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Soil Insect Diversity In The Cultivation Of *Xanthosoma Undipes* K.Koch In Talaga Warna Village, Serang Regency

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Abstract

Talas beneng (*Xanthosoma undipes* K.Koch) is an endemic plant species originating from Banten Province, specifically distributed in Serang Regency. Soil insects are those that inhabit and are active on or within the soil. Information regarding the diversity of soil insects in Talaga Warna Village, particularly within *talas beneng* cultivation areas, remains limited. This study aimed to determine the diversity and functional roles of soil insects associated with *talas beneng* cultivation in Talaga Warna Village, Pabuaran Subdistrict, Serang Regency. The research was conducted from November 2024 to January 2025. This study employed a quantitative descriptive method with an exploratory approach. Sampling was performed using *purposive sampling* with *pitfall traps*. Identified soil insects were analyzed using the Shannon-Wiener diversity index and dominance index. The identification results revealed a total of 326 soil insect individuals collected from the *talas beneng* cultivation habitat, belonging to seven families. The Shannon-Wiener diversity index value obtained was 1.332, indicating moderate diversity. The dominance index value was 0.368, suggesting low dominance within the community. Four ecological roles of soil insects were identified: predator, herbivore, pollinator, and detritivore.

Keywords: *Talas beneng (Xanthosoma undipes), soil insects, biodiversity, agricultural ecology, identification*

INTRODUCTION

Talas beneng (*Xanthosoma undipes* K. Koch) is a tuber crop that originated from the tropical regions of South America. This plant later spread to other tropical regions, including Indonesia, through processes of introduction and adaptation. In Indonesia, *talas beneng* is known as an endemic plant of Banten Province, particularly found in Pandeglang Regency and distributed as far as Serang Regency. *Talas beneng* is a biodiversity plant that grows wild around forests and mountainous areas. Belonging to the family Araceae, this plant is referred to as *talas beneng* ("beneng" meaning large and yellow) due to its large, yellowish-colored tubers, short stem, and mostly subterranean growth habit (Suhaendah *et al.*, 2021).

Talas beneng has a large size and broad leaves, with high carbohydrate and protein content. It has a distinctive yellow color, making it potentially suitable for development into various food products (Haq, 2023). The tuber part of *talas beneng* can serve as an alternative food source to rice, although it has not yet been fully utilized. Not only the tubers but also the leaves can be used as a tobacco substitute, offering the advantage of being free from nicotine content Sugiyanto *et al.*, 2024. Furthermore, according to Hermita *et al.* 2017, as a species within the genus *Xanthosoma*, *talas beneng* has been introduced and developed as a valuable local food resource with potential to support food security.

As noted by Khastini (2018), the ecosystem surrounding *Talas Beneng* is closely influenced by the important role of soil insects. These insects contribute to accelerating the decomposition of organic matter, enhancing soil nutrient availability, and acting as natural pest controllers by preying on the eggs, larvae, or pupae of pest insects in or on the soil surface. A similar view was expressed by Nabilah (2022), who stated that soil insects play a crucial role in the food chain, particularly as decomposers, since without these organisms, nature would be unable to recycle organic materials. Soil insects are involved in determining soil material cycles, thereby facilitating faster decomposition processes within the soil with their presence.

Soil insects are a type of insect that live in the soil and belong to one class within the Insecta subclass. According to Moleong *et al.*, 2023 , soil insects play an important role in the ecosystem, particularly in the breakdown or decomposition of organic soil materials. This is also mentioned by Shelinda *et al.*, 2023 , who state that soil insects in a community act as decomposers of organic matter. The result of this decomposition process is humus, which serves as a valuable nutrient source for plants.

Soil insect diversity refers to the variation in species, abundance, and distribution of insects found either within or on the soil surface, and can serve as an indicator of ecosystem balance. Talaga Warna Village has extensive *talas beneng* cultivation areas due to its high economic value and suitability to the local climate and soil conditions. However, information regarding soil insect diversity in Talaga Warna Village, which is categorized as a lowland area, remains very limited. Moreover, studies examining the roles of soil insects in relation to *talas beneng* cultivation are still scarce. Based on the aforementioned background, it is necessary to conduct research on the diversity of soil insect species and their ecological roles in the *talas beneng* (*Xanthosoma undipes* K. Koch) cultivation areas of Talaga Warna Village, Pabuaran Subdistrict, Serang Regency.

