

A COMPARATIVE PROFITABILITY ANALYSIS OF HYBRID PIMA AND UPLAND COTTON CULTIVARS IN NORTHEAST TEXAS

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Abstract

The U.S. is the third largest cotton producing country and the world's top exporter, generating over \$50 billion in annual revenue and nearly 191,000 jobs. Texas is an integral component of this industry, producing 27.5 million bales on 5.9 million acres. While upland cotton dominates the industry, Pima hybrids are appraised higher but produce lower yield. Seven cultivars are evaluated for yield, fiber quality, and returns in replicated small plot trials (n = 106) in Fairlie, Texas in 2020-2023. Lint yield and profit are analyzed using ANOVA and Tukey test in SAS version 9.4. Profit scenarios are considered at various yield and price levels. Cotton lint yield averaged 472.83 pounds per acre for upland cotton and 390.96 for hybrid Pima. Loan values averaged 50.81 for the upland cotton and 54.18 cents per pound for hybrid Pima, when both are saw ginned. Profits are estimated at a loss of \$281.23 per acre for upland cotton and at a loss of \$371.66 per acre for hybrid Pima. In general, results indicate no statistically significant differences in lint yield or profit among cultivars, with the possibility to increase profitability when fiber market exceeds loan values and a roller gin is utilized to preserve premium Pima fiber characteristics.

Introduction

The cotton industry is the mainstay of many rural economies and is currently dominated by the production of upland cotton due to the yield and vigor associated with these cultivars. A small but growing portion of the industry is designated to the cultivation of long-staple cotton due to their fiber length, fineness, strength, and subsequent increased value and their use in the manufacture of luxury cotton materials. Given this, the potential to increase profitability of cotton enterprises through expanding production into this area exists. However, an agronomic and economic analysis of hybrid Pima cultivars is critical to evaluate the feasibility of reintroducing production to this region.

Materials and Methods

The study utilizes data on cotton lint yield and loan price for the period 2020-2023 from six upland cultivars (DP 1646, FM 2398, PHY 332, PHY 350, PHY 400 and ST 4990) and a hybrid Pima cotton cultivar (HA 1432). Data was collected by conducting experiments in Fairlie, Texas (33.30725° N, 95.96367° W). Cotton cultivars were seeded in two row plots, 40 feet in length using a randomized complete block design with four replications. Final populations were calculated by counting the number of plants harvested and multiplying by 1000. Lint was deburred by hand, and samples were ginned on a conventional saw gin to determine lint yield and turnout. Replications were assessed by Texas Tech Fiber Lab for quality determination via high-volume instrument (HVI). Seven cultivars of interest were evaluated for lint yield and profitability based on the 2020-2023 growing seasons.

Yield data (lbs/acre) and profitability (\$/acre) were evaluated using two-factor analysis of variance (ANOVA) in Statistical Analysis System (SAS) software version 9.4. to calculate any statistically significant differences in yield or profits among the seven cultivars utilized in this study.

Additionally, a sensitivity analysis was conducted in Microsoft® Excel® for Microsoft 365 Microsoft Online (MSO) to evaluate how profitability of cotton enterprises may be affected by changes in pounds of cotton lint produced and market price of cotton lint. Input costs were held constant while price level (ct/lb) and total yield (lbs/acre) varied.

Results and Discussion

There were statistical differences in cotton lint yield between PHY 350 and ST 4990, as well as PHY 350 and HA 1432 (hybrid Pima). Average lint yield was 472.83 lbs/acre for upland cotton and 390.96 lbs/acre for hybrid Pima. Upland variety PHY 350 for period 2020-2023 averaged 548.75 lbs/acre lint yield, compared to 391.99 lbs/acre from ST 4990 and 390.96 lbs/acre from HA 1432. Figure 1 presents a boxplot representation of lint yield by cultivar.

