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# Performance evaluation of small tractor operated seed ferti drill cum inter row cultivator

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**Abstract**
A small tractor operator seed ferti drill cum inter row cultivator was evaluated for its performance in the Department of FPM, Dr. PDKV, Akola. During sowing season, there is an acute shortage of labour, which causes delay in sowing of crop which ultimately results in a reduction in yield. There is a need of such versatile machine which overcomes the economic constraints of farmer and can perform both sowing and Intercultural operation. Another limitation is that about 90 percent of farmers fall in the category of marginal, small and semi-medium land holding (Agricultural Statistics at a Glance-1995). The implement was tested in laboratory and in the field as per RNAM test code for PKV-Kranti, JAKI 9218 & Paras variety of sorghum, chickpea & maize respectively. The percentage of the visible damaged seeds was found in the range of 1 to 1.25%. For sowing operation, fuel consumption and average tractor wheel slip of the machine was found 4.51lit/ha and 6.68 per cent respectively. For Intercultural operation, fuel consumption and average tractor wheel slip of the machine was found 3.21lit/ha and 6.78 per cent respectively. For sowing operation the effective field capacity, theoretical field capacity and field efficiency of implement was found to be 0.403 ha/h, 0.485 ha/h and 83.09 percent respectively. For intercultural operation the effective field capacity, theoretical field capacity and field efficiency of implement was found to be 0.428 ha/h, 0.469 ha/h and 91.26 percent respectively. The average weeding efficiency and plant damage of the machine was found to be 90.02 percent and 1.4 percent respectively. The cost of operation for sowing was Rs. 484.45/h and Rs. 1334.57/ha. The cost of operation for intercultural was Rs. 426.04/h and Rs. 1479.30/ha. The implement also had seed covering device to cover seed after sowing. The overall performance of the small tractor operator seed ferti drill cum inter row cultivator during the operation carried in small area regarding seed placement and effective working of inter row cultivator was found to be satisfactory.

**Keywords:** Field capacity, field efficiency, fuel consumption, weeding efficiency

## Introduction
Performance evaluation of small tractor operated seed ferti drill cum inter row cultivator can fulfill the mechanization gap to do the sowing and weeding operation at the faster rate. Tractor drawn, high clearance cultivators using sweeps and seed cum fertilizer drill has given good results. This shows, there is an urgent need to introduce the multipurpose implement i. e. small tractor operated seed ferti drill cum inter row cultivator in Vidarbha region. Multipurpose implement will perform sowing, fertilizer application, intercultural operation and seed covering.

## Methodology
The field experiment was carried out at CRS shivar block, agronomy field and dairy field Dr. PDKV Akola, for Sorghum, Chickpea and Maize. A field of 10 ha area was selected for three crops and it was divided into three plots, 1 ha area was selected for Sorghum crop, a field of 8 ha area was selected for Chickpea crop a field of 1 ha area was selected for Maize crop for sowing by seed. As per the recommendation the intercultural operation was carried in all three crops to test inter row cultivator as per standard test procedure.

## Experimental technique
After completion of calibration test of seed drills, the field experiment was conducted. To evaluate the performance of seed drills as well as inter row cultivator the following parameters have been considered.

**A) Soil parameters**
1) Moisture content of the soil
2) Bulk density of soil

**B) Machine and operational parameters**

**Table 1:** Machine and operational parameters

| Sowing operation | Intercultural operation |
|---|---|
| • Speed of operation | • Speed of operation |
| • Draft requirement | • Draft requirement |
| • Effective field capacity | • Effective field capacity |
| • Theoretical field capacity | • Theoretical field capacity |
| • Field efficiency | • Field efficiency |
| • Fuel consumption | • Fuel consumption |
| • Tractor wheel slip | • Tractor wheel slip |
| • Depth of placement of seeds | • Weeding efficiency |
| • Row to row spacing | • Plant damage |
| • Germination percentage | |

The performance of seed ferti drill cum inter row cultivator was evaluated by taking the laboratory tests and field tests, as per RNAM test code Anonymous (1995).

**Soil moisture content**
Soil moisture content on dry basis was measured as suggested by Mohsenin (1979) using oven dry method. The moisture content on dry basis was calculated using following formula.

$$\text{Moisture content (db)} = \frac{w_1 - w_2}{w_2} \text{x100}$$

Where,

$w_1$ = initial weight of soil sample, g

$w_2$ = weight of dry soil sample, g

**Bulk density**
It is the ratio of mass of soil sample to the volume of core cutter. The bulk density of soil was calculated by following formula.

$$\text{Bulk density}(g/cm^3) = \frac{\text{Mass of soil sample}}{\text{Volume of core cutter}}$$

$$= \frac{M}{\pi D^2 L}$$

where,

$\rho$ = bulk density, $gm/cm^3$

M = borne dry weight of soil sample, g
D = diameter of cylindrical core sampler, cm
L = length of cylindrical core sampler, cm

**Speed of operation**
The forward speed of operation was calculated by observing the distance traveled with time taken and calculated by following formula (Mehta *et al.*, 2005).

$$S = \frac{L}{t}$$

Where,
S = forward speed of machine, m/s
L = distance travelled, m
t = time taken, s

**Draft of implement**
Draft measurement was done with the help of digital dynamometer with load cell. Requirement of implement were calculated by following formula (Mehta *et al.*, 2005).

