UNIVERSITY OF IDAHO
AGRICULTURAL EXPERIMENT STATION

EXPERIMENTS IN THE SIZE OF THE SEED PIECE AND OTHER FACTORS IN THE PRODUCTION OF POTATOES UNDER IRRIGATION IN SOUTHERN IDAHO

By

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EXPERIMENTS IN THE SIZE OF THE SEED PIECE AND OTHER FACTORS IN THE PRODUCTION OF POTATOES UNDER IRRIGATION IN SOUTHERN IDAHO

By

L. C. AICHER, Superintendent

Aberdeen Substation

Potatoes are one of the most important commercial crops grown on the irrigated lands of southern Idaho. The quality of Idaho potatoes is exceptional and a premium is paid for them on certain markets. There are, however, many questions concerning the raising of potatoes which, as yet, have not been answered. For example, considerable difference of opinion exists among growers as to the most economical size and kind of seed piece to plant; in regard to spacing between hills in the row, and its effect upon the yield and net income per acre. Responsible seed houses and potato growers sometimes lay special emphasis on the value of seed potatoes grown on dry land as compared to those grown on irrigated land. In order to arrive at more definite conclusions as to what are some of the best practices to follow in the production of this important commercial crop, these experiments were undertaken.

The experiments herein reported were made upon the following questions: Whole vs. cut seed; size of seed piece; distance to plant within the row, and irrigated compared with dry-land seed potatoes for irrigated land. These experiments were begun on the Aberdeen Substation at Aberdeen, Idaho, in 1913. In 1912 suitable seed stock of the Idaho Rural potato was grown for all the experiments wherein this variety was used. This variety is now supposed to be of the same stock as the Charles Downing. It is a flattened, oval-oblong, very smooth, medium-sized tuber with shallow eyes and white creamy skin, and is a very good keeper. The sprout is white with tips slightly colored but is in no sense a purple sprout, hence does not belong to the true Rural group of potatoes such as the Rural New Yorker No. 2 or the Sir Walter Raleigh.

In 1913 and 1914 all seed potatoes were given the formaldehyde treatment (1 pint of formaldehyde, 40 per cent solution, to 25 gallons of water). The tubers were soaked in this solution for two hours. In 1915-16-17-18 the bichloride treatment was given (4 ounces of bichloride of mercury, corrosive sublimate, to 30 gallons of water). The tubers were soaked in this solution for 1½ hours. Those which were to be planted whole were treated after the stem ends had been examined

for discoloration. Potatoes showing discoloration were thrown out, and all stock which was to be cut was treated after cutting to avoid reinfection of disease should any be met in cutting.

The soil on the Aberdeen Substation is a sandy clay loam. Plantings in 1913 were made on land which was cleared of sagebrush two years previously and had produced two successive crops of wheat. In 1914 the crop was planted on land which had produced three successive crops of wheat and had received one coat of manure (20 tons to the acre) the fall before the potatoes were planted. The 1915 crop was planted on land which produced a crop of field peas harvested for seed and which had previously been in wheat for three successive years, and manured the fall before the peas were planted. Plantings for 1916-17-18 were made on land which had grown a good alfalfa crop for two to three years.

To insure the careful working out of the experiment, the furrows were opened with a shovel plow and the seed pieces or tuber sets were dropped by hand and covered with a "crowder". The rows were 33 inches apart and the sets were spaced 16 inches apart in the row excepting in the experiment on the distance in row where various distances were used. All the potatoes were planted at a depth of 4 inches. A chain with strings tied at the proper spacings was used as a guide to the planters to insure accurate placement of each seed piece.

Three or four irrigations and cultivations were given during the growing season, the number of irrigations given depending upon the seasonal precipitation and other climatic factors. Cultivation always followed irrigation until the vines were large enough to shade the ground.

WHOLE COMPARED WITH CUT SEED—SMALL COMPARED WITH LARGE SEED PIECES

This experiment was planned to include seed pieces of maximum and minimum sizes and various sizes between these extremes. Tubers weighing 8 ounces, 4 ounces and 3 ounces were used. A portion of each lot was planted whole, a portion was halved and a portion was quartered. Halved portions were obtained by cutting the potato lengthwise, dividing the bud end, care being taken to divide into equal parts. The quartered seed was obtained by cutting the tuber lengthwise and then crosswise, making the quarters as nearly uniform in size as possible. No attempt was made to have a definite number of eyes on each seed piece. Each whole tuber was examined for external indications of disease. A thin slice was then cut off the stem end of the tuber as a further precaution against planting diseased stock. All tubers showing brown discoloration were discarded.

