Performance of Intercropping Corn on Mature Oil Palm Plantations on Dry Land

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Performance of intercropping corn on mature oil palm plantations on dry land

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ABSTRACT

The intercroping area (IC) is around 0.5 ha from one hectare of mature oil palm (YH). The research aimed to observe the growth and yield of corn from the Bisi 16 variety in oil palm plantations from the SJ 5 variety and the effect of corn as IC on oil palm. The research location was in Mesuji Raya Sub-district, Ogan Komering Ilir, South Sumatra, from April 2024 to July 2024. The interspace number of oil palm of 1 ha were 12 and it was six interspaces as the object research was as frond staking. The research method used was non-experimental. Each of front staking had two sample plots of corn (3×3 m), and samples selected for each plot were 15 crops. For oil palm (8×8×8 m) two samples of crops were beside the corn plot. The total of oil palm samples was 24 crops from oil palm IC, and compared to 24 crops from monoculture. The research results showed that the growth of IC corn was lower for plant height (16%), and the reduction in corn yield (26%) from one ha compared to the description. The total yield from corn IC as approximately 2.09 tons of corn shells, which were lower from monoculture description. The growth and yield of oil palm IC were better than monoculture, with an increase a number of fruit bunches (9%) and FFB weight (11%). Corn is an intercrop/polyculture crop in oil palm plantations after one or two years of production.

Keywords: food crops, frond staking, path, plantation crops, polyculture

INTRODUCTION

The area for oil palm cultivation includes wetlands and drylands because various new varieties have been discovered that are adaptive and high-yielding on both lands. In 2023, there will be approximately 15.4 million hectares of oil palm cultivation areas in Indonesia (BPS, 2024). The use of the surjan system in oil palm cultivation and continuous air flooding, and polyculture planting with food crops in swampy areas are challenges in oil palm polyculture (Namanji et al., 2021). Oil palm cultivation on dry land was relatively easier to implement overlapping, especially for replanting, which was expected to reach 480,000 ha in 2023 (BPDPKS, 2023). Since 2017, oil palm replanting in South Sumatra had reached 70,000 ha (Disbun Sumsel, 2023). Oil palm cultivation on dry land is relatively easier to implement overlapping, especially for replanting, which was expected to reach 480,000 ha in 2023 (BPDPKS, 2023). Since 2017, oil palm replanting in South Sumatra had reached 70,000 ha (Disbun Sumsel, 2023). Since 2017, oil palm replanting in South Sumatra had reached 70,000 ha (Disbun Sumsel, 2023). To optimize the productivity of oil palm replanting, the Ministry of Agriculture had directed this land to be polycultured or intercropped with food crops such as upland rice and corn Meanwhile, for oil palm that is more than 10 years old, it can be mixed with red ginger (Edvanido et al., 2023). Farmers or oil palm companies often cultivate corn plants as a

polyculture on immature oil palm plants (IPT) to gain economic benefits from the plantations before they reach maturity. Field crops of rice and corn are very popular as intercrops with IPT, especially planted in all existing plantations, and this activity lasts for around two to three years (Hamdani & Susanto, 2020).

In the current oil palm replanting program, it is recommended to use short frond varieties. The planting distance used is 8x8x8 m or 7x7x7 m, and when oil palms enter their first year of harvest (YH 1), farmers usually no longer intersect the oil palm plantations. When YH 1 is until the oil palm enters the replanting phase, farmers usually no longer plant in oil palm rows/interspace. In oil palm plantations, there are usually types of interspace, namely frond staking (places where fronds are piled up) and paths as roads in the plantation with a total of 12-14 interspaces. The frond staking is used to pile up palm fronds and become a place for the cultivation of inset plantings in producing oil palms. Thus, there are around 6-7 interspaces for planting inserts for each hectare. The width of the frond staking on oil palms in YH1 ranges from 7 m to 8 m. Based on the area of oil palm plantations per hectare, the potential planting area is around 4900 m^2-5600 m^2 for each ha of oil palm (49%-56% of the area of oil palm plantations).

A further problem for inserting plants in oil palm plantations at this time is continuing TS on oil palms that are already produced. Research on TS using food plants and spices when oil palm is IPT has begun to be carried out by various researchers, but the cultivation of these plants when oil palm is already producing, has not been widely researched. Measuring each effect of the cultivation activities of insert crops requires a complex approach and a long time. According to Nengsih (2016) and Arifin et al. (2024), the influence of competition between plants in utilizing space can be anticipated by regulating the planting distance between trees and also the tree canopy. The canopy of mature oil palms over 10 years old usually completely covers the canopy so that plants that need full light are hampered in growing. For YH 1 or YH 2 oil palm plants, the fields are still open (open space) so that the full intensity of sunlight can enter for around 6-8 hours/day, which is thought to be still suitable for corn and other plants.

