Comparison of Mechanical and Hand Harvesting of Cotton Regarding Lint Quality Factors under Turkish Conditions

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ABSTRACT

A research study intending to determine the effects of mechanical picking on lint quality factors in comparison with hand harvesting was carried out. Field trials were held at 8 locations in the Aegean and South East Anatolian regions. Three domestic (Nazilli-84, NC 873-143 and Sayar-314) and one American (DPL 5690) cotton varieties were planted and harvested by Case IH 2155, 4-Row (narrow) picker and seasonal labour. Trash contents of machine picked cotton were higher than hand picked in general. As a result, one-half or one-full lower Color Grades were obtained for machine picked and roller-ginned samples due to insufficient cleaning. However, the differences regarding color grades between harvesting methods have disappeared by saw-ginning due to efficient cleaning. There were no significant differences between the lint samples of hand and machine picked for the other quality factors of Fiber Length, Length Uniformity, Fiber Strength and Micronaire.

Introduction

Cotton is of great importance to the Turkish economy with its big share in agricultural income mostly from export; besides, it is the most important raw material source for textile, vegetable oil and feed industries that are steadily developing. Thus Turkey needs to increase production of cotton every year but due to problems in harvesting, it is facing a possible decline. The labour supply is decreasing and the unit costs of hand harvesting are increasing making mechanical harvesting more attractive. On the other hand, cotton traders and farmers have some doubts about the effects of mechanical picking on quality compared to hand harvesting. A research study was initiated to determine the effects of mechanical picking on lint quality factors in comparison with hand harvesting.

Methods

Field trials were held at eight locations in Aegean and South East Anatolian regions. Three domestic (Nazilli-84, NC 873-143 and Sayar-314) and one American (DPL 5690) cotton varieties were planted at 76 cm inter-row spacing with 4-row mechanical planters. The farmers, generally using traditional methods, performed other cultural operations. There were some exceptions such as furrow irrigation where it is possible and defoliation before harvest. A Case IH 2155, 4-narrow row cotton picker was used for mechanical harvesting while hand harvesting was performed by seasonal labour. Measurements of quality factors were performed on the lint samples on a high-volume instrument line (HVI). All measurements and sampling were replicated at least three times.

Results

The results are summarized in Table 1, 2 and 2a.

The trash content of machine picked cotton was generally higher than hand picked cotton. It was about 2% more with the picker than with seasonal labour. However, it was effectively removed by cleaning during saw-ginning. Other differences between the methods in was the size and number of the particles. In picker-harvested cotton, the trash content was mostly formed from lots of fine particles, while with hand picking it was mainly a few large particles. The prototype pre-cleaning system designed for the roller-gin process was unsatisfactory and in need of further development.

The colour was generally one-half or one-full grade lower with for machine picked, roller-ginned samples due to insufficient cleaning. However, the differences between harvesting methods regarding colour grades disappeared with saw-ginning due to efficient cleaning.

There were no significant differences between the lint samples of hand and machine picked for the other quality factors measured, fiber length, length uniformity, fiber strength, Micronaire and elongation.

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Table 1. Field conditions and losses.

Location	Cotton Variety	Yield (S/C) (kg/ha)	Field/Crop Conditions	Pre-Harvest Loss[1] (%)	Ground Loss[2] (%) (machine)	Stalk Loss[3] (machine) (%)	Spot Work Rate[4] (ha/h)
Menemen	Nazilli-84	4470	good- good	6.0	5.0	3.0	1.7
Söke (1)	NC 873-143	4340	med.-bad	6.0	5.0	2.7	1.3
Torbalı	Nazilli-84	3310	bad-bad	2.1	5.2	4.7	0.8
Salihli	Nazilli-84	4870	bad-bad	2.3	8.6	2.8	1.5
Saruhanli	NC 873-143	3200	good- good	1.6	3.6	2.5	1.4
Bergama	Nazilli-84	4250	good- good	2.9	3.9	4.0	1.3
Söke (2)	DP - 5690	4810	med.-good	1.7	3.3	3.3	1.6
Koruklu	Sayar 314	3450	good- bad	11.0	6.2	8.4	--

1) The amount of cotton naturally fallen to ground before harvest, as a percentage of the field yield.
2) The amount of cotton fallen to ground by picker, as a percent of the yield. (Inverse indicator of picker efficiency)
3) The amount of unpicked cotton, as a percentage of the field yield. (Inverse indicator of picker efficiency)
4) Working time at average operating speed and effective operating width. (Excluding routine interruptions for turning, unloading, etc.)

Table 2. Results of the lint quality factors (measured by HVI method at Nazilli Cot. Res. Inst. Lab.).

