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Sarcosporidiasis in Rat Pests (*Rattus sp*) in People's Oil Palm Plantations in Deli Serdang Regency, North Sumatra

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Abstract

Rats are significant pests in oil palm plantations, attacking nearly all growth stages of the plants and causing damage that adversely affects productivity, leading to substantial losses. The protozoan *Sarcocystis sp*. is a parasite that infects rats and, in sufficient quantities, can cause death in these hosts. This protozoan is naturally present in rats but typically in small amounts. This study aimed to determine the prevalence of sarcosporidiasis (the presence of *Sarcocystis sp*.) in several rat species inhabiting smallholder oil palm plantations in Deli Serdang Regency, North Sumatra. Rat sampling was conducted from June to August 2025 using baited traps. The captured rats were then identified and categorized by species, sex, and weight. *Sarcocystis sp*. infection was detected by observing the presence of 'milky white threads' in the muscles, particularly in the rats' legs. The data obtained were analyzed both descriptively and quantitatively. Results showed that two rat species were captured: Rattus argentiventer and Rattus tiomanicus. Only 29.4% of the captured rats tested positive for the protozoan, of which 63.3% were male and 36.7% were female. All rats testing positive for the protozoan belonged exclusively to the R. tiomanicus species.

Keywords: Parasite, Protozoa, Rodent, Sarcosporidiasis, *Sarcocystis sp*.

1. Introduction

Indonesia is the world's largest producer of palm oil, accounting for the majority of global production. This commodity has a significant impact on the Indonesian economy, contributing to government revenue and creating employment opportunities for local communities.(Siregar et al., 2019). Efforts to increase palm oil production continue; however, oil palm cultivation still faces various challenges, including fertilization issues, drought, and significant pest and disease attacks (Rahutomo et al., 2019). Several types of pests commonly infest oil palm plants, causing damage and losses during both the immature period (TBM) and the productive period (TM). Among these pests is the rhinoceros beetle (Oryctes rhinoceros), which can reduce yields by up to 25% in TM plants and delay harvests from 3 to 4 years to 5 to 7 years in TBM plants (Susanto Agus et al., 2012). Oil Palm Leaf-Eating Caterpillars (UPDKS), such as fire caterpillars, can cause a decrease in fresh fruit bunch (FFB) production of up to 60% (Pahan, 2008). The extent of damage depends on several factors, including the type of pest, the intensity of the attack, the location, and the environmental conditions. (Ouaarous et al., 2025).

Rats are rodents that often become nuisances in residential areas (urban pests) and cause damage to various agricultural and plantation crops. Rat infestations frequently result in significant losses. In oil palm plantations, rats can attack plants at nearly all stages of growth. In young, immature plants (TBM), rats target the growing points or shoots, which can cause the plants to die, resulting in mortality rates of 20% or higher, necessitating replanting. In mature plants, rats consume both young and mature fruit. In young fruit, rats eat all parts, including the core and flesh. In mature fruit, they consume only the flesh, leaving the fibers behind. This damage can directly reduce production by 5% or more, equivalent to over 240 kg.

Palm oil yields/ha/year if the rat population reaches 306 individuals/ha. Rat infestation of fruit can lead to an increase in free fatty acids (FFA). Attacked flowers will result in a low percentage of fruit per bunch (Subiantara et al., 2022). Rats also favor the pupae and larvae *of*

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Elaeidobius kamerunicus found in male flowers of oil palms. As a result of hunting these pollinating insects, male flowers are also damaged. Damage to male flowers and a reduced SPKS population will result in low *fruit set in* oil palms, leading to reduced fruit production (Priyambodo, 2009)

Various control methods have been applied in controlling rats, including sanitation and habitat manipulation, mass and continuous trapping, fumigation/composting, the use of chemical rodenticides, and biologically using owls. (Widiyanto, 2022). In oil palm plantations, rat control strategies such as trapping and fumigation are rarely implemented. Most rats are controlled chemically, using chemical poisons (rodenticides), both acute and chronic. However, in addition to being expensive, the use of chemical rodenticides has negative impacts common to other chemical pesticides, such as soil and ditch/river water pollution, can be dangerous for workers if they don't wear PPE during application, and can kill organisms or animals other than rats.

