



UNIVERSITI PUTRA MALAYSIA

***COMPARISON BETWEEN PORTABLE HAND SEEDER AND HAND
TRANS PLANTER IN TERMS OF FIELD CAPACITY AND GROWTH
RATE OF PLANTED SWEET CORN***

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THESIS

**COMPARISON BETWEEN PORTABLE HAND SEEDER AND
HAND TRANS PLANTER IN TERMS OF FIELD CAPACITY
AND GROWTH RATE OF PLANTED SWEET CORN**

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Submitted in partial fulfillment of the requirements

For Bachelor Degree

In the

Department of Agricultural and Biological System

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ACKNOWLEDGEMENT

To start with, I would like to begin by giving thanks to God who made this project a success. If not for His grace, I would not have gotten to the end of this project. Apart from my efforts, I extend my utmost gratitude to my project supervisor Professor Ir. Dr. Azmi Yahya who gave me the opportunity to work on this project. I thank him for guiding me through the huddles of this project by proving me with logistic and valuable suggestion; I must confess that he is God sent.

I am grateful to my family members especially my Mom and Dad, who supported me from the start of this project with prayers and words of encouragement. I also extend my sincere appreciation to my friends who supported me in one way or the other throughout this project.

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ABSTRACT

The study attempts to evaluate the field performances between a manual seeder against a handheld Trans planter in manual planting of sweet corn. In addition, the study also attempts to evaluate the field performance in preparing sweet corn seedlings in a plastic tray for the seedling Trans planter, the growth parameter of sweet corn plant and to recommend design modifications and improvements to be done on the manual seeder and Trans planter.

Time motion was taken for operations of preparing the sweet corn seedling in a plastic tray, planting of seeds and seedlings in the test plot for both methods of manual planting and application of fertilizer. In addition, physical properties, which involved the height, width and weight of both sweet corn seeds and seedlings, was taken. In order to accomplish the objective of this study, the results obtained using both manual planting methods were compared. And based on the comparison, results and conclusions were made.

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CHAPTER 1

INTRODUCTION

1.1 Background

The sweet corns cultivation in Malaysia is done by small holders. These farmers normally sell the fresh harvested sweetcorn ears to the intermediary or to the agricultural collection center. Until date, not much machinery are being used in the cultivation of sweetcorn. The current mechanization index for sweetcorn cultivation is 0.26. So local farmers have resorted to using manual equipment; but unfortunately, the equipment used has not brought so many changes. Therefore, this study focuses on the use of appropriate hand tool to help farmers in planting sweetcorn.

1.2 Overview

Achieving sustainable food security from local agricultural production demands much of Smallholder agricultural systems. Under the increasing pressures of growing populations and an exceedingly unpredictable climate, smallholder farmers of the developing world face low and declining yields, soil degradation, unsustainable soil, crop management methods and erratic weather patterns (Csaki and deHaan, 2003). These challenges characterize the 500 million Smallholder farms from SSA, Central and South America and South and Southeast Asia that feed over 2 billion people (IFAD, 2013). As we may observe, agriculture is one of the most important impact in humanity. In order to help boost up production in sweet corn to be precise, Improvement and designs of new equipment's are designed.

In Malaysia, sweet corn is one of the crops grown not just for consumption but also exported and so it is in some other parts of the world. The growing and

exportation of sweet corn in Malaysia tends to be more advantageous to private companies and government agencies, as they plant on large scale with the help of machineries which boost farmland productivity and the use of tools, implements, and machineries of appropriate type, size, which in turn helps to improve the efficiency of human time and labour. Farmers involved in low scale farming in the other hand due to the lack of enough capital to buy or rent advanced machineries, face difficulties. Furthermore, problems might be the unavailability of enough land for the use of machinery. Low scale farming tends to use low technology in other areas such as the use of a simple watering can for irrigation, and so on.

For a small-scale farmer, in the course of practicing conservation agriculture, the appropriate equipment is necessary in order to penetrate harder soil surfaces and surface residues. Even though there is no need for heavy land preparation for conservation of agriculture, the penetration on a hard soil for planting can be made easy or difficult depending on the use of energy through the process of using the tool employed (Kienzle, 2014). Conservation agriculture for a small-scale farm makes it necessary to get a seeding equipment that will last long and at the same time suitable for the operator.

A study conducted shows that throughout the developing world, women are highly responsible for preparing seedbeds, planting seeds and harvesting (FAO, 2011). In this case, women use hands or if necessary use tools such as hand hoes which requires them to bend over, which might cause them serious pains and affect them in a long run. For a conservative agriculture to be well practiced, there should be available equipment's or tools designed to suit both men and women, boys and girls who are involved in agricultural activities most especially seeding. Hand seeder have been in existence for a very long time now coming in different shapes and sizes.

Even though modern mechanization of agriculture has tried to make balance the use of manual work in some area, agriculture for subsistence farmers up to now relies mostly on hand manual work which is in turn tedious for the growers. In the course of getting a suitable seeding equipment for any smallholder, the most important thing to take note of is to get the appropriate equipment which is community accepted, economic feasible and usable (Mrema, 2008; Baudron, 2015). Seeders are mostly evaluated based on three things namely: field performance, crop growth and yield. Therefore, for an improved seeder to be accepted, it must also be usable, save time, increase agricultural productivity, and most importantly be affordable for the people it is designed for.

Therefore, In this research, we tend to design a concept for the existing manual hand planter which is solely used to trans plant seedlings like corn seedling, tulip seedling etc. This existing trans planter has a long barrel through which the seedling passes. It has a ring like structure as the top opening, a handle and a spring attached to the barrel that connects to the bottom part, and a cone like bottom part pointed in shape to pierce into the soil and open up when the spring is squeezed against to the handle.

This existing manual hand planter if it is to be used for seedling has a limitation of dropping the seeds. Being that the seeder was used for transplanting, so no room for hover was made available. Therefore, in the case of the manual hand planter, seedlings were planted by dropping one seedling at a time through the long barrel into the soil. Another limitation it has for it to be used as a seeder is the absence of the measurement of the spacing between the seeds in a single row, which ranges from 8-15inches (20-38cm). Furthermore, another main issue falls where the soil is not being covered after the seed is dropped using the same hand seeder, but

rather it is involved in another process of covering it with the user's foot or totally another operation, which makes the work much tedious. Design of a manual portable hand seeder with all the necessary seeding operations meet, makes it a way for farmers involved in low scale farming to have better income, high production yield and most importantly reduce the tedious work which is faced in the process of seeding operations.



Source: Mechanization status in sweet corn cultivation in Malaysia, (Ishak et. al 2018).

Figure 1. Field operation of planting conducted using seeds with hoe as equipment.

Work Quality

The Plant population of a hectare of land ranges from 35000 - 55000 plants per hectare. Average spacing between seeds ranges from 30-35cm. The average row distance is about 70cm.

Table 1: General mechanization index with operations sweet corn

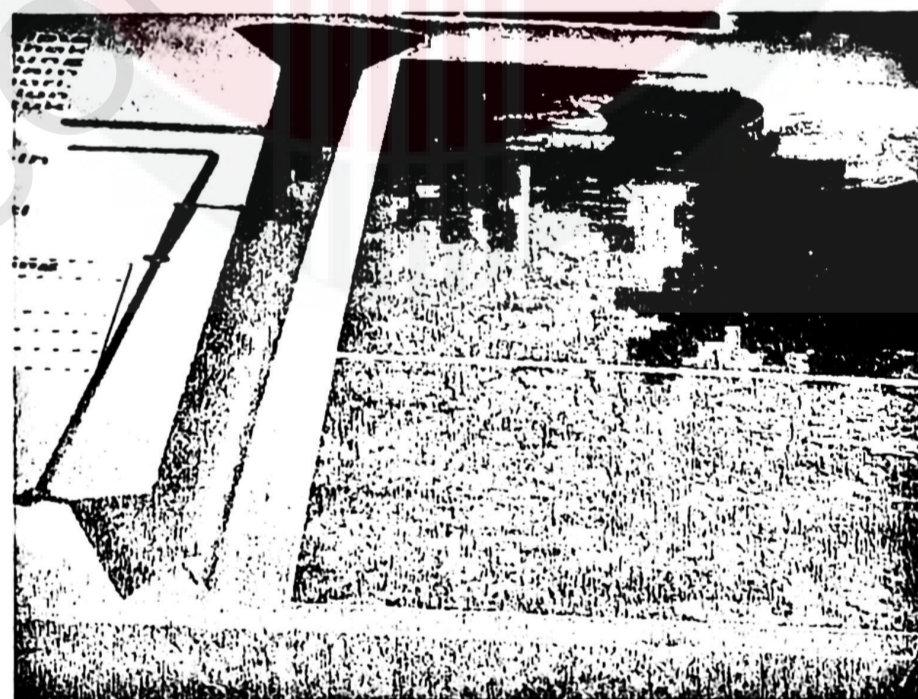
Operations	Human, MJ/ha	Machinery, MJ/ha	Mechanisation index, %	Ranking decrease order
Tillage	6.62 ^c	105.35 ^a	94.09 ^a	1
Planting	64.14 ^a	11.90 ^d	15.65 ^d	4
Fertilising	46.07 ^{ab}	2.504 ^d	5.16 ^d	6
Spraying	32.92 ^b	37.96 ^c	53.56 ^c	3
Harvesting	54.33 ^a	69.17 ^b	56.01 ^b	2
Cutting plants	49.96 ^{ab}	3.93 ^d	7.29 ^d	5
Average	42.34	38.47	38.62	-

