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Identification, documentation and relative abundance of predatory spider fauna in rice ecosystems of Telangana state

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Abstract

As a part of this study, assessment of spider populations was done in rice ecosystem in different locations of Telangana during 2018-19. A total of 3532 spider samples were collected and identified from six rice growing districts of Telangana. Among 23 species identified, 8 were dominant, 13 were sub-dominant and 2 were satellite species viz., *Arctosa formosana* and *Cheiracanthium sp.* Families Lycosidae, Tetragnathidae and Araneidae collectively accounted for 71.7 per cent of the total spider population collected in Telangana during both seasons. As a dominating species *T. mandibulata* was documented in three zones with the highest species richness levels. District wise species richness suggested that Nalgonda had the highest species richness with 21 species followed by Khammam 19 species, Jagtial 16 species, Nizamabad 16 species and Warangal 15 species. In Telangana, spiders in rice fields exhibited a modest degree of diversity with an equal distribution across all districts. Highest diversity, evenness and richness was found in Nalgonda. Rice ecosystem was dominated by orb weavers (38.8%) and ground runners (35.9%). Significantly high abundance of *Tetragnatha mandibulata*, *T. elongata*, *Lycosa pseudoannulata* and *Araneus inustus* were found throughout the vegetative and reproductive stages of rice crop during *Kharif* and *Rabi* seasons in Telangana.

Keywords: Documentation, Telangana, Spider fauna, Lycosidae, Tetragnatha, diversity, species richness, Shannon index, Simpson index, Abundance, seasonal variance, *Tetragnatha mandibulata*

Introduction

Spiders are the biggest group of arachnids with 44,906 species spread across 114 families and 3,935 genera (World Spider Catalog, 2015). *Sebastian et al.* (2009) ^[1] documented 1520 spider species belonging to 377 genera and 60 families. They are highly suited to particular environs due to their capacity to tolerate times of low food supply as well as thrive on periods of prey abundance. Spiders are also recognized as potential predators in biological pest control in agricultural crops due to their ability to kill a large number of insects per unit time. Their good searching ability, wide host range, adaptation under food constraints, low metabolic rate, ease of multiplication, polyphagous nature and energy conservation mechanism ^[2] is a witnessing factor for their abundance. Spiders are major predators of pests of rice, maize, cotton, apple, banana, and a variety of other crops and plantations. The Gazetteer of India's General Series on Fauna, Eastern Ghats of Southern Andhra Pradesh, recorded 90 species of spiders from 14 families ^[3]. It was stated that spiders in rice fields account for 80 per cent of the overall predatory community. They are a miraculous gift from nature to farmers for controlling insect pest populations in rice fields ^[4]. Spiders are obligate predators and the only major predatory arthropods in the rice habitat ^[5]. In India and worldwide spiders play a vital role in pest management under rice ecosystem ^[5]. It's becoming more and more apparent that spiders play a key role in reducing insect population in the area. Spiders are an important but generally poorly studied group of arthropods that play a significant role in the regulation of insect pests and other invertebrate populations in most ecosystems. Among arthropods, spiders in agro-ecosystems are the least explored, and their distribution and abundance in Telangana less studied. Identification of spider fauna in crop ecosystems of Telangana and documentation of their distribution is need of the hour. In this context the present study was performed and executed to document and quantify the spiders and examine their species diversity, seasonal occurrence and abundance in rice ecosystems of Telangana.

Materials and Method

Location of study area: Studies on spider fauna in rice ecosystem was taken up in Telangana which is located on the Deccan plateau between coordinates 18.1124° N and 79.0193° E. The entire geographical area of the State was 112.08 lakh hectares, ranking it 12th in India. Geographically Telangana state located in semi-arid region with hot and dry environment. The state was physio-geographically split into three agro-climatic zones *viz.*, Northern Telangana Zone (NTZ), Central Telangana Zone (CTZ) and Southern Telangana Zone and the populations of spiders were collected from all the zones.

Collection, identification and documentation of spider fauna: In order to acquire diverse samples of spiders from different parts of Telangana, the locations for collection were selected to cover all the Northern, Central and Southern zones of key rice growing areas of Telangana. The locations for primary collection were Nizamabad and Jagtial in NTZ, Warangal and Khammam in CTZ, and Nagarkurnool and Nalgonda in STZ (Table 1 and Fig. 1). Regular surveys were under taken in all the selected locations two times during the cropping season during *Kharif* and *Rabi* of 2018 and *Kharif* and *Rabi* of 2019. Five fields were

selected from each location during the entire cropping season. The spider population was collected from 10 quadrates (1×1m) from each field selected. The spiders with distinct size/colour/ web were collected first. Later each plant observed for presence of spiders from top to bottom of plant and ground area near the plant with in the quadrate.

Method of samples collection: For collecting and preservation of spiders the methods primarily, the methods described by Tikader (1987) [2] and Barrion and Listinger (1995) [5] were used. The spiders were collected by visual search, sweeping, gently tapping and by beating sheet. The ground area near the plants also searched. Spiders were easily collected by leading them into glass vials (5.2 cm x 2.0 cm) from the ground stratum and from the terminals of the plants. The collected spiders were preserved in 70 per cent ethanol with proper labelling indicating locality date and area from where the specimens were collected. Collected samples of spiders were brought to laboratory, sorted out, counted, identified up to species, genus and family level using stereo microscope. The collected spiders were identified up to the species level with the help of available literature (Tikader, 1987; Barrion and Litsinger, 1995, Sudhikumar *et al.*, 2005, Sebastian *et al.*, 2009, Platnick 2013) [3, 5, 7, 1, 8].



Fig 1: Locations of spider samples collected in Telangana.

Results and Discussion

1. Identification, documentation and abundance of spider fauna in rice ecosystem of Jagtial

Under Northern Telangana Zone, 601 spider individuals were collected during *Kharif* and *Rabi* 2018-19 in Jagtial as part of a roving survey (Table 1). From the collections, a total of 16 species were identified and documented in the rice ecosystem of the Jagtial region of Telangana. There were 28.15 percent of Lycosidae, followed by Tetragnathidae with 12.98 per cent, Pisauridae with 10.31 and Oxyopidae with 5.89 per cent. The

species *T. montana* (n=67) significantly found predominant among both seasons followed by *A. inustus* (n=62), *T. mandibulata* (n=61), *H. carolenensis* (n=60), *D. aquaticus* and *P. milvina* (n=45), *A. maculata* (n=42), *O. salticus* (n=36), *Agelenopsis spp.* (n=32), *Z. spinimana* and *R. grammica* (n=28), *P. pseudoannulata* (n=25), *H. venatoria* (n=24), *E. falcata* (n=20), *D. tenebrosus* (n=18) and *Zygiella indica* (n=8) (Table 1). Shannon-wiener index obtained in *Kharif* (2.616) and *Rabi* (2.681) and Simpson's index in *Kharif* (0.076) and *Rabi* (0.071) indicated that there is high

diversity of spiders in *Rabi* than *Kharif* (Table 7). Similarly, Pielou's evenness index in *Kharif* (0.71) and *Rabi* (0.76) indicated that spiders were evenly distributed in both *Kharif* and *Rabi*, while Margalef species richness index in *Kharif* (2.43) and in *Rabi* (2.83) suggested that there is considerably high species richness in *Rabi* than *Kharif*. During both stages of *Kharif* season the species *T. montana* documented as significantly ($P < 0.05$) predominant species. *Z. spinimana* accounted lowest abundance during the vegetative stage, whereas *P. pseudoannulata* during the reproductive stage. During the vegetative stage of *Rabi* season *A. inustus* and *T. mandibulata* was accounted as the more abundance, whereas the reproductive stage *T. mandibulata* was recorded as more number followed by *A. maculata* and *H. Carolenensis* and *D. tenebrosus* was lowest. The species *Agelenopsis spp.* and *E. falcata* were documented at reproductive stage only.

