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Tractor Drawn Modular Planter for Gram-A Performance Study

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ABSTRACT

The performance of the tractor drawn modular planter was evaluated in laboratory as well as in field conditions. It consists of 7 rows, row to row spacing was kept 20 cm, working efficiency was 65%, draft required was 2000 N, working capacity was 0.47 ha/h, fuel consumption was 3.5 l/h, operating cost was 740 Rs/h and was operated at 4.0 km/h. The field trial was conducted at etawah college farm in well-prepared field after rice cultivation. The type of soil was loamy, having initial moisture content of 14.7%. The bulk density of experimental plot after seedbed preparation was 1.53 g/cm^3. Its field capacity was 0.47 ha/h, while 0.42 ha/h by multi-crop seed cum ferti drill and 0.152 ha/h by broadcasting. The average loss of seed due to abrasion in metering mechanism of modular planter was 0.73%, which is less than 1.63% of multi-crop seed cum ferti drill. The average plant population was 23.6plants/m^2 for modular planter, which were 23.6% higher than plant population by multi-crop seed cum ferti drill and 37% by broadcasting method. The average yield of the plots shown by modular planter was 28.5 q/ha while the average yield of multi-crop seed cum ferti drill was 26.5q/ha and the average yield of broadcasting was 21q/ha. The seed required by modular planter was 90 kg/ha and by multi-crop seed cum ferti drill was 100 kg/ha and by broadcasting was 120 kg/ha. The time requirement by the modular planter is 2.06 h/ha, which is less than 2.7h/ha by multi crop seed cum ferti drill and 4.7 h/ha by the broadcasting. There was 16.54 % labor saving while using modular planter with respect to the broadcasting method and 4.04% labor saving while using multi crop seed cum ferti drill.

Key words: *Modular planter, Multi-crop seed cum ferti drills, Broadcasting, Yield, Fuel consumption.*

The manual method of hand dropping using funnel and tube behind the traditional equipment has been common site in the country. The few attempts were also made by developing manual, animal and tractor drawn mechanical planters. The height of fall of seed and in turn seed bouncing effects the seed placement considerably and could not prove its superiority over its traditional counterpart.

For medium size seeds, many designs of seed drills/seed cum fertilizer drills have been developed and are commercially available. These machines are mostly suitable for drilling of medium size seeds at the rate of 20 kg/ha and above (*Training Manual CIAE/T/98/213*). These are mostly provided with fluted roller seed metering mechanisms. The crops having very small or bold size seeds cannot be handled with fluted rollers. Modular planter has vertical rotor type seed and fertilizer metering mechanism (*Biswas H.K., 2000*). The sowing operation of bold and very small seed is performed using country plough followed by dropping of seeds manually. Few animals drawn designs have been developed having rotor with cells on its periphery to meter seeds or adjustable aperture with agitator to drop the seeds *(Development of e-courses for agriculture lecture 8, 5 may, 2014*). All these methods could not provide precision in sowing. The development of modular planter for achieving uniform seed to seed spacing and row spacing. A separate seed

and fertilizer hopper are also provided with vertical rotor to meter granular fertilizer and seed. This machine is also suitable for inter row cultivation.

A seven-row tractor drawn modular planter was procured for saving the costly seeds and pre-determined seed/row spacing. Keeping this in view, tractor drawn modular planter has been proposed to be used for sowing of gram after paddy harvesting.

METHODOLOGY

The present investigation performance evaluation of modular planter for gram crop was carried out at the agronomical condition of Etawah in an area of about 0.5 ha in well-prepared field after paddy harvesting. The observations and methodology adopted for the performance evaluation is carried out in accordance with standard BIS test code. Gram crop was carried out by adopting all of the following treatments as per recommended package of particles of gram.

The modular planter required two persons for its continuous operation, one person for operating the tractor with machine and other for filling the seed and fertilizer in the seed and fertilizer hopper and follow the machine and in case of conventional multi crop seed cum ferti drill, one person for operating tractor and other for filling the seed and fertilizer in the seed and fertilizer hopper. Tractor mounted planters are extremely well adapted for intercropping operations (*business.docbox.com, 2017*). In order to plant seeds of different crops in adjacent rows or alternate rows, a modular planter has been developed. All the planting units have individual hopper, ground wheel and seed metering mechanism, which are mounted on a common frame and hitched to the tractor with the three-point linkage. It consists of modular frame, individual hopper for each row with seed and fertilizer chamber, vertical roller metering mechanism, ground wheel etc. It is suitable for planting Groundnut, Soybean, Bengal gram, Mustard etc.

