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# Performance Evaluation of Manually Operated Single Row Cotton Planter

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## Abstract

Cotton plays a major role in Indian economy and offers employment for more than 60 million people. The yield of cotton in Gujarat state about 758 lakh bales. In Gujarat the sowing of cotton is labour intensive as its plating requires 12-15 hr/ha. The single row cotton planter was tested and calibrated in laboratory as well as in field as per Indian Standard Test Code No. 6316:1993. The field evaluation of manually operated cotton planter was done by pulling the cotton planter in which, speed of planter was 1.62 km/h, actual operating time in 4.53 minute was required to cover area of 0.01 ha with actual field capacity of 0.132 ha/hr and field efficiency was 79.52%. The percentage damage in cotton seed is 1.236% more by planter compared to conventionally manual dibbling. The average time requirement by manually operated cotton planter was 7.57 hr/ha while manually sowing around 11.12 hr/ha. The average seed rate in manual cotton planter was 3.031 kg/ha. The cost of planting cotton by manually method is approximately 209 Rs/ha, where as the cost by this machine is 168 Rs/ha.

**Keywords**: Calibration, Conventional method, Cotton, Cotton planter

## Introduction

Cotton *(Gossypium* spp.), the "King offibre" and "White gold" is one of the most important crops commercially grown over 111 countries throughout the world. In India, cotton is cultivated in an area of about 117.27 lakh hectare area with a production potential of 390 1akh bales (1 bale =170 kg) [1]. Cotton plays a major role in Indian economy and offers employment for more than 60 million people. Around 30% per cent of the foreign exchange earnings are from the export of cotton and cotton based textile produce.

The yield of cotton in Gujarat state about 758 lakh bales. In Gujarat the sowing of cotton is labour intensive, ultimately resulting in higher cost of cultivation. The labour requirement for planting cotton seed is high (15%) which is next to harvesting operation (44%) [6]. Thus, it results in higher cost of cultivation.

Modern farming calls for carful sowing to get the highest yield. The sowing operation involves opening the furrow to the proper depth, meter the seed, placing the seed in the furrow in an acceptable pattern and covering the seed and compact the soil around the seed to proper degree. However, the selection of any type of sowing equipments depends upon is ability to place the seed at proper distance and depth without clusters with minimum draft and better coverage. About 70 to 80 % of total cropped area of Saurashtra region of Gujarat is covered under cotton crop. Generally, person who sow the seed by hand dibbling walks along the row and sow the seed in the soil, which is very labour intensive, tedious, costly and improper seed distance.

Now a day, there is scarcity to find labours in required numbers and at desired price. Even if one gets it, then there is no guaranty to timeliness in operation and proper plant to plant distance. On another side this Single Row Cotton Planter have labour requirement of one and have more accuracy in sowing, time saving and cost effective as compare to manual dibbling. Hence manually operated single row cotton planer was evaluated.

Sharma (1983) et al. developed a bullock drawn single row seed cum fertilizer drill with combined furrow opener for seed cum fertilizer drill placement and suitable for wheat, cotton and gram crops. Kathirvel (2001) et. al. evaluated that the till planter machine for cotton has forward speed of operation was optimized as 1.4m/s. The average draft and fuel consumption unit as 2300 N and 3.82 X $10^{-3}$ $m^3$ / hr, respectively. The field capacity of the unit was 0.81 ha / hr. with field efficiency of 71.43 %. The till planter resulted in 23.65, 90.09 and 18.25 % saving in cost, time and energy respectively when

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compare to conventional method. Kamarajl and Kathirvel (2008) developed a belt type cotton planter. The use of belt type cotton planter for planting cotton resulted in 68.62 and 98.46% saving in cost and time, respectively when compared to the manual planting. Raghavendra (2013) et. al. developed a ridge planter for cotton. The cost of operation of ridge planter for sowing cotton was found to be 433 Rs/ha compared to 1013 Rs/ha for conventional method.

## Materials and methods

In present study manually operated single row cotton plante was calibrated at Farm Machinery and Power Department, College of Agricultural Engineering and Technology, Junagadh Agricultural University Campus.

In laboratory test calibration of manually operated single row cotton plante was conducted as per IS-6316:1993 [7]. The field performance test was conducted in order to obtain actual data for over all machine performance operating , accuracy, work capacity, field condition and field efficiency. In field testing soil parameter and machine parameter under desired field condition during field testing the parameter like Draft, speed of operation, field capacities field efficiency ,power requirement, and depth of seed placement were measured. Fig. 1 shows manually operated single row cotton planter and Table 1 shows its specification.

