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THE MORPHOLOGY OF SUNFLOWER (*HELIANTHUS ANNUUS*) 'SUNBRIGHT' GROWN AS CUT FLOWERS CHANGES WITH PLANTING DATE AND FROST/FREEZE EVENTS

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Abstract. **Seeds of 'Sunbright' sunflower (*Helianthus annuus* L.) were planted weekly throughout the year as part of an overall scheduling experiment. Plants grown from seeds and planted on 12 December 2001 through 30 January 2002 were exposed to naturally occurring frost/freezing temperatures during 27-28 February and on 1 March 2002. The purpose of this paper is to report on the observations made on these plants after they made additional growth and flowered subsequent to the frost/freeze events. These temperatures where not low enough to kill the plants, but were cold enough to kill differentiated flower buds. Vegetative buds were not damaged. Thus, sunflower plants that had set terminal and lateral flower buds and had flower buds in different stages of maturity were damaged by the freeze, resulting in an altered plant morphology. Mature plants with flower buds within days of opening were most severely damaged while immature plants with only vegetative buds where not damaged by the freeze event. However, those plants with dead differentiated terminal and lateral flower buds continue to grow vegetative lower lateral buds that were not damage by the frost/freeze events as they were vegetative at that time and subsequently flowered with short lateral stems very low on the main stem. While all plants with differentiated terminal buds had the buds killed, plants from planting dates closer to the frost/freeze events had more vegetative buds higher up the main stem. Plants with a small differentiated terminal bud were only thermally pinched resulting in a well branched plant with long lateral stems and numerous small marketable flowers from the surviving vegetative buds. Plants that were all vegetative at the time of the frost/freeze events produced single stem flowers without damage.**

The primary purpose of the University of Florida specialty cut flower program is to study the cultural physiology of crops that may be grown as specialty cut flowers. One of the major objectives in the program is to develop a crop scheduling database. Sunflower (*Helianthus annuus* L. 'Sunbright') is the model cultivar used for this work. The purpose of this manuscript is to report observations made on plants that were being grown for this database and subjected to a freeze event. It

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is not a report from a controlled experiment testing a hypothesis but rather a description of these observations. There is extensive literature on sunflower as an agronomic crop but literature is minimal as a cut flower. Chapman et al. (1993) developed a sunflower grain yield model and, in a subsequent paper, Meinke et al. (1993), working with Chapman's model commented on frost risk as a factor in yield. However, they did not elaborate on the actual effect of the frost on the plant. Schneiter and Miller (1981) described a system for sunflower plant development. First they described vegetative (V) and then reproductive (R) stages followed by subdividing each. Stage R1 describes the immature bracts becoming visible. R4 is the stage for commercial cut flower harvest and the completion of R5 is the useful life of a sunflower as a cut flower. However the classification goes to R9 where the head has reached physiological maturity as a grain crop.

Materials and Methods

The sunflower cultivar 'Sunbright' is the model plant used in the database study and is a popular specialty cut flower (Seals, 1991). It is a vigorous F1 hybrid, day neutral, pollenless, with golden yellow rays and a dark brown disk. 'Sunbright' has been named as "cut flower of the year" by the Association of Specialty Cut Flower Growers (Anonymous, 2000). Plants described in this paper were grown from seed starting with the planting date of 12 Dec. 2001 through 30 Jan. 2002 with the exception of the week of 2 Jan. 2002 when no planting occurred. The seedlings received normal cultural practices (Armitage, 1993) including weekly fertilization at the equivalent of 150 ppm of N of a 20-20-20 complete fertilizer. These plants were exposed to naturally occurring frost during 27 Feb. and on 1 Mar., and a short light freeze on 28 Feb. with a minimum temperature of near -8 °C (FAWN, 2002). Digital images of the plants were taken on 27 Feb. 2002. Digital images of the plants were again taken on 30 Apr. 2002. Observations were made and sunflower plants classified according to the system of Schneiter and Miller (1981).

Results and Discussion

The temperatures that occurred on 28 Feb. 2002 where not low enough to kill the plants but were cold enough to kill differentiated flower buds. Vegetative buds were not damaged. The results of eight planting dates are summarized in Table 1. The results show that sunflowers that had set terminal and lateral flower buds and had flower buds in different stages of maturity were damaged by the freeze resulting in an altered plant morphology. Mature plants with flower buds within days of opening were most severely damaged while immature plants with only vegetative buds were not damaged by the freeze events. However, those plants with dead differentiated terminal and lateral flower buds continue to grow vegetative lower lateral buds that were present at the frost/freeze but were not damage by these frost/freeze events as they were vegetative at that time and these subsequently flowered with short lateral stems very low on the main stem. While all plants with differentiated terminal buds had the buds killed, plants from planting dates closer to the frost/freeze events had more vegetative buds higher up the main stem. Plants with few differentiated buds or with only a differentiated terminal were thermally pinched resulting in a well branched plant with long lateral stems and numerous small marketable flowers from those surviving vegetative buds.

