been planted at Riverside in June, 1963. Trees were Frost nucellar navel on Kryder trifoliate rootstock spaced 12 by 22 ft. After thinning, the remaining trees were 24 by 22 ft. The trees were cut off with a chain saw as close to the ground as practical, usually 5 to 6 inches.

Soil was removed to a depth of approximately 4 inches around each stump to expose the base of the roots for spraying. The entire stump and exposed root base were thoroughly covered with spray.

Test plot

The experiment was set up as a randomized block of four replications with two stumps to a replication. One stump of each pair received a second spray three months after the first treatment. The 10% solutions were available in aerosol sprays, and treatments started on March 16, 1971. The 5% plus 1% naphthalene acetic acid, ethyl ester solution, was not applied until three months later, when it became available as an aerosol spray—to coincide with the 10% solution treatments.

Counts on regrowth were made three, six, nine, 12, and 15 months after spraying for the 10% solution, and at three-month intervals for a period of 12 months where the 5% plus 1% naphthalene acetic acid ethyl ester was used.

Two treatments with a 10% solution of either ethyl hydrogen 1-propylphosphonate or 1-propylphosphonic acid inhibited all sprout growth for 15 months. Single applications greatly reduced regrowth over the untreated checks (see table).

Ethyl hydrogen 1-propylphosphonate, used at a 5% concentration, plus 1% naphthalene acetic acid was more effective than the 10% concentration of the chemical alone, when applied as one treatment.

No adverse effects were noted on any of the nearby trees remaining in the orchard. Recommendations for the use of ethyl hydrogen 1-propylphosphonate or 1-propylphosphonic acid cannot be made for agricultural use until approval has been granted by appropriate governmental agencies.

S. B. Boswell is Specialist, Department of Plant Sciences; C. D. McCarty is Horticulture Technologist, Agricultural Extension Service, University of California, Riverside. M. P. Miller, is Farm Advisor, Emeritus, Riverside County. Dr. I. A. Rammer of FMC Corporation, Niagara Chemical Division supplied the chemicals.

"SURVIVAL POWER"

key to successful carrot stands

BURTON J. HOYLE

Obtaining good commercial carrot stands in the San Joaquin Valley has often proven to be unpredictable and sometimes difficult. Carrots are becoming a major crop in this area and growers are using many mulching, irrigation and planting techniques in an effort to improve stands. During the last three years an increasing number of growers have used only large-sized seed in an attempt to guarantee stands. These studies at the U.C. West Side Field Station, Five Points, indicate that under most conditions small seed may be as good or better than large seed.

CARROT SEED SIZE was evaluated as a factor in obtaining good commercial stands using three planting densities for five varieties, at three planting periods (table 1). The tests were conducted at the West Side Field Station and included: Test 1, cool season, planted March 16 and harvested five times in June and July (NK Imp. 58 seed only); Test 2, hot season, planted June 17 and harvested three times in September (NK Imp. 58 seed only); and Test 3, six varieties planted April 15 and harvested five times in July.

TABLE 1. ESTIMATED NUMBER OF CARROT SEED PLANTED PER FOOT OF ROW*

Seed size	Approximate number of seed per lb	Approximate seeds planted per foot from seed plate hole number: 5	7	9
Large	231,595	8–12	18–22	28–32
Medium	295,750	12–16	26–30	40–46
Small	329,000	15–19	32–36	55–60
Very Small	462,626	28–32	40–46	65–75

* Ave. values from static tests with a Planet Jr. planter. Variety, NK imperator 58, especially sized by the plant.

All samples were graded into: total roots, Cello grade, and Jumbo grade (for number and weight). Cello grade consisted of roots 7 to 9 inches long and 3/4 to 1 1/4 inches in diameter. Jumbo grade consisted of roots 7 to 9 inches long and 1 3/8 to 1 3/4 inches in diameter.