The modular planter consists of modular planting units mounted on a frame. Each modular unit consists of a seed box, fertilizer box, seed metering mechanism, furrow openers and spiked drive wheel. The row spacing between different modular can be adjusted by sliding the units on the tool bar. On the rear tool bar of frame, shoe type furrow openers with modular units of seed boxes are clamped. Each seed box is provided with vertical roller seed metering mechanism. Seed metering system is driven by a spiked ground drive wheel (*coordinating meeting, 1996, Pandey, 1997*). It is a 35 hp tractor drawn implement. It was designed and developed for sowing crops such as gram, maize, groundnut and mustard.

Specification of Tractor drawn modular planter

Particulars	Specifications
Type of implement	Modular planter
Make	CIAE, Bhopal
Number of rows	7
Row spacing, cm	20
Normal working width, cm	200
Material of seed disc	Bakelite
Material of seed plate	Aluminum
Seed for which implement is suitable	Gram, Groundnut, Maize, Soybean, Mustard
Overall dimensions	
Length, cm	133
Width, cm	200
Height, cm	55
Box section size	
Length, cm	20
Width, cm	10
Height, cm	40
Material for box section frame	Mild steel
Drive wheel	
Number	7
Rim diameter, cm	40
Type	Spiked
Hitching	Three point linkage
Source of power	Tractor, 35 hp
Recommended traveling speed for equipment	3 km/h
Working efficiency	65%
Power requirement	25 hp
Weight of implement	210 kg
Draft required	2000 N
Working capacity	0.4-0.5 ha/h
Cost	Rs. 15000/-
Fuel consumption	3.5 l/h
Labor requirement	2
Operating cost	740 Rs/h

Specification of tractor drawn multi-crop seed cum ferti drill	
Manufacturer	Khalsa Farm Equipment
No of rows	9
Row spacing	22 cm
Normal working width	200 cm
No of Fertilizer openers	9
Overall dimension	
Length	193 cm
Width	180 cm
Height	136 cm
Source of power	Tractor
Recommended traveling speed of machine	4 km/h
Recommended power of tractor	35 hp
Type of seed metering mechanism	Vertical rotor with cell type metering mechanism
Type of fertilizer metering mechanism	Vertical rotor with cell type metering mechanism
Source of power for driving metering mechanism	Ground drive wheel
Capacity of seed box	100 kg
Capacity of fertilizer box	100 kg
Material of seed and fertilizer box	Mild steel
Furrow openers	Type: reversible shovel type
	Material: Carbon steel
Covering device	Type: drag bar
	Material: mild steel
Ground drive wheel	Shape: Lugged type
	Size: 34 cm in dia.(without lugs)
	Material: Mild steel
Hitching	Three point linkage

RESULTS AND DISCUSSION

The laboratory testing and field evaluation of tractor drawn modular planter was carried out as per as standard test code. Performance of modular planter (T_1) was carried out by comparing with multi crop seed cum ferti drill (T_2) as well as by broadcasting method (T_3).

Modular planter machine and conventional seed drill were operated at 3.0 km/h forward speed with 35hp tractor. The effective field capacity of these machines were 0.47 ha/h and 0.42 ha/h respectively. The effective field capacity of the modular planter was higher than seed drill. The size of modular planter and conventional seed drill were 7×20 cm and 9×22 cm respectively. The tractor wheel slippage was 5.96 for treatment T_1 i.e. modular planter and T_2 i.e. multi-crop seed cum ferti drill. Average plant-to-plant spacing was 15 cm, 12 cm. and 9 cm in treatments T_1, T_2 and T_3 i.e. broadcasting respectively. Fuel consumption for tractor was 3 l/h as for multi-crop seed cum ferti drill and 3.5 l/h for modular planter, which was mentioned in specification.

