POTATO REFERENCE GUIDE

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Quality in seed potatoes is based primarily upon the tuber's freedom from disease, physical condition, and size.

Freedom from seed-borne diseases such as viruses, ring rot, and late blight and dry and wet rots is most important. Without it, you have decreased yields and grade quality resulting from missing hills and decayed tubers.

Potato growers who are in the seed business will find it profitable to plant a percentage of their yearly seed acreage with foundation grade certified seed. Producers for the consuming market should use certified seed of "blue tag" quality. Don't use non-certified seed.

Shriveled, bruised, and numerously desprouted tubers used for seed may result in lower yields and lower grade quality. This is because a poorer stand will result than from the use of good seed.

Small tubers, and preferably those of one drop size, produce the largest yields of high-grade quality potatoes. Large tubers cut into seed pieces have large wound surfaces and are more easily attacked by soil pathogens. Also, the use of large tubers is wasteful.

If you do use seed pieces cut from large tubers they are best planted when soil conditions are most favorable for growth.

**CUTTING POTATO SEED:**

Potatoes should be warmed to 55° F. prior to cutting into blocky seed pieces from 1-1/2 to 2 ounces each. The larger pieces are especially preferred for early planting where frosts may occur and the plant may be required to make a second start.

Large seed pieces have shown the following advantages over small seed pieces:

1. Better stand of plants.
2. More rapid and uniform production of vigorous sprouts.
3. Larger percentage of smooth, medium-sized tubers.
4. Greater total yields.

The average weight of seed piece in ounces can easily be determined by counting the seed pieces resulting from 100 pounds of potatoes and dividing that figure into 1600 ounces.

**TIME TO PLANT:**

Generally, the largest yields are associated with early planting. However, it is doubtful if potatoes should ever be planted before the soil temperature reaches 45° F. Warm, moist soils favor rapid healing of cut and injured surfaces and quick emergence of young shoots. Sprout injury by rhizoctonia and seed piece rot, and poor stands generally, are associated with cold, wet soils.
DEPTH OF PLANTING:

Potatoes are usually planted deeper in light soils than in heavy soils. Don't plant at depths greater than 3 to 4 inches below the level of the soil surface. Deep planting and high ridging delay the emergence of the young plants. This makes them more subject to decay organisms. In addition, high ridging results in roots and tubers developing too high in the ridge where temperatures are likely to be high and soil moisture limiting.

SPACING BETWEEN ROWS AND BETWEEN SEED PIECES:

Proper spacing of seed pieces within rows, and the distance between rows, depends upon at least five factors:

1. Fertility of the soil.
2. Available water.
3. Potato equipment used.
4. Variety.
5. Purpose of the crop.

Spacing of the seed pieces in the row influences seed requirement, yield, the average size of the tubers at maturity, and the uniformity of the crop produced. Spacing between the plants in the row varies from 6 inches on highly fertile soils with abundant water to 36 inches under dry-land conditions. Generally, close spacing—8 to 12 inches—results in higher yields with a greater percentage of well-formed, medium-sized tubers than do wider or closer spacings.

Spacing between the rows also influences seed requirement and total yield. The optimum distance between rows is influenced by the amount of soil necessary to form a ridge to protect the tubers, the ease with which water moves laterally in the soil, and the size of the tires on the equipment used for the tillage and harvesting operations. In general, the row distances are 32 to 36 inches apart.

If the rows are too close together, tuber greening will be frequent and much bruising may result from equipment wheel pressures. On the other hand, if the rows are too far apart, excessive quantities of water will be required before moisture has seeped laterally into the root zone. Also, land will be wasted.

IRRIGATION:

The most poorly understood, and yet the most critical, factor in potato production is the proper adjustment of soil moisture to the plant growth. The effect of spacing, depth of planting, response to fertilizers, and tuber-grade-quality are dependent upon the judicious use of water. Too little water reduces yield and grade. Too much water causes disease and leaches away valuable nitrogen. An irregular moisture supply, even before the tubers are larger than the tip of a little finger, causes misshapen tubers.
No definite recommendations for amount of water to apply at any one irrigation, or for frequency of irrigation can be made. This is due to the differences in water-holding capacity of different soils, differences in rate of water movement into the root zone, and differences in water requirement due to wind and temperature.

A few general statements can nevertheless be made:

1. If the soil is not moist at planting time, it is advisable to pre-irrigate and withhold plowing, tillage, and planting until the soil can be worked without the formation of clods.

2. The first irrigation should be made when the plants are 4 to 6 inches high, which will be about 30 to 40 days after planting. Allow the water to run until the moisture has subbed well into the ridge. If the ridge is kept moist, roots formed there will absorb mineral nutrients from the soil, and the extra water will be an advantage during hot spells.

3. Examine the soil in the root zone for moisture content with a shovel or with a soil auger, preferably at both ends of the rows, to determine the status of the soil moisture.

4. Killing the plants by drought to toughen the skins may be a poor practice if carried to extremes.

VINE KILLER:

Vine killers have been used to toughen potato skins, prevent oversize of tubers, prevent late season spread of some diseases, increase the number of small size tubers, and most important of all, to make harvesting easier.

Many different methods of killing potato vines have been tried. However, in the western states, beating-off the vines is the most popular. In the eastern states, killing the vines with arsenical sprays predominates.

Generally vine killing, if done while vines are still green, reduces the yield and also the specific gravity of the tubers. Under dry soil conditions, a brown discoloration at the stem-end may result.

