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Potato Growing in Missouri

A general view of the potato experiment plots of the College of Agriculture, Columbia, Missouri.

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Potato Growing in Missouri

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ABSTRACT.—Recommendations are given for the culture of potatoes based on experiments at the Missouri Agricultural Experiment Station. Data are given which show the value of some different fertilizers, alone and in combination with barnyard manure and green manures. Acid phosphate in combination with barnyard manure gave economical returns. The largest yield, 327.9 bushels per acre, followed the use of 400 pounds of a 3-12-4 fertilizer plus 8 tons of barnyard manure, plus soybeans as a green manure. Data on the rate of application of a complete fertilizer showed greatest net returns from applications of 400 to 500 pounds per acre. Over a period of three years, certified northern grown seed potatoes showed an increase over spring home grown seed of 22.7 bushels for the Irish Cobblers, and 25.6 bushels for the Early Ohios. Date-of-planting tests indicated that on the average for Central Missouri, the highest yields were received from potatoes planted between March 20 and March 30. The corrosive sublimate method of seed treatment gave an average increase of 27.1 bushels while the hot formaldehyde method (1 pt. to 15 gals. water, 122°-124° for 4 min.) gave an increase of 22.8 bushels. Soils, crop rotations, varieties, planting, diseases, and insects, harvesting, grading, storage, late potatoes and straw potatoes are discussed.

Missouri produces approximately 7,000,000 bushels of potatoes annually on 90,000 acres. The average yield per acre for the last ten years is 74 bushels. The annual consumption of potatoes in the State is nearly 12 million bushels. This marked difference between production and consumption can be greatly reduced through the adoption of cultural methods that increase the yield per acre.

The principal commercial potato growing sections in Missouri are: the east central district consisting of St. Louis, Jefferson and St. Charles Counties, and the west central district consisting of Ray, Clay and Jackson Counties, which is known as the Orrick district. Buchanan and Andrew Counties in the northwest, known as the St. Joseph district are also important in potato production. Although the greater part of the commercial acreage is grown in these districts, it will be noted from figure 1 that potatoes are grown in every county in the State.

SOILS

While the potato may be grown on a wide range of soils, maximum yields and most profitable returns are generally obtained on soils that are loose and friable, well drained, and contain a liberal amount of plant food. Soil lacking in plant food can be improved easily through the application of barnyard manure, green manures and commercial fertilizers.

CROP ROTATION

No definite system of crop rotation for potatoes can be recommended which would suit the various crops in different sections of the State. In the districts where potatoes are grown on a commercial scale, the three-year

rotation is most common. On the general farm where crops are grown in greater variety, a three-, four- or five-year rotation may be used.

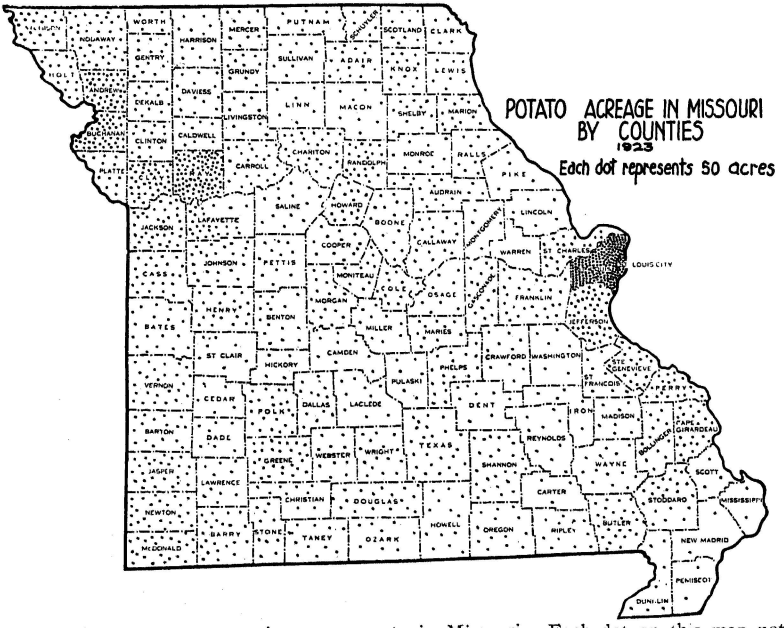

Fig. 1.—Potatoes are grown in every county in Missouri. Each dot on this map not only represents 50 acres of potatoes grown in 1923, but indicates that for each dot approximately one carload of seed potatoes was used.

Although some growers produce fair yields cropping continuously the same land, it is known that by following some system of crop rotation the fertility of the soil may be maintained in a more satisfactory way and the possibilities of loss from diseases which live over in the soil greatly decreased. A rotation used by some of the potato growers in the commercial districts is as follows:

FIRST YEAR.—Potatoes. Followed by soybeans or cowpeas turned under for a green manure in the fall.

SECOND YEAR.—Potatoes. Followed by fall seeding of wheat.

THIRD YEAR.—Wheat. With either red or sweet clover drilled or broadcast on the wheat in the spring and turned under for green manure in the fall of the same year.

Another system of cropping which is used to some extent in the Orrick district is as follows:

FIRST YEAR.—Potatoes. Followed by wheat in the fall.

SECOND YEAR.—Wheat. With red clover drilled or broadcast on the wheat in the spring. The stubble clover may be turned under in the fall as a green manure or the clover may be left for the next year.

THIRD YEAR.—Clover. Cut the first crop of clover for hay and turn under second crop.

A longer rotation adapted to general farming is as follows:

FIRST YEAR.—Potatoes. Followed by soybeans or cowpeas turned under for a green manure in the fall.

SECOND YEAR.—Corn. As a grain crop or with soybeans or cowpeas to hog down.

THIRD YEAR.—Oats. Clover sown with oats.

FOURTH YEAR.—Clover.

For some of 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. In this way the fertility of the soil may be maintained by following the potatoes with a green manure crop and by heavy applications of barnyard manure following the truck crop.

GENERAL CONDITIONS OF EXPERIMENTS

The experiments reported in this publication were conducted on the truck crops field of the Missouri Agricultural Experiment Station at Columbia, Missouri, on Putnam silt loam of medium to low productivity. With the exception of the fertilizer experiments, no commercial fertilizer was used. The land was fall plowed each year. Weather conditions for the different years varied greatly. The seasons of 1921 and 1922 were only fairly favorable, the 1923 and 1924 seasons were very favorable, being above the average for potato production. The season of 1925 proved to be one of the most unfavorable experienced by Missouri potato growers for many years. This variation in weather conditions is reflected in the yields for the different years.

Planting for these experiments, with the exception of the date-of-planting tests, was done about the first of April. For the 1921 and 1922 experiments, the rows were 42 inches apart and the seed pieces spaced exactly 15 inches in the row, 100 seed pieces being used for each plot. In 1923, 1924, and 1925 the rows were spaced 40 inches apart, spacing the seed exactly 15 inches in the row, 120 seed pieces being used in each plot. Check plots were used throughout the experiments and the yields have been corrected accordingly. Certified northern grown potatoes were used and the seed pieces cut to average about 1½ ounces each. The potatoes were harvested the latter part of July, and graded into No. 1s and culls, the grading being done through a screen, to meet U. S. Standard grades. The yields have been calculated upon the actual stand.

FERTILIZERS

Most Missouri soils are lacking in phosphorus. A number of fertilizers high in phosphorus were, therefore, used to determine what combinations of fertilizers with different rates per acre would give the most profitable returns. The Irish Cobbler and Early Ohio varieties were used.

Potatoes for the 1923 crop were planted on April 9, the 1924 crop on April 12, and the 1925 crop on April 8. The plots received the ordinary cultivation usually given a commercial crop. Bordeaux sprays were not applied, but one application of arsenate of lead was made each year for the control of the Colorado potato beetle. The crop was harvested each year during the latter part of July, the 1923 and 1924 seasons being somewhat longer than the previous years. Table 1 gives the results of the use of some of

the more common fertilizer mixtures. The fertilizer was applied in the row, being mixed into the soil with a small garden cultivator before planting the seed pieces.

