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Check list of agrobiont spiders from citrus fields, Amravati region, MS, India

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Abstract
For one year, a research study was conducted in the citrus fields of Amravati region, MS, India, to examine the diversity of agrobiont spiders. A total of 56 species of agrobiont spiders were identified during the study, which belonged to 31 genera and 13 families. These spiders were found in various locations such as ground, litter, crevices, and on vegetation. Among the spider species identified, 21.42% were from the families Araneidae and Salticidae, respectively, 14.28% were from the family Lycocidae, 12.5% were from the family Oxyopidae, 7.14% were from the family Thomisidae, 5.35% were from the family Gnaphocidae, and 3.57% were from the families Clubionidae, Eradicate, and Philodromidae. Additionally, 1.78% of the spider species belonged to each of the following families: Mitergidae, Tetragnathidae, Theridadae, and Uloboridae. The spider population was abundant in the fields, and species richness and diversity were at their highest from August to October.

Keywords: Agrobiont spiders, citrus fields, abundance, diversity

Introduction
Spiders are one of the most fascinating and diverse group of invertebrate animals on the earth. Spiders are among the earliest animals to live on land. They probably evolved about 400 million years ago from thick- waisted Arachnids ancestors. Currently 50,619 species of spiders have been identified in the world (World Spider Catalog 2022) [12]. Spiders can survive in most environments and are polypagous; therefore, they have great biodiversity. Spiders are ubiquitous predators in terrestrial ecosystem and generalist feeders mainly attack on insects and other arthropods. They not only prey on one stage of the prey but eggs, larvae, pupae and adults are fed on. Irrespective of agricultural products it has been observed that most of the spiders are common to citrus fields. Due to variation in vegetation the insect fauna may vary but the abundance and diversity of spiders in any agro-ecosystem indicates that spiders feed on all most all types of insects and keeping the insect population under control naturally. The population densities and species abundance of spider communities in agricultural fields can be as high as in natural ecosystems (Turnbull, 1973; Riechert, 1981 and Tanaka, 1989) [11, 6, 7]. Total of 48 species of spiders were recorded from different locations, at N. M. College of Agriculture, Navsari Agricultural University (NAU) campus Navsari, Gujarat, India. J.N. (Prajapati *et. al.* 2018) [5]. Fathey El-Sayed Soliman *et al.* (2018) [2] reported fifteen species belonging to fifteen genera and twelve families from Lemon agro ecosystem. Also reported that hunting spiders were more abundant than the web building ones, and the most species-rich family was Salticidae.

Spiders are a diverse and intriguing group of invertebrate animals that live on land. They are thought to have evolved from thick-wasted Arachnid ancestors about 400 million years ago, and there are currently over 50,000 known spider species worldwide (World Spider Catalog 2022) [12]. Spiders can thrive in various environments and are generalist feeders that primarily prey on insects and other arthropods at various life stages, including eggs, larvae, pupae, and adults. Citrus fields are particularly popular habitats for spiders, where they help to control insect populations by preying on a variety of species. Spider communities in agricultural fields can have densities and species abundances comparable to those found in natural ecosystems (Turnbull 1973, Riechert 1981, Tanaka 1989) [11, 6, 7]. For instance, Prajapati *et al*. (2018) [5] found 48 spider species in different locations on the N. M. College of Agriculture, Navsari Agricultural University (NAU) campus in Navsari, Gujarat, India. Similarly, Fathey El-Sayed Soliman *et al*. (2018) [2] reported fifteen spider species belonging to twelve families and fifteen genera in the Lemon agro ecosystem, with hunting spiders being more abundant than web-building ones and Salticidae being the most species-rich family.

Spiders have evolved unique adaptations to support their predatory way of life, including feeding on insects and other arthropods. This makes them an important factor in controlling pests. Spiders have a distensible abdomen, allowing them to consume large amounts of food in a short period of time. When food is abundant, their rate of predation can greatly increase.

