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Development of Seed Planting Machine for Rural Communities in Nigeria

By

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Abstract
A simple and low cost prototype seed planter was designed, constructed and tested. The materials used for construction are mild steel and wood. The test crop was cowpea with expected distribution of 2 seeds per drop at 25cm spacing. The test result shows an average of 2 to 3 seeds per hole at average spacing of 25.2cm. The field capacity is 0.1036hl/hr at 0.75m row spacing while the seed rate is 26.81kg/ha. Optimum planting efficiency of 58% was found at operational working speed of 0.6m/s. The germination percentage of planted seeds was 52%.

Introduction
The need for Nigerians to feed themselves rather than depend on importation of food, has been the priority of successive Governments of Nigeria. This need has been articulated through the concept of "Operation Feed the Nation" (OFN) programme (1977); the "Green revolution" programme (1980); the "Back to Land" program, (1985); and the "Directorate of Food, Road and Rural Infrastructure" (DIFRRI) programme. These programmes were aimed at encouraging local agricultural production.

The traditional farmers in Nigeria today are in the majority. According to Abubaka (1994), these groups of farmers seem to have no access to credit facilities, and cannot afford to buy or hire the agricultural machinery to enhance their farming capabilities. Traditional farming method in Nigeria is labour intensive. Although, some of the farmers can afford the services of animal drawn implements for the ploughing of land, since this local method of mechanized tilling of the land can cultivate a large farmland more than the use of hands and local hoes. This improved method of cultivation has necessitated the need for mechanized planting of seeds so as to eliminate that physical exhaustion that is usually associated with manual labour. More existing seed planters are drawn by tractors and the majority of these traditional farmers cannot afford the price of a tractor. Based on these explained facts, it becomes necessary to construct and develop a seed planter that will depend on human efforts for its motion initially, but can plant the seed at a greater speed than human beings. The seed planter will have a front wheel and a double roller-like wheel at the rear. The three wheels will facilitate the smooth movement of the planting machine. The machine may require a source of power to energize its movement; meanwhile, the motion will be produced by the operator who gives it a steady but slight push by means of the two handles. The operation of this machine will be unique due to its steady construction, steadiness on the ground, its frame will enable the mounting of the seed container and adjustable soil-penetrating implement and furrow opener which will guarantee uniform tunnel dimension and position.

The seed-planting machine will easily be adopted to various kinds of seed by adjusting the seed distribution plate. All the above features will enable the traditional farmers to master the use of the equipment with ease. It will be simple to use, adjustment and changes can be made effortlessly. The operator will enjoy excellent visibility in that nothing blocks his views. It will be safe to operate and virtually maintenance free, though, a prolonged life span will be ensured with periodic lubrication of the ball bearings and the chain that supports the wheels.

Literature Review
Research evidence from the Directorate of Food, Road and Infrastructure, (DIFRRI), (1988), show that most Nigerians lie below poverty level. The report also shows that most of these Nigerians are peasant farmers. Okorie (2000), explained that most problems facing the Nigerian farmers include manpower and
lack of mechanized approach to farming. The report explained that these farmers expend much more human effort to achieve minimal harvest. The much time wasted on the preparation of the farmland and the planting method used do not usually result to appreciable yield. In Nigeria, for instance, some state Governments have made serious efforts to purchase agricultural equipment, most times these agricultural items do not reach the local farmers who are in the majority. Since these farmers need improved harvest for better living, a more effective method for better agricultural practice becomes an important necessity.

Adekoya and Buchele (1987), reported the construction of a punch planter for use as a tilled and untilled soil. The row spacing of the punched hole and the depth of planting of the seeds were independent of the travel-speed of the planter. They observed that the percentage of the punched holes containing the seed decreased as the travel speed increased. Seeds that were not dropped in any hole fell on the ground, leaving some holes empty.

