Mammoth™ ‘Yellow Quill’
Garden Chrysanthemum

Neil O. Anderson
Department of Horticultural Science, University of Minnesota, 286 Alderman Hall, 1970 Folwell Avenue, St. Paul, MN 55108

Steven Poppe
46352 State Hwy 329, West Central Research and Outreach Center, Morris, MN 56267

Peter D. Ascher and Esther Gesick
Department of Horticultural Science, University of Minnesota, 286 Alderman Hall, 1970 Folwell Avenue, St. Paul, MN 55108

Shengrui Yao, David Wildung, and Patricia Johnson
1861 US Highway 169, North Central Research and Outreach Center, Grand Rapids, MN 55744

Vincent Fritz and James Hebel
35838 120th Street, Southern Research and Outreach Center, Waseca, MN 56093

Lee Klossner and Neal Eash
23669 130th Street, Southwest Research and Outreach Center, Lamberton, MN 56162

Barbara E. Liedl
West Virginia State University, Gus R. Douglass Institute, Agricultural and Environmental Research Station, 201 ACEOP Administration Building, Institute, WV 25112

Judith Reith-Rozelle
West Madison Agricultural Research Station, 8502 Mineral Point Road, Verona, WI 53593

Additional index words. Asteraceae, chrysanthemum breeding, Dendranthema, winterhardiness, herbaceous perennials

Mammoth™ ‘Yellow Quill’ (U.S. Plant Patent 15,027; Canadian Plant Breeders’ Rights Certificate No. 2951) is a new interspecific garden chrysanthemum cultivar, Chrysanthemum · hybridum Anderson (=Dendranthema · hybrida Anderson) with common names of hardy mum, chrysanthemum, and garden mum. It is a new and distinct form of shrub-type garden mum in the Mammoth™ series with spoon-shaped ray florets, frost-tolerant flower petals, self-pinching growth, and serves as a butterfly attractant in the garden. Mammoth™ ‘Yellow Quill’ is a winter-hardy herbaceous perennial in USDA Zones 4–9 with its cushion growth form displaying extreme hybrid vigor, increasing in plant height from 0.46 m in its first year to a shrub of 0.84–1.07 m in the second year, and thereafter with greater than 3000 leaves/plant. Flowering is prolific, covering the entire plant at full flowering and sporting as many as greater than 3500 flowers in Year 2.

Origin
Mammoth™ ‘Yellow Quill’ (Minnesota Sel’n. No. MN98-M91-1; U.S. Patent 15,027; Canadian Plant Breeders’ Rights Certificate No. 2951) is a descendant of the 1989 open-pollinated interspecific cross No. 90-287 (Anderson et al., 2008) between two allohexaploid (2n = 6x = 54) species, C. weyrichii (Maxim.) Miyabe ‘Pink Bomb’ × C. · grandiflora Tzvelv. ‘Adom’ (PP 6,059) or ‘Crusador’ (PP 6,531) (Fig. 1). To distinguish these unique interspecific hybrids, which exhibit shrub-like growth in Year 2 onward, from classic garden and/or greenhouse chrysanthemums [Chrysanthemum · xgrandiflorum Tzvelv. (=Dendranthema · xgrandiflora Tzvelv.)] that have smaller and consistent plant sizes regardless of plant age, all such selections have been taxonomically designated Chrysanthemum · hybridum Anderson (=Dendranthema · hybrida Anderson) (Anderson et al., 2004, 2008). Hybrid genotype Mn. Sel’n. 90-287-185 was crossed (as male) with Mn. Sel’n. No. 90-275-27 as female (PP 14,749) in 1994 to produce cross No. 95-332. Plant no. 3 (95-332-3) from that cross was hybridized (open-pollinated) with ‘Centerpiece’ (male; with spoon ray florets; Anderson et al., 2001; Widmer et al., 1981) in 1997 to produce Sel’n. No. MN98-M91-1. Stem tip cuttings of Mammoth™ ‘Yellow Quill’ were rooted in 1999 and thereafter with all vegetative generations having stable expression of selected traits. This genotype was selected in trials during 2000 at Morris, MN, Agric. Experiment Station field trials with the shrub-type habit serving as a butterfly attractant in the garden. Mammoth™ ‘Yellow Quill’ is a winter-hardy herbaceous perennial in USDA Zones 4–9 with its cushion growth form displaying extreme hybrid vigor, increasing in plant height from 0.46 m in its first year to a shrub of 0.84–1.07 m in the second year, and thereafter with greater than 3000 leaves/plant. Flowering is prolific, covering the entire plant at full flowering and sporting as many as greater than 3500 flowers in Year 2.

