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GROWTH AND FLOWERING OF FREEZE DAMAGED ROSE PLANTS

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INTRODUCTION

Since 1983, east Texas field grown rose plant crops have been exposed to several severe winter freezing events. These freezes have had devastating effects on plants that were still in the field, but ready for harvest. The damage has been particularly costly as rose plants require two years for production and represent a tremendous monetary investment prior to harvest. Because of the high value of the crop, questions have been raised by producers concerning how a visual inspection of the plants can be used to determine the severity of damage from a freeze. And, further, if a visual inspection can aid in predicting how freeze damaged rose plants will withstand the rigors of storage and marketing.

Various types of damage ranging from discoloration of the xylem and/or pith to cane tissue blackening has been described as resulting from freeze damage of rose plants. Indeed, the standard recommendation for garden culture is to prune away all discolored cane tissue, however slight, during the annual late winter pruning or cutback. A limited amount of work has been done where plant exposure to freezing temperatures has been correlated to subsequent regrowth. However, descriptions of the visual damage resulting from freezing have been incomplete and the numbers of cultivars used have been few and are outdated. Our objective for the present study was to describe the damage observed after a freeze event in the field and to correlate these results to subsequent regrowth for several cultivars commonly grown in east Texas.

MATERIALS AND METHODS

Plants of *Rosa* cvs. Blaze, Gold Glow, Queen Elizabeth, Mister Lincoln, Montezuma, Don Juan, Chicago Peace, and Pink Peace endured two major freezes in the field. Temperatures fell to 9° F on 16 December 1989 and as low as -4° during an extended period from 17 to 28 December 1989 when the highest temperature reached was 41°. Grade 1 plants of each cultivar were harvested on 5 January 1990. At harvest, discoloration of the pith, xylem ray parenchyma and bud union tissue was assessed (Table 1). Additional plants were then potted in 2 gallon black plastic pots

using a bark:sand (4:1 by volume) media. Forcing was accomplished in a glasshouse at 60° F night temperature with venting and fan and pad cooling sequences starting at 70° during the day. At the end of the initial flush of growth, which was defined as either the opening of the first flower or the determination that all new shoots were blind, new growth was rated and measured (Table 2).

RESULTS AND DISCUSSION

Blaze exhibited minimal damage with only slight pith discoloration (Table 3). The total number of flowering shoots (TNFS) for Blaze was 5.5 per plant which is an expected number from a grade 1 plant (Table 4). Of the other cultivars, Gold Glow and Pink Peace exhibited pith, xylem, and bud union damage with up to 50% cane dieback, but produced more flowering shoots from the graft union than the other cultivars (Tables 3 and 4). However, only half the expected TNFS per plant were produced. The remaining cultivars also exhibited higher damage levels than Blaze which resulted in reduced shoot numbers and flowering. Only Blaze plants received an acceptable plant marketability rating (Table 4).

Pith, streak, and bud union ratings were negatively correlated with the number of nonbasal flowering shoots produced by freeze damaged plants in that more severe ratings were associated with a reduction in nonbasal flowering shoot production (Table 5). Also, the pith and streak ratings were correlated with the plant marketability rating indicating that more severe freeze damage ratings were associated with less marketable plants. However, these correlations were only significant between the 5 and 10% levels.

The data reveal that a visual rating of freeze damage in the field can be a strong indication of how rose plants will perform after harvest and marketing. This is certainly not surprising except that moderate pith discoloration alone, as seen with Blaze plants, did not appear to have an effect on subsequent plant growth. Thus, recommendations to remove all canes with pith discoloration need to be modified based upon other manifestations of freeze damage such as discoloration of the xylem ray parenchyma and bud union tissues. Also as expected, there were differences in tolerance of the various cultivars to freeze damage. Blaze exhibited the least damage while plants of Chicago Peace, Mister Lincoln, Queen Elizabeth, Don Juan, and Montezuma exhibited severe damage and poor regrowth. Gold Glow and Pink Peace

plants exhibited severe cane damage, but were able to regenerate flowering shoots from the graft union.

Table 1. Rating systems used to assess field freeze damage of rose plants prior to forcing.

Pith discoloration

1. No damage
2. Slight discoloration in middle of pith or along edge of pith
3. Moderate discoloration through pith
4. Dark throughout pith

Streaking^z

1. None
2. Slight - just barely detectable
3. Severe

Bud union discoloration^y

1. No discoloration
2. Slight - light brown color
3. Severe - dark brown to black

^zDiscoloration of xylem ray parenchyma cells in the canes.

