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Development of Bullock operated twin ferti hoe

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Abstract : Traditional methods of weeding and fertilizer application reduces the efficiency of work by increasing the requirement of labour cost. A Bullock operated twin ferti hoe was designed and developed in department of farm machinery and Power, College of Agricultural Engineering and Technology ,VNMKV ,Parbahni . The developed machine is two row blade weeder with fertilizer drilling attachment. The Twin ferti hoe used to remove weeds from crop & application of fertilizer consists of following components or systems Frame, Fertilizer box , Metering mechanism for fertilizer ,Tines with shovels, Beam ,Hitch .The depth obtained for field test of weeder was in the range of 55-68 mm with weeding efficiency of 80-83% . Advantages Of developed Twin Ferti Hoe Over Traditional Method observed are Saving of Labour (3 Labour are saved) ,Fertilizer placement is as per recommendations, Increased fertilizer use efficiency ,Cost operation is less than , traditional method.

Key Words : Twin Ferti Hoe, Bullock Operated Implements, Weeder,Fertilizer Application

Introduction

Traditional methods of weeding and fertilizer application reduce the efficiency of work by increasing the requirement of labour cost. In traditional methods of weeding and fertilizer application animal drawn hoes made by village artisans from locally available (usually wood for the framework and steel for soil working components) are used widely by farmers. M. VEERANGOUDA (2008) recorded that maximum values of average actual field capacity and minimum number of man-hrs requirement with the animal drawn blade hoe while the maximum value of weeding index and man-hrs requirement were observed for weeding operation by hand khurpi . They require extra labour for fertilizer placement in vicinity of crop root zone. Thus there are two operations carried separately at a time. Animal drawn weeder’s cum ferti-hoes play an important role in the mechanized control weed and fertilizer application. Due to high output, animal drawn weeder’s cum ferti-hoes help in the timelines of operations compared with manual methods and is cheaper. The shortage of labour is thus to be bridged by mechanization. Considering the socio-economic background of farmers of Maharashtra about 80% of the land is rain fed or dry land. Land holding of the farmers is so small, that the large machinery with highly mechanized devices is not feasible. Among most of the farmer's bullock drawn implements are very popular as they have their own pair of bullock.

Methodology :

The Twin ferti hoe was developed, fabricated to remove weeds from crop & application of fertilizer consists of following components or systems.

1.Main Frame 2. Fertilizer box 3. Metering mechanism for fertilizer 4.Tynes with shovels, 5. Beam 6.Hitch

Main Frame : A frame 40x40x3mm, which able to support the enter machine elements was fabricated from M.S. angles of 40x40x3 in the workshop. A main frame was design by considering bending stresses acting on it. A 40x40x3mm square frame was made from M.S. angle; holes of 6 mm were drilled to the whole frame the position of the twin ferti-hoe unit could be adjust as per the crop spacing by just changing the position of support flat with respect to the hole on the main frame.

Blade (M.S.) : Straight blade was used to serve the function of weeding. The thickness and width of blade was kept low but it had a sufficient strength to resist a load. Sharpness angle was 30^0.It has extension of square piece 2.5 x 2.5 cm of 5mm thick M.S. flat. On that extension 4 mm diameter hole drilled to attach it with weeding assembly by nut and bolt. It was made up from spring steel.

Fertilizer box with agitator: Trapezoidal shape of fertilizer box will be used in the machine for free flow of fertilizer in hopper bottoms. For easy construction, balanced operation of the fertilizer drill and symmetry in size the same size and shape of fertilizer box is selected as that of seed box.

a) Size of twin ferti-hoe of fertilizer drill

The size of manual operated fertilizer drill can be calculated as

Z = D/d , Where, Z = Number of openers in the drill

D = draft of drill, kgf , d = draft at each row, kgf

Working width of the machine, cm

$W = Z$ x a , Where W = working width of machine, cm

Z = number of openers in the drill, and a = row to row distance, cm (depends on type of crop)

b) Design of fertilizer box

i) Fertilizer box Trapezoidal shape of fertilizer box used in the machine for free flow of fertilizers in the hopper bottoms.

The fertilizer box may be of MS sheet. The length of box is

Where,

L_b = Working width of fertilizer drill – 2b , L_b = Length of box, cm

b = Distance between the side box wall and ground

ii) Specification of fertilizer box

Length of fertilizer box = 38.5 cm , Bottom width of fertilizer box = 10 cm , Top width of fertilizer box = 16 cm , Height of fertilizer box = 20 cm , Angle of repose = 30^0 Material = MS sheet

iii) Thickness of fertilizer box

$$Ts = \frac{3\sqrt{3} X \rho X a^2 X h^2}{4XaXbs}$$

Where,

Ts = Thickness of fertilizer box, cm , ρ = Bulk density, Kg/cm^3 , a = Bottom width of fertilizer box, cm , h = height of fertilizer box, cm , bs = Bending stress, Kg/cm^2

iv) Volume of fertilizer box

$V_b = 1.1V_f$ Where, V_b = Volume of fertilizer box, cm^3 , V_f = Volume of fertilizer, cm^3

Also, $V_f = W_f/\gamma_f$ Where, W_f = Weight of fertilizer in box, gm , γ_f = Bulk density of fertilizer , g/cm^3

Putting , $V_f = W_f/\gamma_f$

Get, $V_b = 1.1\ W_f/\gamma_f$

RESULTS AND DISCUSSION

Performance evaluation of the unit

The laboratory test and field tests were taken on developed ferti hoe. The details about tests are mentioned below.

