The Effect of Palm Oil Planting Material Characteristics on the Population of Weevil Pollinator (*Elaeidobius kamerunicus*)

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Abstract. The productivity of oil palm plants is determined by the success of pollination. Some factors that influence are the planting material, rainfall conditions and the adequacy of pollinating weevil, namely *Elaeidobius kamerunicus* (EK). Producers of planting materials produce crosses of Dura X Pisifera hybrids with their specific characters. This research aim was to determine the effect of planting material on flowering characteristics and EK population. The research was conducted in Adolina (DxP Simalungun) and Dolok Ilir (DxP La Me) in January 2018 - October 2018 with a descriptive method. The research results showed that the character of oil palm planting material affected the number and character of male flowers as a source of pollen. In planting material with a large number of male flower spikelet, the DxP Simalungun has a positive effect on the population of *Elaedobius kamerunicus*. The efforts to increase the EK can be achieved by applying the Hatch and Carry technique which can increase EK populations by 32-45%.

1. Introduction

Plantation Statistics Data noted that the area of oil palm plantations in Indonesia in 2016 was 11.67 million ha with CPO production of 31.5 million tons [1]. Production of Fresh Fruit Bunches (FFB) is influenced by the success of pollination/fruit set which depends on several factors, namely planting material, wind speed, rainfall conditions and the activity of weevil pollinator, namely *Elaedobius kamerunicus* (EK).

According to Prasetyo and Susanto, in some plantations, there are problems with the decline in oil palm productivity which is closely related to the low fruit set [2]. Palm oil plants are monoecious but the bloom of male and female flowers takes place at different times hence the nature of pollination is cross-pollination which requires the help of pollinating weevil [3]. The optimum condition needed to obtain a good fruitset value (>75%) is the existence of a sufficient number of male flowers inflorescence of 4 pieces/ha, EK population > 20,000/ha and optimum rainfall conditions of 250 mm.

Today, there are several producers of oil palm planting materials that produce Dura x Pisifera hybrids with flowering characters and other different characters. The I Oil Palm Research Institute (IOPRI) produces several planting materials including DxP Yangambi, DxP Simalungun, DxP Langkat, DxP PPKS 540, DxP Dumpy; PT Socfindo produces DxP La Me and DxP Yangambi. This research aim was to determine the effect of oil palm planting material on the flowering character and the population of palm oil pollinating weevil, *Elaedobius kamerunicus*. 
2. Materials and Methods

2.1. Study site
The research was carried out on oil palm plantations of PT. Perkebunan Nusantara IV, namely: Adolina Estate (Afdeling III) located in Perbaungan, Deli Serdang District, ± 20 m asl, the DXP Simalungun planting material produced by IOPRI planted in 2010, and Dolok Ilir Estate (Afdeling VI) in Simalungun District, at an altitude of ± 210 m asl, DXP La Me planting material produced by PT Socfindo, planted in 2013. The research period was from January to October 2018. The average rainfall data (2014-2017) in Adolina was 1,313 mm/year (110 mm/month). In Dolok Ilir the average rainfall is 1,644 mm/year (137 mm/month) (Figure 1).

![Figure 1. Average rainfall in study sites: Adolina and Dolok Ilir between year 2014 – 2017](image)

2.2. Field trial
The materials used were oil palm plants, DXP Simalungun, DXP La Me, male flowers, plastic and insecticides. The equipment used were stairs, knives, machetes and plastic tools. Blocks were determined as sampling points. Male flowers were characterized as a source of pollen. The presence of E. kamerunicus population in sampling blocks were calculated by trapping weevils from 3 spikelets in which the male flowers were inserted into cotton-fed plastic dipped in insecticide. Parameters observed in this study were the number of male flowers, the characteristics of male flowers, the number of spikelet and population of E. kamerunicus.

3. Results and Discussions

3.1. Male flower characteristics
The results on male flower characteristics between two study sites are presented in Table 1. At the DXP Simalungun crossing, observations on the number of male flowers in April 2018 and August 2018 were 2 and 3 pieces/ha. Sex ratio (the ratio of the number of male flowers to all flowers in 1 year) is 75% hence it is calculated that in one year the number of frond is 18 with 3 bunches of male flowers as a source of pollen and 15 bunches female flowers that will develop into Fresh Fruit Bunch (FFB) [3].

The sex ratio adequacy is important because there is a tendency for researchers to produce planting material that tends to be "feminine" dominated by female flowers. Lack of pollen sources can have a negative impact, especially for new plantations which are predominantly by young plants. The increasing age of plants, the sex ratio value of 50% is the balance of the number of male and female flowers [3]. Corley stated that the formation of flower inflorescence was influenced by the speed of photosynthesis [4].
Table 1. Observation on male flowers (MF) characteristics and the E. kamerunicus (EK) population

| Plantation | Planting Material | Block | Area (Ha) | Treatment | Data       | MF/Ha | S/MF  | EK/S  | EK/Ha | %    |
|------------|------------------|-------|-----------|-----------|------------|-------|-------|-------|-------|------|
| Adolina    | DxP Simalungun    | D     | 10        | -         | April 18   | 3     | 213   | 221   | 47.286| 100  |
|            |                  |       |           |           | August 18  | 2     | 236   | 233   | 34.928| 74   |
| Dolok Ilir | DxP La Me        | 13 T  | 20        | -         | April 18   | 4     | 67    | 55    | 14.740| 100  |
|            |                  | 13    | 30        | HC        | April 18   | 4     | 82    | 65    | 21.320| 145  |
|            |                  | U,V   | 20        | -         | August 18  | 4     | 71    | 68    | 19.312| 100  |
|            |                  | 13 T  | 30        | HC        | August 18  | 4     | 85    | 75    | 25.500| 132  |

