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THEORETICAL DEVELOPMENT OF RICE TRANSPLANTING MACHINE

Chetan Chaudhari

* Student At Mechanical Engineering Department, Government College of Engineering Aurangabad, India

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ABSTRACT

As in India, the plantation cost is increasing day by day. As such time the efficiency of production is decreases. One of the reason behind this is the cost of labourship, availability of labours and the expenses during the farming. So my project is basically on the modification on such processes. For that I have designed the mechanical rice-transplanter machine which will be replacement of manual plantation process. My study is based on theoretical development of mechanical rice-transplanter and the basic design on the CAD-CAM software. For the design I have taken some consideration and designed a mechanical rice-planter. In the design padded wheel, gear drive and planting finger plays important role. As per the working of the rice-transplanter I have worked on some calculation area and find that it will be approx 95% or more than that efficient than the manual planting process for the samearea of planting. The design will be little complex due to the relative driving between the padded wheel and spur gear. Design involved the selection of padded wheel, spur gear assembly, belt drive and base design.

KEYWORDS: Design, Moving velocity, Efficiency.

INTRODUCTION

Rice is a major food grain crop of world. Unlike upland row crops, cultivation of low land rice crop is a labour intensive process. In spite of the common belief of availability of surplus agricultural labours in India, there actually exists a scarcity of skilled agricultural workers during the peak transplanting seasons. If this operation is not done in time the yield goes down. In view of this, there is an urgent need to mechanize this operation. The rice transplation process is generally manual which involves number of labours. The process of manual ricetransplantation is not so efficient as compared to the mechanical ricetransplantation. Machine transplanting using rice transplanters requires considerably less time and labour than manual transplanting. It increases the approximate area that a person can plant. The fig. shows the distribution of food grain production which shows the rice production is major in India.

Figure:

Table 5.2 Production of Major Agricultural Crops

(Million Tonnes)

S. No.	Crops	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2011-12	2012-13	2013-14	2014-15*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	Foodgrains	50.82	82.02	108.42	129.59	176.39	196.81	244.49	259.29	257.13	265.04	252.68
	Rice	20.58	34.58	42.22	53.63	74.29	84.98	95.98	105.30	105.24	106.54	104.80
	Wheat	6.46	11.00	23.83	36.31	55.14	69.68	86.87	94.88	93.51	95.85	88.94
	Maize	1.73	4.08	7.49	6.96	8.96	12.04	21.73	21.76	22.26	24.26	23.67
	Coarse Cereals	15.38	23.74	30.55	29.02	32.70	31.08	43.40	42.01	40.04	43.29	41.75
2	Pulses	8.41	12.70	11.82	10.63	14.26	11.08	18.24	17.09	18.34	19.25	17.19
	Gram	3.65	6.25	5.20	4.33	5.36	3.86	8.22	7.70	8.83	9.53	7.17
	Tur (Arhar)	1.72	2.07	1.88	1.96	2.41	2.25	2.86	2.65	3.02	3.17	2.78
	Lentil (Masur)	–	–	0.37	0.47	0.85	0.92	0.94	1.06	1.13	1.02	–
3	Oilseeds	5.16	6.98	9.63	9.37	18.61	18.44	32.48	29.80	30.94	32.75	26.67
	Groundnut	3.48	4.81	6.11	5.01	7.51	6.41	8.26	6.96	4.70	9.71	6.56
	Rapeseed & Mustard	0.76	1.35	1.98	2.30	5.23	4.19	8.18	6.60	8.03	7.88	6.31
	Soyabean	–	–	0.01	0.44	2.60	5.28	12.74	12.21	14.67	11.86	10.53
	Sunflower	–	–	0.08	0.07	0.87	0.65	0.65	0.52	0.54	0.55	0.42
4	Cotton #	3.04	5.60	4.76	7.01	9.84	9.52	33.00	35.20	34.22	35.90	35.48
5	Jute & Mesta @	3.31	5.26	6.19	8.16	9.23	10.56	10.62	11.40	10.93	11.68	11.45
6	Sugarcane	57.05	110.00	126.37	154.25	241.05	295.96	342.38	361.04	341.20	352.14	359.33
7	Tobacco	0.26	0.31	0.36	0.48	0.56	0.34	0.88	0.75	0.66	0.74	–

Fig -1: Production of Major Agricultural Crops

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NECESSITY

As India is the most developing country all over the world, it is very important to improve in each and every field. Agriculture is the major business in India and hence it is very important to develop it. For that we have worked on the plantation process of rice, and we find that the manual rice transplantion process is slow and also the cost is more. Hence it is very important to find the modified method so that the plantation process will be more effective and low in cost.

