chubut. Rev Mus Argent Cs Ns Bernardino Rivadavia Zool. 1:127–160.

Luiselli S, Beltrame L, Zequin S. 2002. Ciclo ninfal de tucuras (Orthoptera: Acrididae), en agroecosistemas del centro oeste de Santa Fe y centro este de Córdoba. Rev FAVE – Cs Agrs. 1(1):37–45.

Oma EA, Streett DA, Henry JE. 1990. Establishment of a nondiapause *Melanoplus differentialis* (Thomas) (Orthoptera: Acrididae) colony. Can Entomol. 3:583–584.

Ronderos RA, Carbonell CS, Mesa A. 1968. Revisión de las especies del género *Dichroplus* Stal, del grupo *elongatus* (Orthoptera, Acrididae, Catantopinae). Rev Mus La Plata. 10: 271–325.

Salto CE, Beltrame R. 1999. Manejo y reconocimiento de tucuras. Centro oeste de Santa Fe y centro este de Córdoba. INTA Rafaela Pub Téc. 59:1–23.

Sisler GM. 1981. Embryonic development of *Dichroplus elongatus* G.Tos (Orthoptera: Acrididae) under ambient conditions. Rev Fac Agr UBA. 2(1):47–52.

Turk SZ, Barrera M. 1979. Acridios del NOA. III. Estudio bio-ecológico sobre siete especies del género *Dichroplus* Stal (Orthoptera, Acrididae). A Zool Lill. 35:785–805.

Zequín L, Beltrame R, Luiselli S, Salto C, Strasser R. 1999. Abundancia y diversidad de tucuras (Orthoptera: Acrididae) en el centro norte de Santa Fe y centro oeste de Córdoba. Anuario 99, INTA Rafaela. p. 113–120.