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EVALUATION OF BULBOUS PERENNIALS FOR USE IN CENTRAL FLORIDA

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Abstract. **In December 1994,** × ***Amarcrinum memoria-corsii, Hippeastrum* 'Germa', three species and 28 cultivars of *Narcissus,* two *Triteleia* species, and seven *Watsonia* cultivars were planted in Tavares-Millhopper fine sand soil in Apopka, FL. The bulbs and corms were grown under one or more shade levels (0, 30, 50 and 80%), depending on the plant. Plots were mulched and irrigated based on tensiometer readings using overhead sprinklers. Chilling-degree hours and plant survival and flowering were monitored during 1995, 1996, and 1997. Chilling-degree hours were 194, 455 and 157, respectively, for the winters of 1994-95,1995-96, and 1996-97. Plant survival varied from 0% to 100% after three years.** × ***Amarcrinum memoria-corsii, Hippeastrum* 'Germa',** ***N. canliculatus, N.* 'Golden Perfection', and *N.* 'Silver Chimes' had 100% survival. Flowering was also variable, with** × ***Amarcrinum memoria-corsii, Hippeastrum* 'Germa',** ***N.* 'Golden Perfection',** ***Triteleia hyacinthina* and *T. laxa* flowering all three years. Several of the *Narcissus* cultivars flowered the first two springs but not after the warmest winter. Watsonias did not perform well, in part, due to cold damage occurring each winter. Shade level had little effect on plant survival or flowering (number and longevity).**

Interest in perennial flowering plants continues to increase nationwide and central Florida horticulturists are not immune to the siren call of these plants. A subgroup that is of interest to many is that of bulbous perennials. These are plants that have storage organs (true bulbs, corms, rhizomes, or tubers) that develop to carry the plant through dormancy. Although many easy-to-grow bulbous perennials are recommended for use in Florida, others of these plants are less well known or are not recommended because it is not known if they will thrive and/or flower here.

One of the reasons this project was started was because the senior author had planted bulbs of *Narcissus* (daffodil) 'Carlton' in his yard in 1983 and this daffodil had persisted and flowered every year since then, without any special care or the need to dig and chill the bulbs as is often recommended to Florida gardeners. *N.* 'Carlton' is touted as a super perennializer, especially in the south (Heath and Heath, 1994) and, yet, daffodils are not recommended for central Florida because of their need for winter cold (MacCubbin, 1997).

Narcissi are bulb-producing members of the family Amaryllidaceae, a group of monocots that include many that are bulbous and herbaceous. Because of the experience with *N.* 'Carlton', other daffodil cultivars and species were acquired for testing. In addition, two other bulb-producing members of the Amaryllidaceae with potential for use in central Florida were tested—× *Amarcrinum* and *Hippeastrum* (*Amaryllis*). × *Amarcrinum* (formerly *Crinodonna*) are intergeneric hybrids between *Amaryllis* spp. and *Crinum* spp., both of which thrive in central Florida (MacCubbin, 1997). Herbaceous cormous perennializer from two other plant families were also tested. They included two species of *Triteleia* (grassnut, triplet lily, family Liliaceae) and seven cultivars of *Watsonia* (bugle lily, family Iridaceae). The purpose of this experiment was to evaluate bulbous perennials for their ability to grow and flower in central Florida under various shade levels ranging from 0% to 80%.

Materials and Methods

This research was conducted at the Central Florida Research and Education Center in Apopka, FL. Donated bulbs and corms (The Daffodil Mart, Gloucester, VA 23061) were planted under various shade levels (0, 30, 50 and 80%), depending on the plant (Table 1).

Plants arrived on 12 Dec. 1994. Twenty-eight cultivars and three species of *Narcissus* (daffodils) were planted on 16 and 19 Dec. 1994 and the other bulbs and corms were planted on 23 Dec. 1994. The selection of daffodils included representatives from ten of the twelve daffodil divisions. The soil was Tavares-Millhopper fine sand [hyperthermic; uncoated Typic Quartzipsamments (Tavares), Grossarenic Paleudults (Mill-

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Table 1. Stem and flower characteristics, number of bulbs or corms planted per plot, and survival of bulbous herbaceous perennials evaluated for use in Central Florida.

