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Research Article

PERFORMANCE EVALUATION OF MANUALLY OPERATED PUSH TYPE MULTI CROP PLANTER

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Abstract- A manually operated push type multi crop planter was developed and was tested in laboratory as well as in field for crops *viz.*, Bengal gram, red gram and paddy as per Indian Standard Test Code No. 6316:1993. The parameters like planter capacity, seed rate, field capacity, field efficiency and operation cost were determined. The capacity of the planter was found to be 2.25, 2.87 and 1.91 kg h^{-1} for Bengal gram, red gram and paddy respectively. The effective field capacity of the planter is found to be 0.087, 0.152 and 0.059 ha h^{-1} with a field efficiency of 77.33 %, 81.06% and 78.66 %respectively for Bengal gram, red gram and paddy. The seed rate was found to be 30.67, 24.76 and 36.26 kg ha^{-1} for Bengal gram, red gram and paddy respectively. The cost of operation of planter was found to be Rs. 474.99 ha^{-1}, Rs. 271.60 ha^{-1} and Rs. 700.29 ha^{-1} for Bengal gram, red gram and paddy respectively with an operation cost of Rs. 41.34 per hour. The planter is useful for small and marginal farmers who cannot afford large machinery and for fields where large machinery is not suitable.

Keywords- Planter, Red gram, Paddy, Evaluation, Cost of operation.

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Introduction

The productivity of the farm depends greatly on the availability and proper use of farm power by the farmers. Under intensive cropping, timeliness of operations is one of the most important factors, which can only be achieved if appropriate use of agricultural machines is used [1]. Agricultural machines and implements enable the farmers to employ the power judiciously for production purposes. Agricultural machines and implements increase productivity of land and labour by meeting timeliness of farm operations and increase work output per unit time. Besides its greatest contribution to the multiple cropping and diversification of agriculture, mechanization also enables efficient utilization of inputs such as seeds, fertilizers and water.

Sowing is one of the most important operations in crop production. The time and method of sowing decisively influence the germination and hence production. Sowing at optimum depth and time is essential which will affect the yield of the crop. Sowing in late season will decrease yield about 35%. With the present day advanced agronomic technologies, seed genetics and on- farm technology to deliver optimal yield while using fewer resources, precision planting is not out of place.

There are different methods of sowing, *viz.* broadcasting, dibbling, drilling and planting. Broadcasting is spreading seeds with hands on the field. It requires larger amount of seed and distribution of seed will not be uniform. In manual seeding with conventional practice, the higher and non-uniform plant population adversely affect grain yield of different crops [2]. Dibbling is placing the seed in the holes made by machine or human. Drilling includes placing the seeds continuously behind the plough with the help of seed drill. With seed drill row to row spacing of seeds can be obtained but plant to plant spacing is not achieved. For better aeration and better fertilizer, pesticide utilization plant to plant spacing is also to be maintained. This can be achieved with the use of planters.

Most of the farmers in India use traditional methods for sowing such as broad casting and seed dropping behind the plough due to undulating topography, small land holdings and higher cost of equipment, which effects germination due to non-uniform placement of seeds at proper depth. Precision and timely sowing are essential for getting good plant stand, higher yield and optimum utilization of rainfall and reduction in the incidence of pests and diseases. Although many planters having different seed metering mechanisms i.e. inclined plate, cup feed type and roller with cells on periphery for the application of single seed at a time has been developed, their performance is not up to the mark due to non-performance in obtaining required spacing for irregular shaped seed crops like Paddy, Maize, Black gram etc. [3,4]. Considering the above factors and need of small farm mechanization, the present study on evaluation of manual operated push type multi crop precision planter has been taken up to test the performance against high seed rate and cost of sowing.

