Tropical Agricultural Research Vol. 19: 160 - 169 (2007)

Preservation of *Plumeria rubra* L. (*Rathu Araliya*) for Dry Flower Arrangements

D.P. Karunananda and S.E. Peiris[1]

Postgraduate Institute of Agriculture
University of Peradeniya
Peradeniya, Sri Lanka

ABSTRACT. *This study was carried out to optimize a flower drying technique applicable for long term preservation of Plumeria rubra L. in dry flower arrangements. Silica gel, borax with corn meal, river sand, sea sand and air drying were used to dry the P. rubra flowers. Retention of colour and shape of dried flowers were evaluated comparing against Royal Horticultural Colour Chart and designating weighted scores for each colour. Reduction of flower weight was used to select the methods for rapid drying. Preservation using silica gel and river sand showed significantly performances in colour retention at the completion of drying at four days. Silica gel, river sand, borax with corn meal and sea sand showed significantly different performances (p = 0.05) in shape retention when compared with the control. P. rubra petiole fixed well to metal wires showing ability of use for dry flower arrangements.*

INTRODUCTION

Plumeria rubra L. (*Rathu araliya*) is an attractive garden flower in the tropics, which yields large number of flowers during the dry season of the year under minimum supply of growing requirements. Use of *P. rubra* as a cut flower or in flower arrangements is hindered due to its short vase life, short stalk and seasonal production. Because of these reasons, the best possible way of introducing it to floriculture industry would be as a value added floriculture product.

Dried flowers and dry flower arrangements are popular value added products which are used at certain time of the year such as the winter months and hot summer in some part of the world. These products have high demand in export markets and it will be a good avenue for export earnings.

Many flower species such as rose, statice, aster, larkspur, geranium, delphinium and chrysanthemum have been identified as suitable flowers for dry flower arrangements, (Smith, 1985). However, most of them are not commonly available in Sri Lanka or availability is limited to up country regions requiring special environmental conditions to grow. Introduction of tropical flowers such as *P. rubra* into dry flower industry may give a valuable contribution to the development of local floriculture industry. Dried flowers can be used in distinctive decorative arrangements which are long lasting, and can enjoy for months and require little care. Flower drying is not complicated or time consuming. It is inexpensive and no special technical training is needed and it is a good way to extend gardening activities (Smith, 1985).

[1] Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka.

Colour is undoubtedly one of the most outstanding features of many flowers, not only because of its role in attracting pollinators but also for the beauty it brings to nature and human life. Colour is considered as an important factor in drying of flowers. It is known that colour of the flower is formed mainly by carotinoids and flavonoids but actual colour is affected by other pigments, metal ions and vacuole pH (Simioni *et al.*, 1998). These pigments and compounds behave in different ways in the drying processes and some time denature the chemical structure and lose the colour (Yu *et al.*, 2006).

Therefore, drying of flowers should be done using special techniques which remove moisture slowly while maintaining the original shape, colour and texture of the flower as much as possible (Ranjan and Misra, 2002). Several flower drying methods have been perfected for many flowers to preserve for longer time period without losing the original colour. Air drying desiccant drying and freeze drying are the most common methods among them, but applicability varies with flower types (http:// www. Ipm. Isatate. Edu/ ipm/ hortnews/1998/7-10-1998/ dryflower.html). However, no methods are available for the most tropical species such as *P. rubra*, which may respond similarly or differently to these techniques. Therefore, assessing of methods before adapting a technique for drying of *P. rubra* is required. This study was conducted using several desiccating agents along with air drying in order to identify the most applicable method to preserve *P. rubra* flowers to use in floral arrangement and identify the phenomena behind the drying of flowers. In addition to that addressing the challenge of use of short stalk flowers in floral arrangement was one among the objectives.

MATERIALS AND METHODS

Common *P. rubra* flowers were subjected to preservation techniques in the study. The experiment was conducted in the laboratory of Floriculture and Home Gardening Division of Horticultural Research and Development Institute, Gannoruwa during January, 2007 to March, 2007. Fully opened *P. rubra* flowers harvested in a dry sunny day were used for the experiment.

Flowers with dark yellow centre were selected for the study (Yellow group A-Royal Horticultural Colour Chart centre colour) and ten flowers were used per treatment. Each and every flower was weighed using an electronic balance and the treatments were applied within one hour after harvesting. Four desiccants; silica gel, borax with corn meal, river sand and sea sand were used as treatments in flower preservation while keeping the air drying as the control. The experiment was arranged according to the Randomized Complete Block Design with four replicate per treatment. Particle size of river sand and sea sand was 0.5 - 5.0 mm and 0.2 - 2.0 mm, respectively. Fine borax powder available in the market with finely ground corn flour in 1:2 ratio was used in the study. Each desiccant was dried in an electrical oven by heating at 90 - 100^{o}C for five min and allowed to cool in closed container before using in the experiment.

