PERFORMANCE EVALUATION OF TRACTOR OPERATED GROUNDNUT THRESHER

1. Abstract

The production of groundnut in India is being rapidly increased in the last ten years and is expected to increase further in coming decade. Farmer mostly used traditional cultivation practices for production of groundnut, which are labour and time intensive. Therefore, time saving machineries suited to labours should be used by growers to handle harvest and post-harvest operations for this crop. The performance evaluation of the thresher for groundnut crop was conducted with 50 hp tractor. The experiment was carried out at the Cotton Research Centre and Instructional Farm of College of Agricultural Engineering and Technology, Junagadh Agricultural University, Junagadh for kharif groundnut for Virginia Bunch type varieties of GG-20 and GG-22, respectively. The pod output capacity was observed as 524.66 kg/h (cylinder speed ~ 292 rpm) and 407.60 kg/h (cylinder speed ~ 421 rpm) for GG-22 and GG-20 varieties, respectively. The percentage of blown pods, unthreshed pods, broken pods and spilled pods were observed as 14.51, 18.92, 0.126, 1.04 % and 6.07, 14.59, 0.361, 0.99 % for GG-22 and GG-20 varieties, respectively. The average threshing and cleaning efficiency were found as 81.08, 88.21 and 85.41, 88.74 % for GG-22 and GG-20 varieties, respectively. The overall average cost of threshing operation was observed Rs.729.42 per hour and Rs.156 per quintal for both the varieties.

Keywords: Tractor, Thresher, Performance, Evaluation, Threshing efficiency, Cleaning efficiency, Groundnut.

2. INTRODUCTION

The peanut, also known as the groundnut and taxonomically classified as Arachis hypogaea, is a legume crop grown mainly for its edible seeds, and they are high in protein, oil and fiber. This plant is native to South America. The botanical name of groundnut, Arachis hypogaea, is derived from two Greek words, Arachis meaning a legume and hypogaea meaning below ground, referring to the formation of pods in the soil. Peanut or groundnut is a self-pollinating, indeterminate, annual herbaceous legume crop (Burns, 2010). It is also known as earth nut, peanut or monkey-nut. It is commonly called the poor man's nut. Peanut mostly grown due to its oil, protein and carbohydrates (Abdzad Gohari etal, 2010).The oil of peanut is one of

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the most important vegetable oil in regions where other oily vegetables cannot grow up (Hosseinzadeh Gashti et al., 2012). Peanut has several uses as whole seeds or is processed to make peanut butter, oil, and other products (Putnam et al., 2013). Peanut is one of the most important oilseed plants in the world. Its seeds contain 40 - 50% fat, 20 - 50% protein and 10 - 20% carbohydrate depending on the variety (Okello et al., 2010).

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Groundnut is grown on nearly 24.73 million hectares in world with annual production of 403.70 lakh tons of nuts-in-shells and the productivity is 1630 kg/ha. It is grown on large scale in India, China, USA, Senegal, Indonesia, Nigeria, Brazil and Argentina. The total area under groundnut cultivation in India is 4.56 million hectares, which accounts for the total production of 67.71 lakh tons with the productivity of 1486 kg/ha (Anonymous, 2016). Country wise groundnut production for the year 2015- 2016 is shown in Table 1.

Table 1: Area, Production and Yield of Groundnut Major Countries

Sr. No.	Country	Area (Lakh ha)		Production (Lakh tons)		Yield (Kg/ha)	
		2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
1	China	46.00	46.00	164.80	165.00	3580	3590
2	India	47.69	45.55	74.02	67.71	1552	1486
3	Nigeria	27.70	25.00	34.10	30.00	1230	1200
4	USA	5.40	6.30	23.50	27.20	4400	4310
5	Sudan	12.50	21.80	9.60	18.70	770	860
6	Myanmar	8.90	8.90	13.80	13.80	1550	1550
7	Indonesia	6.30	6.20	11.50	11.30	1830	1840
8	Senegal	8.80	11.40	6.70	10.70	760	940
9	Niger	7.80	7.40	4.00	3.50	520	470
10	Cameroon	4.70	4.00	6.40	5.50	1360	1380
	Others	64.71	64.75	49.98	50.29	772	777
	World	**240.50**	**247.30**	**398.40**	**403.70**	**1660**	**1630**

