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**A Scandal in the New Bohemia:
 The Case of the California
 One Variety Cotton Law**

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Introduction

The California One Variety Cotton Law (OVL) has been used to dictate the planting of cotton in six counties in the San Joaquin Valley (SJV) since 1925. From 1929 to 1979, cotton producers were permitted to grow only one variety of cotton from only one type of seed produced by a single seed breeder, the USDA experiment station at Shafter in Kern county, and sold by a single distribution agency, the CPSCD. The advantage of the law, according to its proponents and supporters, is that it provides a quality guarantee for textile mills which results in a higher price per pound to producers. Its disadvantage is that it forces some producers to grow a cotton variety that has lower yields per acre and higher costs per pound than competing varieties.

Between 1950 and 1975, producers in some of the six counties and seed companies became increasingly vocal in their opposition to the OVL. Eventually, in 1975 the U.S. Department of Justice (USDJ) initiated an investigation of the monopoly provided in seed breeding and distribution created by the OVL. As a result, in 1979 the law was amended to permit cotton growers to use more than one type of Acala seed, although cotton growers were still prohibited from producing non-acala cotton and new acala seeds have to be approved by the licensing authority. The amendment also permitted other seed breeder to develop and market new acala varieties.

The purpose of this paper is to examine whether the benefits of the one variety law have outweighed its costs. First we provide a brief history of the OVL. Next, we examine the theoretical consequences of the 1979 change in the law that permitted growers to choose between different types of acala seed. Finally, we provide empirical estimates of the effects of the 1979 OVL amendment on producer welfare. The empirical evidence strongly suggests that the unamended, pre 1979 version of the OVL adversely affected aggregate producer welfare and that rates of return from investments in introducing new seeds are very high. The findings presented here about the effects of a law that inhibits technological innovation are therefore similar to those reported for similar restrictions on Canadian wheat producers by Ulrich, Furtan and Schmitz and Carter, et. al.

In addition, we also demonstrate that the 1979 amendment to the OVL also created winners and losers among SAV cotton producers. The amendment effectively lowered the price of cotton and therefore revenues for producers who did not switch to new varieties. Those who switched enjoyed revenue and producer surplus gains because the demand for cotton from the SJV is relatively elastic and average proportional increases yields exceeded the proportional decrease in the price of cotton.

A Brief History of the California One Variety Cotton Law

California is currently the second largest cotton producing state in the United States, producing 14.8 percent of total U.S. output in 1991. Moreover, California cotton producers enjoy exceptionally high yields.¹ The state has not always been such an important producer of cotton. Prior to 1925, when the California One Variety Law was enacted, large scale commercial cotton production was almost unknown in the state. At that time, given prevailing prices and transportation costs to major markets in the east cotton simply was not profitable. Nevertheless, officials at the United States Department of Agriculture (USDA) actively promoted the western region's desert valleys, which enjoy long growing seasons and ready access to irrigation water, as areas with the potential to produce high quality cottons. The USDA was concerned about high quality cotton production because in the early 1900's such cottons, most of which were imported, were used in the production of tires, airplanes and other industrial commodities associated with national defence. The USDA therefore initiated a California seed breeding program and, because of lack of competition from private growers and breeders, established itself as the major breeder in the region by the mid nineteen twenties.

In 1916, USDA officials began to explore the possibilities of producing high quality cotton in the SJV. By 1924, USDA personnel had decided that Acala would be the most suitable cotton variety for the SJV, and also that the only way to guarantee that just one variety would be grown was to legally prohibit planting of any other varieties (Constantine). The USDA argued that marketing California Acala would be facilitated by such a ban since, because inadvertent mixing of high and low quality fibers at the cotton gins would be precluded, textile mills would be provided with a quality guarantee for which they would be willing to pay a quality price premium. California legislators and cotton growers found these arguments to be compelling and, in 1925, the OVL was enacted with little or opposition.

