

Original Research Article

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Performance Evaluation of a Power Tiller Operated Seed Drill

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ABSTRACT

In recent years, there has been an acute shortage of agricultural labourers during sowing season due to migration of youths for employment opportunities in urban areas. Due to non-availability of labour and draft animals during sowing seasons resulting in delay in sowing operation which may effect on the yield of crop. In many places the seed is sown even when the soil is at a low moisture content, which affects the germination of the plant stand and yield. Therefore, in order to mechanize crop sowing operation under rainfed conditions, a suitable seed drill is vital as it places the seed in the zone of adequate moisture and at desired depth. The power operated seed drill gives proper seed rate, uniform distribution and correct placement of seed and fertilizer resulting in higher yield and reduces human drudgery. Presently the available seed drills are need of modification to suit intercropping system as well as perfect depth of sowing under dryland conditions. Due to the uneven and erratic rainfall distribution during early and late kharif may lead to unfavourable conditions for the sole crop, so the system of intercrop can be adopted which acts as a crop insurance for the farmer without dependence on the sole crop. The study indicated that, the field experimentations and laboratory results the crops whose row to row spacing is 30 cm, the implement requires approximately 16hrs, i.e. 2 days to complete the sowing for 1 hectare of land. If the crop selected has row to row spacing of 60 cm then sowing of the crop seeds can be completed within 1 day for 1 hectare which can be economical to the farmers besides, sowing area under sowing can be increased by adapting this seed drill to overcome the dependency on sole crops and reduce the drudgery.

Keywords

Seed drill, Power operated, Performance evaluation, Power tiller

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Introduction

Crop planting refers to placing the seeds in the soil, broadcasting seeds on the field surface or transplanting the seeds in the soil, under optimum soil temperature and moisture conditions. To get high yields, right amount of seed should be placed at the right time at a predetermined depth and spacing in the soil. Usually the depth of sowing depends upon the moisture availability and emergence capacity.

The spacing between the seeds is governed by plant growth and their distribution per unit area. However, the space requirement of a plant is so adjusted between the rows that the subsequent use of interculturing implements is made possible for the crops. In general, the larger seeds are sown at comparatively greater depth and plants need wider spacing.

The seeding equipment for unirrigated areas are designed to place the seed in firm moist

soil. The moisture from the surface layer of seed bed in arid areas is evaporated quickly. Germination of seeds may be adversely affected if the seeds are sown at shallow depth of four to five centimetres as done in irrigated areas. However, the soil moisture at deeper depths may be sufficient for successful germination of seeds. Deep sowing with a conventional seed drill will result in too deep placement of seed and poor germination. Therefore, the requirements of seed drills for unirrigated areas are that it should make a furrow in the dry soil layer and place the seed in firm moist soil below in the bottom of the furrow. The multirow seed drills/planters with packer wheels (tractor drawn and animal drawn) are designed to obtain the optimum environment for the germination of seed and growth of seedlings under unirrigated condition. The seed boots are designed to place about the seed about 4cm below the bottom of the furrow made in the dry soil layer. Packer wheels fixed to the rear of the machine pack the soil over seed. A chain driven toothed wheel fixed to the drive shaft of the seed dropping mechanism can be set to obtain the desired seed to seed distance in sowing. The wheel actuates the flap gates provided at dropping mechanism. The seeds drop out every time the gate is open. By fixing wheels with different spacing of teeth, any desired seed to seed distance can be obtained. This feature makes the seed drill suitable for sowing close growing crops like wheat and row crops like maize, cotton and sorghum.

A seed drill is a sowing device that precisely positions seeds in the soil and then covers them. Before the introduction of the seed drill, the common practice was to plant seeds by hand. Besides being wasteful, planting was very imprecise and led to a poor distribution of seeds, leading to low productivity. The modern seed –drill allows seed drilling without prior tilling. This means that soil

subject to erosion or moisture loss is protected until the seed germinates and grows enough to keep the soil in place. This also helps in preventing soil loss by avoiding erosion after tilling.

Generally, a seed drill employs a series of runners spaced at the same distance as the ploughed furrows. These runners or drills open the furrow to a uniform depth before the seed is disposed. Behind the drills are the presses, metal discs which cuts down the sides of the furrow into which the seeds have been planted covering them over. This permits the farmer to have a precise control over the depth to which the seeds are planted.

This greater measure of control means that fewer seeds germinate early or late and that seeds are able to take optimum advantage of available soil moisture in a prepared seedbed. The result is that the farmers are able to use less seeds and at the same time experience a larger yield than broadcast methods. Seed drill machines that can vary the distance between rows of planting, a means of controlling/ regulating the seed rate and means of varying the depth of planting.

Before the introduction of the seed drill, most seeds were planted by hand, an imprecise and wasteful process with a poor distribution of seeds and low productivity. The use of a seed drill can improve the ratio of crop yield (seeds harvested per seed planted) by as much as nine times.

