

Integration of crop with oil palm optimises land utilisation and provides additional income for the growers. There are several crops suitable to be integrated with oil palm. Integration can be carried out in a longer period with the double row avenue oil palm planting system. Thus, this integration technology can sustain the additional income during the mature palm stage without affecting oil palm production. However, only certain crops had fulfilled these conditions. In this case, the black pepper integration with oil palm was studied for several years in MPOB Research Station in Belaga and Keratong. The crop was found technically and economically suitable for integration in double row avenue oil palm (Figure 1). Therefore, this article aims to discuss the technology on good agriculture practices for integrating black pepper in double row avenue oil palm planting for maximising income of the growers.



Figure 1. Black pepper integration in double row avenue oil palm.

GOOD AGRICULTURE PRACTICE

It is highly recommended to integrate the black pepper in double row avenue oil palm planting after the oil palm planting completed. Otherwise, it can be carried out at any age of oil palm but preferably at the early age. This is important to ensure that the black pepper is integrated for its economic life span of 15-20 years. And later, it can be replanted at the time of oil palm replanting.

However, the most important thing is to ensure that the black pepper is planted and managed according to good agriculture practices. The following practices are recommended for black pepper integration in double row avenue oil palm.

OIL PALM PLANTING

For integrating black pepper, the oil palm must be planted according to the double row avenue planting system. This oil palm planting system is described by Suboh *et al.* (2009). The planting rows are highly recommended to be in the east-west orientation to maximise sunlight penetration even though at mature oil palm stage. This is because the black pepper vines require ample sunlight to produce high berries yield.

Low lying and water logged areas must be avoided for planting the black pepper. It has been observed that high infestation of root diseases occurred in these areas. As a result, many plants died due to root disease infection. Therefore, a good drainage system must be provided if black pepper to be planted in such areas.

BLACK PEPPER PLANTING

Land Preparation

Natural vegetation in the integration area must be cleared prior to land preparation either mechanically or by herbicide spraying. Stumps and roots of trees should be uprooted and burned as initial step to prevent infestation of the root diseases. Then, the land needs to be ploughed three times, *i.e.*, two disc ploughings and one rotor tilling.

Planting Density

Three rows of black pepper are recommended for planting in 15.2 m area of the double row avenue oil palm. The seedlings are planted at 2.4 m x 2.4 m square. This planting system will give 360 black pepper vines per hectare of the double row avenue oil palm.

Supporting Poles

Good supporting poles either dead or alive are highly required for planting black pepper. This is to ensure black pepper plants can creep and grow satisfactorily on the poles. Preferably, the hardwood poles are recommended for use in black pepper integration with oil palm. The hardwood poles are stronger and can sustain longer in the field. The poles should be fixed at 0.3 m – 3.0 m (1-2 ft) depth in the soil and have 3.0 m (10 ft) height from the ground level.

For live support, *Dracaena* sp. or iron tree is recommended for black pepper integration with oil palm (Figure 2). Based on observation, it is better than *Erythrina indica* as live support for black pepper in term of easiness for maintaining. The live support should be planted two to three months prior to black pepper planting. Use stem cuttings with 2 m length and 5 cm diameter. The cuttings should be planted in the planting hole at 30 cm depth. Planting should be carried out during rainy season for good growth.



Figure 2. Iron tree as live support for black pepper integration in oil palm.

Planting

For planting, use good black pepper planting material from selected variety. Kuching, Semongok Emas and Semongok Aman are black pepper varieties that had been tested suitable for integration in oil palm area. The Semongok Aman is better than the rest in term of yield and disease resistant. The planting materials must be taken from mature and disease free vines. Stem cuttings with 3-5 internodes are suitable for use as planting material. The cuttings need to be sown in polythene bags and nursed for three to four months before transplanting into the field. Select only good seedlings with vigorous growth and disease free for field planting.