To study the effect of corn interplants on YH oil palm and the effect of YH oil palm on corn, an approach based on the planting distance and canopy between the two plants was carried out. Based on this, the spacing between rows and the spacing within rows are applied for TS corn. In general, the planting distance for hybrid corn is 70-100 cm x 20-30 cm. In this research activity, the planting distance between rows was set at 100 cm, and the distance between planting holes in the row is 25 cm (100 cm x 25 cm) so that there is room for sunlight to enter. To obtain further information about the growth and yield of IC corn on YH oil palm and also the growth and yield performance of YH oil palm, this research was carried out, as well as to obtain the economic value of TS corn. The objective of this research was to study the growth and yield of corn from the Bisi 16 variety in oil palm plantations from the SJ 5 variety and the effect of corn as IC on oil palm.

MATERIALS AND METHODS

The research was carried out on land owned by oil palm farmers, with coordinates WGS 84 (-3.66049, 105.04946). Mesuji Raya District, Ogan Komering Ilir, South Sumatra Observations were carried out during one corn planting season in April-July 2024.

Sample Plot

Oil palm plants (*Elais guinensis* Jacq.) have been produced from the DXP Sriwijaya 5 (SJ 5) variety, more than 4 years old with a planting distance of 8x8x8 m, chosen as the research object with an area of one ha. The oil palm plantation features 12 interspaces, each measuring 8 m in width, with 6 front stakings serving as deadlines and another 6 interspaces serving as lifelines. Corn plants were planted as intercrops in all dead plantations, and dead plantations were chosen as the location for the corn plots, and two corn observation plots were placed in each dead plantation with a distance between the plots of around 30 m so that the total number of observation plots was 12 observation plots. The size of the corn observation plot was 3x3 m (9 m^2) in the middle position between two

oil palm plants. The position of the corn sample plot on the hurdle was in the middle of the corn plant row. In the corn observation plot, 15 plants were randomly selected, and the total research sample of corn was 180 plants. The corn variables observed and measured were plant height, number of leaves, cob length, number of seeds, seed weight, and harvest shell weight (tons/ha). The two oil palm trees designated as IC samples flanked the corn sample plot, resulting in a total of 24 oil palm sample trees for each dead plantation. The growth and yield of oil palms that were observed and measured were the number of fronds, length of fronds, number of FFBs, weight of FFBs, number of female flower bunches, and number of male flower bunches.

Corn Cultivation

The corn planting area for oil palm in dead areas was first plowed twice with a 4x4 tractor and then leveled and loosened with a hoe. The next activity was the application of one ton/ha of dolomite, which was sprinkled evenly on the barrier and incubated for 14 days. Next, six rows of corn were planted in the dead rows of oil palm with a distance of 100 cm between the rows, and holes were drilled in the rows for planting corn at a distance of 25 cm so that the distance between the corn plants was 100 x 25 cm. Each planting hole was given one grain of Bisi 16 corn seed. Fertilization was done by digging around 10 cm of corn seedlings that were around seven days after planting (DAP) with a dose of Urea + TSP in a ratio of 3:1 of 150 kg/ha + 50 kg /ha and given twice, namely 7 DAT and 45 HST. Weed control uses herbicides with the active ingredient atrazine (500 g/L) + mesotrione (55 g/L), which was applied at 15 HST and 45 HST.

Pests and diseases were controlled with the active insecticides emamectin benzoate (30 g/L) and difenoconazole (250 g/L) given every 10 HST. Foliar fertilizer containing macro and microelements was given at a dose of 3 mL/L applied at 10 DAP, 30 DAP, and 50 DAP. Corn plants were harvested at 96 HST when all the leaves dry out and the seeds become hard.

Palm Oil Cultivation

The oil palm plant planted was the DXP Sriwijaya 5 (SJ 5) variety with a planting distance of 8x8x8 m, which was more than four years old and had produced fruit bunches (FFB) with a width of around 8 m. Oil palm plants were fertilized with NPK Phonka at a dose of 3 kg/tree and urea 1 kg/tree, which was applied in two stages, namely in November and May. The conditions around the oil palm roots were classified as clean from weeds. IC palm oil plates were relatively clean, and frond pruning was also following regulations, and pest attacks on oil palms were not found.

