

DOUBLE-ROW AVENUE SYSTEM FOR CROP INTEGRATION WITH OIL PALM

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Maximizing land use in oil palm areas through crop or livestock integration can generate additional income for oil palm growers, and enhance national food production which is in line with the Third National Agriculture Policy. During the immature phase (*i.e.* when palms are less than three years old), the growth of oil palm fronds and roots is limited, permitting sufficient sunlight to penetrate to the ground, especially in the areas between the palm rows. This condition allows other crops to be planted in the inter-rows. During the mature phase, when the fronds of the palm grow bigger and start overlapping with fronds of adjacent palms, light penetration is reduced drastically, restricting the growth of most crops; thus, conditions are no longer feasible for crop integration. One way to overcome this problem and to extend the duration of integration activities is by planting the palms in a double-row avenue planting system. This planting system provides a wider space between two palm avenues, hence, enabling several crops to be planted (*Figure 1*).



Figure 1. One-year-old palms planted within the double-row avenue system.

METHODOLOGY

In the double-row avenue system, oil palm is planted in two rows for every avenue as shown in *Figure 2*. The planting distance between the palms in the same row is 6.1 m and 9.1 m between rows, while the distance between two avenues is 15.2 m – wide enough to plant other crops. The palm density in the double-row avenue system is 136 palms ha⁻¹, which is similar to the normal triangular system that uses the planting distance of 9.1 m x 9.1 m x 9.1 m.

Double-row avenue planting is recommended in areas with flat to undulating terrain (*i.e.* with slope 0°-6°). It is advisable to have the planting rows in an east-west orientation so that when the oil palm grows taller, a higher amount of sunlight can reach the area between two avenues so as to enhance the growth of the integrated crops. In sloping areas, planting rows follow the slope to facilitate land preparation and maintenance of the cash crops.

Field roads are constructed perpendicular to the oil palm planting rows, similar to those in the conventional triangular planted fields. The distance between the roads is also similar to those in the conventional triangular planting, *i.e.* 350-400 m. The number of palms in each row is 58-65 for the double-row avenue system.

LIGHT PENETRATION THROUGH THE OIL PALM CANOPY

Light penetration through the oil palm canopy can be increased with the double-row avenue oil palm planting system. Measurements on light penetration in six-year-old oil palms at MPOB Keratong show that total photosynthetically active radiation (PAR) passing through the leaf canopy increased with distance from the palms. PAR reaching the soil surface was higher at the centre of the area between the palm rows (in conventional

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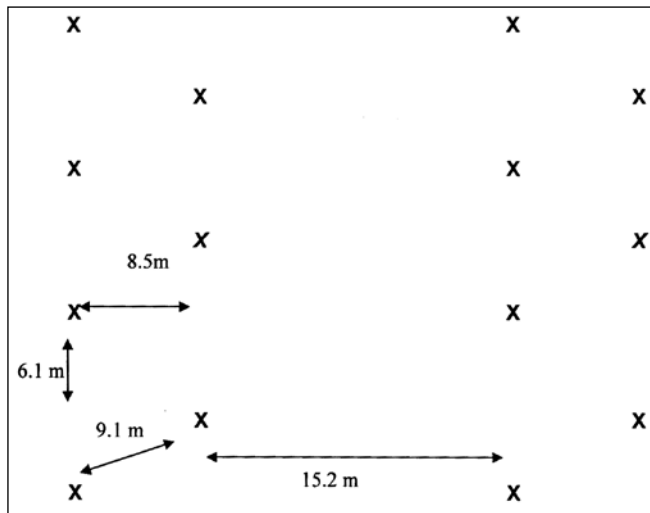


Figure 2. Arrangement of oil palms in double-row avenue planting.

triangular planting) or between two avenues (Haniff *et al.*, 2003). They also reported that the average PAR that reached the soil surface in the double-row avenue planting system was 40%, two times higher than that in the normal triangular planting system which was only 20%. As shown in Figure 3, the highest PAR passing through the oil palm canopy was 62% and 25% for double-row avenue and normal triangular planting systems, respectively. The extra light penetration in the double-row avenue planting system will therefore increase the availability of suitable planting areas for integration with other crops.

AVAILABLE LAND FOR CASH CROP CULTIVATION

Observations carried out at the MAB (Malaysian Airport Berhad) Plantation at Sepang show that the land area available for cash crop cultivation is dependent on the oil palm planting technique and the age of palm (Table 1).

The available land for crop integration when the zero burning technique was adopted was lower because old palms or other tree trunks were stacked in the areas or avenues between the young palms. With the conventional burning technique, all the trunks were burned and all the area, either between palms or avenues, was utilized for crop cultivation. As the oil palm matured (at the age above three years), there was no more suitable area for crop integration in the triangular planting system. However, about 30%-35% of the area was still suitable for crop integration in the double-row avenue system.

CROPS SUITABLE FOR INTEGRATION IN DOUBLE-ROW AVENUE OIL PALM

Studies show that various crops can be integrated with oil palm, such as banana, pineapple, groundnut and soyabean (Figures 4, 5, 6 and 7). These cash crops and oil palm have to be planted and properly managed following good agriculture practices so that they can grow well together and not affect each other to provide good returns. Among the good agriculture practices are the use of good quality planting materials, and the adoption of the right planting technique, correct fertilization and, efficient pest and disease control. Crops selected have to be suited to the prevailing soil type and climate, especially rainfall distribution, of the designated location.