This study aims to identify the diversity of soil insect species in *talas beneng* (*Xanthosoma undipes* K. Koch) cultivation areas and to determine their ecological roles in Talaga Warna Village, Pabuaran Subdistrict, Serang Regency. It is expected that this research will serve as an informative reference regarding the diversity and functional roles of soil insects in relation to *talas beneng* cultivation.

RESEARCH METHODOLOGY

This research was conducted in *talas beneng* cultivation areas owned by local farmers in Talaga Warna Village, Pabuaran Subdistrict, Serang Regency, Banten Province, with the coordinate point at -6.218102, 106.049738. Talaga Warna Village is located at an elevation of 343 meters above sea level (masl), classifying it as a lowland area (<400 masl). The identification of soil insects was carried out at the Laboratory of Basic Sciences and Plant Protection, Faculty of Agriculture, Sultan Ageng Tirtayasa University. The research was conducted from November 2024 to January 2025.

The instruments used in this study included stationery, a stereo microscope, a spade, a measuring tape, scissors, a utility knife (cutter), forceps, name labels no. 103, an insect killing jar (infra board), 380 ml thinwall cups, standing pouches measuring 9 cm x 15 cm, raffia string, and bamboo skewers. The materials used in this study were liquid detergent, 70% alcohol, 96% ethanol, water, and soil insects collected during the research.

This study employed a quantitative descriptive approach using an exploratory method, involving direct observation and field sampling. The focus of the research was to identify soil insects present in the surrounding environment of *talas beneng* cultivation areas. The research subjects included all soil insect species found in the vicinity of *Talas Beneng* fields in Talaga Warna Village, which constituted the target population of this study.

The sampling method used in this study employed *pitfall traps*. As stated by, a pitfall trap is a technique used to assess the density or abundance of ground-dwelling insects and macrofauna. The trap consists of a plastic container (380 ml thinwall cup) buried in the soil, with the rim of the container aligned with the soil surface. Each trap was filled with 10 ml of liquid detergent, followed by the addition of a 70% alcohol solution mixed with water in a ratio of 1:4 per liter.

he traps were filled with this solution up to one-quarter of the volume of the buried thinwall cup. The addition of detergent to the pitfall trap serves to submerge insects that fall into the trap (Rezatinur *et al.*, 2016). Similarly, (Tanjung *et al.*, 2018) stated that the use of detergent helps reduce surface tension, allowing trapped insects to sink and preventing them from escaping to the surface.

A. Sample Collection and Identification

The selection of sampling locations was conducted using purposive sampling, a technique in which sample sites are chosen based on specific criteria. In this study, the primary criterion was based on preliminary observations focusing on the presence of soil insects in talas beneng cultivation areas. Sample collection was carried out using the pitfall trap method, in which traps were installed by burying plastic containers in the soil with the rim aligned to the soil surface to allow easy access for ground-dwelling insects. Sampling was conducted four times, with a three-day interval between each sampling session. After each collection, the pitfall trap solution was refreshed to ensure the continued effectiveness of the traps.

Soil insects captured using pitfall traps were transferred into standing pouches filled with 96% ethanol as a preservative. Subsequently, the soil insects were brought to the laboratory for morphological identification using a stereo microscope, up to the family level. The identification process utilized reference materials such as insect identification manuals and relevant scientific journals.

B. Data Analysis and Processing

The parameters observed in this study included the composition of soil insects captured around the *talas beneng* (*Xanthosoma undipes* K. Koch) cultivation area, the calculation of diversity and dominance indices of the collected samples, and the identification of the ecological role of each identified insect family.

- Composition

The composition of insects was determined by counting the total number of soil insects captured in the *pitfall traps* throughout the study period. The data were then presented in a table, categorized by family.

