



## Laboratory and field performance of manual seed drill for sowing jute and tiny seeds

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Received: 28 June 2018; Accepted: 2 October 2018

### ABSTRACT

Jute (*Corchorus olitorius*) is one of the bast fibre producing cash crops in the world and it is the second most important textile fibre next to cotton. Jute plays a significant role in livelihood of the resource poor small and marginal farmers in India. Jute farmers generally follow broadcast method of jute sowing where the placement of seeds at proper soil depth and uniformity cannot be attained. It becomes extremely difficult to place correct quantity of tiny seeds manually at desired depth of soil for optimum plant population due to small size of seeds. On the other hand, line sowing of small seeds like jute, mustard, sesame etc. is very much desirable to save seed as well as maintaining plant population, reduce cost of sowing, weeding and thinning. Therefore, a simple manually drawn multi-row seed drill for jute as well as small seeds of other crops was developed and evaluated in laboratory and field conditions. It ensures uniform germination and proper crop stand on one hand and facilitates other post sowing operations like weeding and thinning, fertilizer application, plant protection measure, irrigation and harvesting of jute crop on the other hand. The developed seed drill required only 75.16 N of draft for its operation which is within the capacity of an average man. It was found that the time required in line sowing for jute is only 6 man-hours/ha which is same as compared to traditional method of sowing.

**Key words:** Field evaluation, Jute, Laboratory test, Seed drill, Tiny seeds

India and Bangladesh are two major jute (*Corchorus olitorius*) producing countries in world and accounting about 80% of total export worldwide. The total area under jute cultivation in India is about 0.80 million ha. In India, it is mainly grown as a rainfed crop in eastern and north-eastern states. It is especially grown by small and marginal farmers as cash crop with scanty resources and is followed by paddy. Jute is mostly sown at the advent of pre-monsoon showers in March and April months. It grows better in a well distributed minimum rainfall of 1200 mm with high temperature and high humidity during April to August. It grows well in loamy and sandy loam soil (Kundu *et al.* 1959, Anonymous 1992, 1991, Shambhu 2016).

Agricultural development involves the availability and use of implements and power units by farmers either as individually owned or available on hire basis. In West Bengal about 95 % of land owners fall in the category of marginal and small holdings. Such farmers neither can afford to purchase tractor nor can they afford its economic use, individually at their farms (Shambhu 2007, 2014). There is a need of introducing improved implements on small size land holding to be operated manually.

Farmers sow small seeds like jute, mustard, sesame and

black cumin by broadcasting methods. During sowing by hand (Broadcast), it is difficult to maintain the recommended seed rate because of small seed size and low seed rate. In practice, farmers use a seed rate much higher than the recommended seed rate and the optimum plant population is maintained by ensuring thinning operation, as a result total cost of seeding and weeding increases considerably (Anonymous 1991, 1992, Shambhu 2014). Sowing by hand leads to irregularity in plant growth, besides problems in weed control which in turn leads to heterogeneity in size of the fibre. The placement of seeds at proper soil depth also cannot be attained. On the other hand, line sowing of small seeds using seed drill saves precious seed, ensures proper depth of placement and germination and reduced cost of sowing and weeding (Borkar *et al.* 2008, Shambhu 2007, 2014). A few seed drills, available commercially for small seeds, use sophisticated pneumatic metering and are costly. Those seed drills are not suitable for resource poor small and marginal farmers having low investing capacity. Therefore, a simple and low cost seed drill was developed to meet the requirement as well as acceptability to the small and marginal jute farmers.

### MATERIALS AND METHODS

The manual jute seed drill mainly consists of seed dispenser-cum-seed box, main shaft, drive wheels, furrow

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Fig 1 4-rows low cost manual seed drill in sowing operation.

openers and seed covering device etc. The seed dispenser (seed box) is made of MS sheet in conical section with larger side diameter of 122 mm and smaller side diameter of 75.5 mm. Two bushes of bore 21.2 Ø mm are provided on each side of the seed box through which main shaft passes. The main shaft is driven through drive wheels. Thus, the motion of the drive wheels through main shaft causes the seed dispensers (seed box) to rotate. Fourteen seed metering orifices are provided on each seed dispenser. When seed dispenser rotates, the seeds are fallen through these orifices in the furrow made by the furrow openers. The seeds are then covered by soil through a chain type covering device. The main shaft and furrow opener shaft are fitted with a rectangular frame which serves as a handle to pull the seed drill.

