

**PRESERVATION OF SELECTED FLOWERS WITH  
THE HELP OF DESICCANTS FOR DIFFERENT PERIODS**

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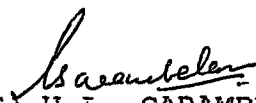
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C E R T I F I C A T E - I

MISS SHAIKH SHEEMA NAAZ has satisfactorily prosecuted her course of research for a period of not less than two Semesters and that the dissertation entitled "PRESERVATION OF SELECTED FLOWERS WITH THE HELP OF DESICCANTS FOR DIFFERENT PERIODS" submitted by her is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the dissertation or part thereof has not been previously submitted by her for a degree of any university.

  
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C E R T I F I C A T E - II

This is to certify that the dissertation entitled "PRESERVATION OF SELECTED FLOWERS WITH THE HELP OF DESICCANTS FOR DIFFERENT PERIODS" submitted by MISS SHAIKH SHEEMA NAAZ to the Marathwada Agricultural University in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE (Home Science) in the Subject of HOME MANAGEMENT has been approved by the Students' Advisory Committee after Viva-Voce in collaboration with the External Examiner.

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## A C K N O W L E D G E M E N T S

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## **INTRODUCTION**

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## CHAPTER: 1

### INTRODUCTION

Flowers are universally loved, admired and adored. The nature's bounty is available in fascinating colours, forms and shapes. Flowers are more than decoration. They express happiness, cheerfulness, reverence on all occasions of social, cultural and religious functions. Thus, flowers with their divine and commemorating characteristics have become the emblems for a vast range of human feelings.

Among people, flowers are; favourite sacrificial offering to the God, a pleasurable job if arranged, decorated in a room or clubed into a bouquet. Evidences of past history show that, using cut flowers as decoration was almost a hobby as domesticity itself. Flowers add warmth, freshness and beauty to a room in a way that no other accessory can, they form the inexpensive assets in decoration.

A home without flowers is bare, lifeless and cold. Cheerful and bright blooms, arranged with imagination make a dark room look sunny and expresses the personality of a room, (Derbyshire, 1966).

Flowers, either fresh, dried or combined with artificial stalks add colour, variety and charm to an arrangement with a little expense and effort, (Marian-Klamkin).

During victorian era, when home decoration gained

its importance, women collected fresh flowers, gourds and seedpods and spent their time, effort and ingenuity in drying and preserving them, using it in arrangement to cheer the drafty houses of icy winters. Further during Georgian period large, massive symmetrical and triangular arrangements were made out of fresh and dried flower materials, especially dried bouquets were common and extensively used as winter offerings.

In United States permanent flower arrangement existed since nineteenth century, these lasting arrangements were artistically embellished and protected by belljars or were elaborately arranged in the museums.

To prolong the vase life of 'cut flowers' on household basis, materials like charcoal, sugar, common salt, vinegar, aspirin, olive oil, camphor etc are used as preservatives which helped the flower to retain its firmness and freshness within the vases for not more than a week. These results could not satisfy the enthusiasts and florist. Therefore, General Condon experimented the seasonal flowers through the process of desiccation i.e. drying the flowers with an aid of certain chemicals.

Time, in today's dynamic routine is the most important resource to be used efficiently. Hence, the daily time required in selecting the cutflowers from the garden or farmside and

the fast wilting and fading of fresh flower arrangement in the vases, poses the problem of wastage of human and material resources. Besides, even the ideal conditions cannot prolong the vase-life of fresh flowers for more than few weeks, therefore, the best alternative of course may be the use of dried flower material.

Fresh flowers, in fact are more appreciated and preferred as compared to artificial flowers. But certain biological drawbacks and non availability of fresh seasonal flowers, makes one to go in for those plastic bunches, which at present have gained a good market. On the other hand, as dried flowers look fresh, real, fantastic and exotic by itself with its own kind of beauty (Geneal Condon) it can compete the market if started on commercial basis. Thus the preserved flowers brought home can be converted into a bouquet, arrangement or used for decorative purpose whenever needed as per occasion.

Dried materials of all types offer another excellent medium for flower arrangement in the tropics and they all are handy often during summers and off season periods, (Nancy Aldrich Inman). Today, ever increasing kinds of plant material can be preserved with perfection of form and retention of fascinating colours through methods of "dehydration" which is based on the principle of quickly reducing the moisture

content of flowers with the help of desiccants (Bhutani - 1968). The flowers thus dehydrated may maintain the structure, colour, and texture over a longer period of time. These dried flowers can be used for permanent arrangements, bouquets, wall hangings, framed arrangements, greeting cards etc., (Walter E. Larmie). Every flower comprises of four characteristics viz: contour, flexibility, colour and texture that must be maintained if the preserved specimen is to resemble the original. (Geneal Condon) which can only be achieved by the use of effective drying methods.

Dried flowers are a minor item in the florist trade, they fill the void when fresh flowers are absent (Williams, Shumack) thus, these beautiful creations of nature have been freed from the bondage of seasons, to be used in a number of ways, for pleasure or for profit.

Not much of the work has been done in this field of preserving flowers, with the help of desiccants. Though the work has been carried out regarding preservation of fresh flowers and about longevity studies, this field has not yet gained much importance. In the light of this, there is a felt need to study the preservation of flowers through the process of dehydration, so that the flowers are available throughout the year.

Therefore, the aim to study the present topic is to fulfil following objectives:-

1. To study the different drying methods used for flower preservation.
2. To make the seasonal flowers available in off-season period.
3. To compare and select the most suitable drying methods for preserving flowers used for home decoration purposes.
4. To choose and evaluate the best period for preserving the flora.

## **REVIEW OF LITERATURE**

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## CHAPTER: 2

### REVIEW OF LITERATURE

The literature published and research carried out on preservation of flowers through desiccation is still very little. Recognising the importance of dried flower material it may gain success, and encourage for further more research in this field.

According to Condon "To reach a conclusion in flower drying may require months or year, because as yet there is no known substance that will preserve all flowers perfectly, same as that, there is no one medicine to cure all diseases". Though the progress is slow but very soon desiccation will become a general topic of routine.

In 1985 Kenneth Turner wrote "Experiments based on desiccation gave a positive response to his commercial sale of flowers and a changed attitude of art among people.

The work carried out in this field are reviewed and categorised under following heads:

1. Effect of different drying methods on flowers.
2. Effect of cutting time on drying flowers.
3. Effect of drying on the characteristics of flowers.
4. Effect of season or atmospheric changes on drying of flowers.

1. Effect of different drying methods on flowers:

Air drying and sun drying was the cheapest and simplest form of dehydration of flowers as reported by Bhutani (1970).

Among Sawdust, Sugar, talcum powders, cornstarch, washing powder, silica gel, borax plus cornmeal and sand are only a few materials used as best desiccants as claimed by Condon (1970).

Timing is essential with silicagel because over exposure can cause damage as ascertained by Chase (1972).

Flowers of good quality and size when dried in silica gel granules usually retain their colour and form, better than when dried in any other desiccant as investigated by Williams and Shumack (1972).

According to Bhutani (1972) the method adopted for embedding the flower is important and has to be varied to suit the structure of the material to be dehydrated.

Sand drying was the most preferred media by many florist for most of the flowers as it retained the natural shape, as reported by Vance (1972).

According to Chase (1975) Silica gel is an extremely absorbent form, it dries the flower within 2-8 days providing colours that are brighter and clearer.

The desiccants draw out every bit of moisture from the flower petals leaving the flower intact and with much of the

original natural shape and colour retention, as referred by Cowles (1975).

According to Roesen (1978) Borax method was found to be most suitable for fragile wild flowers.

The recent use of microwave oven gave superb results, the flowers got dehydrated just within 2-3 minutes, as reported by Bhutani (1987).

The spikes of Ixoras and statice are especially suitable for 'press drying' as reported by Kher and Bhutani (1987).

Desiccants, glycerine, pressing and air-drying are the most common methods of preserving flowers and foliage as ascertained by Caryco and Gaym (1988).

## 2. Effect of cutting time on drying of flowers:

Flowers to be desiccated must be harvested early morning or late evening as reported by Condon (1970).

The flower comes out from drying medium same as it was embedded in, the success of dried flower depends largely on the time of harvesting and the manner it was desiccated, as mentioned by white (1971).

Cavendish (1973) quoted that success of dried flower depends on the predesiccating care, like, time of harvesting, blooming stage and retention of freshness.

According to Chase (1975) flowers which are to be dried

should be in perfect condition. Generally, at the peak of their bloom and cut after the dew has dried but before the sun reaches its height.

As ascertained by Bhutani (1975), flowers required for drying must be harvested a day or two after irrigating the field, so that the water content of flowers and foliage is not exceptionally high.

Selection and picking of flowers be made when the flower is fully charged with moisture and the flower is open and dry, either at dawn or late afternoon as suggested by Dale and Gunnel (1976).

Most flowers should be gathered at the peak of their maturity and in the early hours of morning, as ascertained by Larmie (1980).

### 3. Effect of drying on the characteristics of flowers:

White, yellow, orange and pink flowers of Gerbera retained their colour to the maximum, while red ones darkened a bit after dehydration as studied by Kher and Bhutani (1969).

As reported by Condon (1970) some colours regardless of flower last longer than others, thus stability of colour in a preserved flower depends to a great extent upon the colour as well as the variety of the flower.

Condon's findings (1970) show that some white flowers develop colour due to the oxidation of tannin present in

flower during process of drying in the media.

To maintain the original shape and outline, the flower needs proper support and uniform pressure while drying as quoted by Condon (1970).

According to Condon (1970) colours vary with the type of drying material used, select the medium that preserves the true tints.

A wide and fascinating range of colours can be obtained by the use of inert material as revealed by Vance (1972).

According to Chase (1975) wilting caused by water loss is the greatest danger to cut flowers. To avoid this, cut flowers when it is cool, moist and there is no wind, either before the sun is well up in the morning sky or after it has set in the evening and the days heat has passed.

Air-dried flowers are less likely to react to moisture in the atmosphere and to sag or loose colour after they are placed in arrangements, than are sand or Silica gel dried flowers as reported by Chase (1975).

Damp newspaper in the bottom of the basket holding cut-flowers prevent wilting as identified by Chase (1975).

According to Dale and Gunnell (1976) the desiccants all absorb moisture from the flower, leaving the structure and colour intact.

Flowers are buried in granular desiccants for a period of 4 days to preserve them in such a way so that the forms is intact to still look natural and fresh, as quoted by Roesen (1979).

Larmie (1980) suggested that the flowers for drying should be of highest quality as the mediums used will never improve their quality.

4. Effect of season or atmospheric changes on drying of flowers:

The flowers of winter and rainy season were found to maintain its colour and form to the maximum with dehydration period ranging between 48 to 96 hours, as experimented by Bhutani (1970).

