Density Dependence of *Trissolcus* spp. (Hymenoptera: Scelionidae) on Eggs of *Eurygaster integriceps* Puton (Hemiptera: Scutelleridae)

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Abstract

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Egg parasitoids of Sunn Pest, *Eurygaster integriceps* Puton, were studied from 1997-1998 in Varamin, Iran. The hymenopteran parasitoids *Trissolcus grandis* Thomson, *T. vassilievi* Mayer, *T. semistriatus* Nees and *T. basalis* Wholaston were identified. These parasitoids regulate their host population in a density-dependent manner. A positive temporal density-dependent relationship was observed each year between parasitism rate for each species and host density. Regression analyses were significant indicating a positive spatial density dependence.

Keywords: Density dependence, *Eurygaster integriceps*, parasitoids, Sunn Pest, *Trissolcus* spp.

Introduction

Interactions between populations of insect herbivores and their parasitoids are important in biological control because they influence how parasitoids regulate their hosts. For a biological control agent to successfully control its prey, it should act in a density-dependent manner (11). Aggregation in response to local host density should increase control (5).

The response of a parasitoid to host density (density dependence) can be either intergenerational (temporal) or behavioural (spatial) (2). Parasitoids of univoltine herbivores feeding on cultivated annual plants experience within their habitats variations in host density that follow a predictable yearly pattern and parasitism can be temporally density-dependent. Differences between host density in adjacent habitats (i.e. fields) can be important and the parasitoid may then respond with spatial density dependence. Both factors must be taken into account in quantifying the density dependence of mortality caused by a parasitoid.

The Sunn Pest, *Eurygaster integriceps* Puton, feeds on wheat and barley and is a major pest in West and Central Asia (3). They are univoltine and have an oviposition period lasting 30 to 45 days (A.Amir-Maafi pers. commun). This pest oviposits in small clusters, typically in even multiples of 14, on the leaf blades of the crop. *Trissolcus* spp. are parasitoids of Sunn Pest eggs and are present throughout the oviposition period (1, 8, 6, 12). These parasitoid species have 2-3 generations per year and are a major biotic mortality factor in Sunn Pest population dynamics (4, 7, 8).

The objective of this research was to determine the temporal and spatial density dependence of *Trissolcus* spp.on Sunn Pest eggs in Iran.

Materials and Methods

The study was done during the 1997 and 1998 growing seasons in six wheat (variety Mahdavi) fields in Varamin, Iran.

Sampling methods: Each field, which was approximately 1 ha in size, was divided into 5 blocks (each 2000 sq. m.) and each block was subdivided into 5 (400 sq. m.) plots. Using a standard 1 x 1 m quadrate we took one sample in each plot twice a week from mid-April to the end of May each year. The sample consisted of collecting all Sunn Pest egg masses in each quadrate. Each egg mass was placed in a polyethylene tube (10 cm height) and held for parasitoid emergence in an incubator at 25°C, 50 ± 5% RH and 16:8 LD. Parasitoids were identified and the number of eggs parasitized by each *Trissolcus* sp. was recorded. Voucher specimens are held at the Sunn Pest Research Department, Varamin.

Statistical analysis: Data were analysed by species for temporal and spatial density dependence by the weighted regression technique of Reeve and Murdoch (9). A significant positive slope indicated a positive density dependence and a significant negative one an inverse density dependence. The proportion of parasitized eggs was transformed by arc-sine square-root and a weighting factor of 4n, where n is the sample size on which the proportion was based. Regression was performed using Reg. producers in SAS (10).

Results and Discussion

Sunn Pest began ovipositing in mid-April and the number of eggs produced peaked in early to mid-May each year. Wheat fields had a maximum of 16.08 and 18.72 eggs/m² in 1997 and 1998 respectively (Fig.1).

Egg masses of Sunn Pest were attacked by four parasitoids species, *Trissolcus grandis* Thomson, *T. vassilievi* Mayer, *T. semistriatus* Nees and *T. basalis* Wholaston. The most effective and widespread of these parasitoid species was *T. grandis.* The rate of parasitism by *T. grandis*, *T. vassilievi* and *T. semistriatus* slowly increased as host density increased and then egg population density decreased rapidly but, the rate of parasitism remained high. No clear pattern emerged for *T. basalis* (Fig. 1).

To quantify temporal density dependence for *T. grandis, T. vassilievi* and *T. semistriatus* weighted regressions of parasitism rates (for each species) on host densities were done for all pooled data for each year. For these species in 1997 and 1998 slopes were positive but no significant departure from a slope of 0 was observed (Table 1). These results indicate a positive temporal density dependence although dependence was not strong, but the correlation is strong and consistent for *T. semistriatus* (Table 1).

