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Single Stem Rose Research at the University Of Kentucky

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Summary

Commercial quality cut roses were produced in a single stem production system from single node cuttings. Through seven sequential crops of rose cuttings grown from February through May 1995, rooting required a mean of 16 days, flower buds were visible in 42 days and flower harvest required a mean of 58 days. Approximately 1900 rose cuttings in seven sequential crops were followed individually from 7500 cuttings grown from December 1994 through May 1995. Over 70% of the cut stems harvested from these cuttings were 46 to 75 cm long. Longer stem roses had significantly more nodes and grew from lower, older nodes than shorter rose stems. Longer stem roses required significantly more days to flower harvest because the number of days to axillary bud break was longer than for shorter rose stems. Axillary buds began to grow before rooting in shorter stems and began to grow a mean of 8 days after rooting in the longest rose stems.

The numbers of days for rooting, days from axillary bud break to visible bud and days from visible bud to flower harvest were similar in longer and shorter rose stems. Single node cuttings from cut stems of 'Lady Diana' rose were characterized by the location of the node of origin, in numerical sequence from the flower, and initial stem size, large (thick stems, long length, many nodes), moderate (moderate thickness, moderate length and node number) and small (generally not commercial quality). The initial node of origin was significantly correlated to the final stem length of the single stem rose. The number of days to rooting was not affected by the initial node of origin of the cutting. The correlation with initial stem size had variable results.

Twenty-four inch (60 cm) stems of 'Lady Diana' rose, grown in 2 ½ inch (6.5 cm) pots, just before harvest.

Cutting Yield from Rose Stock Plants

Two and three year old, own-rooted, 'Lady Diana' rose plants were used as stock plants for cuttings. Plants were grown in 6 L of growing medium (soil, peat, vermiculite, perlite, 1:5:2:2, by volume) in plastic containers. Plants were grown in a glass greenhouse, 62F

(16C) heating set point and 75F (24C) ventilation set point, and received supplemental high pressure sodium lighting at 60 : moles m^{-2} sec^{-1}, 2000HR to 800 HR each day. Plants were irrigated and fertilized 3 to 7 times per week with 200 ppm 15-5-15-5Ca-2Mg (Scotts Excel CalMag fertilizer, Maryville OH). Double rows of plants were placed on benches with 30 cm in row spacing, 45 cm row spacing and 60 cm aisles.

All rose stems were harvested at the standard harvest stage to determine the potential number of cuttings that could be produced over time. Stems were harvested two to three times per week from week 50 1994 to week 22 1995. The stems were graded as small (generally not salable commercially), medium (short and medium commercial grades) and large (fancy and extra fancy commercial grades). Over 1900 stems and 9950 cuttings were harvested during the 24-week period from 105 rose plants (Table 1). Rose plants produced nearly 30 cuttings per plant per week when all harvested stems were used as cutting stock.

Over 40% of the harvested stems were too small for commercial use. While these stems yielded the lowest number of cuttings per stem, the small stems accounted for one-third of the cuttings harvested. The higher number of cuttings per stem on the medium and large stems compensated for the lower stem numbers harvested each week.

Table 1. The number of harvested rose stems and number of potential cuttings from 'Lady Diana' rose stock plants from December 1994 to June 1995.

Grades of stock rose stems harvested for cuttings	Mean number of stems harvested each week	Mean number of cuttings harvested from each stem	Mean number of cuttings produced each week per plant
Small	30.2	4.6	27.9
Medium	22.7	6.0	27.3
Large	16.1	9.3	29.6

Rose Production Procedures

The phenology of single stem rose production and the resultant rose stem quality was studied with seven sequential crops of single stem roses. A portion of the cuttings harvested each week from the 'Lady Diana' stock plants were grown to flower from week 8 to week 20 1995. Cuttings were started FEB23 (Julian day 54), FEB27 (58), MAR6 (65), MAR15 (74), MAR23 (82), MAR31 (90), and APR7 (97) in 1995. All cuttings, 1904 in total, were numbered individually, identified by crop date and by the origin node number from the original small, medium or large stem from which it was harvested. The dates of rooting, growth of the axillary bud, visible flower bud, and flower harvest were recorded. Stem length (from the point of origin on the cutting to the top of flower) and node number were recorded for each stem at harvest.