The 1925 law required that all cotton growers in the SJV plant the same Acala cotton variety. Six counties in the SJV were affected by the law; three on its west side (Fresno, Kern and Kings) and three on its east side (Madera, Merced and Tulare). The SJV currently produces about 95% of all California cotton production. About 80% of the valley's output is grown in the west side counties and the remaining 20% in the east side counties. Farms tend to be larger on the west side and growing conditions differ substantially across the valley.

The 1925 OVL gave the USDA the authority to control all breeding in the SJV, a monopoly that was not revoked until 1979. During this 54 year period, innovations in seed breeding were almost entirely under the control of USDA seed breeders at the Shafter experiment station in Kern county on the west side of the SJV. However, while the USDA Shafter experiment station was given responsibility for breeding seed it could not increase or sell it.² The 1925 OVL dealt with this problem by creating a grower based

non-profit organization called the California Producing Seed Distributors (CPCSD) to perform those operations. The CPCSD also was given authority to collect and distribute seed tax revenues which were to provide 50% of the funding for the USDA breeding program and to support other research activities. The CPCSD board's composition was determined by each county's share of total SJV production and thus its membership was biased towards west side growers whose production conditions and seed breeding needs were often different than those of east side growers.

These differences became important in the mid-1950's when a group of growers and specialists in the east side county of Tulare complained of persistently declining yields, attributing these declines to *verticillium wilt*, a soil borne fungus that also reduces fiber quality¹. The Tulare growers also pointed out that yields in Kern county exceeded yields in Tulare county by rarely less than twenty percent and often by more than thirty percent. They argued that the Acala variety developed by the west side Kern county USDA experiment station was not suitable for lands infested by *verticillium wilt* and asked that the USDA breeders develop a variety more suitable to their growing conditions. Their requests were largely ignored by the USDA and the CPCSD (and, in addition, the University of California to whom direct requests for research help were made) until, under pressure from a U.S. Department of Justice (USDJ) anti-trust investigation, in 1979 the California legislature amended the OVL (Constantine).³

The USDJ investigation was initiated in 1975 in response to claims by Tulare growers that USDA and CPCSD were maintaining a seed monopoly and continued for three years. During the investigation, to protect itself from charges of anti-trust law violations, the USDA distanced itself from the CPCSD. Finally, in 1979, the California legislature responded to remove the threat of USDJ action by amending the law to relax its monopoly components of seed breeding and distribution. The 1979 amendments abolished the USDA seed breeding program and permitted private seed breeding companies to develop Acala varieties, albeit under very strict guidelines. Any new Acala varieties released to growers had to meet minimum quality standards for length, strength, etc. A new organization, the Acala Cotton Board (ACB) was established to monitor the new requirements, ostensibly to ensure quality. However, the structure of the ACB was very similar to that of the CPCSD, which reorganized itself as a private seed breeding company and hired most of its breeders from the now defunct USDA Shafter experiment station breeding program. This raised concerns among outside breeders that the new ACB would use its role as quality monitor to protect the CPCSD's breeding program.

The amended OVL required that any new Acala seed would have to be tested in the SJV on experimental plots for a minimum period of three years before the ACB could evaluate whether the new Acala seed satisfied the law's commercial production quality standards. Thus the first new variety released

in the SJV under the provisions of the 1979 amendments was not approved by the ACB until 1983 and was, in fact, developed by the CPCSD. The first variety released by a new, private breeder - Germain's Seed Company - was not approved by the ACB until 1985. In effect, therefore, the provisions of the 1979 OVL amendments had no effect on cotton production within the SJV until 1985.

Once new privately bred Acala seeds became available, they were adopted rapidly by growers throughout the SJV. Between 1985 and 1991, annually, on average, new private varieties were planted to the following proportions of total cotton acreage in each of the six SJV counties: 55% in Fresno, 19% in Kerns, 26% in Kings, 52% in Madera, 70% in Merced and 44% in Tulare. Within the entire SJV, over the same period, 48% of all cotton acreage was planted to new private varieties and, most importantly, as is shown in Table 1 (which reports annual average yields by county for the periods 1979-84 and 1985-91), differences in average yields between counties almost disappeared.⁴ Statistical analyses of trends in yields in each of the six counties in fact indicate that almost all of the increase in yields within each county that occurred subsequent to 1985 can be accounted for by a dummy variable set equal to 0 prior to 1985 and 1 thereafter (Constantine). Thus, as no other major institutional or technological initiatives occurred between 1985 and 1991, it is not unreasonable to attribute almost all of the growth in SJV yields since 1985 to the 1979 OVL amendments. Thus, this is the assumption utilized in the empirical analysis presented below. The yield data presented in table 1 also show that after the introduction of private varieties in 1985 yields rose more substantially in the east side counties of the SJV (Madera, Merced and Tulare) than in the west side counties of Kern, Kings and Fresno. East side growers appear to have had legitimate complaints about the consequences for them of the pre-1979 version of the OVL.