Plant	Stem Type	Flower Color[z]	Flowering Habit[y]	Number Planted per Plot	Survival After Planting (%)[x]	
					Second year	Third year
× *Amarcrinum memoria-corsii*[w]	bulb	pink	many/stem	1	100	100
Hippeastrum 'Germa'	bulb	yellow	2-4/stem	1	100	100
Narcissus 'Audubon'	bulb	white/pink	1/stem	1	0	0
'Birma'	bulb	dark yellow/red	1/stem	1	100	55
canaliculatus	bulb	white/gold	3-4/stem	5	100	100
'Dolly Mollinger'	bulb	white/orange & white	—	1	50	16
'Early Splendour'	bulb	white & orange	many/stem	3	74	48
'Filly'	bulb	white/white	1/stem	1	0	0
'Golden Perfection'	bulb	yellow/yellow	several/stem	1	100	100
'Hawera'	bulb	pale yellow/pale yellow	several/stem	1	100	85
'Holland Sensation'	bulb	white/yellow	1/stem	1	75	37
'Jumblie'	bulb	canary yellow/yellow-orange	2-3/stem	1	88	14
'King Alfred'	bulb	yellow/yellow	1/stem	1	11	11
'Las Vegas'	bulb	white/canary yellow	1/stem	1	33	11
'Little Beauty'	bulb	white/sulfur yellow	—	1	60	20
'Little Witch'	bulb	yellow/yellow	1/stem	1	62	12
'Meeting'	bulb	lemon-yellow/yellow	1/stem	1	55	55
'Minnow'	bulb	white/buttercup	3-4/stem	1	87	50
obvallaris	bulb	yellow/golden yellow	1/stem	1	57	0
odorus plenus	bulb	yellow/yellow	2-3/stem	1	62	25
'Orangery'	bulb	creamy-white/orange	—	1	50	12
'Palette'	bulb	yellow/green, yellow, orange	—	1	66	0
'Peeping Tom'	bulb	yellow/yellow	1/stem	1	50	12
'Scarlet Gem'	bulb	saffron/red-orange	many/stem	3	69	6
'Scarlet Royal'	bulb	yellow/scarlet red	1/stem	1	77	33
'Silver Chimes'	bulb	white/white	many/stem	1	100	100
'Sir Winston Churchill'	bulb	creamy white/orange	multiflowered	1	77	44
'Sorbet'	bulb	ivory white/yellow, orange	—	1	57	14
'Sugarbush'	bulb	white/yellow	several/stem	4	88	47
'Suzy'	bulb	yellow/brick-red	several/stem	4	100	92
'Tête-à-Tête'	bulb	buttercup/yellow-orange	1-3/stem	1	100	60
'Tittle Tattle'	bulb	saffron/saffron	several/stem	1	22	0
'Verdin'	bulb	yellow/white	several/stem	1	0	0
Triteleia hyacinthina[v]	corm	white	1+/stem	5	66	35
Triteleia laxa[u]	corm	blue	1+/stem	5	96	90
Watsonia 'Bright Eyes'	corm	pink	many/stem	1	22	0
'Dazzler'	corm	orange/purple throat	many/stem	1	44	33
'Humilis'	corm	pink	many/stem	1	37	0
'Malvern'	corm	orchid	many/stem	1	50	16
'Mrs. Bullard's White'	corm	white	many/stem	1	43	0
'Pink Opal'	corm	soft pink	many/stem	1	44	0
'Rubra'	corm	maroon	many/stem	1	12	0

[z]For daffodils (*Narcissus*), perianth (petals and sepals) color is given first followed by a slash (/) and then the corona, cup, trumpet color.
[y]Number of flowers per stem.
[x]Bulbs and corms were planted during Dec. 1994 and percent survival in subsequent years is based on the number of plants that emerged in the spring of 1995.
[w]× *Amarcrinum* (formerly *Crinodonna*) *memoria-corsii* is an intergeneric hybrid between *Amaryllis belladonna* and *Crinum moorei*.
[v]Formerly *Brodiacea lactea*.
[u]Formerly *Brodiacea laxa*.

hopper)] with a soil pH and organic matter content of 6.2 and 2.6%, respectively. This soil has rapid permeability [>6 inch/hr (>15 cm/hr)]. One to five plants of each type (Table 1) were planted in 1 ft² (0.3 m²) square areas in this randomized complete block design experiment with three replications. Shade treatments (30, 50 and 80%) were provided using 8 × 12 ft² (2.4 × 3.7 m²) wooden frames covered with shade fabric mounted 4 ft (1.2 m) above the soil surface on wooden posts. Full sun plots had no posts or frames. Plots were watered after planting, mulched with oak and pine leaves, and hand weeded as needed. Additional municipal mulch was added to the plots as needed.