TABLE 1.—FERTILIZER EXPERIMENT FOR 1923-1924

Treatment	Yield in bushels per acre			
	1923		1924	
	Early Ohio	Irish Cobbler	Early Ohio	Irish Cobbler
No treatment	141.3	165.2	151.5	166.1
3-12-4* fertilizer 400 lbs per acre	245.2	247.9	191.7	264.1
3-12-0 fertilizer 400 lbs per acre	229.7	221.2	168.1	227.1
0-12-4 fertilizer 400 lbs per acre	212.6	192.2	195.3	220.7
Acid phosphate (16%) 300 lbs per acre	202.9	214.8	165.2	221
No treatment	148.6	154.2	150	162.5
2-12-0 fertilizer 400 lbs per acre	217.2	197.6	166.2	206
2-12-2 fertilizer 400 lbs per acre	223	202.4	173.1	215.4
2-12-4 fertilizer 400 lbs per acre	229.6	185.5	172.7	218.5
2-12-6 fertilizer 400 lbs per acre	215.7	188.6	174.6	216.7
No treatment	162.7	169.6	144.4	165
2-16-2 fertilizer 400 lbs per acre	238.9	204.4	195.2	232.5
3-8-6 fertilizer 400 lbs per acre	192.1	209.1	187.5	217.6
4-12-2 fertilizer 400 lbs per acre	238.48	242.7	190	203.9
6-12-2 fertilizer 400 lbs per acre	242.05	197.6	186.6	190.1

*3% ammonia (equivalent to 2.47 nitrogen), 12% phosphate, 4% potash.

RESULTS OF FERTILIZER EXPERIMENTS

In Table 1 are presented the yield data for the fertilizer experiments of 1923-1924. Although fluctuations occur, the larger yields were produced where a high grade complete fertilizer containing a high percentage of phosphorus in combination with from 2 to 4 per cent of nitrogen and 2 to 4 per cent of potash was used. In the first series it would seem that nitrogen was slightly more important than potash. In the second series very little difference is noted between the use of from 2 to 4 per cent of potash. The greatest difference is shown between the yields where no potash was used and where only 2 per cent was used.

Table 2 gives the results of the use of manure, green manure and fertilizers, alone and in combination. The soil in this experiment was all fall plowed with the exception of the rye plots which were plowed in the spring. The manure in all cases was applied in the fall. The soybeans and rye were sown the first week in August, the soybeans being turned under in November.

It is evident from these results that barnyard manure, when available, is one of the best forms of fertilizer to use. It not only adds the necessary plant food, but adds humus, which is so necessary in building up a potato soil. Although, some of the highest yields received were from the use of a 3-12-4 fertilizer in combination with barnyard manure and a green manure, it should be noted that very economical returns were received from

300 pounds of acid phosphate in connection with barnyard manure. The low yields received where rye alone was used are without a doubt due to the fact that the rye was turned under only a few weeks before the potatoes were planted. As a result, the soil was in poor physical condition to work at the time of planting and during most of the season. When rye is plowed under in the spring and followed by wet weather it is unsatisfactory as a green manure crop before potatoes. The harmful effects of spring plowing

TABLE 2.—FERTILIZER EXPERIMENT FOR 1923-1924

Treatment	Yield in bushels per acre			
	1923		1924	
	Early Ohio	Irish Cobbler	Early Ohio	Irish Cobbler
No treatment	143.7	148.1	135.83	153.1
Manure, 8 tons per acre	241	241.6	169	225
Manure, 8 tons per acre plus soybeans	154.9	156.3	122.4	258.3
Manure 8 tons per acre plus rye	141.6	133.5	158.3	237.8
Soybeans only	193.12	152	146.3	160.2
Rye only	133.6	102.4	129.9	141.1
3-12-4 fertilizer 400 lbs per acre	241.4	260.6	236.9	277.3
3-12-4 fertilizer 400 lbs per acre plus 8 tons manure	270.12	274.3	228.7	297.5
3-12-4 fertilizer 400 lbs. per acre plus soybeans	226	206	227.9	243.6
3-12-4 fertilizer 400 lbs per acre plus rye	243.9	235.4	235.5	259.8
3-12-4 fertilizer 400 lbs per acre plus 8 tons manure, plus soybeans	221.1	263.1	270.3	327.9
3-12-4 fertilizer 400 lbs per acre plus 8 tons manure plus rye	259.4	253	255.1	315.9
Acid phosphate (16%) 300 lbs per acre	199.1	177.5	150.4	234.8
Acid phosphate 300 lbs per acre plus 8 tons manure	265.6	236.5	232.5	260.2
Acid phosphate 300 lbs per acre plus soybeans	219.3	202.4	189	241.2
Acid phosphate 300 lbs per acre plus rye	226.1	169.5	246.6	252.2
Acid phosphate 300 lbs per acre plus 8 tons manure plus soybeans	261.9	282.6	264.2	323.1
Acid phosphate 300 lbs per acre plus 8 tons manure plus rye	226.2	188.5	255.5	308

were noted wherever rye was used with the exception of where it was used in combination with acid phosphate or the 3-12-4 fertilizer and 8 tons of barnyard manure. In these cases the poor condition of the soil caused by spring plowing did not offset the beneficial effects of the commercial fertilizer and barnyard manure.

On plots where soybeans plus 8 tons of manure were used, an excessive top growth was noted. The yields from these plots indicate that the excessive top growth, caused from the addition of too much nitrogenous material, was at the expense of yield.

From the results presented in Table 1 and Table 2, it would seem that on a silt loam soil of medium fertility a 3-12-4 fertilizer or acid phosphate in combination with barnyard manure or soybeans should be used.

Rate of Application of Fertilizer.—The amount of fertilizer to apply is not governed entirely by the maximum returns received, but rather from the amount that will give the most economical returns. Table 3 gives the results of applications of from 100 to 1200 pounds per acre over a period of five years.

TABLE 3.—RATE OF APPLICATION OF FERTILIZER

Treatment	Yield in bushels per acre								
	1921	1922		1923		1924		1925	
	Early Ohio	Irish Cobbler	Early Ohio	Irish Cobbler	Early Ohio	Irish Cobbler	Early Ohio	Irish Cobbler	Early Ohio
No fertilizer	52.2	105.1	106.8	138.9	126.8	132.4	140.17	42.02	54.12
100 lbs. 2-12-2*	76.0	120.6	127.2	156	141.6	160.5	153	39.78	72.61
200 lbs.	98.4	117.4	151.9	162	155	178.2	166.8	55.17	91.09
400 lbs.	109.8	134.2	159.5	246.8	187	242.8	252	76.10	109.34
800 lbs.	127.4	143.6	156.6	251.2	191.3	251	256.4	68.82	110.39
1200 lbs.	132.3	141.1	173.2	238.1	207.2	------	------	71.12	113.5

*2-12-2 used in 1921-1922.
3-12-4 used in 1923-1924-1925

The larger yields of 1923 and 1924 are due mainly to the more favorable weather conditions of those years. It should also be noted that a 2-12-2 fertilizer was used in 1921 and 1922, while a 3-12-4 fertilizer was used in the 1923, 1924 and 1925 experiments. Although increased yields were generally obtained where as much as 1200 pounds of fertilizer were used, it is evident that the increased yield for each 100 pounds of commercial fertilizer is small after the application of the first 400 pounds. It is possible that on similar soils low in fertility 450 to 500 pounds of fertilizer per acre might be used, but on the type of soil generally used for the production of potatoes, 400 pounds will usually give the most economical returns.

VARIETIES

Variety tests* with potatoes at this Station have shown that the Irish Cobbler and Early Ohio varieties for the spring crop are superior to other varieties tested. For the fall crop, the Rural New Yorker, Russet Rural, McCormick, Peach Blow, and "Real Irish" have been the most promising. Over a period of seven years, for the spring crop, the Irish Cobbler and Early Ohio varieties have averaged about the same. However, there is a tendency for the Early Ohio to produce a large percentage of "knobby" potatoes and growth cracks during unfavorable years. The Bliss Triumph is another variety for the spring crop, which is being grown to some extent. Although this variety generally produces a good yield and is usually a week earlier than the Irish Cobbler, its susceptibility to potato mosaic has been the main cause for practically eliminating it from Missouri. This disadvantage

* Missouri Agricultural Experiment Station Bulletin 191.

may be overcome by the fact that strict supervision of seed certification in some of the Northern States is furnishing Bliss Triumph seed, which has for the last three years shown a negligible amount of mosaic present.

Irish Cobbler.—One of the best early varieties for Missouri. It is of good quality, matures early, and usually yields a few bushels more per acre than the early Ohio. The vines are medium in size, with dark green stocky stems. The flowers are light purple in color, often fading to white. The tubers, figure 2, are roundish in shape, eyes few, and vary from shallow to deep. The skin is smooth and creamy in color.

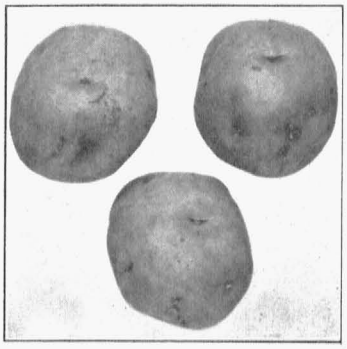

Fig. 2.—Irish Cobbler. One of the best early varieties for Missouri.

