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CIAE TRACTOR MOUNTED INCLINED PLATE PLANTER

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A Success Story



All India Co-ordinated Research Project on
FARM IMPLEMENTS AND MACHINERY
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**CIAE TRACTOR MOUNTED
INCLINED PLATE PLANTER**

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Introduction

For medium size seeds, many design of seed drills/seed cum fertilizer drills have been developed and are commercially available. These machines are mostly suitable for drilling of medium size seeds at the rate of 20 kg/ha and above. These are mostly provided with fluted roller seed metering mechanisms. The crops having very small or bold size seeds can not be handled with fluted rollers. During early eighties the animal drawn inclined plate planter performance was appreciated during demonstrations and various exhibitions but its tractor version was required by tractor owned farmers to complete the planting operation. The application of such planter for oilseeds and pulses can play a key role providing saving in labour, cost and time of operation. The costly inputs (seeds and fertilizers) can be judiciously used to get desired plant stand facilitating interculture operation.

Traditional Practices and Necessity for Development

The sowing operation of bold and very small seeds are performed using country plough followed by dropping of seeds manually. Few animal drawn designs have been developed having rotor with cells on its periphery to meter seeds or adjustable aperture with agitator to drop the seeds. All these methods could not provide precision in sowing. The development of animal drawn inclined plate planter during early eighties succeeded in achieving uniform seed to seed spacing and row spacing. For different crops, inclined plates with cells of different sizes on periphery were used to meter costly seeds. Later a separate fertilizer hopper was also provided with fluted roller to meter granular fertilizer. For tractor owned farmers, the development and testing of machine was carried out at CIAE, Bhopal. This machine is also suitable for inter row cultivation covering 4 ha/day.

Salient Features of the Machine

It consists of main frame, seed boxes, fertilizer box, furrow openers, ground drive wheels, seed tubes, seed metering mechanism and power transmission system. For sowing bold seeds like groundnut, cotton, maize a six row machine was prepared using Pro/ENGINEER CAD Software. The main frame is made of 40 x 40 x 5 mm size box section. On the rear tool bar of the frame, shoe type furrow openers with modular units of seed boxes are clamped. Each seed box (capacity 15 kg) is provided with inclined plate (120 mm dia) type seed metering mechanism. The seed metering system is driven by a spiked ground drive wheel, fitted on front side of the frame through sets of chain and sprockets and bevel gears. The drive ratio (1:1) can be changed at different stages. A common fertilizer box with 6 units of fluted roller assemblies for metering granular fertilizer is fixed on the main frame. The drive to fertilizer metering shaft is through the main drive shaft of the planter. The provision has been made for different crops by selecting seed plates and by changing the transmission ratio. The size of cells and inclined plate thickness depends on the seeds to be sown. The row spacing (225-450 mm) between furrow openers can be changed by sliding the furrow openers on rear tool bar of main frame. The depth control of planter is performed by tractor hydraulic system. At later stage, some refinements were carried out on the basis of feed back from farmers and manufacturers and researchers. These were replacement of bush bearings used in the mounting of ground wheel from ball bearing for better structural strength. For simplifying fabrication, design of fixing system for seed box to furrow opener and clamp system for furrow opener to main frame has been refined. The hitching system provided on the main frame has been changed and made similar to the hitch system provided on the commercial seed drill.

Evolution of Design

The conventional designs of seed drills with fluted roller metering

mechanism are found suitable for medium size seeds. The CIAE animal drawn planter was developed in mid eighties which was tested extensively for different crops at FIM Project centres. To meet the demand of tractor owned farmers a tractor mounted inclined plate planter was developed at CIAE, Bhopal in 1996 which was evaluated for planting bold seeds viz; cotton, maize, groundnut, soybean and pigeon pea. The machine was feasibility tested at JNKVV, Jabalpur and CIAE, Bhopal covering 50 ha for oilseeds, pulses and vegetable crops. The FIM Project Centre at CIAE, Bhopal evaluated the machine for kabuli gram, mustard, soybean, groundnut, pigeon pea and maize crops during 1997 and 1998. Before taking up prototype production. Refinement of ground drive wheel, hitch system and seed hopper modular unit were taken up to further improve functional performance and simplification in fabrication. It makes easier to use planter for row spacing of minimum 250 mm. The use of ball bearing in ground wheel reduced draft. The hitch system was modified to one used on commercial seed drills. The structural strength of drive wheel was also improved in refinement. The planter was also tested under IVLP at CIAE, Bhopal for sowing maize, pigeon pea and soybean covering 30 ha and feed back from farmers were obtained.

