Design And Experimental Validation Of SSDC

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ABSTRACT

Sowing of a seed at uniform depth not maintained in conventional type of sowing machine tines which results in non uniform growth of plants and hence there is loss in the yield of farmer. The use of self suspended dispensing coulter achieves the uniform depth as well as uniform width of cut and hence there is uniform growth of plants and ultimately there is increment in farmers yield. There must be a conservation moisture contents in soil after furrow is open. But in case conventional type of sowing machine there is not any such provision. Self suspended dispensing coulter allows simultaneous covering of furrow immediately by using passive double inclined disc to retain moisture after furrow is open. In order to increase the germination rate of seed, there is no such a provision in case of conventional type of sowing machine. Self suspended dispensing coulter allows pressing of seed slightly so that soil molecules firmly comes in contact with seed and the germination rate is increase. Shovel type furrow opener produce greater soil disturbance with ultimately requires unnecessarily more draft force for pulling of tractor. Thus main objective of this project is to maintain uniform seed depth with uniform width of cut with conserving moisture content after furrow is open by closing it and pressing of seed in order to increase the germination rate with reduced draft force and tractor power required.

Keyword : *- Disc opener, uniform depth, draft force, germination, tractor power.*

1. INTRODUCTION

The objective of this paper is to design and develop a customized self suspended dispenser to attach to the any tractor drawn seed planter with define objective. So we can say that this is masters of engineers project as a design practice, which took all the steps needed that an engineering design process requires. To design is either to formulate a plan for the satisfaction of a specified need or to solve a problem. In this case, design is being used to satisfy a specific need a customized self suspended dispenser. Engineering design process or mechanical engineering design process is a series of steps that each designer have to go through, to reach to the solution of the problem or to satisfy the need. A brief summary of the design procedure of the customized dispenser is mentioned as the need of a customized dispenser for the seed drill. A thorough study about design of disc dispenser and their components and tool-soil interaction is performed. Conceptual design was performed and between a few ideas, one was selected for analysis and detailing. Design was reviewed and revised after different analyses, and the new design was analyzed again to satisfy all the design criteria. Finalized design was sent to machine shop in order to fabricate the prototype. Fabricated parts were assembled and attached to the seed drill to perform autonomous planting.

1.1 Conceptual Design

The conceptual design phase started with the selection of the parts that were preferred to be used in the dispenser. Self suspended dispensing coulters coulters comprises consist of furrow opener disc, seed covering disc, compression spring, pivot points, press wheel mechanism. Self suspended dispensing coulters are mostly use to overcome the problem of uneven seed depth cause due to the use of conventional type of tines. The conventional type of tine are replace by self suspended dispensing coulters. During the opening of soil by double disc furrow opener the residue is cut and furrow is open seed and fertilizer drop simultaneous. The double disc coulters is applied with spring tension to maintain the recommended seed depth. Seed and fertilizer is cover by the double inclined disc. The seed is press by using the press wheel of design weight. In such a way by using such a type of coulter simultaneously furrowing, seed covering and seed pressing is easily possible.

