THE IMPACT OF THE MANDATORY SEED LAW ON MAINE POTATO ACREAGE, YIELD AND PRICE

By

Joseph F. Guenthner, Edwin S. Plissey, Annette E. Levi and Larry D. Makus

A.E. Research Series No. 90-5

May 1990

Support for this research was provided by the Idaho Potato Commission

Guenthner and Makus are Associate Professors, and Levi is a Research Associate in the Department of Agricultural Economics and Rural Sociology at the University of Idaho. Plissey is Extension Potato Specialist at the University of Maine.

THE IMPACT OF THE MANDATORY SEED LAW ON MAINE POTATO ACREAGE, YIELD AND PRICE

By

Joseph F. Guenthner, Edwin S. Plissey, Annette E. Levi and Larry D. Makus

A.E. Research Series No. 90-5

Department of Agricultural Economics and Rural Sociology

University of Idaho

May 1990

ABSTRACT

A statistical analysis of the economic impact of Maine's mandatory seed potato law was conducted. Results suggest that since the law was implemented, Maine potato yields increased, total Maine potato acreage decreased, Maine seed potato acreage increased, seed potato rejections from certification were reduced, seed potato prices increased, and commercial potato prices decreased. Attempts to estimate the impact on commercial potato quality were unsuccessful. The estimated impact of the Maine mandatory seed law on a typical 200-acre commercial potato grower was an average increase in profits of $14,700 per year since the law was implemented in 1981.

INTRODUCTION

State laws requiring the use of certified seed in potato production have been proposed to help reduce potato disease and quality problems. Opponents claim that mandatory seed laws are unnecessary and violate growers' freedom to farm.

In 1989 a survey of Idaho potato growers was conducted to determine their views on mandatory seed laws and other seed potato issues. The response rate to the mail survey and the follow-up telephone survey was over 80 percent. Sixty-two percent of the respondents favored a mandatory seed law and 38 percent opposed it.

Some of the survey respondents were curious about how a mandatory seed law might impact potato yields, acreage, quality and prices. Some commercial growers were concerned that seed potato prices would become too high. Some seed growers were concerned that commercial growers would begin to grow seed potatoes and depress prices.

The survey was conducted at the request of Potato Growers of Idaho and funded by the Idaho Potato Commission. One of the objectives of the proposal funded by the Commission was to conduct an economic evaluation of a mandatory seed law in Idaho. This report provides the results of an analysis of the important economic factors affected by Maine's mandatory seed law.

The reason Maine was selected for analysis is that it was the first state to implement a mandatory seed law for potatoes. The Maine law has been in effect since the 1981 growing season. This paper analyzes the effect of the law on Maine only. A similar law in Idaho might have different impacts because the Idaho potato industry is larger than the Maine potato industry.

METHODS

The approach was to conduct a statistical analysis of factors that influence yields, quality, acreage and prices. The analysis method chosen was ordinary least squares. A dummy variable was used to measure the impact of Maine's mandatory seed law. The dummy variable was given a value of 0 before the mandatory seed law was implemented and 1 after the law was in place. The dummy variable coefficient calculated by ordinary least squares provided an estimate of the direction and magnitude of impact the mandatory seed law had on the dependent variable.

Data was collected from a variety of sources. Commercial potato prices and acreage were found in Potato Facts, published by USDA ERS. Seed potato prices were provided in USDA NASS Agricultural Prices. The state seed potato price series was discontinued in 1985 but USDA NASS provided unpublished prices for 1986-89. Weather data for the Presque Isle, Maine weather station was obtained from the Northeast Regional Climate Center. Data on tubers per hill, hills per acre, and planting progress for the 1968-89 period came from Annual Maine Potatoes: Acreage, Yield, Size and Grade, published by the New England Crop and Livestock Reporting Service. Seed potato acreages inspected and passed since 1973 were provided by Terry Bourgoin of the Maine Department of Agriculture.

