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THE SPECIES COMPOSITION, WHITIN-PLANT DISTRIBUTION, AND POSSIBLE PREDATORY ROLE OF SPIDERS (ARANEAE) IN A VINEYARD IN SOUTHERN PORTUGAL

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Abstract

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In a vineyard in Southern Portugal, the dominant spider species and their distribution on the plant were investigated. From the 19 spider families present, 61 species were identified, 4 of which were considered to be first records in Portugal. More than 90% of the spiders belonged to 10 species from 7 families. Most spiders were located on the lower surface of leaves, where leafhoppers fed. The predatory capacity of the spiders towards leafhoppers is discussed in the light of some ecological features.

Introduction

Spiders are generalist predators that feed almost exclusively on insects and therefore belong to the general group of possible natural control factors. The importance of spider predation in regulating specific prey populations is controversial (e.g. RIECHERT, LOCKLEY, 1984; NYFFELER, BENZ, 1987). However, there are some studies that suggest a significant control of specific prey populations by an assemblage of spiders (e.g. AGNEW, SMITH, 1989; RIECHERT, BISHOP, 1990). In the form of a multi-specific assemblage, spiders live in different habitats and present different body dimensions and predatory behaviours, all of which increase the probability of encountering potential prey.

AGNEW, SMITH (1989) have pointed out some features that make the presence of spiders desirable in an agricultural ecosystem: they prey on a vast range of potential pest species; they are predators during each stage of their development; they have long life-spans; they rapidly colonise fields; are resistant to starvation and dehydration and they do not migrate during low density prey periods. Thus, spiders may present a settling effect, which contributes towards maintaining the community balance. They should be considered an important component of the natural enemy complex.

Studies on the ecological role of spiders in vineyards have been conducted previously (e.g. COSTELLO, DANE, 1995; MEIERROSE et al., 1998; ROLTSCH et al., 1998). In south Portugal leafhoppers are considered the main potential pest in vineyards and are represented by several species belonging to two genera: *Empoasca* and *Jacobiasca* (QUARTAU, REBELO, 1992).

The purpose of this study was to evaluate the species composition and the within-plant distribution of spiders in a vineyard. The final aim was to detect whether there is a relationship between spiders and leafhoppers.

Material and methods

Fieldwork was done in a vineyard in Reguengos de Monsaraz (Southern Portugal) which is in a vine growing area of about 4000 ha. This region is characterised by a Mediterranean climate with a marked continental influence. Sampling was performed along the ten central lines of vines (variety Trincadeira) in a 1 ha plot, which was surrounded by extensive vineyards. The samples were taken between March and September 1998.

The spider fauna associated with vines was sampled by a standardised visual search on the plant itself and on the supporting structures (wires and posts). This methodology was chosen because it caused minimum disturbance of the habitat. The spiders' location was observed according to the following categories: 1) post; 2) wire; 3) plant, wooden base; 4) plant, branches; 5) leaf, a- upper surface; b- lower surface. One hundred plants were inspected for spiders during about 120 minutes in accordance with the following observation routine: (a) 5 lines per sample, the first line being selected at random; (b) a total of 20 plants per line, the first plant being selected at random. Spiders and any webs present were observed and counted.

After setting up a spider collection, identification was performed in the field whenever possible, without causing the death of the individuals. When necessary, the individual was captured for identification in the laboratory, and later released at the capture place.

Young leafhoppers (Homoptera: Cicadellidae: *Jacobiasca-Empoasca*) were also observed by a standardised visual search of 100 leaves (one leaf per plant), in conformity with the sample sequence for spider fauna already referred to above. The relationship between spiders and young leafhoppers was examined by linear regression analysis. This analysis established the significance of a functional relationship between the variables considered.

Results

Spiders belonging to 19 families and representing 61 species were found (Table 1). Out of these 61 species, 4 were new records for Portugal: *Nurscia albomaculata* (LUCAS), *Trachyzelotes pedestris* (C. L. KOCH), *Pellenes nigrociliatus* (SIMON) and *Thyene imperialis* (ROSSI).

T a b l e 1. Species list. The species that could not be identified to species level are shown as *Genera* sp.