Dried flowers, if exposed to a relative humidity exceeding 60 percent may absorb moisture back into the tissues making petals limp and crispless, further causing them to wilt and droop or even collapse, as reported by Chase (1972).

As described by Dale and Gunnell (1976) the drying and preserving is done when the flower or leaf is fully mature usually during the summer and early autumn.

Almost all flowers irrespective of season retained its compositions, when dried in oven with temperatures ranging between 35° C to 49° C as revealed by Bhutani (1979).

According to Larmie (1980), a room with too much light, especially direct sunlight, will cause excessive fading during the drying process.

## **MATERIALS AND METHODS**

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MATERIALS AND METHODS

Preservation of selected flowers with the help of desiccants for different periods was carried out in the present study. Several methods of dehydration of flowers are being adopted today, ranging from simple drying at room temperature to the most advanced microwave oven drying (Bhutani, 1978) since not much information about material and methods on flower desiccation is available, Geneal Condon's study was therefore taken as a standard.

The present investigation was based on, the methods of drying with the help of different desiccants, periods of drying and varieties of flowers. The various procedures followed are mentioned under following heads:-

- (1) Conducting pilot study
- (2) Selection and standardisation of experimental material.
- (3) Experimental procedure.
- (4) Recording observation.
- (5) Evaluation of techniques involved
- (6) Statistical analysis.

3.1 : Conducting pilot study:

A pilot study was carried out so as to decide the desiccation mixtures and desiccation periods to be chosen for the principle investigation. Different formulation were reached

for sand desiccation mixtures. The best suitable however, are quoted and the same were used for principle investigation. The desiccant mixtures, that were chosen were sand, Borax plus treated sand, silicagel, Aluminium Oxide plus treated sand.

### 3.1.1 : Sand treatment:

Sand is an inert material, it has no reaction on or with the flower substance. Sand that was to be used as desiccant was cleaned, sorted and sifted. Further it was washed thoroughly with water, containing detergent solution and was rinsed, rewashed until clear water poured away. The washed sand was thus, dried in sun, then sterilized in oven at 250° F and immediately in the hot sand melted paraffin was mixed with a preparation of .1 percent to five kilogram of sand, which was mixed vigorously so that the melted wax could coat the sharp edges of sand granules to avoid the damage of delicate flower petals. After the sand was cooled, .1 percent each of sodium bicarbonate and silica gel were added and mixed thoroughly. Thus the treated sand was ready as desiccant to be used.

### 3.1.2 : Borax plus treated sand:

Borax is a colourless, crystalline, slightly alkaline substance with hygroscopic nature. Borax was used as desiccant well mixed with the treated sand in the proportion of 1:2 (One part of Borax and two parts of treated sand).

### 3.1.3 : Aluminium oxide plus treated sand:

Aluminium oxide available in powdered form is white and odourless. It is many times more powerful than silica gel as a desiccant, therefore, it was used alongwith sand forming a mixture of 1:2 proportion (one part of Aluminium oxide plus two parts of sand).

### 3.1.4 : Silica gel method:

Silica gel is a popular, excellent and easy means of preservation for many kinds of flowers. Silica gel is a chemical compound that absorbs moisture quickly. It is harmless, easy to use, light weight almost odourless and highly hygroscopic. When packed around a freshly picked flower this compound removes the moisture so quickly that it does not give the flower an opportunity to shrivel, turn brown or loose its colours.

Silica gel as a desiccant was used as such available in the sealed containers which were opened just before the actual desiccation process due to its strong hygroscopic nature.

The flowers used for study were of three variety i.e. Rose, Marigold and Goldenrods. Then number of varieties were further ~~increased~~ for the main principle study.

The different lengths of drying period during pilot study ranged between three to seven days which was eventually raised to three to eleven days for principle investigation.

### 3.2 : Selection and standardization of the experimental material:

The material selected for the investigation were selection of flowers and selection of desiccants which were standardised and its details are discussed below:-

#### 3.2.1 : Selection of flower:

The flowers selected for experiment were those commonly available during the period of present investigation i.e. during April 1989. Eight different flowers were subjected to four different desiccations with varying periods of drying, taken three replications each time at the same time, to assure that, the desiccation was carried out within the same period for each flower.

The flowers chosen were Rose (Rosa-gallica) Aster (A.amellus), Red and Yellow Galardia, (Galardia Pulchella Pieta) Golden rods (Solidago virga - aurea), Marigold (Tagetes erecta linn), Daisy (Arctotis grandis) and chrys-anthemums (C.coronarium)

Table - 1 : Symbols used for flowers:

Sr.No.	Name of the flower	Symbol
1.	Rose	F <sub>1</sub>
2.	Galardia (Red)	F <sub>2</sub>
3.	Galardia (Yellow)	F <sub>3</sub>
4.	Chrysanthemum	F <sub>4</sub>
5.	Aster	F <sub>5</sub>
6.	Daisy	F <sub>6</sub>
7.	Golden rods	F <sub>7</sub>
8.	Marigold	F <sub>8</sub>

The flowers were harvested taking into consideration the factors such as time of harvesting, stalk-length and freshness. Care was taken to discard infested and unhealthy flowers. The flowers were harvested at dawn, since temperatures are lower during early span of day. The flowers were carefully cut with the help of stainless steel scissors so as to avoid injury to the stem. After harvesting the flowers were immediately subjected to a solution of 1 percent sucrose and salt each in lukewarm water, and were brought to the laboratory. They were drained and excess water was removed with the help of tissue papers. Care was taken that the flowers were not subjected to any excess pressure which might have damaged the appearance, texture and form prior to desiccation.

Before actual process of desiccation, the weight of fresh flower, stalk length were measured. (Appendix- I & III). All the varieties were studied for their moisture content and a mean range value thus reached was taken as a standard for each variety differently. Dry weights of the flowers after desiccation for different periods was also noted.

### 3.2.2 : Selection of desiccants:

The chemicals used for preserving the flowers were sand, Borax, silicagel and Aluminium oxide (Neutral). Desiccants are the drying agents which gradually draw out the moisture from the flowers embedded, thus preserving the original shape of flower, supports the individual petals from all sides so

that there is no room left for them to move turn or contract during the process of dehydration.

The desiccants selected were treated sand which was a whole, Borax plus treated sand with 1:2 proportion respectively. Some proportion was followed in preparing Aluminium Oxide plus treated sand, and silica gel was used directly as it was available in the container.

### 3.3 : Experimental procedure:

The equipment was systematically and carefully divided into following steps i.e. right from selection of boxes for desiccation to the removal of flower from the boxes.

- (1) Preparation of desiccants.
- (2) Preparation of desiccation boxes.
- (3) Preparation of flowers.
- (4) Positioning of flowers.
- (5) Covering of flowers with desiccants.
- (6) Uncovering of flowers from desiccants.
- (7) Cleaning and storing of flowers.

#### 3.3.1 : Preparation of Desiccants:

Desiccant mixtures were prepared and standardised. The number of desiccants used and its proportions used were as follows:-

Sr.No.	Methods	Proportion	Symbol
1.	Treated sand	Total 140 kg sand treated with 750 gm melted paraffin, 100 gm of silicagel and sodium bicarbonate, each	M <sub>1</sub>
2.	Silica Gel	used as such/mesh, directly from the container	M <sub>2</sub>
3.	Borax plus treated sand	1:2, i.e. - One part <u>Borax</u> (15 kg) 2 parts sand (30 kg).	M <sub>3</sub>
4.	Aluminium-oxide plus treated sand	1:2 i.e. one part aluminium oxide (15 kg), 2 parts sand (30 kg).	M <sub>4</sub>

Duration of desiccating the flower in the drying medium were as follows:-

Sr.No.	Periods/duration	Symbols
1.	3 days	P <sub>1</sub>
2.	5 days	P <sub>2</sub>
3.	7 days	P <sub>3</sub>
4.	9 days	P <sub>4</sub>
5.	11 days	P <sub>5</sub>

### 3.3.2 : Preparation of desiccation boxes:

Corrugated paper boxes with size 14" x 10" x 12" were prepared and their sides were sealed with cellotape. Before actually subjecting the boxes for experimentation, they were partially filled with desiccant mixtures to about 1" - 2" layer size. The boxes were made for different duration ranging from three to eleven days.

### 3.3.3 : Preparation of flowers:

The freshly harvested flowers, subjected to one percent solution of salt and common sugar each, were drained off excess water and any excess moisture was absorbed using tissue papers. Care was taken not to disturb the texture, form and appearance of the flowers, nor any injury to the petals and stalk. After this, the flowers were defoliated and unhealthy flowers discarded. The selected ones were weighed and stalk lengths were standardised. The range of flower weights, stalk length, moisture contents are given in appendix (II & III).

### 3.3.4 : Positioning of the flowers:

A flower may be desiccated in one of three position depending on type, shape and delicacy of flower. The position in which the flower retains its form is the most suitable position for that particular flower. The ideal positions are faceup, face down and horizontal positions.

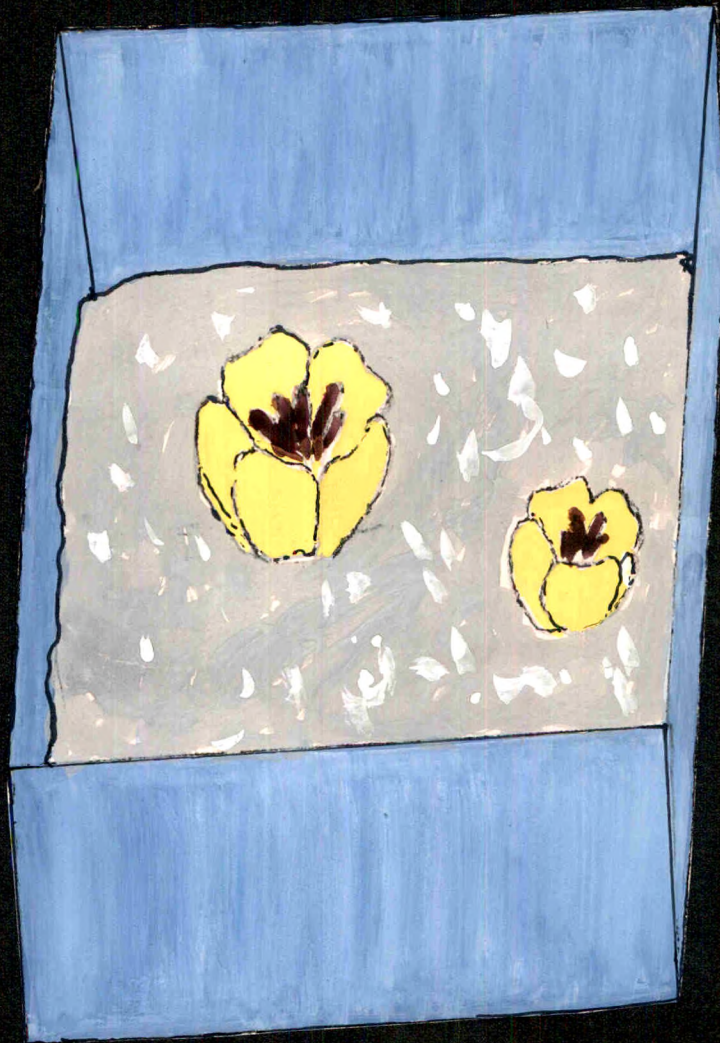


Figure - IV : Illustrating position of flower that is 'Face-up-position' in the desiccant box.



