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Performance evaluation of hand operated dibbler and for multi seeds

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Abstract
A hand operated dibbler was evaluated for its performance without changing the metering mechanism. The performance under study in laboratory tests and field tests were examined. The results revealed that the seed rate required for dibbler was observed to be 73.6 kg $ha^{-1}$and 46.4 kg ha^{-1} for groundnut and maize crops (spacing of 2.5 cm×2.5 cm). The missing rate was found to be 6% and 4% for groundnut and maize respectively. An effective field capacity of the dibbler was found to be 0.00646 and 0.00682 $ha.h^{-1}$ for groundnut and maize crops. The field efficiency was found to be 87.88% and 85.05% with theoretical field capacity for groundnut and maize crops respectively. The average number of seeds per hill for groundnut and maize found to be 1.07 and 1.16 respectively. The number of hills per hour was 953 and 967 for groundnut and maize respectively.

Keywords: Performance evaluation, groundnut, maize, dibbler, effective field capacity and field efficiency

1. Introduction
In countries like India, the small farmer is an imperative client for new technology developed for increasing basic food crops on relatively small farms with very limited capital resources. World Bank in 1987 stated that the leading agricultural machinery manufacturers have not enthusiastic much of their efforts to the requirements of the small farmers. A developing country like India is likely to continue to rely more on hand tools for the near future for cultivation. The use of hand tools for land farming is still predominant in India because draft animals and tractors require resources that many Indian farmers do not have easy access to. The need for agricultural mechanization in India must, therefore, be assessed with a deeper understanding of the smallholder farmer's actions and what values farm power generated for them. As our population continues to increase, we must produce more food, but this can only be achieved through some level of mechanization.
Sowing is one of the main crop development activities. Time and sowing method affected germination and thus development decisively. It is necessary to seed at optimum depth and time and thus to influence the crop yield. Late seed would rising the return by about 35%. Today's advances agricultural practices help to achieve optimum production while using less energy, which are not uncommon with precision plantation. While several plants have specific mechanisms for seed measurement, i.e. inclined plate, cup feed mechanism have been established for single grain application, the efficiency of the these plants is not up to the mark due to a lack of effective spacing of irregularly shaped crops such as groundnut and maize. Most of the commercial equipment available in the market is very expensive to procure and manage by the smallholder farmer (Aikins *et al.*, 2010) [1]. Manually planted seeds gives the outcome is seed placement is very low, spacing efficiencies and severe back pain to the farmer and also reduces the size of the field which can be planted. However, planting a machine or planter that is normally required to produce more food is beyond the buying capacity of smallholder farmers. Madhusudhana reddy *et al*. (2013) [6] and Singh *et al*. (2012) [13] studied on agricultural mechanization is the use of mechanical devices or systems to replace human muscle in all forms and at any level of sophistication in agricultural production, processing storage and so on to reduce tedium and drudgery, improve timeliness and efficiency of various farm operations, bring more land under cultivation, preserve the quality of agricultural produce, provide better rural living condition and markedly advance the economic growth of the rural sector.

Hence, in most of the country, manual broadcasting method of sowing is still in use. This method of crop establishment adversely affects the seed requirement and production per unit area.

The broadcasting method of crop establishment results in improper placement of seed fails to put the seeds firmly in the soil, leads to the uneven placement of seeds at correct interval and exposes seed for consumption by rodents and birds. However, planting a machine or planter that is normally required to produce more food is beyond the buying capacity of smallholder farmers. It is, therefore, necessary to develop a low-cost planter that will reduce tedium and drudgery and enable smallholder farmers to produce more foods.

Thus, it is important to improve the planting operation by reducing human effort, and increasing stand accuracy and field capacity, since timeliness is of extreme importance in the majority of planting operations, it is desirable that a planter be able to perform these functions accurately at high rates of speed. The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing seed rate, seed to seeds pacing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields. Here numerous methods of sowing e.g. dibbling, hill dropping and broadcasting, drilling and planting. Broadcasting is a random scattering of seeds with hands on the surface of the field. It requires a larger amount of seed and the distribution of seed will not be uniform. In manual seeding with conventional practice, the higher and non-uniform plant populations adversely affect grain yield of different crops.

