

THE EFFECT OF SIZE AND SPACING OF SEED PIECES ON THE YIELD AND GRADE OF WHITE ROSE POTATOES IN KERN COUNTY, CALIFORNIA.¹

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INTRODUCTION AND LITERATURE REVIEW

Stuart *et al.* (6), who made an extensive review of the literature prior to 1920, reported on seed piece studies made as early as 1776. From this and later papers, by Bates (1), Chucka *et al.* (2), Singh and Wakankar (3), Smith *et al.* (4), Starring (5), Wakankar (8), and Terman *et al.* (7), it is evident that the influence of size and spacing of seed pieces is modified by such factors as climate, fertility, and variety. However, in the majority of cases reported, the fact stands out that both larger seed pieces and closer spacing usually produce higher yields of smaller tubers, with spacing often producing this effect to a greater degree.

Potato growers in the south of California's San Joaquin Valley generally plant about twenty 100-pound sacks of seed potatoes per acre. These seed tubers are usually cut into fairly small pieces (many weighing one ounce or less), which are planted at 6 to 8-inch intervals in rows 30 to 32 inches apart. White Rose is the principal variety. Planting of the spring crop extends from early December to early March, with the bulk of the acreage being planted during January and February. Harvesting begins in mid-April and extends to early July. Market shipments are heaviest from about May 10 to about June 25.

MATERIALS AND METHODS

These experiments were conducted over four years (1952-1955) on Hesperia sandy loam soil at the U. S. Cotton Field Station, Shafter, California. Certified White Rose seed potatoes were cut into 1-ounce, 1½-ounce, and 2-ounce pieces. Each seed piece was individually weighed, except in 1952, when the seed tubers were cut into unweighed pieces of about 1 and 2 ounces, as judged by the cutters from weighed samples placed before them. Two spacing intervals were used—15 and 7½ inches. The seed pieces were planted with a conventional assisted-feed potato planter, which placed the seed pieces 6 to 7 inches deep and spread fertilizer in two bands about 2 inches below and 2 inches to each side of the seed pieces. Fertilization rate was slightly above a level determined to be adequate in fertilizer trials. The customary irrigation schedule used in the area was followed. Each year the plots were planted in early February and harvested in early June. Individual plots were single rows (2 rows in 1952), 32 inches

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apart; they varied from 45 to 125 feet long in different years. Each treatment was replicated four times, in a randomized block design, in 1952 and 1953 and six times in 1954 and 1955. Following harvest by a conventional mechanical digger and hand picking, the entire yield per plot was graded. In 1952, random samples of 35 to 50 pounds were taken from each plot for grading. Tubers were initially divided into two classes: (1) "rough", which included misshapen, growth-cracked, and second-growth tubers, and (2) "smooth", the well-shaped tubers. Injuries caused by disease, insects, or handling were not considered in the grading. The smooth tubers were further divided by means of sizing rings into three groups: (1) under $1\frac{7}{8}$ inches in diameter, (2) $1\frac{7}{8}$ to $2\frac{1}{4}$ inches in diameter, and (3) more than $2\frac{1}{4}$ inches in diameter. The sum of the last two classes closely represent U. S. No. 1 grade yields. Many of the $2\frac{1}{4}$ -inch tubers averaged about 6 ounces each.

RESULTS AND DISCUSSION

Both larger seed pieces and closer spacing increased total yield (Table 1.). Where the same quantity of seed potatoes were planted per acre ($16\frac{1}{3}$ sacks) there was little difference in yield from 1-ounce seed pieces spaced $7\frac{1}{2}$ inches apart and 2-ounce pieces spaced 15 inches apart. The second method gave but slightly greater yields.

The use of larger seed pieces and closer spacing also increased the yield of smooth tubers over $1\frac{7}{8}$ inches in diameter, U. S. No. 1 yield (Table 2). These increases, however, were somewhat smaller than increases in total yield, and were more erratic from year to year. The larger seed pieces raised U. S. No. 1 yield more when spaced at 15 inches than when spaced at $7\frac{1}{2}$ inches. Close spacing of small seed pieces was more effective in raising U. S. No. 1 yield than close spacing with large pieces.

