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Chili Pepper Cultivation Using Several Spacings Intercropped with Immature Oil Palm

Penanaman Cabai Merah dengan Berbagai Jarak Tanam di antara Tanaman Kelapa Sawit Belum Menghasilkan

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ABSTRAK

Tanaman kelapa sawit (*Elaeis guineensis* Jacq.) merupakan salah satu jenis tanaman dari family Areaceae, yang mempunyai nilai ekonomis cukup tinggi karena merupakan salah satu tanaman penghasil minyak. Penelitian bertujuan untuk mengetahui bagaimana pertumbuhan tanaman kelapa sawit belum menghasilkan dengan menanam cabai merah dan untuk mengetahui jarak tanam cabai merah terbaik di antara tanaman kelapa sawit belum menghasilkan. Penelitian dilaksanakan di Desa Rimba Jaya, Kecamatan Air Kumbang, Kabupaten Banyuasin, Provinsi Sumatera Selatan. Penelitian dimulai bulan Oktober 2017 sampai Februari 2018. Rancangan yang digunakan untuk tanaman cabai merah adalah Rancangan Acak Kelompok dengan satu faktor yaitu jarak tanam (M_1 = 50 x 50 cm ; M_2 = 60 x 60 cm ; M_3 = 70 x 70 cm) dan 5 kelompok. Hasil menunjukkan bahwa tinggi tanaman, diameter batang, diameter tajuk dan tingkat kehijauan daun tanaman kelapa sawit belum berpengaruh dengan adanya tanaman cabai merah. Namun, pada tanaman cabai merah jarak tanam cabai 50 x 50 cm memberikan respons yang positif terhadap pertumbuhan dan produksi tanaman cabai merah. Hasil tertinggi pada cabai merah adalah 10,41 kg produced pada jarak tanam 50 x 50 cm.

Keywords: *Capsicum annum* L, *Elaeis guineensis* Jacq., jarak tanam

ABSTRACT

Oil palm (Elaeis guineensis Jacq.) belong to the Arecaceae family, is economically valuable for oil production. The objective of this study was to evaluate the growth of immature oil palm intercropped with red chili pepper and to evaluate the best spacing for red chilli cultivation between immature oil palm. The study was conducted in Rimba Jaya Village, Air Kumbang District, Banyuasin Regency, South Sumatra. The study began in October 2017 until February 2018. The design used for the red chili pepper cultivation was a one-factor Randomized Block Design. Spacing used as treatments, namely: (M1 = 50 x 50 cm ; M2 = 60 x 60 cm ; M3 = 70 x 70 cm). Treatments were placed in 5 groups. The results showed that plant height, stem diameter, canopy diameter and the greenness level of palm oil leaves did not affect by the presence of red chili pepper. While spacing of 50 x 50

cm provided a positive response to the growth and yield of chili pepper. The highest yield of red chili was 10.41 kg produced in 50 x 50 cm spacing.

Keywords: *Capsicum annum* L, *Elaeis guineensis* Jacq., spacing

INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.) belong to Areaceae family, is an economically valuable for oil production. Oil produced by oil palm fruit can be made into several materials such as CPO (Crude Palm Oil) and PKO (Palm Kernell Oil) (Deilla and Ernah, 2018). Palm oil or CPO is an important raw material for various industrial products, such as food, non-foods and biodiesel. Palm oil is highly preferred as an industrial raw material due to its availability in large quantities with lower prices as compared to other vegetable oils, soybean, sunflower, and corn (Hutabarat, 2017). Crude Palm Oil (CPO) production in 2005 was 11,861,615 tons with an area of oil palm plantation up to 5,453,817 ha and CPO production increased to 6,615,958 tons with plantation area of 8,430.027 ha (Rahayu & Sofyan 2017). Beside producing palm oil, oil palm is tolerant to unfavorable environmental conditions. However, a range of certain environmental conditions are required to achieve optimal growth rates. Climate condition is the main environmental factor that influence the success of oil palm development (Benny et al., 2015).

