Growth and Yield Characteristics of Field-grown *Limonium sinuatum* (L.)

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Abstract Field studies were conducted on the potential of annual statice as an outdoor cut-flower crop for the Midwestern United States. Data was collected on seven cultivars in 1989 and 42 in 1990. In 1989, total fresh stem weight, stem count, and average stem weight differed significantly among cultivars. Yellow cultivars had more stems harvested than the rose, apricot, and blue cultivars, but stems of the yellow cultivars weighed less. The number of stems harvested over time tended to be concentrated in the first 8 weeks after flowering begins. In 1990, the average stem fresh weight was significantly different among the apricot, blue, and rose cultivars, but the number of stems harvested was significantly different only between the blue and rose cultivars.

In recent years, there has been a revival of interest in producing field-grown cut flowers. The production of annual statice is of special interest because the flowers may be used either fresh or dried and are available in an assortment of colors.

There are many cultivars of annual statice. Although general cultural information for this crop is available (Nau, 1988; Sommers, 1984; Wallace, 1988), few studies describe the flowering habits and yield of the various cultivars. General yield ranges have been reported (Espinosa and Healy, 1988; Laushman, 1989; Semeniuk and Krizek, 1973), and limited cultivar comparisons have been made based on studies conducted in Florida (Wilfret and Harbaugh, 1978), Germany (Zimmer, 1982), and Maryland (Healy and Aker, 1988). Our objective was to evaluate the suitability of the many new, annual statice cultivars as outdoor cut-flower crops for the Midwestern United States and to compare their yield potential and flowering habits.

Materials and Methods

Field studies were conducted in 1989 and 1990 on the potential of statice as a field-grown, cut-flower crop. In 1989, seven cultivars were grown. Seeds were sown in a greenhouse in germination trays containing a fine sphagnum peat mix (Terra-Lite Plug Mix; Grace-Sierra, Allentown, Pa.) on 7 Apr. Two

weeks later, the plants were transplanted into cell packs (5.5 × 5 × 6-cm cells) using a 1 soil : 2 sphagnum peat : 2 perlite (by volume) mixture amended with 890 g Ca(H₂PO₄)₂, 593 g KNO₃, 593 g MgSO₄, 4.75 kg ground limestone, and 74.2 g fritted trace elements no. 555 (Peters, Allentown, Pa.), all per cubic meter of mix. The plants were fertilized at each watering with 200 mg-liter⁻¹ each of N and K supplied from 367 mgNH₄NO₃ and 517 mg KNO₃ per liter, with 46 mg P/liter supplied via 75% technical grade phosphoric acid in the irrigation system.

The plants were transplanted into the field at the Pinney-Purdue Agricultural Research Center in Wanatah, Ind., on 22 May. The soil was a Tracy sandy loam with 1.5% organic matter. The field had been plowed and disked before planting. Three replications of each cultivar were grown, and cultivars were randomly assigned within each of three blocks. The plots measured 1 × 3 m; they were covered with black plastic mulch, and a trickle irrigation pipe was placed under the plastic between two parallel rows of plants. Each replication contained 19 plants that were offset-planted (two parallel rows with 30 cm between plants and rows) in the 3-m-long plot. The plants were irrigated as needed and fertilized with 100 mg of 20N4.4P-16.6K/liter through the trickle irrigation system during the first 3 weeks they were in the field. Weeds between plastic strips were controlled by cultivation using hand tools and a rototiller. Weekly harvesting began on 14 July when the plants first bloomed and ended on 9 Oct. when a killing frost terminated flower development. The number of stems, individual stem fresh weight, and stem length were recorded.

In 1990, 42 cultivars were evaluated: 19 blue, five apricot, and 18 rose. We used the same cultural practices as described for the study performed in 1989, except seeds were sown 18 Apr. and transplanted into the field 12 June. Harvesting started on 19 July and ended on 1 Oct. At each harvest, the number of stems and total fresh weight per plot were recorded.

