A predator-prey system: Phytoseiulus persimilis (Acari: Phytoseiidae) and Tetranychus urticae (Acari: Tetranychidae): worldwide occurrence datasets

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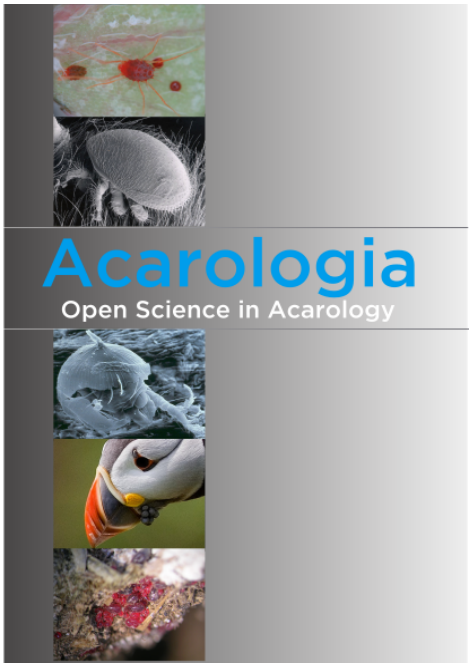

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A predator-prey system: *Phytoseiulus persimilis* (Acari: Phytoseiidae) and *Tetranychus urticae* (Acari: Tetranychidae): worldwide occurrence datasets

Alain Migeon[a] , Marie-Stéphane Tixier[a] , Maria Navajas[a] , Vassilis D. Litskas[b] , Menelaos C. Stavrinides[b]

[a] CBGP, INRA, CIRAD, IRD, Montpellier SupAgro, Univ Montpellier, Montpellier, France.
[b] Cyprus University of Technology, Department of Agricultural Sciences, Biotechnology and Food Science, Arch. Kyprianos 30, Limassol, 3036, Cyprus.

Data paper

ABSTRACT

The predator-prey system *Phytoseiulus persimilis* Athias-Henriot (Acari: Phytoseiidae) and *Tetranychus urticae* (Koch) (Acari: Tetranychidae) represents the most studied and the most known system among the Acari. Because of the agronomical importance of the two mite species, a wealth of modelling studies investigated the interactions of the two species at the individual level. However, regional or global level works on this system are lacking, which is impeding the investigation of climate change effects on biological control effectiveness. Here we compile and geo-locate worldwide occurrences for the two species considered, based on literature, collection and field survey data. The datasets presented in this document gather most of the literature records of both species for which locality data were available for geo-referencing (1,037 for *T. urticae* and 126 for *P. persimilis*). Geo-located data from collections and field surveys including host-plants are also presented for the first time (322 for *T. urticae* and 65 for *P. persimilis*). *Phytoseiulus persimilis* is also reported for the first time from Kenya and La Martinique.

Keywords literature records; collection records; distribution; host-plant; modelling

Introduction

The development of effective biocontrol strategies relies on an in-depth understanding of predator-prey relationships (McMurtry and Croft, 1997). However, while many modelling studies focus at fine scale interactions (Takabayashi *et al.*, 2000; Ellner *et al.*, 2001), few studies address interactions at coarser levels. Furthermore, the investigation of climate change effects on biological control requires studies that expand beyond the local to the regional and global level. Such studies depend however, on the availability of detailed geo-located data on the distribution of both prey and predators.

Among the Acari, due to their economic importance, *Tetranychus urticae* (Koch, 1836) (Acari: Tetranychidae) and its predator *Phytoseiulus persimilis* Athias-Henriot, 1957 (Acari: Phytoseiidae) are the most studied, the most well-known and the most widely distributed prey-predator pair globally. For both species, databases recording host plants (for phytophagous mites) or plant support (for predatory mites) and country level distribution are available (Demite *et al.*, 2018; Migeon and Dorkeld, 2018) but geo-located occurrences are not included in these databases and remain scarce. This lack of information combined with a country scale mapping

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Corresponding author
Alain Migeon: Alain.Migeon@inra.fr

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leads to an over-representation on a global scale as exemplified figures 1 and 2. Furthermore, some reports are made from glasshouses in countries with too harsh winters and unsuitable for outdoor surviving and have no ecological significance.