Growing awareness of the importance of environmental protection and the demands of certification bodies like the RSPO and ISPO have encouraged plantation owners to implement biological control strategies to control rats. Commonly used biological agents include barn owls (*Tyto alba*) and the protozoan *Sarcocystis. Sp. Sarcocystis sp.* is a protozoan parasite on rats. This protozoan has an obligate heteroxenous (dixenous) life cycle, with snakes, specifically Python reticulatus, as the definitive host and rats of the genera Rattus and Bandicota as intermediate hosts (Jäkel et al., 1996). They form cysts (sarcocysts) in the muscles of their intermediate host (rats) and then reproduce into sporocysts in considerable numbers in the intestines of their definitive host or snake (Prakas et al., 2023; Dubey et al., 2015).

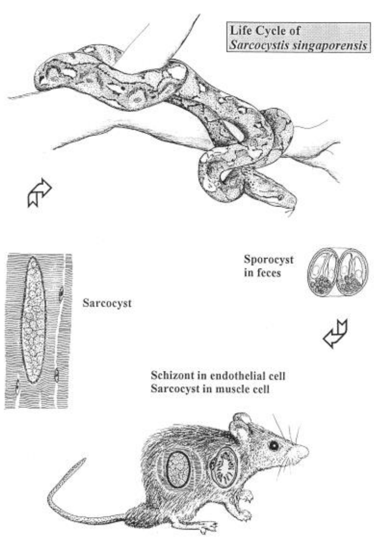

Figure 1. Life cycle *of Sarcocystis sp* .Source: Ginting & Jäkel (2005)

In sufficient quantities, Sarcocystis sp. can be fatal to rats. Research indicates that as few as 100,000 to 300,000 sporocysts can cause death in rats. However, the effectiveness of this protozoan in reducing rat populations has been reported to vary between 55% and 90% within two weeks (Tobing & Siregar, 2009; Reddy & Mehelis, 2015). In nature, this protozoan is naturally found in rats (sarcocystosis) in small quantities, so it does not kill the rats. The effect of this natural infection on rats remains unknown—whether it increases their susceptibility or triggers immunity—thereby influencing the success of Sarcocystis sp. applications in the field. Therefore, baseline information is needed regarding the incidence of sarcocystosis in various species within oil palm plantations.

2. Material and Methods

Rat sampling was carried out in the Mature Plant (TM) area of smallholder oil palm plantations in Deli Serdang Regency in 3 sub-districts, namely Percut Sei Tuan Sub-district located at 3°35'30.6"N and 98°41'43.0"E with an altitude of 15-16 meters above sea level, Pancur Batu Sub-district located at 3°30'50.400"N and 98°35'13.200"E_with an altitude of 12 meters above sea level and Galang Sub-district located at 3.472288 N and 98.853760 E with an altitude of 10 meters above sea level. The sampling locations were determined based on the results of rat infestation detection.

