

Design And Development Of Electric Multiseed Sowing Machine

Asif Inamdar^{*1}, Md. Wahid Ansari^{#2}, Pushkar Mansabdar^{#3}, Abhishek Gujar^{*4}, Dr. V. D. Patil^{#5}

[#]Department of Mechanical Engineering, SITS Narhe, Pune, affiliated to Savitribai Phule Pune University, Pune.

¹asifinamdar789@gmail.com, ²wahidbgp1997@gmail.com, ³pushkarmansabdar@gmail.com, ⁴abhisitsgujar@gmail.com, ⁵vdpatil_sits@sinhgad.edu

Abstract

The seed ploughing and sowing is one of the important process in agriculture. The various techniques used for seed sowing placement are manual, Ox and tractor operated. The manual and Ox operator technique are time consuming and requires more labour. In standard cultivator equipment (tractor operated) the distance between furrows is fixed i.e. the spacing between the seeds is same for all types of seeds this leads to improper utilisation of land and can also affect the crop yield. Also, tractor runs on fossil fuel which emits particulate matter and other pollutants every second. To overcome this issue an alternative solution needs to be required which will also be helpful to the farmers to improve the productivity. While reviewing the conventional methods of sowing it is observed that there is possibility of uneven placement of seeds in terms of depth at which it should be placed & spacing of sowing which depends on seed's type. At present in manual, Ox or use of tractor does not have control on these parameters. For better yield and optimum utilization of land, it is necessary to have proper design of machine which can able to perform the specified task depending on type of seeds and soil. Hence, to overcome this problem and to reduce human effort there should be a system which will work on battery and be able to control the depth and space issues depending on seed types. This paper reviews the required parameters (like- torque, force, distance etc.) for the design of electric multiseed sowing machine that can be useful for different seeds and soil. From the previous available data after analysing, it is decided to use 750 watt, 48 V, 450 RPM BLDC motor for electric multiseed sowing machine. By additional attachment this machine can also perform ploughing and weeding operation thereby saving additional labour and time.

Keywords— Sowing, Ploughing, BLDC Motor.

I. INTRODUCTION

Agriculture is the backbone of Indian economy and it will remain continued. Generally cultivation of any crop involves various steps like seed selection, field preparation, fertilizing, sowing, irrigation, germination, weed removal, vegetative stage, flowering stage, pesticide spraying, and fruit formation stage, harvesting and threshing. Farmer has to use various agricultural equipment's and labours for caring out those steps, our purpose is to combine all the individual tools to form a multipurpose equipment which reduces the overall equipment cost and labour cost and also increases the yield of the crop by using advanced farming method [1].

The present cropping intensity of 137 percent has registered an increase of only 26 percent since 1950-51. According to study the net sowable area in India is 142 Mha [2]. The basic objective of sowing operation is to put the seeds in rows at desired depth and 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 agricultural and climatic conditions to achieve optimum yields. A traditional method of seed sowing has many disadvantages like, there is no control over the depth of seed placement, no uniformity in distribution of seed placement, requires

more number of seeds, time required for sowing is more, more labour required, as the distance between two seeds is uneven there is no proper germination of seed [1]. Also, use of tractor is costly and creates environmental pollution in the form of particulate matter, NO_x and other harmful pollutants that are hazardous to human health and also requires additional efforts to control these emissions [6]. Thus, an efficient machine should attempt to fulfil these requirements, which can save operation time, labour and energy as additional advantages to be derived from use of improved machinery for such operations.

For the development of system it is necessary to understand the work to be performed in agriculture field. The study was done to find out various conditions that are important for farming and one of them is seed sowing. Following are the different types of seed sowing methods:

- *Broadcasting*: - The seeds are thrown randomly with hand is known as broadcasting. In this method the field is feeded by throwing the seeds over the field. Due to this field planted roughly in rows, but having uneven growth of plants.
- *Dribbling*: - In this method more number of labours makes small holes in ground and then they put the seed's in hole, then it is covered with soil.
- *Drilling*: - In this method seeds are dropped in holes with the help of manual seed drill or can use tractor to drill [1].

