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TRACTOR MOUNTED GROUNDNUT HARVESTER

A SUCCESS STORY



ALL INDIA COORDINATED RESEARCH PROJECT ON
FARM IMPLEMENTS AND MACHINERY
CENTRAL INSTITUTE OF AGRICULTURAL ENGINEERING
Nabi Bagh, Berasia Road, Bhopal - 462 038, India

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Year	:	2000
Published by	:	COORDINATING CELL AICRP ON FARM IMPLEMENTS AND MACHINERY CENTRAL INSTITUTE OF AGRICULTURAL ENGINEERING Nabi Bagh, Berasia Road Bhopal - 462 038, India
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Introduction

Among the oilseeds grown in India, groundnut (Peanut) (*Arachis hypogea* L.) is an important source of edible oil. It accounts for 45 per cent of the total area under oilseeds and 55 per cent of oilseed production. The major groundnut growing states in India are Andhra Pradesh, Tamil Nadu, Karnataka and Gujarat. Since it is labour intensive operation, scarcity of labour is experienced during the peak harvesting season due to diversion of labour to other agricultural and industrial works. Under hard-soil conditions blade hoes and harrows do not penetrate up to desired depth of about 8 cm and do not perform digging operation satisfactorily. Harvesting of groundnut crop mechanically is an operation in which whole crop has to be removed from the soil without detaching or damaging the pods entangling the crop, by loosening the soil with a tool.

Traditional Practices

Groundnut is conventionally harvested either by manual pulling if the soil moisture is adequate or hoeing with hand hoe followed by manual pulling. In some places, the field is ploughed with a mould board or country plough to uproot the plants. Both the methods, labour intensive involving drudgery and fatigue. Pulling and stripping requires about 84 man-h/ha. It is important to harvest the crop at an optimum time and at its physiological maturity so that the maximum yield of best quality pods with high shelling percentage, oil content and high seed mass are obtained. The soil moisture content influences the ease in groundnut harvesting.

Salient Features

The groundnut harvester (Fig. 1) consists of a soil loosening tool, a pick up conveying mechanism and gatherer windrower. The soil engaging tool is made of 15 mm thick x 100 mm wide x 1800 length straight high carbon steel blade. The tool at 15 deg rake angle is fixed to a main frame through shanks at both the ends. The pick up conveying mechanism of length 1700 mm is made of two 6mm endless ship chains spaced at 1800 mm apart. Both the chains are connected by conduit pipes spaced at 90 mm. Straight pegs of 100 mm long with end projection are fastened to these pipes at 75 mm spacing in a staggered manner. At the rear a gatherer, windrow the conveyed crop. It is operated by a 35 hp tractor. It weighs 300 kg and has an overall dimension of 2050 x 2100 x 1150 mm.

Function	:	To harvest and windrow groundnut crop
Power source, hp	:	35 (tractor)
Width of coverage, cm	:	175
Capacity/Coverage, ha/d	:	Two
Labour requirement	:	Two
Cost of harvesting by machine, Rs/ha	:	600/- (Rs.880/- per ha by manual method)
Harvesting efficiency, %	:	99
Soil separation efficiency, %	:	95
Saving in labour cost, %	:	40
Saving in labour time, %	:	96
Break even point, ha/y	:	17 ha
Pay back period, y	:	5
Cost of the machine, Rs	:	20,000/-