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Chemical named used: ethanol (EtOH), indole-3-butyric acid (IBA)
1Associate Professor.
2Scientist.
3Professor Emeritus.
4Research Fellow.
5Non/exempt Temporary or Casual Scientist.
6Professor.
7Research Plot Coordinator.
8Research Fellow.
9Associate Research Professor.
10Assistant Superintendent.
11To whom reprint requests should be addressed; e-mail ander044@tc.umn.edu.
Morphological traits for characterization of Mammoth™ ‘Yellow Quill’ were based on plants produced from rooted, vegetative tip cuttings treated with 1000 ppm indole-3-butyric acid (IBA) in 50% ethanol (EtOH), placed in Oasis wedges (Smithers-Oasis, Kent, OH), and kept under intermittent mist (0800–1600HR supplied by 400-W high-pressure sodium lamps; black cloth pulled closed at 1600 HR and opened at 0800 HR; night) followed by 6 weeks short days [8 h (length × width) with a mean of 115/inflorescence. Immature disc florets are RHS yellow group 4C in color, changing to RHS yellow–orange group 15A on maturity (pollen dehiscence). Hirsute peduncles are RHS green group 131C in color, held stiffly at a 45° angle to the stem, with lengths of 3.3 cm (first) to 4.9 cm (fourth). Anthers and trinucleate pollen are both colored RHS yellow–orange group 16A, whereas the styles are RHS yellow group 11D.

The dry, indescribable fruit is an achene with a single seed and lacks a pappus of awns for bristles. A half-inflated football, oval shape, and ridged texture characterizes the shape of each achene. Mature seeds are 0.2–0.4 cm in diameter and are highly polished, with glabrous texture, ranging from RHS green group 147B (abaxial), changing to 137A (adaxial) and 147B (abaxial) on maturity. Leaf venation in mature leaves ranges from RHS yellow–green group 147C (abaxial) to 148B (abaxial), whereas the petiole is uniformly RHS yellow–green group 148B.

Phyllaries (involucral bracts) are crenate with a glabrous texture, ranging from 0.2 to 0.4 cm in length and uniformly in the RHS green group 137A. The inflorescence is a composite (Asteraceae) of numerous disc and ray florets and is classed as a single daisy (petals with a mean bud size of 2.5 × 1.4 cm (length × width) and RHS yellow group 5A coloration. When completely open, inflorescences are 8.3 cm (diameter) × 1.7 cm (depth), whereas the discs are 1.5 cm (diameter). Ray florets (mean of 36.6/inflorescence but ranging as high as 60) have a tubular quill petal (rolled) often with a flattened end or “spoon” (gla-brous; 3.9 × 0.4 cm) with biuretic apices, attenuate bases, rolled (entire) margins, and positioned at ≈45° angle to the stem axis. Ray florets (gynoecious) during elongation (opening) are RHS Yellow Group 3A and 4B, whereas those at anthesis or maturity are 3C and 5C for adaxial and abaxial surfaces (Table 1), respectively. There is 1 ovule each/ray and disc floret. Ray florets fade in color to RHS yellow group 3C.

Disc florets (hermaphroditic) are tubular with a rounded tip, 0.5 × 0.1 cm (length × width) with a mean of 115/inflorescence. Immature disc florets are RHS yellow group 4C in color, changing to RHS yellow–orange group 15A on maturity (pollen dehiscence). Hirsute peduncles are RHS green group 131C in color, held stiffly at a 45° angle to the stem, with lengths of 3.3 cm (first) to 4.9 cm (fourth). Anthers and trinucleate pollen are both colored RHS yellow–orange group 16A, whereas the styles are RHS yellow group 11D.

Two comparative trials were conducted with Mammoth™ ‘Yellow Quill’ vs. ‘Yellow Sandy’ or ‘Golden Star’. Colors were determined on 18 Jan. 2001 and 27 Sept. 2006 for comparison with ‘Yellow Sandy’ and ‘Golden Star’, respectively. When Mammoth™ ‘Yellow Quill’ is grown in comparison with ‘Yellow Sandy’ (PP 8,759), both have cushion plant shapes and similar plant height in Year 1 (Table 1). ‘Yellow Sandy’ did not survive into Year 2, whereas Mammoth™ ‘Yellow Quill’ developed a shrub habit (Table 1). Mammoth™ ‘Yellow Quill’ has a 1 week earlier short-day response group, larger flower diameters, and differing ray floret types. ‘Yellow Sandy’ had RHS yellow group 5A coloration on both adaxial and abaxial mature ray floret surfaces, whereas Mammoth™ ‘Yellow Quill’ was groups 3C and 5C, respectively (Table 1).
Comparative growth of Mammoth™ ‘Yellow Quill’ with ‘Golden Star’ (an earlier University of Minnesota release)—both of which are single, daisy sports with rolled quill tubular florets—show that the two cultivars differ in plant habit (cushion vs. upright, respectively; Table 1). Plant height of ‘Golden Star’ is significantly shorter than Mammoth™ ‘Yellow Quill’ in Years 1 to 2 (Table 1), whereas the short-day flowering response groups are similar (6.5 vs. 6.0, respectively). Mammoth™ ‘Yellow Quill’ has wider leaves, less ray florets, with a lighter yellow color and deeper lower lobe sinuses than ‘Golden Star’ (Strauss, 2007).

