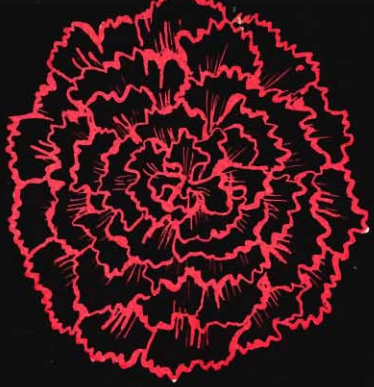

CARNATION VARIETY TRIAL

KAMEMOTO • NAKASONE

HAWAII AGRICULTURAL EXPERIMENT STATION

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CONTENTS

THE AUTHORS

Dr. Haruyuki Kamemoto is associate horticulturist at the Station and professor of agriculture at the University.

Mr. Henry Y. Nakasone is junior horticulturist at the Station and instructor in agriculture at the University.

CARNATION VARIETY TRIAL

H. Kamemoto • H. Y. Nakasone

INTRODUCTION

The carnation, one of the most important commercial field-grown floricultural crops in the Islands, has been under cultivation for several decades. It has been grown primarily for the lei trade; however, in recent years, interest in cut-flower production has increased considerably due to the introduction of Mainland commercial varieties.

The major emphasis in the past has been on the production of carnations for lei flowers, and qualities demanded of cut flowers were generally ignored. Consequently, the types grown had small flowers, short stems, and bushy growths. Many were even grown from seeds, because the requirements for uniformity were not as rigid as those for cut flowers. The "Pink" is one of these varieties; it has been under continuous cultivation for over 40 years and is still the leading lei variety in the Islands. It produces throughout the year relatively small but highly fragrant flowers on short stems.

The main production areas for lei carnations shifted from Waialae to Maunalani Heights and now to the Koko Head area. These regions are suitable for lei flower production, but not for cut-flower production due to the relatively warm night temperatures. The cut-flower varieties are known to require cool night temperatures for optimum growth and production. It has been demonstrated that Kula on Maui and Wahiawa on Oahu are more favorable locations for cut-flower types. The introduction and culture of a few Mainland varieties in both areas have stimulated interest in such varieties, not only within these areas but in other carnation-growing areas as well, for besides the excellent cut flowers obtainable from some of these varieties the larger flowers make large and beautiful leis.

In order to answer some of the questions that may arise on the behavior of Mainland varieties, both as cut flowers and as lei flowers, in slightly warmer areas, a study of several Mainland carnation varieties was conducted at the University Farm in Manoa Valley. The results of this study are reported herein.

SOURCE OF PLANTS

Fifty rooted cuttings of each of 15 carnation varieties were donated by Yoder Brothers of Barberton, Ohio. From Sim Carnation Company of Saugus, Massachusetts, 50 rooted cuttings of each of 6 varieties were received. F. C. Gloeckner and Company of New York gave 50 rooted cuttings of each of 3

varieties. Professor Holley of Colorado A. & M. College sent two varieties, Durango and Fanfare. Included in the test with these Mainland varieties was the local "Pink."

GENERAL CULTURE

The rooted cuttings, which arrived from the Mainland in excellent condition, were planted individually in 3-inch plant bands until they were well established. They were pinched once while in these bands to promote multiple growths.

On January 28, 1954, the varieties were placed in a field divided into two sections, one for cut-flower production and the other for lei flower production. The individual plots consisted of 3-row beds with rows spaced 16 inches apart and plants spaced a foot apart within the row. Twenty-four plants constituted a single plot.

The plants were supported by means of wires running along the rows and string running across these wires. They were fertilized every 4 months with a complete fertilizer. Because of the occurrence of foliar fungus diseases, the plants were sprayed regularly with Dithane Z-78 or Zerlate; but when bacterial spots appeared, tribasic copper sulfate was used. An insecticide was incorporated with the fungicidal spray. DDT or Malathion was used to control thrips, and Aramite was used during the hot summer months when red spider mites became prevalent.

