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Performance Evaluation of Manually Operated Pull Type Inclined Plate Planter

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ABSTRACT

Farm mechanization plays a vital role in reducing cost of crop production and increase in cropping intensity. A manually operated inclined plate planter was developed and its performance was evaluated for crops namely maize, castor and redgram. The field capacity of the planter was found to be 0.12, 0.1225 and 0.097 ha/h for castor, redgram and maize respectively. The seed spacing was found to be satisfactory against the set spacing. The seed rate was found to be satisfactory for castor and maize and was less for redgram. The cost of planter was Rs.4100 with an operating cost of Rs.36 per hour. Cost of sowing was saved up to 69.18% with the planter compared to manual sowing. Seeds, operating time and money can be saved with the planter compared to manual sowing.

Key words*: Cost of Operation, Evaluation, Field Capacity, Field Efficiency,Planter* .

India is an agricultural country agriculture is demographically the broadest economic sector and plays a significant role in the overall economy of India. It contributes 14% of country's GDP, 11% of its exports and 60% of its employment potential. Rain fed agriculture occupies 55% net sown area, contributing 40% of food grain production and supporting 40% of the population. The land holding pattern in India is dominated by the small and marginal farmers (>60%) where farmers rely mostly on draught animals. The farm mechanization with indigenous technologies would enhance the productivity of the small and marginal farmers and make them more sustainable (Mayande *et al.*, 2004).

Farm mechanization plays a vital role in reducing cost of crop production and increase in cropping intensity. The total power availability on Indian farms increased at 4.58% from 0.293 to 1.841kW/ha during the last 40 years, combined share of agricultural workers and draught animals has reduced from 60.3% in 1971-1972 to 10.1% during 2012-2013 (Mehata *et al.,* 2014). For the growth of Indian economy, mechanization is necessary. The main purpose of mechanization in agriculture is to improve the overall productivity and production. Farm machinery has become one of the important inputs that improve the efficiency in field operations at lower cost and high precision, ensuring comfort with reduced drudgery. It has been widely proved that mechanization of various field operations increases the overall productivity by 12 to 34%, facilitates enhancement of cropping intensity by 5 to 22% and more than all, increases gross income to the farmers by 29 to 40% (Sahoo and Srivatsava 2000). Farm mechanization does not mean the use of only big machines and tractors for farm work. Mechanization is a need based process which provides sufficient time gap for self-adjustment of various inputs without causing sudden impact of changes.

Resource poor farmers cannot afford to buy high cost equipment which are available in the market. Varied cropping systems and soil conditions demand location specific and cost effective implements. The timely seeding is essential in rain fed farming. Delayed sowing beyond normal window period prolongs growing, causing moisture stress on maturing crops. With the current seeding practices, farmers are unable to sow the crop at appropriate time because the conventional devices are slow in operation, and require high labour cost, thereby increasing cost of production. Mostly unskilled labours drop the seed leading to gaps and bunching of plants in a row which results in non-uniform cropping. The non-uniform cropping creates imbalance in utilization of nutrients and moisture which leads to reduction in crop productivity.

There are a number of seed metering devices available for use in a planter. The most common device is a rotating circular plate with cells which is provided at the bottom of seed hoppers (horizontal plate). In some planters, vertical plate and inclined plate are also used. There is more spillage and less accuracy in horizontal and vertical plates. To avoid spillage of the seeds, inclined plate seed metering mechanism is preferred. The inclined plate metering mechanism has less spillage than vertical and horizontal plate metering mechanisms which results in more accurate seed placement of seeds in the furrow. It also reduces crushing of seeds in the hopper box which is the major problem in horizontal and vertical metering mechanisms.

To overcome these limitations and to improve the productivity at reduced cost of production, improved design of seed planter with precise seed metering mechanism is need of the hour. Hence a manually operated pull type inclined plate planter was developed and evaluated for its performance.

MATERIAL AND METHODS

The planter was developed and evaluated at the Department of Farm Machinery and Power, College of Agricultural Engineering, Sangareddy, PJTSAU, is shown in Fig.1. The planter was tested in the field and parameters like effective field capacity, field efficiency, average depth of placement of seeds in the furrows, seed rate, spacing of seeds within the row and cost of operation of the planter was determined.

Effective Field capacity and Field Efficiency

Field Capacity

Field capacity is defined as the rate of field coverage by the planter. Turning time at the end of the field was added with actual operating time for effective field capacity determination.

Theoretical and effective field capacity of the planter was determined using the relationship by Bamgboye and Mofolasayo (2006).

a) Theoretical field capacity:

$$C_{th} = \frac{SW}{10}$$

Where,

C_{th} = Theoretical field capacity, ha h^{-1}

S = Forward speed, km h^{-1}

W = Width of coverage, m

b) Effective Field Capacity:

$$C_{eff} = \frac{A}{T}$$

Where,

C_{eff} = effective field capacity, ha h^{-1}

A = Field coverage, ha

T = Actual time of operation, h.