Cuttings consisted of a 4-5 cm stem segment with a leaf and axillary bud, most cuttings had a five-leaflet leaf, but cuttings with three or seven leaflets were also included. The lower 1 cm of the cuttings received a five second dip in 1000-ppm IBA/500 ppm NAA rooting hormone (Dip 'N' Grow, Astoria-Pacific, Inc., Clackamas OR). Cuttings were placed immediately into Scotts MetroMix 360C (Maryville OH) in pots (FEB23 - 10 cm square, 550 ml volume [T&O Plastics, Inc. Minneapolis MN]; FEB27, MAR6 & MAR15 - 7 cm round, 120 ml volume [OS Plastics, Marietta GA]; MAR23, MAR31 & APR7 - 7.5 cm square, 290 ml volume [T&O Plastics, Inc.]). Pots were spaced pot-to-pot on a bench with intermittent mist for four seconds each six minutes for 24 hr per day. Pots were in contact with a hydronic bottom heat system with water temperature

of 27C for the 16-21 days of production stage 1.

The rooting date was determined by handling each cutting to determine that it could not be removed from the growing medium easily. Rooted cuttings were moved to double polyethylene greenhouses with a set point of 20C day / 14C night (FEB23, FEB27, MAR6) or 23C day / 17C night (MAR15, MAR23, MAR31, APR7) for production stage 2. Plants were spaced pot-to-pot and sub irrigated on ebb-flood (FEB23, MAR23, MAR31, APR7) or capillary mat benches (FEB27, MAR6, MAR15) with 150 ppm 15-5-15-5Ca-2Mg fertilizer (Scotts Excel, Maryville OH). Plants received 12 hr of supplemental light (1800-600HR) at 80-100 : moles m^{-2} sec^{-1} until the flower buds were pea-sized.

For production stage 3, the small rose plants with pea-sized buds, 30-35 cm tall, were moved to additional benches in the same greenhouse where the plants received ambient light only. Irrigation and fertilizer practices were continued until flower opening and harvest.

Developmental Stages of Single Stem Rose Crops

Single stem rose production practices were continuously evaluated during the spring of 1995. Five of the seven sequential crops of roses had a satisfactory performance (Table 2). The rooting percentages increased, the amount of flower abortion decreased and the percent of stems harvested in flower increased during the spring as production techniques were refined and improved. Two crops (FEB27 and MAR6) had relatively high percentages of flower abortion thus data from these crops will not be presented.

Table 2. General performance of seven sequential single stem crops of 'Lady Diana' roses.

	Crop date						
	FEB23	FEB27	MAR6	MAR15	MAR23	MAR31	APR7
Number of cuttings per crop	232	312	285	456	216	108	145
Percent dead during rooting	5%	19	5	15	1	0	0
Percent whose flower buds aborted	12%	42	31	14	4	6	3
Percent harvested in flower	83%	40	64	71	95	94	97

Single stem production of five crops of roses required a mean time of approximately 55 days. The time for rooting and the time from visible bud to flowering were nearly equal at an overall mean of approximately 16 days. The stage from rooting to the appearance of the flower buds required a mean of approximately 23 days. The time for rooting was much less variable than the other stages of production (Table 3). There was a relatively large standard error (six to eight days) for the cuttings to initiate growth of the axillary bud, for the cuttings to have a visible flower bud and for flowering to occur. This variation led to flower harvest over an approximately 30-day period for each crop (Figure 1). Cut rose harvest overlapped significantly in the production cycle of the seven weekly rose crops. The period for flower harvest decreased as the spring progressed.

