SUCCESS STORIES

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2. Tractor Operated Aero-blast Sprayer

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8. Tractor Operated Laser Land Leveler

All India Coordinated Research Project on
FARM IMPLEMENTS AND MACHINERY
Central Institute of Agricultural Engineering
Nabi Bagh, Berasia Road, Bhopal - 462 038, India

Extension Bulletin No.CIAE/FIM/2008/80

Year : 2008

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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Published by	:	**Central Institute of Agricultural Engineering** Nabi Bagh, Bhopal-462 038, India
Printed at	:	M/s Drishti Offset MP Nagar, Zone-1, Bhopal-462 011

6. CIAE Multicrop Thresher

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Introduction

The major crops grown by the farmers are wheat, gram, maize, sorghum, soybean and rice. Besides grain, wheat straw is also a primary requirement for animal feed. Nearly 90% of wheat threshers are spike tooth type of which about 80% are 5 hp size. The spike tooth threshers available in the market have cylinder and blower on the same shaft. Therefore, same thresher can not be used for threshing other crops due to design deficiency. Among design and operational factors, cylinder speed is the most important factor responsible for grain damage Oilseed and pulses are very sensitive to impact forces Therefore, these crops are required to be threshed at lower cylinder speed to minimize grain loss including seed viability. This is not possible with commercial spike tooth thresher due to cleaning problem at lower cylinder speed since the cylinder and blower are mounted on the same shaft The traditional methods of threshing other cereals, oilseeds and pulses are expensive, time consuming, besides being tedious and cumbersome. Therefore, the farmers feel a need for a suitable multicrop thresher, as they cannot afford to buy separate machines for each arop. A successful multicrop thresher will have wide scope for introduction in the country because of its usefulness to meet the growing need of the farmers for threshing major cereals, oilseed and pulse crops.

Considering these, a multicrop thresher of 5 hp sizes was developed at the Central lnstitute of Agricultural Engineering, Bhopal during 1981-85.

Traditional threshing methods

Trampling of paddy under feet, beating shelves of rice or wheat crop on hard slant surface, beating crop with a flail, treading a layer of 15 to 20 cm thick harvested crop by a team of animals are traditional methods followed by farmers depending upon capacity, lot size and situation. Threshing by bullock treading is practiced on large scale in the country but it is also time consuming and involves drudgery Tractor in many places is now used in place of animals for treading. Introduction of animal drawn *Olpad* thresher reduced the drudgery of the operator and gave comparatively higher output per unit time. ln all above methods, the threshed materials are subjected to winnowing either in natural wind flow or blast from winnowing fan for separation of grain from straw.

Threshing wheat by traditional method involves drudgery and takes more time to obtain required quality of chaff *("bhusa").* Due to these, mechanical threshers are widely accepted by the farmers.

Evaluation / Design Process

Salient features of the machine developed

The thresher (Fig. 6.1) consists of a feed tray, spiked cylinder, straw thrower, blower and cleaning sieves. The threshing cylinder is fitted with rectangular shaped flats as beaters, welded on eight bars in staggered fashion. On the rear end of the threshing cylinder, impeller blades for throwing long straw in case of paddy are provided. The concave is made out of square bars with fixed opening and clearance. Three concave grates are provided for threshing various crops. A semi-hexagonal top cover with spiral louvers is provided for threshing paddy. The feed tray, hinged for folding during transport, is of sufficient size to hold crop material for continuous feeding. Crop is fed at the feed opening and is taken inside the machine by the cylinder, which rotates on ball bearings. The beaters on the threshing cylinder hit the material, separating the grain from the straw and at the same time accelerating them around the cylinder. The spiral louvers in the top cover move the material axially from the feed end to discharge end. The long straw is discharged from the machine by the paddles at the discharge end of the cylinder. For threshing crops other than paddy, the semi-hexagonal top cover is to be replaced by a semi-circular cover and a semi-circular disc to be inserted in between cylinder and straw thrower. Threshed material is passed through the openings between the concave bars and falls on the upper oscillating screen. An aspirator blower is mounted behind the cylinder with two suction openings, one at the separating chamber and another at main grain outlet. The blower sucks out the lighter material and blows out of the machine from blower outlet. Cleaning sieves are hinged at the bottom of cylinder concave on adjustable hangers. Further separation of grain from straw mixtures takes place due to oscillating motion of shaker assembly, the grains fall through the holes to top sieve over bottom sieve and heavier straw and un-threshed tailings overflow from top sieve. Three screens are provided for threshing various crops. The secondary inlet of blower does final cleaning and thus clean grain is obtained at the main grain outlet. The cylinder and shaker assembly get power from blower shaft through V-belt and pulley drive. The concave clearance, sieve clearance, screen slope and cylinder