RESULTS

Yield

Yield data were available for all Maine potatoes but not specifically for seed potatoes or commercial potatoes. The following equation was estimated for 1968-89 Maine potato yields:

$$Y = -19.9 + .016*HA + 9.49*TH - 30.1*LORAIN - 18.47*HIRAIN$$
$$\quad\quad (4.7) \quad\quad (2.8) \quad\quad (-4.1) \quad\quad\quad (-4.0)$$

$$- 0.06*AGDD + 0.32*FFROST + 28.01*D$$
$$\quad (-2.2) \quad\quad\quad (1.4) \quad\quad\quad (2.8)$$

$R^2 = .87$

where:
Y is average Maine potato yield in cwt/acre;
HA is the number of potato hills per acre;
TH is the number of tubers per hill;
LORAIN is a dummy variable whose value is 1 for years when growing season (May-Sep) rain was less than 14 inches in Presque Isle and 0 for other years;
HIRAIN is a dummy variable whose value is 1 for years when growing season rain was more than 20 inches in Presque Isle and 0 for other years;
AGDD is the growing degree days (base 45) during August in Presque Isle;
FFROST is the number of days after August 1 when the first low of 30 degrees or less was recorded at Presque Isle; and
D is a dummy variable whose value is 0 before 1981 and 1 for 1981 and later, representing those years when a mandatory seed law was in effect.

T-values are printed below the independent variable coefficients.

The R^2 value of .87 indicates that the variables in the equation explain 87 percent of the variation in Maine potato yields. The positive signs on the HA and TH coefficients mean that larger numbers of hills per acre and tubers per hill tend to increase yields.

The negative signs for the LORAIN and HIRAIN coefficients indicate that too little rain or too much rain can reduce yields. The LORAIN coefficient of -30.1 suggests that when growing season rain is less than 14 inches, yields will decrease by about 30 cwt/acre. Rainfall greater than 20 inches can reduce yields by about 18 cwt/acre.

The negative sign for August growing degree days indicates that cool temperatures in August promote tuber bulking. The first frost variable shows that longer growing seasons have a positive impact on potato yields.

The coefficient of 28.01 on the D variable indicates that Maine potato yields increased about 28 cwt/acre after the mandatory seed law was implemented.

Potato Acreage Planted

Acreage planted models were estimated for both Maine seed potatoes and all Maine potatoes. The equation estimated for all potato acreage was:

$$AP = 51.61 + .69*AP_{t-1} + 1.78*P_{t-1} - .44*PH_{t-1} - 4.05*D$$
$$\qquad\quad (3.8) \qquad (1.9) \qquad (-2.2) \qquad (-0.83)$$

$R^2 = .95$

where:
AP is thousands of acres of potatoes planted in Maine;
AP_{t-1} is the potato acreage planted in Maine the previous year;
P_{t-1} is the average price of Maine's previous potato crop;
PH_{t-1} is the price of Maine's previous hay crop; and
D is a dummy variable whose value is zero before 1981 and one for 1981 and later.

T-values are printed below the independent variable coefficients.

The R^2 value of .95 indicates that 95 percent of the variation in Maine potato acreage is explained by the equation.

The AP_{t-1} variable suggests that there is "asset fixity" in Maine potato production. Since potato equipment, land, and facilities are relatively expensive, growers who have already invested in potato production assets are likely to continue to plant potatoes.

The P_{t-1} variable shows that some potato growers base price expectations on last year's price. High prices for the previous crop will lead to increased potato acreage. For each $1.00/cwt increase in potato price, Maine potato acreage can be expected to increase by 1,780 acres.

Hay appears to be a significant alternate crop for Maine potato growers. The negative sign on last year's hay price indicates that if hay prices are high, growers tend to keep more land in hay and reduce potato acreage.

The -4.05 coefficient on the dummy variable means that Maine growers tended to plant 4,050 fewer acres of potatoes after the implementation of the mandatory seed law. The t-value of -0.83, however, indicates that the statistical relationship is not strong. The t-value of .83 means that there is about a 25 percent probability that the actual impact of the mandatory seed law on acreage planted is zero.

Seed Potato Acreage Planted

The estimated equation for seed potato acreage entered in the Maine certification program is:

$$APS = -25.41 + 1.22*APS_{t-1} + 2.58*P_{t-1} + 4.22*D$$
$$\qquad\quad (4.6) \qquad (2.9) \qquad (0.84)$$

$R^2 = .87$

where:

APS is thousands of acres of seed potatoes entered into the Maine certification program,
APS_{t-1} is last year's acres (1,000) entered into the certification program,
P_{t-1} is the average price for all Maine potatoes the previous season, and
D is a dummy variable whose value is 0 before the seed law was implemented and 1 afterwards.

