Study of Special Purposed Reversible Mould Bould Plough In Black Cotton Soil

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Abstract - A field experiment was conducted during the year 2014-15 to study of special reversible M.B plough performance by measuring the actual field capacity, fuel consumption and field efficiency under the actual field conditions is the only way of recognizing their quality and output. This will also help Govt. Agencies in controlling the undeserving units, improving the deficiencies in existing implements, standardization of critical components and saving the energy for this purpose a locally available three bottom 30 cm reversible M.B was taken. The Mould Board (M.B) retains their mirror finish at all-time contributing to well turn furrows. A 30 m x 30 m levelled field was selected for the field experiment. The field having black cotton soil type with the bulk density was 1.4 Mg m-3 and moisture content13.8 per cent (Dry basis). From the study it was observed that the average operating speed was 3.8 km h-1, the average depth of cut and width of cut was recorded 20 cm and 80 cm, respectively and actual field capacity, field efficiency and fuel consumption was observed 0.26 ha h-1,76.38 per cent and 4.61 lith-1, respectively. This is a mechanically operated basic implement for preparation of lands, it is very useful for primary tillage in hard and dry trashy land.

Keywords - Reversible MB plough, Field efficiency, Fuel consumption.

I. INTRODUCTION

Now days most of the Indian farmers are using tractor drawn improved agricultural implements and machinery for different operations in the field. Manufacture of the tillage implements in India is reserved for small scale sector. These units are mostly located in the states of M.P., U.P., Punjab, Haryana, Bihar, and now in Maharashtra and Karnataka. About 70% of these units have an investment of less than Rs. 2 lakh and only about 4% over Rs.5 lakh, in plant and machinery. With such a small investment, there is no facility for design, development testing and quality control. These deficiencies result in more energy requirement, frequent breakdowns, less output and unsatisfactory performance. Though, the Bureau of Indian Standards has brought out about 300 standards in the area of farm machinery, only 650 product licenses have been granted by them as against a total number of about 17000 manufacturers in the country.

The primary purpose of ploughing is to turn over the upper layer of the soil, bringing fresh nutrients to the surface, while burying weeds, the remains of previous crops, and both crop and weed seeds, allowing them to break down Ploughing and cultivating a soil homogenizes and modifies the upper 12 to 25 cm of the soil to form a plough layer.The reversible plough is a unique implement, which is directly mounted to the tractor.

This is a mechanically operated basic implement for preparation of land. It is very useful for primary tillage in hard and dry trashy land. The Mould Board (M.B) retains their mirror finish at all-time contributing to well turn furrows. The plough has special wear resistant steel bottoms with bar points for toughest ploughing jobs. Bar point bottom ensures longer life as it can be extended or reversed. With this plough, ploughing can be done without formation of ridges (back furrow) or hallows (dead furrow or valley). Thus, the layout of the field is not disturbed and unidirectional ploughing (putting the furrow slice on one direction of the field) can be achieved.

II. METHODOLOGY

The field experiment was conducted in the field left after the harvest of soybean crop at Jalgaon jamod region of Vidarbha in Nov. 2014. Study the special reversible M.B plough in black cotton soil, a standard procedure was adopted.

Tractors of 45 HP were selected for the study of operation of ploughing a reversible M.B plough used. The fuel consumption was measured by connecting an auxiliary fuel supply system on the tractors. The different parameters selected for the evaluation of performance were measured in the field and calculated as per RNAM code

Speed of operation

To calculate the speed of operation, two poles 20m apart are placed approximately in the middle of the test run. On the opposite side also two poles are placed in a similar position and 20m apart so that all four poles from corners of a rectangle. The speed will be calculated from the time required for the machine travel the distance of 20m between the assumed line connecting two poles on opposite sides. The easily visible point of the machine should be selected for measuring the time.

Wheel slip

The wheel slip is determined

$$\text{Wheel Slip}\,(\%) = \frac{N_L - N_o}{N_L}$$

Where, N_L and N_O are total number of revolutions at load and at no load respectively for the marked test run.

Duration of test

The test sample should be operated under different soil and surface conditions for a minimum period of 1 h to establish its performance.