Tetranychus urticae is the species that attracts the most interest and has generated the greatest number of works among the family Tetranychidae (Vacante, 2015); the Google Scholar query "Tetranychus urticae" returns 50,600 records (Google Scholar October 2018). It has been recorded from 1,140 host plants in 124 countries (Migeon and Dorkeld, 2018). The annual value of pesticides used against the pest represents 400 million dollars (Van Leeuwen *et al.*, 2015).

Meanwhile *P. persimilis* is the species that attracts the most interest and has generated the greatest number of works among predatory mites; the Google Scholar query "*Phytoseiulus persimilis*" returns 10,200 records (Google Scholar October 2018). It has been recorded in 36 countries from all the continents (Demite *et al.*, 2018), but mainly around the Mediterranean Basin especially before its large introduction all over the world for biological control purposes (Kanouh *et al.*, 2010). This predatory mite is mass-produced by biological control companies throughout the world. *Phytoseiulus persimilis* feeds mainly on *T. urticae* and belongs to the specialist class of Phytoseiidae predators, as it is closely associated with its "unique" prey *T. urticae* (McMurtry & Croft, 1997; McMurtry *et al.*, 2015).

Few datasets regarding Phytoseiidae or Tetranychidae have been published. GBIF (2018) gathered 10,572 occurrences of Phytoseiidae, of which only 69% are geo-located. In the GBIF (Global Biological Information Facility, https://www.gbif.org) dataset we found 121 *P. persimilis* records but only 74 with suitable coordinates (match of location and coordinates and 0.1 or more degree precision) and 65 unique locations. Regarding the Tetranychidae, two datasets exist. The first one deals with the genus *Mononychellus* (Vásquez-Ordóñez and Parsa 2014); the second deals with the whole family (Migeon 2015) and provides 271 *T. urticae* records but only 248 with suitable coordinates and 69 unique locations. To fill the gap in the availability of detailed geo-located data for both species, we publish four datasets. Two are issued from literature records and contain the occurrences retrieved for the two mite species considered. The two others contain new unpublished data from our collections and surveys and report occurrences and host plants or plant support for the two species.

Data published through GBIF

The datasets have been deposited in GBIF and are available under the following references:

- *Phytoseiulus persimilis* literature occurrences
  https://www.gbif.org/dataset/6a5bca76-9c9b-4962-acda-c02ddc2292dc
- *Phytoseiulus persimilis* collection records
  https://www.gbif.org/dataset/4367882e-714d-4268-a657-5dd7680eff15
- *Tetranychus urticae* literature occurrences
  https://www.gbif.org/dataset/a9c0892e-0991-4c73-826d-8629cd71d95a
- *Tetranychus urticae* collection records
  https://www.gbif.org/dataset/f7bec8f5-55a8-4dde-9b2e-571fef74bb23

Usage rights

All the datasets are publicly available and copyrighted under the Open Data Commons Attribution License (ODC-By).

Project details

Project title

A predator-prey system: *Phytoseiulus persimilis* (Acari: Phytoseiidae) and *Tetranychus urticae* (Acari: Tetranychidae): worldwide occurrence datasets.

Personnel

Alain Migeon (data manager, data collector, data publisher), Vassilis D. Litskas (data collector), Maria Navajas (supervisor), Menelaos C. Stavrinides (supervisor), Marie-Stéphane Tixier (data manager, data collector).

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Design description

The dataset was developed to increase the knowledge of a predator-prey system at the world scale. It represents the first basic steps necessary to model species distributions and prey-predator interactions at a large scale.

The collections are deposited at CBGP (CBGP, Campus International de Baillarguet, 755 Avenue du Campus Agropolis, CS30016, 34988 MONTFERRIER-sur-LEZ Cedex, France) in INRA (*Tetranychus urticae*) and Montpellier SupAgro (*Phytoseiulus persimilis*) collections.

The literature records were retrieved by Alain Migeon (*Tetranychus urticae*) and Marie-Stéphane Tixier (*Phytoseiulus persimilis*) by geo-referencing localities indicated in the publications.

