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SOME PHYSIOLOGICAL AND BIOCHEMICAL CHANGES DURING FLOWER DEVELOPMENT AND SENESCENCE IN *Lilium aziatische CV. FABRUANO*

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ABSTRACT

Some physiological and biochemical changes accompanying lily *(Lilium aziatische* cv. *Fabruano)* during flower development and senescence were monitored. Flower development and senescence were categorized into 12 stages, each separated by 2 day. Flower F.Wt and D.Wt increased as flowers developed (stages 1 to 5) and opened (stages 6 to 8) and then declined with senescence (stages 9, to 12), also bud length increased gradually and reaching maximum before opening at (stage 6). When flowering stems placed in water directly after harvest (stage 4 or colored buds), the first visible symptom of senescence in flowers is petal in- rolling, of the "out petal" after about 10 days, followed by "in petal" in 12th day and petal wilting in 16th day. Total soluble sugars and reducing sugars in the petal tissue increased as flower opening was completed and then declined. The protenious amino acids content decreased gradually throughout flower development and senescence, whereas phenolics concentration were decreased followed by an increasing trend with development and senescence (especially at stages 11 and 12).

Keywords: *Lilium aziatische,* development, senescence.

INTRODUCTION

The physiological processes that follow maturity and lead to the death of a whole plant, organ, tissue, or cell are called senescence (Watade *et al.*1984). Senescence is often dramatic as in monocarpic plants, where the completion of reproductive development culminates in the death of the entire plant. In contrast, senescence in polycarpic plants is restricted to parts of the flower and fruit, while the plant continues to develop. The study of senescence is the underlying theme of most postharvest physiology research. Clearly an increased understanding of the developmental biology of senescence would have implications in the control of fruit ripening and flower longevity, (Borochov and Woodson, 1989).

Flowers provide an excellent organ for the study of senescence. Their senescence is generally rapid and predictable. The flower is a complex organ composed of many different tissues, all of which senesce at different rates. Flowers, it is usually the life span of the petals which determine the effective life of the flower. Therefore, the study of petal senescence should provide not only methods to improve the postharvest longevity of cut flowers, but insights into the mechanisms underlying the control of plant senescence in general, (Borochov and Woodson, 1989).

The commercial development stage of flower at picking varies greatly in different flowers and is influenced also by the season, environmental conditions, the distance to the market, and the requirement of specific consumers. In general flowers are cut at the earliest stage that will assure full

opening and development with good quality in the vase. Cutting flowers in the bud stage is preferable, when possible, since they are easier to handle and are less susceptible to detrimental environmental conditions like high temperature and ethylene (Halevy and Mayak, 1979).

There are three primary groups of *Lilium*: 1. Oriental Lilies, 2. Asiatic Lilies, and 3. Easter Lilies. Flowers appear on short branches at the end of the stem. Asiatic; Cup-shaped flowers, 4 to 6 inches across, clusters of 5 to 8 flowers on stems 24 to 36 inches long (Christopher 1989).

The present study aimed to study the changes in F.Wt, D.Wt, bud length, total sugars, reducing sugars, non-reducing sugars, protenious amino acids and phenolics accompanying floral development and senescence in *Lilium aziatische cv. Fabruano.*

MATERIAL AND METHODS

Plant material

Lily plant (*Lilium aziatische cv. Fabruano "Lillaceae"*) was grown in open filed during winter season at the "Flormix farm", Imbaba, Giza, Egypt. Under these conditions flower bud appear after 80 days from planting. Flower development and senescence in *Lilium aziatische cv. Fabruano* categorized into twelve stages, each separated by two day. As the bud developed (stages 1 to 5), flower opening (stages 6 and 7), flower fully open (stage 8) and flower senesced (stages 9 to 12) (Fig. 1). Flowers were harvested at specific time (after 90 days from planting or at stage 4).

