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PHYSIOLOGICAL STUDIES ON FLOWERS OPENING AND KEEPING QUALITY OF ROSE, CARNATION AND GLADIOLUS.

Magda M. El – Saka
Post-harvest lab, Floriculture Dept. Hort. Res. Inst.

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ABSTRACT: Three kinds of cut flowers {*Rosa hybarids* L. cv "Carmen" , *Dianthus Caryophyllus* L. cv " Lila Flavio" and *Gladiolus hybrids* Linn cv "Oscar"} were used in this study. The flowers were labeled on mother plants and that were harvested at tight bud stage. The opening solution for rose flowers was florissant 600 + sucrose, carnation flowers was florissant 100 + sucrose + citric acid and gladiolus flowers was chrysal + sucrose + citric acid. Flowers life and quality after holding in the opening solution directly surpassed as compared with stored flowers then holded in opening solution and flowers left on mother plants, respectively in all flowers under study. Stored flowers accelerated flowers opening than other treatments. Cytokinin level decreased during flower development from tight bud to wilting stage. But ABA level increased progressively with the age of flowers. Gibberelline level showed highest level as compared to other phytohormones under discussion. ABA induced ethylene production during flowers opening. The ethylene production increased then decreased with flowers wilting.

INTRODUCTION

The postharvest life of flowers includes a period during flowers opening from the buds.

Techniques for handling cut flowers may include bud harvest, storage and understanding of the physiology and the mechanisms of bud opening.

Many species of cut flowers are harvested before they are fully opened. There are several advantages to harvesting in buds stage : I Satisfactory quality and long display time of flowers. II reduction of production time, damage during handling and transport and shipping costs. III Buds are less sensitive to ethylene action and production (Reid and Evans, 1986)..

The cut flower no longer receives the sap, i.e. the dissolved nutritive elements as soon as separated from the mother plant. Thus the flower has to depend entirely on its own reserves, in particular sugar which is quickly exhausted. The consumption of sugar is a general phenomenon due to cellular oxidations, since sugar is a source of energy for the flower. (Paulin, 1986).

The plant growth regulators have marked effects on opening of cut flowers. Gibberellins might be expected to affect flowers where opening involves growth of petals or subtending tissues. GA_3 increased the number of open flowers on stalks of statice (Steinitz and Cohen, 1982) and bird-of-paradise (El-Saka *et al*, 1994). GA_3 increased growth, flower dry weight and petal size in carnations (Cywinska *et al*, 1978) Flowers exhibit varying degrees of sensitivity to ethylene. Ethylene is known to prevent opening of carnation buds, causing sleeping symptom and floret abscission in snapdragon and tuberose.

In spite of increased literature on extending flowers longevity and flowers senescence, little is known about process of flower opening after harvest at bud stage. The present study is a trial to understand the physiology of flower opening, keeping quality of roses, carnation and gladiolus and relationship between flowers opening and phytohormones , ethylene and carbohydrate contents in flowers on the mother plant or in vase solution.

MATERIALS AND METHODS

This study was carried out at Horticultural Research Institute, Giza for two successive seasons. Three kinds of cut flowers were used. Flowers were purchased from a commercial farm. Uniform flowers were harvested in the early morning. Precooling of flowers were performed by placing them in ice cold water for three hours. After that, flowers were prepared to begin experiments.

The experiments were conducted under Lab conditions (24hr fluorescent light at 1000 Lux, 18 ± 2 °C and 50-60% RH). Flowers were always held in distilled water (D.W) 300 ml per jar (500 ml). D.W was used for the preparation of opening solutions. Each treatment had five replicates with five flowers per replicate.

I. Flowers:

1-Roses (*Rosa hybrids*, L.)cv "Carmen" belongs to family *Roseaceae*. The flowers were harvested at tight bud stage (when color of petals just visible). Flower stems were 60 cm long with the same number of leaves. The experiment was conducted in the middle of November during the seasons of 1998 and 1999.

2.Carnation (*Dianthus caryophyllus* L.) cv "Lila Flavio" belongs to family *Caryophyllaceae* . The uniform flowers were harvested at cross stage (when petals just began to appear on the upper position). Flower stems were 40 cm long with the same number of leaves. The experiment was conducted on the first of January during the seasons of 1998-1999.

3.Gladiolus (*Gladiolus hybrids*, Linn)cv "Oscar"belongs to family *Iridaceae*. Uniform flowers were harvested when the color was just began to be visible at the bottom of first floret. Flower stems were 80 cm long with the same number of leaves. This experiment was conducted on the first of December1999 and 2000 seasons.