The Model

Let two agronomically suitable varieties of acala cotton, A1 (CPCSD acala seed) and A2 (private breeder acala seed), be represented by the production possibility locus a_0b_0 in figure 1. This locus is constructed under the assumption that a fixed bundle of resources is available for the production of cotton in the six San Joaquin counties of interest. The OVL forces cotton producers to operate at a_0 where they specialize in a single cotton variety, A1. The products from the two acala cotton varieties are assumed to be sold for identical prices in the market. Thus the slopes of lines P_0 and P_1 , which show the price of A2 relative to A1, are both -1. In the short run, a partial deregulation of the law that permits the use of A2 (the 1979 OVL amendment) shifts cotton producers from a_1_0 to x . The effect is to shift the production of acala cotton from a_0 to a_1 .

If the price of acala cotton, p_a , remains unchanged there is a clear short run welfare gain for producers $p_a \cdot a_0 a_1$. However, if California acala producers face a downward sloping demand curve for their product, the welfare enhancing effects of expanded production will be mitigated by lower prices. Still, as long as a demand is price elastic, as a group they will increase total revenues from acala cotton sales and, because resource use is unchanged, producer surplus will increase.

The longer run effects of permitting cotton growers to use multiple varieties of acala cotton are more difficult to assess. If the price of acala cotton remained unchanged, given that at least some growers face expanded production possibilities because of the removal of restrictions on seed use, the Le Chatelier principle suggests that additional resources will flow into cotton production. However, if the price of acala falls as a result of the change in the OVL it is conceivable that resources allocated to the production of acala cotton could fall, though not sufficiently to reduce total output below its initial level of a_0 (otherwise the price of acala would rise).

The above analysis disguises the fact that relaxing the OVL in the above fashion has distributional effects among different groups of producers. If p_a remains constant, producers in counties that continue to specialize in the original cotton variety, A1, experience none of the producer surplus gains that result from the relaxation of the law. If p_a falls, then they suffer welfare losses. All of the gains are concentrated among producers who find it optimal to switch to the new seed variety. As will be shown below, eighty percent of producers in the San Joaquin valley are in counties which continued to use the original OVL seed. Only twenty percent of producers switched to alternative seeds. Thus, despite the fact that relaxing the law resulted in a large increase in aggregate producer surplus, it is easy to understand why most grower groups resisted the change.

The welfare effects of the 1979 amendment to the California OVL on society as a whole are contingent on a plethora of considerations, not the least of which concern implications for tax payer outlays through the federal cotton program, the effects of changes in cotton quality on consumer surplus, and the social costs of irrigation and other changes in agricultural input use in the SJV. These, effects, which may be very important, are not considered in the empirical analysis of the 1979 amendment that is presented below.

Empirical Results

This section describes the methods used to calculate and report estimates of the average annual welfare impacts of the 1979 OVL amendment on San Joaquin Valley cotton producers. First, aggregate measures of changes in producers' surplus associated with the amendment are calculated for each county.

Second, these estimates of aggregate producer surplus changes are disaggregated between two groups of growers; those who kept their production in the original USDA Acala and those who switched to the newly available private varieties.

