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Calibration and Field Performance of MPT Seed cum Fertilizer Drill for Paddy Cultivation

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Abstract

The aim of this study is to calibrate bullock drawn Multi Purpose Tool Seed cum Fertilizer Drill and evaluate field performance of MPT Seed cum Fertilizer Drill. An experiment was conducted in 0.05 ha to evaluate field performance of MPT Seed cum Fertilizer Drill at FAE, IGKV Raipur (C.G.). During calibration of Seed cum Fertilizer Drill seed rate was observed in different hopper capacities and exposure length of fluted roller and found 76.8 kg/ha at 10 mm fluted roller exposure length. Field performance was evaluated by field capacity, field efficiency, Draft, yield and Power requirement to operate Seed cum Fertilizer Drill and found 0.0853 ha/h, 73.9% , 53.7 kgf , 44.3 q/ha and 0.4 hp respectively. A comparative analysis was composed to determine energy input and output ratio of MPT Seed cum Fertilizer Drill and Conventional Seed cum Fertilizer Drill.

Keywords: Seed cum Fertilizer Drill, Calibration, Draft, Yield, Energy input – output ratio.

Introduction

The main purpose of farmers in developing countries is to produce more agricultural products with the lowest possible energy input to meet the growing demand for food in the region [3]. Many agricultural operations are performed with the help of draught animals on the small and marginal farms. Animal power contribution in the total power used in agriculture is about 33% [12]. To maintain sustainable production, natural resource conservation is importance. Thus to maintain the natural resource base and at the same time increase food production with suitable sowing implement and minimum energy input requirement is necessary. Multipurpose Tool Seed cum Fertilizer Drill is one of the most suitable sowing implement for small farmers. It has main advantage that it consist a frame which can be change according to operation required. Fig.1 depicts Multipurpose Tool Seed cum

Fertilizer Drill with their features. It consists of inverted T type furrow opener with fluted roller metering mechanism. It is driven by a pair of animal and power transmission is given by chain and sprocket system. It consists three furrow opener with spacing of 2 cm. Sharma *et al*. (1983) developed a single row seed cum fertilizer drill with frame of 40×40×3 mm mild steel angle iron and rectangular boxes capacity of 5 kg for seed and fertilizer with separated fluted roller assembly to ensure uniform dropping of seed and fertilizer [16] . Devnani (1991) reported that the inclination of the seed delivery tube from vertical was kept smaller than 20 degree. Study resulted with that draft for the shoe type furrow opener was recommended 20 kgf and 30-35 kgf for light and heavy soil respectively [4]. Vershney *et al*. (1991) reported that fluted roller for metering of seed and adjustable opening for fertilizer gave better results for placement of seed and fertilizer. It opens new mechanism for seed cum fertilizer drill for better operating system [18]. Behera *et al*. (1995) analysed that Naveen seed cum fertilizer drill of CIAE Bhopal performs best in term of highest return and benefit ratio. Study shows that Naveen seed cum fertilizer drill provides highest return of Rs.4693.75/ha and benefit ratio of 1.35. [2]

Fig. 1: MPT Seed cum Fertilizer Drill

Qasim and Verma (1995) studies on Indira seed drill and resulted with information that Indira seed drill cover 0.8-1.0 ha/day with draft required

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was 25-30 kg. In this study it is found that Indira seed drill perform better for line sowing in loam clay soil [13]. Kumar and Hugar (2011) analysed the energy use pattern in paddy cultivation under irrigated areas. The study resulted with that the total energy utilized for paddy cultivation by small farmers was significantly higher than that of medium and large farmers [11]. Yadav *et al*. (2013) reported energy input–output and the level of agricultural mechanization for cultivation of rice and maize [19].

Material and Methods

In present study MPT Seed cum Fertilizer drill was calibrated at FAE, IGKV Raipur (C.G.) and field experiment were conducted at Farm of FAE Raipur. FAE, IGKV Raipur was situated at longitude 21.16° and latitude 81.36° at an elevation of 289.56 m above from mean sea level. The experimental field was sandy loam with electric conductivity of 0.25 and pH value of 7.5.

In laboratory test calibration of MPT seed cum fertilizer drill was conducted as per IS-6316:1993 [8]. The field performance test was conducted in order to obtain actual data for over all machine performance operating , accuracy, work capacity, field condition and field efficiency. In field testing soil parameter and machine parameter under desired field condition during field testing the parameter like Draft, speed of operation, field capacities field efficiency ,power requirement, and depth of seed placement were measured.