II. Treatments:

A.On mother plant, some groups of buds at bud stage were labeled and observed during the whole life until senescence. (control).

B. Other groups were harvested at the same bud stage, then divided to two groups :

* The first group was directly hold in opening solution(Table A) for 48 hr. Then transferred into D.w. to complet shelf life.

*The second group was packaged in polyethylene film (30 micron thickness) then packed in boxes, after that the boxes were stored at 0-2 °C for two weeks. At the end of storage period, flowers were hold in opening solution as mentioned above.

III. Measurements:

1- Days required from tight bud to fully open flowers or as percentage to control. (on mother plant).

2-Flower life in days or as percentage to control .

Table A : The opening solution for flowers

Flowers	Composition of opening solution.	P^H
Rose	Florissant 600 (Aluminum sulphate and wetting agent) + 20g / L sucrose.	3.5
Carnation	Florissant 100 (silver thiosulfate) 70g/L. sucrose + 200 mg / L citric acid.	4.5
Gladiolus	Chrysal (8-HQC) + 30g / L sucrose + 200 mg / L citric acid	3.8

3.Phytohormones were determined at three stages tight bud, fully open and beginning of welting during vase life. They were determined according to Shindy and Smith (1975) and modified by Tawfick and Habib (1988).

4.Ethylene production from flower head was determined according to Mayak *et al* (1972).

5.Carbohydrate contents in petals during flowers opening from maturity bud (every two days for rose and carnation and every three days for gladiolus) on each of the mother plant and vase. They were determined according to A.O.A.C (1984).

IV. Statistics:

The simple experimental design was used. Treatments of different conditions of flower bud development was arranged as completely randomized block. For each type of used flower. According to Thomas and Hill (1978) analysis of variance ($P \leq 0.05$). The treatment means were compared using L.S.D at 5%.

RESULTS AND DISCUSSION

1-Effect of different conditions on flower bud development and flower life:

It was observed that, The flowers on mother plant required more days to complet development from bud stage to fully open stage as compared to flowers development after holding in opening solution. However, stored flowers required the least number of days to reach fully open as compared to other treatments, in all flowers under study (Table 1)

Flower life was increased when the flowers were hold in opening solution as compared with those opened naturally on mother plants and those stored flowers then opened in opening solution. Similar trends were observed in roses, carnation and gladiolus (Table 2)

these studies showed that, fresh flowers development in sucrose solution had long-life and high quality as compared with flowers left on mother plant or flowers stored then opened in vase solution. The considerable dry matter gained which occured during the opening of buds and reach fully open flowers, underline the flower need for a supply of carbohydrate to maintain the level of natural carbohydrate in flower tissues.

Table 1 : Days required from tight bud to fully open flowers in each of rose, carnation and gladiolus flowers, during the two seasons.

Treatments	Rose				Carnation				Gladiolus			
	1998		1999		1998		1999		1999		2000	
	Days	%	Days	%	Days	%	Days	%	Days	%	Days	%
Flowers open on mother plant.	6.0	100	6.2	100	9.0	100	10.0	100	15.0	100	16.0	100
Flowers open in opening solution.	4.3	71.6	3.5	56.4	8.3	92.2	7.5	75.0	13.5	90	14.3	89.3
Flowers were stored then open in opening solution.	2.8	46.6	3.1	50.0	6.3	66.6	6.8	68.0	10.5	70	9.7	60.6
L.S.D. at 5 %	0.9	---	1.3	---	1.6	---	1.8	---	2.7	---	3.2	---

Table 2: Flower life (days or as%), in each of rose, carnation and gladiolus flowers, during the two seasons.

Treatments	Rose				Carnation				Gladiodus			
	1998		1999		1998		1999		1999		2000	
	Days	%	Days	%	Days	%	Days	%	Days	%	Days	%
Flowers open on mother plant.	14.2	10.0	13.5	100	8.0	100	8.1	100	16.0	100	15.7	100
Flowers open in opening solution.	16.5	116.2	16.3	120.7	14.5	181.3	15.8	195.0	20.0	125	21.5	136.9
Flowers were stored then open in opening solution.	15.3	107.7	15.0	111.1	12.5	156.2	13.5	166.6	17.0	106.2	18.5	117.8
L.S.D. at 5 %	1.5	---	N.S	---	3.2	---	3.6	---	3.4	---	3.5	--

2-Phytohormones:

It is pointed out from Table 3 that ,the endogenous level of cytokinin decreased during flower development from tight bud to beginning of wilting respectively, in all flowers of roses, carnation and gladiolus. Similar trend was observed with gibberellins in both of rose and carnation flowers and also auxins in all kinds of flowers used. In case of gladiolus flowers, the gibberellins increased during bud development from tight bud to fully open stage then decreased at the beginning of wilting stage. In the same time, gibberelline content showed highest level when compared with other phytohormones under study. These results are in agreement with El-Saka (1992).