Taxonomic coverage

Kingdom: Animalia.
Phylum: Arthropoda.
Class: Arachnida.
Order: Parasitiformes.
Family: Phytoseiidae.
Genus: *Phytoseiulus*
Species: *persimilis* Athias-Henriot, 1957

Order: Trombidiformes.
Family: Tetranychidae.
Genus: *Tetranychus*
Species: *urticae* (Koch, 1836)

Temporal coverage

The temporal coverage ranges from the second half of the twentieth century to now for both species.

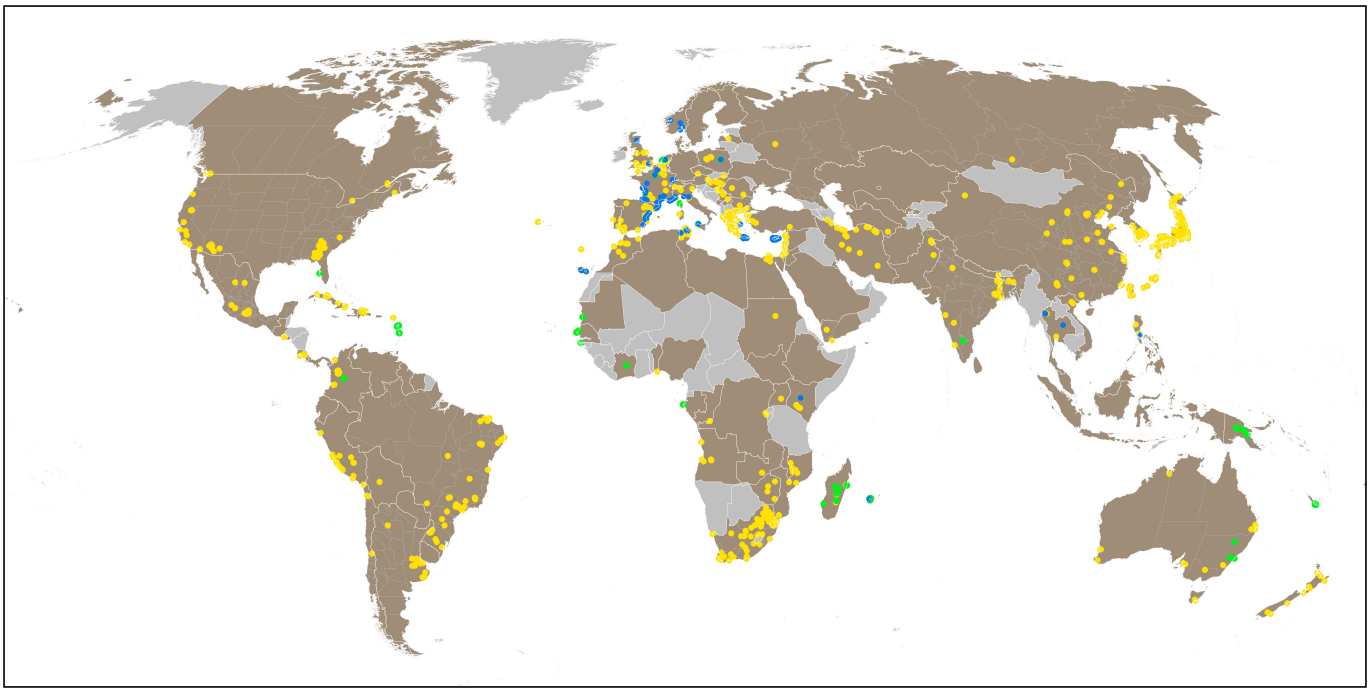

Figure 1 *Tetranychus urticae*. World map representing all the locations included in the dataset. Global literature survey (yellow dots), collections and fields surveys (blue dots). Brown countries indicate literature country records (Migeon and Dorkeld, 2018). Migeon (2015) data (green dots) are also added.

Table 1 Countries for which *Tetranychus urticae* occurrence was not accurate enough to determine the corresponding geographical coordinates and then including them in the dataset.

