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Calibration of small tractor operated seed ferti drill cum inter row cultivator

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Abstract
The laboratory test was conducted as per RNAM test code. Laboratory tests were conducted in the Department of farm power and machinery, Dr. P.D.K.V; Akola. The test of small tractor operated seed ferti drill cum inter row cultivator was evaluated by determining seed rate and visible seed damage. After conducting the laboratory test of newly developed implement in accordance with standard test procedure. laboratory test of the seed metering mechanism is satisfactory. In calibration test the desired seed rate obtained was 13.84, 79.76, 23.28 and 146.17 kg/ha. In sorghum, chickpea, maize and urea respectively. During the calibration trial seed damage was found negligible.

Keywords: Seed drill, metering mechanism

1. Introduction
The level of agricultural productivity is increasing in manifold with mechanization of different farm operations. It's aims is achieving timeliness of operations, efficient use of inputs, improvement in quality of produce, safety and comfort of farmers, reduction in loss of produce and drudgery of farmers on farm value addition of crops.
There is need for high capacity machines for custom hire services. For precise application of seed and fertilizer, mechanically metered seed drill and seed-cum- fertilizer drill operated by small tractor have been developed and are being manufactured to suit specific crops and regions. There is a high demand for small tractor for the small farm along with matching implement small tractor operated seed ferti drill is an urgent need. (Maheshwari *et al*, 2006) [4]

2. Materials and methods
2.1. Working principle of seed drill
The seed drill was provided a ground wheel. A ground wheel shaft was provided to transmit the power of ground wheel to counter shaft. Counter shaft was used to transmit power from ground wheel to seed metering shaft. Two ball bearings were used to mount counter shaft on main frame. A positive chain drive mechanism was used to transmit power from ground wheel shaft to counter shaft and from counter shaft to seed metering shaft. Four furrow openers were provided to seed drill with a common seed box. A fluted roller seed metering mechanism was used. The fluted roller was provided with number of flutes which were used to meter the seed at constant rate. During operation of seed drill, fluted roller rotates in the same direction, as that of the rotation of ground wheel, after receiving power from counter shaft through chain drive. Seeds flow by gravity from rubber seed tube provided at bottom of seed box to furrows which were created by furrow openers at specified intervals. (Bansal *et al*, 1989) [1]

2.2. Instrumentation
The following instruments were used during testing of small tractor operator seed ferti drill cum inter row cultivator. (Mehata *et al*, 2003) [5]

2.2.1 Stop watch
Stopwatch, measuring a minimum of one tenth of a second and maximum of 12 hours was used to record the travel speed and time required to cover the measured during the test.

2.2.2 Metallic and steel tape
A metallic tape of 30 m and steel tape of 3 m were used for measuring the diameter of ground wheel.

2.2.3 Weight balance
An electronic weight balance of 1 kg capacity was used to measure the weight of seed.

2.2.4 Polyethylene bags
Eight Polyethylene bags were used for collecting the seeds & fertilizers dropped from each furrow opener during the calibration test.

2.3. Testing of seed ferti drill cum inter row cultivator
The laboratory testing of small tractor operated seed ferti drill was carried out in order to study following performance characteristics.
1. Calibration of seed drill
2. Visible damage caused to the metered seed

2.3.1 Calibration test for seed drills (laboratory tests)
It was necessary to calibrate the seed drills for Sorghum, Chickpea, Maize and urea to find desired seed/fertilizer rate. Calibration was done to get the pre-determined seed rate of the machine. Seed drill was calibrated by the following method. Plate 1 depicts the view of calibration of the drill. (RNAM 1983)

1) Seed box was filled with 5 kg of all seed.
2) The seed drill was jacked up in such a manner that it was exactly parallel to ground surface.
3) The reference point was marked on ground wheel with chalk piece.
4) The diameter of ground wheel was measured and noted as 'D' meter.
5) From diameter 'D', circumference of ground wheel was worked out i.e. πD.
6) Working width of implement was worked out as,