Fig. 3.—Early Ohio. An early variety well adapted to Missouri.

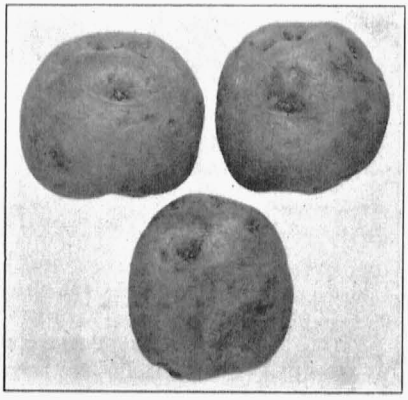

Fig 4.—Bliss Triumph.

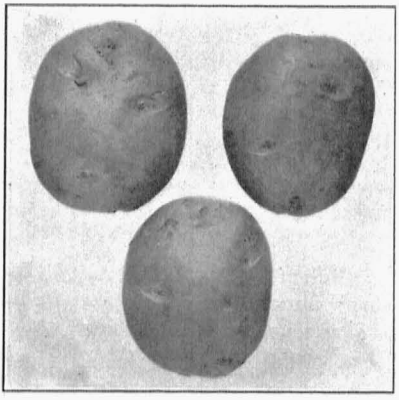

Fig. 5.—Rural New Yorker (White Rural).

Early Ohio.—A good early variety. Matures at about the same time if not a few days earlier than the Irish Cobbler. The flowers are white. The tubers, figure 3, are round to oblong, with rounded seed and stem ends. The eyes are shallow. The skin varies from a light pink to a reddish hue in color. The principal objection to the Early Ohio variety, is its tendency to produce "knobby" potatoes or second growth during seasons having unfavorable weather conditions.

Bliss Triumph.—An early variety usually a few days to a week earlier than either the early Ohio or Irish Cobbler. The vines are dark green in color, upright, with little branching. The color of the flowers is a very light rose to purple. The tuber, figure 4, is small to medium in size, of a blocky shape, slightly shouldered on the stem end. The eyes are few in number slightly depressed. The deep eyes at the seed end are characteristic of the variety. The skin is light red in color. Success with the Bliss Triumph in Missouri depends almost altogether on good seed. If home grown or common Northern grown seed which carries a high percentage of mosaic is planted, the crop will be a failure. It is only through the use of high grade certified disease-free seed that any degree of success can be obtained with this variety.

Rural New Yorker (White Rural).—A good late variety. The vines are medium large, upright, and rather long pointed. The stems are usually streaked with dark purple. The flowers range from a deep violet in the center to a faded violet as the other portions of the flower are reached. The tubers, figure 5, are round to round oblong, usually flattened. The eyes are few and very shallow. The skin is creamy white in color.

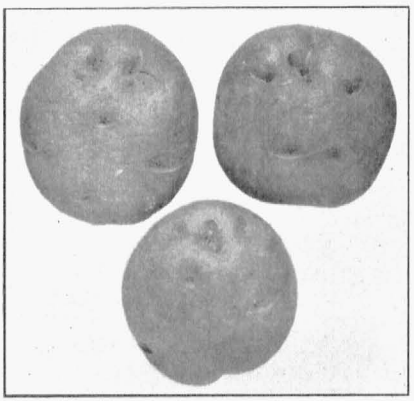

Fig. 6.—Russet Rural. One of the best varieties for the fall crop in Missouri.

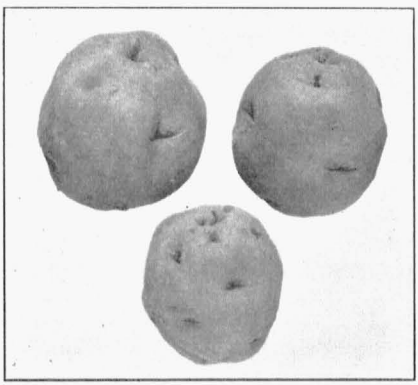

Fig 7.—Peach Blow. A variety for the late crop well suited to the home garden.

Russet Rural.—This variety (figure 6), is similar to the White Rural in many respects, its main difference being the color of the skin. As the name suggests, the skin is of a deep russet color, and usually quite heavily netted. It is one of the principal varieties for the late crop. Both the White and Russet Rural keep very good in storage and are much in demand for baked potatoes.

Peach Blow.—A late variety grown to a considerable extent as a late crop for the home garden. Produces a large healthy vigorous vine with sturdy stems. The flowers, usually abundant, are medium purple in color. The tubers, figure 7, range from round to round oblong in shape. The eyes, which are medium in number, are fairly shallow on the main body of the tuber, but very deep in the eye cluster at the seed end. The potato is a very good keeper, staying dormant for the late crop under favorable common storage conditions.

Real Irish.—A local variety grown in St. Louis County. It is one of the principal late commercial varieties for that section. The growing plant has much the same characteristics as that of the Green Mountain variety. The tubers are rather broad, ranging from round oblong to round, usually slightly shouldered on the stem end. The eyes are shallow and few to medium in number. The skin, which is very tender, is of a creamy white color.

SEED

Sources of Seed.—Most of the larger commercial growers in Missouri are using northern grown certified seed, but there is still a large acreage being planted annually with spring home grown potatoes. The principal objection to northern seed among some growers has been its cost. The first cost to the grower may be higher for northern grown seed, but the increased returns will more than offset the additional price. The results from the use of seed from different sources are shown in Table 4. In general, the certified northern grown seed gave the highest total yield and the lowest percentage of cull potatoes. However, very little difference is noted when compared with the fall home grown seed, except for the year 1925, when the percentage of culls of the fall home grown potatoes was very high. The short period of common storage for the fall home grown seed is one of the principal factors in making it compare so favorably with certified northern grown potatoes.

TABLE 4.—RESULTS OF SOURCE OF SEED EXPERIMENT

Variety	Seed Source	Yield in bushels per acre					
		1923		1924		1925	
		Total Yield	Per cent Culls	Total Yield	Per cent Culls	Total Yield	Per cent Culls
Irish Cobbler	Northern Grown Certified Seed	142.2	22.4	156.8	17.8	78.4	18.1
	Northern Grown Not Certified	128.6	27.1	141	21.6	56.8	23.4
	Fall Home Grown	139.4	23.6	142.7	18.2	71	22.8
	Spring Home Grown	118.6	43.2	126.3	39.1	64.5	36.4
Early Ohio	Northern Grown Certified Seed	145.5	26.7	153	22.5	76.8	24.7
	Northern Grown Not Certified	132.6	38.2	136.2	26.2	70.2	26.2
	Fall Home Grown	140.2	24.8	148.8	21.3	88	33.8
	Spring Home Grown	121.9	49.6	117.4	46.8	59.4	38.1

The inferiority of the spring home grown seed is not only shown in the low yield but especially in the large percentage of cull potatoes. It is very evident, and is known from experience by large commercial growers, that profitable yields cannot be obtained from the continued use of spring home grown seed.

Certified Seed.—The large amount of northern seed potatoes used by Missouri and other Central and Southern States has caused a number of the

Northern States to give particular attention to the production of a special crop for this trade. This special crop is in the form of certified seed. Certified seed is the outcome of the production of potatoes under a state inspection service. To be able to qualify as a producer of certified seed, a grower must have at least two field inspections and one bin inspection. The field inspections are for the purpose of detecting varietal mixture, and such diseases as rhizoctonia, mosaic, black-leg, spindling-tuber, curly-dwarf, leaf-roll, or others that show up on the plants in the field. The bin inspection is for the purpose of detecting diseased tubers and the grade. If the inspector finds the potatoes conform to the requirements for certification for his particular state, he issues certificates and inspection tags. The certified potatoes are then sacked and sealed with the official tags. See figure 8.

Fig. 8.—Front and back of the official tag, with seal, as used on all bags of Minnesota certified seed potatoes. All Northern grown certified seed potatoes will have similar official tags. Different states having various forms.

Strains.—Experiments* at this Station have shown that there is a great difference between strains within a variety. Realizing this to be of great importance to the growers, trials of a large number of the leading strains from Northern states are conducted each year. Differences in strains have run as high as 120 bushels. High yielding strains have been observed to continue the trait year after year.

Cutting the Seed.—Only well shaped, disease-free potatoes should be used for seed purposes. Each seed piece should contain one or more healthy eyes and average from 1½ to 2 ounces in weight. In general, blocky seed pieces as shown in figure 9 are to be preferred to wedge-shaped pieces. The blocky pieces will work much better in the automatic planters than will thin or ill-shaped pieces. The potatoes should be planted soon

* Missouri Agricultural Experiment Station Bulletin 191.

after they are cut; or if this is impossible they should be spread out in a cool dry place. If cut potatoes are stored in bags or piled to any appreciable depth, heating may take place and the vitality of the seed reduced.