Field parameters

Various parameters to define soil characteristics and surface condition of the test plot as specified below, should be observed and recorded:

TABLE - 1 The experiment field parameters

Field Parameters	
Location of test plot	Jalgaon (Jamod)
Size of test plot	62 m X 29 m (0.18 Ha)
Last crop grown	Soybean
Detail of previous tillage operation, if any.	No
Topography of field	Level

Field test Various following parameters are observed, evaluated and summarized.
Width of cutFor determining width of cut, average of 3runs should be taken. The measurement of composite width should be taken at minimum 3 equidistant places in the direction of travel and average working width should be determined.

Effective field capacity

$$\text{It can be calculate as } E_e = \frac{A}{T_P + T_N}$$

Where,

Ee = Effective field capacity (ha/h)
A = Area covered (ha)

T_N = Non productive time (h)T_P= Productive time (h)

(Non-productive time is the time lost for turning and adjustments etc. Excluding refuelling and machine trouble)

c) Field efficiency

The field efficiency is the ratio of effective field capacity to the theoretical field capacity expressed as percentage.

$$\text{Theoretical field capacity} = \frac{\text{Theoritical width of implement(cm)} \times \text{speed of opeation}(^{m}/_{sec}) \times 36}{10000}$$

$$\text{Field efficiency}\,(\eta\eta = \frac{\text{Effective field capacity}\,(E_e)}{\text{Theoretical field cpacity}\,(E_t)} \times 100$$

For most of the tillage operations field efficiency ranges between 75-90%.

III. RESULTS AND DISSUSSION

The performance was conducted in Jalgaon (Ja.). and following result was found.

Mechanical analysis of soil:

The results of the soil analysis tests carried out on the research farmland are shown in Table. The soil is found to be predominantly Clay-loam, almost neutral and has high water retention ability with average moisture content of 13.80% dry basis and 1,403.6 kg m^{-3} bulk density.

Moisture content:

Before conducting the trials, soil moisture was measured at four different places in selected plot at depth of 6 to 8 cm was 15.9%, 12.62%, 13.35% & 13.20%on dry basis. The plot size selected was 62 m in length and 9.7 m in width comprising total area of 0.06 ha for all trials.

Bulk Density

The bulk density was measured at four different places in selected plot was found to be 1406kg m^{-3}, 1400kg m^{-3}, 1394kg m^{-3}& 1414 kg m^{-3}.

Texture of soil

The following table shows Soil analysis tests on research farm

Table 2: Soil analysis test

Variables	Soil Characteristics
Sand/%	25.58
Silt /%	32.25
Clay/%	42.10
Soil type	Black cotton
Soil moisture content (db.)	13.80%
Soil bulk density	1,403.6 kg m^{-3}

Field test

Reversible M.B. Plough of 3 bottoms of 30 cm each was tested in the fields. In42.45 min 0.18 ha area was covered. Average fuel consumption rate was observed to be 17.36lit ha^{-1} (4.61lit h^{-1}). At the time of operation, an average operating speed was 3.8 km h^{-1}. During the test average depth of cut and width of cut was observed 20 cm and 80 cm, respectively. During the operation average wheel slip was observed 38.72%.

Theoretical field capacity

The theoretical field capacity varied from 0.29 hah^{-1} to 0.40 ha h^{-1} at different forward speeds. It was observed that, the maximum actual field capacity of 0.40 ha h^{-1} was recorded at a forward speed of 4.5 km h^{-1}, while it was minimum of 0.29 ha h^{-1}at forward speed of 3.25 km h^{-1}.

Actual field capacity

The actual field capacity varied from 0.22 hah^{-1} to 0.33 ha h^{-1} at different forward speeds. It was observed that, the maximum actual field capacity of 0.33 ha h^{-1} was recorded at a forward speed of 4.5 km h^{-1} while, it was minimum of 0.22 ha h^{-1} at forward speed of 3.0kmh^{-1}.

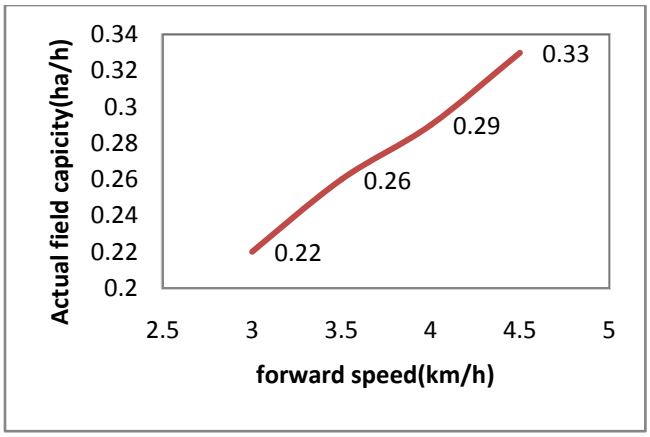

Fig.1 Actual field capacity (ha h^{-1})

It was observed that, the average field capacity increased with increase in speed as shown in table 4.1. In 42.45 min 0.18 ha area was covered at average speed of 3.75 kmh^{-1}. Actual field capacity and theoretical field capacity was measured i.e. 0.24 ha h^{-1} and 0.30 ha h^{-1}.