W = No. of furrow openers × Spacing between furrow openers

7) The seed drill was assumed to be used in a field of size 100 × 100 m^2.
8) The revolutions of ground wheel required to travel a distance of 100 m were calculated as,

$$x = \frac{100}{\pi D}$$

9) Polyethylene bags were attached to the each furrow opener to collect the metered seed.
10) 'X' revolutions were given to the ground wheel and seeds were collected from each furrow opener, separately
11) Seeds collected from each furrow opener were weighed separately on digital weighing balance and total weight of seed was noted as 'P' kg.
12) Total number of revolutions required to cover one hectare area of the field were calculated as,
13) The total amount of seed for 'Y' revolutions and ultimately for 1 ha area was calculated as,

$$y = \frac{100 \times 100}{\pi \, D \times W}$$

14) For 'X' revolutions 'P' kg of seed was collected and for 'Y' revolutions it would be,

$$G = \frac{P}{X} \times Y, (kg)$$

Thus, 'G' was seed rate of that particular all seed in kg/ha. (Karayel *et al*, 2006) [3]

Plate 1: Calibration of seed drill

2.3.2 Visible damage caused to the metered seed
It was conducted to determine if any mechanical damage done to the seed during calibration. Visible damage caused to metered seeds was represented by average crushing percentage of seeds. For that number of crushed seeds in every 100 seeds passed through each metering mechanism were counted and from observed data crushing percentage was calculated by using following formula.

$$\text{Seed crushing (\%)} = \frac{\text{observed No.of seeds crushed}}{\text{No.of seeds passed through metering unit}} \times 100$$

3. Result
The seed cum Ferti drill was tested in the laboratory test. The laboratory tests were conducted in the Department of Farm Power and Machinery; Dr. PDKV, Akola.
The RNAM test code was followed for the testing of the small tractor operated seed ferti drill cum inter row cultivator. The results obtained in the laboratory tests are discussed and presented in table no. 1 to 2.

3.1 Laboratory testing of small tractor operated seed cum ferti drill
Before running the machine actually in field, it was tested in laboratory to assess performance of seed metering mechanism viz; calibration of seed drill and visible damage caused to metered seeds. Results obtained in laboratory testing are presented through Table no. 1 to 2.

3.2 Calibration of seed drill
The seed drill was calibrated for determining the seed rate. Standard calibration procedure was followed as discussed earlier in Materials and Methods topic. In calibration of seed for PKV-Kranti, Jaki-9218 and paras varieties of sorghum, chickpea, maize and urea fertilizer, these total three replications were taken. The data collected during the test is presented in Table 1. The weight of seeds was collected from respective furrow openers corresponding to 84 revolutions of ground wheel of the seed drill to cover 135 m^2 area under test theoretically. (Chaudhari *et. al*, 2003) [2].

Table 1: Calibration of seed drill for PKV Kranti, JAKI-9218 and Paras varieties of Sorghum, Chickpea, Maize and urea Fertilizer

Selected Seed/fertilizer	No. of Replication	Weight of seed collected from each Replication	Average seed rate (kg/ha)
Sorghum	I	13.70	13.84
	II	13.82	
	III	14.02	
Chickpea	I	78.34	79.76
	II	82.12	
	III	78.83	
Maize	I	23.59	23.28
	II	22.16	
	III	24.09	
Urea	I	146.67	146.17
	II	147.77	
	III	144.06	

Table 2: Selected rate setting after calibration of seed drill

Sr. No.	Seed/fertilizer	Recommended seed rate (kg/ha)	Actual seed rate (kg/ha)	Selected rate setting
1	Sorghum	12-15	13.74	3/4
2	Chickpea	75-85	78.34	2
3	Maize	20-25	23.59	1
4	Urea	125-150	146.67	3

3.3 Visible damage caused to metered seeds

The visible damage caused to metered seeds was 100 gram through each metering unit and number of crushed seeds was counted from the sample of 100 seed taken, such three replications were taken. The percentage of the damaged seeds was found in the range of 1 to 1.5 per cent. (Average 1.25 per cent) which was negligible observed the similar results of mechanical damage to seeds which was negligible in planter comparison to 4-5 per cent in seed drills. The percentage of visible damage to seed in the drill shall not exceed 0.5 to 1 per cent.

4. Conclusions

The laboratory test was conducted as per RNAM test code. Laboratory tests were conducted in the Department of farm power and machinery; Dr. P.D.K.V; Akola. The test of small tractor operated seed ferti drill cum inter row cultivator was evaluated by determining seed rate and visible seed damage. After conducting the laboratory test result for newly developed seed drill in accordance with standard test procedure, were calculated in table no. 1 and from these results final conclusion were drawn which are as follows. The laboratory test of the seed metering mechanism is satisfactory. In calibration test the desired seed rate obtained was 13.84, 79.76, 23.28 and 146.17 kg/ha. In sorghum, chickpea, maize and urea respectively. During the calibration trial seed damage was found negligible. This seed drill recommended for multiple seed sowing in field crops.

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