Growing Potatoes in Missouri

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Harvesting a crop of Missouri potatoes.

COLUMBIA, MISSOURI
The potato is one of the most important horticultural crops grown in Missouri. The greater part of the 40,000 acres planted to this crop is on fields of one acre or less. The chief commercial district is located along the Missouri River in the West Central part of the state, where the operations are on an extensive scale with most fields larger than 40 acres. The 5,000 acres of commercial potatoes produce a crop with an annual value of over one million dollars. This crop moves in carlot quantities to the larger centers of the Middle West where it dominates the potato market during the first two weeks of July. A similar acreage in Northwestern Kansas is marketed at the same time. There are other large areas in Missouri equally well suited for potatoes, and can be made to produce good crops when there is sufficient demand or greater production is needed.

The average acre yield of potatoes in Missouri is under 100 bushels, but commercial growers maintain that they must secure yields of at least 200 bushels to meet operating costs. Yields of over 300 bushels are not uncommon, and yields as high as 400 bushels are occasionally secured. Such yields can be reached only on favorable sites and by careful attention to every detail of good production.

Soil Management

Potatoes are planted on a wide range of soil types but a good yield can be expected only on deep, friable, well drained loams, high in fertility. Sandy loams are favored by commercial growers, but most types can be made to produce satisfactory crops through the judicious use of crop rotations, manures and commercial fertilizers. Because of the high cost of production a commercial crop should be grown only upon those soils that are naturally adapted.

A long rotation of 4 to 5 years is best for potatoes. Crops like corn and the sorghums make a heavy demand upon plant food and leave the soil in a poor condition for potatoes. Preferably, legumes should precede the potato crop. The residue from a harvested crop of the clovers, alfalfa, soybeans, cowpeas, and hairy vetch may be turned under or these crops may be turned under as green manure.

Winter rye is used almost exclusively in the commercial area as a crop to precede potatoes. The rye is planted late in the sum-
mer and pastured throughout the fall and winter to be turned under just before planting time. Hairy vetch is sometimes sown with the rye. The high cost of vetch seed and frequent failure to secure a stand have discouraged its more general use. Green manures such as soybeans or cowpeas planted after digging potatoes have never been used on a large scale. Omitting this practice is justified since recent work has shown that allowing the potato land to lie fallow during July and August is an important factor in controlling scab and rhizoctonia diseases.

Potatoes, as a general rule, can be used in almost any good rotation instead of the regular cash crop. A rotation that has been found to be practical for use with the potato crop is:

First year—Corn
Second year—Oats and sweet clover
Third year—Sweet clover for hay or pasture
Fourth year—Potatoes

Red clover can be substituted for sweet clover. If manure is used, it should be applied to the corn crop. A standard Missouri rotation that can be used by replacing corn with potatoes is:

First year—Soybeans
Second year—Wheat
Third year—Red clover
Fourth year—Potatoes

Where the soil is very valuable for potato production, a somewhat shorter rotation can be used:

First year—Wheat with red and alsike clover
Second year—Clover for hay or pasture
Third year—Potatoes

Satisfactory yields can be maintained through the use of generous quantities of manures and a winter cover of rye. Scab and other potato troubles may become quite serious under a continuous cropping system. One of the most satisfactory rotations is to follow a stand of alfalfa that has stood for several years with potatoes.

In the vegetable and truck crop sections a very good combination is the growing of potatoes one year and such crops as tomatoes, cabbage, onions, or other vegetables the next year. The fertility of the soil may be maintained by following the potatoes and truck crop with a green manure and by heavy applications of barnyard manure preceding the truck crop.
A good rotation will not alone maintain a satisfactory state of fertility for economical potato yields. A planned system for maintaining a high turnover of organic matter must be provided. This can be secured most readily through the use of green manures. Legumes, because of their nitrogen fixing ability, are generally preferred.

The most desirable crops are the clovers and large seeded legumes which produce a high tonnage, have a short growing season and are capable of being grown during the season when commercial crops do not occupy the soil. The crop to be turned under may be fertilized to secure maximum growth.

*Barnyard manure* is a good source of plant food and organic matter for the potato crop but should be supplemented with superphosphate since most manures are low in phosphorus. Where extensive cattle feeding operations are carried on, manure is used frequently in the potato rotation. Light applications are made on rye before it is turned under. Manure in large quantities applied preceding the potato crop may activate the scab organism. It is usually safest to apply manure to some other crop in the rotation. Profitable increases in yield are secured from applications at the rate of 10 to 20 tons per acre.