While vine killing is used to toughen potato skins, the measurable effects are small in comparison with drying the soil or simply delaying harvest for 2 weeks. At present there appears to be some doubt as to the desirability of withholding water until the plants die of drought. Evidence indicates that it makes the potatoes more susceptible to black spot.

HARVESTING AND HANDLING:

It requires about 120 days of almost constant care to produce a large yield of high quality potatoes. Actually, much more time than this is required. The 120 days does not include the time spent in planning the crops or preparation of the seed bed for planting.
It is during the harvesting and handling operations that the efforts of the growing season can be lost in a matter of minutes. Very few of the nicks and bruises can be easily seen at the time they occur. Close examination, or a delay of 10 days to 2 weeks after harvesting, are required to reveal the extent of the injuries which may have occurred. It is to the growers' and shippers' interests to make careful examinations of the tubers and make the proper corrections.

It is now known that potatoes are not just susceptible and non-susceptible to black spot. The force with which potatoes are bruised is probably as important as any other factor in making potatoes show internal black spots. Therefore, if the equipment and handling operations are conducted so that bruising is eliminated, it will automatically reduce many of the losses and complaints resulting from black spot.

The following suggestions should prove beneficial to all growers and handlers:

1. Prior to full-scale harvesting, make a trial run with all equipment and carefully examine the potatoes for cuts, bruises, and nicks. Remember that drops greater than 6 inches, and wood and metal surfaces that have not been covered with rubber, are likely to be sources of trouble.

2. Make a few trial runs with the equipment operating at different speeds to determine the maximum speed at which the particular equipment being used should be operated. This again requires careful examination of the tubers.

3. Try to adjust the soil moisture so the soil will sift freely through the chains with a minimum of shaking.

**STORAGE:**

The purpose of storing potatoes is to prolong the market season. Storage reduces serious losses of potato stocks, avoids glutted markets, and thus helps to stabilize prices.

After potatoes have been placed in storage, they pass through three physiological changes. The first change is a rapid water loss. Most of the weight lost will be during the first 2 or 3 weeks of storage. During this period, the temperature should be held at 60°F to 70°F, and the relative humidity maintained at 80 per cent or above. This is very desirable if no tuber rot is present, since effective wound healing does not occur below 55°F, or when the relative humidity is below 75 per cent. If rot is present, the storage temperature should be lowered to 40°F as rapidly as possible. During the fall of the year, temperatures of 60°F-70°F are easily obtained. However, special efforts are required to raise the humidity to the desired level. This requires a thorough soaking of the floors and walls long enough prior to storage to prevent the floors being muddy at storage time.

The period of rapid water loss is followed by an 8 to 14-week rest period during which time the potatoes are virtually in "hibernation." During this
second period, weight losses are at a minimum. They will remain that way as long as the storage temperature is kept below $40^\circ F$. Once the temperature rises above $40^\circ F$, unless artificial methods are used to prolong dormancy, the potatoes begin to sprout and the third physiological change has started.

After tubers begin to sprout, they lose water rapidly, shrivel, and in due time the culinary quality is greatly reduced.

In recent years, a larger and larger percentage of the potato crop is moving to market in processed forms, potatoes high in sugars are not satisfactory for processing. Potatoes stored at or below $40^\circ F$. accumulate sugars and become sweet. Potatoes for processing should be stored at about $50^\circ F$. To prevent sprouting, special treatment of the tubers is required. Certain chemicals such as methyl ester of alpha naphthalene acetic acid (MENA), maleic hydrazide (MH 40), and chloro isopropyl phenyl carbamate (CIPC), are useful in this. Before any of these chemicals are used, explicit instructions should be obtained.

IN SUMMARY:

1. Sound tubers store well even under poor conditions. Injured, diseased, or frozen potatoes require special care.

2. To promote wound-healing, storage temperatures should be kept at $60 - 70^\circ F$. and the relative humidity above 80 per cent for the first 2 or 3 weeks of storage.

3. Potatoes should be warmed to $50^\circ F$. before removal from storage.

4. Sprout inhibitors are useful to keep potatoes from sprouting when stored at $50^\circ F$. 
POTATO VARIETIES*

by

C. L. Vincent, Professor of Horticulture

Within recent years many new potato varieties, both early and late, have been developed, tested, and introduced by government and cooperating state experiment stations. Some of them have proven their worth in comparison with older varieties and are now generally grown in certain sections of the United States. Some of the new varieties are not only high yielding sorts possessing good market and cooking qualities but some are fairly resistant to common diseases. However, no variety has yet been introduced that could be called a "perfect" variety, adaptable to all locations. In fact it is doubtful whether such an ideal variety will ever be produced or whether such a one would be desirable.

The Washington Agricultural Experiment Station has been engaged in the testing of these new potato varieties and numbered strains since 1944 to determine their adaptability to the potato sections of Washington and particularly to the central irrigated areas. In all approximately 60 newly named and 100 numbered strains have been tested.

Some of the varieties tested proved to be exceedingly high yielders but they had undesirable cooking qualities. Other varieties and strains proved to have objectionable plant and tuber characteristics and in some cases were so highly susceptible to leafroll and other diseases that further testing seemed unnecessary.

New varieties were always checked against Russet Burbank, the principal late variety grown commercially in the Northwest, and Katahdin, a popular recent addition to the potato varieties. When making comparisons the basic factors considered were whether the individual variety was adaptable to a given location, was high yielding, of good quality, attractive, resistant to diseases, and marketable. These points are of great importance to every potato grower. Yields of high grade marketable potatoes influence the returns to the grower more than any other one factor, with the exception of price.