Draft of Implement = with load draft – Without load draft

**Effective field capacity**
Effective actual field capacity was calculated by following formula (Mehta *et al.*, 2005).

$$E.F.C. = \frac{A}{T_p + T_1}$$

Where,
E.F.C. = effective field capacity (ha/hr)
A = area (ha)
$T_p$ = productive time (hr)
$T_1$ = non-productive time, (hr) (Time loss for turning and cleaning blades)

**Theoretical field capacity**
For calculating the theoretical filed capacity, working width and travelling speed was taken in to consideration. It is always greater than the actual field capacity.
Theoretical field capacity was calculated by using following formula (Mehta *et al.*, 2005).

$$T.F.C. = \frac{S \times W}{10}$$

where,
T.F.C.= theoretical field capacity (ha/hr)
W = theoretical width of Implement (m)
S = speed of operation (km/h)

**Field efficiency**
Field efficiency was calculated by taking ratio of effective field capacity to theoretical field capacity. It is always expressed in percentage. It was calculated by following formula (Mehta *et al.*, 2005).

$$\text{Field efficiency (\%)} = \frac{\text{E.F.C.}}{\text{T.F.C.}} \times 100$$

Where,
E.F.C. = effective field capacity
T.F.C. = theoretical field capacity

**Fuel consumption**
To measure the fuel consumption, the tractor was placed on leveled ground. Then fuel tank of tractor was filled up to top of the tank before operation. After the completion of the operation tractor was placed at a leveled ground and then tank was again filled with fuel to maintain the original level of fuel. Quantity of fuel filled in the tank was measured by measuring cylinder. The quantity of fuel required to make up the original level as before the operation was the actual fuel consumption.

**Tractor wheel slip**
The tractor drive wheel normally slips in all field operations. The tractor wheel slip depends upon depth of operation and moisture content of the soil. The tractor wheel slip was determined in percentage by using following formula.

$$\text{Wheel slip, \%} = \frac{N_2 - N_1}{N_2}$$

Where,
$N_2$ = No. of revolutions of tractor wheel with load
$N_1$ = No. of revolutions of tractor wheel without load

**Depth of placement of seed**
The implement was operated in the field with some setting in depth adjusting mechanism, in order to get 3, 5, & 7 cm average depth of seed placement. The depth of seed was measured with meter rule. Observations were taken randomly from entire field during operation.

**Row to row spacing**
The distance between two rows was measured with the help of steel tape after germination i.e. 10 days after sowing. The observations are presented in Table 4.16. Crop germination and crop stand after 15 days of sowing is respectively. Measurement of row to row spacing is shown in Plate 3.9.

**Germination percentage**
Germination percentage is useful to know actual plant population (No. of plants per hectare) maintained in the field. The germination percentage was calculated by following formula.

$$\text{Germination percentage, \%} = \frac{Na}{Nt}$$

Where,
$N_a$ = Actual number of plants observed in same selected area
$N_t$ = Number of plants that to be present in selected area

**Weeding efficiency**
The weeding efficiency was calculated on weed count method. In this method one square meter area ring was randomly thrown in the field and number of weeds before and after operation was noted in entire area of ring, such reading were taken at the different location. The weeding efficiency of the implement was calculated by using the following formula (Mehta *et al.*, 2005).

$$E_w = \frac{W_1}{W_1 + W_2} \times 100$$

Where,
$E_w$ = Weeding efficiency, %
$W_1$ = No. of weeds after weeding in $1m^2$ area
$W_2$ = No. of weeds before in $1m^2$ area

**Plant damage**
Plant damage can be calculated by counting the number of plants in 10m rows before weeding and number of the plant damaged in 10 m row length after weeding (Biswas and Yadav, 2004).

$$\text{Plant damage (\%)} = \frac{Q}{P} \times 100$$

Where,
Q = Total no. of plant after weeding in 10 m rows
P = Total no. of plant before weeding in 10 m rows

**Results**
The implement was tested in 10 ha field. The field was prepared for sowing by performing preparatory tillage operations like ploughing and harrowing. All the settings and adjustments were done before performing the test. The observations recorded during field testing and results obtained

**Moisture content of soil**
Soil moisture content was determined during field test by gravimetric method. The average moisture content of the soil at the time of sowing 24.70 per cent and the average moisture content of the soil at the time of intercultural operation was found 15.20 per cent.

**Bulk density of soil**
The bulk density of soil was calculated by considering weight of core cutter, mass of core cutter + wet soil, mass of core cutter + dry soil and volume of core cutter. The bulk density of soil was 1.31 g/cm$^3$.

**Table 2:** Field performance results of seed cum ferti drill

| SN | Particulars | seed cum ferti drill | Inter row cultivator |
|---|---|---|---|
| 1 | Actual operating time, min | 70 | 90 |
| 2 | Time loss in turning, min | 21 | 22.26 |
| 3 | Forward speed, km/h | 2.50 | 2.55 |
| 4 | Area covered, | 4000 | 4000 |
| 5 | EFC, ha/h | 0.295 | 0.321 |
| 6 | TFC, ha/h | 0.349 | 0.344 |
| 7 | Field efficiency, % | 84.52 | 93.31 |
| 8 | Draft requirement, kg | 198.1 | 167.1 |
| 9 | Fuel consumption, l/h | 4.8 | 3.10 |
| 10 | Wheel slip, % | 6.68 | 6.78 |
| 11 | Cost of operation, Rs/ha | 1334.57 | 1479.30 |

**Conclusions**
**a) Seed cum ferti drill**
- The working width is 135 cm with a depth of 2 to 10 cm.
- Row to row spacing of 44.9 cm
- Average depth of sorghum, chickpea & maize seed was found to be 2.5, 6.9 and 3.9 cm resp.
- The germination percentage for Sorghum, Chickpea and Maize crops was 84.77%, 93.80% and 79.81% resp.

**b) Inter row cultivator**
- The working width is 90 cm with a depth of 6 to 15 cm.
- Weeding efficiency was found to be 90.02%.
- Plant damage was found to be 1.4%.

The overall performance of the small tractor operated seed ferti drill cum inter row cultivator was found to be satisfactory.

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