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Development of Sutiable Size Bed Maker for Low Hp Tractor

K.H.Telang (M-Tech)
Dept.of Farm power and machinery
Dr. Panjabrao Deshmukh Krishi Vidhyapeeth.
Akola, India

Dr.V.P.Khambalkar
(Asst.Prof.). Dept. of Unconventional Energy Sources and Electrical Engineering.Dr. Panjabrao Deshmukh Krishi Vidhyapeeth, Akola, India

Dr. S. H. Thakare, Dr.S.K.Thakare, Dr.(Ms).M.M.Deshmukh.
(Prof & HOD.): Dept. of Farm power and machinery.
Dr.Panjabrao Deshmukh Krishi Vidhyapeeth Akola, India

Abstract:- A Suitable size low hp BBF maker was developed and evaluated for its performance in the Department of Farm power and machinery, Dr.PDKV, Akola. During preparation of sowing seasons, there is an acute shortage of labour, which causes delay in sowing of crop which ultimately results in a reduction in yield. Bed making operation is one of the important tillage operation which control water logging problems which reduce the crop yield. There is a need of such machine which overcome the economic constraints of farmer and can perform bed making operation. Another limitation is that about 90 percent of farmers fall in the category of marginal, small and semi-medium land holding, They could not offer heavy price of big tractor and implements. Big tractors operated machineries are not suitable for small and scattered land holdings since it gives low field efficiency in small fields. The evaluated performance of the Suitable size low hp BBF maker during the operation of was found to be satisfactory.

Keywords:- *Power source selection, Drawbarpull, Drawbar power.*

I. INTRODUCTION

Bed making is an important operation carried out after harvesting, ploughing and harrowing. It is an art of collecting the soil from ploughed field. Also high labor wages coupled with its scarcity during the period of bed making leads to increase in the cost of bed making and simultaneously the cost of field preparation which reduces the net profit of farmer. Development of small tractor broad bed furrow maker is the need of our today's farming to reduce the drudgery in the operation with saving time and labor, to do work effectively and covering more area with minimum time Methodology.

- **Specification of Machine**
  - Size of implement was 1200x 600 x50 mm.
  - Size of blades was 75mm x 10 mm.
  - The distance between two forming board is kept 90 cm and 55 cm from the front and rear side

II. MATERIALS AND METHODS

Different parameters like draft, speed of operation, broad bed intensity, time required to cover the field, fuel consumption, moisture content and bulk density of the soil were measured during the laboratory and field tests .The following instruments were used during development and design of broad bed furrow maker.

A. Stop watch.

Stopwatch, measuring a minimum of one tenth of a second and maximum of 12 hours was used to record the travel speed and time required to cover the measured area during the test

B. Metallic and steel tape.

A metallic tape of 30 m and steel tape of 3 m were used for measuring and marking the layout of test plot. A steel tape was also used for measuring the depth of broad bed making.

C. Measuring cylinder.

One liter capacity measuring cylinder with 100 ml graduation was used to measure fuel consumption of tractor at the time of field operation.

D. Dynamometer.

A hydraulic pull type dynamometer of 500 kg capacity was used to measure the draft required to operate the implement in the field.

E. Weight balance.

An electronic weight balance of 1 kg capacity was used to measure the weight of wet and dry soil for determination of moisture content and bulk density of the soil.

F. Electric oven.

Electric oven was used for drying the soil samples, for determination of moisture content and bulk density of the soil.

G. Sample boxes.

The sample boxes were used for keeping the soil samples in oven.

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III. DESIGN CONSIDERATION

A due attention was provided on the following design aspects while designing and fabrication of small tractor operated broad bed furrow maker.

- Agronomical requirements
- Physical and economical consideration.

A. Agronomical requirement.

A machine was designed by keeping in mind the various Type of crop, planting method and condition of field that is type of soil and its physical properties.

B. Physical and economical consideration.

- Machine should be simple in design and it should be easy to operate.
- Cost of the machine should be low.
- It should be easily repairable by farmer or village artisans.
- The total power requirement should not exceed the power available from available small tractors.(18 to 25 hp)
- Machine should be light in weight.