*Commercial fertilizers* have come into general use on potatoes. Since most Missouri soils are deficient in phosphorus, the potato crop shows a great response to this plant food. Nitrogen-carrying fertilizers also give a favorable response even in soil well supplied with organic matter. The potato plant starts growth before the temperature is high enough for bacterial action to make the nitrogen held in organic matter available. The nitrogen carried by the fertilizer can be utilized immediately to nourish the plant during the first stages of growth.

Potash is usually present in sufficient amounts in most Missouri soils to mature a good crop. This plant food is generally included in the fertilizer mixture as a safety measure.

Fertilizer mixtures analyzing 4 to 5% nitrogen, 10 to 16% phosphorus, and 4 to 6% potash are most generally advised. If liberal quantities of manure are used, a material carrying only nitrogen and phosphorus such as ammo-phos and other ammoniated phosphates is satisfactory. An application of 300 to 600 lbs. of an analysis such as 4-12-4 or 4-16-4 can be used economically. Analyses like 4-8-6, 4-10-6, or 9-18-18 are favored on very sandy soils.
The fertilizer is most often applied at planting time. It should be placed near the seed piece but not in direct contact since nitrogen and potash salts cause serious injury to the young sprouts and may prevent emergence. It has been found that the best placement of the fertilizer, to secure most effective use by the plant and not produce injury, is to apply it in narrow bands at the level of the seed piece and two inches to the side.

Recent experiments have indicated favorable results from spreading the fertilizer on the surface before plowing. A fertilizer distributor has been devised which places the material in the bottom of the furrow. These methods are quite satisfactory when large quantities are used.

Missouri soils are frequently deficient in lime or calcium which is supplied through ground limestone. The potato crop does not require as much of this as is necessary for growth of the legume crops. Soil containing enough lime to support clovers will not require additional amounts for the potato crop. Limestone should not be used in excessive quantities or applied just preceding the potato crop since this material tends to make the scab organism active.

**Potato Varieties**

Irish potatoes are grown in Missouri almost entirely as a spring crop. Because of the hot dry summers, only the early varieties can be depended upon to produce satisfactory yields.

None of the new varieties which have been introduced during the last few years have been found to be superior to the older kinds. The commercial acreage is almost entirely planted to Irish Cobbler and Bliss Triumph varieties. The Cobbler is justly the most popular variety throughout the state. The new variety, Red Warba, may become a valuable sort for growing in the farm garden and where an early maturing red variety is preferred by the market.

The commercial demand for Missouri grown potatoes is strongest during the latter part of June and the first two weeks of July. With the advent of hot weather, the demand for potatoes falls off sharply. Most of the early crop from the South has been shipped by this time. Missouri potatoes shipped during August must compete unfavorably with the early crop from the northern states. Only the early varieties should be planted for commercial purposes.

**Irish Cobbler.**—The Irish Cobbler is the best of the early varieties for Missouri. It is of good quality, matures early and will
produce a yield equal to any variety tested in the state. The stocky vines are medium in size. The dark green foliage is vigorous and resistant to leaf hopper injury and foliage diseases. Also, it stands up well during hot weather. The few tubers that set develop to marketable size even during adverse seasons. They are roundish to roundish-flattened or slightly oblong-flattened with a rather deeply notched stem end. The eyes are moderately deep and the skin is smooth, creamy in color and sometimes slightly netted. Because of its long rest period, sprouting and shriveling may not be serious during the fall; moreover, it keeps well in storage.

**Bliss Triumph.**—This is an extra early variety that matures from a week to ten days ahead of the Irish Cobbler. The vines are upright in growth but branch very little. The foliage is light green, rather sparse and very susceptible to hopper burn and heat injury. The tuber is small to medium in size, of a blocky shape and slightly shouldered at the stem end. The eyes are frequently deep near the apex. The pores may become quite large and detract from the appearance during wet seasons. The skin has a light red color in demand on certain markets. The susceptibility of the foliage to injury frequently results in low yields. There are several strains of this variety, differing in earliness of maturity. Only the very early strains should be grown in Missouri since early maturity is the chief merit of this variety.

**Red Warba.**—This is a comparatively new variety that matures just ahead of the Irish Cobbler. During an average season, it will yield as high as that variety. Under unfavorable conditions it may set more tubers than the vines can grow to marketable size. The vines are vigorous and resemble those of the Cobbler. The medium size tubers resemble those of the Cobbler but are not as flattened and the shoulder is not so pronounced. The eyes are few but may be fairly deep around the apex. The table quality is much superior to that of the Triumph. The skin color is a bright lustrous red but may be blotchy under certain conditions. This is not objectionable if marketed as new potatoes. Since the rest period is very short, seed from the spring planting may be replanted for a fall crop. This variety is well worthy of consideration by those who grow potatoes for the home supply or are engaged in producing for sale to local markets.