Planting holes should be prepared in advance before transplanting black pepper seedlings. Recommended size for planting holes is 45 cm x 45 cm x 45cm. After digging the holes, put 5 kg of

organic manure and 1 kg of ground magnesium lime in each planting hole. Mix altogether with top soil thoroughly. Cover back the holes with top soil and leave it for about one month. For planting, dig the holes back and pour 200 g of CIRP in the hole. Then, the black pepper seedlings need to be planted in slanting position following the supporting pole's direction at 10-15 cm from the poles.

Shading

Newly transplanted black pepper seedlings should be shaded from direct sun light in the field. This can be done by using pruned oil palm fronds as shading material. Cuttings of oil palm frond at 0.6 m – 0.9 m (2-3 ft) length are fixed on the ground so that it cover-up black pepper seedlings from direct sunlight (Figure 3). This shading material can be removed from the black pepper vines gradually from four to eight weeks later.



Figure 3. Newly transplanted black pepper seedlings are shaded using oil palm frond cuttings.

Fertiliser Application

Good fertiliser application is highly important for good growth and berries production. Fertiliser requirements are differ based on stages of growth. At immature stage of first three years, few fertilisers are required for growth. But at mature stage, more fertiliser is needed for growth and berries production. Recommended fertiliser application for black pepper integration is shown in Table 1. These fertilisers should be broadcasted in circle position of the vine's base and cover with the soil.

Pruning

Black pepper vines should be pruned to form a good canopy for good yield production. Few shoots emerged from the main stem after it was pruned and later grow as secondary and tertiary stems. These stems will form a good and balance canopy for the vines. First pruning is carried out at six months after transplanting in the field. Pruning height should be at 60-80 cm from the ground surface. Then, the vines are pruned again at 1.0-1.2 m height after one year of age. Final formation pruning is carried out at 1.5 years after planting

TABLE 1. FERTILISER APPLICATION FOR BLACK PEPPER INTEGRATION

Type	Immature stage	Mature stage	Remarks
Basal fertiliser	200 g/hole	-	Use CIRP in planting hole
NPK 12:12:17:2	1.5 kg/vine	2 kg/vine	Apply in six batches
Foliar fertiliser	Grofas Blue	Grofas Blue	Spray 2 times/month
Kieserite	100 g/vine	200 g/vine	One/year
Organic manure	1-2 kg/vine	3-5 kg/vine	One/year
Lime	500 g/vine	1 kg/vine	One/year

at 1.8 -2.0 m height. After that, only maintenance pruning is practice for removing unwanted stems.

Weed Control

Black pepper integration area should be free from excessive weeds. This can be achieved by carrying out good weed control programme. Generally, manual weeding is highly recommended to be carried out in black pepper integration area. Circle weeding is carried out using hand-hoe at the base of the black pepper plant surrounding the soil mounding area. The area should be kept free from weeds at most of the time. Weeds in between the rows should be controlled using grass cutter machine. Herbicide can also be used but be careful. Paraquat or glufosinate ammonium can be sprayed for controlling weeds in between the rows of black pepper.

Pest Control

Stem borer, tingid bug and mealy bugs are common insects that affect growth and berries production of the black pepper. Insects need to be controlled using suitable insecticide. Chlorpyrifos can be used for controlling stem borer. And for tingid and mealy bug, use dimethoate for spraying. But, minimum period of no yield harvest need to be implemented according to the product recommendation.

Disease Control

Foot rot disease caused by *Phytophthora capsici* is a serious root disease for black pepper planting. Infected vines had yellowing leaves that drop on the ground within three to four weeks. Heavy infestation will cause vines succumbed to permanent death (Figure 4). Infestation is prominent during the rainy season. Preventative is better than curing/treating. Soil drenching and foliar spraying using copper oxychloride or metalaxyl are effective in preventing disease spread. Carry out this practice prior and during wet season. In addition, use of organic manure and field sanitation also help in curbing this disease.



Figure 4. Foot rot disease of black pepper.