Seed drill

Seed drill is a machine for placing the seeds in a continuous flow in furrows at uniform rate and at controlled depth with or without the arrangement of covering them with soil.



Functions of seed drill

- To carry the seeds.
- To open furrow to a uniform depth.
- To meter the seeds.
- To place the seed in furrows in an acceptable pattern.
- To cover the seeds and compact the soil around the seed.

Seed drill may be classified as

- Bullock drawn.
- Tractor drawn.

Depending upon the seed metering device, seed drills may be classified as follows

- Manually metered drills.
- Mechanically metered drills.
- Pneumatically metered drills.

They may also be classified as:

- Plain seed drills (Traditional type).
- Fertilizer drills or combination drills.
- Seed planters and dibblers.

Seed drill

Seed drill is machine for placing the seeds in a continuous flow in furrows at the uniform rate and in controlled depth with or without the arrangements of covering them with soil.

Components of a seed drill

A simple outline of a typical divided hopper type of a seed drill is given in figure 1 below but the constituent parts of the drill may vary in design and shape depending on the make of the machine. However, essentially they perform the functions as listed below;

Frame

The frame is usually made of angle iron with suitable braces and brackets. The frame is strong enough to withstand all types of loads in working condition. It is rod like structure where the whole setup of seed drill is placed on and connected to power tiller

Seed box

The seed box or hopper on a seed drill may be trapezoidal or oval in shape, and may be made of wood, sheet metal or plastic or a combination of materials. The capacity of the box may also vary depending on the size of machine. Making the seed box trapezoidal in shape helps to ensure a free flow of seed.

Seed metering mechanism (fluted rollers)

The mechanism of the modern external force feed drill consists essentially of a fluted roller which rotates just below the seed box and draws seeds from the bottom of the box into hoppers at the top of the seed tubes. The seed box is a single compartment and the fluted roller rotates in feed runs attached at the bottom of it.

The rollers are fluted over only half their length, and can be moved laterally so that either plain or the fluted portion or a part of each is in contact with the seed. This provides a simple regulation of the seed rate for no seed is delivered by the smooth part of the roller. On some machines the rollers are

connected to the drive shaft by individual dog clutches, and coulters may be shut off as required by disengaging these clutches. The use of a spring-loaded baffle plates in the feed runs causes less damage to the large seeds and permits adjustments for drilling various types of seeds and for varying the seed rate. A type of feed roller with spiral flutes is self-cleaning and can provide a continuous flow of seeds which in practice results in a very even spacing of cereals and small seeds.

On a typical drill the baffle plates or feed gates can be set in any of three positions; quarter-open for small seeds, half-open for medium seeds e.g cereals and three-quarters open for large seeds. The force-feed seed drill is steady over clods and work with little need for attention on hilly land. It has also the advantages of simplicity and cheapness.

Drive mechanism

It transmits power from the transport wheels to the seed delivery system either by chain and sprocket

Gearing mechanism

Where means of adjustments of seed rate are provided in the feed mechanism, as in external force-feed, the drill gearing can be relatively simple. Where simpler feed mechanisms are employed e.g in internal force-feed, more complex devices are needed, and to save changing pinion wheels, use may be made of gearboxes of various kinds. Adjustment of the seed rate is then secured by means of levers controlling these gears. Many drills have fairly complex series of spur gear trains and a system of selection by means of a movable idler. On modern drills a simple land measure consisting of a dial driven from the axle by worm gearing registers the area seeded.

Furrow openers

The furrow openers are provided in a seed drill for opening a furrow. The seed tube conducts the seed from the feed mechanism into the boot from where they fall into the furrows.

The furrow opener consists of: (1) tine (2) shoe (3) seed tube (4) boot for seed and fertilizer.

Shoe

It is made of carbon steel having carbon content of 0.5 per cent and a minimum thickness of 4.0 mm.

Seed tube

Seed tubes may be either of the collapsible type or rigid type. The length of a collapsible tube can be altered, either by telescopic action or by spring coil. It is used to convey the seeds from the metering mechanism and drop it on the field. The seed tube can be made of plastic (Which if clear, allows the seed flow to be monitored) or metal. Minimum diameter of seed tube is 25 mm.

Boot

It is a part of the sowing machine which conveys the seeds or fertilizers from the delivery tube to the furrow. It is bolted or welded to the tine.

Results and Discussion

Seed drill calibration

Working width of the implement(W)
= No. of furrow openers * spacing
between furrow openers
= 2 * 0.3mts = 0.6mts
Length of the strip = 400/W

$$\begin{aligned} &= 400/0.6 \\ &= 666.67\text{mts} \\ \text{No of revolutions}(n) &= L/\pi d \\ &= 666.67/3.14*0.56 \\ &= 380 \text{ revolutions / min} \end{aligned}$$

Assume,

n = 20 and rotate the drive wheel and collect the seeds and weigh them,

Weight of the seeds collected = 78+87=165 gms.

