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DESIGN AND DEVELOPMENT OF POWER TILLER OPERATED COCONUT BASIN OPENER

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ABSTRACT

Every year, organic as well as inorganic fertilizers are applied to coconut palm by opening basins of 1.8m radius and 15-20 cm depth sloping towards the periphery for achieving higher productivity. This is a labour intensive job and therefore, the cost of application of fertilizer has become higher. A simple attachment has been designed and developed, which can be attached behind the modified rotor blade of the power tiller. This mainly consists of a soil dispenser which has a rectangular structure with straight surface at the left side (from behind the power tiller) and curved surface at the right side. Mild steel sheet of 18 gauge thickness, 200 mm width, at left end and 300 mm at the right end is gradually curved from left to right for easy moment of soil. A scraper blade made of spring steel plate of 760 x 80 x 6 mm, with the bottom end sharpened to cut the soil, was welded to the lower portion of the soil dispenser. During anticlockwise movement of the power tiller, a basin of 1.8m radius and 15-20 cm depth is obtained in about 5 minutes. The cost of the implement is Rs. 2000/- and the cost of opening one basin is Rs. 8.55/-.

Key words: Coconut basin opener, Power tiller, Economics of basin opening.

INTRODUCTION

India is one of the leading countries of the world in area and productivity of coconut with an estimated area of 1.89 million hectare and productivity of 6863 nuts per hectare. India is second only to Indonesia in terms of production of coconut. Most of the coconut gardens are in the coastal areas and the spacing is about 7.5m x 7.5m. (Kushwah *et al.*, 1973). As per the recommended package of practices, inorganic and organic fertilizers are being applied to coconut palm by opening basins of 1.8m radius and 15-20cm depth sloping towards the periphery for obtaining higher productivity. This is labour intensive and labour being the costlier input, fertilizer application has become costlier. As the power tiller is a handy machine, having a small turning radius, as compared to tractor, it could be utilised with slight modifications in the basin opening work. Also, the cost of a power tiller is affordable and is a multipurpose machine suitable for all odd jobs of the farmers like ploughing, inter cultivation, puddling, furrowing, power takeoff and haulage etc. Keeping the above points in view, the design and fabrication of a power tiller operated basin opener was undertaken.

MATERIALS AND METHODS

Prime mover: Kubota power tiller was used as the prime mover in the present study. The detailed specifications of the prime mover is given in Table 3. The basic concept used was to shift the soil to one side using one sided rotary blades

of rotavator. This was achieved by selecting twenty numbers of only the right bent blades from two sets of blades of size suitable to the rotavator of kubota. The end blades were modified to avoid touching the frame of the power tiller by modifying the curvature of the blade slightly.

The basin opener: The basin opener was fabricated using 18 gauge mild steel sheet, 760 x 80 x 6mm spring steel plate and 25 x 6mm flat bar. A rectangular structure with straight surface at the left side (from behind the power tiller) and curved surface at the right side was fabricated (Fig. 1). Mild steel sheet of 18 gauge thickness, 200 mm width, at left end and 300 mm at the right end is gradually curved from left to right for easy moment of soil. A scraper blade made of spring steel plate of 760 x 80 x 6 mm, with the bottom end sharpened to cut the soil, was welded to the lower portion of the mild sheet at an angle of 45° for minimum resistance of the soil forces acting on the implement. The entire frame was hinged at four points of the power tiller at an angle of 10° with the rotar shaft for the displacement of soil towards the right side during anti-clockwise moment. Provision has been made to change the angle of the scraper blade with respect to the rotor shaft for most effective soil shifting under different soils and soil conditions. This adjustment was simple and could be achieved by changing the hole of the blade holder on either side (Fig. 1).

