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# Comparative Performance Evaluation Of Bullock Drawn Maize Planters

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***Abstract*— This study was carried out during winter season of 2015-16 at Sant Kabir College of Agriculture and Research Station, Kabirdham (CG). A single row maize planter and three row inclined plate planter were compared for laboratory test and field test. In lab testing seed rate of both planters were found as 26.34 kg ha$^{-1}$ and 27.65 kg ha$^{-1}$, respectively. The theoretical seed rate ($R_{st}$) and the seeding mass rate ($R_{sm}$) of a single row maize planter and three row inclined plate planter were found as 74074 seeds ha$^{-1}$, 83333 seeds ha$^{-1}$ and 19.3 kg ha$^{-1}$, 21.7 kg ha$^{-1}$ respectively. Draught, operation speed, power requirement, depth of seed placement, field efficiency and effective field capacity of both planters were recorded as 56.89 kgf, 1.32 km h$^{-1}$, 0.204 kW, 5.56 cm, 68.33 %, 0.041 ha h$^{-1}$ and 47.54 kgf, 1.50 km h$^{-1}$, 0.194 kW, 5.44 cm, 66.66 %, 0.12 ha h$^{-1}$ respectively where the theoretical field capacity was found to be 0.06 and 0.18 ha h$^{-1}$, respectively.**

***Keywords*— Maize, single row maize planter, three row inclined plate planter, draught, power requirement***

## I. INTRODUCTION

Maize in Chhattisgarh is one of major cereal crop as it contributes (102.70 area in thousand hectares which have production 177.82 thousand MT and productivity 1655 kg per hectare in Kharif and 30.88 area in thousand hectares which have production 50.18 thousand MT and productivity 1624.90 kg per hectare in rabi) in the year 2012-2013 (Directorate of Agriculture, Raipur).

It is basically grown in Sarguja and Jagdalpur region. In Sarguja district of Chhattisgarh maize is highly preferable by the farmers after rice. Sarguja contributes 12272 thousand hectares area and the productivity of maize in Sarguja district is 2200 kg per hectare, production is about 26.99 Mt in the year 2012-2013 (Deputy Director of Agriculture, Ambikapur).

Chhattisgarh has the total geographical area 137.9 lakh hectare, in which 46.04 percent forest, 4641 thousand hectare area kharif cropped, 1542 thousand hectare area rabi cropped. Chhattisgarh has average annual rainfall 1200-1300 mm. (Banjare, 2015). Animals are the largest contributor of farm power in India and yet, the major source of marginal, small and even medium farmers who account for more than 80% of total agricultural holding and 40% of total cultivated land (Nirala, 2011). Planters are used for row drilling (hill dropping) or check row planting of larger seeds than those which normally go through seed drills. They give more accurate results with larger seeds. They may be tractor operated or animal drawn. In the state of Chhattisgarh the average height of bullocks is less as compared to other states and most of the field operations are done by bullocks. So a single row maize planter and three row inclined plate planter are taken to the performing in the field.

## II. MATERIALS AND METHODS

The study was carried out during winter seasons of 2016 at Sant Kabir College of Agriculture and Research Station, Kabirdham (CG).

Table 1. Specification of planters

| Particulars | Single row maize planter | Three row inclined plate planter |
|---|---|---|
| Length, mm | 2614 | 1820 |
| Width, mm | 790 | 1270 |
| Height, mm | 475 | 940 |
| Weight, kg | 7.5 | 80 |
| Number of rows | 1 | 3 |
| Power source | Pair of bullock | Pair of bullock |
| Developed by | SVCAET and RS, IGKV, Raipur | C.I.A.E. Bhopal |

*Planters*

A single row maize planter (Fig 1) and bullock drawn three row inclined plate planter (Fig 2) were used for sowing of maize crop where combinations of various tillage operations were done.

Fig 1. Single row maize planter

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Fig 2. Three row inclined plate planter

*Laboratory test*

*Calibration of maize planters*

A single row maize planter and three row inclined plate planter were calibrated according to the IS: 8956-1981 test code of planter.

*Theoretical seeding rate (Rst)*

The number of maize seeds planted per hectare was calculated by using the following relationship (Bakhtiari and Loghavi, 2009):

$$R_{st} = \frac{10000 \times 10000}{W \times Xs}$$

Where,

Rst = Theoretical seeding rate, seeds $ha^{-1}$;
W = Row width, cm; and
Xs = Seed spacing along the row, cm.

*Seeding mass rate (Rsm)*

The total mass of maize seeds planted per hectare expressed in Mg $ha^{-1}$ was calculated by using the following relationship (Bakhtiari and Loghavi, 2009):

$$R_{sm} = \frac{M}{W \times Xs} \times 100$$

Where,

Rsm = Seeding mass rate, Mg $ha^{-1}$;
M = Average mass of one seed, g;
W = Row width, cm; and
Xs = Seed spacing along the row, cm.

*Field-test*

The 3-row inclined plate planter and a single row maize planter were tested in the field at Sant Kabir College of Agriculture and Research Station, Kabirdham (CG) during the month of February, 2016 for sowing of maize. The shape of field was rectangular and the area of each plot was 40 x 11 $m^2$.

*Draught of maize planters*

If the line of pull through the dynamometer is not horizontal, measure the angle which the line of pull makes with the horizontal and calculate the horizontal component (draught) by the following formula (IS: 11235 - 1985):

$$D = P \cos \theta$$

Where,

D = Draught, kg;
P = Pull (dynamometer reading), kg;
θ = Angel between line of pull and horizontal, degrees.

