Effect of Various Ginning Technologies on Fibre Properties of Machine Harvested Cotton

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Outline

- Challenges and issues related to mechanical harvesting & processing of mechanically harvested cotton
- Machinery required for processing of mechanically harvested cotton
- Effect of different ginning technologies on fibre properties and trash content

Why Should Cotton be Machine Harvested?

- There are about 75 cotton producing countries in the world
- USA, Australia and Israel 100% mechanical harvesting
- Mechanical picking/stripping is practised in 28 countries
- Picking is one of the most labour intensive operations
- The cost of cotton harvesting in India is quadrupled; high inflation, migration of labour, NREGA act, etc.
- Cost of picking is 10-12% of the total cotton selling price
- Increased cotton productivity due to mechanisation in USA, Brazil, Turkey, Philippines, etc.
- Konduru et al. estimated income of Rs. 10,000/- per acre if cotton is harvested mechanically
- By increasing plant population to 30,000 plants/acre

Issues and challenges

- Appropriate plant physiology: H:1.5-2m; Less branches; 15-20 bolls/plant
- Chemical applications: growth regulators & breeding practices
- Synchronise boll opening: India 3-4 pickings
- Defoliation: Shedding of leaves – low temp. problem: 80% leaves in trash content
- Field losses : 4-5% and Unopened bolls: 10-12%
- Appropriate harvesters: small land holding; large size pickers (6-8 rows): small size harvesters (1 row side mounted picker & brush type stripper- used in USA for 20% harvesting)

Promising Pickers suitable for Indian farms

Tractor	50 HP or more
Diesel	7l/h
Harvesting time	1.15 h/acre
Basket capacity	200-250 kg

Single row cotton picker attempted in India by John Deere and New Holland Tractors

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Single row cotton picker attempted in India by John Deere and New Holland Tractors

- Brush Stripper developed by M&M in association with CICR & CIRCOT
- Simple Design, low cost, easy maintenance, field cleaner

Issues and challenges

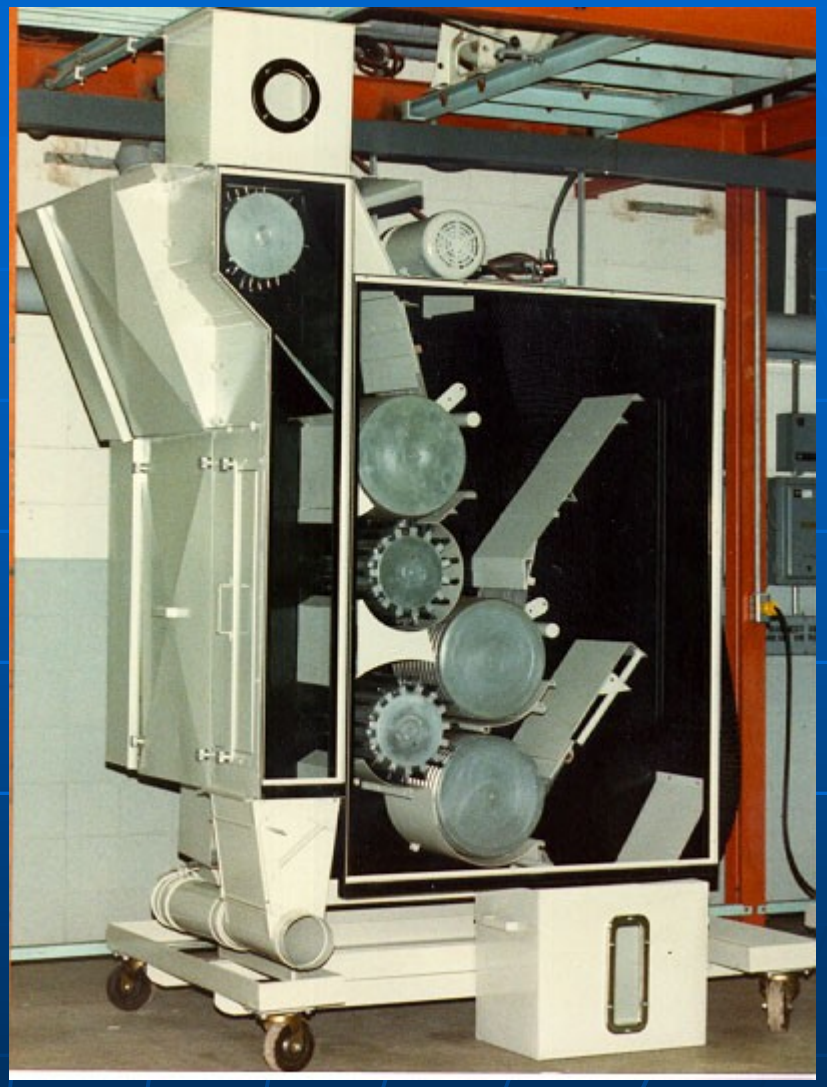
- Trash content: 1-1.5%, 8-11%, 16-18% for handpicked, machine picked and stripped cotton on raw cotton