To design different components of the seed drill, physical and morphological parameters like length, breadth, thickness, bulk density, test weight and angle of repose of *Corchorus olitorius* jute seed (JRO 524) and mustard (B 9) were determined in the laboratory. Using these physical parameters and some other agronomic information, number and size of dispensing holes of the metering mechanism, capacity of seed box-cum-seed dispenser and distance between the metering mechanisms were decided. The wall thickness of the seed box was determined based on the bulk density of the seed. The shape and size of the dispensing hole were determined for jute and mustard separately by trial and error method taking seed rate into account.

The seed drill (Fig 1) was calibrated in the laboratory as per IS 6316 (1993) test code. For calibration, the seed drill was jacked up and supported on its frame so that the wheels were free to rotate. A plain cloth was laid under each seed dispenser for collection of seeds. The seeds were cleaned and seed box-cum-seed dispenser of the drill was filled with cleaned seeds. The ground wheel of the drill was rotated manually for 50 revolutions at normal working speed and seed collected were weighted. The test was repeated thrice at three fourth and half capacity of the seed box-cum-seed dispenser (metering mechanism) for jute and mustard seeds.

Mechanical damage imparted to the seeds by the metering mechanism was also determined as per BIS test

code in the laboratory. The seed samples collected after the calibration tests were analysed for visible mechanical (germination) damage.

The field experiment was conducted at the institute farm as per BIS test code for jute and mustard crops. The soil at the experimental site was sandy loam having sand, silt and clay in the ratio of 74.80, 13.30, and 11.90% respectively. The test was replicated thrice in the plot size of 50 × 10 m. The field observations included speed of operation, depth of seed placement, effective field capacity and draft. A direct reading type spring dynamometer was used to measure the pull of the seed drill. Draft of the seed drill was computed taking angle of pull into account. The power required to pull the implement was computed using the following relation.

$$\text{Power (kW)} = \frac{D \times S}{55.95}$$

where, D = Draft of the implement, kg; S = Speed of the implement, m/s.

Labour requirement, field efficiency and power requirement were computed from the observed field data as per BIS standard.

## RESULTS AND DISCUSSION

### *Physical properties of jute and mustard seeds*

Physical parameters of jute (JRO 524) and mustard (B 9) seeds are given in the Table 1. It was observed that length of the mustard seed was slightly smaller than the jute seed, whereas breadth was higher than that of jute seed. Hence, the dispensing hole size for jute was little longer than that of mustard. The thousand seed weight of jute and mustard seeds were 1.92 g and 2.61 g, respectively. Test weight of mustard seeds was higher than jute seeds. Bulk density and angle of repose of jute seed was more than mustard seed. Hence, the design of the seed box-cum-seed dispenser was based on the parameters of jute seed.

### *Calibration of seed drill*

The calibration of the seed drill was done in laboratory for jute and mustard separately using the desired metering mechanism for each crop. The results of the calibration are shown in the Table 2. The variation between mean discharge and seed dispensers in different rows ranged 0.40 - 4.02% and 0.09 - 4.38% for jute and mustard, respectively. This variation was acceptable for both the crops. There was a little variation in seed rate at different seed box condition for both the crops. This variation may be due to unequal size of seeds. Average seed rate was 2.39 and 3.42 kg/ha for jute and mustard seeds, respectively. This seed rate was significantly lower than the recommended seed rate of 6-7 kg/ha for jute and 6-8 kg/ha for mustard for traditional practice. Thus, this reduced seed rate may help in reducing the total cost of seeding as well as the cost in thinning and weeding operations. Jute crop requires optimum plant population for better and quality fibre yield.