- Species Diversity

The Shannon-Wiener diversity index was used to assess the species diversity of soil insects collected in each habitat. The index was calculated using the following formula:

$$H' = -\sum_{i=1}^{s}[(pi)(\ln pi)]$$

Explanation:

H' = Shannon-Wiener Diversity Index
Pi = Proportion of individuals of a particular species relative to the total number of individuals in the sample (ni/N)
Ni = Total number of individuals of the first species
N = Total number of all individuals across all species
S = Total number of species

The value categories of the species diversity index are divided into three levels: If the H' value < 1, it is classified as low diversity. If the H' value is between 1 and 3, it is classified as moderate diversity. If the H' value > 3, it is classified as high diversity (Pramudi *et al.*, 2022)

- Dominance

The dominance index is used as a measurement tool to identify the insect species that have the greatest influence within a community. The index is calculated using the following formula:

$$C = \sum_{i=1}^{s} (\frac{ni}{N})^2$$

Explanation:
C = Dominance index
Ni = Number of individuals of each species
N = Total number of individuals across all species

The dominance index (C) is used to assess the degree to which one or a few species dominate within a community. It is categorized into three levels: low dominance ($0 < C \leq 0.5$), moderate dominance ($0.5 < C \leq 0.75$), and high dominance ($0.75 < C \leq 1$) (Krebs, 1978).

RESULTS AND DISCUSSION

The identification results of soil insects collected using the pitfall trap method around the *talas beneng* (*Xanthosoma undipes* K. Koch) cultivation area revealed a total of 326 individuals, belonging to six orders and classified into seven families: Cicindelidae, Formicidae, Gryllidae, Acrididae, Thripidae, Muscidae, and Blattidae.

Based on the data presented in *Table 1*, the composition of soil insects obtained in this study is relatively lower compared to several previous studies. This may be influenced by several factors, one of which is the cultivation method. In the *talas beneng* cultivation area in Talaga Warna Village, a monoculture system is predominantly practiced, resulting in lower vegetation diversity and, consequently, a reduced diversity of soil insect communities. This is supported by the findings of (Tustiyani *et al.*, 2020), who reported that the number of insects found in monoculture chili pepper cultivation was lower, with a total of 1,234 individuals belonging to 7 orders and 11 families, compared to 1,567 individuals from 9 orders and 15 families in polyculture systems. A similar observation was made by Januarisya *et al.*, 2023 , who found that monoculture chili pepper cultivation yielded only 249 insect individuals, whereas polyculture systems resulted in 410 individuals. This difference can be attributed to polyculture systems, which involve growing multiple plant species together, thereby promoting greater biodiversity within the environment.

Table 1. Composition of Soil Insects in *Talas Beneng* Cultivation Areas

No.	Order	Family	Number of Individuals				Total Individuals
			I	II	III	IV	
1.	Coleoptera	Cicindelidae	4	3	3	1	11
2.	Hymenoptera	Formicidae	57	42	39	44	182
3.	Orthoptera	Gryllidae	21	13	18	14	66
		Acrididae	2	4	1	-	7
4.	Thysanoptera	Thripidae	11	7	6	8	32
5.	Diptera	Muscidae	7	4	4	6	21
6.	Blattodea	Blattidae	2	2	1	2	7
	Total		104	75	72	75	326

Another factor contributing to the relatively low composition of insects obtained in the *talas beneng* cultivation area is the high rainfall during the research period. According to (Diyasti & Amalia, 2021), high rainfall can lead to excessive soil moisture, which reduces soil insect activity due to disturbances in nests and microhabitats. In addition to these factors, the use of only one sampling method (pitfall trap) in this study may also have influenced the recorded composition of soil insects. This is supported by (Aryoudi *et al.*, 2015) , who stated that combining pitfall traps with yellow traps placed on surrounding vegetation can yield more comprehensive data: 187 individuals consisting of 8 orders and 18 families from pitfall traps, and 1,544 individuals comprising 10 orders and 35 families from yellow traps.

Table 1 also shows that the family Formicidae, belonging to the order Hymenoptera, was the most abundant insect group collected, with a total of 182 individuals. The availability of food is one of the factors contributing to the high population of Formicidae, particularly due to the use of organic materials in *talas beneng* cultivation practices in Talaga Warna Village. This is in line with the statement by (Romarta *et al.*, 2020), who noted that environments providing abundant food sources, such as nectar, other insects, and organic debris, can significantly increase ant populations within the ecosystem.