These results for the first five planting dates are illustrated in Fig. 1. Plants that were all vegetative at the time of the frost/freeze events produced single stem flowers without damage. A brief discussion of the first five planting dates follow as illustrated in Fig 1.

Fig. 1A shows a representative plant from the 12 Dec. 2001 planting. This plant as the oldest had a differentiated terminal flower bud that was within a few weeks of opening and numerous lateral buds that had differentiated flower buds. Only buds near the stem base were vegetative and were not killed. These buds continued to grow after the freeze and differentiated small flowers on short pedicels as seen on the evaluation date of 30 Apr. 2002.

Fig. 1B shows a representative plant from the 19 Dec. 2001 planting or one week younger. This plant also had a differentiated terminal flower bud but had few differentiated lateral buds. However, the time for the lateral buds to continue to grow vegetatively was not sufficient to provide stem length for a commercial crop. The pedicels of the lateral branches were longer than those in Fig. 1A.

Fig. 1C represents a plant from the 26 Dec. 2001 planting and is very similar to the plant described in Fig. 1B, except that this plant had slightly longer lateral branches, the main stem is shorter representing much lower height at the time of the freeze and the flowers are slightly larger.

Fig. 1D represents a plant from the 9 Jan. 2002 planting or four weeks younger than the plant represented in Fig. 1A. This plant has a shorter main stem compared to the previous plant and longer lateral branches. It would appear that all of the lateral branches were vegetative at the time of the freeze and only the differentiated terminal bud was killed effectively thermally pinching the plant. However, the plant had grown sufficiently tall at the time of the freeze that did not allow for adequate lateral branch growth to support a terminal flower

Table 1. Summary of the results from nine planting dates prior to the freeze/frost events. Plants were evaluated on 30 Apr. 2002.

Planting date	Approximate height on 28 Feb 2003	Terminal bud killed	Lateral bud killed	Commercial flower	Flower location
12 Dec. 2001	60 cm	yes	xxxxx	no	—
19 Dec. 2001	54 cm	yes	xxx	no	—
26 Dec. 2001	45 cm	yes	x	no	—
9 Jan. 2002	30 cm	yes	no	no	—
16 Jan. 2002	24 cm	yes	no	no	—
23 Jan. 2002	15 cm	yes	no	yes	lateral branch
30 Jan. 2002	6 cm	no	no	yes	terminal
6 Feb. 2002	3 cm	no	no	yes	terminal

