DESIGN AND DEVELOPMENT OF TEMPLATE ROW PLANTER

Adisa A. F.
Department of Agricultural Engineering, University of Agriculture, Abeokuta, Nigeria

Braide F. G
Formally of Agric. Engineering Department, Ahmadu Bello University, Zaria, Nigeria

Abstract

The basic requirements for small scale cropping machines are, they should be suitable for small farms, simple in design and technology and versatile for use in different farm operations. A manually operated template row planter was designed and developed to improve planting efficiency and reduce drudgery involved in manual planting method. Also it increased seed planting, seed/fertilizer placement accuracies and it was made of durable and cheap material affordable for the small scale peasant farmers. The operating, adjusting and maintaining principles were made simple for effective handling by unskilled operators (farmers). The planting rate of the template row planter was found to be 0.20ha/h. Template seed filling efficiency was found to be 88% and draft requirement was found to be 85N at average speed of 2.16km/h.

Keywords: Template, row planter, peasant farmers, planting rate

Introduction

Under intensive cropping, timeliness of operations is one of the most important factor which can only be achieved if appropriate use of agricultural machines is advocated (Salokhe and Oida, 2003). With the present day advanced agronomic practices, seed genetics and on- farm technology to deliver optimal yield while using fewer resources, precision planting is not out of place.

Manual method of seed planting, results in low seed placement, spacing efficiencies and serious back ache for the farmer which limits the size of field that can be planted. Hand-pushed and

tractor mounted row seeders (usually single and multiple row) normally requires a well prepared seed-bed which may be ridged or flat bed.

In the past, various types of design have been developed with different design approaches which have their advantages and disadvantages and also operational limitations. Adisa (1980) designed and constructed a manually operated flute planter/fertilizer distributor which was found to be 94% efficient in seed spacing but could not be used on the ridged seed bed and requires quite some effort and time to change seed drill size and seed spacing. Also Braide and Njidda (1989) developed a combined jab planter which was found to be 73.4% efficient and was three times faster than manual planting with hoes and cutlass. Abubakar (1987) made used of the principle of jab planter in applying fertilizers. Adekoya and Buchele (1987) developed a cam activated precision punch planter which was capable of planting an untilled soil. Braide and Ahmadu (1990) developed a transplanter for some selected crops in Guinea Savannah of Nigeria which has 0.19ha/h field capacity and 20% field efficiency. All of the above designs were reported to have got quite promising results.

This author found out that a simply designed planter, constructed from readily available materials with less moving parts, that can plant on both ridged and on flat seed bed will be required. It should be able to plant more wide seed size range. The planter should eliminate as much as possible transplanting operation of most vegetables and some other seed crops if their seeds can be planted directly and accurately.

Material and Methods

The materials used in constructing this planter were those that can easily be found locally in Nigeria cities and towns. Also the design was made as simple as possible which can readily be produced with available present day intermediate technology. This then made the machine and its parts reproduction possible and could be made readily available at reasonable price for the peasant farmers. The design also reduced to the barest minimum the number of moving parts to reduce cost of parts replacement and eventually low maintenance cost.

Planter Prototype

The range of shapes and sizes of agricultural grain crops and their physical properties like grain length, width and thickness as determined byNdinka and Oyeleke (2002), Mohammed (2002) and Oyeleke(2002) were made used in designing grain cell sizes on the seed metering unit.

Planter hopper was divided into seed apartment (1.5kg seed capacity) and fertilizer apartment (2kg fertilizer capacity) made of light durable galvanized metal sheet. Seed metering mechanism, template type was made out of aluminum alloy and wood for large seed grain like maize, cowpea etc and small seeds like vegetable, guinea corn, rice and wheat to mention few. The seed holes on the template provide seed spacing of 60cm, 30cm, 20cm, and 10cm which can be changed within very short time. The same was done for fertilizer metering unit ranging from complete drilling to spot dropping of fertilizer side by side with the seeds since they were both mounted on the same drive wheel shaft to reduce number of moving parts. The furrow opener (adjustable) was made of runner type that provide V-shaped furrow to reduce seed rebouncing when dropped to improve seed placement accuracy. The planter's handle was made of adjustable galvanized square pipes to make planting on the ridge and as well as on the flat bed possible. Drive wheels were made of aluminum alloy with both of them coupled to the seed/fertilizer template drive shaft. See figure 1 for the planter parts drawing.

