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Study of different methods of maize harvesting and threshing in Hoshiarpur district of Punjab

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■ **ABSTRACT :** This study was conducted to evaluate the performance of different methods of maize harvesting and threshing *i.e.* manual harvesting and threshing with conventional maize thresher (T_1), manual harvesting and threshing with maize dehusker-cum thresher (T_2) and harvesting, threshing and cleaning using self propelled maize combine harvester (T_3) in district Hoshiarpur of Punjab. Threshing efficiency of conventional thresher, maize dehusker-cum-sheller and self propelled maize combine harvester was in the range of 97-99%, 97-98% and 95-97%, respectively. The total grain losses were highest (2-4%) for harvesting of maize with combine harvester and least (0.5-1.5%) for conventional maize thresher. The net cost of harvesting per hectare was highest (Rs. 9000/-) in T_3 and lowest (Rs. 2650/-) in T_1. The total income from the maize residue per hectare was highest (Rs. 5250/-) in T_1 as compared to T_2 (Rs. 3750/-) and T_3 but there was saving of 100-140 man-h/ha as labour requirement for de-husking of the crop in T_2 and T_3. The maize residue left in T_3 can be incorporated into the soil with rotavator operation which helps in improvement of soil health.

■ **KEY WORDS :** Maize harvesting, Threshing, Dehusker-cum-sheller

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Maize (*Zea mays*) in India ranks fifth in total area and third in total production and productivity. Uttar Pradesh (15.5%), Bihar (11.9%), Rajasthan (12.1%), Madhya Pradesh (11.9%), Punjab (8.4%), Andhra Pradesh (8.25%), Himachal Pradesh (7.1%), West Bengal (6.9%), Karnataka (5.8%) and Jammu & Kashmir (5.8%) jointly account for over 95% of the national maize production (Anonymous, 2008). Maize occupied 139 thousand hectares, with a production of 475 thousand tones in the Punjab State. The average yield per hectare during 2009-10 was 34.14 q per hectare (Anonymous, 2011). Maize is utilized as human food, animal feed, poultry feed and industrial products. Maize can be successfully grown in rainy (*Kharif*), winter (*Rabi*) and summer spring (*Zaid*) crop seasons. Mostly harvesting of maize crop is being done manually with traditional sickle. After harvesting, cobs are plucked manually by hand and cobs are dried in sunshine to reduce moisture content to 15-21 per cent (dry basis). Dehusking of cob is done by hand to remove its outer shell either just after harvesting or after sun drying. After that grain is obtained from dehusked cob (the process is called shelling). The output in terms of dehusking maize cobs traditionally (by hand) are reported to 30 kg/h and shelling efficiency with manually shelling (beating wooden stick) is reported to be 80% with 8.3 per cent grain damage (Mudgal *et al.*, 1998). Thus, this operation is highly labour intensive with full of drudgery in addition to losses in quality and quantity. Power operated maize shellers are being used for threshing maize. Punjab Agricultural University, Ludhiana has modified spike tooth wheat thresher and axial flow sunflower thresher to dehusking-shelling of un-dehusked maize cobs (Singh and Pandey, 2008). Self-propelled maize combine harvester are also used for direct harvesting and threshing of maize with husk.

■ METHODOLOGY

This study was conducted to evaluate the performance of various methods of harvesting and threshing maize crop in district Hoshiarpur of Punjab. The details of various farm machineries used for maize threshing is given below:

Conventional maize thresher:

It is used for shelling maize cobs. The machine consists

Table A : Specifications of conventional maize thersher	
Size of feeding hopper, mm	575 x 510
Length of drum, mm	890
Diameter of drum, mm	305
Concave opening size, mm	11
Cylinder concave clearance, cm	1.6
Machine weight, kg	80.0

of a threshing cylinder, concave and centrifugal blower mounted on a frame. The feeding of maize cobs is done manually. The threshing cylinder is of spike tooth type. Round bars are used as spikes, which are fitted on the circular rings. Fig. A shows the conventional maize thresher while the specification details are given in Table A.

Fig. A : Conventional maize thresher

Maize dehusker-cum-sheller:

It is used for shelling of un-husked maize. It is an axial flow type thresher. It constitutes a main frame, feeding chute, arrangement for threshing and cleaning. It is used for dehusking and shelling of maize cobs simultaneously. It is operated by a PTO of 35 hp tractor. In axial flow type threshers, pegs are provided on the cylinder and louvers were provided on the upper periphery of the drum to convey the crop to the outlet. A blower is also provided for winnowing of the dry trash out of the grains for cleaning. Fig. B shows the demonstration of maize dehusker cum sheller. The details of specifications of maize dehusker cum sheller is given in Table B.