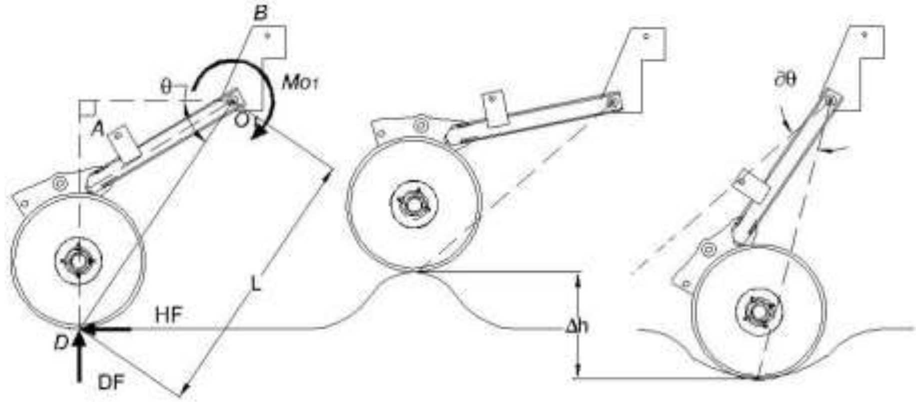

Fig. 1 : Travel of Double Disk Opener through uneven surface

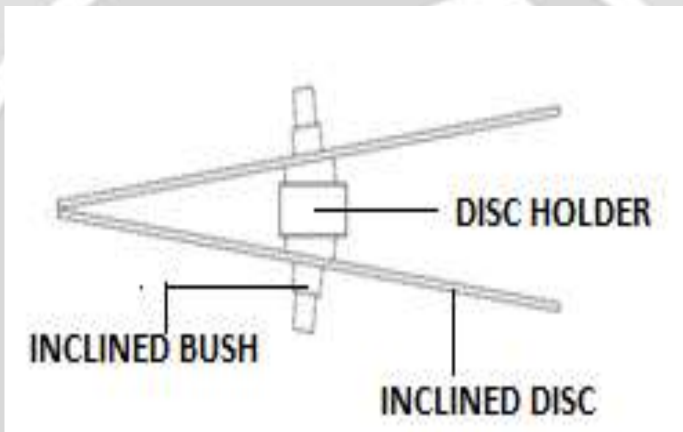

Fig. 2 : Disc holder with inclined angle disc

2. DRAFT CALCULATION

2.1 Draft force and power required

The practical knowledge of soil, draft and traction is important in tillage. A force required to pull tillage tool through the soil is called its draft. The draft force is located at the point where a power unit is usually a tractor, name coined from the more ponderous word traction engine that translate the power developed by the internal combustion engine into forward motion. The direction of the draft force is in the direction of travel and the units to measure it are Newton. Agricultural production in the world will be Agricultural production in the world will be demand for food by the domestic and world population. Increasing the production while maintaining or reducing the energy inputs will be needed to provide food in the future years to come when energy resources is limited. Draft is the horizontal component of the pull, parallel to the line of motion. The draft depends upon

- Sharpness of cutting edge
- Working speed
- Working width
- Working depth
- Type of implement
- Soil condition
- Attachments

Taking into consideration five row planter with adoption of five disc coulters attached to the frame instead of conventional type of tines and are fixed at a distance of 8 cm, with working depth of 10 cm and speed is 3 km/hr. Turning loss is 10%. The soil resistance is 0.6 kg/cm^2 .

The cross section area of 5 disc coulters = No. of disc x cross sectional area

= 10 x 0.3 x 10

= 30 cm^2

Maximum draft = Total cross sectional area x soil resistance

= 30 x 0.6

= 18 Kg.

Required power , KW =Draft (N) x Speed (m /s) / 1000

= 18 x 9.81 x 3 x 1000 / 60 x 60 x 1000

= 0.14 KW.

2.2 Comparative analysis with conventional type of tine

It is necessary to compare the draft force with conventional type of tine. Taking into consideration five row planter with adoption of five conventional tine attached to the frame are fixed at a distance of 8 cm, with working depth of 10 cm and speed is 3 km/hr. Turning loss is 10%. The soil resistance is 0.6 kg/cm^2 .

The cross section area of 5 tines showel = No. of tine x cross sectional area

= 5 x 5 x 10

= 250 cm^2

Maximum draft = Total cross sectional area x soil resistance

= 250 x 0.6

= 150 Kg.

Required power , KW =Draft (N) x Speed (m /s) / 1000

= 150 x 9.81 x 3 x 1000 / 60 x 60 x 1000

= 1.2 KW.

Table 1 : Comparative analysis of draft force on disc and on conventional tine

Sr. No.	Seed depth (mm)	Draft disc (N)	Draft conventional tine (N)
1	50	17.65	147.15
2	75	26.487	220.72
3	100	36	294.3
4	125	44.145	367.875
5	150	52.974	441.45

Table 2 : Comparative analysis of required power on disc and on conventional tine

Sr. No.	Seed depth (mm)	Required power disc (KW)	Required power CONVENTIONAL TINE (KW)
1	50	0.015	0.1225
2	75	0.0225	0.1833
3	100	0.03	0.245
4	125	0.0375	0.305
5	150	0.044	0.367

3.1.10 Design of bearing for passive double inclined furrow opener

The bearings are used for the passive double inclined furrow opener disc as well as for seed covering disc. The bearing are mainly subjected to the two types of forces radial forces and axial forces. Radial forces are mainly induced due to the vertical force applied by the springs.

Let,

Fr = Radial force, N.

Fa = Thrust force, N.

Lh = Expected life of bearing, hrs.

n = Rotating speed, rpm.

D = Diameter of shaft, mm.

C = Dynamic load capacity, N.

C0 = Static load Capacity, N.

X = Radial factor.

Y = Thrust factor.

We have,

Fr = 2.5 KN.

Fa = 1.55 KN.

L10h = 8000 Hr

n = 100 rpm.

d = 17 mm.

When the bearing is subjected to radial as well as axial loads, the values of X and Y factors are obtained from table 1. It is observed from table 1 that values of X are constant and the values of Y varies only in case when,

$$\frac{Fr}{Fa} > e$$

In this case, the value of Y varies from 1.0 to 2.0. We will assume the average value 1.5 as the first trial value for factor Y. Therefore

X = 0.56, Y = 1.5, Fr = 2500 N, Fa =1550 N.

