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Performance evaluation of sigle row manual cotton planter

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■ **ABSTRACT :** A proper placement of seed in field is most important operation in order to obtain optimum yield of crop. Day by day the land fragmentation was increased and which resulted near about 65 pre cent of the land holders are small and marginal land holding capacity in the region. Considering the limitations due to costly seed, traditional method of manual dibbling, labour shortage and small marginal land holding pattern there is need of small manual planter for small and marginal land holders. In view of the above, the manually operated seed planter was tested at Deptt. of Farm Power and Machinery, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. A single row cotton planter was evaluated for performance by conducting laboratory and field tests. In laboratory test calibration of planter for seed rate, uniformity of seed planting and percentage of seed damage was determined at three cell plate, two gear ratio and level of seed in hopper. Based on the laboratory test cell plate, gear ratio and level of seed in hopper were selected for field test. The three trials of planter were taken for planting Bt-cotton crop. The field tests comprised of determination of effective field capacity, average depth of placement of seeds in the furrows and mean spacing of seeds within each row. The rate of work was observed to be in the range of 0.18 to 0.21 ha/h at forward speed of 2.24 to 2.5 km/h in well prepared seed bed along with the opened furrows. The average depth of planting was observed in the range of 4.5 cm to 5cm. The field efficiency of the planter was observed in the range of 88.88 to 91.1 per cent.

■ **KEY WORDS :** Cotton, Planter, Performance evaluation, Field tests, Spacing, Depth, Efficiency

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Cotton (*Gossypium* spp.), "the king of fibre" and "white gold" is one of the most important crops commercially grown over 111 countries throughout the world. India ranks first in the world under cotton cultivation and accounts for 11 million ha area (Anonymous, 2011). Cotton accounts for around 80 per cent of the total fibre consumption in textile sector, which accounts nearly 30 per cent of India's industrial.

In India, there is diverse farm mechanization scenario in country due to varied size of the farm holdings and socio-economic disparities. Most of farmers in India are small and marginal land holder hence, tractor drawn planter have been eliminated acceptability. Cotton planting is conventionally done by manual dibbling. The seeds are dibbled in lines at a depth of 30 mm with two seeds per hill maintaining the desired spacing between the rows and plants. The labour requirement for planting cotton is high (15 %) which is next to harvesting operation (44 %) (Vaiyapuri, 2004). This results higher cost of cultivation. Moreover, the traditional planting method is tedious, causing fatigue and backache due to the longer hours required for careful hand metering of seeds if crowding or bunching is to be avoided.

Kumar *et al.* (1986) tested a manually operated seeding attachment for an animal drawn cultivator. The

seed rate was 43.2 kg/hr while the field capacity was 0.282 ha/h. Tests showed minimal seed damage with good performance for wheat and barley.

Simalenga and Hatibu (1991) tested the Magulu hand planter on the field and found the work rate of the planter to be between 18 man-hours per hectare and 27 man-hour per hectare when using conventional hand-hoe planting method.

Gupta and Herwanto (1992) evaluated performance of paddy seeder to match a two-wheel tractor. The machine had a field capacity of about 0.5 ha/h at a forward speed of 0.81m/s. Damage due to the metering mechanism was nil for soaked seeds and 3 per cent for pre germinated seeds.

Ladehinde and Verma (1994) undertook a study to compare the performance of three different models of jab planters with the traditional method of planting. In terms of field capacity and labour requirements, there was not much difference between the traditional planting method and the jab planters. However, backache and fatigue were substantially reduced while using the planters.

Pradhan *et al.* (1997) developed a power tiller-operated groundnut planter cum fertilizer drill and reported that actual field capacity of developed planter was 0.160 ha/h.

The performance evaluation of manual cotton planter for Bt- cotton was taken in study as a objective.

METHODOLOGY

The test sample of single row manually operated planter tested has the following main components.

Seed metering mechanism :

Seed metering mechanism consists of vertical rotor cell plate. On the periphery seed plate grooves are made with suitable size for holding and deliver the seed in to opening of seed tube.

