Borneo Journal of Resource Science and Technology (2022), 12(1): 135-140
DOI: https:doi.org/10.33736/bjrst.4176.2022

Variation of the Pronotal Markings in *Rhynchophorus* (Coleoptera: Curculionidae) Species from Kuala Terengganu, Terengganu

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Received: 15 November 2021 Accepted: 24 December 2021 Published: 30 June 2022

ABSTRACT

The notorious palm weevils from the genus *Rhynchophorus* (Coleoptera: Curculionidae) are known to be polymorphic and show high phenotypic plasticity. Due to these characteristics, this study attempts to document the typologies based on the pronotal markings observed from Kuala Terengganu population. Samples were collected using baited traps with pheromones and fruits as well as through handpicking method, where the sampling sites were located at two villages, namely, Kampung Tanjung Paya and Kampung Pulau Sekati. A total of 100 individuals were collected of which 19 typologies were successfully identified. Of all, the most prominent pattern observed was typology A, represented by 37 individuals. Findings from this study suggested that the variation was driven by various factors including resource limitation, habitat preference, diet preference and competition. However, a comprehensive study should be initiated to measure possible factor(s) which possibly induce the pronotal variation within *Rhynchophorus* at a local scale.

Keywords: Kuala Terengganu, morphology, palm weevil, *Rhynchophorus*, variation

INTRODUCTION

The palm weevils from the genus *Rhynchophorus* (Herbst, 1795) were known to be one of the notorious pests to palm trees of Aracaceae. They were widely distributed throughout the Southeast Asia and Melanesia (Wattanapongsiri, 1966; Murphy & Briscoe, 1999; Hill & Abang, 2005; Rugman-Jones *et al.*, 2013). In Peninsular Malaysia, the red palm weevils *R. ferrugineus* were initially reported in Setiu, Terengganu in early 2007 and caused severe destruction to coconut plantations. Azmi *et al.* (2017) reported this species spread to other states of Perlis, Kedah, Penang and Kelantan in 2016. On the other hand, Sabah and Sarawak did not report any major pest issues pertaining to the presence of the red stripe weevils *R. vulneratus*, though their larvae were abundant in sago plantations. Instead, the pests provide the natives with economic returns as their larvae were cultivated and sold in markets to meet local demands for a protein source.

Morphological variation in beetles can be driven by many factors such as localities, habitat types (surroundings), resource availability, larval density, abiotic factors, and even competition and predation (see Laparie *et al*., 2010; El-Mergawy *et al*., 2011; Tambe *et al*., 2013; Rugman-Jones *et al*., 2013; Hassan *et al*. 2017; Sazali *et al*., 2018; 2019). Such conditions thus lead to taxonomic ambiguities within *Rhynchophorus* species of which they exhibit high polymorphisms and phenotypic plasticity in different populations (Sazali *et al*., 2018).

Rugman-Jones *et al.* (2013) discussed on the colour polymorphism in the red palm weevil, *R. ferrugineus*. They suggested that these specimens in fact represented at least two species, namely, *R. ferrugineus* and *R. vulneratus*. On the other hand, Hallett *et al*. (2004) considered the palm weevils as colour morphs of the same species and be synonymised under the name *R. ferrugineus* based on their synonymity. Subsequent studies were also conducted by Abad *et al*. (2014), Lannino *et al*. (2016) and Yong (2016), but none of these could assist in reconfirming the specific status of *Rhynchophorus* species complex, since respective studies were conducted at local

geographical areas, and thus lead to inconclusive results at a global scale.

As these pests are widely distributed, studies on pronotal variation of *Rhynchophorus* have been conducted across different regions including by Longo (2006) in Italy, Mizzi *et al*. (2009) in Malta, Haq *et al*. (2018) in Pakistan, as well as by Sukirno *et al*. (2018) and Rozziansha *et al*. (2021) in Indonesia. Azmi *et al*. (2017) also initiated a similar study in Terengganu and suggested that the pest showed more than 30 variations in relation to size, colour, number and shape of pronotal markings, yet no further details are provided. Therefore, to complement the study by Azmi *et al*. (2017), this preliminary study attempts to document the typologies based on the pronotal markings of *Rhynchophorus* populations from Kuala Terengganu. The recognition could be useful in providing prior information on the presence of significant colour morphs of the palm weevils, and thus could enhance on the rapid identification for early detection and effective pest management control.

MATERIALS AND METHODS

This study was conducted in two sites in Kuala Terengganu, namely, Kampung Tanjung Paya (5°20´6´´N, 103°8´41.28´´E) and Kampung Pulau Sekati (5°19´11.64´´N, 103°5´51.72´´E) from 14 April to 26 May 2021. A total of 12 baited traps were deployed in both sites, in which each trap was filled with 700 mg P028 Ferrolure+ pheromone lure and pineapple slices to attract the weevils, and the pineapple were changed every four days to keep the freshness of the baits. The traps were placed and hanged approximately 1.5 m from the ground on the infested coconut trees and checked regularly for every two days. Additionally, the handpicking method was also done within the sampling sites to maximise the capture rates.