We have,

P = XFr + YFa

= 0.56 x (2500) + 1.5 x (1550)

= 3725 N

Expected life millions of revolution,

We have,

$$L10 = \frac{60 \times n \times L10h}{10^6}$$

= 60 x 100 x 8000 / 10^6

= 48 millions of revolution.

We have,

C = P $L_{10}{}^{1/3}$

= 3725 x $48^{1/3}$

= 13537 N.

From table 2 it is observed that for the shaft of 17 mm diameter, Bearing No. 6303 (C = 13500) is suitable for the application.

For this bearing C0 = 6550 N

Therefore,

$Fa/_{Fr}$ = 1550 / 2500

= 0.62

$Fa/_{C_0}$ = 1550 / 6550

= 0.236

Referring table 1

e = 0.31(approximately) $Fa/_{Fr} < e$

The value of Y is obtain by linear interpolation.

Y = 1.2

X = 0.56

Dynamic load capacity,

P = XFr + YFa

= 0.56 x 2500 + 1.2 x 1550

= 3260 N

C = $P\ L_{10}{}^{1/3}$

= $3260 \times 48^{1/3}$

= 11847.6 N

Hence Bearing No. 6303 is suitable (C = 13500 N)

3. EXPERIMENTAL VALIDATION

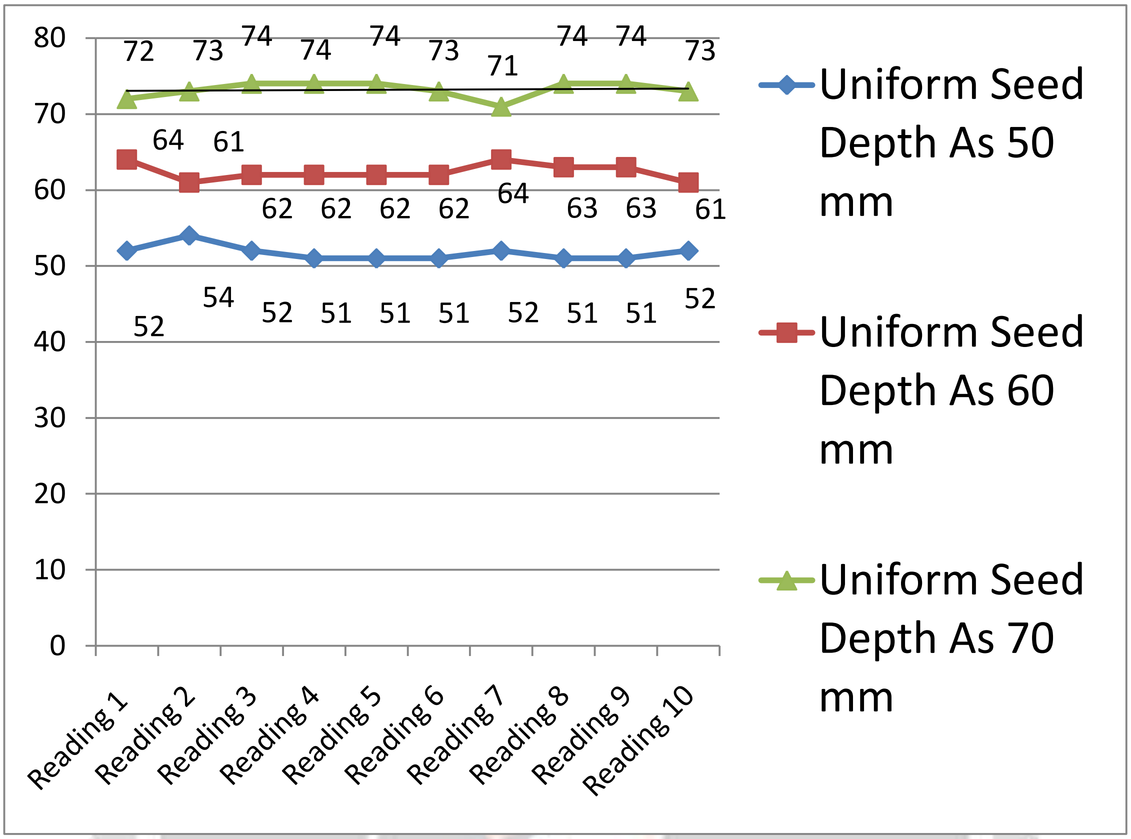

Fig 3 : Result for uniform seed depth

Fig 3 shows that seed depth having variation in a range of 2 to 3 mm only which is negligible. Hence we will get uniform seed depth and hence there will be uniform growth of plants and increase in yield.

