RJOAS: Russian Journal of Agricultural and Socio-Economic Sciences
ISSN 2226-1184 (Online) | Issue 5(161), May 2025

UDC 632

ABUNDANCE AND DIVERSITY OF SPIDERS AND DRAGONFLIES DURING CAYENNE PEPPER CULTIVATION IN PEATLAND OF PALANGKA RAYA CITY

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ABSTRACT
Kalampangan Village in Palangka Raya City is one of the centers for Cayenne pepper production. Farmers often use chemical insecticides to control pests. However, the continuous use of chemical insecticides reduces the population of natural pest enemies, such as spiders and dragonflies. Preserving these natural enemies is necessary to suppress pest populations. This study aims to determine the abundance and diversity of spiders and dragonflies in Cayenne pepper (Capsicum frutescens) cultivation on peatland. The research was conducted from March to May 2023 in Palangka Raya City. The study took place in a 4,800 m² Cayenne pepper field, divided into four trial plots, each measuring 30 × 40 m². Observations were made at 3–8 Weeks After Planting (WAP). Data were collected using purposive sampling with sweep nets and hand-sorting methods. The biodiversity of spiders and dragonflies was analyzed using the Shannon-Weaver Diversity Index (H'). The results showed a total of 529 individuals, consisting of 329 spiders (4 species) and 200 dragonflies (6 species). The diversity index (H') for spiders and dragonflies was in the moderate category (1.57–1.87), while the dominance index (D) was in the low category (0.21–0.28).

KEY WORDS
Cayenne pepper, spiders, dragonflies, diversity.

Kalampangan Village in Palangka Raya City is one of the cayenne pepper production centers. Cayenne pepper *(Capsicum Frutescens L.*) is widely cultivated on peat soil by farmers because it has a fairly high vitamin C content, can be used as an ingredient in the food and medicine industry, and has a high selling price (Ashour *et al*., 2021; Badan Pusat Statistik Provinsi Kalimantan Tengah. 2024; Salahuddin, 2018). One of the reasons for the low yield of cayenne pepper is pest attacks. Cayenne pepper farmers often use chemical insecticides to control pests. Continuous use of chemical insecticides leads to the decline or local extinction of natural predator populations such as spiders and dragonflies.

Intensive pest control using synthetic insecticides can reduce abundance and species diversity, for example, a decrease in the abundance and diversity of predatory arthropods following application of synthetic insecticides (Biondi *et al.* 2012; Hanif *et al.* 2020). The research results of Melhanah *et al.* (2024) showed that the number of spider populations found on semi-organic chili plants on sandy land in Palangka Raya was relatively high (225 individuals/49.67%), while the dragonflies found were few (12 individuals/2.65%). The research results of S. Sinha *et al* (2018) also showed that there were high populations of spiders (326 individuals/22.56%) and dragonflies (154 individuals/10.54%) on bell peppers in sandy clay soil. The existence of natural enemies of spiders and dragonflies must of course be preserved to suppress pest populations.

Spiders and dragonflies are natural enemies that play an important role in agriculture. There are several types of spiders that are commonly found in agricultural land, including the following: Grass cross spider (*Argiope catenulate*), Dwarf spider (*Atypena formosana*), Wolf spider (*Lycosa pseudoannulata*), Lynx spider (*Oxyopes javanus* T). Spiders can eat any

insect pests, including aphids, armyworms, butterflies, and leafhoppers. Dragonflies are predatory insects, both adults and nymphs, and prey on various types of plant pests, such as stem borers and brown planthoppers (Ansori, 2009).

Environmentally friendly cayenne pepper management is needed to maintain the stability of the cayenne pepper ecosystem, as well as to add a new perspective on predators that must be preserved because they can suppress the population of pests that attack cayenne pepper plants. Therefore, this study was conducted with the aim of following objectives: Knowing the types and number of spider and dragonfly populations and knowing the diversity index and dominance index of spider and dragonfly populations in cayenne pepper plantations in Kalampangan Village, Palangka Raya City.