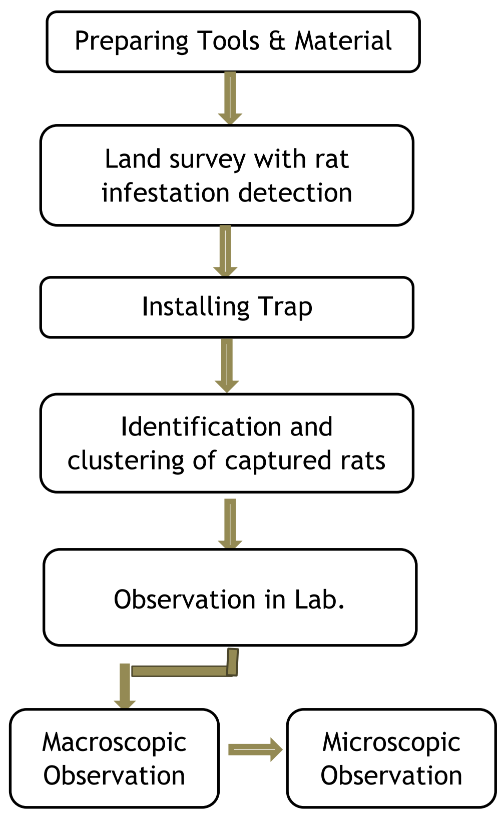

Figure 2. Research Flowchart

Sampling was conducted by placing traps baited with salted fish twice a week at each location from June to August 2025. The rats obtained were then identified using the Rat Identification module (Swastiko, 2021), and their sex, weight and maturity level (adult and juvenile) were recorded. Observation of sarcosporidiasis is carried out in the laboratory by examining the presence of white spots (muddy white threads) in the muscles.

Subcutaneous infection, especially in the legs. This result was followed by a microscopic (Dubey et al., 2015) and anatomical examination of the diaphragm muscle affected by Sarcocystis sp. (Jäkel et al., 1997). Data processing was performed using Microsoft Excel 2016, including data tabulation and graph creation.

3. Results and Discussion

3.1. Types of Rats

Throughout the trapping process, not all traps contained mice, and often none contained mice. Empty traps were frequently found, but the bait was gone. Some traps were even dented or damaged. The final result was 102 mice, as shown in the Table 1.

Table 1. Type, Number and Percentage of Rats Captured

Types of mice	Amount (tail)	Percentage (%)
Rattus argentiventer	18	18
Rattus tiomanicus	84	82
Total	102	100

Table 1 shows that only two types of rats were trapped: Rattus tiomanicus and Rattus argentiventer. According to Subiantara et al (2022) and Pradana et al. (2020), various kinds of rats are often found in oil palm plantations, namely the scrub rat (Rattus tiomanicus), the rice field rat (Rattus argentiventer), and the house rat (Rattus diardii). The absence of house rats in this study is attributed to the research area being located far from settlements, which are the original habitat of these rats.

The rats captured were predominantly *R. tiomanicus* (82%). The dominance of *R. tiomanicus rats* is due, in part, to the fact that this type of rat is also commonly found on plantations, in addition to forests.(Hafidzi & Saayon, 2001) (Ikhsan et al., 2020). The research location, which is covered with bushes, is also a suitable habitat for R. tiomanicus. According to Sudarmaji and Herawati (2009, the bush rat, or Rattus tiomanicus, can be found in grassy land or land with bushes, which is its habitat for nesting and breeding.

The small number of *Rattus argentiventer* caught was due to the research location not being the primary habitat of rats. The *R. argentiventer rat, also known as the rice field rat, inhabits rice fields and their* surrounding areas—settlements during the rice fallow season. The presence of trapped *R. argentiventer rats is attributed* to the research location being adjacent to rice fields.

3.2. Rat Sex Ratio

Data on the sex of the mice of each species caught are shown in Figure 4. Figure 4. shows that in both species, the number of male rats caught is greater than the number of female rats. Research by Fajri et al (2021) in Singingi Riau also yielded the same results, where the number of male rats of both *R. argentiventer* and *R. tiomanicus species* was slightly greater than the number of female rats. The fewer female rats caught does not mean that there are more females than male rats, but this is thought to be because female rats spend more time in the nest than male rats. Anggara et al. (2015) found that female rats typically rest or care for their offspring in the nest, so they are rarely found outside the nest. In contrast, male rats spend more time engaging in other activities, such as exploring, sniffing, digging, watching, and licking their bodies.