Density dependence of egg mortality of Sunn Pest by *T. grandis*, *T.vassilievi,* and *T. semistriatus*. was expected because certain characteristics of this insect favour such a relationship. These characteristics include its sedentary behaviour, its status as a native insect and its presence on a limited number of host plants (11). During the oviposition period of Sunn Pest the relationship between parasitism rate and host density changed. As host density increased rapidly in mid-spring the parasitism rate followed closely resulting in a positive temporal density dependence. Later in the season, which ended at the end of May, density dependence was not present as the rate of parasitism remained high and the egg density decreased (Fig. 1).

The absence of a relation between parasitism rate and host density in mid- and late-May may have resulted from a marked increase in adult parasitoid density. The high parasitism rate even when host density was decreasing could reflect an important increase in parasitoid density. Although the searching efficiency of individual parasitoids may have decreased their total efficiency remained high. These results indicated that the parasitoid density did not reach levels at which mutual interference would occur (9).

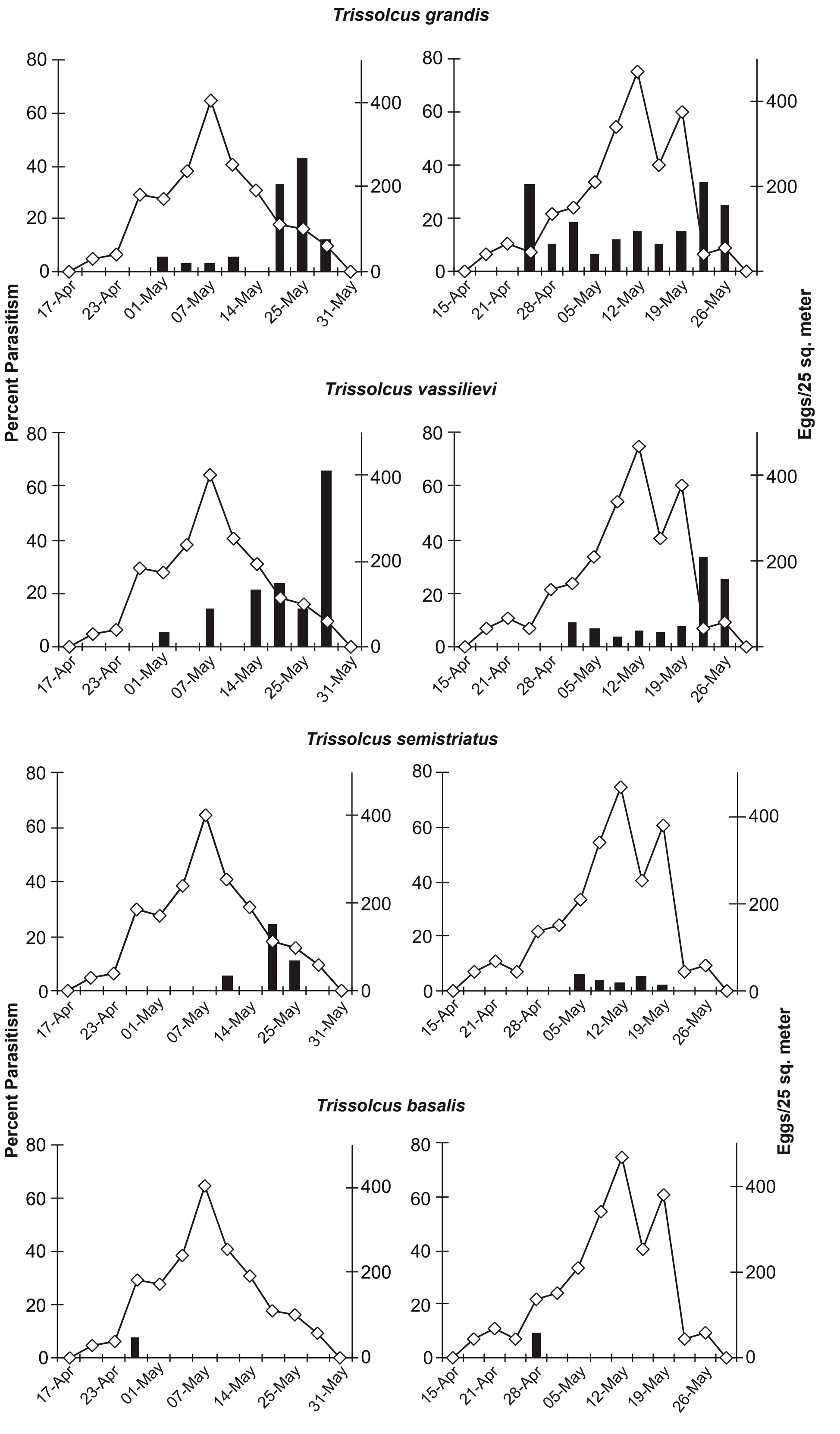

Figure 1. The number of Sunn Pest, *Eurygaster integriceps,* eggs per 25 square meters (line) and the percentage of eggs parasitized (solid bar) by four species of *Trissolcus* in Varamin, Iran in 1997 (left) and 1998 (right).