A number of excellent varieties have been introduced during the last few years. Unfortunately, they are not suitable for main crop production under Missouri conditions. The varieties, Chip-
pewa, Kathadin, Houma, and Pontiac are vigorous, disease resistant and of high quality but mature so late that production is limited by summer temperatures. These varieties may be grown for winter storage but the grower will have to contend with low yields except in very favorable seasons. The popular market varieties, Russett Burbank, White Rose and Green Mountain are not adapted to the climatic conditions that prevail in the Midwest and cannot be recommended to Missouri growers.

**Seed Potatoes**

One of the most important factors in successful potato production and one over which the grower has complete control is the selection of good seed. Such factors as purity of variety, and freedom from defects and surface diseases can be readily determined by visual inspection of the seed stock. Those qualities which have the greatest effect on yield; as strain, vitality and the internally carried diseases; cannot be discerned by examination. Strains can be identified only by knowing the past history and performance of a certain lot. Vitality is determined by the conditions under which the potatoes were grown and stored. The presence of internally carried diseases is only evident when the plants are growing. If a seed stock is to be kept relatively free from such diseases, it must be inspected at intervals during the summer and the affected plants removed by careful roguing.

**Northern Grown Seed.**—The potatoes produced in the northern states have been proven by many trials to be better for planting in Missouri than home grown seed. The reason for this is that the growing conditions in the North are more nearly ideal for the growth of the potato plant. Since the crop matures during cool weather and can be stored under almost ideal conditions, the natural vitality is better preserved until planting time. Also the insects responsible for the transmission of diseases are less numerous; hence, it is easier to maintain healthy stocks. Generally, the farther north the crop is grown, the better the quality for seed.

**Certified Seed.**—Once a seed stock becomes infected with a degenerative disease, the virus will gradually spread until so many tubers are infected that it becomes worthless. Methods have been developed whereby a disease free stock can be built up through the increase from healthy tubers. When these foundation stocks have been grown under definitely prescribed conditions and the fields and crop have passed inspection by a licensed inspector, the seed are certified as being practically free from internal
disease and other factors which might make it unsafe for planting. The seed certification is carried out by state governmental agencies. Every bag of potatoes that has been produced from inspected and approved fields carries a certification tag which states that the seed have passed these inspections.

Many misleading brands and tags are used on seed potatoes to convey the impression that the stock has been certified. Labels stating that the seed has been northern grown, selected for seed, or certified to be grown under irrigation are not true certifications. Actually certified seed carries a tag on which is printed the state seal and the signature of the state inspector. The name and address of the grower is also shown.

Most of the certified seed used in Missouri come from the states of North Dakota, Minnesota, and Wisconsin, largely because of the advantage in freight rates. Certified seed usually sell for about 50 cents per Cwt. more than table stock. The difference in price is justified from the increased yield of 50 to 75 bushels per acre in favor of certified seed. Only certified seed can be recommended for planting in Missouri.

Seed Treatment

There is much confusion in the mind of the average grower concerning seed treatment and certified seed. No method of seed

Fig. 1.—A convenient arrangement for treating seed potatoes.
treatment will free seed stock from the diseases carried inside the tubers. On the other hand, certified seed may carry appreciable quantities of scab and black scurf (Rhizoctonia). Seed showing black scurf will give a serious loss from seedling blight unless the seed is treated. If the stock is free from these surface diseases, there is nothing to be gained by treating the seed. Since most seed even if certified carry these diseases, it is usually a profitable practice to treat all seed before planting. The only equipment needed is a barrel or tank, a drain board, and baskets. By using a half-wooden barrel with a drain board 3 by 10 feet, made of one inch lumber and covered with roofing paper, and one dozen bushel stave baskets; two cutters can be kept busy. This equipment is adequate for a field of twenty acres or less. (Fig. 1) Metal containers and wire baskets may be used if they are covered with a good coating of asphaltum paint. The drain board should be placed so that after treatment the excess liquid will drain from the potatoes and back into the barrel.

