



An economic analysis of an elite seed potato farm in Montana  
by Joseph Frank Guenther

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE  
in Applied Economics  
Montana State University  
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**Abstract:**

An elite seed potato farm has been proposed as an improvement to the Montana seed potato industry. The elite farm would provide seed growers in the state with superior elite seedstocks, replacing the stocks that the growers themselves produce. The purpose of this study is to estimate the costs of operating an elite farm and to evaluate whether or not it would be an economic improvement. A computer budget generator program is used to estimate the elite farm's cost of production and economic feasibility.

Results indicate that it would cost less to produce elite seed potatoes on an elite farm than it currently costs seed potato growers to produce such seed on their own commercial seed potato farms. The superior quality of the elite farm seed means that growers could sell PVX-free seed and receive higher prices. As a result, the net farm income of a typical Montana seed grower would increase by more than \$11,000.00 per year. The total potential net benefits to the industry are estimated at \$517,702.00 per year. Brief speculations are made as to why growers have not yet taken advantage of this. A target price scheme is devised to finance the elite farm. By charging \$11.80/cwt for elite seed the initial loan requirements of \$338,800 may be paid off.

Three alternative forms of elite farm organization are explored: a state agency; a cooperative; and a private entrepreneurship. Because of likely bureaucratic inefficiencies and freedom of choice questions, it would seem that the cooperative or private organizational farms have advantages over the state agency farm. Because of economies of size and mutual benefits resulting from an elite farm there are arguments supporting the cooperative organization over a private entrepreneurship. In addition, an existing organization, the Montana Potato Improvement Association, may facilitate forming a cooperative elite seed potato farm. On the other hand, the benefits from an elite farm are sufficiently large to warrant individual action if collective action is not taken. Regardless of the form of organization, personnel at Montana State University may be instrumental in certain aspects of setting up an elite farm.

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Approved:

  
Chairperson, Graduate Committee

  
Head, Major Department

  
Graduate Dean

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## ABSTRACT

An elite seed potato farm has been proposed as an improvement to the Montana seed potato industry. The elite farm would provide seed growers in the state with superior elite seedstocks, replacing the stocks that the growers themselves produce. The purpose of this study is to estimate the costs of operating an elite farm and to evaluate whether or not it would be an economic improvement. A computer budget generator program is used to estimate the elite farm's cost of production and economic feasibility.

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## Chapter I

### POTATO PRODUCTION IN MONTANA

Potatoes were first cultivated in South America over 2,000 years ago and then subsequently introduced into Europe by the Spaniards. In 1719 potatoes were brought from Ireland into what is now the U.S. and production slowly spread westward.<sup>1</sup> Since at least 1841 potatoes have been cultivated in Montana. Potatoes were an especially important crop during the gold rush era of the late 1800's as they were used to prevent scurvy among miners.<sup>2</sup>

At present potatoes are an important crop only in certain areas of Montana. The value of the 1973 crop in Lake County, for example, was nearly six million dollars which was about one third of the county's total farm receipts. However, on a statewide basis the crop has been of moderate importance. During the ten year period 1964 to 1973 cash receipts from potatoes represented between 0.4

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<sup>1</sup>Ora Smith. Potatoes: Production, Storing, Processing. The AVI Publishing Co., Inc.: Westport, Connecticut, 1968.

<sup>2</sup>James McClellan Hamilton. From Wilderness to Statehood: A History of Montana. Binford's & Mort: Portland, Oregon, 1957. p. 350.

and 1.5 percent of the total cash receipts from Montana agricultural commodities.<sup>3</sup> Figure 1 shows the geographical distribution of the potato crop in Montana. The areas of production are primarily the mountain valleys of western Montana. Table 1 lists acreage, yield and value for each potato producing county and region in Montana. This study, therefore, involves a crop that is not very important on a statewide basis but is a locally significant commodity.

The potato market, as diagrammed in Figure 2, consists of three distinct submarkets: (1) the tablestock (fresh, unprocessed potatoes) market; (2) the processing market; and (3) the certified seed market. There is a separate group of buyers in each submarket. However, on the selling side potatoes grown on a single farm may, under certain conditions, be sold in two or even all three of the submarkets.<sup>4</sup> The major restrictions are imposed on those potatoes intended for the certified seed submarket.

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<sup>3</sup>Montana Agricultural Statistics, Volume XV. Montana Department of Agriculture and Statistical Reporting Service - USDA. Helena, Montana, Dec., 1974. p. 10.