Performance of the Machine

The *trifan* for sowing oilseeds, pulses is unable to provide desired plant population in the black soil region. On the other hand animal drawn planter serves partial purpose on large farms due to low field capacity. The developed tractor mounted multi-crop planter was tested in the laboratory for seed metering mechanism performance and calibration of fertilizer rate for granular fertilizers. The laboratory tests (Table-1) included inter row variation in seeds dropped from different furrow openers, average number of cell fillings, percentage of cells with more than one seed and seed rate at recommended row spacings for different crops. The functional testing was carried out at research farm to check functionality of different sub-assemblies. The

results of laboratory calibration of planter for groundnut, kabuli gram, pigeon pea and maize crops indicated a maximum variation in quantity of seeds dropped from different metering units which was up to $\pm 6\%$ from the average value for the seeds of groundnut, pigeon pea and kabuli gram. The variation was higher for maize seeds and it ranged from -7.3 to 8.5%. The mechanical damage to seeds was about 1.5% for groundnut seeds. The average number of cell filling was above 93%. The percentage of cells carrying more than one seed was 2-3%. The variation in the quantity of seeds dropped from different seed metering units was more for maize seeds because of irregular shape of seeds and large variation in size of seeds. For metering of cotton seeds, a seed plate with 10 cells was selected and each cell could accommodate 2-3 seeds (Fig.1).

During field trials (Table-2) at CIAE farm, the planter was evaluated for sowing kabuli gram, maize and cotton crops. The seed rate in the field was 20 kg/ha for maize, 105 kg/ha for kabuli gram and 14 kg/ha for cotton. The field capacity was 0.56-0.59 ha/h for maize and 0.44-0.47 ha/h for sowing kabuli gram. The average plant population was 11.5-13.8 plants/m² for kabuli gram. The planter was tested for groundnut crop at four farmer's field (Vill: Mugalia hat). It was also demonstrated in 30 ha under IVLP & FLD activities at villages viz; Ratatal, Khajuri, Mugalia hat, Arwalia for inter crop cultivation of soybean-maize and maize-pigeon pea and soybean-pigeon pea crops (Fig.2).

Status of the Technology

Tractor mounted inclined plate planter is now commercialized. Two manufacturers have taken up the planter for limited commercial manufacturing. Twenty prototypes of planter have been supplied to different organizations for multi location trials.



Fig.1: CIAE Tractor mounted inclined plate planter with fertilizer box



Fig.2: Soybean crop sown with CIAE Tractor mounted inclined plate planter

Item of observation	Ma-ize	Ma-ize	Ma-ize	Kabuli gram	Cotton	Ma-ize	Ma-ize	Kabuli gram
Average seed rate (kg/ha)	19.5	20.3	21.4	108.5	13.9	21.5	21.0	105.6
Average plant population (pl/m ²)	11.5	13.8	12.3	32.5	3.0	11.3	12.6	29.6

Specifications of Machine

Dimensions (lxbxh), mm	2500 x 1215 x 1010
Weight, kg	210
Suitability for crops	Cotton, groundnut, maize, pigeon pea, pea, soybean, mustard, Bengal gram
Box section, mm	40 x 40 x 5
No. of rows	6
Row spacing range, mm	225 - 450
Furrow opener	Shoe type
Change of row spacing	By sliding the furrow openers on rear tool bar of main frame
Seed hopper, No.	6
Seed hopper capacity, kg	15
Seed metering mechanism	Inclined plate with edge cells
Fertilizer box	One
Fertilizer metering	Through aluminium fluted rollers (6 Nos.)
Depth control	By tractor hydraulic
Power transmission	From ground drive wheel to seed feed shaft through chain, sprockets and set of bevel gears
Power transmission ratio	1:1

Size of ground drive wheel, mm	550 (Tip dia)
Provision for sowing different crops	By selecting seed plates for different crops and by changing the transmission ratio
Cost, Rs	14,500/- 17,500/- (with fertilizer unit)

Appendix-II

List of Manufacturers

1. Prototype Production Centre
Technology Transfer Division
Central Institute of Agricultural Engineering
Nabi Bagh, Berasia Road, Bhopal-462 038
2. M/s Vasundhara Krishi Yantra Udhog
Nishatpura, Berasia Road, Bhopal
3. M/s Yashodhara Engineering
Shed No.12, I-Sector
Industrial Area, Govindpura, Bhopal
4. M/s Manak Industries
Indrapuri, Bhopal
5. M/s Fine Fabrication Works,
104 A, Industrial Estate, Govindpura,
Bhopal-462 023