**Acidulated Mercury Method.**—The potatoes are immersed in the following solution. Dissolve 6 ounces of corrosive sublimate in 1 quart of commercial hydrochloric acid (muriatic acid). Add this mixture to 25 gallons of water and stir solution thoroughly. The 25 gallons of solution will treat 40 to 50 bushels of potatoes unless they are very dirty. After this quantity has been treated, the solution should be strengthened by dissolving 1½ ounces of corrosive sublimate in ½ pint of hydrochloric acid and adding this mixture to the solution and also adding enough water to make the original volume of 25 gallons. After another 40 bushels have been treated, the solution should be thrown away. (Use caution in disposing of the solution, since mercury compounds are very poisonous. An effective method is to bury it in a pit.) The usual time of immersion is 5 minutes. If, however, there is considerable scab or black scurf, the time should be longer. If the potatoes are completely dormant they may be soaked for 30 minutes provided they are planted immediately or dried out carefully.

**Yellow Oxide of Mercury.**—An effective and simple treatment is made by using two pounds of yellow oxide of mercury (technical grade) to 30 gallons of water. This material should be stirred vigorously into the water with a wooden paddle. It will not dissolve but remains in suspension. The baskets of potatoes should be plunged up and down in the suspension two or three times to insure thorough wetting of the tubers. All that is neces-
sary is to be sure that the entire surface is thoroughly wetted. The suspension must be kept stirred to prevent settling. The agitation given by the baskets is usually sufficient. Thirty gallons will treat about 200 bushels of seed.

**Organic Mercury.**—There are several organic mercury compounds sold on the markets under trade names. These materials are simple to use and are quite effective. They should be used strictly according to the manufacturer's recommendations. Since no soaking period is required and unpainted metal containers can be used, the methods may prove satisfactory for the small grower.

**Cutting the Seed**

All potatoes showing rotten or badly diseased areas are thrown out when cutting the seed. Each seed piece must contain one healthy eye. The first cut is preferably made lengthwise of the tuber and through the apex. Further transverse cuts divide it into blocky pieces weighing from 1½ to 1¾ ounces each. (Fig. 2) Long wedge shaped pieces are to be avoided, since they rot more readily and are not handled uniformly by the planter. Where a large acreage is planted, it is necessary to employ enough cutters to keep the planter running. (Fig. 3) It is best to plant the seed as soon after cutting as possible. When this is not feasible, store the cut seed in shallow piles or half filled sacks in a well ventilated place, safe from freezing temperature and away from strong sunlight and drying winds. A temperature of 70° Fahrenheit and a high humidity will hasten healing of the freshly cut surfaces.

**Green Sprouting**—A practice that has been used for years in European countries and has recently become popular in this country is to allow the seed to develop short green sprouts by exposing
them to sunlight in a greenhouse. Potatoes treated in this way are more resistant to stem disease, mature earlier, and start to grow sooner. Most of the advantages of green sprouting can be secured by storing the seed for ten days to two weeks in a fairly warm place so that the sprouts start to grow. Potatoes should not be planted immediately after removal from storage. This is especially important if they have been held in cold storage.

**Seed Required.**—The amount of seed required will vary with the variety, size of stock and planting distances. If the seed pieces are planted 12 inches apart in rows 36 inches wide, 20 bushels of seed will be required for each acre. When closer spacings or larger seed pieces are used a proportionately greater amount of seed will be needed.

**Soil Preparation**

Special attention to soil preparation will increase the quality and yield of the early potato crop. The special requirement of this crop is a deep loose seed bed. Any operation which has a tendency to firm or pack the soil must be avoided.

Plowing is probably the most important of all soil preparation practices. The potato field should be plowed as deeply as possible. If the plowing has been shallow in the past, the plow sole should be lowered until the tilled area is at least 9 inches deep.
On shallow soils this will have to be done gradually since a large amount of subsoil thrown on the surface is detrimental. Some of the better potato growers regularly plow as deeply as 12 inches or as deep as the plow can be made to work. Spring plowing has come into favor for the crop since the soil does not have a chance to become compacted from winter rains and snows.

A winter cover of rye permits plowing earlier than when the land is bare. The soil containing the rye roots also remains in a loose condition longer. The spring plowing of rye in certain sections has increased yields to a greater extent than any other improved practice. It is probably needless to add that the soil should not be plowed when it is too wet. The only other preparation required is a light harrowing to level the surface. Potatoes do not require a firm fine seed bed. Any further preparation will only compact the soil to the detriment of the potato crop.

