

CIAE TRACTOR MOUNTED PNEUMATIC PLANTER

A Success Story



All India Co-ordinated Research Project on
FARM IMPLEMENTS AND MACHINERY
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Introduction

Field plot machinery like tractor operated pneumatic planter provides accurate and precise rate of seed placement. No varietal mixing occur between the plots during sowing. A large number of experiments can be completed avoiding the effect of date of planting by the researchers. The high cost of the hybrid seeds restricts the use of higher seed rates. Accurate placement of single seed in soil ensures saving in costly seeds, reduces the problem of thinning and crop yield is also higher as each plant gets the desired quantity of sunlight, water and nutrients. At CIAE, Bhopal six row and 10 row units have been designed and developed for accurate planting of single seed at predetermined seed/row spacing.

Traditional Practices and Necessity for Development

The traditional methods of sowing behind country plough or bullock operated or tractor drawn seed drills leads to uneven seeds distribution. In order to complete the planting of costly hybrid seeds, there was a need to design and develop tractor operated modular planting equipment. The bio-scientists were in need of such a machine for accurate row and seed to seed spacing in experiments.

Evolution/Design Process

A few plot machines for precision sowing of hybrid seeds were imported in 1982. These machines were evaluated for different varieties under black cotton soil. The evaluation included laboratory test and field testing of imported units. Under Indian conditions, they required simplification, reduction of weight and cost and were tested at different suction pressures to optimize for different crops. For its use for groundnut, cotton and vegetable seeds (lady finger) multiples

and missing pattern were checked. The cost of refined unit was Rs 30,000/-, weighing 320 kg.

Salient Features of the Machine

It consists of main frame, aspirator blower disc with cell type metering plate, individual hopper, furrow openers, pto driven shaft and ground drive wheel. It is a six row (2 and 4 optional) tractor drawn unit which has been designed and developed at CIAE, Bhopal for accurate planting of single seed at predetermined seed to seed and row spacing. The machine works on the air suction principle. Air is sucked through a rotating plate having various holes radially. Specifications of the seed plates to be used for different crops are given in table-1. A seed coming in contact gets stuck to the holes on the plate and falls when suction is cutoff at the lowest position near the ground. The fall of the seed is synchronized with the predetermined seed spacings. Since the seed is lifted under suction no mechanical seed damage takes place. The machine is operated with a 26 kW tractor. The hopper can accommodate 8 kg groundnut and 10-15 kg cotton and lady's finger seeds. For wide row crops, number of modular units are 4 & 3 to achieve row spacings of 60-75 cm and 90-100 cm, respectively.

Performance of Pneumatic Planter

The different performance evaluation tests of the planter involved:

1. Laboratory tests to check pattern of multiples and missing and for measurement of suction pressure
2. Field performance trials to evaluate the commercial viability of the machine and to determine the plant distribution patterns.

For carrying out laboratory tests, the blower of the planter was run by tractor pto in stationary position. The ground wheel was rotated manually for 10 revolutions. The total number of seed metered, the

number of holes having missing seed and number of holes having multiple seeds were counted for each row. The blower rpm was changed and the tests repeated.

The engine rpm for which minimum missing and multiples occurred was selected for further field trials. The pressure at the optimized blower rpm was measured using a manometer. The machine was then tested in field for different seeds. The seed spacing distribution was observed by taking seed to seed distance for 100 seeds. The depth of planting, forward speed, field capacity, field efficiency and skid of ground wheel were the other variables measured. The data on the plant population was also recorded.

The field tests were carried out in CIAE farm and in farmers fields (Fig 1). In all about 15 ha planting was done for several crops such as soyabean, gram, kabuli gram, pigeon pea, ladies finger, peas and cotton. Ladies finger crop sown with the pneumatic planter is shown in Fig.2. Results of laboratory and field testing of the planter are given in Table 2 to 5.