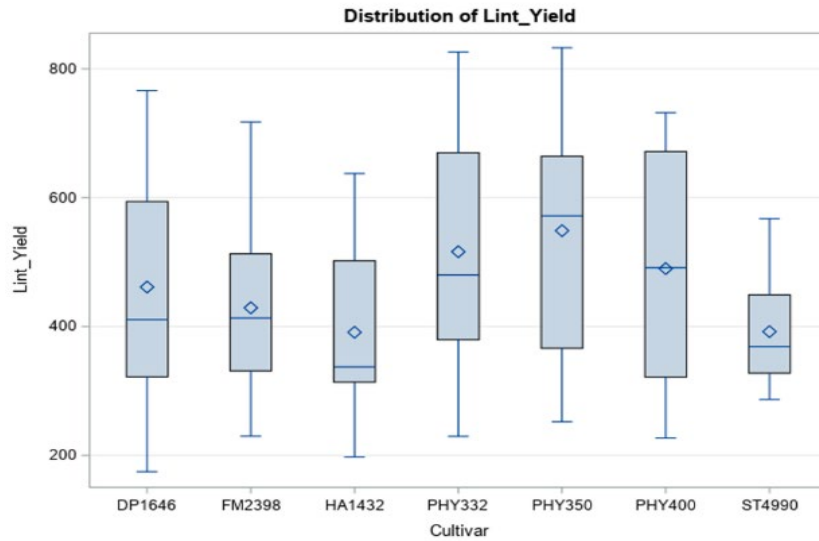


Figure 1. Lint Yield (Lbs/Acre) by Cultivar

There were also statistical differences in cotton lint yield across years, regardless of cultivar. Cotton lint yield in 2021 and 2023 were statistically different from 2020 and 2022. In 2021, lint yield averaged 560.17 lbs/acre and was statistically higher than 2020 and 2023, each generating 452.82 lbs/acre and 306.92 lbs/acre, respectively. Cotton lint yield averaged 501.19 lbs/acre in 2022. Yield was lower in 2023 due to an exceptionally hot and dry growing season. Figure 2 presents a boxplot visual representation of lint yield distribution by year.

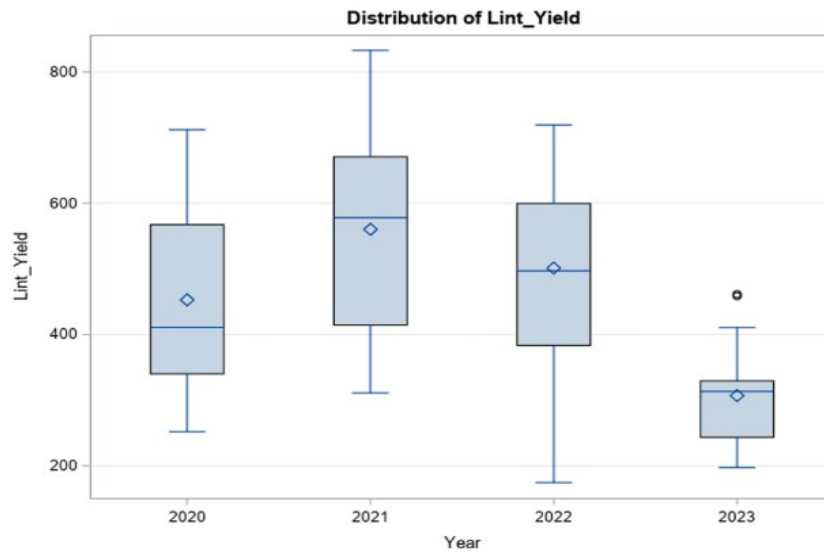


Figure 2. Lint Yield (Lbs/Acre) by Year

There were statistical differences in profit or loss by cultivar. Losses ranged from \$247.09/acre for PHY 350 to \$316.55/acre for ST 4990. For HA 1432, the loss averaged \$371.66/acre. PHY 350, PHY 332, PHY 400, and DP 1646 all have significant differences in profit compared to hybrid Pima. Loan values averaged 50.81 cent/lb for upland cultivars and 54.18 cent/lb for hybrid Pima when both are saw ginned. Overall, our estimates indicate a loss of \$281.46 per acre for upland and a loss of \$371.66 for hybrid Pima. Figure 3 presents a boxplot visual representation of profit by cultivar.