Cut flowers placed in vase containing distilled water (changing each 24 h.) and maintained under conditions, 23 – 25°C, 60% RH and with light intensity (1000 µW / cm^2 in 12 h. photoperiods) supplied from white fluorescent tubes. At each stage diameter, length, fresh weight and dry weight of a minimum of 10 replicate flowers were determined. At each stage gram petal tissue was fixed in hot 80% ethanol. The tissue was homogenized and centrifuged. The cleared supernatant was collected and the pellet was resuspended in fresh 80% ethanol, centrifuged again and the second supernatant was combined with the first and used for determination of various tissue constituents (Lay-Yee *et al.* 1992).

Determination of total soluble sugars, reducing and non-reducing sugars.

The total soluble sugars as well as reducing sugars were colorimetrically determined by method of Nelson (1944) using glucose as the standard. The non- reducing sugars were determined by calculating the difference between total soluble sugars and total reducing sugars.

Determination of phenolic compounds.

The colorimeter method of Folin-Denis described and improved by Daniel and George (1972) and recommended by A.O.A.C. (1970) was employed for chemical determination of phenolic compounds.

Determination of protenious amino acids

For the determination of protenious amino acids, remaining tissue after alcohol extraction, samples were hydrolyzed by adding 10 ml of 6N HCL for each gram of the remaining tissue, and hydrolyzed for 60 minutes at 120 °C. The hydrolytes centrifuged at 10,000 rpm for 10 minutes and amino acids were determined in supernatants according to the colorimetric method described by Abd El-Hafez *et al.* (1977). Using leucine as the standard and ninhydrin reagent.

RESULTS AND DISCUSSION

Flower development and senescence in *Lilium aziatische cv. Fabruano* categorized into twelve stages, each separated by two day. As the bud developed (stages 1 to 5), flower opening (stage 6 to 7), flower fully open (stage 8) and flower senesced (stages 9 and 12). (Fig.1).

During bud development from the visible bud stage to open flower at stages (1,2,3,4,5,6,7and 8), diameter, fresh weight (F.Wt) and dry weight (D.Wt) increased gradually and reaching maximum in the fully open stage (stage 8) and then declined as the flowers senesced from stage 9 to 12, also bud length increased gradually and reaching maximum before opening at (stage 6). (Fig.2, 3). This results consonance with the several previous studies *Hemerocallis* (Lay-Yee *etal.* 1992); *Sandersonia* (Eason *and Webster* 1995); *Iris* (Sultan and Farooq 1998); *Narcissus* (Sultan and Farooq 1999).

