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Identification of White Grub Pests (*Coleoptera: Scarabaeidae*) on Six Sweet Potato Cultivars (*Ipomoea batatas* L.)

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ABSTRACT

Sweet potato (*Ipomoea batatas* L.) is an important agricultural commodity and serves as an alternative food source. White grubs are among the major pests attacking sweet potato plants and can cause a decline in external tuber quality. This study aimed to identify white grub species infesting six sweet potato cultivars. The research was conducted from July to November 2024 on farmers' agricultural fields. An experimental method was employed using a Randomized Block Design (RBD) consisting of six cultivars as treatments, with four replications, resulting in 24 experimental units. The treatments were K1 (Lato-lato), K2 (Cilembu), K3 (Thailand), K4 (Potato), K5 (Ase), and K6 (Purple). The results showed that two white grub species infested all sweet potato cultivars, namely Phyllophaga sp. and Leucopholis sp., which belong to the family Scarabaeidae, order Coleoptera. The Purple cultivar exhibited the lowest mean population, with 8.5 individuals, whereas the Ase cultivar showed the highest mean population, with 16 individuals. White grub infestation primarily reduced the external appearance quality of sweet potato tubers; however, the tubers remained suitable for consumption.

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is one of the major food crops widely cultivated and serves as an important source of carbohydrates after wheat, rice, maize, and cassava. In addition to its role as a staple food, sweet potato provides various health benefits, including anti-infective, anticancer, anti-inflammatory, antidiabetic properties, and support for the healing of atherosclerotic wounds (Elmaniar & Muhtadi, 2017). According to Ji et al. (2015), based on tuber flesh color, sweet potato is classified into four types: white, yellow, orange and purple-fleshed sweet potatoes.

Based on data from the Center for Agricultural Data and Information (2023), sweet potato production in Indonesia has declined over the past five years. In 2018, national production reached 1,806,389 tons, but it decreased to its lowest level in 2022, amounting to 1,511,041 tons. According to NTB Satu Data (2023), sweet potato production in West Lombok Regency also declined during the 2018–2022 period. This decrease is reflected in production figures, which fell from 1,000.50 tons to 886.04 tons. Such declines may be attributed to a reduction in harvested area and increased attacks by plant pest organisms (PPOs).

Market demand for sweet potato is generally high; however, current production has not yet been able to meet this demand. According to Erari (2022), one of the main factors contributing to low sweet potato productivity is the high incidence of pest and disease attacks. As reported by Saleh et al. (2015), various pests, including insects, mites, and aphids, can infest leaves, stems, roots, and tubers.

White grubs are among the pests that attack sweet potato plants during the generative phase. White grubs are the larval stage of beetles belonging to the family Scarabaeidae; they live in the soil and feed on plant tubers. Infestation by this pest can cause severe damage to sweet potato plants, particularly during the tuber formation stage, thereby directly reducing yield quality (Virman, 2016). The most severe damage to sweet potato caused by white grub infestation is generally attributed to third-instar larvae, which damage tubers by feeding on them. According to Saragih (2009), symptoms of white grub attack are characterized by bite marks on the tuber skin surface, leading to a decline in tuber quality and market value.

Morphological variation among sweet potato cultivars may influence their level of resistance to white grub infestation. Cultivars with harder tuber skin textures are generally more resistant to attack than those with

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softer skins. In addition, tuber size and shape also play important roles, as small and uniform tubers tend to experience less damage than large and irregularly distributed tubers. The color of the tuber skin and flesh is also presumed to affect the feeding preference of white grubs. Based on field surveys and interviews with sweet potato farmers in West Lombok Regency, six cultivars are commonly cultivated in the area, namely Ase, Thailand, Lato-lato, Purple, Cilembu, and Potato cultivars (Yasmin et al., 2024).