Table 3. Production stages, in days ("standard error), for five crops of single stem 'Lady Diana' roses.					
	Crop date				
	FEB23	MAR15	MAR23	MAR31	APR7
Days to rooting	15.9 " 1.6	18.3 " 4.3	15.8 " 1.6	17.1 " 3.8	16.0 " 0.0
Days to axillary bud break	18.2 " 5.8	20.8 " 7.7	19.0 " 5.6	18.9 " 7.6	15.2 " 6.3
Days to visible flower bud	41.2 " 7.3	40.9 " 7.2	35.9 " 7.4	36.9 " 8.3	35.8 " 6.0
Days to harvest	62.3 " 7.5	55.7 " 7.8	51.4 " 7.9	52.2 " 7.7	50.6 " 5.2

The length of the production stages were compared based on stem length grades for three rose crops (Table 4). The numbers of days for rooting, number of days from axillary bud break to visible bud and number of days from visible bud to flowering were relatively similar for all stem length grades. Production stages 2 and 3 required four to seven days longer for FEB23 because this crop was grown at cooler temperatures. The total days to flowering increased significantly with increased harvested stem length grades. This increase in the time for flowering can be explained by the differences in time required for axillary bud break of the cuttings. Cuttings destined to be shorter harvested stems had axillary bud break before rooting was completed (Figure 2). On the other hand, axillary bud break occurred 4 to 9 days after rooting in those cuttings destined to be long stems.

The size of the stock stem had no clear effect on the production stages of single stem roses (Table 5). The percentage of cuttings that rooted and the number of days to rooting were similar between cuttings from small, medium or large stems. Likewise, the variations in the percent of stems that were harvested in flower were not significantly different. There was a trend for cuttings from larger stems to require more time to flower.

Table 4. Production stages for harvested 'Lady Diana' single stem roses that were graded into standard stem length grades.

Stem length grades	Number of stems harvested	Mean number of days for:			
		Rooting	Axillary bud break to visible bud	Visible bud to flowering	Flowering
FEB23					
<36 cm	18	17.1	27.0	19.3	59.7
36-45 cm	11	16.9	25.5	19.3	59.7
46-55 cm	55	15.5	22.2	21.0	59.0
56-65 cm	54	15.5	22.4	21.5	63.8
66-75 cm	22	15.0	25.5	21.1	69.8
MAR23					
<36 cm	13	16.5	16.0	15.7	47.3
36-45 cm	14	16.4	15.0	14.6	43.1
46-55 cm	73	15.7	15.5	14.5	45.1
56-65 cm	56	15.6	17.2	15.5	54.1
66-75 cm	57	15.6	18.5	16.1	58.9
MAR31					
<36 cm	8	17.6	21.2	16.0	45.8
36-45 cm	13	21.7	16.8	16.1	49.6
46-55 cm	29	16.9	17.3	15.4	49.7
56-65 cm	33	16.3	17.4	15.2	54.6
66-75 cm	19	15.2	18.3	14.5	56.6

Table 5. Effect of size of origin stem on performance of single stem 'Lady Diana' roses.						
	Size of origin stem	Crop date				
		FEB23	MAR15	MAR23	MAR31	APR7
Cuttings harvested in each crop	Small	26	21			
	Medium	62	324	178	34	82
	Large	144	111	38	74	63
Percent rooted	Small	88 %	100 %			
	Medium	94 %	85 %	98 %	100 %	100 %
	Large	97 %	81 %	100 %	100 %	100 %
Percent harvested in flower	Small	54 %	86 %			
	Medium	76 %	72 %	94 %	91 %	98 %
	Large	91 %	62 %	95 %	96 %	97 %
Days to rooting	Small	17	18			
	Medium	16	18	16	17	16
	Large	16	19	16	17	16
Days to flower harvest	Small	62	53			
	Medium	60	55	50	50	50
	Large	63	57	56	53	51

Characteristics and Quality of Cut Rose Stems

The quality of cut rose stems is the most important criteria to determine the success of a single stem rose system. The mean stem length and node number for all cut rose stems from the five rose crops was 53.6 cm and 13.8, respectively, and there were small differences between the means for the five crops (Table 6).