Hopper :

The hopper of the planter was divided in to two compartments, main hopper has trapezoidal shape and sub hopper have semicircular shape. Main hopper allows seed in to sub hopper through sliding knob which is placed at bottom of main hopper and opening to sub hopper. Capacity of the hopper is 3kg.

Seed tube :

Single seed tube is made up of MS which clamped the seed from sub hopper to boot which is clapped at bottom of sub hopper.

Furrow opener :

Furrow opener is shoe type which makes furrow before dropping a seed in soil.

Seed covering device :

Seed covering device consists of semi circular MS strip provided at the rear end of the planter for covering a dropped seed by soil.

Beam :

Beam consists of hollow MS pipe which helps to pull the planter.

Ground wheel :

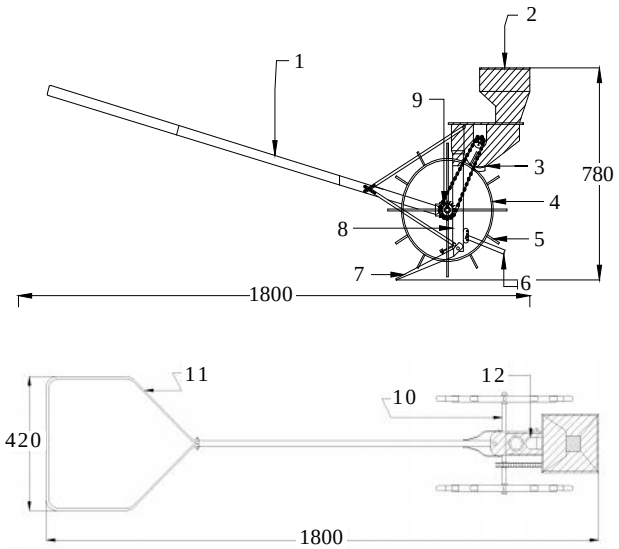
Drive wheel is consists of mild steel having 450mm diameter. On the periphery of drive wheel pegs are welded for better traction. Two drive wheels are provided on planter. (Single row cotton manually operated planter shown in Plate A. Side and top view of manually operated planter are shown in Fig. A and B).

Performance evaluation of manually operated planter :

Major tests carried out on the planter in laboratory by fixing rotor cell plate. The planter was calibrated

Plate A : Single row manually operated cotton planter

in laboratory to determine seed rate, evenness of seed spacing in row and seed damage. The independent parameters selected were three rotor plate (7, 7A and 7B) are shown in Fig. C with two gear ratio (0.66 and 1.5) and three position of hopper fill (Full, 1/2 and 3/4). The dependent parameters were taken seed rate, evenness of seed spacing and seed damage.



1.	Beam	2.	Main hopper
3.	Sub hopper	4.	Ground drive wheel
5.	Pegs	6.	Covering device
7.	Furrow opener	8.	Seed tube
9.	Sprocket	10.	Ground drive wheel axle
11.	Handle		

Fig. A : Side and top view of single row namually operated cotton (All dimensoins in mm)

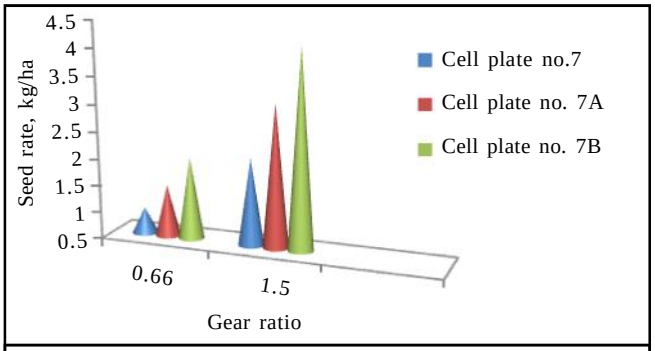


Fig. C : Effect of gear ratio, cell plate on seed rate at 90 cm row spacing

Laboratory test of manually operated cotton planter:

Calibration :

The planter was held above the ground in order to get free rotation of drive wheel at stationary position. A paint mark was made on each drive wheel to serves reference points to count the number of revolution when turned; and polythene bag was placed on discharge spot to collect the seed discharged. Rotor cell plate (7) having two grooves on periphery fixed to rotor shaft. Hopper of planter was filled in full position with Bt. cotton seed. Gear ratio of 0.66 between drive wheel and rotor shaft was fixed. Drive wheel was rotated by manually as per the corresponding walking speed of human and seed from the boot was collected in plastic bag. Stop watch was used to measure the time taken to complete revolutions. The weight seed in bag was measured by using precision balance. This procedure was repeated three times at each setting of three rotor cell plate, two gears and three hopper fill positions. (By using of this procedure as per suggested by test code seed rate was calculated).

