European Journal of Biology and Medical Science Research

Vol.8, No.5, pp.1-7, December 2020

Published by ECRTD- UK

Print ISSN: ISSN 2053-406X, Online ISSN: ISSN 2053-4078

OIL PALM YIELD IN RELATED TO PLANT DENSITY AND *GANODERMA BONINENSE* INFECTION IN SIMALUNGUN AND ASAHAN PLANTATIONS, NORTH SUMATERA, INDONESIA

[1]Riyanto, [2]Sartini, [3]Jamilah Nasution

[*1,2,3] Biology Study Program, Faculty of Science and Technology, Universitas Medan Area, Jl Kolam. No.1 Medan 20223,
North Sumatera, Indonesia

ABSTRACT: *The yield of oil palm of total area 26.9 hectare in period of 25 years in oil palm plantation in Asahan and Simalungun Regency, North Sumatera, Indonesia was studied. The objective was to analyze the impact of planting densityand Ganoderma boninense infectionto the number of fresh fruit bunch and stand palm trees. The yield was harvested three 3 years after planting and subsequently every 2 weeks until 25 years.Oil palm density was determined based on number of palms per hectare. Palm infected by Ganoderma was identifiedsymptomaticallyandcensusof the palms wasconducted every two weeks.The number ofstand palm tree was calculated by comparing the number of dead palms to start stand palm.Each area was plotted 6×8 metres that consisted of 48 palms. The experiment used was randomized complete block design using 3 palms densities i.e high density (160 palms/ha), medium density (143 palms/ha) and low density (128 palms/ha). Five replications were used for each treatment. Oil palmsat high densityboth in Simalungun and Asahan have significant effect (P>0.05)on the yield of fresh fruit bunch compare to medium and low density.Ganoderma infection occured in both areas and no significantly different among densities. The infection started at15 years after planting followed by reducingfresh fruit bunch and stand palm tree. At 25 years after planting the number of stand palm and fresh fruit bunch production at highh density is higher and significantly different (P>0.05) than that of medium and low density.*

KEYWORDS: plant density, oil palm tree, fresh fruit bunch, *Ganoderma boninense*

INTRODUCTION

Oil palm (*Elaeis guineensis*Jack) is one of the main export commodities in Indonesia.Tropical climate with high relative humidity for oil palm cultivation is one of the most profitable land uses Sayer et al. (2012). Previous study by Pallas et al. (2013) reported that optimal density of oil palm is 130-150 trees per hectare in terms of canopy development and leaf area index 4 and 5.Normal planting density on coastal and inland soil between 136 and 138 palms/ha respectively (Latif et al 2003).Density of palm commonly was arranged 9 meter distance for each other. Thus a 9 meter triangular of planting tree will have 9 meters between trees and roughly 7.8 meters between tree rows. The space per palm (9x7.8m) was 70.2 m². Therefore, the number of palm per hectare 10,000/70.2 m² = 143. Variation of planting density on oil palm plantation have significant effect onfruit bunch and bunch weight (Rafii et al. 2013).Whereas, Bonneau et al. (2018) stated that optimum planting density for agronomic optimal density was between 143 and 160 palm/ha and related to Leaf Area Index of 4. At high planting density the availability of sunlight can become limiting factor for growth and productivity oil palm. Basal stem rot caused by *Ganoderma boninense*is the most predominant disease in Asahan and Simalungun plantation, North Sumatera

Indonesia, devastate thousands of hectares of the palm tree and there is no effective fungicides to control this disease. The disease is symptomless at the early stage of infection. The fungus infect mature oil palm tree initially causing to yield loss, killing the trees and therefore reducing stand trees per hectare(Azahar et al. 2014). Previous factor were studied to influence the occurrence of basal stem rot such as previous crops, techniques for replanting, types of soils, age of trees and density.Ariffin et al. (1996) and Idris et al. (2003) reported that prevalence of the infection commonly occurred in mature palm when the palm are half way through their normal economic life span. The objective of this study was to analyzed the effect of oil palm density and infection of *Ganoderma boninense* on the fresh fruit bunch and stand palm trees in Asahan and Simalungun plantation.