Survival power

The ability of a seed to produce a surviving plant of any quality, when disease is not a factor, has been termed "survival power" in these tests. In tests 1 and 2 the surviving plants ranged from near 100% down to 30% of the seed planted, depending on density of planting.

The survival power for each seed size and planting density is shown in table 2 as a per cent of seed planted. Nearly 100% of the large seed survived when planted at 10 to 15 per foot, 50% at 20 seeds per foot and 40% at 30 seeds per foot. For each of the four seed sizes, the highest survival rate was at the lowest planting rate. Actual percentages of sur-

TABLE 2. PER CENT OF SEED PLANTED WHICH PRODUCED CARROTS OF ANY QUALITY (TEST 2, HOT SEASON)

Seed planted* per foot	Harvest dates† 1	2	3	4	5	Ave.
Large seed—231,595 count						
10	100	93	109	120	98	106
20	50	50	45	41	58	49
30	40	37	34	52	52	43
Medium seed—295,750 count						
14	71	61	57	62	73	65
28	46	38	40	44	36	41
42	41	54	37	42	40	43
Small seed—329,000 count						
17	63	41	45	55	67	54
34	20	29	25	29	29	26
58	31	38	34	32	40	35
Very small seed—426,626 count						
30	47	50	50	34	51	46
45	42	45	38	30	44	40
70	27	39	51	39	35	38

* Estimated from static tests.
† (1) June 16, (2) June 24, (3) July 1, (4) July 7, (5) July 14.

vival varied but as the seeding rates exceeded 20 to 25 per foot, the survival rate stabilized at around 40% for the trials reported in table 2.

These tests showed that seed size did not greatly affect survival power but seed lots and varieties did.

Planting 15 seeds per foot provided the highest survival rate, but an excess of 20 surviving plants per foot was required for optimum yield and quality. Above the initial rate of 15 seeds per foot, only 10 to 20% of any additional seed was effective in providing for more surviving plants. For this reason, "survival power" may be an important concept in establishing desirable stands.

Saleable roots

Saleable roots were found to remain nearly constant at 9.5 and 7.5 per foot of row, for the cool and hot season respectively, regardless of the total population per foot within a range of 12.4 to 39.6 plants. The highest yields of saleable roots occurred when the total population did not exceed 30 plants per foot and the number of cull roots did not exceed 60% of the total. The presence of these culls or extra plants was not detrimental to maximum yield within the limits mentioned.

For the cool season planting, there was no significant difference among large, medium, small, and very small seed for producing the Cello-plus-Jumbo grades (table 4). There was a trend toward smaller yield from very small seed for Cello—plus—Jumbo because of the diminished number of Jumbo grade at high seeding rates). For Cello grade, there were significant differences showing the high population, (seed plate hole 9) yielding more than the low population, (seed plate hole 5), for large and medium seed. For small and very small seed there were no significant differences between population obtained from seed plate holes 5, 7, or 9. For each of the four seed sizes there is a persistent trend of increasing yield from increasing populations obtained from seed plate hole 5 to 7 to 9. Nearly a 25% increase in Cello grade occurred between holes 5 and 9.

TABLE 4. EFFECT OF SEED SIZE ON CARROT YIELD & QUALITY

Seed size	Total harvested* no	lbs	Cello no	lbs	Cello plus Jumbo no	lbs
Test 1—cool season						
Large	19.0	1.0	4.7	.52	7.0	1.1
Medium	23.1	2.1	5.5	.62	7.7	1.1
Small	24.2	2.4	6.1	.75	9.1	1.5
Very small	28.8	2.3	6.0	.70	8.0	1.1
Test 2—hot season						
Large	16.6	2.2	6.6	.90	9.9	1.7
Medium	18.8	2.3	6.5	.83	9.6	1.6
Small	19.1	2.2	7.2	.92	10.4	1.7
Very small	28.8	2.2	7.7	.89	9.3	1.2

* Values are per foot of row.