T-values are printed below the equation coefficients.

The lagged acreage variable rationale is similar to the lagged acreage in the total acreage planted equation. Growers who invest in seed potato production assets are likely to continue to plant seed potatoes.

The lagged potato price is used by some Maine seed potato growers to set price expectations. The coefficient of 2.58 means that for each $1.00/cwt increase in potato price, Maine seed potato acreage will increase by 2,580 acres the next year. Maine seed potato prices for the previous crop were not statistically significant and were therefore excluded from the equation. Apparently, the general price level of all potatoes has more of an influence on Maine seed growers than seed prices in particular.

The 4.22 coefficient on the dummy variable indicates that Maine seed potato acreage tended to increase about 4,220 acres following the implementation of the mandatory seed law. Due to the low t-value of 0.83, there is about a 25% probability that the mandatory seed law had no impact on seed potato acreage.

Seed Potato Acreage Rejected

Since one of the goals of mandatory seed laws is the reduce the incidence of potato disease, it is interesting to model seed potato acreage rejected for certification. The estimated equation is:

$$REJ = -0.56 + \underset{(1.4)}{0.0002}*APS + \underset{(1.5)}{0.55}*NORAIN + \underset{(1.2)}{0.14}*FFROST$$

$$- \underset{(-1.3)}{0.066}*MP - \underset{(-2.3)}{7.1}*D$$

$R^2 = .84$

where:
REJ is the percentage of Maine seed potato acreage that was rejected from the certification program;
APS is the thousands of acres of seed potatoes entered into the Maine certification program;
NORAIN is the maximum number of consecutive days during the growing season when no rain was recorded at Presque Isle;
FFROST is the number of days after August 1 when the first low of 30 degrees or less was recorded at Presque Isle;
MP is the percentage of the Maine potato crop that was planted by May 30; and
D is a dummy variable whose value is zero before 1982 and one for 1982 and later. 1982 was chosen rather than 1981 in order to capture the improvements in foundation seed quality produced under the first year of the mandatory seed law.

The positive coefficient for the seed acreage planted variable indicates that as seed acreage increases, the rejection rate goes up. This may occur when seed acreage expands due to new, inexperienced growers entering the seed market, or seed growers expanding into fields that are not in the best seed production areas, or seed growers expanding too rapidly to properly care for the seed potatoes.

The positive coefficient for the NORAIN variable suggests that drought-weakened potato plants are more susceptible to disease pathogens than are plants that have adequate soil moisture. As the NORAIN variable gets larger, rejections increase.

The first frost variable is included to capture the influence of late season infections. Early killing frosts reduce the likelihood of aphids transmitting the leafroll virus to seed potato plants. A first killing frost that comes later in the season tends to increase the rejection rate.

The MP variable was also used to capture the influence of late season infections. The negative sign indicates that earlier planted crops are less likely to be rejected. Seed potatoes that had an early start can be vine-killed earlier to prevent late-season infections.

The coefficient of -7.1 on the dummy variable indicates that the percentage of certified seed potato acreage that was rejected declined by 7.1 percentage points following the implementation of the mandatory seed law.

Commercial Potato Quality

Maine potato grade data was obtained from the New England Crop and Livestock Reporting Service. The percentage of U.S. Number 1's and 2's was obtained for both russets and whites for the 1968-89 period. Unfortunately, attempts to model commercial potato quality were unsuccessful.

Seed Potato Prices

The following equation was developed to model Maine seed potato prices:

$$PS = -4.47 + \underset{(10.4)}{2.07}*PC + \underset{(3.6)}{.091}*AC - \underset{(-1.8)}{.075}*ASC_{t-1} + \underset{(1.8)}{1.22}*D$$

$R^2 = .94$

where:

PS is the average price of Maine seed potatoes deflated by the farm prices paid index;

PC is the average price of Maine commercial potatoes deflated by the farm prices paid index;

AC is the acreage (1,000) of commercial potatoes planted in Maine;

ASC_{t-1} is the acreage (1,000) of Maine seed potatoes that passed certification the previous year; and

D is a dummy variable whose value is 0 before the seed law was implemented and 1 afterwards.