Care was taken to get tubers of proper size for each experiment. A

variation of half an ounce was permitted in the selection of the 8-ounce lot, while a variation of but a quarter ounce was permitted in the selection of the 3-ounce and 4-ounce tubers. The average weights in each lot were rigidly maintained.

Results.

Results obtained from this experiment show that there is a characteristic and marked difference in returns to be expected from whole, halved, and quartered seed pieces. The larger and more nearly whole the seed piece is, the quicker the sprouting and starting of growth of the plant.

Sprouting and Early Growth.

The plants from the 8-ounce, 4-ounce and 3-ounce whole tubers appeared first and in the order here mentioned. Next to appear were the 8-ounce halved tubers. Four-ounce and 3-ounce halved and 8-ounce quartered tuber set-plants appeared in the next 24 to 48 hours. The plants from the 4-ounce and 3-ounce quatered tubers were the last to appear, the latter appearing from 2 to 4 days later than those from the 8-ounce whole tubers.

The sprouting and emergence ("coming up") period varied considerably from year to year, depending upon climatic conditions and the condition of the soil. A moist, warm soil hastened growth and a dry warm soil retarded growth of all small cut seed pieces but only slightly affected the growth of the plants from the whole tuber sets. Cold soil and cold weather retarded the growth of the plants from the whole and cut tubers, but the latter were most affected. The early growth of the plants from the large whole tubers was least affected by the soil moisture content and the physical condition of the soil.

TABLE I

Results from an experiment to determine the effect of planting whole or cut potatoes of various sizes on irrigated land at the Aberdeen Substation, Aberdeen, Idaho, 1913 to 1918 inclusive.

Description of tuber set planted	Seed per acre planted	Percent of stand (a)	Stalks per hill (a)	Yield per acre		Percent of Marketable Tubers	Tubers per bushel (a)		Weight per tuber (a)	
				Total	Marketable		Marketable	Culls	Marketable	Culls
	Bushels			Bushels	Bushels				Ounces	Ounces
8-oz. whole	99	99.2	8.4	433.7	263.9	60.8	212.2	517.7	4.6	1.8
4-oz. whole	49	99.2	5.2	394.4	230.9	58.5	173.0	491.2	5.7	1.9
3-oz. whole	37	99.5	4.5	385.2	250.2	64.9	186.2	475.0	5.2	2.0
8-oz. halved ..	49	99.6	4.7	379.7	270.3	71.1	189.0	467.0	5.2	2.0
4-oz. halved ..	25	99.2	2.8	367.2	270.0	73.5	164.5	444.5	5.9	2.1
3-oz. halved ..	19	98.2	2.4	371.8	289.2	77.7	157.5	424.7	6.2	2.8
8-oz. quarter'd	25	92.5	2.6	338.1	255.7	75.6	160.7	440.2	5.7	2.1
4-oz. quarter'd	13	89.1	1.6	311.2	274.2	88.1	144.0	445.7	6.9	2.1
3-oz. quarter'd	10	82.1	1.6	286.1	240.1	83.9	161.7	444.5	5.9	2.1
SUMMARY.										
Whole (b)		99.3	6.0	404.4	248.3	59.0	190.4	494.6	5.1	1.9
Halved (b) ..		99.0	3.3	372.9	276.5	74.1	170.3	445.4	5.7	2.3
Quarter'd (b)		87.9	1.9	311.8	256.6	80.0	155.4	443.4	6.1	2.1

(a) Average for four years only (1915 to 1918 inclusive).
(b) Includes all tubers of the class regardless of weight.

Percentage of Stand.