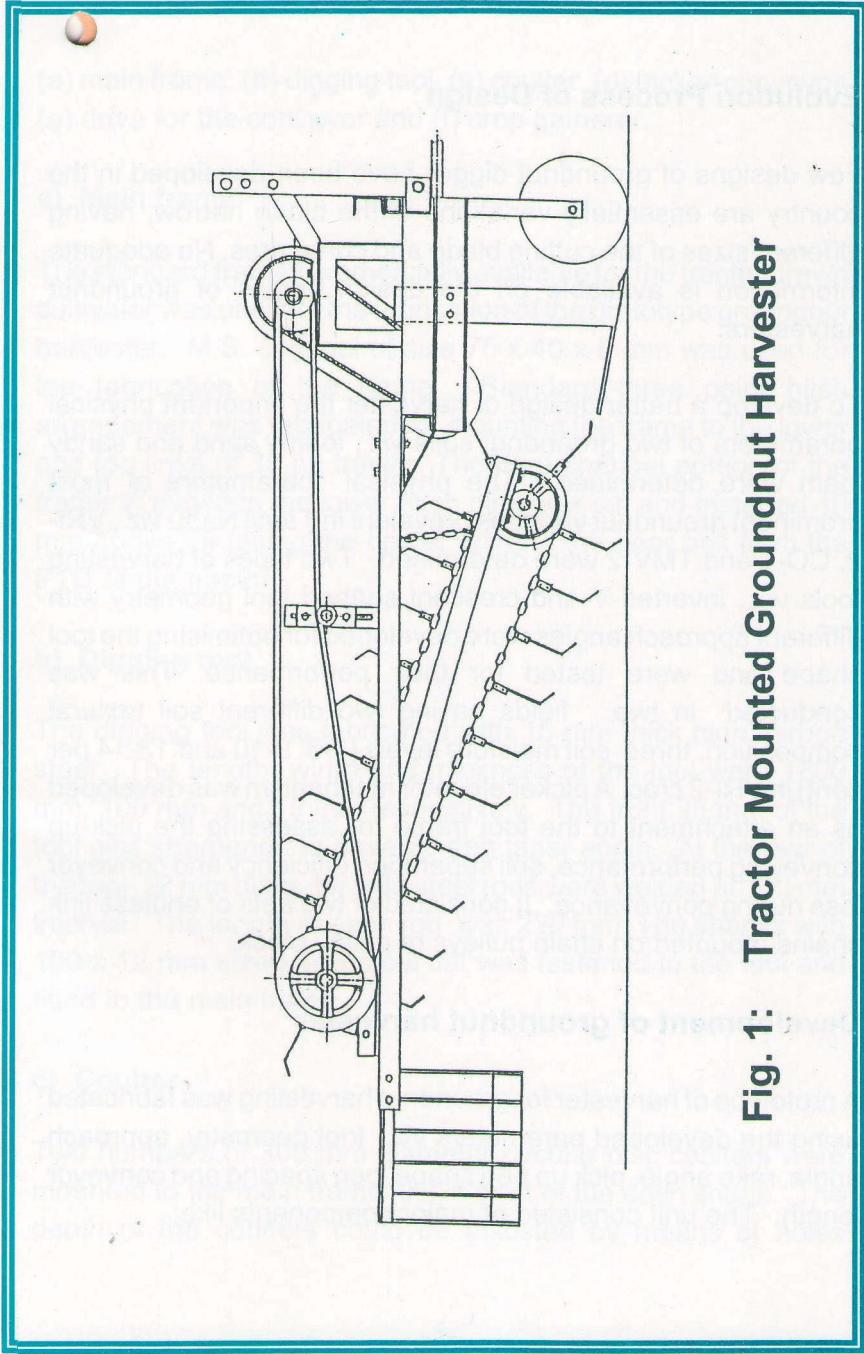


Fig. 1: Tractor Mounted Groundnut Harvester

Evolution Process of Design

Few designs of groundnut digger have been developed in the country are essentially variations of the blade harrow, having different sizes of the cutting blade and curvatures. No adequate information is available on the design values of groundnut harvesters.

To develop a better design of harvester the important physical parameters of two groundnut soils viz., loamy sand and sandy loam were determined. The physical parameters of most prominent groundnut varieties prevalent in Tamil Nadu viz., VRI-2, CO-1 and TMV-2 were determined. Two types of harvesting tools viz., inverted-V and crescent shaped tool geometry with different approach angles were developed for optimising the tool shape and were tested for their performance. This was conducted in two fields having two different soil textural composition, three soil moisture levels (7-8, 9-10 and 13-14 per cent) in VRI-2 crop. A picker elevator mechanism was developed as an attachment to the tool frame for assessing the pick-up conveying performance, soil separation efficiency and conveyor loss during conveyance. It consisted of two sets of endless link chains mounted on chain pulleys of pulley block.

Development of groundnut harvester

A prototype of harvester for groundnut harvesting was fabricated using the developed parameters viz., tool geometry, approach angle, rake angle, pick up peg shape, peg spacing and conveyor length. The unit consisted of major components like;

(a) main frame, (b) digging tool, (c) coulter, (d) picker-conveyor, (e) drive for the conveyor and (f) crop gatherer.

a) Main frame

The standard frame commercially available for the tractor drawn cultivator was used for the fabrication of the prototype groundnut harvester. M.S. channel of size 75 x 40 x 6 mm was used for the fabrication of the frame. Standard three point hitch arrangement was fabricated for mounting the frame to the lower and top links of 35 hp tractor. The front channel portion of the frame in between the lower hitch pins was cut and fastened 40 mm above for taking the center drive to the gear box from the PTO of the tractor.