Where the acreage of potatoes to be planted is large, it is often necessary to cut a considerable quantity of seed before planting operations start. Under such conditions the seed pieces may be dusted with sulphur or gypsum. Either of these materials will tend to decrease the amount of water lost through the cut surfaces, thereby preventing to some extent the shriveling of the seed piece.

The amount of seed required per acre will vary with the variety, size of potatoes used for seed, and planting distances. The Irish Cobbler, having fewer eyes than the Early Ohio, will usually require a few more bushels per acre. The commercial growers in Missouri plant from 12 to 18 bushels per acre.

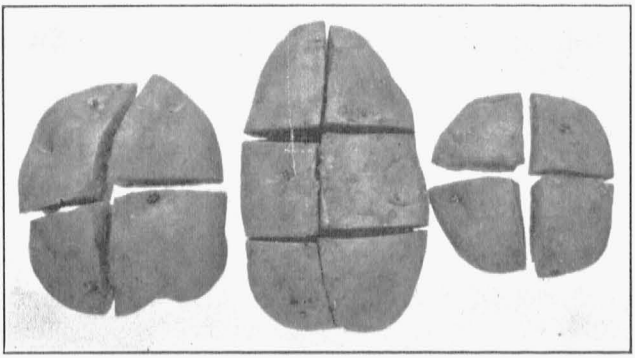

Fig. 9.—Showing correct method of cutting potatoes for seed. Irish Cobbler on the left, Early Ohio in the center, and Bliss Triumph on the right.

PLANTING POTATOES

There are two types of planters which may be used: The automatic or one-man planter (figure 10), and the two-man planter (figure 11). Both types have their advantages and disadvantages. The automatic or one-man planter is being used more in Missouri, principally on account of the additional labor required for the two-man machine. Most potato planters are now equipped with a fertilizer attachment which applies the fertilizer at the rate desired and at the same time mixes it with the soil in the furrow.

Date of Planting.—The date of planting will vary with the weather conditions, but in general there seems to be a definite relation between date of planting and yield. It is known that climate is one of the limiting factors for potato production.

The potato likes a cool, moist soil for its best development. To have such conditions through the greater part of the growing season, it is necessary to plant the potatoes as soon after the middle of March as the weather will permit. The potato should pass its critical period, namely, when the plant is

blossoming and setting tubers, during the latter part of May or the first of June. If this period comes during the hot days of late June and July, low yields will usually result.

The results of the date-of-planting tests are presented in Table 5. These tests were made on the same type of soil and under the same general conditions as those mentioned for the fertilizer tests. Plantings were made approximately every ten days from March 20 to May 10. The exact planting dates are given for the different years. In some cases it was necessary to plant the potatoes under very adverse weather conditions.

TABLE 5.—DATE OF PLANTING EXPERIMENT

		Yield in bushels per acre					
Year	Variety	Mar. 19	Mar. 30	Apr. 11	Apr. 20	Apr. 29	May 10
1921	Irish Cobbler	116.4	112.3	96	104.3	86	54
	Early Ohio	121.7	110.3	106.4	93.2	82.4	37
		Mar. 20	Mar. 30	Apr. 10	Apr. 20	Apr. 30	May 10
1922	Irish Cobbler	136.3	123.2	112	86.4	84.3	66
	Early Ohio	134	138	131.1	104.1	81.7	63.4
		Mar. 20	Mar. 30	Apr. 10	Apr. 20	Apr. 30	May 10
1923	Irish Cobbler	151.4	156.3	139.4	123	86.5	56
	Early Ohio	138.5	131.4	121	112	94.7	43
		Mar. 20	Mar. 31	Apr. 10	Apr. 21	Apr. 30	May 10
1924	Irish Cobbler		186	174.6	154	88	64
	Early Ohio		164	169.4	137	103	73
		Mar. 20	Mar. 30	Apr. 10	Apr. 20	Apr. 30	May 12
1925	Irish Cobbler	80.8	99.5	78.2	66.8	64	32.1
	Early Ohio	84	114.1	90.4	74.2	68.6	47
Average for 5 yrs.	Irish Cobbler	121.2*	135.5	120	106.9	81.8	54.4
	Early Ohio	119.5*	131.6	123.7	104.1	86.1	52.7

*Average for 4 years.

It will be noted that there is a gradual decrease in yield, with few exceptions, for the plantings from March 20 to May 10. Increases are shown for the March 20 planting over the March 30 planting for the 1921 and 1922 seasons, with the exception of the 1922 Early Ohios, which show a slight increase for the March 30 planting. In 1923 the yields decrease with the date of planting, with the exception of March 30 planting

of Irish Cobblers, which showed an increase of 4.9 bushels over the March 20 planting. In 1924 the spring season was such that it was impossible to plant potatoes much before April 1 in Central Missouri. In 1925 the March 20 planting was made under very adverse weather conditions.

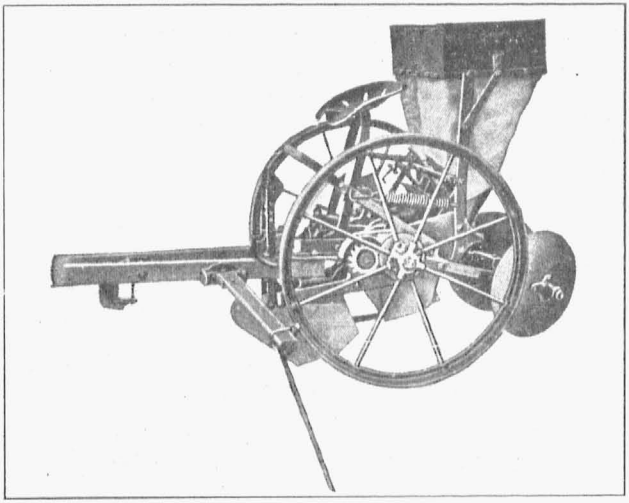

Fig. 10.—An automatic or one-man potato planter.

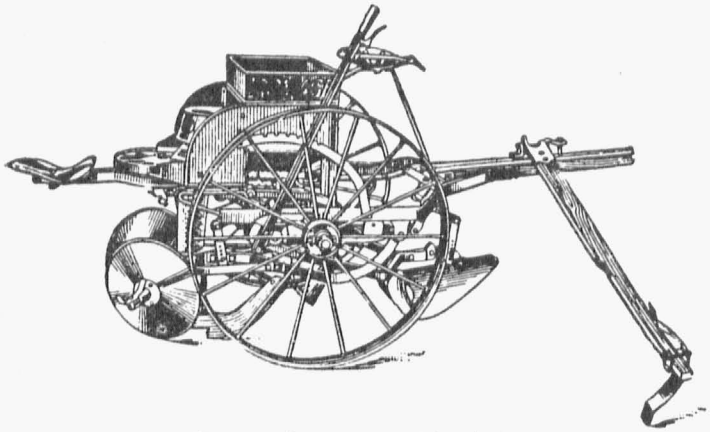

Fig. 11.—A two-man potato planter.

From Table 5 it would seem that on the average the highest yields will be received from potatoes planted between March 20 and March 30. The Table also shows, and it is known from observation, that this will not always hold. In some years when we have what is known as an early spring, it is possible in Central Missouri to plant potatoes the earlier part of March.

Such plantings should produce good yields if conditions are favorable, but if such early plantings are followed by cold, wet weather, the chances for the rotting of the seed pieces in the soil are increased. The low yield for the March 20 planting of 1925 was undoubtedly due to unfavorable weather conditions after planting.

Depth of Planting.—The depth of planting will vary to some extent with the type of soil. Light sandy loam soils will warm up quicker, and therefore planting can be deeper on these than on the heavier types of soil. For the average potato soil in Missouri 3 to 3½ inches is the proper depth. Care should be taken to see that the seed pieces are planted deep enough so that when the ridge of soil thrown up by the planter is removed by cultivation, the seed pieces will still be at the proper depth.

Distance for Planting.—The distance for planting potatoes in Missouri will run from 32 to 40 inches between the rows and from 8 to 15 inches in the row. The most common practice in the larger commercial districts is to plant 12 inches in the row and 36 inches between the rows.

CULTIVATION

A large part of the cultivation of the potato field should be done just after the potatoes begin to show above the ground. About the time the potatoes are starting through the soil, the ridge should be worked down with a section harrow, going diagonal of the field to keep the harrow on the ridges at all times. This is one of the important cultivations, for if the soil is well worked at this time, most of the small weeds which have started will be killed and subsequent cultivations will be easier and more effective. The next cultivation consists in stirring the soil between the rows and close to the ridges to a depth of 6 to 8 inches, with each succeeding cultivation becoming shallower.