OBJECTIVE

The main objective to design this rice transplanter is to develop the simple system which will be easy in handling and lower in cost. The engine based ricetransplanter machine can also be used, but to make easy working and lower cost we have designed the manual rice transplanter.

SYSTEM DISCRIPTION

Padded wheel

It is the most important part of the transplanter which will perform the job to travel the machine in the mud. It is designed in simple way having the flat teeth which can be easily be in the mud. Padded wheel provided with six fins, when the manpower will push the machine the wheel will rotate with the fins and hence gear will rotate and power will get transmitted.

Figure:

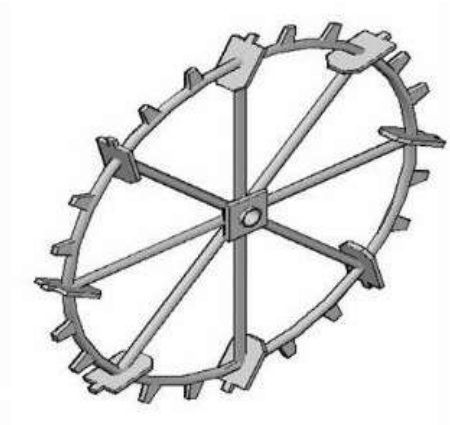

Fig -2: Padded Wheel

Gear wheel drive

The belt drive is used to power transmit so that the power will betransmitted. The large gear will be on the same shaft with the padded wheel and smaller gear will be on the another shaft with the planting finger.

Figure:

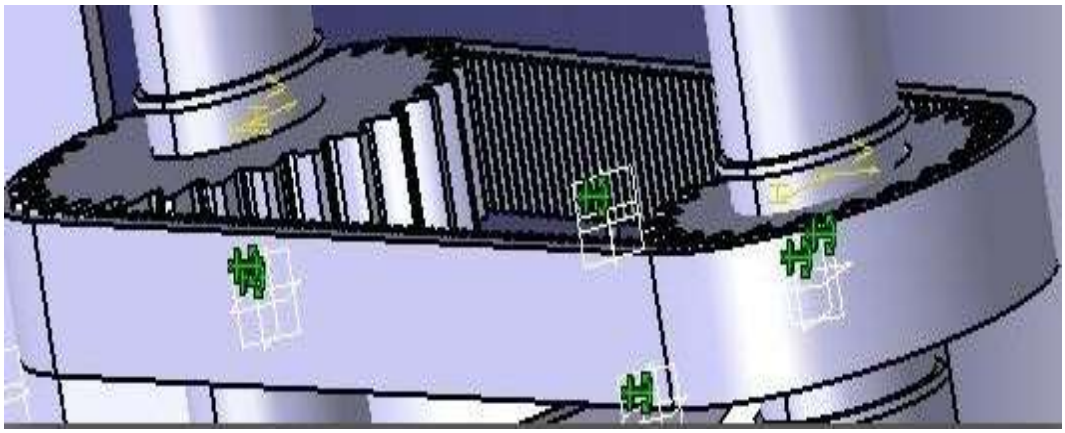

Fig -3: Gear Wheel Drive

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Planting finger

The planting finger is the man element which is responsible for the plantation of the nursery seed. It having the specific shape which pick the nursery seed and plant in mud. It oscillate at certain angle and it is called as fixed fork mechanism.