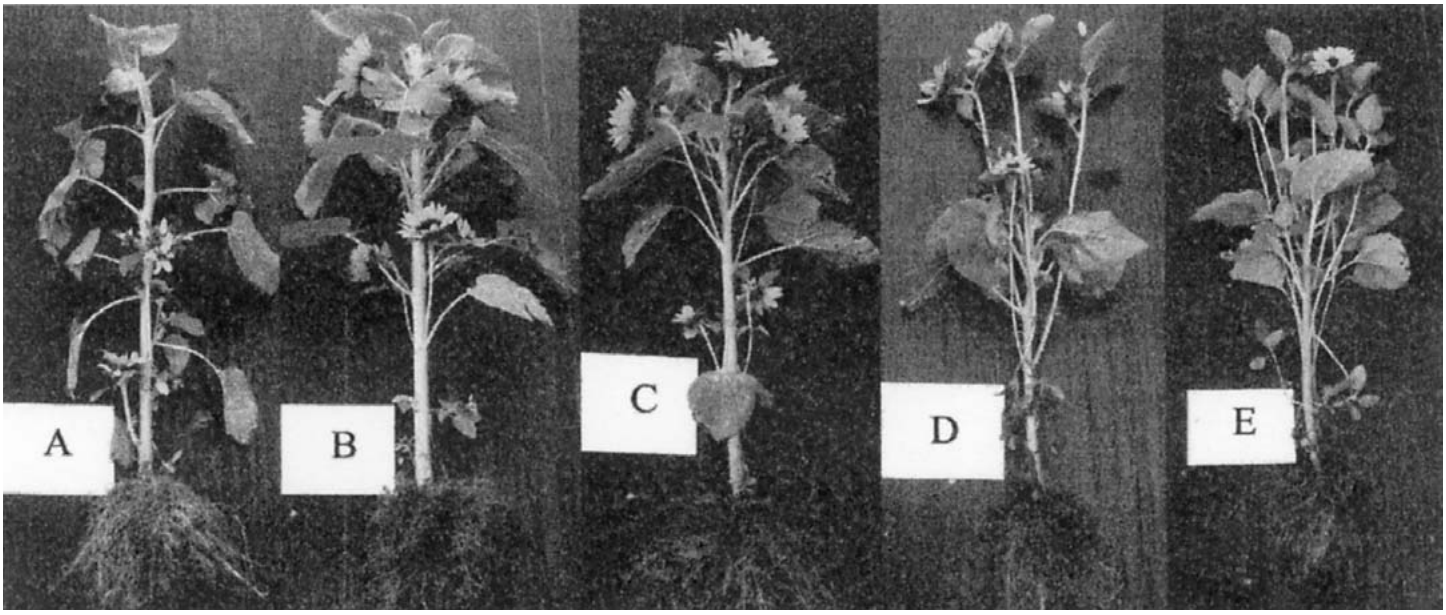

Fig. 1A-E. Change in morphology of sunflower plants subjected to a freeze event 28 Feb. 2002 and flowering of the undamaged vegetative growth that subsequently differentiated into lateral flowers. The plants are in flower on 30 Apr. 2002. A, left, oldest plant and right, E, youngest from weekly plantings.

of commercial quality. The thermal pinch occurred late in the development of the plant.

Fig. 1E is a representative plant from planting date 16 Jan. 2002 or five weeks younger than the plant represented in Fig. 1A. This plant is similar to the plant described in Fig. 1D with the obvious difference of a shorter main stem and longer lateral branches. Again, the plant has grown sufficiently tall at the time of the freeze so the thermal pinch was too high on the plant to allow for adequate lateral branch development. The resulting flowers were too small with stem length shorter than required for either farmer market bouquets or florist quality bunches.

The results of these five planting dates, and planting dates of 23 Jan. 2002, 30 Jan. 2002, and 6 Feb. 2002 are summarized in Table 1. Both planting dates of 16 Jan. 2002 and 23 Jan. 2002 would be classified by Schneiter and Miller (1981) as a V stage, however there is a time in most plants when the terminal apex starts to transition from a vegetative state to a reproductive state and floral primordia are present before visible bud (Emino, 1966). Since plants one week older had visible buds and would be classified as R1 we believe that these buds were reproductive and were killed by the freeze similar to the visible reproductive buds. The planting date of 23 Jan. 2002 was approximately 15 cm tall at the time of the freeze, the freeze event thermally pinched the plants from this planting date sufficiently early in the development of the sunflower plant to let the lateral branches grow enough stem length to terminate in a small but commercially acceptable flower. This flower would be the type preferred for inclusion in mixed bouquets. The last two planting dates discussed in this paper did not have differentiated flower buds at the time of the freeze. Plants from these dates were not thermally pinched but continue to grow determinately resulting in a single terminal flower. However, on 30 Apr. 2002, when the observations were recorded for this paper, only differentiated developing buds were present as anthesis (stage R4) had not yet occurred.

These observations from this freeze event suggests that there may be an optimal time for pinching (removing the terminal bud) of sunflower for lateral branch growth to produce sufficient stem length for commercial quality small flowered sunflowers. This is an opportunity for additional experiments based on these observations.

Literature Cited

Anonymous. 2002. ASCFG Cutflowers of the year 2001. The Cut Flower Quarterly 12:1.

Armitage, A. M. 1993. Specialty Cut Flowers, Varsity Press/Timber Press, Portland, Oregon. pp 98-102.

Bange, M. P., G. L. Hammer, and K. G. Rickert. 1998. Temperature and sowing date affect the linear increase of sunflower harvest index. Agron. J. 90:324-328.

Emino, E. R. 1966. Shoot apex development in the Carnation (*Dianthus caryophyllus*). Proc. Amer. Soc for Hort. Sci. 89:615-619.

Florida Automated Weather Network. 2002. Archived Weather Data. http://fawn.ifas.ufl.edu/scripts/search/costom.

Chapman, S. C., G. L. Hammer, and H. Meinke. 1993. A sunflower simulation model: I. Model development. Agron. J. 85:725-735.

Meinke, H., G. L. Hammer, and S. C. Chapman. 1993. A sunflower simulation model: II. Simulating production risks in a variable sub-tropical environment. Agron. J. 85: 735-731.

Schneiter, A. A. and J. F. Miller. 1981. Description of sunflower growth stages. Crop Sci. 21:901-903.

Seals, J. 1991. Some uncommon and common (but choice) cut flowers from seed for field growing. The Cut Flower Quarterly 3:13-14.