**Date of Planting**

As a general rule potatoes should be planted as early in the spring as the soil can be prepared. In Central Missouri this will occur between March 20, and April 1. Conditions will be satisfactory for planting potatoes a month earlier in the southeastern part of the state. Experiments and observations extending over a period of years have shown that both yields and quality are generally increased by planting as soon as the soil and weather conditions will permit. The yield is greatly reduced if planting is delayed much after April 1.

**Planting Depth.**—Tuber formation under ideal conditions takes place about four inches under the soil surface. Since some soil must be thrown over the rows when cultivating, 3 to 3½ inches is probably the proper depth. This will vary somewhat with the nature of the soil. Planting can be deeper on the light sandy soils than on the heavier types. A ridge is usually thrown over the row so that the seed are covered with six inches of soil. This is removed by harrowing so that the ground is level by the time the plants emerge.

**Planting Distance.**—Potatoes are planted in Missouri in rows varying from 30 to 42 inches apart with the seed pieces spaced from 8 to 16 inches in the row. The closer planting distances will require more seed per acre and usually increases the yield but may frequently cause a decrease in size. It is the common practice in this state, as well as in most potato producing areas, to space the plants 12 inches apart in 36-inch rows.
Cultivation

The primary object of potato cultivation is to control weeds. Cultivation of the crop should be as shallow as possible for many of the roots of the potato plant are near the surface of the soil. A cultivation practice that seems to have some merit is to cultivate deeply the centers of the rows before the plants emerge. This cultivation is used universally in the commercial potato districts and is given just as the sprouts start to grow, which is usually the second week of April. The chief advantages seem to lie in loosening the soil that has become compacted by the planting operations and spring rains.

Fig. 4.—A potato plant six weeks after planting. Note the extensive shallow root system.

During the latter part of April when the sprouts are about two inches long, the ridge is worked down by harrowing diagonally across the field. A second harrowing is frequently possible about a week later. The land is practically level by the time the plants emerge.

The first cultivation can be given with a weeder if the soil is in good condition by driving with the rows. This cultivation may be deep and fairly close to the row, but later workings should be shallow and far enough from the plants to make certain that no
roots are cut. (Fig. 4) Three cultivations are usually all that can be given before the plants occupy the ground. During the last cultivations, some soil is thrown towards the row to form a broad ridge. This ridge helps prevent sunburn, aids drainage and makes digging easier.

**Potato Insects**

There are not a great many insects which attack the potato. Dusting with calcium arsenate or other arsenicals is commonly the only insecticide necessary to use.

**Colorado Potato Beetle.**—This is the most destructive potato insect in Missouri. Most of the injury is done by the leaf eating larvae. Since it is a chewing insect, the control must be in the form of a stomach poison. Calcium arsenate may be applied as a dust using 5 to 10 pounds per acre. The dust is first applied when the bright yellow egg masses are discovered on the under sides of the leaves, and repeated as necessary. For small acreages, arsenate of lead or calcium arsenate may be used as a dust by mixing one part with twelve parts of gypsum or air slaked lime. When a spray is applied, use 1 to 2 pounds of the arsenical to 50 gallons of water.

**Leaf Hopper.**—This is a small, pale green, leaf sucking insect which causes what is known as “tip burn.” It can be controlled by the use of a standard 20-80 copper-lime dust or a 3-4-50 Bordeaux spray. To be effective against leaf hopper the material must be applied at the proper time and in such a manner that both the upper and lower surfaces of the leaves will be covered. The first application is generally made when the vines are about 6 to 8 inches high, and the succeeding 3 to 4 applications, at intervals of one week or ten days. When it is necessary to control the Colorado potato beetle and leaf hopper at the same time, arsenicals may be added to the dust or Bordeaux mixture. The Bliss Triumph variety is the only one grown in this state that is seriously affected by leaf hoppers. Attempts at control are not always profitable even on this variety.

**Flea Beetle.**—These little beetles are responsible for the small round holes in the potato leaf. The adult is a bright, black, hard shelled insect about one-twentieth of an inch long. Thorough spraying on both the upper and lower surfaces of the leaves with Bordeaux mixture to which arsenicals are added will control the flea beetle. The first application should be made when the plants are 3 to 4 inches high as they are most destructive in the early stages of plant growth.
White Grubs and Wire Worms.—These insects cause considerable losses by eating holes in the surface of the tubers. They are most troublesome on new land and fields having been in sod the previous year. It is better to follow sod or new land with some cultivated field crop before planting to potatoes. The injury is more serious if digging is delayed after the crop reaches maturity.

Potato Diseases

Missouri growers are indeed fortunate in that the disease problems are less serious in this area than in most of the other potato producing states. Commercial control can be secured by using certified stock, seed treatment and careful soil management.