Issues in Processing of Machine Picked Cotton

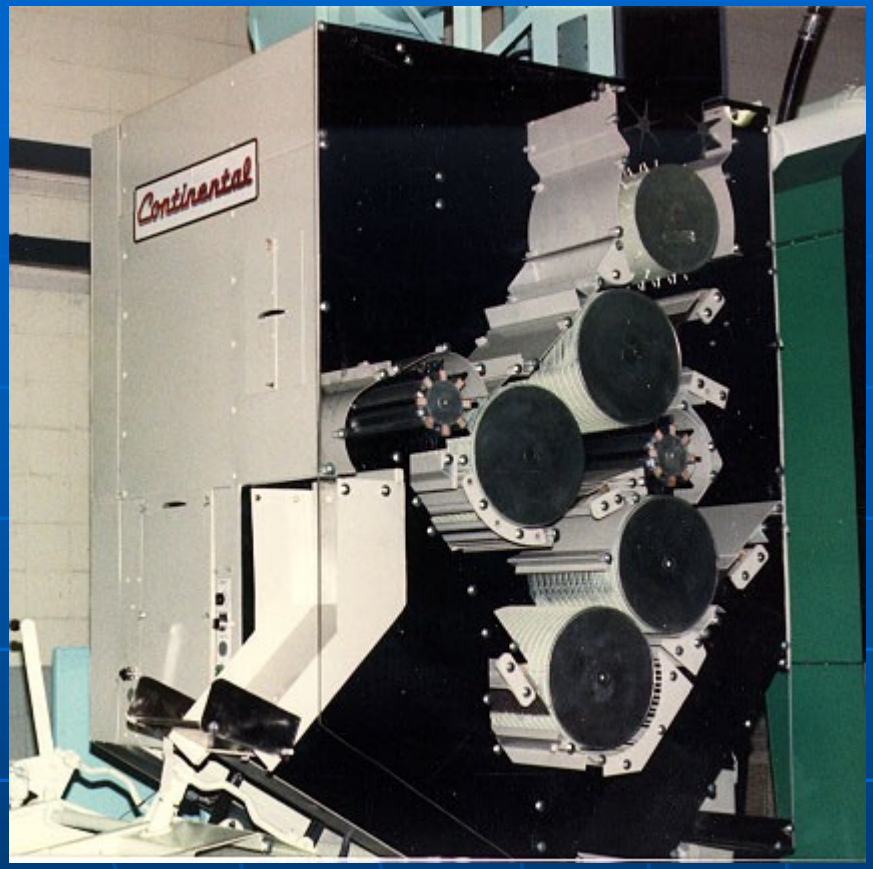
- Indian ginneries: <2% trashes, employ: a pre and a post cylinder cleaner
- A set of special pre and post cleaning machines: 8-10% trashes
- Employ: DR gins for cotton ginning as it yield 0.5 mm higher length, 2-3% extra lint outturn, etc.
- DR gins: closed system-trashes can't escape
- Trashes: pass through ginned lint under high pressure
- Trashes affect the fibre properties negatively