In the cut-flower section the lateral buds were removed to permit only the terminal buds to develop. This practice, known as disbudding, enables the flowers to attain a maximum size. Flowers were harvested regularly twice a week. The number of flowers, stem length, flower size, and percentage of splits were recorded.

With the lei group, every bud was allowed to flower. The individual flowers were plucked and recorded. With this group, the stems that had completely flowered were frequently cut back to promote new growth.

OBSERVATIONS AND RESULTS

Productivity

Considerable differences in productivity were already noticeable in some varieties when the first flowers appeared in late March. As the trial progressed, the differences became more pronounced. Table 1 lists the total yield of the varieties in cut flowers and lei flowers. Apollo, Cupid, Vulcan, and Titan, together with the local variety, were the highest yielders. The high yields are due to the combination of multiple breaks following a pinch or cutting of the flowered stem, rapid break of new shoots and fast rate of growth, and low rate of mortality. Apollo, for example, produced 3.4 breaks per plant following the first pinch and produced a total of 942 cut flowers per plot, or 39 flowers per plant, per harvest year. The other varieties mentioned above behaved in a similar fashion.

The Littlefield varieties, which supposedly do well in warmer areas on the Mainland, were mediocre in their performance, producing only half as much as the high-yielding varieties. Also, White Sim, a popular commercial variety on the Mainland, produced only 371 flowers within the harvest year.

The poorest performers were Canary Queen and Midas, both yellow-flowered varieties, and Saugus Pink. The yellows are generally regarded as poor yielders. Saugus Pink was especially poor because of the high mortality rate. By the end of the trial, 100 percent of the plants in the cut-flower plot and 92 percent in the lei plot had perished.

Some varieties such as Aurora and Minerva seemed outstanding at the outset; however, as time progressed, the plants began to deteriorate, which greatly affected the total production. Minerva produced 429 cut flowers, practically all during the first 7 months. At the end of the trial, 19 of the total 24 plants in the cut-flower plot had died.

The degree of mortality of varieties is listed in Table 1. There is a positive correlation of mortality to total production, which is to be expected. The highest yielders, therefore, are the ones that remained productive throughout the period of the trial.

It is interesting to note that the varieties producing the greatest number of cut flowers were also among the leaders in lei-flower production. Apollo, Cupid, Titan, Vulcan, and "Pink" were the highest producers of lei flowers. Vulcan gave outstanding yields, producing a total of 4,456 blossoms. This high yield is attributable to the production of numerous lateral flowers. The ratio of terminal to lateral flowers produced was 1:4.73 as compared to the ratio of 1:3.05 for Apollo, while the ratio for Cupid was a low 1:2.61.

Figure 1 shows the monthly production curve of cut flowers for four varieties. The April production represents the first crop following the pinch. A peak of production was reached in June and July for Apollo and Cupid when the breaks following the first harvest matured. Then in October a second peak was obtained. During the winter months, production dropped, and began to rise again in March. Table 2 gives the monthly production figures of lei flowers for eight of the varieties tested.

Size of flowers and length of stem

Inasmuch as the night temperatures generally do not fall lower than 65° F. at the location of the test, the varieties under trial were not expected to develop to the maximum sizes attainable at more favorable locations. However, contrary to expectations, the varieties developed remarkably large flowers. In Table 1 are summarized the sizes of cut flowers and the terminal and lateral lei flowers. Aurora, averaging 2.74 inches, and Eros, averaging 2.68 inches, produced the largest cut flowers while Baby Bronze, averaging 2.14 inches, Cupid, averaging 2.23 inches, and "Pink," averaging 1.95 inches, produced the smallest flowers. The local "Pink," which is almost exclusively grown for leis, produced terminal flowers averaging 1.94 inches and laterals averaging 1.80 inches. The leis made from these flowers after the removal of the calyx measures about 2 to 2½ inches in diameter. Contrasted to this, the introduced