(Status paper on groundnut, 2017)

Table 2: State Wise Area, Production and Yield of Groundnut

Sr. No.	States	Area (Lakh ha)			Production (Lakh tons)			Yield (Kg/ha)		
		2013-14	2014-15	2015-16	2013-14	2014-15	2015-16	2013-14	2014-15	2015-16
1	Gujarat	18.40	14.00	14.14	49.20	22.20	23.58	2668	1586	1668
2	AP	13.90	10.30	7.75	12.40	7.90	8.02	892	771	1035
3	Rajasthan	4.60	5.00	5.21	9.00	10.20	10.56	1992	2024	2028
4	Tamil Nadu	3.40	3.40	3.52	9.20	9.00	8.82	2723	2699	2509
5	Karnataka	6.60	6.50	5.91	5.70	5.60	4.85	863	870	821

6	MP	2.10	2.30	2.36	3.20	3.70	3.50	1573	1602	1483
7	Maharashtra	3.20	2.40	2.40	3.90	2.50	2.37	1248	1063	988
8	Telangana	-	-	1.27	-	-	2.06	-	-	1622
9	West Bengal	0.78	0.79	0.84	2.02	2.00	2.00	2573	2544	2372
Others		2.12	2.11	2.15	2.48	2.50	1.95	1308	1639	907
All India		**55.10**	**46.80**	**45.55**	**97.10**	**65.60**	**67.71**	**1764**	**1400**	**1486**

(Status paper on groundnut, 2016)

Table 3 1: District Wise Groundnut Production in Gujarat State (2015-16)

Sr. No.	District	Area ('00ha)	Production ('000tonnes)	Yield (kg/ha)
1	Rajkot	2731	273	1680
2	Junagadh	2538	253	2052
3	Dwarka	1763	176	1627
4	Amreli	1419	142	2200
5	Jamnagar	1316	132	1856
6	Gir-somnath	1196	120	2413
7	Banaskantha	1166	117	1898
8	Bhavnagar	1093	109	1758
9	Kutch	447	45	2234

(SEA Kharif Groundnut Crop Survey 2015-16)

More than 150 varieties of groundnut have been released by AICRP for different agro-ecological situations of India, however only a few age old varieties like TMV-2, TMV-7, GG-11, Chitra Kaushal, SV-xi, JL-24 and AK-12-24, K-6, CO-2, Polachi-1, GAUG-10, and new varieties like TG37-A, GBPD-4, Narayani, ICGV-91114, TPG-41, TG-38, VRI-6 are popular among the farmers for large scale cultivation.

The spreading, semi spreading and bunch types groundnut varieties are grown in Gujarat. The spreading varieties like GAUG-10, GG-11, GG-13 etc. and GG-20 is semi-spreading while bunch type varieties of groundnut like JL-24, GG-2, GG-4, GG-7 etc. have been recommended and adopted by the farmers for cultivation in Saurashtra region. The groundnut is sown at the row spacing of 45 cm and 60 cm for bunch type and spreading type, respectively

3. MATERIALS AND METHODS

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A Groundnut Thresher which is beater or hammer mill type was taken for the study. In fact it is a modification of the drummy type. It is provided with an aspirator blower at the main grain outlet for final cleaning. Sieve assembly is also provided beneath the concave, driven by a crankshaft pulley, which gets its power from the cylinder shaft. The working principle of a hammer mill type threshing drum.