Source: Mechanization status in sweet corn cultivation in Malaysia, (Ishak et. al 2018).

Table 1 shows the most critical operation requiring mechanization generally is fertilizing operation. It has an index of 5.16 % representing human labour involvement of about 94.84 % of the operation's energy expenditure. The second to follow is the operation of cutting of plants with 7.29 % of human labour, and about 92.71 % of the operation's energy expenditure. **The third highest involving the planting operation which is the main focus with human labour involvement labour of 15.65% and about 84.35 % of the operations energy expenditure.** This is not just tiring and laborious, but may impose threat to the health of the farmers due to the exposure of hard work on the farmers.

Concept of manual hand seeder

The Trans planter, was introduced to me at the time of my industrial training in Jabatan Partanian. During my time of training, it was brought to my notice by the fabricator, that I can use it for my final year project and if there is need, make some improvements.



1.3 Problem Statement

Small hold Farmers involved in sweet corn cultivation have little or no help in carrying out planting operations. There is less use of machinery in small hold farming of sweet corn cultivation. The need for small hold farmers to get appropriate hand tools to help them in the planting operation of sweet corn with minimal labour and maximized yield arises.

1.4 Objectives

The main objective of this study is to evaluate the field performance of handheld seeder against the handheld seedling Trans planter in manual planting of sweet corn.

The specific objectives are as follows:

1. To evaluate the field performances in preparing sweet corn seedlings in a plastic tray for the seedling Trans planter.
2. To compare the field performances in manual planting of sweet corn using a seeder and a Trans planter.
3. To compare the sweet corn plant growth parameters between the two methods of manual planting.
4. To recommend some design modifications for the performance and durability improvements on the sweet corn manual seeder and handheld Trans planter.

CHAPTER 2

LITERATURE REVIEW

Growing of crops, which involves seeding operation, which is one of the most important operations in farming, research, and inventions have been made to make the work of seeding in particular to be less tedious and profitable. Our focus in this study is on the crop sweet corn with the operation of planting the seed or in other words seeding to be precise. In the past years, many designs have been made for the seeding operations, so this project is importance because it will be working on the failures and the necessary designs which were not included in the past hand seeder designs to make them stronger and easily handled. Therefore, this project is about getting the appropriate tools to help make the work of local famers easier in terms of planting. The appropriate tool will follow the design concept of having a the hopper for the storage of the seeds, seed metering, seed delivery system, furrow opener to open the soil for the seed and the furrow closer to close the soil after dropping the seed.

Furthermore, different developing countries have designed and tested planting tools, but it turns out to be limited in number, which in turn affects high yield production, resulting in even slower adoptions. Study have shown that some researchers in some of the cases have reported flaws in performance of these maize planting seeder due to poor quality control during commercial manufacturing of these planting tools (Aikins et al., 2010). Designing a working planting tool that is durable and efficient requires putting into perspective conditions under which the tool will be used i.e. the nature of the soil, and understanding the people using those (Friedrich et al., 2009). Harman et al. (2017) makes it clear that the hand planter

development should be gender specific, because women are largely responsible for laborious and manual jobs at crop establishment.

A big issue arises as the most of the tools created are most not suitable for women to use as Harman et al. (2017) proves it or clarifies it that women are more involved in the manual work done most especially when it comes to seeding. Rather more complicated, heavy and less effective tools are made through which women have little or chance of using them. To evaluate the seeders more comprehensively, the hand seeders were compared qualitatively and economically. Technologies like the hand seeder are often not developed with the woman operator in-mind and assessments by female operators are a necessary step to achieve adoption of hand seeders

A great difficulty was found in seeders such as the Brazilian jab seeder and Chinese planting hoe due to its lack of ability to achieve a reliable and controlled seeding rate. The jab planter appears to be a promising tool that could be used potentially for reducing the drudgery of planting maize, and applying fertilizer in Ghana. A jab planter could enable the small-scale farmer work with improved timeliness and reduced drudgery (Ukatu, 2001). It is an easy-to-operate dibble instrument used in various types of soil, including untilled soil with stubble and tilled soil with or without residues from previous crops.

The jab planter comprises a seed hopper and fertilizer hopper mounted on wooden members which terminate in handles at the top and two metal 'beaks', or hole openers at the bottom. The beaks are pushed into the ground with the handles held apart. Once the implement has penetrated the soil, the handles are pushed together and this actuates the sliding seed metering mechanism in the bottom of the seed hopper. The seed falls into a delivery tube and into the hole produced by the

seeder beak. Therefore, the jabber has exhibited poor control of seed metering; such as lack of control of seed metering, which eventually leads to uneven planting density. (Aikins et al., 2010). According to (Haag 2008), seeding maize above the necessary or required rate leads to yield reduction as there is a high likelihood of negative competition stress at the growing stages. Wijewardene and Waidyanatha (1984) have indicated that in many parts of the world, maize is planted at one seed per hole and maximum yields achieved. For subsistence growers in particular, planting any unnecessary purchased seed can be cost prohibitive and excess seeding and thinning can be economically and socially unreasonable (Smith et al., 2002). Chim et al. (2014) showed that single seeding at 0.16-m spacing increased yields by 0.2 – 0.9 Mg ha⁻¹. This was compared to 2-3 seeds per hill at 0.48-m plant spacing. Chim et al. (2014) argues that single seeding not only improves homogeneity of the plant population but also decreases inter-plant competition and can improve yield potential.

A metered PVC pipe marked with 15.2 cm increments was used to maintain uniform distance between manually spaced seeding holes. Control of seed rate and density are crucial to achieve plant stand uniformity. Nafziger et al. (1991) explains that non-uniform plant stands can increase inter-plant competition and decrease yields. Others report that grain yields from diverse environments can be increased up to 3.4 bu. ac⁻¹ for every inch improvement in the plant spacing standard deviation (Doerge et al., 2002). The results from a study shows how important getting the appropriate spacing in between maize seeds. This study talks on two different spacing distance and the effect of each on the last farm operations of maize which gives that the highest maize grain yields (8.97Mg ha⁻¹) were harvested at 0.16m spacing with one seed per hill while the lowest yield (4.01Mg ha⁻¹) was obtained at

0.32m spacing with one seed per hill. Figure 3 illustrates the interaction for plant spacing and the number of seeds per hill on maize grain yield. Yield at 0.16m spacing decreased with number of seeds per hill while those at 0.32 and 0.48m spacing increased with number of seeds per hill, as also seen in 2012.

Source
Images: Accessed 7 July 2015,
<http://www.infonetbiovision.Org/default/ct/254/soilFertilityManagement>
<http://www.fao.org/News/2000/000501-e.htm>



Figure 2: Brazilian Jab

Source
OSU Images: Accessed 7 July 2015
http://www.nue.okstate.edu/Hand_Seeder.htm
http://www.nue.okstate.edu/Hand_Seeder/Uganda/topdress_b.jpg and Rebecca Harman, 2015.