2. Identification, documentation and abundance of spider fauna in rice ecosystem of Nizamabad.

Under Northern Telangana Zone, a total of 623 spider individuals collected from different locations of Nizamabad, of these 337 during *Kharif* and 286 during *Rabi* 2018-19. The pooled data pertaining to both the seasons resulted that the family Lycosidae was representing with highest percentage 26.97 (n=168), followed by Tetragnathidae 20.55 (n=128), Araneidae 15.57 (n=97), Pisauridae 10.27 (n=64), Agelenidae 6.90 (n=43), Sparassidae 6.74 (n=42), Oxyopidae and Thomisidae 4.49 (n=28) and Zoropsidae 4.01 (n=25) (Table 2). The species *T. mandibulata* (n=65) was recorded as significantly ($P < 0.05$) highest richness among both seasons followed by *T. elongata* (n=61), *A. inustus* (n=56), *H. carolenensis* (n=52), *P. milvina* (n=45), *P. pseudoannulata* (n=44), *Agelenopsis sp.* (n=43), *H. venatoria* (n=42), *Z. notata* (n=41), *D. tenebrosus* (n=39), *O. salticus* and *R. grammica* (n=28), *A. maculata* (n=27) and *Z. spinimana* and *D. aquaticus* (n=25) (Table 2). Shannon-wiener index obtained in *Kharif* (2.651) and *Rabi* (2.655) and Simpson's index in *Kharif* (0.072) and *Rabi* (0.07) indicated that there is high diversity of spiders in *Rabi* than *Kharif*. Similarly, Pielou's evenness index in *Kharif* (0.724) and *Rabi* (0.759) indicated that spiders were evenly distributed in both *Kharif* and *Rabi*, while Margalef species richness index in *Kharif* (2.41) and in *Rabi* (2.48) suggested that there is considerably high species richness in *Rabi* than *Kharif* (Table 7). *T. mandibulata* was regularly found in the field throughout both stages of *Kharif* followed by *T. elongata*. *Z. spinimana* had the lowest abundance during *Kharif* and *Z. notata* during reproductive stage. During vegetative stage of *Rabi* *A. inustus* and *Z. notata* were the richest, while *Z. spinimana* and *O. salticus* were the lowest. During the reproductive stage, *A. inustus* was the most numerous, while *D. aquaticus* and *Z. spinimana* were the least.

3. Identification, documentation and abundance of spider fauna in rice ecosystem of Warangal.

Out of the 514(n) spider individuals collected during survey in Warangal of Central Telangana Zone, 15 spider species were identified from 12 genera and 11 families in rice ecosystem. The pooled data pertaining to both the seasons were significant revealed that the family Tetragnathidae was represented with highest percentage 30.5 (n=157) followed by Lycosidae 29.4 per cent (n=151), Oxyopidae 8.8 per cent (n=45), Araneidae 8.0 per cent (n=41), Theridiidae 4.5 per cent (n=23), Zoropsidae and Thomisidae 4.1 per cent (n=21),

Agelenidae, Sparassidae and Cheiracanthiidae 2.9 per cent (n=15) and Salticidae 1.9 per cent (n=10). The species *T. mandibulata* (n=84) was recorded significantly ($P < 0.05$ Table 3) predominant among both seasons followed by *P. pseudoannulata* (n=67), *O. salticus* and *L. pseudoannulata* (n=45), *T. montana* and *A. inustus* (n=41), *P. milvina* (n=39), *T. elongata* (n=32), *Chryso sp.* (n=23), *Z. spinimana* and *R. grammica* (n=21), *Cheiracanthium sp.*, *Agelenopsis sp.* and *H. venatoria* (n=15) and *E. falcata* (n=10) (Table 3). Shannon-wiener index obtained in *Kharif* (2.546) and *Rabi* (2.208) and Simpson's index in *Kharif* (0.088) and *Rabi* (0.088) indicated that there is high diversity of spiders in *Kharif* than *Rabi*. Similarly, Pielou's evenness index in *Kharif* (0.644) and *Rabi* (0.724) indicated that spiders were evenly distributed in both *Kharif* and *Rabi*, while Margalef species richness index in *Kharif* (2.59) and in *Rabi* (2.96) suggested that there is considerably high species richness in *Rabi* than *Kharif* (Table 7). In both stages of *Kharif* *T. mandibulata* was occurred highest richness followed by *P. pseudoannulata*. The species *E. falcata* was recorded as the lowest abundance during the vegetative stage, whereas *Agelenopsis sp.* during the reproductive stage. During the vegetative stage of *Rabi*, *L. pseudoannulata* was recorded as the highest abundance and *Z. spinimana* was the lowest, whereas during the reproductive stage *P. milvina* recorded as high richness and *H. venatoria* and *E. falcata* were lowest.

4. Identification, documentation and abundance of spider fauna in rice ecosystem of Khammam

A total of 552 spider individuals were collected from different locations of Khammam in Central Telangana Zone, out of these 311 samples were collected during *Kharif* and 241 during *Rabi* 2018-19. 19 species were documented belonging to 15 genera and 12 families from rice ecosystem of Khammam. Family Lycosidae occupied highest percentage 40.9 (n=221) followed by Tetragnathidae 31.1 per cent (n=168), Araneidae 9.6 per cent (n=52), Sparassidae 3.7 per cent (n=20) Cheiracanthiidae 3.3 per cent (n=18), Theridiidae 2.6 per cent (n= 13), Oxyopidae 2.2 per cent (n= 12), Pisauridae and Salticidae 1.8 per cent (n=10), Agelenidae 0.7 per cent (n= 4), Zoropsidae 0.6 per cent (n=3) (Table 4). The species *L. pseudoannulata* (n=107) was recorded as predominant among both seasons followed by *T. mandibulata* (n=65), *T. elongata* (n= 57), *P. pseudoannulata* (n=51), *T. montana* (n=46), *P. milvina* (n=39), *A. maculata* (n=24), *A. inustus* (n=23), *H. venatoria* (n=20), *Cheiracanthium sp.* (n=18), *Z. indica* (n=16), *Z. notata* and *Chryso sp.* (n=13), *O. salticus* (n=12), *E. falcata*, *D. aquaticus* and *R. grammica* (n=10), *Agelenopsis sp.* (n=4) and *Z. spinimana* (n=3) (Table 4). Shannon-wiener index obtained in *Kharif* (2.549) and *Rabi* (2.566) and Simpson's index in *Kharif* (0.098) and *Rabi* (0.089) indicated that there is high diversity of spiders in *Rabi* than *Kharif*. Similarly, Pielou's evenness index in *Kharif* (0.62) and *Rabi* (0.67) indicated that spiders were evenly distributed in both *Kharif* and *Rabi*, while Margalef species richness index in *Kharif* (2.96) and in *Rabi* (2.92) suggested that there is considerably high species richness in *Rabi* than *Kharif* (Table 7). During both stages of *Kharif* the species *L. pseudoannulata* significantly occupied as dominant species followed by *T. mandibulata* ($P < 0.05$).

