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DEVELOPMENT AND TESTING OF A MOTOR OPERATED WEEDER

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ABSTRACT

A motor operated weeder was developed and tested in the field for weeding operation using sweep blade. The non-polluting eco-friendly traction device has less moving parts, negligible noise and vibration. A minimum power consumption of 550 W and an effective field capacity of 0.09 ha/h was obtained with the machine at a forward speed of 1.86 km/h with 450 mm width sweep blade at 20 mm depth of operation. The test results indicate the suitability of the machine for weeding and intercultural operations in row crops.

KEY WORDS : Motorised weeder, power weeder, sweep blade

In India about 1 lakh diesel engine operated power tillers have been produced so for. The annual expenditure on fuel for the operation of these machines is around Rs. 600 million. An electric motor operated traction device is an alternative to the existing internal combustion (IC) engine operated ones. The efficiency of electric motors is 75 to 85 per cent where as IC engines have low efficiency of 30 to 35 per cent (Latif and Christianson, 1994). The non-polluting and easy starting electric motor operated traction devices have less vibration and negligible noise which make the machine eco-friendly. The life of an electric motor is 15 years whereas life of an IC engine is only 10 years (Sahay, 1992). Hence a motor operated weeder was developed and field tested for weeding operation.

MATERIALS AND METHODS

Sweep blade of 250 - 450 mm width were selected to carry out the weeding operation at an operating depth of 60 mm. The unit draft of the soil normally varies from 0.25 to 0.80 kgf/cm^2 (Tajuddin *et al.*, 1992). Taking 0.5 kgf/cm^2 as the unit draft of medium soil, the total draft was calculated as 75-135 kg. At a normal walking speed of 2.5 km/h, drawbar power required was calculated to be 0.60 hp. Hence an alternating current (AC) induction motor of 1 hp capacity having 1440 rpm continuous rating was selected as the prime mover. A 230 V, AC power supply was taken through a 3 KVA voltage stabilizer. Output from the voltage stabilizer was connected to the motor through a 1500 W analog type AC watt meter for measuring power consumed by the motor. The motor pulley diameter and gear box input pulley diameters were selected as 100 mm and 300 mm respectively. A chain and sprocket type speed reduction system having a ratio of 15:1 and two lugged ground wheels of 406 mm diameter were selected to yield a forward speed of 2.50 km/h. The power from motor was transmitted to gear box input pulley through a V-belt drive. The rotational speed of ground wheel was calculated to be 32 rpm corresponding to the forward speed of 2.5 km/h of the traction device.

Initially the power consumed by the motor without any load was measured. Then the traction device was jacked up and the power required to rotate the ground wheels was measured. This included power required to rotate the motor and frictional losses in the speed reduction system. The power required to run the unit in the field without attaching any implement was also measured.

Field tests were conducted to assess the performance of the AC motor operated weeder. The independent variables selected were depth of operation (20, 40 and 60 mm), width of sweep blade (250, 380 and 450 mm) and forward speed (1.7, 1.84 and 2.45 km/h). The forward speed was changed by changing suitable motor pulley and gear box input pulley. The dependent variables measured were effective field capacity, power consumption and wheel slip.

Time required to travel a distance of 15 m and number of ground wheel rotations under load and no load to cover this distance were noted to find out the slip of the ground wheel.

RESULTS AND DISCUSSION

Power consumption was found to increase with increase in forward speed and depth of operation. A maximum power consumption of 670 W was obtained with 450 mm width blade at 60 mm depth of operation. A minimum power consumption of 548 W was obtained at 20 mm depth of operation. A maximum power consumption of 572 W and a minimum power consumption of 472 W were obtained when using 380 mm width blade. In the case of 250 mm width of sweep blade, the maximum and minimum power consumption obtained were 425 W and 318 W respectively (Table 1).

The wheel slip increased with increase in forward speed in the case of 450 mm width blade. For 40 mm depth of operation, the wheel slip initially increased steadily upto 1.8 km/h forward speed and decreased slowly with further increase in forward speed. A maximum wheel slip of 19.08 per cent was obtained with 450 mm blade at 60 mm depth of operation. A minimum wheel slip of 6.5 per cent was obtained with 450 mm blade at 40 mm depth of operation.