Data Processing

Observations of all oil palm variables were carried out after two days of IC corn harvest, so they were carried out only once. Two days before the IC corn harvest (96 HST), all vegetative components of the plant were observed, and during the corn harvest, all generative component observations were made on all sample plants. Observations of the duration of sunlight on sample plots were carried out directly when there was no rain, once every time. The measurement was by recording the length of full exposure using a watch on the IC corn sample plot. This research uses non-experimental methods, and all observed data was calculated for the mean and standard deviation.

RESULTS

Observation of the duration of full sunlight on a sample plot of IC corn plants flanked by two oil palm trees using a watch. Generally, IC oil palm corn plants with canopy heights exceeding 4 m received sunlight exposure from 10:00 to 15:00, a duration of 7 hours. When the corn plants were still small and up to a month old, the oil palm canopy provided shade, resulting in less than 5 hours of sunlight exposure. Table 1 provides complete information about the duration of full sunlight on each obstacle plot for each month. The growth of inserted corn plants in mature oil palms (YH1) showed a relatively low height of around 40 cm compared to monoculture corn. The limited light reaching the leaves of IC oil palm corn also results in a smaller number of leaves and a shorter leaf length. Furthermore, the generative component of corn also decreased compared to monoculture corn planting. The decrease in various generative components of IC corn plants was due to the influence of

decreasing leaf size and plant height. Despite its relatively lower physical appearance, IC corn still yields between 2 and 3 cobs per plant in oil palm plantations.

Table 1. The duration of full sunlight on sample plots of IC corn next to oil palm trees for each month

The duration of full sunlight minutes/day/month)			
Aprile	May	June	July
310	350	382	389

The results of this study were relatively the same as those obtained by Utari et al. (2023) in 50% shading reduced the production of sweet corn cobs. Furthermore, Li et al. (2024) explained that light stress affects the decrease in the activity of superoxide dismutase, catalase and peroxidase and accelerates the aging of cob leaves during the grain-filling phase so that corn production decreases. With an area of approximately 0.5 ha, the overall harvest yield of IC corn was 0.6, while one hectare of YH1 oil palm yields 2.09 tons of shelled fruit. Table 2 provides comprehensive information on this subject.

Table 2. Growth and yield of corn planted with intercropping on oil palm plantations

Parameter	Mean
Plant Height (cm)	186.80 ± 41.72
Number of Leaves (pieces)	10.02 ± 1.40
Leaf length (cm)	74.58 ± 14.63
Cob Length(cm)	16.91 ± 4.44
Number of Seeds (seeds)	339.11 ± 15.29
Weight of 100 Seeds (g)	126.30 ± 12.06
Yield per hectare (tons/ha)	2.09

The number of fronds and frond length of YH 1 oil palms inserted by corn plants were relatively the same as monoculture oil palm plants. Furthermore, the number of female flower clusters was found to be higher than the number of male flower clusters. Interestingly, the amount of FFB on the tree and the weight of FFB at harvest was higher in IC corn oil palms compared to monoculture oil palms. Table 3 provides comprehensive information about the growth and yield performance of YH 1 oil palm plants compared to IC and non-IC oil palms.

The planting conditions for corn as an insert crop in oil palm during the generative phase appeared normal and the leaves were green and did not experience certain nutrient deficiencies so that harvest results could be obtained from the corn (Figure 1). Furthermore, in general the number of fruit bunches (FFB) from corn IC oil palms appears to be greater than from monoculture oil palms (Figure 2).

Table 3. Yield and growth of oil palm inter croping and monoculture

Parameter	Mean	
	Intercroping	Monokultur
Number of fronds (frond)	46.17 ± 3.94	47.28 ± 4.1
Midrib Length (cm)	3.98 ± 0.10	3.90 ± 0.21
Number of FFB (bunches)	15.72 ± 2.05	13.23 ± 2.29
FFB weight (kg)	14.29 ± 0.96	12.93 ± 1.04
Number of female (bunches)	18.30 ± 1.13	15.61 ± 2.03
Number of male (bunches)	1.83 ± 0.71	2.10 ± 0.50

a b

Figure 1. Growth of vegetative (a) and harvest (b) of corn interspersed with oil palm

a b

Figure 2. Condition of fruit bunches and other generative organs of oil palm monoculture (a) and oil palm intercropping (b)

DISCUSSION

The number of oil palm fronds when they have produced FFB since YH 1, which have covered dead plantations, is a problem for intercropping on plantation land, including oil palm, so that intercropping or polyculture plants grow and produce less well. The conditions that farmers or planters are worried about are not proven, especially if oil palm plantations use SJ-5 oil palms since YH 1 with a planting distance of 8x8x8 m. At the time of the YH1 oil palm, there was still open space in its wicket with a width of around 3–4 m. Open Space on IC is very importants for growing of crops (Dewi et al,