5. Identification, documentation and abundance of spider fauna in rice ecosystem of Nagarkurnool

Rice ecosystems of Nagarkurnool in southern Telangana Zone

were surveyed and collected 601 spider individuals belonged to 14 genera and 12 families. The pooled data pertaining to both the seasons resulted that the family Lycosidae occupied significantly highest 39.4 per cent (n=237) followed by Tetragnathidae 28.0 per cent (n=168), Araneidae 14.5 per cent (n=87), Oxyopidae 3.8 per cent (n= 23), Agelenidae 2.7 per cent (n=16), Thomisidae 2.5 per cent (n=15), Sparassidae 2.3 per cent (n= 14), Pisauridae 2.2 per cent (n=13), Linyphiidae 2.0 per cent (n= 2.0), Salticidae and Zoropsidae 1.3 per cent (n=8) (Table 5). The species *T. elongata* (n=96) was recorded as predominant among both seasons followed by *P. pseudoannulata* (n=94), *L. pseudoannulata* (n=89), *T. mandibulata* (n=72), *T. montana* (n=46), *P. milvina* (n=39), *A. maculata* (n=24), *A. inustus* (n=23), *H. venatoria* (n=20), *Cheiracanthium sp.* (n=18), *Z. indica* (n=16), *Z. notata* and *Chryso sp.* (n=13), *O. salticus* (n=12), *E. falcata*, *D. aquaticus* and *R. grammica* (n=10), *Agelenopsis sp.* (n=4) and *Z. spinimana* (3) (Table 5). Shannon-wiener index obtained in *Kharif* (2.436) and *Rabi* (2.440) and Simpson's index in *Kharif* (0.104) and *Rabi* (0.069) indicated that there is high diversity of spiders in *Rabi* than *Kharif*. Similarly, Pielou's evenness index in *Kharif* (0.626) and *Rabi* (0.634) indicated that spiders were evenly distributed in both *Kharif* and *Rabi*, while Margalef species richness index in *Kharif* (2.6) and in *Rabi* (2.66) suggested that there is similar species richness in *Kharif* and *Rabi* (Table 7). *P. pseudoannulata* significantly occupied as dominant species followed by *L. pseudoannulata* during both stages of *Kharif* and *Rabi*.

6. Identification, documentation and abundance of spider fauna in rice ecosystem of Nalgonda

A total of 641 spider individuals collected from different locations of Nalgonda in Southern Telangana Zone, out of these 341 spiders collected during *Kharif* and 300 during *Rabi* 2018-19. 21 species were documented belonging to 15 genera and 11 families from rice ecosystems of Nalgonda. Majority of spider individuals belonged to the family Lycosidae, occupied highest percentage 33.2 (n=213) followed by Tetragnathidae 32.1 (n=206), Araneidae 10.8 (n= 69), Pisauridae 5.7 (n=35), Oxyopidae 3.9 (n= 25), Zoropsidae 3.3 (n=21), Sparassidae 3.0 (n= 19), Thomisidae 2.7 (n=17),

Salticidae 2.3 (n=15), Agelenidae 1.9 (n=12), Linyphiidae 1.4 (n= 9) (Table 6). *T. mandibulata* (n= 79) was recorded as dominant among both seasons followed by *L. pseudoannulata* (n=75), *T. elongata* (n=70), *P. pseudoannulata* (n=66), *T. montana* (n=57), *P. milvina* (n=46), *O. salticus* (n=25), *A. inustus* and *Z. spinimana* (n=21), *Z. indica* and *D. tenebrosus* (n=20), *H. venatoria* (n=19), *R. grammica* (n=17), *A. maculata* (n=16), *H. carolenensis* and *D. aquaticus* (n=15), *E. falcata* (n=15), *Z. notata* (n=12), *A. maculata* (n=11) and *A. formosana* (n=9) (Table 6). Shannon-wiener index obtained in *Kharif* (2.818) and *Rabi* (2.749) and Simpson's index in *Kharif* (0.069) and *Rabi* (0.077) indicated that there is high diversity of spiders in *Kharif* than *Rabi*. Similarly, Pielou's evenness index in *Kharif* (0.759) and *Rabi* (0.736) indicated that spiders were evenly distributed in both *Kharif* and *Rabi*, while Margalef species richness index in *Kharif* (3.43) and *Rabi* (3.51) suggested that there is considerably high species richness in *Rabi* than *Kharif* (Table 7). During vegetative stage the species *L. pseudoannulata* documented as dominant species followed by *P. pseudoannulata*, whereas the reproductive stage *T. mandibulata* was recorded as predominant. During both stages of *Rabi* *T. mandibulata* was recorded as the significantly highest abundance.

Out of 3532 collected samples in Telangana, the species *T. mandibulata* (n=426) recorded as predominant species richness followed by *P. pseudoannulata* (n=347), *T. elongata* (n=318), *L. pseudoannulata* (n=316), *P. milvina* (n=268). Pooled data pertaining to Telangana resulted that 23 species were documented belonged to 17 genera and 13 families. Spider genera collected during the study period were classified into eight categories on the basis of mode of predation or attack on the prey. The orb weavers constituted 38.8 per cent of the population, while ground runners comprised 35.9 per cent, Ambushers to an extent of 8.6 per cent, stalkers to 6.9 per cent, sheet web builders to 4.0 per cent, foliage runners comprised 3.8 per cent, space web builders to an extent of 1.0 per cent and sac web builders to 0.9 per cent (Fig.3). Majority of spiders belonged to orb weavers and ground runners were dominated in rice ecosystem of Telangana.