Continent	Northern America	Southern America	Africa	Europe	Asia Temperate	Asia Tropical	Pacific
Country		Ecuador	Algeria	Finland	Afghanistan	Indonesia	Fiji
		Guatemala	Ethiopia	Germany	Jordan	Malaysia	
		Guyana	Libya	Sweden	Kazakhstan	Vietnam	
		Paraguay	Malawi	Ukraine	Kuwait		
		Suriname	Nigeria		Nepal		
		Uruguay	South Soudan		North Korea		
		Venezuzla			Saudi Arabia		
					Uzbekistan		

Geographic coverage

The spatial coverage differs among the two species.

The known distribution of *T. urticae* is shown in the figure 1 along with the geo-located records. Among the 411 references on *T. urticae* distribution in the Spider Mites Web database (Migeon and Dorkeld, 2018) representing 124 countries, we were able to find 246 references with localities (see Supplementary materials). These references correspond to 96 countries. For 29 countries, the information was not accurate enough to be included in the dataset (Table 1).

The known distribution of *P. persimilis* is reported on figure 2 along with the geo-located records. Among the 86 references dealing with the *P. persimilis* distribution in the Phytoseiidae Database (Demite et al. 2018) representing 36 countries, we were able to find 54 references

with localities (see Supplementary materials). These references correspond to 29 countries. For 17 countries, the information was not accurate enough to be included in the dataset (Table 2). Kenya and Martinique are new records. For two countries (Finland and Hungary), only indoors records were reported and not included in the dataset.

Methods

Method step description

The datasets pool two different data types. (i) All available literature for the two species was analysed. Geographical data (coordinates) were compiled when available. When only textual descriptions of locations were available, occurrence data were assigned using several geolocation tools like GoogleMaps, GeoNames and other gazetteers, completed when necessary by textual search. Each record contains an indication of uncertainty. (ii) Unpublished data from INRA-CBGP collection, SupAgro collection and Cyprus University of Technology, Department of Agricultural Sciences, Biotechnology and Food Science (CUT-ABF) survey