The development of oil palm plantations has progressed very rapidly in Indonesia. Oil palm plantations reached 2,399,172 ha in 2013 with a production of 7,570,854 tons (Sudarso et al., 2015). In 2014, the total area of oil palm plantations reached 10.9 million ha and grew continuously in 2015 up to 11.4 million ha (Muhdan et al., 2015). In 2016, Indonesia became the largest producer of palm in the world which produced 34 million tons of total world production (approximately 62 million tons). Indonesia exported 25 million tons of world total exports from various countries approximately 46 million tons. Domestic total consumption as much as 9.47 million tons (Deilla & Ernah, 2018). The area of oil palm plantations in Indonesia in 2017 was 12,307,677 ha and produced 35,359,384 tons of TBS with volume and total production value of 1,126,194 tons TBS respectively (Ariyanti et al., 2017). It shows that the palm oil is able provide source of employment and improve public welfare.

Oil palm planted in a wide distance (9 x 9 x 9 m) and during early vegetative stage, leaves canopy and roots are still relatively undeveloped. Oil palm canopy will increase exponentially along with age until maximum growth reached. After 8 years, the interception of oil palm will tend to be stable in productive stage (Wasito et al., 2014). Empty space is available during immature stage of oil palm (0-3 years) and poor control of weeds growth will potentially harmful for the plants (Prasai et al., 2018). Besides, intercropping between oil palm will increase the efficiency of labor, land use and absorption of sunlight. In addition, plant populations can be adjusted and the presence of intercropping in staple crops is a source of income during immature stage of oil palm (Fransiskus & Syprianus, 2018). The pattern of planting two or more different types of plants simultaneously in the same area is called intercropping (Pasa et al., 2018). One of potential plants to be utilized for intercropping with oil palm is red chili pepper due to its shallow root system (Marliah et al., 2011; Suherman et al., 2018). Red chili pepper (*Capsicum annum* L.) belongs to solanaceae family with a fairly complete nutrition contents, specific aroma, taste and color. Thus, chili pepper is widely used as spices and cooking ingredients by the community. Nutrients needed by humans found red chili are vitamin A, vitamin C, carotene, iron, potassium, calcium, phosphorus and alkaloids such as capsaicin, flavonoid, and essential oils (Setiawan et al., 2016). In

daily life, red chili is an important vegetable for the community. The demand for red chili continuously increases in line with the escalation of population and the development of food industry that requires chili supply. This condition usually causes hot issue in the community for this the price of the commodity can highly increase sometimes (Khan et al., 2012).

Chili is suitable to be developed in tropical regions such as Indonesia. The largest chilli cultivation areas are in West Java, Central Java, East Java, Lampung, West Sumatra and eastern Aceh (Murniati et al., 2013). The total area of red chili in 2008 was 109,178 ha and increased to 120,275 ha in 2012 which 22,706 ha were found in Central Java. The intensification is due to the demand of chili increases in line with the increasing number of population and the development of industries that used chili as raw material (Jamilah et al., 2016). The objective of this research was to evaluate the growth of immature oil palm with the presence of chili pepper and to understand the most suitable plant spacing for chili pepper growth intercropped with immature oil palms.

MATERIALS AND METHODS

Place and Time

The study was conducted in Rimba Jaya Village, Air Kumbang District, Banyuasin Regency, South Sumatra. The study began in October 2017 until February 2018.

Method

The plants in this study was arranged in Randomized Block Design (RBD) with one factor of spacing (M_1 = 50 x 50 cm; M_2 = 60 x 60 cm; M_3 = 70 x 70 cm) and five groups.

The obtained data were analyzed with analysis of variance (Anova) by comparing F value with F table. If F value greater than F tables at 5% and 1% levels, then treatment significantly affected the observed variable. If F value smaller than F table at 5% and 1% levels, then there were no significant effect of treatments.

Procedure

Immature Oil Palm

Land Clearing of Palm Oil Plants

Empty space between oil palm plants cleared from weeds by using hoes and machetes.

Determination of Study Area

Determination of plot area was conducted by pulling the measurement tape from the base of the palm stem with a distance of 1 m, then a marker was installed as a sign of plot and form a 7 x 6 m plot between the oil palm plants.

Red Chili

Red Chili Pepper Germination

Seeds were soaked into water approximately ± 24 hours prior to germination. Seeds then sown in germination tray. After 3 weeks, seedling transplanted to prepared plot area.