speed are adjustable. Table 6.1 gives detailed specifications of multicrop thresher.

The salient features of CIAE multicrop thresher over commercial spike tooth threshers are:

- lt can be used effectively for threshing variety of crops without much loss of grains.
- The cylinder and blower are mounted on separate shafts and the speeds can be varied independently as per crop requirement. This ensures minimum grain damage, blower loss and better cleaning.
- Different accessories are provided for threshing different crops,
- Axial flow threshing principle is used for threshing rice crops.
- Though the cost of the machine is slightly more (about 12%) but it is quite economical to use, as the machine use is s00 h per year against 200 h for single crop thresher.

Evolution / Development process

For popular commercial model (spike tooth, hammer mill, axial flow, multicrop) of 5 hp thresher were evaluated on different crops during the period 1979-80 with the objective to identify a thresher which can thresh major cereals, oilseed and pulse crops satisfactorily. lt was found that only spike tooth type thresher having independent drive to cylinder and blower could be used for threshing major crops except rice. For threshing rice in a multicrop thresher major design changes were required. Therefore, the CIAE multicrop thresher was designed with the following designing considerations:

(i) The thresher should be able to thresh major crops like rice, wheat, maize, sorghum, gram, soybean, etc., by feeding whole crop except maize, sunflower and sorghum.

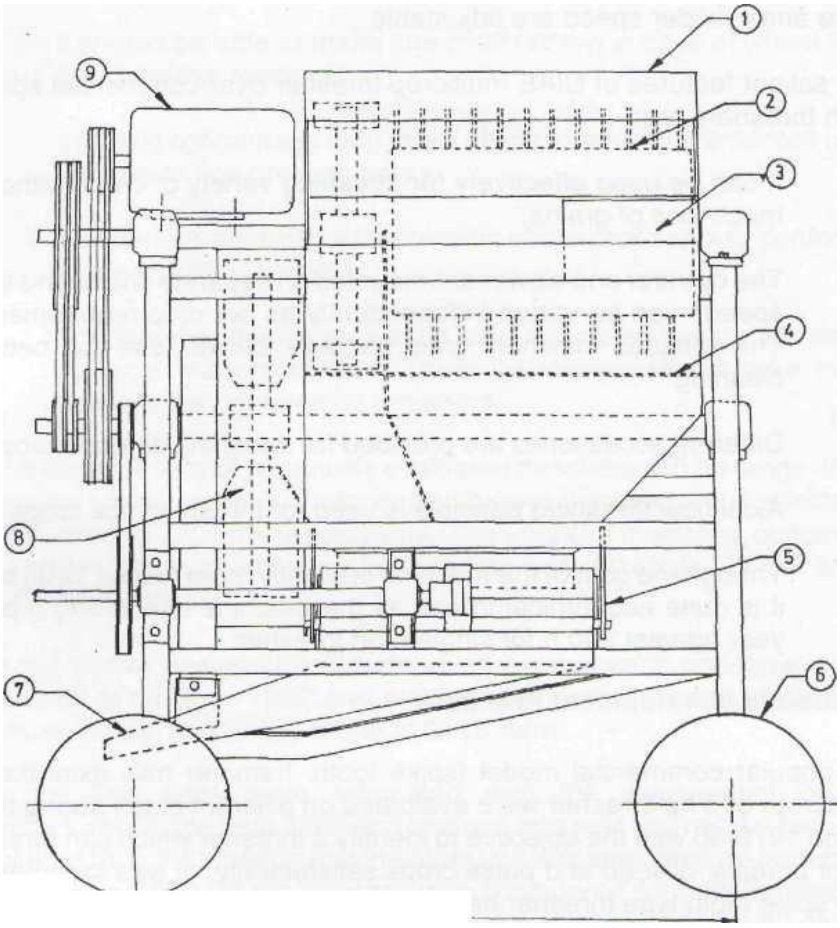
(ii) lt should be operated by an electric motor of 5 hp or 7.5 hp diesel engine, as they are available with majority of farmers.