b) Digging tool

The digging tool was fabricated with 15 mm thick high carbon steel. The length, width and thickness of the tool were 1800 mm, 100 mm and 15 mm respectively. The front 25 mm of the tool was sharpened to have 25 deg taper angle. At the rear of the tool 12 mm diameter mild steel rods were welded at 150 mm interval. The length of each rod was 220 mm. The shanks with 100 x 12 mm sized mild steel flat was fastened to the tool and fitted to the main frame.

c) Coulter

Two numbers of 300 mm diameter circular disc coulters were mounted to the main frame just in front of the each shank. The depth of the coulters could be adjusted by means of holes

provided vertically on their shanks. This facilitated guiding and dividing the soil and crop ahead of the tool shank.

d) Picker-conveyor

The picker-conveyor mounting frames were fabricated with 40 x 40 x 6 mm mild steel angles and the entire conveyor unit was hinged to the main frame. The picker-conveyor consisted of two shafts mounted on self aligned bearings fixed apart at a center distance of 1250 mm. Four pulleys with pulley block were mounted two each on both the shafts. Link chains of size 6 mm were connected end to end on both sides. Cross members spaced at 90 mm were fixed on the chains. Picker pegs were welded at 75 mm spacing on each cross member. All the pegs had a little bend at their end along the travel direction for easy pick up. The lower end of the conveyor level could be adjusted for making the pegs to comb the soil for easy pick up.

e) Drive for the conveyor

The standard gear box and chain drive commercially available for use with the tractor drawn rotavator were used to reduce the speed of the PTO output shaft and to convert the drive at 90 deg. From the output shaft of the gear box chain drive V-pulley and belt members were used. This gave drive to the conveyor side shaft driving the picker-conveyor assembly. Necessary belt tensioner was also provided.

f) Crop gatherer

Two mild steel sheets of size 300x1000 mm sloping downwards converging towards the centre were fixed at the end of the conveyor. The harvested crop is picked up and conveyed by the conveyor and then passed on to these gatherer sheets. The gatherer sheets windrow the crop in the middle of each pass of harvest.

Performance

The prototype was field tested (Fig. 2) as per RNAM Test Code. The prototype was mounted to a 26.11 kW tractor on its three point linkage. The PTO propeller shaft was connected to the gear box of the prototype. The engine speed of the tractor was kept constant at 1600 rpm throughout the field test yielding a PTO speed of 520 rpm. The tractor forward speed of approximately 2.5 kmh was obtained by selecting the appropriate transmission ratios. The harvester was operated in the field to harvest 2 ha in each of VRI-2, CO-1 and TMV-2 crops. The performance of the harvester was evaluated in terms of draft, harvesting efficiency and capacity (Table 1). The performance of the harvester and crop harvested by the unit are furnished in Fig.3.

Table-1: Field testing of groundnut harvester

Soil	Crop variety	Soil Moisture, % db	Draft, kg	Harvesting efficiency, %	Capacity, ha h ⁻¹
Loamy sand	VRI-2	13.5	290	99.75	0.29
Sandy loam	CO-1	9.5	295	99.50	0.30
Sandy loam	TMV-2	7.5	330	99.20	0.27



Fig. 2: Groundnut harvester in operation

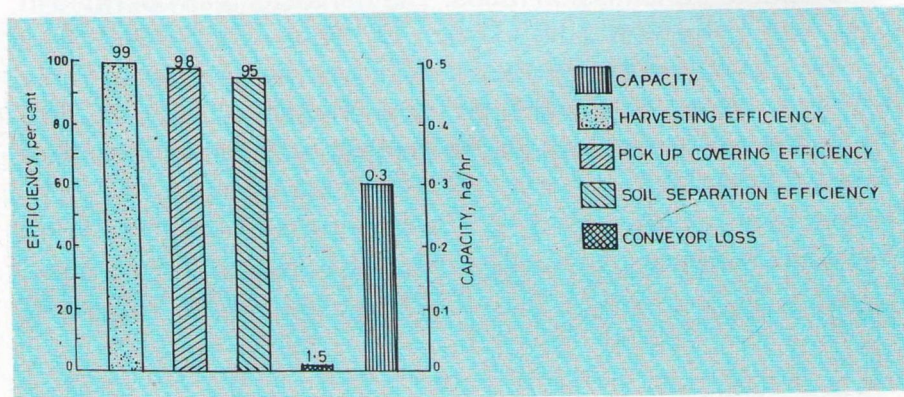


Fig. 3: Performance of groundnut harvester

An area of 5.5 ha in research farm and 39.5 ha in farmers fields totalling 45 ha (Table 2) was harvested with the groundnut harvester and necessary incorporation of suggestions and improvements namely, provision of additional drive belt to the other side of the picker conveyor was also done.