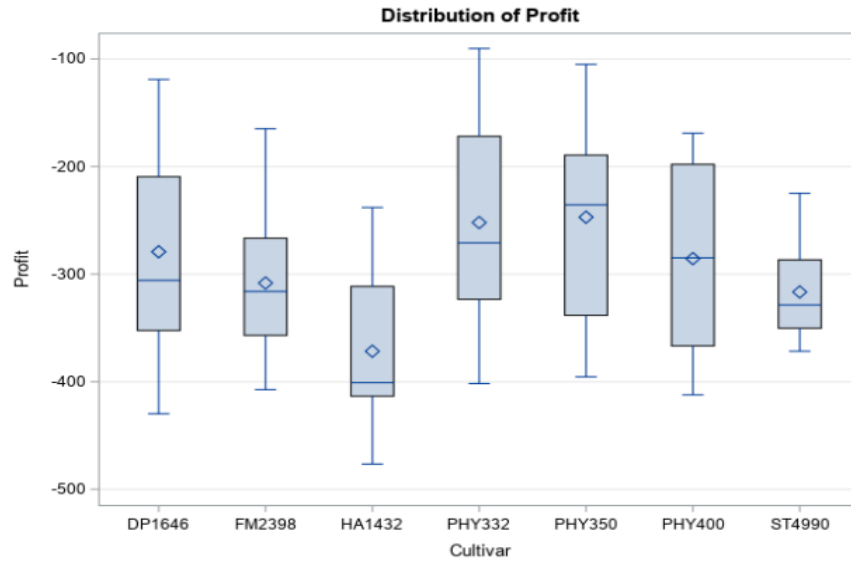


Figure 3. Profit (\$/Acre) by Cultivar

Overall, for the period 2020-2023, there were statistical differences in profitability by year. Losses ranged from \$243.64/acre in 2021 to \$374.05/acre in 2023. The years 2020 with a loss of \$298.46/acre and 2021 with a loss of \$243.64/acre were statistically different from one another, with losses in 2023 being statistically different from the losses in all other years. Figure 4 presents a boxplot representation of profit by year.

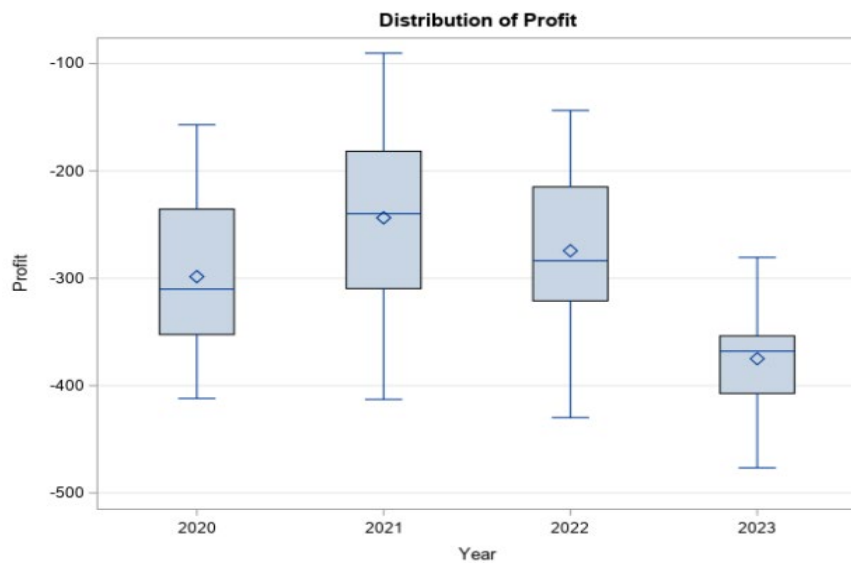


Figure 4. Profit (\$/Acre) by Year

Sensitivity analyses report various lint yield and market price levels. In 2022, the market price of upland cotton lint was 71.0 cents/lb and average lint yield was 500lbs/acre, with a calculated loss of \$166.47. For the period 2020-2023, hybrid Pima averaged 390.96lbs/acre. When the market price of Pima cotton lint is \$1.50/lb, and lint yield is 400 lbs/acre, a profit of \$16.53/acre is estimated. Tables 1 and 2 report sensitivity analyses of upland and hybrid Pima production for various lint yields and market price levels.