The results showed the decrease in cytokinins, GA_3 and auxins with bud development up to wilting stage. This is in agreement with Mayak and Halevy (1970) who showed that ,the level of cytokinin in rose petals decreased as the flowers aged and the level was lower in a short life cultivars than in a long-life cultivars.

The hormonal regulation of a physiological process may be accomplished by a proportionate mechanism. Thus, the process is enhanced as concentration increased and diminished as the concentration drop. Accordingly, the changes in plant hormone concentration may be interpreted as being signal controlling the processes (Halevy and Mayak, 1981).

The results under discussion pointed out that, ABA level increased during development of bud opening untile wilting stage. This agreed with Mayak *et al* (1972). They mentioned that endogenous level of ABA increased in roses with petals senescence.

3- Ethylene:

Data in figure 1 indicated, general, that ethylene production by roses, carnations and gladiolus flowers increased with the progressive from tight bud to fully open flowers, then began to decrease until wilting stage. Also it was observed that, the rate of ethylene production from gladiolus was higher than that produced from roses and carnation flowers ,in all cases.

This is in agreement many investigators. Ichimura *et al* (1998) found that, in *Eustoma grandiflorum*, ethylene production of flowers increased with flower

Table 3 : Phytohormones contents (μ /100 g dry wieght) of petals as attributed to different open stage in rose, carnation and gladiolus flowers.

Open stage	Cytokinin	Gibberellins	Auxin	ABA
	Rose			
Tight bud	260	600	320	65
Fully open	188	411	220	108
Beginning of wilting	108	240	112	158
	Carnation			
Tight bud	290	713	278	23
Fully open	159	585	215	85
Beginning of wilting	120	205	165	115
	Gladiolus			
Tight bud	353	788	323	45
Fully open	315	862	195	93
Beginning of wilting	250	515	153	136

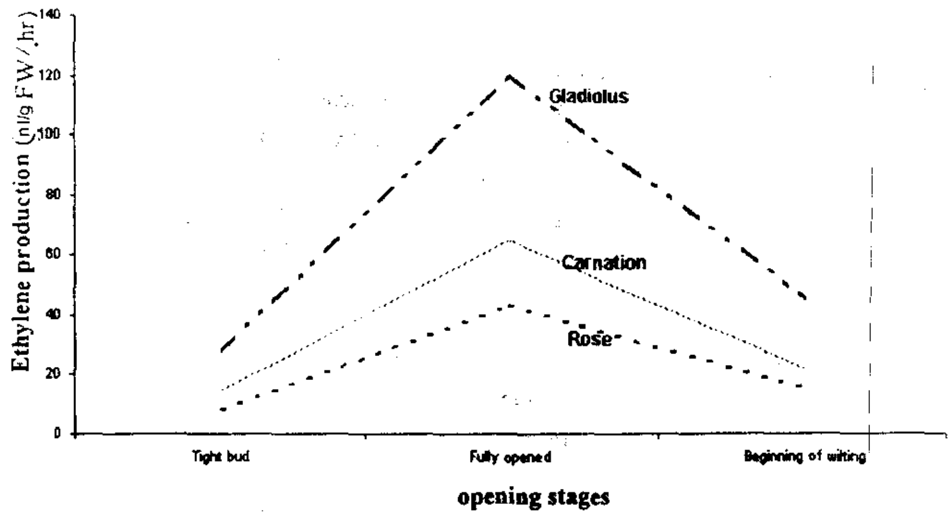

Fig. 1: Ethylene production from rose, carnation and gladiolus as attributed to different opening stages .