Table 1: Relative abundance and documentation of spider fauna in different stages of rice ecosystem in Jagtial district of Northern Telangana Zone (NTZ) during the year 2018-19

| Family | Genus | Species | Total no. of spiders/ 5 Location/10 quadrants | | | | | | | | | | | | | | |
|------------------|-------------|--------------------------|--|------------------|------------------|----------------|----------|---|------------------|----------------|----------|------------------|---|-----|-------|--|--|
| | | | Kharif -18 | | | | | Rabi-2018-19 | | | | | Pooled data per Year 2018 -19 | | | | |
| | | | Veg.Rep. | Total No./season | Total No./Family | Percent Family | Veg.Rep. | Total No./Season | Total No./Family | Percent Family | No./year | Total No./Family | Per cent Family | | | | |
| 1. Araneidae | Zygiella | <i>Z. indica</i> | 0 | 0 | 0 | 32 | 10.1 | 4 | 4 | 8 | 38 | 12.9 | 8 | 70 | 11.46 | | |
| | Araneus | <i>A. inustus</i> | 12 | 20 | 32 | | | 15 | 15 | 30 | | | 62 | | | | |
| 2.Tetragnathidae | Tetragnatha | <i>T. mandibulata</i> | 14 | 13 | 27 | 67 | 21.1 | 15 | 19 | 34 | 61 | 20.7 | 61 | 128 | 20.95 | | |
| | | <i>T. montana</i> | 18 | 22 | 40 | | | 12 | 15 | 27 | | | 67 | | | | |
| 3. Lycosidae | Hogna | <i>H. carolenensis</i> | 15 | 20 | 35 | 91 | 28.7 | 8 | 17 | 25 | 81 | 27.6 | 60 | 172 | 28.15 | | |
| | Arctosa | <i>A. maculata</i> | 5 | 16 | 21 | | | 5 | 17 | 21 | | | 42 | | | | |
| | Pardosa | <i>P. pseudoannulata</i> | 4 | 6 | 10 | | | 7 | 8 | 15 | | | 25 | | | | |
| | | <i>P. milvina</i> | 10 | 15 | 25 | | | 8 | 11 | 20 | | | 45 | | | | |
| 4. Pisauridae | Dolomedes | <i>D. aquaticus</i> | 13 | 12 | 25 | 35 | 11.0 | 8 | 12 | 20 | 28 | 9.5 | 45 | 63 | 10.31 | | |
| | | <i>D. tenebrosus</i> | 3 | 7 | 10 | | | 2 | 6 | 8 | | | 18 | | | | |
| 5. Thomisidae | Runcinia | <i>R. grammica</i> | 3 | 12 | 15 | 15 | 4.7 | 1 | 12 | 13 | 13 | 4.4 | 28 | 28 | 4.58 | | |
| 6. Oxyopidae | Oxyopes | <i>O. salticus</i> | 5 | 16 | 21 | 21 | 6.6 | 7 | 8 | 15 | 15 | 5.1 | 36 | 36 | 5.89 | | |
| 7. Sparassidae | Heteropoda | <i>H. venatoria</i> | 3 | 9 | 12 | 12 | 3.8 | 3 | 9 | 12 | 12 | 4.1 | 24 | 24 | 3.93 | | |
| 8. Agelenidae | Agelenopsis | <i>Agelenopsis spp.</i> | 3 | 15 | 18 | 18 | 5.7 | 0 | 14 | 14 | 14 | 4.8 | 32 | 32 | 5.24 | | |
| 9. Zoropsidae | Zoropsis | <i>Z. spinimana</i> | 2 | 13 | 15 | 15 | 4.7 | 2 | 11 | 13 | 13 | 4.4 | 28 | 28 | 4.58 | | |
| 10. Salticidae | Evarcha | <i>E. falcata</i> | 0 | 11 | 11 | 11 | 3.5 | 0 | 9 | 9 | 19 | 6.5 | 20 | 30 | 4.91 | | |
| Total (N) | | | 110 | 207 | 317 | | | 97 | 187 | 284 | | | 601 | | | | |
| | | | Kharif= t cal.(3.455) > t. crit.(2.05), two tail = S | | | | | Rabi= t cal.(3.481) > t. crit.(2.045) = S | | | | | Pooled= t cal.(2.482) > t. crit.(2.045) = S | | | | |

NS = Non-significant

*S= Significant (P value < 0.05)

Table 2: Relative abundance and documentation of spider fauna in different stages of rice ecosystem in Nizamabad district of Northern Telangana Zone (NTZ) during year 2018-19

| Family | Genus | Species | Kharif-2018 | | | | Rabi 2018-19 | | | | | Pooled data per Year 2018 -19 | | | |
|-------------------|-------------|--------------------------|-------------|------|------------------|------------------|----------------|------|------|------------------|------------------|-------------------------------|-------------------|------------------|----------------|
| | | | Veg. | Rep. | Total No./season | Total No./Family | Percent Family | Veg. | Rep. | Total No./Season | Total No./Family | Percent Family | Total No. spiders | Total No./Family | Percent Family |
| 1. Araneidae | Zygiella | <i>Z. notata</i> | 15 | 6 | 21 | 44 | 13.5 | 15 | 5 | 20 | 53 | 18.5 | 41 | 97 | 15.57 |
| | Araneus | <i>A. inustus</i> | 10 | 13 | 23 | | | 15 | 18 | 33 | | | 56 | | |
| 2. Tetragnathidae | Tetragnatha | <i>T. mandibulata</i> | 18 | 21 | 39 | 76 | 23.2 | 12 | 14 | 26 | 52 | 18.2 | 65 | 128 | 20.55 |
| | | <i>T. elongata</i> | 17 | 20 | 37 | | | 10 | 16 | 26 | | | 63 | | |
| 3. Lycosidae | Hogna | <i>H. carolenensis</i> | 10 | 19 | 29 | 91 | 27.8 | 8 | 15 | 23 | 77 | 26.9 | 52 | 168 | 26.97 |
| | Arctosa | <i>A. maculata</i> | 4 | 8 | 12 | | | 7 | 8 | 15 | | | 27 | | |
| | Pardosa | <i>P. pseudoannulata</i> | 10 | 15 | 25 | | | 8 | 11 | 19 | | | 44 | | |
| | | <i>P. milvina</i> | 13 | 12 | 25 | | | 8 | 12 | 20 | | | 45 | | |
| 4. Pisauridae | Dolomedes | <i>D. aquaticus</i> | 5 | 10 | 15 | 34 | 10.4 | 4 | 6 | 10 | 30 | 10.5 | 25 | 64 | 10.27 |
| | | <i>D. tenebrosus</i> | 7 | 12 | 19 | | | 8 | 12 | 20 | | | 39 | | |
| 5. Thomisidae | Runcinia | <i>R. grammica</i> | 5 | 8 | 13 | 13 | 4.0 | 7 | 8 | 15 | 15 | 5.2 | 28 | 28 | 4.49 |
| 6. Oxyopidae | Oxyopes | <i>O. salticus</i> | 7 | 9 | 16 | 16 | 4.9 | 3 | 9 | 12 | 12 | 4.2 | 28 | 28 | 4.49 |
| 7. Sparassidae | Heteropoda | <i>H. venatoria</i> | 9 | 15 | 24 | 24 | 7.3 | 6 | 12 | 18 | 18 | 6.3 | 42 | 42 | 6.74 |
| 8. Agelenidae | Agelenopsis | <i>Agelenopsis spp.</i> | 10 | 13 | 23 | 13 | 4.0 | 12 | 8 | 20 | 20 | 7.0 | 43 | 43 | 6.90 |
| 9. Zoropsidae | Zoropsis | <i>Z. spinimana</i> | 6 | 10 | 16 | 16 | 4.9 | 3 | 6 | 9 | 9 | 3.1 | 25 | 25 | 4.01 |
| Total (N) | | | 146 | 191 | 337 | | | 126 | 160 | 286 | | | 623 | | |