MATERIALS AND METHOD

Location, Soil and Climate

Simalungun and Asahan Regency located in North Sumatera-Indonesia, The distance of the two sites is about 112 km. Climatic data show two seasons:a dry season from October to March and a wet season that occurs from April to September. Rainfall is well distributed, the average rainfall yearly in Simalungun was 1622 mm with 87 rainy days and in Asahan, was 2583 mm with 151 rainy days per year. Soil typeof both areas had red and yellow-podsolic. Simalungan Regency is oil palm plantation in many generation with slopes >90%, volcanic soil, sandy texture on the surface with soil solum 30-60 cm, whereas, Asahan had flatarea and relatively new oil palm plantationwith aluvial soil.

Planting Density

Oil palm variety usedboth in Simalungun and Asahan was DxP Dami. Planting densities (number of palms per hectare) used was 9.5m×9m and 8.5 m using an equilateral triangle design according to Bonneau et al. (2018). The densities observed were high (160 trees/ha), medium(143 palms/ha) and low density (128 palms/ha). Each tree in each density has a space that is defined by a square per unit area. The space was defined by space between trees and tree rows. Each 9 meter triangular densityhas space 9 and 7.8 meter between trees and rows successively.

Harvestingof Fresh Fruit Bunch

Oil palm tree was harvestedstart at3 years after planting.The ripe bunches were harvested continually every two weeks until period of 25 years.The number of bunchesper palm and the average bunch weight were recorded. The data then were analyzed per year and consequently into ton/hectare/year.

Determination of Infected Oil Palms by Ganoderma Boninense

All infected mature stand palm treecaused by *G. boninense* were marked based on the symptoms according to Turner and Gillbanks (1974) and Hasan et al. (2005). The infection was characterized morphologically byspear leaves do not unfold, yellowing and die from the tip to the base, bend downwards, more fronds shrivel and hang down to a skirt structure, stem rot at the basal tissues and basidiocarp were found at the base of stem. Oil palms infected by*Ganoderma* subsequently wererecorded andcensus was carried out every two weeks for 25 years. Tree losses per hectare was determined by comparing the numberof infectedpalmsto the start standpalm

2.5 Statistical Analysis

Alldata were analyzed using randomized complete block design consisted of planting densities (high, medium,low density)and yield (fresh fruit bunch). Fivereplications were used for eachobserved density.

III. Results and Discussion

The yield of oil palm in Simalungun were obtained started three years after planting. In compare to medium and low density, the average of annual fresh fruit bunch continue to increase over timeat high density particularly at five years after planting **(Figure 1).** However, after period of 6 to 14 year the yieldat highdensity decrease, eventually below those of medium and low density. The decreasing of fresh fruit bunch might causedby etiolation. This result is in concordance with Donough and Kwan (1991) that competition increase until the palm reach their maximum foliage span. Whereas, Larbi et al 2013) stated oil palm tree in high density increase rachis length and plant height but produce small and fewer bunches.Crowding might the availability of sunlight become a limiting factor for inflorescence.Henson and Tayed (2003) stated that female inflorescence decrease with increasing density. High density (160 palms per hectare) after 14 years reduce fresh fruit bunch was similar to Breure (2003) that yield of oil palm per hectare above 7 years after planting decrease at density above 150 palm per hectare. Oil palms were infected by *Ganoderma*startedat period of 15 years after planting and the palms can survive for 5 to 7 years before die. The infection initially cause yield loss in all densities particularly on high density. At the subsequent years the stand palm tree tend to decrease gradually.

