

Performance Evaluation of a Single Seeder Machine for Sowing Different Varieties of Seed

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Abstract

A manually operated push type seeder was tested in laboratory testing bed near the workshop of DFPM, Bangladesh Agricultural University, Mymensingh. Seeds of different variety were sown by a single seeder changing its metering device. The seeder was calibrated in the lab to maintain the desired seed rate for maize, wheat, black gram and groundnut. In the laboratory test the effective field capacity, average distance of dropped seed and missing rate were found as 0.128 ha/hr, 22.5 cm, and 13.43%, for maize, 0.063 ha/hr, 28.5 cm, 19% for wheat, 0.053 ha/hr, 17 cm, 14.29% for black gram, 0.055 ha/hr, 17 cm and 17.86% for ground nut respectively. The field efficiency of the seeder was also quite satisfactory. Despite of comparatively high missing rate, the machine might be acceptable since it is easy to operate, simple in design and mechanism, light in weight, requires less labor and the most significant feature is using one seeder for different types of crop by adjusting the metering devices only. Modification of the seed metering devices could give better performance of the seeder.

Key words: Seeder, Calibration, Seed rate, Different types of seed.

1. Introduction

Along with the increasing population the demand for food production in Bangladesh is increasing day by day. On the other hand, the cultivable land is decreasing due to need for development works such as roads, industries and housing. At the same time, productive lands are being damaged by active rivers and floods. To meet up the food demand, now the pressure in food production is increasing by growing more crops per unit area of land. Farmers are producing large volumes of crops continuously throughout the year. They are busy doing many agricultural activities season after season. Most of the agricultural operations are still accomplished by human labor which is slow, tedious, time consuming, and costly. They are facing trouble for carrying out agricultural operations such as planting, harvesting and threshing due to labor shortage especially during the peak periods. Among them planting or seed sowing is prime operation in cultivation practice. Farmers practice broadcast sowing of cereals and pulses which costs less, but ultimate income is also less due to higher intercropping operational costs and lower grain yields. The farmers are being deprived of benefit from cultivation

due to difficulties in maintaining suitable spacing and seed rate.

It is assumed that during sowing of seeds maintaining proper line spacing would reduce the seed rate which would reduce cultivation cost. On the other hand, line sowing might help in uniform growth of plants and easy intercropping operations. Efficient sowing of seed can reduce seed loss and can increase the production of the crop. In the case of maize cultivation, farmers practice labor intensive line sowing method which is an advantage for the introduction of planters. (Ahmad *et al.*, 2014). Traditional methods include broadcasting manually, opening furrows by a country plough and dropping seeds by hand and dropping seeds in the furrow through a bamboo/metal funnel attached to a country plough. Hossain (2014) developed a single row maize seeder which is also cost effective than manual seeding. Further, Asha and Nafisa (2014) modified this seeder for better performance. Now, this seeder is well known among the farmers. They prefer the manually operated seeder due to affordable cost. Seeder helps farmers to sow seeds in suitable spacing and depth according to the seed rates.

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Seed-metering system is an important component in terms of uniform seed distribution. Metering mechanism is the heart of sowing machine and its function is to distribute seeds uniformly at the desired application rates. The main target of sowing operation are to put the seeds in rows at desired depth, maintaining 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 seed spacing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields. Now-a-days, farmers are using drum seeder or transplanter in sowing paddy along with the traditional method, but they are still practicing the traditional method in case of other crops. In this regards, Sarker (2015) modified the drum seeder to a multi-crop seed drill at department of Farm Power and Machinery in which different seeds can be sown by changing the seed openings in the drum.

The present experiment was undertaken to evaluate the performance of a single seeder to sow maize, black gram, groundnut and wheat at predetermined seed rate and suitable spacing. In this experiment two types of plate with cell type metering devices were used. This experiment was carried out to sow in furrow method.

2. Materials and Methods

To carry out the experiment four types of seeds were used such as maize, blackgram, wheat and groundnut. By changing the seed metering devices, the laboratory and field tests of the seeder were done in the workshop of the Department of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh.

3.1 Components of the seeder

The seeder was constructed with locally available materials at the workshop of Farm Power and Machinery. The photographic view of the seeder is illustrated in Fig. 1, where as Fig. 2 represents the seed metering device and the specification of the machine was given in Table 1. The main components of the seeder are: seed hopper, plate type seed metering device, seed tube, runner wheel, and handle.

Machine specifications

The specifications of seeder are shown in Table 1.

Laboratory test of the seeder

The seeder was tested in the laboratory of the department of Farm Power and Machinery. In laboratory test the following parameters were measured.