Location	Sample	Trash Content[1] (%)	Number of Particles	Fiber Length (mm)	Length Uniformity (%)	Fiber Strength (g/tex)	Elong-ation
	Yield Sample[2]	0.26	15	27.5	85.8	32.3	10.0
Menemen	Mach Picked[3]	1.32	46	28.3	85.9	32.3	10.2
	Hand Picked[4]	0.56	28	29.2	86.4	32.0	9.6
	Mach Picked + Roller Gin[5]	0.83	25	29.4	86.0	31.1	9.4
	Yield Sample	1.19	33	29.4	87.3	29.8	9.0
Söke 1	Mach Picked	2.22	67	29.9	86.7	29.6	9.1
	Mach Picked (Undelinted)	2.36	70	31.0	89.3	30.8	10.2
	Yield Sample	0.45	15	30.4	89.2	33.3	10.6
Torbali	Mach Picked	3.55	84	30.9	88.6	31.7	10.1
	Hand Picked	1.25	33	29.7	87.2	27.8	9.1
	Yield Sample	1.18	28	30.7	88.3	27.3	9.2
Salihli	Mach Picked	1.64	69	29.8	87.5	30.5	9.2
	Hand Picked	0.93	34	28.5	87.4	33.2	9.5
	Yield Sample	0.26	11	29.2	87.3	30.0	8.5
Saruhanli	Mach Picked	1.56	49	29.9	86.8	29.5	8.4
	Mach Picked +Saw Gin[6]	0.32	18	29.5	83.4	29.4	8.6
	Yield Sample	0.51	20	29.6	87.9	32.7	9.4
Bergama	Mach Picked	1.92	58	30.0	87.1	31.8	9.1
	Hand Picked	0.94	26	29.4	86.9	33.2	9.3
	Yield Sample	0.40	23	30.3	86.8	33.3	8.9
	Mach Picked	2.12	75	30.2	87.1	32.2	8.7
	Mach Picked + Roller Gin	0.58	51	28.7	85.9	30.4	9.1
Söke 2	Mach Picked +PCL+RG[7]	0.71	34	29.6	85.0	29.7	9.1
	Mach Picked + Roller Gin	1.89	93	30.8	88.6	27.3	9.5
	Mach Picked +PCL+RG[8]	1.99	70	30.5	88.3	27.6	9.6
	Yield Sample	0.40	22	30.3	86.3	31.5	8.6
Koruklu	Mach Picked	2.12	108	30.6	86.8	27.8	9.2
	Mach Picked (Undelinted)	2.40	126	31.6	88.7	28.6	9.9
	Hand Picked	0.41	35	31.6	88.1	30.0	9.2

Table 2a. (Table 2 Continued).

Location	Sample	Micronaire	Trash Content (%)	Colour Grade
	Yield Sample[2]	5.3	0.26	W-*LM / SLM*
Menemen	Mach Picked[3]	5.2	1.32	W-LM / SGO ↓ [9]
	Hand Picked[4]	4.5	0.56	W-LM / SGO ↓

	Mach Picked + Roller Gin[5]	5.0	0.83	W-LM / SLM
	Yield Sample	4.5	1.19	W-*LM / SLM*
Söke 1	Mach Picked	4.6	2.22	W-SGO ↓
	Mach Picked (Undelinted)	4.7	2.36	W-Lt Sp-*SGO / GO* ↓
	Yield Sample	4.8	0.45	W-*LM*
Torbali	Mach Picked	4.7	3.55	W-SGO ↓
	Hand Picked	4.6	1.25	W-LM
	Yield Sample	4.0	1.18	W-*LM / SLM*
Salihli	Mach Picked	4.8	1.64	W-Lt Sp- LM / SGO ↓
	Hand Picked	4.9	0.93	W-LM / SLM
	Yield Sample	4.5	0.26	W-*LM*
Saruhanli	Mach Picked	4.4	1.56	W-LM / SLM
	Mach Picked +Saw Gin[6]	4.5	0.32	W-LM / SLM
	Yield Sample	5.0	0.51	W-S*LM / SGO*
Bergama	Mach Picked	5.0	1.92	W-LM / SGO ↓
	Hand Picked	5.1	0.14	W-LM
	Yield Sample	4.3	0.40	W-Lt Sp- *SLM / SGO*
	Mach Picked	4.4	2.12	W-LM / SGO
	Mach Picked + Roller Gin	2.9	0.68	W-*LM*
Söke 2	Mach Picked+PCL+RG[7]	3.2	0.71	W-*LM*
	Mach Picked + Roller Gin	4.3	1.89	W-*LM*
	Mach Picked +PCL+RG[8]	4.2	1.99	W-*SGO* ↓
	Yield Sample	4.1	0.40	W-S*LM*
Koruklu	Mach Picked	4.8	2.12	Lt Sp-Sp-SGO ↓
	Mach Picked (Undelinted)	4.7	2.40	Lt Sp-*SGO* ↓
	Hand Picked	4.1	0.41	W-LM ↓

Abbrvs. About Color Grades:
W : White Lt Sp : Light Spotted Sp : Spotted T : Tinged Y St : Yellow Stained
GM : Good Middling SM : Strict Middling M: Middling SLM: Strict Low Middling
LM : Low Middling SGO : Strict Good Ordinary GO: Good Ordinary BG: Below Grade

[1] Non-lint content of cotton as a percent of the total trash surface area of the cotton sample, scanned by video camera
[2] Picked by hand to determine yield, then ginned with laboratory type roller-gin (without cleaning)
[3] Picked by machine, then ginned with laboratory type roller-gin (without cleaning)
[4] Picked by seasonal workers, then ginned with laboratory type roller-gin (without cleaning)
[5] Ginned at roller-gin plant, with standard cleaning for seed cotton and lint
[6] Ginned at saw-gin plant (Continental), with standard cleaning operations for seed cotton and lint
[7] 1st picking by machine, then precleaned with the specially designed for roller-gin and ginned at roller-gin
[8] 2nd picking by machine, afterwards precleaned with the specially designed for roller-gin and ginned at roller-gin
[9] Lower grade comparing with hand picked cotton for field yield determination.