Continued deep cultivation close to the plants would destroy many of the roots which are close to the surface. The first one or two cultivations may be done with an ordinary one row corn cultivator, while for succeeding cultivations a cultivator with many small shovels may be used.

The number of cultivations will be regulated by weather conditions. Like other crops, the soil should be stirred as soon after a rain as the land will work, to prevent baking or cracking. The last cultivation should be just before the potatoes show full bloom. At this time a low ridge should be thrown to the potatoes, care being taken not to form too much of a ridge which would cause the soil to dry out more rapidly and result in a decrease in yield.

Although it is customary to discontinue cultivation just before blooming, it is often necessary during a wet season to continue shallow cultivation between the rows to keep down weeds. The same may be true during dry seasons when the shallow stirring of the soil between the rows will aid in conserving moisture.

POTATO DISEASES IN MISSOURI

The annual loss from potato diseases in Missouri amounts to many thousands of dollars. This loss may mean the difference between a profit or a loss on a potato crop. Although disease prevention and control is only one of the important factors in potato production, it is, nevertheless, essential that the grower recognize the symptoms of the more common potato diseases.

The potato grower has to deal with three types of potato diseases; those which are carried within the tuber, such as mosaic; those usually carried on the surface of the tuber, as common scab; and those that affect the foliage of the plant.

The three different methods for controlling these three types of diseases are: the use of certified seed and crop rotation, seed treatment with corrosive sublimate or hot formaldehyde, and spraying the plants in the field with bordeaux mixture.

The more important tuber borne diseases in Missouri are: rhizoctonia, common scab, black-leg, wilt, mosaic and spindling 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 dirt-like masses, figure 12, which adhere to the surface of the potato. This stage is considered 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 13. This stage is characterized by the small sunken area of a brownish black color which attacks the surface of the underground steam, often girdling the plant at the surface of the soil. Missing hills and small sickly plants are usually caused by this disease.

Fig. 12.—Rhizoctonia (black scurf). The sclerotia stage of this disease is shown by the dirt-like masses on the tuber.

Control Measures.—Use only seed which is practically free from Rhizoctonia, and treat the potatoes before cutting, in either corrosive sublimate or hot formaldehyde solution, as described under seed treatment. Although the main source of infection is diseased seed, it is possible that the fungus may live over in the soil. The rotation of the crop is therefore advised.

Potato Scab.—Potato scab (figure 14) 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.—The causal organism is known to live over in the soil. When soil once becomes infected with this organism it is necessary to practice

at least a three or four year rotation. The use of some of the legumes as a green manure crop will aid in conditioning the soil. Badly infected potatoes

Fig. 13.—Dry stem rot, the form of Rhizoctonia which causes the greatest damage in Missouri.

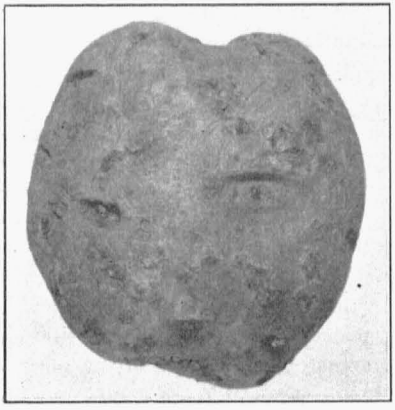

Fig. 14.—Common Scab lesions on potato tuber.

should not be used for seed and all should be treated with either the corrosive sublimate or hot formaldehyde solution.

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, figure 16, show the quite common discoloration of the water vessels of the tuber. 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 depending 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 of controlling wilt.

Black-leg.—This disease (figure 15), while not always as serious in Missouri as rhizoctonia, is quite prevalent during years having a cool, damp spring. Both the young plant and seed piece are affected. It is often confused with rhizoctonia in the field. Black-leg attacks the young plant producing a black slimy rot, while rhizoctonia causes a dry rot, brownish in color.

Control Measures.—Since the bacteria which cause this disease are carried in the tuber, the use of disease-free seed is of first importance. Rotation will help under some conditions and the seed should be treated with either the corrosive sublimate or hot formaldehyde solution.

Fig. 15.—Black-leg injury on the young potato plant.

Mosaic.—In Missouri, mosaic is quite common on the Bliss Triumph variety, but is of minor importance with the Irish Cobbler and Early Ohio varieties. Where home grown seed of the Bliss Triumph is used, the infection will often run as high as 85 per cent. The trouble is characterized by the crinkled and mottled appearance of the leaves, affected plants being of a lighter green than healthy plants. Figure 17 gives the general appearance of the disease in an advanced stage.

Control Measures.—The use of certified disease-free seed is the only practical means for eliminating this trouble.

Tip-burn.—Tip-burn may be due to a number of causes, but in Missouri it is usually the result of severe attacks of a small leaf hopper. This ac-

counts for the term "hopper-burn" often applied to this trouble. Although not occurring every year, when present it is capable of causing a considerable decrease in yield by drying up the vines before the potatoes mature.

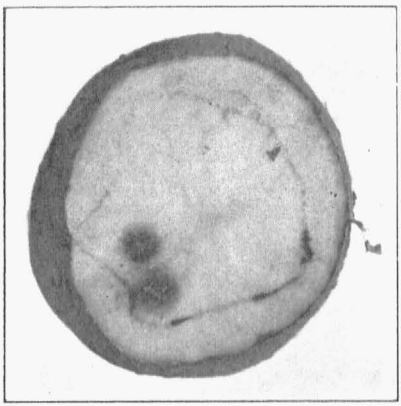

Fig 16.—Ring discolorations caused by Fusarium wilt.

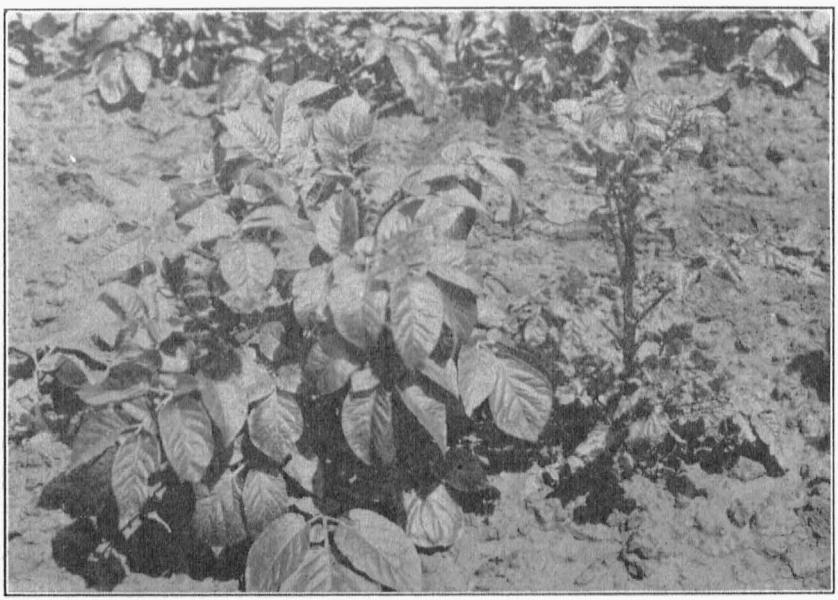

Fig. 17.—Mosaic. Healthy plant on left, diseased plant on right.

Control Measures.—Experiments* have shown that tip-burn can be controlled through the use of a bordeaux spray. At least two applications of a standard mixture of the 3-4-50 formula should be applied.

* Missouri Agricultural Experiment Station Bulletin 198.

Hollow Heart.—This trouble was quite common with some varieties during the 1924 season. The hollow tuber, as shown in figure 18, cannot be distinguished from healthy tubers until the potato has been cut. Hollow heart seems to be more prevalent during years having alternate dry and wet periods. The dry weather tends to ripen the tubers prematurely while the tops are still green. A wet period following causes the potato to resume growth with the hollow centers resulting. Since this trouble is seemingly due to natural climatic conditions, no control can be given.

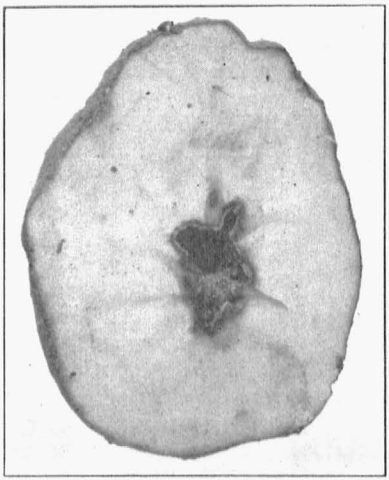

Fig. 18.—Hollow heart.