MATERIALS AND METHODS OF RESEARCH

Field research was carried out in peatland Kalampangan Village, Palangka Raya City, while Laboratory research was conducted at Agronomy Department, Faculty of Agriculture, University of Palangka Raya, Central Kalimantan, from March to May 2023. This research is divided into field study and laboratory experiment. In the field study, the research was carried out in cayenne pepper cultivation owned by four farmers covering an area of 4,800 m2. The land was divided into four plots.

Figure 1 – Map of Kalampangan Village, Sabangau District (Source: Map Data, 2024)

Observations were made at ages 2-8 Week After Planting (WAP). Observations were determined by Purposive Sampling using a sweep net and hand sorting method. Caught arthropods were managed as a dry collection. The arthropods identification was done based on identification books of Shepard, *et al* (2011); Borror, *et al* (1991); and Orr & Kalkman 2015). The data analysis encompassed the following aspects: 1) Abundance of spiders and dragonfly; 2) Diversity index (H'), and Dominance index (D), of spiders and dragonfly. The diversity index and abundance of spiders and dragonflies were analyzed by Shannon-Wiener Index (Zar, 1984). The dominance index calculated by Odum (1971) and Price (1997) *in* Effendi *et al*, 2019).

RESULTS AND DISCUSSION

Based on the research results from six observation periods, the total population of spiders and dragonflies caught in four locations of cayenne pepper plantations was 529 individuals, with details of spiders totaling 329 individuals and dragonflies totaling 200 individuals.

Based on Table 1, the highest spider population found in each observation phase was the Wolf Spider *(L. pseudoannulata*) species with a total of 220 individuals. Wolf Spiders were found under leaf litter and the surface of cayenne pepper soil (Figure 2). According to

Foelix (1996), Wolf spiders are spiders that are very active in hunting prey on the surface of the soil, especially insects that can be paralyzed.

Table 1 – Number of Spider population in each observation phase of Cayenne Pepper Fields in Kalampangan Village, Palangka Raya City

N	Spiders	Age of observation						
	(*Arthropoda Araneae*)	P-1	P-2	P-3	P-4	P-5	P-6	Total
1.	Wolf Spider (*Lycosa pseudoannulata*)	29	36	36	41	36	44	220
2.	The Black House Spider(*Badumna insignis*)	5	10	13	13	15	14	70
3.	Striped Lynx Spider *(Oxyopes salticus)*	0	0	0	1	0	4	5
4.	Stretch spiders (*Tetragnatha isidis*)	0	2	10	11	5	6	34
	Total	34	48	59	66	56	68	329

Information: P1= Final Vegetative Phase (3 WAP); 2. P2= Final Vegetative Phase (4 WAP); P3 = Generative Phase (5 WAP); P4= Generative Phase (6 WAP); P5= Ripe Phase (7 WAP); P6= Ripe Phase (8 WAP) WAP= Week After Planting.