Placing the seed in the holes made by mechanically or manually, the equipment used for dibbling is called dibbler. Hill dropping is the method in which seeds are dropped at fixed spacing and continuous stream. With seed drill, the seeds may be distributed between rods, but the spacing between plants is not achieved. Plant-to-plant spacing will also be preserved to allow proper aeration and fertilizer usage. Through the usage of planter, that may be done. In planter, plant-to-plant and row to row distance are uniforms. Different designs of improved seed drills/planters have been developed for the sowing of crops (Kyada and Patel, 2014 [5] and Vinchu *et al.,* 2006 [5]). The basic difference in the design of these seed drills is mainly in the type of seed metering mechanism and furrow openers **(**Tsegaye, A. 2016) [14]. Therefore, it is essential to select the machine with a metering unit and furrow opener suitable for the crop and soil conditions. A metering mechanism is the heart of the sowing machine and its function is to distribute seeds uniformly at the desired application rates. In planters, it also controls seed spacing in a row (Olajide and Manuwa 2014) [11].

The proper design of the metering device is an essential element for the satisfactory performance of the seed planter. A common type of metering devices used on seed drills and planters are adjustable orifice with agitator, fluted roller, vertical roller or roller with cells, a plate with cells (horizontal, inclined or vertical plate with cells) and cup feed metering devices **(**Khan and Ashok kumar, 2015) [4]. The seed-metering device has many cells on its periphery. The size and number of cells on the seed-metering device depends on the size of the seed and desired seed spacing **(**Hongxin, L. *et al*. 2015) [3]. For small seeds like rapeseed-mustard seed drill or planter with vertical roller with cells, inclined seed plate with cells or small grooved fluted roller metering system is recommended. For medium seeds such as wheat, soybean, safflower and linseed, Olajide and Manuwa (2014) [11], Nejadi and Raoufat (2013) [9] recommend seed drills with standard fluted rollers. For bold seeds as if groundnut and castor planters with inclined cell plate or cup feed type-metering system are recommended as said by Yang *et al*. (2015) [16]. Furrow openers should be selected according to the type of soil and depth of seed placement. Molin and Agostini (1996) [7] and Molin and Dagostine (1996) [8] developed machine for trashy, stony and light to medium soils, shovel type openers are used. The depth of seed placement from 50 to 100 mm is achieved with these openers. Small shoe or shovel type openers are also used for shallow (20 to 50 mm deep) placement of seeds in dry farming areas Sanjeeva reddy and Adake (2013) [12]. Shoe type openers with single or twin boots are used for sowing in heavy and medium soils for seed placement at 20 to 70mm depth. Runner type opener is widely used for placement of seeds at the shallow depth where soil disturbance required is minimum. Soil cover over seed is also minimal.

There are different types of manually operated seed sowing equipment like a dibbling stick, Naveen dibbler, precision drill planting, rotary dibbler, dibbler, manual seed and fertilizer drill. The dibbling stick is a device for creating a conical cavity in the soil in which the seed is placed. Naveen dibbler is used for dibbling bold (like maize, soybean) or costly/scarce seeds in less area and for gap filling purpose and for gap filling in rows. It also avoids bending posture, which is generally adopted in the traditional method, reducing drudgery and seed saving is achieved. Used for digging soil for making pit, dibbling of seeds and weeding and loosening of soil around the plants. The precision pattern resulting from the accurate placement (and subsequent covering) of single seeds in furrows at about equal intervals to give definite rows of almost equally spaced single plants Rotary dibbler is manually operated push-type equipment for dibbling bold and medium-size seeds in rows at a uniform spacing in well-prepared soil and seed-to-seed distance depends upon the size of the polygon plate to which jaws are attached.

2. Materials and Methods

A manually operated single seed Dibbler was developed at SHUATS. The specifications of the material used for the development of dibbler are given in Table. 1. Materials are selected in such a way that these are available in the local market.

2.1 Performance Evaluation of Dibbler

2.1.1 Laboratory Test

Parameters of laboratory tests such as self-weight, the discharge rate of dibbler were determined.

Table 1: Dibbler specifications

S. No	Constraint	Specifications	Material
1.	Seed hopper	0.53m height, 0.076m diameter	MS pipe
2.	a) Seed roller	Cylindrical roller with 0.052 m diameter,0.05 m bottom height, two cells with 0.012m and 0.008m	Wood
	b) Seed roller shaft	M.S bar; Length= 90 mm, diameter =10 mm	MS rod
3.	Cone	the angle of a cone as 37^0 and length 0.0315m, top diameter of cone 0.075m with bottom hole opening 0.012m	GI sheet
4.	Seed tube	length= 0.30 m and inside diameter= 0.0254 m	MS pipe
5.	Handle	length= 0.155 m and inside diameter= 0.02 m	MS pipe
6.	Lever mechanism	Spring and lever	MS rod
7.	Furrow opener	Tyne with 0.05m wide, 160m long , 0.005m thickness	High Carbon Steel
8.	Nut & bolts and screw	2 number and 6 number	MS bar
9.	Height	0.96 m	-
10.	Width	0.40m	-
11.	Weight	2.64kg	-

2.1.1.1 Self-Weight of the dibbler

Self-weight of machine or device is important because less weight device is easy to carry in the field. In the case of manually operated dibbler, the self-weight of the machine is a very important factor. By using simple balance, the self-weight of the dibbler was measured.