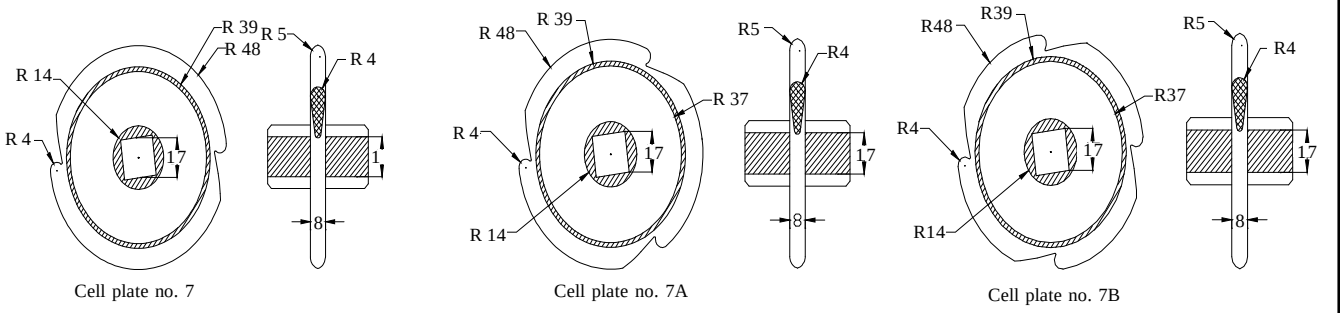


Fig. B : Cell plate no. 7, 7A and 7B (All dimensions in mm)

Mechanical damage test :

Mechanical seed damage test was conducted with planter held in a similar position to that described above. The analysis for the visible damage to the seeds of Bt cotton was carried out by counting and weighing the damage seeds from 100 g sample collected from furrow opener. The seed free from mechanical damage was used. The analysis was carried out at thee rotor cell plate, two gear ratio and three hopper fill position as described above.

Uniformity of seed spacing :

To determine the evenness of seed spacing, 200g of seed were paint to make them visible when discharged on ground. The seed then sundried to ensure that the seed do not stick together. A 5 m length was marked on plain ground and the planter was operated within the length at human walking speeds. A measuring tape was used to measure the distance between successive dropped seed. This procedure was repeated three times at each setting of three rotor plates, two gear ratio and three hoppers fill position.

Field test of single row cotton planter :

The manually operated planter was evaluated for the performance at best setting of combination of rotor plate, gear ratio and hopper fill position based on the result of laboratory test to which fulfil requirement for cotton planting. The field test was carried out at the dairy farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. For the test a smooth seed bed was prepared and water was showered by sprinkling to get proper planting condition on the test field. For recommended planting at 90 cm row spacing, furrows were marked by the marker in test field as it is essential to operate a manually operated cotton planter.

RESULTS AND DISCUSSION

The present study was conducted in laboratory and field at Deptt. of Farm Power and Machinery, Dr. Panjabrao Deshmukh Krishi Vidhyapeeth, Akola. In laboratory test, calibration for discharge rate, uniformity of spacing and mechanical damage tests were carried out at the different combination setting as described above.