(iii) lt should be able to make fine chaff (straw) in case of wheat for direct animal feeding.

(iv) It should not damage long straw of rice as per requirement of the farmers in rice growing areas.

(v) The performance of the machine on above crops should conform to the Indian Standards.

(vi) The thresher design should be safe, simple and easily adopted by local manufacturers. Thus, the design should take into account the commercial threshers.



1. Top cover 2. Cylinder 3. Feed inlet 4. Concave
5. Shaker 6. Wheel 7. Grain outlet 8. Blower
9. Motor

. **Fig. 6.1: Details of CIAE multicrop thresher**

On the basis of data of previously evaluated threshers of 5 hp range, the values for blower outlet air velocity and blower diameter were selected as 28.8 m/s and 720 mm, respectively. The areas for threshing concave opening and sieve opening per kg feed rate were taken as 99, 3.8 and 0.7 cm^2, respectively.

With the above design considerations an experimental prototype was developed at CIAE in 1982 and evaluated on wheat, gram, soybean, sorghum, maize and paddy crops at CIAE farm (Fig. 6.2).

Later on two units were fabricated with the involvement of a manufacturer in the year 1985 and one unit was sold to a nearby farmer to get feedback information and the other unit was evaluated on farmer's field. During 1989-90 the thresher was considered for popularization under FLD programme of ICAR on oilseed and pulses. About 80 units got manufactured through two manufacturers from Punjab and Gujarat and were distributed to the FIM Scheme centres and KVK centres under this programme. These centres evaluated / demonstrated the machine on various crops during 1986-90. One unit was tested at CFMTTI, Budni during 1989-90 on different crops under implement release programme. As per their suggestion minor modifications were done and the modified thresher was tested at CIAE in the year 1992. At present some manufacturer has started commercial production.

Fig. 6.2: A view of multicrop thresher.

Table 6.1 Specification of CIAE Multicrop Thresher

A	General	
	(i) Type of machine (ii) Design and developed by (iii) Model (iv) Price without prime mover (2002)	Spike tooth type AICRP on FIM, CIAE, Bhopal 5 hp Rs 25,000/-
B	Overall dimensions, mm	
	(i) Length x Width x Height (iv) Ground clearance	1950 x 1650 x 1450 250
C	Weight (with accessories)	460 kg
D	Crops for which the machine is designed	Wheat, gram, maize, sorghum, soybean, rice, etc.
E	Power unit	
	(i) Type of prime mover (ii) Type of drive	5 hp electric motor or 7.5 hp engine V-belt and pulley
F	Main drive	
	(i) Type and size of belt (ii) Size of pulley	Double V-belts, B-62 Motor 125 mm, Blower 225 mm
G	Crop feeding device	
	(i) Type (ii) Method (iii) Height above ground (iv) Size of opening	Chute type Manual feeding 1270 mm 160 x 265 mm
H	Threshing cylinder	
	(i) Type (ii) Constructional feature (iii) Diameter, mm (iv) Length, mm (v) Recommended peripherial speed (m/s)	Spike tooth Flat spikes welded on bars and bolted on cylinder periphery 500 600 Wheat : 21 Paddy : 16 Sorghum : 15 Gram : 12 Maize : 9