Market data were combined with data from test plot experiments to estimate changes in producers' surplus under the assumption that resource use and production costs remained fixed. The results show that the 1979 OVL amendment resulted in substantial increases in aggregate producer surplus among SJV cotton growers. However, growers who did not switch varieties lost while those who switched always gained. Although the OVL amendment was enacted in 1979 no new varieties were planted until the 1985 production season. The empirical analysis is therefore divided into two time periods, 1979-84 and 1985-1991.⁵

Resources devoted to cotton, including land, are assumed to be identical in both time periods. As the OVL becomes less restrictive, *ceteris paribus*, more land probably would be put into cotton production, especially in the counties where the USDA Acala variety did not perform well. However, other factors also influence cotton acreage in a county including the price of cotton, federal farm program regulations and the availability of state and federally delivered irrigation water.⁶ Thus the assumption of fixed resources is perhaps not too unreasonable and, in fact, the amount of land actually used for cotton production in the SJV has fallen slightly since the 1979-84 period.

Table 1 presents county-level SJV Acala cotton production data for the six SJV counties for the period 1979-84 and 1985-91, annual average planted acreages for the 1979-91 production period, and average yields per acre and total production for both time periods. Column G of table 1 shows that average per acre yields were substantially larger in the post-amendment period than in the pre-amendment period. Total production also increased in each county. This study assumes that the large yield changes that occurred can be attributed to the availability of new Acala variety seed; that is, there was a production shock, not an overall gradual trend towards higher yields.

A important question is whether the increase in SJV Acala output in the post-amendment period affected the price received by SJV producers for their cotton? If the relevant demand function is downward sloping, an outward shift in the supply function will cause a decrease in price or "terms of trade" effect.⁷ It was not possible to estimate the demand function for SJV Acala because of lack of data. A lower bound estimate was obtained by dividing a USDA estimate of the total elasticity of demand in the U.S. (-0.25) by the ratio SJV output to total U.S. cotton production (typically about fifteen percent). This approach provided an estimate of the own-price demand elasticity for SJV Acala cotton (η_A) of -about 2.0. However, this is almost certainly an underestimate as about 80% of all SJV Acala cotton is exported. Thus welfare

effects are computed for elasticities of -2, -5, and -1. Point estimates of the slope of the demand curve were obtained by adjusting the assumed elasticities of demand using average SJV output for the 1979-84 period and an estimate of the 1984 Acala price (analyzed to 1991 dollars) of \$1.027 per pound.⁸

Using market data on production and estimates of the price changes based on the above range of demand elasticities, changes in average annual producers' surplus and total revenues from Acala production for the periods 1979-84 and 1985-91 were calculated. These estimates are reported in table 2. Table 2 shows that, in the aggregate, each county realized gains in producers' surplus with the enactment of the amended law. In Table 2, as the price elasticity of demand increases, aggregate producer surplus gains increase because cotton prices fall by less. Estimates total producers' surplus gains to growers in the SJV from the amended law therefore range from \$77.67 million to \$181.11 million per year, depending on the assumed elasticity of demand for SJV Acala cotton.

The welfare estimates in table 2 have not been disaggregated between producers who continued to grow USDA Acala after 1985 and those who switched to the new private Acala varieties. Each county has two types of Acala growers: those who planted USDA Acala in both periods, and those who switched their acreage to new privately bred Acalas when the option became available in 1985.

Estimating the disaggregated welfare effects of the amendment on growers who switched and growers who did not requires estimates of the effects of the amendments on yields for the two groups. Data were available on actual county wide average annual yields for the two periods, 1979-84 and 1985-91 and the share of county acreage planted to new private Acala varieties and original varieties (see Table 1). In addition, for each county, experimental plot data on the performance of both new and original varieties were available for the period 1983-1990. The ratios of the experimental plot yields for the new relative to the original Acala cottons were assumed to reflect the ratios of actual commercial yields for the two types of cotton in each county¹. In addition, average yields on land that continued to be planted to the original pre-1985 Acala varieties were assumed to remain constant between the pre-amendment period of 1979-84 and the post-amendment period of 1985-91. Under these assumptions, it was possible to estimate average yields on land that continued to be planted to original Acala varieties and land that was switched to new varieties in both the pre-amendment and post-amendment periods. These yield estimates, reported in Table 3, are combined with the county level data on average planted acreage and the share of acreage planted to new varieties in the post-amendment period to obtain disaggregated county level estimates of the welfare effects of the 1979 OVL amendments on producers who switched to new varieties and producers who did not. These estimates are reported in Table 4.