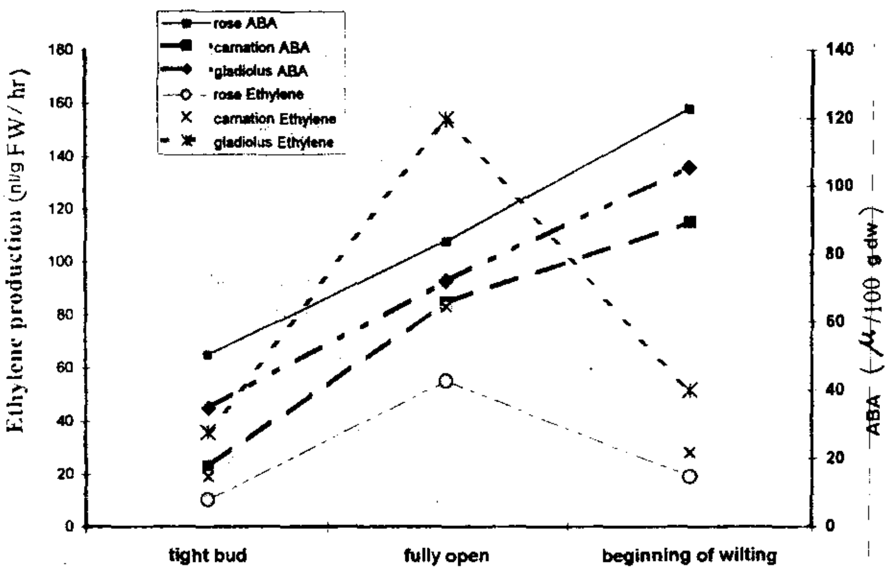

Fig. 2: The relationship between ABA & Ethylene production from head of flowers

senescence. Also, Van Altvorst and Bovy (1995) demonstrated that, the biochemical changes associated with petales senescence include a climacteric-like increase in ethylene production and that ethylene plays a critical role in the regulation and coordination of senescence processes.

Another explanation was mentioned by Onoue *et al* (2000) that, ABA plays a crucial role in the induction of ethylene production during natural senescence in carnation flowers. This is in agreement with results under discussion in Figure 2.

4- Carbohydrate content:

Date in Figure 3 the contents of carbohydrate (starch, glucose, fructose and sucrose) were measured during development flowers opening from maturity bud stage (sepals starting to reflex in rose flowers, paintbrush in carnation flowers and 2-3 floret color on gladiolus flowers) on mother plants or in vase solution illustrate that: starch content decreased rapidly during opening in vase, while it remained at more level during flowers opening on mother plant. Glucose content increased during flowers opening on mother plant, while its values remained relatively low in flowers opening in vase. Fructose content increased and showed nearly double concentration of glucose during flowers opening on the mother plant. Also fructose increased during flowers opening in vase, but it did not reach similar level as that in flowers opening on mother plants. Sucrose content was always low. Sucrose content in petals during flowers opening on mother plant was slightly higher than that of the flowers opened in vase.

During flower development in vase only, the fructose level increased, but other carbohydrate fractions decreased or remained at the same level. However, suger contents increased during opening on the mother plant , this may be correlated with the increase of osmotic value during opening. This agreed with Marissen (1991).On the other hand , Ichimura and Hisamatsu (1999)found that, glucose, fructose and sucrose concentrations in petals of snapdragon decreased after one day from harvest and remained at low levels, but sucrose treatment suppressed the decrease in these kinds of sugar. Adding sucrose to solution promoted bud opening, improved flowers quality,