Planting Hole and Plant Spacing

Plant spacing of this study were 50 x 50 cm, 60 x 60 cm, and 70 x 70 cm. During planting hole and spacing preparation, soil mixed with 700 g manure each hole and incubated for 1 week. Planting hole and spacing prepared with hoes, measurement tape, rope, and peg wood as marker.

Red Chili Pepper Transplanting

Planting the chili between oil palm was conducted by transplanting the 3 weeks old seedling from seedling tray to prepared plot area. Seedling was removed from the tray along with the soil that stacked with the root.

Observation

Immature Oil Palm

Oil Palm Height (m)

Plant height measurements were carried out before planting the red chillies until the beginning of generative stage of chili. Plant

height were measured with a measurement tape. Plant height measured from the ground up to the highest leaf buds by straightened the leaves upward. Plant height measurements were taken from each experimental unit.

Oil Palm Stem Diameter (cm)

By measuring the enlarged part of the stem around midrib area using the measurement tape. Observations of stem diameter were taken from sample of each experimental unit.

Canopy Diameter of Oil Palm (m)

By using a measurement tape and bamboo, which bamboo was placed at the end of the longest canopy to the end of another longest canopy. Observations of stem diameter were taken from sample of each experimental unit.

Greenness Level of Palm Oil Leaves

The greenness level of leaves were measured on leaves that were exposed to direct sunlight, using SPAD by clipping the leaf. The measurement was taken on the tip, middle and base of the leaf. Greenness level was measured before chili transplanted to empty area between oil palm plants and after harvesting the chili. Observation of greenness level of the leaves was conducted in each experimental unit.

Red Chili Plant

Plant Height (cm)

Plant height was measured from the base of the stem to the highest growing point by using a ruler. Plant height was measured until plants entering the flowering stage. The number of red chili plants observed were 5 samples from each treatment.

Number of Branches

The calculation of the number of branches was done by removing the chili leaves and counting the total number of branches on the plant. The calculation was done when the harvest is finished. The branches number of red chili plants observed was 5 samples from each treatment.

Total Production (kg)

Observation of total yield was conducted by counting the sum of first harvested yield to the third harvest on each replication.

RESULTS AND DISCUSSION

Results

Based on the analysis of variance, of the observed variables in immature oil palm shows that the presence of red chili among oil palm plants did not significantly affect the plant height, canopy diameter, stem diameter and leaf greenness level. In spacing treatments, including M_1 (50 x 50 cm), M_2 (60 x 60 cm), and M3 (70 x 70 cm) did not significantly affected plant height and number of branches but significantly affected the total yield (Table 1).

Immature Oil Palm

Plant Height in 4 Months (m)

The results of analysis of variance showed that planting chili among oil palm plants did not significantly affect the height of oil palm plants. In P5 (the last observation) the highest plant height was obtained in the M_1 treatment with an average plant height of 2.88 m, while the lowest plant height was M_3 with an average of 2.78 m. The highest increase in plant height from the first month observation (P1) to the fourth month observation (P4) was found in M_2 with an increase of 0.38 m while the lowest was M_3 with an increase of 0.28 m (Figure 1).

Plant Stem Diameter in 4 Months (cm)

The results of analysis of variance showed that planting chili among oil palm plants did not significantly affect the stem diameter of oil palm plants. In P5 (the last observation) the highest plant stem diameter was obtained in the M_2 treatment with an average plant height of 53.6 cm, while the lowest plant stem diameter was

M_3 with an average of 48.8 cm. The highest increase in plant stem diameter from the first month observation (P1) to the fourth month observation (P4) was found in M_3 with an increase of 12.8 cm while the lowest was M_1 with an increase of 9.4 cm (Figure 2).