***Fig.1: Manually operated cotton planter***

***Table 1. Specification of manually operated single row cotton planter.***

| Sr. No. | Parameter | Specification |
|---|---|---|
| 1 | Length | 2057 mm |
| 2 | Width | 508 mm |
| 3 | Height | 635 mm |
| 4 | Transmission ratio | 1:1.5 |
| 5 | Furrow opener type | Shoe type |
| 6 | Metering Mechanism | Cell feed |
| 7 | Power transmission | Chain and sprocket |

**A. Laboratory test**

**a. Calibration**

The calibration of the unit was carried out in the laboratory with a test rig to obtain the seed rate at various speeds of planter.

**b. Determination of mechanical damage test.**

For each of the tests conducted in calibration test, seeds were taken from each tests. The number of seeds with visible damage seeds in above sample was taken and percentage of damaged seeds after the test was determined.

$$\% \text{ mechanical damage} = \frac{\text{total no. of damaged seeds}}{\text{total no. of seeds}} \quad (1)$$

**c. Seed uniformity test by sand bed method**

Prepare an artificial leveled bed of 25 cm depth from fine sand and of a length of at least 2 m. and width equal to the nominal width of planter. Allowed the planter to travel over this bed with furrow openers or seed tube lower to 3 to 5 cm from the top surface of the bed. Observed the number of seeds dropped and the average distance between 2 seeds for each meter of bed length. Repeat the test at least three times.

**B. Field test**

Set the planter in a well prepared seed bed that was 15 to 20 cm deep, firm the fine structure smooth and leveled, respectively free of surface trace and at appropriate moisture content. In the field a distance was marked when traversed represented a convenient part of hectare. The same identical adjustment setting as in calibration test was used. The performance of cotton planter was compared with manual planting techniques. The planter was evaluated with optimized forward speed of 1.62 km/hr at 14 % moisture content (db) of the soil.

**a. Placement of seed test**

The planter was operated in the field under the good seed bed conditions and with avg. depth settings of the furrow openers. Cover 10 m of row length. Then the soil was removed carefully without disturbing the seed at several spot in each row. The depth of the seed below the soil surface was measured. A plank was laid across the row and measurements were taken downwards.

**b. Power requirement test**

To check the draft in kg dynamometer was inserted in the hitch. The draft is defined as horizontal component of the pull, Parallel to the line of motion. No. of observations were taken for the first meter from the boundary line, so as to ensure the adjustment and stability of the observations then the observations for the next 5 m. were taken. The performance was repeated till the least 5 m from the boundary, average of these given the pull in kg and horizontal component of these draft.

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The power is computed as

Metric h.p. $= \frac{\text{Draft (kg)} \times \text{Speed(m/s)}}{75}$ ……..…..…. (2)

Draft = p x cos θ, θ = Angle of draft with horizontal

c. **Field operation**:

The field performance test was conducted in order to obtain actual data for over all machine performance operating, accuracy, and field capacity. The field performance test was conducted according to recommended plant to plant spacing for Saurashtra region of Gujarat is 1.25 m row to row and 0.4 m plant to plant for Bt-cotton (American).

Field capacity was calculated by following expression:

TFC = (W × S) / 10.....(3)

Where, TFC = theoretical field capacity, W = theoretical width of implement, m and S = speed of operation.

Actual field capacity was determine by expression given as

AFC = A / T.....(4)

Where AFC = Actual field capacity, A = actual area covered by implement, ha and T = effective time in hr (hours). Field Efficiency is determine by the ratio of actual field capacity and theoretical field capacity.

In Saurashtra region of Gujarat person who sow the seed by hand dibbling walks along the row and sow the seed in the soil, which is very labour intensive, tedious, costly and improper seed distance. Time required to cover 0.01 ha area is measured and calculate cost economics.

## Results and discussion

According to I.S. Code No. 6316:1993 planter has been tested in laboratory condition as well as in field condition. The soil was clay loam and the bulk density and the moisture content of the soil was 1.3 gm/cc and 14 % respectively during the field test. In laboratory, calibration of planter, mechanical damage determination test and seed uniformity test by sand bed method were carried out. In the field tests, placement of seeds, power measurement, field efficiency and labour requirement and field efficiency tests were performed.

**Laboratory Test**

**Calibration:** The planter was calibrated as per recommended seed rate of cotton i.e. 3 kg/ha. The observations obtained from the calibration test were that the effect in seed rate due to the level of seeds in the hopper is negligible. The calibrated seed rate was found as 3.031 kg/ha.

