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Roose et al.

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(54) **MANDARIN TREE NAMED ‘KINNOWLS’**

(50) Latin Name: *Citrus reticulata*
Varietal Denomination: **KinnowLS**

(75) Inventors: **Mikeal L. Roose**, Riverside, CA (US);
Timothy E. Williams, Riverside, CA
(US)

(73) Assignee: **The Regents of the University of
California**, Oakland, CA (US)

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Primary Examiner — June Hwu

Assistant Examiner — Louanne Krawczewicz Myers

(74) *Attorney, Agent, or Firm* — Kilpatrick Townsend &
Stockton LLP

(57) **ABSTRACT**

‘KinnowLS’ is a mid- to late-season maturing (depending on
climate) diploid mandarin that combines large-sized fruit of
excellent quality and production with low seed content even
in mixed plantings. It may be successful in the mid-to-late
season marketing window that currently has few low-seeded,
high quality cultivars.

8 Drawing Sheets

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Latin name of the genus and species: The mandarin cultivar
of this invention is botanically identified as *Citrus reticulata*.

Variety denomination: The variety denomination is ‘Kin-
nowLS’.

BACKGROUND OF THE INVENTION

‘KinnowLS’ is a mandarin selection developed at River-
side, Calif. and derived from an irradiated bud of the diploid
mandarin cultivar ‘Kinnow’ (unpatented), a mid-to-late sea-
son maturing variety. ‘Kinnow’ is a hybrid of two *Citrus*
cultivars, ‘King’ (unpatented, *Citrus reticulata* ‘Blanco’) and
‘Willowleaf’ (unpatented, *Citrus reticulata* ‘Blanco’), which
was first developed by H. B. Frost in Riverside, Calif. After
evaluation, the ‘Kinnow’ was released as a new variety for
commercial cultivation in 1935.

Irradiation of budwood from registered ‘Kinnow’ trees in
Exeter, Calif., was accomplished in June of 1997 in Riverside,
Calif. Specifically, irradiation of 150 buds of ‘Kinnow’ man-
darin was accomplished using 40 Gray units of gamma irra-
diation from a Cobalt-60 irradiation source. Buds from this
irradiation were propagated onto Carrizo rootstocks in a
greenhouse in Exeter, Calif. where they were grown to field-
plantable-sized trees. Out of these irradiations, a total of 73
trees were obtained. This low yield of trees is typical because
the radiation kills many of the buds. These trees were then

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planted in May 1998 in Exeter, Calif. Fruit production and
evaluation began in 2001. One selection from this irradiated
population (propagated on Carrizo rootstock) distinguished
itself from the others in having tree growth typical of ‘Kin-
now’ mandarin, very low seed counts in comparison to the
original ‘Kinnow’ cultivar, and excellent fruit quality and
normal fruit production characteristic of the ‘Kinnow’ parent.
After two seasons of fruiting, this selection was given the
name ‘Kinnow IR5’ and selected for further trials. In January
2003, buds of this selection were taken and propagated onto
Carrizo and C35 citrange rootstock for field trials. In June of
2004, 72 trees, produced in Exeter, Calif., were planted at six
sites (twelve trees at each site): Arvin, Irvine, Lindcove, Ther-
mal, Riverside, and Woodlake, Calif. All trials were propa-
gated equally on Carrizo and C35 citrange rootstocks. All
trials were in mixed-plantings with other cultivars, including
seedy cultivars with high pollen viability. Fruit production of
these propagated trees commenced in 2006 (a few trees at
each site) and 2007 (all trees at all sites). In October 2008,
budwood from the selected tree was sent to Exeter, Calif. for
evaluation of disease status and, as needed, elimination of
viruses and other pathogens. Six trees were then established
as disease-free ‘mother’ trees in a greenhouse in Exeter, Calif.
The properties of ‘KinnowLS’ were found to be true to type
and transmissible by asexual reproduction in comparing these
plantings with the original ‘KinnowLS’ selection.

BRIEF SUMMARY OF THE INVENTION

‘KinnowLS’ is a mid-season maturing diploid mandarin that combines large-sized fruit of excellent quality and production with low seed content even in mixed plantings. It may be successful in the mid-to-late season marketing window that currently has few low-seeded, high quality cultivars.

BRIEF DESCRIPTION OF THE DRAWINGS

- FIG. 1 shows fruit of ‘KinnowLS’ taken at Riverside in February.
- FIG. 2 shows a side-by-side comparison of (left) ‘KinnowLS’ and (right) ‘Kinnow’.
- FIG. 3 shows the eleven-year old mother tree on Carrizo citrange rootstock.
- FIG. 4 shows a three-year old ‘KinnowLS’ tree in Exeter, Calif.
- FIG. 5 shows the bud union of ‘KinnowLS’ on ‘Carrizo’ citrange rootstock, eleven-years old.
- FIG. 6 shows fruit clusters on a three-year old ‘KinnowLS’ tree in Exeter, Calif. in the month of February.
- FIG. 7 shows leaves of ‘KinnowLS’.
- FIG. 8 shows open and closed flowers of ‘KinnowLS’.

DETAILED DESCRIPTION OF THE INVENTION

‘KinnowLS’ is a mandarin selection developed at Riverside and Exeter, Calif. by mutation breeding of the mandarin cultivar ‘Kinnow’, for which harvest is typically begun from mid-January to mid-February, depending on location. Evaluation of ‘KinnowLS’ began on the original tree at Exeter, Calif. in 2001 and has continued annually until the present. ‘KinnowLS’ has been asexually reproduced by grafting (budding), using the standard T-bud method generally used to propagate *Citrus* in California. Asexual propagation of the selected tree was first accomplished in January 2003 at Exeter, Calif. to produce 72 trial trees on Carrizo and C35 rootstocks.