Table 1. The results of the diversity analysis of all variables observed

Number	Observed Variables	F-value	CD (%)
1	Oil Palm		
	- Plant Height (m)	0.13 ^{ns}	12.59
	- Stem Diameter (cm)	0.53 ^{ns}	14.61
	- Canopy Diameter (m)	0.94 ^{ns}	9.34
	- Greenness Level of Palm Oil Leaves	4.35 ^{ns}	6.96
2	Red Chili		
	- Plant Height (cm)	3.56 ^{ns}	17.73
	- Number of Branches	1.68 ^{ns}	32.99
	- Total Production (kg)	34.54**	17.36

Note: CD= coefficient of diversity, ns = not significant influence, ** = very real influence

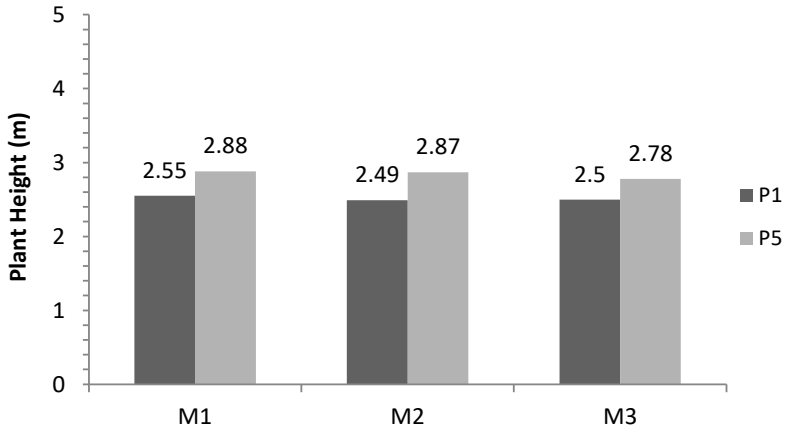

Figure 1. Plant height in 4 months (m)

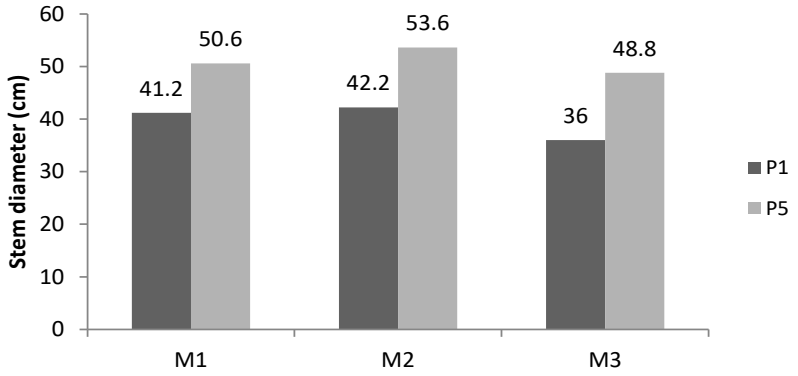

Figure 2. Stem diameter in 4 months (cm)

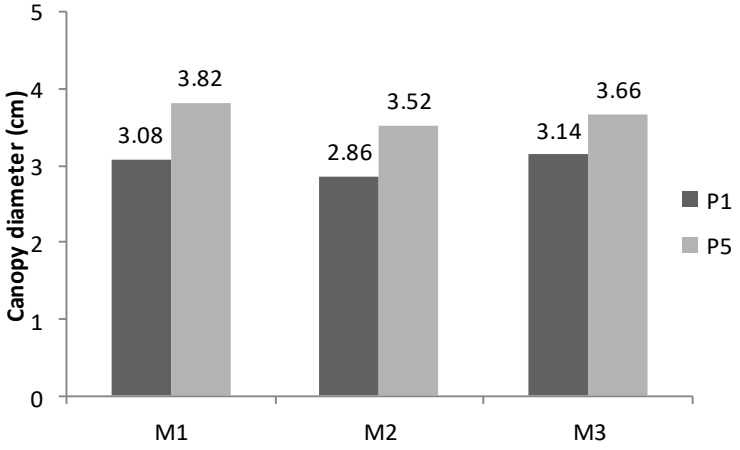

Figure 3. Canopy diameter in 4 months (m)