Table 2: Feasibility tests conducted with the groundnut harvester

Sl. No	At	Location	Variety	Area, ha
I	Research Farms	Oilseeds Research Station, Tindivanam, Villupuram district	TMV 2	2.5
		Oilseeds Research Station, Tindivanam, Villupuram district	TMV 7	1
		Oilseeds Research Station, Tindivanam, Villupuram district	TMV 2	1
		Oilseeds Research Station, Tindivanam, Villupuram district	TMV 7	1
II	Farmers Fields	Nallampalli, Trichy district	VRI 2	3.0
		T.Udaiyapatti, Trichy district	VRI 2	2.0
		Karalapakkam, Tiruvallur district	TMV 7	1.5
		Ellapuram, Tiruvallur district	TMV 7	3.5
		Kavanthapad Bhavani, Erode district	CO 1	0.5
		Vadakkipalayam, Pollachi, Coimbatore district	POL	4
		Karadimadai, Thondamuthur, Coimbatore district	CO 1	25
		Total		45

Fabrication Techniques and Industrial Extension

Detailed manufacturing drawings have been prepared. Necessary jigs and fixtures have been fabricated for fabrication of the picker-conveyor components. Consequent upon the release of the equipment by Tamil Nadu Agricultural University during January 1999, two manufacturers came forward to manufacture the harvester. Necessary technical guidance, manufacturing techniques and detailed manufacturing drawings were provided to them.

Status of technology

The groundnut harvester was extensively tested for its feasibility in university research farms and farmers fields totalling 45 ha. Also considerable number of demonstrations were conducted under Frontline Demonstration (FLD) Projects on Oilseeds. More than 20 prototypes have been sold to farmers and different agencies. Linkages were developed with several manufacturers and at present five manufactures have started production of the machine.

Tractor Mounted Groundnut Harvester

Specifications

- | | | |
|--|---|---|
| 1. Name of machine | : | Groundnut harvester |
| 2. i) Make | : | TNAU |
| ii) Model | : | 1999 |
| 3. Market price of machine | : | Rs. 20,000 /- Year : 1999 |
| 4. Dimensions, mm | : | Length : 2050 |
| | | Width : 2100 |
| | | Height : 1150 |
| 5. Cutting width, mm | : | 1800 |
| 6. Weight, kg | : | 300 |
| 7. Crops for which machine is suitable | : | Groundnut |
| 8. Field condition | : | Specific planting method is not required. There should not be any cross bund/channel |
| 9. Recommended operating speed km/h | : | 2.5 |
| 10. Power source | : | 35 hp or above (tractor) |
| 11. Range of soil moisture for which it is suitable, per cent (db) | : | 7 to 15 |
| 12. Soil cutting mechanism | | |
| i. Mechanism of cutting | : | Shearing |
| ii. Type of pick-up device | : | Endless chain with pipe having pegs |
| iii. Type of gathering and windrowing | : | Two converging mild steel sheets |
| 13. Field capacity of the machine - ha/hr | : | 0.28 |
| 14. Workers required for operation: | : | An operator and a helper |
| 15. Workers required for handling the cut material per hectare | : | Five unskilled labours |
| 16. Any other information | : | The vines entangling at the shanks need to be cleared at intervals depending on the nature of crop variety. |

Production and Supply

1. Number of prototypes fabricated and sold by TNAU centre of AICRP on FIM:
 - (i) KVK and other centres : 3
 - (ii) R&D organisations : 5
 2. Number of prototypes manufactured and sold by different manufacturers : 12
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List of Manufacturers

1. M/s Beracha Engineers,
436, Maruthamalai Road, P.N.Pudur (P.O),
Coimbatore - 641 034, Tamil Nadu.
2. M/s Sree Annapoorna Farm Equipments
8-A, Iyer Hospital Road
Trichy Road, Singanallur, Coimbatore - 641 005, Tamil Nadu.
3. M/s Vigneswara Textile Engineers,
84, Extension Street No.1,
Singanallur, Coimbatore - 641 005. Tamil Nadu
4. M/s Valampuri Industries,
Mauthamalai Road, P.N.Pudur (PO),
Coimbatore - 641 041, Tamil Nadu
5. M/s Universal Agro Industries
SF No. 374/5 Near Bimetal Bearings,
Maruthamalai Road, P.N.Pudur
Coimbatore - 641 041, Tamil Nadu