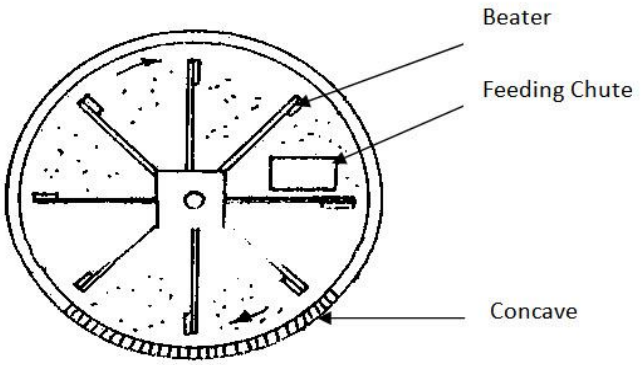

Fig. 1: Hammer mill type threshing drum

Fig. 2: Groundnut thresher

Table 3.2: Specification of Groundnut Thresher

A. General		
1	Name	Groundnut thresher (square, box type tractor operated)
2	Make	Geeta works
3	Model	B
4	Type	Tangential flow
5	Year of manufacture	2015
B. Power unit		
2	Type of prime mover	Tractor operated
3	Recommended power	35hp and above
4	Type of drive	PTO
C. Main drive		
1	Type	Belt pulley
2	Size of belt, mm	2580
3	Diameter of pulley, mm	203
D. Threshing system		
1. Cylinder		
1	Type	Beater
2	Constructional feature	It is fabricated from circular CI flanges locked on the cylinder shaft at spacing. MS

			flat beater (perpendicular to the axis of cylinder) are welded on MS angle (3 nos.) fitted parallel to the axis of cylinder of which are bolted to each flanges with nut bolts.
	3	Diameter, mm	540
	4	Width, mm	825
	5	No.& type of bearings	2 pillow block bearing
	6	No. & size of beaters/projections/bars	7 (4+3 fitted perpendicular to each other, on each MS angle (3 nos.), blade edge)
	7	Spacing between beaters, mm	230
	8	No. of flanges	2

2. Concave

	1	Type	Semi-circular, open
	2	Effective width, mm	650
	3	Effective length, mm	830
	4	Effective area, m^2	0.5395
	4	Concave clearance range, mm	15-30
	5	Concave clearance, mm	20
	6	Method of clearance adjustment	By raising and lowering the concave
	7	Constructional feature	It is fabricated from longitudinal MS flats at spacing and semi-circular MS rods are inserted with MS pipes spacer across the longitudinal flats to maintain spacing
	8	Concavity, mm	265
	9	Nos. and spacing of cross bars, mm	4, 245
	8	Method of fixing	It is mounted on two curved angle iron of size bolted by 2 nut bolts

E. Sieve

Sr. No.	Parameters	Upper sieve	Lower sieve
1	Type	Punched elliptical holes	Punched elliptical holes
2	Material and size	GI sheet, 0.79 mm	GI sheet, 0.79 mm
3	Size of holes, mm	32.09x2.07(F), 49.17x19.19(R)	56.43x7.77(F), 113.32x8.64(M), 49.38x19.14(R)
4	Density of holes in 100 cm^2	36(F), 3(R)	5(F), 5(M), 3(R)
5	Size of sieve, mm	1445x760	1510x750
6	Effective size, mm	685x150(F), 710x420(R)	695x525(F), 695x225(M), 695x560(R)
7	Effective area, cm^2	1027 (F), 2982(R)	3478(F), 1563(M), 3892(R)
8	Sieve slope, degree	5	10

F. Shaking Mechanism

	1	Constructional details	The mechanism consists of a pitman shaft supported by two bearings and connected to the sieve box. The rotational motion of pitman shaft is converted into to and fro motion of sieve box. The sieve box is mounted on two connecting arms (with ball bearings) at its front and to connecting arms at its rear end.
	3	Pitman shaft	
		Material	MS rod
		Size , mm	655x38.0 ϕ
		No and types of bearings on pitman shaft	2
		Provision for lubrication	One grease nipple is provided on each bearing cover.
	4	Hangers	
		Numbers	4
		Length of angles, mm	
		Total	200(F), 240(R)
		Center to center	145(F), 190(R)
		Stroke length, mm	55
		Nos. and type of bearing on each hanger	2, Ball bearing
91	G. Blower		
	1	Number	1
	2	Type	Suction type
	3	No. of blade	4
	4	Size of blade, mm	730 x 175 x 0.80
	5	Diameter, mm	700
	6	Provision for changing air displacement	Suction windows are provided
	7	Nos. , location and size of window, mm	2, LHS-RHS, 400 ϕ
	8	Nos. and type of bearings	2, Pillow block bearing
92	**H. Crop feeding**		
	1	Type	Hopper
	2	Method of feeding	Manual
	3	Size of feeding hopper, mm	815 x 325
	4	Height of hopper form platform, mm	870
	5	Height of feeding hopper from ground level, mm	2300
93	**I. Transport**		
	1	Type	Tractor mounted
94	**J. Overall Dimensions**		
	1	Length, mm	2770
	2	Width, mm	1360
	3	Height, mm	2120
	4	Ground clearance, mm	430
	5	Total mass, kg	1160