Figure-II : Illustrating position of flower that is 'face-down position' in the desiccant box.



Figure-III : Illustrating position of flower that is 'Horizontal position' in the desiccant box.

During the process of desiccation in face up position the flowers to be kept were allowed to rest the lower petal layer on the surface of chemical leaving an inch of drying medium all around the flower that is bottom, top and sides.

Horizontal position is best suited for long sprays, spikes and stalks. The items that were desiccated require no additional support. Flowers that were desiccated in this position were arranged in centre and enough space was left around to allow the medium to build up, to flow under around between and into each individual flower to support them as in the face up position.

Face down position requires less medium in the bottom. It is most suitable for single and flat petalled flowers. Holding the flower by its stem with the face of the bloom pointed downward, the flower was rested gently on thin layer of medium then slowly covered with desiccant.

#### 3.3.5 : Covering of flowers:

During desiccation process hand technique was found to be the best suited for covering the flower as the flow of desiccant can be controlled with a slight twist given to the wrist. The actual method followed was such that a handful of desiccant was taken and the closed palm was tipped sideways, further the desiccant was allowed to flow slowly and evenly through the opening where little finger meets the palm. After positioning the flower in the box the desiccant was

poured by same method till the whole flower got covered by the medium. Thus, the technique used was followed consciously so as to avoid the damage that could be caused to the petals due to heavy medium or its fast flow which may break or wither the flower.

#### 3.3.6 : Uncovering the flowers:

Uncovering the flowers from desiccants was a tedious job and required care and support to prevent breakage of those fragile dried flowers, as pulling would cause petals to break and scatter. Therefore, to uncover the flowers the box was tipped to allow the desiccant to flow slowly on the plastic sheet, as the flow continued the flowers appeared up and were thus lifted and separated from the desiccant as they became free.

#### 3.3.7 : Cleaning and storing the flowers:

The dried flowers soon after uncovering were brushed with fine hair brush to remove the residue stuck over the petals. Further the dried flower blooms were protected and sealed in closed cartons.

#### 4 : Recording observations:

While weight, stalk length, moisture content of the flowers were noted prior to subjecting them to desiccation, temperature and humidity during the drying period were noted in Appendix (IV & V). After uncovering the flower, dry weight of different flowers were recorded as per period and its range is given (Appendix - III).

5. Evaluation of the techniques:

A evaluation card holding 4 point scale was designed to examine the desiccated flowers. The characteristics of flower that were to be judged and scored were form, colour, smell, wilting and over all appearance. The 4 point scale included the retention of each characteristics that was whether original, fully, moderately or slightly. The score range comprised of 1 - 10 rank. 1 being the least and 10 being the maximum. The evaluation cards were given to the panel members selected from the college staff and students.

[APPENDIX -VI]

Record of 3 replications was maintained separately by the investigator.

6. Statistical analysis:

The data collected for various factors like methods of drying, variety of flower etc., was subjected to statistical analysis by factorial. randomised block design and the results obtained were discussed for the best suited variety of flower for drying, best techniques for drying and drying periods.

## **RESULTS AND DISCUSSION**

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RESULTS AND DISCUSSION

The present study was based on preservation of flowers with the help of desiccant for different periods. The standardised fresh flowers were subjected to prepared desiccants and selected drying periods. The dried flowers thus, were judged in terms of their characteristics like form, colour, smell, wilting and overall appearance. The data obtained were analysed, tabulated and presented under following heads:

- (1) Effect of desiccating methods on the characteristics of flower.
- (2) Effect of drying periods on the characteristics of flowers.
- (3) Combine effect of drying methods and drying periods on the flowers and its respective characteristics.

1. Effect of desiccating methods on the characteristics of flower:

Table 4-1 refers to the desiccating methods and its effect on different characteristics of flower. It is evident from the data that methods are significantly different from each other, with regards to the form of the flower,  $M_2$  was found the best (81.67) followed by  $M_1$  (74.17). In  $M_4$  and  $M_3$  form retention was observed but it was comparatively poorer to the other methods and the values were at par. (69.03 and 67.24).

Table 4.1.1. : Effect of different methods on the characteristics of flower:

Methods	Characteristics				Average means of methods	
	Form	Colour	Smell	Wilting Overall appearance		
M <sub>1</sub> Treated sand method	74.17	69.20	35.85	70.81	77.78	65.56
M <sub>2</sub> Silica gel method	81.67	81.86	39.78	84.11	86.92	74.86
M <sub>3</sub> Borax plus treated sand method	67.24	65.02	22.76	61.14	70.62	57.75
M <sub>4</sub> Aluminium oxide plus treated sand	69.03	70.09	44.2	75.33	81.63	68.66
SE	0.504	0.717	0.717	2-24	0.586	
CD	1.39**	1.98**	1.98**	6.20**	1.62**	

\*\* - Significant at 1 percent level

NS - Non-Significant.

The colour of the flower in  $M_2$  was significantly dominant over other desiccants scoring a value of 81.86.  $M_4$  and  $M_1$  were seen to retain the colour to quite a good extent with par values (70.09 and 69.20) where as  $M_3$  was noted to be poor in colour retention with value 65.02.

With reference to smell, it was found that  $M_4$  with value 44.22 retained better smell as compared to other methods.  $M_3$  was found to be the poorest holding value 22.76 and the corresponding values for smell retention in  $M_2$  and  $M_1$  scored moderately (39.78 and 35.85).

Among the drying methods  $M_2$  was noted the best to minimise the wilting with value 84.11 followed by  $M_4$  (75.33) which was also found better in decreasing the wilting. However, a high rate of wilting was observed in  $M_3$  and  $M_1$  (61.14 and 70.81).

The overall appearance in  $M_2$  and  $M_4$  (86.22 and 81.63) were significantly superior to all other methods, though  $M_1$  and  $M_3$  (77.78 and 70.62) also maintained fairer overall appearance but at lower rate.

Statistically it was affirmed that all the methods were highly significant and  $M_2$  was the most suitable method found for drying fresh flowers.

The results obtained indicate that silica gel method was best method for preserving flower. This may be due to higher moisture absorbent quality of silica gel, due to which

Table 4.1.1. a : Effect of interaction between sand method and characteristics of flowers:

Flowers	Characteristics				Overall appearance	Average means of flowers
	Form	Colour	Smell	Wilting		
Rose	69.53	68.4	52.86	50.46	55.13	57.47
Red Galaridia	84.33	77.13	49.19	77.66	80.46	73.76
Yellow Galaridia	74.46	97.53	37.53	67.06	77.19	70.76
Chrysanthemums	62.20	49.39	25.4	53.84	66.4	51.42
Aster	76.13	62.99	14.33	50.01	67.73	67.78
Daisy	65.32	44.06	15.86	43.73	54.33	44.66
Golden Rods	72.93	69.13	12.90	50.86	68.06	54.60
Marigold	76.73	99.61	63.46	66.2	73.4	75.88
Average mean of characteristics	71.57	71.03	33.94	67.21	67.87	
SE	0.504	0.717	0.717	0.708	0.586	
CD	1.39**	1.98**	1.98**	1.962**	1.624**	

\*\* Significant at 1 percent  
NS : Non-significant.

Table 4.1.1.b : Effect of interaction between Silica gel and characteristics of flowers:

Flowers	Characteristics					Overall appearance	Means of flowers
	Form	Colour	Smell	Wilting	Overall appearance		
(F <sub>1</sub> ) Rose	77.46	77.4	58.13	60.08	79.60	70.53	
(F <sub>2</sub> ) Red Galaridia	82.26	86.93	51.33	82.13	82.26	79.05	
(F <sub>3</sub> ) Yellow Galaridia	78.26	98.2	48.46	60.48	71.26	71.33	
(F <sub>4</sub> ) Chrysanthemums	66.0	51.8	38.95	56.13	66	55.77	
(F <sub>5</sub> ) Aster	57.73	76.53	24.20	63.06	47.73	53.87	
(F <sub>6</sub> ) Daisy	52.02	58.40	34.20	41.81	62	60.77	
(F <sub>7</sub> ) Golden Rods	90.93	82.66	35.11	76.53	82.8	73.60	
(F <sub>8</sub> ) Marigold	78.8	100	57.93	80.46	82.4	79.91	
Means	72.93	78.49	43.51	65.08	71.75		
SE	.504	.717	.717	.708	.586		
CD	1.39**	1.98**	1.98**	1.962**	1.624**		

\*\* Significant at 1 percent level  
 NS : Non-significant.

the moisture from the flower gets absorbed quickly without shrivelling and with minimum changes in colour values. It also helped in retention of form due to its fine particles that easily flow and fill the cavities of flower.

These results almost coincide with the studies and reports given by Condon and Bhutani that the preservation with the help of silica gel ensures the shape and colour to a greater extent as compared to other drying medias.

#### 4.1.1: Effect of interaction between methods and flowers on the characteristics of flowers:

Significant effect of interaction between methods and flowers on the characteristics of flower is evident from the following tables:-

As inferred from Table 4.1.1.a it was seen that  $M_1$  was the best suited for the retention of form and colour which was highly significant. Though the other values were significant they were comparatively lower. The best flower in  $M_1$  was marigold followed by red and yellow galardia in respect to their form, colour and overall appearance.

Sand drying was most preferred by Vance, for most of flowers as it retained the natural shape of flower. Also as sand is an inert material it does not react with the flower substance due to which the flowers are not excessively dehydrated and keep a natural appearance. Besides, sand drying provide a wide fascinating range of colour among flowers.

Table 4.1.1.c : Effect of interaction between borax plus treated sand and

Characteristics of flowers:

Flowers	Characteristics				Overall appearance	means of flowers
	Form	Colour	Smell	Wilting		
Rose	67.8	64.13	47.53	52.66	69.8	60.38
Red Galaridia	78.4	86.59	58.6	73.93	78.8	72.26
Yellow Galaridia	71.27	93.93	46.46	70.13	73.06	56.35
Chrysanthemums	78.93	51.06	37.6	41.26	66	54.97
Aster	57.73	59.26	12.6	58.4	66.13	50.82
Daisy	64.26	40.73	15.23	34.53	64.26	43.80
Golden Rods	68.93	66.26	18.53	42.92	74.33	54.1
Marigold	73.67	87.53	67.68	55.8	77.27	60.19
	70.12	68.68	18.10	53.82	71.20	
SE	.504	.717	.717	.708	.566	
CD	1.39**	1.98**	1.98**	1.962**	1.624**	

\*\* Significant at 1 percent level

NS: Non-significant.

