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POTATO CULTURE ON IRRIGATED FARMS OF THE WEST.

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
Washington, D. C., December 30, 1909.

SIR: I have the honor to transmit herewith a paper on Potato Culture on Irrigated Farms of the West, prepared by Mr. E. H. Grubb, a practical potato grower of Colorado, who has been very successful in the commercial production of potatoes as well as in developing superior strains of varieties peculiarly suited to the irrigated area in which he is located. The methods described are largely based on the writer's experience.

Respectfully,

A. F. WOODS,
Acting Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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POTATO CULTURE ON IRRIGATED FARMS OF THE WEST.

INTRODUCTION.

The natural home of the potato is the mountain valleys of South America. Where natural conditions are favorable for the growth of a plant, there it will reach the highest degree of perfection. In the mountain valleys of Colorado are found conditions of altitude, soil, and moisture naturally favorable to the growth of the potato, with an almost entire absence of harmful freezes and bacterial enemies.

PREPARATION OF THE SOIL.

In providing a suitable soil for potatoes, the question naturally arises, How shall we perfect and husband fertility? Live stock is the real basis of success in every agricultural district of the world. The feeding of grains and grasses on the farm replaces in the soil the vegetable matter which produces the humus and furnishes the nitrogen that keeps up the fertility of the soil. In the mountain country, where water is a prime requisite, it should be remembered that there is no better storage for water in the soil than decayed vegetable matter, and if one grows grain crops and ships them off every year, his land will become less porous and harder to work, and fungous diseases will more readily find a lodgment there. It is utterly impossible to grow good potatoes without an open porous soil.

Nothing but the legumes—alfalfa or clover—should be used as a foundation crop. The writer grows clover or alfalfa, one or the other (sometimes both), for three or four years previous to a potato crop. The soil is broken up in the fall quite deep. The winter freezes disintegrate the soil and loosen it from the roots, thus putting it in fine mechanical condition for the seed bed. Fall plowing is beneficial for the additional reason that it puts the soil in better condition to receive and store heat from the rays of the sun than spring plowing. In the spring the fall plowing should be worked over with a disk or a spring-tooth harrow until it is thoroughly fined. The seed bed should be put in as good tilth as a garden, by repeated harrowings. It is very important that the soil be well fined and well firmed in order that the root system of the young plant may be able to secure plant food as quickly as possible.

PLANTING.

USE OF PLANTING MACHINES.

Planting potatoes by hand on any large scale is out of the question on account of the expense. The large potato grower can of course afford the most modern machinery. In a community of small potato growers it is possible for them to own machinery jointly, and thus avoid any large expense to the individual farmer. The two most expensive machines connected with potato growing are the planter and the digger. (See fig. 1.) A planter will cover 5 or 6 acres a day, so that during the planting season, in the irrigated regions of the West, one planter will cover 100 acres. A good planter will cost about $70 in the West, and this expense divided among 10 farmers growing 10 acres each is a trifle.

A word of caution about the type of planter is perhaps desirable. There are some planters which pick up the seed potatoes by means of a prong or fork which breaks the skin of the tuber. This exposes the potato to any germs of potato diseases which may be present in the soil. Furthermore, it carries any germ disease that may be on some of the seed potatoes to others. There are planters which pick up the potatoes in such a way as not to break the skin. This point is especially important in planting whole seed. In planting cut seed there is still the danger of transferring the disease from one piece of potato to another. Whatever planter may be used, some one should ride on the machine in order to see that it works regularly, so as to give as nearly a perfect stand as possible.

FIG. 1.—Potato digging on an irrigated farm near Carbondale, Colo.

The improved planters of to-day open the furrow, drop the seed, cover it, firm the dirt over the seed, and mark the next furrow. Such a planter is drawn by two horses. The writer plants the potatoes about 2 or 2½ inches below the surface of the soil. Experiments with potatoes planted in rows all the way from 36 to 42 inches apart indicate that the best distance depends upon the seasonal conditions and type of soil; it is a problem for each grower to solve for himself. The distance apart the potatoes should be planted in the row also depends so much upon the variety, the fertility of the soil, the availability of water, etc., that each farmer must determine this from his own

experience. I plant them 8 inches apart in rows 36 inches apart. This gives the largest tonnage of potatoes of desirable size.

CUTTING SEED; PLANTING WHOLE TUBERS.

The writer's experience has been that seed of large size (2 to 6 ounces) produce strong vigorous shoots, as they furnish an ample supply of plant food to sustain a strong and vigorous growth until the feeder roots can take up the food from the soil. An insufficient supply of plant food in the seed may cause the plant to become stunted before the root system becomes so developed that it can take up the plant food from the soil.