‘KinnowLS’ distinguishes itself by being low seeded (2-3 seeds/fruit) in all situations of cross-pollination, while ‘Kinnow’ has 15-30 seeds per fruit in cross-pollinated situations. At Riverside, Calif. ‘KinnowLS’ matures in winter (mid-January) and holds its fruit quality characteristics through April. Fruit size is large for mandarins, classed as Jumbo by State of California standards and size 21 for industry packing standards. Fruit are oblate in shape with an orange rind color and a very smooth rind texture. Flesh is deep orange in color and finely-textured. Fruit are easy to peel and juicy, with a rich, sweet and distinctive flavor when mature. Tree growth habit is vertical and vigorous, producing a large and rather dense upright crown with excellent production commencing in the third year after planting. ‘KinnowLS’ is well adapted to growing in all California climate zones normally associated with *Citrus*, including desert regions, because the fruit, which matures during January through April at most locations, does well in hot climates where it matures in December. Alternate bearing can be a problem in trees that are not culturally managed to reduce this tendency.

‘KinnowLS’ mandarin can be grown according to accepted cultural practices for larger, more vigorous mandarin varieties, including planting densities of 180-250 trees per acre, normal fertilization and pest control practices, and the use of standard rootstocks for mandarins. Other rootstocks adapted to more marginal growing conditions of salinity, high pH or very heavy soils, including the lemon types *C. macrophylla*,

Volkameriana, and rough lemon, may be useful in those conditions but overall fruit quality would likely be affected negatively. Sour orange or mandarin type rootstocks such as Cleopatra might be more suitable in these marginal conditions since fruit quality would not be affected to the extent the lemon-type rootstocks impart.

‘KinnowLS’ is a very vigorously growing tree and therefore pruning will likely be necessary to control this vigor. Such pruning should include topping the trees to control vertical growth and selective interior pruning to enhance production and health of the tree. These pruning procedures can be applied after the second year of full fruit production and regularly thereafter.

The Royal Horticulture Society (R.H.S.) color numbering system is used herein for the color description of the rind, seed, bark, leaf, flower, flesh color and other interest of the ‘KinnowLS’ mandarin cultivar.

Comparison With Existing Mandarins

A comparison of ‘KinnowLS’ with other low-seeded late-season mandarins is provided in Table 1 below. ‘KinnowLS’ is distinctive in having a very wide climatic growing area (including very hot desert areas), excellent production (though some tendency to alternate bear), and fruit quality characteristics (large size, shape, very smooth rind texture, and very rich, sweet flavor) that may be preferred in some markets.

TABLE 1

Comparison of ‘KinnowLS’ with other late season, low-seeded mandarins. Data for Riverside, California.			
Trait	‘KinnowLS’	‘TDE2’ (U.S. Plant Pat. No. 15,461)	‘TDE3’ (U.S. Plant Pat. No. 15,703)
Maturity	Mid-February	February	January-February
Seeds per fruit	2.45	0.02	0.29
RHS rind color	Orange 25A	Orange-Red N30D	Orange-Red N30C
Rind texture	very smooth	slight pit	papillate
Fruit weight (g)	145	185	134
Fruit height/width	0.81	0.78	0.85
Alternate bearing	medium-high	medium	medium-high

Trait	‘TDE4’ (U.S. Plant Pat. No. 16,289)	‘Gold Nugget’ (unpatented)	‘Tango’ (U.S. Plant Pat. No. 17,863)
Maturity	February	February-March	February
Seeds per fruit	0.32	<0.1	0.22
RHS rind color	Orange-Red N30C	Orange 25A	Orange N25A
Rind texture	smooth	bumpy	smooth
Fruit weight (g)	175	108	90
Fruit height/width	0.78	0.88	0.81
Alternate bearing	medium-high	high	medium

Trees, Foliage, and Flowers

Tree size and growth characteristics of ‘KinnowLS’ have been consistent with those of ‘Kinnow’ throughout the evaluations. Growth of both the ‘Kinnow’ and ‘KinnowLS’ varieties have been quite vigorous throughout the evaluation period, producing large, vertically growing trees with dense crowns. The eleven-year-old ‘KinnowLS’ mother tree at Lindcove, Calif. on Carrizo citrange rootstock, shown in FIG. 3, is 3.1 m high and 3.0 m wide with an upright, though beginning to spread, crown exhibiting a dense growth habit

and yielding a canopy volume of 14.6 m³. In comparison, an eleven-year-old ‘Kinnow’ control tree has averaged 3.1 m tall and 2.9 m wide, yielding a canopy volume of 13.7 m³ on Carrizo citrange rootstock. These trees are smaller than normal because they were in a very high density planting until surrounding trees were removed at 7 years-of-age. In the younger, multi-location trials with more typical tree spacing, five-year-old ‘KinnowLS’ trees on Carrizo rootstock have averaged 3.1 m in height and 2.9 m in diameter with canopy volumes of 13.7 m³. Trees on C35 rootstock averaged 3.2 m in height and 3.0 m in diameter with canopy volumes of 15.1 m³.

Bud unions are slightly benched, as shown in FIG. 5, resulting in a scion circumference for the eleven-year-old ‘KinnowLS’ mother tree on Carrizo rootstock of 44.5 cm with the rootstock circumference 56.5 cm measured 38 and 18 cm above the soil level, respectively. Scion circumference for five-year-old ‘KinnowLS’ trees on Carrizo rootstock averaged 40.0 cm with the rootstock circumference averaging 50.5 cm when measured about 25 and 15 cm above the soil level, respectively. Scion circumference for five-year-old ‘KinnowLS’ trees on C35 rootstock averaged 41.0 cm with the rootstock circumference averaging 51.5 cm when measured about 25 and 15 cm above the soil level, respectively.

Leaves of ‘KinnowLS’, as shown in FIG. 7, are moderately large for a mandarin (80.8 mm in length×25.5 mm in width), lanceolate in shape and concave in cross-section and are dark-green in color (adaxial — RHS Green 137A, abaxial — RHS Yellow-Green 146B). The leaves have an acute apex with occasional weak emargination and an acute base. Petioles are medium in length (10.1 mm) and normally lack wings. The selection further lacks thorns.

As shown in FIG. 8, flowers of ‘KinnowLS’ are hermaphroditic, borne in clusters, medium in length, with greenish-white (RHS Green White 157D, adaxial and abaxial) petals averaging 13.1 mm in length and 6.2 mm in width, and with about 18 anthers which are yellowish in color (Yellow 13B). The five sepals are rudimentary, yellow-green (RHS Yellow Green 1D) in color and partly fused into a calyx. The free portion of the sepals averages 1.53 mm in length and 1.97 mm in width. The fused portion is about 1.0 mm in length. Pollen is yellowish in color (RHS Yellow 12B).