The sowing was done with modular planter (T_1) as well as 9-row conventional multi-crop seed cum ferti drill (T_2) and broadcasting method (T_3) on 0.5 ha area. In Fig.1, the skilled, unskilled and total m-h/ha required were shown in Fig.1, which was also given in table1. As per table1, total labor required in T_1, T_2 and T_3 were 10.08, 9.00 and 8.65 m-h/ha respectively. There was

Table 1. Details of man power required in gram crop cultivation in different treatments

Particulars	T_1	T_2	T_3
Skilled man power required (m-h/ha)			
Seed bed preparation	2.00	2.50	2.50
Sowing	6.00	4.00	1.05
Unskilled man power required (m-h/ha)			
Seed bed preparation	2.08	2.50	-
Sowing	-	-	2.55
Fertilizer broadcasting	-	-	2.55
Total unskilled labor (m-h/ha)	2.08	2.50	5.10
Total skilled labor (m-h/ha)	8.00	6.50	3.55
Total labor (m-h/ha)	10.08	9.00	8.65
Labor saving (m-h/ha) w.r.t T_3 (%)	40	11.00	-

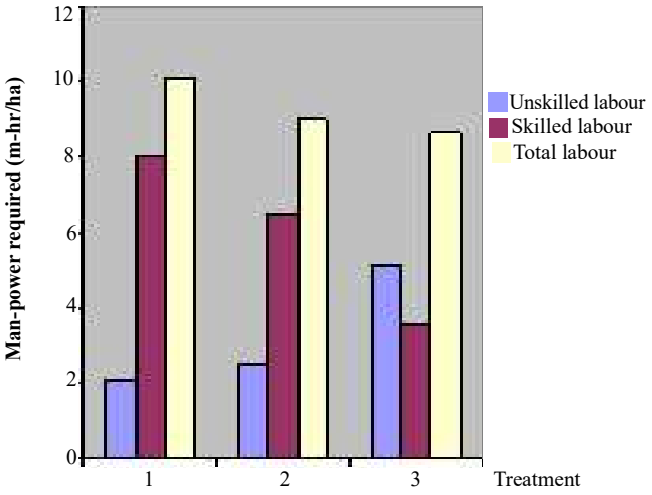

Fig. 1. Man-power required in gram crop cultivation in different treatments

16.54% labor saving while using modular planter (T_1) with respect to the broadcasting method (T_3) and 4.04% labor saving while using multi crop seed cum ferti drill (T_2), which was given Table1.

In Fig. 2, however, the cost of sowing was highest in T_2 (1963.80 Rs/ha) followed by T_1 (1833.50 Rs/ha) and lowest in T_3(1306.6 Rs/ha).In case of modular planter (T_1) the cost of sowing was more as compared to sowing by broadcasting (T_3) because experimental

Table 2. Cost of gram cultivation under different Treatments

Particular	T_1	T_2	T_3
Cost for seedbed preparation (Rs/ha).	1256.6	1256.60	1256.6
Operating cost of sowing machine with tractor (Rs/ ha).	576.90	657.20	-
Cost of fertilizer broadcasting (Rs/ha)	-	-	50
Total cost of sowing (Rs/ ha)	1833.5	1913.8	1306.6

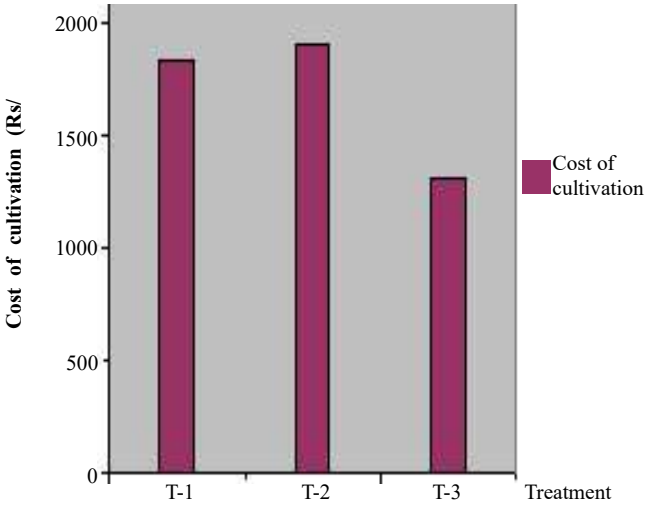

Fig. 2. Cost of cultivation for different treatments

field was small as it was discussed in Table 2.

In Fig.3, it is clear from the figure that the grain yield was 21q/ha, 26.5q/ha and 28.5 q/ha under broadcasting (T_3), multi-crop seed drill (T_2) and modular planter (T_1) treatments respectively, which were mentioned in Table 3.