Additional Cleaners for Machine Picked Cotton

Cylinder cleaner



Stick machine



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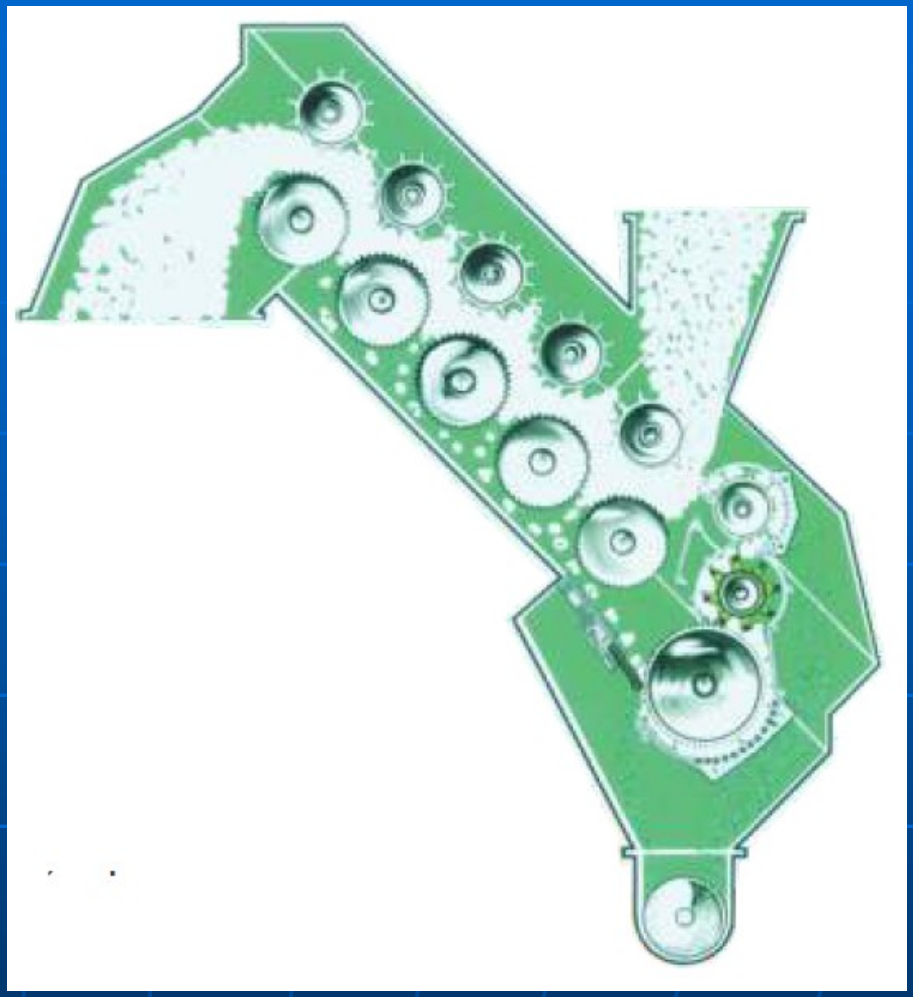
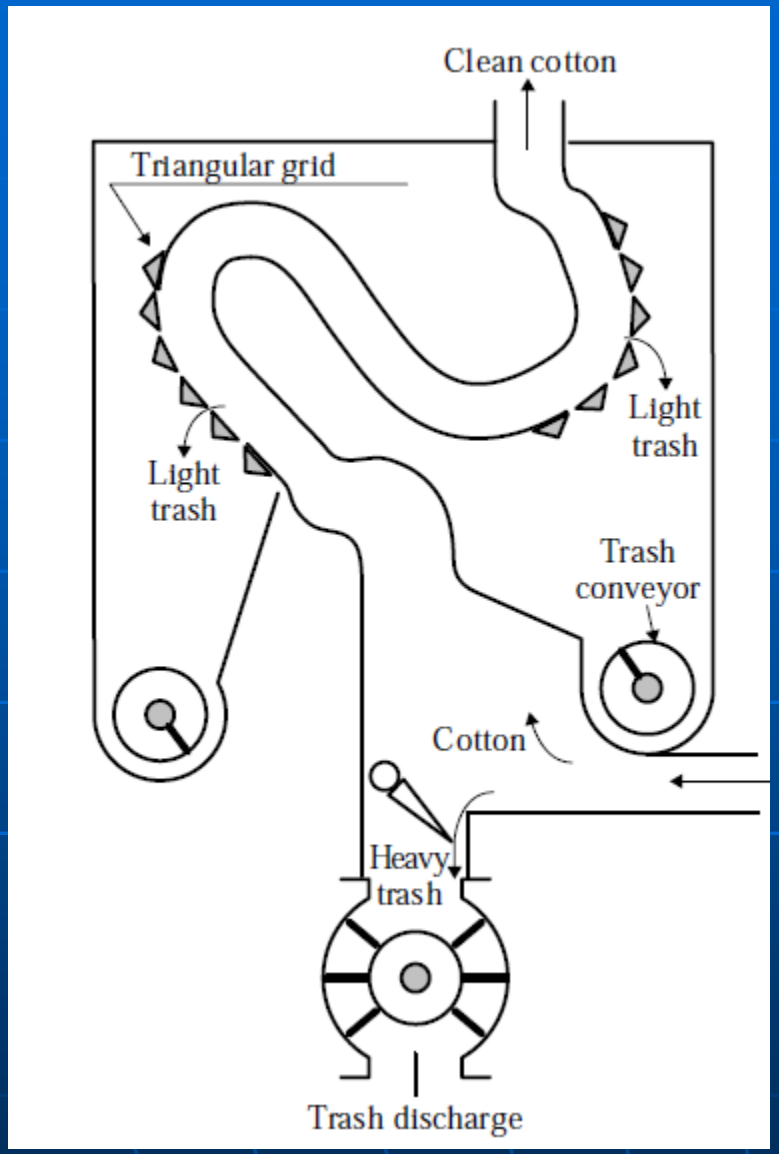
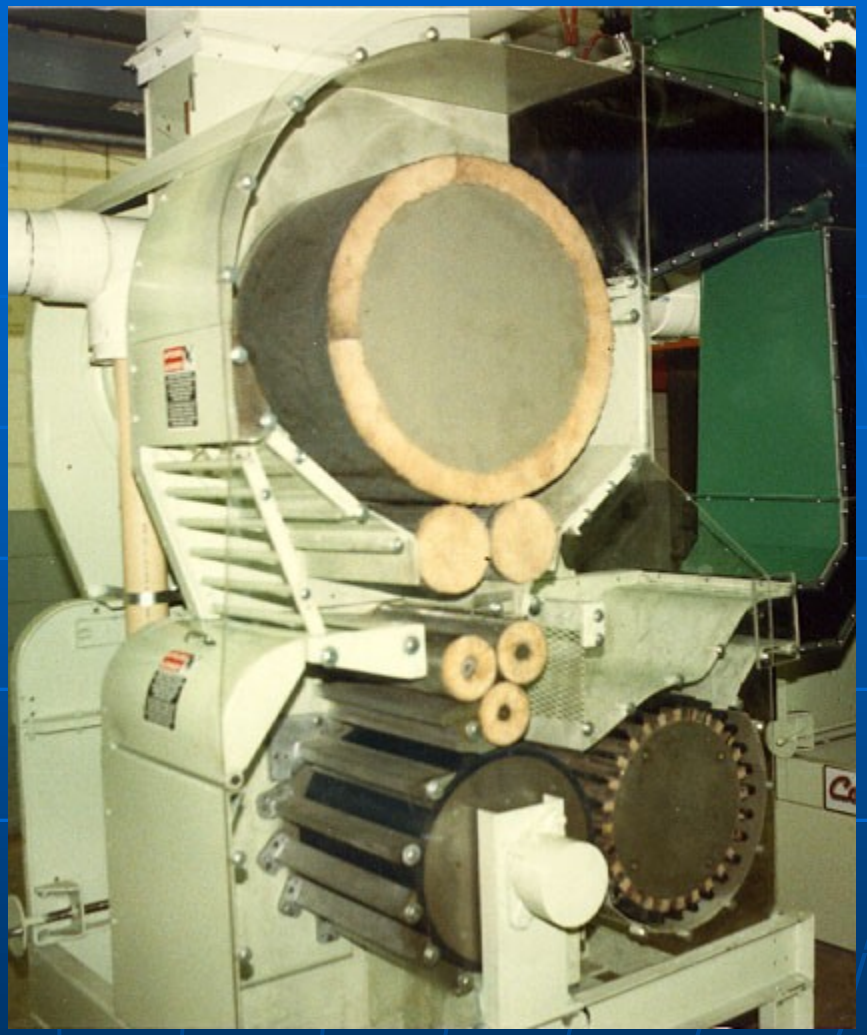