TABLE 2

Tree, leaf, flower and seed characteristics (for eleven-year-old tree) of ‘KinnowLS’ mandarin on Carrizo.	
1. Tree height	3.1 m
2. Crown diameter	3.0 m
3. Crown shape/density	Upright, spreading with age and dense
4. Scion circumference	44.5 cm
5. Height scion measured above soil surface	38 cm
6. Rootstock circumference	56.5 cm
7. Height Carrizo rootstock measured above soil surface	18 cm
8. Scion circumference ^z	40.0 cm
9. Rootstock circumference ^z	50.5 cm
10. Scion circumference ^y	41.0 cm
11. Rootstock circumference ^y	51.5 cm
12. Bud-union characteristics (on citrange rootstock)	Slightly benched (scion diameter smaller than rootstock)
13. Rootstock-scion compatibility	No evidence of incompatibility in trees Carrizo citrange at 11 years old (mother tree) or on C35 citrange at 7 years old (trial trees)
14. Tree vigor	Vigorous
15. Bark color	RHS Grey-Brown N199A
16. Leaf shape	Lanceolate

TABLE 2-continued

Tree, leaf, flower and seed characteristics (for eleven-year-old tree) of ‘KinnowLS’ mandarin on Carrizo.	
17. Leaf cross-section	Concave
18. Leaf blade length	80.8 mm
19. Leaf blade width	25.5 mm
20. Leaf apex	Acute with weak emargination
21. Leaf base	Acute
22. Leaf margins	Very slightly crenate
23. Leaf abaxial color	RHS Yellow-Green 146B
24. Leaf adaxial color	RHS Green 137A
25. Petiole length	10.1 mm ± 0.7
26. Petiole width	1.5 mm
27. Petiole wings	Absent
28. Petiole color	RHS Green 137A
29. Thorniness	Not present
30. Inflorescence type	Clustered
31. Flowering habit	Flowers once per year
32. Flower structure	Complete
33. Bud length (one day before opening)	12.2 mm
34. Bud width (one day before opening)	7.5 mm
35. Bud shape (one day before opening)	oblong
36. Petal number	5
37. Sepal number	5
38. Petal length	13.1 mm
39. Petal width	6.2 mm
40. Petal apex	acute
41. Petal base	truncate
42. Petal color (adaxial)	RHS Green-White 157D
43. Petal color (abaxial)	RHS Green-White 157D
44. Petal shape	elliptic
45. Petal margin	smooth
46. Sepal number	5
47. Sepal color	RHS Yellow-Green 1D
48. Sepal shape	partly fused, tips attenuate
49. Sepal length (free portion)	1.53 mm
50. Sepal width	1.97 mm
51. Number of anthers	18 (range 17-20)
52. Anther color	RHS Yellow 13B
53. Pollen color	RHS Yellow 12B
54. Pollen viability	Moderately low (15-25%)

^{z,y}Bud union measurements are averages for 5-year-old trial trees on Carrizo^z or C35^y measured about 10 cm above (for scion) and 10 cm below (for rootstock) budunion, generally about 15 and 25 cm above soil.

Pollen viability for ‘KinnowLS’ is moderately low (15-25% germination) in comparison to ‘Kinnow’ (~70% germination), and pollen production in comparison to normal ‘Kinnow’ is significantly reduced. These pollen characteristics suggest that ‘KinnowLS’ will not cause appreciable seediness in adjacent varieties. Crosses of ‘KinnowLS’ pollen onto Clemenules and W. Murcott gave low fruit set (6 and 9% respectively) and fruit set from these pollinations had few seeds (average 1.8 and 2.2 seeds/fruit respectively).

Fruiting, Fruit and Production Characteristics

As shown in FIG. 1, fruit of ‘KinnowLS’ are oblate in shape with no neck. The fruit has a rounded basal end which is flattened at the stem attachment point with a truncate (slightly depressed) distal end. The fruit is large-sized for a mandarin (classed as Jumbo by State of California standards and size 21 for industry packing standards) averaging 2.7 in (68.0 mm) in diameter and 2.2 in (55.2 mm) in height. Fruit average 0.32 lb (145 g) in weight. It has a very smooth, orange color rind and slightly conspicuous, slightly depressed oil glands. The rind is slightly adherent at maturity and relatively thin, averaging 0.1 in (2.5 mm) in thickness. Fruit peel easily. The fruit interior has a moderately fine flesh texture with 10-11 segments and is quite juicy, averaging 49% juice. Fruit from trees on Carrizo and C35 citrange rootstocks average 12.2-13.9% soluble solids and 1.26-2.09% acid in mid-January at four

trial locations in California increasing in soluble solids to 13.5-15.8% with acid decreasing to 0.97-1.98% in mid-February. By mid-March juice averaged 13.3-17.0% soluble solids and 0.80-1.87% acid. Fruit generally continue to increase in soluble solids and decrease in acidity well into April and May at all trial sites. See Tables 4a-4b below for mean and standard deviation of soluble solids, acid and solids/acid ratio for ‘KinnowLS’ on various rootstocks from 2007 to 2009. The earliest recommended harvest date occurs when fruit reach average soluble solids content of at least 12% and an average acid content of less than 1.2%. This may occur as early as late November in hot desert regions (Coachella Valley of Calif.), but can be as late as early April in cool locations (Irvine, Calif.) or years (2008-9).

Based on evaluation of an average of 1500 fruit per location, fruit average 2.45 seeds per fruit in the presence of heavy cross-pollination at all locations from 2007 to 2009. Rarely, individual fruit may have 4-7 seeds. In the 2010-11 season one tree was identified with a branch on which most fruit had high seed content (more than 10 seeds/fruit). However, for 5200 fruit sampled from trail trees during 2009-10 and 2010-2011, the percentage of seedy fruit was about 0.06%. Seeds are polyembryonic. See Table 5 below for average number of seeds per fruit for ‘KinnowLS’ and ‘Kinnow’ (control trees) from 2007 to 2009. Seeds are polyembryonic, with a wrinkled surface and greyed yellow seed coat (RHS 161C). Seeds average about 140 mg in weight, with about 10% of seeds much smaller and apparently lacking developed embryos.