In recent years, more attempts have been made at improving the seed-planting machine. Abubakar (1994) constructed and tested a multi-crop rotary job planter to be used on sandy loose soil and suggested that thicker flat-bar-material be used for the jabbing devices, so that bending do not occur. He also suggested that two units of the planter be produced and mounted to a single frame so that a semi-working animal could pull it. Bankole (1992) also designed and constructed a precision maize planter but reported an observed need for improvement on the constructional method. The report explained that a guide sheet should be incorporated to guide the seeds from the upper plant cell to the middle plant cell so that there will be no wastage of the grains. Arama (1998), designed, constructed and tested a manually operated single row planter and reported cases of non-uniformity of seed distribution and little cases of seed crush. Adamu (1999), also designed, constructed and tested a single row manually operated precision maize planter with fertilizer applicator attached to it. The main problem with the planter was the non-uniformity in the sizes of seeds and constructional errors. It has been generally observed that most planters available have some shortcomings in their distribution uniformity of seeds, soil sticking to seeds, irregular seed dropping and the problem of seed crushing. It becomes necessary, therefore, that a more localized machinery for rural agricultural practice be sought for. The availability of this agricultural equipment will assist rural farmers become more committed to agricultural practice.

Purpose of the Study

The purpose of the study is to produce a simple manually operated and inexpensive seed-sowing machine.

Specifically, the study attempted to;

(a) Design a seed-sowing machine that can open the furrow to the proper dept, meter and deposit the seeds in a desired pattern.
(b) Construct the designed machine by the assembly of appropriate components and materials.
(c) Carry out field performance test of the seed-planting machine.

Methodology

Design Considerations.

The design for the study was research and development, depicting step-by-step procedure for the design and construction process. In the design and construction of this seed-planting machine, the physical properties of the seeds of various sizes were put into consideration to avoid seed damage and for proper placement of seeds in the soil at the desired depth and compaction.

Tools and Materials

The tools and materials used for this project include, the mechanical Engineer drawing instrument, like the iron rods, angle irons, flat steel bars, sheet metals, hard wood materials, chain and sprockets, Drilling machine, grinding machine, energy cloth for finishing and marking out equipment in the fitting shop was also used during the construction of the planting machine.
Determination of Seed Shape
The shape of the seed is described in terms of its roundness and sphericity. Roundness is a measure of the sharpness of the corners of the solid object, which was taken into consideration during the construction of the Planting Machine.

Determination of the Tractor Wheel Diameter
The tractor wheel diameter was determined based on:
(a) available sprockets that conformed with the minimum tractor wheel size.
(b) available wheel which reduced the degree of soil compaction and
(c) the traction wheel diameter size used, (D) for this construction is 29cm (0.29m).
(d) the distance covered by the traction wheel for one revolution is therefore, 
TTD = \pi x 29 = or = 0.91m.

The sprocket size was based on,
(1) the size of the traction wheels
(2) the seed spacing
(3) the number of seed cells on the metering plate equals number of 15 teeth.
The press wheel was made out of a 9% bar metal 48 x 4mm with internal diameter equal to 210mm and outer or external diameter and the shaft's bushing. The metering device was made of hard wooden shape plate of diameter, 168mm with a 22mm diameter shaft passing laterally through its center connected to the driven sprocket. The metering plate has four seed cells round its circumferential length space at 132mm. The seed hopper was designed to refill seeds and made out of flat sheet metal of 3mm thickness and made of trapezoid shape with dimensions of 250mm x 150mm x 150mm. A shoe type single furrow opener was fabricated out of an angle iron of 38 x 3mm and fitted on the bottom face of the frame. The length was adjusted to facilitate desirable penetration depth. The lower end of the seed tube was fitted between the wings of the furrow opener. The tube of the delivering funnel was designed in a parabolic shape to reduce the rebounding of seeds against the wall of the seed tube; this will improve the uniformity of the seed delivery to the furrow.