2022). According to field observations, palm fronds shade the staking area, allowing it to receive full light for approximately 6-8 hours per day. Ideally, corn plan IC should receive 10-11 hours of light per day, and any less than 8 hours can disrupt growth and yield (Andayani et al., 2020). The study revealed that the corn sample plots received 6-8 hours of full sunlight per day, with IC corn receiving less full sunlight in the morning and evening. As a result of receiving less than 11 hours of full sunlight per day, corn experiences slow growth. This condition affects the height and number of leaves of IC corn, causing them to fall below the variety description. The decrease in the number of leaves in corn is less resistant to low light intensity due to a decrease in photosynthesis rate, and transpiration (Dewi et al., 2022; Zhang et al., 2023).

Tilling the land with a large tractor in the IC corn plantation, followed by the application of dolomite, compost, urea fertilizer, and TSP, is thought to be able to improve soil structure and soil chemistry for corn growth in the YH1 oil palm plantation. The condition of the soil structure, which is processed by a large tractor and accompanied by the addition of organic material, will increase the water content of the soil and provide sufficient nutrient supply for the growth and development of corn. It should also be added that the soil from planting food crop inserts in oil palms affects increasing the species and number of soil microbes so that they are very useful for food crops and oil palms (Sapalina et al., 2022). Based on the color of the IC leaves, it was green and looked normal, which is an indicator that the IC corn did not experience nutrient deficiencies and received sufficient water. According to Akmalia & Suharyanto (2017), corn plants that are exposed to light stress and sufficient water show a decrease in height and number of leaves.

Therefore, Bisi 16 IC corn still produces 2–3 cobs per stem, even though the cob size is relatively small. The cobs produced by Bisi 16 TS turned out to have dense, full seeds, even though the seed size was relatively small compared to monoculture. The dense and full condition of the seeds on the corn cobs suggests that the inserted corn plants are under light stress, allowing for a relatively normal formation of carbohydrates as the seed's raw material. According to Syafruddin et al. (2014) and Zhang et al. (2019), corn genotypes that are relatively resistant to low light intensity are still capable of producing cobs and seeds, and have a greater influence on photosynthesis characteristics and chlorophyll fluorescence. It was also reported that Bisi 16 TS corn on YH 1 oil palms still has a shell production of around 2.09 tons of shells/ha, and this means that relatively large oil palm plantations can be relied on to produce feed corn for livestock and also a source of additional income for farmers palm oil.

Improving the physical soil and soil nutrients in YH1 oil palm plantations will impact the availability of water and nutrients for oil palms. This is because, theoretically, oil palm roots can penetrate areas based on canopy cover. In addition, we fertilize each oil palm tree with urea and phonska to meet its nutrient needs. Therefore, IC oil palm plants grown alongside corn exhibit a similar number and length of fronds compared to their monoculture counterparts. Observations reveal that IC oil palms typically have more female flower bunches when harvesting corn. This is thought to be due to IC oil palm plants receiving more water and nutrients than monoculture. Because of this, IC oil palms continue to grow well and have more female flower clusters, and stem girth remains good (Khomphet et al., 2021).

The number of fruit bunches (FFB) is also relatively greater, with the weight of the FFB being heavier than the IC oil palm. This is thought to be due to the ongoing effect of fertilizing previous oil palm and corn crops, which has the effect of increasing the availability of nutrients for IC oil palm compared to monoculture oil palm. This research is in line with the results reported by Ezinwane et al. (2020), that IC oil palm, which is sufficient in nutrients, will produce FFB, and the weight of the FFB is heavier, and insert planting activities have less effect on the oil palm.

In general, it can be said that planting Bisi 16 corn inserts on SJ 5 oil palms at YH 1 does not effect on inhibiting oil palm growth, as long as soil and nutrient management is carried out well and adequately. This research aligns with the findings of Nchanji et al. (2016) and (Firmansyah & Umami, 2021) study, which

found that the combination of oil palm and food crops promotes robust growth. Planters, KUDs, and private companies can therefore intensify corn planting activities in YH 1 oil palm plantations.

CONCLUSSION

The cultivation of Bisi 16 corn as an intercropping/polyculture with SJ 5 oil palm YH1 reveals a lower growth and yield of corn compared to monoculture, although it still yields a relatively good shell weight of 2.09 tonnes/ha. Meanwhile, SJ-5 oil palm plants at YH1 showed better growth and yield organ performance compared to monoculture.

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