2.1.1.2 Discharge rate of the dibbler

The discharge rate of the dibbler was considered as the total weight of seed dropped per unit time. The discharge rate in Kg h^{-1} was calculated by taking the weight of seed dropped in a period of 3 minutes.

The discharge rate was estimated by the following equation.

$$\text{Discharge rate of dibbler (kg h}^{-1}) = \frac{W}{T} \quad \dots (1)$$

Where,

W = Dropped seed weight in 3 minutes of operation, kg.

T = Time taken, h.

2.1.2 Field Test

2.1.2.1 Seed rate

The seed rate was determined by calibration in field conditions. A known area of 6.25 m^2 was selected with a hill spacing of 25 cm×25 cm and the weight of seed dropped collected to calculate the seed rate in Kg ha^{-1}. The seed rate was calculated using the following formula.

$$\text{Seed rate (kg ha}^{-1}) = \frac{\text{weight of Seeds obtained,(kg)}}{\text{area,(ha)}} \quad \dots (2)$$

2.1.2.2 Seed damage

The damage of the seed was calculated using a visual damage test. In this test the damaged seed is weighed from the dropped seed and the ratio of damaged seeds to dropped seeds gives damaged seed percentage (Oduma *et al.*, 2014) [10].

$$\text{Seed damage, \%} = \frac{\text{weight of damaged seed in collected seed}}{\text{Total weight of seed collected}} \times 100 \quad \dots (3)$$

2.1.2.3 Effective field capacity

A field of 6.25 m^2 area with a hill spacing of 25 cm×25 cm was selected to calculate the actual field capacity of dibbler. The total time taken for covering the entire field was calculated; this time included the losses and fillings of the hopper. Effective filed capacity was calculated by using the following equation given by Hossain, 2014 [2].

$$\text{Effective field capacity } \frac{ha}{h} = \frac{\text{totalareacovered}}{\text{totaltimetaken}} \quad \dots (4)$$

2.1.2.4 Field efficiency

Field efficiency represents the ratio of effective field capacity to theoretical field capacity and was expressed as percentage. The field capacity was calculated by following formula.

$$\text{Field efficiency} = \frac{\text{Effectivefieldcapacity,ha/h}}{\text{Theoriticalfieldcapacity,ha/h}} \times 100 \quad \dots (5)$$

3. Results and Discussions

3.1 Performance evaluation of the dibbler

The performance evaluation of developed planter was conducted in terms of self-weight, seed rate, field capacity, field efficiency, seed damage, missing rate; the number of hills per hour of dibbler were discussed in the following sections.

3.1.1 Self-Weight of the dibbler

The self-weight of the dibbler is 2.64 kg. The weight of the dibbler is mainly due to the weight of the seed hopper. The implement is made lightweight to reduce drudgery during operation.

3.1.2 Discharge rate of hand-operated dibbler

The weight of the dropped seed in an hour is presented in Table 2. for groundnut and maize crops.

Table 2: Discharge rate of dibbler

S. No	Type of crop	Weight of seed dropped in 3 min. (g)	Dibbler discharge rate, kg h^{-1}
1.	Groundnut	24.7	0.493
2.	Maize	18.6	0.373

The dibbler discharge rate was found to be 0.493 kg h^{-1} and 0.373 kg h^{-1} for groundnut and maize respectively. It is evident that the dibbler discharge rate is more for groundnut compared to maize due to the size of groundnut seeds.

3.1.3 Seed Rate
The dibbler was calibrated for seed rate and the test result of calibration is presented in Table 3. for groundnut and maize crops.

Table 3: Calibration of dibbler for seed rate

S. No	Crop	Spacing (cm)	Seed obtained, g	Seed rate, kg ha^{-1}
1.	Groundnut	25×25	46.3	74.13
2.	Maize	25×25	28	44.8

The seed rate was found to be 73.6 kgha^{-1} and 46.4 kgha^{-1} for groundnut and maize crops. Dibbler seed rate is more for groundnut compared to maize due to the weight of groundnut seeds.