IV. DESIGN OF SMALL TRACTOR OPERATED BROAD BED FURROW MAKER

The Suitable size low hp BBF maker was designed and developed by considering physical characteristic of crop, agro technical soil parameters, type of crop, soil and machine. This theoretical design parameters considered in designing the Suitable size low hp BBF maker were discussed in the following ways. The development of any machine mainly depends on the parameters considered in the design phase. The designing aspect of machine are mostly involved the following characteristics.

- Width of broad bed furrow.
- Height of broad bed furrow.
- Adjustment of height and width of broad bed furrow.
- Calculation of soil load parameters.
- Requirement of power for the operation.

By considering the alone facts, the design of the machine will be worked out to suit for the machine will be worked out to suit for the small tractor operation.

A. Soil Parameters

The soil parameters also have influence on mechanical broad bed making. The soil properties relevant to the design of tool for broad bed making were identified as soil type, soil texture, and soil moisture and bulk density. The type of soil influences the design of broad bed tool as the soil resistance varies with type of soil. The moisture content of soil affects the draft required for broad bed making tool and slip of tractor wheel. Bulk density of soil is the measure of a compaction of soil condition which influences draft required for collection.

B. Soil type.

The soil of vidharbha region of maharashtra is charactrrized under black, medium black,red and clay loam that contains predominantly montmorillonite clay.The soil has good moisture holding capacity and it swells considerably with moisture content.When dry, soil shrinks and forms cracks. It is necessary to know the resistance offered by different soil to the soil working tool. Moisture content of soil, bulk density and soil resistance was considered for design. Under this region majority of soil is clay soil hence clay soil properities was considered for design purpose. The soil resistance varies from soil tio soil .The soil resistance values are given in table.

SN	Type of soil	Soil resistance (Kg/cm^2)
1	Sand soil	0.2 to 0.5
2	Sandy loam	0.3 to 0.65
3	Heavy soil	0.7
4	Clay soil	0.35 to 0.8

Table 1

C. Moisture content of soil.

Draft, work ability, power transmission of machine during operation and wheel slippage has great influence of soil moisture. Hence moisture content of soils major soil parameter which influences the design. The moisture content of soil was calculated by formula. (Mohsenin, 1979)

The moisture content of soil was calculated by formula.

$$\text{Moisture content (db)} = \frac{\text{Wt. of wet soil sample} - \text{Wt. of oven dry soil sample}}{\text{Wt. of wet soil sample}} \times 100$$

D. Bulk density of soil.

Measure of compaction of soil condition is Bulk density which influences the machine components. Bulk density of the soil for the sowing in black cotton soil was considered in the range from 1.51 to 1.63 Mg/m^3. It was calculated by the formula.

$$\text{Bulk density}(g/cm^3) = \frac{\text{Mass of soil sample}}{\text{Volume of core cutter}}$$

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V. DEVELOPED COMPONENTS OF THE IMPLEMENT

The material to be used for the fabrication of broad bed furrow maker is given as per test code IS12334-1988. The components of the small tractor operated broad bed furrow maker are.

- Main frame.
- Hitch Assembly.
- Forming board.
- Cutting blade.
- Hitch pair

A. *Main frame.*

The whole frame consisted of a M.S.L- Angle pipe which is made by welding of size 75x 60x10 mm. The length of the middle frame was 1200 mm and side frame is 509 mm. The complete frame was made with L-section welded at both its sides with a 500 mm long M.S.L-angle. The frame shall be capable of sustaining a pull of 9.8 N/mm of nominal size of bund former without any permanent deflection or change in shape.

B. Hitch Assembly.

The implement has standard three hitch points; two lower and one upper. The implement was attached to tractor through these three hitch points with the help of link pins. The proper meshing of tractor with machine is important task in implement design. Proper hitching of any kind of tractor operated implement is necessary to maintain quality of work and eliminating the power losses as per IS: 4468-1977 Specification for dimensions for three point linkage of agricultural wheeled tractors.