Tabulated results for the 6-year period will be found in Table 1. This table shows that the stands from the whole and halved tuber sets were excellent, while the loss in the stand of the quartered tuber seed pieces was quite severe. The loss in stand from the 8-ounce quartered seed piece (2-ounce set) was 7½ per cent while the loss from the 4-ounce quartered seed piece was 11 per cent, and the loss from the 3-ounce quartered seed pieces was 18 per cent. This loss is no doubt due to the inability of the plants from the small tuber sets to overcome adverse climatic and soil conditions, and to a possible lack of eyes on many of the small quartered seed pieces. The Idaho Rural potato has from 8 to 10 eyes and very rarely 11. Six or more of these eyes are on the bud end of the potato. When this potato is quartered without regard to placement of the eyes, the stem-end quarters may have one eye and sometimes none at all.

Stalks Per Hill.

The average number of stalks per hill, as determined by actual count, varied directly with the size of the tuber set, in each respective lot of whole, halved and quartered tubers, for the larger the seed piece the

greater the number of stalks per hill. Four-ounce whole tubers produced a greater number of stalks per hill than the 8-ounce halved tubers altho both are really 4-ounce sets. This is due to the greater number of eyes on the whole tuber. Four-ounce halved sets produced more stalks per hill than the 8-ounce quartered tubers, altho both are 2-ounce sets. The 4-ounce quartered sets produced the same number of stalks per hill as the 3-ounce quartered sets, due undoubtedly to the sets being very nearly the same size and having the same number of eyes. Table 1 shows that the whole tubers produced almost twice as many stalks per hill as the halved sets and that the halved sets produced almost twice as many salks as the quartered sets.

Practically every eye on the 8-ounce whole, halved and quartered tuber sets produced stalks as will be noted by comparing the number of stalks per hill and the number of eyes per tuber on the Idaho Rural potato. The earlier sprouting bud eye on the larger sets does not grow to the exclusion of growth of the other eyes of the tuber. Idaho Rural potatoes are not given to producing a master or single sprout to the exclusion of growth of other eyes of the tuber. If this potato by breeding or selection, could be made to grow a master sprout, the undesirable features resulting from planting this potato whole would be eliminated. Size of the set determines very largely how many stalks will be produced, for the larger the set the more plant food there is available and the greater the stimulus given each eye to produce a plant. The 4-ounce and 3-ounce whole tubers have just as many eyes as the 8-ounce tubers, but the eyes on the small tubers are not as well developed, hence do not send out sprouts from all the eyes. It will be noted in Table 1 that the largest whole tubers produced an average of over 8 stalks per hill whereas the 4-ounce produced a little over 5 stalks and the 3-ounce only 4½ stalks per hill. Tubers are produced by all of these stalks and it is this fact which has such a large bearing upon the percentage of marketable tubers from the whole, halved, and quartered seed pieces. These percentages are likewise given in Table I.

Vine Growth.

Whole tubers invariably produced a larger and more plentiful growth of vine than the cut pieces and the growth was directly in proportion to the size of the set. The vigorous growth from the large sets is due to the better start given the plants by the greater supply of food available in the larger sets; to the greater proportion of eyes producing stalks; and to the greater supply of natural moisture in the whole and larger cut sets. Because of the extra advantage given the vines by the larger seed sets such a vigorous vine growth is maintained that it cannot be overcome by the smaller seed pieces even tho all are planted on the same soil and given the same subsequent treatment. The vine growth from the 3-ounce quartered sets was the least vigorous of the group, and comparatively was the shortest in height.

Yield per Acre.

The total yield per acre is almost directly proportional to the size of the seed piece, and the larger the seed, the more vigorous the plant and the greater the number of potatoes produced. Whole tubers invariably produced the largest total yield of potatoes per acre. The average increase in yield per acre of whole seed over halved seed thruout the experiment is but 21.5 bushels per acre, whereas the average increase of halved seed over quartered seed is 61.1 bushels per acre. Total yield, however, does not really indicate the relative values of the crops produced by the various sized seed pieces, for the percentage of marketable tubers, unless the small stock can be marketed, has a greater bearing on the comparative productive values of the various seed groups. Eight-ounce whole tubers produced 60.8 per cent of marketable stock (over a 2-inch screen), whereas the 3-ounce quartered sets produced 83.9 per cent of marketable stock. The percentage of marketable potatoes increased as the size of the set decreased. This is due in part to the smaller number of stalks per hill, to the smaller number of tubers per hill and to the greater growth per tuber in the hills from the smaller seed pieces. Whole sets produced more tubers per hill than cut sets and the average size of the tuber was much smaller. The larger the set the greater the number of potatoes produced and the smaller the average weight per tuber. This is due to the greater number of stalks per hill from the large sets, the greater competition for moisture and food, and the greater number of tubers produced per hill. It will be noticed in Table I that the percentage of marketable tubers in the 4-ounce quartered lot is the highest of all the lots. The yield per acre of this group is next to the highest of all the groups. Results of this experiment indicate that the 4-ounce quartered and the 3-ounce halved seed sets are the most economical to plant from the standpoint of yield per acre and the amount of marketable potatoes produced when the amount of seed used per acre is considered.