3.1.4 Field capacity of dibbler
The theoretical field capacity of dibbler calculated as 0.00646 ha h^{-1} and 0.00682 ha h^{-1} for crops groundnut and maize respectively. The effective field capacity of the dibbler was calculated by measuring the time taken to cover the given area and is presented in Table 4. for groundnut and maize crops.

Table 4: Effective field capacity of planter for different crops

S. No	Crop	The total area covered, m^2	Time is taken to cover an area, s	Effective field capacity, ha h^{-1}
1.	Groundnut	6.25	396	0.00568
2.	Maize	6.25	388	0.00580

The effective field capacity was found to be 0.00568 and 0.00580 ha h^{-1} for groundnut and maize respectively. The effective field capacity of the dibbler was affected by the time for turning at the headlands, row-to-row spacing and speed of operation. With high, row-to-row spacing higher effective field capacity can be obtained.

3.1.5 Field Efficiency of dibbler
Field efficiency is the ratio of effective field capacity to the theoretical field capacity. The test results of field efficiency of dibbler are presented in Table 5. for groundnut and maize crops.

Table 4: Field efficiency for different crops

S. No	Crop	Theoretical field capacity, ha h^{-1}	Effective field capacity, ha h^{-1}	Field efficiency,%
1.	Groundnut	0.00646	0.00568	87.88
2.	maize	0.00682	0.0580	85.05

The field efficiency was found to be 87.88% and 85.05% for groundnut and maize crops.

3.1.6 Seed Damage in the dibbler
Seed damage of the dibbler was calculated by measuring the weight of the damaged seed from the dropped seed during the calibration of the dibbler and presented in Table 6. for groundnut and maize separately.

Table 6: Seed damage of the dibbler

S. No	Crop	Total number of seed dropped	Seed damage, %
1.	Groundnut	47.6	1.66
2.	Maize	28	0.82

The seed damage was found to be 1.66% and 0.82% for groundnut and maize respectively. The seed damage can be decreased by adjusting the cell size in seed roller according to the size of the seed. It is evident that seed damage is more for groundnut compared to maize due to the irregular shape of the groundnut.

3.1.7 Missing Rate of dibbler
The missing rate of the dibbler was calculated by counting the number of hills with no seeds dropped to a total number of hills and is presented in Table 7. for groundnut and maize crops.

Table 7: Missing rate of dibbler for different crops

S. No	Crop	Total number of hills	Number of hills with seed	Missing rate,%
1.	Groundnut	100	94	6
2.	Maize	100	96	4

The missing rate was found to be 6% and 4% for the groundnut and maize crops.

3.1.8 Average number of seeds per hill
The average number of seeds per hill is the ratio of the total number of seeds planted in hills to the total number of hills in an area of 6.25 m^2 with the spacing of 25 cm×25 cm. The average number of seeds per hill is presented in Table 8. for groundnut and maize crops.

Table 8: Average number of seeds per hill

S. No	Crop	Total no. of hills	Total no. of seeds	Avg. no. of seeds per hill
1.	Groundnut	100	107	1.07
2.	Maize	100	114	1.14

3.1.9 Number of hills per hour
The number of hills per hour for groundnut and maize are obtained by counting the number of hills made for 3 minutes in three replications and are presented in table 9.

Table 9: Number of hills per hour

Type of seed	Trails	Number of hills in 3min.	Number of hills per hour	Average number of seeds per hill
Groundnut	1	46	920	953
	2	48	960	
	3	49	980	
Maize	1	49	980	967
	2	49	980	
	3	47	940	

4. Summary and Conclusions

The dibbler was designed for dibbling bold (like maize, groundnut) or costly/scarce seeds in less area and for gap filling purpose in rows. It also avoids bending posture, which is generally adopted in the traditional method, reducing drudgery and seed saving is achieved. The dibbler consists of the metering system i.e. seed roller. The seed roller had two cells for single seed dropping of maize and groundnut seeds. The seed roller and cone are fitted inside the seed hopper and are operated by spring and lever mechanism. Seed tube is connected at the lower portion of the seed hopper and a furrow opener is attached at another end of the seed tube. Table 10. Shows the summary of the performance evaluation.