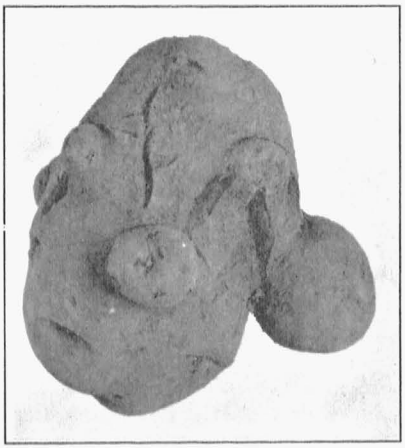

Fig. 19.—Second growth (knobby growth) and growth cracks on Early Ohio potato.

Second Growth—Growth Cracks.—These conditions are shown in figure 19. Observations indicate that the same weather conditions which cause hollow heart are associated with second growth (knobby growth) and growth cracks. The Early Ohio variety is much more subject to second growths than the Irish Cobbler.

SEED TREATMENT

Seed treatment consists of disinfecting the potato tuber in such a way that all disease organisms carried on the surface of the tuber will be killed. It should be understood that internal diseases of the potato such as mosaic and wilt cannot be controlled by seed treatment. Tubers showing signs of any of the internal diseases, when potatoes are being cut, should be discarded. All treating should be done before tubers are cut. Badly sprouted potatoes should not be treated.

The two methods recommended are the cold corrosive sublimate method and the hot formaldehyde method. For the farmer who plants only a few bushels of seed, the corrosive sublimate method is the more practical. For the commercial grower who treats large quantities of seed, the hot formaldehyde method should be used. Both methods are effective in controlling the common surface borne diseases of the tuber.

Corrosive Sublimate Method.—Metal tanks or tubs should not be used for the metal containers will be corroded and the solution weakened. When

only a few bushels are to be treated a wooden barrel may be used. In mixing the solution, 4 ounces of corrosive sublimate should be used to each 30 gallons of water. As corrosive sublimate dissolves slowly in cold water. it should first be dissolved in a glass jar of hot water and then poured into the 30 gallons of water. The temperature of the water should be approximately 60° F. The potatoes must be immersed in this solution for 1½ hours and then allowed to dry before cutting. The seed may be treated in crates or sacks using the same sacks each time since some sacks tend to weaken the solution. Never place the treated potatoes in sacks which have not been disinfected. When the solution is to be used over a number of times, it should be strengthened by adding ½ ounce of corrosive sublimate and enough water to bring it up to the original volume after each four bushels have been treated. After treating 12 to 16 bushels in this manner the entire solution should be emptied where stock cannot reach it and a new solution prepared. Corrosive sublimate (bichloride of mercury) is a POISON, if taken internally, but will not injure the hands.

Hot Formaldehyde Method.*—This method consists in treating the seed for four minutes in a solution of 1 pint of liquid commercial 40 per cent formaldehyde to each 15 gallons of water at a temperature of from 122° to 124° F. When this method is practiced the potatoes are usually treated in their original sacks. Wooden or metal tanks may be used for this purpose. The temperature of the liquid can be maintained by passing steam from a stationary or steam traction engine boiler through a coil of 1 or 1¼-inch pipe near the bottom of the tank. False bottoms for the tanks should be used to keep the hot pipes from direct contact with the potatoes. For treating smaller quantities of seed, smaller tanks may be used with oil or gas burners supplying the heat. It is necessary that the solution be kept at the proper temperature and a good grade Fahrenheit thermometer should be used for this purpose.

TABLE 6.—EFFECT OF SEED TREATMENT ON YIELD
(Variety, Early Ohio)

Treatment	Yield in bushels per acre		
	1923	1924	1925
No treatment	133	128.7	66.3
Corrosive Sublimate 4 oz. 30 gal. water for 1½ hours	164.8	157.5	87.1
Formaldehyde 1 pt. to 30 gal. water for 1½ hour	156.3	141.8	70.2
Hot Formaldehyde 1 pt. to 15 gal. water 118-122° for 4 min.	158.4	146.4	85.6
Hot Formaldehyde 1 pt. to 15 gal. water 122-124° for 4 min.	155.3	154.6	86.7

Table 6 gives the results of the effect of the different methods of seed treatment on the yield. The Early Ohio variety was used in this test. In 1923 the potatoes were planted April 10, in 1924 on April 13, and in 1925 on April 10. In 1923 the corrosive sublimate treatment gave an increase of 31.8 bushels, in 1924 28.8 bushels, and in 1925 20.8 bushels over the untreated

* In 1925, 117 carloads of seed potatoes were treated by the hot formaldehyde method in 14 community or central treating stations established by growers in cooperation with E. M. Page, extension horticulturist of the Missouri College of Agriculture.

plots. The corrosive sublimate treatment gave the highest yields while the difference between the different formaldehyde methods varied only 3 bushels in 1923, though a difference of 12.8 bushels was received in 1924. In 1925 there was a difference of 16.5 bushels. The seemingly good control obtained from the cold formaldehyde in 1923 may be due to the fact that the potatoes used had a very small percentage of rhizoctonia, while the seed used in 1924 and 1925 showed considerable rhizoctonia.

TABLE 7.—THE EFFECT OF DIFFERENT SEED TREATMENTS ON STAND AND SCAB CONTROL
(Variety, Early Ohio)

Treatment	Per cent of tubers affected with scab		Per cent of Stand	
	On new soil	On old soil	On new soil	On old soil
No treatment	51.8	62.9	90.8	91.6
Corrosive Sublimate 4 oz. to 30 gal. water 1½ hours	8.6	49.5	95.8	98.3
Formaldehyde 1 pt. to 30 gal. water 1½ hours	9.4	27.2	92.5	93.3
Hot Formaldehyde 1 pt. to 15 gal. water 4 min. 118-122° F.	12.7	40.9	97.5	98.3
Hot Formaldehyde 1 pt. to 15 gal. water 4 min. 122-124° F.	8.4	32.2	95	95.8

It is known that some of the common potato diseases live over in the soil, and for this reason the growing of potatoes year after year on the same land has been discouraged. To determine to what extent old soil served as a source of infection, especially for the common scab, the following tests were made in 1923. Two series of plots adjoining each other were so located that one of the series was on soil which had grown potatoes for the two previous years, the other series was on soil which had not had potatoes on it for at least four years. The plots in both series were treated in the same manner as given in Table 7. The Early Ohio variety was used for this test and all potatoes were counted and inspected for the smallest scab lesions. With all treatments the percentage of scabby potatoes was considerably more on the old soil than on the new soil. From the fluctuation of the percentage on the old soil it would seem that seed treatment is of but little value in controlling scab if the potatoes are planted in infected old soil. Table 7 further indicates the effects of old and new soil upon the percentage of stand when treated with the different standard seed treatments.

There are a number of interesting points brought out by this table. The untreated plots show a lower percentage of stand, which is to be expected. The figures support the fact that scab, except in severe cases, does not affect the stand, and further that rhizoctonia (black scurf) and black-leg, the diseases mostly responsible for poor stands, may not be carried over in the soil from year to year under Missouri conditions.

POTATO INSECTS

Although there are not a great many insects which attack the potato, it is nevertheless absolutely necessary that the insects be controlled if profitable yields are to be obtained.

Colorado Potato Beetle.—This is the most serious potato insect in Missori. Most of the injury is done by the leaf eating larvae. Since this is a chewing insect, the control must be in the form of a stomach poison. Arsenate of lead may be applied as a dust or a spray. When a spray is applied, use 1½ pounds of powdered arsenate of lead to 50 gallons of water. When applied as a dust, use 1 part of powdered arsenate of lead to 10 parts of air-slaked or hydrated lime.

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 thorough spraying of the plants with a standard 3-4-50 bordeaux spray.

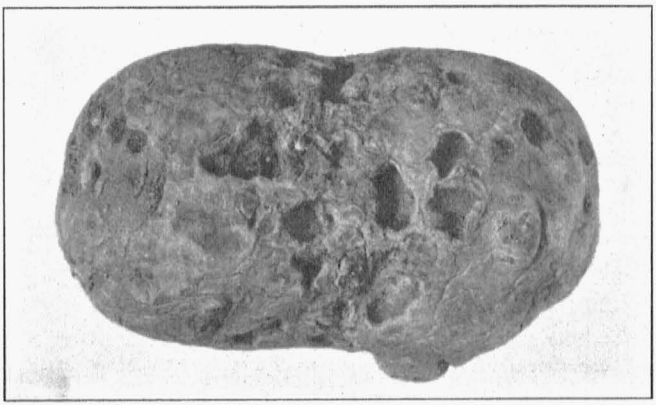

Fig 20.—Potato showing holes made by white grub.