Table 4.1.1.d : Effect of interaction between Aluminium oxide plus treated sand and characteristics of flowers:

Flowers	Form	Characteristics			Overall appearance	Means of flowers
		Colour	Smell	Wilting		
Rose	53.0	71.0	46.93	55.13	80.93	61.39
Red Galaridia	80.13	74.33	64.34	69.33	73	72.22
Yellow Galaridia	73.0	92.46	46.6	68.73	67.20	69.59
Chrysanthemums	64.68	52.19	44.46	45.13	58.66	53.02
Aster	59.16	70.53	16.0	65.26	64.40	55.07
Daisy	56.2	45.40	19.70	36.80	34.13	38.44
Goldern Reds	80.76	71.53	24.33	85.26	80.13	70.20
Marigold	85.39	98.66	63.73	59.40	79.66	77.36
Means	67.79	72.01	40.77	56.25	67.11	
SE	.504	.717	.717	.708	.586	
CD	1.39	1.98	1.98	1.962	1.624	

\*\* Significant at 1 percent level  
 NS: Non-significant.

The effect of interaction between silica gel and the characteristics of flower was highly significant at 1 percent level as noted from table 4.1.1.b. It was found that M<sub>2</sub> was best suitable for marigold with extremely good colour retention also among goldenrods, <sup>yellow</sup> and red galardia, it was better retained. Colour retention was at a fairer rate. The interaction results are almost in line with Chase, as according to him "Silica gel is an extremely absorbent from it dries the flowers within two to eight days providing colours that are brighter and clearer". As reported by Williams and Shumack. Roses and marigold turn best when dried in silica gel for 3-4 days, and almost all flowers retain their form and colour better as compared to other desiccants.

Table 4.1.1.C, depicts the interaction between borax plus treated sand and characteristics of flowers was found significantly superior. The characteristics that turned the best were the overall appearance and form of the flower. M<sub>3</sub> was found to be suitable for red galardia for retention of colour, form and overall appearance.

A positive result was noted by Roesen, in which borax was best suitable for fragile wild flowers. But there are some contradictory statements given by Vance and Bhutani. According to Vance, Borax method adopted by many florist gave disappointing results also Bhutani's research indicated that borax being highly hygroscopic bleaches the flowers if kept in it for appreciable length of time.

In present study, though borax ranked the least, but still some qualities of it helped to turn best few finer textured flowers like red gailardia.

A highly significant interaction was seen between Aluminium oxide plus treated sand and characteristics of flowers. In table 4.1.1. d, it was observed that for the retainment of form in marigold, gailardia, and golden rods  $M_4$  was suitable whereas the values for retainment of smell were found the least.

#### 4.2.1. Effect of periods on the characteristics of flowers:

The periods of drying and the characteristics of the flowers are given in table 4.2.1. It was noted that form was best retained in  $P_2$  (79.42) followed by  $P_3$  (74.42) whereas in  $P_1$  (70.95) was moderately retained. Least form retainment was found in  $P_4$  and  $P_5$  which were at par (67.15 and 66.69).

Colour retainment was observed to be best in  $P_1$  (87.64) followed by  $P_2$  (78.89). As the drying period increased the colour retainment decreased. In  $P_3$  it was moderately retained (73.89) and found the least in  $P_5$  (65.17).

Smell was seen to be adversely affected by extended periods. However, smell retainment was better observed in  $P_1$  (49.13) as compared to other periods where the smell got diminished as the periods were extended (45.22, 32.42, 31.23 and 29.02).

Table 4.2.1 : Effect of periods on the characteristics of flower:

Periods	<u>Characteristics</u>					Overall appearance	Means of periods
	Form	Colour	Smell	Wilting			
(P <sub>1</sub> ) 03 days	70.95	87.64	49.13	54.79	70.48	70.48	67.39
(P <sub>2</sub> ) 05 days	79.42	78.89	45.22	73.07	84.71	84.71	72.26
(P <sub>3</sub> ) 07 days	74.42	73.98	32.42	70.05	76.85	76.85	65.54
(P <sub>4</sub> ) 09 days	67.15	71.66	31.23	60.50	66.65	66.65	59.43
(P <sub>5</sub> ) 11 days	66.69	65.17	29.02	59.23	65.41	65.41	57.10
SE	0.564	0.80	0.82	0.669	0.655	0.655	
CD	1.56**	2.21**	2.27**	1.89**	1.81**	1.81**	

\*\* Significant at 1 percent

NS : Non-significant.

Table : 4.2.1.a : Effect of interaction between treated Sand Method and periods of drying on characteristics of flowers:

Periods of drying	Characteristics				Overall appearance	means of periods of drying
	Form	Colour	Smell	Wilting		
(P <sub>1</sub> ) 03 days	77.25	77.16	39.19	60.45	67.54	64.31
(P <sub>2</sub> ) 05 days	75.25	64.29	49.5	72.04	71.37	64.89
(P <sub>3</sub> ) 07 days	70.33	71.67	38.33	81.66	77.70	67.93
(P <sub>4</sub> ) 09 days	74.37	67.41	32.57	69.33	64.41	61.61
(P <sub>5</sub> ) 11 days	73.42	65.50	24.70	65.58	65.91	45.84
Average means of characteristics						
	74.12	69.20	35.85	69.81	69.38	
SE	1.12	1.60	1.60	1.58	1.31	
CD	NS	NS	NS	NS	NS	

\*\* Significant at 1 percent level

NS : Non-significant.

Table : 4.2.1.b : Effect of Silica gel and periods of drying on the

characteristics of flowers:

Periods of drying	Characteristics					Overall appearance	means of periods of drying
	Form	Colour	Smell	Wilting	appearance		
(P <sub>1</sub> ) 03 days	77.83	95.45	55.92	65.12	78.83	74.63	
(P <sub>2</sub> ) 05 days	84.16	80.87	48.34	83.5	84.41	76.25	
(P <sub>3</sub> ) 07 days	67.04	79.85	38.5	81.58	86.83	70.76	
(P <sub>4</sub> ) 09 days	82.74	79.44	34.12	63.66	81.91	68.37	
(P <sub>5</sub> ) 11 days	74.37	73.71	24.70	62.71	77.63	62.62	
Average means of characteristics							
SE	1.12	1.60	1.60	1.58	1.31		
CD	NS	NS	NS	NS	NS		

\*\* Significant at 1 percent level  
 NS : Non-significant.

Wilting was least observed in  $P_2$  (73.07) followed by  $P_3$  (70.05). Wilting in  $P_4$  and  $P_5$  were found at part (60.50 and 59.23) and wilting was seen maximum in  $P_1$  (54.79).

Considering the overall appearance it was affirmed that in  $P_2$  (84.71) the appearance was best followed by  $P_3$  (76.85).  $P_1$  showed moderate values (70.48) whereas  $P_4$  and  $P_5$  maintained overall appearance with lower values and at par (66.65 and 65.41).

In general, it could be said that five days period was significantly superior over other all periods.

According to Geneal Condon almost all types of flowers require two to three weeks to get dried in the desiccants. Whereas the present findings prove that as the period of desiccation was reduced the results were better. This may be due to the humidity level and atmospheric temperature present during processing. Also the drying capacity and ability to dry the material depend on the type and proportions of desiccant mixtures.

By adopting more sophisticated drying methods as reported by Shutani, the flowers could be dried into the oven within hours or minutes producing superb and high quality dried materials

#### 4.2.1 Effect of interaction between drying methods and drying periods on the characteristics of flower:

The interaction between <sup>drying methods and</sup> drying periods are found to be non-significant and are depicted in the tables.

Table : 4.2.1.c. Effect of interaction between Borax plus treated sand and drying periods on the characteristics of flowers:

Periods of drying	Characteristics				Overall appearance	means of periods of drying
	Form	Colour	Smell	Milting		
(P <sub>1</sub> ) 03 days	76.73	71.53	38.79	57.95	66.24	62.24
(P <sub>2</sub> ) 05 days	70.41	63.75	43.87	56.83	64.61	59.89
(P <sub>3</sub> ) 07 days	66.45	56.45	27.10	60.83	80.46	58.25
(P <sub>4</sub> ) 09 days	61.25	55.33	14.87	52.54	68.70	50.53
(P <sub>5</sub> ) 11 days	61.37	43.04	10.58	42.56	59.33	43.37
Average means of characteristics						
	67.24	58.01	27.04	54.14	67.86	
SE	1.12	1.60	1.60	1.58	1.31	
CD	NS	NS	NS	NS	NS	NS

\*\* significant at 1 percent level.

NS : Non-significant.

Table : 4.2.1.6 : Effect of interaction between aluminium oxide plus treated sand and periods of drying on the characteristics of flowers:

Periods of drying	Characteristics				Overall appearance of flowers
	Form	Colour	Smell	Wilting	
(P <sub>1</sub> ) 03 days	68.70	68.58	48.45	63.37	69.74
(P <sub>2</sub> ) 05 days	69.66	75.66	45.35	80.33	81.58
(P <sub>3</sub> ) 07 days	70.87	71.75	45.58	72.75	82.24
(P <sub>4</sub> ) 09 days	64.62	68.41	39.20	80.04	67.83
(P <sub>5</sub> ) 11 days	66.33	66.30	42.54	69.41	66.74
Average means of characteristics	68.03	70.14	44.22	73.18	73.62
SE	1.12	1.60	1.60	1.58	1.31
CD	NS	NS	NS	NS	NS

\*\* Significant at 1 percent level

NS : Non-significant.

From table 4.2.1.a, it was obvious that interaction was found to be non-significant between sand method and periods of drying.

As noted from table 4.2.1.b, there was no significance amongst the interaction between silica gel method and periods of drying.

The interaction between borax plus treated sand and different periods of drying was found non-significant and is depicted in table 4.2.1.c.

The effect of interaction between the Aluminium oxide plus treated sand method and different periods is given in table 4.2.1 d which was statistically found non-significant.

#### 4.3.1 Combine effect of drying methods and drying periods on flowers and on its respective characteristics:

As inferred in table 4.3.1 with regard to the varieties of flowers and the characteristics of flower, it has been seen that form retention in red galardia was best (83.78) followed by marigold, goldenrods and yellow galardia which were found to be at par (77.89, 75.89 and 74.25) whereas daisy and Aster were found to retain their form with least values (62.69 and 60.45).