Figure 3: OSU Green seeder

It was suggested that small-scale farmers could improve their efficiency through the use of a semi-mechanized hand planter (Ukatu 2001; Aikins et al. 2011). Although there have been numerous attempts to develop maize hand planters for farmers in developing countries, there have been few products developed that actually deliver individual maize seed. Aikins, Bart-Plange, and Opoku-Baffour (2010) compared 30 local hand planters with five different maize varieties and four different fertilizer rates. They noted poor quality control in manufacturing the planters and this was the cause of the poor performance. Oklahoma State University (OSU) developed a single maize hand planter (Green Seeder) capable of placing one seed at a time, with up to 80% single efficiency and 20% multiple seed delivery over a range of seed sizes (Omara et al. 2016). A close study also shows a comprehensive review and description that was made on the planter developed by the OSU, which could be also called OSU hand planter, which was marked out by Omara et al. (2016).

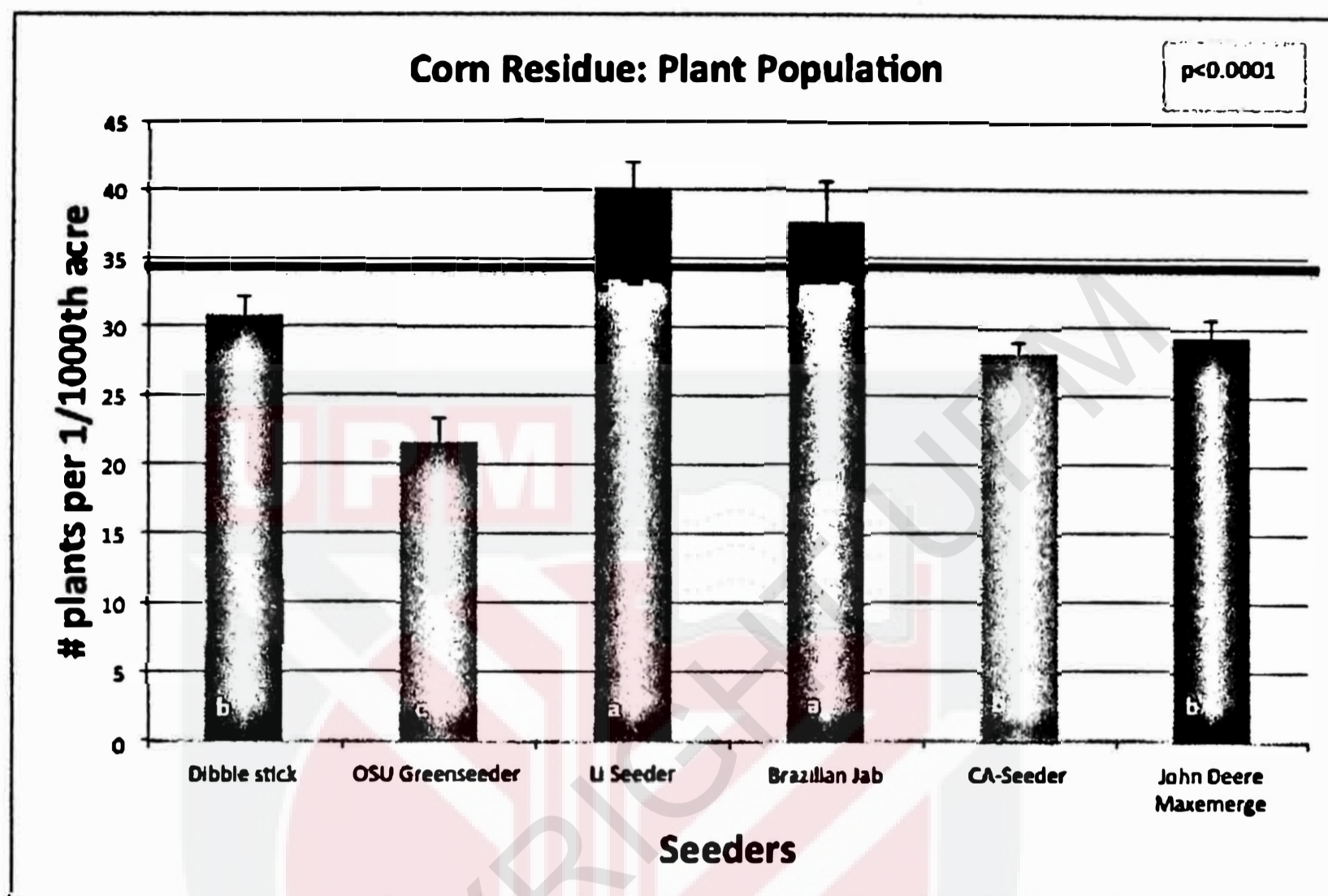
The OSU hand planter can be easily operated by striking the ground surface with the planter leaning towards the operator, keeping the tip in the ground and moving the handle forward and then removing the planter from that strike while moving forward. With each strike, a reciprocating drum rotates upward and receives one seed; excess seeds are removed by an internal brush, and each individual seed is dropped as the planter is relaxed (moving upwards), thus rotating the internal drum. It is an all-terrain hand planter capable of being operated in topographically steep slopes (hilly areas) that are not well suited to being mechanized. Planting with the OSU hand planter is less labor intensive than the traditional hand planting operation of making a hole, bending to drop seeds within the hole, and covering it with

surrounding soil. The drum cavity and angle (internal drum) have proven to be crucial for delivering a single seed per strike during operation of the OSU hand planter (Omara et al. 2016).

Previous testing has also shown that during planting, the depth to which the seed is planted can vary greatly. Heterogeneity of planting depth can lead to delayed emergence (Gupta, Schneider, and Swan 1988; Ford and Hicks 1992), and delayed emerging plants result in reduced yields (Nafziger, Carter, and Graham 1991; Lawles et al. 2012). Depth control (tip stop), recently installed, can aid in planting seeds at a uniform depth. This variable along with the different internal drums has not been comprehensively evaluated. This study was conducted to evaluate the effect of drum cavity size and tip-depth control on emergence and yield of maize using a new hand planter developed by OSU.

Significant differences were found between seeders ($p < 0.001$) with the Dibble Stick achieving the closest to 34,000 plants ac-1 (or 34 plants 1/1000th ac-1) desired density (31 plants 1/1000th ac-1) (Figure 17) (SAS output, Appendix 6.1). The Brazilian Jab and the Chinese Planting Hoe had significantly higher populations (38 and 40 plants 1/1000th ac-1 respectively). These two seeders both displayed similar difficulty: their seed meter mechanism was very sensitive to a harder soil surface and to residue, causing more seeds to be released than expected. The dibble stick was statistically the same as the John Deere MaxEmerge (29 plants 1/1000th ac-1) and the CA-Seeder (28 plants 1/1000th ac-1). The most archaic of instruments performed equally well to the most mechanized seeders in establishing a plant population—one would expect this degree of similarity given the dependability found in each. The OSU Green seeder had significantly lower plant populations than the desired 34 plants at 22 plants 1/1000th ac-1 operator notes indicate that seed

bounced off of residue from the moment it left the end of the hopper and fell toward the hole.



A Similar performance in the corn residue plots, the seed metering mechanisms in the Brazilian Jab and the Chinese planting hoe were easily disrupted by the impacts with hard soil surfaces and more seeds were dispensed as a result. The waste of seed in this instance indicates the need for improvement to the sensitivity of the seed metering mechanism if these seeders are to be employed on harder soil surfaces found in no-till environments.

CHAPTER 3

MATERIALS AND METHOD

3.1 Overview

In this project, we used the hand held sweet corn seeder for the seeds and the hand held planter for transplanting of seedlings. In this case, for the hand held seeder, samples of the physical properties of the sweet corn were taken with respect to the seed weight (gm), bulk density (gm/cm^3), thickness (mm), width (mm), length (mm) and moisture content (%). In conducting the physical properties, five (5) samples of five (5) sweet corn seeds were taken for the seed weight, five(5) samples for the bulk density, fifty (50) sweet corn seeds each for thickness, width and length and five(5) samples of five(5) sweet corn seeds for the moisture content. In the case of using the hand held planter for transplanting seedlings, seedlings were prepared in trays of four (4) and waited until it was mature for transplanting. Samples of the physical properties were taken with respect to total weight (gm) of the seedling plus the compost, plant height (mm), plant width (mm), soil-mass height (mm), plant weight (gm), soil-mass weight (gm). A plot of length 20.79m and width 2.42m was prepared starting from clearing, plowing, and the use of rotovator and levelling of the plot. The plot was also divided into two in order to carry out the test for both seeder and transplanting.