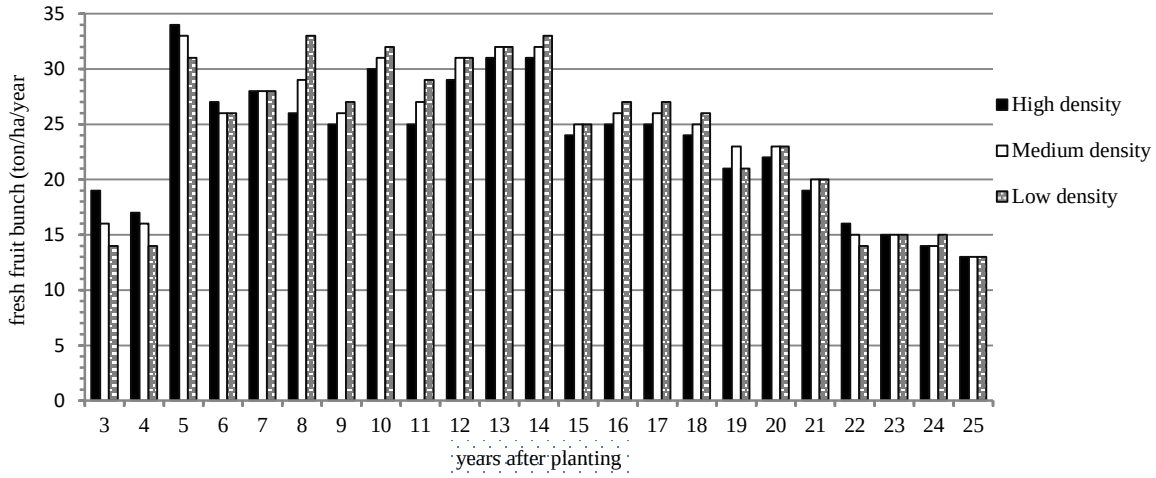

Figure 1. Fresh fruit bunch oil palm at different density after 25 years at Simalungun oil palm plantation

Twenty five years yield data from oil palm plantation in Simalungun and Asahan showed that the effect of *Ganoderma* infection on oil palm reduce stand palm tree per hectare (**Figure 2**). The loss

of stand palm occurred gradually at all densities starting at 15 years after planting. Najmie et al (2011) reported that external symptoms of basal stem rot can not be seen until the the pathogen infect too far advance. We assumed that the palm previously infected before 15 year as the basal stem rot infect oil palm as early as 1-2 years after planting (Henson and Tayed. 2003).However, the infection was signed by lowering fresh fruit bunch starting at 15 yearsin mature palm and occurred subsequently at the following years. Previous study by Ariffin et al (1996) reported that basal stem rot disease was the most prevalent and devastating in mature oil palm.

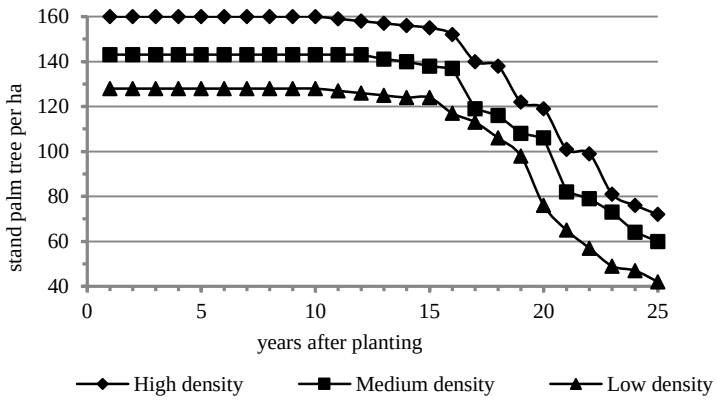

Figure 2.Stand palm tree at Simalungun after 25 years at different densities

Figure 3 showed the effect of planting densities on yield (fresh fruit bunch) in period of 25 yearsin Asahan Regency.The yieldat high density harvested from period three to seven years after planting was higher than that of medium and low density.However, at the following period particularly started at 15 years, the number of fresh fruit bunchdecreased gradually at all densities.