Colour retention in case of marigold and Yellow Galardia was observed to be significantly superior with similar

Table 4.3.1 : Combine effect of drying methods and drying periods on different

Flowers and its respective characteristics:

Flowers	Characteristics				Overall appearance	Means of flowers
	Form	Colour	Smell	Wilting		
Rose	66.94	70.23	61.36	54.58	69.58	64.53
Red Galaridia	83.78	78.74	40.91	85.81	80.61	73.97
Yellow Galaridia	74.25	95.53	44.76	61.6	73.62	69.91
Chrysanthemums	67.95	51.11	39.10	49.09	66.4	54.73
Aster	62.69	67.32	16.78	49.18	60.06	51.12
Daisy	60.45	47.14	11.26	59.21	56.24	46.86
Golden Rods	75.89	72.39	24.96	74.11	75.33	64.53
Marigold	77.89	96.45	53.2	65.46	78.43	74.28
SE	0.713	1.01	1.01	1.001	0.688	
CD	1.976**	2.79**	2.79**	2.774**	1.906**	

\*\* Significant at 1 percent

NS : Non-significant.



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values (96.45 and 95.53). Red Galardia also retained its colour to a better extent (78.74). It was also noted that golden rods, Rose and Aster retained their colour moderately and were at par (72.39, 70.23 and 67.32). Least colour retention was seen in Chrysanthemum and Daisy which were also at par (51.11 and 47.14).

Smell being volatile in nature it was affected during desiccation process. However, a better retention was found in Rose (61.96) followed by Marigold (53.2). Moderate retention was observed in Yellow galardia, Red galardia and chrysanthemum which were at par (44.76, 40.91 and 39.10). The retention was least in Golden rods, Aster, Daisy with values 24.96, 16.78 and 11.26 respectively.

Among the flowers selected, red galardia and Golden rods were observed to be least wilted which were having values at par (85.81 and 74.11). A moderate wilting was noticed in Daisy and *Roses* (59.29 and 54.58). Aster and Chrysanthemum were seen to be wilted at similar rate, whereas minimum wilting was found in multipetalled Marigold and Yellow Galardia (55.46 and 49.6).

Scores of overall appearance indicated in Red Galardia and marigold to be ranked highest which were at par (80.61 and 78.43) followed by Golden Rods and Yellow galardia which were also at par (75.33 and 73.62). Moderate retention was observed

Table 4.3.1.a : Effect of interaction between Rose and different periods on the characteristics of flowers:

Periods of drying	Characteristics					Overall appearance	Means of periods
	Form	Colour	Smell	Wilting			
03 days	93.17	84.67	52.17	69.92	52.42	70.41	
05 days	78.17	71.42	42.67	72.67	69.92	66.97	
07 days	76.17	71.58	41.69	73.50	63.42	59.83	
09 days	60.58	63.75	40.58	69.92	46.50	56.26	
11 days	60.33	59.35	38.17	63.17	59.15	56.03	
Means of characteristics	73.68	64.75	53.49	69.83	58.23		
SE	1.59	2.26	2.26	2.24	1.85		
CD	4.40**	6.26**	6.26**	6.20**	5.12**		

\*\* Significant at 1 percent level

NS - Non-significant.

both in Rose and Chrysanthemum and least was seen in Aster and daisy (60.06 and 56.24).

On the whole it could be affirmed that colour value was obviously significant over other factors. Form and overall appearance was significantly retained in almost all the flowers. Smell and wilting were seen to be scoring moderate or least depending on the variety of flowers.

The means calculated and analysis done showed that marigold turned the best among all other flowers selected for study in respect to all the characteristics scoring significantly excellent, secondly red and yellow galardia were found superior in maintaining its delicate overall appearance.

Further golden rods, Roses and Chsyanthemuns scored moderately in maintaining the form and over all appearance.

Least score values were recorded by Asters and Daisy.

#### 4.3.1 Effect of interaction between drying periods and flowers on the characteristics of flower:

The effect of interaction between flowers and periods on the characteristics of flower was found significant and each flower interaction with periods as depicted in the given series of tables:

From the table 4.3.1 a it was indicated that the interaction between Rose and periods was highly significant at 1 percent level. The retention of form was best in  $P_1$  and best in  $P_5$ .

Table 4.3.1.b: Effect of interaction between Red Galardia and periods of drying  
on the characteristics of flowers:

Periods of drying	Characteristics					Means of periods
	Form	Colour	Smell	Wilting	Overall appearance	
03 days	87.50	83.67	66.17	65.17	88.42	78.16
05 days	85.50	83.25	50.25	80.50	84.92	76.88
07 days	77.33	80.00	33.25	78.42	78.67	69.53
09 days	79.92	76.25	31.33	74.52	73.52	67.05
11 days	78.92	71.58	30.17	71.92	72.08	64.93
Means of characteristics	81.83	78.95	42.23	74.10	79.46	
SE	1.59	2.26	2.26	2.24	1.85	
CD	4.40**	6.26**	6.26**	6.20**	5.12**	

\*\* Significant at 1 percent level  
 NS- Non-significant.

Table 4.3.1.c. Effect of Yellow Galardia and periods of drying on the characteristics of flowers:

Characteristics of flowers:

Periods of drying	Characteristics				Overall appearance	Means of periods.
	Form	Colour	Smell	Wilting		
03 days	80.75	97.42	58.54	53.78	81.42	74.38
05 days	76.83	96.58	55.08	75.50	82.00	77.19
07 days	70.75	96.17	50.92	71.00	77.67	73.30
09 days	68.25	94.75	45.42	67.25	77.08	70.55
11 days	62.17	92.73	28.17	67.92	74.17	66.23
Average means	72.95	95.53	47.62	67.09	78.46	
SE	1.59	2.26	2.26	2.24	1.85	
CD	4.40**	6.26**	6.26**	6.20**	5.12**	

\*\* Significant at 1 percent level

NS- Non-significant.

Same was observed in Williams and Shumack's findings where roses turned best when dried in 3 to 4 days of duration. Also according to Bhutani, white roses turned excellent when dried in microwave oven by using sand or silica gel as medium.

Table 4.3.1 b illustrates the results of interaction in respect to flower and period was highly significant at one percent level and the most suitable period for red galardia was noted to be in  $P_1$  and  $P_2$  with excellent retention of form colour and overall appearance, however the least retention value was seen in  $P_5$ . The change in red tone during desiccation was observed, which is in line to the statement given by Bhutani "Red tones grow darker after desiccation".

High level of significance at one percent was noted in table No.4.3.1.c. In the interaction among Yellow galardia and periods of drying it was found that  $P_1$  was the best period for colour retention and  $P_2$  for overall appearance with high values.

Yellow colour retention in present study, was found in line with Condon's study where Yellow colour regardless of any flower substance and desiccant retained best with natural sheen over the surface.

The effect of interaction between chysanthemums and period of drying was highly significant at 1 percent level. As it is evident from table 4.3.1.d  $P_1$  and  $P_2$  was superior in maintaining the overall appearance also colour retention found was extremely well.

Table : 4.3.1 d : Effect of Chrysanthemums and periods of drying on the characteristics of flowers:

Periods	Characteristics				Overall appearance	means of <del>periods</del>
	Form	Colour	Smell	Wilting		
03 days	65.75	55.67	45.67	50.50	67.17	56.95
05 days	65.92	55.08	44.50	56.22	66.33	57.61
07 days	66.50	57.17	37.25	44.17	64.83	53.98
09 days	65.08	47.42	35.25	41.17	64.75	50.73
11 days	50.08	47.42	28.00	34.08	65.25	44.96
<hr/>						
Average Means of characteristics	62.36	52.55	38.13	45.22	65.66	
<hr/>						
SE	1.59	2.26	2.26	2.24	1.85	
CD	4.40**	6.26**	6.26**	6.20**	5.12**	
<hr/>						

\*\* Significant at 1 percent

NS : Non-significant.

Table 4.3.1.e : Effect of interaction between Aster and periods of drying on the characteristics of flowers:

Periods	Characteristics				Overall appearance	means of periods
	Form	Colour	Smell	Wilting		
03 days	71.93	74.25	25.0	58.67	73.50	60.67
05 days	63.67	72.08	23.33	65.00	76.00	60.01
07 days	64.33	72.08	14.78	62.33	66.50	56.0
09 days	63.0	62.25	12.58	59.78	64.17	52.35
11 days	55.67	60.25	6.42	52.92	62.08	47.46
Average means of characteristics	63.72	68.18	16.42	59.74	68.45	
SE	1.59	2.25	2.26	2.24	1.85	
CD	4.40**	6.26**	6.26**	6.20**	5.12**	

\*\* Significant at 1 percent  
 NS : Non-significant.

Table : 4.3.1. f : Effect of interaction between Daisy and periods of drying  
on the characteristics of flowers:

Periods of drying	Form	Characteristics			Overall appearance	Means of periods of drying
		Colour	Smell	Wilting		
03 days	55.08	54.92	22.42	45.50	50.42	45.66
05 days	60.67	53.50	21.13	58.33	50.92	48.91
07 days	49.83	47.33	21.42	38.83	47.50	40.88
09 days	54.08	43.08	13.92	38.75	51.75	40.31
11 days	45.33	39.92	13.00	36.83	45.83	36.18
Average means of characteristics						
	52.99	47.75	18.37	43.64	49.28	
SE	1.59	2.26	2.26	2.24	1.85	
CD	4.40**	6.26**	6.26**	6.20**	5.12**	

\*\* Significant at 1 percent level  
 NS- Non-significant.

Chrysanthemums being white and delicate could retain their originality only when they were desiccated in proper manner and was uncovered immediately after drying.

Table 4.3.1. e ascertained that the interaction between asters and periods was found to be highly significant at 1 percent level. The best period for aster for retention of colour and overall appearance was  $P_1$  and  $P_2$ .

According to Condon's experiment violet turned to blue tinge after desiccation, similar results were observed in present study by the investigator.

As observed from the table 4.3.1.f the effect of interaction of daisy and periods of drying was noted highly significant, the most suitable periods for daisy ( $F_6$ ) were  $P_1$  and  $P_2$  for retention of form. The extended periods could not retain the form as flower bunches of daisy started withering due to over drying or thinning of the petals.

Table 4.3.1.g shows the interaction among Golden rods and periods of drying was highly significant at 1 percent level. It was seen that retention of form colour and overall appearance was elegant in almost all the period of drying except  $P_1$ .

The reason for retention of form even at eleven days may be due to the strong and turgid stalk and firmness of flower which does not allow, the tiny petals to shrivel or cause deforming.

