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Draft Requirement of Furrow Covering Device

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Abstract* - The study was undertaken in soil bin laboratory and research farm of College of Agricultural Engineering and Technology, OUAT, Bhubaneswar, Odisha. The furrow covering device was tested for sowing of groundnut and its performance evaluation was carried out with LVDT. The test was conducted in a loamy sand soil (78.4 %, silt: 14% and clay: 7.6%) at speed of 3km/h with varying dept, moisture content (7-8%, 9-10%, 11-12%) and soil resistance within 300-500 kpa. The draft requirements of soil covering attachment with 5kg load in shovel with shoe type furrow opener were measured for different moisture content and depth. These were found to be 42.02-59.21 for 7-8% moisture content, 40.21-54.52 for 9-10% moisture content and 39.92-56.27 for 11-12% moisture content at three depths of 60 mm, 80 mm and 100 mm respectively. Although the draft requirement is more but the soil coverage was proper for soil covering attachment at 5kg load in comparison to other types (Shovel+shoe and shovel+shoe+attachment) at all depth and moisture content.

Keywords: Draft, furrow covering device, EORT, moisture content, depth.

I. INTRODUCTION

Different types of seed drill and seed cum fertilizer drills have been introduced to suit various sources of power available in farmer's fields and facilitate seeding operation.Preparation of seed bed is a specialized task which requires skill, time energy and labour in addition to different soil manipulating implements. A furrow opener is a important working element of sowing device, the function of which is to insure proper deposition of seed in the soil for better germination. Shoe type furrow openers are found suitable for these major crops like paddy, groundnut etc. Recent improvements to the shoe type furrow opener permit seed-drilling with proper placement, covering of seed and levelling of soil. Main objectives of this research are to develop a soil covering attachment to the existing shoe for seed cum fertilizer drill in order to improve the furrow coverage and to evaluate and compare the performance between the developed device and the existing shovel, shoe attachment.

II. SYSTEM MODEL

The study was conducted on a test soil bin on loamy sand type soil at depth of 60mm, 80mm, 100mm and soil resistance level of 500 kPa required for seeding. The bin was 15.0m long, 1.8m wide and 0.6m deep. Two rails on top of each side of the bin wall were used for supporting the soil processing and the test trolleys. This provides a test soil bed of about 12m long and 1.2m wide over which furrow opener runs along with the test trolley. The processing trolley consists of a frame, rota-tiller for soil tillage, leveller for levelling the soil, roller for compacting the soil to obtain the desired soil resistance and a water sprayer for spraying water on the soil to maintain the desired moisture content (7-8%, 9-10%, 11-12%).

The speed of operation was obtained by choosing suitable gears of a gear reduction unit coupled to the input shaft of the revolving drum, which was attached to soil processing trolley with stainless-steel rope. A control unit placed outside the soil bin controlled the direction of movement of the soil processing trolley.

III. PREVIOUS WORK

The furrow covering attachment of 1mm thick mild steal plate was developed in this study. It was attached along with dead loads on it to the rear of the existing shoe as shown in [Fig. 1]

Fig.1 Soil covering attachment with shoe type furrow opener and load

The experiments were conducted with 3 types of furrow openers (Shovel+shoe, shovel+shoe+attachment, shovel+shoe+attachment+load) at a speed of operation of 3km/h for loamy sand soil under 7-8%, 9-10%, 11-12% (wet basis) moisture content and at depths of 60mm, 80mm, 100mm. Soil coverage were observed for each trial. The soil coverage was maximum in case of shovel+shoe+attachment with a load of 5kg as compared to other methods. From the study it was also found that, at moisture level of 11-12%, furrow coverage was better than at other moisture levels. However, when the moisture content increased beyond 12%, the soil coverage in the furrow was less than that observed at lesser moisture content levels as soil sticks to the furrow opener for which soil covering was not proper.

IV. PROPOSED METHODOLOGY

Seed bed Preparation

Before starting the experiments, the soil bed was prepared to achieve the desired level of soil resistance. The rotary tiller attached to the soil bin was used to pulverize the soil after spraying water to achieve the required moisture content. Then, the soil was levelled with the leveller blade and compacted by the roller to achieve the required cone penetration resistance. At the end of each soil preparation, soil cone penetrometer attached to the soil bin was used to measure the cone penetration resistance to a depth of 0.15m.

