Population of oil palm pollinator insect (*Elaeidobius kamerunicus faust.*) at PTP Nusantara VIII Cisalak Baru, Rangkasbitung-Banten

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Abstract. The role of *Elaeidobius kamerunicus* in oil palm plantations in recent times is questioned related to the decline in oil palm productivity. The research aim is to study the *E. kamerunicus* beetle population and the factors that influence it. The study was carried out in the oil palm plantation PTP Nusantara VIII Cisalak Baru, Rangkasbitung-Banten. The beetle population were calculated on 3 spikelets at the base, middle, and end of an anthesis flower bunch of oil palm plant samples aged 13 and 5 years using purposive sampling method. Observation were carried out 3 times in May, September and November 2015. Morphological observation of beetle *E.Kamerunicus* was carried out in Balitro laboratory. The results showed that the population of *E. kamerunicus* in the study area was quite abundant and fluctuated. The average population of *E. kamerunicus* in oil palm plantation in May, September and November, are 15.168, 6.139, and 37.575 insect/ha in plantations aged 13 years, and 11.205, 7.534, and 49.209 insect/ha in oil palm plantation aged 5 years with the higest population occur in November. The fluctuation seem influenced by environmental factors such as rainfall, the present of rats as natural enemy, and the number of spikelet.

Keywords: *Elaeidobius kamerunicus*, oil palm, pollination

1. Introduction
Oil palm is one of the main oil producing plants and as a foreign exchange earner which is very important for Indonesia. The area of oil palm in Indonesia currently reaches more than 14 million hectares (14,03 ha) in 2018, spread in almost all provinces in Indonesia, with centers mainly in Sumatra and Kalimantan [1]. This plant includes monocotyledonous plants where male flowers and female flowers are found in one tree [2]. These plants are known to pollinate themselves or cross pollinate with the help of wind, and especially pollinator insects [3]). Although male and female flowers are in the same individual tree, the male and female flowers usually bloom at different times. The role of pollinating insects is very prominent/important considering the structure of the oil palm flower is unique because the female petals are covered with crowns so they need pollinating agents that are able to pass through the crown. In addition, oil palm flowers, both male and female flowers emit a distinctive and strong aroma that attracts insects to come. Male flowers are arranged in spikelet and are located above female flowers. While female flowers are arranged in bunches. Male flowers are very numerous in one spikelet and the anthesis period is tiered starting from the bottom to the top, so that even though the anthesis period is shorter than the female flower, it gradually alternates from the bottom up. While female flowers have a longer receptive period of 3-5 days.
One of the main pollinators of oil palm, *Elaeidobius kamerunicus* Faust., is a weevil beetle, which belongs to the order Coleoptera, family Curculionidae. This beetle is small (±4 mm long and ±1.5 mm wide) and blackish brown [4], and undergoes perfect metamorphosis (holometabola), i.e., its life cycle consists of egg-larvae-pupa-imago. *E. kamerunicus* has an important role in pollinating oil palm plants. Pollination occurs because this beetle is attracted by the scent of flowers, especially male flowers that are stronger in aroma than female flowers. When perched on male flowers, pollen will stick to his body then when perched on a receptive (blooming) female flower, pollen will be released from the beetle and pollinate female flowers [5]. In addition, this beetle is harmless and does not damage other plants, because this beetle can only eat and reproduce in oil palm male flowers [4]. *E. kamerunicus* beetles have the best ability to pollinate oil palm flowers than other types of pollinators, because their shape, structure and size match the size and structure of oil palm flowers, supported by high populations due to their proliferation in male oil palm flowers [4], and has behavior that supports its function as a specialist pollinator on oil palm. This beetle began to be developed in Malaysia since 1981 and was introduced to Indonesia in 1982.

Palm oil production depends on pollination from oil palm pollen [6]. Pollination of oil palm in Indonesia is strongly influenced by the conditions of *E. kamerunicus*, pollen conditions and the environment that affect the pollination interaction process [7]. There is a presumption that the effectiveness of pollinator insect, *E. kamerunicus* has decreased [8]. The role of this beetle decreases in various oil palm plantations, resulting in oil palm bunches with very low fruit set values [9]. Related to that matter, research has been carried out to determine the condition of *E. kamerunicus* population on the Cisalak Baru oil palm plantation PTPN VIII, Rangkasbitung-Banten and the factors that influence its population.

# 2. Materials and Methods

## 2.1. Time and Location

This research was conducted in May - November 2015 in the PTP Nusantara VIII oil palm plantation in Cisalak Baru, Rangkasbitung-Banten on Afdeling V Gunung Tunggal (Figure 1). Calculation of beetle populations and observations was carried out at the Indonesian Spice and Medicinal Crops Research Institute (Balittro), Center for Plantation Crops Research (Puslitbangbun) and PT Cisalak Baru's PTP VIII Plantation, Rangkasbitung-Banten.