C. Forming board

The parts which gather the soil to form the bund. Forming board forms a supporting structure of size of 303mm x890mm which is supported by M.S .flat as per IS:226-I975 of size 50 mm x 6 mm x 10mm.At the bottom of this Forming board soil cutting blade are attached .It forms a supporting structure for the soil cutting blade and provide strength during soil cutting operation.

D. Soil cutting blade.

The soil cutting blade designed to have proper fixing on the main frame of broad bed furrow maker .The suitable assumption has been considered for designing the blade. The maximum unit draft of the soil has been considered with the factor of safety is 2.0 for collection operations. Considered the impact load is 2.edges of the cutting blade shall be beveled to a distance between 5 and 10 mm. The thickness of the edge shall be between 0.5 and 2 mm. The thickness of the cutting edge shall be uniform. The hardness of the cutting blade edge shall be between 450 and 500 HB or 50f3HRC up to a distance of 50 mm from the front of cutting edge when measured in accordance with IS: 1500-I 983 Method for Brine11 Hardness test for metallic materials (second revision) or IS:1586-1986,'Methods for Rockwell hardness test (B and C scales) for steel (first revision) respectively.

Constructional details of broad bed furrow maker.

VI. DESIGN OF COMPONENTS OF THE IMPLEMENTS

The following parameters were useful for development of broad bed furrow maker.

A. Determination of Power Requirement

Selection of matching power for the effective formation of broad bed is very importance. The properties of soil, speed of operation were affected by the power. By considering the suitable physical and mechanical properties of various soil type we in the region (Kepner et.*al., 2005*), the power requirement of machine was calculated using following formula,

Draft requirement of broad bed furrow maker (kg) = Total soil contact perimeter of blade (cm) x Soil resistance (kg/cm^2)

We know that, 1 kg = 9.81 N.

The basic draft and speed of operation of the machine ensure the draft requirement of the machine in the field operation. (gill and berg,1968)

$D = Do + KV^2$

Where,

D= Draft
Do= Basic draft, kg
V= Speed, Km/h
K= constant

We know that,

Drawbar power= Draft x Speed

As 1 hp=746 watt

Drawbar horsepower available (DBHP) is equal to 60 % of brake horsepower (BHP) of the tractor (Sharma and Mukesh, 2008)

Drawbar horsepower is given by

DBHP=60% of BHP of tractor

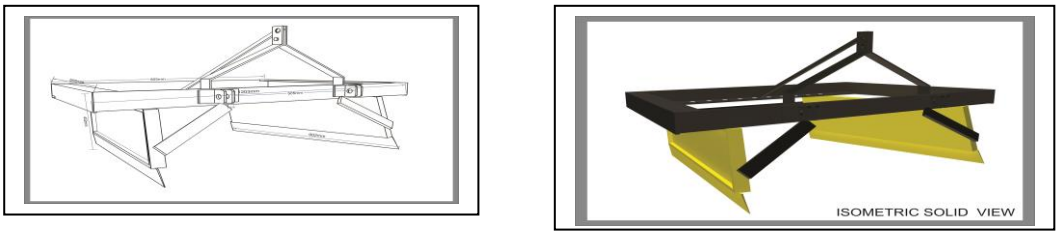

Fig. 1: Isometric view of broad bed furrow maker

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B. Selection of Power Source

Any farm machine is intended for the particular task in field. In proposed investigation, Broad bed has been designed and developed for small range of tractor (18 to 25 hp). The appropriate power source was selected according to the requirement and design specification.