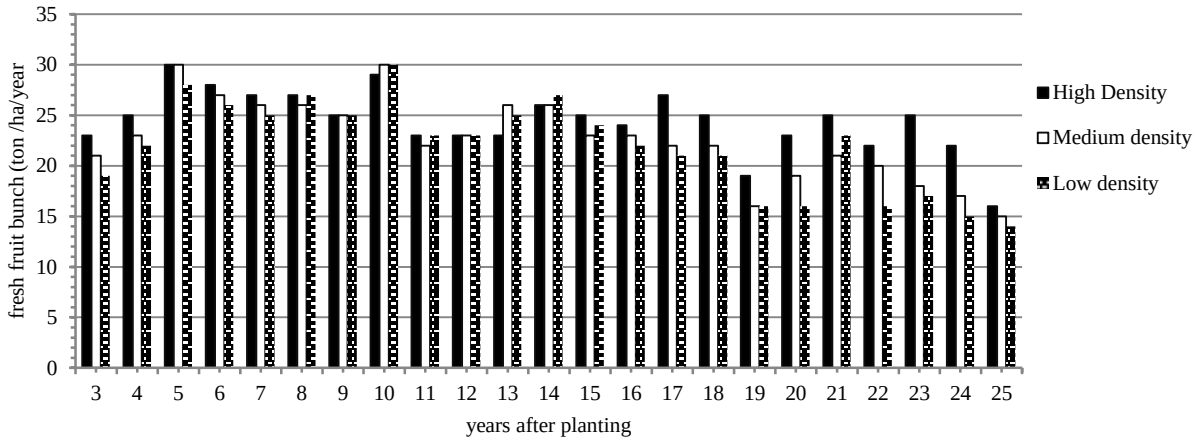

Figure 3. Yield of fresh fruit bunch oil palm at different density after 25 years at Asahan oil palm plantation

This was related to the loss of stand palm tree caused by *G. boninense* infection (in **Figure 4**). Incidence of the infection occured in period 15 years after planting and decline at all densities. Nevertheles, the remain of stand palm tree at high density still higher than medium and low density, therefore, the yield at high density was the highest until the end period of 25 year.

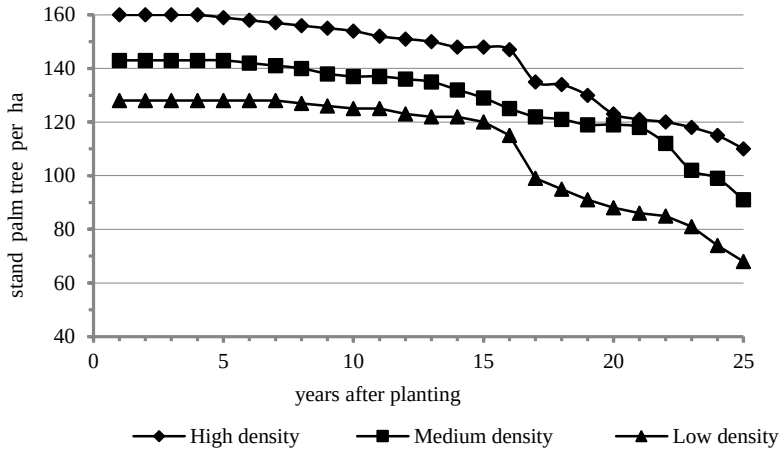

Figure 4. Stand palm tree at Asahan after 25 years at different densities

Generally, oil palm with high density (160 palms/ha) both in Simalungun and Asahan plantation have significantly different to medium 143 palm/ha) and low density 128 palm/ha)on the production of fresh fruit bunch (**Table 3**).At the end of period 25 years less stand palm tree at Simalungun than Asahan. We assumed propagules *G. boninense*spread through root contact with inoculum sources in the soil (Idris et al. 2002).