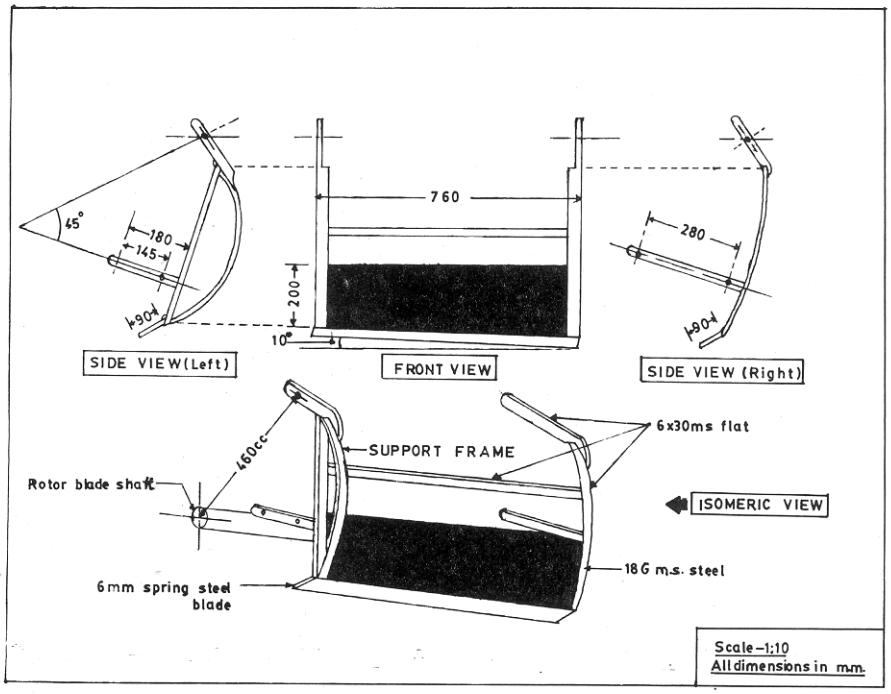

Fig. 1. Attachment for power tiller operated basin opener.

Table 1. ***Economics of power tiller operated basin opener, with two types of wheels***

	With pneumatic wheels	With cage wheels
Fixed cost		
Cost of implement	Rs. 1000.00	Rs. 1000.00
Cost of blades	Rs. 800.00	Rs. 3800.00 (Including cage wheels)
Cost of accessories	Rs. 200.00	Rs. 200.00
Total fixed cost	Rs. 2000.00	Rs. 4800.00
Recurring cost		
Depreciation	Rs. 20.00	Rs. 40.00
Hire charges of power tiller	Rs. 650.00	Rs. 650.00
Maintenance cost per day including the cost of fuel	Rs. 150.00	Rs. 150.00
Total recurring cost	Rs. 820.00	Rs. 840.00
No. of basins opened in one day	96	96
Cost of opening one basin	Rs. 855	Rs. 8.75

RESULTS AND DISCUSSION

The power tiller operated basin opener was tested in the coconut gardens of C.P.C.R.I. (Fig. 2 & 3). It was observed that shifting of soil to one side and forming a basin during anticlockwise movement of the power tiller was possible using the implement attached behind the modified rotor blade set. It took about 4-5 minutes in sandy loam soil and about 7-8 minutes in other types of soils to form one basin of 20 cm depth and 1.8 m radius. The detailed observations are presented in table-2. From the table, it is evident that the approximate depth of cut per revolution around the palm varies from 4.0 to 4.5 cm and it takes about 4-6 revolutions to achieve the desired depth. The moisture content during test ranged from 19±1% to 23±1% (wet basis). During test operation, it was observed that for effective forward movement during high moisture content, cage wheels were more effective than pneumatic wheels. It was observed that

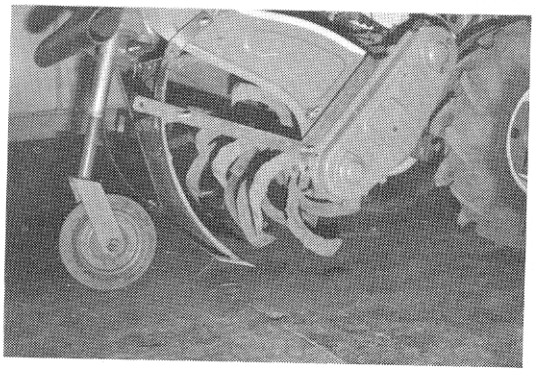

Fig. 2. Power Tiller operated basin opener with implement.

Fig. 3. Power Tiller operated basin opener with cage wheels under operation.