The potato grower has to deal with three types of diseases: (1) Those which are carried within the tuber, such as mosaic and spindle tuber; (2) those usually carried on the surface of the tuber, as common scab and rhizoctonia; and (3) those that affect the foliage of the plant, such as tip burn.

![Fig. 5.—Dry stem rot, the form of rhizoctonia which causes the greatest damage in Missouri.](image)

The more important tuber-borne diseases affecting potatoes under Missouri conditions are: Rhizoctonia, common scab, bacterial ring rot, wilt, mosaic, and spindle tuber. The only foliage trouble of importance is tip burn (hopper burn). The blights which affect the foliage are seldom serious in Missouri.
**Rhizoctonia (Black Scurf).—**The fungus which causes this disease is responsible for such common symptoms as black scurf, dry stem rot, russet scab, “little potato,” and “dwarf rosette.” The most common form is the black scurf which is characterized by the small black dirtlike masses, which adhere to the surface of the potato. This stage is believed to be the main source of infection under Missouri conditions. The form of rhizoctonia which causes the greatest damage in this state is the dry stem rot as shown in Figure 5. This stage is characterized by the small sunken area of a brownish black color which attacks the surface of the underground stem, often girdling the plant at the surface of the soil. Missing hills and small sickly plants are often caused by this disease.

**Control Measures.**—Use only seed which are comparatively free from rhizoctonia and treat the potatoes before cutting, as described under seed treatment. Although the main source of infection is diseased seed, the fungus also lives over in the soil.

Allowing the potato field to lie fallow from harvest time until fall is an important factor in reducing the carry-over of this disease. Crop rotation is also advised. This disease also attacks hairy vetch and alfalfa which may become sources of infection for the potato crop.

**Potato Scab.**—Potato scab (Fig. 6) is one of the very common potato diseases with which most potato growers are acquainted. It can be distinguished by its rough, corky brownish areas on the surface of the tubers. In severe cases these corky areas may form a crust over the entire potato. Although the effects of this disease may not be noticeable on the growing plant, the blemishes and roughening of the tubers greatly reduce their market value and often make them unsalable.

**Control Measures.**—Seed treatment will kill most of the scab spores on the seed stock but has little value when the soil is already infected. Scab is most severe in slightly alkaline soil. Therefore, it is wise to avoid the use of land that has been heavily limed within two or three years. If several crops of alfalfa or clover have been removed since liming, it may be quite satisfactory for potatoes. Commercial fertilizers should be used as a source of plant food rather than manure unless the manure can be applied long enough before potato planting for it to have become at least partially decayed. The use of legumes as green manure crops and practicing
crop rotation will aid in controlling scab. The general control for scab is seed treatment and the avoidance of alkaline soil.

**Fusarium Wilt.**—This disease affects both the plant and tuber. On the plant it is characterized by the gradual rolling and discoloration of the lower leaves. This condition continues until the whole plant wilts. Affected tubers show the characteristic discoloration of the water vessels of the tuber (Fig. 7). A cross section of the stem end of an infected tuber will show the discoloration, which extends through the potato toward the "seed" end. The extent of the discolorations will depend on the severity of the infection. The organism causing the disease is carried in the tuber and is known to live over in the soil.

**Control Measures.**—The use of disease free seed and crop rotation are the two principal methods used in controlling wilt.

**Bacterial Ring Rot.**—This is a relatively new disease that has caused serious losses in certain potato districts. The organism survives the winter in the seed tubers but does not live over in the soil. The disease attacks the entire plant causing wilting and yellowing of the foliage and rotting of the tubers. It has been shown that the bacteria may be spread from diseased tubers to healthy seed pieces by the cutting knife. For this reason a small percentage of bacterial ring rot in the seed may cause a great many diseased plants to develop in the field.

**Control Measures.**—The only known practical means of control is the use of disease free seed and this means seed from fields where the disease did not occur. Seed, therefore, should come from
fields inspected and certified that none of the disease was present.

**Degenerative Diseases.**—Potato growers have long recognized that potato strains grown for several years degenerate or "run out." Scientists have shown that this is not due to climate, cultural practices, senility or bacterial or fungous parasites, but that it is caused by an infective agent termed a virus. This agent is present in the juice of all "run out" potato plants, and when any of the virus is transmitted by sucking insects such as aphids and leaf hoppers, to healthy plants, they become diseased. These diseases live over winter in the seed tubers. There is the possibility that weeds related to the potato plant carry the diseases from one year to the next in their root systems. Fortunately, the virus does not live from year to year in the soil. The degenerative diseases called Leaf Roll, Spindle tuber, Mosaic and Giant Hill are the ones most commonly seen in Missouri.