The above results have been obtained with the spacing in the row at 16 inches with rows 33 inches apart. It is very probable that if the experiments here reported were also run with different spacings within the row the results might be more or less affected. The experiment on spacing which immediately follows this experiment in this publication indicates that wider spacing within the row would give higher yields of marketable stock from cut seed and the same would no doubt hold for whole seed. If whole seeds were planted from 24 to 28 inches apart in the row, depending upon the size of the seed piece, with the larger seeds planted the greater distance apart, it is very probable that the results here reported would need some revision.

Whole potatoes planted closely within the row and at a later date than the main potato crop would bring about the production of an excellent lot of 3 to 5-ounce seed potato stock with a minimum amount of large or cull stock.

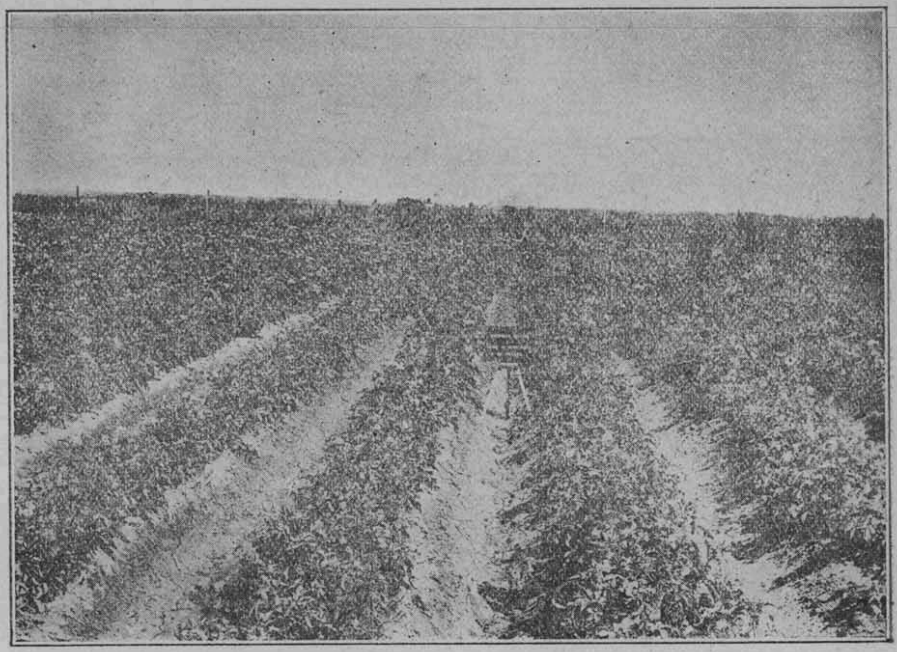
EIGHT OUNCE WHOLE

EIGHT OUNCE HALVED

FOUR OUNCE WHOLE

FOUR OUNCE HALVED

FOUR OUNCE QUARTERED



THREE OUNCE HALVED

THREE OUNCE QUARTERED

EIGHT OUNCE QUARTERED

EFFECT OF SPACING IN THE ROW UPON YIELD OF POTATOES

This experiment was planned to include minimum and maximum limits of spacing in the row. It was assumed that no commercial planting of potatoes would be made as close as 8 inches in the row or more than 28 inches in the row on irrigated land. All information available at the time the experiment was planned seemed to point to 12 and 20 inches as the minimum and maximum distances between plants in the row. The seed used in this experiment was all cut seed and averaged in size per set from 1½ to 2 ounces in weight. The same care in cutting and treatment for disease was exercised as heretofore described. Planting was done by hand and the chain with spacings made by tying strings at proper intervals was used as has been previously indicated. The seed sets were of ample size to promote quick and vigorous growth.