During the last two years the best results were obtained from planting medium-sized whole seed. While the cost of the seed has been considerably greater, the stand has been approximately perfect. Experience has proven that from one or two eyes only are sprouts developed in uncut seed. The seed end furnishes a strong vine; the other eyes usually remain dormant.

One of the greatest advantages of using whole seed is the protection from disease which may be present in the soil and which may attack the more tender exposed parts of the cut seed. The potato grower can ill afford to grow a crop of potatoes and lose from 20 to 40 per cent of a stand on account of using poor seed, or improperly cut seed, or seed of weak vitality. It is a matter of vital importance to get the plants started into strong, vigorous growth in order that they may better withstand adverse conditions later in the season.

CULTIVATION.

As soon as possible after the potatoes are planted the cultivator should be started. This implement has four shovels, each 4 or 5 inches wide and about 15 inches long, two on each side of the row, and is drawn by two heavy horses. These shovels should run as close as possible to the planted tubers without disturbing them. The first cultivation adds to the depth of the dirt over the seed, and permits the use of a light smoothing harrow without disturbing the tubers. The cultivator also loosens the soil on each side of the row and better fits it for the potato roots which will soon invade it.

After this the potatoes should be harrowed once a week, if possible, first lengthwise of the rows and then across, until the vines are 5 to 6 inches high. This practice gets rid of the weeds so thoroughly that the use of the hand hoe in the row is rendered unnecessary. It destroys all the weeds in the hills and between the hills in the row.

After this the cultivator is used but is not run so deep as at the first cultivation. Frequent shallow cultivation keeps the surface of the soil loose, conserves the moisture, and gives a chance for the root system to spread.

IRRIGATION.

With thorough cultivation, for potatoes planted the first of May, irrigation is seldom necessary until July. Generally speaking, irrigation water is cold and it is highly important not to irrigate too frequently, since the water not only causes the soil to run together but lowers the temperature to a point that is not favorable to the growth of potatoes. Irrigation water is applied only when the condition of the plants indicates that they are in need of water, as by darkening of the foliage. Or one may dig down in the hill and press a handful of soil in the hand; if it fails to retain its form, irrigation is needed. Care should be taken not to wait until the ground is too dry, because one can not cover the whole field of potatoes in one day's irrigation, and some are likely to suffer for water before being reached. The writer's experience is that if potatoes are grown as rapidly as possible, so as to become strong and well established early in the season, they withstand the maximum of unfavorable weather conditions later on, when the hot dry winds become a menace to the crop.

When the time for irrigation arrives, a V-shaped trench half-way between the rows should be opened in alternate middles with an 8 or 10 inch lister plow; that is, a narrow plow with a double moldboard which throws the dirt each way. In these furrows the irrigation water is run so that the soil will not become solidified by flooding, and the necessary amount of water may be properly distributed. For the second irrigation furrows are opened in the middles that were not opened at the first irrigation, and this alternation is continued for succeeding irrigations. At the head of each field is a feeder ditch from which the water is admitted to these irrigation furrows between the rows. It is essential that the right quantity of water be used, and that it be uniformly distributed. Cultivation should commence as soon after irrigation as the soil will permit so as to insure rapid and uniform growth without check. This will not only result in the production of smooth, uniform tubers of attractive appearance, which are always in demand at high prices, but will also result in large, profitable yields and at the same time keep the soil in good mechanical condition for future crops. Do not irrigate after August 10, so as to give fifty or sixty days for ripening in dry earth.

If great care and scientific methods are necessary for best results in the production of market potatoes, they are tenfold more important in growing seed stock for next year's planting. Uniform growth of tubers for seed purposes, without check in development, produces a seed potato of higher vitality than tubers of uneven growth; and the clean, smooth tuber with tough skin, free from clinging soil or dirt, keeps better and is freer from disease germs during the long season before next year's planting.

STORAGE.

Each year the storage of potatoes is becoming a subject of greater importance. The object to be aimed at in storage is to keep the potatoes at as low a temperature as possible without freezing, and at the same time keep the surrounding air as dry as possible. Potatoes should be pretty ripe when harvested, as skin-slip potatoes turn black, do not keep well, and are unattractive when exposed for sale.

