Studies On Furrow Covering Device For Seed Cum Fertilizer Drill

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Abstract - Proper tillage and precise placement of seed and fertilizer in the moist zone are the most critical parameters for successful crop establishment. Different types of seed drill and seed cum fertilizer drills have been introduced and popularized to facilitate seeding operation. Furrow opener is the working element of sowing device, the function of which is to insure proper deposition of seed in the soil for better germination. Thus, furrow openers of sowing devices are very important to provide proper soil environment in a seedbed. Presently, both animal drawn and tractor operated seed cum fertilizer drill are commonly used for the major crops like paddy and groundnut in the state of Odisha, India. Shoe type furrow openers are found suitable for these major crops. However, further improvement of furrow covering shall make these equipments more acceptable by the farmers. The present study was taken up with a view to develop a soil covering attachment to the existing shoe type furrow opener. The study was under taken in the test soil bin of the Department of Farm Machinery and Power, College of Agricultural Engineering and Technology, Bhubaneswar, Odisha, India. The experiments were conducted with 3 types of furrow openers (Shovel, shovel with shoe, shovel with shoe and covering attachment) at a speed of operation of 3km/h for loamy sand soil under 5-6%(wet basis) moisture content. Soil coverage and draft requirement were observed for each trial. It was observed that at a 50mm furrow depth, the soil coverage was maximum of 45mm, compared to other devices like shoe which resulted in only 25mm coverage. This study will help in higher soil coverage required for the major crops for the state of Odisha.

Keywords - furrow opener, speed of operation, depth of operation, moisture content, test soil bin, data acquisition system, furrow covering attachment.

I. INTRODUCTION

In India, rainfed agriculture contributes food grain production to ensure access to food to growing population. For getting higher yield and optimum utilization of rain fall; proper tillage, timely sowing & precise placement of seed in moist zone are important. Different types of seed drill and seed cum fertilizer drills have been introduced and popularized to facilitate seeding operation. Furrow openers of sowing device are very important to provide proper soil environment in a seedbed. Furrow opener is the working element of sowing device, the function of which is to ensure proper deposition of seed in the soil for better germination. Presently, both animal drawn and tractor operated seed cum fertilizer drill are commonly used for the major crops like paddy and groundnut in the state of Odisha, India. Shoe type furrow openers are found suitable for these major crops however further improvement of furrow covering shall make these equipments more acceptable by the farmers..

II. SYSTEM MODEL

The present study was taken up with a view to develop a soil covering attachment to the existing shoe type furrow opener. This furrow covering device covers the seed with displaced soil for establishing an appropriate seed environment i.e. reduce the rate of moisture loss, provide the moisture availability to seed, protect the seed from predators like mice, birds, insects etc. and prevent the excess accumulation of moisture in rainy season when furrow tends to concentrate the rain water. The furrow covering attachment developed in this study was a 1mm thick mild steel plate of dimensions shown in Fig. 1. It was attached along with dead loads on it to the rear of the existing shoe (Fig. 2).

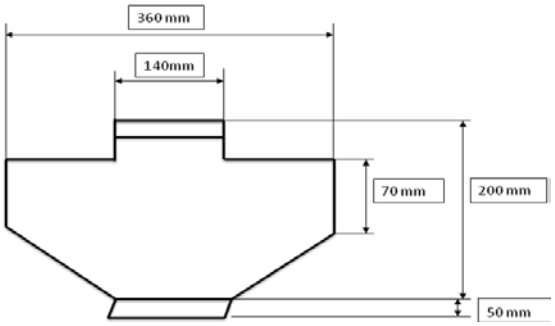

Fig. 1 Soil covering attachment for shoe

Fig. 2 Test setup with covering device attachment

III. PROPOSED METHODOLOGY

The study was conducted on a test soil bin (Fig. 3) on loamy sand type soil at the moisture level within 5 to 6%

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.

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.

Fig. 3 Test soil bin

Soil Bed preparation

Experiments were conducted under laboratory conditions in a loamy sand soil. 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.