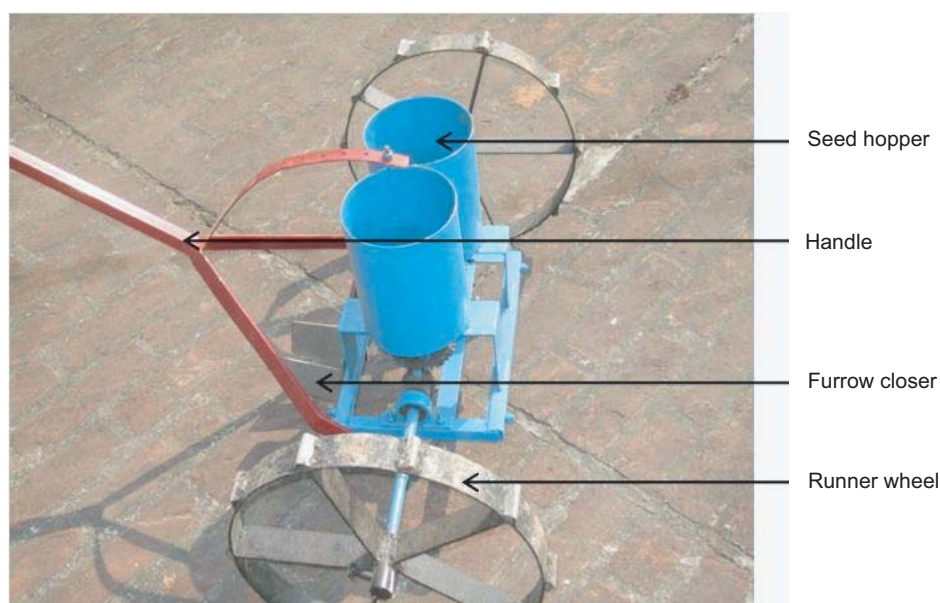


Fig. 1: Photographic view of seeder showing its components

Table 1: Specifications of a seeder

Name of the component	No. of items	Dimension (cm)	Material
Seed hopper	1	20.3 height, 21.6 and 17 diameter	Plastic sheet
Plate type seed metering device	1	16.8 diameter, 8 cell	Plastic
Seed tube	1	30.48 height and diameter 2.54	Plastic
Sweep type bed former	2	Diameter 25.4	MS bar
Runner wheel	2	Diameter 40.64	Rubber
Handle	1	Length 60.9 and 2.54 diameter	MS bar
Nut & bolts	24		MS bar
Depth control devices	2	Length 33	MS bar



Fig. 2: A photographic view of a seed metering device

Self weight: Self-weight of a machine or device is important, because less weight device is easy to carry and also for maneuver in the field. The self-weight of the applicator was measured by spring balance.

Seed rate: Seed rate is determined by calibrating the seeder in the laboratory shown in Fig. 3. Uniform seed rate in the plate type seed metering device was maintained by adjusting gap of seed meter. The seed rate of different types of seed for seeder machine was calculated by using the following formula.

$$\text{Seed rate, } \left(\frac{\text{kg}}{\text{ha}} \right) = \frac{\text{Seeds obtained by 10 revolution of drive wheel, (gm)}}{\text{Width of seeder, (m)} \times \text{circumference of drive wheel, (m)}} \quad (1)$$

Field test of the seeder

This study was conducted at the testing bed of Farm Power and Machinery Workshop of Bangladesh Agricultural University, Mymensingh in 2015. The experimental site is a flat land. The length and width of the testing bed was 13.41m and 2.13m, respectively. The average rainfall is about 1300 mm. The average daily temperature is 26.88°C with a

range between 10.36 and 32.85°C. The experimental field was ploughed. The soil texture at the experimental site was sandy loam with low moisture content. The following parameters were determined during this experiment.



Fig. 3: Calibration of the seeder

Distance of dropped seed

Distance of dropped maize seed, maintained by the seeder was measured very carefully. After each pass of the seeder operation, one observer measured the spacing of dropped maize seed in the field separately (Fig. 4(a) and (b)). After the observation, the average distance of dropped maize seed is calculated.

Missing rate

The missing rate measurement during operation in the field is not an easy task. Keen attention is needed while operating the maize seeder in the testing bed. So, during operation operator and one observer counted the number of seed missed to drop