Soil Insect Diversity in *Talas Beneng* Cultivation Areas

The results of the Shannon-Wiener diversity index (H') analysis presented in **Table 2** indicate that the soil insect diversity obtained from the *talas beneng* cultivation area in Talaga Warna Village is 1.332, which falls under the moderate diversity category. This is by the statement by (Pramudi *et al.*, 2022) , who classified species diversity index values into three categories: low diversity if H' < 1, moderate diversity if 1 < H' < 3, and high diversity if H' > 3. The moderate diversity category observed in the *talas beneng* habitats in Talaga Warna Village indicates a balanced interaction among various soil insect groups, including predators, decomposers, and herbivores. This interaction helps maintain soil ecosystem stability and prevents the dominance of a single species. This is supported by the statement of Nursafitri (2021), who found that a moderate soil insect diversity index with an H' value of 1.633 in semi-organic citrus orchards indicated the role of soil insects in maintaining agricultural ecosystem balance, including pest control and soil fertility maintenance.

Table 2. Soil Insect Diversity and Dominance Index Based on Family in *Talas Beneng* Cultivation Areas

No.	Family	Number of Individuals	Diversity Index			Dominance Index
			Pi	ln	-(Pi.lnPi)	Pi^2
1.	Cicindelidae	11	0.033742	-3.389	0.114353	0.001138545
2.	Formicidae	182	0.558282	-0.58289	0.325418	0.311679024
3.	Gryllidae	66	0.202454	-1.59724	0.323368	0.040987617
4.	Acrididae	7	0.021472	-3.84099	0.082475	0.000461064
5.	Thripidae	32	0.09816	-2.32116	0.227844	0.009635289
6.	Muscidae	21	0.064417	-2.74237	0.176656	0.004149573
7.	Blattidae	7	0.021472	-3.84099	0.082475	0.000461064
	Jumlah	326			1,332	0,368

Another factor contributing to the moderate (balanced or stable) soil insect diversity index in the talas beneng cultivation area of Talaga Warna Village is the use of organic farming techniques by local farmers, which are free from chemical inputs. This is supported by (Ferdiansyah *et al.*, 2024), who stated that the level of insect diversity index depends largely on the availability of food sources for insects, which in turn is influenced by the vegetation serving as their habitat. Their study also noted that the *talas beneng* cultivation area in Cinyurup Village applied an organic agricultural system without the use of chemical substances. Similarly, research conducted by Sulaminingsih (2024) indicated that the use of organic fertilizers can improve soil health and microbial diversity, thereby supporting the sustainability of the agricultural ecosystem. In addition to organic fertilizer application, the absence of chemical pesticides in pest and weed control, as practiced in the *talas beneng* fields of Talaga Warna Village, also influences the diversity of soil insect species. This is consistent with the findings of (Dirham *et al.*, 2022) , who reported that organic tomato farming systems exhibited higher arthropod diversity due to the use of botanical pesticides. These practices support predator insect populations and reduce pest dominance, ultimately contributing to a more balanced and diverse agroecosystem.

Based on the data presented in Table 2, the dominance index obtained from the *talas beneng* cultivation area is 0.368, which falls into the low dominance category ($0 < C \leq 0.5$). The dominance index is an ecological measure that indicates the extent to which one or a few species dominate a community within an ecosystem. A low dominance index suggests a more even distribution of individuals among insect families in the *talas beneng* cultivation area of Talaga Warna Village. The findings align with those of (Amrulloh *et al.*, 2023) , who stated that a low dominance index indicates a well-distributed species abundance, suggesting the absence of a dominant species within the community. This pattern is commonly linked to ecosystems that are both ecologically stable and biologically diverse.

In the habitat surrounding the *talas beneng* cultivation area, only one family (Formicidae) showed a tendency to begin or potentially dominate in the future. If this trend continues, it may increase the vulnerability of the ecosystem surrounding the *talas beneng* fields. This is consistent with the findings of Houadria *et al.* (2016) who reported that ant (Formicidae) dominance can reduce ecosystem stability, particularly at night when most insect activity peaks. In addition to the impact of predation by ants, intense competition may also reduce the diversity of ant species themselves. According to (Arnan *et al.*, 2018) , the relationship between dominance and diversity varies depending on whether the ant community is native or invaded. In invaded communities, high dominance by non-native species often leads to a decline in species diversity. This occurs because dominant species, such as invasive ants, aggressively compete with native species, thereby reducing species richness within the ecosystem.