Winterhardiness of Mammoth™ ‘Yellow Quill’ is classified for USDA Zones 4 to 9 with marginal survival in USDA Zone 3 (Anderson et al., 2004). Snow cover throughout the winter period is required for adequate survival of Mammoth™ ‘Yellow Quill’ (Table 2). We evaluated garden performance and winter survivorship during 2000 to 2008 at seven sites in USDA Zones 3b (Grand Rapids, MN), 3b/4a (Morris, MN), 4a (St. Paul, MN), 4b (Lamberton, MN; Waseca, MN), 5a (Verona, WI), and 6a (Institute, WV), although not all sites had Mammoth™ ‘Yellow Quill’ planted each year (Table 2). All trials were conducted in open field or garden plots without protective mulch or covering. In years with adequate snow cover (2000–01, 2003, 2005–07; Table 2), winter survival was higher, ranging from 30% (2005, Institute, WV) to 100% (2001, Morris MN; 2003, Lamberton and Morris, MN; 2005, St. Paul, MN; 2006, Morris and Waseca, MN). Grand means for each year ranged from 45.8% (2008) to 83.3% (2003) (Table 2).

**Propagation and Production**

Asexual propagation is necessary to ensure the morphological traits are firmly fixed. Mammoth™ ‘Yellow Quill’ is vegetatively propagated through herbaceous stem tip cuttings, which root in 1 week under mist or fog propagation after treatment with 1000 ppm IBA in 50% EtOH (Anderson et al., 2008). Plants can then be programmed to flower by potting in a high-porosity soilless medium, 3- to 4-week long days for vegetative growth (0800 to 1600 HR + 2200 to 0200 HR night interruption lighting) at 18.5/22.0 °C day/night followed by 6 weeks short days [8 h (0800–1600 HR); black cloth pulled closed at 1600 HR and opened at 0800 HR], 18.5/22.0 °C day/night, and standard fertilization, e.g., 300 ppm N 20–10–20 weekly liquid feed based on weekly soil tests, and monthly fungicide drench rotations (Langevin, 1992). Mammoth™ ‘Yellow Quill’ is a facultative short-day plant (Anderson et al., 2004). This cultivar may be grown for spring bedding plant sales (Mother’s Day) in liners (Fig. 2). After consumers enjoy the flowers in May, the liners are planted in the garden or containers for subsequent regrowth and fall flowering (Fig. 3; Anderson et al., 2008; Langevin, 1992). Mammoth™ ‘Yellow Quill’ may also be grown outdoors in “mum pans” to form flowers under naturally shorter day-lengths for sale as larger plants in the fall. If either type is overwintered, the plants will display the shrub habit in Year 2 and onward (Fig. 4).

To maximize summer growth potential, both in containers and direct-planted, full sun is required along with intensive fertilization and irrigation (Anderson, 2006; Anderson et al., 2008). Mammoth™ ‘Yellow Quill’ is classified as a “heavy” feeder requiring as much as 1361 g/30.48 m² of 5–20–20 preplant fertilizer or weekly 300 ppm N 20–10–20 postplant soluble fertilization (Anderson et al., 2008).

**Use**

All Mammoth™ garden chrysanthemums are notably winter-hardy herbaceous perennials that are butterfly attractants and frost-tolerant. Mammoth™ cultivars have standard plant dimensions in the first year (Anderson et al., 2001) but achieve shrub status in Year 2 (Anderson et al., 2004, 2008). The Mammoth™ series is a collection of low-maintenance perennials resulting from their genetic “self-pinning,” removing the necessity to hand or mechanically pinch terminal shoots in mid-summer to form the cushion habit (Anderson et al., 2008). Mammoth™ ‘Yellow Quill’ may be grown as a specimen shrub within the garden in Year 2 (Anderson, 2006) but should be spaced as much as 1 m away from adjacent plants. This cultivar may also be grown as a flowering hedge, spacing the plants 0.3–0.6 m on center. Likewise, Mammoth™ ‘Yellow Quill’ is well-suited for large container plantings in landscapes, providing fall color at eye level.

**Availability**

Mammoth™ ‘Yellow Quill’ (U.S. Plant Patent 15,027; Canadian Plant Breeders’ rights Certificate No. 2951) is available as
certified unrooted or rooted cuttings from Ball Seed Company (622 Town Road, W. Chicago, IL 60185; <http://www.ballseed.com>) under the Mammoth™ brand. European distribution rights are currently under negotiation.

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