Effect of Ripe Level on Palm Fruit Threshing Efficiency

Adi Ruswanto[1,2*], *Sri* Gunawan[1,2], *Hermantoro*[1,2], *Arif* Panca Putra[1], and *Purwanto* Wirutomo[1]

[1]Akademi Komunitas Perkebunan Yogyakarta, Jl. Petung 2 Paringan Yogyakarta, Indonesia
[2]Institut Pertanian Stiper Yogyakarta, Jl. Nangka II Maguwoharjo, Depok, Sleman, Yogyakarta, Indonesia

Abstract. The processing of palm fruit bunches (FFB) into crude palm oil (Crude Palm Oil) has been around for decades, requiring innovations in technology and methods that are based on time efficiency, costs, and environmental friendliness. One of them is the development of processing FFB into Crude Palm Oil (CPO) without boiling. The process stages include threshing the FFB using a thresher, separating the mesocarp, pressing, filtering, and evaporating the water in the CPO. The research aimed to determine the effect of FFB ripening level on the efficiency of palm fruit harvesting. The research method included testing the efficiency of the thresher machine separating palm fruit at various levels of FFB ripening (F1=fraction 1, F2=fraction 2, F3=fraction 3) and rest level. FFB (R1=1 day, R2=2 days, R3=3 days). Based on the research results, the success of the process of separating the fruit from the fruit (threshing) in ripe FFB fractions F2 - F3 and restan R2 gave good results, namely being able to separate around 80% of the palm fruit and the level of damage was minimal.

1 Introduction

Indonesia's crude palm oil (CPO) production is a source of state income and fulfills 47% of the world's vegetable oil needs [1]. In 2021, Indonesia's CPO palm oil production will be 45.12 million tonnes and 61% will come from private plantations, 34% from community plantations, and 5% from state plantations [2]. People's plantations are the second largest contributor to CPO production. However, many oil palm farmers sell palm fruit bunches (FFB) to privately owned Palm Oil Mills (Mill) or state-owned mills which are relatively far away, which results in high transportation costs. Many FFB processing is delayed (restant), causing damage to palm oil with a marked increase in free fatty acids (FFA). The increase in FFA can be caused by several factors, including processing delays, overripe, and poor processing methods [3]. The length of the processing delay can increase the FFA of CPO by 0.94% every 1 day on the bran fruit [4]. Oil damage that

* Corresponding author: adiroeswanto@gmail.com

causes an increase in FFA is the hydraulic process, which can degrade the oil and form free fatty acid.

Novelty in FFB processing technology is needed considering time, cost, and environmental efficiency, one of which is processing FFB into CPO without boiling (steam). The CPO processing process so far starts from fruit reception (weighing and grading), sterilization (using steam), fruit shelling, digesting & pressing, and clarification [5]. The raw material in CPO processing is FFB and in the actual boiling (sterilization) process in the field the temperature is around 135°C-145°C using a pressure of 1.5 - 3.0 bar, and time is around 80 - 90 minutes [6]. The use of steam with high temperatures, high pressure, and long periods will affect the characteristics of the palm oil produced [7], and produces high levels of liquid waste which requires a long time to handle, large areas, high costs, and has an impact on the greenhouse effect (high methane gas formation) so it is not environmentally friendly and the use of liquid waste to become biogas also requires high costs. So innovation and new methods are needed in processing FFB CPO palm oil.

One alternative is to process FFB into CPO without boiling, starting from the process of threshing the fruit from fresh FFB at the initial stage of the process. The problem that exists is that fresh TBS is greatly influenced by the level of maturity. For this reason, this research aims to determine the treatment of FFB maturity level and shelf life on the efficiency of the thresher machine that has been designed

2 Material and method

The FFB material is obtained from oil palm plantations in Central Java at various levels of maturity, Fraction 1 means that for every 1 kg of FFB, there is 1 that is free from the mark. Fraction 2 has 2 loose from the bunch for every 1 kg of FFB. Each treatment required 10 FFB and was repeated 3 times. The research method includes testing the efficiency of the thresher machine separating palm fruit at various levels of maturity of FFB consisting of 3 levels, F1=fraction 1, F2=fraction 2, F3=fraction 3 as the first factor, and the level of delay in the process of threshing palm fruit from FFB consisting of R1= 1 day delay, R2= 2 day delay, R3= 3 day delay as the second factor. The results of the process are evaluated, consisting of the efficiency of the threshing process, namely the fruit that is crushed, the palm fruit that is left behind, and the level of damage.

3. Result and discussion

Based on the results of research that has been carried out on the efficiency of the threshing process on the level of maturity and the length of the threshing delay time, the results are as below.

3.1 Percentage of peeled fruit

Based on the results of observations in this research, the percentage of palm fruit that is peeled from the threshing process is presented in Fig. 1.