**Control Measures.**—The control of these diseases lies in the use of disease free seed since the disease is perpetuated only in the tubers. No form of seed treatment is effective and no sprays are beneficial. The infected tubers cannot be told from healthy stock until the plants have developed. The fields from which seed are secured must be inspected carefully and all of the diseased plants removed. The symptoms of these diseases are more easily identified in the northern states. Also the insects causing their spread are less numerous so that they are much easier to control. This is the chief argument for planting northern grown certified seed.

**Harvesting**

The potato tubers continue to grow until the vines are almost dead. The commercial crop is marketed as new potatoes and is frequently dug as soon as profitable yields can be harvested. Digging usually begins around the first of July but may start two weeks earlier in favorable seasons. The markets at this time generally pay a better price than later in the season. When potatoes can be dug during the first part of July, they will be on the market before the bulk of the crops from the Northern districts.

Potato buyers frequently complain that the Missouri potato crop is dug before it is sufficiently mature to reach the market in good condition. The grower should make a careful study of his market. The best prices are paid for the maturity and quality most in demand. A determined effort should be made to supply the consumers with the kind of potatoes they want to buy.
On the average farm where potatoes are being grown for home use, it is better to leave them in the ground until they are fully mature. If the skin no longer slips when pressed with the thumb, the tubers have stopped growth and are considered to be matured. When the vines are almost dead, there is nothing to be gained by permitting the potatoes to remain in the ground. Therefore, they should be dug and placed in the best storage available. The soil is a poor storage place during the hot summer months.

Power driven elevating diggers are favored by commercial growers, but a large acreage must be planted to justify the purchase of a machine. A side digger is most practical for small acreages. This machine is constructed like an ordinary plow with the mouldboard replaced by steel rods. Regardless of the type used, it should be run deeply enough to carry over considerable soil to reduce bruising and cutting to the minimum.

The freshly dug potatoes should not be allowed to lie exposed to the direct rays of the sun for any length of time. They should be picked up as soon as the soil dries. When the temperature is high and the soil dry, they must be picked up as soon as dug. Commercially grown potatoes are picked into 5½ bushel wire baskets and poured into burlap bags. (Fig. 8) The half-filled bags are then hauled to the grading and washing sheds. When pickers are paid by the piece, two baskets are considered to equal one bushel. The potatoes must be handled carefully since they are immature and are easily scuffed, bruised or cracked. It is necessary to caution the pickers and handlers of the importance of careful handling and constantly supervise their work. Conditions are very favorable at the time of year when the potatoes are dug for the growth of rot-producing organisms which gain entrance through breaks in the skin.

Storage

Many growers of potatoes for home use make the mistake of allowing the crop to remain in the ground exposed to the torrid heat of late summer. This is permissible only when there is no better storage place available. The ideal storage for potatoes is a cool, dark place where a high humidity can be maintained and adequate ventilation given. The temperature should be as low as possible with one of 40° F. being optimum. If such conditions are not available, the potatoes should be placed in the coolest, best ventilated place available. The Irish Cobbler is the best of the early
varieties for storage because of the long rest period. It can be carried through the summer without serious loss from shriveling and sprouting.

The crop intended for storage should be allowed to become fully mature before digging. It must be handled carefully since only potatoes that are entirely free from mechanical injury are suitable. Tubers showing deep scab, worm holes or other disease injury must also be sorted out.

The potatoes after digging should be cured before placing in storage. During this period a cork formation takes place over wounds which protects the contents of the tuber from the invasion of rot producing organisms. The conditions optimum for cork formation are a high temperature of 70° to 80° F. and a very high humidity. The potatoes must be held in the dark away from strong winds, and should be kept in shallow piles to avoid heating. After curing, the potatoes should be removed to the best storage available.

The outside storage cellar is much preferred to the storage pit. If the storing of a quantity of potatoes is a yearly practice, it will pay to erect a storage cellar, which will be a permanent structure. A pit is for temporary use only and unless it is made and handled carefully, including good ventilation, the potatoes will not keep properly.