C) Fieldefficiency

Field efficiency is the ratio of effective field capacity to the theoretical field capacity. It was calculated using the formula

$$F_e = \frac{C_{eff}}{C_{th}} \times 100$$

Where,

F_e = field efficiency, %

Depth of sowing

The average depth of seed placement was determined by running the planter over an area of 10 m^2 without the furrow covering device and with medium setting of the furrow opener. Along the furrow, five hills were randomly sampled and investigated for depth of placement. A steel rule was used to measure the depth of placement of seed.

Seed to seed spacing

After the operation of planter in the field, five hills were randomly selected along the furrow to determine the inter row (seed to seed) spacing. A measuring tape was used to measure the seed to seed spacing.

Cost of Operation

The cost of operation of the planer was determined using straight line method (Jagadishwar Sahay, 2006). Cost of operation was calculated in Rs. /h.

RESULTS AND DISCUSSION

The results of the evaluation of the planter is discussed in this section

Field Capacity

The theoretical field capacity for maize, red gram and castor was found to be 0.1125, 0.1422 and 0.1269 ha/h respectively and is shown in Fig.2. The theoretical field capacity is more for castor and redgram due to more row to row spacing than

Fig.1. Planter developed for the study.

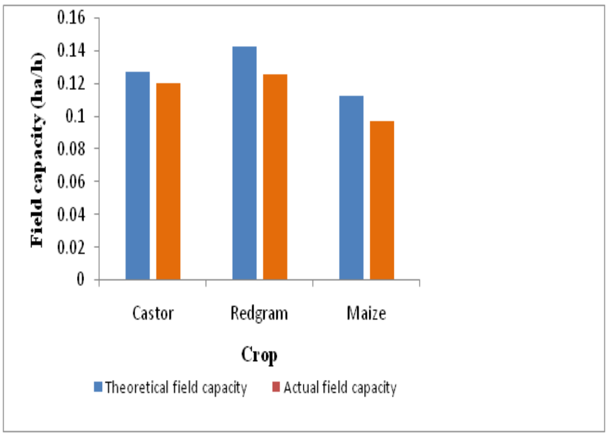

Fig.2. Theoretical field capacity and Actual field capacity for different crops.

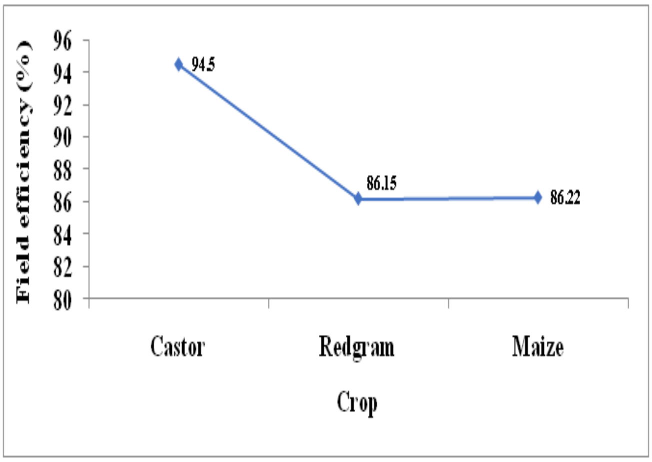

Fig.3. Field efficiency for different crops.

maize. Actual field capacity for castor, redgram and maize was found to be 0.12, 0.1225 and 0.097 ha/h respectively and shown in Fig.2. The actual field capacity of maize is less than castor and redgram due to more turning losses during operation of planter.

Field efficiency

The field efficiency of the planter for castor, redgram and maize was found to be 94.5 %, 86.15 % and 86.22 % respectively and shown in Fig.3. The Field efficiency was found to be more for castor than redgram and maize.

Depth of sowing

The depth of sowing for castor, redgram and maize was found to be 4.23, 3.6 and 3.76 cm respectively and shown in Fig.4.The depth of sowing varied for different crops due to variation in operational speed.

Seed to seed spacing

The seed to seed spacing in castor, redgram, and maize was found to be 28 cm, 18 cm and 21 cm respectively against a set spacing of 30 cm, 20 cm and 20 cm respectively and shown in Fig.5. The seed to seed spacing was found to be satisfactory. The variation of spacing was due to variation in operational speed.

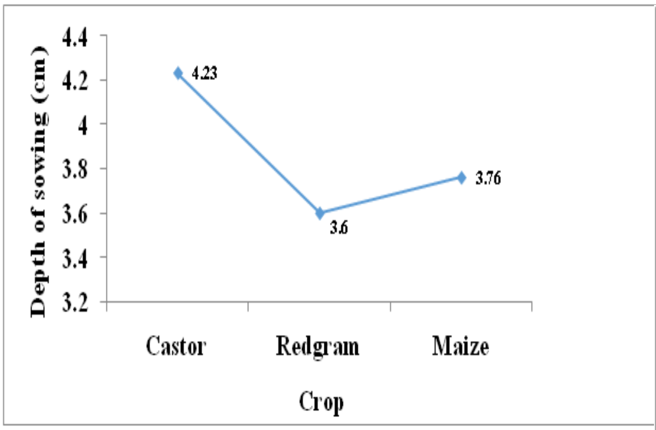

Fig.4. Depth of sowing for different crops.