DYSDERIDAE
Dysdera crocata C. L. K.
OONOPIDAE
Oonops sp.
ULOBORIDAE
Uloborus walcknaerius LATR.
THERIDIIDAE
Anelosimus aulicus (C. L. K.)
Crustulina sp.
Enoplognatha ovata (CL.)
Paidiscura pallens (BL.)
Theridion melanurum (HAHN)
Theridion musivum SIMON
LINYPHIIDAE
Perinerigone vagans (AUDO.)
Microlinyphia pusilla (SUND.)
Lepthyphantes tenuis (BL.)
Frontinellina frutetorum (C. L. K.)
TETRAGNATHIDAE
Tetragnatha obtusa C. L. K.
ARANEIDAE
Aculepeira ceropegia (WALC.)
Agalenatea redii (SCOP.)
Araniella cucurbitina (CL.)
Cyclosa conica (PALL.)
Cyclosa insulana (COSTA)
Gibbaranea bituberculata (WALC.)
Hyposinga albovittata (WEST.)
Mangora acalypha (WALC.)
Neoscona adianta (WALC.)
Nuctenea umbratica (WALC.)
Zilla diodia (WALC.)
Zygiella x-notata (CL.)
PISAURIDAE
Pisaura mirabilis (CL.)
OXYOPIDAE
Oxyopes heterophthalmus LATR.
Oxyopes linneatus LATR.
Oxyopes sp.
AGELENIDAE
Textrix caudata L. K.

DICTYNIDAE
Marilynia bicolor (SIMON)
Nigma puella (SIMON)
TITANOECIDAE
Nurscia albomaculata (LUCAS)
CLUBIONIDAE
Cheiracanthium erraticum (WALC.)
Clubiona sp.
ZODARIIDAE
Zodarion sp.
GNAPHOSIDAE
Berlanidina plumalis (O. P.-C.)
Drassodes sp.
Trachyzelotes pedestris (C. L. K.)
Zelotes civicus (SIMON)
HETEROPOIDIDAE
Micrommata ligurina (C. L. K.)
Olios argelasius (WALC.)
PHILODROMIDAE
Philodromus aureolus (CL.)
Thanatus sabulosus (MENGE)
Thanatus vulgaris SIMON
Tibellus oblongus (WALC.)
THOMISIDAE
Misumena vatia (CL.)
Ozyptila sp.
Runcinia grammica (C. L. K.)
Synaema globosum (FABR.)
Thomisius onustus WALC.
Xysticus cristatus (CL.)
Xysticus nubilus (SIMON)
SALTICIDAE
Chalcoscirtus infimus (SIMON)
Heliophanus flavipes C. L. K.
Pellenes nigrociliatus (SIMON)
Phlegra bresnieri (LUCAS)
Salticus propinquns LUCAS
Salticus scenicus (CL.)
Thyene imperialis (ROSSI)

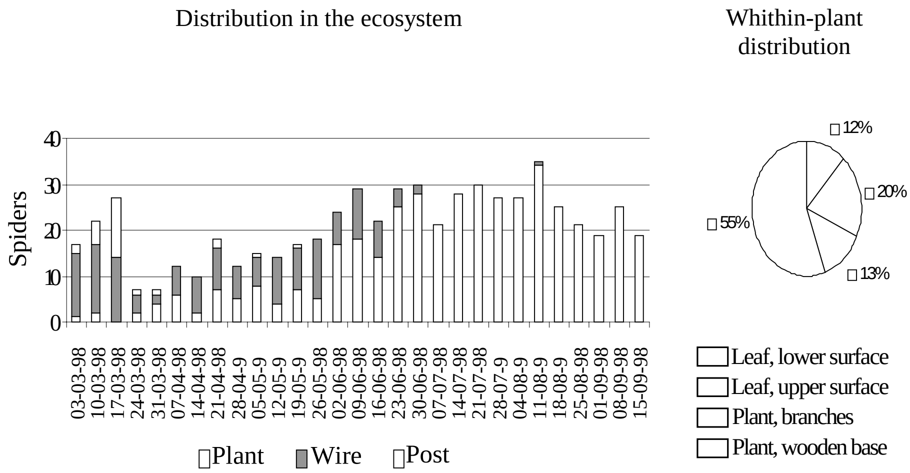

Fig. 1. Distribution of spiders on different structures in a vineyard, throughout the sampling period.

T a b l e 2. Statistical tests (F) and probabilities (P) associated with the linear regression of the observed numbers of young leafhoppers and spiders. The dependent variable is the square root of leafhopper numbers (d.f.=28; α=0.05).