Ecological Roles of Soil Insects in *Talas Beneng* Cultivation Areas

The soil insects found in the talas beneng cultivation areas play important ecological roles, particularly in enriching the soil and maintaining ecosystem balance. Based on their functional roles, these insects are categorized as follows: 2 families act as predators, 3 families function as herbivores, 1 family serves as pollinators, and 1 family acts as detritivores..

Table 3. Identification of Soil Insects Based on Their Ecological Roles in *Talas Beneng* Cultivation Areas

Order	Family	Role
Coleoptera	Cicindelidae	Predator
Hymenoptera	Formicidae	Predator
Orthoptera	Gryllidae	Herbivor
	Acrididae	Herbivor
Thysanoptera	Thripidae	Herbivor
Diptera	Muscidae	Polinator
Blattodea	Blattidae	Detrivor

Based on the identification of soil insect roles in *talas beneng* cultivation, several species were found to act as predators. Predator insects are those that prey on other animals for food or nutrients. These insects play a crucial role in agricultural ecosystems, as they can help control pest populations and maintain ecological balance. This aligns with the observation made by (Di *et al.*, 2021) who emphasized that predatory insects feed on pests, such as caterpillars, aphids, and thrips, thereby reducing plant damage without the use of chemical pesticides. This makes predatory insects an effective alternative for biological pest control in sustainable farming systems.

The insects classified under the predatory role include Cicindelidae and Formicidae. Cicindelidae, commonly known as tiger beetles, act as predators that prey on small soil-dwelling insects such as larvae and aphids. This is in line with the statement by Duran & Gough (2020) , who noted that Cicindelidae, both in their adult and larval stages, are aggressive predators that prey on small insects such as spiders, aphids, and other arthropods. This predatory role contributes to pest population control and helps maintain ecological balance, particularly in tropical habitats.

Formicidae, commonly known as ants, play a predatory role in the ecosystem surrounding *talas beneng* cultivation areas. Studies by (Saslidar *et al.*, 2022), indicate that insects in the Formicidae family act as natural predators, contributing to biological control due to their ability to actively capture and consume other insect species. Furthermore, as explained by Halim (2019) , Formicidae is one of the most commonly encountered soil insect families and plays a predatory role in reducing agricultural pest populations. These insects live in large colonies, enhancing their effectiveness in biological pest control.

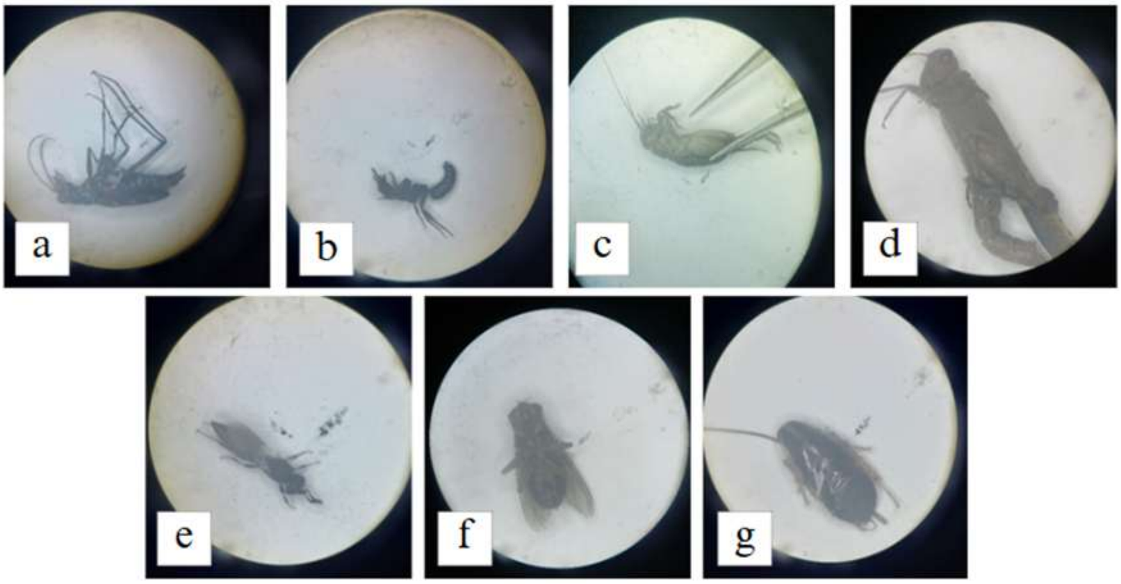

Figure 1. Soil Insects in *Talas Beneng* Cultivation Areas; (a) Cicindelidae, (b) Formicidae, (c) Gryllidae, (d) Acrididae, (e) Thripidae, (f) Muscidae, (g) Blattidae