For 20 revolutions 0.165 kg seeds were collected.

For 380 revolutions 3.135 kg seeds will be collected.

For 1 acre 31.73 kg seeds will be collected.

For 1 hectare 78.37 kg seeds will be collected.

Distance taken for conducting calibration experiment = 40 mts

Time taken to cover the distance of 40mts = 144secs

Width of the implement = 0.6mts

Area covered in 144 seconds = 40*0.6 = 24sq.mts

Seeds dropped for the area of 24 sq.mts = 194 gms

Theoretical seed rate for soybean for 24sq.mts = 189.12gms

Specifications of power operated seed drill

Model: KK-SRT-910D

Rated power: 6.3kW (8.5 hp)

Displacement: 406 cc

Engine type: 4-stroke, air cooled

Fuel used: diesel

RPM: 3600(engine), 1800 (pto)

Fuel tank capacity:

(1) Engine: 1100 ml

(2) Gear box: 2800 ml

(3) Air filter: 100ml

Width of cultivation: 45cm -91cm

Depth of cultivation: 2.5cm-20.3cm

Number of gears: 1 reverse, 3 forward

Fuel consumption: 850ml-950ml

Observations

Theoretical seed rate for soybean for 1 hectare = 78.83kgs

Practical seed rate calculated from calibration = 80.83 kgs

Time required for 1 hectare = 16.67 hrs

Specifications of seed drill

Number of furrow openers : 2

Spacing between furrow openers : 30 cm (0.3 mts)

Width of the implement: spacing*width : 0.3*2 (0.6 mts)

Diameter of gauge wheel: 56cm : 0.56 mts

Circumference of gauge wheel : 176 cm (1.76 mts)

Length of seed box : 70 cm (0.7 mts)

Depth of seed box : 17cm (0.17 mts)

Width of seed box : 13cm (0.13 mts)

Outcome of the project

From the field experimentations and laboratory results clearly indicated that the followings results;

1. For the crops whose row to row spacing is 30 cm, the implement requires approx. 16hrs, i.e. two days to complete the sowing for 1 hectare of land.
2. Therefore, from this we can conclude that if the crop selected has row to row spacing as 60 cm then sowing of the crop seeds can be completed within 1

- day for 1 hectare which can be economical to the farmers.
3. Sowing area under intercropping can be increased by adapting this seed drill to overcome the dependency on sole crops.
 4. Reduce the labour and drudgery.
 5. Under available moisture condition timely sowing can be achieved.
 6. Dependency on the sole crop can be minimized.

Table.1 The functions of different components of seed drill as follows:

Component	Main Function
Seed box or Hopper	To contain seeds
Seed metering device	To control placement of seeds at give rate.
Furrow opener	To open the soil for the seeds to be placed.
Seed tube	To carry the seeds from the seed metering device to the furrow opener.
Transport device	To move the machine over the soil while planting is in operation and to transport the machine between the store and the field To provide the source of power to drive the seed metering device
Frame	To provide a base to which all the above components may be fitted, either directly or indirectly.

Table.2

Replication	Wt of seeds(gms/20 revolutions)		Seed rate(kg/ha)
	Furrow opener 1	Furrow opener 2	
1	79.5	89	80
2	78.5	88	79.08
3	76	89	78.375
4	73	89	76.915
5	77	89	78.85
6	80	83	77.425
7	82	88	80.75
8	76	85	76.475
9	77	89	78.85
10	84	87	81.225



Lab experimentation



Seed dill calibration



Field experimentation

In conclusion, there is an acute shortage of labour for agricultural operations in time and to carry the sustainability to maintain for the selected crops. In this contest, developed a power operated seed drill to suit the farmers of various categories.

The developed seed drill has performed better with respect to the sowing operation resulting that the crops sown whose row to row spacing is 30 cm, the implement requires approximately 16 hrs, i.e. 2 days to complete the sowing for 1 hectare of land. If the crop selected has row to row spacing of 60 cm then sowing of the crop seeds can be completed within 1 day for 1 hectare which can be economical to the farmers besides, sowing area under sowing can be increased by adapting this seed drill to overcome the dependency on sole crops and reduce the drudgery.

Future thrust

- Provision for giving support to the ground wheel during transportation.
- During transportation purpose on the field if the equipment is heavy it is very difficult to lift it manually and transport it to field so a provision for separate wheel should be given for easy movement.
- Development of the seed drill for different intercropping ratios.
- Provision of providing different hopper for different type of seeds instead of partition in the single hopper.
- Reduction of weight of the implement can be done by using lighter materials.

Seed drill with fluted roller mechanisms for uniform size seeds should be an option given to replace with other seed metering mechanism depending on the selected seeds.

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