Results.

The outstanding feature to be noticed in the results of this experiment, as found in Table 2, are that the size of the marketable tubers and the percentage of marketable tubers rose as the distance between the tuber sets was lengthened. The total yield per acre increased also as the distance between the plants in rows increased. The additional yield in rows of widely spaced plants was unlooked for and was a rather surprising result. Many authorities on potato production state that to obtain yields of a high excellence fairly close planting must be followed. On the other hand, the wide spacing resulted in exceptionally large potatoes being produced. The question of the advisability of wide spacing rests to a great degree upon the size of potato the market demands. If 28-inch spacing produces too large potatoes, the spacing may have to be reduced to 24 inches or less.

Explanation should here be made also that the first three crops grown out of the six crops here reported were grown on land which had grown wheat two years in succession following the clearing of brush. Only in the third year of potato production, was the crop grown with fertilizer and this was applied the year previous to the growing of the potato crop in the form of barnyard manure at 20 tons per acre. The remaining three years of the experiment the potatoes were grown on alfalfa land, and the results of this planting favor the plantings of 20 and 24 inches within the row, in so far as total yield is concerned, but the percentage of marketable potatoes has still remained in favor of the 28-inch spacing.

It seems certain, however, that the 16-inch spacing which is quite generally used is too close for the most economical results. It may be possible that extremely rich soil would support the spacing of 16 inches in the row. But soil which will yield an average of 372 bushels of potatoes with a marketable percentage of 309 bushels per acre from such a gross yield, as was the case with these experiments, cannot be said to be poor land.

Good alfalfa land (land having grown alfalfa for two or more years) well fertilized with barnyard manure will produce an excellent crop of highly marketable potatoes, when the spacing between plants in the row is 20 inches or wider. Where whole potatoes are to be planted

the spacing in the row should be at least 24 inches if marketable stock is desired. If it is desired to grow seed stock, close planting—8 to 12 inches—will reduce the size of the tubers and increase greatly the number of potatoes of seed size.

The results from this experiment are recorded in Table II.

TABLE II

Five years average of yield per acre in bushels in a spacing in the row experiment with potatoes on irrigated land at the Aberdeen Substation, Aberdeen, Idaho, 1914 to 1918 inclusive.

Spacing between plants in row	Seed planted per acre	Yield per Acre		Percent Marketable	Marketable tubers per bu. (a)	Ave. wgt. per marketable tuber (a)
		Total	Marketable			
Bushels	Bushels	Bushels	Bushels	Per Cent	Number	Ounces
8	49.5	345.3	198.9	57.6	211	4.5
12	33.0	348.5	239.9	68.8	160	6.0
16	24.7	349.7	268.9	76.8	160	6.0
20	19.7	371.2	279.5	75.2	157	6.1
24	16.5	354.4	280.9	79.2	137	7.0
28 (b)	14.0	372.2	309.7	83.2	126	7.6

(a) Two year average only (1917-1918).
(b) Four years average only (1915 to 1918 inclusive).

SEED GROWN ON IRRIGATED LAND COMPARED WITH THAT GROWN ON DRY LAND FOR POTATO PRODUCTION UNDER IRRIGATION

There has been much discussion regarding the respective merits of dry-land seed transferred to irrigated land and seed grown on irrigated land for use on irrigated land. The present experiment was planned in 1914 to determine the respective merits of these kinds of seed. The Early Rose and Pearl varieties of potatoes were used in this experiment, primarily because they were the two best yielding varieties on dry land and were producing reasonably well on irrigated land. Seed sets of 1½ to 2 ounces were used in this experiment. The distance between rows was 33 inches and the hills were spaced 16 inches apart in the row. Planting was done by hand as in all previous experiments and a chain with strings tied at 16-inch intervals was used as a guide to insure accurate placement of seed pieces in the row.