For 380 mm width sweep blade, the wheel slip decreased with increase in forward speed initially and became asymptotic. The effective field capacity generally increased with increase in forward speed for all the three blade widths. For 20 mm depth of operation the effective field capacity was higher. But at higher depths of operation the effective field capacity decreased because of high load on the prime mover and excessive ground wheel slip. Higher the blade width, higher was the effective field capacity. A maximum effective field

Table 1. Test results of AC motor operated weeder with sweep blades

Sl.No.	Depth of operation (mm)	Forward speed (km/h)	Effective field capacity (m^2/h)	Power consumption (W)	Ground wheel Slip (%)
Width of sweep blade : 250 mm					
1	20	1.49	373	318	1.39
2	40	1.50	375	322	8.88
3	60	1.46	364	342	13.23
4	20	1.59	396	330	5.29
5	40	1.57	392	346	5.29
6	60	1.53	382	372	5.29
7	20	2.00	500	343	5.29
8	40	1.89	474	380	8.88
9	60	1.81	452	425	5.29
Width of sweep blade : 380 mm					
10	20	1.46	554	472	6.25
11	40	1.45	552	503	8.88
12	60	1.42	538	533	8.88
13	20	1.69	641	485	0
14	40	1.64	622	510	1.39
15	60	1.66	631	550	6.46
16	20	1.90	720	510	0
17	40	1.87	712	535	1.39
18	60	1.83	696	572	6.46
Width of sweep blade : 450 mm					
19	20	1.42	636	548	8.88
20	40	1.33	599	578	6.46
21	60	1.29	580	612	15.31
22	20	1.52	680	572	9.97
23	40	1.35	605	585	12.15
24	60	1.28	580	612	17.24
25	20	1.95	878	608	8.88
26	40	1.86	836	638	11.11
27	60	1.86	836	670	19.08

capacity of 878 m^2/h was obtained at 1.86 km/h speed for the 450 mm width blade at 20 mm depth of operation. A minimum effective field capacity of 364 m^2/h was obtained at 1.49 km/h forward speed for the 250 mm width blade at 60 mm depth of operation.

The test results reveal that there is scope to carry out the weeding operation in between the row crops with the help of the motor operated weeder.

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HYDRAULIC DESIGN AND PERFORMANCE EVALUATION OF A SEMI-AUTOMATED SURGE IRRIGATION DEVICE

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ABSTRACT

Extensive experimentation on surge flow furrow irrigation has confirmed its supremacy over the continuous flow irrigation as realised through quicker water front advances, reduced infiltration rates and high order of soil moisture storage and distribution efficiencies. To facilitate surge flow into furrows, two semi- automated surge irrigation device were fabricated and evaluated. These devices operate satisfactorily in effecting surge flow in the non-erosive and non-silting furrow discharge of 1.0 ls^{-1} and specific surge cycle ratios of 1/2 and 1/3 under low to medium operating pressure head of around 40 cm of water.

KEY WORDS : Surge flow, cycle ratio, surge device

In Tamil Nadu, the conventional furrow layout comprising short strip furrows (4 - 6 m long) carved on level basins are predominantly used for raising row crops, while rice is cultivated in basins. The short strip furrow layout leads to more than 20 per cent of the area lost for cultivation. Too many field inlets and manual cutting and plugging of cross ridges and feeder channels to divert water into furrows require more time and labour to complete irrigation. Besides, on account of extensive channel conveyance losses through seepage and deep percolation, the irrigation efficiencies in short strip furrow layout get reduced and the area lost results in lower plant populaiton. A long furrow (100-200 m long) layout coupled with surge irrigation seems to be a feasible solution in order to minimise the land loss and to maximise irrigation efficiencies.

Surge irrigation (Hympherys, 1989) is a relatively new technique whereby water to surface irrigated furrows is applied intermittently in a series of relatively short ON and OFF time periods of irrigation cycles. The net result is a reduction in soil infiltration rates (Izuno *et al.*, 1985) and an increase in the rate of water front advance. Thus, the difference in intake opportunity time between the upper and lower ends of the furrow becomes less and results in a more uniform soil moisture