In Indonesia, studies on the identification of white grub pests on sweet potato remain limited. However, high-intensity infestations of these larvae can cause serious damage, leading to a decline in external appearance quality and overall yield (Saragih, 2009). Therefore, this study entitled *"Identification of White Grub Pests (Coleoptera: Scarabaeidae) on Six Sweet Potato Cultivars (Ipomoea batatas L.)"* was conducted.

This research focuses on identifying white grub pests infesting six sweet potato cultivars. The objective of the study was to determine the species of white grub pests attacking the six sweet potato cultivars. The research hypothesis proposes that several species of white grub pests infest the six sweet potato cultivars.

MATERIALS AND METHODS

This study was conducted from July to November 2024 in Sigerongan Village, Lingsar Subdistrict, West Lombok Regency. The research employed an experimental method with direct field observations. The experimental design used was a Randomized Block Design (RBD), with cultivar (K) as the treatment factor. The treatments consisted of K1 (Lato-lato), K2 (Cilembu), K3 (Thailand), K4 (Potato), K5 (Ase), and K6 (Purple). A total of six treatments were applied with four replications, resulting in 24 experimental units.

The equipment used in this study included wooden boards, bamboo, sickles, hoes, a digital camera, stationery, raffia string, knives/cutters, measuring tape, a microscope, an analytical balance, a digital caliper, 200 mL thin-wall containers, forceps, and Petri dishes. The materials used consisted of planting materials of six sweet potato cultivars (Lato-lato, Cilembu, Thailand, Potato, Ase, and Purple), NPK fertilizer (16–16–16), label paper, and 70% alcohol.

The research activities included land preparation, establishment of experimental plots, preparation of planting materials, planting, crop maintenance, and harvesting. Land preparation was carried out by clearing weeds and tilling the soil using a hoe to loosen soil clods. Experimental plots (raised beds) were constructed for planting sweet potato cuttings, with a height of 30 cm, a length of 100 cm, a width of 88 cm, and a spacing of 30 cm between beds. Planting material preparation involved selecting healthy and normal sweet potato plants at least two months old, then cutting vine cuttings 25–30 cm in length or consisting of 3–4 nodes from the apical part of the stem, with a maximum of three cuttings per vine, using a sharp knife. Planting was conducted in the afternoon by inserting the cuttings obliquely into the soil. Each raised bed was planted with eight cuttings, with a spacing of 20 cm between plants and 20 cm between plants and the edge of the bed.

Crop maintenance included fertilization, irrigation, replanting, weeding, and vine turning. Fertilization was carried out before planting (basal fertilization) and after planting (top dressing) when the sweet potato plants were 45 days after planting (DAP), using NPK 16–16–16 fertilizer at a rate of 40 g per bed. Irrigation was conducted four times at one-month intervals and performed manually by channeling water from ditches into the sweet potato field. Replanting was carried out up to two weeks after planting (WAP) to replace dead or non-growing plants. Weeding was conducted when weeds were abundant in the sweet potato field. Vine and shoot turning was performed at six weeks after planting, with an interval of once every three weeks. Harvesting was carried out when the sweet potatoes were four months old, when the tubers had reached physiological maturity.

Sampling was conducted once after harvest using a zigzag method, resulting in four sample plants. The observed parameters included white grub population, attack symptoms, and attack intensity. Attack intensity was assessed by identifying tubers showing symptoms of white grub damage, counting the number of infested tubers, and determining the damage scale. White grub population was observed by hoeing the post-harvest beds, then collecting and counting the number of grubs found. The collected white grub samples were subsequently reared to confirm species identification.

The following formula was used to calculate the percentage of relative damage according to the Directorate of Food Crop Protection (2018):

$$IS = \Sigma \frac{(ni \times vi)}{N \times Z} \times 100\%$$

Notes:

IS = Attack intensity (%)

ni = Number of infested tubers
vi = Scale value of each attack category
N = Total number of observed tubers
Z = Highest scale of the predetermined attack categories

After calculating the attack intensity, the scale, attack category, and damage description can be determined.