White Grub.—The white grub which is the larvae of the common June bug, causes considerable loss by eating holes in the surface of the tubers, figure 20, and thus decreasing their market value. The insect is most troublesome on new land or on 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. Considerable injury may be expected when potatoes are planted in sod or new land after the first breaking.

Blister Beetle.—These insects are often called the old fashioned potato beetles. They move about in large numbers and can do a great deal of damage to a potato field in a single day. Driving from the field with the aid of brush or other means has proven to be one of the most effective methods of control.

Flea Beetle.—The damage from these little beetles is often overlooked, but they 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. The adult beetles overwinter in trash, emerging in the early part of summer. Thorough spraying with bordeaux mixture and arsenate of lead will control the flea beetle.

SPRAYING

Although experiments* at this station have shown that increases in yields may be had from the use of bordeaux, the practice is not general in Missouri. The general absence of the two leaf diseases, early blight and late blight, from Missouri is probably the reason that spraying with bordeaux is not practiced more. Bordeaux, to be effective against either diseases or insects, must be applied at the proper time and sprayed on the plant in such a way that the entire leaf, both upper and lower surfaces, will be thoroughly covered.

Bordeaux Mixture.—Standard bordeaux mixture, commonly known as 3-4-50 bordeaux, is composed of 3 pounds of copper sulphate (blue vitriol) and 4 pounds of lime to 50 gallons of water. To prepare a small quantity of a 3-4-50 bordeaux, dissolve 3 pounds of copper sulphate in a few gallons of water and add additional water to make up to 40 gallons. In another vessel slake 4 pounds of stone lime. If hydrated lime is used, 6 pounds is required; this should be made into a thin paste. Pour the lime mixture into the copper sulphate solution and add enough water to bring it up to 50 gallons.

When considerable spraying is to be done, stock solutions of both copper sulphate and lime should be made. Stock solutions of copper sulphate can be prepared by dissolving copper sulphate in water at the rate of 1 pound of copper sulphate to 1 gallon of water. Copper sulphate, if suspended in a bag in a wooden or earthenware container, will dissolve in a few hours. Stock solutions of lime are made by slaking a definite number of pounds of lime and diluting with water so that each gallon of the solution will contain one pound of lime.

To prepare a 3-4-50 bordeaux mixture from the above stock solution, it will be necessary to use 3 gallons of the copper sulphate solution and 4 gallons of the lime solution to each 43 gallons of water. The spray tank should first be filled about two-thirds full of water. Then add through a strainer the stock copper sulphate solution followed by the stock lime mixture, using 3 gallons of the copper stock solution and 4 gallons of the lime stock solution for every 50 gallons of spray, after which the mixture is ready for use.

* Missouri Agricultural Experiment Station Bulletin 198.

HARVESTING

The potato continues to develop until the vines are practically dead. In the commercial potato districts, digging starts around the 10th to the 20th of July, at which time the potato tubers are still green, but are harvested to take advantage of the earlier markets which generally pay a better price than the later market. If potatoes from the commercial districts can be harvested the first part of July they will be on the market before the bulk of the early crop comes in from other districts. On the average farm where potatoes are being grown for winter use, it is best to leave them in the ground as long as possible before they are placed in storage. During dry falls, it is possible to delay digging until later, but during wet seasons the danger from rotting may necessitate earlier digging.

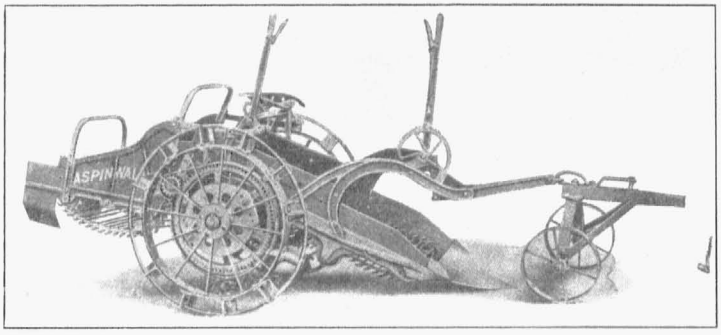

Fig. 21.—A modern potato digger.

The methods of digging potatoes in Missouri vary from the use of the common two-horse turning plow to the operation of large mechanical diggers (figure 21) used in the commercial districts. The two-horse potato digger (figure 22) is used extensively. If possible, the potatoes should be dug at a time when the soil is fairly dry. It is best to leave the freshly dug potatoes exposed to the sun for a few hours. Potatoes treated in this manner will be freer from dirt and the hardening will prevent the skin from peeling so badly from handling. Great care should be taken in harvesting the crop to prevent severe bruises and other mechanical injuries. Such injuries favor the development of the different rots in storage. Most of the potatoes in Missouri are graded in the field, sacked and hauled either to the car or to storage.

GRADING

Potatoes well graded as to size and quality command a much better price than ungraded stock. There may have been a time when ungraded potatoes could be shipped in bulk car lots and not be discriminated against. Such practices are now obsolete and with the increased competition and modern methods of handling, it is absolutely necessary that all commercial potatoes be graded according to the U. S. standard grades for potatoes.

The following standard grades for potatoes are recommended by the U. S. Department of Agriculture*:

U. S. No. 1.—U. S. No. 1 shall consist of potatoes of similar varietal characteristics which are not badly misshapen, which are free from freezing injury and soft rot, and from damage caused by dirt or other foreign matter, sunburn, second growth, growth cracks, hollow heart, cuts, scab, blight, dry rot, disease, insects, mechanical or other means.

The diameter of potatoes of round varieties shall be not less than one and seven-eighths inches, and of potatoes of long varieties, one and three-fourths inches.

In order to allow for variations incident to proper grading and handling, not more than five per cent, by weight, of any lot may be below the prescribed size, and in addition, not more than six per cent, by weight, may be below the remaining requirements of this grade, but not to exceed one-third of this six per cent tolerance shall be allowed for potatoes affected by soft rot.

U. S. No. 1 Small.—U. S. No. 1 Small shall consist of potatoes ranging in size from one and one-half inches to one and seven-eighths inches in diameter but meeting all the other requirements of U. S. No. 1.

In order to allow for variations incident to proper grading and handling, not more than five per cent, by weight, of any lot may be below the prescribed size, but not to exceed one-fifth of this tolerance, shall be allowed for potatoes under one and one-half inches in diameter. In addition not more than six per cent, by weight, may be below the remaining requirements of this grade, but not to exceed one-third of this six per cent tolerance shall be allowed for potatoes affected by soft rot.

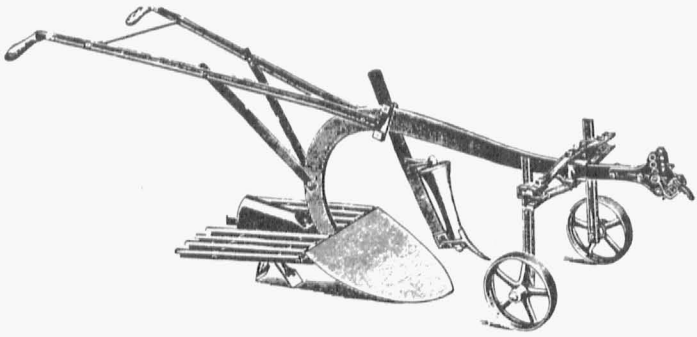

Fig. 22.—Ordinary two-horse potato digger.

U. S. No. 2.—U. S. No. 2 shall consist of potatoes of similar varietal characteristics which are free from freezing injury and soft rot, and from serious damage caused by sunburn, cuts, scab, blight, dry rot, disease, insects, mechanical or other means.

The diameter of potatoes of this grade shall be not less than one and one-half inches.

In order to allow for variations incident to proper grading and handling, not more than five per cent, by weight, of any lot may be below the pre-

*U. S. Department Circular 238, July, 1922.

scribed size, and in addition, not more than six per cent, by weight, may be below the remaining requirements of this grade, but not to exceed one-third of this six per cent tolerance shall be allowed for potatoes affected by soft rot.

U. S. Fancy No. 1.—U. S. Fancy No. 1 shall consist of potatoes of one variety which are mature, bright, well shaped, free from freezing injury, soft rot, dirt or other foreign matter, sunburn, second growth, growth cracks, hollow heart, cuts, scab, blight, dry rot, disease, insect or mechanical injury, and other defects. The range in size shall be stated in terms of minimum and maximum diameters or weight following the grade name, but in no case shall the diameter be less than two inches.*

In order to allow for variations incident to proper grading and handling, not more than five per cent, by weight, of any lot may vary from the range and size stated and in addition, not more than six per cent, by weight, of any lot may be below the remaining requirements of this grade, but not to exceed one-third of this six per cent tolerance shall be allowed for potatoes affected by soft rot.