Collected palm weevil samples were identified following descriptions made by Wattanapongsiri (1966), Chung (2003) and Sazali *et al*. (2018). To enable typology identification based on respective pronotal variation, the samples were segregated according to pronotal markings (patterns) and photographed accordingly, following procedures by Mizzi *et al*. (2009) and Rozziansha *et al*. (2021), with modifications. The number of individuals recorded for each typology was also documented and for showing enhanced marking visuals, each typology was redrawn in black and white coloured, using mobile application called Tayasui Sketches.

RESULTS

A total of 100 individuals of *Rhynchophorus* species were successfully collected, of which each sample was grouped accordingly and resulting to 19 different typologies (Figure 1). Identification of typologies were made based on unique pronotal patterns due to the positioning of spot(s) or mark(s) and coloration. Redrawn of the typologies in black and white coloured with number of recorded samples for each is also illustrated in Figure 2. The most abundant markings were recorded by typology A (n=37) with seven spots (three at anterior, four at posterior), followed by typology B (n=13) with 10 spots (three large spots at posterior), and typology K (n=10) with six spots (two at anterior, four at posterior), respectively. Additionally, there are unique pronotal markings which were only represented by a single individual, namely, typologies F, H, O, P, Q, R and S.

DISCUSSION

Rhynchophorus species are polyphagous pests to many palm trees including coconut (*Cocos nucifera*), oil palm (*Elaeis guineenis*), sago palm (*Metroxylon sagu*) and some ornamental palm trees (Azmi *et al*., 2017). The pests' invasions to Peninsular Malaysia in 2007 were believed to have been started from the introduction of date palm trees which were used for plantation or landscaping purposes (Azmi *et al*., 2013). The infestation of these weevils unfortunately cannot be detected during the early phase of trees damage, leading to rapid death of palm trees only between six to eight-month time (Azmi *et al*., 2017).

In the present study, some pronotal markings were relatively similar to those pronotal variation documented by Azmi *et al*. (2017) such as observed in typologies A, I, and K, respectively. This finding hence reconfirmed the pests as a polymorphic species with high phenotypic plasticity, which supports the

taxonomic ambiguity status within the *Rhynchophorus* species complex (Rugman-Jones *et al*., 2013; Abad *et al*., 2014; Lannino *et al*., 2016). Apart from exhibited colour polymorphism, these weevils were also observed to exhibit size polymorphism across island and mainland populations, that adhered to the van Valen's (1973) island rule (Sazali *et al*., 2018). *Rynchophorus vulneratus* from the island population were relatively larger in size, as compared to *R. ferrugineus* from the mainland population that were much smaller. In general, this morphological variation could be due to different environmental conditions during their juvenile development including food source and quality, larval density or abiotic factors (Mizzi *et al*., 2009; Tambe *et al*., 2013).

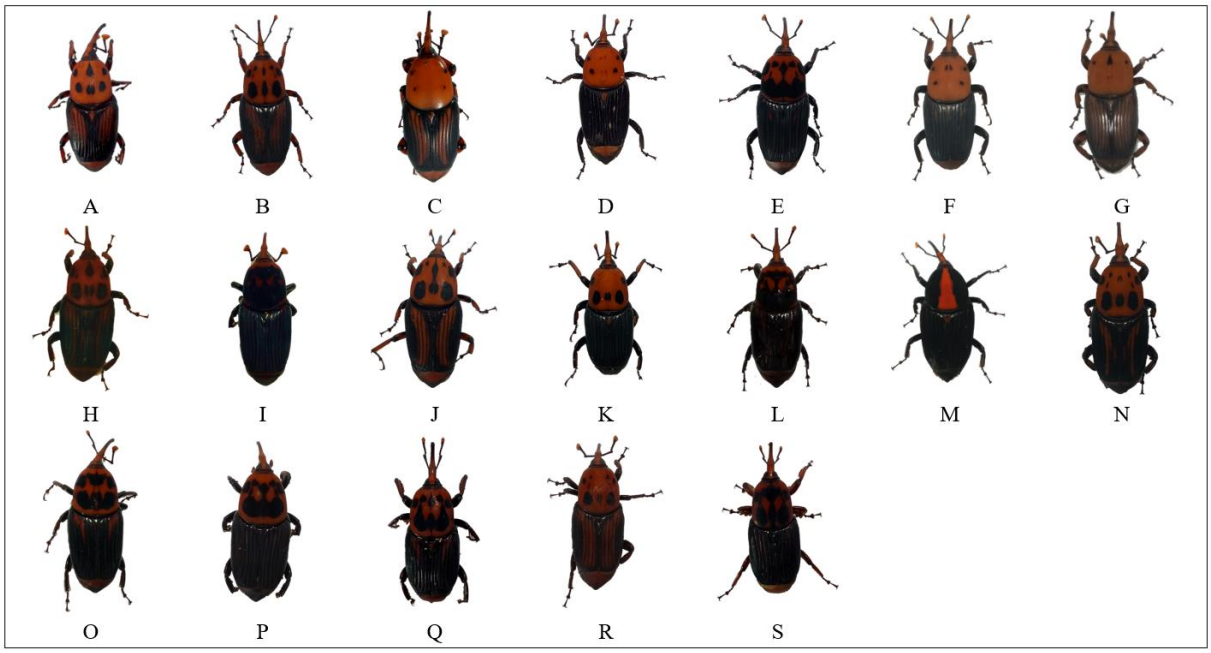

Figure 1. The colour polymorphism in adult specimens of *Rhynchophorus* species collected from Kuala Terengganu

