KANSAS STATE AGRICULTURAL COLLEGE.

Agricultural Experiment Station.

Bulletin No. 194.

POTATO CULTURE.

MANHATTAN, KANSAS.
DECEMBER, 1913.

KANSAS STATE PRINTING OFFICE.
W. C. AUSTIN, State Printer.
TOPEKA. 1914.
5-1483

Index.

	page
Arsenate of lead	489
Blister beetle	488
Bordeaux mixture	489
Colorado potato beetle	486
Cultivation	479
Crop rotation	474
Disease conditions in general	482
Dry rot	483
Early blight	484
Fertilizers and manure	476
Flea beetle	488
Home-grown seed	479
Late blight	485
Northern-grown seed	479
Planting	479
Potato diseases	482
Potato insects	486
Potato scab	484
Potato stalk weevil	488
Seed	479
Seed cutting	479
Soils adapted to potato growing	473
Spraying machinery	489
Spraying material	489
Tip burn	486
Varieties	481

Potato Culture.

By ALBERT DICKENS, *Horticulturist.*

Few crops are of more general interest than is the potato. A great majority of all the farmers of the state plant potatoes. A very large number of the citizens of towns and villages plant potatoes in their gardens. The value of the crops produced for sale may be closely approximated, but it is impossible to secure any close estimate of the value of those produced in the gardens of the state. Any improvement in the crop is of interest to both large and small growers, and it is with this object in mind that this bulletin is distributed. The results given and tables printed are from the records of recent years, for the reason that the conditions will be more readily recalled by those interested, but the records and results published here are confirmatory of work done and records secured in former years. Much more extensive data might be published if space were available, but the records of these experiments and observations are selected with the hope that they may serve as suggestions helpful to those interested in increasing and improving the potato crops of Kansas.

The most favorable soil condition for a crop of potatoes is a deep, fine soil that retains moisture well and contains an abundance of plant food with no excess of readily available nitrogen. Large areas of the river-valley soils have in the past furnished almost ideal conditions, and with proper care these conditions may be maintained. This maintenance will be the result of careful soil management, including application of fertilizers and a system of crop rotation.

The upland soils, even stiff clay soils, may be expected to produce fair crops if careful management is given. Careful plans covering several years' work must replace the haphazard methods which have satisfied many growers in the past.

There is an element of uncertainty in the growing of any crop due to the variation in season and the resultant of these weather forces upon soil conditions, but there is a method of

procedure which best prepares for any combinations of conditions. This combination, would include—

1. Selection of soil having such a crop history as experience has shown to be a good preparation for potatoes.
2. Fall plowing and previous tillage favorable to the accumulation of plant food and the conservation of moisture.
3. Good seed.
4. Proper planting.
5. Thorough cultivation.

Careful observations of crops in several localities and the experience of many old-time growers indicate that many times soil which has produced potatoes the preceding year is in better condition for the second season than is soil which grew other crops. Theoretically a cornfield, a stubble field or old alfalfa ground should be better for potatoes than a last year's potato field, but many know from experience that such is not the case. A field that with favorable conditions has produced only thirty or thirty-five bushels of corn can not be expected to produce a heavy crop of potatoes. An old alfalfa field may be so deficient in moisture that a good crop the following season is impossible. The cornfield and alfalfa field had a much greater tax upon their moisture supply than the potato field from which the crop was removed by August 1, and which had the equivalent of a poor plowing in the work of digging.

The soil of the potato field was in better condition to receive moisture. The few weeds growing there used but a small fraction of the moisture used by the corn or the alfalfa, and the action of frost was much more efficient in the moist than in the dry soil, and the potato, being an early crop, found much more available food in the field where potatoes followed potatoes, and the grower sneered at the theory of crop rotation. He tried it and proved it erroneous, but his proof was not exhaustive.

Experiment Station records indicate the year 1911 as having been one of the two least favorable for potatoes of any year since the establishment of the station in 1887.

Field A.—Corn in 1909; sweet potatoes in 1910; produced 108 bushels of potatoes in 1911.

Field B.—Corn in 1909; onions 1910; produced 98 bushels of potatoes in 1911.

Field C.—Corn 1909; potatoes 1910; produced 65 bushels of potatoes in 1911.

