Practical 10

HARVESTING & PRIMARY PROCESSING OF FLOWERS

EXERCISE

10.1 : Learn about harvest maturity, safe harvesting, primary processing and storage of flowers

OBJECTIVES

- To learn the maturity indices of flowers
- To practice safe cutting/harvesting of flowers
- To learn about primary processing of different flowers
- To learn about safe storage of flowers

Delivery schedule: 04 periods

Student expectations/learning objectives

- Importance of maturity index in harvesting of flowers
- Importance of safe cutting/harvesting of flowers
- Importance of primary processing of flowers
- Importance of safe storage of flowers

Pre-learning required: Acquaintance with different kinds of flowers and their growing and harvesting season etc.

Handouts/material/equipment's & tools required: Paper sheet and pen to note down the instructions, different tools/ equipments for harvesting, primary processing and safe storage of flowers

INTRODUCTION

Like other plants, flowers also attain maturity after certain time. Flowers should be harvested when they are fully mature but their harvesting is mainly guided by market demands. The following

points should be kept in mind while harvesting the floricultural crops:

- Time of harvesting of flowers
- Method of harvesting of flowers
- Different stages of harvesting of flowers
- Post harvest management (primary processing) of flowers
- Methods of storage of flowers

Time of harvesting of flowers

Right time of harvest is of considerable importance to ensure long vase life of cut flowers. Flowers should always be harvested when temperatures are mild because high temperatures lead to faster respiration rates and cause excessive water loss. Therefore, flowers should be harvested in the morning or in the evening. In the morning, flowers are fully turgid due to low transpiration at night. The flowers such as rose, chrysanthemum and gerbera, which are highly prone to water stress, should preferably be harvested in the morning. Evening harvest is also advocated because of high sugar level in the stem due to high rates of photosynthesis during daytime. Immediately after harvest, the flowers are put in water or preservative solutions.

Student's activities/exercises

The students should harvest the flowers of rose, chrysanthemum, gerbera, gladioli, delphinium, antirrhinum, narcissus, etc., early in the morning or evening hours and at noon. Then observe the differences between morning/ evening and noon harvested flowers.

Method of harvesting of flowers

The stems should always be cut with sharp knives or secateurs. While harvesting, care should be taken not to crush the stem. Hardwood stems should always be given slanting cut so as to expose the maximum surface area to ensure rapid water absorption. The nature of the cut, however, does not matter much in case of the herbaceous stems, because such stems have ability to absorb water through epidermal tissue too.

Specific flowers such as, stems of chrysanthemum, should be harvested at least 10 cm above the ground level. The stem close to the soil is harder and lignified, which results in lesser water uptake by the stem. The rose stems should be harvested leaving at least two 5 leaflet leaves on the stem. This ensures

Student's activities/exercises

The students should harvest the flowers of rose, chrysanthemum, gerbera, gladioli, delphinium, antirrhinum, narcissus, etc., using suitable methods for a particular flower. Then, observe the differences in flowers harvested with different methods.

sufficient leaf area on the plant for sustained production of flowers for a longer duration. Some flowers such as dahlia, poinsettia and papaver release latex upon cutting that can be overcome by hot water (80-90^{o}C) treatment for few seconds. Gladiolus spikes are harvested leaving at least 2 pair of leaves on the plant, which are required for the development of corms and cormels.

Different stages of harvesting of flowers

Flowers should always be harvested at an optimum maturity stage. Too immature buds do not open properly whereas over mature ones also wither quickly. The stage of harvest varies with the species and even with the cultivar, prevailing temperature conditions, distance to the market place and requirement of the consumer. In general, for transport to the distant markets, the flowers should be harvested at tight bud stage whereas for the local market, the flowers can be harvested at a relatively open stage.

Many flowers like rose, gladiolus, carnations, daffodils, lilies, iris, freesia and tulip can be harvested at bud stage as the buds of these flowers possess the ability to open in water. However, flowers like orchids, dahlia, gerbera, calendula etc., are harvested when fully open.