¹These data are reported in Constantine.

The results show that those producers who adopted the new Acala varieties in the post-amendment period were net gainers and those who remained in the USDA Acala were net losers. The 1979 amendment had two countervailing effects. First, the new Acala varieties led to average per acre and total Acala production increases. Second, as noted above, as total production increased the price of Acala decreased. The size of the price effect is uncertain. Thus, in table 4, results are presented for price elasticities of -2 and -10.

In all cases, growers who continued to produce original Acala varieties after 1984 were losers. In the aggregate, SJV growers lost an estimated producers' surplus of between \$61.15 million and \$12.23 million. Producers of the "old" USDA cotton in Kern and Kings counties, the two counties which had the smallest shares of their acreages adopt the new Acalas, lost the largest amounts of producers' surplus - \$4.18 million and \$3.01 million, respectively (assuming a demand elasticity of -10).

In contrast, growers who adopted private Acalas after the 1985 period gained in the aggregate. For the range of elasticities -2 to -10 the respective SJV welfare gains ranged from \$139.30 million to \$173.30 million. The gains to producers who switched to new, private varieties of Acala in Fresno, Madera, Merced and Tulare counties are large relative to the losses incurred by non-switchers.

Conclusions

This study has demonstrated that amending the California One Variety Cotton Law simply to permit growers to use more than one variety of Acala cotton resulted in large net welfare gains to producers. This finding raises questions as to why the law, in its original form, endured for over 50 years. At least part of the answer lies in the fact that even the modest 1979 amendment to the law to permit the use of more than one variety of Acala cotton seed created both winners and losers among Acala cotton producers. To the extent that increased production resulted in lower prices, those who switched generally gained and those who did not lost. In addition, the original law created a natural monopoly supplier of seed, the CPCSD, whose monopoly power was substantially eroded by the 1979 amendment. It is interesting that the law was only modified after disadvantaged producers in Tulare county (very much a switch-to-private-varieties) county sought relief under federal anti-trust legislation through the USDJ.