Materials and Methods

The study was conducted in the year 2015 at College of Agricultural Engineering, Bapatla. The planter was tested both in the laboratory and field, (10 m length and 10 m width, sandy soil). The planter was tested as per BIS test code IS 6316: 1993[5] for Bengal gram, red gram and paddy. The planter is shown in [Fig-1]. The field was prepared before evaluation. Instruments like measuring tape, stop watch, polythene bag, square metallic frame and weight balance were used to

evaluate the planter. Cost of operation of planter was calculated and was compared with different practices. The procedure for evaluation of planter is given in the following sections.

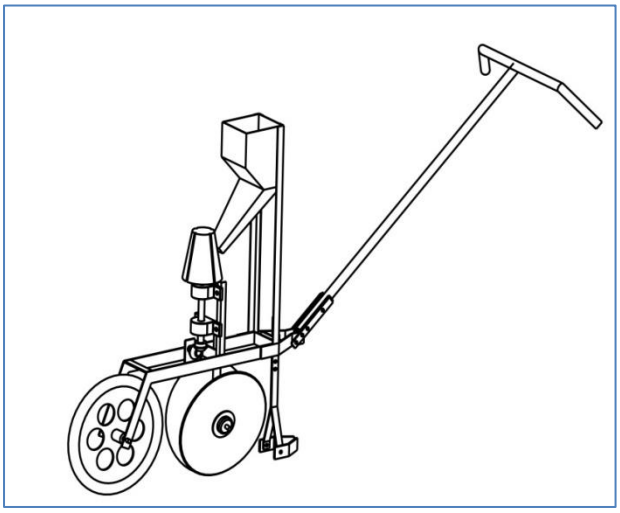

Fig-1 Isometric view of developed multi crop precision planter

Evaluation of the planter

Parameter such as planter capacity, seed rate, field efficiency and cost of operation of the planter was evaluated.

Capacity of the planter

The capacity of the planter was considered as total weight of seed dropped per unit time in laboratory. Four bricks were used to determine the capacity of the planter and the planter was placed on the bricks. One polythene bag was kept just below the seed tube to collect the seeds. Then weight of the seed was measured for the experiment using electronic balance. Ground wheel was rotated manually equivalent to normal walking speed (2.5 km h^{-1}) and gave 10 revolutions. The time required for 10 revolutions of runner wheel was recorded by a stop watch. Uniform speed of the wheel was maintained during rotation.

The capacity was estimated by the following equation.

$$\text{Capacity of planter}\,(\text{kg h}^{-1}) = \frac{W}{T} \qquad \text{----[1]}$$

Where,

W= Weight of dropped seed in 10 revolutions of the ground wheel, kg.

T= Time required for 10 revolutions of ground wheel, h.

Seed Rate

Seed rate was determined by calibration in the laboratory. The seed rate for different types of seed was calculated by using the following formula.

$$\text{Seed rate}\,(\text{kg ha}^{-1}) = \frac{\text{Seed obtained by 10 revolutions of round wheel}\,(\text{kg})}{\text{Width of planter,}\,(\text{m}) \times \text{circumference of drive wheel}\,(\text{m})} \qquad \text{--- [2]}$$

Field efficiency

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

$$F_e = \frac{C_{eff}}{C_{th}} \qquad \text{---[3]}$$

Where,

F_e = field efficiency, %

Theoretical and effective field capacity of the planter was determined by the following two equations.

a) Theoretical field capacity

$$C_{th} = \frac{S \times W}{10} \qquad \text{--- [4]}$$

Where,

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

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

W = Width of coverage, m

b) Effective Field Capacity

$$C_{eff} = \frac{A}{T} \qquad \text{---[5]}$$

Where,

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

A = Field coverage, ha

T = Actual time of operation, h.

Cost Operation of planter

The cost of operation of planter was determined considering the fixed cost and variable cost parameter of the planter.

Fixed Cost

Fixed cost is the total cost of depreciation, interest on investment and shelter. Straight-line method was used for calculating the depreciation of the machine.

a) Annual depreciation

$$D = \frac{C - S}{L \times H} \qquad \text{---[6]}$$

Where,

D = Depreciation, Rs h^{-1}.