In the period of this project, equipment was used to aid in carrying out all the operations to make this project a success. Table 2 shows the tools and materials that were used and the function of each in this project.

Table 2: Tools and materials used in the methodology

No.	Machine/Tool Name/ Material	Purpose
1	Seeder	To plant seeds in the row of test plot
2	Trans planter	To trans plant seedlings in the row of the test plot
3	Measuring Tape	Measure the area of the test plot
4	Tray	For planting of seedlings
5	Electronic Measuring Scale	Weighing of sweet corn seeds physical properties (Bulk density and Seed weight)
6	Rods	To mark boundaries around test plot
7	Vernier Caliper	Measure sweet corn physical properties (Length, width and Thickness)
8	Rake	Spread and level the plot and to also remove stones from test plot
9	Shovel	Lifting of Soil
10	Wheel Barrow	Transportation of Soil into the test plot
11	Rotovator	Turning of soil for aeration

3.2 Description and technical specifications of hand held sweet corn seeder

The hand held sweet corn seeder shown in figure 6, also known as the Agricultural manual plastic single barrel hand corn seeder machine is a lightweight seeder made of plastic and stainless steel. The seeder has a hopper where the seeds are stored during a operation, it has a seed metering or numbering from 1-3 seeds which controls the number of seeds to be delivered. The seeder is also made up of a furrow opener which opens the soil and through which the seeds drops into the soil by free fall and lastly the spacer in order to get a proper space between seeds. The seeder has a spring which enables the seed metering to rotate and drop seeds according to numbering. This is possible by pushing the seeder into the soil by holding the handle and as soon as it is lifted up, the furrow opener opens and drops the seed/seeds.

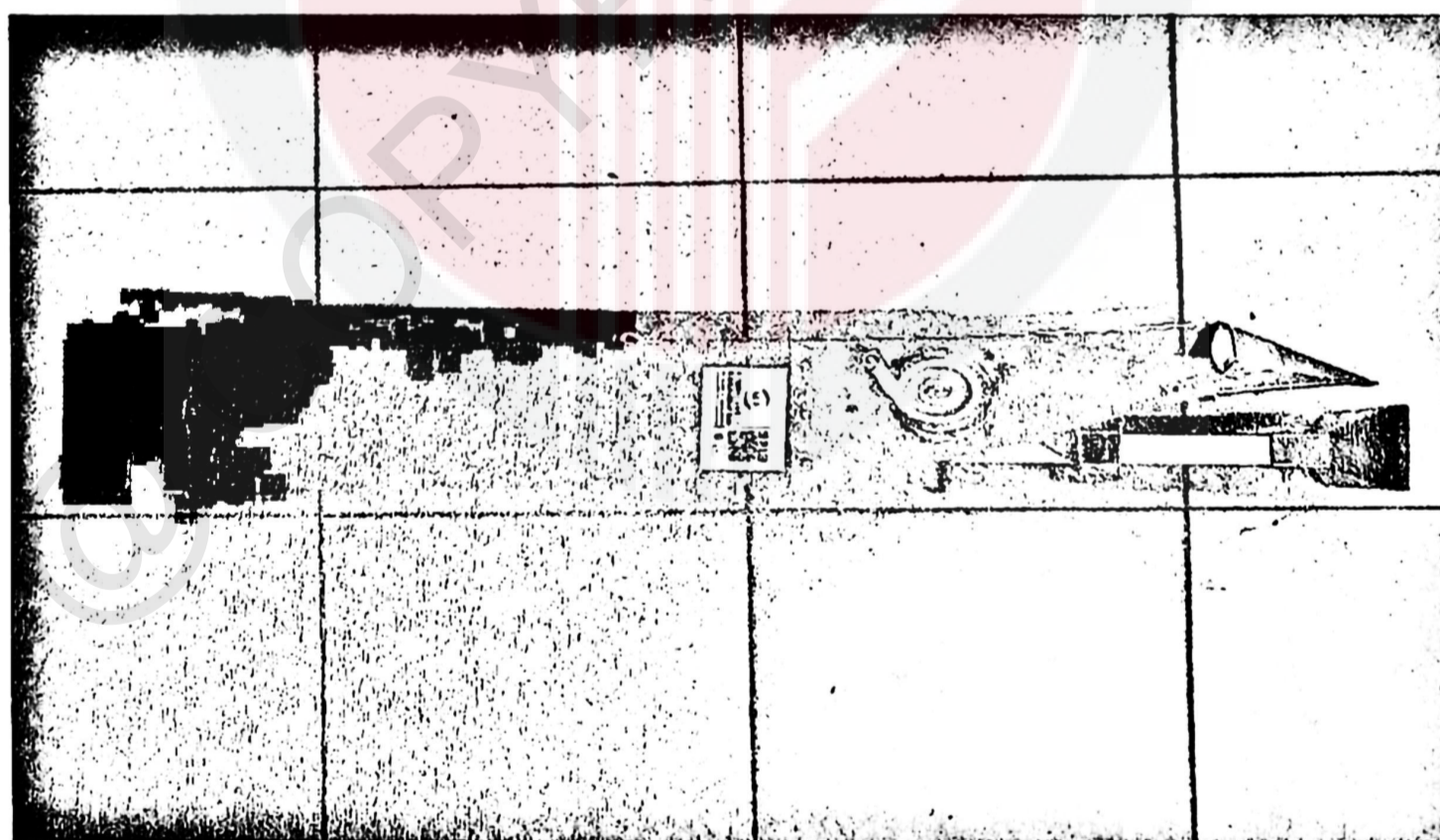


Figure 4: Manual sweet corn seeder

Table 3: Manual seeder technical specifications

BRAND	UNIT	ABK
Type	-	Manual Seeder
Usage	-	Planting Seeds
Seeding Number	-	1-3 seeds
Height	cm	39
Width	cm	41
Length	cm	82
Weight	kg	1.8
Tank	kg	3

3.3 Description and technical specifications of hand held sweet corn hand Trans planter.

The hand Trans planter shown in figure 7 is a machine made of galvanized iron, operated manually. The planter has a handle to hold and carry it about, next to the handle, there is a rod, which goes all the way down to the furrow opener, and this aids in opening the furrow opener by squeezing the rod against the handle. The rod moves back and forth with the aid of a spring around it. The furrow opener opens the soil for the seedling to be planted in the soil.



Figure 5: Hand held Trans planter

Table 4: Showing technical specifications of handheld sweet corn Trans planter

Type	Hand held Trans planter
Usage	Planting seedling
Weight	1kg
Diameter	7.5cm
Height	90cm
Metal	Galvanized iron
Seedling Number	1 seedling at a time

3.4 Determining sweet corn seed physical properties

In the method of determining the sweet corn seed physical properties, six (6) properties were considered which are the seed weight, seed length, thickness, width, bulk density and the seed moisture content. The materials used in getting the physical properties were:

- 250ml cylinder
- Vernier caliper
- Electronic Weighing scale

For the seed weight, since we wanted the average weight of the seeds, five (5) different seeds of five (5) samples were taken. The procedure involved taking the weight of the empty cylinder with known volume and record it and then came the weighing of the cylinder plus the seeds, this was done using the electronic weighing scale. At the end, the weight of the empty cylinder was subtracted from that of the cylinder plus the seeds in order to get the weight of the five sample of seeds. For the length, width and thickness of the seeds, fifty-(50) random seeds were selected and with the use of the Vernier caliper, the length, width and thickness was recorded.



Figure 6: Measuring Length, width and thickness of sweet corn seed with the use of Vernier caliper

In order to get the bulk density of the sweet corn seeds, a sample of the cylinder filled to the brim with sweet corn seeds was taken. This sample was repeated five (5) times with different sweet corn seeds in the cylinder, this was also done with the use of the electronic weighing scale as shown in Figure 7. The glass cap of the weighing scale was opened and the sample placed in the middle gently and then the glass closed back in order to get an accurate reading. After getting the weight from the calculation, the density was being calculated by dividing the weight over the known volume of the cylinder.



Figure 7: weighing of the bulk density

For the moisture content, five (5) seeds were selected randomly for five (5) different samples; the five seeds were put in five different tins of equal weight, and then weighed and recorded. The tins were put in an oven of room temperature and 105°C for 24 hours. At the 24th hour, the samples were taken out of the oven and weighed again. Note that the weight of the tin will be subtracted from the total weight of the tin plus the seeds to get the moisture content.