TABLE 3. CARROT QUALITY AND YIELD AFFECTED BY SEED SPACING AND VARIETY (TEST 3)*

		Variety						
FOR TOTAL YIELD	Hole #	King	WHC	Ace	Nia58	NK58	Gold Pak	Ave.
Plants/ft	5	8.9	20.6	13.2	14.2	11.9	10.6	13.2
	7	10.3	28.8	19.4	23.8	18.8	16.8	19.7
	9	13.0	34.4	32.6	34.0	27.6	21.8	27.2
Weight lbs/ft	5	1.7	2.1	2.4	1.7	1.6	1.9	1.90
	7	1.8	2.2	2.2	1.9	1.7	1.9	1.95
	9	1.4	2.4	2.0	1.9	2.2	2.0	1.98
CELLO PAK								
Plants/ft	5	3.2	4.9	3.4	4.2	4.6	3.4	3.95
	7	5.5	5.0	6.6	5.6	6.4	4.8	5.65
	9	4.4	4.9	5.2	5.6	6.0	5.2	5.22
Length—inches	5	8.4	7.1	6.6	7.0	7.7	7.6	7.40
	7	7.7	6.9	7.4	6.6	7.5	6.5	7.10
	9	8.6	7.2	7.2	6.8	7.5	7.3	7.43
Weight lbs/ft	5	.41	.52	.51	.47	.57	.51	.50
	7	.72	.59	.71	.65	.67	.61	.66
	9	.60	.55	.70	.61	.73	.63	.64
JUMBO PAK								
Plants/ft	5	2.8	4.3	4.4	2.9	2.9	4.1	3.57
	7	2.8	3.3	3.5	2.3	2.7	3.1	2.95
	9	2.7	2.9	2.7	2.3	2.3	3.3	2.70
Length—inches	5	9.7	7.6	9.7	7.0	7.7	7.4	8.18
	7	8.2	7.4	7.6	7.5	7.7	7.5	7.65
	9	9.5	7.4	7.5	7.0	7.7	7.8	7.81
Weight lbs/ft	5	1.2	1.0	1.2	.73	.80	1.1	1.01
	7	.87	.64	.87	.42	.65	.73	.70
	9	.73	.67	.46	.42	.50	.73	.58

* See table 1 for seed size, hole number and grade description. All values average of 10 samples.

The hot weather planting of June 17 (table 4) was similar in most respects to the cool season planting. Both small and very small seed were equal to or better than medium or large seed. In the variety test (table 3), all varieties showed a trend of increasing Cello grade yield with each increase in planting densities. For the combination of Cello plus jumbo, the low population gave the higher yields.

There were no significant differences between large, medium small, and very small seed in production of saleable roots, as indicated in table 4. A slight and persistent trend did exist showing that small seed was always equal to or higher than large or medium seed in saleable yield and quality.

Hot weather, with a day-time maximum at over 100° during a sustained period did not affect emergence or stand of any one seed size.

Quality carrots were harvested over a 1-month period for both the hot and cool seasons. Net weight gain per foot of bed was 0.5, 0.4, and 0.3 lbs respectively for planting densities from holes 5, 7, and 9. Seed size had no influence on weight gain per week. Root length changed little during this month of harvest: i.e., ½ inch to 1 inch for the Cello grade in the cool season, and less in the warm season. By the time the carrot diameter had enlarged to fit the Cello grade, its length was relatively stable during the period of quality harvest.

In commercial fields it is not uncommon to have culls number 60% of all carrots hauled to the packing shed. Cull percentages in these tests ranged from 20% to 81% of the total number, which amounts to 20% to 60% of the total weight. The largest yields of Cello and Jumbo grades were associated with 34.6% and 55.2% culls. In the cool season test 1, the highest Cello grade was associated with the highest Cull percentage. More research is planned to explore this point further.

Burton J. Hoyle is Vegetable Crops Specialist, West Side Field Station, Five Points. This report is a summary of a detailed study by the author, a copy of which may be obtained from the West Side Field Station. These investigations are being continued.