Fiber quality, gin and harvest efficiency evaluation of a new stripper shaker system compared to the picker system

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ABSTRACT

Fiber quality and gin and harvester efficiencies obtained by a new stripper shaker system as compared to a picker system, were studied. The objectives of this study were: (i) To compare the harvesters efficiencies of both system. (ii) To determine the resultant marketing classification. (iii) To analyze the fiber quality and gin efficiency for both systems. In order to determine the crop harvest efficiency for the two treatments (Stripper-Shaker vs. Picker), the experimental design chosen was a randomized complete block in a production field, and once harvested seed cotton samples were taken and sent for analysis to INTA Experimental Station at Saenz Pena, where gin, foreign matter, and fiber quality determinations were carried out. The results obtained indicate: (i) The Stripper-Shaker system had better crop harvest efficiency than the Picker system. But this increase in crop efficiency was related to a greater percentage of foreign matters ($P \leq 0.05$). (ii) It was possible to reduce the initial differences in foreign matters contents of both systems to comparable values after ginning. This could be assessed by a very small difference obtained in marketing classification (Low Middling vs. Strict Low Middling). (iii) The greater harvester efficiency brought along lighter seeds, and hence a lesser degree of maturity in its development. This degree of seed immaturity was reflected in the HVI analysis by means of micronaire that present association with seed weight ($r^2=0.78$).

Introduction

Cotton mechanical harvesting has been widely adopted in Argentina during the last decade. The harvesting system most widely used by farmers is the picker system, which allowed for the increase in cotton acreage in the country, reaching 1.200.000 planted hectares in 1997 (Elena *et al*., 2000).The mechanical harvester brought along higher moisture and foreign matter contents in seedcotton compared to hand harvesting. As a consequence, post-harvesting and ginning had to adapt to the new conditions.

Other harvesting systems like stripper types were underused because they produced a higher content of foreign matter, lowering fiber quality, as well as having the problem of being inadequate for the installed ginning system. But new technological advances in different fields like agrochemistry (Chu *et al*., 1992) transgenic varieties and ultra narrow row system (Vories *et al*., 1999) revived the interest in using alternative systems to that of the Picker. Various researchers have studied how to decrease the foreign matter in Stripper systems (Bennet *et al*., 1994; Yankey and Mayfield, 2000; Anthony *et al*., 2000).

Another alternative system is the stripper shaker, which consists basically on a stripper platform header with the attachment of injectors that insert pressured air. The shaking rollers are aimed at shaking the cotton plant to make seed cotton fall into a vacuumed hopper. A transporting unit carries the cotton to a cleaning drum that blows the cleaned material into the basket (Mor and Ron, 2000). This machine is made by Kesher Magneti LTD. Israel.

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Experimental procedure

The trial was conducted by INTA, Agricultural Experimental Station Saenz Pena (26^0 50' latitude South, 60^0 20' longitude West) in Argentina, during the 2001/2002 crop season, in cotton production fields treated with defoliants and desiccants in order to prepare them for mechanical harvesting.

Treatments

Treatments consisted of two different harvester systems: picker and stripper shaker. The picker system consisted on JD 9900 spindle picker of American origin, and the stripper shaker system consisted of a platform header stripper with shaking rollers that injected pressured air.

Experimental design

The experimental design was a randomized complete block with three replications. Each plot consisted of four rows, separated 1 meter from each other and with a length of 50 meters. The variety used was Deltapine 50B of American origin.

Measurements

Initially each plot was mechanically harvested by two different treatments (picker and stripper shaker).

The quantity of seed cotton mechanically harvested was measured weighting each plot, and then the remaining crop was hand harvested (to collect plant and ground losses). Both were weighted (mechanical and hand harvest) so as to determine losses in the systems by weight difference. Sub-samples were sent to the fiber laboratory in order to analyze lint percentage, foreign matter (Feeder-Extractor, Shirley analyzer, and Lint Cleaner), HVI quality, and market classification. The weight of 100 seeds was taken (after ginning) as seed weight and seed size estimators.

Statistical analysis

The differences between the means of the treatments of each experiment were established by means of the least significant difference when the variance analysis revealed significant differences. Regression analysis was used after averaging the replications for each treatment. The level of significance used was P=0.05 in all analyses.