TABLE 3

Fruit characteristics of ‘KinnowLS’ mandarin at maturity	
1. Fruit shape	Oblate
2. Fruit diameter	68.0 mm ± 2.8
3. Fruit height	55.2 mm ± 2.1
4. Aspect ratio (height/diameter)	0.81
5. Fruit: shape of basal end	Rounded (flattened at stem)
6. Fruit: shape of distal end	Truncate (slightly depressed)
7. Fruit: distal end areola	Present but faint
8. Fruit: distal end areola diameter	18.8 mm
9. Fruit neck	Not present
10. Style	Not persistent
11. Rind texture	Very smooth
12. Oil glands	Slightly conspicuous, slightly depressed
13. Rind Color	RHS Orange 25A
14. Rind thickness	2.5 mm
15. Albedo thickness	1.5 mm
16. Albedo color	RHS Orange-White 159A
17. Rind adherence	Medium-Low
18. Rind separation	Slight
19. Flesh (pulp) color	RHS Orange N25B
20. Flesh (pulp) texture	Moderately fine
21. Number of segments	10-11
22. Axis: structure	Semi-solid
23. Axis: size	Medium
24. Navel presence	Not present
25. # Seeds/fruit (mean)	2.45 (cross-pollinated conditions)
26. Seed embryony	Polyembryonic
27. Seed coat color	Greyed-Yellow 161C
28. Seed cotyledon color	Greyed-Yellow 160C
29. Seed inner coat color	Greyed-Brown 199D
30. Seed weight	140 mg
31. Seed length	12.2 mm
32. Seed width	6.0 mm
33. Seed thickness	4.2 mm
34. Fruit weight	145 g
35. % Juice	49.1%
36. % Soluble solids (at peak maturity)	14.7%
37. % Acid (at peak maturity)	1.18%
38. Season of maturity	Late (January-May in Northern Hemisphere)

TABLE 3-continued

Fruit characteristics of ‘KinnowLS’ mandarin at maturity	
39. Fruit holding ability on tree past maturity	Excellent (6-8 weeks)
40. Fruit quality after storage (5.6° C., 30 days)	Very Good

TABLE 4a

Mean of soluble solids, acid and solids/acid ratio for ‘KinnowLS’ on Carrizo and C35 citrange rootstock at four trial sites for the 2007/8 crop year.					
Site	Dates Sampled	# Trees	Tree Age In 2008 (yrs)	Soluble Solids % Carrizo	Soluble Solids % C35
20	Riverside Jan. 15, 2008	6	4	13.2	13.1
	Riverside Feb. 14, 2008	5	4	14.6	14.8
	Riverside Mar. 12, 2008	3	4	16.5	16.6
	Lindcove Jan. 14, 2008	6	4	13.0	12.8
	Lindcove Feb. 12, 2008	6	4	14.5	14.3
	Lindcove Mar. 13, 2008	3	4	16.4	16.9
25	Irvine Jan. 16, 2008	6	4	12.2	12.3
	Irvine Feb. 15, 2008	6	4	13.9	13.5
	Irvine Mar. 11, 2008	4	4	15.1	14.6
	Arvin Jan. 15, 2008	6	4	13.6	13.1
	Arvin Feb. 13, 2008	6	4	14.8	14.4
	Arvin Mar. 14, 2008	4	4	15.7	15.6
Site	Dates Sampled	% Acid Carrizo	% Acid C35	S/A Ratio Carrizo	S/A Ratio C35
30	Riverside Jan. 15, 2008	1.60	1.66	8.3	7.9
	Riverside Feb. 14, 2008	1.41	1.45	10.4	10.2
35	Riverside Mar. 12, 2008	1.19	1.25	13.7	13.3
	Lindcove Jan. 14, 2008	1.29	1.36	10.1	9.4
	Lindcove Feb. 12, 2008	1.20	1.26	12.1	11.3
	Lindcove Mar. 13, 2008	0.91	0.90	18.0	18.8
40	Irvine Jan. 16, 2008	1.88	1.69	6.5	7.3
	Irvine Feb. 15, 2008	1.50	1.56	9.3	8.7
	Irvine Mar. 11, 2008	1.21	1.18	12.5	12.4
	Arvin Jan. 15, 2008	1.20	1.23	11.3	10.7
	Arvin Feb. 13, 2008	1.03	1.07	14.4	13.5
	Arvin Mar. 14, 2008	0.88	0.90	17.8	17.3

TABLE 4b

Mean of soluble solids, acid and solids/acid ratio for ‘KinnowLS’ on Carrizo and C35 citrange rootstock at four trial sites for the 2008/9 crop year.					
Site	Dates Sampled	# Trees	Tree Age In 2009 (yrs)	Soluble Solids % Carrizo	Soluble Solids % C35
50	Riverside Jan. 15, 2009	6	5	15.6	16.5
	Riverside Feb. 4, 2009	5	5	15.8	15.8
55	Riverside Feb. 25, 2009	5	5	16.2	16.5
	Riverside Mar. 16, 2009	3	5	16.9	17.0
	Lindcove Jan. 13, 2009	6	5	13.4	13.9
	Lindcove Feb. 2, 2009	6	5	13.4	14.5
60	Lindcove Mar. 14, 2009	3	5	14.0	14.4
	Lindcove Apr. 1, 2009	3	5	15.6	15.5
	Irvine Jan. 7, 2009	6	5	13.7	13.9
	Irvine Jan. 26, 2009	6	5	13.5	14.3
	Irvine Feb. 24, 2009	6	5	13.4	14.6
	Irvine Mar. 16, 2009	4	5	13.4	14.7
65	Irvine Mar. 30, 2009	4	5	13.4	14.9
	Arvin Jan. 14, 2009	6	5	13.3	12.3
	Arvin Feb. 3, 2009	6	5	12.6	12.1