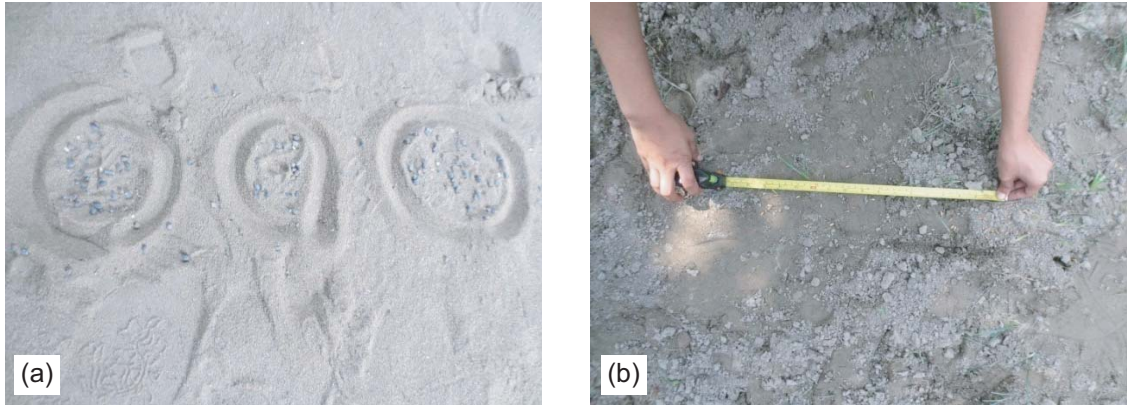


Fig. 4: Photographic view of the (a) dropped seed mash bean & wheat and (b) measurement of the distance between dropped seed

into the seed tube for different crops. Then the actual numbers of seed dropped in experimental area were determined if no missing occurred. Then missing rate is determined by the following equation (Karim *et al.*, 2015).

$$\% \text{ missing rate} = \frac{N_1}{N_2} \times 100 \quad (2)$$

Where,

N_1 = No. of maize seed missing during pickup by metering device into seed tube.

N_2 = No. of maize seed drop by the metering device if no missing occurred and not more than one seed per cell.

Field capacity

Field capacity is defined as the rate of field coverage by the seeder. Turning time at the end of the field was added with actual operating time for effective field capacity determination. Theoretical and effective field capacity of the seeder was determined by the following equations (Berger *et al.*, 1978).

a) Theoretical field capacity:

$$C_{th} = \frac{Sw}{10} \quad (3)$$

Where,

C_{th} = Theoretical field capacity, ha/hr

S = Forward speed, km/hr

w = Width of coverage, m

b) Effective field capacity:

$$C_{eff} = \frac{A}{T} \quad (4)$$

Where,

C_{eff} = Effective field capacity, ha/hr

A = Field coverage, ha

T = Actual time of operation, hr

Field efficiency

It is the ratio of the effective field capacity to theoretical field capacity. It is the ratio of the theoretical field time to the total time spent in the field. It includes the effects of time lost in the field and failure to utilize the full width of the machine. Field efficiency of the machine was calculated using the following equation (Berger *et al.*, 1978):

$$\text{Field efficiency, } e (\%) = \frac{\text{Effective operating time (hr/ha)}}{\text{Theoretical operating time (hr/ha)}} \times 100$$

Field efficiency can also be expressed as,

$$\text{Field efficiency, } e (\%) = \frac{\text{Effective field capacity (hr/ha)}}{\text{Theoretical field capacity (hr/ha)}} \times 100$$

3. Results and Discussion

The study was undertaken to determine technical performance of a push type manually operated seeder in the laboratory testing bed. Self weights, missing rate, seeder capacity, field capacity, distance of dropped seeds were calculated. For the entire data, a simple statistical analysis was performed by using Microsoft Excel software. The self weight of the seeder was 17 kg, so it can be concluded that the machine can be easily operated by a single man/women.

Laboratory test result of missing rate

A graphical presentation was made with test of missing rate for maize, wheat, black gram and groundnut.

From the observation in Fig. 5, the values of missing rate for maize, wheat, black gram and groundnut were 13.43 %, 19% 14.29% and 17.86%, respectively. The percentage of missing rate of wheat and ground nut was high compared to the expected values because of the clogging of seeds in between the metering device and the seed box. It was caused due to faulty design or improper design of seed metering devices and clog of the seeds inside the hopper. The surface of the ground nut seed was too rough to clog inside the hopper. Use of inclined metering device could solve this problem.

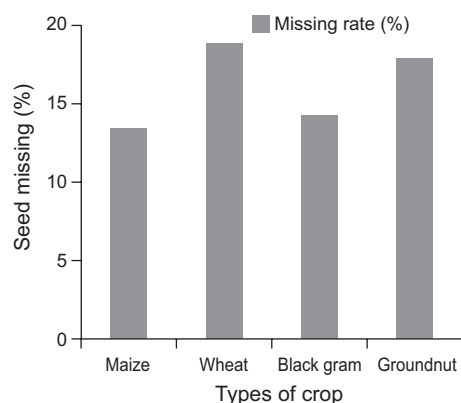


Fig. 5: Graphical representation of laboratory test result of missing rate (%)

Seed spacing

The seeder was tested in the laboratory for different types of crops. The rate of seed falling varies due to seed metering devices and crop types. The required seed to seed spacing also varied due to seeds trapped between seed hopper and seed metering device, uneven rotation of seeder, and varying forward speed of the operator.

