New Name ‘Styer Group’ Proposed for Interspecific Hybrids of *Exacum* Species Native to Sri Lanka

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Abstract. We propose the name *Exacum* Styer Group for an interspecific population derived from several Sri Lankan *Exacum* taxa. Confirmation of hybrid status was determined by the appearance of either unique trait combinations or intermediate forms of traits originally represented by individual native taxa. Through 12 sexual generations, the proposed cultivar-group continues to exhibit these unique traits and now forms a cohesive fertile population.

The genus *Exacum* L. (Gentianaceae Juss.) contains about 65 species, most of which are annual or perennial herbs (Klackenberg, 1985). Of the recognized species, only *E. affine* L., native to Socotra, has been successfully domesticated and introduced to commercial floriculture. However, several species and taxa native to Sri Lanka have been identified as potential new horticulture crops based on the presence of horticulturally desirable traits (Riseman and Craig, 1995). These traits include prolific flowering during the summer; abundant, large flowers (4 to 7 cm in diameter) that range in color from light blue to dark violet with contrasting bright yellow anthers; diverse growth habits from erect to decumbent; attractive, glossy green foliage; and efficient production attributes (e.g., easily propagated via vegetative cuttings). Unfortunately, no single species or taxon possesses sufficient desirable traits for either direct introduction or domestication. For example, *E. macranthum* Arn., known primarily for its large, dark blue-violet flowers, was identified over 30 years ago as a potential new horticultural crop (S. Suda, personal communication). Unfortunately, several independent

breeding programs using this species as the sole germplasm source have yet to produce a commercially viable cultivar. Despite garnering significant attention for their beautiful flowers, failure to produce a worthy introduction was attributed to the lack of genetic variation of those nonfloral traits important for horticultural acceptance (e.g., height, branching habit and garden performance). Therefore, a controlled breeding program was initiated at The Pennsylvania State University using five taxa of Sri Lankan *Exacum* to combine desirable traits into genotypes worthy of commercialization.

Morphology of the primary hybrids was used to confirm hybrid status through the appearance of unique trait combinations not present in the parental taxa. In addition, the current population exhibits acceptable fertility levels (e.g., both pollen and ovule viability are typically at levels suitable for production of large progeny populations; however, overall fertility of individual genotypes varies) and important production characteristics (i.e., reliable vegetative reproduction, high density bench spacing). Based on these observations, we propose a new name for this group of hybrids derived from *Exacum* taxa native to Sri Lanka. The cultivar-group name ‘Styer’ is in tribute to J. Franklin Styer (Botany, University of Pennsylvania), who was recognized by Swarthmore College as one of the “...most creative and broadly competent horticultur-

- = production of many primary interspecific hybrids (>50)
- = production of some primary interspecific hybrids (> 10<50)
- = production of few primary interspecific hybrids (<10)

Fig. 1. Crossing diagram representing production of viable hybrids from among Sri Lankan *Exacum* taxa. Arrow heads point to the taxon used as the seed parent in the cross. Double-headed arrows indicate successful reciprocal crosses.

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Table 1. Distinguishing morphological characters of Sri Lankan *Exacum* species and *E. Styer* Group.

Species	Stem shape (ht at anthesis)	Leaf shape (L × W)	Flower color RHS code (petal number)	Calyx lobe length	Petal apex arrangement (L × W)	Anther length
<i>E. macranthum</i>	Cylindrical (29–55 cm)	Ovate to oval-suborbicular (4.5–9.7 × 1.8–4.3 cm)	Dark violet RHS 89B (5-merous)	8–9 mm	Acuminate overlapping 14–32 × 8–25 mm	6–13 mm
<i>E. pallidum</i>	Cylindrical with 2 opposite lines (17–48 cm)	Ovate (3.0–7.5 × 1.6–2.3 cm)	Pale blue RHS 91C (5-merous)	9–10 mm	Acute not overlapping 10–11 × 6–8 mm	2–4 mm
<i>E. pedunculatum</i>	Quadrangular (8–22 cm)	Elliptic to ovate (1–2 × 0.5–0.6 cm)	Medium blue RHS 90D (4-merous)	3–4 mm	Acute, reflexed overlapping 6–8 × 4 mm	4 mm
<i>E. trinervium</i>	Quadrangular with wings (39–73 cm)	Lanceolate to narrowly elliptic (5.6–11.8 × 1.8–4.7 cm)	Medium to light blue RHS 92B (5-merous)	7–10 mm	Acute not overlapping 6–16 × 5–15 mm	6–13 mm
<i>E. trinervium</i> ssp. <i>ritigalensis</i>	Quadrangular with wings (20–63 cm)	Lanceolate to ovate or narrowly elliptic (6.5–14.8 × 1.3–4.3 cm)	Medium to dark blue RHS 93B-D (5-merous)	10–24 mm	Acute overlapping 6–25 × 6–20 mm	6–13 mm
<i>E. Styer</i> Group	Cylindrical to quadrangular, with and without wings or lines (12–36 cm)	Lanceolate to ovate or narrowly elliptic (5.5–11 × 1.8–3.7 cm)	Pale blue to dark violet RHS 89B-C through 93A-C (5-merous)	3–24 mm	Rhomboidal to broadly obovate, overlapping or not 20–28 × 16–21 mm	8–18 mm