TABLE 4b-continued

Mean of soluble solids, acid and solids/acid ratio for ‘KinnowLS’ on Carrizo and C35 citrange rootstock at four trial sites for the 2008/9 crop year.					
Arvin	Mar. 14, 2009	4	5	13.3	13.4
Arvin	Apr. 1, 2009	4	5	15.3	14.1
Site	Dates Sampled	% Acid Carrizo	% Acid C35	S/A Ratio Carrizo	S/A Ratio C35
Riverside	Jan. 15, 2009	2.09	2.21	7.5	7.5
Riverside	Feb. 4, 2009	1.78	1.98	8.9	8.0
Riverside	Feb. 25, 2009	1.68	1.99	9.6	8.3
Riverside	Mar. 16, 2009	1.50	1.87	11.3	9.1
Lindcove	Jan. 13, 2009	1.26	1.47	10.6	9.5
Lindcove	Feb. 2, 2009	1.18	1.17	11.4	12.4
Lindcove	Mar. 14, 2009	0.80	0.97	17.5	14.8
Lindcove	Apr. 1, 2009	0.70	0.89	22.3	17.4
Irvine	Jan. 7, 2009	1.88	2.11	7.3	6.6
Irvine	Jan. 26, 2009	1.79	2.62	7.5	5.5
Irvine	Feb. 24, 2009	1.64	1.94	8.2	7.5
Irvine	Mar. 16, 2009	1.37	1.77	9.8	8.3
Irvine	Mar. 30, 2009	1.18	1.59	11.4	9.4
Arvin	Jan. 14, 2009	1.17	1.16	11.4	10.6
Arvin	Feb. 3, 2009	0.97	1.11	13.0	10.9
Arvin	Mar. 14, 2009	0.80	0.87	16.6	15.4
Arvin	Apr. 1, 2009	0.76	0.75	20.1	18.8

TABLE 5

Seed counts (average number of seeds per fruit) for ‘KinnowLS’ and ‘Kinnow’ (control trees) at four trial sites over two years, 2007/2008 and 2008/2009.				
Site	Selection	# Trees	Tree Age In 2009 (yrs)	Rootstock
Riverside	‘KinnowLS’	6	5	Carrizo
Riverside	‘KinnowLS’	5	5	C35
Riverside	‘Kinnow’ control	3	5	Carrizo/C35
Lindcove	‘KinnowLS’	6	5	Carrizo
Lindcove	‘KinnowLS’	6	5	C35
Lindcove	‘Kinnow’ control	3	5	Carrizo/C35
Lindcove	‘KinnowLS’ (mother tree)	1	11	Carrizo
Irvine	‘KinnowLS’	6	5	Carrizo
Irvine	‘KinnowLS’	6	5	C35
Irvine	‘Kinnow’ control	4	5	Carrizo/C35
Arvin	‘KinnowLS’	6	5	Carrizo
Arvin	‘KinnowLS’	6	5	C35
Arvin	‘Kinnow’ control	4	5	Carrizo/C35
Site	Selection	2007/8 Mean Seeds/Fruit (range/tree)	2008/9 Mean Seeds/Fruit (range/tree)	
Riverside	‘KinnowLS’	2.4 (1.6-3.0)	2.3 (2.1-3.0)	
Riverside	‘KinnowLS’	2.2 (1.5-2.9)	2.4 (1.9-3.1)	
Riverside	‘Kinnow’ control	18.9 (17.4-20.6)	20.8 (18.8-22.1)	
Lindcove	‘KinnowLS’	2.8 (2.3-3.1)	2.6 (2.2-2.9)	
Lindcove	‘KinnowLS’	2.4 (1.7-2.9)	2.5 (2.0-3.0)	
Lindcove	‘Kinnow’ control	26.2 (22.1-27.5)	22.3 (19.7-23.7)	
Lindcove	‘KinnowLS’ (mother tree)	2.4	2.1	
Irvine	‘KinnowLS’	2.0 (1.7-2.8)	1.8 (0.8-2.3)	
Irvine	‘KinnowLS’	1.9 (1.4-2.6)	2.4 (1.4-2.9)	
Irvine	‘Kinnow’ control	20.6 (17.8-22.1)	18.6 (16.9-19.7)	
Arvin	‘KinnowLS’	1.6 (0.8-1.9)	1.8 (0.9-2.2)	
Arvin	‘KinnowLS’	1.4 (1.0-2.0)	1.5 (0.7-2.1)	

TABLE 5-continued

Seed counts (average number of seeds per fruit) for ‘KinnowLS’ and ‘Kinnow’ (control trees) at four trial sites over two years, 2007/2008 and 2008/2009.			
Arvin	‘Kinnow’ control	22.1 (18.6-24.5)	17.9 (17.3-18.4)
Site	Selection	% Fruit with 0-3 seeds (2008/9)	
Riverside	‘KinnowLS’	87.3	
Riverside	‘KinnowLS’	88.8	
Riverside	‘Kinnow’ control	0	
Lindcove	‘KinnowLS’	86.9	
Lindcove	‘KinnowLS’	90.7	
Lindcove	‘Kinnow’ control	0	
Lindcove	‘KinnowLS’ (mother tree)	89.1	
Irvine	‘KinnowLS’	86.5	
Irvine	‘KinnowLS’	91.4	
Irvine	‘Kinnow’ control	0	
Arvin	‘KinnowLS’	91.2	
Arvin	‘KinnowLS’	87.1	
Arvin	‘Kinnow’ control	0	

Full fruit production of ‘KinnowLS’ normally begins in the third year after planting, however trees can be precocious and set some fruit in the second year after planting. FIGS. 4 and 6 illustrate fruit production on a three-year old tree. ‘KinnowLS’, is similar to ‘Kinnow’ in reaching high production levels relatively quickly. Mean yield of five year-old trees ranged from 152-211 lb (69-96 kg) on Carrizo rootstock and 165-196 lb (75-89 kg) on C35 rootstock at the four fruiting trial sites. The original ‘KinnowLS’ mother tree at Lindcove, Calif. produced 156 lb (71 kg) in the fifth year and in years 9, 10 and 11 yielded 191, 101, 240 lb of fruit respectively, which indicates that the variety has somewhat of a tendency to alternate bearing. In this respect, it is similar to ‘Kinnow’, which can exhibit severe alternate bearing if the crop is not managed to reduce overproduction in ‘on’ years.