Field D.—Potatoes both preceding years; 60 bushels of potatoes in 1911.

Field E.—In alfalfa several years previously; 55 bushels in 1911.

Other and older potato-growing sections have proved the value of rotation, and it seems that the potato grower, while appreciating the other crops, should have the potato crop always in mind. In 1913 the best yields were from field T, in alfalfa in 1911; fall plowed and corn in 1912, corn cut early and fall plowed, and potatoes in 1913; yielded 150 bushels—a large yield when the season's deficiency in rainfall is remembered.

Land of the same quality as field T, alfalfa in 1912, fall plowed, and potatoes in 1913, gave a very low yield—35 bushels. It seems probable that when it appears advisable to follow alfalfa with potatoes that the alfalfa ground should be plowed as early as September 1, in order to avoid the demand upon soil moisture made by the late growth of alfalfa.

That fall plowing is one of the prime requisites is shown by the unanimity of all the observations made; aside from the value of fall plowing as an aid in the control of insects, the increased yield is sufficient argument. On heavy soils the need of a second plowing in the spring has sometimes been indicated. On loamy soils the harrow and disk have been sufficient to put the soil in condition for planting. Shallow spring plowing has been better than deep spring plowing, and immediate harrowing has been practiced. The increase in yield in the most favorable seasons indicated that the liberation of plant food in fall-plowed land is a most important factor in potato production.

The following tables present the evidence.

LAWRENCE, 1911.

When plowed.	Yield per acre. bu.
March	63
September and March	108
October and March	101

BONNER SPRINGS, 1911.

July and March	98
March	65

LENAPE, 1911.

July and March	80
March	60

MUNCIE, 1911.

When plowed.	Yield per acre. bu.
August	93
March	65

LAWRENCE, 1912.

July	161
March	143

BONNER SPRINGS, 1912.

July and March	225
July	200
March	180

MUNCIE, 1912.

August and March	198
March	113

STATION, 1912.

July and March	339
March	258
September and March	287

Fertilizers and Manure.

Barnyard manure is without doubt the great factor in maintaining fertility and renewing worn fields, but many observations and comparisons indicate that an application made one year before the field is planted to potatoes is a better practice than applying it immediately preceding the potatoes. The following figures are from a considerable number of observations and are fairly representative. In both sets of experiments manure was applied in 1911 but omitted in 1912.

COLLEGE.

	Manure.	None.
Yield, 1911	75 bu.	80 bu.
Yield, 1912	210 bu.	160 bu.

BONNER SPRINGS.

Yield, 1911	65 bu.	98 bu.
Yield, 1912	225 bu.	175 bu.

The question of the value of commercial fertilizers for Kansas potato soils is one in which there is great diversity of opinion among farmers, both as to methods and amount of application and the resultant increase in yields. This diversity of opinion is due to many reasons. First and most important is lack of water, fertilizers being of little value for a dry season. Then there is the difference in physical condition

of the soil. Fertilizers will never give satisfactory returns on a soil which has been depleted of organic matter. Such soils pack easily, the particles adhere closely after a rain, and the soil, losing its friability, is rendered undesirable for potatoes. Soils may also contain enough necessary elements in such quantity that fertilizers will produce no appreciable results.

The advisability of applying fertilizers must be determined largely by the individual farmer, owing to the varying character of the land and the varying proportion of the elements

NITROGEN.
POTASSIUM.
PHOSPHORUS.
CHECK.
NITROGEN AND POTASSIUM.
NITROGEN AND PHOSPHORUS.
POTASSIUM AND PHOSPHORUS.
CHECK.
NITROGEN, POTASSIUM AND PHOSPHORUS.
BARNYARD MANURE.

of plant food. This can not be shown by chemical analysis for this reason, viz., the acids used in chemical analysis liberate plant food which is held in such combinations in the soil that plants can not utilize it. This often shows sufficient plant food, but it is not available for use of plants. The only time when chemical analysis is of benefit is when it shows a lack of any one element. When this is the case one may be quite sure that that element must be supplied. The best method, and one which is accessible to any one, is the plat method shown by the accompanying diagram.

Fertilizer Data.

Lawrence, 1911.