Calibration of planter for cotton :

The results of the calibration test are presented in Table 1. It could be seen that minimum average weight of seed collected and minimum seed rate was value kg/

Table 1 : Stationery calibration for discharge rate cotton

Level of seed in sub hopper	Gear ratio	Average weight of seed in g from furrow openers				Seed rate in kg/ha	Variation from avg. (%)
Cell plate No. 7A, three cell							
		I	II	III	Average		
Full	Gear ratio=	13.67	10.44	10.41	11.51	3.07	9.55
3/4th	1.5(18T/12T)	7.93	7.91	7.83	7.89	2.04	0.76
1/2		3.05	2.97	3.05	3.02	0.806	1.65
Full	Gear ratio=	7.68	6.9	6.6	7.06	1.88	6.51
3/4th	0.66(12T/18T)	3.67	3.72	3.45	3.61	0.964	4.43
1/2		1.35	1.28	1.25	1.29	0.345	3.10
Cell plate No. 7A, three cell							
Full	Gear ratio=	13.72	13.48	13.58	13.57	3.62	0.66
3/4th	1.5(18T/12T)	11.40	11.36	11.29	11.35	3.03	0.52
1/2		7.8	8.42	6.59	7.60	2.03	13.28
Full	Gear ratio=	10.21	9.18	9.45	9.61	2.56	4.47
3/4th	0.66(12T/18T)	5.41	5.36	5.58	5.45	1.45	1.65
1/2		4.44	4.39	3.95	4.26	1.37	3.05
Cell plate No. 7B, four cell							
Full	Gear ratio=	19.26	21.97	19.86	20.36	5.54	5.40
3/4th	1.5(18T/12T)	16.92	16.52	15.79	16.41	4.38	3.77
1/2		5.61	7.0	8.46	7.02	1.87	20.08
Full	Gear ratio=	10.87	11.23	10.70	10.93	2.92	2.10
3/4th	0.66(12T/18T)	7.20	7.34	7.03	7.19	1.92	2.22
1/2		5.53	5.14	5.48	5.05	1.35	1.78

Table 2 : Planting uniformity test for cotton

Rate setting	Parameter	Test no.	Bed length 5 meters			Average
			I	II	III	
Cell plate No: 7 (Two cell) gear ratio 18T/12T=1.5						
Optimum	No. of seeds fallen	I	8	9	15	
		II	11	13	9	
		III	9	12	7	
		Average	9.33	11.33	10.33	10.33
	Average distance between two seeds (cm)	I	50.6	53	50.5	
		II	53	51	51	
		III	49.4	100	50.8	
		Average	51	68	50.07	56.35
Cell plate No: 7(Two cell) gear ratio 12T/18T=0.66						
Optimum	No. of seeds fallen	I	6	6	4	
		II	4	5	5	
		III	5	7	4	
		Average	9.33	6	4.33	6.55
	Average distance between two seeds (cm)	I	116	113	115	
		II	114.4	114.5	114.5	
		III	115	116	113	
		Average	115.13	114.5	114.1	114.57
Cell plate No:. 7A (Three cell) gear ratio 18T/12T=1.5						
Optimum	No. of seeds fallen	I	12	18	13	
		II	17	14	19	
		III	16	13	14	
		Average	15	15	15.33	15.11
	Average distance between two seeds (cm)	I	36.2	35.6	35.8	
		II	35.5	36.3	35	
		III	35.8	35.9	36	
		Average	35.83	35.93	35.6	35.78
Cell plate No: 7 A(Three cell) gear ratio 12T/18T=0.66						
Optimum	No. of seeds fallen	I	7	8	5	
		II	6	7	7	
		III	9	8	8	
		Average	7.33	7.66	6.66	7.21
	Average distance between two seeds (cm)	I	76.4	75.9	76.9	
		II	76.8	76.4	77	
		III	77	75.7	75.1	
		Average	76.73	76	76.33	76.35
Cell plate No: 7B (Four cell) gear ratio 18T/12T=1.5						
Optimum	No. of seeds fallen	I	22	20	18	
		II	17	23	21	
		III	19	17	19	
		Average	19.33	20	19.33	19.55

Table 2 : Contd.……

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		Average	19.33	20	19.33	19.55
	Average distance between	I	26	50	24	
	two seeds (cm)	II	25.2	25.7	25.8	
		III	25.4	25.4	25	
		Average	25.53	33.7	24.93	28.05
Cell plate No:. 7B (Four cell) gear ratio 12T/18T=0.66						
Optimum	No. of seeds fallen	I	8	11	12	
		II	10	9	8	
		III	11	10	9	
		Average	9.66	10	9.66	9.77
	Average distance between	I	56	57	56.8	
	two seeds (cm)	II	55.9	56.8	57	
		III	55	56.4	56.9	
		Average	55.63	56.73	56.9	56.42

ha observed at setting of half fill position of hopper, cell plate 7 and gear ratio of 0.66. Whereas maximum average weight of seed collected and maximum seed rate was observed at setting of full fill position of hopper, cell plate 7B and gear ratio of 1.5.