Shaft Design
The shafts are often subjected to torsion, axial tension, bending and compression or to a combination of any or all of these actions of failure loads shocks and stress concentration. Consequently, the design of the shaft most involves the determination of the minimum diameter of the shaft material that can withstand certain loading of shaft material. This was based on the locally available material that can easily be machined into desirable size. The material is medium mild steel C1040 with properties as stated by ASMF; (1984) Allowance for Shock and Fatigue Conditions
The tentative code for the design of transmission shaft of A.5A (American Standard association) requires that the values of bending Moment and Torque acting on the shaft was multiplied by certain shock and fatigue factors for bending moment, and tensional stress respectively; depending on the service conditions. The applied loads with minimum shock were the condition under which the shaft is designed for the planting machine. The value of the bending moment and tensional stress are under this condition ranges from 1.5 to 2.0 and 1.0 to 0.5mm respectively. The value of the bending moment and tensional stress are taken at 1.5 and 1.0mm respectively for the design of this machine.

Laboratory and Field Tests
The performance evaluation of the prototype single row manually operated planter was conducted in two ways;
(a) the Laboratory tests,
(b) the Field tests
The major materials needed for the tests are
(i) the prototype machine
(ii) the measuring tape
(iii) the stop watch
(iv) cowpea seed

Test Conditions

The test was conducted at the Agric Engineering Department of Zango Kataf Local Government. The total area of the field was 0.25ha and of clay loamy soil. The field was ridged and irrigated manually.

The seed used for the laboratory test was cowpea with the following average dimension:
Length of the tested grain = 10.12mm
Width of the tested grain = 7.40mm
Thickness of the tested grain = 4.02mm

The laboratory test was conducted to determine the following:
(i) Seed distribution
(ii) Seed rate per hectare
(iii) Speed effect on seed drop
(iv) Failure rate

Seed Distribution
The seed distribution of the prototype machine was determined in the laboratory test by running the machine at a distance of 15m long at 2.5 km/hr, the spacing between seed drops and number of seed per drop were recorded.

Seed Rate Per Hectare
The seed rate was determined by placing the prototype machine at a height with a container placed under the seed tube to collect seeds dropped by turning the drive wheel for 10 revolutions. Then the machine was moved on field for 10 revolutions of the drive wheel and the distance was noted.

The distance of run of the machine per hectare was determined with these data, the seed rate was calculated as presented below:

\[
\text{Number of wheel revolutions to cover } 1 \text{ hectare} = \frac{14635.93 \times 9.3 \text{ Rev/ha}}{9.3} = 136144 \text{ Seed per hectare} = 26.81 \text{ kg/ha}
\]
Effect of Speed on Seed drop

The effect of speed on seed drop of the prototype machine was determined by timing five different runs through a measured distance of 10m. The machine was pushed along this distance slowly at an average walking speed of 2.6km/hr by the operator. The speed was increased progressively for each run. The average number of seed dropped, average seed to seed spacing, number of seed damaged were recorded as shown in Table 1 below.

Table 1. The Effect of Speed on Seed Drop

<table>
<thead>
<tr>
<th>No of Runs</th>
<th>Duration of Runs</th>
<th>Distance covered (m)</th>
<th>Speed (m/s)</th>
<th>Speed (km/hr)</th>
<th>Average seed</th>
<th>Average seed drop</th>
<th>No of damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>14sec</td>
<td>10m</td>
<td>0.71</td>
<td>2.57</td>
<td>25.9</td>
<td>2.2</td>
<td>1</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>10sec</td>
<td>10m</td>
<td>1.00</td>
<td>3.60</td>
<td>30.5</td>
<td>2.1</td>
<td>0</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>9sec</td>
<td>10m</td>
<td>1.11</td>
<td>4.00</td>
<td>36.1</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>8sec</td>
<td>10m</td>
<td>1.25</td>
<td>5.4</td>
<td>40.4</td>
<td>1.8</td>
<td>1</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>6sec</td>
<td>10m</td>
<td>1.67</td>
<td>6.00</td>
<td>47.6</td>
<td>1.8</td>
<td>2</td>
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</table>

Failure Rate

The failure rate was conducted on the machine by determining the expected number of seeds delivered per hole at 15m distance. The numbers of seeds dropped per hole were recorded. From the table, the number of holes with expected seed and those with unexpected number of seeds were noted and the failure rate was then calculated.