Figure 8: Tin samples of sweet corn for moisture content



Figure 9: Weighing of tin plus seed sample

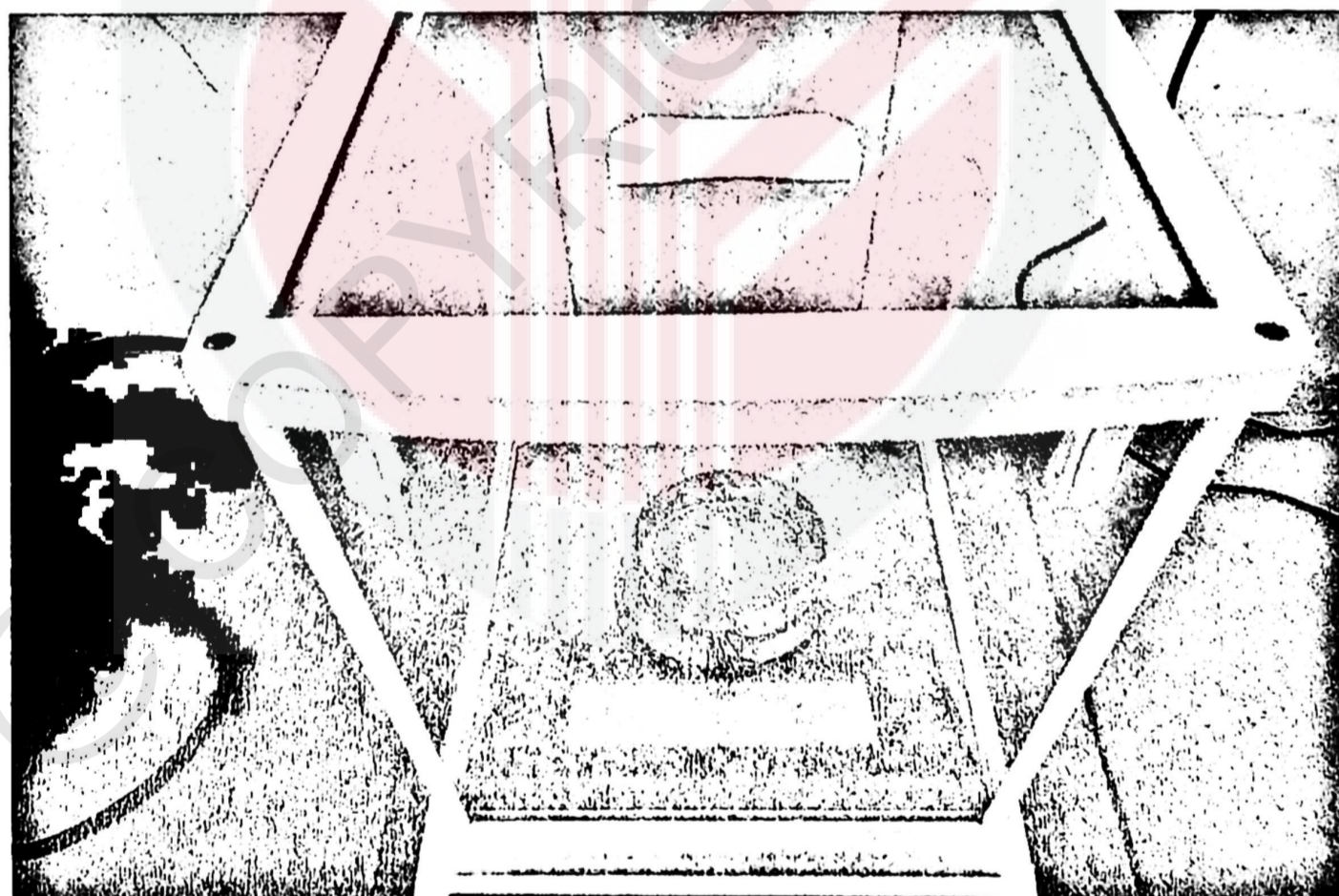


Figure 10: Sample in the Electronic weighing scale

3.5 Evaluating Field performance in sweet corn seedling preparations in trays

In the evaluation of preparing the sweet corn seedling in trays, the following was done tasks was done in order to evaluate its field performance. The pots in the tray were quarter filled with peat soil; one seed of sweet corn was placed in the center of each pot, again the pots were half filled with compost to cover the seed and four (4) granular of fertilizer was placed in each pot and finally each pot was again filled with peat soil to make it full. In fulfilling these entire task, time motion of each task was taken for all four of the trays.

For the first tray, the time motion started immediately the tray was picked up and placed on the time for the operation to start which was taking a hand full of compost in my hand and spread it in all the pots on the tray as shown in figure 11. The time was stopped and time recorded as soon as the first tray was done with and the same done for the rest of the trays.

The time motion was again taken as soon as a hand full of seeds were picked up from the seed bag and then placed one at a time in all the pots by placing them in the middle and pushing the seeds with the tomb into the compost soil as shown in figure 12. Again the time was stopped and recorded after the seeds were returned back to the seed bag and the same procedure was done for the rest of the trays. The time motion was again taken when a hand full of compost was taken from the bag to fill up the pots in order to get them half-filled and again the time stopped and recorded after the compost is returned to the compost bag.

Figure 13 shows the placing of the four granular fertilizer which was also done by taking the time motion with a stopwatch immediately a hand full of granules were picked from the bag. Four granules were pushed into the soil of each pot one at a time and the time stopped and recorded when the remaining granules were put back

into the bag. At the end of placing the granular fertilizer into the compost, another hand full of compost was used to finally fill the pot to the top and in carrying out this task, the time motion was also taken as the other task. These were the five tasks with four samples carried out during the preparation of sweet corn seedling in trays.



Figure 11: Filling pots with handful of compost



Figure 12: Placing of sweet corn seeds in tray pots



Figure 13: Placing of granular fertilizer in tray pots

3.6 Determining sweet corn seedling physical properties

In determining the physical properties of the sweet corn seedlings, we considered the Total weight of the seedling plus the soil, plant height (mm), plant width (mm), soil-mass height (mm), plant weight (gm) and soil-mass weight (gm) as shown in figure 14 and 15. In determining all these properties, five samples of seedlings after about two weeks were taken from each of the four trays.



Figure 14: Taking the height of seedling and compose

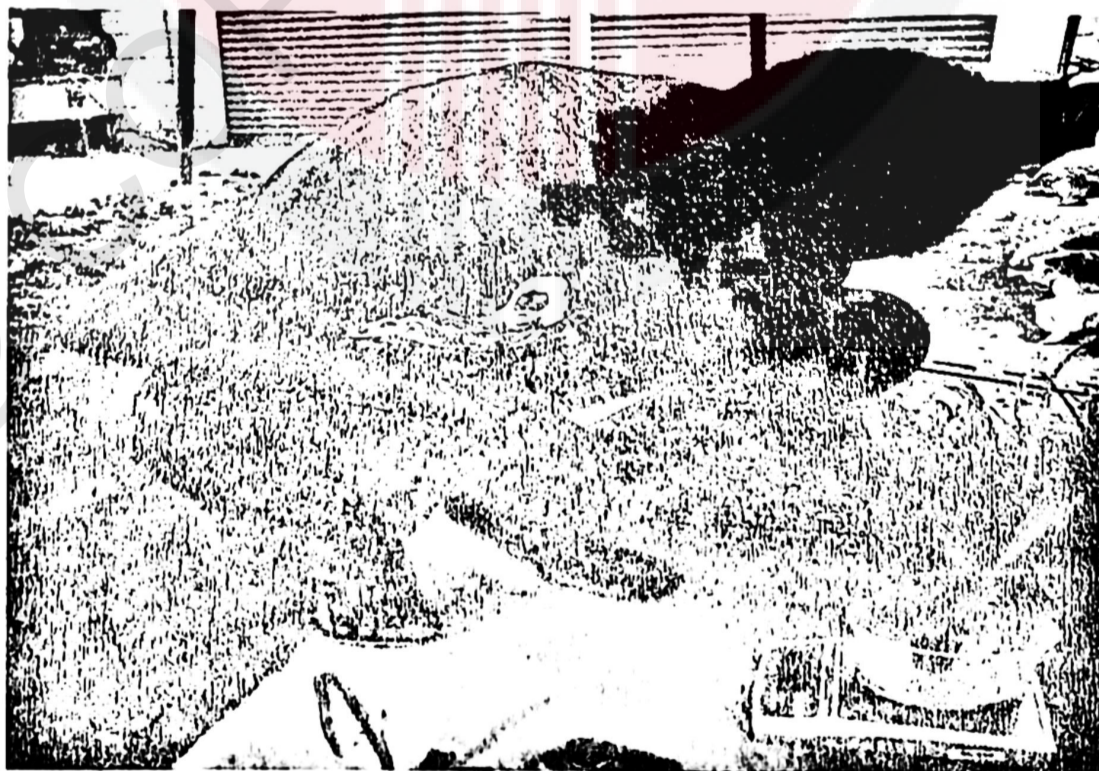


Figure 15: Weighing of the seedling and compose

3.7 Preparing test plot for hand held sweet corn seeder and seedling trans planter

As the plot is one of the essential things needed for the project, the preparation of the test plot started with the operation of clearing, plowing, and use of rotovator and adding and levelling of the soil, punching rods into the soil, measuring and marking of the plot for seeding and transplanting. The clearing was done with the aid of a long hand hoe to free the soil from all unwanted plants also known as weeds. The plowing was done with the use of chisel plow. This operation was done to loosen and break every chunk soil in the test plot.