Draft measurement

The draft was calculated by measuring pulling force along the line of pull and its inclination angle. Pulling force was measured by dynamometer. It is expressed as:

$$D = P\cos\theta \quad \text{..... (1)}$$

Where D = Draft, kg, P = pull (dynamometer reading), kg, θ = angel between line of pull and horizontal, degrees

Power requirement

The power requirement was determined from the draft and speed of operation using the relation (IS-7640-1975) [10].

$$hp = \frac{Draft\,(kg) \times Speed\,(m/s)}{75} \quad \text{..... (2)}$$

Field capacity and efficiency

The theoretical field capacity is the rate of field coverage that would be obtain if implement were performing its function 100% of the time at the rated speed and always covering 100% of its rated width. Field capacity was calculated by following expression:

$$F_t = \frac{W \times S}{10} \quad \text{..... (3)}$$

Where F_t = Theoretical field capacity, W = Width of Machine and S = Speed of operation

The actual field capacity is the actual rate of coverage by the implement. The total time required to complete the operation was recorded and actual field capacity was calculated followed (IS 6288-1971) [9].

$$F_a = \frac{A}{T} \quad \text{..... (4)}$$

Where F_a is the actual field capacity, A is the area covered by machine and T is the time taken by machine to cover area A.

Field efficiency is the ratio of actual field capacity and Theoretical field capacity. It is expressed in percentage by following expression:

$$Field\ efficiency = \frac{F_a}{F_t} \quad \text{..... (5)}$$

Energy Input

Energy input is estimated source wise and operation wise input with different parameter. Energy input was calculated by expression given as:

$$Energy\ input = E_{hl} + E_p + E_{mt} \quad \text{..... (6)}$$

Where Energy input is in MJ/ha, E_{hl} is energy from human labour, E_p is energy from power source and E_{mt} is energy from material

Energy Output

Energy output is estimated by energy from main product and by product.

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$$Energy\ output = E_{mp} + E_{bp} \text{.....(7)}$$

Where Energy output is in MJ/ha, E_{mp} is energy from main product and E_{bp} is energy from by product. Energy input – output ratio is determined by ratio of energy output and energy input.

Results and Discussions

The MPT Seed cum Fertilizer Drill machine was calibrated for the desired seed rate by adjustment of the exposed length of flutes. Data depicted in table 1 show that the recommended seed rate was found 76.8 kg/ha when the seed drill was three fourth hopper capacity and flute exposure length 10 mm. It is also revealed that for all the capacities of hopper one fourth, half, three, fourth and full with 10 mm flute exposure the seed rate was close to the recommended seed rate. The observed seed rate for 10 mm flute exposure were 76.8 kg/ha, 78.54 kg/ha, 82.9 kg/ha and 84.5 kg/ha for full, three fourth, half and one fourth hopper capacity.

Table 1: Calibration of Multi Purpose Tool Seed cum Fertilizer Drill

S. No.	Crop	Hopper Capacity	Seed Rate kg/ha Exposure Length mm		
			7	10	13
1	Paddy	Full	44.5	76.8	116.5
		Three fourth	49.2	78.5	120.4
		Half	52.6	82.9	126.9
		One fourth	53.6	84.5	128.3

Table 1 shows that desired seed rate was found 76.8 kg/ha at full hopper capacity at 10 mm exposure length of fluted roller.

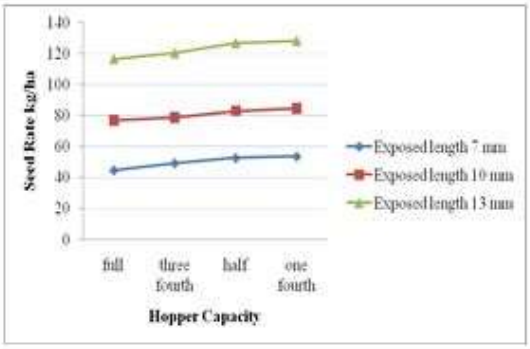

Fig. 2: Seed rate for MPT Seed cum Fertilizer at Different hopper capacity

Table 2: Field Test of Multi Purpose Tool Seed cum Fertilizer Drill

S.No.	Speed of Operation, km/hr	Draft , kgf	Power Requirement , hp
1	2.10	52.0	0.39
2	2.00	56.0	0.40
3	2.10	53.0	0.41
4	1.90	52.5	0.35
5	2.00	55.0	0.41

Table 2 shows that draft varies from 52 kgf to 56 kgf while speed varies from 1.9 km/hr to 2.1 km/h. The draft of implement was increases as the depth of sowing increases. The average draft and power requirement was found 53.7 kgf and 0.4 hp respectively.

Table 3: Field Capacity and Efficiency of MPT Seed cum Fertilizer Drill.

Implement	F_t , ha/h	F_a , ha/h	Efficiency, %
MPT Seed cum Fertilizer Drill	0.115	0.085	73.9

Table 3 shows that theoretical field capacity and actual field capacity of MPT Seed cum Fertilizer Drill was found 0.115 ha/h and 0.085 ha/h respectively.