<sup>4</sup>John K. Hanes. Organization and Structure of the Red River Valley Potato Industry. Economic Study Report No. 568-3. Department of Agricultural Economics, Institute of Agriculture, University of Minnesota in cooperation with the U.S. Department of Agriculture. Feb. 1969. p. 27.

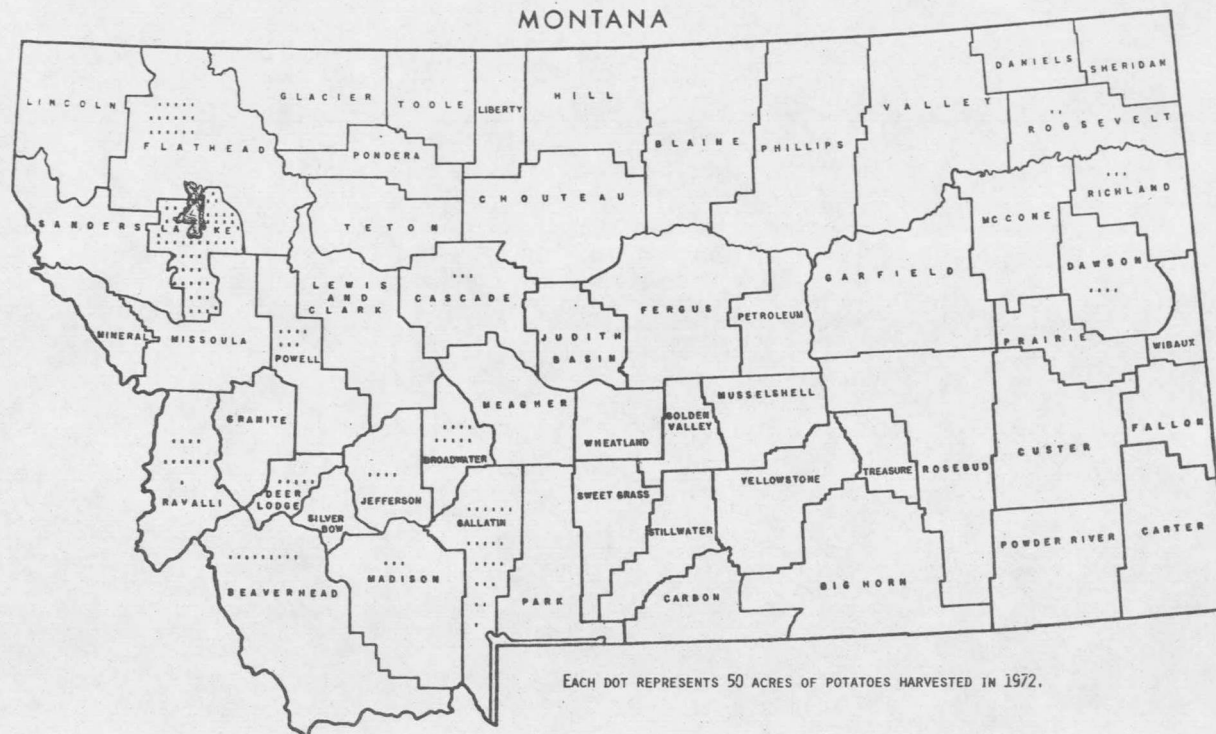


Figure 1. Areas of Potato Production in Montana

TABLE 1

## POTATO ACREAGE, YIELD, PRODUCTION AND VALUE BY COUNTIES, 1974

District and County	Acres Harvested	Yield	Value	Acres Harvested	Yield	Value
Deer Lodge	230	220	255,600	150	200	324,000
Flathead	830	250	1,047,900	730	240	1,892,200
Lake	2,230	240	2,702,900	2,250	240	5,832,300
Powell	330	230	383,300	200	180	388,800
Ravalli	530	210	562,100	460	200	993,600
Other Co.	10	180	9,100	30	113	36,700
<u>N. West</u>	4,160	236	4,960,900	3,820	230	9,467,600
<u>N. Central</u>	200	130	131,300	200	138	297,000
Dawson	200	150	151,500	100	180	194,400
Richland	150	150	113,600	150	180	291,600