*Operating speed of maize planters*

The speed of operation of planter was determined in test plots by putting two marks 30 m apart (A & B). The time was recorded with the help of stop watch to travel the distance of 30 m. The speed of operation was calculated in km $h^{-1}$ as given below:

$$S = 3.6 \times \text{distances traveled (m)} / T$$

Where,

S = Speed of operation, km $h^{-1}$;
T = Time needed to cover 30 m distance, sec.

*Power requirement of maize planters*

The power requirement was determined from the draught and speed of operation using the relation (IS: 11235 - 1985):

$$HP = \frac{Draft\ (kg) \times Speed\ (m\ s^{-1})}{75}$$

*Theoretical field capacity (TFC)*

It is the actual area covered by the implement, based on 100% of time at the rated speed and covering 100% of its rated width. Field capacity was calculated by following expression (Bainer *et al*., 1960):

$$TFC\ (ha\ h^{-1}) = (W \times S) / 10$$

Where,

W = Theoretical width of implement, m;
S = Speed of operation, km $h^{-1}$.

*Effective field capacity (EFC)*

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

$$EFC = \frac{A}{T}$$

Where,

EFC = Effective field capacity, ha $h^{-1}$;
A = Actual area covered by implement, ha;
T = Effective time, h.

*Field efficiency*

The field efficiency is the ratio of effective field capacity to the theoretical field capacity and expressed in %.

$$\text{Field efficiency} = EFC / TFC \times 100$$

Where,

EFC = Effective field capacity
TFC = Theoretical field capacity

## III. RESULTS AND DISCUSSION

The observations and results obtained during the study are presented in this chapter.

*Testing of the maize planters*

*Laboratory Test*

*Calibration of planters*

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In lab testing seed rate of a single row maize planter and three row inclined plate planter were found as 26.34 kg ha-1 (74074 seeds ha-1) and 27.65 kg ha-1 (83333.33 seeds ha-1), respectively.

*Theoretical seeding rate (Rst)*

The number of maize seeds planted per hectare was calculated by using the following relationship;

$$R_{st} = \frac{10000 \times 10000}{W \times Xs} = \frac{10000 \times 10000}{45 \times 30}$$

= 74074.07 ≈ 74074 seeds $ha^{-1}$ (for single row maize planter)

$$R_{st} = \frac{10000 \times 10000}{W \times Xs} = \frac{10000 \times 10000}{40 \times 30}$$

= 83333.33 ≈ 83333 seeds $ha^{-1}$ (for three row inclined plate planter)

Where,

Rst = Theoretical seeding rate (No. of seeds $ha^{-1}$);
W = Row width (cm); and
Xs = Seed spacing along the row (cm)

*Seeding mass rate (Rsm)*

The total mass of maize seeds planted per hectare expressed in Mg $ha^{-1}$ was calculated by using the following relationship;

$$R_{sm} = \frac{M}{W \times Xs} \times 100 = \frac{0.26}{45 \times 30} \times 100$$

= 0.0193 Mg $ha^{-1}$ = 19.3 kg $ha^{-1}$ (for single row maize planter)

$$R_{sm} = \frac{M}{W \times Xs} \times 100 = \frac{0.26}{40 \times 30} \times 100$$

= 0.0217 Mg $ha^{-1}$ = 21.7 kg $ha^{-1}$ (for three row inclined plate planter)

Where,

Rsm = Seeding mass rate, Mg $ha^{-1}$;
M = Average mass of one seed, g;
W = Row width, cm; and
Xs = Seed spacing along the row, cm.

*Field-test*

The planters were field tested for their mechanical and functional performances in field area of 0.10 ha.

*Draught of maize planters*

The average draught was recorded of single row maize planter and three row inclined plate planter was 56.89 kgf and 47.54 kgf for maize, respectively.

*Operating Speed of maize planters*

The average speed of operation for sowing was found to be 1.32 and 1.50 km $h^{-1}$ respectively, for both the planters.

*Power requirement of maize planters*

The average power required for single row maize planter and three row inclined plate planter was found to be 0.204 kW (0.27 hp) and 0.194 kW (0.26 hp) (Table 2).

Table 2. Draught, Speed of operation and Power requirement of maize planters

| Treatment | Draught | | Speed of operation (m $s^{-1}$) | Power requirement | |
|---|---|---|---|---|---|
| | (N) | (kgf) | | (kW) | (hp) |
| T1 | 558.16 | 56.89 | 0.37 | 0.204 | 0.27 |
| T2 | 466.45 | 47.54 | 0.42 | 0.194 | 0.26 |

*Field capacity and field efficiency*

The field efficiency was calculated using standard method as described earlier and results are presented in (Table 3).

Table 3. Field performance results of planters during planting operation

| Particulars | Data of field performance | |
|---|---|---|
| | *Single row maize planter* | *Three row inclined plate planter* |
| Travelling speed, km $h^{-1}$. | 1.32 | 1.50 |
| Theoretical field capacity, ha $h^{-1}$. | 0.06 | 0.18 |
| Effective field capacity, ha $h^{-1}$. | 0.041 | 0.12 |
| Field efficiency, % | 68.33 | 66.66 |

The effective field capacity of single row maize planter and three row inclined plate planter were found to be 0.041 and 0.12 ha $h^{-1}$, respectively, whereas the theoretical field capacity was found to be 0.06 and 0.18 ha $h^{-1}$, respectively. From the effective and theoretical field capacity, the field efficiency of both planters was calculated as 68.33 and 66.66 %, respectively.

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