Results

There was significant difference between both treatments. Total seed cotton losses were 310 kg/ha. for the picker system, and 34.3 kg/ha. for the stripper shaker system (9% and 1% respectively). The significant difference had its origin in the fraction of plant losses, being the ground loss fraction not significant (Table1).

The content of initial foreign matter in seedcotton was analyzed by feeder-extractor (removed and classified foreign matter). The stripper shaker had twice the foreign matter content than picker system, averaging 13.9% vs. 7.7%. The foreign matter content composed mainly of bolls, hulls, sticks, sterns and small leaves (Table 2).

Final foreign matter content in lint was analyzed with a Shirley equipment, and a combination of the Shirley analyzer and a lint cleaner (Table 2).

When analyzing with the Shirley equipment, a significant difference of 12% vs. 8.4% between the stripper shaker system and the picker system was detected for total foreign matter content. Visible fraction differences were significant: 10.8% stripper shaker vs. 7.1% picker, and the Invisible fraction differences were not significant (1.2% vs. 1.3%) for the stripper shaker system and picker system respectively. A combination of the Shirley analyzer and the lint cleaner was tested, the range of foreign matter content obtained was: total (6.6% stripper shaker vs. 4.8% picker) and visible (5.4% stripper shaker vs. 3.7% picker), resulting less significant than when only the Shirley analyzer was used. The Invisible fraction (1.2% stripper shaker and 1.1% picker) presented similar values as with the Shirley analyzer alone (Table 2).

The lint turnout (ratio of ginned weight to initial seedcotton weight) differed significantly by 29.5% stripper shaker vs. 32.4% picker. This difference was caused by the initial foreign matter content as previously explained (Table 3). The difference in the 100 seeds weight was significant, 87.9 g vs. 97.1 g for the stripper shaker and picker respectively.

The fiber quality characteristics as measured by HVI was not significant (length, strength, uniformity), except for micronaire index average (3 stripper shaker vs. 3.4 picker) (Table 4). The marketing classification displayed a small difference between both harvesting systems (Low Middling vs. Strict Low Middling for stripper shaker and picker respectively).

Discussion

The harvest efficiency comparison between the stripper shaker system and picker systems was a subject of research in many experiments and publications. The results obtained indicate that the stripper system has a high harvest efficiency, with a high increment in the initial foreign matter content in seed cotton, and a lower lint percentage than the picker system (Copley, 1986; Kerby *et al*., 1988; Brashears and Hake, 1995; Brashears and Baker, 2000). Our results comparing both systems showed a similar tendency, having the stripper shaker system a better harvest efficiency than the picker system. But this increase in harvest efficiency was related to a greater percentage of foreign matters ($P \leq 0.05$).

Results from marketing classification determine fiber price and economic return (Bennet *et al*., 1994; Anthony, 1998; Nelson *et al*., 1999), this being the reason to reduce foreign matter content to a minimum. In the stripper harvesting system it is more difficult to reduce it, what makes additional cleaning equipment necessary to obtain a better marketing classification (Baker, 1995; Muhidong *et al*., 1996; Baker and Brashears, 2000).

In this test, it was possible to reduce the initial differences in foreign matter contents, for both systems, to comparable values after ginning. This could be assessed by a small marketing classification difference obtained (Low Middling vs. Strict Low Middling for stripper shaker and picker respectively).

The HVI parameters were not significantly affected, except micronaire (Thibodeaux and Rajasekaran, 1999; Vories *et al*., 1999; Bradow and Davidonis, 2000). The shaker stripper cotton had consistently lower micronaire than the picker system. The difference could be explained by the harvest efficiency of both. The picker system had more losses in the field but these losses relate to a low quality seedcotton. The stripper shaker system collects both good and bad quality seed cotton from the plant, and as a consequence the better harvest efficiency meant lighter seeds an also a smaller degree of maturity in its development. This degree of seed immaturity was reflected in the HVI analysis by means of micronaire that had association with seed weight ($r^2=0.78$, Figure I).