Careful note was taken of the stands obtained in this experiment and in every case the averages of stand were high and the vine growth vigorous. It should be particularly noted that the irrigated and the dry-land seed of both lots for this experiment were produced from seed grown on this station in 1913. The irrigated seed was carried on from year to year from the previous year's seed stock. The dry-land seed was obtained each year from the dry-land seed stock which had been carried on from year to year on dry land.

TABLE III

Annual and average yields obtained in an experiment with irrigated and dry land seed potatoes grown on irrigated land at the Aberdeen Substation, Aberdeen, Idaho, 1914 to 1918, inclusive.

Variety and Source of Seed (a)	Yield per Acre.											
	1914		1915		1916		1917		1918		Average 1914-18	
	Total	Marketable	Total	Marketable	Total	Marketable	Total	Marketable	Total	Marketable	Total	Marketable
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
Early Rose (Dry Land)			321.6	193.8	386.6	358.2	245.3	215.3	440.0	406.0	348.3	293.3
Early Rose (Irrigated)			319.0	194.4	394.4	341.2	232.6	201.3	454.6	403.3	350.1	285.0
Pearl (Dry Land)	184.6	158.0	306.3	217.1	394.6	378.6	251.3	232.0	399.0	377.0	307.1	272.5
Pearl (Irrigated)	208.0	175.0	322.3	216.4	366.6	348.2	239.2	214.6	446.0	406.0	316.4	272.0

(a) 1½ oz. cut seed pieces used. Distance between hills, 16 in. Rows 33 in. apart

Results.

The tabulated result obtained from a five years' experiment with dry-land and irrigated seed on irrigated land will be found in Table 3. It will be noticed that fluctuations in yield occur from year to year. This fluctuation is largely one of soil variation. Two varieties were used in order to have a closer check on the problem under consideration. It will be noted that the final average yields of the varieties are quite comparable. The yields from dry-land and irrigated seed of the same varieties are almost identical and the difference of 2 bushels per acre in favor of the Early Rose is more likely due to variations in soil than to differences in kind of seed. The difference in the average of total yields between the irrigated and dry-land Pearls is but 9 bushels per acre in a five year experiment. In a total production of over 300 bushels per acre such a small difference does not warrant expressing favor for seed grown on dry land as compared with that grown under irrigation. This is particularly true when we note that the yields of marketable potatoes from the Pearl variety of both irrigated and dry-land seed are the same.

The results clearly indicate that seed grown on irrigated land is just as good as that grown on dry land, other things being equal. In interpreting these results, it should be noted that good, healthy tubers true to variety were used. If the potato grower will look to these vital qualities, irrespective of whether the seed was grown on irrigated or dry land, his yields of potatoes will not suffer, provided the crop is planted on good ground and receives good care.

SUMMARY

1. Whole tubers sprouted and came up more quickly than those from cut tubers.

2. Whole-tuber sets produced a larger and more plentiful vine growth than cut-tuber sets.

3. The vigor and size of the plant increased as the size of the set increased.

4. The loss in stand from planting whole and halved tubers averaged less than 1 per cent, while the loss in stand from planting quartered tubers averaged 12 per cent.

5. The earlier sprouting bud eye of the Idaho Rural potato does not grow to the exclusion of the growth of the other eyes of the potato.

6. The number of stalks per hill increased directly as the size of the set increased.

7. The total yield from whole tubers was 15.4 per cent more than from cut tubers.

8. Cut tubers yielded 18 per cent more marketable potatoes per acre than whole tubers.

9. The percentage of marketable tubers increased as the size of the set decreased.

10. The larger the set, the greater was the number of tubers produced and the smaller the average weight per tuber.

11. The 3-ounce halved and the 4-ounce quartered seed gave the most economical returns considering yield and amount of seed used.

12. The greater the distance between hills within the row, the greater the percentage of marketable potatoes, and the greater the weight per tuber obtained.

13. Sixteen-inch spacing in the row is too close for most economical results unless soil is exceedingly rich.

14. Potatoes will give best results on good alfalfa land if planted from 24 to 28 inches in the row.

15. Seed potatoes can be grown more profitably if spacing in the row is reduced to 8 to 12 inches.

16. No difference exists between irrigated and dry-land seed.

17. Healthy potatoes, true to type and variety, are the main essentials in selecting good seed-potato stock.