Kharif = t cal.(2.84) > t. crit.(2.048), two tail = S Rabi= t cal.(1.601) < t. crit.(2.048) = NS Pooled= t cal.(2.283) > t. crit.(2.051) = S
 NS = Non-significant
 *S= Significant (P value < 0.05)

Table 3: Relative abundance and documentation of spider fauna in different stages of rice ecosystem in Warangal district of Central Telangana Zone (CTZ) during the year 2018-19

| Family | Genus | Species | Kharif-2018 | | | | Rabi-2018-19 | | | | | Pooled data per Year 2018 -19 | | | |
|--------------------|----------------|---------------------------|-------------|------|------------------|------------------|----------------------|------|------|------------------|------------------|-------------------------------|----------------------|------------------|----------------------|
| | | | Veg. | Rep. | Total No./Season | Total No./Family | Percentage of Family | Veg. | Rep. | Total No./season | Total No./Family | Percent of Family | Total No. of spiders | Total No./Family | Percentage of Family |
| 1. Cheiracanthidae | Cheiracanthium | <i>Cheiracanthium sp.</i> | 4 | 8 | 12 | 12 | 4.1 | 0 | 3 | 3 | 3 | 1.3 | 15 | 15 | 2.9 |
| 2. Therididae | Chryso | <i>Chryso sp.</i> | 5 | 10 | 15 | 15 | 5.2 | 3 | 5 | 8 | 8 | 3.6 | 23 | 23 | 4.5 |
| 3. Araneidae | Araneus | <i>A. inustus</i> | 11 | 15 | 26 | 26 | 8.9 | 6 | 9 | 15 | 15 | 6.7 | 41 | 41 | 8.0 |
| | | <i>T. mandibulata</i> | 22 | 30 | 52 | 95 | 32.6 | 14 | 18 | 32 | 62 | 27.8 | 84 | 157 | 30.5 |
| <i>T. elongata</i> | 8 | 10 | 18 | 6 | 8 | | | 14 | 32 | | | | | | |
| <i>T. montana</i> | 10 | 15 | 25 | 7 | 9 | | | 16 | 41 | | | | | | |
| 5. Lycosidae | Pardosa | <i>P. milvina</i> | 6 | 10 | 16 | 74 | 25.4 | 10 | 22 | 32 | 77 | 34.5 | 39 | 151 | 29.4 |
| | | <i>P. pseudoannulata</i> | 15 | 20 | 35 | | | 9 | 13 | 22 | | | 67 | | |
| | Lycosa | <i>L. pseudoannulata</i> | 8 | 15 | 23 | | | 15 | 8 | 23 | | | 45 | | |
| 6. Thomisidae | Runcinia | <i>R. grammica</i> | 3 | 7 | 10 | 10 | 3.4 | 4 | 7 | 11 | 11 | 4.9 | 21 | 21 | 4.1 |
| 7. Oxyopidae | Oxyopes | <i>O. salticus</i> | 9 | 14 | 23 | 23 | 7.9 | 8 | 14 | 22 | 22 | 9.9 | 45 | 45 | 8.8 |
| 8. Sparassidae | Heteropoda | <i>H. venatoria</i> | 2 | 6 | 8 | 8 | 2.7 | 5 | 2 | 7 | 7 | 3.1 | 15 | 15 | 2.9 |
| 9. Agelenidae | Agelenopsis | <i>Agelenopsis sp.</i> | 1 | 5 | 6 | 6 | 2.1 | 3 | 6 | 9 | 9 | 4.0 | 15 | 15 | 2.9 |
| 10. Zoropsidae | Zoropsis | <i>Z. spinimana</i> | 5 | 9 | 14 | 14 | 4.8 | 2 | 5 | 7 | 7 | 3.1 | 21 | 21 | 4.1 |
| 11. Salticidae | Evarcha | <i>E. falcata</i> | 2 | 6 | 8 | 8 | 2.7 | 0 | 2 | 2 | 2 | 0.9 | 10 | 10 | 1.9 |
| Total (N) | | | 111 | 180 | 291 | | | 92 | 131 | 223 | | | 514 | | |

Kharif = t cal.(2.16) > t. crit.(2.051), two tail = S Rabi= t cal.(2.369) > t. crit.(2.056) = S Pooled= t cal.(2.137) > t. crit.(2.051) = S
 NS = Non-significant
 *S= Significant (P value < 0.05)

Table 4: Relative abundance and documentation of spider fauna in different stages of rice ecosystem in Khammam district of Central Telangana Zone (CTZ) during the year 2018-19