Mechanical damage test :

In case of mechanical damage test of seed, during test at all setting no visible mechanical damage was observed.

Uniformity of seed spacing :

Table 2 reveals that, in 5 m bed length a minimum average seed to seed distance was observed at setting of three fourth fill capacity/position of hopper, cell plate 7B and 1.5 gear ratio. Whereas, average maximum seed to seed distance value was observed at setting of three fourth fill capacity/position of hopper, cell plate 7 and 0.66 gear ratio.

Field test of single row cotton planter :

Three filed trials were carried out for planting cotton at a 90 cm row spacing by using cell plate 7, both gear ratio and three fourth capacity of hopper which are shown in Table 3. As shown in Table 3, the range of field efficiency obtained from the trials was 88.88 to 91.1 per cent. This showed a satisfactory performance as it fell within the range of values obtained for planting operation by various investigators (Kepner *et al.*, 1978). Furthermore, from the tables, the effective field capacities for the first, second and third trials were 0.176 ha/hr, 0.191 and 0.205 ha/hr, respectively. This value corresponds to those of the literature cited and even has a similar those of the manually-operated seeding attachment for an animal drawn cultivator developed by Kumar *et al.*(1986). Similar finding was reported by Bamgboye and Mofolasayo (2006). The satisfactory result may be due to its manoeuvrability, which saves time in turning or moving the planter from one point to another recommended by Andersen (2002). The average depth of sowing for cotton crop was observed upto 5 cm depth. The average draft requirement was found 10.60 kg for single row manually operated cotton planter. The effect of gear ratio and cell plate on seed discharge rate at 90 cm row spacing has been presented in Fig. 3. It is evident from these figures that seed rate increased as gear ratio increased for all type of cell plate. However, higher seed rate was observed in case of cell plate number 7B at gear ratio of 1.5. Whereas, minimum seed rate was observed in case of cell plate number 7 at gear ratio of 0.66 (Sharma *et al.*, 2013).

Conclusion :

The objective of the study was to evaluate the performance of single row manually operated cotton planters. The test of implement was carried out by well

Table 3 : Result of performance evaluation of manually operated cotton planter

Sr. No.	Parameters	Test trials		
		I	II	III
1.	Area of test plot, ha	0.36	0.36	0.36
2.	Furrow length (m)	90	90	90
3.	Net duration of test (h)	2.04	1.88	1.75
4.	Soil moisture (%)	15.6	14.16	16.30
5.	Bulk density (g/cc)	1.49	1.43	1.47
6.	Av. speed of travel (km/h)	2.24	2.4	2.5
7.	Av. row spacing (cm)		90	
8.	Av. depth of Seed, cm		4.95	
9.	Hill to hill spacing (cm) avg. of 5 m length			
	Rotor cell plate 7 speed ratio 18/12	51.34	50.08	49.89
	Rotor cell plate 7 speed ratio12/18	114.46	113.00	115.10
	Rotor cell plate 7 A speed ratio 18/12	34.18	35	34.90
	Rotor cell plate 7 A speed ratio12/18	74.94	77.10	76.50
	Rotor cell plate 7 B speed ratio 18/12	25.20	23.90	26.10
	Rotor cell plate 7 B speed ratio 12/18	55.10	57.75	55.90
10.	No. of seeds per meter of row length			
	Rotor cell plate 7 speed ratio 18/12	3	2	2
	Rotor cell plate 7 speed ratio12/18	1	1	1
	Rotor cell plate 7 A speed ratio 18/12	3	3	4
	Rotor cell plate 7 A speed ratio12/18	1	2	2
	Rotor cell plate 7 B speed ratio 18/12	4	5	4
	Rotor cell plate 7 B speed ratio 18/12	2	1	2
11.	Av. width of planting (cm)	90	90	90
12.	Area covered (ha/h)	0.176	0.191	0.205
13.	Time required for one ha (h)	5.68	5.27	4.87
14.	Seed rate (kg/ha) for all rotor plates for 90 cm row spacing			
	Rotor cell plate 7 speed ratio 18/12	2.12		
	Rotor cell plate 7 speed ratio12/18	0.987		
	Rotor cell plate 7 A speed ratio 18/12	3.14		
	Rotor cell plate 7 A speed ratio12/18	1.466		
	Rotor cell plate 7 B speed ratio 18/12	4.18		
	Rotor cell plate 7 B speed ratio 12/18	2.02		
15.	Field efficiency (%)	88.88	88.65	91.1
16.	Av. draft (kgf)	10.60		
17.	Power requirement kW (Ps)	0.073		