Procedure for measurement of Soil Moisture Content

Moisture contents of soils were determined using oven drying method. Soil samples were collected at random, immediately after each observation. Each soil sample was collected in a labeled container and weighed on a digital balance, and then oven dried at a temperature of 105°C in an oven for 24 hours. The soil moisture contents (wet basis) were computed using the expression

$$\text{Soil m.c (Wet basis) in \%} = \frac{(m_2 - m_3)}{(m_2 - m_1)} \times 100$$

Where; m.c = moisture content (%)

m_1 = mass of container in grams (g)

m_2 = mass of container + wet soil sample in grams (g)

m_3 = mass of container + oven dried soils in grams (g)

Procedure for measurement of Speed of operation

The initial and final position of the furrow opener in the test soil bin was marked while taking observation for draft measurement. Time taken for each run was recorded by a stop watch. The ratio of distance travelled to time was taken as the speed of travel.

IV. EXPERIMENTAL RESULTS

The study was conducted on loamy sand soil with moisture level of 5-6% and depth of operation of 50 mm to observe soil coverage. A mild steel straight edge flat on the rails of soil bin was taken as a reference line to measure the soil coverage. Vertical distances from the reference line to furrow were measured at 20mm interval in a horizontal direction from one end of furrow to the other end as shown in Fig. 4.

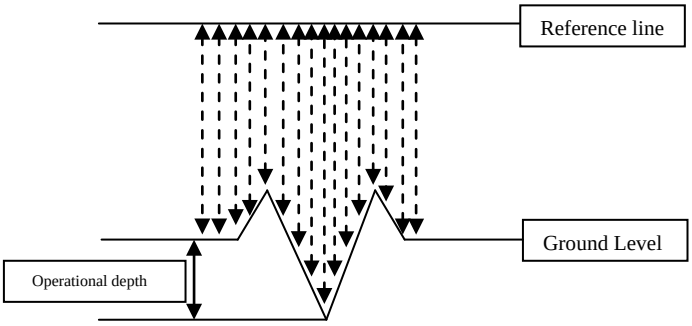

Fig. 4 Soil coverage profile

The procedure was repeated for each replication for each furrow opener. The graphical presentation of the data for soil coverage is presented in Fig 5.

Series1-operation depth

Series2= soil coverage with shoe type furrow opener

Series3= soil coverage with covering device

Series4= soil coverage 730 kg load on covering device

Series5= soil coverage 1300 kg load on covering device

The result showed that, with the developed furrow covering device, furrow was covered up to 45 mm with dead load of 1300 gram on the covering device.

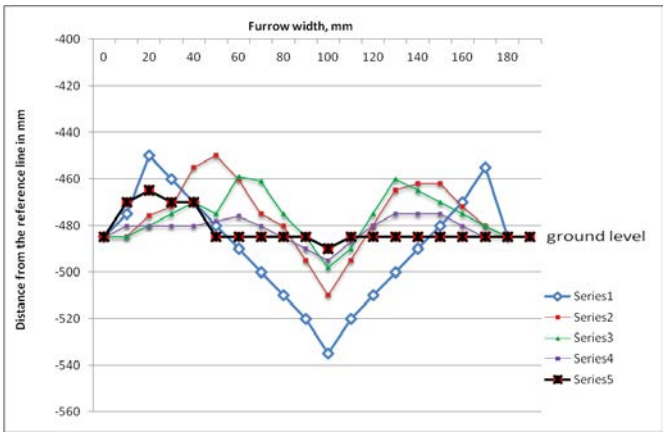

Fig. 5.Soil Coverage

V. CONCLUSION

The soil covering attachment with shoe resulted in maximum soil coverage in the furrow in compared to other treatments. The soil coverage was found to be 45mm out of 50mm soil depth.

VI. FUTURE SCOPES

Further studies can be done for draft requirement of the developed soil covering device to know its suitability for tractor operated seed cum fertilizer drills.

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