In the Amravati region, orange production is a major agricultural activity, but crop damage from diseases like Citrus cancer and pests like bugs and mites is common. While farmers often resort to pesticides to control pests, these chemicals are not species-specific and may harm non-harmful insects and arthropods. Additionally, overuse of pesticides can increase pest resistance and cause environmental harm. To address this, it is important to encourage farmers to use natural insecticides like spiders. The goal of this study was to identify and investigate the spider fauna in citrus fields in Amravati, with the aim of promoting spider conservation and augmentation as a simple method of pest control. Farmers should recognize spiders as valuable allies in the fight against harmful pests.

Material and Method

To establish the spider fauna of the citrus fields, a study was conducted between June 2017 and May 2018. Spider specimens were collected weekly as necessary for identification, with only mature spiders being collected to avoid repetition. Spiders were collected from the ground, litter, and vegetation (including citrus plants and other herbs) using various methods. The spiders were identified using the taxonomic keys of Biswas (1984b) [1], Gajbe (1995, 2008) [3], Tikader (1962, 1973, and 1982) [8], Tikader and Biswas (1984) [1], and Zabka (1989) [13].

Observations and Results:

The study identified 56 spider species from 31 genera and 13 families in citrus fields, with a total of 690 specimens collected between June 2017 and May 2018. Female spiders were more common, representing 76.66% of the specimens, while males represented 23.34%. The most abundant families were Araneidae and Salticidae, accounting for 21.42% of the species each, followed by Lycosidae with 14.28%. Oxyopidae had 12.5% of the species, while Thomisidae, Gnaphocidae, Clubionidae, Erecidae, and Philodromidae each had 3.57% of the species. Mitergidae, Tetragnathidae, Theridadae, and Uloboridae had 1.78% of the species each (refer to Table I and II for more details).

The family Araneidae is known for building orb webs that can reach up to two meters in diameter. These spiders typically construct their webs in the evening and dismantle them in the morning, and their webs often capture a large number of small insects. Social spiders, on the other hand, occupy large areas with unkempt webs that also trap a relatively large number of insects and larvae. Gnaphosids and Lycosids are ground-dwelling spiders that can be found in litters or crevices, and they are active hunters that run very quickly to catch their prey. Salticids, although they do not build webs, are hunting spiders that are active in trapping insects and other small arthropods on the ground. Thomisids are often found around flowers, catching insects that come to visit. Oxiopids, meanwhile, build their webs on shrubs where small insects can easily get trapped.

After analyzing diversity and abundance, it was observed that most of the species from the Salticidae family were present throughout the year, with the highest species richness observed from September to November and the lowest in late April and May. The abundance of spiders from the Araneidae family was highest after the rainy season when the flora had flourished and the insect population was at its peak. However, the abundance of other spiders varied depending on the availability of food and seasonal changes. During the rainy season, with the flourishing of seasonal flora and high availability of insects and other arthropods, the abundance and diversity of spiders were at their peak. The species belonging to the families Araneidae, Salticidae, Glycosidase, and Thomisidae were more frequently recorded in the fields.

To conclude, the citrus fields exhibited a remarkable range and number of spider species, with the spider population showing changes in accordance with seasonal variation and food availability. Spiders are able to prey upon a variety of small insects, arthropods, larvae, and eggs, making them key regulators of pest populations in fields. The excessive use of non-species-specific pesticides poses a threat to spiders and their beneficial role in pest control.

Table 1: List of spiders from citrus fields.