Table 1. Attack Scale and Plant Damage Levels

Scale	Attack Kategory (%)	Demage Class
0	0%	Healthy
1	≤ 25%	Light
2	> 25% - ≤ 50%	Moderate
3	> 50% - ≤ 75%	Severe
4	> 75% - ≤ 100%	Very Severe

The data were then analyzed using analysis of variance (ANOVA). When the analysis indicated significant differences among treatments, a Honestly Significant Difference (HSD) test was performed at the 5% significance level. The following is the formula for the Honestly Significant Difference (HSD):

$$\text{BNJ } (\alpha) = q\ (p.v)\ \frac{\sqrt{KTG}}{r}$$

Notes :
KTG = Mean Square Error
q (p.v) = Critical value from the statistical table
p = Number of treatments
v = Error degrees of freedom
r = Number of replications
α = Significance level 5%

RESULTS AND DISCUSSION

Based on the identification of white grub pests referring to their morphological characteristics, two white grub species were found to infest all sweet potato cultivars. These species belong to the family Scarabaeidae, specifically the genera *Phyllophaga* and *Leucopholis* (Figures 1 and 2). This can be observed from the morphological characteristics of these beetles, which exhibit wide variations in size, color, and behavior. According to Borror et al. (1992), beetles of the family Scarabaeidae generally have oval-shaped bodies. Their tarsi consist of five segments, although in some species the anterior tarsi may be reduced or absent. Their antennae are expanded into lamellate structures that can be spread open or closed to form a compact club at the tip.

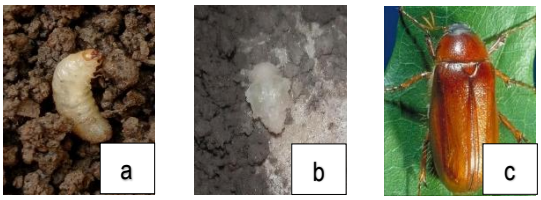

Fig 1. *Phyllophaga* sp.
Notes: a. Larva, b. Pupa, c. Imago

The first species identified was *Phyllophaga* sp. (Figure 1). At the larval stage, it has a white body with three pairs of legs located on the thoracic segments. The pupae are white, and the adults (imago) measure 8–25 mm in length, with a somewhat rounded body, reddish-brown coloration, and a glossy surface. The forewings are hardened (elytra) and completely cover the abdomen (Setiawati et al., 2014). In Indonesia, although specific data on its infestation of sweet potato are limited, *Phyllophaga* sp. is considered to pose a serious potential threat to agriculture. According to Martian (2004), *Phyllophaga* sp. is known to attack various forest plant species, including young teak (*Tectona grandis*).

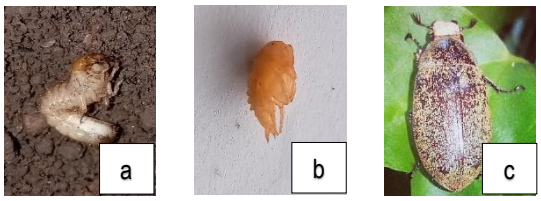

Fig 2. *Leucopholis* sp.
Notes: a. Larva, b. Pupa, c. Imago

The second white grub species identified was Leucopholis sp. (Figure 2). The larvae are yellowish white in color, while the pupae are yellow. At the adult (imago) stage, the beetles measure approximately 2–3 cm in length and are dark brown to blackish brown in color. The elytra (hardened forewings) are smooth or slightly setose and bear punctations (small yellowish spots) on the pronotum and elytra. The forelegs (protibiae) are robust and equipped with teeth, which are used for digging in the soil during the larval stage and when adults emerge from the soil.

These findings support previous studies indicating that Leucopholis sp. is a pest of sweet potato, along with the sweet potato weevil (Cylas formicarius) and rodents, as sweet potato serves as a host for various pests (Virman, 2016).

1. Symptoms of White Grub Infestation

White grub infestation on sweet potato plants generally attacks the tubers located underground (Figure 3).