The distribution of seed spacings for ladies finger, groundnut and cotton crop are shown in Figs 3 to 5. The planter was operated to give a theoretical spacing of 15cm, 10cm and 30 cm in case of ladies finger, groundnut and cotton crops respectively. Fig 3 shows the distribution of seed spacing in three trials with ladies finger crop. 90-100% seed were found to lie within ± 5 cm of desired spacing. In the case of groundnut crop (Fig. 4) 94% seeds were found to lie within ± 5 cm of the desired spacing. Similarly in the case of cotton crop, (Fig. 5) 90 % seeds were found to lie within ± 5 cm of the desired spacing.



Fig.1 CIAE Pneumatic Planter used for Planting of Ladies Finger crop



Fig. 2 Ladies Finger crop sown with CIAE Pneumatic Planter

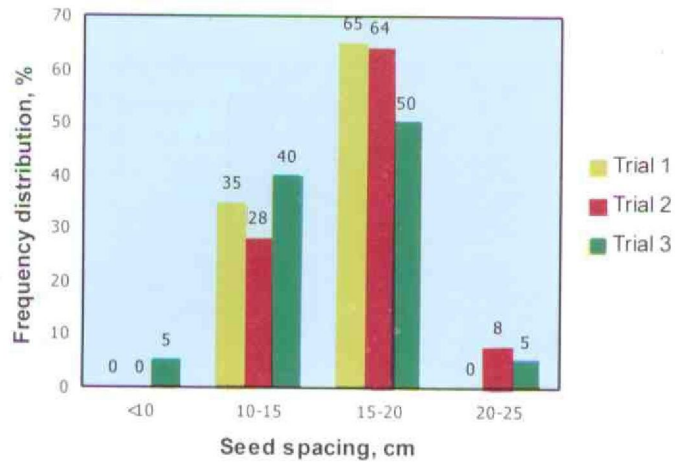


Fig. 3 Distribution of seed spacing for ladies finger crop obtained in three trials of planting of Ladies Finger crop