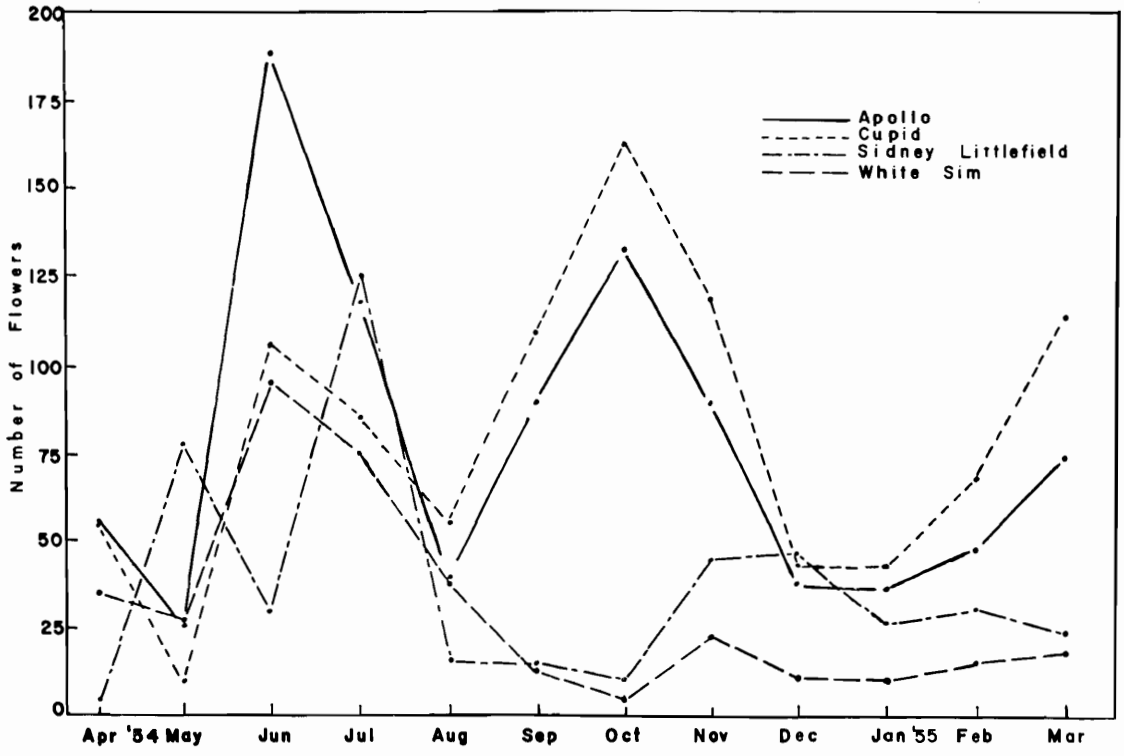

Figure 1. Monthly production of cut flowers of Apollo, Cupid, Sidney Littlefield, and White Sim varieties.

varieties with flower sizes approximating 2½ inches make larger leis measuring from 3½ to 4 inches in diameter. The lateral flowers average about ¼ inch less than the terminals.

Favorable stem lengths were obtained with Apollo, Cassandra, Canary Queen, Eros, Midas, Siren, Vulcan, Venus, and White Sim, all of which averaged 18 inches or longer (Table 1). The Littlefield varieties produced strong and erect but rather short stems averaging 15 to 16 inches. Saturn and Titan produced stems averaging 14.5 inches and 13.2 inches, respectively; these lengths are too short for the cut-flower trade.

For lei flower production, long stems are not required. Short-stemmed varieties are often more desirable, for staking may be unnecessary and, also, the plants are able to better withstand the wind. Titan was one of those that appeared suitable for lei flower production but undesirable for cut-flower production because of the high percentage of splits and short stems.

Splitting of calyx

One of the major problems in carnation culture is the splitting of the calyx. This condition results in an asymmetrical flower through the drooping of some petals at the split region and thus greatly decreases the value of the cut flower. In the case of lei flowers, however, splitting of the calyx is not an important factor, for the calyx is generally removed before the flowers are strung into leis.

Some of the causes of the calyx splitting are 10 degrees or more drop in night temperature below the normal, a high level of nutrients in the soil, and a low nitrogen level.[1] It is also known that splitting is an inherent characteristic; some varieties produce splits regularly while others produce them rarely or not at all. Inasmuch as splitting considerably reduces the value of cut flowers, it is essential to consider this characteristic in any varietal trial.