Fertilization in each plot consisted of 0.5 lb (222 g) of 6-month release duration 15N-2.2P-12.4K ($15N\text{-}5P_2O_5\text{-}15K_2O$) controlled release fertilizer with minor elements (HI-Temp Palm fertilizer, Helena Chemical, Memphis, TN 38119) applied per 32 ft² (3 m²) once a year at the beginning of Feb. This application rate was equivalent to 200 lb N/acre per yr (224 kg N/ha·yr^{-1}). Irrigation water was applied overhead individually to each plot using a single spray head sprinkler (8F-FLT, L. R. Nelson, Peoria, IL 61615) mounted on a 2-ft (0.6-m) riser in the center of each plot. Each plot was equipped with a 6-inch [15-cm] tensiometer (model R, Irrometer, Riverside, CA 92516). Irrigation was initiated when the soil moisture tension reached -12 cbar (-12 kPa). Basing the irrigation of each plot on tensiometer readings was intended to remove bias due to differences in water availability that might occur because of variable evapotranspiration rates in plots with different shade levels and/or amounts of mulch or plant material.

Table 2. Average number of flowers per plant for bulbous herbaceous perennials grown in Central Florida under various shade levels during the three years following planting.[z]

	Flowers per Plant Under Various Shade Levels (%)													
	First year after planting					Second year after planting					Third year after planting			
Plant	0	30	50	80	*Significance*	0	30	50	80	*Significance*	0	30	50	80	*Significance*
× *Amarcrinum memoria-corsii*[y]	2.0	—[x]	—	—	NA[w]	1.5	—	—	—	NA	1.5	—	—	—	NA
Hippeastrum 'Germa'	1.3	—	—	—	NA	2.3	—	—	—	NA	1.0	—	—	—	NA
Narcissus 'Audubon'	0.0	0.0	0.3	—	NS	‡[v]	‡	‡	—	NA	‡	‡	‡	—	NA
'Birma'	0.0	0.7	0.0	—	NS	0.0	0.3	0.0	—	NS	0.0	0.0	0.0	—	NA
canaliculatus	0.0	0.0	0.0	0.0	NA	0.8	1.0	0.2	0.1	NS	0.0	0.0	0.0	0.0	NA
'Dolly Mollinger'	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA	‡	0.0	‡	—	NA
'Early Splendour'	0.1	0.2	0.0	1.2	NS	0.0	0.0	0.0	0.0	NA	0.0	0.0	0.0	‡	NA
'Filly'	0.0	0.0	0.0	—	NA	‡	‡	‡	—	NA	‡	‡	‡	—	NA
'Golden Perfection'	2.0	2.0	2.0	—	NS	3.3	2.0	2.3	—	NS	0.0	1.7	1.7	—	NS
'Hawera'	0.0	2.0	2.0	—	NS	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA
'Holland Sensation'	0.3	0.7	0.3	—	NS	0.0	0.0	0.0	—	NA	0.0	0.5	‡	—	NS
'Jumblie'	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA	‡	0.0	‡	—	NA
'King Alfred'	2.0	2.3	2.0	—	NS	‡	1.0	‡	—	NA	‡	‡	0.0	—	NA
'Las Vegas'	1.0	1.0	1.7	—	NS	1.0	0.5	1.0	—	NS	‡	0.0	‡	—	NA
'Little Beauty'	0.0	1.0	0.0	—	Q***	0.0	0.0	0.0	—	NA	‡	0.0	‡	—	NA
'Little Witch'	0.0	0.0	0.3	—	NS	0.0	0.0	0.0	—	NA	‡	‡	0.0	—	NA
'Meeting'	1.7	1.3	1.0	—	NS	1.0	1.5	0.0	—	NS	0.0	0.0	0.0	—	NA
'Minnow'	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA
obvallaris	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA	‡	‡	‡	—	NA
odorus plenus	0.0	0.0	0.0	—	NA	0.5	0.0	‡	—	NS	2.5	2.0	‡	—	NS