Table : 4.3.1.9 : Effect of Golden rods and periods of drying on the

characteristics of flowers:

Periods of drying	Characteristics				Overall appearance	means of periods of drying
	Form	Colour	Smell	Wilting		
03 days	68.50	77.58	20.92	36.78	67.58	54.27
05 days	71.17	77.25	18.67	58.78	78.33	60.84
07 days	71.58	68.33	15.83	67.50	72.42	59.13
09 days	81.17	72.00	13.58	62.33	75.17	60.85
11 days	78.33	66.83	10.67	62.92	70.33	57.81
Average means of characteristics						
	74.15	72.39	15.93	57.66	72.76	
SE	1.59	2.26	2.26	2.24	1.85	
CD	4.40**	6.26**	6.26**	6.20**	5.12**	

\*\* Significant at 1 percent level

NS : Non-significant

Table : 4.3.1.h : Effect of interaction between Marigold and periods of drying on the different characteristics of flowers:

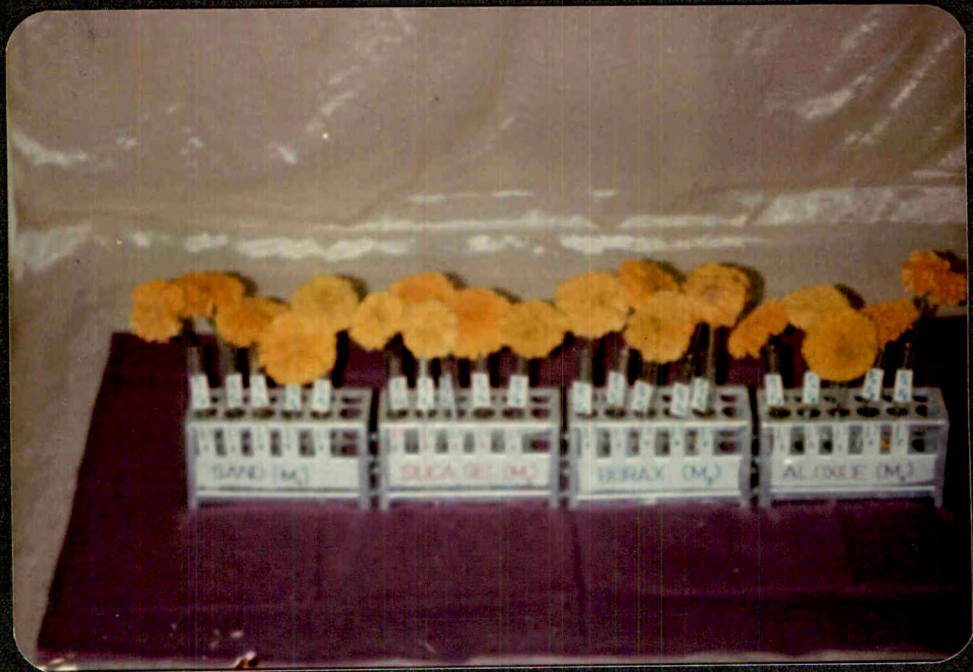
Periods of drying	Characteristics					means of periods of drying
	Form	Colour	Smell	Wilting	Overall appearance	
03 days	74.92	97.00	72.17	57.42	72.92	74.88
05 days	78.50	98.00	68.17	60.25	73.33	75.65
07 days	79.25	97.00	45.42	66.25	81.83	73.95
09 days	79.17	97.83	38.67	82.33	80.58	75.71
11 days	70.75	98.92	28.58	72.52	73.92	68.93
Average means of characteristics						
	79.50	97.75	36.97	67.60	76.51	
SE	1.59	2.26	2.26	2.24	1.85	
CD	4.40**	6.25**	6.26**	6.20**	5.12**	

\*\* Significant at 1 percent level

NS : Non-significant

From the interaction table 4.3.1.h it was obvious that flower and periods of drying were highly significant at 1 percent level. Marigold was found superior in respect to colour, form and overall appearance regardless of any period.

Marigold being thick petalled and its strong adherence to the thallamus as compared to other flowers, it hardly got affected by extended periods and different mediums used. This finding go along with the research carried out by Bhutani and as opined by William and Shuzmack in which marigold retained its yellow tinge and maintained its form excellently when dried in any medium.



Picture- I : Depicting Marigolds preserved, using different methods and periods.



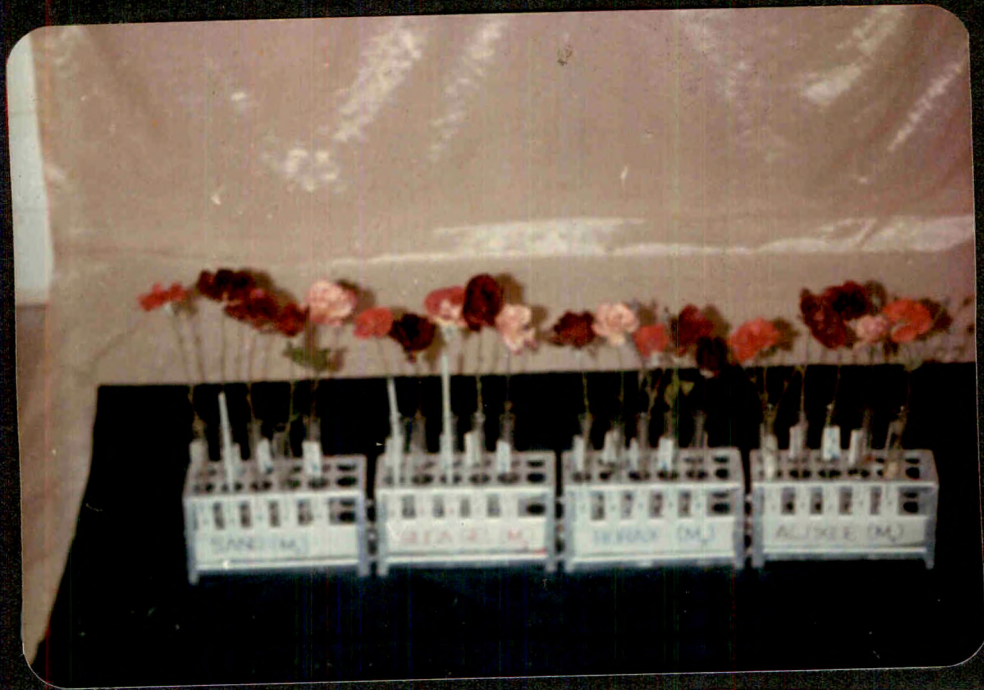
Picture-II : Depicting Red Galardias preserved, using different methods and periods.



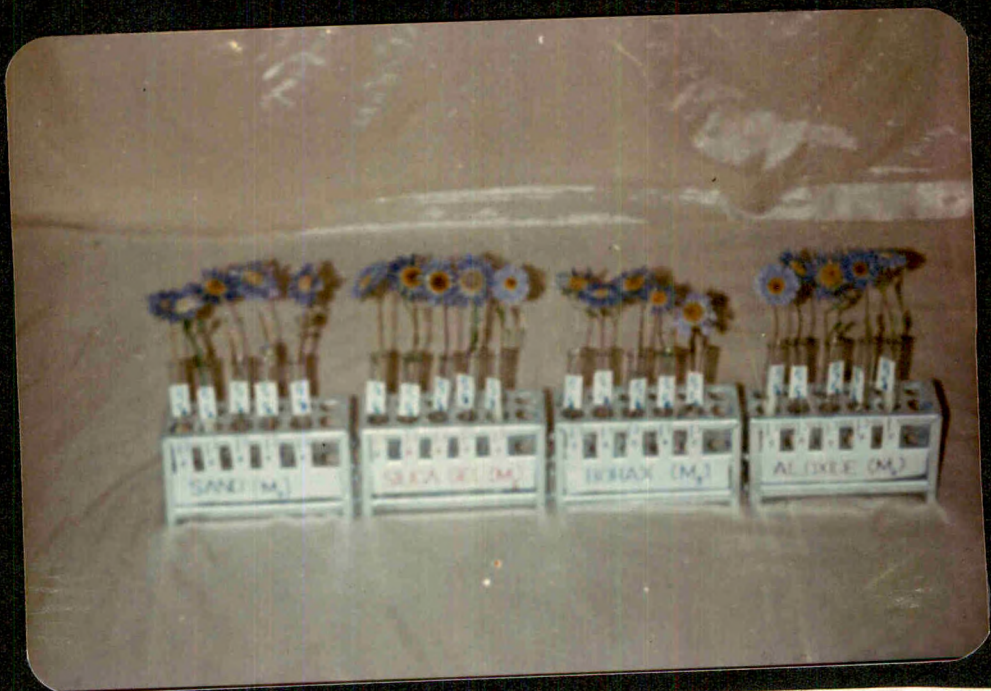
Picture-III: Showing Yellow Galardias preserved, using different methods and periods.



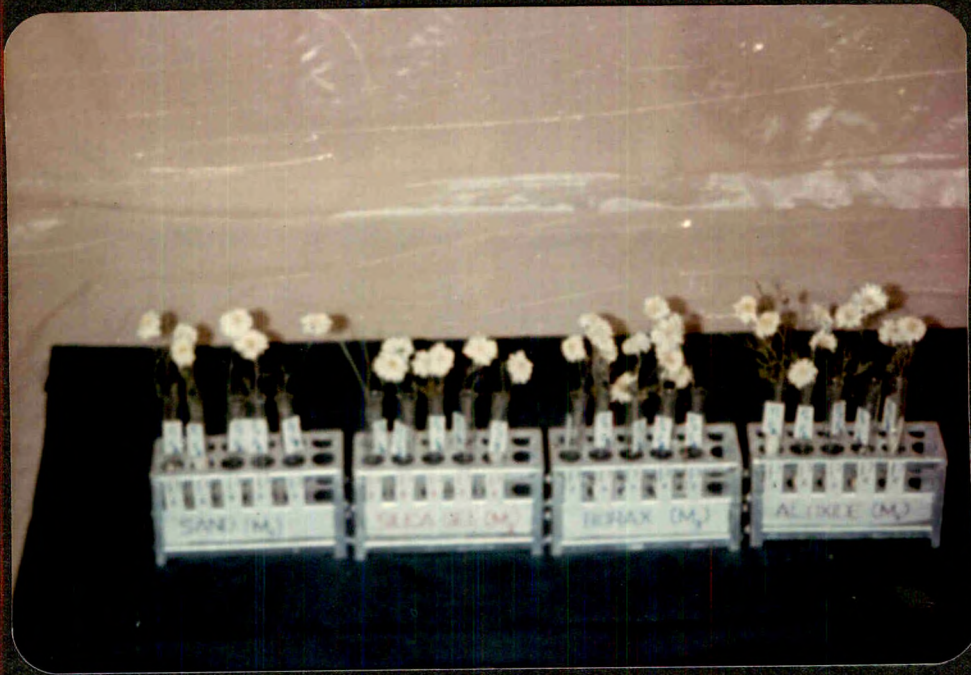
Picture-IV : Illustrating Goldenrods preserved, using different methods and periods.