As shown in Table 1, differences in percentage of splits were obtained among the varieties. Splitting ranged from a high of 81 percent for "Pink," the local variety, to no splitting for Siren. Aurora, Canary Queen, Eros, Fanfare, Gordon, and Titan produced more than 60 percent spilts, while Cassandra, Cupid, Apollo, and Vulcan produced less than 3 percent splits. The Littlefield varieties produced few splits, while White Sim gave about 28 percent splits.

In Figure 2 is shown the monthly percentages of splits for several varieties. The percentage of splits for each variety did not fluctuate greatly throughout the year. This means that splitting is influenced primarily by the inherent nature of the variety rather than in changes of environment such as temperature, light intensity, daylength, rainfall, irrigation, etc.

Fragrance

The "Pink" variety has a strong but pleasant fragrance, which is perhaps one of the reasons for its being the leading lei variety in the Islands. The majority of the Mainland varieties lack fragrance or are only faintly scented.

[1]Kenneth Post. *Florist Crop Production and Marketing*, New York: Orange Judd Publishing Co., Inc., 1949.

TABLE 1. Yield, Flower Size, Stem Length, Percentage Splits, and Mortality of Carnation Varieties

Variety	Source of plants*	Flower color	Year's production April 1954—April 1955			Average flower size			Stem length	Splits	Number of plants dead	
			Cut Flower	Lei Flower terminal	Lei Flower lateral	Cut Flower	Lei Flower terminal	Lei Flower lateral			Cut Flower Plot	Lei Plot
						inches	*inches*	*inches*	*inches*	%		
Achilles	1	White	456	125	495	2.45	2.36	2.07	17.94	1.53	10	20
Apollo	1	Light pink	942	815	2487	2.47	2.50	2.25	18.73	2.33	2	5
Aurora	1	White	645	371	1390	2.74	2.74	2.35	16.28	72.55	7	21
Baby Bronze	2	Bronze	405	340	605	2.14	2.24	1.92	16.99	11.60	1	12
Canary Queen	2	Yellow	114	104	290	2.56	2.53	2.24	21.32	64.91	22	18
Cassandra	1	Yellow bronze	518	407	1006	2.52	2.58	2.26	20.32	0.57	5	2
Cupid	1	Light pink	974	788	2059	2.23	2.28	2.04	17.77	0.51	2	1
Durango	4	Dark red	316	–	–	2.30	–	–	17.24	29.43	4	–
Eros	1	Light pink	770	530	1324	2.68	2.63	2.28	21.82	69.35	0	4
Fanfare	4	Dark pink	261	–	–	2.57	–	–	17.13	68.95	5	–
Gordon	2	Light pink	451	372	719	2.53	2.65	2.19	15.25	73.83	0	1
Juno	1	White	812	289	939	2.48	2.43	2.11	15.59	21.42	1	1
Jupiter	1	White	257	161	641	2.57	2.40	2.12	17.12	12.45	16	24
Light-Pink Littlefield	3	Light pink	438	243	759	2.54	2.57	2.23	16.68	4.56	1	3
Midas	1	Yellow	295	–	–	2.47	–	-	19.02	9.15	5	–

*1 = Yoder Brothers, Inc., Barberton, Ohio
2 = Sim Carnation Co., Saugus, Massachusetts
3 = F. C. Gloeckner & Co., Inc., New York, N.Y.
4 = Professor Holley, Colorado A. & M. College
5 = University of Hawaii, Honolulu, Hawaii