Fertilizer.	Amount per acre	Cost.	How applied.	Yield salable.	Culls.	Salable.	Crop value.
	Lbs.			*Bu.*	*Per ct.*	*Per ct.*	
Special potato	500	$7.50	Broadcast	75	2.6	97.4	$60.00
Special potato	500	7.50	Drill	76	2.6	97.4	60.80
Acid phosphate	400	3.50	"	107	2.15	97.85	85.76
+ potassium sulphate	200	5.50					
Potassium sulphate	200	5.50	"	101.2	3	97	80.96
Check				70.6	7.5	92.9	58.48

Lawrence, 1912.

Kainit	250	$2.50	Drill	136	4	96	$68.00
Potassium	200	5.80	"	150	4	96	75.00
Acid phosphate	400	3.54	"	157	3	97	78.50
Bone meal	400	5.28	"	161.5	2	98	80.75
Complete	1,000	13.62	"	161.5	2	98	80.75
Check				161.5	8	92	80.75

Linwood, 1911.

Potassium sulphate	200	$5.50	Drill	58	20	80	$72.50
Acid phosphate	400	3.50	"	60	20	80	75.00
Complete	500	7.55	"	68	25	75	85.00
Potassium sulphate + acid phosphate	200	5.50	"	71	20	80	88.75
Check				52	25	75	65.00

Linwood, 1912.

Complete	1,000	$13.62	Drill	162	2	98	$81.00
Garden City phosphate	400	3.54	"	163	2	98	81.50
Potassium sulphate	200	5.80	"	162	2	98	81.00
+ bone meal	400	5.28					
Check				162 5	5	95	81.25

In 1911, in addition to the College plats, experiments with fertilizers were begun cooperatively at Lawrence, Linwood, Bonner Springs, and Muncie, and in 1912 Kiro and Alma were added to the list. The fertilizers used were nitrogen, sodium nitrate, ammonium sulphate, potassium sulphate, muriate of potash, kainit, phosphorus, bone meal, and acid phosphate. Mixed fertilizers: Armour's Complete Potato Fertilizer—composition, N. 2%, P. 8%, and K. 10%; Swift's Onion, Potato and Tobacco Fertilizer—composition, N. 2%, phosphorus 8%, and potassium 7%; and home-mixed, with the same amount of plant food.

The object of these experiments was primarily to determine whether it is profitable to use commercial fertilizers, and what elements, if any, need be applied.

Seed.

A comparison of a great many lots of seed potatoes, and careful tests with a considerable number, force the conclusion that northern seed is usually a better investment than home-grown, although there have been a few tests where the home-grown seed was less seriously affected with disease than some of the seed from the north.

The early maturity of Kansas potatoes and their tendency to sprout early easily accounts for the greater yield often obtained from northern seed.

Greater care should be exercised by buyers of seed potatoes to avoid the use of seed potatoes affected by disease. The grower who has home-grown potatoes that show no deterioration in quality and no evidence of disease may plant them and expect good results, but a most careful examination should be made as to the condition and freedom from disease.

The machine cutters are considerably used, but many large growers prefer to cut by hand, as a closer inspection can he given the seed and a better division of the eyes can usually be secured.

Fields planted with the horse planter have produced as good yields as those planted by hand, when large areas were compared. A very careful placing of the seed pieces might give a slight advantage, but the cost would in most cases exceed the return. The ridge left by the planter affords a guide for the first cultivation, or "blind plowing," as it is usually called. When the soil has been well prepared the planter will do excellent work.

The distance between seed pieces depends upon the size of the piece and the supply of soil moisture. In the eastern part of the state one-eye pieces nine to twelve inches apart have given the best returns, requiring ten or twelve bushels per acre if the one-eye pieces weigh about one ounce.

In sections where the rainfall is less, two-eye pieces, planted twelve to eighteen inches, have usually given better results than one-eye cuttings. In the eastern part of the state thirty to thirty-two inches is a common distance between rows. Farther west thirty-six is a better distance.

The most successful growers are those who cultivate most frequently. As soon after planting as any weeds sprout the

field is "blind-plowed," using a two-horse cultivator, and ridging the soil over the row before the sprouts are large enough to be injured. The field is leveled with the harrow, and as soon as the rows can be seen they are given a deep cultivation; afterwards shallow and frequent cultivation should be given, so long as the vines are not injured.