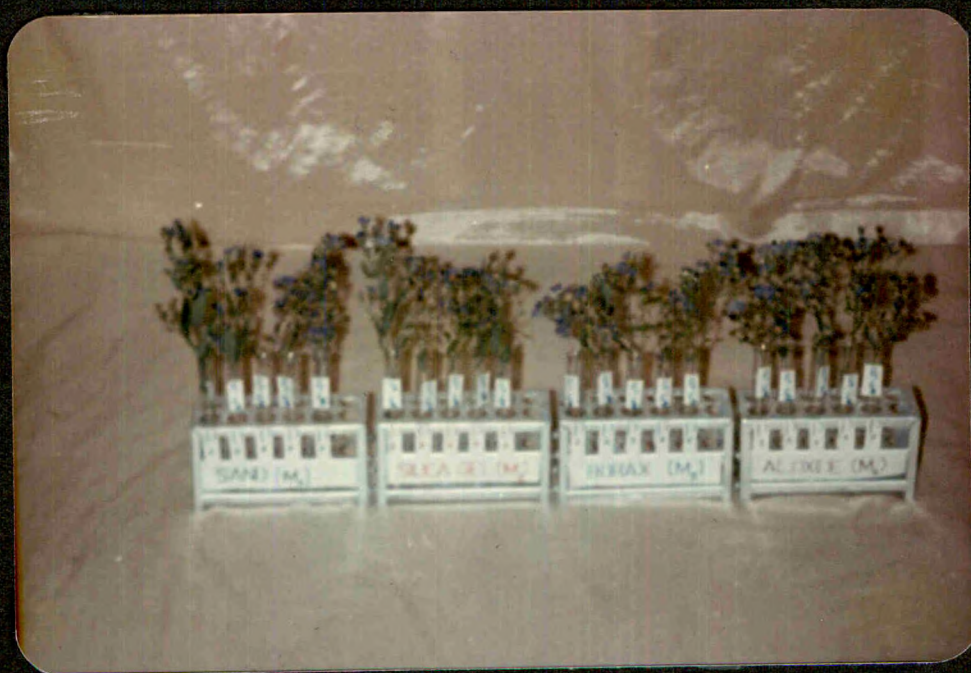
Picture-VI : Illustrating Roses preserved, using different methods and periods.



Picture-VI : Illustrating Asters preserved, using different methods and periods.



Picture-VII : Showing Chrysanthemums preserved, using different methods and periods.



Picture-VIII: Depicting Daisies preserved, using different methods and periods.

## **SUMMARY AND CONCLUSION**

SUMMARY

The study entitled "Preservation of flowers with the help of desiccant for different periods" was under taken with the following objectives:-

To study the different drying methods used for flower preservation.

To make the seasonal flowers available in off-season period.

To compare and select the most suitable drying methods for preserving flowers used for home decoration purposes.

To choose and evaluate the best period for preserving the flora.

5.1 To study the different drying methods used for flower preservation:

Flower preservation with the help of desiccants though not new but still unknown to many homemakers. The flowers that are dried through desiccation, unbelievably turn fantastic and resemble to the fresh flowers if kept together.

Desiccation is a drying process of flowers where the moisture and flower juices are withdrawn or ~~absorbed~~ by the desiccant leaving the flower intact and well retained with its original form colour and appearance.

Therefore present study comprised of using different desiccants that were treated sand, borax Al. oxide and Silica gel. All these desiccants hold different properties but one common factor that is it absorbs the moisture present in flower during process of drying and retain the flowers characteristics amazingly good and beautiful. Only the rate of absorption and ability to maintain the flower's originality depends upon the type and proportion of desiccant mixtures.

5.2 To make the seasonal flowers available in off-season period.

Flowers life if would have long lasted, florist and Scientists must have not tried to preserve them to increase longevity and retain its freshness or dry them for off-season period.

The present study pertains on same idea to make those seasonal flowers available in off-season period. The flowers selected are golden rods, marigold, Aster, daisy, Galaridias roses and Chrysanthemum for the study. After dessicating these flowers turned best that is Marigold and galaridias were excellent in respect to its over all appearance, form and colour retention.

Golden rods, roses and chrysanthemums seen to be moderately retaining its originality.

Daisy and Aster showed negative results with regard to its retention of form and colour.

5.3 To compare and select most suitable drying methods.

It was observed that Silica gel method produced flowers of superb quality and positively retained all the general characteristics of almost all flowers.

Aluminium oxide plus treated sand turned best in maintaining the form and over all appearance.

Treated sand method also gave positive results but its heaviness affected the over all appearance of few flowers and distortion of few flowers was observed.

Borax being highly hygroscopic was found to be the poorest desiccant. Through it dried the flower fast it faded or shrivelled the flower petals also in case of some flowers browning was observed resulting in wilted flowers.

5.4 To choose and evaluate the best period for preserving the flora:

Flowers regardless of its characteristics respond differently to different media of drying, so also the drying of flower depends on its moisture contents, type of media and duration used for drying.

It was noted that 5 days period of drying was most suitable for almost all flower selected. Some flowers that were single petalled and fragile got dried even in 3 days. Very few flowers dried in 7 days period, *eg - Marigold*

The extending period of drying showed deterioration in the colour and quality of the flowers.

Thus, it may be concluded that Silica gel method was best suited for almost all the flowers. Borax though cheapest desiccant was not found suitable for all types of flower, due to its draw backs such as browning and scorching of petals resulting in wilted flowers.

The best duration was five days and also 3 days for majority of fragile flowers. Whereas extended periods were found suitable only for few flowers.

Among selected flowers marigold and galardias turned best and retained its originality to the maximum in almost all the medias and periods.

## **LITERATURE CITED**

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### LITERATURE CITED

The study carried on "THE PRESERVATION OF SELECTED FLOWERS WITH HELP OF DESICCANTS FOR DIFFERENT PERIODS", is a unique and renown study in itself therefore the references related to it are quite less and are cited below :

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A P P E N D I X - I

Stalk length of flowers

Sr.No.	Flowers	Stalk length
1	Rose	6 inches
2	Red Galardia	4 inches
3	Yellow Galardia	4 inches
4	Chrysanthemums	5 inches
5	Asters	6 inches
6	Daisies	7 inches
7	Golden Rods	10 inches
8	Marigold	7 inches

## **APPENDICES**

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A P P E N D I X - II

Table - Moisture content of standardised fresh  
flowers:

Sr.No.	Standardised flowers	Moisture content
1	F <sub>1</sub> Rose	2.162 Percent
2	F <sub>2</sub> Red Galardia	1.521 Percent
3	F <sub>3</sub> Yellow Galardia	1.842 Percent
4	F <sub>4</sub> Chrysanthemums	1.143 Percent
5	F <sub>5</sub> Aster	1.392 Percent
6	F <sub>6</sub> Daisy	2.009 Percent
7	F <sub>7</sub> Golden Rod	2.655 Percent
8	F <sub>8</sub> Marigold	3.307 Percent

A P P E N D I X - III

Fresh weight range and Dry weight range of standardised

flowers during periods of drying:

Flowers	Fresh weight range					Dry weight range				
	P <sub>1</sub> gm	P <sub>2</sub> gm	P <sub>3</sub> gm	P <sub>4</sub> gm	P <sub>5</sub> gm	P <sub>1</sub> gm	P <sub>2</sub> gm	P <sub>3</sub> gm	P <sub>4</sub> gm	P <sub>5</sub> gm
F <sub>1</sub>	5.10 - 6.5 gm	1.05 - 3.45	1.94 - 2.08	1.75 - 2	1.75 - 1.86	1.25 - 1.70				
F <sub>2</sub>	1.80 - 2.07 "	1.25 - 2.00	1.15 - 1.85	1.10 - 1.65	1.10 - 1.45	1.10 - 1.45				
F <sub>3</sub>	2.00 - 2.30 "	1.85 - 2.10	1.60 - 1.95	1.60 - 1.95	1.40 - 1.75	1.40 - 1.75				
F <sub>4</sub>	1.65 - 2.90 "	1.45 - 2.65	1.45 - 2.60	1.35 - 2.55	1.35 - 2.55	1.35 - 2.55				
F <sub>5</sub>	1.97 - 2.10 "	1.40 - 1.25	.95 - 1.20	.90 - 1.10	.80 - 1.00	.80 - 1.00				
F <sub>6</sub>	2.20 - 2.95 "	1.25 - 2.65	1.10 - 2.25	.95 - 1.25	.90 - 1.10	.90 - 1.10				
F <sub>7</sub>	8.7 - 13.10 "	4.00 - 7.10	4 - 6.70	4.5 - .50	3.50 - 5.25	3.25 - 5.50				
F <sub>8</sub>	6.50 - 11.88 "	4.25 - 8.00	4 - 7.20	3.85 - 6.10	3.50 - 5.00	3.50 - 4.75				

A P P E N D I X - IV

Temperature range recorded during research period

<u>Date</u>	<u>Maximum temperature recorded</u>	<u>Minimum temperature recorded</u>
17th April 1989	40.8°C	19.8°C
18th April 1989	40.3°C	23.6°C
19th April 1989	40.6°C	25.1°C
20th April 1989	39.7°C	27.1°C
21st April 1989	40.0°C	22.6°C
22nd April 1989	41.3°C	23.9°C
23rd April 1989	42.4°C	25.0°C
24th April 1989	40.7°C	23.9°C
25th April 1989	40.6°C	22.1°C
26th April 1989	41.0°C	24.6°C
27th April 1989	40.6°C	22.6°C

Temperature range recorded during post research period:

<u>Month</u>	<u>Maximum temperature recorded</u>	<u>Minimum temperature recorded</u>
June	44°C	31°C
July	41°C	29°C
August	38°C	24°C

A P P E N D I X - V

Humidity percentage recorded during research period

Date	Antimeridian (5.30 am)	Post Meridian (6 pm)
17th April 1989	33 Percent	15 Percent
18th April 1989	32 Percent	13 Percent
19th April 1989	52 Percent	18 Percent
20th April 1989	42 Percent	15 Percent
21st April 1989	40 Percent	23 Percent
22nd April 1989	34 percent	20 percent
23rd April 1989	55 Percent	13 Percent
24th April 1989	25 percent	14 Percent
25th April 1989	36 Percent	17 Percent
26th April 1989	39 Percent	15 Percent
27th April 1989	31 Percent	12 Percent

Humidity percentage during Post research period

Month	Antimeridian (5.30 am)	Post Meridian (6 pm)
June	57 Percent	36 Percent
July	69 Percent	57 Percent
August	72 Percent	61 Percent

A P P E N D I X - VI

4-Point scale Evaluation Card given to Panel members:

N - R-

Characteristics P<sub>2</sub><sup>F</sup><sub>1</sub> P<sub>2</sub><sup>F</sup><sub>2</sub> P<sub>2</sub><sup>F</sup><sub>3</sub> P<sub>2</sub><sup>F</sup><sub>4</sub> P<sub>2</sub><sup>F</sup><sub>5</sub> P<sub>2</sub><sup>F</sup><sub>6</sub> P<sub>2</sub><sup>F</sup><sub>7</sub> P<sub>2</sub><sup>F</sup><sub>8</sub>

1. Form of the flower

Fully retained  
Moderately retained  
Slightly retained  
Totally lost

2. Colour of the flower

Original  
Slightly discoloured  
Moderately discoloured  
Totally changed

3. Smell

Original  
Slightly weak  
Weak  
Not original

4. Wilting

Not wilted  
Slightly wilted  
Moderately wilted  
Totally wilted

5. Overall Appearance

Fresh  
Moderately fresh  
Slightly fresh  
Totally fresh

Dated:

SIGNATURE

Note: Please rank between 1-10 score where 1 taken as least rank and 10 taken as maximum rank.