'Orangery'	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA	‡	‡	0.0	—	NA
'Palette'	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA	‡	‡	‡	—	NA
'Peeping Tom'	1.0	1.0	0.3	—	NS	0.0	1.0	0.0	—	Q***	0.0	‡	‡	—	NA
'Scarlet Gem'	0.4	0.6	0.6	1.2	NS	0.0	0.0	0.0	0.0	NA	0.0	‡	‡	‡	NA
'Scarlet Royal'	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA	0.0	‡	0.0	—	NA
'Silver Chimes'	0.7	1.0	1.0	—	NS	0.7	0.7	0.7	—	NS	0.0	0.0	0.3	—	NA
'Sir Winston Churchill'	0.3	0.0	0.3	—	NS	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA
'Sorbet'	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA	‡	0.0	‡	—	NA
'Sugarbush'	0.0	0.0	0.0	0.0	NA	0.1	0.2	0.3	0.0	NS	0.0	0.0	0.0	0.7	NS
'Suzy'	0.8	1.1	0.5	0.8	NS	0.5	1.4	0.8	1.1	NS	0.0	0.0	0.1	0.0	NS
'Tête-à-Tête'	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA	0.0	0.0	0.0	—	NA
'Tittle Tattle'	0.0	0.0	0.0	—	NA	‡	‡	0.0	—	NA	‡	‡	‡	—	NA
'Verdin'	0.0	0.0	0.0	—	NA	‡	‡	‡	—	NA	‡	‡	‡	—	NA
Triteleia hyacinthina[u]	0.9	1.0	0.8	1.0	NS	1.1	1.9	0.9	0.9	NS	0.3	1.5	1.3	1.8	L*
Triteleia laxa	0.9	0.9	0.9	0.9	NS	1.3	1.9	0.7	0.5	NS	0.1	0.4	0.0	0.3	NS
Watsonia 'Bright Eyes'	0.0	0.0	0.3	—	NS	‡	0.0	‡	—	NA	‡	‡	‡	—	NA
'Dazzler'	0.0	0.3	0.3	—	NS	‡	0.5	0.5	—	NS	‡	1.0	1.0	—	NS
'Humilis'	0.0	0.0	0.3	—	NS	‡	‡	0.0	—	NA	‡	‡	‡	—	NA
'Malvern'	0.0	0.3	1.0	—	NS	‡	0.0	0.0	—	NA	‡	1.0	‡	—	NA
'Mrs. Bullard's White'	0.0	0.5	1.0	—	L*	0.0	‡	0.0	—	NA	‡	‡	‡	—	NA
'Pink Opal'	0.0	0.7	0.7	—	NS	0.0	0.0	0.0	—	NA	‡	‡	‡	—	NA
'Rubra'	0.0	0.0	0.0	—	NA	‡	‡	0.0	—	NA	‡	‡	‡	—	NA

[z]Bulbs and corms were planted during Dec. 1994.
[y]× *Amarcrinum* (formerly *Crinodonna*) *memoria-corsii* is an intergeneric hybrid between *Amaryllis belladonna* and *Crinum moorei*.
[x]— indicates that plants were not planted under these shade levels.
[w]NA, NS, L, Q, *, *** indicate not applicable, not significant, linear, quadratic, and significant at the 5% or 0.1% levels, respectively.
[v]‡ indicates that no plants were alive under that shade level.
[u]Formerly *Brodiacea lactea*.
[t]Formerly *Brodiacea laxa*.

Plots were checked weekly for the emergence of new plants. Emergence was recorded and each plant marked using 5¼-inch (13-cm) plastic straws. Flowering was checked daily and each new inflorescence was marked using a metal-rimmed paper tag (model 14-314-1, Avery Dennison, Framington, MA 01701). When the flowers were spent, the tags were removed and the date recorded. Flower longevity was, therefore, the interval between the tagging date and the tag removal date for each inflorescence.

Temperatures were monitored using copper-constantan thermocouples (AWG 24, Omega Engineering, Stamford, CT 06907) attached to a datalogger (CR10, Campbell Scientific, Logan, UT 85321). Chilling degree hours were determined for each winter by summing the number of hours temperatures were 45°F (7°C) or colder.