K. Main pod/ grain outlet

1	Size, mm	225×100
2	Inclination, degree	5
3	Height of outlet from ground level, mm	535

L. Foreign material outlet

1. For stones/soil clods

1	Size, mm	205x115
2	Inclination, degree	5
3	Height of outlet from ground level, mm	515

1. For soil powder

1	Size, mm	100x40
2	Inclination, degree	Vertical
3	Height of outlet from ground level, mm	825

3. Sieve overflow outlet

1	Size, mm	250x35
2	Inclination, degree	5
3	Height of outlet from ground level, mm	535

4. Straw outlet

1	Size, mm	845x390
2	Inclination, degree	40-75
3	Height of outlet from ground level, mm	985

4. RESULTS AND DISCUSSION

Experimental data collected during the course investigation. It is also including the evaluation of the various crop parameters like moisture content of pods and vine, pod-vine ratio. It also includes various performance parameter like crop feed rate, pod output capacity, percentage of blown pods, percentage of un threshed pods, percentage of broken pods, percentage of spilled pods, threshing efficiency and cleaning efficiency.

4.1 Field Testing and Evaluation

Performance of groundnut thresher was evaluated at Cotton research Centre and Instructional Farm of College of Agricultural Engineering & Technology, JAU, Junagadh for the varieties of GG-22 and GG-20, respectively.

4.2 Crop Parameters

The crop parameters such as crop variety and pod-vine ratio were determined during the study.

4.2.1 Type of crop and variety

The experiment was conducted on groundnut of GG-22 and GG-20 varieties. Both are Virginia Bunch type groundnut which are semi-spreading type.

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4.2.2 Pod-vine ratio

Pod-vine ratio was determined by taking crop samples. The pods and plant matters (vine) were separated and it was observed as 0.3354 and 0.5836 for varieties GG-22 and GG-20 respectively.

4.3 Field Observations

Field observations such as moisture content, crop feed rate, fuel consumption and labour requirement were determined during the study.

4.3.1 Crop moisture content

The moisture content of pods and vine were measured by the oven drying method as shown in Appendix-III. It was found that moisture contents of pods are 11.73 % (d.b.) and 6.81 % (d.b.) for varieties GG-22 and GG-20, respectively. The moisture contents of vine are 11.53 % (d.b.) and 12.92 % (d.b.) for GG-22 and GG-20 varieties respectively.

4.3.2 Crop feed rate

Crop feed rate was measured as per standard method. Test results indicated that at threshing cylinder speed of 292 rpm and 421 rpm, the crop feed rate was varied from 2033.89 to 2117.65 and 1282.05 to 1333.33 for GG-22 and GG-20 varieties, respectively.

4.3.3 Fuel consumption

The hourly fuel consumption in case of threshing was 2.46 lit/hr and 2.14 lit/hr for the varieties GG-22 and GG-20, respectively. Both tests were carried out by 50hp tractor.

4.3.4 Labour requirement

Six labours were required during the threshing of groundnut crop. One labour was required for feeding of crop, one labour was required for straw handling, one labour was required for pod handling and others were required for crop handling.

4.4 Determination of Threshing Parameters

The threshing parameters such as crop feed rate, pod output capacity, percentage of blown pods, percentage of un threshed pods, percentage of broken pods, percentage of spilled pods, threshing efficiency and cleaning efficiency were determined during the study.