| Family | Genus | Species | Kharif-2018 | | | | Rabi-2018-19 | | | | | Pooled data per Year 2018 -19 | | | |
|--------------------|----------------|---------------------------|-------------|------|------------------|------------------|----------------------|------|------|------------|------------------|-------------------------------|----------------|------------------|----------------------|
| | | | Veg. | Rep. | Total No./Season | Total No./Family | Percentage of Family | Veg. | Rep. | No./season | Total No./Family | Percentage of Family | No. of spiders | Total No./Family | Percentage of Family |
| 1. Araneidae | Zygiella | <i>Z. indica</i> | 4 | 5 | 9 | 20 | 6.4 | 4 | 3 | 7 | 32 | 13.3 | 16 | 52 | 9.4 |
| | | <i>Z. notata</i> | 0 | 0 | 0 | | | 6 | 7 | 13 | | | 13 | | |
| | Araneus | <i>A. inustus</i> | 4 | 7 | 11 | | | 6 | 6 | 12 | | | 23 | | |
| 2. Cheiracanthidae | Cheiracanthium | <i>Cheiracanthium sp.</i> | 2 | 3 | 5 | 5 | 1.6 | 5 | 8 | 13 | 13 | 5.4 | 18 | 18 | 3.3 |
| 3. Therididae | Chryso | <i>Chryso sp.</i> | 3 | 5 | 8 | 8 | 2.6 | 3 | 2 | 5 | 5 | 2.1 | 13 | 13 | 2.4 |
| 4. Tetragnathidae | Tetragnatha | <i>T. mandibulata</i> | 20 | 23 | 43 | 106 | 34.1 | 10 | 12 | 22 | 62 | 25.7 | 65 | 168 | 30.4 |
| | | <i>T. elongata</i> | 18 | 25 | 43 | | | 6 | 8 | 14 | | | 57 | | |
| | | <i>T. montana</i> | 7 | 13 | 20 | | | 12 | 14 | 26 | | | 46 | | |
| 5. Lycosidae | Arctosa | <i>A. maculata</i> | 4 | 9 | 13 | 119 | 38.3 | 5 | 6 | 11 | 102 | 42.3 | 24 | 221 | 40.0 |
| | | <i>L. pseudoannulata</i> | 25 | 36 | 61 | | | 21 | 25 | 46 | | | 107 | | |
| | Pardosa | <i>P. pseudoannulata</i> | 12 | 12 | 24 | | | 15 | 12 | 27 | | | 51 | | |
| | | <i>P. milvina</i> | 8 | 13 | 21 | | | 9 | 9 | 18 | | | 39 | | |
| 6. Thomisidae | Runcinia | <i>R. grammica</i> | 3 | 5 | 8 | 8 | 2.6 | 2 | 0 | 2 | 2 | 0.8 | 10 | 10 | 1.8 |
| 7. Oxyopidae | Oxyopes | <i>O. salticus</i> | 5 | 7 | 12 | 12 | 3.9 | 5 | 6 | 11 | 11 | 4.6 | 23 | 23 | 4.2 |
| 8. Sparassidae | Heteropoda | <i>H. venatoria</i> | 4 | 9 | 13 | 13 | 4.2 | 3 | 4 | 7 | 7 | 2.9 | 20 | 20 | 3.6 |
| 9. Agelenidae | Agelenopsis | <i>Agelenopsis spp.</i> | 2 | 2 | 4 | 4 | 1.3 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 0.7 |
| 10. Zoropsidae | Zoropsis | <i>Z. spinimana</i> | 0 | 3 | 3 | 3 | 1.0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0.5 |
| 11. Salticidae | Evarcha | <i>E. falcata</i> | 3 | 6 | 9 | 9 | 2.9 | 1 | 0 | 1 | 1 | 0.4 | 10 | 10 | 1.8 |
| 12. Pisauridae | Dolomedes | <i>D. aquaticus</i> | 1 | 3 | 4 | 4 | 1.3 | 2 | 4 | 6 | 6 | 2.5 | 10 | 10 | 1.8 |
| Total (N) | | | 125 | 186 | 311 | | | 115 | 126 | 241 | | | 552 | | |

Kharif = t cal.(2.243) > t. crit.(2.037), two tail = S Rabi= t cal.(0.337) < t. crit.(2.041) = NS Pooled= t cal.(2.237) > t. crit.(2.035) = S
 NS = Non-significant
 *S= Significant (P value < 0.05)

Table 5: Relative abundance and documentation of spider fauna in different stages of rice ecosystem in Nagarkurnool district of Southern Telangana Zone (STZ) during the year 2018-19

| Family | Genus | Species | Kharif-2018 | | | Rabi-2018-19 | | | | | Pooled data per Year 2018 -19 | | | | |
|---|-------------|--------------------------|--|-----|-------------------|-------------------|----------------------|--|-----|------------------|-------------------------------|----------------------|----------------------|-------------------|-------------------|
| | | | Veg | Rep | Total No./ Season | Total No./ Family | Percentage of Family | Veg | Rep | Total No./season | Total No./ Family | Percentage of Family | Total No. of spiders | Total No./ Family | Percentage Family |
| 1. Araneidae | Zygiella | <i>Z. indica</i> | 3 | 7 | 10 | 48 | 15.1 | 1 | 4 | 5 | 39 | 13.7 | 15 | 87 | 14.5 |
| | Araneus | <i>A. mitificus</i> | 9 | 8 | 17 | | | 7 | 8 | 15 | | | 32 | | |
| | | <i>A. inustus</i> | 8 | 13 | 21 | | | 6 | 13 | 19 | | | 40 | | |
| 2. Tetragnathidae | Tetragnatha | <i>T. mandibulata</i> | 16 | 21 | 37 | 86 | 27.1 | 14 | 21 | 35 | 82 | 28.9 | 72 | 168 | 28.0 |
| | | <i>T. elongata</i> | 20 | 29 | 49 | | | 18 | 29 | 47 | | | 96 | | |
| | | <i>P. milvina</i> | 11 | 16 | 27 | | | 11 | 16 | 27 | | | 54 | | |
| 3. Lycosidae | Pardosa | <i>P. pseudoannulata</i> | 25 | 27 | 52 | 127 | 40.1 | 16 | 26 | 42 | 110 | 38.7 | 94 | 237 | 39.4 |
| | | <i>L. pseudoannulata</i> | 22 | 26 | 48 | | | 19 | 22 | 41 | | | 89 | | |
| | Lycosa | | | | | | | | | | | | | | |
| 4. Pisauridae | Dolomedes | <i>D. aquaticus</i> | 2 | 6 | 8 | 8 | 2.5 | 1 | 4 | 5 | 5 | 1.8 | 13 | 13 | 2.2 |
| 5. Thomisidae | Runcinia | <i>R. grammica</i> | 3 | 5 | 8 | 8 | 2.5 | 2 | 5 | 7 | 7 | 2.5 | 15 | 15 | 2.5 |
| 6. Oxyopidae | Oxyopes | <i>O. salticus</i> | 4 | 7 | 11 | 11 | 3.5 | 5 | 7 | 12 | 12 | 4.2 | 23 | 23 | 3.8 |
| 7. Sparassidae | Heteropoda | <i>H. venatoria</i> | 6 | 3 | 9 | 9 | 2.8 | 2 | 3 | 5 | 5 | 1.8 | 14 | 14 | 2.3 |
| 8. Agelenidae | Agelenopsis | <i>Agelenopsis spp.</i> | 2 | 6 | 8 | 8 | 2.5 | 2 | 6 | 8 | 8 | 2.8 | 16 | 16 | 2.7 |
| 9. Zoropsidae | Zoropsis | <i>Z. spinimana</i> | 1 | 3 | 4 | 4 | 1.3 | 1 | 3 | 4 | 4 | 1.4 | 8 | 8 | 1.3 |
| 10. Salticidae | Evarcha | <i>E. falcata</i> | 0 | 2 | 2 | 2 | 0.6 | 4 | 2 | 6 | 6 | 2.1 | 8 | 8 | 1.3 |
| 11. Linyphiidae | Atypena | <i>A. formosana</i> | 2 | 4 | 6 | 6 | 1.9 | 2 | 4 | 6 | 6 | 2.1 | 12 | 12 | 2.0 |
| Total (N) | | | 134 | 183 | 317 | | | 111 | 173 | 284 | | | 601 | | |
| Kharif = t cal.(0.987) < t. crit.(2.045), two tail = NS | | | Rabi = t cal.(2.385) > t. crit.(2.051) = S | | | | | Pooled = t cal.(2.355) > t. crit.(2.042) = S | | | | | | | |