Results and Discussion

Chilling degree hours. The number of hours when temperatures were below 45°F were 194, 455 and 157, respectively, for the winters of 1994-95, 1995-96, and 1996-97.

Plant survival. *Species and cultivar effects.* Survival data for the second and third years after planting are based on the changes in the number of plants of each cultivar and species compared to the number that came up the first spring after planting (1995).

Table 3. Average flower longevity of bulbous herbaceous perennials grown in Central Florida under various shade levels during the three years following planting.[z]

Plant	Flower Longevity (in days) Under Various Shade Levels (%)														
	First year after planting					Second year after planting					Third year after planting				
	0	30	50	80	*Significance*	0	30	50	80	*Significance*	0	30	50	80	*Significance*
× *Amarcrinum memoria-corsii*[v]	24.5	—[x]	—	—	NA[w]	18.0	—	—	—	NA	22.3	—	—	—	NA
Hippeastrum 'Germa'	10.0	—	—	—	NA	11.6	—	—	—	NA	15.0	—	—	—	NA
Narcissus 'Audubon'	†[y]	†	11	—	NA	‡[u]	‡	‡	—	NA	‡	‡	‡	—	NA
'Birma'	†	8.0	†	—	NA	†	7.0	†	—	NA	†	†	†	—	NA
canaliculatus	†	†	†	†	NA	7.0	8.5	5.0	6.0	NS	†	†	†	†	NA
'Dolly Mollinger'	†	†	†	—	NA	†	†	†	—	NA	‡	†	‡	—	NA
'Early Splendour'	9.0	5.5	†	7.0	Q*	†	†	†	†	NA	†	†	†	‡	NA
'Filly'	†	†	†	—	NA	‡	‡	‡	—	NA	‡	‡	‡	—	NA
'Golden Perfection'	9.5	9.3	10.5	—	NS	11.2	12.3	11.9	—	NS	†	8.8	12.3	—	NS
'Hawera'	†	9.5	10.5	—	NS	†	†	†	—	NA	†	†	†	—	NA
'Holland Sensation'	10.0	9.0	8.0	—	NS	†	†	†	—	NA	†	7.0	‡	—	NA
'Jumblie'	†	†	†	—	NA	†	†	†	—	NA	‡	†	‡	—	NA
'King Alfred'	9.8	9.2	9.3	—	NS	‡	9.0	‡	—	NA	‡	‡	†	—	NA
'Las Vegas'	8.0	9.7	8.8	—	NS	11.0	14.0	14.0	—	NS	‡	†	‡	—	NA
'Little Beauty'	†	7.0	†	—	NA	†	†	†	—	NA	‡	†	‡	—	NA
'Little Witch'	†	†	7.0	—	NA	†	†	†	—	NA	‡	‡	†	—	NA
'Meeting'	8.8	10.5	7.3	—	Q*	9.0	11.0	†	—	NS	†	†	†	—	NA
'Minnow'	†	†	†	—	NA	†	†	†	—	NA	†	†	†	—	NA
obvallaris	†	†	†	—	NA	†	†	†	—	NA	‡	‡	‡	—	NA
odorus plenus	†	†	†	—	NA	15.0	†	‡	—	NA	22.6	19.3	‡	—	NS
'Orangery'	†	†	†	—	NA	†	†	†	—	NA	‡	‡	†	—	NA
'Palette'	†	†	†	—	NA	†	†	†	—	NA	‡	‡	‡	—	NA
'Peeping Tom'	8.0	12.0	11.0	—	NS	†	15.0	†	—	NA	†	‡	‡	—	NA
'Scarlet Gem'	8.5	8.2	9.0	9.2	NS	†	†	†	†	NA	†	‡	‡	‡	NA
'Scarlet Royal'	†	†	†	—	NA	†	†	†	—	NA	†	‡	†	—	NA
'Silver Chimes'	11.0	9.3	10.0	—	NS	15.5	14.5	14.0	—	NS	†	†	12.0	—	NA
'Sir Winston Churchill'	6.0	†	11.0	—	NS	†	†	†	—	NA	†	†	†	—	NA
'Sorbet'	†	†	†	—	NA	†	†	†	—	NA	‡	†	‡	—	NA
'Sugarbush'	†	†	†	†	NA	11.0	12.0	11.0	†	NS	†	†	†	11.0	NA
'Suzy'	9.8	8.8	9.4	9.8	NS	10.8	11.0	10.6	11.1	NS	†	†	17.0	†	NA
'Tête-à-Tête'	†	†	†	—	NA	†	†	†	—	NA	†	†	†	—	NA
'Tittle Tattle'	†	†	†	—	NA	‡	‡	†	—	NA	‡	‡	‡	—	NA
'Verdin'	†	†	†	—	NA	‡	‡	‡	—	NA	‡	‡	‡	—	NA
Triteleia hyacinthina[t]	28.1	27.4	28.5	31.0	NS	30.6	30.4	27.0	25.3	NS	21.0	40.0	36.0	34.6	NS
Triteleia laxa[u]	17.8	23.2	19.6	22.3	NS	15.6	19.4	13.2	14.2	Q*	12.5	20.5	†	32.0	L**
Watsonia 'Bright Eyes'	†	†	27.0	—	NA	‡	†	‡	—	NA	‡	‡	‡	—	NA
'Dazzler'	†	23.0	23.0	—	NS	‡	21.0	5.0	—	NS	‡	17.5	17.0	—	NS
'Humilis'	†	†	25.0	—	NA	‡	‡	†	—	NA	‡	‡	‡	—	NA
'Malvern'	†	19.0	27.0	—	NS	‡	†	†	—	NA	‡	54.0	‡	—	NA
'Mrs. Bullard's White'	†	44.0	36.0	—	NS	†	‡	†	—	NA	‡	‡	‡	—	NA
'Pink Opal'	†	15.0	MD[r]	—	NA	†	†	†	—	NA	‡	‡	‡	—	NA
'Rubra'	†	†	†	—	NA	‡	‡	†	—	NA	‡	‡	‡	—	NA