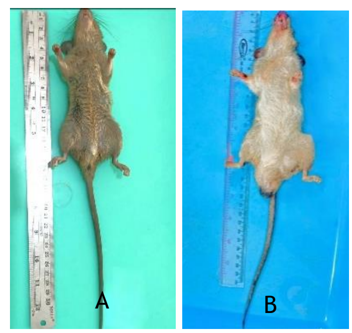

Figure 3. (A) *Rattus argentiventer,* (B) *Rattus tiomanicus*

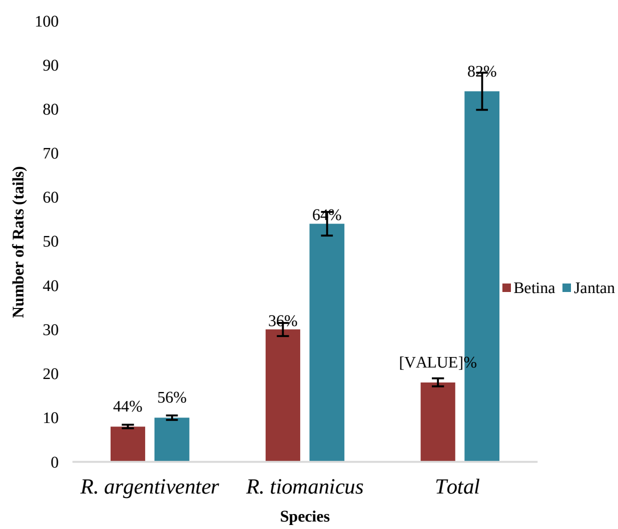

Figure 4. Number and Percentage of Types Rat Sex Based on Species

3.3. Rat Weight

Collecting rat weight data is essential because rat maturity is often measured by body weight. Ikhsan et al. (2020) consider rats mature if they weigh more than 70g and have a higher roaming range than immature rats. The minimum and maximum weights of rats caught for each species are shown in Figure 5.

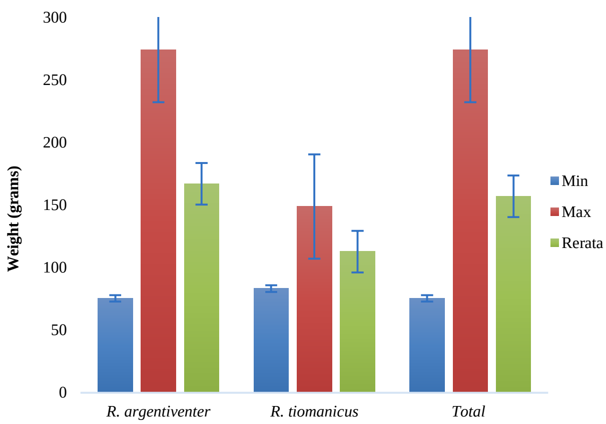

Figure 5. Weight graph (g) of mice by Species

Neither *the R. argentiventer* nor *the R. tiomanicus* rats caught weighed less than 70 grams. Therefore, it can be said that all the rats caught were adults. Kuswardani & Maimunah (2008 found that out of 50 sample rats observed, no young rats weighed less than 70 grams. Meanwhile, Ikhsan et al. (2020) found that the trapped rats were predominantly adult. It is suspected that immature rats spend a considerable amount of time in their nests; their movement area is relatively narrow, and they are unfamiliar with their habitat (Ikhsan et al., 2020). Therefore, the possibility of being caught will be complicated.

3.4. Percentage of Sarcosporidiasis in Mice

The presence of the protozoa *Sarcocystis sp.* in the rat's body is evident in muscle morphology, particularly in the legs, both front and hind legs. The presence of the protozoa is usually indicated by the presence of oval-shaped white spots on the muscles (Figure 6). These white spots are typically found on the legs of the affected rat. In severe cases, these spots can also be found on the back of the neck. Anatomically, the presence of this parasite can be seen by the presence of red spots on the muscle cross-section, as in Figure 7.