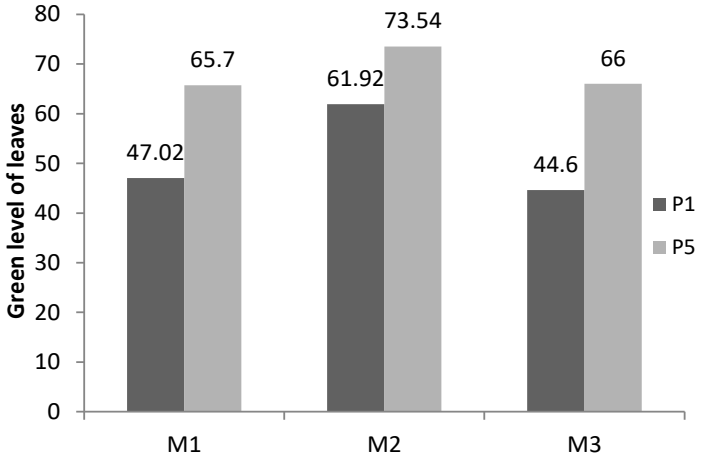

Figure 4. Greenness level of palm oil leaves

Canopy Diameter in 4 Months (m)

The results of analysis of variance showed that planting chilli among oil palm plants did not significantly affect the diameter of oil palm plants. In P5 (the last observation) the highest canopy diameter was obtained in the M_1 treatment with an average canopy diameter of 3.82 m, while the lowest canopy diameter was M_2 with an average of 3.52 m. The highest increase in canopy diameter from the first month observation (P1) to the fourth month observation (P4) was found in M_1 with an increase of 0.74 m while the lowest was M_3 with an increase of 0.52 m (Figure 3).

Greenness Level of Palm Oil Leaves in 4 Months

The results of analysis of variance showed that planting chili among oil palm plants did not significantly affect the level of greenness of oil palm leaves. In P5 (the last observation) the highest level of greenness of leaves was obtained in the M_2 treatment with an average greenness of leaves 73.54, while the lowest level of greenness of leaves was M_1 with an average of 65.7. The highest level of greenness of leaves from the first month observation (P1) to the fourth month observation (P4) is the highest M_2 with 21.4 increase, while the lowest is M_3 with an increase of 11.62 (Figure 4).

Red Chili Plant

Plant Height (cm)

The results of analysis of variance showed that planting chili among oil palm plants did not significantly affect the height of the chili plants. The highest plant height was obtained in the M_3 treatment with an average plant height of 43.86 cm, while the lowest plant height was M_2 with an average of 32.46 cm (Figure 5).

Number of Branches

The results of the diversity analysis showed that planting chili among oil palm plants did not significantly affect the number of chilli branches. The highest number of branches in chilli plants was obtained in M_1 treatment, with an average number of 40.40 branches, while the lowest number of chilli branches was M_3 with an average of 28.84 branches (Figure 6).

Total Production (kg)

The results of the diversity analysis showed that planting chili among oil palm plants had a very significant effect on the total production of chili plants. The M_1 treatment had a very significant effect on the M_2 and M_3 treatments, a high value was obtained for the M_1 treatment with an average of 10.41 kg followed by the M_2 treatment with a mean of 6.46 kg and the lowest value obtained at treatment of M_3 with a mean of 4.10 kg (Table 2).

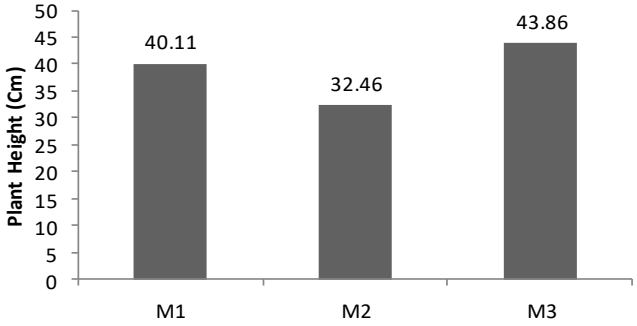

Figure 5. Plant height (cm)