Average stem fresh weight was calculated at each harvest by dividing the total weight of stems harvested per cultivar plot by the stem count.

We performed an analysis of variance on the data by general linear model procedures (SAS Institute, 1985). Significantly different means were separated by least significant differences at $P \leq 0.05$. For 1989 data, all statice cultivars were analyzed together. Due to variations in the number of stems produced and stem size among the color groups in 1990, we analyzed data for each of the three color categories separately.

Results and Discussion

In 1989, there were significant variations among cultivars in the number of stems produced, average stem length, and average stem fresh weight (Table 1). The yellow cultivars, 'Fortress Yellow' and 'Gold Strike', produced more stems per plot, but they had a lower average stem fresh weight than blue cultivars. The blue and purple cultivars, which have a higher demand in the marketplace, produced fewer stems, but they were heavier.

There was a significant difference in average stem fresh weight for all cultivars over the harvest season (data not shown). Stem fresh weights increased up to the sixth harvest and then remained fairly constant until the end of the harvest period. Although the average stem fresh weight tended to remain constant during the weekly harvests, the corolla of the individual flowers was noticeably smaller in later harvests and reduced the quality of the stems cut later. For the yellow and rose cultivars, the number of stems cut over the harvest season was concentrated during the first 8 weeks of the harvest season (Fig. 1). The blue and apricot cultivars had a less concentrated harvest season. Stem length was not significantly affected over the harvesting periods. The flowering concentration during the first 8 weeks of harvest for the yellow and rose cultivars and the decreasing flower quality during the later harvests suggests that growers should schedule multiple plantings of statice to maximize yield and flower quality over the entire growing season.

Table 1. Average number of statice stems harvested annually, average stem length, and average stem fresh weight per plot of 19 plants, by cultivar, 1989.

Cultivar	No. stems	Stem length (cm)	Fresh wt (g)
Fortress Yellow	658	49.9	14.2
Gold Strike	535	52.0	16.7
Fortress Rose	419	40.6	14.0
Fortress Apricot	253	45.7	16.7
Market			
Growers Blue	184	43.3	26.8
Fortress Purple	169	52.1	31.3
Fortress			
Dark Blue	151	49.6	33.8
Significance	***	***	***
LSD _{0.05}	12.8	4.1	2.7

***Significant at $P \leq 0.0001$.

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The same cultivars grown in both years produced fewer stems in 1990 than 1989. The number of 'Fortress Rose', 'Fortress Apricot', 'Market Growers Blue', and 'Fortress Dark Blue' stems produced per plot was 24.0%, 52.8%, 53.5%, and 59.8% lower, respectively, in 1990. Unseasonably cool weather in June and July 1990 seemed to slow plant development and may have contributed to the difference.

Five apricot static cultivars were compared in 1990. There were significant cultivar differences in average stem fresh weight, but not in the number of stems harvested (Table 2). Over the harvest season, there were significant differences among the harvests for the number of stems (data not shown), with the distribution over time similar to 1989.

The 19 blue static cultivars differed significantly in stem count (5–130) and average stem fresh weight (Table 2). The first harvest for blue static cultivars was later than that for the other two colors. The number of stems harvested differed significantly among cultivars over the harvest season. For most blue cultivars, the number of stems harvested was still increasing when production was stopped because of a killing frost; however, the number of stems cut had peaked in some cultivars ('Compindi', 'Excellent Blue', 'Fortress Dark Blue', and 'Modra') as they had in 1989 (data not shown). There were also significant differences in average stem fresh weight among blue cultivars over the harvest season. The overall average stem fresh weight peaked by the third harvest and then decreased, but some cultivars ('Excellent Blue', 'Heavenly Blue', 'Pale Blue Strike', 'Sky Blue', 'Splendor Dark Blue', 'Splendor Light Blue', 'Splendor Midnight Blue', and 'Splendor Sky Blue') showed

an increased average in stem fresh weight with later harvests.