C = Purchase price, Rs

S = Salvage value, Rs

L = Life of machine, years.

H= no of operating hours per year.

b) Interest on investment

$$\text{Interest}\,(\text{Rs.h}^{-1}) = \frac{\text{C} + \text{S}}{2} \times \frac{\text{i}}{\text{H}} \qquad \text{--- [7]}$$

Where,

i = Rate of interest, %

c) Shelter

Shelter = 1% of purchase price of machine, Rs

Total fixed cost per year, FC = Depreciation + Interest + shelter

Variable Cost

Variable cost is related to the operation of the planter. Variable cost includes

a) Repairs and maintenance

The repairs and maintenance cost is taken as 5% of initial purchase price.

$$\text{Repairs and maintenance cost (Rsh}^{-1}) = \frac{5}{100} \times \frac{c}{L \times H}$$

b) Wages to operator

The wages to operator is taken as Rs300 per day of 8 working hours.

$$\text{Total variable cost, VC} = \text{labour cost} + \text{repair \& maintenace cost} + \text{wages}$$

Total Cost of Operation

Total cost of operation is the sum of fixed cost and variable cost of the planter.

Total cost, TC = Fixed cost + Variable cost

Results and Discussion

Capacity of Planter.

The capacity of planter was determined by calibrating the planter in laboratory. The capacity of planter was found to be 2.25, 2.87 and 1.91 kg h^{-1} for Bengal gram, red gram and paddy is shown in [Fig-2].

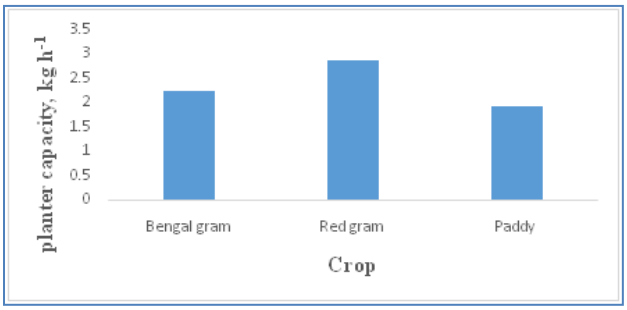

Fig-2 Capacity of planter for different crops

Seed Rate

The seed rate was found to be 30.67 kg ha^{-1}, 24.76 kg ha^{-1} and 36.26 kg ha^{-1} for Bengal gram, red gram and paddy respectively is shown in [Fig-3]. It was observed that the seed rate was more for paddy due to narrow row to row spacing and multiple seed per hill. The seed rate of planter was compared with the manual sowing and is show in [Fig-4]. The seed rate was found to be less for planter compared to manual sowing for all the three crops.

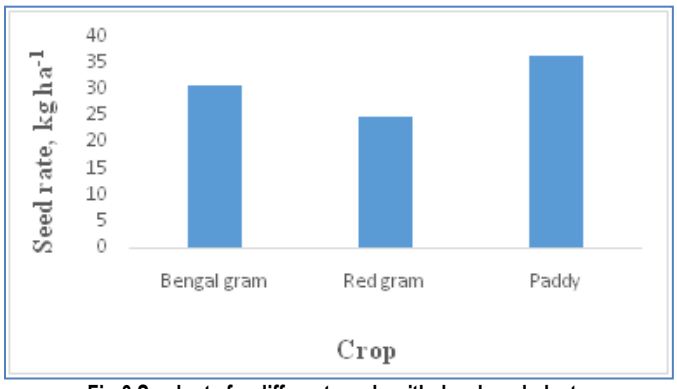

Fig-3 Seed rate for different seeds with developed planter

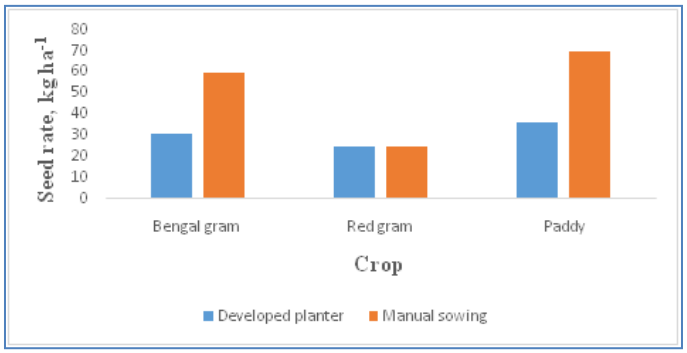

Fig-4 Comparison of seed rate for different crops with different methods of sowing