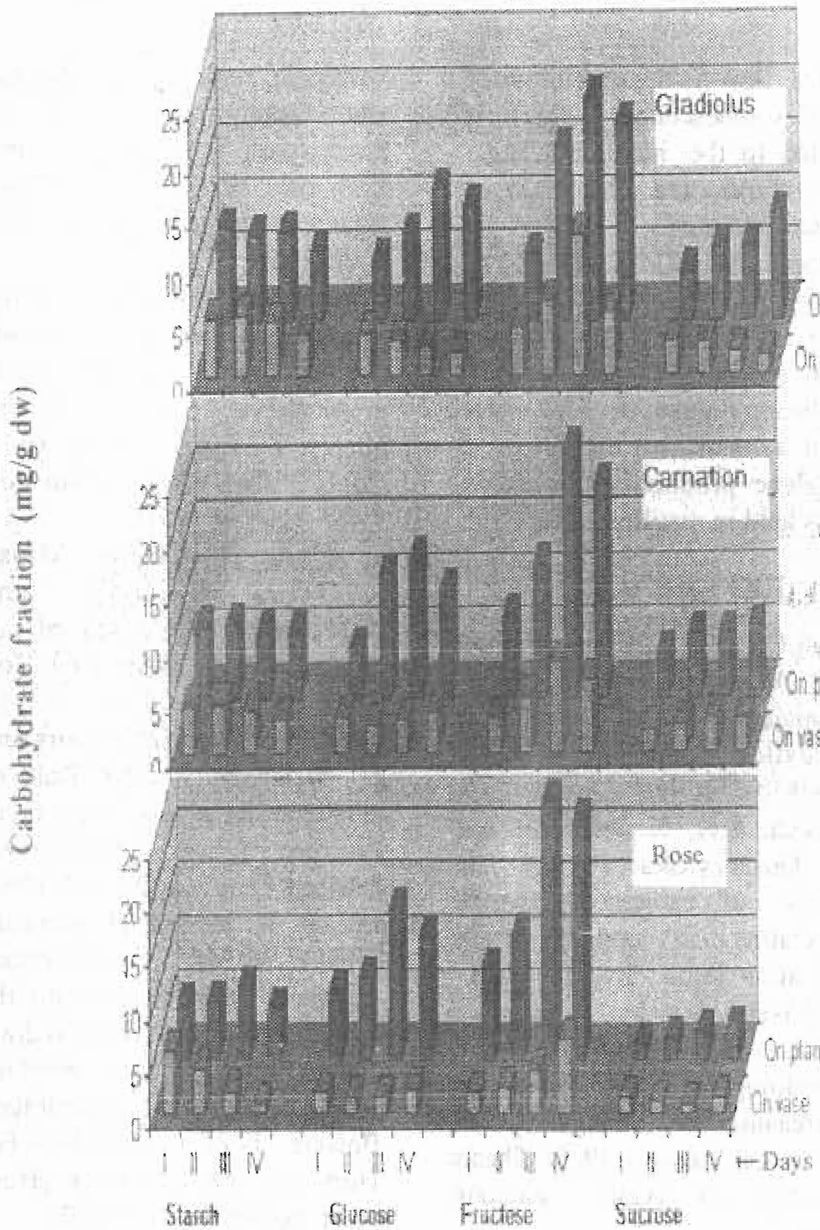

Fig. 3 : Carbohydrate fraction (mg/g dw) of rose and carnation (every tow days) and gladiolus(every 3 days) from maturity of bud stage on mother plant or in vase solution

extended flowers life and inhibited flowers senescence, this is attributed to the increase in sugar concentrations and inhibition of ethylene synthesis. This is in agreement with EL-Saka (1996) on bird-of- paradise and gladiolus flowers, who found that, flowers held in sucrose solution for 24 hr then placing them in distilled water showed a continuous little increase in ethylene production more than flowers held in distilled water.

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دراسات فسيولوجية على تفتح وحفظ جودة أزهار الورد والقرنفل والجلاديوس

ماجدة مصطفى السقا

معهد بحوث البساتين - قسم بحوث الزينة - معمل تداول الزينة

أجري هذا البحث بمعهد بحوث البساتين بالجيزة . شملت الدراسة ثلاثة أنواع من النباتات المزهرة خلال موسمين متتاليين؛ الورد صنف كارمن (١٩٩٨-١٩٩٩)؛ القرنفل صنف ليلافلافيو (١٩٩٨-١٩٩٩) ؛الجلاديوس صنف أوسكار (١٩٩٩-٢٠٠٠)

تم تعليم الأزهار عل النباتات الأم في مرحلة البراعم الناضجة التي تم القطف عليها. واختلف محلول تنتج الأزهار على حسب أنواع الأزهار المستخدمة :أ- الورد استخدام فلوسنت ٦٠٠ +السكروز ب- القرنفل استخدام فلوسنت ١٠٠ +سكروز +حمض الستريك

ج -الجلاديولس استخدام الكريزال +سكروز +حمض الستريك

ومن أهم النتائج المستخلصة من هذه الدراسة :

تفوقت الأزهار في زيادة فترة حياتها عند وضعها في محلول التفتح عقب القطف مباشرة بمقارنتها بعمر الأزهار علي النباتات الأم أو بوضعها في محلول التفتح بعد التخزين الجاف لمدة أسبوعين في كل من الورد والقرنفل والجلاديولس كذلك أوضحت الدراسة ان الأزهار التي تم تخزينها كانت أسرع في التفتح بمقارنتها بالأزهار علي النبات الأم أو الأزهار الطازجة (غير مخزنة)

حدث انخفاض في مستوى السيتوكينين مع تقدم الأزهار في العمر من مرحلة البرعم الناضج حتى الذبول في كل من الورد والقرنفل والجلاديولس مع حدوث زيادة في مستوى حمض الأبسيسك في حين أظهرت الدراسة أن مستوى الجبريللين كان مرتفعا بالمقارنة بالهرمونات الأخرى تحت الدراسة . زاد معدل إنتاج الايثيلين مع تقدم الأزهار في العمر ثم حدث انخفاض حاد مرة أخرى