4.4.1 Pod output capacity

Pod output capacity was varied from 518.63 kg/h to 531.97 kg/h with an average capacity of 524.66 kg/h for groundnut variety of GG-22. For GG-20 it was varied from 375.41 kg/h to 454.79 kg/h with an average capacity of 407.60 kg/h.

Table 4.1: Feed rates and pod output capacity for GG-22 variety

Sr. No.	Crop feed rate, kg/h	Pod output capacity, Kg/h
1	2117.65	518.63
2	2033.89	523.38
3	2195.12	531.97
Av.	**21115.55**	**524.66**

Table 4.2: Feed rates and pod output capacity for GG-20 variety

Sr. No.	Crop feed rate, kg/h	Pod output capacity, Kg/h
1	1298.70	392.59
2	1333.33	375.41
3	1282.05	454.79
Av.	**1304.36**	**407.60**

4.4.2. Percentage of blown pods

It is indicated in Table 4.3. Percentage of blown pods was varied from 12.17 % to 16.07 % with an average value of 14.51 % at sieve shaker speed of 182 rpm the variety GG- 22. It was varied from 4.34 % to 8.58 % with an average value of 6.07 % at sieve shaker speed of 248 rpm for the variety GG- 20.

Table 4.3: Percentage of blown pods for GG-22 and GG-20 varieties

Sr. No.	For variety GG-22, %	For variety GG-20, %
1	15.31	4.34
2	16.05	8.58
3	12.17	5.29
Av.	**14.51**	**6.07**

4.4.3. Percentage of unthreshed pods

Percentage of unthreshed pods was measured it is indicated in Table 4.4. Percentage of blown pods was varied from 17.62 % to 20.70 % with an average value of 18.92 % at cylinder speed of 292 rpm for the variety GG- 22. It was varied from 13.52 % to 16.39 % with an average of 14.59 % at cylinder speed of 421 rpm for the variety GG- 20.

Table 4.4: Percentage of unthreshed pods for GG-22 and GG-20 varieties

Sr. No.	For variety GG-22, %	For variety GG-20, %
1	18.44	13.52
2	20.70	16.39
3	17.62	13.88
Av.	**18.92**	**14.59**

4.4.4. Percentage of broken pods

Percentage of broken was varied from 0.088 % to 0.168 % at a blower speed of 627 rpm with an average value of 0.126 % for the variety GG-22. It was varied from 0.337 % to 0.373 % at a blower speed of 775 rpm with an average value of 0.361 % for the variety GG- 20.

Table 4.5: Percentage of broken pods for GG-22 and GG-20 varieties

Sr. No.	For variety GG-22, %	For variety GG-20, %
1	0.088	0.372
2	0.123	0.337
3	0.168	0.373
Av.	**0.126**	**0.361**

4.4.5 Percentage of spilled pods

Percentage of spilled pods was varied between 0.83 % and 1.30 % at sieve shaker speed of 182 rpm with an average value of 1.04 % for the variety GG-22. It was varied from 0.854 % to 1.130 % at sieve shaker speed of 248 rpm with an average value of 0.99 % for the variety GG- 20.

Table 4.6: Percentage of spilled pods for GG-22 and GG-20 varieties

Sr. No.	For variety GG-22, %	For variety GG-20, %
1	0.99	0.854
2	0.83	1.130
3	1.30	0.99
Av.	**1.04**	**0.99**