Field efficiency

The field efficiency varied from 73.28 % to 81 % at different forward speeds. It was observed that, the maximum field efficiency of 81 % was recorded at a forward speed of 3.0 km h^{-1} while, it was minimum of 73.28 % at forward speed of 4.5 km h^{-1}.

Average field efficiency was measured i.e. 76%. Similar findings were reported by Potekar and Tekale (2001), they concluded that, the field efficiency was 67%.

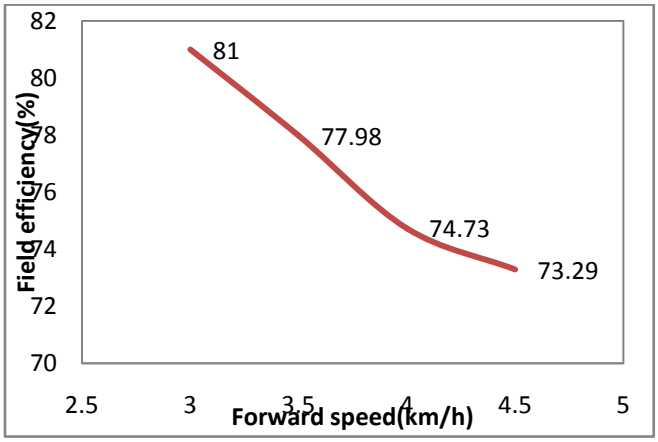

Fig. 2 Field efficiency (%)

Fuel consumption

The fuel consumption varied from 2.9lit h^{-1}(13.11lit ha^{-1}) to 6.3 lit h^{-1} (21lit ha^{-1}) at different forward speeds and trends is shown in Fig.3 It was observed that, the maximum fuel consumption of 6.3 lit h^{-1} (21lt ha^{-1}) was recorded at a forward speed of 4.5 km h^{-1}while, it was minimum of 3.1lit h^{-1} (13.11lit ha^{-1}) at forward speed of 3.25 km h^{-1}.

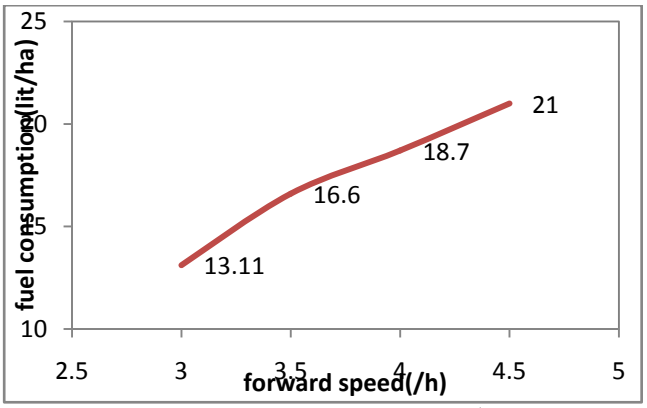

Fig. 3 Fuel consumption (lit h^{-1})

IV. CONCLUSION

It is very useful for primary tillage in hard and dry trashy land. The Mould Board (M.B) retains their mirror finish at all-time contributing to well turn furrows. Bar point bottom ensures longer life as it can be extended or reversed. Reversible M.B. Plough of 3 bottoms of 30 cm each was tested in Jalgaon (Ja.) region Dist. Buldana. We tested the soil and were obtained soil type, bulk density, and moisture content as clay loam, 1.4 Mg m^{-3}, 13.80% respectively. During the test average depth of cut and width of cut was observed 20 cm and 80 cm, respectively. Average fuel consumption rate was observed to be 17.36lit ha^{-1} (4.61lit h^{-1}). At the time of operation, an average operating speed was 3.8 km h^{-1}. Average actual field capacity and theoretical field capacity was measured i.e. 0.26 hah^{-1} and 0.34ha h^{-1}, respectively.

Average field efficiency was 76.38%. During the operation average wheel slip was observed 38.72%.

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