	Intercept	**Slope**	**R^2**	**F**	**P**
Araneae	–1.44	0.16	0.23	7.94	0.01
Thomisidae	1.49	0.20	0.03	0.87	0.36
Salticidae	1.82	0.09	0.02	0.56	0.46
Oxyopidae	0.37	1.23	0.61	42.10	0.00
Agelenidae	0.97	0.51	0.25	9.05	0.00
Theridiidae	–0.09	0.59	0.34	14.09	0.00
Araneidae	2.78	–0.20	0.14	4.27	0.05
Linyphiidae	3.74	–0.47	0.21	7.19	0.01

The majority of spiders observed during sampling by standardised visual search belonged to the families Thomisidae, Salticidae, Oxyopidae, Agelenidae, Theridiidae, Araneidae and Linyphiidae. More than 90 % of the spiders observed belonged to a small number of species: *Xysticus sp.* (Thomisidae); *Salticus propinquns* LUCAS, *S. scenicus* (CLERCK) and *T. imperialis* (Salticidae); *Oxyopus heteroptalmus* LATREILLE and *O. linneatus* LATREILLE (Oxyopidae); *Tetrix caudata* L. KOCH (Agelenidae); *Theridion sp.* (Theridiidae);

Agalenatea redii (Scopoli), *Gibbaranea bituberculata* (Walckenaer) and *Mangora acalypha* (Walckenaer) (Araneidae) and an unidentified morphotype of Linyphiidae.

In the pre-flowering period, when the plant was less developed, the majority of spiders were associated with the wires as web support or hiding places (particularly in the dry spirals from previous years). With further plant development, the spiders were found on the plant itself (Fig. 1). Between June and September, 92% of spiders sampled were located on the plant. For the whole sampling period, 71% of spiders were located on plants, 25% on wires and only 4% on posts. With regard to the plant itself, 12% of spiders observed were found on the wooden base, 20% on branches and 68 % on leaves (13% on the upper surface of the leaf and 55% on the lower surface of the leaf) (Fig. 1).

Out of 304 web samples, 79% were equally distributed among the Agelenidae, Araneidae and Theridiidae. Webs of Agelenidae were found on the wooden base and lower branches of the plant. The Araneidae built their webs using wires or leaves as supports. Webs belonging to the Theridiidae were located on the leaves or even spun around them. In this case, several young leafhoppers were found as prey.

A regression analysis was performed, using the young leafhoppers as the dependent variable (Table 2); it was significant and positive for the total spiders, as well as for the families Oxyopidae, Agelenidae, and Theridiidae.

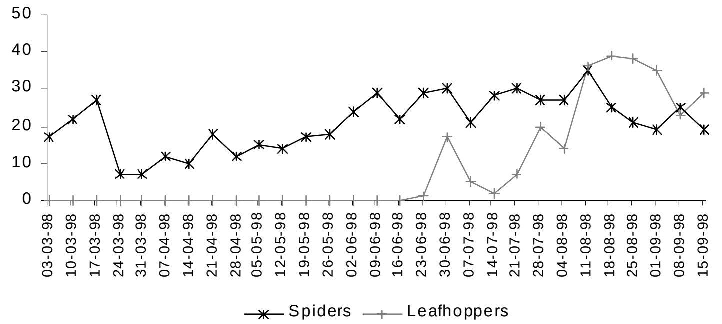

Fig. 2. Total number of spiders and leafhopper nymphs throughout the sampling period.

T a b l e 3. Monthly percentages of web and hunting spiders. (In July the application of methidathion occurred).

	March	April	May	June	July	August	September
Hunting spiders	39	23	22	10	49	61	38
Web spiders	61	77	78	90	51	39	62

During the sampling period the total number of spiders showed a decrease in late March, during a period of heavy rainfall (Fig. 2). At the beginning of July, an organophosphate (methidathion as active ingredient) was applied to the vineyard. A decrease in number was observed in some families, mainly in Araneidae. Total spiders did not show a significant decrease but a considerable change in the composition of the spider population was observed (Table 3).

Discussion

Although a high diversity had been recorded, the spider fauna of this viticultural ecosystem was dominated by a rather small number of species. COSTELLO, DAANE (1995) had already noted this fact in California vineyards. The decline in the number of spiders observed in late March might have been due to heavy rainfall that led to lower activity and search for shelter. The application of methidathion may have caused the observed alteration in spider populations. The significant decrease in Araneidae adults, together with the appearance of immature Oxyopidae and Thomisidae, were probably the reason for the change in the ratio of hunting spiders versus web spiders.

The diversity of potential prey of the spiders in the vineyard is relatively high (OLIVEIRA, in prep., information on the same field and during the same year). The diversity of spiders encountered is most likely to be a function of the diversity of potential prey, the leafhoppers being just a tiny component. Nevertheless, some considerations can be made regarding a possible relationship between spiders and leafhoppers. Leafhoppers chose the lower surface of the leaves to feed. As the spiders are mainly located on the plant, and particularly on the lower side of the leaves, one could suggest a high probability of encounters between spiders and leafhoppers.

The potential of spiders for pest management is not generally taken into consideration (due to the classical idea of biological control, which is based on specialised predators or parasitoids). For integrated pest population management little consideration is given to organisms that naturally limit those populations without having to be introduced or released. However, there is evidence that spiders may play an important role in the natural limitation of some pests (e.g. AGNEW, SMITH, 1989; RIECHERT, BISHOP, 1990; NYFFELER et al., 1994; PROVENCHER, RIECHERT, 1994; ROLTSCH et al., 1998).