Field Efficiency

The field efficiency was determined using theoretical field capacity and effective field capacity. The theoretical field capacity of planter is calculated as 0.1125 ha h^{-1}, 0.1875 ha h^{-1} and 0.075 ha h^{-1} for crops Bengalgram, red gram and paddy respectively. The effective field capacity was found to be 0.087, 0.152 and 0.059 ha h^{-1} for Bengal gram, red gram and paddy respectively. It was observed that the effective field capacity of the planter was more for red gram than Bengal gram and paddy due to wide row to row spacing of red gram (0.75 x 0.3 m) than Bengal gram (0.45 x 0.3 m) and paddy (0.3 x 0.3 m). The effective field capacity of the planter was affected by the time for turning at the head lands and row to row spacing. The field efficiency was found to be 77.33%, 81.06 % and 78.66 % for Bengal gram, red gram and paddy is presented in [Table-1].

Table-1 *Field efficiency for different crops*

Sl. No	Crop	Theoretical field capacity, ha h^{-1}	Effective field capacity, ha h^{-1}	Field efficiency, %
1	Bengal gram	0.1125	0.087	77.33
2	Red gram	0.1875	0.152	81.06
3	Paddy	0.075	0.059	78.66

The average seed to seed spacing was 28.20 cm, 27.42 cm and 26.64 cm for Bengal gram, red gram and paddy respectively. The depth of sowing was found to be 4.10 cm, 3.62 cm and 3.55 cm for Bengal gram, red gram and paddy respectively.

Cost of operation

The cost of planter was found to be Rs 4500 with an operating cost of Rs 41.34 per hour. The cost of operation was found to be Rs 474.99, Rs 271.60 and Rs 700.29 per ha for Bengal gram, red gram and paddy respectively. The cost of sowing for red gram was found to be less with planter than compared to other crops. The cost of sowing of planter was less compared with manual sowing and is shown in [Fig-5]. The cost of sowing with the planter is less compared to manual sowing for all the three crops.

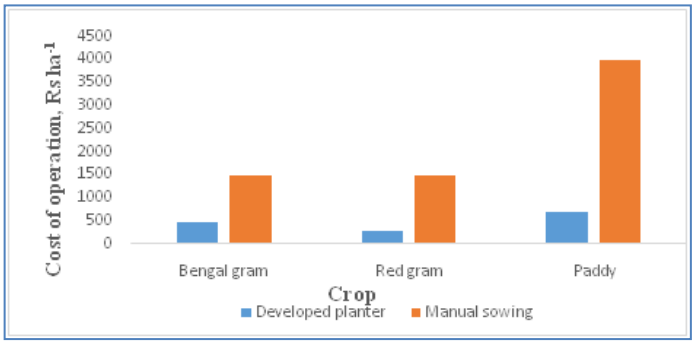

Fig-5 Comparison of cost of sowing with manual sowing for different crops

Conclusion

The study concluded that the seed rate of the planter was less when compared to traditional method of sowing. The cost of operation was found to be Rs 41.34 per hour for all the crops. The cost of sowing was less with the planter when compared to traditional methods of sowing. Seed, time and labour can be saved with the planter compared to manual methods of sowing. The planter is useful for small and marginal farmers who cannot afford large machinery.

The planter is useful for small and marginal farmers who cannot afford large machinery and for fields where large machinery is not suitable.

Conflict of Interest: None declared

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