DxP Simalungun crosses have a large number of spikelet, which is more than 200 spikelet/male flower infloresences. According to[3] the spikelet length is 12-20 cm, each spikelet consists of 400-1500 male flowers; thus, in one male flower inflorescence can contain 85,200 – 319,500 male flower seeds and if processed can produce 40 g of pollen. The character of DxP La Me in Dolok Ilir showed more of male flowers inflorescence than DxP Simalungun planting material. Although still in young plants (5 years) the number of male flowers inflorescence/ha is 4 pieces, but the number of spikelets is small, i.e. between 67-85 spikelet, or only as much as 25-35% compared to that found in the DxP Simalungun crossing. With a small number of spikelet, the availability of male flowers for EK food sources is limited.

3.2. Population of Elaeidobius kamerunicus (EK)

In accordance with a large number of spikelet and a large number of EK / spikelet, it also resulted in the DxP Simalungun EK population in Adolina exceeding the pollination requirements, namely > 20000 weevil/ha. In the August 2018 observation the EK population declined by 26% which could be caused by variations in rainfall conditions, but the EK population still met the standards. The increased population of EK with the Hatch and Carry technique in Dolok Ilir Estate in April 2018 and August 2018 was 45% and 32%. EK population can reach > 20,000 weevil/ha hence it can achieve optimum pollination requirements (Figure 2).

![Figure 2. Population of E. kamerunicus in sampling blocks](image)
EK’s interest in male flowers inflorescence is because male flowers release the hormone with the most one as estragole [2]. EK visits to male flowers in addition to taking food sources as well as for breeding reported that the EK population in oil palm male flower inflorescence reaches 98.57%, while the rest are local pollinating insects such as Thrips hawaiensis [5]. Teo stated that native pollinating insects from Malaysia are Thrips hawaiensis and Pinderces sp [6]. The advantages of EK are monophagous, easy to develop and able to reach female flowers in the inner flower inflorescence structure. The DxP La Me planting material has a smaller number of spikelet and the number of EK/spikelet varies from 55-75 heads; 30% compared to DxP Simalungun planting material. The difference in number can result in low concentrations of volatile hormones spread by male flowers inflorescence hence EK is less interested in visiting male flowers from the DxP La Me planting material.

EK undergoes perfect metamorphosis from eggs, larvae, cocoon and beetle. The life span of male beetles is 46 days and female beetles are longer, which is 65 days. Likewise in general the number of female beetles is more than that of male beetles to continue their life cycle [7]. EK beetle laid 57.64 eggs in male flowers and will hatch in 2-3 days. The larvae consist of 3 phases (5-9) days, eat the stalk and on the 3rd instar larvae are ready to make a hole to become a cocoon place [8]. In a series of male flower inflorescence the maximum number of EK occurs on the 5th day of the flowers bloom. The effect of rainfall in 2 research locations with an average of < 200 mm/month did not have a significant effect on the EK population fluctuations. Other researcher suggested that in the rainy season with high humidity it can result in reduced pollen production [9].

In DxP La Me planting material in block 13 T of Dolok Ilir Estate, the number of EK<20000 weevil/ha means that it does not meet the requirements for optimal pollination. The Hatch and Carry technique (EK breeding) was applied to increase the EK population by captivity in special boxes placed in oil palm plantation blocks. The source of EK is from eggs placed in male flowers (from adult plants); the egg will hatch and on the 8th day the box is opened hence the weevil flies. A research in Kalimantan Timur with a sample of 10.123 FFB with the results of 35.1 % fruits not developing (parthenocaphy) and 64.4% of fruits developing well (fruit set > 75%) [10]. A research at the Kebun Lama of PTPN I Hatch and Carry techniques increased fruitset from 69% to 80% and productivity increased by 14.4% [7].

Likewise in other results, Hatch and Carry techniques contribute positively to plantations that are dominated by young plants which are able to increase productivity by 6-15% [11]. An increase in fruit set may reach until 30% [12]. However, previous study reported that in natural pollination conditions of fruit set, results may vary from 13.2-79.4% [13].

EK population dynamics are also influenced by several other factors, namely the presence of rat pests, other predators, extreme rainfall conditions and excessive application of insecticides at the time of pest control/oil palm leaf-eating caterpillar. The pollination of oil palm is more likely carried out by entomophilous than anemophilus (wind) [8]. As the importance of EK in pollination of oil palm, all important aspects are considered hence the productivity target can be achieved.

4. Conclusion

The character of oil palm planting material influenced the number and character of male flowers as a source of pollen. In planting material with a large number of male flower spikelet, the DxP Simalungun has a positive effect on the population of Elaeidobius kamerunicus. The efforts to increase the EK population to achieve optimum pollination requirements can be achieved by applying the Hatch and Carry technique which can increase EK populations by 32-45%.
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