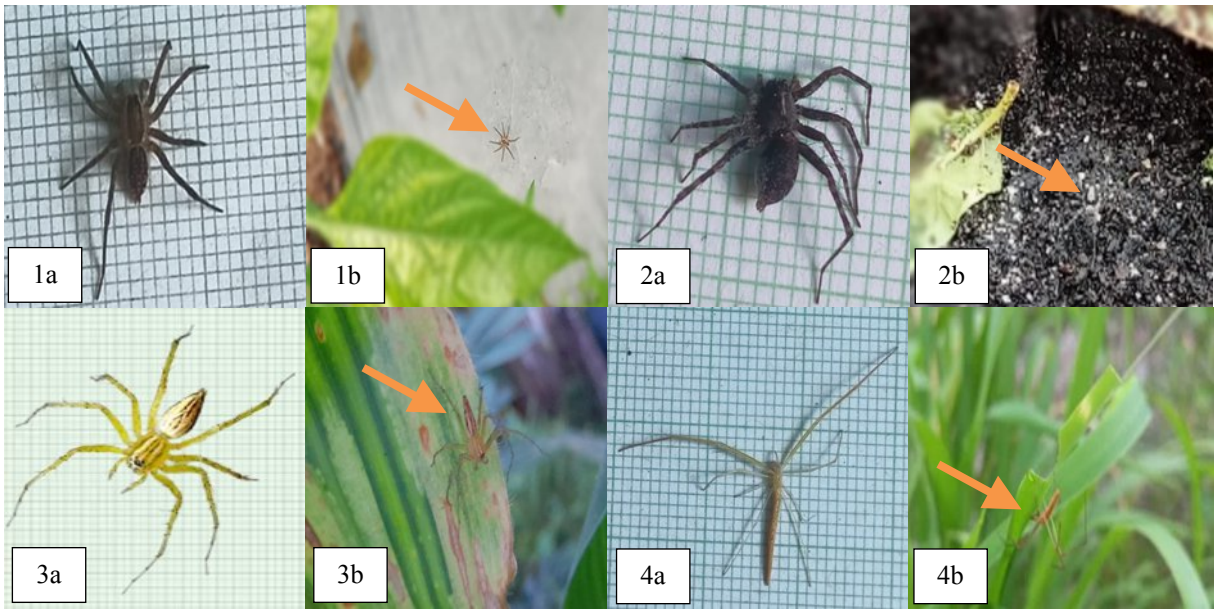

Figure 2 – Spiders found around chili pepper fields. 1a. and b. Wolf Spider (*L. pseudoannulata*); 2a and b. The Black House Spider (*B. insignis*); 3 a and b. Striped Lynx Spider (*O. salticus)*; 4 a and b. Stretch spiders (*T. isidis)*

Table 2 – Number of Dragonfly population in each observation phase of Cayenne Pepper Fields in Kalampangan Village, Palangka Raya City

N	Dragonflies	Age of observation						
	(*Odonata: aranae)*	P-1	P-2	P-3	P-4	P-5	P-6	Total
1.	The scarlet skimmer (*Crocothemis servilia*)	3	5	1	0	5	7	21
2.	The slender skimmer (*Orthetrum sabina)*	3	2	6	5	7	4	27
3.	Ditch jewel (*Brachythemis contaminata*)	5	8	6	9	5	7	40
4.	Yellow-barred Flutterer *(Rhyothemis phyllis*)	14	10	19	15	10	12	80
5.	Wandering midget *(Agriocnemis pygmea)*	5	3	3	1	5	2	19
6.	Small Red Damselfly (*Ceriagrion tenellum)*	0	3	1	3	4	2	13
	Total	30	31	36	33	36	34	200

Information: P1= Final Vegetative Phase (3 WAP); 2. P2= Final Vegetative Phase (4 WAP); P3 = Generative Phase (5 WAP); P4= Generative Phase (6 WAP); P5= Ripe Phase (7 WAP); P6= Ripe Phase (8 WAP) WAP= Week After Planting.

Based on Table 2, the highest dragonflies population found in each observation phase was the Yellow-barred Flutterer dragonfly (*R.phyllis*) with a total of 80 individuals (Figure 3). This dragonfly flies in groups in the cayenne pepper field area, and this dragonfly is only found in the shaded area of cayenne pepper plants and the grass around the cayenne pepper plants.