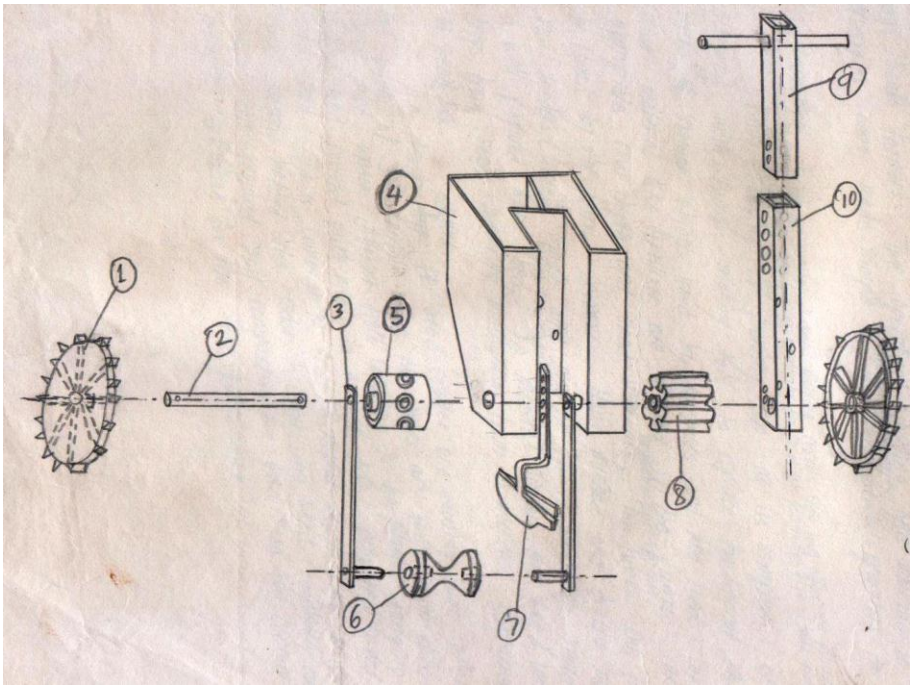


Figure 1: Template row planter in parts.

Key: (1) Drive wheel (2) Shaft (3) Furrow cover frame
(4) Seed/ fertilizer hopper (5) Seed metering mechanism
(6) Furrow cover/ presswheel (7) Furrow opener
(8) Fertilizer metering mechanism (9) Male handle
(10) Female handle

The design of this planter was made to plant the new breed of cowpea and groundnut that requires two rows on a single ridge by replacing the fertilizer metering unit with seed metering unit. Fertilizer can be applied later by replacing both seed metering units with fertilizer metering units after the emergence or germination of seeds.

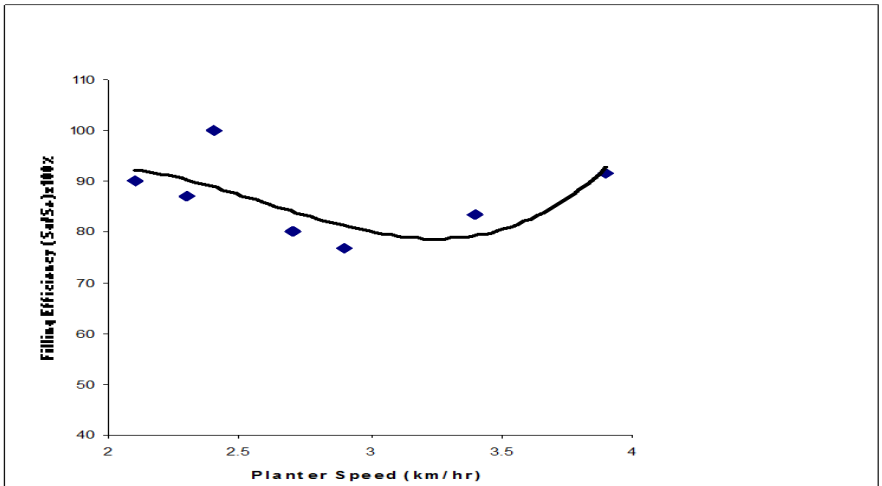
Testing

The planter prototype parts after fabrication were coupled and taken to the laboratory and field for testing. At various speed of planting, which was determined by recording the time taken to plant a length of 10 m per each run, number of seeds dropped in uncoverd seed furrow was counted. Expected number of seeds to be dropped per each run was 60 seeds. This was to determine seed filling efficiency of the planting metering system. Maize and cowpea were made used for seed testing while urea fertilizer was used. The maximum seed hopper capacity was determined with that of fertilizer by weighing the full contents. Furrow opening depths and sizes were measured. Also field planting rate capacity at normal walking speed (2.16km/h) on a prepared seed bed was determined. With spring balance coupled to the planter, draft requirement was measured several times and the average was found at the planting speed.