In Fig.4, shows that average no. of plants in per square were 23.6, 18.15 and 13.7 by modular planter, multi-crop seed cum ferti drill and by broadcasting for treatments T_1, T_2 and T_3 respectively, which were

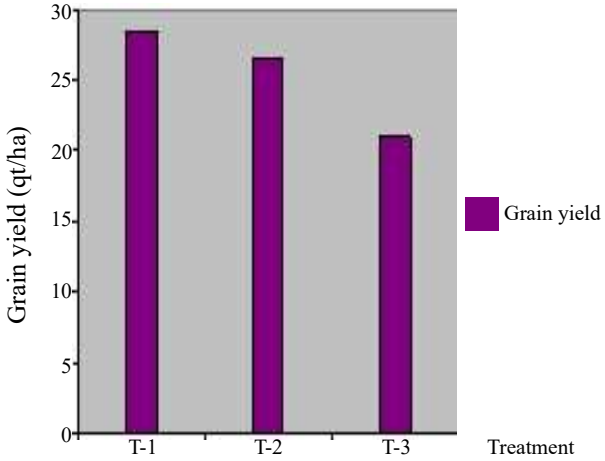

Fig. 3. Grain yield in different treatments

Table 3. Grain yields in different treatments

Particular	Yield (q/ha)
Broadcasting (T_3)	21
Multi-crop seed drill (T_2)	26.5
Modular Planter (T_1)	28.5

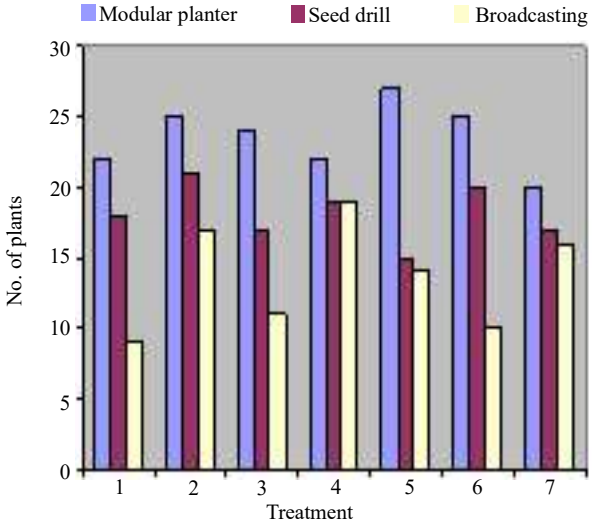

Fig. 4. No. of plants per square meter in different treatments

Table 4 a. Plant establishment in per m² for Modular planter

Reading	No. of plants in per m²	Average
1	22	
2	25	
3	24	
4	22	23.6
5	27	
6	25	
7	20	

Table 4 b. Plant establishment in per m^2 for Multi-crop seed cum ferti drill

Reading	No. of plants in per m^2	Average
1	18	
2	21	
3	17	
4	19	18.15
5	15	
6	20	
7	17	

Table 4 c. Plant establishment in per m^2 for broadcasting method

Reading	No. of plants in per m^2	Average
1	9	
2	17	
3	11	
4	19	13.7
5	14	
6	10	
7	16	

highlighted in Table 4a, 4b and 4c respectively. These values are statistically significant according to statistical analysis.

CONCLUSION

The performance of the modular planter was evaluated in laboratory as well as fold conditions. The field trial was conducted at CAET farm Etawah in area of about of 0.5 ha in well prepared field after rice cultivation. The type of soil loamy, having moisture comment of 14.7%. The bulk density of experimental plot after seedbed preparation was 1.53 g/cm^3. From the laboratory as well as field trial following conclusions has been drawn. The working of modular planter was found satisfactory daring the field trial Its field capacity was 0.47 ha/h while 0.42 ha/h by multi-crop seed cum ferti drill and 0.152 ha/h by broadcasting method. The average loss of seed due to abrasion in metering mechanism of modular planter was 0.73% which is less than 1.63% of multi crop seed cum ferti drill. The average plant population was 23.6plants/m^2 for modular planter which was approximately 23.6% higher than plant population by multi-crop seed cum ferti drill and 37% by broadcasting method. The average yield of the plots shown by modular planter was 28.5 q/ha while the average yield of multi-crop seed cum ferti drill was 26.5 q/ha and the average yield of broadcasting was 21 q/ha. The seed required by modular plaster was 90 kg/ha and by weed cum fan drill was 100 kg/ha, and by broadcasting was 120 kg/ha. Time requirement by the modular planter is 2.06 h/ha which is less than 2.7 h/ha by multi-crop seed cum ferti drill and 4.7 h/ha by the broadcasting. It is more advantageous to use modular planter than any other seed drill because plant establishment and yield was higher and seed requirement was low which made the machine economical as compared to other machines. Based upon this it may be summarized that modular planter had more advantage comparison to multi-crop seed cum ferti drill as well as broadcasting method of seeding.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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