**Seed damage test:** For each of the tests and conducted in one above, seeds were taken from each tests. The number of seeds with visible damage seeds in above sample was taken and percentage of damaged seeds after the test was determined. Seed damage determination test indicates the mechanical damage was 1.236 %.

**Seed uniformity test by sand bed method:** The uniformity in sowing of seed is more than manually sowing. The average distance between two seeds is about 38 to 39 cm which is near to 40 cm recommend plant to plant spacing for cotton. The alignment of seeds in furrow is near to the center line of furrow which is harder to maintain in manual sowing.

**Field test**

The field efficiency of planter for sowing cotton is 79.52 %. Theoretical field capacity and Actual field capacity were observed 0.166 and 0.132 ha/hr respectively.

**Power requirement test:** Angle of draft with horizontal θ was calibrated as 26.56° and speed at the time to cover 10m run were shown in Table 2. The observation made during the power measurement test shows the maximum draft calculated was 8.8 kg and average draft ranges from 8.75 to 8.85 kg. The result shows that the number of furrow openers and depth of sowing were increased, the draft requirement was more and field efficiency was less and vice-versa. The average power required was ranged from 0.050 hp to 0.055 hp.

***Table 2: Field Operation Data Sheet***

| Sr. no. | Speed (m/sec) | Pull (kg) | Draft (kg) | H.P. | TFC (ha/hr) |
|---|---|---|---|---|---|
| 1 | 0.45 | 9.85 | 8.81 | 0.052 | 0.194 |
| 2 | 0.43 | 9.78 | 8.75 | 0.050 | 0.185 |
| 3 | 0.47 | 9.89 | 8.85 | 0.055 | 0.203 |
| Avg. | 0.45 | 9.84 | 8.80 | 0.052 | 0.194 |

**Cost Economics:** In cost analysis the value of Purchase Price (P) in Rs, Working hour per year (h), Life in year (L), Life in working hour (H), Salvage value (S) in Rs of planter were consider as 2000, 80, 12, 960, 200 respectively. Cost of operation and time saving of cotton planter and manual planting was shown in Table 3. It was observed that the cotton planter for planting in 88.14 and 94.74 per cent saving in cost and time respectively compared to the manual planting.

**Cost analysis:**

**For planter:**

**A. Fixed cost per hour**

1. Depreciation $= \frac{P-S}{H} = \frac{2000-200}{960}$

$= 1.87$ Rs. / hr

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2. Interest on average investment @ 13 % per year

$$= \frac{P+S}{2} \times \frac{13}{100} \times \frac{1}{80}$$
$$= \frac{2000+200}{2} \times \frac{13}{100} \times \frac{1}{80}$$
= 1.79 Rs. / hr

3. Housing rate: - @1 %

$$= \frac{P+S}{2} \times \frac{1}{100} \times \frac{1}{80}$$
$$= \frac{2000+200}{2} \times \frac{1}{100} \times \frac{1}{80}$$
= 0.14 Rs. /hr

**Total fixed cost** = 1.87 + 1.79 + 0.14
= 3.8 Rs. /hr

**A. Variable cost:-**

Labour charge @ 150 Rs/day
= 150/8 @ 8 hours for one day
=18.75 Rs / hr

**Total operating cost per hour**
= Fixed cost + Variable cost
= 3.8 + 18.75
= 22.05 Rs/hr
**= 168 Rs/ha** (with effective field capacity = 0.132 ha/hr)

**For manually dibbling:** total time required to cover 1 hectare land was 11.12 hr.

Labour charge @ 150 Rs/day
= 18.75 Rs / hr @ 8 hours for one day

**Total operating cost per hour**
= Total Rs per hour X Time required to cover per hectare
= 18.75x11.12
**= 209 Rs/ha**

***Table 3: Comparative performance in terms of saving***

| Treatments | Cost, Rs/ha | Time, hr/ha | Per cent saving | |
|---|---|---|---|---|
| | | | Cost | Time |
| Cotton Planter | 168 | 7.58 | 19.61 | 31.83 |
| Manual planting | 209 | 11.12 | - | - |

## Conclusion

The tests were conducted in laboratory and field at Farm Machinery and Power Department, College of Agricultural Engineering and Technology, Junagadh Agricultural University Campus. Efficiency of the manually operated cotton planter was more effective as compare to manual dibbling as the effective field capacity of planter was 0.132 ha/hr, the field efficiency of planter was 79.52 %, the cost of sowing of cotton by this machine was 22.05 Rs./hr and 168 Rs./ha The average power required was ranged from 0.050 hp to 0.055 hp. The cost of planting cotton by manually method is 209 Rs/ha, where as the cost by this machine is 168 Rs/ha. Hence it's better than conventional manual dibbling.

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