Table 3. Oil palm densities and effect of *Ganoderma boninense*infectionon stand palm, fresh Fruit bunch and tree loss in 25 years oil palm plantation atSimalungun and Asahan Regency

Oil palm density	Simalungun				Asahan			
	Stand palm/ha		Fresh fruit bunch (ton/ha/year)	Tree loss per hectare (%)	Stand palm/ha		Fresh fruit bunch (ton/ha/year)	Tree loss per hectare (%)
	Initial	End			Initial	End		
High	160	72	23.48 b	55	160	110	24.43 a	31
Medium	143	60	24.00 ab	58	143	91	22.65 c	36
Low	128	42	24.17 ab	67	128	68	21.96 c	46

However, the percentage of palm tree losses at period of 25 year in Simalungun is higher than that of Asahan. It is therefore reasonable to assumed that land use as oil palm for generation in

Simalungun lead to the plantation was more susceptible infected by *G. boninense* than that of Asahan,

CONCLUSION

The production of fresh fruit bunch andstand palm tree at period of twenty five yearswas slightly influenced by planting density. *Ganoderma boninense* infection reduce yield and stand palm tree at all densities.

References

Ariffin D, Idris AS, Marzuki A. 1996. Spread of Ganoderma boninense and vegetative compatibility studies of a single field palm isolates. Proceedings of the 1996 PORIM International Palm Oil Congress (Agriculture), September 1996, Palm Oil Research Institute Malaysia, Bangi.

Azahar TM, Idris AS, Abu Hassan D, I Norazlin. 2014. Assesment of basal stem rot disease distributionin oil palm plantationusing geographical information system. Journal of Science and Technology 6(2): 81-92.

Bonneau X, Impens R, Buabeng R. 2018. Optimum oil palm density in West Africa. Oilseeds & fats Crops and Lipids 25(2): 1-10.

Breure C J (2003). The search for yield of oil tree - basic principles. The Oil Tree. Management for Large and Sustainable Yields (Fairhurst, T and Hardter, R eds.). Potash & Phosphate Institute/Potash Institute of Canada and International Potash Institute. p. 59- 98.

Donough C, Kwan B. 1991. Oil palm planting density: results from trials in Sabah and possible options. Planters 67(787): 483-506.

Hasan Y, Foster H, Flood J. 2005. Investigation on the cause of upper stem rot (USR) on standing mature oil palms. Mycopathologia 159: 109-112.

Henson IE, TayedMD. 2003. Physiological analysis of an oil palm density trial on a peat soil. Journal of Oil palm Research 15(2): 1-27.

Idris AS, Ismail S, Arifin D, Ahmad H. 2002. Control of Ganoderma infected palm-Development of pressure injection and field applications. MPOB Information Series TTNo. 131.

Larby E, Anim-Okyere S, Danso F, Danso I, Afari P, Nuertey BN, Asamoah TEO. 2013. Effect of planting densities on growth, development and yield of oil palm (Elaes guineensis Jacq.) in Ghana. International Journal of Current Research 5(10): 2997-3000.

Latif S, Noor M T Dolmat, AK Din. 2003. Economics of higher planting density in oil palm plantations. Oil Palm Industry Economic Journal 3(2): 32-39.

Najmie MMK, K Khalid, A A Sidek, MA Jusoh. 2011. Density and ultrasonic characterization of oil palm trunk infected by Ganoderma boninense disease. Measurement Science Review 11(5):160-164.

Pallas B, Clement-Vidal A, Rebolledo M C, Soulie JC, Luquet D. 2013. Using plant growth modeling to analyze C source-sink relations under drought: inter and intra specific comparisons Front. Plant Science 4:437.

Rafii MY, Isa ZA, Kushairi A, Saleh GB, Latif MA, 2013. Variation in yield components and vegetative traits in Malaysian oil palm (*Elaeis guineensis* Jacq.) *dura x pisifera* hybrids under various planting densities. *Industrial Crops and Products* 46: 147–157.

Sayer,J.,Ghazoul,J.,Nelson,P.,andKlintuniBoedhihartono,A.(2012).Oilpalm expansiontransformstropicallandscapesandlivelihoods. GlobalFoodSecur. 1, 114–119.
Turner PD, Gillbanks R. 1974. Oil palm cultivation and management. Incorporate Society of Planters. University Press, Kula Lumpur, Maalaysia. P 672.