Based on total acreage of certified seed harvested in the United States in 1956, the 10 leading potato varieties listed in order of their importance are Katahdin, Russet Burbank, Red Pontiac, Irish Cobbler, White Rose, Kennebec, Chippewa, Cherokee, Sebago, and Bliss Triumph. Of these Russet Burbank, Irish Cobbler, White Rose and Bliss Triumph are older sorts and are well known to most Washington growers. Some of the others mentioned are known to growers by name, and a few have been grown in Washington with more or less success. The principal objection to the new varieties has been the difficulty encountered in marketing them.

While most of Washington's commercial potato acreage is planted to Russet Burbanks, some growers have become interested in planting the newer varieties

*Findings based on studies with new potato varieties, Horticulture Project 1122.
because they outyield Russets in percentage of U.S. No. 1 potatoes produced. This has been proven by variety plantings made in several locations in the State over a period of years. Even so, the Russet Burbank remains the first choice of most Washington and Idaho growers because of its distinctive shape and color making it easily recognized by retail buyers. Also a higher price is paid for Russets over smooth white or red varieties. Russets have enjoyed the distinction of being outstanding in baking qualities. Baking quality is based largely on the dry matter content of a tuber, but it has been demonstrated in the variety plantings that many of the new varieties when grown in the same location with Russet Burbanks equal it and in some cases surpass it in dry matter content.

At one time it was generally stated that the Russet variety was adaptable only to the climatic and soil conditions of the Western states. This, however, has proven to be false, for Russets of equal appearance are now grown commercially in Maine, New York, Minnesota, and Wisconsin. Whether the dry matter content of Russets grown in those States is as high as those grown in Washington and Idaho might be questioned by some.

Results of Variety Testing in Washington

Of the 10 varieties mentioned above as being leaders in acreage planted to certified seed throughout the United States, the new ones in that group will be described and their adaptations to Washington conditions discussed:

**Katahdin:** This variety has led all others varieties for the 10th consecutive year in the production of certified seed. It appears to be adapted to most of the commercial potato areas of the United States and is probably the most cosmopolitan variety of the hundreds in existence.

**Katahdin** is a late variety immune to mild mosaic and is resistant to net necrosis. Its plants are upright in growth habit during the early growing season but become spreading as the plants mature. The skin of the tubers is an attractive white, smooth, with few shallow eyes. The internal color is white. In shape, the tubers are short elliptical to roundish, and are of medium thickness. When grown under Midwest and Eastern conditions, the dry matter content of Katahdin is not as high as when grown under Washington conditions. Katahdin produces very few culi potatoes, and most of this cullage is due to small potatoes. The tubers seldom or never develop knobs or growth cracks. Katahdin yielded at the rate of 20.0 tons of Number 1 tubers per acre, while Russet Burbanks grown under the same conditions produced 17.0 tons. These were the results of a 10-year variety test with four replications per variety at the Irrigation Experiment Station on a Sagemore fine sandy loam soil.

**Red Pontiac:** This is a late, dark red variety, a mutant of Pontiac. It has a vigorous, upright growing plant with large, dark green, rough textured leaves. The tubers are round and smooth with medium deep eyes. According to western potato standards the eyes of Red Pontiac are a trifle too deep, especially when compared with the eyes of Russet Burbank or Katahdin. Red Pontiac has shown no pronounced resistance to any of the common insect and disease
pests attacking potatoes. It has been reported to be more drought-resistant and freer from hollow heart and misshapen tubers than some varieties.

During the three years that Red Pontiacs were grown at the Irrigation Experiment Station, they consistently outyielded Russet Burbank in tons of Number 1 potatoes produced. The average yield of Number 1 Red Pontiacs was 24.4 tons per acre compared to 16.6 tons for Russets. The dry matter content of Red Pontiac appears to be equal to that of Russets. Anyone desiring a late, red high yielding variety may find Red Pontiac to his liking. Red Pontiac should not be confused with Pontiac or White Pontiac.

Kennebec: This variety is a vigorous, fast growing, high-yielding, late-maturing potato. It has wide adaptations and a high degree of resistance to late blight. While it is susceptible to leafroll it is highly resistant to mild mosaic and net necrosis.

Kennebec plants have large, thick stems that spread with age. The tubers are elliptical to oblong and slightly wider than thick. The skin is smooth, creamy-white in color with few, shallow eyes. The flesh color is white. The tubers separate easily from the plant when harvested.

Kennebec has good baking and boiling qualities, as demonstrated by its high dry matter content which equals Russets when grown under similar conditions. A five-year yield comparison study at Prosser shows Kennebecs yielding 24.2 tons of Number 1 tubers per acre against 17.3 tons for Russet Burbanks. Tubers of Kennebec are inclined to be too large if planted further apart than 12 inches in the row. Overly-large tubers often show hollow-heart.

Chippewa: This medium-late variety is similar to Katahdin in appearance but is not as extensively grown as Katahdin. The plant is medium large, and spreading in growth habits with prominently angled stems. It is immune to mild mosaic but very susceptible to leafroll. The leaves of Chippewa have a tendency to roll naturally when climatic and moisture conditions are unfavorable, making it very difficult to distinguish this natural rolling from the true leafroll disease.