The required seed to seed spacing for maize, wheat, black gram and groundnut cultivation was 20 cm, 30 cm, 15cm and 15 cm respectively (Fig. 6). Seed spacing by using seeder ranges from 19-24 cm for maize, 26-31 cm for wheat, 15-19 cm for black gram, 15-19 cm for groundnut which were closed to standard spacing.

Field capacity

The effective field capacity was 0.128 ha/hr, 0.063 ha/hr, 0.053 ha/hr, 0.055 ha/hr for maize, wheat, black gram and groundnut, respectively. It was low according to the theoretical field capacity because of low operating speed. It was also found that slower speed was comparatively better for seed placement into soil. Fig. 7 shows the graphical representation of comparative performance of effective field capacity and theoretical field capacity.

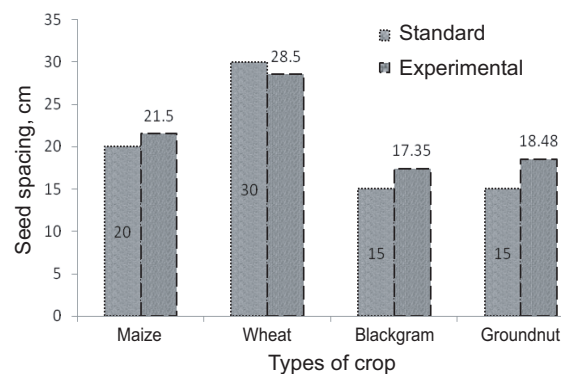


Fig. 6: Graphical representation of comparative performance of dropped seeds

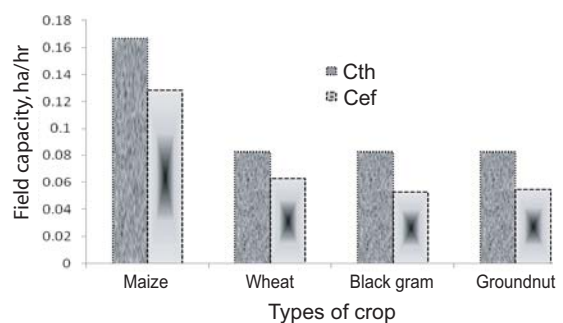


Fig. 7: Graphical representation of comparative performance of effective field capacity and theoretical field capacity

Seed rate

Seed rate that were found experimentally in case of maize, wheat, groundnut & black gram were shown graphically with respect to the recommended seed rate respectively in Fig. 8. It is observed that the seed rate varies with the time required for revolutions and seed metering devices. Since the metering device was not uniformly rotated for all kind of seeds and non-uniformity of operator speed caused this variation. Skidding was also a reason for variation in optimum seed rate. Besides, some of the seeds were trapped between the seed hopper and

the metering device such as- ground nut seed. The standard of seed rates of different crops were collected from BARI- Hand book (2014).

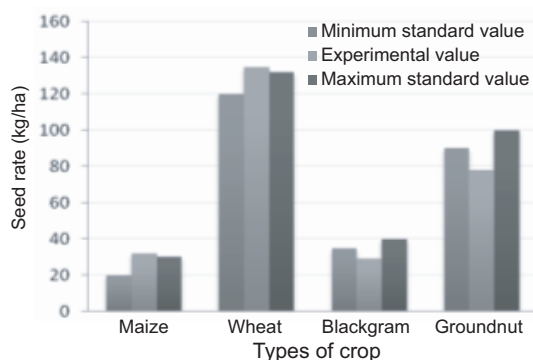


Fig. 8: Graphical representation of comparative performance of seed rates (kg/ha)

4. Conclusions

The seeder was tested in the laboratory for different type of crops. The rate of seed falling varied due to seed metering devices and crop types. The required seed to seed spacing for maize, wheat, black gram and groundnut cultivation were 20 cm, 30 cm, 15 cm, and 15 cm respectively. Seed spacing by using seeder ranges from 19-24 cm for maize, 26-31 cm for wheat, 15-19 cm for black gram, 15-19 cm for groundnut which were close to standard spacing. The values of missing rate for maize, wheat, black gram and groundnut were 13.43%, 19% 14.29% and 17.86%, respectively. The percentage of missing rate of wheat and ground nut was high compared to the expected values because of the clogging of seeds in between the metering device and the seed box. The values of effective field capacity were also found satisfactory according to the theoretical field capacity. Although the missing rate of wheat was quite high, field capacity was nearly standard.

Performance evaluation of a single seeder machine

However, walking speed of the operator is a detrimental factor on the field capacity. Therefore, it can be concluded that cultivation of maize, wheat, black gram and ground nut by using this seeder is better than the hand sowing and it will be quite helpful for farmers using same seeder with only two types of seed metering devices for planting four different types of crops.

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