Figure 1

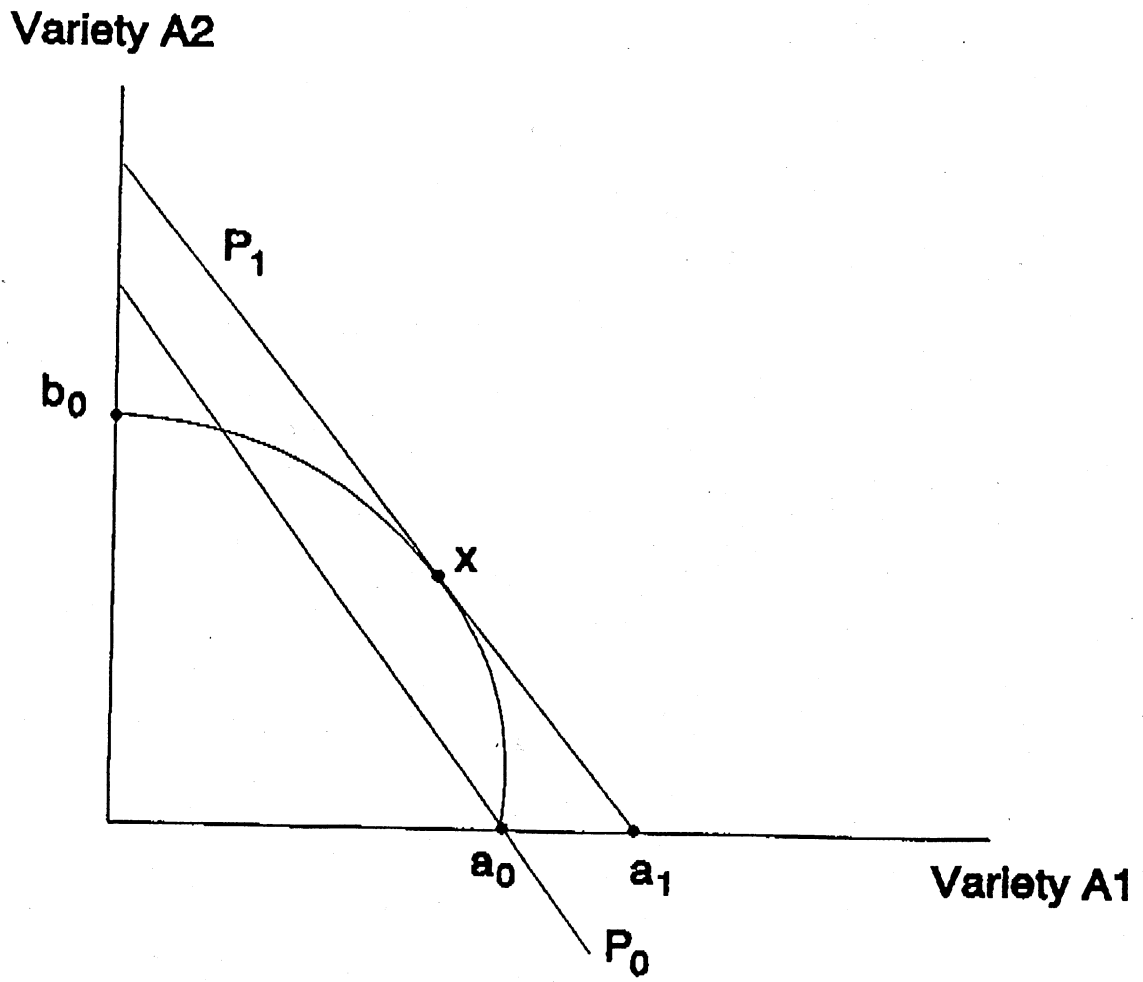


Table 1. Average Acala Per Acre Yields and Aggregate Average Acala Cotton Production by County 1979-86 and 1985-91.

County	(A) Total Annual Average Planted Acreage 1979-91	(B) Actual Average Acala Yields/Acre 1979-84 lbs/acre ^a	(C) Actual Average Acala Yields/Acre 1985-91 lbs/acre ^b	(D) Changes in Average Acala Yields/Acre (C - B) lbs/acre	(E) Estimated Annual Average Acala Production 1979-84 (A * B) million lbs	(F) Estimated Annual Average Acala Production 1985-91 (A * C) million lbs	(G) Estimated Change in Annual Average Acala Production (F - E) million lbs	(H) Annual Average ??? of Total Acreage planted to New Varieties (1985-91)
Fresno	386,923	1,155	1,345	190	446.896	520.441	73.515	55%
Kern	303,264	1,100	1,215	115	333.590	368.466	34.876	19%
Kings	258,397	1,040	1,120	80	268.733	289.405	20.672	26%
Madera	48,290	860	1,090	230	41.529	52.636	11.107	20%
Merced	63,118	960	1,180	220	60.593	74.479	13.886	44%
Tulare	156,232	960	1,100	140	149.982	171.855	21.872	38%
Total	1,216,224	1,070	1,215	145	1,301.360	1,477.712	176.352	48%

Notes:

^a Only one variety of Acala, provided by the U.S.D.A. Shafter Station, was grown in these counties between 1979 and 1984.

^b Several varieties of Acala, including privately bred varieties as well as Shafter Station varieties, were grown between 1985 and 1991.

Table 2. Estimated Yearly Average Absolute and Percentage Changes in Total Revenues and Producer Surplus for Acala Cotton by County (millions of dollars).^a

Assumed Elasticity of Demand	Fresno	Kern	Kings	Madera	Merced	Tulare	Total
$\eta_D = 2$	39.100 (8.5%)	10.025 (2.9%)	0.972 (0.3%)	7.722 (18.11%)	9.103 (14.6%)	10.434 (6.8%)	77.674 (5.8%)
$\eta_D = 5$	60.958 (13.2%)	25.501 (7.4%)	13.127 (4.8%)	9.933 (23.3%)	12.231 (19.6%)	17.652 (11.5%)	139.738 (10.4%)
$\eta_D = 10$	68.245 (14.8%)	30.659 (8.9%)	17.178 (6.2%)	10.670 (25.0%)	13.274 (21.3%)	20.058 (13.0%)	160.426 (12.0%)
$\eta_D = \infty$	75.531 (16.4%)	35.818 (10.5%)	21.230 (7.7%)	11.407 (26.7%)	14.191 (22.8%)	22.464 (16.6%)	180.641 (13.5%)