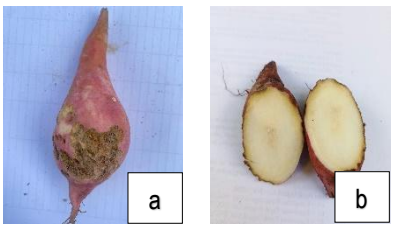

Fig 3. Attack Symptoms
Notes: a. External appearance, b. Internal appearance

Symptoms of white grub infestation on sweet potato tubers appear as bite wounds on the surface of the tuber skin. This finding is consistent with the report of Virman (2016), who described the presence of dark brown to blackish feeding scars on the sweet potato skin. Such damage reduces the visual appearance quality of the tubers, thereby decreasing their market value (Saragih, 2009). Meanwhile, the internal part of the tuber generally remains in good condition without noticeable damage. Therefore, although physical damage occurs on the outer surface, the taste of sweet potato is not affected, and the tubers remain safe and suitable for consumption. In addition to damaging surface tissues, white grub infestation can also hinder the absorption of water and nutrients by the plant, which ultimately affects productivity and overall harvest quality.

2. Karakter Morfologi Umbi Beberapa Kultivar Ubi Jalar

Each sweet potato cultivar exhibited distinct tuber morphological characteristics in terms of color and shape (Figure 4).

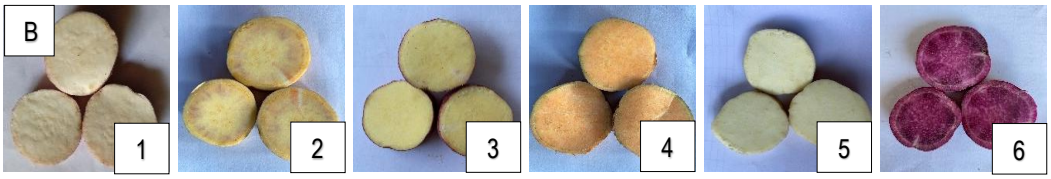

Fig 4. Skin and flesh color of sweet potato tuber
Notes: A. Tuber skin color, B. Tuber dlesh color, 1. Purple, 2. Potato, 3. Lato-lato, 4. Cilembu, 5. Ase, 6. Thailalnd

The Lato-lato cultivar has purple tuber skin and white flesh. This characteristic is consistent with the description by Bugis et al. (2024), who reported that white-fleshed sweet potatoes generally have round tubers with purple skin and white flesh. These tubers tend to have a soft texture and relatively uniform size.

The Cilembu cultivar is characterized by cream-colored skin and flesh. Cilembu sweet potatoes are known for their elongated and long tuber shape. A distinctive feature of this cultivar is its ability to produce a honey-like sweetness after baking, which is attributed to its high natural sugar content. The tubers have a soft and fluffy texture (Putri et al., 2024).

The Thailand cultivar has purplish-red tuber skin and yellowish-white flesh. These characteristics are consistent with the findings of Pujiastuti et al. (2024), who reported that yellow-fleshed sweet potatoes generally have yellow internal flesh, an elongated shape, and a soft tuber texture.

The Potato cultivar has elongated and long tubers with orange-colored skin and flesh. This characteristic aligns with the statement of Bugis et al. (2024), who noted that orange-fleshed sweet potatoes typically have oblong or slender tubers with orange skin and flesh. The bright color of the flesh indicates a high beta-carotene content.

The Ase cultivar has white tuber skin and flesh with an oval-shaped tuber form. Tubers of this cultivar tend to be larger in size compared to those of other cultivars (Yasmin et al., 2024). The pale flesh color indicates a low beta-carotene content.

The Purple cultivar has slender and slightly elongated tubers with pointed ends. The tuber skin is dark purple, while the flesh is deep purple in color. These characteristics are in line with the findings of Bugis et al. (2024), who reported that purple sweet potatoes generally possess purple flesh due to their high anthocyanin content.