ists in North America.” Styer helped write the first edition of the *International Code of Nomenclature for Cultivated Plants* was a strong supporter of horticultural education and introduced many plant cultivars including *Cedrus deodara* (D. Don) G. Don ‘Kashmir’, *Ilex crenata* Thunb. ‘Green Island’, *I. crenata* ‘Birmingham’, and *Berberis × gladywynensis* E. Anders. ‘William Penn’.

Origin

The taxonomic treatment of Sri Lankan *Exacum* has been revised three times during the past 20 years (Cramer, 1981; Klackenberg, 1985; Sumanasinghe, 1986). The primary difference among these treatments is centered on taxon rank, not taxon recognition (except for Klackenberg’s treatment of *E. trinervium* (L.) Druce ssp. *ritigalensis* (Willis) Cramer which he collapsed into *E. trinervium*). We have chosen to use the treatment of Sumanasinghe for several reasons. As the most recent, Sumanasinghe had the advantage of reviewing

the prior research and further refining descriptions based on his research using cytogenetics, isozyme profiles, and crossability (prior treatments were based only on anatomy and morphology). In addition, research on hybrid fertility (Riseman, 1990) and edaphic conditions of each taxon’s native habitat (Riseman, 1997), support Sumanasinghe’s conclusions on taxon identity and rank.

The following taxa were collected from their native habitats in 1983 and 1984 and used in controlled hybridizations: *E. pedunculatum* L., *E. macranthum* Arn., *E. pallidum* Trimen., *E. trinervium* (L.) Druce, and *E. trinervium* ssp. *ritigalensis* (Willis) Cramer. All taxa are considered cross-pollinated in nature. However, despite this and the production of inter-taxa hybrids from hand-pollinations, natural hybrids among these taxa are suspected to exist only between *E. pallidum* and *E. trinervium* (Klackenberg, 1983). Primary interspecific hybrids were produced in 1984 and 1985 with varying success, depending on the parental combination (Sumanasinghe, 1986) (Fig. 1). These primary

hybrids were then incorporated into a pedigree breeding program where in each generation, superior progeny were identified and used as the following generation’s parents. Through 12 generations beyond the primary hybrids, we have selected for fertility (individual genotypes’ pollen viability range between 0% to 96%; data not shown), greenhouse production traits, and combinations of horticultural traits that are indicative of hybrid status.

Description

The distinguishing traits among the original taxa used in the breeding program and the distinguishing traits of the Styer Group are summarized in Table 1. Color descriptions are based on the RHS Color Chart (Royal Horticulture Society, 1998). Through repeated cycles of seed production and selection, the proposed cultivar-group includes all distinguishing traits identified in the original populations. However, as a result of the initial interspecific hybridizations and subsequent breeding, these

Fig. 2. Individuals of *Exacum* Styer Group representing the range of plant habits displayed from 12th generation hybrids.

Fig. 3. Flowers from individuals of *Exacum* Styer Group representing the range of flower forms and colors displayed from 12th-generation hybrids.

traits are now expressed in novel combinations and as intermediate forms not displayed in the original taxa. Traits critical in the delineation of the original taxa include: stem shape, leaf shape, flower color, calyx length, petal shape, and anther length (Table 1). In addition, important horticultural traits contributed to the cultivar-group by individual species include dark blue-violet, acuminate petals (*E. macranthum*), pale-blue, nonoverlapping petals (*E. pallidum*), short plant stature and increased branching (*E. pedunculatum*), enhanced flower production and upright growth habit (*E. trinervium*), and large broadly acute petals (*E. trinervium* ssp. *ritigalensis*). The range of phenotypes currently represented in the proposed cultivar-group is presented for plant conformation (Fig. 2) and flower form (Fig. 3). Voucher specimens representing the Styer Group are maintained at the University of British Columbia Herbarium.