The tubers of Chippewa are elliptical to oblong in shape and of medium thickness. They are somewhat longer than wide. This smooth-skinned, cream colored, white-fleshed variety has few shallow eyes and is easily freed of soil on washing.

In the three years Chippewa was included in the potato variety planting tests at Prosser, it did not yield as heavily as Katahdin but did produce somewhat better than Russet Burbanks. The three-year average acre yield of four replicates was 18.6 tons of Number 1 Chippewas to 15.1 tons of Number 1 Russets. The dry matter content of Chippewa is not as high as either Katahdin or Russet Burbank when grown at the same location in Washington. However, dry matter content varies from year to year with the same variety and from tuber to tuber in the same hill.
Cherokee: The plants of this variety are medium in size with slender, spreading stems and medium-large leaves. The tubers are white, slightly flaked, with few, medium shallow eyes. In shape the tubers are predominantly short, elliptical, and somewhat flattened. The flesh color of Cherokee is white. In maturity it is classified as being medium early.

Cherokee is resistant to common scab, late blight, mild mosaic and is somewhat resistant to net necrosis. Since common scab is a limiting factor with most varieties in the production of Number 1 tubers in some areas of the United States and in certain soils, Cherokee can be an important sort to grow. Most of the old American varieties are very susceptible to scab, if the netted varieties are eliminated. In the case of netted varieties, like Russet Burbank, and Russet Rural, their scab resistance is more apparent than real, since the number of scab infections are often as great on the russeted types as on the smooth types, but the scab pustules are normally less conspicuous.

Cherokee was planted in the potato variety plots during the years 1951, 1952, and 1953 at the Irrigation Experiment Station. During that period the average yield of Number 1 tubers from Cherokee was 23.0 tons per acre compared to 17.4 tons of Russet Burbank. In dry matter content the two varieties were almost identical.

Since Cherokee is medium early in maturity, it might replace other early varieties lacking some of the disease resisting qualities of Cherokee.

Sebago: Sebago is a cross between Katahdin and Chippewa and was heralded, when introduced, as being somewhat resistant to late blight and highly resistant to mild mosaic. It is susceptible to leafroll.

Sebago is a vigorous, late-growing variety with large, erect plants. Its tubers are a round white, with medium-shallow eyes, and at digging time are harder to separate from the plants than many other varieties. Of the 10 leading varieties planted for certification in 1956, Sebago ranked 9th in acreage planted in 1956 with Triumph the 10th variety.

Sebago was planted five times in the variety plots at the Irrigation Experiment Station. The average yield of Number 1 potatoes for that period was 20.7 tons for Sebago and 16.8 tons for Russet Burbank. Because of its resistance to late blight, commercial plantings of Sebago were made during the 1940's in Whatcom County, but growers found it difficult to sell round whites in the retail markets in competition with the longer Russets. Sebago may be of value when planted in late-potato sections subject to epidemics of late blight.

From a limited number of tests made in Washington, Sebago is somewhat lower in dry matter content than the Russets.

Early Gem: Early Gem is not an important variety at present, but some mention is made of it because it is the only netted variety similar to Russet Burbank.
Early Gem is the result of a cross between Russet Burbank, the female parent, and a numbered government strain. The plant is medium-small and spreading in growth habits. The tubers are russeted, medium long to long, elliptical and medium thick, with shallow eyes. Its flesh is white. This variety does not form growth knobs like the Russet Burbank, but the tubers are subject to growth crack formation which results in considerable cullage.

Work in North Dakota showed that any check in growth, followed by a resumption in growth, may cause second growth injury largely in the form of growth cracks in Early Gems. Close planting in the row does not overcome entirely the formation of growth cracks.

Early Gem was grown for three years at the Irrigation Experiment Station and averaged 17.2 tons of Number 1 tubers per acre compared to 16.6 tons for Russet Burbank. This variety appears well adapted to the climatic and soil conditions of central Washington, but its main fault is the formation of growth cracks causing heavy cullage.

Other Varieties: Besides the varieties listed above, a number of others yielded well in Washington and were high in dry matter content. A few worthy of mention are Menominee, Ontario, Sequoia, Red Warba, and White Warba. The last two named are very early varieties and show no resistance to any of the common potato diseases. The tubers of each variety are large with very deep eyes, making peeling wasteful and difficult. They are particularly recommended for home garden plantings because of their earliness.
A successful potato crop requires high soil fertility. Nitrogen is the main fertilizer element needed but phosphorus, potassium, and zinc must be adequate also. Other elements are used but no deficiencies of them have been observed.

Phosphorus and Potassium

A reliable soil test is the best guide for phosphorus and potassium needs. The analyses and recommendations are available from the State College of Washington for $1.00 per sample.

If a soil is low in phosphorus it may take as much as 200 pounds of P\(_2\)O\(_5\) per acre to bring it to a desirable level. Then smaller annual applications will do. Enough for 2 or 3 years can be used at one time if preferred. Even soils quite well supplied with phosphorus will need an application of this fertilizer during a crop rotation to maintain high yields. About 50 pounds of P\(_2\)O\(_5\) are removed annually by a normal rotation for the area.

Use potassium according to soil needs. Phosphorus and potassium in excess of the amount needed for maximum yield will not influence the quality of potatoes.

Zinc

A deficiency of zinc causes a condition described as "fern leaf" in potatoes. By the time the potatoes show visual symptoms of deficiency it is too late to correct the conditions. To avoid this trouble apply 10 pounds of zinc per acre ahead of planting or drilled in at that time. This will last 3 or 4 years.