Table 10: Field test data of hand-operated dibbler

S. No	Particulars	Groundnut	Maize
1.	Discharge rate (kg h^{-1})	0.493	0.373
2.	Seed rate (kg/ha)	74.13	44.8
3.	Theoretical field capacity. (ha/hr)	0.00646	0.00682
4.	Effective field capacity. (ha/hr)	0.00568	0.00580
5.	Field efficiency (%)	87.77	85.05
6.	Seed damage (%)	1.66	0.82
7.	Missing rate (%)	6	4
8.	Avg. Number of hills	1.07	1.14
9.	Number of seeds hills/hr	953	967

4.1 The conclusions of the study are given below

The weight of the dibbler was found to be 2.64 kg. The discharge rate of dibbler was found to be 0.493 and 0.373 kg h^{-1} for groundnut and maize respectively. The discharge rate of dibbler is more for groundnut compared with maize due to the size of groundnut seed. The seed rate required for dibbler was observed to be 74.13 and 44.8 kg ha^{-1} for groundnut and maize crops. The effective field capacity of the dibbler was found to be 0.00568and 0.00580 ha h^{-1} for groundnut and maize crops. The field efficiency was found to be 87.88% and 85.05% for groundnut and maize crops. The seed damage was found to be 1.66% and 0.83% for groundnuts and maize respectively. The seed damage was the due size of the groove on seed roller and rupture of the seed between hopper and seed roller. The missing rate was found to be 6%, and 4% for groundnut and maize crops. The average number of seeds per hill for groundnut and maize found to be 1.07 and 1.14 respectively. The number of hills per hour for groundnut and maize calculated to be 953 and 976 hills respectively.

5. References

1. Aikins SHM, Bart-Plange A, Opoku-Baffour S. Performance evaluation of jab planters for maize planting and inorganic fertilizer application. ARPN Journal of Agricultural and Biological Science, 2010, 5(1).
2. Hossain. Development and evaluation of low cost seeder for maize establishment, MS Thesis, Department of Farm Power and Machinery Bangladesh Agricultural University Mymensingh, 2014.
3. Hongxin L, Lifeng G, Lulu F, Shifa T. Study on multi-size seed-metering device for vertical plate soybean precision planter. International Journal of agriculture and biological Engineering. 2015; 8(1):1-8.
4. Khan K, Ashok kumar SCM. The Design and Fabrication of a Manually Operated Single Row Multi - Crops Planter. IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS). 2015; 8(10):147-158.
5. Kyada AR, Patel DB. Design and development of manually operated seed planter machine. All India Manufacturing Technology, Design and Research Conference (AIMTDR 2014), 2014, 590-597.
6. Madhusudhana Reddy K, Vijaykumar D, Sahadeva Reddy, Ravindranathareddy B. Development, and performance evaluation of tractor drawn groundnut planter for Rabi season. Agricultural Engineering Department. Shiraz University. Shiraz, Iran. 2013; 6(1):128-132.
7. Molin JP, Agostini VD. Development of a rolling punch planter for stony soil conditions. Agric. Mech. Asia, Africa and Latin America. 1996; 27(3):17-19.
8. Molin JP, Dagostine V. Development of a rolling punch planter for stony soil conditions Agricultural mechanization in Asia, Africa and Latin America. 1996; 27(3):17-19
9. Nejadi J, Raoufat MH. Field performance of a pneumatic row crop planter equipped with active toothed coulter for direct planting of corn in wheat residue Agricultural Engineering Department. Shiraz University. Shiraz, Iran. 2013; 11(2):327-334.
10. Oduma O. Development and Performance Evaluation of a manually operated Cowpea Precision Planter, International Journal of Engineering and Technology. 2014; 4(12):693-699.
11. Olajide OG, Manuwa SI. Design, Fabrication and Testing of a Low-cost Row-Crop Planter for Peasant Farmers. International Soil Tillage Research Organization (ISTRO) Nigeria Symposium, 2014, 94-100.
12. Sanjeeva Reddy B, Adake RV. Performance of tractor operated horizontal rotor plate planter. International Journal of Engineering. 2013; 6(1):39-43.
13. Singh MK, Narendra Kumar Prasoon Verma, Garg SK. Performance evaluation of mechanical planters for planting of chickpea and pigeon pea. Journal of Food Legumes. 2012; 25(2):131-134.
14. Tsegaye A. Development of animal drawn multi crop planter. International Journal of Engineering Research. 2016; 4(1):205-211.
15. Vinchu RM, Solanki SN, Takalgavhankar KS. Design and Performance Evaluation of M.A.U. Dibbler. Journal of Agricultural Engineering. 2006; 43(2):68-71.
16. Yang L, Xiantao H, Cuitao, Dongxing Z, Song S, Zhang R, Wang Mantao. Development of mechatronic driving system for seed meters equipped on conventional precision corn planter. International Journal of agriculture and biological Engineering. 2015; 8(1):1-8, 8(4):1-9.