Fully mature carnations

A right stage of harvesting gladiolus

A right stage of harvesting roses

Marigold flowers, ready for harvesting for garland making

Optimum stage of harvest for some important flowers

Name of flower	Stage of harvest
Antirrhinum majus (snapdragon)	1/3 florets open
Calendula officinalis	Fully open flowers
Cattleya spp. (orchid)	4-5 days after opening
Chrysanthemum morifolium (Florist's chrysanthemum)	Standard :When outer florets fully expanded Spray: Flowers open but before shedding of pollens Pompons and decorative :Centre of the oldest flower filly open Anemones: Open but before central disc florets begin to elongate
Dahlia variabillis	Fully open flowers
Dendrobium spp. (orchid)	Fully open flowers
Dianthus caryophyllus (carnation) Freesia hybrids	*Standard:* Paint brush stage when flowers are half open *Spray:* At least 2 flowers fully open Coloured buds
Gerbera jamesoni	Flowers open but outer 2 rows show shedding of pollens
Gladilous cultivars	1-5 florets show colour
Gypsophila paniculata	Flowers just open
Iris germanica	Coloured buds
Lilium spp. (lily)	Coloured buds
Narcissus spp. (daffodil)	Goose neck stage
Polianthes tuberosa (tuberose)	Single : Buds fully developed but unopened Double: Maximum florets open
Rosa × hyrida (Rose)	1-2 petals beginning to unfold
Strelitzia reginae (bird of paradise)	First floret opens
Tulipa spp. (Tulip)	Half coloured buds
Zinnia elegans	Fully open flowers

Student's activities/ exercises

- Student should choose flowers of rose, gladiolus and spray chrysanthemum for their experiments.
- Five stems of each flower be harvested at different stages of flower development as directed by the teacher.
- Keep the flowers in plain water at room temperature and record the various parameters for the determination of appropriate harvesting stage.

The following observations to be recorded:

Rose

i) **Degree of bud opening:** The degree of bud opening at senescence will be Determined on numerical scale (1-4 i.e. 1-up to 25 % opening; 2- >25 to 50% opening 3->50 to 75% opening; 4->75 to complete opening.

ii) **Vase life:** When the petals show wilting or stem shows bent neck.

Gladiolus

i) **Vase life:** From the opening of the basal floret till half of the open florets show wilting.

ii) Percent opening of florets

iii) Floret size (second floret).

Spray chrysanthemum

To maintain uniformity, six buds at the same stage of development will be maintained on each stem.

i) **Degree of bud opening:** The degree of bud opening at senescence will be determined on numerical scale (1-4 i.e. 1-up to 25% opening; 2- > 25 to 50% opening; 3->50 to 75% opening; 4-> 75 to complete opening).

ii) **Vase life:** Till half of the buds wilting of ray florets or half the leaves show wilting

Primary processing of flowers

Pre-cooling of flowers

Most of the cut flowers are pre-cooled either by simply placing them packed or unpacked in cold chambers or by forced air cooling. Forced air cooling involves forcing cool air in the packed boxes. The system is efficient and the flowers can be cooled in 6 to10 hours. Cold chain linkage from farm to the market is necessarily required to maintain quality of the cut flower. Optimum temperature to which the flowers are cooled varies with different flower species. Flowers are generally cooled at 2-3^{o}C but those originating in tropical and sub-tropical climates, are prone to chilling injury and hence, pre-cooled at higher range of temperatures.

Use of Floral preservatives

The term 'Floral Preservative' is used for any chemical formulation, which is used for extending the vase life of flowers. Besides increasing vase life, floral preservatives help to improve flower opening, flower size, shape and colour. Many commercial formulations are now available in liquid or powder forms in many countries like U.K., U.S.A. and Holland for extending flower vase life. These formulations are to be used as per the guidelines provided by the manufacturer. Floral preservatives can be applied as (i) pulsing solutions, (ii) bud opening solutions, and (iii) holding or vase solutions.

Pulsing solutions: "Pulsing" refers to short duration (16-24 h) pre-shipment or pre-storage treatment. The effect of such a treatment lasts throughout the entire vase life of the flower. Sugar (sucrose) is a main component of the pulsing solution. Since pulsing involves short duration treatment, relatively higher levels of sucrose are used.

Student's activities/exercises

- Students should harvest spikes of gladiolus at tight bud stage (When the basal floret show colour).
- Put the spikes in sucrose (20%) + aluminium sulphate solution (400 ppm) for 24 hours at ambient conditions (20-25°C).
- After pulsing, put the spikes in plain water.
- Compare the pulsed spikes with control (unpulsed).