At the 15-inch spacing, the percentage of U. S. No. 1 tubers was not affected by seed piece size as shown in table 3. At the $7\frac{1}{2}$ -inch spacing there was a small decrease in percentage of U. S. No. 1's as seed piece size was increased. With 1-ounce seed pieces, spacing had little or no effect on the percentage of U. S. No. 1's; with larger seed pieces, wider spacing gave a higher per cent of U. S. No. 1's.

It is economically significant to compare the yield of U. S. No. 1 tubers with the quantity of seed potatoes needed to plant an acre. Average figures indicate a continuous increase in yield as the quantity of seed potatoes is increased, but at a declining rate. Increasing the quantity of seed potatoes from $8\frac{1}{3}$ sacks to $16\frac{1}{3}$ sacks per acre increased U. S. No. 1 yield at approximately 8 to 49 sacks per acre, averaging 30 sacks. Increasing the quantity of seed potatoes further—to $32\frac{2}{3}$ sacks—increased the average yield of U. S. No. 1 potatoes by approximately 10 sacks. With equal quantities of seed tubers ($16\frac{1}{3}$ sacks per acre), 2-ounce seed pieces 15 inches apart produced only slightly more U. S. No. 1 potatoes than did 1-ounce pieces $7\frac{1}{2}$ inches apart. With plantings up to $16\frac{1}{3}$ sacks of seed per acre the percentage of total yield in the U. S. No. 1 classification averaged 85 or 87 per cent; increasing the seed rate to $32\frac{2}{3}$ sacks per acre, resulted in reducing the percentage of U. S. No. 1's 5 or 6 per cent.

TABLE 1.—*Total yield of White Rose potatoes with varied seed piece size and spacing.*

Seed Piece		Seed Potatoes Required (100-lb. Sacks/A)	Total Yield (100-Lb. Sacks per Acre)					
Size (Oz.)	Spacing in Row (Inches)		1952	1953	1954	1955	Average 4 Years 1952-55	Average 3 Years 1953-55
1	15	8 $\frac{1}{6}$	247	296	328	262	283	295
1	7 $\frac{1}{2}$	16 $\frac{1}{3}$	276	346	340	289	312	325
1 $\frac{1}{2}$	15	12 $\frac{1}{4}$	..	327	305	290	..	307
1 $\frac{1}{2}$	7 $\frac{1}{2}$	24 $\frac{1}{2}$	..	355	353	304	..	337
2	15	16 $\frac{1}{3}$	294	337	350	307	322	331
2	7 $\frac{1}{2}$	32 $\frac{2}{3}$	331	369	371	336	351	359

Difference required for significance at odds of 19:1 17 26 n.s. 19

TABLE 2.—*Effect of seed piece size and spacing on yield of smooth, well-shaped tubers over 1 $\frac{1}{8}$ inches in diameter (U. S. No. 1)*

Seed Piece		Seed Potatoes Required (100-lb. Sacks/A)	U. S. No. 1 Yield (100-Lb. Sacks per Acre)					
Size (Oz.)	Spacing in Row (Inches)		1952	1953	1954	1955	Average 4 Years 1952-55	Average 3 Years 1953-55
1	15	8 $\frac{1}{6}$	226	256	270	227	245	251
1	7 $\frac{1}{2}$	16 $\frac{1}{3}$	248	314	269	252	270	278
1 $\frac{1}{2}$	15	12 $\frac{1}{4}$	..	293	240	254	..	262
1 $\frac{1}{2}$	7 $\frac{1}{2}$	24 $\frac{1}{2}$	..	311	273	259	..	281
2	15	16 $\frac{1}{3}$	254	296	288	273	278	286
2	7 $\frac{1}{2}$	32 $\frac{2}{3}$	280	315	266	274	284	285