Since, at present there are certain issues which still need to be taken care, hence it has been decided to search for alternative solution that may be economical and more efficient. For this an electric multiseed sowing machine which can perform ploughing and sowing operations at the same time, may become possible alternative solution[11][13]. This machine may be helpful in ploughing and sowing of seeds in a desired position and depth thereby assisting the farmers in saving time and money. Thus, this paper reviews different types of methods of seed sowing with respect to seed's placement and depth along with type of soil which will be helpful for the development of system.

II. LITERATURE SURVEY

According Prof.Swapnil Umale et.al spacing and depth plays very important role for better output. They mentioned about the basic requirement to develop machine that will be helpful to human being. According to them the traditional sowing methods have numerous drawbacks which lead to low yield in agricultural field [1].

Fen lu et.al studied and explained the relation of soil and seed effect for better yield on depth and spacing. The row to row distance between various seeds is different so the seed metering unit calculations based on the various seed requirements are very essential. The author also explained design parameters which are helpful in the design of furrow for ploughing process [3].

AkhileshYamsani et.al reviewed on various track condition and vehicle types for calculating tractive force overall weight of vehicle, pulling force and rolling resistance. This paper gives us basic information related to tractive force which is done on the basis of rolling resistance, aerodynamic resistance and gradient resistance. According to author while designing the vehicle various performance goals kept in mind are speed, torque, power, economy, acceleration and restivity of vehicle [4].

K.W.E. et.al described about the recent and future advancement in the electric vehicles. They mentioned the basic information of different types of motors and batteries used in the electric vehicles propulsion system and also comparison between them. They gives information related to the parameters required for designing of electric vehicle [5].

III. METHODOLOGY AND WORK

From the review it is observed that use of electrical vehicle may provide better alternative solution for agricultural field. Hence to provide better solution there is an utmost need to design and develop a machine that will perform sowing & ploughing operations for different types of seeds which will also control depth and distance depending on the seeds to sow in the field.

The fig.1 shows the schematic representation of Electric battery operated Multiseed Sowing Machine which may be able to perform sowing and ploughing operation by minor adjustments.

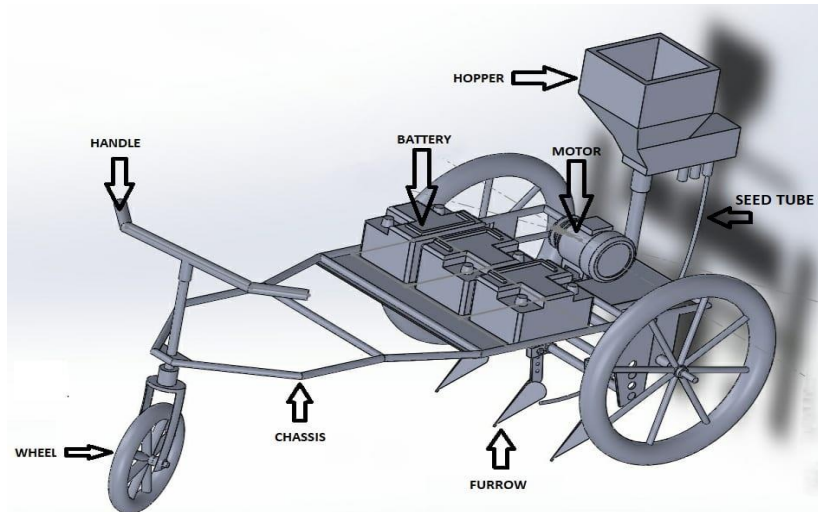


Fig I .SCHEMATIC REPRESENTATION OF MULTI SEED SOWING MACHINE

From the figure it can be seen plough is connected to the Frame using fasteners and ploughing of the soil is performed, later during sowing seed drill is attached to the frame along with leveller for levelling of soil for sowing , the seeds stored in the seed box. The disc picks up the seeds from the seed hopper and drops them to the furrow through the seed tube as shown in Fig I. After the seed is dropped at a specific distance, seed covering device will cover soil over the seed. After germination of seed takes place, weed are also developed in the field [12]. By replacing the seed drill by weeding tools arrangement we can use it for weeding purpose. Weeding blade is attached in inclined position such that it uproots the weeds. For the large farm to increase effectiveness multiple hopper can be attached.