C. Calculating drawbar pull

Drawbar pull available for tractor is given by
DBHP= Pull (kg) x Speed (m/min)/4500
Drawbar Pull (kg) = DBHP x 4500/Speed (m/min)

D. Width of Implement

The width of broad bed furrow maker (W) can be calculated by,

Total draft (Kg) = Unit draft (kg/cm^3) x width of implement (cm) x Depth of collection (cm)

Therefore,
Width of Implement (cm) = Total draft (kg)/ Unit draft (kg/cm^3) x Depth of collection (cm)

E. Selection of Main frame

The soil cutting blade, hitching unit were mounted on the frame .The whole frame consisted of a M.S.L-Angle which is made by welding of size 50x 6 x10 mm, the length of middle frame was 1000 mm and side frame was 400 mm on both side of small size tractor. The complete frame was made with square sections welded at its both sides and with a 500 mm long M.S.L .Angle of size 50x6x10 mm. The Total length of frame was 1200 mm. The top view and side view of the main frame shown in figure below**.**

A hitching arrangement was provided at the front of square section of middle frame and adjustment was so made that: three-point linkages could be easily hitched to the frame. For design of the frame, the length of the frame and blade to blade spacing were considered. The mounting of blade on the frame was fitted with nut so that were easy to shift to achieve desired spacing.

F. Selection of Hitching System

The implement has standard three hitch points; two lower and one upper. The implement was attached to tractor through these three hitch points with the help of link pins. The proper meshing of tractor with machine is important task in implement design .Proper hitching of any kind of tractor operated implement is necessary to maintain quality of work and eliminating the power losses. Srivastav (1990) stated that the proper hitching not only drops seeds at correct depth but also prevents plugging of furrow opener with grass, dust wearing of heads of boots.

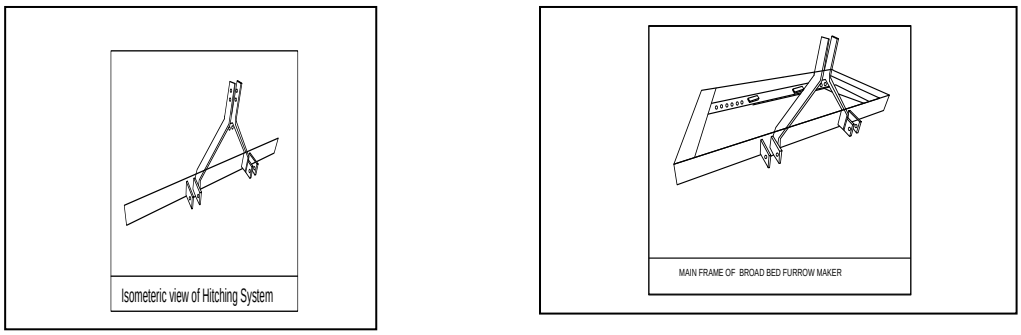

Fig. 2: Isometric view of Hitching System

G. Design of soil cutting blade of broad bed furrow maker.

The soil cutting blade designed to have proper fixing on the main frame of broad bed furrow maker. The suitable assumption has been considered for designing the blade. The maximum unit draft of the soil has been considered with the factor of safety is 2.0 for collection operations. Considered the impact load is 2 (Sharma and Mukesh, 2008). The maximum draft on blade was calculated using following formula.

Soil shear angle ($Ø_s$) = 45^o – ($Ø_s$/2)
Where, Ø = angle of friction between metal and soil (for medium soil we may assume Ø=20^o)

Assuming unit draft of medium soil = 0.5 kg/cm^2
Also take factor of safety as 2.0

Therefore, design draft of broad bed furrow bottom = width X depth X unit draft

$$\text{Total soil pressure on soil cutting blade} = \frac{\text{Total load,kg}}{\text{Area of share cm2}}$$

Fig. 3: A .Developed machine in Laboratory.

Fig.3: B. Developed machine during field Operations.

VII. CONCLUSIONS

The tractors are categories as small, big and very big tractor implement was developed. There of a need for such machine which overcomes the economic constraints of farmer's .Keeping in the view the above facts, the research project entitled development of small tractor operated broad bed furrow maker was undertaken with the following objectives. To develop suitable size broad bed furrow maker small tractor operation. To evaluate the techno-economic feasibility of the developed machine. The performance of the newly developed implement was evaluated in the field. Field trials were carried out on 1.2 ha field. Field test of the newly developed implement results were calculated separately and from the results the final conclusion was drawn which are as follows. The low hp tractor operated broad bed furrow maker can be used for making beds**.**

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