When the potatoes are not to be dug early it is a good practice to ridge the soil over the row after the crop is made.

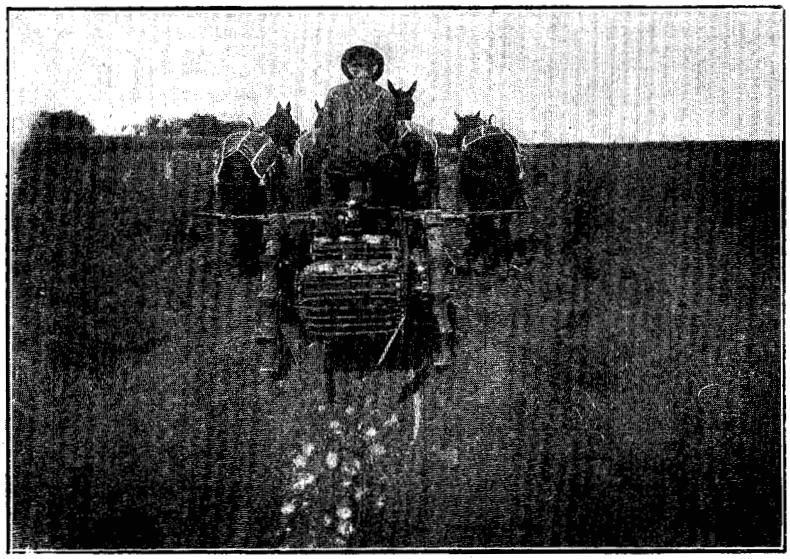

FIG. 1.

Many forms of diggers are successfully used, and when the crop is dug early, while the ground is loose and free from weeds, any digger does satisfactory work. For late digging, the simpler digger, having simply a wide, strong share and rods, is a general favorite.

Varieties.

Acme.—Vines large, upright when young, spreading with age. Leaves broad and dark, subject to early blight. Blooms scarce and white. Tubers resemble Early Ohio, except that they are more inclined to irregularity. Keeping and cooking qualities slightly inferior to Early Ohio. Heavy cropper. Early.

Six Weeks.—Vines small to medium, upright, bright green. Subject to early blight, tipburn, and drought. Tubers elliptical. Eyes numerous, skin smooth, lenticels numerous. Flesh yellowish white. Keeping and cooking qualities fair. Medium heavy cropper.

Nebraska.–Vines medium, upright, very dark colored foliage. Blight and drought resistant. Fair amount of purple blossoms. Tubers long and irregular. Skin white, smooth. Eyes numerous, flesh white. Keeping and cooking qualities fair to good. Late. Light cropper.

Early Rose.—Vines medium large, spreading. Leaves broad, bright green. Flowers white and abundant. Resists early blight and tipburn. Tubers medium to long, often tapering at stem end. Seed end blunt. Surface smooth. Eyes numerous and shallow. Skin pinkish white; flesh white, slightly streaked with red. Light cropper. Tubers uneven in size. Keeping and cooking qualities fair to medium. Medium early.

Gold Coin.—Plants medium slender, leaves bright green. Not subject to early blight and drought. Tubers medium long to long; regular; surface smooth. Skin white, often netted. Flesh white, firm. Light cropper.

Irish Cobbler.—Vines large and heavy. Stems stiff and triangular. Leaves dark green and heavy. Blooms very freely; blossoms purple or white. Resistant to early blight and tipburn. Tubers round, flattened, often irregular. Skin white, often slightly netted. Keeping and cooking qualities good. Late. Heavy cropper.

Bliss Triumph.—Vines small to medium, upright, very slightly spreading. Broad, deeply wrinkled leaves; deep, dark green. Very susceptible to drought, tipburn and early

blight, Flowers white, very scarce. Tubers round, slightly flattened, surface smooth. Eyes medium to deep, scarce, and not evenly distributed. Skin deep rose color; flesh yellowish white. Keeping qualities good; cooking qualities fair to good. Very early. Light to medium-heavy cropper.

Quick Lunch.—Vines small to medium, upright. Leaves broad and deeply wrinkled, dark green. Very susceptible to drought. Subject to early blight and tipburn. Tubers round, slightly irregular. Eyes medium to shallow. Skin white, tinted with rose. Keeping qualities excellent if grown late; cooking qualities excellent. Very early.