TABLE 6

Crop yields for ‘KinnowLS’ and ‘Kinnow’ (control trees) at three trial sites over two years, 2007/2008 and 2008/2009					
Site	Selection	# Trees	Tree Age in 2009 (yrs)	Rootstock	2007/8 Mean Yield (kg)
Riverside	‘KinnowLS’	6	5	Carrizo	40
Riverside	‘KinnowLS’	5	5	C35	32
Riverside	‘Kinnow’ control	3	5	Carrizo/C35	36
Lindcove	‘KinnowLS’	6	5	Carrizo	59
Lindcove	‘KinnowLS’	6	5	C35	63
Lindcove	‘Kinnow’ control	3	5	Carrizo/C35	52
Lindcove	‘KinnowLS’ (mother tree)	1	11	Carrizo	46
Irvine	‘KinnowLS’	6	5	Carrizo	44
Irvine	‘KinnowLS’	6	5	C35	47
Irvine	‘Kinnow’ control	4	5	Carrizo/C35	39
Arvin	‘KinnowLS’	6	5	Carrizo	70
Arvin	‘KinnowLS’	6	5	C35	73
Arvin	‘Kinnow’ control	4	5	Carrizo/C35	64
Site	Selection	2007/8 Yield Range (kg)	2008/9 Mean Yield (kg)	2008/9 Yield Range (kg)	
Riverside	‘KinnowLS’	28-46	71	59-83	
Riverside	‘KinnowLS’	20-36	75	48-89	
Riverside	‘Kinnow’ control	32-39	62	51-74	
Lindcove	‘KinnowLS’	49-66	69	22-90	
Lindcove	‘KinnowLS’	54-71	78	55-87	
Lindcove	‘Kinnow’ control	45-58	28	17-31	

TABLE 6-continued

Crop yields for 'KinnowLS' and 'Kinnow' (control trees) at three trial sites over two years, 2007/2008 and 2008/2009				
Lindcove	'KinnowLS' (mother tree)	46	109	109
Irvine	'KinnowLS'	35-50	72	33-91
Irvine	'KinnowLS'	34-55	76	53-88
Irvine	'Kinnow' control	30-44	58	31-80
Arvin	'KinnowLS'	61-86	96	81-110
Arvin	'KinnowLS'	60-89	89	78-112
Arvin	'Kinnow' control	55-74	91	75-105

Fruit storage trials included storage of washed but not waxed fruit at 5.6° C. for up to 30 days with fruit samples taken every 15 days for analysis. Data indicates that the

storage characteristics of 'KinnowLS' are very good with very little measureable loss of rind quality or color, no significant loss in juice quality or deterioration in taste, and no significant indication of fungal or other disease problems over the 30 day storage period. Overall 'KinnowLS' can be considered to be very good in storage ability for 4-6 weeks under controlled environment storage conditions.

No susceptibilities to plant or fruit diseases, or to pests, beyond those normally associated with *Citrus* species, have been observed.

What is claimed is:

1. A new and distinct mandarin tree having the characteristics substantially as described and illustrated herein.

* * * * *

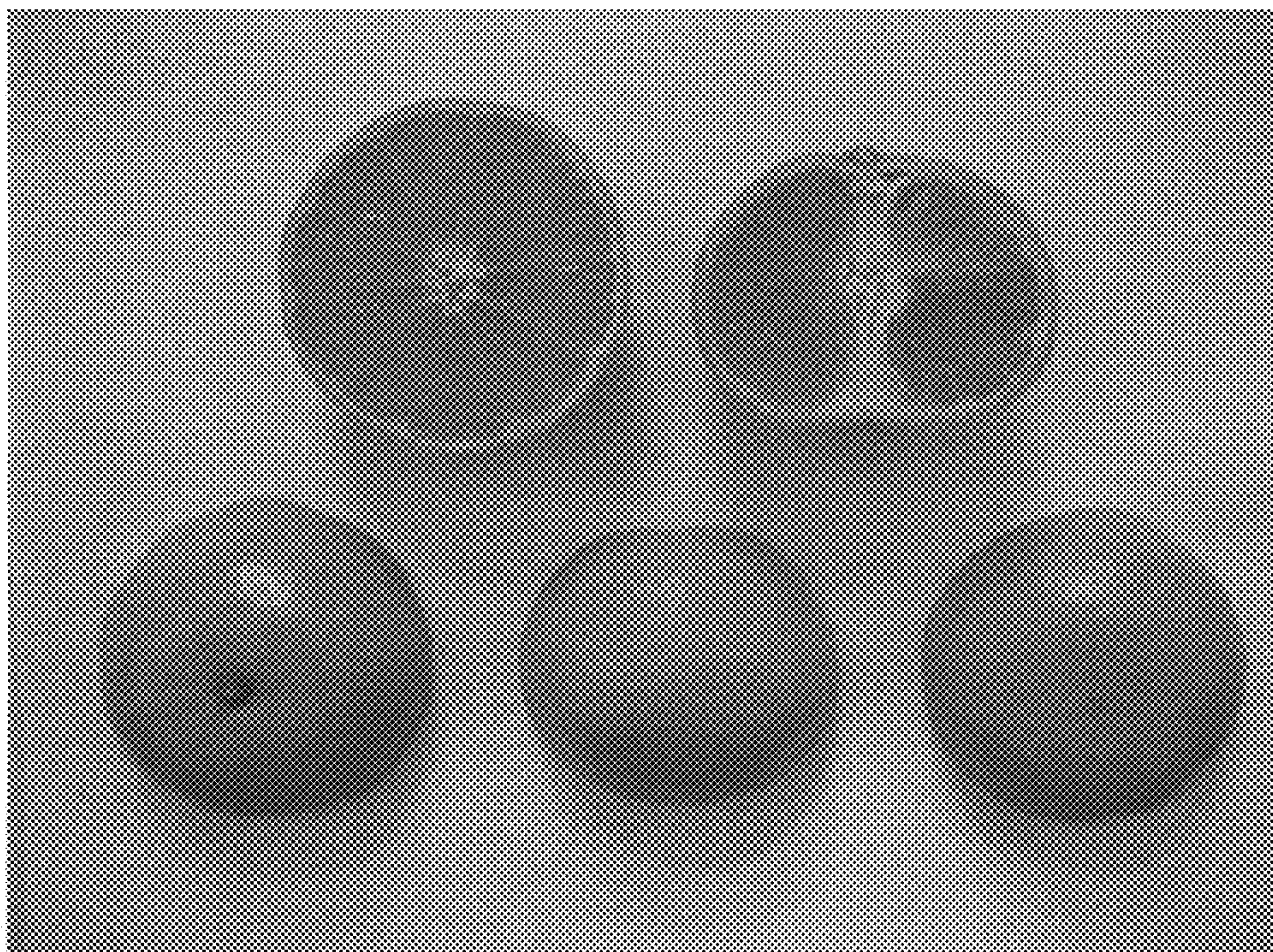


FIG. 1