Figure 16 shows the next operation, which was the adding of top soil to the test plot with the aid of a wheelbarrow and shovel. The other operation shown in figure 17 was the use of the rotovator in order to mix or turn the soil for more aeration and for the proper passage of water. Figure 18 then shows levelling the soil to make it even in the test plot. In order to set a boundary and proper maintenance of the test plot, six (6) rods were punch into the soil at both side of the plot, and strings tied round it from one end to another. There was also an operation of measuring and marking of the plot in order to get the required rows and spacing for the seeds.

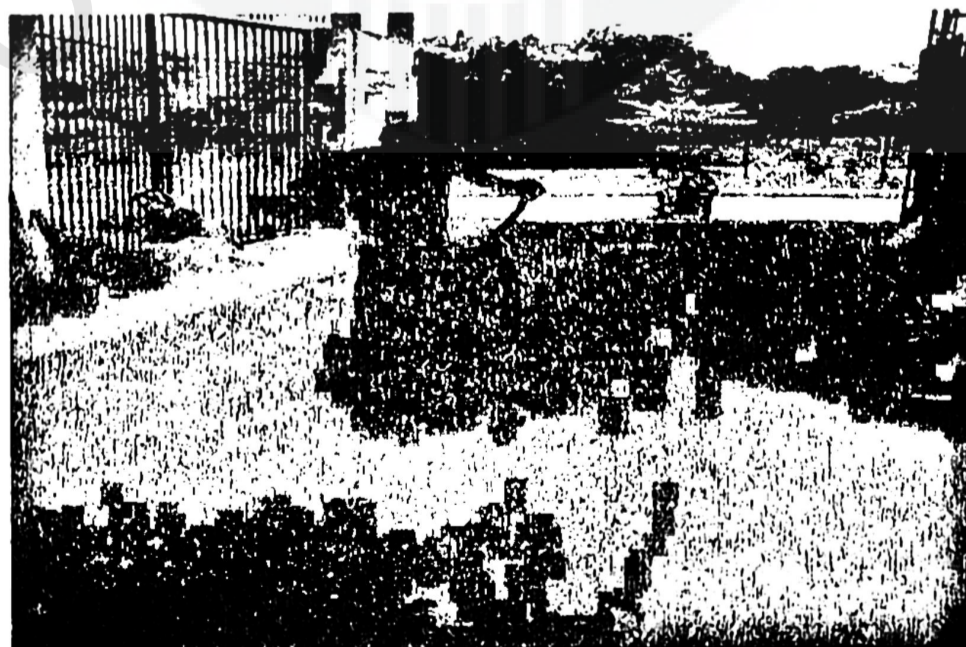


Figure 16: Adding more soil to test plot



Figure 17: Use of rotovator on the test plot



Figure 18: Levelling and spreading of the soil

3.8 Evaluating field performances of manual sweet corn planting using seeder

In evaluating the performance of the manual seeder in planting sweet corn, the actual performance of the seeder was taken based on an actual field. The evaluation was taken based on the operations which were carried out on the day of planting and a time motion of the whole process was done throughout the operation. The operations include:

- Filling seeds into the seeder
- Entering the field
- Planting seeds in a row
- Turning to the next row
- Returning to the filling point
- Filling seeds into the seeder
- Returning back to the field

The operation included the point of filling the seeder with the sweet corn seeds and the time is set to start as soon as the filling started and the time left running on as the person doing the planting walked to the row of the field to start planting. The time was stopped as soon as the person reaches the first row and the time recorded as. At the first row will be the second point where the time is started again as soon as the planter starts using the seeder and this goes on until the next point which could either be to refill the seeder or to begin the second row. Figures 19 and 20 shows the use of the seeder in the test plot.

In the case were the seeds in the seeder got finished, the time was stopped and recorded then immediately move to the point where the seeder was refilled. Note that Separate time was taken for that process of going to refill and coming back to

start using the seeder. The time was stopped and recorded when the first row was completed. The same process was done for the second row until the planting operation was done with.



Figure 19: Using the hand held seeder in sweet corn seeding operation



Figure 20: Covering of seeds

3.9 Evaluating field performances of manual sweet corn seedling transplanting using Trans planter

Evaluating the field performance of the trans planter transplanting seedling to the field is much similar to that of the seeder. The operations are similar except for that the trans planter was used. As shown in figure 21, a tray filled with seedlings was carried by the side with the aid of strings around the individual through the process and instead of refilling the tray, another tray was prepared beforehand and was picked up from the refilling point when the seedlings in the first tray got finished.

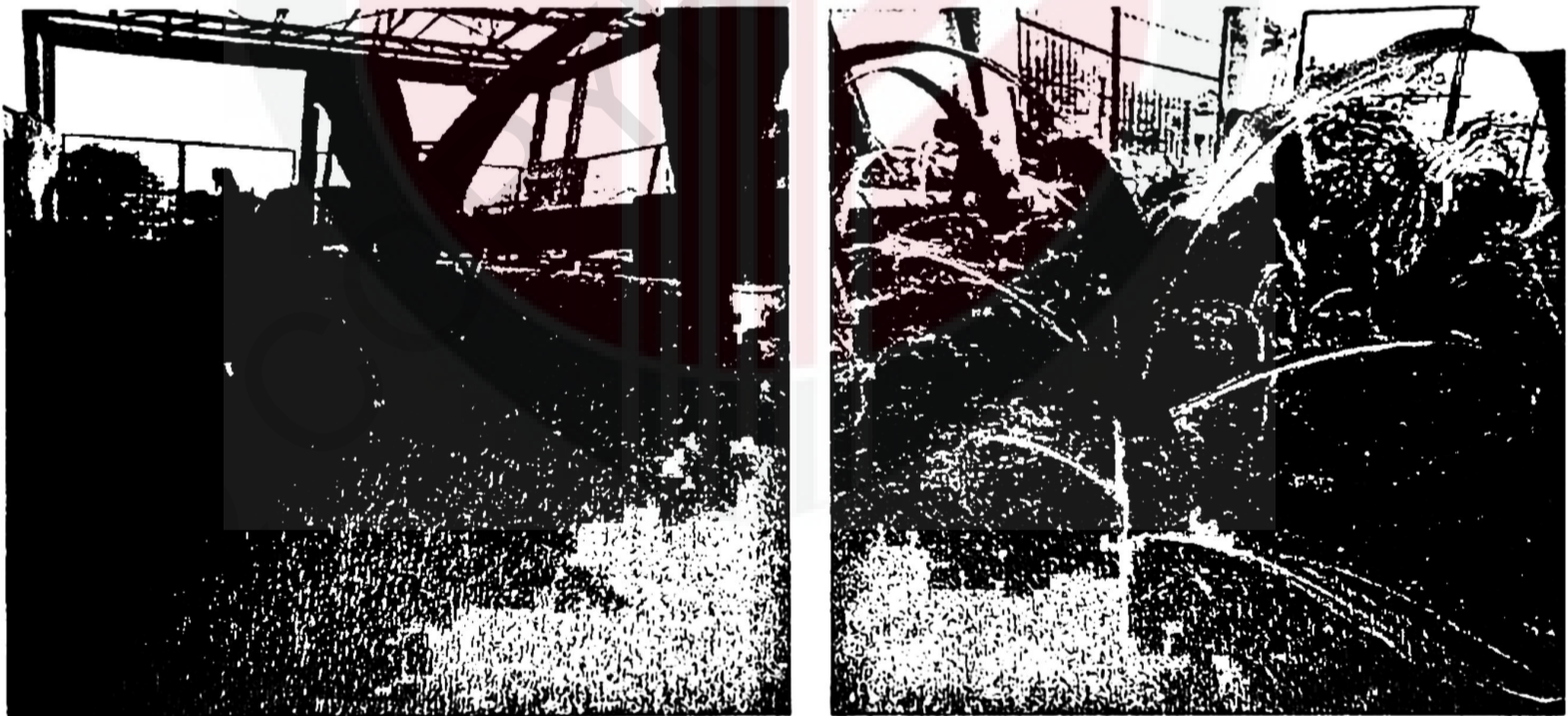


Figures 21: Picking of the seedling and dropping it through the trans planter; **a** Picking seedling from container; **b** Putting seedling in hopper.