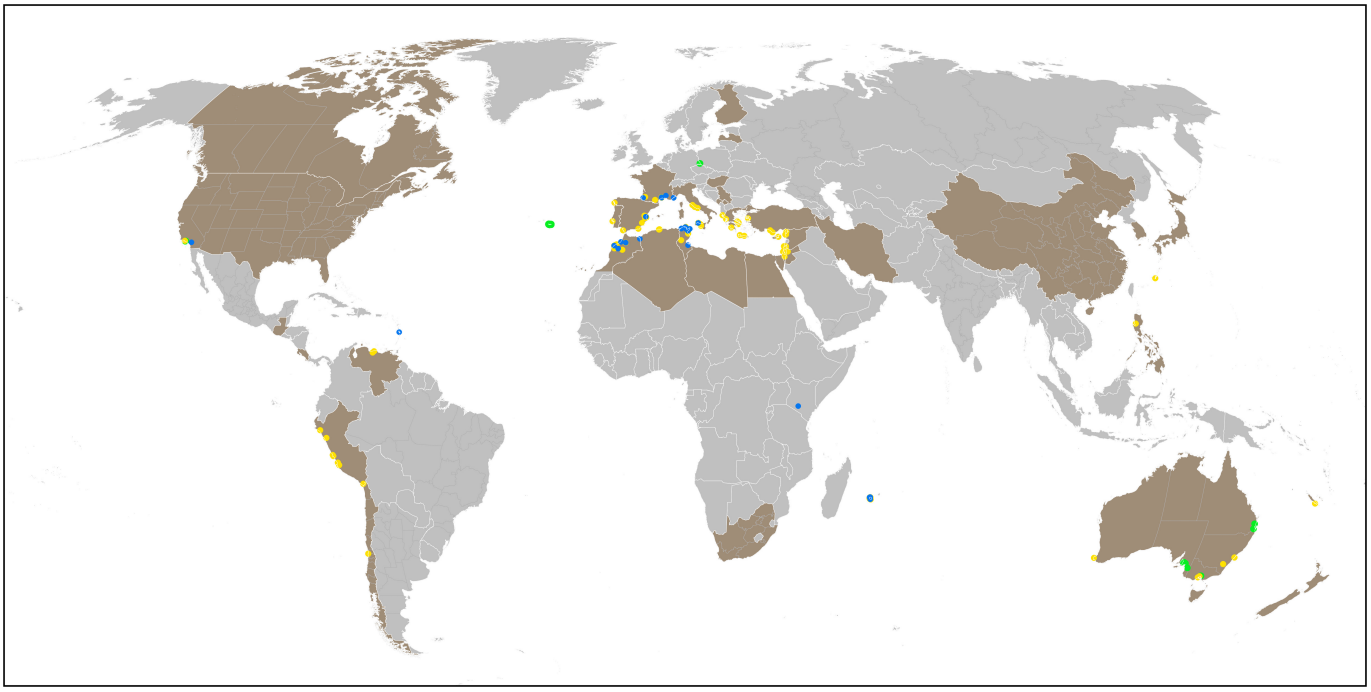

Figure 2 *Phytoseiulus persimilis*. World map representing all locations included in the dataset. Global literature survey (yellow dots), collections and fields surveys (blue dots). Brown countries indicate literature country records (Demite *et al.*, 2018). GBIF (GBIF, 2018) (green dots) are also added.

Table 2 Countries for which *Phytoseiulus persimilis* occurrence was not accurate enough to determine the corresponding geographical coordinates and then including them in the dataset.

Continent	Northern America	Southern America	Africa	Europe	Asia Temperate	Asia Tropical	Australasia	Pacific
Country	Canada	Costa Rica	Canary Is.	Kosovo	China	Indonesia	New Zealand	Fiji
		Guatemala	Egypt	Latvia	Iran			
			Libya	Montenegro	Republic of Korea			
			South Africa	Serbia				

were added for the two species. These latter records are also completed by host (or support) plant when available. To avoid confusions and provide solely "natural records", only records not reported, according to the literature, from glasshouses or indoors supports were used.

The coordinates are in decimal degrees (DD) based on the WGS84 geodetic system. Geographic coordinates were visually verified using the Check Coordinates tool in Diva-GIS (Hijmans *et al.*, 2012) and manual verification (e.g. points in the sea).

Host plant nomenclature is in accordance to current taxonomy reference (The Plant List, 2013).

A total of 1,037 *T. urticae* occurrences were retrieved from literature; 941 of them are unique location records. Unpublished data from INRA-CBGP collection gather 178 occurrences / host plant records. Unpublished data from CUT-ABF gather 144 occurrences / host plant records. Altogether unpublished data represent 212 unique location records.

A total of 126 *P. persimilis* occurrences were retrieved from literature; 103 of them are unique location records. Unpublished data from Montpellier SupAgro-CBGP collection gather 65 occurrences / support plant records. These unpublished data represent 35 unique location records.

Uncertainty issues

Collection and survey records — Location precision was set to 0.001° DD for collection and surveys where recent locations had coordinates records

Literature records — Location precision has been set to 0.001° DD when coordinates or precise locality was indicated in the publication to 0.01 DD when the place was found to correspond to a bigger area (10 to 50 km²). Less precise locations were not recorded.

Dataset

- **Object name** — Darwin Core Archive *Phytoseiulus persimilis* (Acari: Phytoseiidae) and *Tetranychus urticae* (Acari: Tetranychidae): worldwide occurrences records.
- **Character encoding** — UTF-8.
- **Format name** — Darwin Core Archive Format.
- **Format version** — 1.0.
- **Distribution**
  - *Phytoseiulus persimilis* literature occurrences https://www.gbif.org/dataset/6a5bca76-9c9b-4962-acda-c02ddc2292dc
  - *Phytoseiulus persimilis* collection records https://www.gbif.org/dataset/4367882e-714d-4268-a657-5dd7680eff15
  - *Tetranychus urticae* literature occurrences https://www.gbif.org/dataset/a9c0892e-0991-4c73-826d-8629cd71d95a
  - *Tetranychus urticae* collection records https://www.gbif.org/dataset/f7bec8f5-55a8-4dde-9b2e-571fef74bb23
- **Publication date of data** — 2019-08-07
- **Language** — English.
- **License of use** — Open Data Commons Attribution License (ODC-By).

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