Table 6. Mean stem length and node number of five crops of single stem 'Lady Diana' roses.					
	Crop date				
	FEB23	MAR15	MAR23	MAR31	APR7
Mean stem length (cm)	53.1	50.0	58.1	54.8	55.5
Mean node number	12.7	13.1	14.7	14.7	14

The mean stem length of cut rose stems from a single stem production system is important but the number of stems that occurred in the standard stem length grades is equally important. Less than 20% of the roses were graded in the short or non-commercial grades in the crops initiated on FEB23, MAR23 and MAR31 (Figure 3). A significant number, 14% to 26%, fell in the extra fancy stem length grade of 66-75 cm with the remaining 60% to 70% in the medium and fancy grades. Although data on stem weight and flower size were not collected, the stems in the top three stem length grades met commercial standards for flower size and stem strength.

Stem length at harvest was significantly different between the small, medium and large origin stems (Table 7). However, the node number at harvest was not significantly different between the original stem grades. The trend was to have more nodes for cuttings that came from larger stock stems.

Trend analysis demonstrated that the initial node of origin was significantly correlated to the stem length and node number of the single stem roses at harvest. Older initial nodes, furthest from the flower, produced longer stems with more nodes than initial nodes from near the flower of the stock stem (Figures 4 and 5). This relationship is much clearer when the initial node for graded rose stems was analyzed. The initial node number of harvested rose stems increased significantly as the stem length grades increased from short to long stem roses (Table 8).

Table 7. Effect of origin stem on stem length and node number of single stem 'Lady Diana' roses.

	Size of origin stem	Crop Date				
		FEB23	MAR15	MAR23	MAR31	APR7
Stem length at harvest (cm)	Small	46	47			
	Medium	46	49	57	50	54
	Large	56	55	63	57	58
Mean node number at harvest	Small	12	12			
	Medium	12	13	14	13	13
	Large	13	15	16	15	15

The node number of harvested rose stems was also correlated to the stem length. Longer rose stems had significantly more nodes than shorter rose stems (Figure 6).

Table 8. Mean initial node number for the cuttings that resulted in cut 'Lady Diana' rose stems that were graded into standard stem length grades.

Stem length grades	Crop Date				
	FEB23	MAR15	MAR23	MAR31	APR7
36-45 cm	6.7	7.3	7.9	7.9	5.8
46-55 cm	7.7	6.6	7.4	11.3	8.2
56-65 cm	10.1	8.1	9.7	9.9	9.7
66-75 cm	11.5	10.3	10.1	10.5	9.3