Bud opening solutions: Immature buds of many flowers can be made to open in chemical solutions, referred to as "bud opening solutions" The components of bud opening solutions are essentially the same as those of pulsing solutions, but in case of bud opening solutions, lower concentrations (2 to 5 per cent) of sucrose are used.

Holding or vase solutions: Holding or vase solutions are meant to hold flowers continuously, until the termination of vase life. The level of sucrose in vase solutions is, therefore, also kept very low

(0.5 to 2 per cent), due to long durations for which flowers are kept in the solution. Many commercial vase preservatives are also available for use as holding solutions and are required to be used as per recommendations of the manufacturer.

Student's activities/exercises

- Cut the spikes of gladiolus at green bud stage (When the basal floret is yet to show colour).
- Put the spikes in water and solution containing sucrose (4%) + aluminium sulphate (400 ppm) + GA_3 (50 ppm).
- Compare the treated spikes with control (water).

Student should perform the following activities in the school lab :

- Harvest the stems of rose at tight bud stage.
- Put the harvested stems in vase solution containing sucrose (1.5%) + aluminum sulphate (300 ppm).
- Campare the treated rose stems with control (water).

Observations to be recorded

Rose

iii) **Degree of bud opening:** The degree of bud opening at senescence will be determined on numerical scale (1-4 i.e. 1-up to 25 % opening; 2- >25 to 50% opening 3->50 to 75% opening; 4->75 to complete opening.

iv) **Vase life:** when the petals show wilting or stem shows bent neck.

Gladiolus

iv) **Vase life:** From the opening of the basal floret till half of the open florets show wilting.

v) Percent opening of florets

vi) Floret size (second floret)

Bunching and packaging of flowers

Flowers are generally made in to bunches of 5, 10, 12 or 20 stems, and loosely tied with rubber band. Bunches should be carefully put together to prevent any damage to the blooms and leaves and

secured with the rubber band at the base and close to the bunched head. Flowers such as gerbera, orchids, anthurium and standard chrysanthemum are packed individually.

The bases of some tropical flowers such as dendrobium and anthurium are kept moist by putting them in specially designed vials filled with water or in moist wool. Bunches are held in polyethylene sleeves or buds are wrapped in corrugated paper to protect them from mechanical damage. Polyethylene sleeves are generally employed for wrapping a wide range of flowers but such a wrap may tend to retain moisture and encourage fungal attack. Hence, many wholesalers prefer naked bunches. Hot-needle sleeves allow the bunches to breath and reduce the chance of fungal attack.

The flowers are generally packed in telescope types boxes made of corrugated fiberboard. The quality board (usually 4-5 ply boxes) should be strong enough to hold the weight of at least eight such completely filled boxes) should be used. The dimensions of the packing boxes are worked out keeping in view the length of the stem, type of the flower to be packed and efficient utilization of the space in the cargo or in refrigerated trucks.

Gladioli, snapdragon and some other species, which show geotropic bending during transport, should be transported in vertical hampers. A new packaging system, the 'Procona' system, which uses plastic container and a cardboard sleeve and allows transport of flowers upright in water is very useful to keep flowers fresh during transport, especially when they are not transported under proper temperature conditions.

Students should perform the following activities in the school lab:

- Harvest the spikes of gladiolus and stems of rose as required for the exercise.
- Grade the flowers as per length and other quality criteria.
- Graded flowers be bundled and tied with the help of a rubber band.
- Bundled flowers be packed in the corrugated boxes and keep them at ambient conditions for 16, 24, 48 and 72 hours.

Observations to be recorded

Rose

i) **Degree of bud opening:** The degree of bud opening at senescence will be Determined on numerical scale (1-4 i.e. 1-up to 25 % opening; 2- >25 to 50% opening 3->50 to 75% opening; 4->75 to complete opening.

ii) **Vase life:** when the petals show wilting or stem shows bent neck.

iii) **Fresh weight changes:** The initial weight of the stems will be taken. Weight of stems will also be measured daily and correlated with the opening and wilting of flowers.

Gladiolus

i) Days for the opening of basal floret

ii) **Vase life:** From the opening of the basal floret till half of the open florets show wilting.

iii) Percent opening of florets

iv) Floret size (second floret)

v) **Fresh weight changes:** The initial weight of the spikes will be taken. Weight of spikes will also be measured daily and correlated with the opening and wilting of florets on the spike.