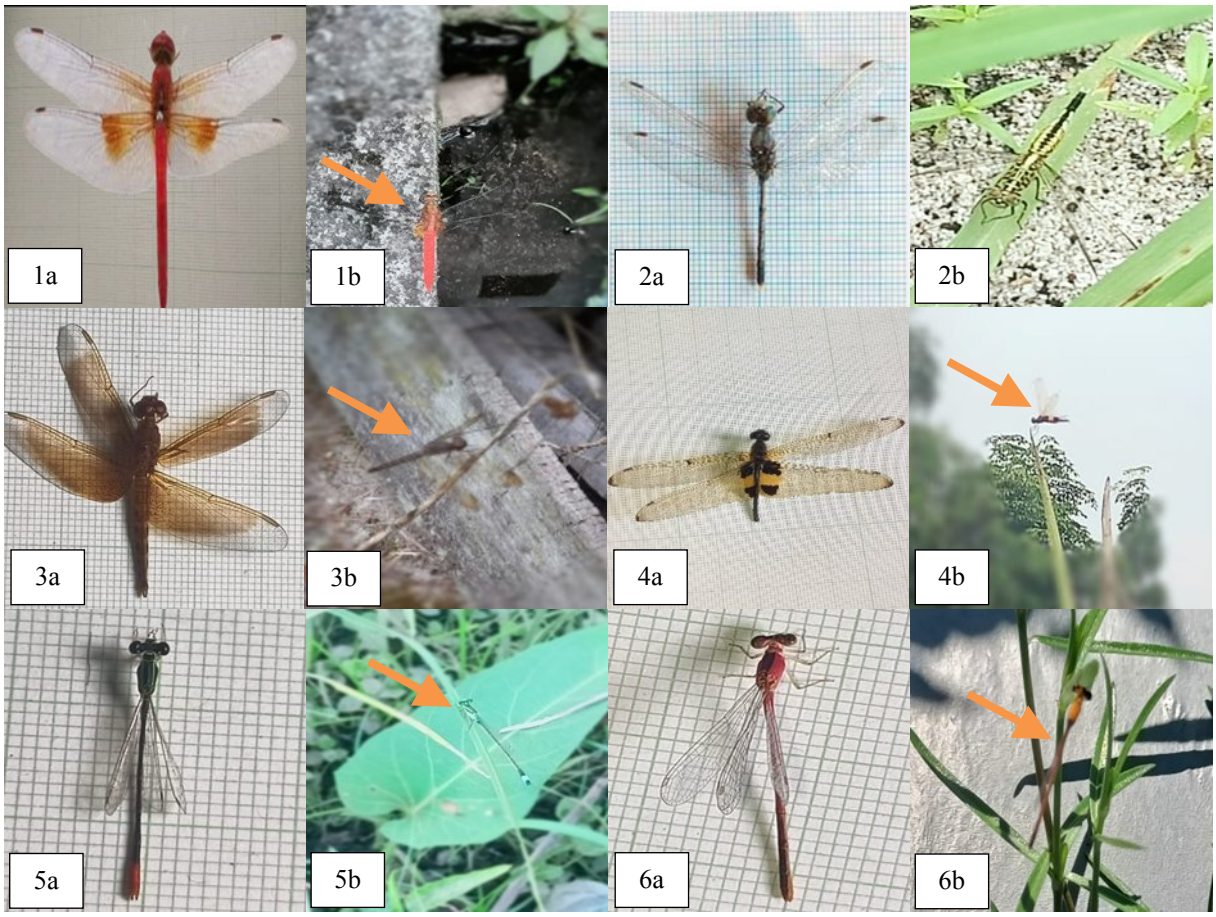

Figure 3 – Dragonflies found around cayenne pepper fields. 1 a and b. The scarlet skimmer (*C. servilia)*; 2 a and b. The slender skimmer (*O. sabina*); 3 a and b. Ditch jewel (*(B. contaminata)*; 4 a and b. Yellow-barred Flutterer (*R. phyllis*); 5 a and b. Wandering midget (*A. pygmea*); 6 a and b. Small Red Damselfly (*C. tenellum*)

Based on Tables 1 and 2, the number of spiders and dragonflies obtained is quite high, a total of 529. According to Jayakumar & Sankari (2010), the abundance of predator species differs based on environmental conditions and predator living habits. Overall, in four locations of cayenne pepper plantations, the identical species of spiders and dragonflies were found even though the observation locations were different. This is because the cultivation system with almost the same plant management is carried out by farmers so that the distribution of dragonflies and spiders is the same in each field.