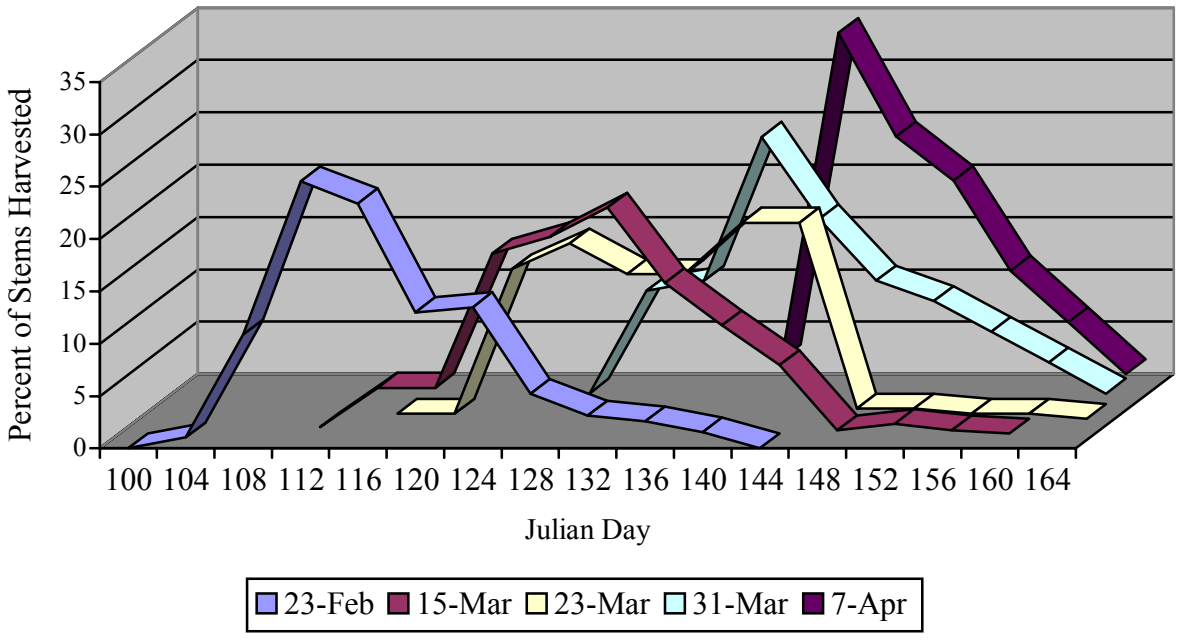

Figure 1. Frequency of harvested single stem roses from five 'Lady Diana' rose crops started on Julian day 54 (FEB23), 74 (MAR15), 82 (MAR23), 90 (MAR31) and 97 (APR7).

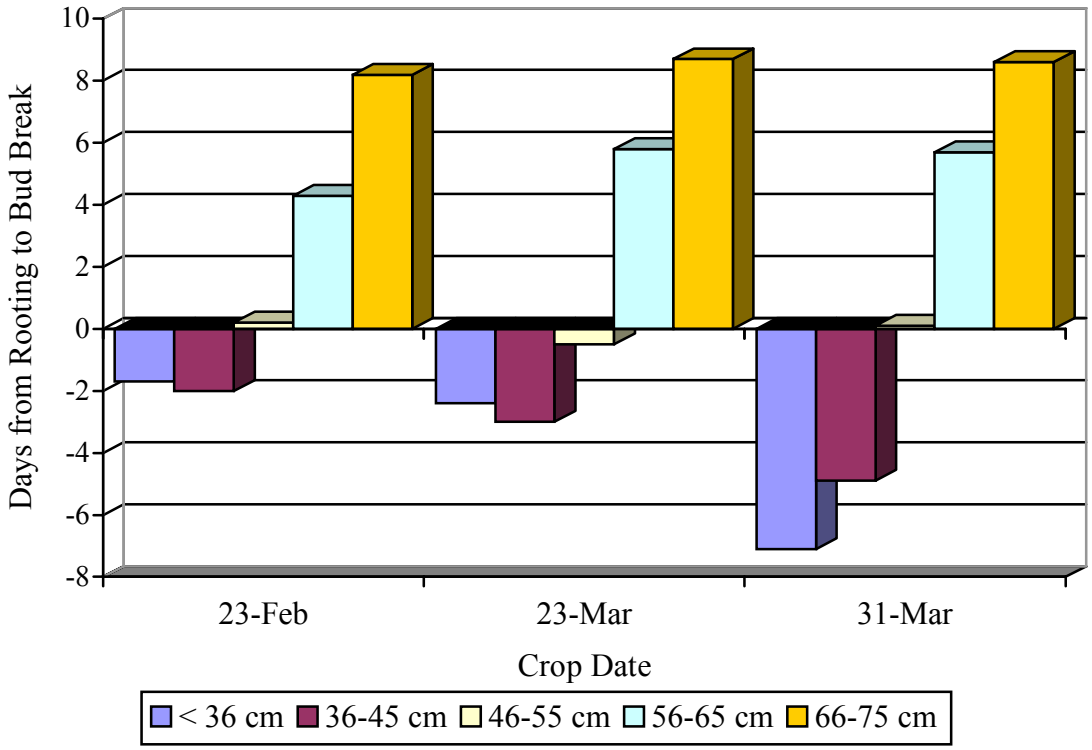

Figure 2. The difference, in number of days, between the time of rooting and the time of axillary bud break for stem length grades of selected crops of single stem 'Lady Diana' roses.