Impact cleaner



Air-jet lint cleaner



Saw type lint cleaner

Trials Conducted

HDR - Handpicked cotton ginned using DR gin

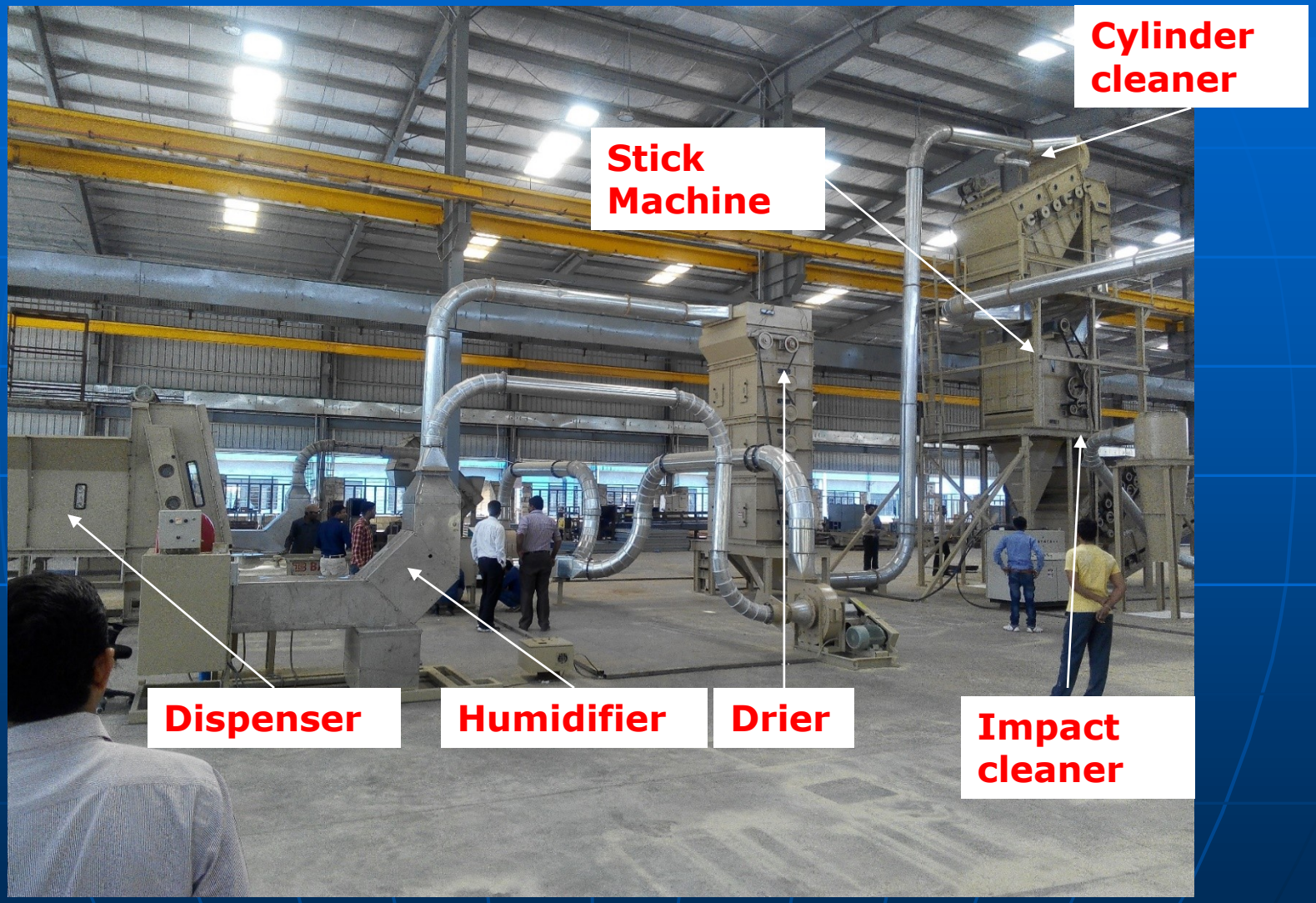
MDR - Machine picked un-cleaned cotton ginned using DR gin