IV. DESIGN CALCULATION

Design calculations were carried out by considering standard tractor specifications of model John Deere 5039C which having 39 HP power @ 2100 RPM [9]. Normally the cultivator which is used for the tractor has 9 Furrows as shown in fig II, so the torque required for one furrow is calculated. Ploughing Force and Torque required for number of furrows calculated and tabulated in Table No 1. Tractive effort calculated by using tyre rolling resistance, force due to gradient, aerodynamic drag. The total force is calculated by addition of tractive effort and pulling force required for ploughing [4] [7] [8]. Torque calculation for motor and shaft calculated and mentioned in table No 2.



Fig II. JOHN DEERE TRACTOR PLOUGHING EQUIPMENT [10]

TABLE I
PLOUGHING FORCE AND TORQUE REQUIRED FOR NUMBER OF FURROWS

No. of Furrow	Force (N)	Torque (Nm)
1	48.19	14.69
2	96.39	29.38
3	144.58	44.07
4	194.78	58.76
5	240.97	73.45
6	289.17	88.14
7	337.36	102.83
8	385.56	117.52
9	433.75	132.21

TABLE II
TORQUE CALCULATION FOR MOTOR AND SHAFT (calculated for 3 furrow)

RPM	Motor Torque (Nm)	Shaft Torque (Nm)	Velocity (Km/Hr.)
50	143.23	449.72	1.829
100	71.61	224.85	3.658
150	47.74	149.9	5.489
300	23.87	74.95	10.978
450	15.91	49.95	16.467

Parameters required were can be found by taking reference from John Deere tractor 5039C. Table I shows the torque required which is calculated by assuming the system is having 3 furrows. From the table it can seen that for developing electric seed sowing machine a 750 watt, 48 V, 450 RPM BLDC motor is suitable which provides us the required torque listed in Table II . For the power source due to cost constraints lead acid battery will be selected although Li-ion batteries have more efficiency [4] [14] [15].

Gear ratio Calculation of seed metering disk is done with the help of diameter of wheel, seed to seed spacing, row to row distance, by considering rotation of tyre. Time and distance calculation is done as shown in Table III for the equipment by considering standard seed spacing for various seed. It will need 54 min to cultivate 1 acre farm.

TABLE III
TIME AND DISTANCE FOR SEED SPACING [1]

Seed Type	Row to Row Distance (cm) [1]	Distance (Km)	Time (Min)
Wheat,Rice,Bajra	20	6.82	81.84
All kind of Bajra,Gram Soybean,pea,groundnut, sesamum	30	4.55	54.6
Sunflower	40	3.4	40.8
Jawar,Maize	45	3.03	36.36

V. CONCLUSIONS

Parameters required were found out for the design of electric multi-seed sowing machine. For the ploughing with 3 furrows the maximum torque is 44.07 Nm and the force required for the ploughing is 144 N. The motor torque required is 15.91 Nm and shaft torque required is 49.95 Nm for the 3 furrows for this 750 watt, 48 V, 450 RPM BLDC motor is suitable. According to seed types and standard seed to seed spacing the time and distance required with the 3 furrows for the seed sowing for 1 acre area is calculated. Some of the additional features can also be implemented in this machine like introduction of Cutter in place of drill can be used as grass cutter equipment, by using IOT based steering mechanism in this equipment, water dripping unit could be included in seed sowing machine for irrigation purpose.

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