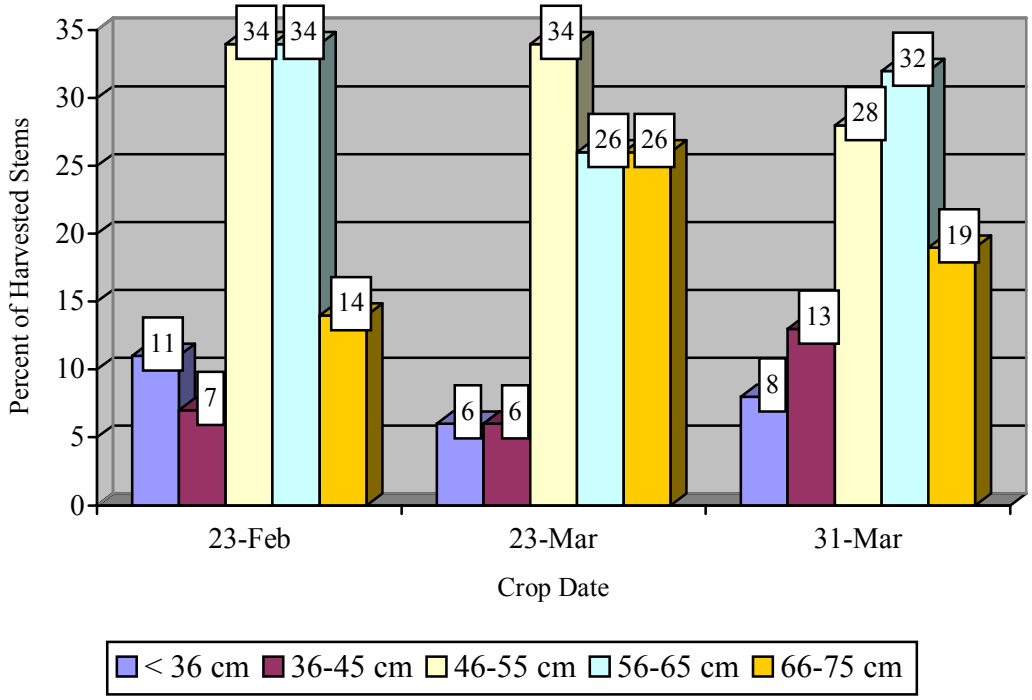

Figure 3. Percent of harvested 'Lady Diana' rose stems that were graded into standard stem length grades from single stem rose crops initiated on selected crops.