Nitrogen

Kinds

Use whichever kind is the cheapest per pound of nitrogen applied to the soil or which fits into your program the best. There is no benefit in using, for example, a source of nitrogen containing sulphur over one without sulphur. The irrigation water alone supplies more sulphur than is needed by crops in the Columbia Basin. The various sources of nitrogen give the same results if used at the same depth in the soil.

Rates

The amount of nitrogen to use is influenced by the previous land use and fertilizer history. The following table will serve as a general guide.
After alfalfa or legume nursery crop | 80 - 100
After row crops | 160
New land | 200 - 240
On old wheat land not previously irrigated | 240 - 260

**Method of Application**

It is important to get the fertilizer into the soil. Harrowing ordisking the fertilizer into the ground is not sufficient. Broadcast and plow down the fertilizer or band it into the soil. Fertilizer attachments on the planter which place the fertilizer to the side and a little below the seed piece are usually satisfactory. Fertilize as the ground is being prepared or at planting time.

**Green Manure**

Vetch or legume green manure improves soil conditions and produces part of the needed nitrogen. Make sure the soil is well watered at planting time. Potato failures following a green manure crop of vetch have resulted because of poor moisture and seedbed.

**Watering**

Water should be considered a plant nutrient. The assumption that "If a little is good a lot is better" does not apply to water. Use only enough water to fill the soil reservoir of the root zone. Over-irrigation is expensive in lost water, leached fertilizer, poor physical conditions and possible seepage condition. Use a shovel or probe to find out how deep the moisture has penetrated during irrigation.
POTATO INSECT CONTROL*

by

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A number of insects attack potatoes and may seriously damage plants or tubers by their feeding. Several species of insects may transmit diseases such as "leaf roll" and "aster yellows". Most of these insects can be satisfactorily controlled although several applications of insecticides are required to control some of them.

**Colorado Potato Beetle**

The adults are stout, oval beetles about 3/8 of an inch long and 1/4 inch wide. There are black and yellow stripes running lengthwise along their wing covers. Orange-yellow eggs are laid in masses of 10 to 30 or more on the under sides of the leaves. The larva are dark red when young and later become orange. There is usually a spring and fall generation of this insect. Insecticide applications should not be made until the eggs have hatched.

**Control** - Apply 5 per cent DDT dust at the rate of 25 to 30 pounds per acre or 3 per cent Thiodan dust at 33 pounds per acre; or as a spray, 2 quarts Thiodan (2 pounds per gallon material) in 8 to 10 gallons of water per acre by aircraft or 20-40 gallons water with ground equipment or 1/2 pound of actual endrin or parathion per acre.

**Wireworms**

Wireworms feed on potato seed pieces and chew deep pits or holes in developing tubers. Adult wireworms are slender beetles about 1/2 inch long ranging in color from reddish brown to black. They are commonly called "click" beetles. Wireworms have hard jointed bodies, 3/4 to 1 inch long, and are yellow to dark orange. They spend several years in the soil before changing to adults.

**Control** - Apply 10 pounds of actual DDT, 4 pounds actual aldrin, or 3 pounds actual dieldrin or heptachlor either as a spray or dust to the soil surface and immediately disk in thoroughly to a depth of 6 to 9 inches. A single application will prevent wireworm infestation for one or more years, and in the case of DDT as long as 5 years or more.

**Note** - Aldrin or heptachlor applied at 3 pounds actual per acre has controlled tuber flea beetles for 1 to 2 years whereas dieldrin at 2 pounds actual per acre has given control for 4 years.

*The author wishes to acknowledge the assistance of H. S. Telford, Washington Agricultural Experiment Station, Pullman; and B. J. Landis, USDA, Union Gap.*
Flea Beetles

Three species of flea beetles attack potatoes in Washington, but only the tuber flea beetle is likely to cause commercial damage to potatoes. At present, the tuber flea beetle is not known to be in Grant, Adams, and Franklin counties. It generally occurs in the other potato producing areas in the state.

The adult flea beetle is about 1/16 of an inch long, feeds on the foliage, and the threadlike larva scar the surface of potato tubers or may bore into them. There are several generations of this insect a year and the overwintering adults become active in the spring as soon as the potatoes break ground.

Control - Treat the soil either with a spray or dust with aldrin, heptachlor, or dieldrin immediately before planting, using 3 pounds actual of either aldrin or heptachlor or 2 pounds of actual dieldrin per acre. Spray or dust the material on the soil and disk thoroughly to a depth of 4 or 5 inches immediately after application. Aldrin and heptachlor have given control for 1 to 2 years and dieldrin has been effective for 4 years. If soil insecticides are not applied or if potato flea beetles appear on the foliage, 4 to 5 applications of 5 per cent DDT dust at 25 to 30 pounds per acre will give control. Make the first application when the potatoes just break ground if beetles are present and repeat treatment at 10 day intervals.

Note - Soil insecticides applied for wireworm control will protect potatoes from flea beetle damage from 1 to 4 years depending on the insecticide used.

Green Peach Aphid

The green peach aphid transmits the "leaf roll" virus which causes net necrosis in tubers of Russet Burbank potatoes. In eastern Washington the aphid usually passes the winter in the egg stage on peach trees, but in mild winters some may survive as adults on weeds. Spring flights of aphids near Quincy originate in peach orchards in the Trinidad and Wenatchee areas. Spring infestations in the Yakima Valley arise from peach trees in the areas of Ellensburg, Yakima, Zillah, and Pasco.