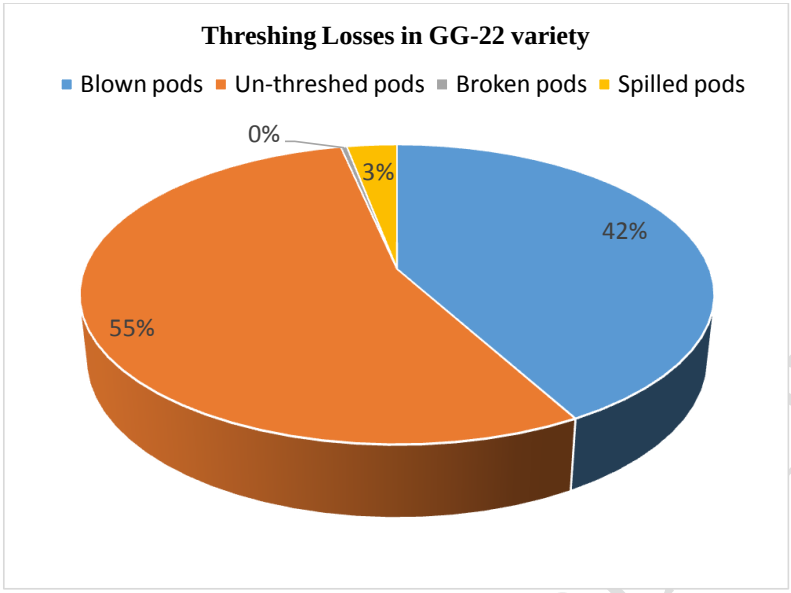

Fig 3: Various losses during threshing operation for GG-22 variety

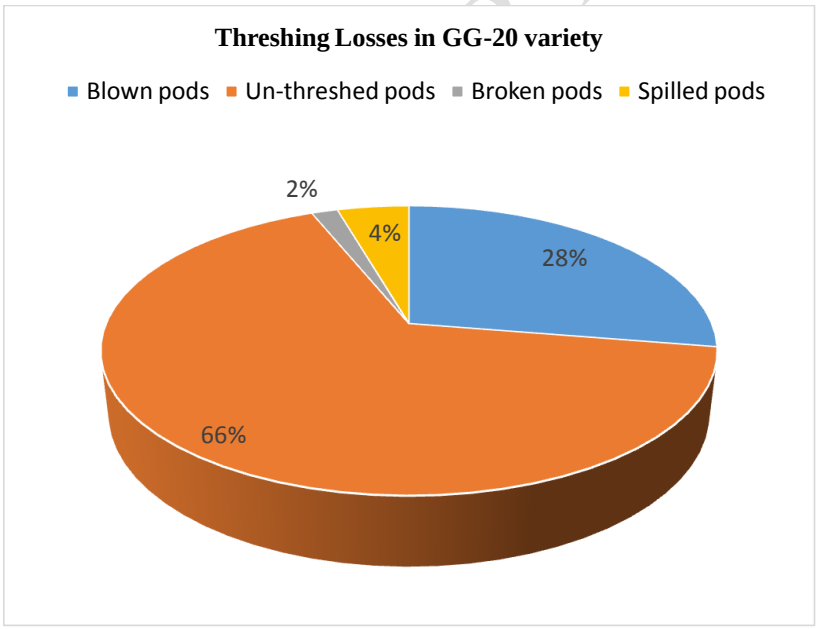

Fig 4: Various losses during threshing operation for GG-20 variety

4.4.6. Threshing efficiency

Threshing efficiency was varied from 79.3% to 82.38 % with an average value of 81.08 % for the variety GG-22. It was varied from 83.61 % to 86.48 % with an average value of 85.41 % for the variety GG- 20. Thus higher threshing efficiency was observed in GG-20 (85.41 %) as compared to GG-22 (81.08 %).

Table 4.7: Threshing efficiency for GG-22 and GG-20 varieties

Sr. No.	For variety GG-22, %	For variety GG-20, %
1	81.56	86.48
2	79.30	83.61
3	82.38	86.13
Av.	**81.08**	**85.41**

4.4.7. Cleaning efficiency

Cleaning efficiency varied from 85.89 % to 90.80 % with an average value of 88.19 % for the variety GG-22. It was varied from 88.39 % to 89.35 % with an average value of 88.74 % for the variety GG-20. It was observed that due to sufficient drying of the crop the groundnut was separated easily and efficiently from the foreign materials (stone, soil and plant stem). Thus higher cleaning efficiency was obtained for both the varieties.