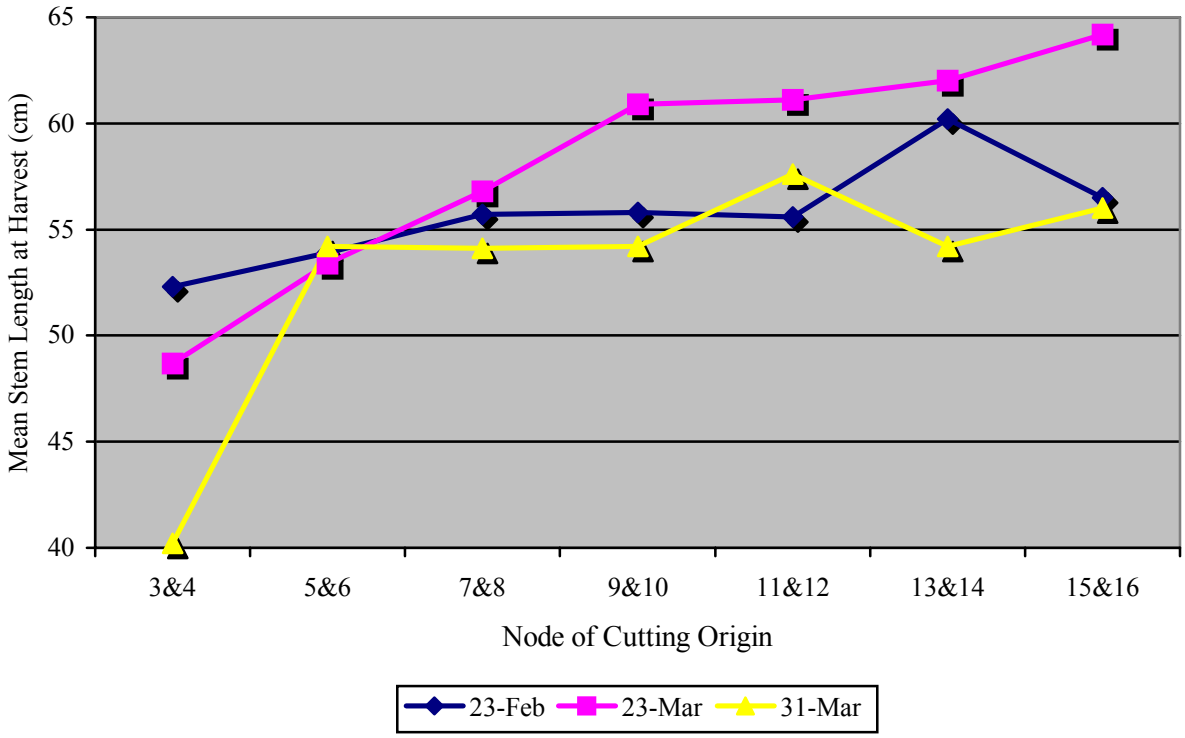

Figure 4. Effect of the original node position (3&4, proximal to flower, 15&16, distal to flower) on the stem length of single stem 'Lady Diana' roses at harvest.