While mining in the early days of Colorado, at an altitude of 12,000 feet, the writer met an old prospector who was going to leave the country. He said that in an old tunnel I would find some supplies, including 12 sacks of potatoes, which had been put there two years before, and which I might have. The condition of these potatoes was apparently the same as when they were dug; they were not shriveled, no shrinkage was apparent, the eyes were not swollen, and when cooked they were just as edible as when dug out of the ground. There had been an air shaft constructed at the end of the tunnel and through the tunnel was a good current of dry air. The temperature was about 40° F. When the writer came to build a potato cellar he tried to get as near those conditions as possible.

The cellar is 50 by 200 feet. At each end there is a dead-air space of about 10 feet in the form of a vestibule between the outer and inner doors which affords protection from freezing. There is a driveway clear through and on either side the bins are located, skylights and ventilators being placed every 10 feet. The temperature of the cellar may be lowered by opening the doors and letting a current of air pass through. When it is too cold for this, the ventilators at the top may be opened. The best ventilation is always secured by building the cellar in line with the direction of the prevailing air currents. During the winter the temperature should be kept as near 32° F. as possible; it should never go below 30° nor above 36°. Potatoes will not freeze until the temperature falls below 28° F. In the spring of the year, when the weather becomes warm, the cellar doors are kept open at night and closed in the daytime.

One important point in the storage of potatoes is to reduce the temperature to as low a point as possible directly after the product is stored. Put about 1 foot of potatoes on the cellar floor, and by the time the entire floor is covered to that depth the heat from those potatoes is pretty well carried off by the air currents. Then add another layer, thus properly regulating the temperature as the storage progresses. Ordinarily, when the cellar is filled the potatoes are piled about 5 feet deep.

MARKETING.

In deciding what kind of potatoes to plant, the grower should study the conditions and demands of the market. He should grow a medium-sized potato. On rich land the potatoes planted 8 inches apart in the row will yield not only a greater tonnage, but tubers of more desirable size. There are few markets, except in the South, that will pay a good price for large potatoes.

Our methods of packing and marketing potatoes have been, and are yet for the most part, more crude than those used with other products. By the time they get to the consumer they are more or less bruised or crushed. The writer has thought of crating potatoes and developing that idea in Denver and New York. At the present time he favors a 40-pound crate. This size may be increased or decreased to suit the market. The grower should cater to the demands of the most particular and exacting consumers. He should try to educate the public to appreciate the delicacy of a first-class potato. The grower need not be afraid of freight bills if he can furnish better potatoes than anybody else. Hood River has a reputation for apples that makes them cost more to the consumer on the eastern market than the eastern apples by two or three times. This reputation was gained by packing apples that did not have an imperfect specimen in a car. Do not put in a package a potato that you would not serve to a guest at your own table.

SELECTION OF SEED.

Of all the factors in potato growing, selection of seed is by far the most important. Some twelve years ago the writer undertook to improve and develop a potato along the same lines that he follows in improving his Shropshire sheep and Shorthorn cattle, using the best method of selection and giving the seed plat the best possible cultivation and irrigation in order to obtain uniformity of product. Since that time he has been selecting seed potatoes of the size and type which he wants to produce. As a 12-ounce potato is about ideal in size, seed potatoes of that size were selected from the bin in the spring and then 4 or 5 acres were planted in a special plat for seed, to be used for the main crop the following year. This plan was followed for twelve years with a potato (the Perfect Peachblow) which it was said would degenerate and ultimately run out; but that potato continued to improve during all that time.

Three years ago Prof. E. R. Bennett, a specialist in potato work from the East, came to our state agricultural college. He became interested in the work the writer was doing and freely complimented him on his success in potato production; but he wanted to take up and further improve the stock. Out of specially selected seed he selected perfect tubers and planted them in a field by themselves, and when the potatoes were ready to harvest we dug all of them by hand and

kept the product of each hill separate. (See figs. 2 and 3.) All hills that did not have 20 tubers of uniform size, without knot, crack, or rough end were discarded. No hill was selected unless it came within these requirements, and surprisingly few hills were found which passed muster. Enough were selected, however, to make about 200 pounds, and these were planted the following spring. When harvested it was a most marvelous row of potatoes. By pursuing this method it is hoped soon to have a potato that will make 25 perfect tubers to the hill.

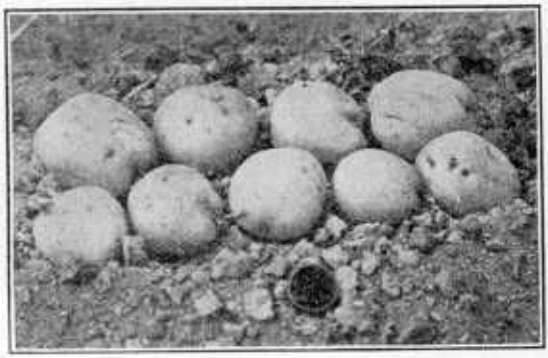

FIG. 2.—Product of a single hill, showing uniformity of size and shape resulting from hill selection of seed.