Figure:

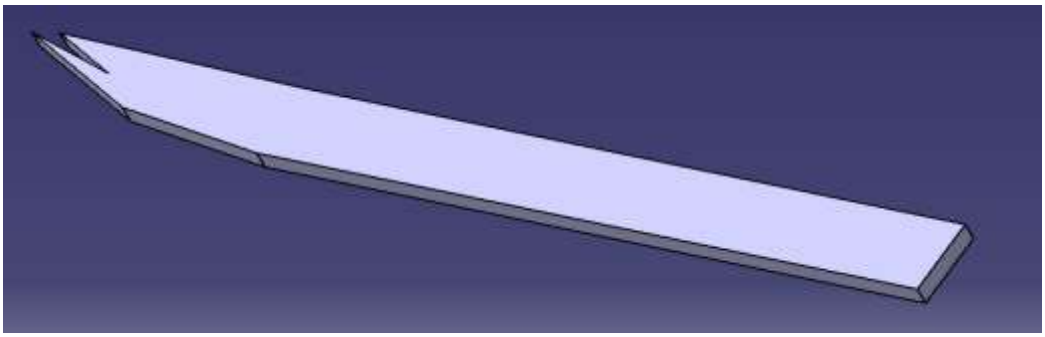

Fig -4: Planting Finger

WORKING PROCESS

As the process is manual the worker has to provide the initial motion. When the rice transplanter eill move forward the padded wheel will get rotate. The wheel is provided with the fins so that it can travel easily in the mud. Then we have larger gear is provided on the same shaft with the padded wheel and hence at the same time gear will also rotate. The larger gear is in engagement with the smaller gear by using the belt drive. As the power will get transmitted to the smaller gear, it will rotate. On the same shaft planting finger will be fixed through the linkage so that it will oscillate for certain angle. As the drive is provided by the worker it will not have high speed and hence through this gear arrangement we have increase the planting finger speed. As the planting finger will oscillate, it will pick the nursery seed from the seedling mat and planted in mud. The planting finger is designed in such a way that nursery seed should be easy to pick during the motion and also it should pick during the downward motion only.