ML - Machine picked un-cleaned cotton ginned using lab model gin

MCDR - Machine picked cleaned cotton ginned using DR gin

MCSG - Machine picked cleaned cotton ginned using saw gin

Facility used for Pre-cleaning of Machine Harvested Cottons



Types of foreign matter particles and the ratio of foreign matter to fibre mass across treatments

Treatments	HDR	MDR	ML	MCDR	MCSG
Burs	-	3.7	3.4	0.4	0.3
Sticks	-	1.8	1.4	1.0	1.5
Green leaves	-	4.6	4.3	0.5	0.4
Pin Trash	3.13	15.8	15.7	6.8	5.1
Total Foreign Matter	3.13	25.9	24.8	8.6	7.3

Saw Gin: Air blasting & falling of trashes in between ribs causes trash removal

HVI Analysis

Treatments	HDR	MDR	ML	MCDR	MCSG
Length, UHML (mm)	30.12	29.2	29.6	29.53	29.73
Uniformity Index (%)	84.8	80.1	80.8	81.6	81.8
Micronaire (µg/inch)	4.01	3.6	3.8	3.98	3.96
Strength (g/tex)	31.7	31.8	31.7	31.2	31.2
Elongation (%)	6.1	5.2	5.2	5.9	5.9
Short Fibre Index (%)	4.2	6.3	6.4	7.8	7.6
Reflectance (%)	82.10	58.1	60.1	64.2	68.1
Yellowness (%)	7.40	8.8	8.7	9.9	9.1
Colour Grade (CG)	21-2	62-2	62-1	53-1	42-2

AFIS Length Module Results

Treatments	HDR	MDR	ML	MCDR	MCSG
Length (w), mm	27.3	24.1	24.9	25.05	27.0
Length (w), %CV		37.1	37.0	39.5	37.0
Length (n), mm	21.9	17.7	18.7	17.82	19.45
Length (n), %CV		58.8	58.2	63.8	58.6
UQL (w), mm	33.5	30.3	30.8	31.60	32.30
5% Length, mm	37.9	34.1	34.9	35.71	36.78
SFC (w), mm	6.9	11.0	9.9	11.7	9.8
SFC (n), mm	22.7	33.6	31.9	37.2	30.9

AFIS Trash Module Analysis

Treatments	HDR	MDR	ML	MCDR	MCSG
Total trash count/g	1466	6156	4661	3692	2168
Mean size, µm		276	249	215	314
Dust count/g	1295	5462	4200	3499	1809
Trash count/g	171	694	461	193	359
Visible foreign matter (VFM), %	3.25	13.5	8.48	4.57	4.37

Conclusions

- Fibre properties of DR ginned lint is slightly affected due to presence of trashes in machine harvested cotton
- Saw ginned lint is comparable to DR ginned lint for machine harvested cotton
- Saw ginning system may be economically viable for processing of machine harvested cotton in India

Thank You!

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