Observation data on the number of sarcosporidiasis cases for all captured rats are presented in Table 2. From the Table 2, it can be seen that the total number of rats that tested positive for sarcosporidiasis was 30 (29.4%), and those that tested negative were 72 (70.6%). Of the 30 rats that tested positive, none belonged to the R. argerntiventer species, regardless of sex. Among the rats that tested positive for sarcosporidiasis, 37% were female, and 63% were male. This percentage is relatively small compared to Thailand, where it was reported that in certain areas, almost 100% of wild rats were infected with *Sarcocystis sp.* However, in general, the incidence of sarcosporidiasis is approximately 30% (Jäkel et al., 1997).

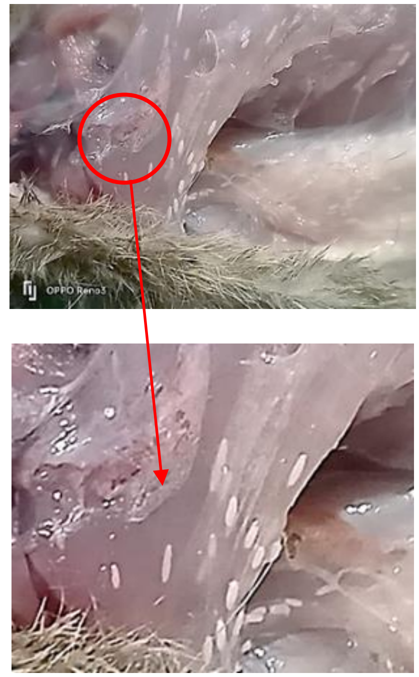

Figure 6. Rats Legs Positive *Sarcocystis sp* (sarcosporidiasis)

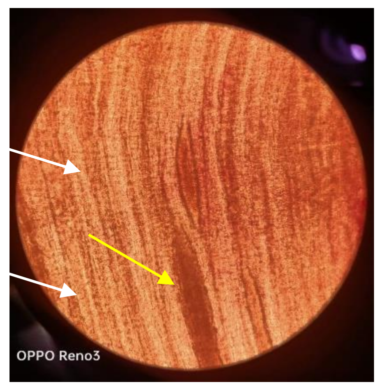

Figure 7. Display Microscopic Muscle Mouse Positive Sarcosporidiasis

Table 2. Number of Sarcosporidiasis in Mouse

Sarcosporidiasis	*R. argentiventer*		*R. tiomanicus*	
	Male	Female	Male	Female
Positive (+)	0	0	19	11
Negative (-)	10	8	35	19

According to Ginting and Jäkel (2005), the percentage of sarcosporidiasis in an area is indirectly related to the presence of *Python reticulatus* (rice field snake), which is the definitive host of *Sarcocystis sp.* Transmission of this protozoan occurs through a predator-prey relationship. The life cycle of *Sarcocystis sp* can only happen if both hosts, namely pythons and rats, are present. The protozoa manifest as cysts in the muscle tissue of rats and complete reproduction in the intestines of pythons after they eat infected rats. (Paperna & Martell, 2000). The sporocysts of this parasite are excreted in the faeces of pythons, and the cycle is completed when the intermediate host ingests the sporocysts. (Devan-Song et al., 2017). Therefore, *Sarcocystis sp* is only found in areas where intermediate and definitive hosts are located.

Although there is a difference in the percentage of sarcosporidiasis between male and female mice, the research results (Tobing & Siregar, 2009 indicate that there is no difference in the results of applying Sarcocystis sp. to male and female mice.

Further research on the effect of Sarcocystis sp application on sarcosporidiasis-positive and negative rats is needed to increase the effectiveness of *Sarcocystis sp* as a biological rodenticide.

4. Conclusion

Of the 102 mice, 29.4% tested positive for sarcocystiasis, while 70.6% tested negative. None of the mice, male or female, tested positive for R. argentiventer.

There is limited research on sarcosporidiasis in Indonesia, particularly within oil palm plantations. The results of this study can serve as a basis for dosage recommendations when applying biorodenticides containing the active ingredient Sarcocystis sp. However, further research is necessary to determine the effect of sarcosporidiasis on rat resistance to this biorodenticide..

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