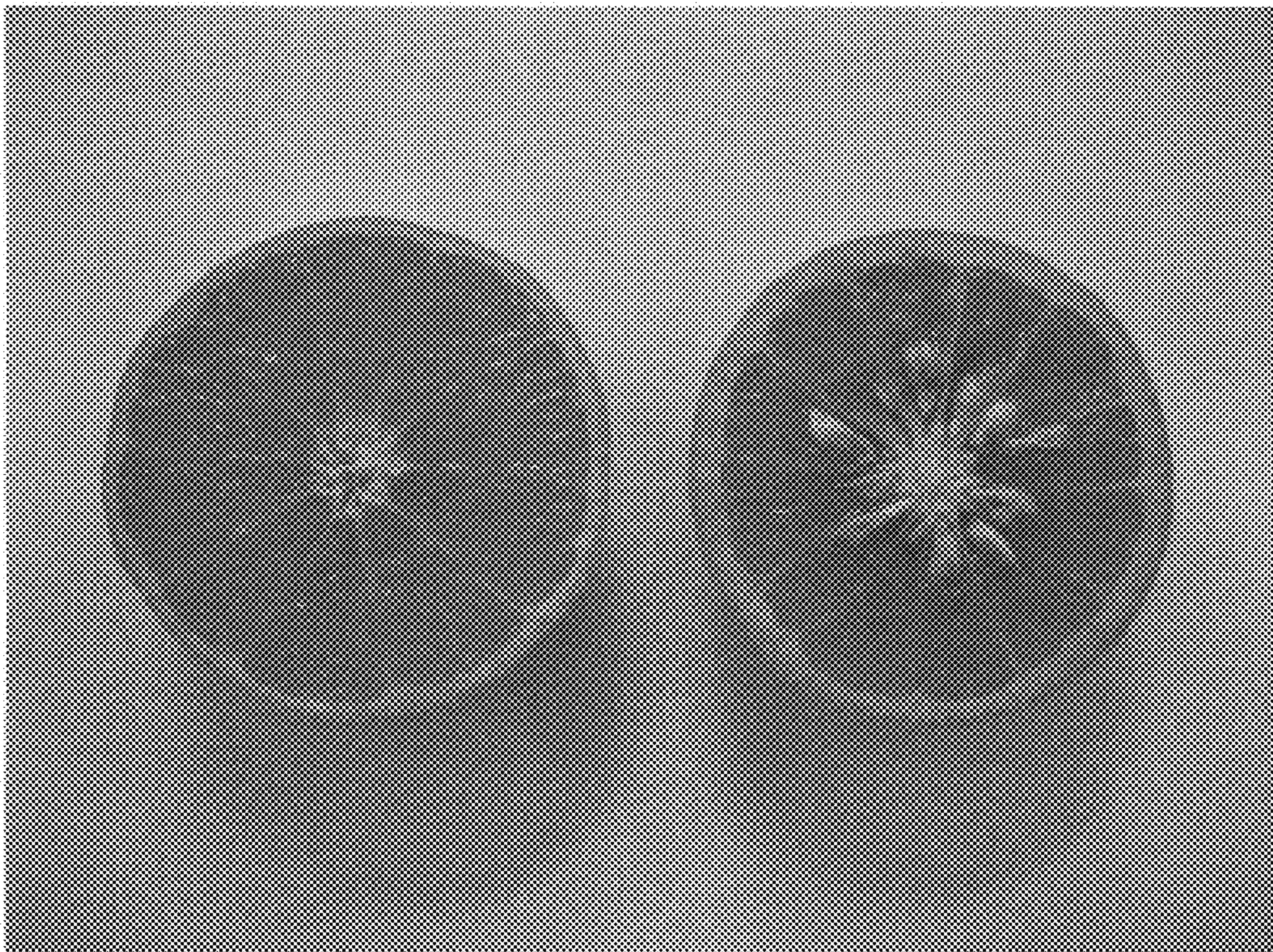


FIG. 2

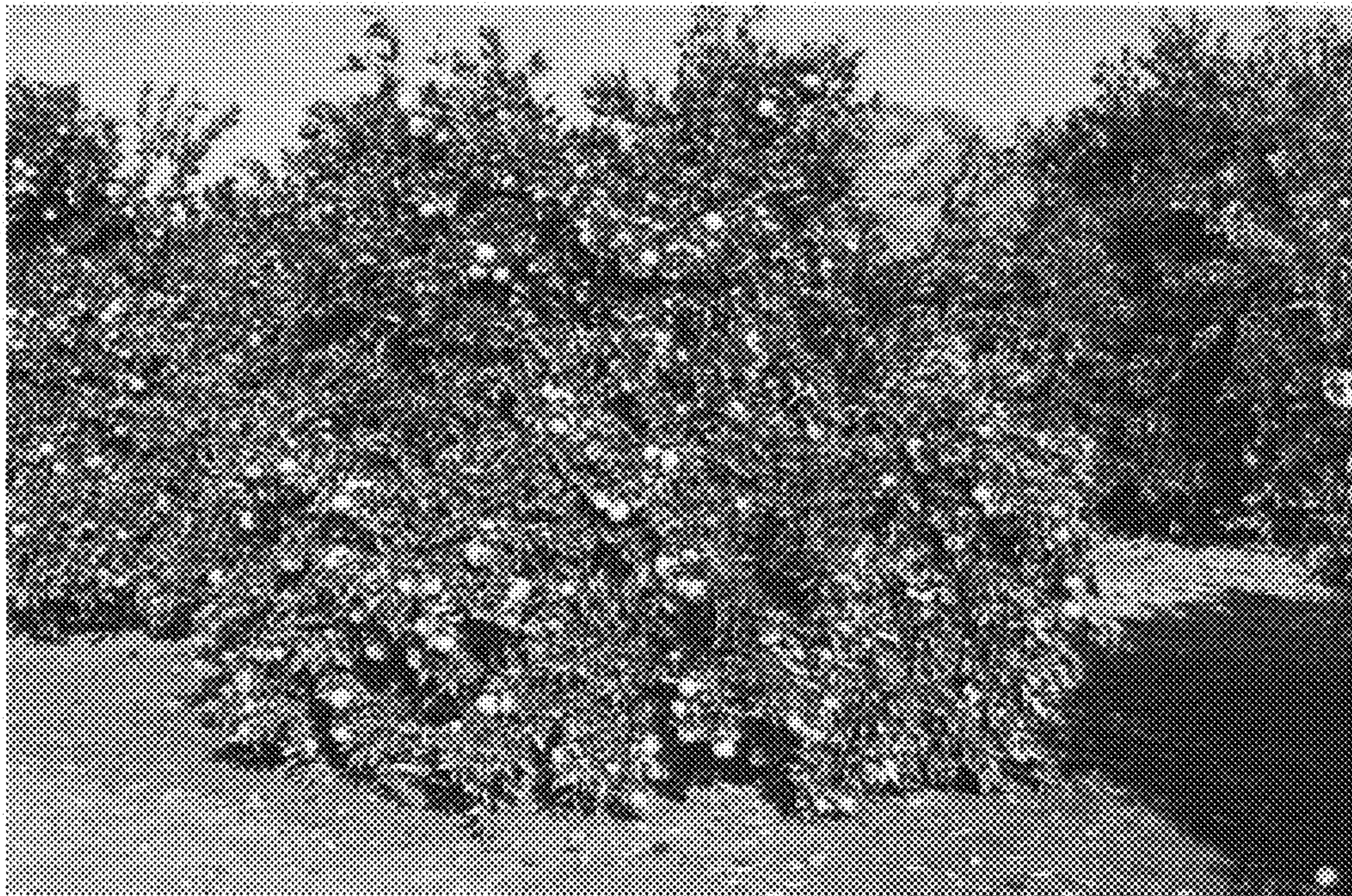


FIG. 3



FIG. 4



FIG. 5



FIG. 6

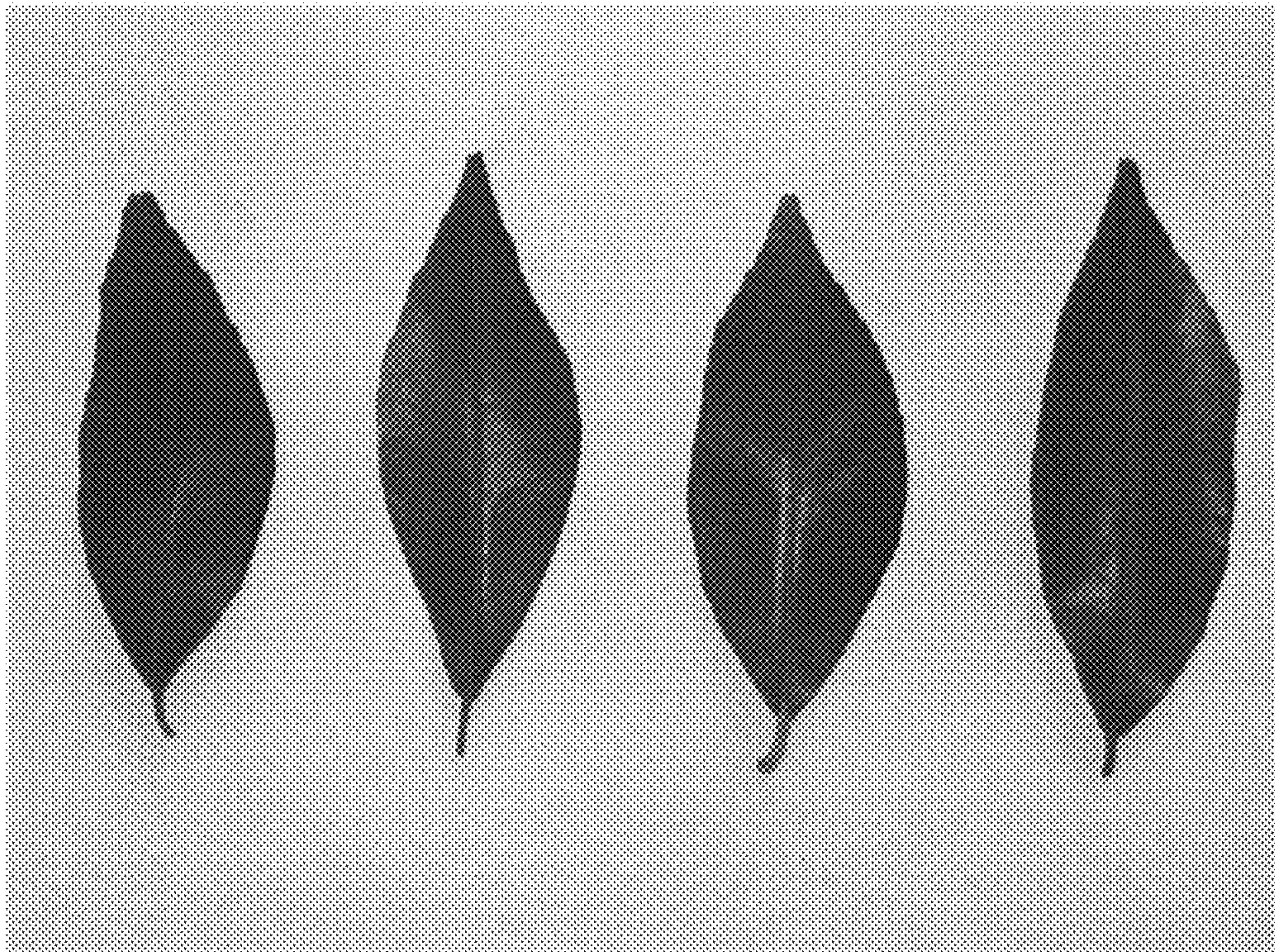


FIG. 7



FIG. 8