prepared seed bed, watered by sprinklers to get adequate moisture for sowing of cotton crop. Based on the results obtained, it can be concluded that, overall working of the prototype planter during the test was found satisfactory. Based on field test following conclusions were drawn. The rate of work was observed as 0.176 to 0.205 ha/h at forward speed of 2.24 to 2.5 km/h in well prepared seed bed along with the opened furrows. The field efficiency of the planter was observed in the range of 88.88 to 91.1 per cent. The average depth of sowing for cotton seed was observed at 5 cm depth, which was in the rage of 4.5 cm to 5cm. The ¾ th filled sub hopper was needed to satisfy the performance of seed metering plate to deliver the proper seed at particular hill spacing. The relative ease with which the machine is adjusted and manoeuvred in the field suits the technical knowhow of the average peasant farmer.

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REFERENCES

Andersen, Craig R. (2002). *Okra*. Home Gardening Series Division of Agriculture, Cooperative Extension Service, University of Arkansas.

Anonymous (2011). Ministry of Agriculture, Govt. of India.

Bamgboye, A. and Mofolasayo, A. (2006). Performance evaluation of a two-row okra planter. *Agric. Engg. Internat. the CIGR E-J. Manuscript PM* 06002. **8** : 1-10.

Gupta, C.P. and Herwanto, Totok (1992). Design and development of a direct paddy seeder. *Agric. Mechaniz. Asia, Africa & Latin America,* **23** (1) : 23-27.

Kepner, R. A., Roy, Bainer and Barger, E. L. (1978). *Principles of farm machinery.* AVI Publishing Company, Inc. Westport, Connecticut.

Kumar, K., Naaresh, N.K. and Ojha, T. P. (1986). Design, construction and performance of a manually-operated seeding attachment for an animal drawn cultivator. *Agric. Mechaniz. Asia, Africa & Latin America,* **17** (2) : 35-38.

Ladehinde, M.A. and Verma, S.R. (1994). Performance evaluation of hand-operated seed planters in light and medium soils in Nigeria. *Agril. Mechaniz. Asia, Africa & Latin America,* **27** (3) : 17 – 19.

Pradhan, S.C., Mahapatra, M.,Samal, P. K. and Behera, B.K. (1997). Development of power tiller operated groundnut planter cum-fertilizer drill. *Agric. Mechaniz. Asia, Africa & Latin America,* **28** (4): 25 – 28.

Sharma, Vineet Kumar, Sharma, D.N. and Kumar, Dinesh (2013). Development and evaluation of tractor drawn inclined cell plate type Bt cotton planter. *Internat. J. Agric. Engg.*, **6**(2) : 329 - 334.

Simalenga, T. E. and Hatibu, N. (1991). Development of low-cost, hand-operated planter. *Agric. Mechaniz. Asia, Africa & Latin America,* **22** (3) : 39 – 41.

Vaiyapuri, K. (2004). Studies on inter-cropping unconventional green manures in irrigated hybrid cotton. Research report, Dept of Agronomy, Tamil Nadu Agricultural University, Coimbatore (T. N.) INDIA.