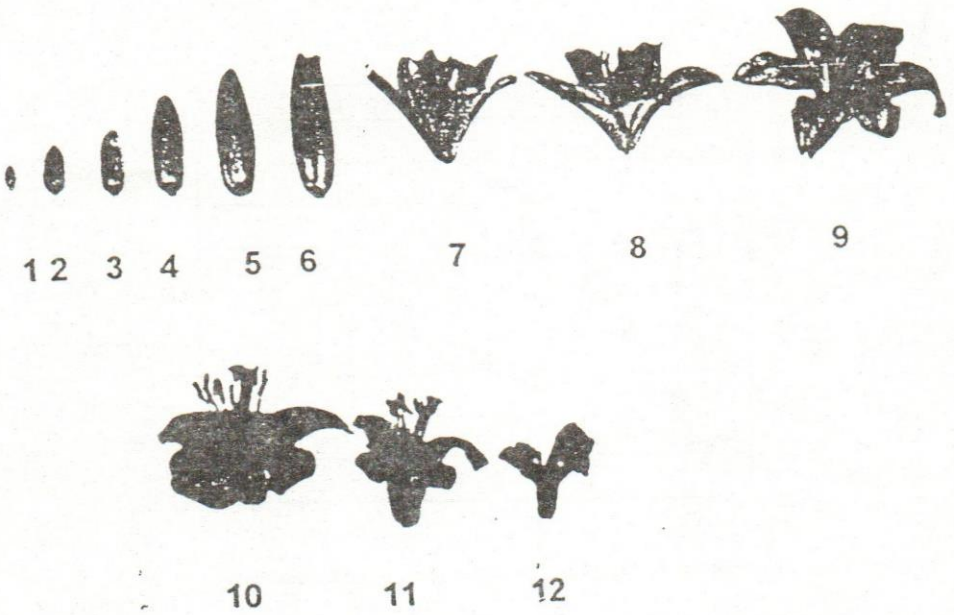

Fig. 1: Stages of *Lilium aziatische cv. Fabruano* flower during development and senescence.

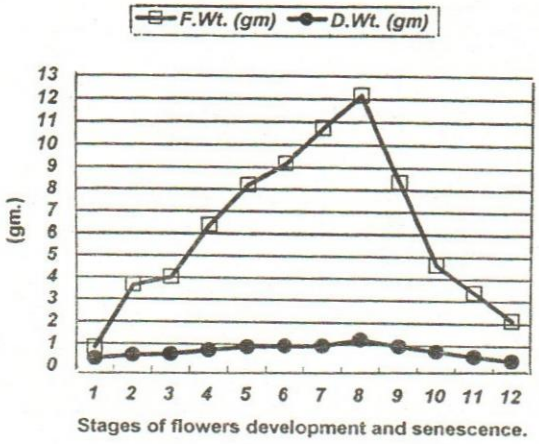

Fig. 2 : C hanges o f fresh weight and dry weight during development and senescence in flowers of *Lilium aziatische cv. Fabruano,* Values are means of 10 flowers.

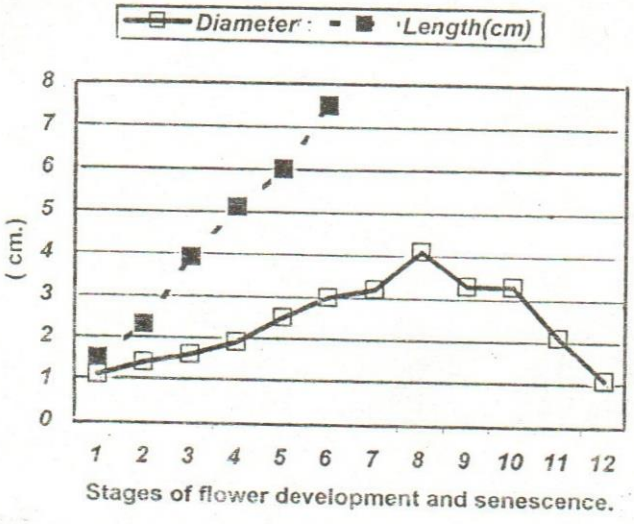

Fig. 3: Changes of diameter and length during development and senescence in flowers of *Lilium aziatische cv. Fabruano,* Values are means of 10 flowers.

Carbohydrates are necessary for the growth of any plant part as carbohydrates provide energy and the building blocks for growth processes. Flowers usually do not have chlorophyll, and therefore cannot carry out photosynthesis to produce carbohydrates for their needs. In addition, flowers have very rapid growth rates that require large amounts of carbohydrates. For these reasons, flowers are dependent upon other parts, especially leaves, for their carbohydrate supply. Therefore, the ability of flower buds to import carbohydrates in vital in flower development.