Table 6: Relative abundance and documentation of spider fauna in different stages of rice ecosystem in Nalgonda district of Southern Telangana Zone (STZ) during year 2018-19

| Family | Genus | Species | Kharif-2018 | | | Rabi-2018-19 | | | | | Pooled data per Year 2018 -19 | | | | |
|--|-------------|--------------------------|--|-----|-------------------|-------------------|----------------------|--|-----|------------------|-------------------------------|----------------------|----------------------|-------------------|-------------------|
| | | | Veg | Rep | Total No./ Season | Total No./ Family | Percentage of Family | Veg | Rep | Total No./season | Total No./ Family | Percentage of Family | Total No. of spiders | Total No./ Family | Percentage Family |
| 1. Araneidae | Zygiella | <i>Z. notata</i> | 2 | 4 | 6 | 35 | 10.3 | 2 | 4 | 6 | 34 | 11.3 | 12 | 69 | 10.8 |
| | | <i>Z. indica</i> | 4 | 6 | 10 | | | 4 | 6 | 10 | | | 20 | | |
| | Araneus | <i>A. mitificus</i> | 3 | 5 | 8 | | | 3 | 5 | 8 | | | 16 | | |
| | | <i>A. inustus</i> | 5 | 6 | 11 | | | 5 | 5 | 10 | | | 21 | | |
| | | | | | | | | | | | | | | | |
| 2. Tetragnathidae | Tetragnatha | <i>T. mandibulata</i> | 15 | 22 | 37 | 100 | 29.3 | 20 | 22 | 42 | 106 | 35.3 | 79 | 206 | 32.1 |
| | | <i>T. elongata</i> | 14 | 21 | 35 | | | 16 | 19 | 35 | | | 70 | | |
| | | <i>T. montana</i> | 10 | 18 | 28 | | | 11 | 18 | 29 | | | 57 | | |
| 3. Lycosidae | Hogna | <i>H. carolenensis</i> | 3 | 5 | 8 | 117 | 34.3 | 3 | 4 | 7 | 96 | 32.0 | 15 | 213 | 33.2 |
| | Arctosa | <i>A. maculata</i> | 2 | 4 | 6 | | | 2 | 3 | 5 | | | 11 | | |
| | | <i>P. milvina</i> | 11 | 15 | 26 | | | 8 | 12 | 20 | | | 46 | | |
| | Pardosa | <i>P. pseudoannulata</i> | 16 | 20 | 36 | | | 14 | 16 | 30 | | | 66 | | |
| | | <i>L. pseudoannulata</i> | 20 | 21 | 41 | | | 15 | 19 | 34 | | | 75 | | |
| 4. Pisauridae | Dolomedes | <i>D. aquaticus</i> | 6 | 4 | 10 | 23 | 6.7 | 3 | 2 | 5 | 12 | 4.0 | 15 | 35 | 5.7 |
| | | <i>D. tenebrosus</i> | 8 | 5 | 13 | | | 4 | 3 | 7 | | | 20 | | |
| 5. Thomisidae | Runcinia | <i>R. grammica</i> | 4 | 6 | 10 | 10 | 2.9 | 2 | 5 | 7 | 7 | 2.3 | 17 | 17 | 2.7 |
| 6. Oxyopidae | Oxyopes | <i>O. salticus</i> | 5 | 8 | 13 | 13 | 3.8 | 5 | 7 | 12 | 12 | 4.0 | 25 | 25 | 3.9 |
| 7. Sparassidae | Heteropoda | <i>H. venatoria</i> | 3 | 7 | 10 | 10 | 2.9 | 3 | 6 | 9 | 9 | 3.0 | 19 | 19 | 3.0 |
| 8. Agelenidae | Agelenopsis | <i>Agelenopsis spp.</i> | 2 | 6 | 8 | 8 | 2.3 | 0 | 4 | 4 | 4 | 1.3 | 12 | 12 | 1.9 |
| 9. Zoropsidae | Zoropsis | <i>Z. spinimana</i> | 3 | 8 | 11 | 11 | 3.2 | 3 | 7 | 10 | 10 | 3.3 | 21 | 21 | 3.3 |
| 10. Salticidae | Evarcha | <i>E. falcata</i> | 2 | 6 | 8 | 8 | 2.3 | 2 | 5 | 7 | 7 | 2.3 | 15 | 15 | 2.3 |
| 11. Linyphiidae | Atypena | <i>A. formosana</i> | 1 | 5 | 6 | 6 | 1.8 | 0 | 3 | 3 | 3 | 1.0 | 9 | 9 | 1.4 |
| Total (N) | | | 139 | 202 | 341 | | | 125 | 175 | 300 | | | 641 | | |
| Kharif = t cal.(2.592) > t. crit.(2.023), two tail = S | | | Rabi = t cal.(2.683) > t. crit.(2.021) = S | | | | | Pooled = t cal.(2.528) > t. crit.(2.035) = S | | | | | | | |

Table 7: Diversity of spider fauna in rice ecosystem of different regions of Telangana in Kharif and Rabi during 2018-19

| Zone | NTZ | | | | CTZ | | | | STZ | | | |
|-------------------------------|---------|-------|-----------|-------|----------|-------|---------|-------|--------------|-------|----------|-------|
| | Jagtial | | Nizamabad | | Warangal | | Khammam | | Nagarkurnool | | Nalgonda | |
| District | Kharif | Rabi | Kharif | Rabi | Kharif | Rabi | Kharif | Rabi | Kharif | Rabi | Kharif | Rabi |
| Season Diversity indices | | | | | | | | | | | | |
| Shannon-Weiner index (H) | 2.616 | 2.681 | 2.651 | 2.655 | 2.546 | 2.508 | 2.549 | 2.566 | 2.436 | 2.44 | 2.818 | 2.749 |
| Simpson's Diversity index (λ) | 0.076 | 0.071 | 0.072 | 0.07 | 0.088 | 0.088 | 0.098 | 0.089 | 0.105 | 0.104 | 0.069 | 0.077 |
| Pielous's evenness index (J) | 0.71 | 0.76 | 0.724 | 0.759 | 0.644 | 0.724 | 0.62 | 0.67 | 0.626 | 0.634 | 0.759 | 0.736 |
| Margalef richness index (D) | 2.43 | 2.83 | 2.41 | 2.48 | 2.47 | 2.59 | 2.96 | 2.92 | 2.6 | 2.66 | 3.43 | 3.51 |