Table 4: Yield characteristics in paddy cultivation with MPT Seed cum Fertilizer Drill

Yield Characteristics	MPT Seed Cum Fertilizer Drill
No. of effective tillers	280
Plant height , cm	111
Length of panicle cm	28
No. of grain/panicle	90
Panicle weight, g	3.2
1000 grain weight, g	28
Yield, q/ha	44.3

Data on crop parameter for MPT seed drill was given in table 4. It shows that number of effective tillers 280 in MPT seed drill while plant height and panicle length was observed 111, 28 respectively. 1000 grain weight and yield was found for MPT seed drill 28g and 44.3q/ha respectively.

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Table 5: Energy input for Conventional Seed cum Fertilizer Drill

S.N.	Operation	Conventional Seed cum Fertilizer Drill energy MJ/ha
1	Field preparation	276.03
2	Sowing	1338.22
3	Plant protection	56.92
4	Interculture	131.71
5	Irrigation	45.68
6	Fertilization	4319.05
7	Harvesting	308.93
8	Transportation	139.29
9	Threshing	767.88
10	Winnowing	282.41

Table 6: Energy input for MPT Seed cum Fertilizer Drill

S.N.	Operation	MPT Seed cum Fertilizer Drill energy MJ/ha
1	Field preparation	278.82
2	Sowing	1388.47
3	Plant protection	46.60
4	Interculture	155.80
5	Irrigation	57.10
6	Fertilization	4022.68
7	Harvesting	312.56
8	Transportation	125.72
9	Threshing	722.12
10	Winnowing	262.42

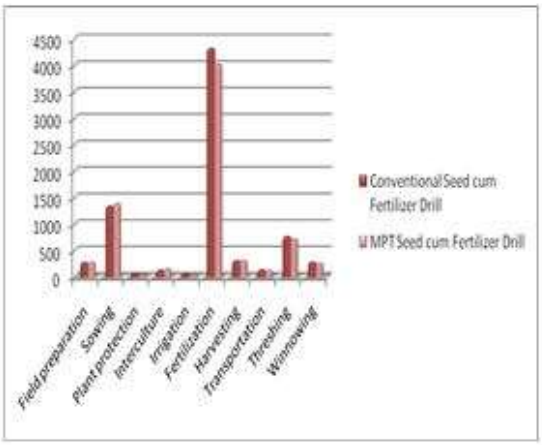

Fig.3: Comparative alalysis of energy input in MPT seed cum Fertilizer Drill and Conventional Seed cum Fertilizer Drill

Fig.3 shows that the highest energy was applied through fertilizer application operation 4022.68 MJ/ha and sowing 1388.47 MJ/ha, field preparation 278.82 MJ/ha, plant protection 46.60 MJ/ha, harvesting 312.56 MJ/ha, transportation 125.72 MJ/ha, threshing 722.12 MJ/ha and energy input was observed in winnowing operation i.e. 262.42 MJ/ha.

Table 7: Energy output – input ratio

Parameter	Conventional Seed cum fertilizer Drill	MPT Seed cum Fertilizer Drill
Energy input	8018.33	7726.5
Energy output by Seed, MJ/ha	66444	65121
Energy output by Straw, MJ/ha	81875	69750
Total output	148319	134871
Output input ratio	18.43	17.4

The energy output-input ratio in line sowing method were computed and it was range from 18.43 to 17.4 (Table 7). The highest energy output-input ratio of paddy found 18.43 in conventional seed cum fertilizer and 17.4 in MPT Seed cum Fertilizer Drill.

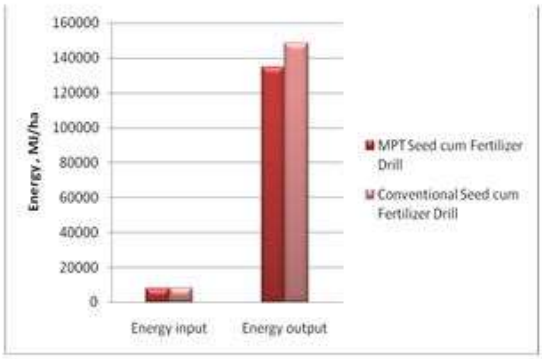

Fig.4: Energy output – input ratio of MPT Seed cum Fertilizer Drill and Conventional Seed cum Fertilizer Drill

Conclusions

An experimental study has been carried out to calibrate an Animal Drawn MPT Seed cum Fertilizer Drill in FAE, IGKV Raipur (C.G.). Laboratory test has conducted to calibrate and it was found that desired seed rate was 76.8 kg/ha at 10 mm exposure length of fluted roller. Field test was resulted with that field capacity and efficiency of MPT Seed cum Fertilizer Drill was 0.085 ha/h and 73.9% respectively. During field test it is found that draft and power requirement was 53.7 kgf and 0.4 hp

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respectively. Energy analysis shows that energy output-input ratio of Conventional Seed cum Fertilizer Drill was higher than MPT Seed cum Fertilizer Drill but MPT Seed cum Fertilizer was a multiple tool implement and it can be used for different field operations.

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