The concentration of total soluble sugars (T.S.S.) in petal tissue declined during successive stages of flower development from 1 to 8 but increased slightly at stage 9 to 12). The concentration of reducing sugars (R.S.) remained without any change during stages 1,2,3,4,5,6,and 7 and then increased sharply during stages 8 to 12. The non-reducing sugars (Non-R.S.) in the petal tissue declined gradually as the flower development and senescence progressed during stages 1 to 12 (Fig. 4). Reducing sugars rather than sucrose were noted as the main constituents of the sugar pool of mature petals (Nichols, 1973). Usually, sucrose (as non reducing sugar) is the form of sugar translocated from leaves to flowers. Once sucrose enters the flower, it has to be broken down to glucose and fructose (as reducing sugars) before it can be used for growth.Petal senescence is generally accompanied by a loss of dry matter. This is apparently due to the hydrolysis of macromolecules such as starch, protein, and nucleic acids and the redistribution of carbon and nitrogen compounds to other parts of the flower. Clearly the carbohydrate status of the petals is one of the factors, which ultimately determines their longevity (Courts, 1973).

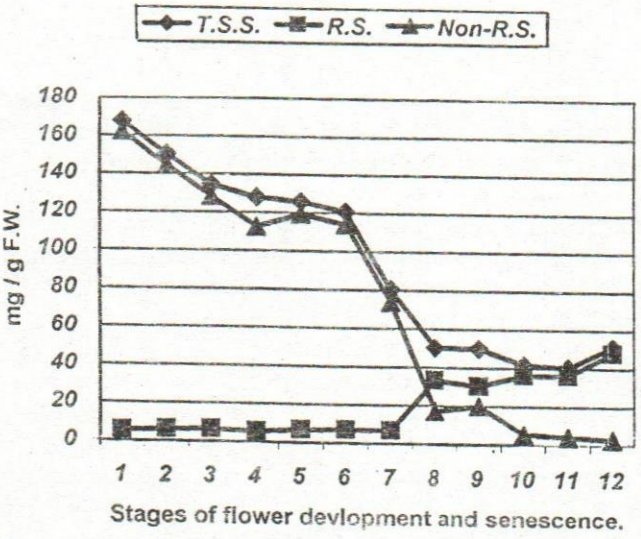

Fig. 4: Changes of total soluble sugars, reducing sugars and non-reducing sugars concentration of petal tissue during development and senescence in flowers of *Lilium asiatische cv. Fabruano*, Values are means of 3 replicates.

The protenious amino acids concentration decreased gradually throughout flower development and senescence, the decrease rate was highly until flower opening and then lowered (Fig. 5). This results consistent with the studies of senescence in cut flowers of carnation, during the first stages of senescence in cut flowers of carnation, the increase in dry weight (Trippi and Paulin, 1984) goes together with a decrease in protein content as a consequence of both an increase in proteolysis, as suggested by the rise of soluble amino acid content (Trippi and Paulin, 1984) and decrease in protein synthesis (Paulin, 1975).

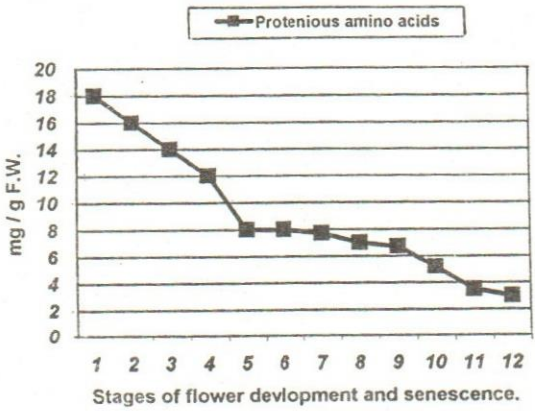

Fig. 5: Changes of protenious amino acids concentration of petal tissue during development and senescence in flowers of *Lilium aziatische cv. Fabruano,* Values are means of 3 replicates.

Total phenolic compounds generally increased during stages 1 to 10. The increase of total phenolics concentration was unparticular during stages 1 through 10, but its was particularly marked at stages 11 and 12 (Fig. 6). In some flowers aging of petals is marked by browning and blackening of the petals, which are caused by oxidation of flavones, leucoanthocyanins, and other phenols, and the accumulation of tannins (Singleton, 1972).