Roosevelt	100	110	55,600	100	130	140,400
Other	40	100	20,200	20	150	32,400
<u>N. East</u>	490	138	340,900	370	165	658,800
Broadwater	410	200	494,100	360	190	738,700
Cascade	120	160	97,000	120	120	155,500
Other	120	192	116,200	100	171	184,700
<u>Central</u>	650	191	627,300	580	172	1,078,900
Beaverhead	470	220	522,200	430	200	928,800
Gallatin	1,020	250	1,287,900	950	240	2,462,500
Jefferson	180	200	200,000	140	210	317,500
Madison	120	220	133,300	120	230	298,100
Other	60	170	51,500	20	180	38,900
<u>S. West</u>	1,850	235	2,194,900	1,660	226	4,045,800
<u>S. Central</u>	100	104	52,500	100	154	166,300
<u>S. East</u>	50	100	25,200	70	100	75,600
State	7,500	220	8,333,000	6,800	215	15,790,000

Reproduced from: Montana Agricultural Statistics, Volume XV, Montana Department of Agriculture, Helena, Montana, 1974.

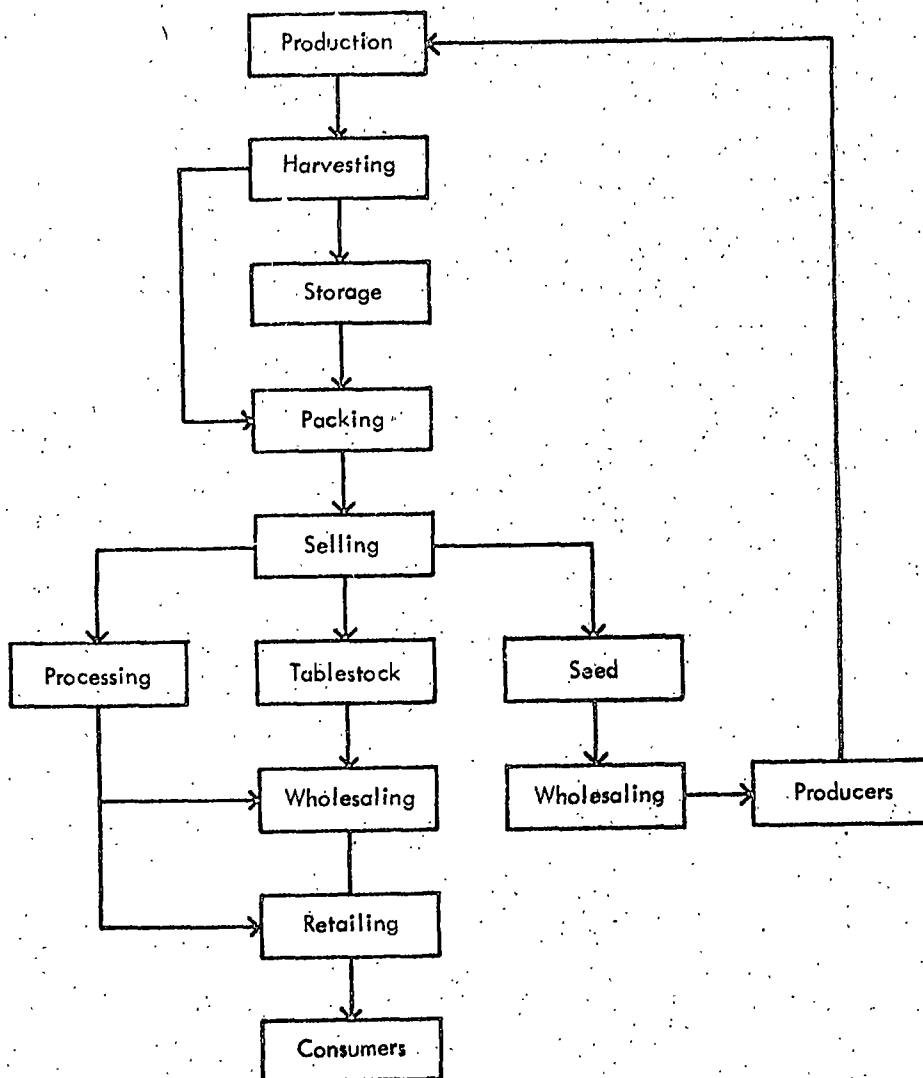


Figure 2. Late Crop Potatoes: production and marketing functions. Reproduced from: Hanes, op. cit., p. 35.