Table 4.8: Cleaning efficiency for GG-22 and GG-20 varieties

Sr. No.	For variety GG-22, %	For variety GG-20, %
1	87.95	89.35
2	85.89	88.39
3	90.80	88.47
Av.	**88.21**	**88.74**

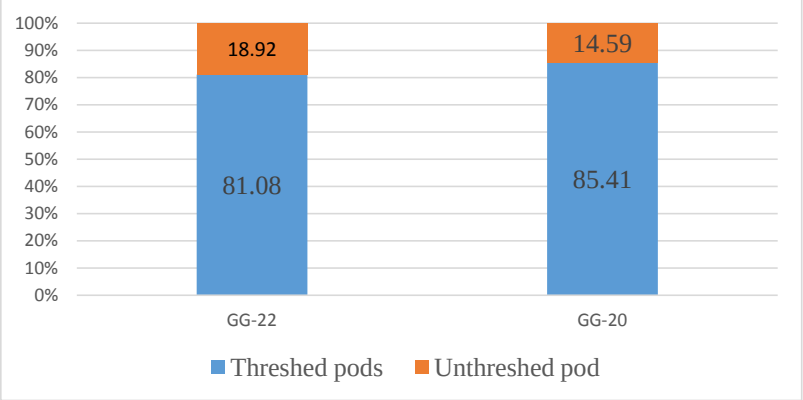

Fig 5: Percentage of threshed and unthreshed pods for GG-22 and GG-20 varieties

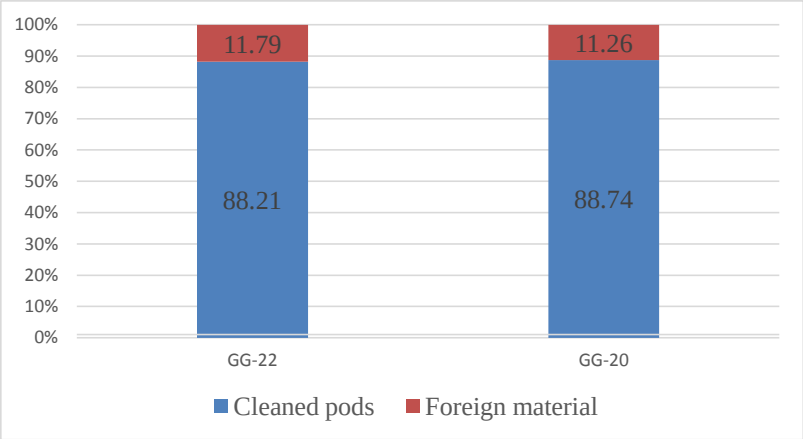

Fig 6: Percentage of cleaned pods and foreign material for GG-22 and GG-20 varieties

4.5 Cost of Operation

Cost of groundnut threshing was calculated in terms of fixed cost and Operating costs:

4.5.1 Cost calculation for thresher

FIXED COST

1. Depreciation cost

Life of thresher = 8 years

Annual use = 300 hrs

$$D = \frac{C - S}{L \times H}$$

Where,

C = Cost of thresher

S = Salvage value

L = Life of thresher

H = No. of working hour per year

$$= \frac{154000 - 15400}{8 \times 300}$$

$$= 57.75 \text{ Rs/h}$$

2. Interest

$$I = \frac{C + S}{2} \times \frac{i}{H}$$

Where,

C = Cost of thresher

S = Salvage value

I = Interest per hour

i = Percentage rate of interest per year

$$= \frac{154000 + 15400}{2 \times 100} \times \frac{10}{300}$$

$$= 28.23 \text{ Rs/h}$$

3. Housing cost

$$= \frac{1.5\% \text{ of initial cost}}{\text{annual use}}$$

$$= \frac{2310}{300}$$

$$= 7.70 \text{ Rs/hr}$$

4. Insurance and taxes cost

$$= \frac{2.0\% \text{ of initial cost}}{\text{annual use}}$$

$$= \frac{3080}{300}$$

$$= 10.27 \text{ Rs/h}$$

Therefore, fixed cost for thresher = Depreciation cost + Interest + Housing cost + Insurance and taxes cost