Soil insects that function as herbivores in the talas beneng cultivation habitat belong to several families, including Grylidae, Acrididae, and Thripidae. According to Efendi (2023) members of the Gryllidae (crickets), Acrididae (grasshoppers), and other herbivorous insect groups primarily feed on plant tissues. When their populations are high, these insects can act as agricultural pests, as their feeding behavior may damage leaves, stems, and other plant parts. The presence of herbivorous insects can significantly reduce crop yields if their populations are not properly managed.

Meanwhile, Thripidae (thrips) are small herbivorous insects that typically attack plant leaves and flowers. These herbivores feed by sucking plant cell contents, which can cause visible damage such as silvering or stippling on the leaf surface. In the study by (Indrayanti et al., 2025), it was noted that thrips cause symptoms such as leaf thickening and curling, drying and blackening of shoot tips, and tissue necrosis, dan nekrosis jaringan. Ecologically, thrips have a significant impact as they are known vectors of devastating plant viruses such as Tomato Spotted Wilt Virus (TSWV). This virus spreads rapidly through thrips populations, causing severe damage to a wide range of crops. However, in the talas beneng cultivation area of Talaga Warna Village, the population of herbivorous insects from these three families remains relatively low. As a result, they have not yet reached pest status or caused significant damage to the crops.

The insect that serves as a pollinator in talas beneng cultivation belongs to the family Muscidae. Ecologically, these insects provide significant benefits as pollinators, particularly in areas where bee populations are limited or insufficient. According to the study by (Trianto et al., 2020), insects from the family Muscidae are highly active in searching for food sources, including nectar and floral exudates from open flowers. This behavior indirectly enables them to act as pollinators, as pollen grains can adhere to their bodies and be transferred to other flowers during movement. Although not considered primary pollinators, Muscidae species still contribute to the pollination process, especially in agricultural environments where bee populations or specialized pollinators are scarce.

The next group of soil insects found in the talas beneng cultivation area plays a detritivorous role, specifically belonging to the family Blattidae (cockroaches). Detritivores are insects that feed on dead organic matter such as dry leaves, plant debris, and dead arthropods. These insects play an essential ecological role in accelerating the decomposition process and recycling nutrients within the soil. This is in line with the statement by (Rubiana et al., 2018) who noted that the activities of detritivorous insects can be categorized into three functions: regulating the population of other organisms, breaking down organic nutrients, and decomposing plant residues. This is further supported by Rubiana & Meilin (2022), who emphasized that insects such as those in the family Blattidae contribute significantly to the breakdown of organic material on the soil surface. Their activity not only supports nutrient cycling but also improves soil structure, enhancing overall soil health and fertility.

CONCLUSION AND RECOMMENDATIONS

Based on the research findings, the composition of soil insects collected from the talas beneng cultivation habitat consisted of 326 individuals, belonging to seven families: Cicindelidae, Formicidae, Gryllidae, Acrididae, Thripidae, Muscidae, and Blattidae. The soil insect diversity index (Shannon-Wiener index) obtained was 1.332, which falls into the moderate diversity category ($1 < H' < 3$). Meanwhile, the dominance index value was recorded at 0.368, placing it within the low dominance category ($0 < C \leq 0.5$). The ecological roles of the identified soil insects include predators (Cicindelidae and Formicidae), herbivores (Gryllidae, Acrididae, Thripidae), pollinators (Muscidae) and detritivores (Blattidae)). It is recommended that further research be conducted on the diversity of soil insect species in talas beneng cultivation using more than one type of trap, such as a combination of pitfall traps, yellow traps, or light traps, to optimize the capture and composition of soil insect samples. In addition, similar studies are better conducted during the dry season to avoid the effects of high rainfall, which can influence insect activity on the soil surface and interfere with trap performance

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