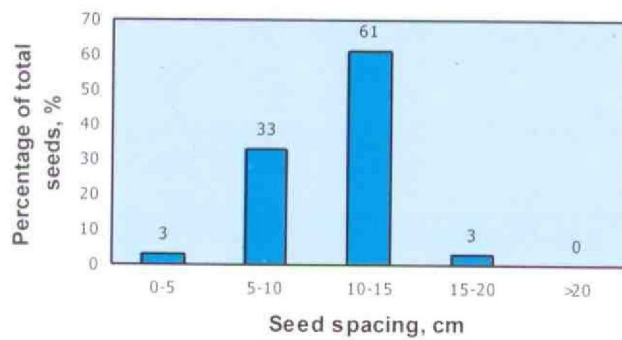


Fig. 4 Distribution of seed spacing in Groundnut crop

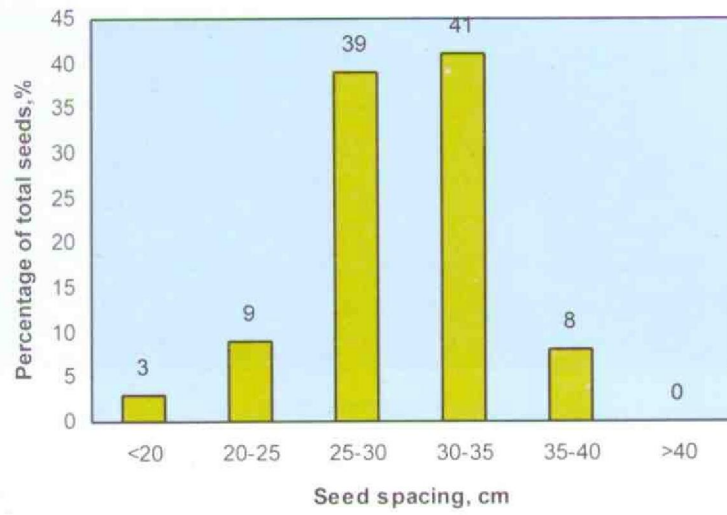


Fig. 5 Distribution of seed spacing in Cotton crop

Table-1 Specifications of seed plates used in the planter

| Crops | Recommended seed spacing (cm) | No. of holes on the plate | Angular displacement of seed hole (degrees) | Seed hole dia (mm) |
|------------|-------------------------------|---------------------------|---|--------------------|
| Soybean | 5 | 32 | 11.25 | 4 |
| Sorghum | 10 | 16 | 22.5 | 3 |
| Pigeon pea | 10 | 16 | 22.5 | 3 |
| Mustard | 10 | 8 | 45 | 1.5 |
| Okra | 20 | 6 | 60 | 3 |
| Maize | 30 | 6 | 60 | 6 |
| Cotton | 45 150 | 4 2 | 90 180 | 3 3 |
| Groundnut | 15 | 12 | 30 | 6 |
| Radish | 10 | 16 | 22.5 | 2 |

Table-2 Laboratory test results of pneumatic planter at CIAE, Bhopal

| Seed with variety | Suction pressure, kg / cm ² | Unfilled holes, % |
|---------------------|--|-------------------|
| Cotton (PKV-081) | 2 | 0 |
| Groundnut (JL-24) | 5.3 | 2.5 |
| Lady's finger (PIC) | 2.0 | 0 |

Table-3 Summarized results of field trials of pneumatic planter at CIAE, Bhopal

| Variables | Trial Numbers | | | | | | |
|--------------------------------------|---------------|---------|-----------|-------------|--------|------------------------|---------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| C r o p planted | Lady finger | Cotton | Groundnut | Lady finger | Cotton | Groundnut & pigeon pea | Lady's finger |
| Variety | Pk | PKV-081 | JL-24 | PIC | NHH-44 | JL-24 PKV-0981 | Pk |
| R o w spacing, mm | 600 | 900 | 450 | 450 | 900 | 450 | 600 |
| Planned intra-row seed spacing, mm | 400 | 400 | 100 | 200 | 250 | 100 | 150 |
| Drive wheel skid, % | 8.1 | 10.50 | 8.80 | 9.50 | 10.75 | 7.50 | 9.80 |
| A c t u a l average seed spacing, mm | 438 | 451.3 | 107.8 | 256.6 | 256.3 | 86.8 | 171 |
| AV Plant spacing, mm | 483 | 502.5 | 122 | 270.2 | 162.1 | 120 | 220.5 |
| Forward speed, km/h | 1.18 | 1.48 | 1.64 | 1.74 | 1.49 | 1.85 | 2.18 |
| F i e l d capacity, ha/h | 0.31 | 0.38 | 0.34 | 0.36 | 0.32 | 0.46 | 0.45 |
| F i e l d efficiency, % | 70 | 81 | 71 | 67 | 75.30 | 85 | 66.92 |

Table-4: Test results of tractor mounted pneumatic planter at JNKVV, Jabalpur

| Parameter | Crop | |
|--------------------------------------|------------|---------|
| | Sunflower | Soybean |
| Crop variety | Jwalamukhi | JS-335 |
| Seed viability, % | 81 | 74 |
| Seed rate, kg/ha | | |
| i) Calibrated | 2.9 | 80 |
| ii) Obtained in field | 2.8 | 78 |
| Width of operation, mm | 1800 | 1400 |
| Speed of travel, km/h | 2.5 | 2.6 |
| Field capacity, ha/h | 0.43 | 0.36 |
| Field efficiency, % | 70 | 70 |
| Plant spacing, mm | | |
| i) Row to row | 450 | 220 |
| ii) Plant to plant | 200 | 100 |
| Depth of sowing, mm | 28 | 43 |
| Plant population, No./m ² | 12 | 26 |