Difference required for significance at odds of 19:1 24 33 n.s. 23

TABLE 3.—*Effect of seed piece size and spacing on percentage of smooth, well-shaped tubers over 1 $\frac{1}{8}$ inches in diameter (U. S. No. 1).*

Seed Piece		Seed Potatoes Required (100-lb. Sacks/A)	Per cent of Total Yield					
Size (Oz.)	Spacing in Row (Inches)		1952	1953	1954	1955	Average 4 Years 1952-55	Average 3 Years 1953-55
1	15	8 $\frac{1}{6}$	91.6	86.6	82.5	86.6	87.0	85.3
1	7 $\frac{1}{2}$	16 $\frac{1}{3}$	89.9	90.9	79.0	87.1	87.0	86.0
1 $\frac{1}{2}$	15	12 $\frac{1}{4}$	..	90.0	79.3	87.7	..	86.0
1 $\frac{1}{2}$	7 $\frac{1}{2}$	24 $\frac{1}{2}$	..	87.5	77.3	85.2	..	83.6
2	15	16 $\frac{1}{3}$	87.2	88.0	82.2	89.2	86.8	86.6
2	7 $\frac{1}{2}$	32 $\frac{2}{3}$	85.2	85.5	71.5	81.5	81.2	79.8

Difference required for significance at odds of 19:1 n.s. n.s. 0.4 n.s.

The portion of the U. S. No. 1 yield over $2\frac{1}{4}$ inches in diameter, as shown in tables 4 and 5, was affected by both the size and spacing of the seed pieces. The 15-inch spacing yielded more of these large tubers than did the $7\frac{1}{2}$ -inch spacing. At the wider spacing, 65 to 90 per cent of the U. S. No.1 yield fell into this larger size. At the $7\frac{1}{2}$ -inch spacing the figure was about 17 or 18 per cent less. Although increasing the size of the seed pieces decreased the proportion of large tubers, the effects of seed-piece size were less significant than the effects of spacing.

The yield of U. S. No. 1 tubers under $2\frac{1}{4}$ inches in diameter (Table 6) was increased by closer spacing and by larger seed piece size.

The yield of smooth tubers under $1\frac{7}{8}$ inches in diameter (Table 7), about 10 per cent of the total crop, was increased by planting the larger seed pieces at the closer spacing. Again, spacing had a greater effect than did seed piece size.

The yield of "rough" tubers which generally did not exceed 10 per cent of the total yield, was not significantly affected by either size or spacing of seed pieces and no consistent trends were apparent (Table 8).

SUMMARY

Both total yield and, to a somewhat lesser degree, yield of U. S. No. 1 tubers were increased by increasing the quantity of seed potatoes planted per acre—through closer spacing and/or larger seed pieces. The rate of yield increase declined with each increment of seed potatoes. Planting more than approximately 16 sacks of seed potatoes per acre did not increase the yield sufficiently to justify the greater expense.

Large seed pieces spaced at $7\frac{1}{2}$ -inch intervals produced the highest proportion of small tubers. Potato size was determined more by spacing than by seed piece size.

The yield of "rough" tubers (misshapen, growth-cracked, and second-growth tubers) was slightly and inconsistently affected by size or spacing of seed pieces.

TABLE 4.—*Effect of seed piece size and spacing on yield of smooth, well-shaped tubers over $2\frac{1}{4}$ inches in diameter.*

Seed Piece		Seed Potatoes Required (100-lb. Sacks/A.)	Yield (100-Lb. Sacks per Acre)					
Size (Oz.)	Spacing in Row (Inches)		1952	1953	1954	1955	Average 4 Years 1952-55	Average 3 Years 1953-55
1	15	$8\frac{1}{2}$	183	239	196	183	200	206
1	$7\frac{1}{2}$	$16\frac{1}{3}$	157	267	129	155	177	184
$1\frac{1}{2}$	15	$12\frac{1}{4}$	..	266	159	188	..	204
$1\frac{1}{2}$	$7\frac{1}{2}$	$24\frac{1}{2}$	..	260	112	138	..	170
2	15	$16\frac{1}{3}$	220	266	171	190	212	209
2	$7\frac{1}{2}$	$32\frac{2}{3}$	191	254	95	135	169	161