Culture

Asexual reproduction. *Exacum* Styer Group is easily propagated throughout the year by stem cuttings. However, higher rooting percentages are observed when cuttings are harvested from nonflowering stock plants. Rooted cuttings are obtained within 4 to 6 weeks from cuttings 2 to 3 nodes in length, basally treated with 1% IBA in talc, and placed in cell packs filled with a well-drained substrate under intermittent mist. Rooting percentages range from 50% to 100% depending on genotype and reproductive status of the stock plant.

Growth medium and fertilization. Plants perform well in a quick draining peat-based medium. Depending on water quality, media pH can be managed through the use of fertilizer; higher ammonium:nitrate ratio will help to maintain a low media pH. Excellent results have been obtained fertigating with acidifying fertilizers high in ammonical nitrogen, used at a rate of 150 to 200 mg·kg⁻¹ total nitrogen. The optimal media pH range is 5.0 to 6.0 and that for electrical conductivity (EC) is 1 to 2.25 dS·cm⁻¹.

Irrigation. Plants perform best when grown on the 'dry side' but without undo wilting. Typically, excessive irrigation or a severe drought followed by excessive irrigation leads to increased susceptibility to root pathogens. Also, plant growth is enhanced by periodically

wetting the foliage with either water or a dilute fertilizer solution.

Pest management. *Exacum* Styer Group is susceptible to attack by several plant pests. Greenhouse whitefly (*Trialeurodes vaporariorum* Westwood) can be controlled through applications of several commercial pesticides; however, Malathion has been shown to have phytotoxic effects on mature buds and open flowers. Fungus gnats (*Bradysia* spp. Winnertz) can be controlled through the introduction of commercially available parasitic nematodes (*Steinernema* Travassos) or application of a Bti (*Bacillus thuringiensis* Berliner spp. *israelensis*) based product. In addition, the root pathogens *Pythium* Pringsh., *Phytophthora* deBary., and *Fusarium* Link ex Fr. can infect *E. Styer* Group. These diseases can be controlled through a combination of cultural modification (e.g., less frequent irrigations) and medium drenches with commercial fungicides.

Environmental conditions and flowering time. *Exacum* Styer Group prefer warm temperatures and high humidity during production. Maintaining aerial temperature between 18 to 26 °C day/16 to 20 °C night and relative humidity between 70% to 85% throughout the production cycle gives good results. Photoperiod control is not required for flowering; however, flowering time will vary based on genotype and will decrease with increasing light intensities. The earliest genotypes flower 6 to 8 weeks after transplanting into a finishing container (e.g., 10 to 15 cm) while the latest genotypes flower between 16 to 20 weeks following transplanting. During naturally low light months, supplemental irradiance promotes earlier and more robust flowering for all genotypes.

Summary

The consistent desire for new and interesting horticultural crops prompted us to evaluate the commercial potential of Sri Lankan *Exacum* taxa, close relatives of *E. affine* (Persian violet). Based on initial evaluations, we concluded no single taxon had sufficient horticultural merit to begin commercialization. When these taxa were intercrossed, however, the interspecific populations displayed novel forms worthy of continued breeding. Through several sexual generations, the resulting population has distinguished itself from the original taxa by

displaying novel forms and full sexual compatibility. We propose the new name 'Styer Group' for the selections from this interspecific population, with the following description (note: cultivated selections designated from interspecific crosses with Sri Lankan taxa *Exacum macranthum*, *E. pallidum*, *E. pedunculatum*, and *E. trinervium*):

Botanical description. Plants decumbent to erect; stems cylindrical to quadrangular, with wings present or lacking. Leaves glossy green, lanceolate to ovate or narrowly elliptic; leaf tips acute to acuminate, leaf bases cuneate to rounded. Flowers blue to violet, pale to dark hues, flattened to cup-shaped or rarely with petals reflexed, corolla base short tubular, the petals rhomboidal to broadly obovate, overlapping along their entire length to overlapping only at their broadest point or not overlapping. Anthers bright yellow, 8 to 18 mm long.

Due to the interspecific origin of these plants, heterozygosity remains high and we anticipate initial introductions to be vegetatively propagated.

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