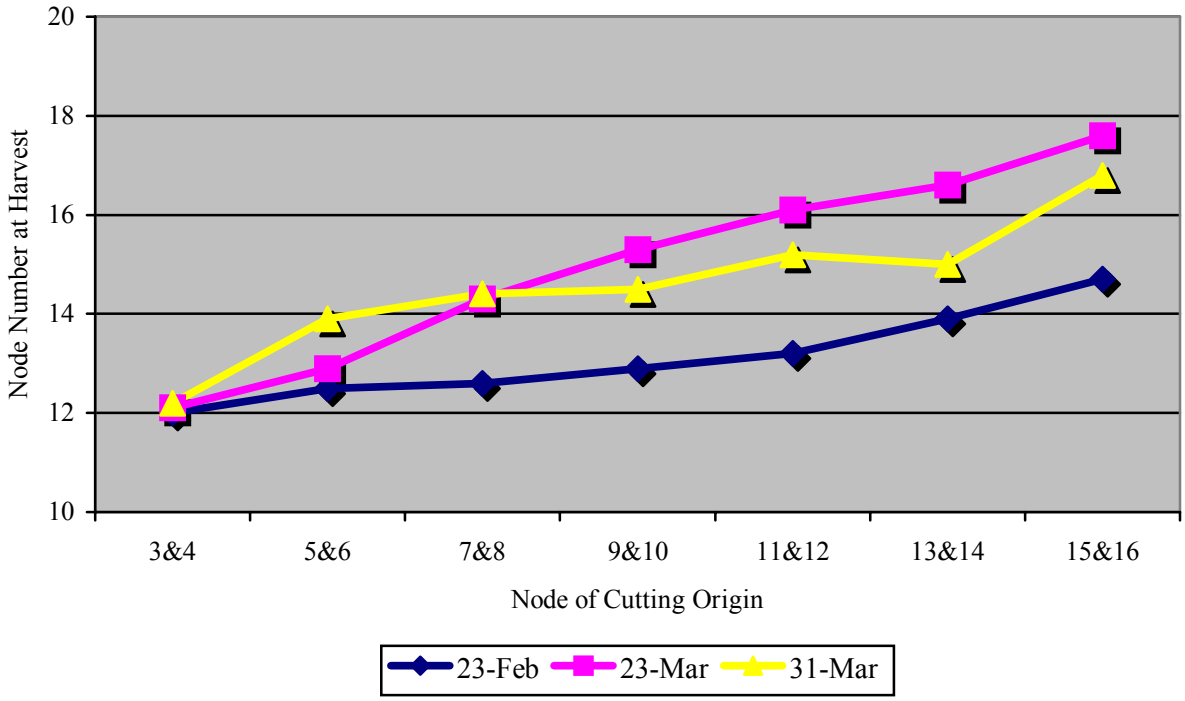

Figure 5. Effect of the original node position (3&4, proximal to flower, 15&16, distal to flower) on the final node number of harvested single stem 'Lady Diana' roses.

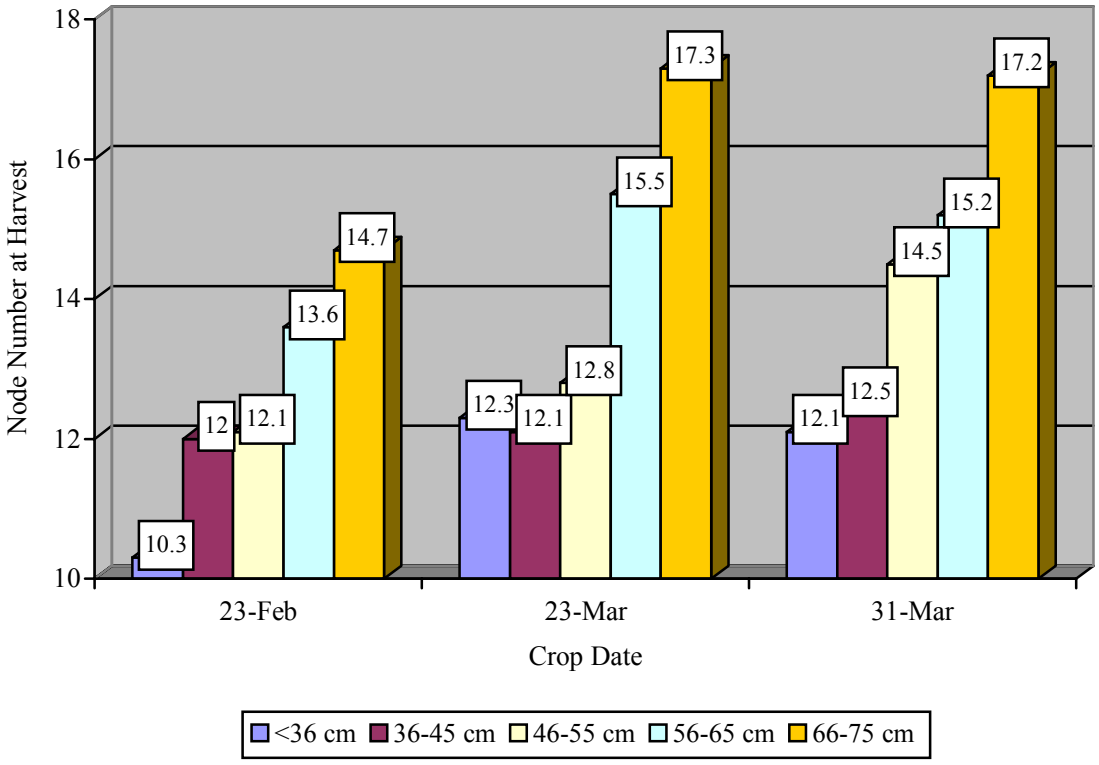

Figure 6. The node number, at harvest, of stem length grades of single stem 'Lady Diana' roses.