Methods of storage for flowers

There are three methods like Simple Refrigerated Storage (which includes both wet and dry storage); Controlled Atmosphere (CA) Storage; Hypobaric or Low Pressure Storage (LPS) for the storage of flowers. Here students will concentrate on simple refrigerated storage for storing of flowers.

Wet storage of gladiolus spikes in cool chamber

Simple Refrigerated storage is the most widely used method for storage of cut flowers. It includes two types of storages viz. wet storage and dry storage.

In wet storage, the stems are stored with their basal portions dipping in water or preservative solution. Wet storage is used to hold the flowers for short duration and for their day-to-day handling. The temperature in wet storage is kept at 2-4^{o}C i.e., slightly higher than that in dry storage.

In dry storage, flowers are sealed in plastic bags to prevent the loss of moisture. Dry storage is also referred to as Modified Atmosphere (MA) storage because sealing of flowers in plastic bags leads to reduction in O_2 and increase in CO_2 levels due to respiration of the tissue. Such conditions

Dry storage of gladiolus spikes in polypropylene sleeves

are suitable for storage of flowers. In general, 5-7 % CO_2 and 1- 2 % O_2 is kept in storage. Build up of very high levels of CO_2 (beyond 4-5 %) or extremely low levels of O_2 (lower than 0.4 %) in the packages, however, may damage the flowers. Therefore, it is very important to identify the suitable films for optimum build up of both CO_2 and O_2 levels inside the packages. Dry storage is more laborious but can be used to hold the flowers for longer duration. Before dry storage, flowers should be pre-cooled to remove the field heat. Pulsing of flowers before storage also improves their storage life. Most flowers are prone to freezing injury below -2°C but since free water freezes at 0°C, water droplets condensing on the petals can also cause injury to the tissues. Therefore, the flowers should be stored at 0.5-1°C. The temperature range for tropical flowers like anthurium, cattleya and poinsettia is 10-15°C and for subtropical flowers such as gladiolus, strelitzia and anemone is 2-8°C.

Ideal storage temperature for dry and wet storage of some important flowers

Storage type	Crop	Storage temperature	Maximal storage period
Dry storage	Carnation	0 - 1°C	16 - 24 weeks
	Chrysanthemum	1°C	3 weeks
		4°C	2 weeks
	Gerbera	2°C	2 days
	Gladiolus	4°C	2 -3 weeks
	Rose	0.5- 2°C	2 weeks
Wet storage	Anthurium	13°C	2 - 4 weeks
	Carnation	4°C	4 weeks
	Chrysanthemum	4°C	2 weeks
	Dendrobium	5 - 7°C	10 - 14 weeks
	Gerbera	4°C	3 - 4 weeks
	Gladiolus	4°C	9-12 days
	Tuberose	7 - 10°C	3-5 days
	Rose	2 - 5°C	5 days

Students should perform the following activities/exercises in the school lab :

- Harvest the spikes of gladiolus and stems of rose as required for the exercise.
- Grade the flowers as per length and other quality criteria.
- Graded flowers be bundled and tied with the help of a rubber band
- Bundled flowers be directly kept in bucket full of water or packed in polythene sleeves.
- Now store the flowers at 2-4^{o}C temperature for wet storage and 0.5-1^{o}C temperature for dry storage.
- After 3, 5, 7, 10 days of storage, students should record the observations.

Observations to be recorded

Rose

i) **Degree of bud opening:** The degree of bud opening at senescence will be Determined on numerical scale (1-4 i.e. 1-up to 25 % opening; 2- >25 to 50% opening 3->50 to 75% opening; 4->75 to complete opening.

ii) **Vase life:** when the petals show wilting or stem shows bent neck.

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Gladiolus

i) Days for the opening of basal floret.

ii) **Vase life:** From the opening of the basal floret till half of the open florets show wilting.

iii) Percent opening of florets

iv) Floret size (second floret)

v) **Fresh weight changes:** The initial weight of the spikes will be taken. Weight of spikes will also be measured daily and correlated with the opening and wilting of florets on the spike.

RESOURCE MATERIAL

- Randhawa G. S. Mukhopadhyay, A. (2007). Floriculture in India. Allied publishers Pvt. Ltd., New Delhi.