Winged aphids start leaving peach trees the first week of May and multiply slowly on potatoes in May and the first half of June. From about June 15 to 25, aphids increase rapidly on early potatoes and fly to younger plants. It is during the period of June 15 to 25 and August 1 that most of the spread of "leaf roll" occurs. During this period, control is very necessary.

Control - Thiodan, either as a dust or spray, at the rate of 1 pound actual per acre applied either with ground equipment or aircraft is recommended for control. This would amount to 2 quarts of the 2 pound per gallon Thiodan in 8 to 10 gallons of water per acre or 33 pounds of the 3 per cent Thiodan dust per acre. Treatment with either ground equipment or aircraft normally should start about June 15.
Green Peach Aphid - Control (Continued)

and should be repeated at 10 to 12 day intervals to at least August 1.

Endrin or parathion at the rate of 1/2 pound of actual material per acre applied with ground equipment will give fairly good aphid control. Treatment with ground equipment normally should start about June 15 and should be repeated at 10 to 12 day intervals to at least August 1.

Leafhoppers

The intermountain leafhopper is usually the most numerous species on potatoes and may reduce yields somewhat. While the six-spotted leafhopper is rarely abundant on potatoes, it does transmit the "aster-yellows" disease to potatoes.

Control - A 5 per cent DDT dust applied at the rate of 25 pounds per acre is effective against leafhoppers. Thiodan, endrin and parathion applied for aphid control will also control leafhoppers.

Lygus Bugs

Several kinds of lygus bugs feed on potatoes. They usually develop on alfalfa and fly to potatoes when the alfalfa crop is cut. These insects feed on the tender new leaves or terminals of the potato plant causing them to wither and die.

Control - A 10 per cent DDT dust applied at the rate of 25 to 30 pounds per acre will give effective control. Usually only one application is necessary. Thiodan or endrin as used for aphids will also control lygus bugs.

Spider Mites

The two-spotted spider mite has caused damage to potatoes in the Quincy area for several years. Heavy populations cause the leaves to turn brown and die. If heavy spider mite populations develop on potatoes before tubers have completed growth, the loss of leaves will affect tuber size. Spider mites develop on beans, alfalfa, and corn to mid-July or early August and are then carried by the wind to nearby potato fields.

Control - A 2 per cent parathion and 50 per cent sulfur dust at 25 pounds per acre applied with either ground equipment or aircraft will give control of mites for 2 or 3 weeks. Thiodan, also kills the adult mites and will give temporary control, particularly when applied at two to three week intervals for aphid control.
Warning

All insecticides are poisonous; some are toxic in very small amounts and may be absorbed through the skin or inhaled in quantities to endanger the health or even the life of the operator. The degree of danger and the necessary precautions to be used are indicated on the label of the container.

Read the manufacturers' labels carefully and follow their instructions.
The control of potato diseases is, in a large measure, dependent upon what is done before potatoes are planted. There must be considerable care taken in selecting seed. Once it has been selected, the seed must be properly treated and handled. If all of these things are done as they should be, disease control would be very much simplified in the average potato field. There are a few diseases in the central part of the state of Washington which can be controlled by spraying, but these diseases do not appear every year and usually are not seen for several years in succession. There are some cultural practices which can aid in the control of some diseases and these will be discussed in turn.

In selecting potato seed it is almost axiomatic among growers of the Columbia Basin that they use certified seed. In doing so they avoid virus and certain other diseases. Certified seed is usually almost entirely free of virus and in some instances completely so. What few plants do show virus can easily be rogued out if the field is inspected early enough in the season. The ring rot disease which is caused by bacteria is carried in the seed but is seldom found in certified lots. Another organism which occasionally causes damage in the Columbia Basin is the late blight fungus which is carried on tubers and grows up on stems to the surface of the soil. It infects adjacent plants. Thus a careful seed selection is essential to eliminate most of the virus diseases and some others due to bacteria and fungi. It is well if a grower becomes accustomed to getting superior seed from one source to continue with that source rather than changing each year to an unknown source of seed.

It is well to treat the seed prior to planting it since this will control seed-piece decay. There are a number of materials which can be used for seed treatment such as Semesan-bel and similar chemicals. However, modern seed treatment usually consists of using one of two substances. Either Captan as a dust or one of the antibiotics such as Streptomycin. Seed treatment is not a means of controlling all of the soil borne diseases since they enter the plant after it has grown away from the seed piece. However, in some instances these soil borne organisms are prevented by seed treatment from attacking the plant while it is still very small and just beginning growth from the seed piece.

There are several practices which should be followed in handling seed and planting the potatoes after the seed has been cut. To begin with, seed which has been in storage is quite dormant. In order to speed up the work of enzymes which change starch to sugar and thus enable the young sprout to get started, the seed should be warmed up for a few days before planting begins. This enables the sprouts in the eyes to begin growth and continue growth after the seed has been cut and planted. When the seed has been cut it should be allowed to stand in a fairly humid storage place for about two days. Temperatures around 60°F. are most commonly used. The humidity will enable the potatoes to heal or callous over the cut areas without losing too much moisture.
This is very essential if the seed piece is to withstand successfully rot caused by fungi and bacteria. The potatoes should not be planted too early in the year or in soil that is too cool. Usually potatoes which are planted too early make very little growth until the soil does warm up. Not much is gained by getting seed pieces into the soil before growing conditions are favorable.