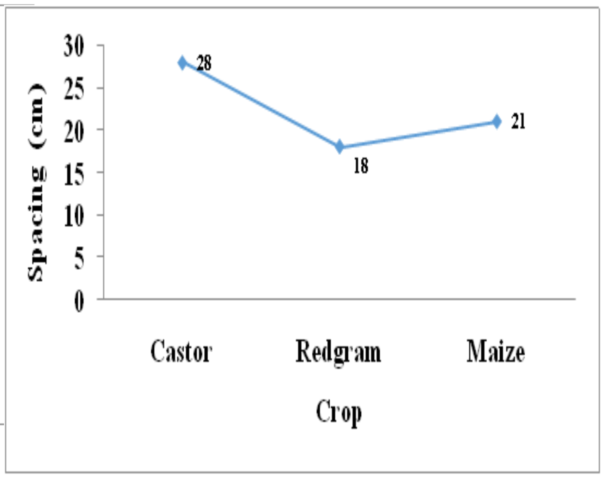

Fig.5. Seed to seed spacing for different crops.

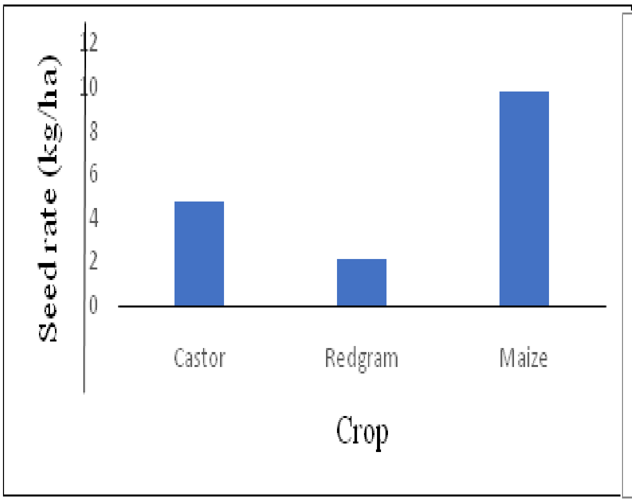

Fig.6. Seed rate for different crops.

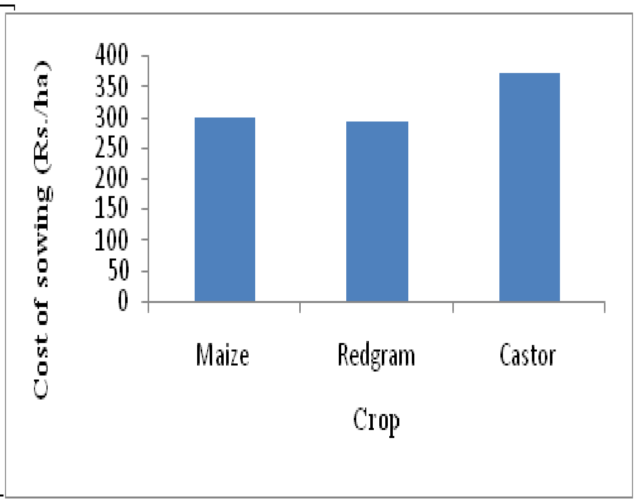

Fig.7. Cost of sowing for different crops with planter.

Seed Rate

The seed rate for maize, red gram and castor was found to be 9.81, 2.09 and 4.71 kg ha^{-1} respectively and shown in Fig.6. The seed rating was found to be more for maize due to less row to spacing (45 cm) than redgram and castor (90 cm). The seed rate was satisfactory for maize and castor, but it was less than the recommended rate for redgram.

Cost of Operation:

The cost of planter was Rs. 4100 and cost of operation was found to be Rs.36 per hour. The cost of sowing for maize, redgram and castor was found to be Rs. 300, 295, 372 per hectare respectively and is shown in Fig.7. The Cost of Sowing was found to be more for maize than redgram and castor due to less actual field capacity for maize than redgram and castor. The cost of sowing was found to be less with planter than manual sowing. On an average there is 69.28%

saving in cost of operation with the planter compared to the manual sowing (which is Rs. 1050 per hectare with manual sowing).

CONCLUSIONS

The field capacity was found almost equal for castor and redgram and it was less for maize. The seed rate was found to be satisfactory for all crops. The cost of sowing with planter was less compared to manual sowing. With the planter time, seed and money can be saved as compared to manual sowing.

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