Table 2. ***Observations on test trials of power tiller operated basin opener using cage wheels and pneumatic wheels***

Trial No.	Type of soil	Type of wheels	Hours of operation	No. of basins opened	No. of persons used	Moisture contents during test (Dry basis) (%)	Radius of basin (m)	Depth of basin (cm)	No. of revolutions around the palm	Depth of cut per revolution (approx.) (cm.)	Year of testing
1	Sandy loam	Cage	4	42	one	22 ± 1	1.81	20.3	4.5	4.5	1996
2	Sandy loam	Cage	4	48	one	19 ± 1	1.83	18.6	5.0	4.0	1996
3	Sandy loam	Cage	4.5	55	one	23 ± 1	1.79	18.4	5.0	4.2	1996
4	Sandy loam	Cage	5	61	one	22 ± 1	1.82	19.7	4.5	4.0	1996
5	Sandy loam	Pneumatic	4	47	one	23 ± 1	1.8	17.8	5	4.5	1996
6	Sandy loam	Pneumatic	3	31	one	22 ± 1	1.78	17.3	6	4.5	1995
7	Sandy loam	Pneumatic	4	46	one	22 ± 1	1.79	17.6	5	4	1995
8	Sandy loam	Pneumatic	4	36	one	22 ± 1	1.8	15.5	6	4	1995

Table 3. ***Specifications of the power tiller, Kubota (Prime mover)***

A	Model	Engine-ER-90 Tiller-KMB-200
B	Type	Rotary, Diesel Powered, Water Cooled
C	Manufacturer	Kerala Agro Machinery Corporation Ltd. Athani, Ernakulam Dist. Kerala
D	Dimensions	Total Length-250mm, Total Width-820mm Total Height-1030mm, Track (max.)-930 Track (min.)-690
E	Total Weight	485 Kg.
F	Rpm	2000
G	Fuel Consumption	1.5 Lit/hr
H	Engine Speed	15 Km/hr (max.)
I	Horse Power	9 hp
J	Track Size	6.00 x 12
K	Ground Clearance	203mm
L	Width of Rotavator	600mm
M	Depth of cut	190mm
N	Total number of blades	20
O	Capacity of Ploughing	1 ha/hr (Dry Soil) 2 ha/hr (Wet Soil)

the rotating wheel of the power tiller (the other wheel is almost without power for minimum turning radius) used to skid at some places due to high moisture content, there by making the power tiller's forward movement almost nil. Under such circumstances, the power tiller was lifted manually and moved ahead reducing the depth of cut. This can be avoided if the depth of soil cut

is restricted to about 4-5 cm per cycle of operation (Table-2). In this case, the effective time for making one basin will increase to about 6 minutes. The total load on the prime mover was measured using a hydraulic load dynamometer which gives the load directly. This dynamometer was fitted in between the power tiller and the attachment. The measurement of load was taken simultaneously during testing and only minimum and maximum values were recorded (Adams *et al.*, 1965). The total load on the power tiller was about 60-70 kgf^2 tangential to the movement of the power tiller. The blade of the soil dispenser did not require any resharpening as it was made of spring steel, unless it came into contact with heavy stones during operation. The total number of basins that can be opened in one day of 8 hours duration is about 96, whereas in the traditional method of opening by labourer, a maximum of 12-15 basins could only be opened. As this job was difficult, cost per labourer was also relatively high. Also as this is a time bound operation, use of a power tiller for this operation could make the basins in the shortest possible time.

CONCLUSION

Basin of size 1.8 m radius and 20 cm depth around the coconut palm can be made using the implement attached behind the power tiller with modified rotor blades in about 4-5 minutes. Ninety six basins can be opened in 8 hours compared to only about 12-15 basins by a human labourer. Thus it is almost 8 times more efficient than human labour. This will be very useful for timely application of organic as well as inorganic fertilizer besides reducing cost of application of fertilizer. Thus, it will be very useful for large and medium holders who have their own power tiller. The cost of opening one basin is about Rs 8.55/- with pneumatic wheels and Rs 8.75 with cage wheels compared to about Rs 10/- by manual labour.

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