Early Ohio.—Vines upright when young, becoming spreading with age; grows medium to large. Leaves broad, dark green. Subject to tipburn and early blight. Flowers white, scarce, and early. Tubers elliptical, blocky, medium size. Eyes fairly numerous and evenly distributed. Skin slightly pimpled; lenticels large and numerous. Flesh firm, yellowish white, slightly tinted with rose at the bud end. Keeping and cooking qualities very good. Heavy yielder. Under unfavorable conditions may grow knotty tubers.

Potato Diseases.

Unhealthy conditions of potato vines or tubers may be brought about by various factors, such as excessive moisture, drought, or heat; too much or too little available plant food; packed or baked soil; sunburn, and other common unfavorable conditions of soil or climate. In addition to these factors there are the bacteria and fungi, which not only destroy the vines or ruin the tubers of infested plants, but, being readily transmitted from a diseased to a healthy plant, may spread over and severely damage an entire field. On account of the fact that the greatest damage results from a combination of one or more of the first set of unfavorable factors with one of the latter, the common idea has become prevalent among growers that the unfavorable soil or weather condition, since it is most conspicuous, was alone responsible for the injury. Usually, however, the injured tubers or dead vines are the work of a fungous disease, the destructive work of which is hastened by the condition of the plant caused by the soil or weather. This

combined injury will be better understood if it is remembered that a fungous disease is caused by a very minute fungous plant, and that the spores of this plant require favorable moisture and temperature for their best germination and growth. It is largely on account of this requirement that the diseases which attack the vines are much more destructive during a period of moist, warm weather. The diseases which attack the tubers are not dependent on the air conditions so much as favorable soil conditions, and are frequently found growing during a period which would be entirely unfavorable for diseases on the vine. A notable instance of this is the presence of a dry rot, or sometimes of soft rot, during the hot, dry part of the summer, when disease upon the vine is most uncommon.

The characteristic appearance as well as the method of control of each of the more common diseases will be considered with the hope that the grower may be able to recognize the presence of disease and possess a method by which it may be controlled.

DRY ROT.—The disease known as dry rot is caused by the fungus *Fusarium oxysporum,* and has become prevalent through the entire state. It attacks both the vine and the tuber, being first noticed in the poor stand that follows the planting of infected tubers. Plants which survive this stage are very frequently killed about the time tubers are beginning to set or a little later. The tips of the leaves begin to brown and curl, the entire plant droops or wilts, and frequently breaks over near the ground. The general effect is of premature ripening and a material shortening of the crop.

In the tuber the fungus causes brown spots or a definite brown ring shortly below the peel, and easily observed by removing the stem end to a depth of one-fourth inch or more. No tubers showing this condition should be used for seed. The affected potatoes develop the common dry rot in storage, unless held at a temperature below 40° F.

Method of Control.—The disease may be controlled by planting seed free from the disease in soil which is free from the spores of the fungus. Clean seed may be selected by removing the stem end of each potato as the first operation in cutting, and rejecting any which show the brown discoloration described above. Soil free from the spores of this fungus can only be insured by practicing rotation, and a rotation

should be planned which would allow two, or, better, three or more years between the two successive years in potatoes.

Potatoes known to be affected should not be stored, but should be dug early and sold immediately, as they possess their maximum value at this time and become more and more worthless with the age and growth of the fungus in the tuber.

Treating the potatoes as for scab has been found helpful in checking the disease, as any adhering spores are thus killed.

EARLY BLIGHT.—The fungus *Macrosporiurn solani* causes a spotting and blighting of the leaves of the potato during the fore part of the season. The injury may become extremely severe during a period of damp, warm weather, or may be almost entirely ignored if dry weather is prevalent at this time. The leaf injury can not well be confused with other leaf spots, since the early-blight spots are marked with concentric rings, usually somewhat irregular in form. The injury is confined almost entirely to the leaves in its early stages, but may penetrate the stem or even the tubers if allowed to grow unchecked.

Methods of Control.—Bordeaux mixture applied at intervals of about seven to ten days during the fore part of the season has proven entirely effective. Spraying should begin when the plants are about six inches high.