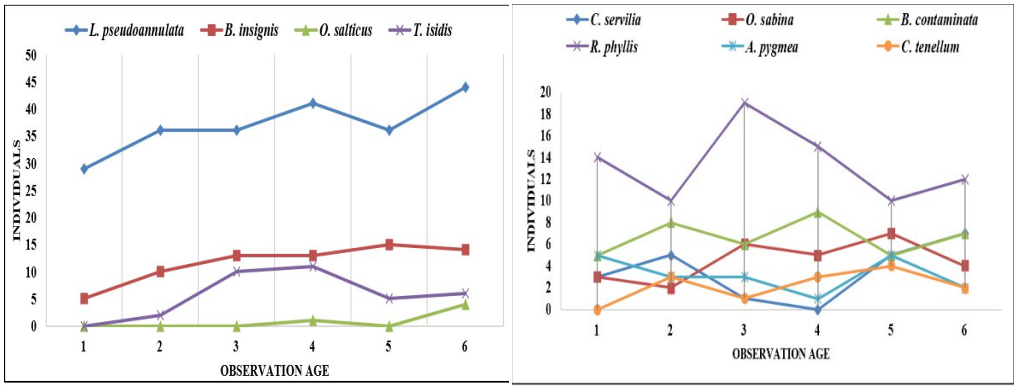

Figure 4 – Graph of population fluctuations of natural enemies at each age of observation; Spider species (Left) and dragonflies spesies (Right). Note: 1. Final Vegetative Phase (3 WAP); 2. Final Vegetative Phase (4 WAP); 3. Generative Phase (5 WAP); 4. Generative Phase (6 WAP); 5. Ripe Phase (7 WAP); 6. Ripe Phase (8 WAP) WAP= Week After Planting

The largest spider population in the ripening phase (8 WAP) was 68 individuals and the most abundant spider species was the Wolf Spider (*L. pseudoannulata*) with 44 individuals. The largest population of dragonflies was found in the generative phase (5 WAP) and the most abundant species is the Yellow-barred Flutterer (*R. phyllis*), numbering 19 individuals. The number of types of spiders and dragonflies in each observation phase of cayenne pepper plants are shown in Figure 4.

The Diversity Index (H') of spiders and dragonflies was classified as moderate (1.58-1.87) (Table 3). According to Wardani *et al* (2015), moderate diversity suggests a relatively low level of ecosystem stability. Karmila (2018) report showed that the arthropod diversity index value in cayenne pepper fields was also in the low category (H'=1.8). Likewise, the results of Melhanah *et al* (2024) showed that the arthropod diversity index (H') values for chili plant canopies and ground surfaces in sandy soil, fell within the moderate diversity category (H' + 1.06-2.48). Low levels of ecosystem stability indicate low numbers of species and individuals and lower diversity.

Table 3 – Diversity Index (H') and Dominance Index (D) of Spiders and Dragonflies in Cayenne Pepper Cultivation

No	Plant Age	H’	Category	D	Category
1.	3 WAP	1,58	Moderate	0,28	Low
2.	4 WAP	1,72	Moderate	0,26	Low
3.	5 WAP	1,75	Moderate	0,22	Low
4.	6 WAP	1,69	Moderate	0,24	Low
5.	7 WAP	1,87	Moderate	0,21	Low
6.	8 WAP	1,73	Moderate	0,25	Low

Information: WAP= Week After Planting.

The Dominance Index (D) of Spiders and Dragonflies was classified as low dominance (0.21-028). Dominant species are species that occur most frequently due to their high abundance. The Wolf Spider (*L. pseudoannulata*) and Yellow-barred Flutterer (*R. phyllis*) species were found in each observation phase with the largest population. Low dominance index values were found in each observation phase. The low dominance value may result from because the four cayenne pepper farmers carry out cultivation and pest control methods that tend to be the same, even though the locations are different resulting in the ecosystem tends to be the same.

The existence and sustainability of these spiders and dragonflies must be maintained, especially from the improper use of synthetic insecticides. Spiders, which serve as biological control agents in agroecosystems and as the main predator group, are one of the most abundant, diverse, and ubiquitous populations in both natural habitats and agriculture (Nyffeler & Sunderland, 2002; Wise, 1993). Dragonflies not only keep the food chain in balance but also serve as bioindicators of the state of the ecosystem. If the environment that is the dragonfly's natural habitat is disturbed or damaged, the dragonfly will react (Susanto, 2023; Buczyń´ski *et al.* 2020).

CONCLUSION

The results showed a population of 529 spiders and dragonflies, consisting of 329 spiders and 200 dragonflies. Four species of spiders were found: wolf spiders (*L.pseudoannulata*), The Black House Spider (B.insignis), Striped Lynx Spider (*O. salticus*), Stretch spiders (*T. isidisskull*). There were 6 species of dragonflies found: The scarlet skimmer (*C. servilia*), The slender skimmer (*O. sabina*), Ditch jewel (*B. ontaminata*), Yellow-barred Flutterer (*R. phyllis*), Wandering midget (*A. pygmea*) and Small Red Damselfly (*C. tenellum*).

The diversity index (H’) was in the moderate category (1.57-1.87) and the dominance index (D) was in the low category (0.21-0.28).

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