Spatial density dependence was detected by weighted regression of parasitism rate for species on host density over the two years of the study. For the 3 species and for two years, all slopes were positive and significantly different from 0 (Table 1). Spatial density dependence was evident because the host density differed between plots and fields. In plots and fields where egg density was markedly different, parasitism was positively density dependent. Spatial density dependence can also be due to increased searching time in habitats with higher host densities.

The spatial scale used was 1m² of field. However, in some species, density dependence may change with the spatial scale used (2). Further studies investigating different spatial scales are needed.

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Table 1. Weighted regression analyses to detect spatial and temporal density dependence for *Trissolcus* spp., parasitoids of Sunn Pest 1997-1998. Varamin, Iran.

Year	Species	Slope	P	r^2
Spatial density dependence				
1997	T. grandis	0.539	0.01	0.79
	T. vassilievi	0.356	0.0003	0.99
	T. semistriatus	0.223	0.03	0.81
1998	T. grandis	0.409	0.02	0.74
	T. vassilievi	0.227	0.02	0.48
	T. semistriatus	0.249	0.06	0.88
Temporal density dependence				
1997	T. grandis	0.049	0.47	0.56
	T. vassilievi	0.081	0.35	0.83
	T. semistriatus	0.03	0.12	0.94
1998	T. grandis	0.043	0.67	0.047
	T. vassilievi	0.071	0.33	0.23
	T. semistriatus	0.08	0.16	0.84

الملخص

أمير مافي، مسعود وبروس باركر. 2002. تبعية الكثافة لأنواع المتطفل *Trissolcus* spp. على بيوض السونة. مجلة وقاية النبات العربية. 20: 62-64.

تمت دراسة متطفلات بيوض السونة *Eurygaster integriceps* Puton خلال الفترة من 1997 إلى 1998 في منطقة فارامن، إيران. وتم تعريف المتطفلات التالية التابعة لغشائيات الأجنحة: *Trissolcus grandis* Thomson، *T. vassilievi* Mayer، *T. semistriatus* Nees و *T. basalis* Wholaston. وتنظم هذه المتطفلات عشائر عائلها بطريقة تبعية الكثافة. وقد لوحظت علاقة ايجابية مؤقتة لتبعية الكثافة كل عام ما بين معدل التطفل لكل نوع وكثافة العائل. وكانت تحاليل الانحدار معنوية مشيرة إلى تبعية فراغية ايجابية للكثافة.

كلمات مفتاحية: تبعية الكثافة، *Eurygaster integriceps*، متطفلات، حشرة السونة، *Trissolcus* spp.

References

1. **Amir-Maafi, M.** 2000. An investigation on the host-parasitoid system between *Trissolcus grandis* Thomson (Hym.:Scelionidae) and sunn pest eggs. Ph.D Thesis, Tehran University, Iran. 220 pp.
2. **Brown, M.W.** 1989. Density dependence in insect host-parasitoid systems: a comment. Ecology, 70: 776-779.
3. **Critchley, B.R.** 1998**.** Literature review of sunn pest *Eurygaster integriceps* Put. (Hemiptera, Scutelleridae). Crop Protection, 4: 271-287.
4. **Kartavtsev, N.I.** 1974. Studying the role of naturally occurring Telenomines. Zashchita Rastenii, 4: 31.
5. **Murdoch, W.W.** 1990. The relevance of pest-enemy models to biological control. Pages 1-24. In: Critical issues in biological control. M. Mackauer, L.E. Ehler and J. Roland (Editors). Intercept, Andover, Hants.
6. **Radjabi, G.H.** 1993. Importance of Scelionid egg parasites of sunn pest in increasing the efficiency of early and rapid harvesting as a cultural control method. FAO/ICARDA Expert Consultation on sunn pest. Sunn pest problem and its control in the Near East region. ICARDA, Aleppo, Syria.
7. **Radjabi, G.H.** 2000. Ecology of cereals' sunn pests in Iran. Agricultural Research, Education and Extension Organization, Tehran, Iran. 343 pp.
8. **Radjabi, G.H. and M. Amir-Nazari.** 1989. Egg parasites of the sunn pest in the central part of the Iranian plateau. Entomologie et phytopathologie appliques. 56: 1-8.
9. **Reeve, J.D. and W.W. Murdoch.** 1985. Aggregation by parasitoids in the successful control of the California red scale: a test of theory. J. Ann. Ecol. 54: 797-816.
10. **SAS.** 1985**.** SAS® Users Guide: Statistics Version, Edition 5. .SAS Institute Inc., Cary, NC.
11. **Stilling, P.D.** 1987. The frequency of density-dependence in insect host-parasitoid systems. Ecology, 68: 844-856.
12. **Zatyamina, V.V., E.R. Klechkovskii and V.I. Burakova.** 1976. Ecology of the egg parasites of pentatomid bugs in the Voronezh region. Zoologicheskii Zhurnal, 55: 1001-1005.

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