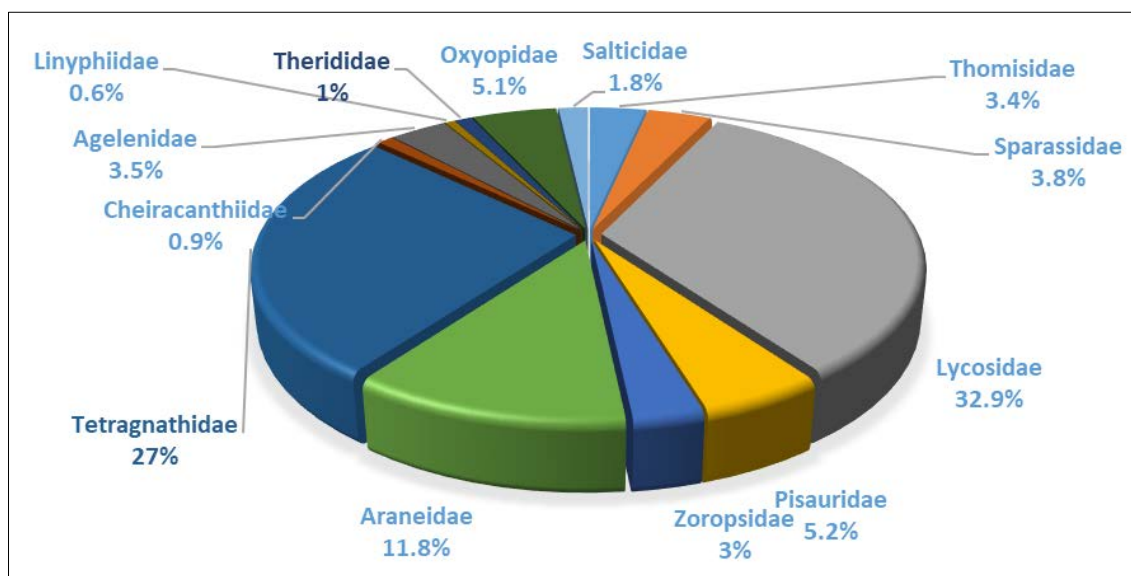


Fig 2: Percentage composition of spider families of Telangana during 2018-19

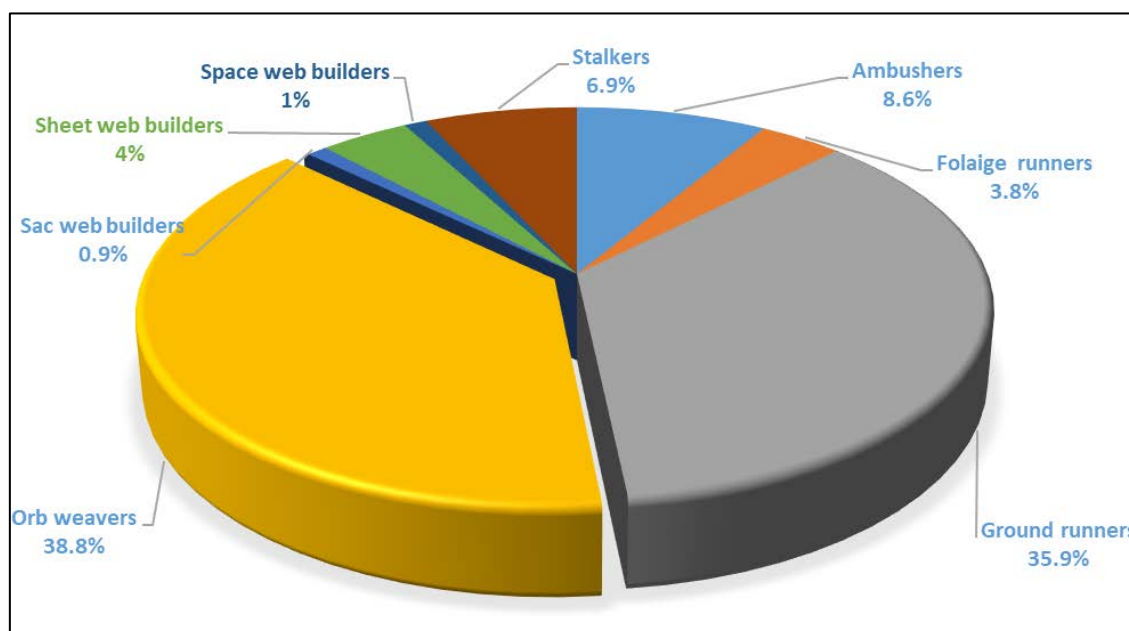


Fig 3: Percentage composition of spider guild structures in Telangana

Conclusions

The present study pertaining to spider fauna in rice ecosystems in different agro-climatic zones of Telangana suggested that, the highest number of species (5) was represented by the family Lycosidae, followed by Araneidae (4) and Tetragnathidae (3), Pisauridae (2). Remaining all families represented by one species each *viz.*, Oxyopidae, Thomisidae, Sparassidae, Agelenidae, Zoropsidae, Salticidae, Linyphiidae, Cheiracanthiidae and Therididae. The pooled data of spiders in rice ecosystems of Telangana indicated that spiders occurred in rice fields exhibited moderate diversity with even distribution in different districts. Spider from Nalgonda district reflected high diversity, evenness and richness followed by Jagtial, Nizamabad, Khammam, Warangal and Nagarkurnool districts (Table 9). The results indicated that the family Lycosidae was predominant followed by Tetragnathidae and Araneidae (Fig.2). The family Lycosidae, Tetragnathidae and Araneidae together contributed 71.7 per cent to the total spider population in both seasons in the Telangana. Among all *T. mandibulata* recorded

as dominant species in all the three zones with highest species richness *i.e.*, NTZ (n=126), CTZ (n=149) and STZ (n=151). The results of abundance and documentation of spiders in rice ecosystem of Telangana were accordance with Yadav *et al.* (2016) [9] who collected a total of 983 individuals belonging to 6 families, 10 genera and 16 species, of these Tetragnathidae constituted highest number (42.8%) followed by Oxyopidae (18.8%), Lycosidae (16.2%), Araneidae (13.0%), Salticidae (5.4%) and Thomisidae (3.8%). These individuals were categorized into four guilds *viz.*, the orb weavers (55.8%), stalkers (24.2%), ground runners (16.2%) and ambushers (3.8%). The highest number of species (5) were belonging to the family Tetragnathidae followed by Oxyopidae and Araneidae (3). Goswami *et al.* (2015) [10] conducted study on quantitative estimation of spider fauna in Bihar and collected 489 individuals of 10 genera belonging to 6 families *viz.*, Lycosidae, Tetragnathidae, Araneidae, Oxyopidae, Salticidae and Thomisidae. Among these *Lycosa pseudoannulata*, *Tetragnatha maxillosa*, *T. javanus* and *Oxyopes javanus* were identified as dominant species.

Sudhikumar *et al.* (2005) ^[11] carried out surveys on spider fauna in rice agro-ecosystem, Kuttanad, Kerala during 2001 to 2003 and collected a total of 17,717 individuals belonging to 94 species, 64 genera and 20 families among that 70 species of 7 families in *Rabi*, 94 species of 20 families in the *Kharif* and 68 species in both crop seasons were documented. The highest number of individuals belongs to family Tetragnathidae followed by Linyphiidae, Lycosidae and Araneidae. The families Tetragnathidae and Linyphiidae constituted 45 per cent, while Lycosidae and Araneidae constituted 31 per cent of the total collection.

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