HALF-TRACK MACHINE FOR ALL WEATHER IN-FIELD COLLECTION OF OIL PALM FRESH FRUIT BUNCHES (FFB)

by: ABD RAHIM SHUIB and AHMAD HITAM

MAY 2002
153
MPOB TT No. 136

MPOB INFORMATION SERIES ISSN 1511-7871

The migration of labour in the agricultural sector to the industrial sector greatly necessitates the development of machines to replace the time-consuming and manual field activities. In the industrial sector, workers have lighter and easier job which are in contrast to the back-breaking job in oil palm fresh fruit bunches (FFB) collection. With the assistance of a machine, strenuous work can be replaced enabling the workers to work longer hours resulting to higher productivity.

A number of machines for in-field evacuation of FFB have been introduced to the oil palm industry. These machines are generally suitable for use in dry and generally flat areas. The choice of machine is merely dictated by the estate ground conditions. A system that is well accepted by the oil palm industry is the mini-tractor with trailer. It performs very well on undulating areas of inland soils. However, this system is not effective in soft and soggy areas. Poor traction prohibits the usage of mini-tractors on soft ground such as in coastal and peat areas.

A tracked machine is known for its ability to work under wet condition. However, track machine for agricultural purpose has one problem where the speed is slow. There are many track designs in the market but most of these tracks are chain and sprocket system. This design slows down the speed of the machine.

The skid steering in the conventional track machine is not only causing high turning resistance but track derailed from its housing or sprocket is also common. MPOB is developing a half-track prime mover for FFB in-field collection. This machine has the rear wheels on track and normal front wheels. In this invention, the sprocket has been replaced with wheels while its steering system remains rack and pinion.

DESIGN AND DEVELOPMENT

The Prime Mover

The main purpose of this machine is for FFB evacuation. The rear wheels are on track hence giving good traction during wet season. This machine can operate in all weather conditions (*Figure 1*). It is built on a 4x4 vehicle and with standard drive components. The front wheel steering is maintained while its rear wheels are fitted with the half-track system. The prototype payload is 500 kg, with tare weight of 1250 kg. The overall construction of the machine consists of chassis, driving unit, mechanical tipping bin and hydraulic control unit. The overall dimensions of the machine are 3300 mm (length), 1740 mm (width) and 1050 mm (height). This machine is front wheel steered. It is powered by a 2-in-line cylinders, 18 hp (2500 rpm) Lambordini diesel engine that is coupled to 5-speed gearbox. The fuel tank capacity of the machine is 30 litres, which is enough for a day's work.

Figure 1. A half-track machine being tested in an area where a wheeled-type vehicle would have poor traction.

Malaysian Palm Oil Board, Ministry of Primary Industries, Malaysia
P. O. Box 10620, 50720 Kuala Lumpur, Malaysia. Tel: 03-89259155, 89259775, Homepage: http: //mpob. gov. my Telefax: 03-89259446

The Track Unit

The rear wheel hub of the machine is extended to accommodate the track. The engine through long shaft and gearbox is propelling the rear axle. The track system consists of a pair of tensioner wheels, axle plate and a screw type tensioning mechanism. The track is a looped belt and is wrapped around the rear and tensioner wheels. The track is made of reinforced rubber sheet material. Steel plates are bolted between the belt, firstly to provide friction, secondly to prevent wheels from jumping out from the track while running and thirdly to strengthen the track. The track length is 2800 mm with 28 sets of grousers and grip plates which are bolted to the loop belt (track). The contact area of the machine had increased from 1000 cm^2 with wheels to 6000 cm^2 with tracks. This contributes to better floatation of the machine. Thus, the ground pressure exerted is reduced by six-fold.

The tracks can be mounted and detached as and when necessary. During wet weather where the ground is soft, the track is installed to the machine. However, during dry weather, the track is taken out allowing the machine to run on wheels only.

FIELD TRIAL

Upon completion of the prototype in March 2000, it was field tested on shallow peat and water soggy areas. The tests carried out included:

- mobility tests. These are straight-line tests, turning tests and obstacle tests on open peat soil and on soft, newly compacted peat soil areas; and
- Inter-row transportation tests. The FFB were harvested and arranged along the harvesting path. The fruits were later picked up and loaded into the FFB bin as the machine moved along the harvesting paths.

From these tests, it was found that in open peat areas wheel sinkage was minimal. The machine was observed to have sufficient power for in-field transportation of 500 kg load. However, the machine seemed to have greater slippage whenever the wheel encountered an obstacle of 150 mm height and above of undecomposed wood in the peat soil. It was also found that this prototype machine has no traction problem on shallow peat. On average, the productivity of the machine was found to be between 2.4 t to 3.6 t hr^{-1}.

DISCUSSION

It was found that the prototype machine was able to meet most of the design requirements. In soft areas, the track sinkage was minimal even with full load. It had little problem of traction and floatation on soft soil. The effective ground contact area of rear wheels of the machine was increased to more than 600% with the track on. These large contact areas enable the machine to encounter less wheel sinkage and improve traction. The steering mechanisms of the machine could be improved by providing power steering as the current one was found to be heavy especially when the tracks are on.

For the economic analysis of the machine, the calculation is based on the machine purchase price of RM 35 000, economic life of five years, annual usage of 2400 hr; giving its depreciation cost to be RM 3.86 hr^{-1}. The labour cost is estimated to be RM 3.12 hr^{-1}, while repair and maintenance and fuel costs of the machine are estimated at RM 3.50 and RM 1.12 per working hour respectively. Therefore, the total cost of operation is RM 11.60 hr^{-1}. Based on field trials results, the output of the machine ranges from 2.4 to 3.6 t FFB hr^{-1}. Considering eight working hours a day, the machine can evacuate 24 t FFB whereas compared with manual using wheelbarrow (4 t $manday^{-1}$), this output required six mandays. Economically, the machine is viable/six looking at its cost of operation per tonne basis is RM 3.86 while the cost of transporting using wheelbarrow is estimated at RM 5.00 t^{-1}.

CONCLUSION

The half-track is suitable for general in-field transportation on shallow peat. It is suitable for in-field transportation of FFB along the harvesting paths that are fairly level and free from obstacles. The tracks provides traction with minimum disturbance to sensitive ground. The vehicle is designed to operate off road, but can be used on normal road. The concept can be applied to other similar sized vehicle. The performance was found to be satisfactory with the output of the machine ranging from 2.4 to 3.6 t hr^{-1}. The fuel consumption was found to be 1.8 litres hr^{-1} with cost of operation at RM 11.60 hr^{-1}. As the design is simple, it is possible to fabricate this attachment in local workshop.

For more information kindly contact:

Director-General
MPOB
P. O. Box 10620
50720 Kuala Lumpur, Malaysia.
Tel: 03-89259155, 89259775,
Homepage: http: //mpob. gov. my
Telefax: 03-89259446