Salticidae and Oxyopidae individuals are generally found on the lower surface of the leaves and it was observed in the field that they preyed on leafhoppers. NYFFELER et al. (1987) showed that leafhoppers composed 17% of the natural diet of the lynx spider *O. salticus* in cotton fields in East Texas. The Theridiidae appears to be an important group with respect to predation of leafhoppers. They are present in relatively high numbers and their webs surround the leaves, easily capturing adult leafhoppers (and especially nymphs). Agelenidae and Linyphiidae build webs in the lower branches and wooden base of the plant, and thus seem less suited to predation of leafhoppers. The orb webs of Araneidae were built in the foliage and were able to intercept leafhoppers. Furthermore, Nyffeler et al. (1987, 1989) recorded effective predation of Araneidae and Oxyopidae on leafhoppers.

Predator-prey interactions between Oxyopidae and leafhoppers take place, as indicated by the regression analysis, which gave a high positive R^2-value for this association. The potential of Oxyopidae as natural enemies of leafhoppers is supported by other authors (Nyffeler et al., 1987, 1992).

Conclusion

A total of 7 families were found to be associated with the vineyard. Lynx spiders are a dominant spider group in this ecosystem. A predator-prey-interaction between Oxyopidae and leafhoppers was demonstrated. The Theridiidae also appear as potential predators of leafhoppers.

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References

Agnew, C.W., Smith, J.W. Jr., 1989: Ecology of spiders (Araneae) in a peanut agroecosystem. Environ. Entomol., *18*, 1, p. 30-42.

Costello, M.J., Daane, K.M., 1995: Spider (Araneae) species composition and seasonal abundance in San Joaquin valley grape vineyards. Environ. Entomol., *24*, 4, p. 823-831.

Meierrose, C., Carvalho, P., Volk, U., Kollas, A.-K., 1998: Cigarrinha verde e aranhas na casta aragonês – ocorrência, dinâmica e efeito global de produtos agroquímicos. 4º Simpósio de Viti-vinicultura no Alentejo. Actas do Simpósio, Évora, *1*, p. 321-327.

Nyffeler, M., Benz, G., 1987: Spiders in natural pest control: A review. J. Appl. Ent., *103*, p. 321-339.

Nyffeler, M., Dean, D.A., Sterling, W.L., 1987: Evaluation of the importance of the striped lynx spider, *Oxyopes salticus* (Araneae: Oxyopidae), as a predator in Texas cotton. Environ. Entomol., *16*, p. 1114-1123.

Nyffeler, M., Dean, D.A., Sterling, W.L., 1989: Prey selection and predatory importance of orb-weaving spiders (Araneae: Araneidae, Uloboridae) in Texas cotton. Environ. Entomol., *18*, 3, p. 373-380.

Nyffeler, M., Dean, D.A., Sterling, W.L., 1992: Diets, feeding specialisation, and predatory role of two lynx spiders, *Oxyopes salticus* and *Peucetia viridans* (Araneae: Oxyopidae), in a Texas cotton agroecosystem. Environ. Entomol., *21*, 6, p. 1457-1465.

Nyffeler, M., Sterling, W.L., Dean, D.A., 1994: How spiders make a living. J. Appl. Ent., *23*, 6, p. 1357-1367.

Oliveira, N., Meierrose, C., Quartau, J.A.: A entomofauna presente numa vinha do Alentejo: diversidade e respostas ao efeito de margem e aplicação diferencial de insecticida. (in prep.)

Provencher, L., Riechert, S., 1994: Model and field test of prey control effects by spider assemblages. Environ. Entomol., *23*, 1, p. 1-17.

QUARTAU, J.A., REBELO, M.T., 1992: Estudos preliminares sobre os cicadelídeos que constituem pragas das vinhas em Portugal (Homoptera, Cicadellidae). Bol. San. Veg. Plagas., *18*, p. 407-417.

RIECHERT, S., BISHOP, L., 1990: Prey control by an assemblage of generalist predators: spiders in garden test systems. Ecology, *71*, 4, p. 1441-1450.

RIECHERT, S., LOCKLEY, T., 1984: Spiders as biological control agents. Ann. Rev. Entomol., *29*, p. 299-320.

ROLTSCH, W., HANNA, R., ZALOM, F., SHOREY, H., MAYSE, M., 1998: Spiders and vineyard habitat relationships in central California. In PICKETT, C.H., BUGG, R.L. (eds): Enhancing Biological Control: habitat management to promote natural enemies of agricultural pests. University of California Press, p. 311-338.