The making of a storage pit is a very simple procedure. Select a well drained spot and remove the soil to the depth of from 1 to 3 feet. Place a 6 to 8 inch layer of straw in the bottom of the pit to keep the potatoes from coming into direct contact with the soil. If a large quantity of potatoes is to be stored in this way, the pile should be narrow and the potatoes should not be piled over five feet deep. Openings should always be left in the top for ventilation. These may generally be left open, but when the temperature is low it is well to close them with burlap bags or other material. The potatoes should not be placed in the pit until late fall or until the days have become fairly cool. The first covering should be of coarse straw or hay. As cold weather approaches, an inch or two of soil should be placed over the straw. It is a good plan not to put all the soil on at one time but to add soil at intervals so that the potatoes will be covered with a ten-inch layer of soil before hard freezing weather occurs.
Marketing Potatoes

The crop must be handled rapidly and carefully to get the product to market in the best possible condition. The potatoes should be removed from the field immediately after digging, graded, washed, dried, bagged, loaded into cars and pre-cooled during the day in which they are dug. Many growers start digging at 4:00 A.M. and have the cars ready by mid-afternoon.

The commercial crop is graded in special sheds built along a railroad siding. The grading operations consist of mechanical separation on the basis of size and picking out the defective tubers by hand. From 5 to 30% of the potatoes may have to be thrown out to bring the product up to grade. Any defect which detracts from the appearance, table quality and keeping will lower the market value. To grade U.S. No. 1, the potatoes must contain less than 1% decaying tuber and less than 6% of defects which detract from table quality or appearance. The standard U.S. grades are recognized on all central markets. The commercial grower should familiarize himself with the requirements of the various grades. This information can be secured through the office of the county agriculture extension agent. A grower who desires to build up a reputation for his product will have to put up the highest grade possible. Some seasons are so unfavorable that the higher grades cannot be packed. Such crops should be graded as highly as possible and true claims made about the actual quality.

Washing has become popular during the last few years largely because of the premium paid for clean stock. This practice permits earlier digging and digging during wet weather. The washed stock must be dried and pre-cooled or the product will decay rapidly. It is quite evident that washing will not improve the appearance of poor stock but even makes the defects more prominent. Such potatoes will not keep as well when washed since decay organisms are washed into the openings in the skin. Moreover, they are difficult to dry. Warm dry air is blown over the potatoes as they leave the washer. Additional drying is accomplished by pre-cooling the cars with dry cold air.

Practically all of the potato crop is marketed in new 100 lb. burlap bags carrying the brand, name and address of the grower. A few new crop potatoes have been sent to market in adjoining states in 15 lb. mesh bags. The operations were successful and this container can be used for the Missouri crop if market demand warrants its use. Washing and the use of small bags may aid in the marketing of a high quality product but may become a distinct disadvantage in handling low grade potatoes.
Fall Crop Potatoes

During favorable seasons potatoes can be planted in late summer to mature just before frost. The plants make very little growth during the warm weather, but after the days become cool, they grow rapidly. This method frequently fails owing to dry summers and an early frost in the fall. It is most successful in the extreme southeastern portion of the state where the rainfall is more evenly distributed and the growing season is longer. The Bliss Triumph variety is usually used for the fall crop since seed saved from the spring crop can be replanted later in the summer. If potatoes of this variety are held in a warm, dry, well ventilated storage for a month after digging, they will usually grow readily when planted.

A chemical known as Ethylene Chlorhydrin is sold in solution form to be used in breaking the rest period of seed from the spring grown crop. This material should be used according to the manufacturer’s directions. The Red Warba also has a short rest period and can be used for the fall crops. If the Irish Cobbler or any of the late varieties is used, the seed from last year’s crop must be kept in cold storage until time for planting. The fall crop seed are treated and prepared for planting in the same manner as the spring crop.

The best date for planting will vary from June 25, in Northern Missouri to August 1, for the southeastern district. The soil should be in the best of condition and amply supplied with moisture. The seed will rot before they can grow if planted in dry soil. The grower contemplating a fall crop should do so with the knowledge that the yields are as a rule much lower than those secured in the spring and that total failures are quite frequent.

Straw Mulch for Potatoes

The growing of Irish potatoes under a straw mulch has proven successful in some years under Missouri conditions. The seed pieces are covered with a thin layer of soil and about 8 inches of wheat straw. The chief advantages of growing potatoes under straw mulch are: It aids in the control of weeds, and in that way helps conserve the soil moisture. It also lessens the possibility of sunburning which sometimes occurs to the potatoes which are exposed to the sun during the latter part of the growing season. One disadvantage of the growing of potatoes under straw mulch is the increased labor and time necessary to apply the straw. Also, unless the soil is fertile and well supplied with nitrogen, the decaying straw may rob the crop of this plant food.