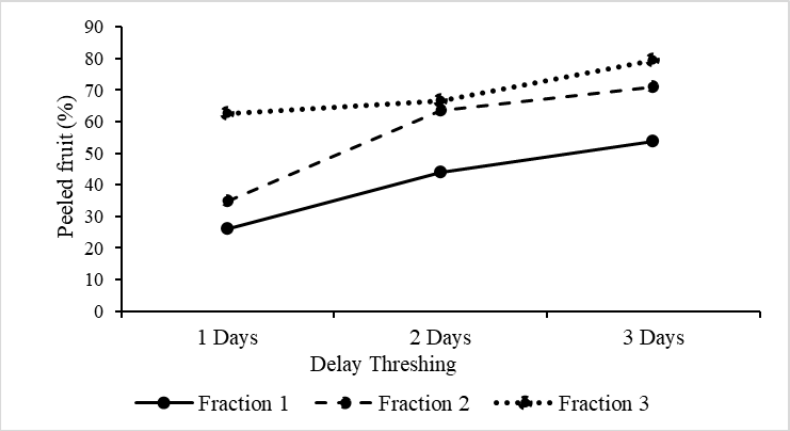

Fig. 1. Relationship between ripening fraction and threshing delay time on the percentage of oil palm fruit that is peeled

In Fig. 1., it can be seen that the longer the threshing delay time and the riper the palm fruit bunches (FFB), the higher the peeled palm fruit will be. As the FFB becomes riper, the bond between the fruit and the palm stalk becomes weaker due to the degradation of the chemical bond, so that the fruit easily separates, especially with physical treatment in threshing. The riper the action of endogenous ethylene is, the greater it is, so the easier it is for the fruit to separate from the length [8]. The presence of ethylene in the palm fruit ripening process will make it easier for the fruit to separate from the bunch [9].

3.2 Level of fruit damage

As a result of the threshing process on fresh FFB, it can result in crushed fruit experiencing both physical and chemical damage. The research results of the level of physical damage can be seen in Fig. 2.

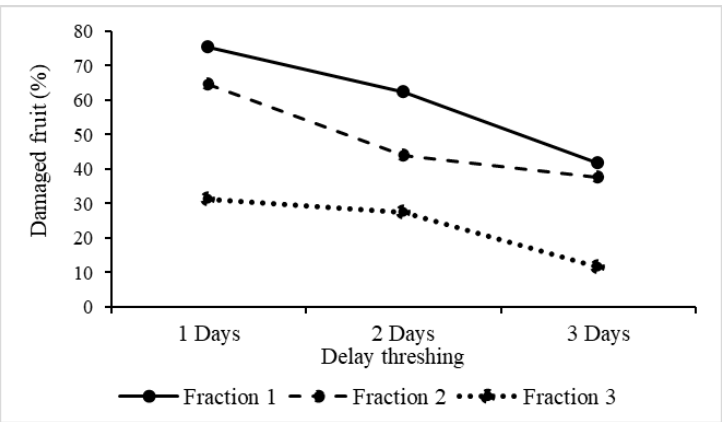

Fig. 2. Relationship between ripening fraction and threshing delay time on the percentage of damaged palm fruit

Damage that occurs with FFB during threshing can affect the quality and quantity of palm oil produced later. Based on Fig. 2, due to the time factor of delaying the threshing process, it can reduce damage to crushed palm fruit. Likewise, with the ripening level (fraction), the higher the fraction (the riper the FFB) the smaller the level of damage. This can be caused by the riper it is and the longer the threshing is delayed, the easier it is for the palm fruit to separate from the stalk [5]. The higher the level of ripening (fraction), the weaker the bonding power of the palm fruit to its stem, because the cross-links within it begin to experience damage [10].

3.3 Percentage of unpeeled palm fruit

The success of the threshing process on fresh FFB is influenced by many factors, including the level of maturity and the length of the process delay. The research results can be seen in Fig. 3.

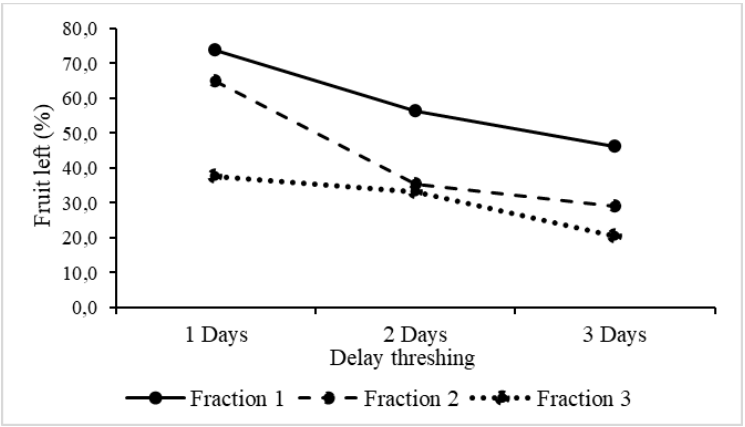

Fig. 3. Relationship between ripening fraction and threshing delay time on the percentage of unpeeled palm fruit

In Fig. 3, it can be seen that the longer the delay in the FFB threshing process, the lower the fruit that is left behind or the more the fruit that is crushed. This is because the longer the FFB is delayed in the threshing (*restan*) process, the more the chemical bonds between the palm fruit and the FFB promise will be weakened, or damaged, as a result, more fruit will be crushed or only a little will be left behind. Previous research stated that the longer the process is delayed, the more post-harvest physiological activities will continue to occur, including making it easier for the fruit to separate from the bunch [11]. Likewise, with the maturity level of FFB, the higher the fraction (ripeness), the easier it will be for the fruit to separate from the bunch. The riper the FFB is expressed as a fraction, the more fruit will be separated from the bunch (blown) because the bond between the fruit and the palm bunch is getting weaker [12].

4 Conclusion

Based on the results of the research that has been carried out, it can be concluded that the FFB maturity level of the F1 fraction and a delay of 1 day have not provided good results in terms of the percentage of separated or damaged fruit. At the FFB maturity level in the F2-F3 fraction and a delay of 2 – 3 days gives good results in terms of quantity

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