Disinfecting the cutting knife is very essential in reducing the spread of such diseases as ring rot and black leg which might be found in the tubers. There are various means of disinfecting a cutting knife. In some cutting sheds knives are kept in a solution of formaldehyde and changed frequently to prevent the spread of disease. In other sheds a rotating disc with a sharp edge is used as a cutting knife. The lower half of the disc is kept running in boiling water which is heated electrically in a vat through which the sharp disc runs. Chemicals can also be added to this water although boiling water is usually sufficient to keep down the spread of the disease. The gloves of men handling tubers during the cutting process and other things such as sacks and boxes coming in contact with cut tubers should be either made of new materials, wood or disinfected after each use. Gloves should be changed more or less frequently and should be disinfected before using again.

After the potatoes are planted and have started growth, the control of a few diseases is accomplished by spraying the vines. Insect control is necessary to avoid virus diseases. You will find this discussed in the entomology section of this paper. There are two fungus diseases which may occur in the Columbia Basin. Late blight is carried on the tubers and brought into the field from other areas. As a rule, any potato which is grown in a dry atmosphere will not be affected with late blight on the tubers. Some seed potatoes grown on the coast where conditions are moist, may have late blight on the tubers when planted. Certified seed is very seldom affected with late blight although an occasional lesion might escape detection by the inspector and grower.

When potato seed infected with late blight is planted, the blight organism infects the new shoots of the potato before they even reach the surface of the soil. These infected shoots produce huge quantities of spores which are scattered around by water. In the Columbia Basin late blight usually appears as a circular area ranging in diameter from a few feet to several hundred depending on how soon the blight got started and how much rain fell during the time the blight was active. It has occurred in the Columbia Basin only a few times in the past 20 years and has only been serious during one year. Spraying with some of the newer chemicals such as Maneb or Zineb will control the disease. Formerly Bordeaux was much used but it stunts the growth of the potato plant to a certain extent and is not as satisfactory as some of the newer materials. Airplane dusting may be useful when the vines are matted over the rows, but dusts are not as successful in controlling disease as are sprays.

Early blight can be controlled much the same as late blight but usually occurs in stands where overhead sprinkling is used to irrigate the plants and where they have been kept quite wet. While some early blight lesions might be found on the lower-most leaves of irrigated vines, it has been very scarce in the Columbia Basin. A virus spot similar in nature to the early blight leaf spot
was detected last year in the Columbia Basin and was thought by some to be caused by the early blight organism, but this was later disproved.

Some potato diseases can be controlled to a certain degree by cultural methods. Rhizoctonia which causes a blighting of the plant and a rotting off of the young stem is usually associated with early season growth during very cool, wet weather. If Rhizoctonia is a problem in a field, the potato seed pieces should be planted later than usual such as in April. They should be planted as shallow as possible so as to get a good start. Hilling can take place later to overcome the lack of soil depth early in the season.

In many fields, a condition known as early drying takes place and is due to a number of causes, none of which are very well worked out. It has been found, however, that by rotating crops which include alfalfa, and planting potatoes only once every seven years, the early dying disease is fairly well controlled. Where it is impossible to rotate for as long a period as seven years, it is not possible to control the early dying where it has been found.

The scab disease has been rather serious in the Columbia Basin on smooth potatoes such as white rose or the red varieties which are grown. Where scab is found in a field, these varieties should not be planted. Ordinarily scab does not seriously affect the netted gem variety or any other netted variety. Frequently netted varieties can be grown wherever scab is present without serious loss. Up to the present time no soil treatment has been devised which will control scab without being very costly.
POTATO PRICE OUTLOOK IN WASHINGTON FOR 1958
by
Karl Hobson, Extension Marketing Price Specialist

Summer potatoes sold in July, August, and September are likely to bring low prices this year, possibly as low as those received in 1955 when the net price to the grower for No. 1's was $25 per ton or lower most of the season.

One exception to this may be July sales, especially those sold early in July. The supply of storage potatoes from the 1957 crop may be small enough late in the storage season and production of early crops may be small enough to continue the potato scarcity into July. This is not certain, however. Prices for storage potatoes advanced sharply in February and continued to advance in March. This price rise may have started early enough to bring enough change in the direction of fuller utilization of storage supplies and heavier planting of acreage in areas that dig and sell in June and early July to make supplies fairly large by July.

As for market supplies in August and September, there seems little chance for favorable prices unless crop disaster should hit a large part of the producing areas that sell in those months. After two relatively favorable years for August and September marketings, acreage is almost certain to be expanded substantially in areas that sell in those months. Also, chances are against the sort of crop disaster that hit eastern summer potato producing areas last year.

Late potatoes grown in 1958 are likely to bring low prices. As is usually the case in a low-price year, prices are likely to be lower toward the end of the storage season than at digging time or early in the storage season.

Late potato acreage does not vary as much from year to year as it used to. That's probably because most of the production is now concentrated in the main producing section where most growers are equipped for potato growing and specialized in potato production. However, there is some acreage variation from year to year. 1958 is likely to bring an increase in acreage because of the favorable prices received for the 1957 crop.

Yields are likely to average higher in 1958. Yields were sharply reduced in most central and eastern late potato areas in 1957 by an unfavorable season. Chances are that average growing conditions will be better in 1958.