It could be concluded that, in the life period of each plant, it can distinguish three basic periods: (1) Intensive development and growth; (2) full maturity; (3) senescence. Flower growth, development, and senescence are very important processes in floricultural crops. Flower development and senescence of *Lilium aziatische cv. Fabruano* were categorized into 12 stages, each separated by 2 day. Flower FW and DW increased as flowers developed (stages 1 to 7) and opened (stage 8) and then declined with senescence (stages 9, to 12) also bud length increased gradually and reaching maximum at (stage 6).

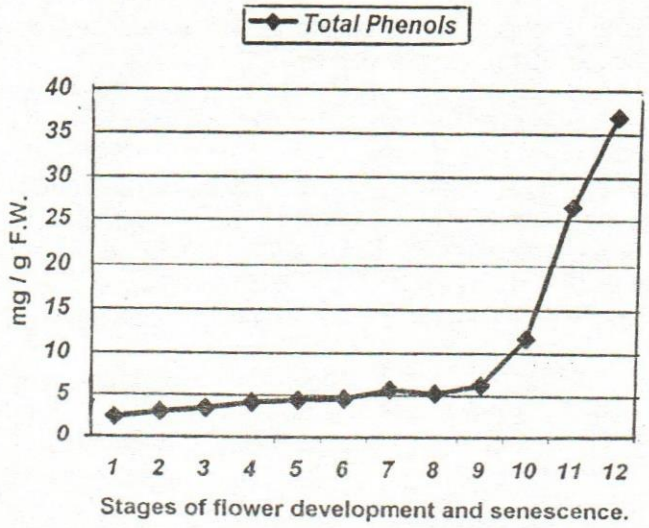

Fig. 6: Changes of total phenols concentration of petal tissue during development and senescence in flowers of *Lilium aziatische cv. Fabruano* Values are means of 3 replicates.

The first visible symptom of senescence in cut flowers is petal in rolling, of the "out petal" after about 4 days, followed by "in petal" in 6th day and petal wilting after about 12 days. Some physiological and biochemical changes associating flower during these stages, total soluble sugars and reducing sugars in the petal tissue increased as flower opening was completed and then declined, The protenious amino acids concentration decreased throughout flower development and senescence, whereas concentration of tissue phenolics ascend followed by an increase trend with development and senescence.

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بعض التغييرات الفسيولوجية و البايوكيميائية المصاحبة لتطور و شيخوخة أزهار *Lilium aziatische cv. Fabruano*

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- يصاحب تطور و شيخوخة بتلات أزهار نبات *(Lilium aziatische cv. Fabruano)* بعض التغيرات الفسيولوجية و البايوكيميائية – صنفت مراحل تطور و شيخوخة هذه الزهرة الى (١٢) مرحلة تستغرق كل مرحلة يومين كاملين.
- و قد لوحظ زيادة فى الوزن الجاف و الرطب و قطر هذه البراعم الزهرية خلال مراحل التطور(المراحل من ١ – ٥) و خلال تفتحها (من المرحلة ٦ الى المرحلة ٨) ثم تلاها نقص تدريجى مع بداية مرحلة الشيخوخة و حتى نهايتها (من المرحلة ٩ الى المرحلة ١٢) و كذلك بالنسبة لطول البرعم الزهرى الذى يزداد تدريجياً حتى وصل الى أقصاه قبل بدايه تفتحه فى (المرحلة ٦).
- لوحظ أيضاً زيادة فى محتوى بتلات الزهرة من السكريات الذائبة الكلية و كذلك السكريات المختزلة مع بداية التطور و حتى تمام تفتح الزهرة ثم يعقبها نقص فى هذه المركبات.
- لوحظ كذلك نقص فى محتوى البتلات من Protenious amino acids خلال مراحل تطورها و أثناء شيخوختها .
- كذلك لوحظ أن محتوى البتلات من الفينولات الكلية قد أخذ اتجاه الزيادة مع مراحل تطورها و خصوصاً أثناء مرحلتى ١١ و ١٢ .