DEFINITION OF TERMS AS USED IN THESE GRADES

"Mature" means that the outer skin (epidermis) does not loosen or "feather" readily during the ordinary methods of handling.

"Bright" means free from dirt or other foreign matter, and from damage, or discoloration from any cause, so that the outer skin (epidermis) has the attractive color normal for the variety.

"Well shaped" means the normal, typical shape for the variety in the district where grown, and free from pointed dumb-bell shaped, excessively elongated, and other ill-formed potatoes.

"Diameter" means the greatest dimension at right angles to the longitudinal axis.

"Free from damage" means that the appearance shall not be injured to any extent readily apparent upon casual examination of the lot, and that any damage from the causes mentioned can be removed in the ordinary process of preparation for use without appreciable waste in addition to that which would occur if the potato were perfect. Loss of outer skin (epidermis) shall not be considered as an injury to the appearance.

"Badly misshapen" means of such shape as to cause appreciable waste in the ordinary process of preparation for use in addition to that which would occur if the potato were perfect.

"Free from serious damage" means that any damage from the causes mentioned can be removed by the ordinary process of preparation for use without a waste of ten per cent or more, by weight, in addition to that which would occur if the potato were perfect.

* Such statements as the following will be considered as meeting the requirements: "U. S. Grade Fancy 2 to 3¼ inches," "U. S. Grade Fancy 10 to 16 oz.," "U. S. Grade Fancy 2 inches and larger," "U. S. Grade Fancy 10 oz. or larger."

STORAGE

Although most of the commercial potatoes grown in Missouri are marketed during the summer, there are many who successfully store potatoes for their winter use.

Potatoes to be stored should be dry, free from dirt, and almost entirely free from mechanical injuries. Potatoes may be stored in out of door cellars or pits, having proper ventilation, low temperature, and all light excluded. The average house cellar or basement is too warm and lacks proper ventilation. It is possible, however, where the house basements have a cool vegetable room to store potatoes successfully during the colder months of the fall and winter. The temperature for storage should not go above 40° F. nor below 35° F. Such conditions are not present at the time of harvesting the spring crop. In some years it is possible to delay digging the spring crop until late fall. The fall crop of potatoes which is harvested just before frost can be carried over the winter under the ordinary storage conditions. If an outdoor cellar is not available, it is possible to store potatoes in a temporary pit. (Figure 23.)

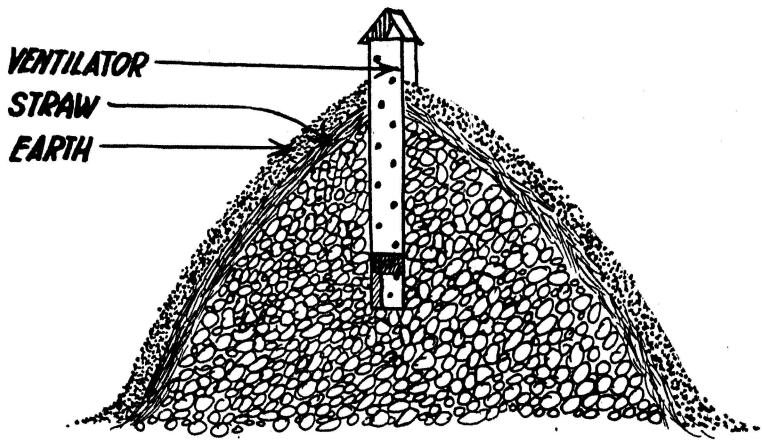

Fig. 23.—Cross section of a potato pit, showing layers of straw and earth, with ventilator in postion.

The making of a storage pit is a very simple procedure. Select a well drained spot, removing all the loose soil from the surface; this will usually mean a pit 3 to 6 inches deep. Place a 6- to 8-inch layer of straw in the pit to keep the potatoes from coming into direct contact with the soil. If a large quantity of potatoes are to be stored in this way, the pile should be narrow, not piling the potatoes over five feet deep. Where large quantities of potatoes are being stored, several openings for ventilation may be needed. Openings should be left in the top for ventilation. These should generally be left open, but when the temperature is low it may be well to close them with burlap sacks 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 soil should be placed over the straw. It is a good plan not to put

all of the soil on at one time, but to cover at intervals so that the potatoes are covered with a ten inch layer of soil before hard freezing weather.

The outside storage cellar is to be 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.

LATE POTATOES

Experiments at this Station* have shown that profitable yields can be secured from the late potato crop. The practice of growing late potatoes has been followed for a number of years in St. Louis, Buchanan, Jefferson and Andrew Counties.

The planting date for the fall crop is from the last week in June to the first week in July. The planting of the late crop at the proper time is just as important as getting the main crop planted early. The late crop must be planted early enough to produce a crop before frost, but late enough so that the critical period of the plant will not come during the hot dry days of July and August.

The varieties most used for the fall crop are the White Rural, Russet Rural, McCormick, Peach Blow, and Real Irish. The McCormick and Peach Blow are generally used for the home garden, while the other varieties mentioned are the principal commercial late varieties.

The seed for the fall crop may be either from the fall home grown or northern seed. If the seed is held in common storage through the winter, it is best to move it to cold storage about March 1. A temperature of about 40° F. is necessary to keep the potatoes dormant until time for planting. The potatoes should be removed from cold storage a week or 10 days before time for planting.

Land to be planted to late potatoes should be plowed early in the spring. Further working of the soil should consist of enough discing and harrowing to keep the soil in the best tilth. In the home garden a late crop of potatoes may follow some of the early vegetables, which will be off the land by this time.

The planting, cultivation and spraying of the late crop will be the same as those prescribed for the early crop. Great care should be taken in harvesting the late crop since the tubers are usually immature and bruise easily. Due to the shorter storage season fall potatoes usually keep much better than the early crop.

STRAW POTATOES

The growing of Irish potatoes under a straw mulch has proven successful in some years under Missouri conditions. The potatoes are planted about a month later than the early crop. The seed pieces are covered with soil to a depth of about 2 inches instead of the usual depth of 3 to 3½ inches. Grain straw is the most common mulch material. However, it is possible to use other materials such as leaves, hay or coarse strawy manure. The mulch should be placed on the soil over the potatoes to a depth

* Missouri Agricultural Experiment Station Bulletin 191.

ot from 4 to 6 inches soon after the seed is planted. The mulching of potatoes is especially profitable when the later part of the potato growing season is hot and dry. The mulch tends to conserve the soil moisture, thereby lowering the temperature of the soil.

During the seasons of adequate moisture there is usually nothing to be gained by mulching, and when there is an abundance or over supply of rainfall mulching is generally not a profitable practice.

The mulching of potatoes is primarily a home garden proposition since the cost of mulching material is usually prohibitive on a commercial scale.

SUMMARY OF RESULTS AND RECOMMENDATIONS IN THIS BULLETIN

Use only high quality seed of a variety adapted to Missouri conditions. (Page 11.)

Treat all seed potatoes before planting by the corrosive sublimate or hot formaldehyde method. (Page 21.)

Early planting is important. For Central Missouri the largest average returns will be obtained from potatoes planted from March 20 to April 1. (Page 13.)

Thorough and timely cultivation is very important for the production of a profitable crop. (Page 16.)

Barnyard manure is one of the best sources of plant food for potatoes. (Page 6.)

Turn under for green manure such crops as soybeans, cowpeas, clover and sweet clover. (Page 7.)

Following are general recommendations for the use of fertilizers on the spring crop of potatoes in Missouri. (Page 8.)

From 400 to 500 pounds of such a complete fertilizer as a 3-12-4, mixed with the soil in the row before or at the time of planting will give profitable returns.

On soils of medium fertility, a mixed fertilizer such as a 3-12-4 is recommended.

On soils of higher fertility a 2-12-2, 2-12-4 or a 2-16-2 may be used.

On sandy upland soils, which are usually low in potash, a 3-12-6 or 2-12-6 may be applied.

On very fertile soils, acid phosphate at the rate of 300 pounds per acre should be used.

Control chewing insects by spraying or dusting with arsenicals. The flea beetle and leaf hopper may be controlled by thorough spraying with bordeaux mixture and arsenate of lead. (Page 24.)

Spray with bordeaux mixture when leaf diseases are present. (Page 25.)

A crop of potatoes carefully harvested and well graded will usually find a ready market. (Page 26.)

Late potatoes can be profitably grown in many counties in Missouri. (Page 30.)

Straw potatoes are grown to some extent, but are mostly a home garden proposition. (Page 30.)