EFFECT OF THE DOUBLE-ROW AVENUE PLANTING SYSTEM ON OIL PALM PRODUCTION

The average fresh fruit bunch (FFB) yield in the first four years of harvest was 15.38 t ha⁻¹ yr⁻¹ in the double-row avenue planting system and

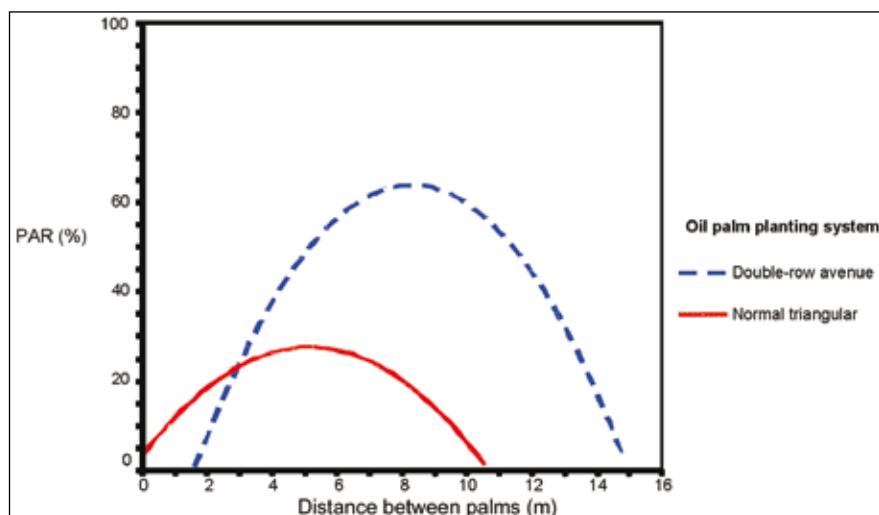


Figure 3. Distribution of PAR penetrating the leaf canopy of two adjacent palms in two oil palm planting systems.

TABLE 1. AVAILABLE LAND AREA (% of oil palm area) FOR CROP INTEGRATION IN THE DOUBLE-ROW AVENUE OIL PALM AND CONVENTIONAL TRIANGULAR PLANTING SYSTEMS USING DIFFERENT LAND CLEARING TECHNIQUES

Age of oil palm (year)	Available land area (%)			
	Double-row avenue planting system		Conventional triangular planting system	
	Conventional burning technique	Zero burning technique	Conventional burning technique	Zero burning technique
0 - 1	55 - 66	66 - 82	80 - 90	40 - 45
1 - 2	50 - 60	60 - 72	50 - 70	25 - 30
2 - 3	45 - 55	45 - 55	20 - 40	10 - 20
3 - 4	30 - 35	30 - 35	0	0
> 4	20 - 30	20 - 30	0	0



Figure 4. Banana in five-year-old oil palm.



Figure 7. Soyabean in four-year-old oil palm.



Figure 5. Pineapple in two-year-old oil palm.



Figure 6. Groundnut in five-year-old oil palm.

15.28 t ha⁻¹ yr⁻¹ in the conventional triangular planting system (Table 2). This indicates that the average FFB yields for the first four years' harvests were comparable between the palms in the two systems of planting. In the control plot where crop integration was not carried out, FFB yield was slightly higher in double-row avenue oil palms. The FFB yield was 16.06 t ha⁻¹ yr⁻¹ compared to 15.88 t ha⁻¹ yr⁻¹ from oil palm in the conventional triangular planting.

CONCLUSION

The double-row avenue oil palm planting system can increase light penetration to provide more suitable areas for most cash crops to be planted together with oil palm. Crop integration can be implemented in the immature as well as in mature stages of oil palm; thus, generating continuous additional income to oil palm growers.

TABLE 2. AVERAGE FFB YIELDS (t ha⁻¹ yr⁻¹) IN THE FIRST FOUR YEARS OF HARVEST AT MAAH PLANTATION, KLIA, SEPANG

Oil palm planting system	FFB yield (t ha ⁻¹ yr ⁻¹)				
	1 st year harvest	2 nd year harvest	3 rd year harvest	4 th year harvest	Mean
Conventional triangular					
a. Integrated with hill paddy	3.97	11.44	26.50	26.01	16.98
b. Integrated with sorghum	2.64	8.58	23.43	20.88	13.88
c. Integrated with tongkat ali	3.93	9.69	21.43	20.76	13.95
d. Integrated with cajanus	3.34	7.61	26.47	25.48	15.73
e. Control plot	3.52	9.04	24.66	26.31	15.88
Mean	3.46	9.27	24.50	23.89	15.28
Double-row avenues					
a. Integrated with hill paddy	3.21	10.71	23.25	23.15	15.08
b. Integrated with sorghum	4.07	11.67	25.40	22.96	16.03
c. Integrated with tongkat ali	3.48	9.08	21.97	22.10	14.16
d. Integrated with cajanus	4.21	9.73	23.20	25.19	15.58
e. Control plot	3.98	9.77	27.12	23.36	16.06
Mean	3.79	10.19	24.19	23.35	15.38

Note: All crop integration in oil palm planted with the conventional triangular system was only carried out in the first three years after planting oil palm.

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