No mechanical damage was observed in case of both

Table 1 Physical parameters of jute and mustard seeds

Type of seed	Size (mm)			Test weight (1000 seeds) (g)	Bulk density (kg/m <sup>3</sup> )	Angle of repose (deg)
	Length (mm)	Breadth (mm)	Thickness (mm)			
Jute (JRO 524)	2.25	1.29	1.14	1.928	738	28.38
	2.09	1.18	1.08	1.920	746	28.34
	2.03	1.15	1.06	1.924	742	28.37
	1.98	1.14	1.01	1.916	741	28.41
Average	2.09	1.19	1.07	1.922	742	28.38
Mustard (B 9)	1.82	1.51		2.554	690	23.32
	1.88	1.54		2.622	687	23.28
	1.78	1.44		2.590	695	23.35
	1.81	1.45		2.663	706	23.30
Average	1.82	1.49		2.607	695	23.31

Table 2 Laboratory calibration of the seed drill

Crop type	Seed box condition	Wt. of seeds dropped in 50 revolution					Seed rate at 250 mm row spacing (kg/ha)	Mean seed rate (kg/ha)
		1 <sup>st</sup> row (g)	2 <sup>nd</sup> row (g)	3 <sup>rd</sup> row (g)	4 <sup>th</sup> row (g)	Total wt. (g)		
Jute	Three fourth	1.86	1.91	1.96	1.97	7.70	2.41	2.39
		1.96	1.85	1.91	1.99	7.71	2.41	
		1.85	1.93	1.86	1.87	7.51	2.35	
	One half	2.01	1.91	1.95	1.86	7.73	2.42	
		1.91	1.86	1.85	1.96	7.58	2.37	
		1.94	1.98	1.86	1.94	7.72	2.41	
Mustard	Three fourth	2.74	2.75	2.76	2.80	11.05	3.45	3.42
		2.81	2.67	2.71	2.78	10.97	3.43	
		2.75	2.58	2.51	2.66	10.50	3.28	
	One half	2.86	2.71	2.74	2.77	11.08	3.46	
		2.75	2.76	2.81	2.73	11.05	3.45	
		2.80	2.71	2.67	2.77	10.95	3.42	

of the seeds, i.e. jute seed and mustard seed. The seed drill was tested in the field for sowing of jute and mustard seeds.

#### Field evaluation of seed drill

Depth of seed placement varied from 27 mm to 31 mm which could be attributed to the uniformity of soil preparation in the field. Average speed of operation in

the field was 2.0 km/h. The field efficiency and labour requirement of the developed seed drill for jute seeds are given in Table 3. Effective field capacity (EFC) of the drill varied from 0.163 to 0.176 ha/h, thus one ha could be sown by this drill in 5.88 h only. Labour requirement of the drill was only 6 man-h/ha. Average field efficiency of the drill was found to be 88.74%.

Force required to pull the developed drill is given in Table 4. Draft of the drill was calculated taking the angle of 39.54°. It was observed that draft of the drill varied

Table 3 Field efficiency and labour requirement of manual jute seed drill

Area (m <sup>2</sup> )	Sowing time (h)	EFC (ha/h)	TFC (ha/h)	Field efficiency (%)	Labour requirement (man-h/ha)
500	0.305	0.164	0.193	84.97	6.10
500	0.289	0.173	0.197	87.72	5.78
500	0.284	0.176	0.195	90.26	5.68
500	0.307	0.163	0.181	90.05	6.13
500	0.284	0.176	0.194	90.70	5.68
Average (500)	0.294	0.170	0.192	88.74	5.87

Table 4 Power requirement of the drill

Speed (m/s)	Pull (N)	Draft (N)	Power required (W)
0.55	110.82	76.24	42.53
0.56	105.91	72.87	41.68
0.57	106.89	73.54	42.68
0.53	113.76	78.26	42.12
0.56	108.85	74.89	42.62
Average (0.56)	109.25	75.16	42.35

from 72.87 N to 78.26 N with an average value of 75.16 N. The power requirement of the drill varied from 41.68 W to 42.68 W with an average of 42.35 W, which could be easily pulled by a man for 2-3 hr continuously.

#### Conclusions

Test weight of thousand jute and mustard seeds were 1.92 g and 2.61 g, respectively. Bulk density and angle of repose of jute and mustard seeds was 742 kg/m<sup>3</sup>, 28.38 degree and 695 kg/m<sup>3</sup>, 23.31 degree respectively. The seed rate with the seed drill was 2.39 and 3.42 kg/ha for jute and mustard seeds, respectively which is lower than recommended in traditional practice of 6-7 kg/ha and 6-8 kg/ha for jute and mustard seeds, respectively. The effective field capacity and field efficiency of the drill was 0.17 ha/h and 88.74 %, respectively. The average power requirement of the seed drill was 42.35 W.

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