Spiders from citrus field	
Family: Araneidae	1) *Araneus mitifica* (Simon) Female
	2) *Argiope* sp. Female. Male.
	3) *Cyclosa bifida* (Doleschall). Female
	4) *Cyclosa insulana* (Costa). Female
	5) Cyclosa *moonduensis* Tikader. Female
	6) *Cyclosa simoni* sp. Male.
	7) *Neoscona bengalensis* Tikader and Bal. F.
	8) *Neoscona mukerjei* Tikader. Female
	9) *Neoscona shillongensis* Female. Male.
	10) *Neoscona theis* Female.
	11) *Neoscona sp*. Female.
	12) *Zygiella indica* Tikader and Bal. F Male.
Family: Clubionidae	13) *Clubiona terrestris* Male.
	14) *Clubiona* sp. Female.
Family: Eresidae	15) *Stegodyphus sarasinorum* Female
	16) *Stegodyphus* sp. Female Male.
Family: Gnaphosidae	17) *Gnaphosa poonaensis* Tikader. Female
	18) *Gnaphosa kailana* Tikader. Female.
	19) *Zelotes kusumae* Female.

Family: Lycosidae	20) *Hippasa agelenoides* (Simon). Female.
	21) *Hippasa lycosina* Pocock. Female.
	22) *Hippasa pisaurina* Pocock. Male.
	23) *Lycosa poonaensis* Female.
	24) *Lycosa shillongensis* Female.
	25) *Lycosa* species Female.
	26) *Pardosa annandalei* (Gravely). Female.
	27) *Pardosa minutus* Tikader and Malhotra. F.
Family: Miturgidae	28) *Chiracanthium* sp. Female
Family: Oxyopidae	29) *Oxyopes burmenicus* (Thorell) Female.
	30) *Oxyopes chittrae* Tikader. Female.
	31) *Oxyopes jabalpurensis* Gajbe &Gajbe. F.
	32) *Oxyopes pankaji* Gajbe and Gajbe. Female
	33) *Oxyopes pawani* Gajbe. Female and Male.
	34) *Oxyopes sp*. Male.
	35) *Peucetia jabalpurensis* Gajbe & Gajbe. F.
Family: Philodromidae	36) *Philodromous* sp. Female
	37) *Thanatus sp.* Female
Family: Salticidae	38) *Euophrys chiriatapuensis* Tikader. Female.
	39) *Euryattus* species female
	40) *Marpissa andamanensis* Female.
	41) *Marpissa bengalensis* Tikader. Female.
	42) *Marpissa decorata* Tikader. Female.
	43) *Marpissa dhakuriensis* Tikader. Female.
	44) *Myrmarachnae poonaensis* Tikader. F.
	45) *Phidippus bengalensis* Female
	46) *Phidippus indicus* Tikader. Female.
	47) *Plexippus paykullii* Female.
	48) *Rhene khandalensis* Female.
	49) *Telamonia dimidiata* (Simon) Female.
Family: Tetragnathidae	50) *Leucage decorata* Female
Family: Theridiidae	51) *Theridion sp.* Female
Family: Thomosidae	52) *Misumena decorata* Female.
	53) *Thomisus andamanensis* Female.
	54) *Thomisus dhakuriensis* Tikader. Female.
	55) *Xysticus minutes* Tikader. Female.
Family: Uloboridae	56) *Uloborus* sp. Female Male

Table 2: Species distribution of agrobiont spider

Sr. No	Family	Common Name	Genera	No. of Species	% species
1	Araneidae	Orb web spider	05	12	21.42
2	Clubionidae	Sac/leaf rolling spider	01	02	03.57
3	Eresidae	Social spider	01	02	03.57
4	Gnaphosidae	Ground spider	02	03	05.35
5	Lycosidae	Wolf spider	03	08	14.28
6	Miturgidae	Dark sac spider	01	01	01.78
7	Oxyopidae	Lynx spider	02	07	12.5
8	Philodromidae	Elongated crab spider	02	02	03.57
9	Salticidae	Jumping spider	08	12	21.42
10	Tetragnathidae	Long jawed spiders	01	01	01.78
11	Theridiidae	Cobweb spider	01	01	01.78
12	Thomisidae	Crab/flower spider	03	04	7.14
13	Uloboridae	Hackled web spider	01	01	01.78
			31	Total – 56	100

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