Table 1. Profitability Analysis for Upland Cultivars

		Price Level (\$/Lb)							
		0.65	0.70	0.71	0.72	0.75	0.85	0.95	1.05
Yield (Lbs/acre)	200	-391.47	-381.47	-379.47	-377.47	-371.47	-351.47	-331.47	-311.47
	250	-358.97	-346.47	-343.97	-341.47	-333.97	-308.97	-283.97	-258.97
	300	-326.47	-311.47	-308.47	-305.47	-296.47	-266.47	-236.47	-206.47
	350	-293.97	-276.47	-272.97	-269.47	-258.97	-223.97	-188.97	-153.97
	400	-261.47	-241.47	-237.47	-233.47	-221.47	-181.47	-141.47	-101.47
	450	-228.97	-206.47	-201.97	-197.47	-183.97	-138.97	-93.97	-48.97
	500	-196.47	-171.47	-166.47	-161.47	-146.47	-96.47	-46.47	3.53
	550	-163.97	-136.47	-130.97	-125.47	-108.97	-53.97	1.03	56.03
	600	-131.47	-101.47	-95.47	-89.47	-71.47	-11.47	48.53	108.53
	650	-98.97	-66.47	-59.97	-53.47	-33.97	31.03	96.03	161.03
	700	-66.47	-31.47	-24.47	-17.47	3.53	73.53	143.53	213.53
	750	-33.97	3.53	11.03	18.53	41.03	116.03	191.03	266.03
	800	-1.47	38.53	46.53	54.53	78.53	158.53	238.53	318.53
	850	31.03	73.53	82.03	90.53	116.03	201.03	286.03	371.03

Note: Profit (\$/acre) calculations reported inside table.

Table 2. Profitability Analysis for Hybrid Pima Cultivar

		Price Level (\$/Lb)							
		0.85	0.95	1.05	1.15	1.25	1.35	1.45	1.5
Yield (Lbs/acre)	200	-413.47	-393.47	-373.47	-353.47	-333.47	-313.47	-293.47	-283.47
	250	-370.97	-345.97	-320.97	-295.97	-270.97	-245.97	-220.97	-208.47
	300	-328.47	-298.47	-268.47	-238.47	-208.47	-178.47	-148.47	-133.47
	350	-285.97	-250.97	-215.97	-180.97	-145.97	-110.97	-75.97	-58.47
	400	-243.47	-203.47	-163.47	-123.47	-83.47	-43.47	-3.47	16.53
	450	-200.97	-155.97	-110.97	-65.97	-20.97	24.03	69.03	91.53
	500	-158.47	-108.47	-58.47	-8.47	41.53	91.53	141.53	166.53
	550	-115.97	-60.97	-5.97	49.03	104.03	159.03	214.03	241.53
	600	-73.47	-13.47	46.53	106.53	166.53	226.53	286.53	316.53
	650	-30.97	34.03	99.03	164.03	229.03	294.03	359.03	391.53
	700	11.53	81.53	151.53	221.53	291.53	361.53	431.53	466.53
	750	54.03	129.03	204.03	279.03	354.03	429.03	504.03	541.53
	800	96.53	176.53	256.53	336.53	416.53	496.53	576.53	616.53
	850	139.03	224.03	309.03	394.03	479.03	564.03	649.03	691.53

Note: Profit (\$/acre) calculations reported inside table.

Summary

The findings indicate generally similar yields and profitability across cultivars involved in this study. Upland cotton averaged lint yields of 472.83 lbs/acre and the hybrid Pima averaged 390.96 lbs/acre. Sensitivity analyses report profitability under various yield and market price scenarios. The study concludes that hybrid Pima production can be an economically viable substitute for upland cotton.

Lint yield across cultivars were not generally statistically significant in this study; however, there were instances in which profit by cultivar resulted in significant differences. HA 1432 had statically lower profit compared to four upland cultivars (PHY 335, PHY 350, PHY 400, and DP 1646) when utilizing USDA loan values for lint price. There were also statistically significant differences in means of lint yield and profit across the years. Hybrid Pima consistently produced less lint yield compared to the upland cultivars; overall input costs per acre were higher due to the price of hybrid seed, and market price was nearly twice that of upland. Upland cotton producers are expected to obtain a loss of -\$166.47/acre when market prices equal the loan value of 71.0 cents/lb and lint yield is 500 lbs/acre. On the other hand, hybrid Pima producers are expected to obtain a profit of \$16.53/acre when market prices equal \$1.50/lb and lint yield is 400 lbs/acre.

Additional research is needed to evaluate the economic durability of producing this cultivar. Growing low-yielding, high-value commodities is a relatively new production method for cotton production, and more time data is needed to understand long-term yield and profits. Additional profitability analyses should be undertaken utilizing input costs and market prices of cotton lint in subsequent years.

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