[z]Flower longevity was determined from the date of first color until the date the inflorescence no longer exhibited that color.
[v]× *Amarcrinum* (formerly *Crinodonna*) *memoria-corsii* is an intergeneric hybrid between *Amaryllis belladonna* and *Crinum moorei.*
[x]— indicates that plants were not planted under these shade levels.
[w]NA, NS, L, Q, *, ** indicate not applicable, not significant, linear, quadratic, and significant at the 5%, or 1% levels, respectively.
[y]†indicates that no flowers were produced on the plants in that shade level treatment.
[u]‡indicates that none of the plants were alive under that shade level.
[t]Formerly *Brodiacea lactea.*
[u]Formerly *Brodiacea laxa.*
[r]MD indicates missing data.

As expected, all the plants of × *Amarcrinum memoria-corsii* and *Hippeastrum* 'Germa' survived (Table 1) and flowered (Table 2) in the two years following planting. The main factor reducing the vigor of these plants was *Romalea microptera* (Beauv.) (lubber grasshopper) feeding, which is a well-known problem of *Amaryllis* (MacCubbin, 1997).

Of the *Narcissus* cultivars and species that emerged the first spring after planting, just over 90% had at least one surviving plant the second year. The percentage survival of individual cultivars and species was variable, ranging from 0% ('Audubon', 'Filly', 'Verdin') to 100% ('Birma', *N. canaliculatus,* 'Golden Perfection', 'Hawera', 'Silver Chimes', 'Suzy', 'Tête-à-Tête') and averaging 64%. By the third year after planting, plants of 81% of the cultivars and species persisted and 34% of the original plants remained.

Survival of the two *Triteleia* species showed differing patterns. *T. hyacinthina* survival declined by about one-third each year after planting while *T. laxa* survival declined only about 5% per year (Table 1).

No more than half of the plants of any of the *Watsonia* cultivars survived to year two and almost none survived to year three. One reason for this loss was frost damage to the plants.

Only plants under shade survived to year three, probably because less frost formed on the plants due to the shade fabric as has been reported previously (Stamps et al., 1994).