ANOV A - C<sub>1</sub>

---

SV	b	e(a)
SS	17469.3	754.75
MSS	2495.61	

---

SV	c	b x c	e(b)
SS	2380.5	23111.5	3356.75
MSS	595.125	825.411	

---

SV	d	b x d	c x d	b x c x d
SS	1073.25	6637.75	147.5	8413.75
MSS	357.75	316.083	12.2917	100.164

---

SV	e(c)	Total
SS	5664.5	69133.5
MSS	23.6021	

---

A N O V A - C<sub>2</sub>

---

SV		b		e(a)
SS		136426		2208
MSS		19489.4		157.714

---

SV	c	b x c		e(b)
SS	6426.25	5179.75		6974
MSS	1606.56	184.991		108.969

---

SV	d	b x d	c x d	b x c x d
SS	8210.75	4092.25	317.5	3521.25
MSS	2736.92	194.869	26.4583	

---

SV		e(c)		Total
SS		10882		184255
MSS		45.3417		

---

A N O V A - C<sub>3</sub>

---

SV		b		e(a)
SS		168907		6054.13
MSS		24129.6		432.438

---

SV	c	b x c		e(b)
SS	6201.38	7361.88		5809.25
MSS	1550.34	262.924		90.769

---

SV	d	b x d	c x d	b x c x d
SS	2048.06	3803.56	1940.88	9138.25
MSS	682.688	181.122	161.74	108.789

---

SV		e(c)		Total
SS		7890.75		219948
MSS		32.8781		

---

A N O V A - C<sub>4</sub>

---

SV		b		e(a)
SS		65909		7507
MSS		9415.57		

---

SM	b x c		c	e(b)
SS	26125.5		1473.13	4931
MSS	933.054		398.281	

---

SV	d	b x d	c x d	b x c x d
SS	2036.63	5308.25	653.375	8158.25
MSS	678.875	252.774	54.4479	97.122

---

SV		e(c)		Total
SS		6834.5		129903
MSS		28.4771		

---

A N O V A - C<sub>5</sub>

---

SV		b		e(a)
SS		50075.8		1712.25
MSS		7153.68		122.304

---

SV	b x c		c	e(b)
SS	8287.25		5226	2925.75
MSS	295.973		1306.5	45.7148

---

SV	d	b x d	c x d	b x c x d
SS	5766.75	7577.75	1726.75	7122
MSS	1922.25	360.845	143.896	84.7857

---

SV		e(c)		Total
SS		8572		99584.3
MSS		35.7167		

---

A P P E N D I X - VII

Table showing interaction scores of M x P x F:

	M1					M2					M3					M4				
	C1	C2	C3	C4	C5	C1	C2	C3	C4	C5	C1	C2	C3	C4	C5	C1	C2	C3	C4	C5
F <sub>1</sub>	88.83	87.00	72.33	52.33	68.67	96.67	97.33	68.33	72.67	79.00	94.33	67.33	63.00	63.36	60.00	95.33	87.00	73.00	70.67	67.33
F <sub>2</sub>	73.67	78.33	59.67	58.67	66.33	85.33	74.67	67.33	78.00	74.00	83.00	68.67	60.67	70.67	64.33	80.67	75.00	61.00	78.67	78.00
F <sub>3</sub>	74.33	74.33	54.33	58.67	50.67	84.67	78.00	59.33	69.33	61.00	69.67	66.00	49.67	62.33	78.00	76.00	72.00	74.23	73.33	54.00
F <sub>4</sub>	64.33	70.67	54.33	50.60	46.33	65.67	69.33	50.33	68.31	50.00	52.00	61.67	42.67	58.67	52.67	60.33	62.33	51.00	72.00	47.00
F <sub>5</sub>	47.66	61.67	51.67	48.67	45.67	78.67	67.67	47.33	68.75	50.37	60.00	58.00	40.00	42.33	50.67	56.67	58.67	40.67	70.10	41.67
F <sub>6</sub>	81.67	86.67	71.33	90.00	89.67	95.33	91.67	60.67	98.15	99.00	33.33	60.33	64.66	73.67	85.00	89.67	80.00	67.00	85.17	80.00
F <sub>7</sub>	85.00	83.33	50.00	86.33	85.67	86.33	93.33	59.33	91.67	87.33	32.67	77.00	52.00	80.67	78.33	88.00	79.33	64.33	90.50	76.33
F <sub>8</sub>	84.00	81.00	50.00	86.00	76.00	85.67	86.67	52.67	78.00	82.67	75.00	81.00	37.74	82.00	76.67	82.67	71.33	59.00	78.42	84.33
F <sub>9</sub>	87.33	70.00	41.00	72.00	75.67	81.67	82.33	28.00	72.67	76.33	74.67	78.33	35.33	73.67	76.00	76.00	72.33	56.00	74.52	69.00
F <sub>10</sub>	84.33	70.67	32.33	71.67	76.33	72.33	78.67	28.00	72.33	69.67	72.33	66.33	31.57	70.33	71.63	77.33	68.67	33.73	71.90	67.67
F <sub>11</sub>	86.67	99.67	56.00	73.67	71.33	78.67	99.00	63.33	65.67	82.00	78.67	95.67	57.67	72.33	92.00	93.67	94.33	58.00	73.78	80.33
F <sub>12</sub>	67.33	90.67	56.33	78.00	64.33	73.67	98.67	57.33	77.33	80.00	83.67	92.67	94.67	78.00	86.33	84.00	96.33	52.00	75.50	87.33
F <sub>13</sub>	70.33	56.66	49.00	75.62	79.66	68.00	96.33	35.67	75.00	76.67	78.00	95.33	41.33	79.00	84.00	76.33	94.33	51.67	71.00	73.33
F <sub>14</sub>	67.33	97.00	45.33	72.33	70.00	67.00	96.67	33.67	73.75	76.33	67.00	82.67	99.67	64.33	80.67	75.33	90.00	29.00	67.25	71.67
F <sub>15</sub>	66.67	95.67	31.00	64.00	73.67	66.00	95.67	25.33	69.61	70.33	69.00	91.33	17.00	62.00	78.67	65.67	88.33	20.33	61.92	69.00
F <sub>16</sub>	70.33	60.33	40.00	56.33	70.67	66.67	70.00	48.07	71.00	75.67	66.33	60.00	43.00	65.00	70.33	69.00	67.33	41.00	56.50	72.00
F <sub>17</sub>	70.00	64.33	40.00	64.33	78.67	75.00	68.67	46.73	79.67	68.00	68.33	37.33	36.00	69.67	70.67	68.00	62.23	32.00	66.22	78.00
F <sub>18</sub>	62.66	50.33	36.33	54.00	63.33	70.33	54.33	41.00	69.67	43.33	70.33	52.67	42.67	44.33	61.33	67.67	52.33	23.00	59.21	68.33
F <sub>19</sub>	63.00	44.33	34.00	46.00	74.00	68.67	51.42	33.00	54.37	64.67	61.67	59.00	29.33	41.48	51.67	61.33	49.67	15.07	59.27	67.67
F <sub>20</sub>	62.67	95.67	27.00	46.07	65.33	64.67	42.00	37.33	54.00	43.33	54.67	42.33	17.33	28.67	58.67	60.73	47.33	08.31	48.17	63.67
F <sub>21</sub>	79.33	72.33	29.00	61.67	65.00	69.00	59.00	29.33	65.00	74.00	78.33	21.67	66.33	61.33	75.00	70.33	20.33	58.67	70.00	62.13
F <sub>22</sub>	81.00	70.00	26.00	68.67	77.67	52.33	76.33	27.00	75.88	78.33	74.33	69.33	18.33	75.33	84.67	76.00	75.33	21.00	65.00	78.33
F <sub>23</sub>	77.67	68.33	20.00	52.67	72.00	50.67	74.33	20.00	68.50	55.67	68.33	63.33	09.67	52.67	73.33	52.01	55.67	13.33	62.34	55.33
F <sub>24</sub>	76.67	58.00	18.67	52.00	68.00	38.33	82.67	26.00	58.33	60.33	67.00	50.00	08.33	41.33	64.33	49.07	65.33	11.67	59.67	55.00
F <sub>25</sub>	69.00	56.33	10.00	51.88	63.00	58.33	70.67	17.00	55.00	54.37	56.00	50.33	05.34	46.67	57.00	49.63	60.67	09.00	57.92	52.67
F <sub>26</sub>	68.00	50.33	10.00	51.88	63.00	52.33	70.67	11.00	65.00	69.37	50.33	48.67	22.00	53.67	62.00	61.00	49.67	21.00	49.33	40.33
F <sub>27</sub>	66.00	51.00	18.00	32.07	59.67	41.67	62.00	26.33	43.67	51.33	43.33	16.31	43.33	50.67	65.67	71.67	17.13	30.67	39.67	40.96
F <sub>28</sub>	58.67	48.00	17.00	28.67	46.67	41.67	60.67	23.00	57.00	47.33	54.00	61.67	14.67	43.31	50.33	55.00	46.67	14.42	26.33	36.67
F <sub>29</sub>	56.67	38.33	11.00	26.67	48.00	35.67	53.67	17.67	33.00	46.67	57.33	38.67	11.67	33.67	38.26	51.67	41.67	11.92	22.67	36.00
F <sub>30</sub>	52.33	36.67	12.00	26.67	54.00	37.00	52.67	08.08	31.60	38.00	50.33	32.00	08.67	27.33	27.22	51.67	37.33	09.00	21.00	32.10
F <sub>31</sub>	73.00	76.00	20.00	51.33	55.00	83.33	60.67	37.33	58.33	71.67	84.00	74.67	20.00	56.00	85.33	79.67	68.67	20.67	78.67	74.33
F <sub>32</sub>	80.67	72.67	15.00	80.67	84.33	81.00	87.00	34.00	74.38	73.67	86.00	71.00	18.17	58.33	75.67	88.00	78.00	22.67	70.90	78.67
F <sub>33</sub>	79.00	70.00	62.00	68.00	78.00	80.67	83.00	16.00	68.00	68.67	82.33	62.00	15.33	56.00	63.07	66.67	74.33	11.83	70.67	70.33
F <sub>34</sub>	75.33	62.33	13.00	68.77	69.33	78.33	79.67	12.01	70.67	61.00	78.67	67.33	13.00	54.63	56.33	75.33	71.33	09.58	70.01	69.00
F <sub>35</sub>	72.67	78.38	12.00	68.67	65.67	75.67	79.00	10.00	10.67	60.00	74.67	59.37	10.77	50.67	51.32	69.33	66.67	06.67	68.37	76.67