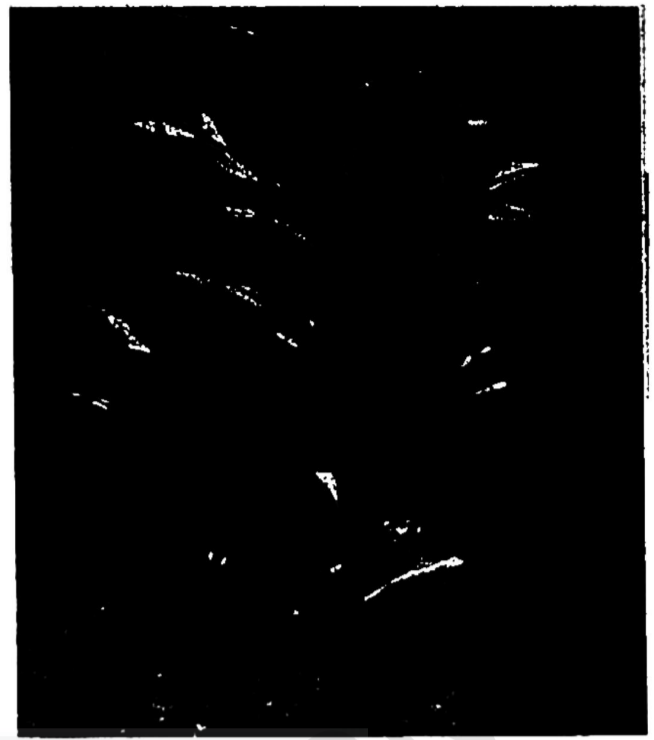
3.10 Monitoring plant growth performances

The monitoring of the crop growth was carried out about 5 and 10 days later. This was done for both rows on which the seeder and planter was used. For the germinated seeds on the side on which the seeder was used. This was done after 5 days. The height of the sweet corn plant was measured after 10 days, and the missing heads counted.

For the side on which the planter was used the same process is done of measuring the plants after 5 and 10 days. The missing or number of dead plants were counted and taken into record. The height of the plants also measured to take record of its growth. Figure 22 shows the plant growth at day 25 and the figures 23 shows the plant growth at day 40.



Figures 22: Growth of plants at 25 days old



Figures 23: Growth of plants at 40 days old

CHAPTER 4

RESULT AND DISCUSSION

Table 5 shows the activity and the time taken during the operation of using the trans planter that aided in getting the estimated field capacity in using the trans planter.

Table 5: Time motion study with Trans planter

ACTIVITY	TIME, SEC			TOTAL TIME	AVERAGE
	Replicate 1 Row 1	Replicate 2 Row 2	Replicate 3 Row 3		
Seedling preparation for trays	13:57.48	13:56.58	14:12.21	42:07.07	14:02.22
Seedling preparation for one pot	0:07.45	0:07.44	0:08.53	0:24.22	0:08.7
Trans planting operation using the trans planter	18:42.76	19:13.41	17:15.23	55:12.20	18:24.7
Time to plant one seedling using trans planter	-	-	-		8.1sec

Table 6 shows the activity that was done during the operation of using the manual seeder and the time taken in completing each activity. This aided in getting the estimated field capacity in using the manual seeder.

Table 6: Time motion study with manual seeder

ACTIVITY	TIME,SEC			TOTAL TIME	AVERAGE
	Replicate 1 Row 1	Replicate 2 Row 2	Replicate 3 Row 3		
Planting operation using seeder	07:24.28	06:22.82	06:32.67	20:20.57	06:46.59
Time to plant one seed using the seeder	-	-	-		3.4sec

Graph 1 compares the average height of plants using the two planting methods in this project, which are using the manual seeder and the trans planter. The results were taken when the seedling was transplanted to the test plot. As the results show, we can observe and see that the line showing the average height of plants using the manual seeder is most likely in a straight and increasing growth compared to the average height of plants using the trans planter. The average height of plants using the trans planter shown above in graph 1, has little increment in the growth of the plants. The reason for this might be the fact that sweet corn roots are fragile and therefore the seedlings which were transplanted suffered a bit of disturbance when they were being transplanted which worked as a disadvantage of slowing down the growing of the plants in terms of its height compared to the roots of the plants using the manual seeder which were not disturbed after it was planted.