The production of certified seed is governed by rules and regulations that prohibit substitution of tablestock and processing potatoes into the seed market. Such rules and regulations are usually administered by either a state Department of Agriculture, state approved seed organization, or the State College of Agriculture.<sup>5</sup> The sale of Montana produced potatoes has become concentrated in the certified seed submarket. The percentage of total Montana potato acreage that was certified seed has steadily increased from 32.5 percent in 1957 to well over 60 percent in the 1970's while the percentage of total U.S. acreage that was certified as seed ranges from 7 to 9 percent, Table 2.

In Montana, the seed certifying agency is the Montana Potato Improvement Association (MPIA) which is state approved and was chartered by the Montana Legislature in 1951. The organization is governed by a Board of Directors consisting of four potato growers and an executive director from Montana State University. The agency has been a financial success, collecting its revenue from growers for

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<sup>5</sup>H.M. Darling and H.O. Werner. "Seed Potato Certification." Potatoes: Production, Storing, Processing. Ora Smith, editor. The AVI Publishing Co., Inc.: Westport Connecticut, 1968. Chapter 13.

TABLE 2

## MONTANA AND U.S. CERTIFIED SEED

Year	Montana			U.S.		
	Acres Entered for Certification	Acres Passed	Percent Entered for Certification That was Passed	Percent of Total Harvested Acreage That was Certified Seed	Percent of Total Acreage That was Seed	Percent Entered for Certification That was Passed
1957	2,842	2,828	99.5	32.5	8.7	80
1958	3,064	2,844	92.8	34.3	7.6	83
1959	2,983	2,611	87.5	31.5	8.4	81
1960	3,026	2,989	98.8	36.5	8.7	85
1961	3,687				7.2	85
1962	3,264	3,128	95.8	39.6	7.7	86
1963	3,104	3,047	98.2	37.6	7.4	89
1964	3,119	2,869	92.0	36.8	9.0	89
1965	3,682	3,385	91.9	42.3	8.1	87
1966	4,370	3,984	91.2	48.6	7.9	83
1967	4,794	4,513	94.1	54.4	7.7	89
1968	4,620	4,587	99.3	55.3	8.3	88
1969	5,092	4,687	92.0	62.5	7.8	89
1970	5,451	4,788	87.8	61.4	7.4	84
1971	5,821	5,487	94.3	68.6	7.0	83
1972	5,028	4,939	98.2	64.1		85
1973		4,613		66.0		90
1974	5,189	4,611	88.9			
Average			93.8		7.83	85.6

Compiled from: Spudlight, Certified Seed Editions, 1957-1975, a publication of the United Fresh Fruit and Vegetable Association; Montana Agricultural Statistics: The National Potato Council Eighth Annual Statistical Report 1973, Denver, Colorado.



such things as: tag fees, inspection fees, indexing fees, and virus testing fees.

It is the responsibility of the MPIA to set seed standards and to conduct field and bin inspections to ascertain freedom from disease, varietal purity and other conditions that may impair seed value. When a lot of seed potatoes has been grown in accordance with the rules and regulations and has passed inspections and grade requirements, the MPIA grants an official color-coded certification tag and seal. The colors designate various tolerances for defects. Certification means only that the grower has met certain requirements and that the crop met certain standards enforced by the MPIA. Certification does not mean immunity or disease resistance and since the seed may become contaminated after leaving the grower's hands, there is a non-warranty clause on the tags.<sup>6</sup>

Montana has evolved into a seed producing state that provides seed to nearby major potato producing areas such as Idaho and Washington. There are several reasons why. First, the climate and growing conditions of the isolated

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<sup>6</sup>Orville W. McCarver. "Potato Certification in Montana." First Annual Washington State Potato Conference. Moses Lake, Washington, 1962.

mountain valleys in Montana are much more conducive to quality seed production than are such areas as eastern Washington.<sup>7</sup> Second, other potato production areas have a comparative advantage over Montana in growing tablestock and processed potatoes because there are no large processing plants or large population centers in Montana.

In each of the last 13 years Montana prices have exceeded the U.S. average price, Table 3. This is because of the large proportion of seed that is grown in Montana. Seed prices in general and Montana seed prices in particular are usually the highest of the three submarket prices.

One reason for this price difference is that the price must be higher to offset the higher costs of growing seed potatoes. As this study will reveal there are certain costly operations that are necessary for seed production which are not necessary for tablestock or processed potato production.