= 57.75 + 28.23 + 7.70 + 10.27

= 103.95 Rs/h

OPERATING COST

1. Repair and maintenance

$$= \frac{5\% \text{ of initial cost}}{\text{annual use}}$$

$$= \frac{7700}{300}$$

$$= 25.67 \text{ Rs/h}$$

2. Wages

Labour cost = 300 Rs per day for 8 hour

= 37.5 Rs/h

Therefore, cost of six labour = 225 Rs/h

Total operating cost for thresher = Repair and maintenance cost + Wages cost

= 25.67 + 225

= 250.67 Rs/h

Total Thresher cost = Fixed cost + Operating cost

= 103.95 + 250.67

= 354.62 Rs/h

4.5.2. Cost calculation for tractor

FIXED COST

1. Depreciation cost

Life of thresher = 10 years

Annual use = 1000 hrs

$$D = \frac{C - S}{L \times H}$$

Where,

C = Cost of tractor

S = Salvage value

L = Life of tractor

H = No. of working hour per year

$$= \frac{750000 - 75000}{10 \times 1000}$$

$$= 67.50 \text{ Rs/h}$$

2. Interest

$$I = \frac{C + S}{2} \times \frac{i}{H}$$

Where,

C = Cost of tractor

S = Salvage value

I = Interest per hour

i = Percentage rate of interest per year

$$= \frac{750000 + 75000}{2 \times 100} \times \frac{10}{1000}$$

$$= 41.25 \text{ Rs/h}$$

3. Housing

$$= \frac{1.5\% \text{ of initial cost}}{\text{annual use}}$$

$$= \frac{11250}{1000}$$

$$= 11.25 \text{ Rs/h}$$

4. Insurance and taxes cost

$$= \frac{2.0\% \text{ of initial cost}}{\text{annual use}}$$

$$= \frac{15000}{1000}$$

$$= 15 \text{ Rs/h}$$

Therefore, fixed cost for tractor = Depreciation cost + Interest + Housing cost + Insurance and taxes cost

= 67.50 + 41.25 + 11.25 + 15

= 135

OPERATING COST

1. Repair and maintenance

$$= \frac{5\ \% \text{ of initial cost}}{\text{annual use}}$$

$$= \frac{37500}{1000}$$

$$= 37.5 \text{ Rs/h}$$

2. Operator cost
   - 300 Rs per day of 8 hrs
   - Therefore, it is 37.5 Rs/h

3. Fuel cost
   - In a one hour 2.5 litre average diesel was consumed and prevailing diesel price was 64 Rs/lit.
   - Therefore, fuel cost for tractor = 160 Rs/h

4. Oil cost
   - Oil consumption is taken as 30 percent of the fuel consumption
   - Therefore, oil cost for tractor = 48 Rs/h

Total operating cost for tractor = Repair and maintenance + Operator cost + Fuel cost + Oil cost

= 37.5 + 37.5 + 160 + 48

= 283 Rs/h

Total tractor cost = Fixed cost + Operating cost

= 135 + 283

= 418 Rs/h

Total operational cost = Thresher cost + Tractor cost

= 354.62 + 418

= 772.62 Rs/h

Therefore, average cost of groundnut threshing, Rs/kg

$$= \frac{\text{Cost of operation (Rs/h)}}{\text{Average pod output capacity (kg/h)}}$$

(Average pod output capacity = 466.13 kg/h)

$$= \frac{772.62}{466.13}$$

= 1.65 Rs/kg

= 165 Rs/q

Thus, the fixed and operating cost were found as Rs.103.95, 250.67 per hour and Rs.135, 283 per hour for thresher and tractor, respectively. The overall average cost of threshing operation was observed Rs.772.62 per hour OR Rs.165 per quintal.

CONCLUSION

Threshing operation is also different in India and among the developing countries. The threshing is done from the old traditional method of using sticks and racks to the modern power threshers. In India the smallholder and marginal farmers do manual threshing. After harvest bunch type plants are stacked in heaps with the pod-end exposed. The crop has remained in this state for a week. The pods are plucked from the plants with labour or threshed by power thresher. Drying the plants for a few days facilitates the threshing operation. In order to get timeliness of threshing, nowadays power thresher is mostly used for groundnut crop. Mechanization of this process removed a substantial amount of drudgery from farm labour.

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Comment [s9]: *Arachis hypogaea*

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