		Soybean : 7 92 spikes in 8 rows
I	Flywheel size	Not provided
J	Concave	
	(i) Type	Welded construction, 3 concaves having gap between bars (i) 7 mm for wheat, sorghum (ii) 9 mm for gram, soybean, paddy and (iii) 25 mm for maize and sunflower
	(ii) Width, mm	600
	(iii) Length, mm	850
	(iv) Concave clearance range, mm	10 to 25
	(v) Method of clearance adjustment	By spacers provided between spike bars and cylinder periphery
	(vi) Method of fixing	Hold in position by pins
K	Sieve	
	(i) Type	Punched sheets at the top and bottom
	(ii) Number	2, one for grain at the top and another for fines at the bottom
	(iii) Effective size: Length, mm Width, mm	 800
	(iv) Sieve clearance, mm	420
	(v) Screen slope	70 1 in 10 (adjustable)
L	Shaker	
	(i) Type	Eccentric shaft, cantilever type
	(ii) Number of strokes/min.	700
M	Blower	
	(i) Number	One
	(ii) Type	Aspirator type
	(iii) Number of blades	4
	(iv) Diameter, mm	720
	(v) Size of blade, mm	280 x 135
	(vi) Provision for changing air displacement	Sliding gates
	(viii) Size of inlet opening	270 mm dia
	(ix) Drive	Mounted on separate shaft with the provision of changing speeds for different crops if required.

Performance of the machine

The thresher was subjected to various tests as per IS:6284 at different speeds and feed rates for threshing gram, wheat, soybean, sorghum, maize, rice etc. The performance data on threshing of above crops include, input and output capacity, threshing and cleaning efficiency, grain damage, losses, energy consumption and cost of operation. The summary of test results is given in Table 6.2. Under multi location trials the thresher was evaluated at Pune, Jhansi, Udaipur, Allahabad and Jabalpur centres of AICRP on FIM. It was also evaluated at Bhopal centre under feasibility evaluation at farmer=s field. The thresher was also evaluated at CFMTTI, Budni under Implement Release Programme. The summary of test results on different crops at above places is given below in Table 6.3.

Table 6.2: Summary of test results

Item	Crops							
	Gram	**Wheat**	**Soy-bean**	**Sorghum**	**Maize**	**Paddy**	**Pigeon pea**	**Safflower**
Crop variety	Radhe	HD 4530	JS 7244	CSH 9	Ganga 5	Pusa 21	JA 3	JSF 1
Straw grain ratio	1.04	1.28	1.8	0.33	0.15	1.5	-	2.6
Straw moisture, %	8.8	5.2	9.6	9.2	14.8	12.2	9.5	6.3
Grain moisture, %	7.8	8.3	8.9	7.6	11.2	14.5	7.5	6.1
Cylinder speed, m/s	11.0	19.4	7.8	10.5	8.4	13.6	9.2	9.2
Feed rate, kg/hr	714	645	560	725	1878	995	-	550
Energy consumption, kWh	2.4	3.4	2.8	3.0	3.3	2.6	2.04	2.1
Broken grain,%	0.52	0.35	2.2	0.35	1.0	0.01	0.21	1.1

Item	Crops							
	Gram	Wheat	Soy-bean	Sorghum	Maize	Paddy	Pigeon pea	Safflower
Blown grain, %	Nil	0.03	Nil	0.14	Nil	0.153	0.16	0.8
Spilled grain,%	0.56	0.08	0.61	0.07	1.1	0.8	0.11	0.5
Threshing efficiency, %	99.2	99.8	98.8	98.9	99.9	99.1	99.5	99.5
Cleaning efficiency, %	94.6	99.01	93.0	96.93	99.3	94.5	95.1	98.0
Output capacity, kg/h	348	276	200	540	1635	392	98	150
Operating cost of the machine, Rs/h	38.65	39.65	39.05	39.25	48.30	38.85	-	-
Cost of operation per tonne of grain, Rs	111.1	143.7	195.3	72.7	29.5	99.1	-	-

Economics of operation

The operating cost of CIAE multicrop thresher has been calculated on the basis of 500 h of annual use and cost of the machine as Rs 25,000/-. It varies Rs 38.65 to 39.65/h for threshing gram, wheat, sorghum, soybean and paddy and for maize it was Rs 48.3/h. The cost of operation per tonne of grain was Rs 111.1, 143.7, 195.3, 72.7, 29.5 and 99.1 for gram, wheat, soybean, sorghum, maize and paddy, respectively, whereas for commercial threshers the nearest value are Rs 216.6, 203.3 and 52.8 per tonne of grain for gram, wheat and maize, respectively.