Plant survival. *Shade effects.* Shade level only affected survival of four plants and only during year two (except for 'Early Splendor'). As shade level increased, survival increased linearly for *Narcissus* 'Minnow' (P = 0.04) and declined linearly for *N.* 'Early Splendor' (P = 0.01) in both years two and three. The responses of *T. laxa* and *Watsonia* 'Humilis' were quadratic (P = 0.02 and 0.0001, respectively) and peaked at 30% and 50%, respectively.

Flowering. *Flowers per plant.* Shade level had little effect on the number of flowers produced per plant (Table 2). × *Amarcrinum memoria-corsii* flowered consistently all three years, averaging 1.5-2.0 flowers per plant (Table 2). Likewise, both triteleias flowered all three years. *Hippeastrum* 'Germa' and *Narcissus* 'Golden Perfection' also flowered all three years, producing the most blooms the spring after the coldest winter (1995-96, second year, 455 chilling-degree hours).

Several daffodils ('Las Vegas', 'Meeting', 'Silver Chimes', 'Suzy') flowered predominantly or exclusively the first two years but did not flower the spring following the very mild winter of 1996-97 (1996-97, year three, 157 chilling-degree hours). An additional reason that 'Las Vegas' and 'Meeting' did not flower the third year was due to poor survival (Table 1). In contrast, it took until the third year for *N. odorus plenus* to become established and flower. *N. canaliculatus* and *N.* 'Sugarbush' only flowered significantly after the cold winter of 1995-96. Some daffodils flowered reasonably well only the first spring after they were planted ('Hawera', 'Holland Sensation', 'King Alfred', 'Peeping Tom', 'Scarlet Gem') and could be treated, at best, as annuals. The remaining daffodils never or almost never flowered. The poor performance of this last group is an indication of why daffodils are not normally recommended for use in central Florida.

In general, the watsonias flowered poorly, due in large part to their being damaged by frost. 'Dazzler' was the only cultivar to flower all three years and it did not survive in the unshaded plots.

Flowering. *Flower longevity.* Almost all flowers lasted one week or longer. × *Amarcrinum memoria-corsii* lasted about three weeks on average (Table 3). *Hippeastrum* 'Germa' flower longevity appeared to increase from year to year, as did most of the daffodils that flowered in more than one year. *Triteleia* and *Watsonia* flowers were quite long lived. Shade level had little effect on flower longevity.

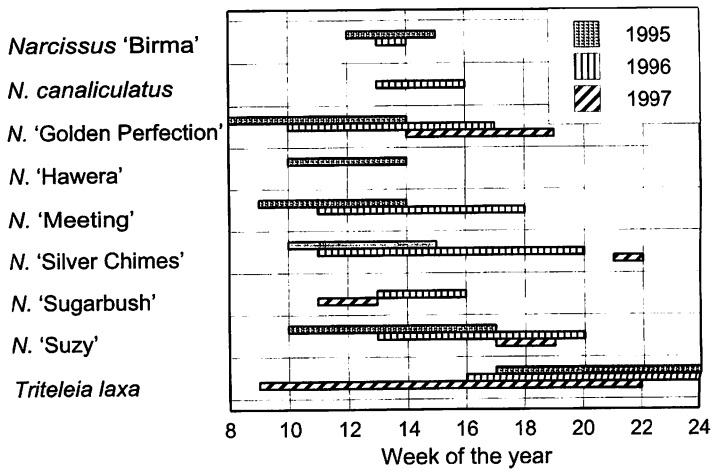

Figure 1. Variability of flowering periods (weeks of the year) from 1995 through 1997 for eight *Narcissus* cultivars and one *Triteleia* species.

Flowering. *Flowering seasonality.* In addition to the presence or absence of flowers from year to year for individual cultivars and species, the time of flowering was also variable from year to year. Both of these variabilities are illustrated in Fig. 1.

As expected, × *Amarcrinum memoria-corsii* and *Hippeastrum* 'Germa' performed well in this test; they had 100% survival and flowering each year. *Triteleia laxa* also had excellent survival and consistent flowering. Of the daffodils tested, only *Narcissus* 'Golden Perfection' had survival and flowering consistency equal to the above plants. However, *N.* 'Silver Chimes' and *N.* 'Suzy' had excellent survival and flowered two out of three years. Most of the other daffodils tested would be better treated as annuals. Due to their apparent susceptibility to cold damage, the watsonias might be better used in protected locations in central Florida or sites further south in the state.

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