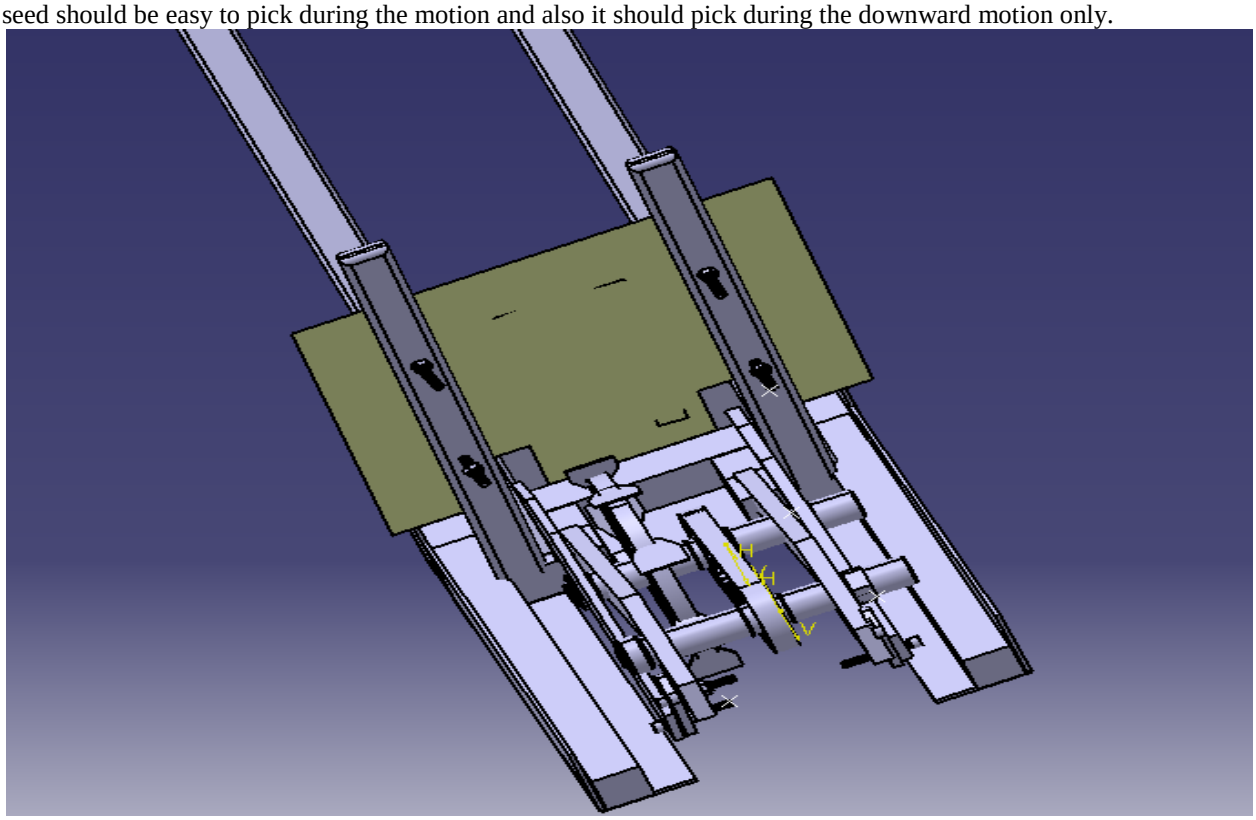

Fig -1: Rice Transplanter Design

SYSTEM CALCULATION

After the design of this machine on CATIA we have worked on system working process and calculations.
For the calculation process we have done few assumuptions such as moving velocity and padded wheel diameter.
Moving velocity= 0.5 m/s
Wheel diameter= 23 inch
Rpm of padded wheel= $(v\times60)/(\pi\times23\times0.0254)$
= 16 rpm
Seeding hill distance: It is the distance between two nursery seed point along the motion of the machine.
Let, seeding hill distance= 15 cm
Row distance: It is the horizontal distance between two nursery seed.
Let, row distance= 20 cm
Circumference padded wheel= $\pi\times D$
$= \pi\times23\times0.0254$
= 1.835 m
= 183.5 cm
Distance travelled during seeding within 1 rev.= 183.5/15
= 12.23 cm (consider 12 cm)
$(Travel/Hill)=(N_{wheel}/N_{seeder})= 12$
$(16/N_{seeder})= 12$
N_{seeder}= 192 rpm
Verification step:
Hill distance= (Vwheel/Nseeder)
$= (\pi\times23\times2.54\times16)/192$
= 15.28 cm……..(nearly same as 15 cm)
So, in this way we have calculated the rpm of both the gears. Now, we will compare the plantation rate of machine transplantation process with the manual plantation process.
We have ideally consider that 12 hrs will require to plant the single hectre of land by using 20 skilled labour.
Therefore, No. of total requirement= 12×20 hr.man/hectre
= 240 hr.man/hectre
Let,
Planting speed= 2 hill/sec
Row distance= 20 cm
Hill distance= 15 cm/hill
Rate of area covered= (Planting speed)×(Row distance)×(Hill distance)
$= (2)\times(20\times10^{-2})\times(15\times10^{-2})$
$= 0.6\ m^2/sec$
$= 2160\ m^2/hr$
Completion time= 1/Rate of area covered
= 1/2160
$= 4.62\times10^{-4}\ hr/m^2$
= 4.62 hr/hectre
This is the completion time for single by single labour, so here we have not consider the timing for the installing the nursery seed on the machine, the timing for the turns during the plantation, etc.
By considering this all,
Completion time by using machine= 6 hr.man/hectre
So, by comparing both the process of plantation, we can find the effectiveness of the machine ricetransplantation process.
$\%\eta= ((240-6)/240)\times100$
= 97%
It means that the machine ricetransplantation process is more efficient than the manual transplantation process.

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RESULT AND COCLUSION

Result

After the design and calculation of the new transplantation process, it is observed that the new process is nearly 97% more efficient than the original i,e manual process of same.

Coclusion

1. The system is easy for handling.
2. The new system is labour efficient.
3. Considering the present scenario, the labour are not easiy available, as such time these system will be the need for farmers.
4. It will be the time efficient system.
5. It is the cost efficient system.

FUTURE SCOPE

In the future, the system can be improved by using the engine for power driven as it will give the efficiency in plantation and also will reduce the effort of human being.

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