^yDiscoloration in tissue located at the interface where callus and woody tissue meet.

Table 2. Ratings of growth on forced plants.

Cane dieback rating²

1.	0-10%	6.	51-60%
2.	11-20	7.	61-70
3.	21-30	8.	71-80
4.	31-40	9.	81-90
5.	41-50%	10.	91-100%

Plant marketability rating

1. No dieback with more than 3 flowering shoots.
2. No dieback with 1 to 3 flowering shoots.
3. 0 - 25% dieback with multiple flowering shoots.
4. 25 - 50% dieback with multiple flowering shoots.
5. 0 - 50% dieback with strong blind shoots that might be pinched and held longer to flower. May have 1 flowering shoot.
6. 0 - 50% dieback with all weak growth and blind shoots.
7. 50 - 75% dieback with 1 or more flowering shoots and strong basal shoots.
8. 50 - 75% dieback with no flowering shoots.
9. 75- 100% dieback with all blind shoots.
10. Plants are completely dead.

²Rated on a whole plant basis (if 3 primary canes, then each cane is worth 33%).

Table 3. Average freeze damage ratings prior to forcing.

Cultivar	Pith ^z	Streaking ^z	Bud Union ^z	Field Rating ^y
Chicago Peace	3.3 ab ^x	1.8 a	1.2	Bad
Gold Glow	2.7 bc	1.7 a	2.0	Bad
Mister Lincoln	2.9 abc	1.5 ab	2.4	Bad
Queen Elizabeth	3.4 a	1.8 a	1.6	Bad-Intermediate
Don Juan	2.6 c	1.4 abc	3.0	Intermediate
Montezuma	3.1 abc	1.6 ab	2.0	Intermediate-Good
Pink Peace	3.3 ab	1.2 bc	1.8	Good
Blaze	1.9 d	1.0 c	1.0	Good

^zSee Table 1 for explanation.

^yBased upon preliminary observations in the field prior to assigning individual ratings.

^xMeans within each column followed by the same letter are not significantly different at the 5% level by Duncan's Multiple Range Test.

Table 4. Growth and ratings of forced plants assessed after the first flush of growth.

Cultivar	Number of Basal Flowering Shoots	Number of Nonbasal Flowering Shoots	Total Number of Flowering Shoots	Total Number of Blind Shoots	Cane ^z Dieback Rating	Plant ^z Marketability Rating	Days to Force Out
Chicago Peace	0.6 bc ^y	0.8 cde	1.4 c	1.8 c	6.6 a	6.9 a	18 b
Gold Glow	1.2 a	1.8 b	3.0 b	0.4 d	5.3 ab	5.2 bc	16 b
Mister Lincoln	0.4 cd	0.4 de	0.8 c	2.8 bc	5.5 ab	6.1 ab	23 a
Queen Elizabeth	0.1 d	0.9 cde	1.0 c	5.2 a	3.0 c	4.7 c	17 b
Don Juan	0.3 cd	0.3 e	0.6 c	2.0 bc	5.0 ab	6.3 ab	17 b
Montezuma	0.04 d	1.0 bcd	1.1 c	3.2 b	3.9 bc	5.1 bc	21 a
Pink Peace	0.9 ab	1.6 bc	2.5 b	2.4 bc	5.0 ab	5.2 bc	18 b
Blaze	0.2 cd	5.3 a	5.5 a	2.0 bc	1.0	2.2 d	18 b

^zSee Table 2 for explanation.

^yMeans within each column followed by the same letter are not significantly different at the 5% level by Duncan's Multiple Range Test.

Table 5. Correlations of freeze damage ratings with plant growth.

	Pith Rating	Streak Rating	Bud Union Rating	Cane Dieback Rating
Cane Dieback Rating	NS	NS	NS	--
Plant Marketability Rating	0.618 ^z 0.10 ^y	0.617 0.10	NS	0.940 0.0005
# Basal Flowering Shoots	NS	NS	NS	NS
# Nonbasal Flowering Shoots	-0.684 0.06	-0.644 0.08	-0.662 0.07	-0.729 0.04
Total # Flowering Shoots	-0.631 0.09	-0.606 0.11	-0.628 0.10	NS

^zPearson Correlation Coefficients (r).

^yProbability > |r|. NS = nonsignificant.