Another reason is the apparent excess demand for Montana certified seed potatoes. Hanes states that reputation is an important factor to the purchasers of seed

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<sup>7</sup>Ken Waud and Nicholas Sandar. "Our Seed Potato Needs." First Annual Washington State Potato Conference, Moses Lake, Washington, 1962.

TABLE 3

POTATO ACREAGE, PRODUCTION, PRICE, TOTAL VALUE AND VALUE PER ACRE

	Acres Harvested	Yield (cwt. per Acre)	Price per cwt.	Value of Production	Value per Acre	Average U.S. Price*
1961	8,000	180	\$ 2.01	\$ 2,894,000	\$ 361.75	\$1.36
1962	7,800	160	2.35	2,933,000	376.03	1.67
1963	7,900	180	2.51	3,569,000	451.77	1.78
1964	7,600	165	6.23	7,812,000	1027.89	3.50
1965	7,800	170	2.89	3,832,000	491.28	2.53
1966	8,000	175	3.00	4,200,000	523.00	2.04
1967	8,400	190	2.59	4,134,000	492.14	1.87
1968	8,100	195	3.95	6,241,000	770.49	2.23
1969	7,000	205	3.77	5,410,000	772.86	2.24
1970	7,500	205	2.83	4,353,000	580.40	2.21
1971	7,800	180	3.15	4,423,000	567.05	1.90
1972	7,500	220	5.05	8,333,000	1111.07	2.55
1973	6,800	215	10.80	15,790,000	2322.06	4.05

Reproduced from: Montana Agricultural Statistics.

\*U.S. prices from National Potato Council Eighth Annual Statistical Report 1973, Denver, Colorado.

potatoes.<sup>8</sup> In Washington, seed lot trials are conducted "to evaluate seed from various sources for their disease content."<sup>9</sup> Montana seed has usually performed quite well in these trials further enhancing the excellent reputation of Montana seed. Moreover, according to Orville McCarver, MSU Extension Horticulturist, the Montana seed potato industry has not expanded as rapidly as it could have. In the past 15 years while Montana's seed potato tonnage has doubled, potato acreage in Washington has increased five-fold due to the agricultural development of the Columbia River Basin. Washington growers who have traditionally depended upon Montana growers for their seed must go elsewhere.

#### The Disease Problem

Certified seed potatoes are not necessarily a homogeneous product. All seed that is certified has met certain disease tolerance levels but some lots may contain more disease and defects than others. The ultimate test of seed quality is for the buyer to use the seed to grow a

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<sup>8</sup>Hanes, op. cit., p. 77.

<sup>9</sup>Robert E. Thornton. "Washington Seed Lot Trials." Ninth Annual Washington State Potato Conference. 1970.

crop. Thus a grower's product may be differentiated on the basis of past performance. A seed grower's past reputation, then, is a factor that buyers depend on. Unlike tablestock and processed growers, seed growers usually make only one sale to a customer per year. Thus, a single year of bad seed production may destroy a grower's reputation and perhaps adversely affect his business in the future.

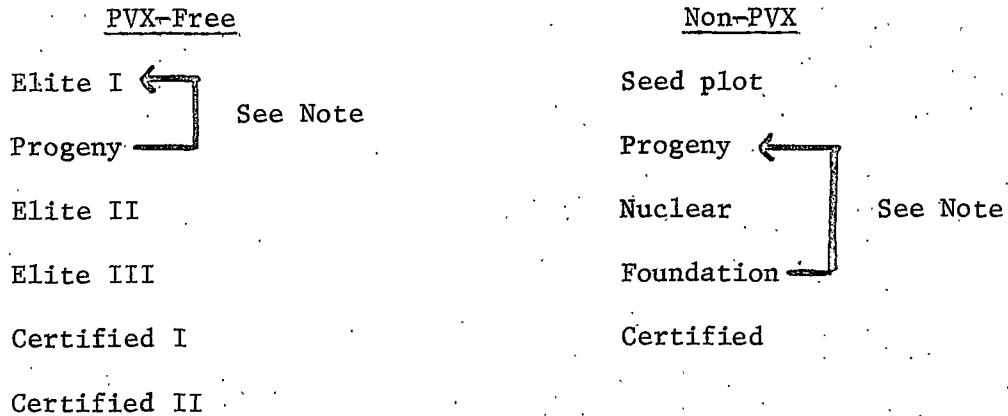
An obvious goal of seed growers is to produce seed of optimal quality every year. Hanes states that, "the quality of seed is determined by the proper selection of foundation stock and by the whole series of production and storage techniques designed to eliminate seed borne diseases . . ." <sup>10</sup> Seed certification programs provide for a genealogical increase scheme to insure that certified seed acreage is planted with seed of good quality. Generations may be divided roughly into three classes: elite, foundation and certified. Foundation stocks are usually required to plant certified fields and the requirements for this foundation class are stricter than for certified. Restrictions for the elite class are stricter yet as this is the