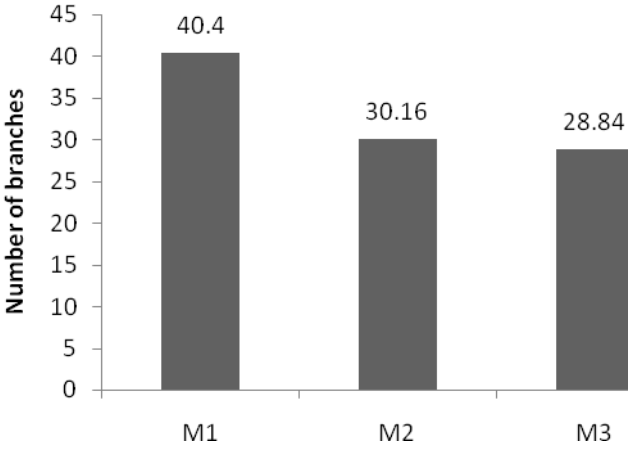

Figure 6. Number of branches

Table 2. BNT test of total red chilli production

Treatment	Average	LSD 5% = 3.11
M_1	10.41	a
M_2	6.46	b
M_3	4.10	b

Note: The numbers followed by the same letter mean no effect on the 5% LSD test

Discussion

This study was conducted in a 36 moths old or immature oil palm (TBM) plantation and the spacing was 9 x 9 x 9 m. During immature stage of plant, empty area between plants can still be utilized to plant horticultural crops. One of horticultural crops that can be commercially cultivated is red chili pepper (Khandaker et al., 2017). Based on the results analysis of variance, the presence of red chili cultivation between oil palm did not significantly affect the plant height, stem diameter, canopy diameter, and greenness level of oil palm leaves. Whereas the spacing of red chili plant did not significantly affect the plant height, and number of branches but was significantly affected the total yield.

The highest plant height and canopy diameter of palm oil canopy were obtained in the M_1 treatment (50 x 50 cm) (Figures 1 and 3). While the highest stem diameter and leaves greenness level of the oil palm plant found in M_2 treatment (60 x 60 cm) (Figures 2 and 4). In closer spacing of red chili, oil palm plants grow higher. Dense population of plants maintain soil moisture and reduce evaporation resulting sufficiently available water content in the soil and can be utilized by oil palm. However, the M_2 and M_3 spacing treatments of red chili were further compared to M_1 which had a denser population of red chili plants. Further distance in M_2 and M_3 allowed the oil palm leaves to grow and resulting the widest canopy diameter and the highest greenness level of oil palm. In addition, the population in M_2 and M_3 is lower and nutrients become more sufficient for plant. Nutrient is very important for plants, its availability affects the growth of above soil plants, the addition of nutrients by fertilizer application is commonly conducts for supplying sufficient nutrients for plants (Sinulingga et al., 2015).

Fertilization is one of the most important activities during plants cultivation, fertilizers can be applied in both organic and inorganic forms. During this study, the fertilizer applied was organic fertilizer that would increase soil nutrient content and reduce the utilization of inorganic fertilizers (Adnan et al., 2015).

In the red chili plant, the highest plant height were obtained in M_3 treatment (70 x 70 cm) (Figures 5). Meanwhile, the highest number of branches and total yield of chili were performed in M_1 treatment (50 x 50 cm) (Figures 6 and Table 2). A further spacing showed the best results during vegetative phase but closer spacing showed best results during reproductive phase. These conditions were because chili can grow optimally in farther spacing since competition between chilli is lower. Although this study used same variety, the spacing was different, and the plant height would be different as well. The more density population showed the best results in the production phase.

Branches are important organs of plants that support the production of chili pepper since flowers and fruit are formed from the branches. The more branches formed, the higher flowers and fruits produced. The spacing was significantly affected total yield of chilli. LSD 5% analysis results showed that the M_1 (50 x 50 cm) produced the highest yield but M_2 (60 x 60 cm) and M_3 (70 x 70 cm). Did not significantly affected chili's yield. This is closely related to number of branches variables. The M_1 treatment showed the highest yield compared to M_2 and M_3 treatments. In the total yield variable, it can be seen that the closer spacing makes the plant population more abundant (Table 2).

CONCLUSION

Red chili pepper cultivation at several plant spacings between oil palm did not affect the growth of immature oil palm and the higher density population of 50 x 50 cm red chilli plants resulted the best growth and yield of chili compared to 60 x 60 cm and 70 x 70 cm spacing. The highest yield of red chili was 10.41 kg produced in 50 x 50 cm spacing.

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