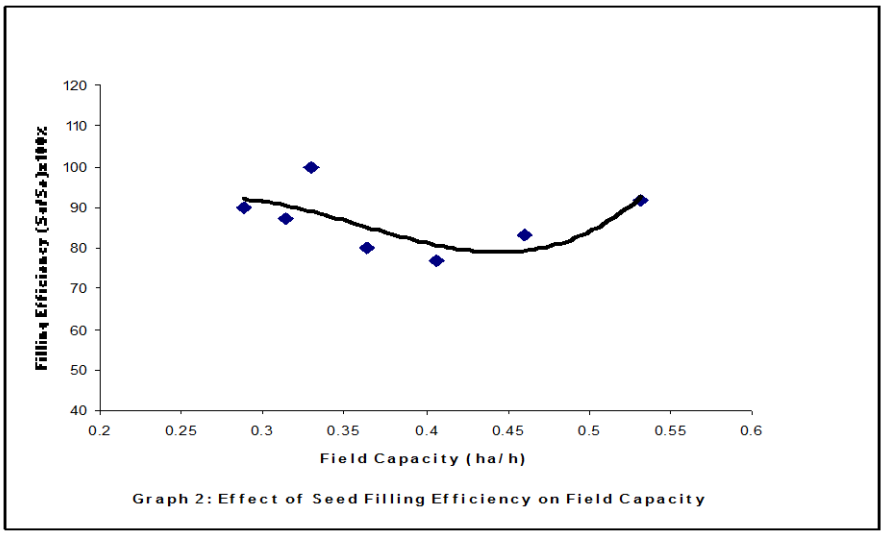
Results and Discussions

The results of the readings taken with the template row planter were as shown in Graphs 1 and 2 for both laboratory and field tests. Graph 1 illustrates the effect of speed on seed filling efficiency, The graph show that the filling efficiency decreases as planter speed increases to 3.5km/h when it begin to rise rapidly again which was directly affected by the walking speed of the planter operator (2.16km/h). Graph 2 is field capacity against seed filling efficiency where the filling efficiency decreases gently to 0.45ha/h field capacity before it rises again. Operator walking speed which was not uniformly, was responsible for this while at higher speed, seed clogging reduced to achieve higher field capacity. Speed that will give the the range of 0.40 to 0.50 ha/h will not be encouraged for attaining reasonable seed filling efficiency when manually operated at lower field capacity but good for tractor operated at higher field capacity that can operate at more uniform speed. Find below template row planter technical data specification.

Planter length	150cm
Net weight (empty)	5kg
Draft requirement	85N
Seed hopper	1.5kg
Fertilizer hopper	2kg
Furrow opening depth	1.5cm to 5cm
Planting speed	2.16km/h
Operating laboratory capacity	0.2ha/h



Graph 1: Effect of Speed on Seed Filling Efficiency



Graph 2: Effect of Seed Filling Efficiency on Field Capacity

Conclusion

Template row planter was found to weigh less than 9kg, while the draft required to push the template row planter was found to be 85N. Average template seed filling efficiency of the planter was found to be 88%. The cost of planter production in 2009 was fifteen thousand five hundred Naira only (N15,500). The template row planter was able to plant on both ridged and flat seed bed at average field capacity of 0.2ha/h (effective planting rate) which was quite adequate for small scale farming.

References:

Abubakar S. Z. 1987. Design and Testing of a Jab Fertilizer Applicator, Unpublished B. Eng Thesis, Ahmadu Bello University, Zaria, Nigeria

Adekoya L.O. and W.F. Buchele, 1987. A Precision Punch Planter for use in Tilled and Untilled Soils. Thesis, Ahmadu Bello University, Zaria, Nigeria

Adisa A.F. 1980. Design and Construction of a Manualy Operated Planter. Unpublished B.Eng. Thesis, Ahmadu Bello University, Zaria, Nigeria

Braide F.G. and S.M. Njidda. 1989. Design and Construction of a Combined Jab Planter, Proceedings of Nigerian Society of Agricultural Engineers (13)

Braide F.G. and W.H. Ahmadu 1990. The Development of Transplanter for Selected Crops in the Guinea Savannah Region of Nigeria, Proceeding of the International

Agricultural Engineering Conference and Exhibition, Thailand

Mohammed S.S. 2002. Determination of Selected Physical and Mechanical Properties of Maize and Sorghum Grains. Unpublished B. Eng thesis, Ahmadu Bello University, Zaira, Nigeria

Ndirika V.I.O. and Oyeleke O.O. 2006. Determination of Selected Physical Properties and their Relationships with Moisture Content for Millet. American Society of Agricultural and Biological Engineers (ASABE) vol. 22/2. Michigan U. S. A

Oyeleke O. O. 2002. Determination of Selected Physical and Mechanical Properties of Millet and Wheat Grains. Unpublished B.Eng Thesis, Ahmadu Bello University, Zaria Nigeria.

Salokhe, V.M. and Oida, A. 2003. Development of Appropriate Agricultural Machinery for Southeast- Asian Countries. Laboratory of Agricultural Systems Engineering. Southeast- Asia.