Conclusion

i) The stripper shaker system had better crop harvest efficiency than the picker system. But this increase in crop efficiency was related to a greater percentage of foreign matters ($P \leq 0.05$).

ii) It was possible to reduce the initial differences in foreign matter contents of both systems to comparable values after ginning. This could be assessed by a very small difference obtained in marketing classification (Low Middling vs. Strict Low Middling for stripper shaker and picker respectively).

iii) The greater crop harvester efficiency brought along lighter seeds, and hence a lesser degree of maturity in its development. This degree of seed immaturity was reflected in the HVI analysis by means of micronaire that presented association with seed weight (r^2=0.78).

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Table 1. *Seed cotton yield and losses factors from picker vs. stripper shaker.*

	Parameter value				
Harvesting method	Seed cotton (kg)	Plant losses (kg)	Ground losses (kg)	Total losses (kg)	Total losses (%)
Picker	3270	265	45	310.5	9.5
Stripper Shaker	3120	10.5	24	34.3	1.1
LSD (p=0.05)	ns*	9.8	ns*	43	5.9

* ns = Not significant

Table 2. *Foreign matters percentage, analyzed by feeder-extractor, Shirley and Shirley lint cleaner.*

Parameter	Harvesting method	Stripper/Shaker	Picker	LSD
Seed cotton	Feeder-Extractor			
	% Total foreign matter	13.9	7.7	0.7
	% For. matt. > 3.5 mm	17.7	6.3	0.7
	% For. matt. > 3.5 mm	0.9	1.4	ns*
Lint	Shirley			
	% Total	12	8.4	0.3
	% Visible	10.8	7.1	0.5
	% Invisible	1.2	1.3	ns
Lint	Shirley with Lint Cleaner			
	% Total	6.6	4.8	ns
	% Visible	5.4	3.7	ns
	% Invisible	1.2	1.1	ns

* ns = Not significant

Table 3. *Lint turnout (%), weight of 100 seeds (g) and market classifications from picker vs. stripper shaker.*

	Parameter value		
Harvesting method	Lint turnout %	Weight of 100 seeds (g)	Market classification
Picker	32.4	97.1	Strict Low Middling
Stripper Shaker	29.5	87.9	Low Middling
LSD (p=0,05)	1.3	3.6	

Table 4. *HVI fiber properties from picker vs. stripper shaker.*

	Parameter value				
Harvesting method	Micronaire index	Length (mm)	Strength (g/tex)	Uniformity (%)	Trash (%)
Picker	3.4	28.9	26.5	81	2
Stripper Shaker	3	28.6	27.1	81.2	3.1
LSD (p=(0.05)	0.24	Ns	ns*	ns	0.8

* ns = Not significant

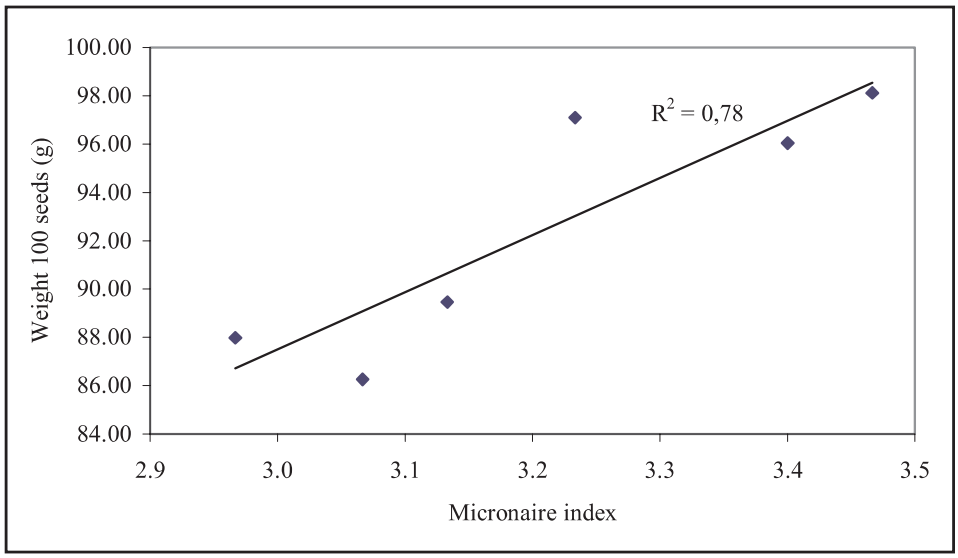

Figure 1. *Relation between micronaire index and weight of 100 seeds (g).*