Had we bred our Shorthorn cattle as we have been in the habit of selecting and breeding our seed potatoes, we would now have no breed of Shorthorns. If we used only the culls and scrubs to breed from, our breeds of stock would soon run out. These breeds have been brought to their present standard by selecting the best on scientific principles of breeding. One reason why potatoes have degenerated in the past is that the potato growers of the United States have planted their culls and screenings under the erroneous impression that such methods in seed selection would produce as good results as any other.

FIG. 3.—Product of a single hill, showing heavy yield and fair uniformity.

In selecting potatoes in the field, considerable dependence can be placed on the appearance of the tops. A large perfect top, with several stems of good shape and size, can be depended upon to have more tubers under it, and of more uniform quality and size, than a hill with a single stalk or one with small weak stems.

One of the essential and most important factors for success in this industry is the selection of perfect seed stock from the hill, in much the same way as seed corn is selected in the field from the best individual stalks. There is no other way to get true breed characteristics in potatoes except by selecting seed from the perfect hill, and seed

should be saved only from hills producing a first-class marketable potato in the growing of which there is no waste of plant food. No manufacturer in this day of economy could stand the loss entailed by methods of manufacture under which he was compelled to cull out and throw in the scrap pile 20 per cent of his product as waste, and no one can expect the highest success in potato culture who adopts methods resulting in a loss of 20 to 60 per cent of his crop in culls and unmarketable potatoes. But this is what the potato growers of the United States are doing to-day.

VARIETIES.

Years of experience have demonstrated that comparatively few varieties of potatoes are really adapted to western or mountain conditions. Among the early varieties none has been so universally successful as the Early Ohio. This potato is of fine quality and uniform in size and shape, though not a heavy yielder. Another good potato, though not so early, is the Rose Seedling.

For a medium to late variety, the Dalmeny Challenge, a Scotch variety, is being used quite extensively on the western slope of Colorado. For later varieties, the White Pearl and Rural New York No. 2 are more extensively used at Greeley, in the San Luis Valley, and in the Uncompahgre Valley; and the Perfect Peachblow is the favorite in the upper Grand Valley. The latter variety has been grown continuously by the writer for twenty-five years, and under the system of seed selection already described it has become a much better and more perfect type of potato than it was ten, twenty-five, or even sixty-five years ago, when first introduced.

POSSIBLE YIELDS.

Mr. Dodge, of the United States Department of Agriculture, and the writer hunted for an hour in a field of good potatoes to find one perfect hill, and it was a marvel of perfection. There were 16 potatoes, not one under 6 and not one over 14 ounces, and the total weight of the hill was 8 pounds. Not one particle of wasted energy or soil fertility was represented in this hill; and by a series of years of seed selection of a perfect type and variety of potatoes, by the exercise of a knowledge of balanced plant foods and soil fertility, and by scientific cultivation and application of moisture by irrigation, such hills could be produced over practically the whole field.

Planting potatoes 12 by 36 inches apart will give 14,520 hills to the acre; allowing for a loss of 10 per cent on account of imperfect stand, there would still be 13,068 hills. At 8 pounds to the hill, this would make a total of 104,544 pounds to the acre. This is 18,656 pounds less than a field crop of potatoes raised by the potato wizard

of Scotland, the Earl of Rosebery, who last year grew 123,200 pounds per acre total crop, with 105,280 pounds of marketable potatoes over a $1\frac{3}{4}$-inch screen. Some day potato growers may be expected to approximate this phenomenal yield in Colorado, as the conditions of climate, soil, heat, and application of moisture are much nearer ideal for potato production than in any part of Scotland.

CONCLUSION.

There is no line of farming in the irrigated districts that gives such marvelous profits as that of scientific potato production.

With scientific knowledge which can be acquired by experiments in supplying perfectly balanced plant food and maintaining soil fertility, the scientific principles of which are similar to those used by every successful breeder in feeding and fitting prize-winning stock; and with the proper proportions of plant foods—phosphates, nitrogen, and potash—in the soil as found in many parts of the West; and by the use of clover and alfalfa, there is no reason for those who contemplate engaging in the potato industry to fear the outcome.

Too much stress can not be put upon the value and importance of live stock in keeping up favorable soil conditions, as no country now known has been continuously successful in crop production without the use of manures from the feeding of forage and grain crops.

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