Measurement of moisture content

Soil moisture contents were measured with moisture meter (PMS-714).

Procedure for measurement of Depth of furrow

There was a provision for vertical up and down motion of the EORT (Extended Octagonal Ring Transducer) of capacity 0.5 kN along with the furrow opener under test by the hydraulic system. A scale was attached to the frame of the test trolley. The initial position of the furrow opener (when the tip of the shovel just touched the ground level) was marked. The suitable depth as per requirement of the observation (60mm, 80mm &100mm) was applied to the furrow opener by the hydraulic lever and scale reading .It may be noted that a opening was previously prepared on the soil bed just in front of the initial position of furrow opener.

Calibration procedure

For calibration of EORT (Fig.2) known weights were used and corresponding change in electrical signal was obtained through the data acquisition system attached to the test set up. To calculate draft a frame and pulley arrangement was fabricated. The frame was fabricated using MS angle of size (25×25×5) and a MS pulley of dia.3 inches was used. The pulley and frame assembly were fixed over a foundation with nuts and bolts, which was strong enough to support the load to be applied on the assembly during operation in the soil bin setup. A brace with a hook was fabricated from MS bar which was to be attached at the back of EORT prior to calibration. A flexible and inextensible wire was attached with the hook at the back of EORT and was aligned to be perfectly horizontal with the inner groove of pulley, so that while taking weights the flexible wire would be in one line with the centre line of hook. Perfectly horizontal alignment reduces the chance of any resolution of force into components.

The wire selected was having yield strength more than that of the load to be applied (> 100kg).After the wire passes over the pulley there was a hook to carry the weights when the EORT was being calibrated. The pulley which was taken for the experiment was well lubricated for minimizing friction.

Fig.2. Caliberatin of EORT

Procedure for measurement of Draft

The laptop was installed with Catman Easy software. The constant voltage power supply was made on with the adjustment of 10V. Data acquisition system (Spider-8) was made on & the signal from data acquisition system was connected to the laptop through USB cable .The sensor of the EORT was connected to the data acquisition system through a cable. The stress signal from EORT was converted to electrical signal and after suitable signal processing through data acquisition system it went to the laptop in recordable form. Suitable adjustment regarding initial value range etc were made on the software .The display was opened with a real time graph (for continuous measurement of draft in Y- axis verses time in X-axis) and a digital display recorder (for maximum draft value).

While the test furrow opener attached to the EORT moved through the soil at particular speed and depth as shown in Fig. 3, the laptop records the draft in mV/V. This value was converted into the actual value of draft in Newton with the calibration curve

Fig.3. EORT moved with furrow opener and its soil covering attachment

V. SIMULATION/EXPERIMENTAL RESULTS

Draft Requirement

The draft requirements were observed with the help of one EORT (Extended octagonal Ring Transducer) of 1kN capacity attached to the tool carrier. The draft requirement was determined on the basis of calibration of EORT as given in Fig 4.

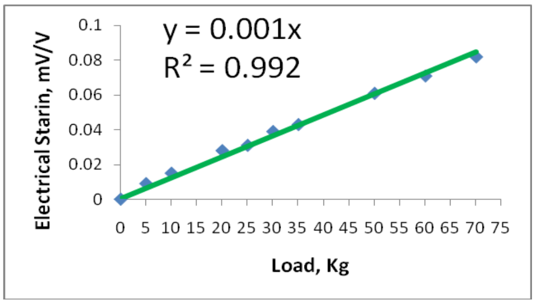


Fig.4. Calibration of the EORT

From the graph between electrical strain (mV/V) and test load on the EORT, it was observed that the straight line curve represents best fit with coefficient of determination, R2 of 0.992 which can be satisfactorily used to determine the draft requirement at different operational parameters

Effect of operational parameters on draft requirement of furrow openers

The draft requirement of the three types furrow openers with different levels of soil moisture content, depth of operation at a speed of 3km/h were determined on the test soil bin. The observed data is given in Appendix-A. The ANOVA presented in Table.1 indicates that the draft requirement is significantly (1% level) affected by soil moisture content, depth of operation and type of furrow opener. The mutual interaction of these factors taken two at a time is also significant at both 1% level. The interaction effects whose CD values are shown in Table.1 show that any variation in moisture level, depth of operation, types of furrow opener within the test range affects the draft requirement.