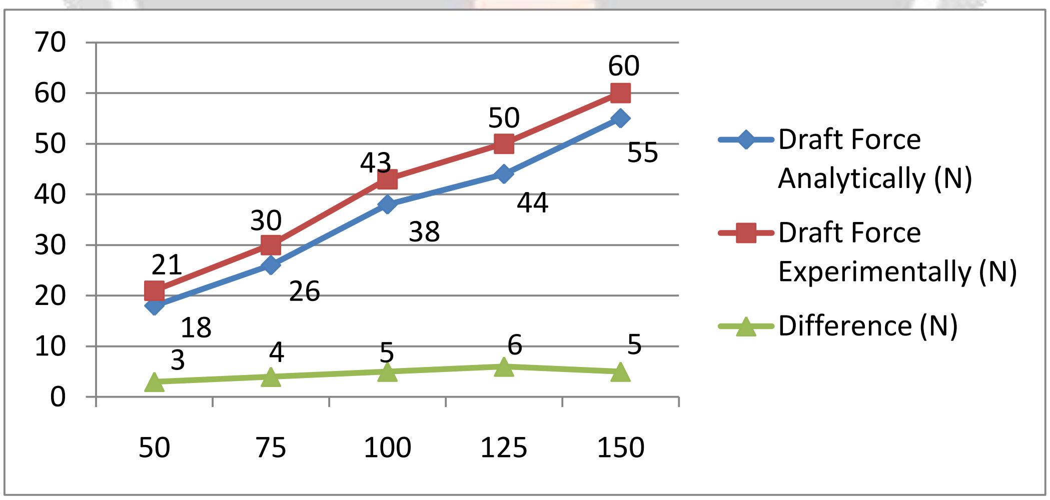

Fig 4 : Result analysis representation of draft force analytically and experimentally

Fig 4 shows the analytical and experimental readings of draft force. There is difference between both readings, in analytical calculations the graph is mostly a straight line as compared to experimental readings. The difference between the analytical and experimental readings is not much more. Hence analysis is found ok.

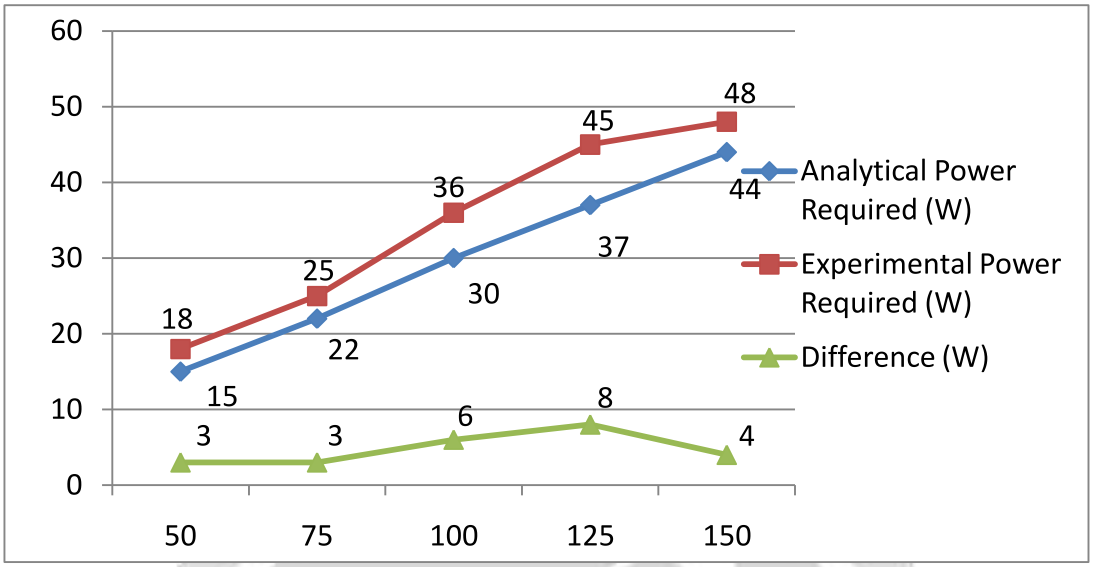

Fig 5 : Result analysis representation of power required analytically and experimentally

Fig 5 shows the analytical and experimental readings of required power. There is difference between both readings, in analytical calculations the graph is mostly a straight line as compared to experimental readings. The difference between the analytical and experimental readings is not much more. Hence analysis is found ok. The variation in readings is due to consideration of same bulk density of soil but practically it is changes as the depth is vary.

4. CONCLUSIONS

- ✓ Uniform seed depth during the sowing process is achieved.
- ✓ Analytical as well as experimental readings of draft force are within a limit hence the analysis meet the requirement.
- ✓ Analytical as well as experimental readings of required power are within a limit hence the analysis meet the requirement.
- ✓ Paper validates the analytical and experimental results.

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