TABLE 1. *Continued*

VARIETY	SOURCE OF PLANTS*	FLOWER COLOR	YEAR'S PRODUCTION April 1954—April 1955			AVERAGE FLOWER SIZE			STEM LENGTH	SPLITS	NUMBER OF PLANTS DEAD	
			Cut Flower	Lei Flower		Cut Flower	Lei Flower				Cut Flower Plot	Lei Plot
				terminal	lateral		terminal	lateral				
						inches	*inches*	*inches*	*inches*	%		
Minerva	1	Dark pink	429	376	901	2.58	2.52	2.25	17.46	29.37	19	16
"Pink"	5	Pink	871	738	2585	1.95	1.94	1.80	17.90	80.94	3	4
Raspberry Ice	2	Dark lavender	437	590	1160	2.42	2.47	2.33	17.13	2.28	13	22
Saturn	1	Variegated bronze	355	327	668	2.43	2.48	2.07	14.51	16.61	11	11
Saugus Pink	2	Dark pink	297	208	447	2.44	2.47	2.22	16.91	36.36	24	22
Sidney Littlefield	3	Dark pink	454	361	956	2.46	2.62	2.18	15.52	1.32	5	1
Titan	1	Crimson	712	664	1816	2.45	2.43	2.22	13.19	64.88	8	6
Venus	1	Light pink	325	153	262	2.50	2.50	2.23	19.13	4.61	19	8
Vulcan	1	Crimson	870	777	3679	2.29	2.37	1.99	19.20	1.95	2	2
White Littlefield	3	White	267	306	945	2.41	2.52	2.29	15.09	3.37	5	6
White Sim	2	White	371	290	941	2.60	2.49	2.25	19.16	28.57	9	2

*1 = Yoder Brothers, Inc., Barberton, Ohio
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Aurora was the only introduced variety that approached the strong fragrance of "Pink." Venus and Jupiter were moderately fragrant, but the rest of the varieties were odorless. If fragrance is a requisite of a lei variety, then the only Mainland varieties that can qualify are Aurora, Venus, and Jupiter.

EVALUATION OF INDIVIDUAL VARIETIES

Achilles

Medium large white flowers. Production was fair to poor due to unthrifty growth and high mortality as the trial progressed. Stems were crooked and tended to recline.

Apollo

Medium large light-pink flowers. Production was outstanding. It was a vigorous grower with strong come-back ability. Stems were thick, sturdy, and erect. Very few splits occurred. It was one of the outstanding varieties in the trial.

Aurora

Very large white flowers. This variety was a good grower and heavy producer until diseases hit it and caused heavy mortality. Despite this, production was good. This variety splits excessively and, therefore, is not recommended for cut flowers. However, the large, many-petaled, highly fragrant flowers make the variety ideal for lei flower production.

Baby Bronze

Small bronze flowers. The stems were weak and sprawling. Leaves were yellowish and plants were generally unthrifty. Production was poor. The variety is not recommended for either lei or cut flowers.

Canary Queen

Large yellow flowers. Production was very poor. Most of the plants died before the termination of the test. Splitting percentage was also high. It is not recommended for either cut-flower or lei production.

Cassandra

Large bronzy yellow, variegated with pink. Stems were long and sturdy. Very rarely did it produce splits. Production was fair. It should be a fair cut flower variety in the yellow-bronze group.

Cupid

Small pink flowers. This was a vigorous grower and heavy producer. Its come-back ability was very good. Stems were sturdy. Except for the small size of flowers this is an excellent performer.

Durango

Medium dark-red flowers. Production was only fair. Stems were long and straight but slightly weak. Percentage of splits was high.