Table.1. Analysis of variance for the effect of soil moisture content, depth of operation type of furrow opener on draft requirement

Factor A: Soil moisture content

Factor B: Depth of operation

Factor C: Type of furrow opener

No of replications: 3

Dependent variable: Draft requirement

K Value	Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Probability	CD (1%)
2	Factor A	2	141.806	70.903	146.4631**	0.0000	0.26845
4	Factor B	2	2546.984	1273.492	2630.6236**	0.0000	0.26485
6	AB	4	13.217	3.304	6.8256**	0.0002	0.4649
8	Factor C	2	1326.752	663.376	1370.3212**	0.0000	0.26845
10	AC	4	0.718	0.180	0.3709^{NS}		0.4649
12	BC	4	33.487	8.372	17.2936**	0.0000	0.4649
14	ABC	8	0.952	0.119	0.2457^{NS}		0.8053
-15	Error	54	26.142	0.484			
	Total	80	4090.059				

Coefficient of variation: 1.61%

** Significant at 1 per cent level

^{NS} not significant

Effect of moisture content and depth on draft requirement.

The effect of the operational parameters like moisture content, depth and speed within the range studied on the draft requirement for different furrow openers is presented in Figs. 5.1(a, b, c) & 5.2(a, b, c).

Fig.5.1.(a). Draft requirement for different furrow opener at different depth with moisture conent 7-8%.

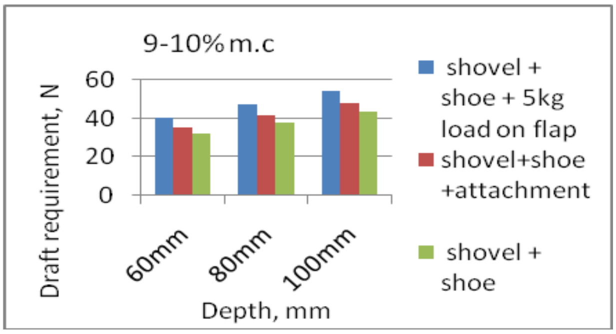
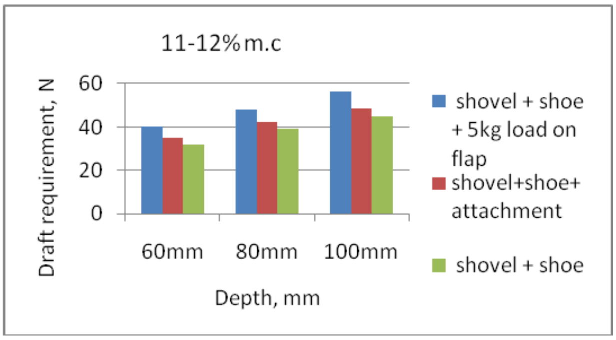


Fig.5.1. Draft requirement for different furrow opener at different depth with moisture conent 9-10%.



These graphs reveal that the draft requirement of the shovel+shoe is minimum followed by the shovel+shoe+attachment and the shovel+shoe+attachment+5kg load with shovel+shoe+attachment+5kg load to be the highest at all operational level.

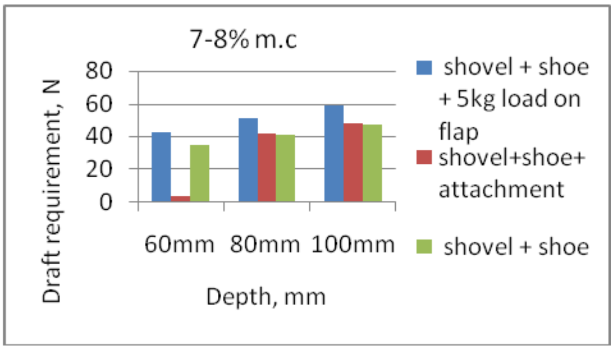


Fig.5.1.(b). Draft requirement for different furrow opener at different depth with moisture conent 11-12%.