The 18 rose static cultivars differed in the average number of stems harvested (19–319) and average stem fresh weight (Table 2). The average number of stems harvested over the season followed the same pattern as in 1989, with the peak in number of stems occurring during the fifth harvest, but the average stem fresh weight remained constant after the third harvest (data not shown). In 1990, most of the rose cultivars followed a similar pattern for the number of weeks that stems were harvested. The exceptions were 'Turbo Peach' and 'Excellent Salmon Shades', which had a condensed flowering period with >93% of the stems being cut during four harvests.

These data show significant differences among commercially available static cultivars. Healy and Aker (1988) used similar cultivars in their study. They harvested more stems of 'Fortress Apricot' and 'Fortress Dark Blue' (35% and 53%, respectively) but had 44% fewer stems of 'Fortress Yellow' compared to our 1989 data. In studying optimal growing temperatures for static, the number of 'American Beauty' and 'Midnight Blue' stems that we harvested per plant was similar to that harvested by Semeniuk and Krizek (1973) for plants grown under a high-temperature regime. In Semeniuk and Krizek's study, the high-temperature regime resulted in more cut stems of 'American Beauty', but lower yields for 'Midnight Blue'. With the variation in results obtained from the different locations, growers should be encouraged to plant cultivars that will maximize yield. The diversity in yield, color, and harvest season allows growers to select cultivars that have characteristics best suited to their market.

Fig. 1. Number of stems harvested weekly (week 1 began 14 July 1989) of six annual static cultivars harvested per plot of 19 plants.

Table 2. Average number of static stems harvested annually and average stem fresh weight per plot of 19 plants, by color and cultivar, 1990.

Color and cultivar	Seed source ²	No. stems	Fresh wt (g)
Apricot			
Apricot Beauty	BA	148	20
Fortress Apricot	GL	119	24
Apricot	GR	114	20
Apricot	HM	76	21
Apricot	GL	47	18
Significance		NS	**
LSD _{0.05}		---	4.7
Blue			
Modra	GL	130	39
Blue River	GL	128	32
Excellent Blue	SK	122	30
Compindi	GL	108	40
Splendor			
Midnight Blue	GL	93	32
Market			
Growers Blue	GL	86	35
Excellent			
Light Blue	SK	75	32
Heavenly Blue	GL	73	33
Fortress			
Dark Blue	GL	61	36
Fortress			
Heavenly Blue	GL	58	39
Dark Blue			
Charm	GL	51	35
Splendor			
Sky Blue	GL	50	35
Sky Blue	HM	36	42
Kamf Blue	GL	32	45
Sunburst			
Dark Blue	BA	27	37
Splendor			
Dark Blue	GL	21	37
Midnight Blue	GL	19	40
Pale Blue Strike	GL	13	29
Sunburst			
Light Blue	GL	5	29
Significance		**	***
LSD _{0.05}		3.8	3.0
Rose			
Fortress Rose	GL	319	11
Turbo Peach	GL	284	14
Excellent Rose			
Shades	SK	236	15
Market Rose	GL	207	16
Excellent Salmon			
Shades	SK	196	14
American Beauty	GR	187	17
Splendor			
Carmine Rose	GL	169	19
Excellent Rose	GR	144	16
Rose Charms	GL	115	22
Rose Charms 320	GL	109	28
American			
Beauty	GL	101	16
Lady Rose	GL	51	20
Roselights	GL	48	22
Superb Rose	HM	41	19
Rosea Splendens	GL	31	21
Rose Strike	GL	26	22
Splendor Rosea			
Splendens	GL	22	19
Sunburst Rose	BA	19	18
Significance		***	***
LSD _{0.05}		6.7	1.9

²BA = Ball Seed Co., West Chicago, Ill.; GL = Fred C. Gloeckner, New York; GR = Grimes Seed Co., Smethport, Pa.; HM = Harris-Moran Seed Co., Rochester, N.Y.; SK = Sakata Seed Co., Salinas, Calif.

NS, **, ***Nonsignificant or significant at $P \leq 0.01$ or 0.0001, respectively.

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