![Location of research in PTP VIII Cisalak Baru Rangkasbitung Banten](image)

**Figure 1.** Location of research in PTP VIII Cisalak Baru Rangkasbitung Banten

## 2.2. Materials and Equipments

The material used is oil palm plantation in the PTP VIII Cisalak Baru Rangkasbitung, Banten. The equipments used are cuttings scissors, hand counters, microscopes, collection bottles, mylar plastic, gauze, stationery and cameras.

## 2.3. Methods of Study

### 2.3.1. Morphological Observation of *E. kamerunicus* Beetle
Morphological observations of male beetles and female beetles include special features found in male and female beetles, as well as observing other features using a microscope (Figure 2).

2.3.2. Population calculation of *E. kamerunicus*

Several possible factors that influence fluctuations are observed through pollinating insect populations at (1) different plant ages (vertical population distribution based on the number of plants aged 5 and 13 years), (2) observation months (May, September and November), (3) proportion of flowers existing male and female, (4) distribution of insect populations vertically based on the location of flower spikelet in one bunch (upper, middle and lower male flowers) and (5) horizontal distribution of population in planting.

The beetle population was calculated on samples obtained from the field. Calculation of the beetle population was carried out by taking 3 spikelets per bunch comprises of 1 spikelet each at the base, middle and tip of the anthesis male flower bunches of oil palm plant samples aged 5 and 13 years using purposive random sampling method (figure 2). Oil palm plant samples were taken as much as 5 plants of 1 ha oil palm plantation in the centre of each block diagonally. The number of the beetle per bunch is known by calculating the number of the beetle per spikelet and the number of spikelet per bunch. Observation of the beetle population were carried out in May, September and November 2015. Apart of that, the number of male and female flowers were also calculated.

3. Results and Discussion

3.1. Morphology of *E. kamerunicus* Beetle

Adult insect (imago) as beetle-shaped *E. kamerunicus* is known as a snout beetle with an elongated mouth part resembling a trunk. The body of the imago is divided into three parts, namely the head, thorax, and abdomen. On the thorax there are two pairs of wings, namely a pair of thick fore wings (elytra) and a pair of thin hind wings (membranous). Male and female beetles have several differences, including females having smaller body size (2-3 mm), long snouts, and fine hairs. Male beetles have a longer body (3-4 mm), shorter snouts, more fine hairs on the abdomen of the female beetle, and a protrusion at the base of the elytra (Figure 3). More fine hairs of male beetles may makes them hold more an important role in the polination of oil palm.
3.2. Population of E. kamerunicus in Oil Palm Plantations

The results of the observation of E. Kamerunicus, insect pollinator population / bunch, the number of spikelet per bunch, the number of male flowers and the number of female flowers of oil palm plants aged 13 and 5 years are presented in the following table:

Table 1. Average population of E. kamerunicus pollinators (individuals / bunches), number of spikelet per bunch, number of male flowers and number of female flowers of oil palm plants aged 13 years and 5 years.

|                  | 13 years       |          |          | 5 years       |          |          |
|------------------|----------------|----------|----------|----------------|----------|----------|
|                  | May            | September| November | May            | September| November |
| Number of individuals / bunches of male flowers | 3.034          | 1.228    | 7.515    | 2.241          | 1.509    | 9.842    |
| Number of spikelet (per bunch of male flowers)  | 194            | 150      | 116      | 130            | 105      | 129      |
| Number of Male Flowers (bunches/tree)           | 6              | 5        | 5        | 9              | 10       | 10       |
| Number of Female flowers (bunches/tree)         | 6              | 5        | 5        | 4              | 6        | 6        |

The average population of pollinator beetles in oil palm estate belonging to PTPN VIII Cisalak Baru on plants aged 13 years in May, September and November 2015 were 3,034; 1,228 and 7,515 individual/bunches of male flowers. While in plants aged 5 years in May, September and November 2015 were 2,241; 1,509 and 9,842 individual/bunches of male flowers. In both plants aged 5 and 13 years, the pollinator insect population has decreased in September 2015, this is probably due to the dry season (see Table 1; Figures 4 and 5).
Figure 4. *E. kamerunicus* pollinators in male oil palm flowers

Figure 5. Average population of pollinators *E. kamerunicus* (individuals /bunche) in oil palm plants aged 13 years and 5 years.