The output capacities of the developed thresher were higher than the commercial threshers for crops tested when operated with a 5 hp electric motor. In terms of economics also, the cost of operation per tonne of grain was lower for all the crops as compared to commercial threshers. The present (2001) cost of the thresher is Rs 25,000/-. When the thresher is used for custom hiring (Rs 250/t), the pay back period is one year or 145 t of threshed grain.

Table 6.3: Summary of multi-location test results

Crop	Centre	Dura-tion, h	Cylin-der speed, m/s	Thres-hing, %	Clean-ing, %	Grain dam-age, %	Output capac-ity, kg/h
Wheat	Bhopal	126	20.5	99.5	99.3	0.72	330
	Pune	5	19.5	99.4	94.4	0.43	240
	Jabalpur	26	19.6	99.4	96.5	0.40	268
	Budni	41	20.4	97.6	96	1.01	348
Gram	Bhopal	4.5	11.0	99	98.2	0.62	310
	Pune	8.5	7.8	98.2	82	0.57	238
	Jabalpur	8.5	11.5	99.3	94.5	0.45	346
	Budni	14.5	11.5	97.5	94	0.67	258
Maize	Bhopal	2	8.4	99.9	99.3	1.0	1635
	Pune	2.5	8.2	99.9	98.9	0.75	1347
Soybean	Bhopal	200	7.8	99.2	98.0	0.5	250
	Pune	12	8.2	98.1	92	0.33	204
	Jabalpur	11.5	7.8	98.3	96.3	2.12	195
Sunflowe r	Bhopal	5	9.0	100	89	6	202
	Pune	4.9	9.4	100	83.5	0.54	149
Safflower	Bhopal	10	9.2	99.5	98	1.1	150
	Pune	11.8	9.4	100	76.4	0.72	83
Linseed	Bhopal	-	17.3	93.6	90.5	0.31	192
	Jabalpur	4	17.1	92.6	89.7	0.49	150
Paddy	Bhopal	-	13.6	99.1	94.5	0.1	392
	Pune	10	15.7	99.8	92.0	0.13	410
	Jabalpur	17	13.3	99.2	94.4	0.1	364
	Budni	32	15.6	99.1	97.2	0.34	430
Pigeon pea	Bhopal	50	9.2	99.5	95.3	0.18	98
	Budni	56	10.3	99.8	98.2	1.6	69
Rapesee d	Bhopal	-	14.1	99.7	94	1.53	85
Barseem	Jhansi	-	16.2	99.0	82/7	Nil	76
Oat	Jhansi	-	16.2	100	98/9	1.2	86

Benefits over traditional technology

Saving in labour, %	26-39
Saving in time, %	26-39
Saving in cost of operation, %	22

Status of technology

Manufacturing drawing	Available
Number of prototypes fabricated	170
Number of manufacturers who adopted the technology	4
Whether technology released	Yes (Tested at CFMTTI, Budni under Implement Release Programme and efforts are being made by the Ministry of Agril. & Coop. for large scale production through Maharashtra Agro. ICAR recommended for FLD programme).

Appendix-I

List of Manufacturers

1. Incharge
   Prototype Production Centre
   CIAE, Nabi Bagh, Berasia Road,
   Bhopal-462 038, M.P.

2. M/s Fine Fabrication Works
   104-A, Sector-I, Industrial Area,
   Govindpura, Bhopal-462 023, M.P.

3. M/s Parmar Iron Works
   Near New Bus Stand
   Jasdan, Rajkot, Gujarat

4. M/s Sansar Industrial Corporation,
   Nabha, Patiala, Punjab

5. M/s Laxmi Industries
   4, Kali Parade
   Chola Road
   Bhopal