Table-5: Performance results of tractor mounted pneumatic planter at Dr. PDKV, Akola

| Parameter | Value |
|--------------------------------|--------------------------------|
| Crop and variety | Cotton (PKV Rajat, AK-7, AK-5) |
| Soil moisture (db), % | 14.37 |
| Row spacing, mm | 600 |
| Seed rate, kg/ha | 3 (Rajat) 9-10 (AK-5, AK-7) |
| Depth of operation, mm | 40 |
| Speed of operation, km/h | 4.60 |
| Effective field capacity, ha/h | 0.55 |
| Field efficiency, % | 76 |
| Fuel consumption, l/h | 4.43 |
| Cost of operation, Rs/ha | 473.30 |

From laboratory and field testing of the planter, it was seen that the machine can be used as a precision planter for different sizes and shapes of seeds. During feasibility testing at Dr. PDKV, Akola it saved 44.42% time and 23.85% in cost of operation compared to conventional method for sowing cotton.

Status of Technology

After multi-locational trials, the tractor mounted pneumatic planter has been taken up for commercialization. Five manufacturers have taken up its manufacturing and 25 units have been produced.

Specifications of Pneumatic Planter

| | |
|--------------------------------|---|
| Overall dimensions (lxbxh), mm | 924 x 2400 x 1373 |
| Weight, kg | 320 |
| Suitability for crops | Groundnut, cotton, pigeon pea, mustard, pea, maize, lady finger, soybean, sunflower |
| Hopper capacity, kg | 8 (Groundnut) 10-15 (Cotton & Lady finger) |
| No. of rows | Adjustable 6, 4, & 2 |
| Row spacing, mm | 250 and above |
| Type of blower | Aspirator |
| Speed of aspirator, rpm | 6,000 |
| Seed metering | Pneumatic disc suction principle |
| Seed planting spacing | By changing sprocket settings |
| Field capacity, ha/h | 0.5-0.6 |
| No. of holes on disc | 16 (pigeon pea), 16 (soybean), 2-4 (Cotton), 6 (maize), 16 (groundnut) |
| Seed hole dia, mm | 3 (pigeon pea & cotton), 4 (soybean), 6 (groundnut & maize) and 1.5 (mustard) |
| Power source | 25 kW tractor or above |
| Cost, Rs | 30,000/- |

List of Manufacturers

1. Prototype Production Centre
Technology Transfer Division
Central Institute of Agricultural Engineering
Nabibagh, Berasia Road,
Bhopal
2. M/s Yashodara Engineering
Shed No 12, I Sector, Industrial Area,
Govindpura, Bhopal.
3. M/s Lalwani Earth Movers,
Hamidia Road, Bhopal
4. M/s Laxmi Industries,
Berasia Road, Bhopal
5. M/s Vinod Enterprises,
Govindpura Industrial Area
Bhopal
6. M/s Fine Fabrication Works,
104, Sector-1, Industrial Area,
Govindpura, Bhopal

..... A Step Towards Farm Mechanization

Substenance of a desirable level of agricultural productivity goes hand in hand with mechanization of different farm operations, which aims at achieving timeliness of operations, efficient use of inputs, improvement in quality of produce and safety and comfort of farmers and reduction in loss of produce and drudgery of farmers.

The All India Coordinated Research Project (AICRP) on Farm Implements and Machinery (FIM) with its 28 centres in different parts of the country, has been endeavouring to develop, test and popularize need based farm implements and machinery for different regions. The research and development activity under AICRP on FIM involves design, development, testing and design refinement of farm implements and machinery. Prototype manufacturing activity is for multiplication of research prototypes for multilocation trials, development of manufacturing technology for new machines and promoting their manufacture by involving local manufacturers. Prototype feasibility testing activity of a Centre includes identification of farm mechanization needs under local agro-climatic conditions and identification and adaptation of machines to fill the identified mechanization gaps through their feasibility trials.

One-hundred-seventy-eight farm implements and machinery have been designed and developed under the AICRP on FIM. Ninety-one of these have been commercialized. This publication is one among the series of such publications being brought out by the Project on successful technologies.