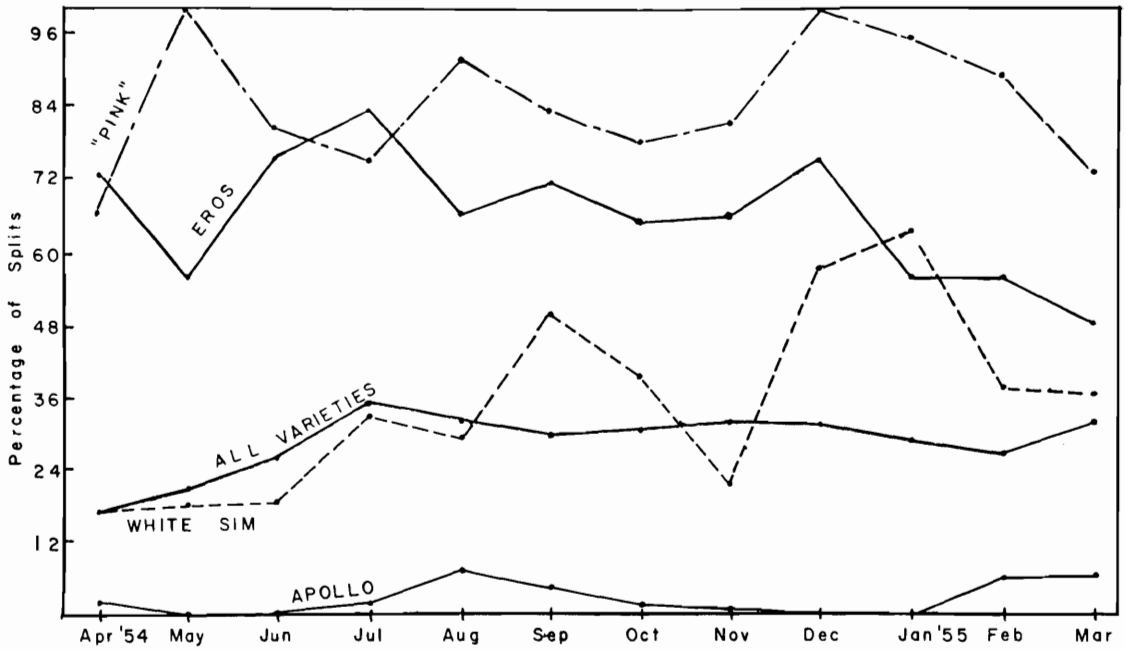

Figure 2. Monthly percentage of splits for Apollo, Eros, "Pink," White Sim, and all varieties.

Eros

Large light-pink flowers. It was a vigorous grower with long erect stems. Production was good, but because of the high degree of splitting it is not recommended for cut flowers. The lateral flowers do not develop well and, therefore, the variety may not be suitable for leis either.

Fanfare

Very large dark-pink flowers. Production was fair. This variety produced considerable number of splits.

Gordon

Large light-pink flowers. Production of cut flowers was fair but the production of lei flowers was poor due to few lateral flowers. Stem length was short. It produced excessively high percentage of splits and, therefore, coupled with short stems it is undesirable as a cut-flower variety.

Juno

Medium-sized white flowers. Production was good as cut flowers but poor as lei flowers. Stems were short and crooked. Twenty-one percent of flowers produced were splits.

Jupiter

Large white flowers. The first growths were strong and erect and produced large attractive flowers. However, the come-back ability was poor, and during the summer months most of the plants perished. Twelve percent of the flowers were splits.

Light-Pink Littlefield

Large light-pink flowers. The rooted cuttings were not in as good a condition as the other varieties. Some of the leaves were afflicted with rust disease and, therefore, the plants did not do well in the early stages. However, the come-back ability was fairly good. Stems were erect, sturdy, and of good length. Splitting occurred rarely. It should serve as a cut-flower variety.

Midas

Medium-sized yellow flowers. Production was very poor. Plants in the lei section died early in the test and, consequently, no record is available for lei flowers. It is not recommended because of its poor performance.

Minerva

Large dark-pink flowers. At the outset, growth was vigorous and production was very good. However, during the summer a great number of the plants succumbed. It is probably unadapted to hot summer conditions. The percentage of splits was high. The color tends to bleach during sunny days.

"Pink"

Small pink flowers. This variety produced weak stems, small flowers, and a high percentage of splits and, therefore, is entirely unsuitable for cut-flower production. However, for lei flowers it is outstanding. It was a vigorous

TABLE 2. MONTHLY PRODUCTION OF SOME VARIETIES OF LEI FLOWERS

VARIETY	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	TOTAL
Apollo	298	198	684	567	146	96	329	421	189	126	133	115	3302
Aurora	175	426	144	482	335	107	59	33	–	–	–	–	1761
Cupid	273	219	259	589	170	209	194	261	154	162	141	216	2847
"Pink"	–	146	78	992	602	128	431	686	187	93	41	139	3323
Sidney Littlefield	7	413	47	190	171	75	50	68	51	73	95	87	1327
Titan	130	182	94	545	180	102	279	232	194	187	150	130	2480
Vulcan	86	521	371	1219	468	203	222	331	365	262	220	188	4456
White Sim	105	205	218	280	163	53	34	32	26	24	43	48	1231

grower and produced a great quantity of highly fragrant flowers. It sends out a number of shoots from the lower portions of the stems, which facilitates propagation of the variety.