POTATO SCAB.—Scabby spots upon the surface of the potato tuber may be caused by a number of factors, but those caused by *Oospora scabies,* the fungus causing the true scab, is commonly known to all growers of the state. The fungus lives over winter in the soil, and if potatoes follow potatoes year after year, it will be found impossible to secure clean tubers even by the use of treated seed. If the tuber becomes affected when small it frequently becomes so unsightly as to be unsalable, but when the scab spot appears after the potato is well developed it is of much less importance.

Method of Control.—Practice crop rotation. Potatoes affected with scab, or those which have been stored or shipped with scabby tubers, should be treated before planting in one of the following ways. To thirty gallons of water add one pint of 40 per cent formaldehyde, and soak the potatoes in this solution for two hours before cutting. After removing from the solution they should be dried, cut and planted in the ordinary way, being careful not to place the treated seed in containers which have held untreated potatoes. A good

plan is to place the tubers in coarse burlap sacks and submerge the sack completely in the solution. The sacks may then be used for the treated tubers. Corrosive sublimate may be used instead of formaldehyde for this work, at the rate of one part of corrosive sublimate to one thousand parts of water. This material is a deadly poison and must be handled with care.

FIG. 2.

LATE BLIGHT. — Although little known to the growers of the state, the late blight caused by the fungus *Phytophthora infestans* may become serious under favorable weather conditions. The disease makes its appearance as a mildew upon the leaf, changing to a brown color and having an offensive odor. From the leaf the fungus spreads to the stem and tuber. Its presence in the stem causes a dark discoloration, and in the tuber it causes a dry rotting, at first noticed near the surface, but finally extending through the potato.

Methods of Control. — Crop rotation, selection of clean seed and spraying are entirely effective as control measures in this state. The disease is usually absent during dry, hot seasons, becoming serious only during seasons of cool, moist weather.

TIPBURN.–Not uncommonly disease is charged with the death of plants which really have been killed by other causes. When hot, bright weather follows a period of rain, the injury commonly known as tipburn is almost sure to appear. The potato leaves have become gorged with water, and are tender and easily killed by hot, bright sunshine. Keeping the plants in the best possible growing condition by frequent cultivation and spraying has been found the only practical method of preventing such injury.

A similar injury is frequently caused by Paris green when applied in water without the addition of lime. Two or more pounds of lime should be added to each fifty gallons of water containing one-half pound of Paris green.

Insects.

COLORADO POTATO BEETLE. — This insect is so well known to potato growers that a very brief description is all that is necessary to connect the name with the greedy bug. The adult beetle is yellow-and-black striped and has a rather hard wing cover. The eggs are oval shape and orange colored, and are found in masses of a dozen or more on the under surface of the potato leaf. From these eggs the slug hatches. This is a soft-bodied, red-and-yellow spotted larva, which bears little resemblance to the mature beetle. It is larger, when fully developed, than the adult, and possesses a most ravenous appetite.

The winter is passed by the adult beetle, usually, in the soil and rubbish in and around potato fields. Early in the spring, about the time the potatoes are coming through the soil, or sometimes before, these beetles emerge and mate. If present in large numbers they may cause serious injury to the young vines, but usually the injury does not commence in earnest until the eggs are hatched and the larvae begin feeding.

Under favorable conditions the larvæ may hatch in a week, and consequently are ready to begin their destruction by the time the potatoes are from two to four inches high. After maturing they crawl into the ground, pass through a resting stage and emerge as adult beetles. This entire life cycle from the egg to the adult may be passed in a month, hence it is possible to have two or more broods during a season.

Methods of Control.—Rotation of crops aids materially in the control of this beetle, but is not entirely effective, since they may live on a number of weeds which furnish food for a considerable number in fields used for other crops. They may also migrate some distance, though they do not commonly travel far.

Late fall plowing has been found to aid in breaking up the winter quarters and exposing the beetles to birds and other enemies.