According to [10] and [11] the population of *E. kamerunicus* is influenced by biotic and abiotic factors, biotic factors include predators, especially rat. Decrease in insect pollinators of oil palm plantations that occurred in Cisalak Baru Rangkasbitung apart from long droughts also due to other pest attacks ie. rats. This was seen by the number of young fruit eaten by rats, and also the possibility of eating pollinating insects as a source of protein for rats. Field observations showed that several oil palm fruit bunches were damaged and there were damage of rats (Figure 6). A part of eating palm fruit, rats are also reported to eat palm flowers where eggs, larvae, pupae and *E. kamerunicus* are included in them are eaten. High levels of rat attack negatively correlated to the density of pollinator populations per bunch ie if there is an increase in rat pest attacks then *E. kamerunicus* population will decline [12]
Figure 6. Damage of oil palm fruit by rat

The density of the *E.kamerunicus* beetle population is also strongly influenced by the large number of male flowers that bloom, which is the main food source of the insect. The life and reproduction rate of *E. kamerunicus* is strongly influenced by the presence of oil palm male flowers [13]. Male flowers that are anthesis have a stronger odor than receptive female flowers. This is caused by more volatile compounds released by male flowers [14]. Volatile compounds produced and released by oil palm flowers serve to attract insects, especially pollinating insects to visit and pollinate oil palm flowers [9].

Figure 7. Male flower bunches in oil palm plantations in the field

The number of spikelet per bunch of oil palm plants 13 years old in May, September and November 2015, were respectively 194.2, 150 and 115.6. While in oil palm plants 5 years old in May, September and November 2015 were respectively 130, 105.4 and 129.4 (Figures 7 and 8). The number of spikelet in plants aged 13 years and 5 years is relatively not much different, even though in plant aged 13 years the number spikelet is slightly higher.[15] and [16] also indicate that the more older oil palm plant the more number of spikelet. The sufficient availability of a number of spikelet determine the abundance of the population of *E. kamerunicus*. The research results of [17] and [18] state that the number of spikelets affects the number of insect populations *E. kamerunicus*.

The abundance of *E.kamerunicus* beetles is very influential on pollination and the formation of fruit sets of oil palm flowers. In North Sumatra to produce 75% fruit sets of oil palm, it needs at least 20,000 beetles with the availability of three male anthesis flowers per hectare [19] In [20] ; [21]. The population of *E. kamerunicus* in Afdeling V in PTP Nusantara VIII Cisalak Baru fluctuated from 1.228 to 9.842 individuals. In one hectare on average there were around 140 palm trees, with an average male flower per tree of 4-9 bunches, while the number of male flowers that anthesis is on average 5 bunches. So that in one hectare we found 6.139 – 7.543 (in September), and 37.575 – 49.209 (in November) of beetles in plants aged 13 and 5 years, respectively. The total population is still lacking to meet optimal pollination needs, especially in September, while in November the population is above the population needed to meet optimal pollination.
Figure 8. Average number of spikelet per bunch on oil palm plants aged 13 years and 5 years.

In addition to the presence of beetle predators and the availability of male flowers in bloom, rainfall is also an important factor affecting the development of *E. kamerunicus* populations in the field. The development of the population of *E. kamerunicus* in Indonesia is generally faster in the rainy season than in the dry season. According to [22] the development of *E. kamerunicus* population will increase sharply if monthly rainfall > 250 mm. The results of observations in Banten indicate that the pattern of population development of *E. kamerunicus* is closely related to the rainfall. Observations in May, September and November 2015 showed that *E. kamerunicus* population fluctuated according to the pattern of rainfall fluctuations. In May 2015, when rainfall was still high, the beetle population was also high. On the other hand, in July, August and September 2015 the rainfall is very low and reaches the peak of the dry season, the beetle population also decreased. Furthermore, in November when rainfall has increased again, the *E. kamerunicus* beetle population has also risen sharply. This occurs in 5-year-old plants and 13-year-old plants (Figure 7 and Figure 9)

![Graph showing monthly rainfall in Pandeglang, Banten in 2015.](image-url)

Source: BPS Kabupaten Pandeglang, 2015-2016

Figure 9. Monthly rainfall in Pandeglang, Banten in 2015.
4. Conclusion

The population of *E. kamerunicus* pollinators in oil palm plantations in the PTP VIII plantation in Cisalak Baru Rangkasbitung Banten in 2015 was fluctuated. The observations showed that: the population of *E. kamerunicus* is estimated to reach > 20,000 individuals/ha only in November, during rainfall season. While in dry season the population is less than that for sufficiently pollination processes to support the optimization of oil palm productivity. At the age of new fruiting plants (age 5 years), the population of *E. kamerunicus* tends to be high compared to 13 years old oil palm plants. However, the population of *E. kamerunicus* decreased to a very low level during the dry season, in both young and productive plants. The proportion of male flower bunches compared to female flowers is higher in the new oil palm fruiting plants, but the number of male flowering spikelet tends to be higher in productive plants, (4) The population of *E. kamerunicus* fluctuated because of the environmental factors that are by rainfall, the number of spikelet and the existence of natural enemies.

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