Raspberry Ice

Medium-sized dark-lavender flowers. Production was fair. Stems were erect. Percentage of splits was low.

Saturn

Medium-sized variegated bronze flowers. Leaves were yellowish, and plants were not thrifty. Production was poor. The stems were short. The flowers are highly attractive but the poor production may not warrant the commercial culture of this variety.

Saugus Pink

Medium large dark-pink flowers. It was a weak grower and poor producer. The mortality rate was extremely high. Splitting was common. It is a variety unadapted for the present location.

Sidney Littlefield

Large dark-pink flowers. Behavior was similar to that of Light-Pink Littlefield.

Siren

Large scarlet flowers. The variety produced numerous strong and vigorous growths at the outset. However, during summer the plants began to deteriorate and about 50 percent of the plants died by the end of the trial. Consequently, total production was only fair. The stems were strong, long, and erect. Not a single split was obtained. The flowers produced during the early season were excellent as cut flowers.

Titan

Medium-sized crimson flowers. Productivity was good both for cut flowers and leis. The stems were very short and the percentage of splits was excessively high and, therefore, it is unsuitable for cut flowers. However, because of the sturdy growth and heavy flower production, it seems quite desirable for lei flower production.

Venus

Large, salmon-pink flowers. The flowers are camellia-like and very attractive. Stems were long and sturdy. Production during the early stage was good, but toward summer and fall the mortality rate was high and, consequently, total production was very low. It had a low percentage of splits.

Vulcan

Medium-sized crimson flowers. Growth was excellent and production was high. Stems were long. The percentage of splits was very low. The flowers of this variety have a tendency of "sleepiness," which is a highly undesirable characteristic. Therefore, despite the good qualities, it cannot be recom-

mended for cut-flower production. This variety gave a remarkably high yield of lateral flowers. Its total production surpassed that of any other variety.

White Littlefield

Medium-sized white flowers. Behavior was about the same as for Light-Pink Littlefield.

White Sim

Large white flowers with occasional splashes of red. This variety did rather poorly. The plants started out well, producing vigorous, long and sturdy stems, but toward the end of the trial the plants began to look unthrifty. Several plants died. Production was poor. Stem length was good. Twenty-nine percent of the flowers were splits.

RECOMMENDED VARIETIES

From the above variety test a list of recommended varieties for areas similar in climatic conditions to that at the University Farm has been evolved. For cut-flower production the following are recommended:

Apollo	Cassandra
Cupid	Littlefield varieties

Figure 3. Apollo, the outstanding variety in the trial.

Apollo was by far the most outstanding variety in the trial. It was excellent from the standpoint of productivity, length and strength of stem, color and shape of flowers, and freedom from splitting. Cupid, except for its small flowers, was also outstanding. Cassandra was rather poor in productivity but was relatively free of splitting, and the large yellow-bronze flowers were carried on long sturdy stems. The Littlefield varieties yielded few flowers, but they were of high quality.

For lei flowers the following can be recommended:

Apollo Cupid
Aurora "Pink"
Titan

Apollo and Cupid, because of their vigor and high productivity, are favorable for both lei flower and cut-flower production. Aurora is perhaps the outstanding variety for lei flowers. The flowers are large and many-petaled and make large, full, white leis. Furthermore, the flowers are richly fragrant. The "Pink" will continue to be one of the leading lei varieties in the Islands; the merits of this variety have been established. Titan has a bushy habit of growth. It is highly productive and, therefore, is satisfactory for lei flower production.

Production note — Text, 10 point Bodoni leaded 1 point; tables, 8 point Bodoni; center and side heads, 10 point Bodoni bold. Cover display, various sizes of Lydian. Printed by letterpress on substance 70 Hifect enamel book. M.L.A., R.W.S.

UNIVERSITY OF HAWAII
COLLEGE OF AGRICULTURE
HAWAII AGRICULTURAL EXPERIMENT STATION
HONOLULU, HAWAII