Although each of the above methods aids in the control of this insect, by far the most effective method is by spraying the vine with poison. Spraying should begin as early in the spring

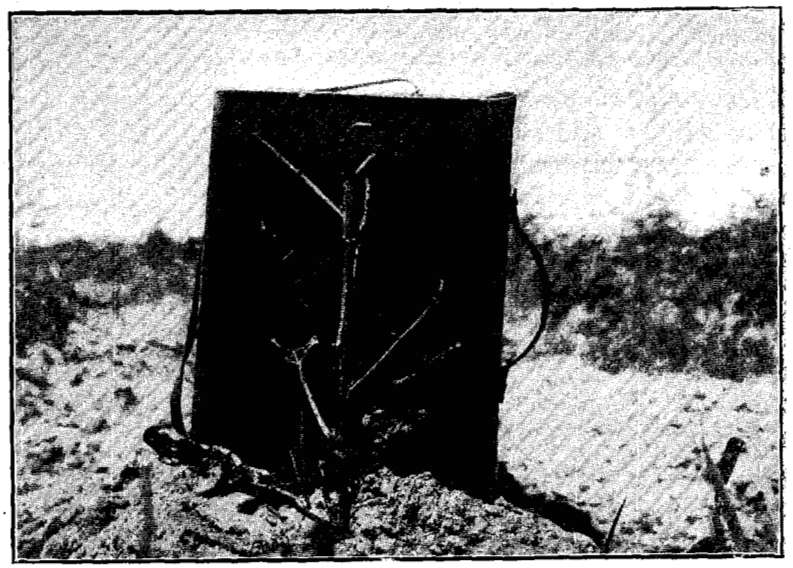

FIG. 3.

as necessary to prevent injury to the plants, and should be repeated as often as necessary to keep the vines covered with poison. For this insect alone two or three sprayings, perhaps more, will be required, but by combining the poison with Bordeaux mixture both fungus and insects are controlled without making separate applications necessary.

Arsenate of lead used at the rate of three pounds to fifty gallons of water or fifty gallons of Bordeaux mixture is considered the best poison, since it will stick well to the leaves. Paris green is still used by many, especially when the bugs are

numerous, as it has a quicker effect but it has the disadvantage of washing off the leaves with each rain. When used in water, two or three pounds of well-slaked lime should be added to each fifty gallons, together with one-half pound of the Paris green.

When used in Bordeaux mixture, one-half pound may be added to fifty gallons of the mixture without the addition of more lime.

FLEA BEETLES.–Several species of flea beetles are common in the potato fields of the state. They vary from a beetle about one-twentieth of an inch long and black or pale brown to one twice or more as large and black in color. The injury is due to punctures in the leaves, becoming serious when large numbers are present. The leaf tissue around one of these punctures usually dies, and in this way considerable leaf surface is lost. Disease spores frequently enter through these wounds.

Methods of Control.—Plants thoroughly sprayed with Bordeaux mixture and arsenate of lead have been found almost immune from flea-beetle injury. It will probably not be necessary to make separate applications for this insect, as the regular sprayings usually afford control.

BLISTER BEETLES.—In some sections of the state, one of the most serious pests is the blister beetle, or "old-fashioned potato bug," as it is frequently called. There are several types, varying from black to spotted or gray striped, and from three-fourths up to an inch or more in length. The adult beetle causes the injury by devouring the potato leaves, and frequently they appear suddenly and in such numbers as to ruin a small field in a few days.

Methods of Control.–This is one of the hard insects to poison, and spraying with Paris green, using one-half pound to fifty gallons of water or Bordeaux mixture, should be applied to the vines with thoroughness as soon as the beetles appear. Some growers have succeeded in driving the beetles into windrows of dry grass, where they are burned.

POTATO STALK WEEVIL.—Frequently potato plants are found wilting, and finally die, without apparent cause. This usually happens at irregular intervals over the field. An examination of the stems of such plants shows the presence of small larvæ, which by cutting out the water-conducting cells cause the wilt-

ing of the leaves. There are two species of insects, which are commonly called stalk borer or cane borer, but the effect and control are similar,

Methods of Control.—Practice crop rotation and spray thoroughly with Bordeaux mixture and arsenate of lead.

Spraying Materials and Spraying Machinery.

The best materials for use in potato spraying are copper sulphate and lime combined in water to make Bordeaux mixture for the control of fungous diseases, and arsenate of lead or Paris green as poisons to control insects.