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<sup>10</sup>Hanes, op. cit., p. 77.

parent stock for foundation seed. The names and number of seed classes may vary from state to state. Montana currently has two classification systems, Figure 3. The PVX free classes are: Elite I, Elite II, Elite III, Certified I and Certified II, and the non-PVX free classes are: Nuclear, Foundation, and Certified. For purposes of simplification the classification system in this report will contain only elite, foundation, and certified as classes. The Montana classes of Elite I and Nuclear will jointly be referred to as elite seed, which is defined as the stocks used to plant the progenitor(s) of certified seed.

In spite of the required steps for certification, there are many seed potato fields in Montana that contain some potato disease and each year there are some that exceed tolerance levels and fail to pass inspection. There are certain diseases that seem to be more of a problem in Montana than others. Dallas Batchelor, executive-director of the MPIA, believes that blackleg and leafroll are the two diseases that cause the most problems in the state. A third disease, Potato Virus X (PVX), is important in that the MPIA has a separate system of seed classification for it. A description of these three diseases is presented



Note: Greenhouse Indexing Required

Figure 3. Outline of Required Steps in Montana's Seed Potato Program

Reproduced from: Montana 1975 Certified Seed Potato Directory, Montana Potato Improvement Association, Johnson Hall, Montana State University, Bozeman, Montana, p. 1.

below giving special attention to how the disease is spread, symptoms, damages caused, and control measures.

Blackleg. Blackleg disease is a worldwide potato problem that is capable of causing great potato losses both in the field and in storage. The disease is caused by the bacterial organism, Erwinia Carotovara. The bacteria overwinter in infected plant debris in the field and in stored tubers. Infection usually begins in the seedpiece, often entering through a wound, and spreads upward.

One of the first apparent symptoms of the disease is a wilting or yellowing of the lower leaves which later spreads to the upper leaves. The chief characteristic of the disease is the black streak which appears on the lower stem near the surface of the soil. The tubers of an infected plant have a soft rot at the stem end and may develop secondary infection and rot entirely. This tuber decay may be delayed and result in a serious loss during storage. Also, the bacteria may rot seed pieces in the ground and attack young sprouts which will result in a poor stand that is not usually attributed to blackleg.<sup>11</sup>

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<sup>11</sup>M.D. Harrison. "Potato Blackleg: Its Nature and Prospects for Control." Fourteenth Annual Washington State Potato Conference. Moses Lake, Washington. Feb. 6, 1974, p.23.



Three common sources of infection are: (1) infected seed pieces; (2) infection of seed pieces by bacteria in the soil; and (3) infection following the attack of seed pieces by the seed corn maggot.<sup>12</sup> Also mentioned as sources of infection are: contaminated machinery, cutting knives, and nematodes;<sup>13</sup> and storage facilities.<sup>14</sup> There are factors other than the presence of bacteria that dictate the amount of blackleg that will develop and the stage of plant growth when it will be expressed. The factors are: the number of bacteria in the seedpiece; soil temperature; other microorganisms attacking the seedpiece; soil nutrition; and storage and handling facilities.<sup>15</sup> Because of the variability of these factors the blackleg problem varies in severity from year to year.

Infection is usually favored by high moisture so planting in well drained soils and not irrigating until

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<sup>12</sup>M.M. Afanasiev. Potato Diseases and Their Control. Bulletin 329, Cooperative Extension Service, Montana State University, Bozeman, MT, Dec. 1970.

<sup>13</sup>W.A. Hodgson, D.D. Pond, and J. Munro. Diseases and Pests of Potatoes. Publication 1492, revised 1974. Canada Department of Agriculture, Ottawa. p. 16.

<sup>14</sup>Harrison, op. cit., p. 26.

<sup>15</sup>Harrison, op. cit., p. 25.







































































































































































