^a The estimates of changes in total revenues are based on the assumption that the initial price for Acala cotton is \$1.027. This is the Fresno price of Acala Cotton forecasted for 1984 (in terms of 1991 dollars) from a simple regression of Fresno spot prices for 31-35 quality cotton. The price forecast model is $P_f = 1.7395 - 0.246T$ when T is a trend variable equal to one in 1956, and P_f is the Fresno cotton price measured in 1991 dollars. The R^2 for the equation is 0.47 and the data used to estimate the model are for the period 1956-89. Other nonlinear forecast models did not perform as well as this equation.

^b The figures in parentheses indicate changes in producer surplus as a percentage of initial total revenues.

Table 3. Estimated Average Yields by County: 1979-84 and 1985-91 (lbs/acre).

County	Original Variety Cotton Acreage		New Variety Cotton Acreage	
	(A) 1979-84	(B) 1985-91	(C) 1979-84	(D) 1985-91
Fresno	1,245	1,245	1,080	1,245
Kern	1,215	1,215	605	1,215
Kings	1,125	1,125	800	1,125
Madera	1,090	1,090	645	1,090
Merced	1,175	1,175	860	1,175
Tulare	1,075	1,075	835	1,075

ENDNOTES

1. In 1990, yields in California averaged 1,252 pounds per acre; almost twice the U.S. average of 652 pounds.
2. Between 1925 and 1979, only four individuals held the post of head seed breeder at the Shafter experiment station. Thus a surprisingly small number of breeders controlled the flow of seed innovations into the SJV cotton industry.
3. In the early 1960's, growers in Madera and Merced also protested against the USDA Shafter experiment station breeding program on the grounds that the Acala variety developed by the USDA breeder was unsuitable for their shorter growing seasons. Yields in both counties were also typically 30% to 40% lower than in Kern county, where the Shafter experiment station was located (Constantine).
4. The period 1979-84 is chosen as a bench mark period because, during that period, very little innovation occurred and weather conditions were relatively normal.
5. Starting with 1979 as the pre-amendment period is somewhat arbitrary although a disastrous cotton crop in 1978 determined the cutoff point.
6. As water becomes scarce, as has happened in California due to a six year drought, perennial crops such as grapes and fruit/nut trees are given first priority, often at the expense of field crops such as cotton. **BOTTOM LINE, IT IS DIFFICULT TO SORT OUT WHAT EFFECTS CONTRIBUTE TO DIFFERENT AMOUNTS OF COTTON ACREAGE.**
7. There are two components to the effects of changes in the OVL on the Acala price: the terms of trade effect and the effect of changing OVL on the price premium. It is assumed here that the 1979 amendment had no effect on the premium. If the OVL were completely repealed so that both Acala and non-Acala varieties were permitted one would expect that the premium would disappear if, in fact, it existed in the first place.
8. This estimate was obtained using a simple linear trend forecasting model for cotton prices. Other functional forms did not perform as well as the linear model.

Table 4. Distribution of Welfare Effects Among Acala Cotton Producers

County	Original Variety Producers' Surplus Change (million \$)		New Variety Producers' Surplus Change (million \$)	
	$\eta_D = -2$	$\eta_D = -10$	$\eta_D = -2$	$\eta_D = -10$
Fresno	-15.174	-3.035	54.173	71.155
Kern	-20.892	-4.178	31.197	35.117
Kings	-15.058	-3.012	17.133	21.366
Madera	-1.769	-0.354	9.431	10.964
Merced	-1.577	-0.315	10.659	13.566
Tulare	-6.675	-1.335	16.705	21.132
Total	-61.145	-12.229	139.298	173.300