Effect of Speed on Seed Spacing

It was observed that as the forward speed increased the spacing between the seed drops also increased. This could be as a result of high speed that causes inadequacy in the time for the speed to settle in the seed cells before they are carried along by the seed plate for deliverance.

Effect of Speed on Number of Seed dropper Hole

As the forward speed increased, the number of seed dropped per hole also decreased. This could be as a result of high speed that does not provide sufficient time for the seed to enter the cell of the seed plate, thus causing lesser number of seeds dropped per hole.

Table II. Seed Frequency Distribution Table

<table>
<thead>
<tr>
<th>No of seed per hole (X)</th>
<th>Frequency (f)</th>
<th>F(X)</th>
<th>X - X&lt;sup&gt;2&lt;/sup&gt;</th>
<th>F(X - X&lt;sup&gt;2&lt;/sup&gt;)</th>
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<tr>
<td>0</td>
<td>17</td>
<td>17</td>
<td>-0.93</td>
<td>0.865</td>
</tr>
<tr>
<td>1</td>
<td>17</td>
<td>34</td>
<td>0.075</td>
<td>0.006</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
<td>76</td>
<td>1.075</td>
<td>1.156</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
<td>72</td>
<td>2.075</td>
<td>4.306</td>
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Field Capacity

The area cover per unit time of the prototype i.e. hectare per hour was found to be 0.1036ha/hr. This was achieved using average human walking speed of 2.4km/hr.

In the field, a total of 375 seeds were planted using prototype machine along the ridges. Five ridges were planted using the planter and a ridge by manually planting method to compare the time rate of planting. It was seen that average time to plant 60m length with the planter was 3.6 minutes and that of the manual planting was 27minutes.

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Seed Distribution and Uniformity

It was observed as shown in table II, that the highest frequency on the table is two seeds per hole. This is so because; the design drop per hole was two seeds. The degree of uniformity of seed distribution in percentage was calculated to be 32%. This could be as a result of variations in seed sizes.

Failure Rate

The prototype percentage failure rate was 43.34% as calculated in the determination of failure rate. This could be due to the variation in seeds dimension.

Conclusion

The result from the design, construction and testing of the manually operated single row planter were tabulated. The sizes of the seeds varied, thus, causing non uniformity in the number of seeds dropped per hole. However, the number of seeds dropped per hole was found to be encouraging on the average basis. Another factor that affected the rate of seed drop is the forward speed of the machine. At a higher speed, fewer seeds are dropped and at a lower speed, more seeds are dropped. This may be as a result of ploughing at lower speed more seeds tends to have adequate time to settle in the seed cell, while at higher speed, the gravitational speed of drop of the seeds is less than the speed of ration of metering device, causing reduction in the number of seeds dropped.

It was found that the average number of seeds dropped by the planter was two seeds per hole at an operational walking speed of 2.4km/hr, as determined during the field test. It was also seen that the average time to plant 60m length of land with the planter was 3.6 minutes while that of the manual planting was 27 minutes. The machine was observed to be lesser in weight in comparison to most existing planter that are often more difficult to move.

Recommendation

The following recommendations are made for an improved seed planting machine.

1. The wood used for the seed planter, in order to save cost of construction, should be well seasoned by treating it with oil or light metal material like aluminum. The same wood should also be used for the construction of the seed plate.
2. The chain for the wheels can be eliminated by moving the drive-wheel directly on the shaft, driving the metering device.
3. The frame could be reconstructed with a flat metal bar 25 x 4mm size to ease or reduce the push force when in operation.
4. The need for pressure pump tyres is very important and may be incorporated instead of bar metal used for the traction wheel to reduce pushing force.
5. The planting machine could be energized through the powering system.

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The Relationship Between Home Economics and Other Disciplines in Attaining National Objectives of Education. Olaosebikan Victoria Bola (Mrs.)

Technical Education: A Panacea for Poverty Alleviation. Shita. M.B. Kumbo

Improving the Competence of Unskilled Employee Unbridling Industry for Poverty Alleviation. Godwin A. Onyemachi

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