Bordeaux Mixture (4-4-50 formula).—Dissolve four pounds copper sulphate and add it to twenty-five gallons of water. Slake four pounds good stone lime as for mortar, and add to twenty-five gallons of water. Pour, in any convenient way, the dilute copper sulphate and dilute lime water together in equal amounts. Do not pour one entire amount into the other if it can be prevented, but let the two solutions mix as they are poured into the spray tank, in equal amounts. About fifty gallons are required to spray an acre.

Arsenate of Lead.—This poison may be obtained of any company handling spray materials, in dry or paste form. All formulæ given in this pamphlet are based upon paste lead; if the dry material is used only one-half as much will be required.

Mix the lead with a quantity of water until it is in a thin milky condition, entirely suspended in the water; then pour into the tank of Bordeaux or water and stir thoroughly. If no mechanical agitator is provided care must be used to frequently stir the material. Paris green is dissolved in the same way and added to the tank of prepared solution. Agitation is less important when this poison is used.

Spray Machinery.—Gasoline power sprayers have the advantage of giving a higher, more constant pressure than hand or traction machines, but good work can be done with the latter outfits if nozzles adapted to lower pressure are used. Several good types of potato sprayers are found on the market, and the following points should be especially considered in

choosing a machine: (1) sufficient pumping capacity to afford good pressure; (2) large air chamber; (3) good agitator; (4) easily adjustable nozzle carriers; (5) good relief valve to maintain constant pressure; (6) strong, durable, easily accessible parts. The tank should hold at least fifty gallons and be well made of good materials. The wheels should be high, and a tongue should ordinarily be provided and the wheels so spaced that two horses may be used, as the draft is too great for one horse. Such a machine will properly spray from fifteen to twenty-five acres a day, provided that water may be obtained easily.

A machine may easily be constructed at home if a good pump and engine are at hand. Barrels placed in an ordinary

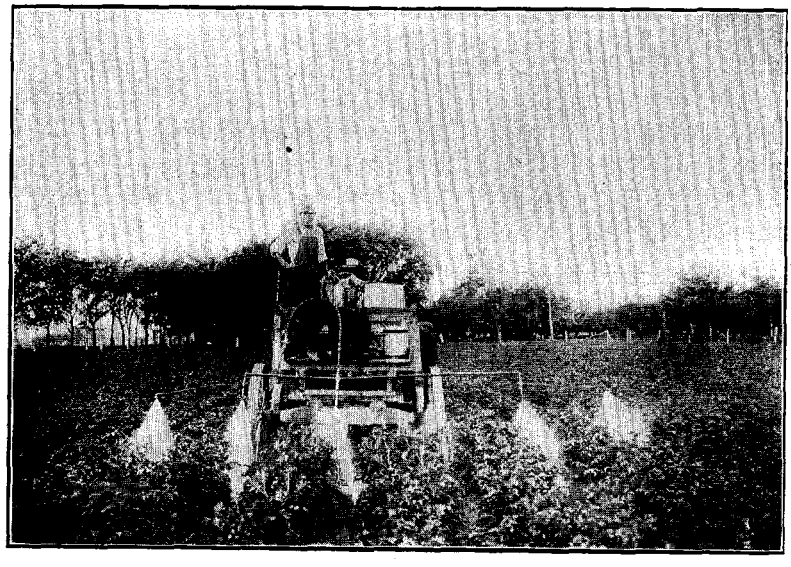

FIG. 4.

wagon take the place of a tank, and the suction hose is changed from one to the other as each is exhausted. The discharge hose from the pump is connected to a three-fourths or one-inch gas pipe long enough to cover from three to five rows. This gas pipe is suspended from the rear of the wagon bed and one-half-inch pipes are dropped from it at such intervals that they are carried immediately over the rows to be sprayed. Nozzles placed upon these pipes complete the outfit. Care must be

used, in operating a sprayer of this kind, that a good hand agitator is placed in the barrel from which the liquid is being drawn, and kept moving almost constantly. Such an outfit, especially when five or more rows are sprayed at a time, is not well adapted to uneven ground or to rows of unequal widths. A barrel pump or large hand pump may take the place of engine and pump in an outfit of this kind. It has been stated by growers that a wagon containing so much weight packed the ground between the rows, and in this way caused some injury to the vines.