3. White Grub Population on Six Sweet Potato Cultivars

The white grub pests found infesting sweet potato showed different population levels among the cultivars (Table 2).

Table 2. Skin and Flesh Color of Sweet Potato Tubers

Sweet Potato Cultivar	White Grub Species	Number
Lato-lato	*Phyllophaga* sp.	19
	Leucopholis sp.	25
Cilembu	*Phyllophaga* sp.	32
	Leucopholis sp.	17
Thailand	*Phyllophaga* sp.	26
	Leucopholis sp.	11
Potato	*Phyllophaga* sp.	27
	Leucopholis sp.	13
Ase	*Phyllophaga* sp.	42
	Leucopholis sp.	22
Purple	*Phyllophaga* sp.	22
	Leucopholis sp.	12
Total		268

A total of 268 white grubs were found infesting all sweet potato cultivars. In each cultivar, two white grub species belonging to the family Scarabaeidae were identified. *Phyllophaga* sp. was recorded at 168 individuals, while *Leucopholis* sp. accounted for 100 individuals. The dominance of *Phyllophaga* sp. is

attributed to a combination of strategic advantages, including a long life cycle with strong environmental adaptability, polyphagous feeding behavior with a wide host range, high reproductive capacity with effective oviposition preferences, broad geographic distribution, and greater tolerance to control measures. These factors enable *Phyllophaga* sp. to be more competitive and to establish larger populations compared with *Leucopholis* sp.

4. Rerata Populasi dan Intensitas Serangan Hama Uret

The white grub populations and the intensity of infestation varied among the sweet potato cultivars (Table 3).

Table 3. Average Population and Intensity of Grub Attacks

Treatment	Population (tail)	Attack Intensity (%)
K1 (Lato-lato)	11[a]	23,63[b]
K2 (Cilembu)	12,25[a]	26,34[ab]
K3 (Thailand)	9,25[a]	20,32[b]
K4 (Potato)	10[a]	21,03[b]
K5 (Ase)	16[a]	40,23[a]
K6 (Purple)	8,5[a]	15,82[b]

Notes: Values followed by the same letter within the same column are not significantly different based on the Honestly Significant Difference (HSD) test at the 5% significance level.

The Ase cultivar exhibited the highest mean white grub population, with an average of 16 individuals, and the highest mean attack intensity of 40.23%, which falls into the moderate damage category. This result is consistent with the findings of Virman (2016), who reported that white grub infestation was highest on white-fleshed sweet potato and lowest on red-fleshed sweet potato. This indicates that white-fleshed sweet potatoes, which contain lower levels of phenolic compounds and anthocyanins, are more susceptible to pest attacks. In addition, the larger tuber size of the Ase cultivar is presumed to provide more space for larval development.

In contrast, the Purple cultivar showed the lowest mean white grub population, with an average of 8.5 individuals, and the lowest mean attack intensity of 15.82%, which is categorized as light damage. The high anthocyanin content in the Purple cultivar (Husna et al., 2013) likely contributes to reduced white grub infestation, as anthocyanins function as antioxidants and natural pest deterrents. Genetic factors, particularly tuber color and size, therefore play an important role in determining white grub feeding preferences.

White grubs are generally more attracted to sweet potatoes with white skin or white flesh. White-colored tubers typically contain lower concentrations of phenolic compounds and anthocyanins, which serve as natural pest repellents. The absence or low level of protective pigments also indicates reduced resistance to biotic stress, including pest attacks (Virman, 2016).

CONCLUSIONS

The results of the study revealed that two white grub species infested all sweet potato cultivars, namely *Phyllophaga* sp. and *Leucopholis* sp., which belong to the family Scarabaeidae, order Coleoptera. The Purple cultivar exhibited the lowest mean white grub population, with 8.5 individuals, whereas the Ase cultivar showed the highest mean population, with 16 individuals. White grub infestation primarily reduced the external appearance quality of sweet potato tubers; however, the tubers remained suitable and safe for consumption.

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