Difference required for significance at odds of 19:1

31 n.s. 41 22

TABLE 5.—*Effect of seed piece size and spacing on yield of smooth, well-shaped tubers over 2¼ inches in diameter as per cent of U. S. No. 1 yield.*

Seed Piece		Seed Potatoes Required (100-lb. Sacks/A)	Per cent of U. S. No. 1 Yield over 2¼ Inches in Diameter					
Size (Oz.)	Spacing in Row (Inches)		1952	1953	1954	1955	Average 4 Years 1952-55	Average 3 Years 1953-55
1	15	8½	81.2	93.5	71.9	80.6	82.6	83.1
1	7½	16⅓	63.0	85.1	47.7	61.2	65.0	65.7
1½	15	12¼	..	90.8	65.8	73.7	..	77.8
1½	7½	24½	..	83.6	40.7	53.5	..	60.2
2	15	16⅓	86.6	90.0	58.9	69.5	77.5	74.1
2	7½	32¾	68.9	80.5	35.4	49.7	59.2	55.9

Difference required for significance
at odds of 19:1 1.1 0.5 0.6 0.5

TABLE 6.—*Effect of seed piece size and spacing on yield of smooth, well-shaped tubers between 1⅞ and 2¼ inches in diameter.*

Seed Piece		Seed Potatoes Required (100-lb. Sacks/A)	Yield (100-Lb. Sacks per Acre)					
Size (Oz.)	Spacing in Row (Inches)		1952	1953	1954	1955	Average 4 Years 1952-55	Average 3 Years 1953-55
1	15	8½	43	17	74	44	45	45
1	7½	16⅓	91	46	139	97	93	94
1½	15	12¼	..	27	81	66	..	58
1½	7½	24½	..	51	162	121	..	111
2	15	16⅓	34	29	117	83	66	77
2	7½	32¾	89	61	171	139	115	124

Difference required for significance
at odds of 19:1 28 13 25 23

TABLE 7.—*Effect of seed piece size and spacing on yield of smooth, well-shaped tubers 1⅞ inches or less in diameter.*

Seed Piece		Seed Potatoes Required (100-lb. Sacks/A)	Yield (100-Lb. Sacks per Acre)					
Size (Oz.)	Spacing in Row (Inches)		1952	1953	1954	1955	Average 4 Years 1952-55	Average 3 Years 1953-55
1	15	8½	7	5	25	12	12	14
1	7½	16⅓	17	10	44	23	24	26
1½	15	12¼	..	7	27	15	..	16
1½	7½	24½	..	14	52	33	..	33
2	15	16⅓	9	6	30	17	15	17
2	7½	32¾	23	16	65	38	35	40

Difference required for significance
at odds of 19:1 9 4 12 6

TABLE 8.—*Effect of seed piece size and spacing on yield of rough tubers (misshapen, growth-cracked, and second-growth).*

Seed Piece		Seed Potatoes Required (100-lb. Sacks/A.)	Yield (100-Lb. Sacks per Acre)					
Size (Oz.)	Spacing in Row (Inches)		1952	1953	1954	1955	Average 4 Years 1952-55	Average 3 Years 1953-55
1	15	8½	14	34	33	23	26	30
1	7½	16⅓	11	22	27	14	18	21
1½	15	12¼	..	27	38	21	..	29
1½	7½	24½	..	30	28	12	..	23
2	15	16⅓	31	35	32	17	29	28
2	7½	32¾	28	38	40	24	32	34

Difference required for significance
at odds of 19:1

n.s. n.s. n.s. n.s.

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