The positive sign on the commercial potato price coefficient shows that seed potato prices and commercial potato prices move together. High commercial potato prices allow growers to bid up the price of seed potatoes.

The commercial acreage planted in Maine was also found to have a positive impact on seed potato prices. When commercial acreage expands, the increased demand for seed as a potato production input pulls up the price of Maine seed potatoes.

Maine seed potato acreage that passed certification the previous year is a supply variable. The negative sign indicates that as the supply of seed potatoes produced the previous fall increases, the price declines.

The dummy variable coefficient of 1.22 suggests that after accounting for other price influencing variables, Maine seed potato prices have increased $1.22/cwt since the mandatory seed law was implemented.

Commercial Potato Prices

Researchers have estimated the relationship between the supply of fall-crop potatoes and the price of potatoes. Estimates of price flexibilities have ranged from 2.5 to 5. This means that a one percent increase in the U.S. fall potato crop can cause a 2.5 percent to 5 percent average price decrease during that marketing season.

The price impact of the mandatory seed law extends beyond one season. During the first year, increased production could give lower prices, but growers would respond to the lower prices by reducing their acreage the following year. Then, the reduced plantings would in turn cause prices to increase the year after that. The year-to-year dynamics of grower's responding to prices make it difficult to estimate average price impacts which are spread over more than one year.

J.F. Guenthner and R. J. Folwell analyzed the year-to-year dynamics of the potato market in research conducted at Washington State University. They found that the impact of a one percent increase in U.S. fall potato supply would lead to a price decline of 1.2 percent five years later.

If the mandatory seed law did indeed cause Maine potato acreage to decline by 4,000 acres and yields to increase by 28 cwt/acre (as indicated in the first two equations above), this would represent about a 1.1 percent increase in the U.S. fall potato production. The price effect after five years would be a price decrease of about 1.3 percent for all U.S. potato growers. The impact on prices during other years would likely be different.

SUMMARY AND CONCLUSIONS

Statistical analysis suggests that Maine's mandatory seed law increased potato yields by 28 cwt/acre, reduced total Maine potato acreage, increased Maine seed potato acreage, decreased seed potato certification rejection rates, and increased seed potato prices by $1.22 per cwt.

Maine's mandatory seed law may have caused U.S. fall potato production to increase about 1.1 percent. The impact on prices could have ranged from as much as a 5 percent decrease the first year to a 1.3 percent decrease after five years.

Table 1 shows that the mandatory seed law likely had a positive economic impact on typical Maine commercial potato growers. A grower producing 200 acres of potatoes would have 5,600 more cwt of potatoes to sell each year because of increased yields. Assuming that increased production caused an average 2 percent price reduction, the mandatory seed law reduced grower prices by $0.10 during the 1981-88 period. The typical grower also paid an additional $1.22/cwt for seed potatoes. The additional cost of harvesting and handling the extra 28 cwt/acre was estimated at $0.50/cwt.

TABLE 1

Effect Of The Mandatory Seed Law On A Typical Maine Commercial Potato Grower's Profits, 1981-88 Average

	Without M.S. Law	With M.S. Law	Change
Acres	200	200	
Yield	234 cwt/A	262 cwt/A	+ 28 cwt/A
Price	$4.94/cwt	4.84/cwt	- $0.10/cwt
REVENUE	$231,200	$253,600	+ $22,400
Seed Price	$5.86/cwt	$7.08/cwt	+ $1.22/cwt
Planting Rate	20 cwt/A	20 cwt/A	
Total Seed Cost	$23,440	$28,320	+ $4,900
Harvest Cost			+ $2,800
COSTS			+ $7,700
PROFIT			+ $14,700

The analysis in Table 1 does not include any impact that the mandatory seed law may have had on commercial potato quality. Although attempts to model quality were unsuccessful, it is likely that the mandatory seed law could enhance quality. If so, Table 1 underestimates the impact that the mandatory seed law has on a typical grower's profitability.

The impact of a mandatory seed law in Idaho might be similar to the impact in Maine. One key difference would be that the impact on potato prices would be larger. If an Idaho mandatory seed law increased yields by the same 28 cwt/acre as in Maine, Idaho potato production would increase by nearly 10 million cwt. This would represent a three percent increase in the total U.S. fall crop. Additional analysis of the Idaho impacts is recommended.