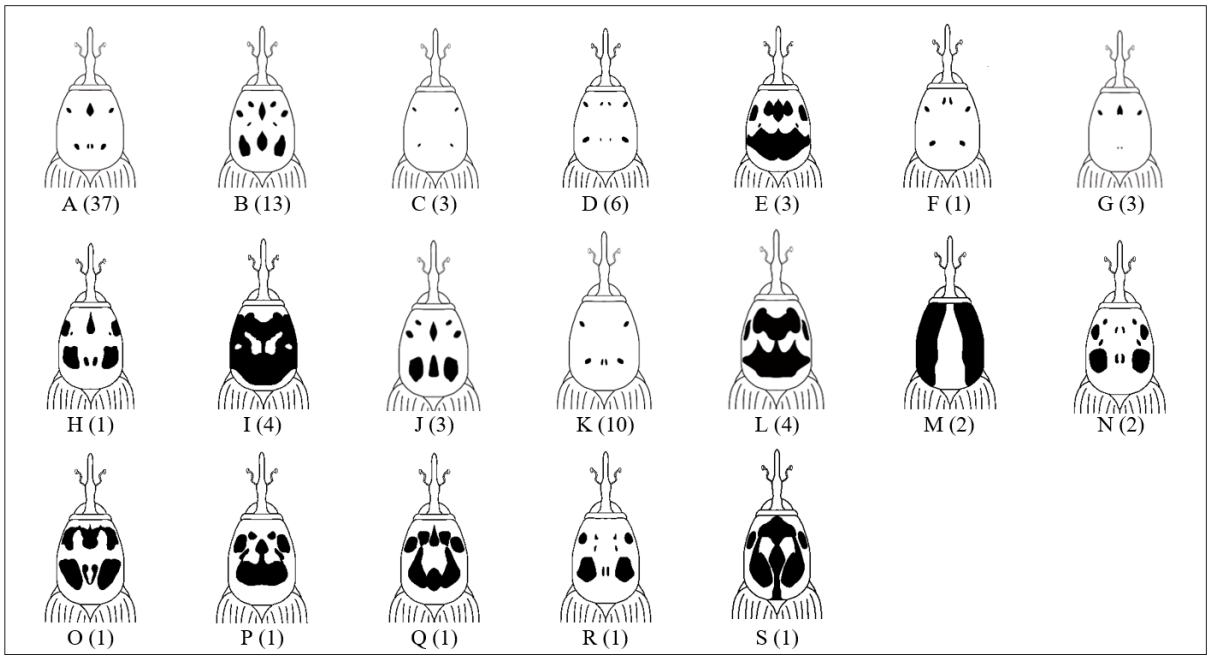

Figure 2. Variation of the pronotum dorsal view of the *Rhynchophorus* species. Letters A-S represent the different morphological patterns. Number of samples were noted in bracket

It is assumed that the phenotypic variation resulted in insects might be driven from various factors such as resource limitation (Lomolino, 1985), habitat preferences (Tan *et al.*, 2017; Sazali *et al*., 2018), diet preferences (Mizzi *et al*., 2009; Wang *et al*., 2015; Tan *et al*., 2017; Rozziansha *et al*., 2021) and intra- or interspecific competitions (Lomolino, 1985; Song, 2011; Silva *et al*., 2017). With the capability to alter their morphological characteristics and physical appearance in short time, these weevils especially could adapt well and survive in any kind of environmental conditions. Consequently, changes in insects' morphology are beneficial to increase their survivability, fecundity, fitness, population density as well as species range (West-Eberhard, 2003; DeWitt & Scheinerm 2004; Whitman & Ananthrakrishnan, 2009).

CONCLUSION

To summarise, this preliminary study suggests *Rhynchophorus* species in Terengganu exhibited many typologies due to their unique pronotal markings. In the present study, at least 19 typologies were successfully identified from Kuala Terengganu population where it is expected that the number of colour morphs might be higher if considering other infested area from different localities as well. However, comparative studies may be useful to justify the possible morphotypes resulted from these typologies. Additionally, a comprehensive study to measure any possible factor(s) which possibly induce the pronotal variation within *Rhynchophorus* at a local scale should be initiated. This may include (but not limited to) food availability and quality, larval density, diet preference and other abiotic factors.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the Faculty of Resource Science and Technology, Universiti Malaysia Sarawak. Special thanks to the head of villages of Kampung Tanjung Paya and Kampung Pulau Sekati, Kuala Terengganu for their consent to conduct this research and to the helpful villagers for their kind assistance during the field samplings.

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