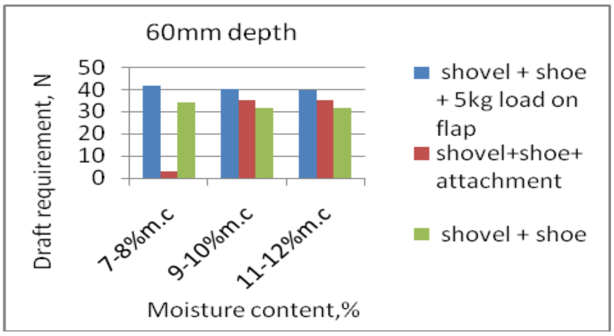


Fig.5.2.(a). Draft requirement for different furrow opener at different moisture content with depth 60mm

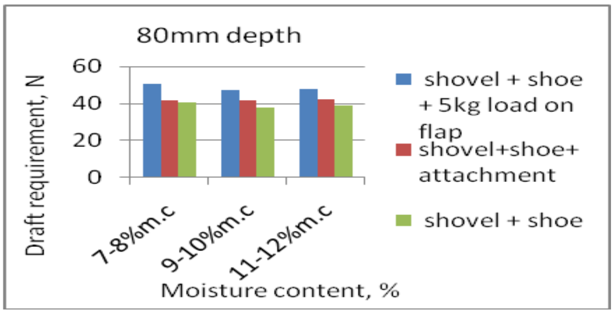


Fig.5.2.(b). Draft requirement for different furrow opener at different moisture content with depth 80mm.

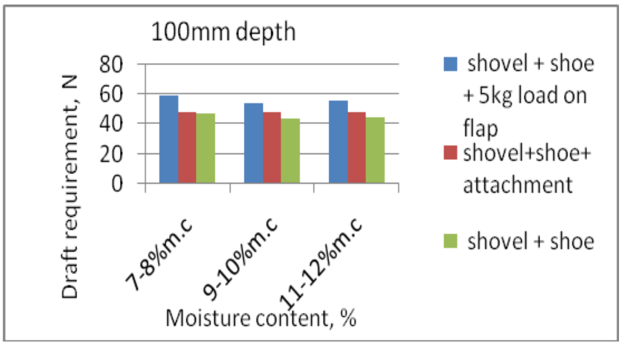


Fig.5.2.(c). Draft requirement for different furrow opener at different moisture content with depth 100mm.

VI. CONCLUSION

The draft requirement of the developed soil covering attachment with 5kg load in shovel with shoe type furrow opener were found to be in the range of 42.02-59.21 for 7-8% moisture content,40.21-54.52 for 9-10% moisture content and 39.92-56.27 for 11-12% moisture content at three depths of 60 mm, 80 mm and 100 mm. Considering the operational parameters such as moisture content and depth of operation, it was found that the draft requirement for developed soil covering attachment with 5kg load in shovel with shoe type furrow opener is more than other types. But the soil coverage was proper for soil covering attachment at 5kg load in comparison to other types at all depth and moisture content.

VII. FUTURE SCOPES

Further study can be done for other different types of soil to know its performance in other types of soil.

VIII. REFERENCES

[1] Rashidi M, Najjarzadeh I, Namin S.T, Naserzaeim F, Mirzaki S. H., Beni M. S. “Prediction of Mouldboard Plow Draft Force Based on Soil Moisture Content, Tillage Depth and Operation Speed”. American-Eurasian J. Agric. & Environ. Sci., 13 (8): 1057-1062, 2013

[2] Rashidi M, Lehmali F.H, Fayyazi M, Akbari H, Jaberinasab B. “Effect of Soil Moisture Content, Tillage Depth and Forward Speed on Draft Force of Double Action Disc Harrow”, American-Eurasian J. Agric. & Environ. Sci., 13 (8): 1124-1128, 2013.

[3] Kepner R.A; Bainer Roy; Barger E.L,crop Planting, “Principles of Farm Machinery”, Third Edition, 220-222, CBS publisher and Distributers, 2005

[4] Hasimu A. & Chen Y. “Soil disturbance and draft force of selected seed openers”. Elsevier, Soil & Tillage Research, 140: 48–54, 2014

[5] Darmora D.P. “Draft Requirement of a Shovel Type Furrow Opener under Coarse Textured Soil Condition”, Journal of Agricultural Engineering, 44(3): July-September, 2007