Self propelled maize combine harvester:

Self-propelled maize combine harvester are used for

Fig. B : Demonstration of maize dehusker-cum-sheller

direct harvesting and threshing of maize crop. It has specially designed cutter bar for maize. It has a gathering unit to guide the stalks into the machine and snapping rolls to remove the ears from the stalks. The speed of cylinder should be kept between 500 to 600 rpm. Fig. C shows the demonstration of

Table B : Specifications of maize dehusker cum sheller	
Parameters	Specifications
Threshing cylinder	
Type	Axial flow
Power source	35 hp tractor
Size of threshing cylinder	368 x 1206 mm
Cylinder speed	450 rpm
Type of threshing drum	Peg type
Cleaning system	
Type of blower	Centrifugal
Blower speed	1200 rpm
No. of sieves	Three (round holes)
Sieve size	1900 x 900 mm
Sieve speed	225 strokes/min
Sieve stroke length	25 mm

Fig. C : Demonstration of self propelled maize combine harvester

Table C : Specifications of combine used for maize threshing

Parameters	Specifications
Engine	
Power	110 BHP @ 2200 rpm
No. of cylinder	Six
Air cleaner	Combination of Dry & Wet Type
Cooling system	Water Cooled
Clutch	
Type	Single, Heavy Duty Dry Clutch
Diameter	310 mm
Transmission	
No. of gears	3 Forward and 1 Reverse
Cutter bar	
Width	3.4 m
No. of rows	6
Spacing of rows	610 mm
Threshing mechanism	
Diameter of thresher drum	610 mm
Speed	500-600 rpm
Cylinder-concave clearance	2.54 cm
No. of straw walker	5
Length of straw walker	3770 mm
Width of straw walker	234 mm
Upper sieve area	2.23 m^2
Lower sieve area	1.53 m^2
Main dimensions	
Length of combine	8370 mm
Width of combine	4665 mm
Height of combine	3800 mm
Ground clearance	340 mm

self propelled maize combine harvester at farmers' field. The details of specifications of self propelled maize combine harvester are given in Table C.

■ RESULTS AND DISCUSSION

The details of performance of different farm machines used for maize threshing are given in Table 1. The conventional maize thresher threshed the husked maize cobs having moisture content in the range of 25-30% while maize dehusker-cum -sheller threshed the unhusked maize cobs successfully within the moisture range of 12-24%. The harvesting and threshing of maize crop with self propelled maize combine harvester had been done in the moisture range of 12-15%. The threshing efficiency was highest (97-99%) in conventional maize thresher followed by maize dehusker-cum sheller (97-98%) and combine harvesting of maize (90-95%). The cleaning efficiency of conventional maize threshing was highest (96-98%) as compared to maize dehusker-cum-sheller (90-95%) and combine harvesting of maize (90-93%). The total grain losses for conventional maize thresher was in the range of 0.5-1.5%, 1-2% for maize dehusker-cum-sheller and 2-4 % for combine harvesting of maize. Harvesting in weed infested fields choked the combine harvester frequently. Manual attention is required in lodged maize crop in combine harvesting of maize crop. The lodged maize crop required manual attention in combine harvesting of maize.

The economic analysis of various methods of maize harvesting and threshing is shown in Table 2. The cost of harvesting includes the cutting of crop and shelling of maize cob. The cost of harvesting of maize crop was highest (Rs. 7900/ha) in method T_1 (Manual harvesting and threshing with conventional maize thresher) followed by T_2 (Manual harvesting and threshing with maize dehusker-cum thresher) *i.e.* Rs. 7000/ha and T_3 (Harvesting, threshing and cleaning using self propelled maize combine harvester) *i.e.* Rs. 6250/ ha. The inner maize cob pitch was broken in T_2 and T_3. The income from maize residue includes the cost of maize stock

Table 1 : Performance of different machines for maize threshing

Parameters	Observations		
	Conventional maize thresher	Maize dehusker-cum-sheller	Self propelled maize combine harvester
Moisture content of grains	25-30 %	12-24 %	12-15 %
Average feed rate	20-25 q/h	25-30 q/h	30-35 q/h
Average grain output	20-25 q/h	20-22 q/h	20-25 q/h
Threshing efficiency	97-99 %	97-98 %	95-97 %
Cleaning efficiency	96-98 %	90-95%	90-94%
Broken grain	0.5-1.0 %	1-3%	2-3 %
Total grain losses	0.5-1.5 %	1-2 %	2-4 %

Table 2 : Economic analysis of different methods of maize harvesting and threshing

Methods of harvesting and threshing	Cost of harvesting (Rs./ha)	Income from residue (Rs./ha)	Addl. Cost of field preparation (Rs./ha)	Decreased rate of produce owing to damaged quality (Rs./ha)	Net cost of harvesting (Rs./ha)
T_1:- Manual harvesting and threshing with conventional maize thresher	7900	5250	-	-	2650
T_2:- Manual harvesting and threshing with maize dehusker-cum thresher	7000	3750	-	1250.00	4500
T_3:- Harvesting, threshing and cleaning using self propelled maize combine harvester	6250	-	1500.00	1250.00	9000

Fig. 1 : Incorporation of maize residues with rotavator

as well as inner maize cob pitch. The total income from maize residue was highest in T_1 (Rs. 5250/ha) as compared to T_2 (Rs. 3750/ha). There was a saving of 100-140 man-h/ha in T_2 and T_3 of labour requirement for de-husking of the maize crop as compared to T_1. There was no damage to maize stocks in T_1 and T_2 and can be used as animal fodder. The maize residue left in T_3 can be incorporated into the soil with the operation of rotavator (Fig. 4) which helps in improvement of soil health. The additional cost of Rs. 1250/ha for incorporation of maize residue was required for field preparation in T_2 and T_3. The net cost of harvesting was highest (Rs. 9000/ha) in T_3 followed by T_2 (Rs. 4500/ha) and T_1 (Rs. 2650/ha). The farmers were convinced about the utility of mechanization of maize harvesting due to increasing labour shortage. At present fully mechanized harvesting of maize is comparatively expensive but popularization of maize combine may bring down the cost of harvesting and threshing.

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