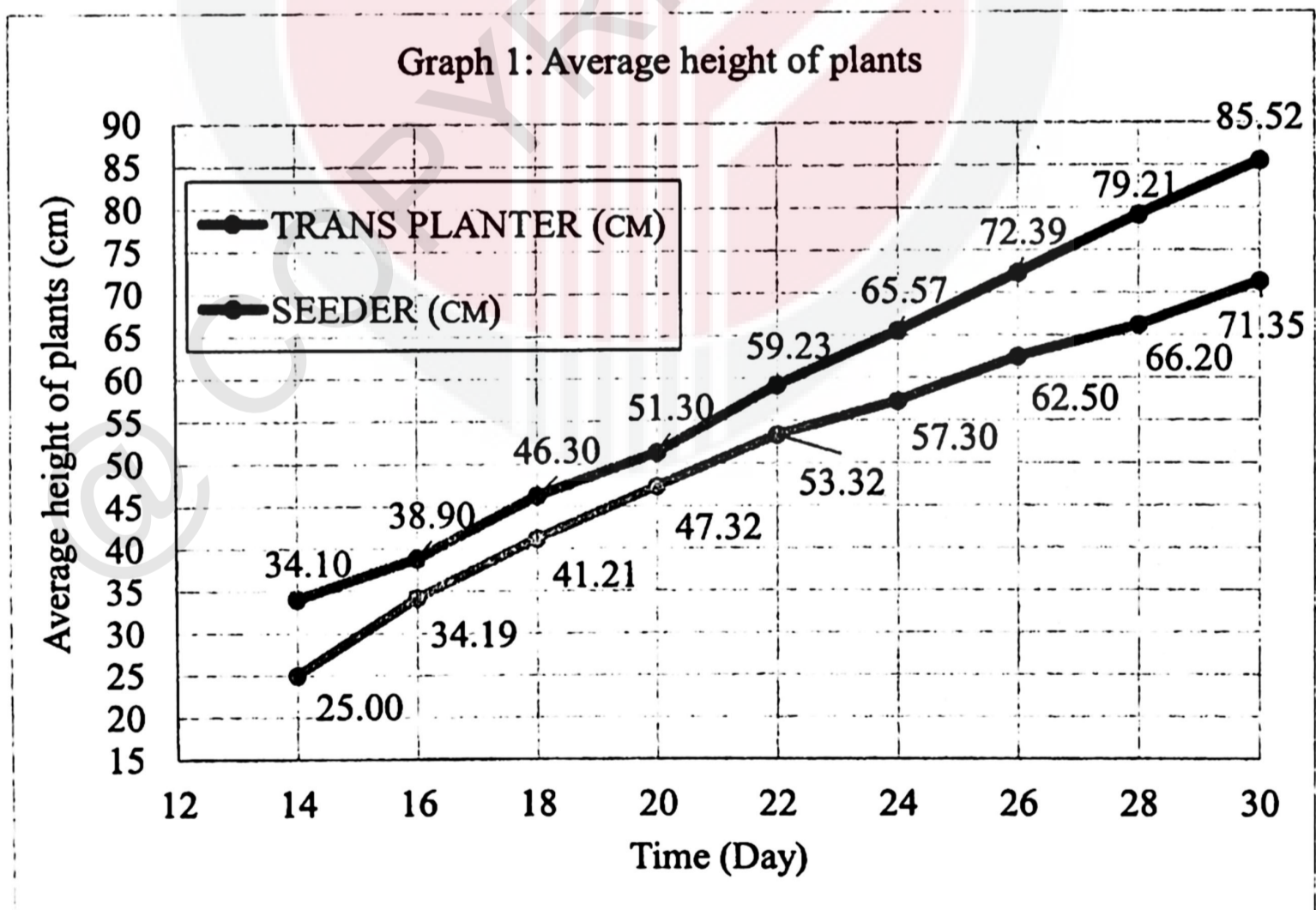


Figure 24 shows the percentage of the plants that survived between the two methods of using a manual seeder and hand held Trans planter. The results of plant survivability rate between the two methods of using the manual seeder and Trans planter shows that in terms of plant survival, using the trans planter is the best as it has a higher rate of average plants surviving and less rate of plants dying. The result of using the manual seeder shows the highest rate of average plants that did not survive and lowest survival rate compared to the Trans planter. The reason behind this may be that some of the small seedlings which are to be germinated from the seeds in the prepared soil stand a great chance of being attacked by mice, snails, fungal disease to name a few compared to the seedlings using the trans planter which were already 2 weeks old.

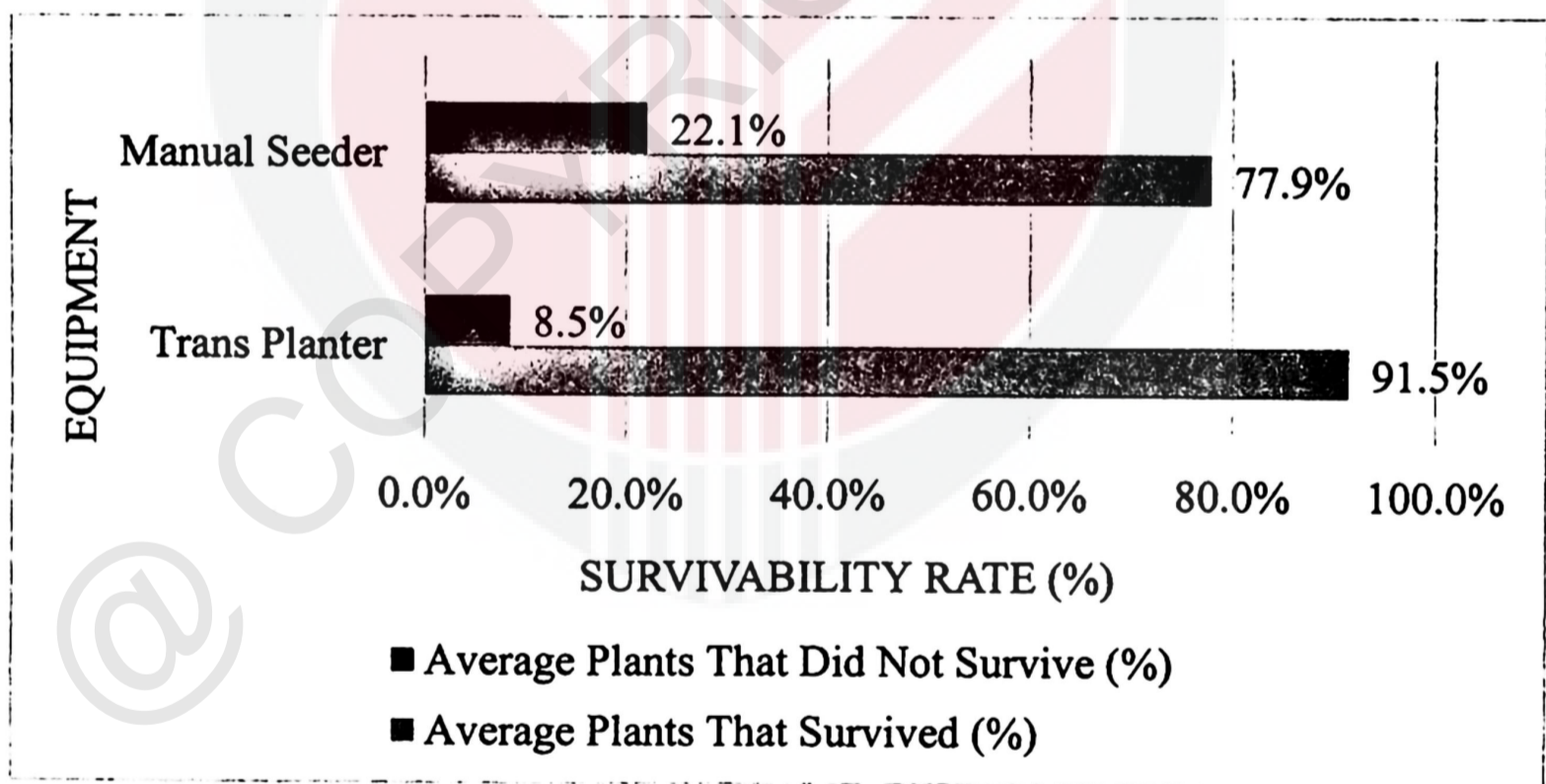


Figure 24: Survival rate of sweetcorn plant from two methods of planting

Table 7 shows the estimated field capacity using both methods, which is using the manual seeder and Trans planter. From the results, it shows that using the manual seeder based on the estimated field capacity, is better compared to using the Trans planter. The manual seeder gets to cover a land area of 3.1 hectare per hour, which doubles that of the estimated field capacity using the trans planter which can cover a land area of 1.5 hectare per hour. Using a Trans planter has greater setbacks, as the seedling needs to be carried for trans planting which tend to bring discomfort to the farmer or individual planting it

Table 7: Estimated field capacities of planting sweetcorn plants from two tested methods.

ACTIVITY	TRANS PLANTER (ha/hr)	SEEDER (ha/hr)
Estimated Field Capacity	1.3	1.5

Table 8 shows the physical properties of the sweet corn includes the average seed weight and average seed size (Diameter, cm x Length, cm). This involved taking the total weight of selected number of seeds and seedling. The total number of seeds and seedling selected divided this total weight of selected seeds. The same was done in getting the average size of the seeds and seedling. Therefore, an average seed weighs about 0.7grams and that of a seedling weighs 13grams. In terms of size, an average seed measure (0.6 x 0.9) cm in diameter and length, and a seedling weighs (2.0 x 27.6) cm in diameter and length.

Table 8: Physical properties

STAGE	AVG.WEIGHT (grams)	AVG.SIZE (Diameter, cm x Length, cm)
SEED	0.7	0.6 x 0.9
SEEDLING	13	2.0 X 27.6

CHAPTER 5

CONCLUSION

In this study, the field performance in preparing sweet corn seedling in plastic was evaluated; both the manual seeder and Trans planter were tested and evaluated in a test plot; the plant growth using the manual seeder and trans planted were also compared based on monitoring the plant growth. From the results of the study, in conclusion, the preparation of the seedlings takes about two weeks of the time before trans planting, while using the seeder involved direct planting to the field. In terms of field capacity, the manual hand seeder has a field capacity of 1.5ha/hr, while the handheld Trans planter has a field capacity of 1.3ha/hr. This making the manual seeder covering 0.2ha/hr ahead of the trans planter in terms of field capacity. In the case of comparing the plant growth parameters in terms of height, based on the results shows in (graph 1), the height of plants using the manual seeder is higher than the heights of plants using a hand held trans planter. In terms of plant survival rate between the two methods of planting, using the manual showed 22.1% higher of average plants that did not survive and 77.9% lower of average plants that survived while the use of the hand held trans planter showed 8.5% lower of average plants that did not survive and 91.5% higher of average plants that survived.

CHAPTER 6

RECOMMENDATION

Manual Seeder

The area of the stand, which supports the manual seeder, is recommended to be bigger in order to have a firm stand in the soil and not sink in. Another is that, it is recommended that the manual seeder have adjustable heights to aid the comfort of every user.

Trans Planter

It is recommended that a section be made for the application of fertilizer in order to make the operation of planting and applying fertilizer one. Another recommendation is that, a proper metering system be made to give proper spacing for the roots of the plants.

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