With both acreage and yields likely to be up in 1958, production of late potatoes is likely to be quite large, possibly as large as in 1956. The marketing agreement and diversion programs may not be as fully utilized early in the storage season as was the case this past season. Many growers remembering the high prices received late in the 1957-58 storage season will be reluctant to divert potatoes to low-price outlets early in the storage season.
POTATO PRODUCTION COSTS PER ACRE \(^1\) - COLUMBIA BASIN - 1957

(Based on Good Management Practice \(2\))

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Production Costs by Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quincy</td>
</tr>
<tr>
<td>Crown or spray alfalfa</td>
<td>3.00</td>
</tr>
<tr>
<td>Plowing</td>
<td>5.00</td>
</tr>
<tr>
<td>Cut and Treat</td>
<td>7.00</td>
</tr>
<tr>
<td>Plant and apply fertilizer (3)</td>
<td>6.00</td>
</tr>
<tr>
<td>Ditch, cultivate, disc, hill, float and pack</td>
<td>13.00</td>
</tr>
<tr>
<td>Irrigate</td>
<td>10.00</td>
</tr>
<tr>
<td>Dust</td>
<td>15.00</td>
</tr>
<tr>
<td>Hand working</td>
<td>00</td>
</tr>
<tr>
<td>Roto beat</td>
<td>6.00</td>
</tr>
<tr>
<td>Combine</td>
<td>120.00</td>
</tr>
<tr>
<td>Sorting</td>
<td>80.00</td>
</tr>
<tr>
<td>Other, Comm., Assns., Insurance and etc.</td>
<td>10.00</td>
</tr>
</tbody>
</table>

MATERIALS PURCHASED AND MISCELLANEOUS COSTS

<table>
<thead>
<tr>
<th>Item</th>
<th>Quincy</th>
<th>Othello</th>
<th>Pasco</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>45.50</td>
<td>35.75</td>
<td>45.50</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>36.00</td>
<td>39.00</td>
<td>37.00</td>
</tr>
<tr>
<td>Aldrin (soil treatment)</td>
<td>6.50</td>
<td>6.50</td>
<td>6.50</td>
</tr>
<tr>
<td>Water</td>
<td>10.00</td>
<td>8.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Other</td>
<td>00</td>
<td>00</td>
<td>1.00</td>
</tr>
<tr>
<td>TOTAL Material Costs</td>
<td>98.00</td>
<td>89.25</td>
<td>100.00</td>
</tr>
<tr>
<td>TOTAL Operation Costs</td>
<td>275.00</td>
<td>247.00</td>
<td>237.50</td>
</tr>
<tr>
<td>Land Charge</td>
<td>40.00</td>
<td>40.00</td>
<td>40.00</td>
</tr>
<tr>
<td>Grand TOTAL</td>
<td>413.00</td>
<td>377.25</td>
<td>377.50</td>
</tr>
</tbody>
</table>
Yields Expected By Grades

<table>
<thead>
<tr>
<th>Grades</th>
<th>Quincy</th>
<th>Othello</th>
<th>Pasco</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons</td>
<td>Tons</td>
<td>Tons</td>
</tr>
<tr>
<td>No. 1's</td>
<td>15</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>No. 2's</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Culls</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>20</td>
<td>20</td>
<td>18</td>
</tr>
</tbody>
</table>

Total Cost per Ton (Including Land Charge, but no charge for management or risk.)

- Based on Total Yield: $20.65, $18.81, $20.97
- Based on No. 1's & 2's: 22.94, 23.52, 26.96

1/ These costs are for better than average management. They include labor costs. A small group of outstanding producers in each of the three areas were asked to assist in setting up recommended practice for producing potatoes and give the costs of carrying out these practices and the yields that could be expected. In general, custom rates were used as a guide for costs, when available. Some large producers owning their own equipment might be able to do some operations for less.

2/ The practices recommended by these potato producers will be prepared as part two of the report.

3/ Some of the fertilizer was applied before planting and some as part of the planting operation.
If a potato producer plans to own his own major pieces of equipment desirable for potato production, the new cost according to producers interviewed might be like this:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Cap. Inv. est. for machinery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tractor (45hp.)</td>
<td>$3600.00</td>
</tr>
<tr>
<td>Truck</td>
<td>4000.00</td>
</tr>
<tr>
<td>Plow (two 16's)</td>
<td>700.00</td>
</tr>
<tr>
<td>Disk (10ft.)</td>
<td>700.00</td>
</tr>
<tr>
<td>Harrow 4 section</td>
<td>160.00</td>
</tr>
<tr>
<td>Cultivators &amp; tow bar</td>
<td>300.00</td>
</tr>
<tr>
<td>Packer</td>
<td>200.00</td>
</tr>
<tr>
<td>Planter</td>
<td>1100.00</td>
</tr>
<tr>
<td>Sprayer</td>
<td>400.00</td>
</tr>
<tr>
<td>Fertilizer spreader</td>
<td>350.00</td>
</tr>
<tr>
<td>Roto beater</td>
<td>900.00</td>
</tr>
<tr>
<td>Potato combine</td>
<td>5000.00</td>
</tr>
<tr>
<td></td>
<td>17,410.00</td>
</tr>
</tbody>
</table>

This equipment expense if allocated on the basis of the acres that each item might be used, would mean a new machinery investment of about $200.00 per acre. Since most farmers do not have all new machinery and some machinery is well depreciated out, the average investment of those having a full line of major potato machinery would generally be between one half and two thirds the above figure.