Harvesting

There are two peak harvests in a year. Normally, peak harvests are prevail in the second- and fourth-quarter of the year. Mature berries have hard seeds or one ripe seed on each spike can be considered as standard for harvesting. Mature spikes are picked manually. During peak harvests, the mature spikes need to be harvested at one to two weeks round depending on the ripeness intensity. Delay harvest will cause yield loss.

Post-harvest Processing

Harvested green berries should be processed as soon as possible. It should be threshed using thresher machine to split the berries from spikes. Then, detached berries can be sun dried to produce black pepper product. Normally, three to five sunny days drying are sufficient to achieve desired moisture content in the black pepper product for safe storing. Raised drying platform can prevent contamination and keep the black pepper product hygiene. Otherwise, detached berries can also be processed into white pepper product by immersing gunny sack filled with berries in the moving water stream for 10-14 days. Then, it must be washed thoroughly to remove its pericarp from the white seeds. Clean white seeds then need to be sun dried for several days before storing.

TECHNICAL VIABILITY

Integrated black pepper in the double row avenue oil palm showed satisfactory growth. The black

pepper vines started producing berries in the first year of planting. But, the berries yield quite low in the first and second year. In third year after planting, berries are feasible to be kept for harvesting with average berries yield of 2-4 kg per vine. Berries production increases progressively in subsequent years. Based on trial in MPOB Research Stations in Belaga and Keratong, average green berries yield was 6-8 per vine per year for black pepper vines aged four years and above. The average green berries yield is comparable to the black pepper planted conventionally. At planting density of 360 vines ha⁻¹, estimated total green berries yield of integrated black pepper is 2160-2880 kg ha⁻¹. At 33% conversion rate of green pepper to black pepper product, total black pepper product that can be produced is estimated at 713-950 kg ha⁻¹ per year.

On effect of black pepper integration on oil palm yield, there was no significant difference of fresh fruit bunch (FFB) yield between the oil palm-black

avenue oil palm is a financially feasible project to be carried out by the oil palm growers.

CONCLUSION

Black pepper is suitable crop for integration in double row avenue oil palm planting. It is technically and economically feasible to be practised by the oil palm growers. Integration of black pepper did not affect oil palm production. It optimises oil palm land utilisation and provides additional long-term income to the growers. However, the growers need to maintain the integrated black pepper according to good agronomic practices highlighted in this technology.

REFERENCE

SUBOH, I; NORKASPI, K and RAJA ZULKIFLI, R O (2009). Double-row avenue system for crop integration with oil palm. *MPOB Information Series No. 465*.

TABLE 2. MEANS OF FFB YIELD BETWEEN BLACK PEPPER-OIL PALM INTEGRATED PLOT AND CONTROL PLOTS (t ha⁻¹)

Oil palm plot	1 st year harvest	2 nd year harvest	3 rd year harvest	4 th year harvest *
Double row avenue & black pepper	6.0	13.0	16.9	13.2
Double row avenue (control)	5.5	10.3	14.4	13.0
Normal triangular (control)	n.a	n.a	15.1	13.6

Note: * Nine months record, n.a = not available.

pepper integration plot and control plots. Based on trial carried out at MPOB Research Station in Belaga, Sarawak, FFB yield recorded as shown in Table 2. These results indicated that black pepper integration did not affect oil palm production.

ECONOMIC VIBALITY

Financial analysis was computed for this project based on several assumptions such as 7 kg per vine of green berries yield, 33% conversion rate to black pepper, selling price of RM 19 kg⁻¹ and 20 years economic life. The calculated financial parameter for this black pepper integration such as net present value (at 10% discount rate) was RM 54 328. Internal rate of return was 49%. Benefit cost ratio was 2.6 and payback period of four years. Therefore, the black pepper integration in double row

For more information, kindly contact:

Director-General
MPOB
6, Persiaran Institusi,
Bandar Baru Bangi,
43000 Kajang, Selangor,
Malaysia
Tel: 03-8769 4400
Fax: 03-8925 9446
www.mpob.gov.my