Laboratory test

The main objectives of the laboratory test were to study and confirm the specifications and essential components of the unit such test assist in modification and improvement of the machine design.

Testing of specifications

This laboratory test include the static dimensions of machine. The test was carried on in a laboratory when machine was in rest position and all its parts were ready to work.

Table 2 Specification of Twin Ferti Hoe

Sr. No.	Particular	Specification
1.	Name of machine	Twin Ferti Hoe
2.	Make	MAU,Parbhani.
3.	Model	Prototype
4.	Type of machine	Blade type(straight)

Material of blade

Blade was the soil working tool for machine. Spring steel was used for blade after heat treatment.

Test consideration The weeder was taken to the field and trials were conducted in black cotton soil. The parameters like soil type, moisture content, crop parameters were studied. Other factors which taken into considerations were speed of operation, depth of operation, placement of Fertilizer. The field tests were conducted as per RNAM test code procedure 1983.

Field tests of Twin Ferti hoe .

The **Twin Ferti hoe** was operated in the field of Dryland Research Center, MAU, Parbhani.& CCBP, VNMKV, Parbhani. The field test was carried out as per RNAM test code procedure for weeder. The weeder was evaluated for the actual field capacity, theoretical field capacity, weeding efficiency, Placement of fertilizer etc. The readings were taken for the two crops and are tabulated in table

Row spacing The engine operated weeder would be used in crop of row spacing between 37.5 to 45 cm. Thus width can be adjusted according to row spacing. It was suitable for crops having maximum row spacing because it can be operated speedily without or minimum crop damage.

Depth of operation The depth obtained for field test of weeder was in the range of 55-68 mm. This was more than sufficient for weeding.

Speed of operation Speed of prototype depends upon the moisture content, draft of machine, working width blade. When blade length decreases draft also decreases and speed increases and vice-a-versa. Speed of machine should be such that man can comfortably operated i.e. 1.8-2.3 km/h.

Effective field capacity Effective field capacity is always less than theoretical field capacity because it includes turning loss and other field losses. Mean actual field capacity of machine for Soyabean , jowar, Maize are 0. 170 ha/h,0. 168 ha/h. 0. 174ha/h or avg.**1.36ha/day**

Observed field values for weeding

Name of field: Dry land research centre, MAU Parbhani (For Soyabean & Jowar)

Name of field: CCBP, MAU Parbhani (For Maize)

Sr. No.	Particulars	Soyabean Dryland	Jowar Dryland	Maize CCBP
1	Width of operation (cm)	45	45	45
2	Depth of operation	6.5	6	7
3	Draft (kg)	40	43	40
4	Speed of operation (km/h)	2.1	2.1	2.1
5	No. of weeds before hoeing	93	105	104
6	No. of weeds after hoeing	20	12	14
7	Weeding efficiency (%)	78.49	82	83
8	Depth of placement of fertilizer (cm)	6.8	5	6.5
9	Distance of fertilizer application from plant (cm)	6	4	5
10	Time required to cover plot (min)	15	17	13
11	Actual field capacity (ha/h)	0. 170	0. 168	0. 174
12	Theoretical field capacity (ha/h)	0. 189	0. 189	0. 189
13	Field efficiency (%)	90	88	92

Field efficiency Average field efficiency for developed twin ferti hoe was 85-90 % It is nothing but ratio of actual field capacity and theoretical field capacity.

Placement of Fertilizer : The fertilizer was placed at the depth of 5-7cm &at distance of of 4-6cm away which is recommended .

Cost of Operation : The cost of operation by developed implement is Rs. 115 per hectare as compared to that of Rs 365 per hectare with traditional method , this is due to labour saving in the developed Twin Ferti Hoe.

Conclusion :

1. The Twin ferti hoe to remove weeds from crop & application of fertilizer was fabricated, which was consists of following components or systems.1.Frame 2. Fertilizer box 3. Metering mechanism for fertilizer 4.Tynes with shovels, 5. Beam 6.Hitch

2.The depth obtained for field test of weeder was in the range of 55-68 mm with weeding efficiency of 80-83%

3. The fertilizer was placed at the depth of 5-7cm &at distance of of 4-6cm away which is recommended.

4. The cost of operation by developed implement is Rs. 115 per hectare as compared with traditional method ,due to labour saving in the developed Twin Ferti Hoe.

Twin Ferti Hoe in

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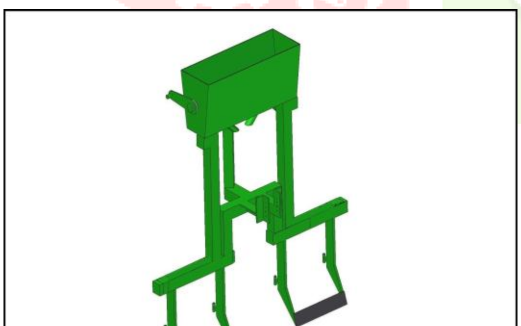
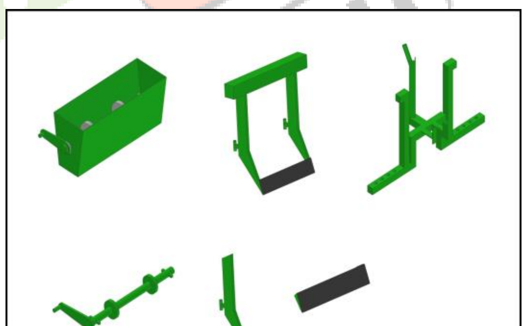


Isometeric view of Twin Ferti hoe



Parts of Twin Ferti hoe

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