Clear plastic containers (2L volume) with a tight lid were filled separately with desiccants and selected flowers which are fixed to metal wire at the petiole were immersed in each desiccant by carefully heaping up around the flowers. Containers of silica gel and borax with corn meal were tightly closed to prevent water absorption from the outside. However, containers with sand were to be kept open to facilitate evaporation of water. All

the flowers were taken out, weighed and colour was recorded every other day for ten consecutive days.

Removal of moisture was assessed by computing reduction of weight as a percentage of original weight of each sample. The rate of drying was obtained by plotting of weight reduction percentage against time. Reduction of colour was assessed by comparing the flowers with royal horticultural colour chart and shape of flower petals was assessed with the judgments of non biased judging panel (5 members). Each level of colour was given a score while giving the maximum score of 100 for original center colour (Yellow group A) of the flower. The scores of flowers were used to assess the retention of colour after flower drying. Table 1 gives the colour of the flower and given weighted score for them. The scores of the flower shape were computed by assessing scores as Table 2. Data was analyzed using ANOVA and CATMOD procedure.

Table 1. Scoring scheme developed to assess the flower colour using Royal Horticultural Colour chart.

Colour of the centre	Score
Yellow group A	100
Yellow group B	75
Yellow group C	50
Yellow group D	25
Colours do not belong to yellow group	0

Table 2. Scoring scheme developed to assess the floral shape using visual characters.

Original and deviation from original Shape	Score
As per original shape	100
Up to 10% deviation	75
10% to 20% deviation	50
20% to 30% deviation	25
More than 30% deviation	0

RESULTS

Plumaria rubra retained colour and shape in desiccant drying and it showed good performances in silica gel and river sand which made the flower suitable for dry flower arrangements (Plate 1).

Colour of *P. rubra* is remained constant during the period of drying in silica gel and river sand and significant colour retention ($p=0.05$) was obtained after completion of the treatment. Sea sand and borax with corn meal preservation also showed good performances of colour retention during first few days of drying but the colour of the flowers was reduced as the drying progressed (Figure 1).

Retention of original shape of *P. rubra* petals was significantly different in silica gel, sea sand, river sand and borax +corn meal when compared to the control (air drying) (p=0.05). The control showed poor performances (Table 3, Plate 2 and Figure 2).

Table 3. Score of colour retention and Shape retention after drying.

Treatment	Colour Retention at 10 days after treatments	Shape retention at 10 days after treatment
Borax and corn meal	60[b]	95[a]
River sand	95[a]	95[a]
Sea sand	75[ab]	95[a]
Silica gel	100[a]	100[a]
Air drying	25[c]	50[b]
Coefficient of variation (CV)	20.83	19.4

Note: Mean values followed by the same letter in each column are not significantly different at p = 0.05

All the flowers showed reduction of weight (as percentage from original weight of each sample) with the time and the flower weight has become constant in the complete drying. All the flowers reached complete drying within eight days of time where flowers treated with silica gel and river sand reached to constant weight in the forth day of treatment showing quick drying (Figure 3).

These flowers had shrunken the petiole during drying but retained the ability of fixing to a metal wire while facilitated to use them in an arrangement (Plate 3).

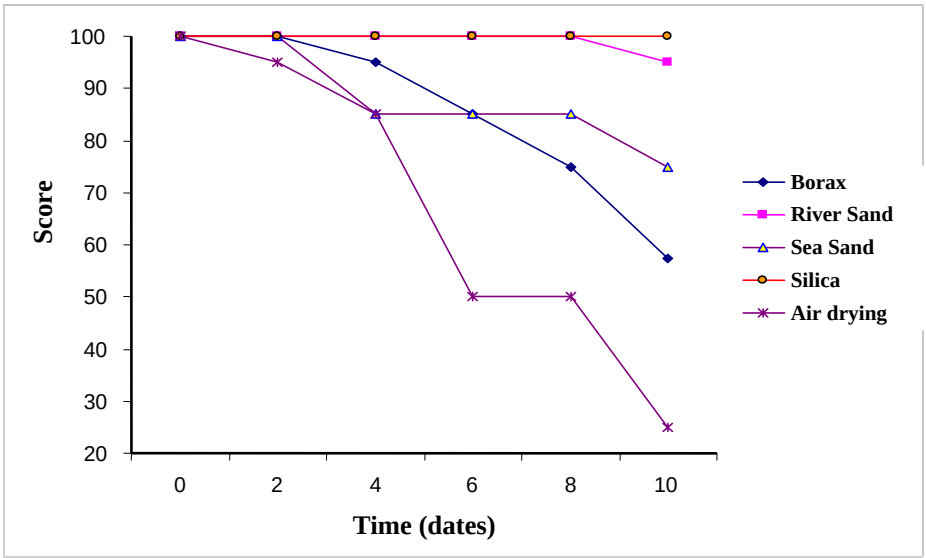

Figure 1. Colour retention of flowers during drying time.

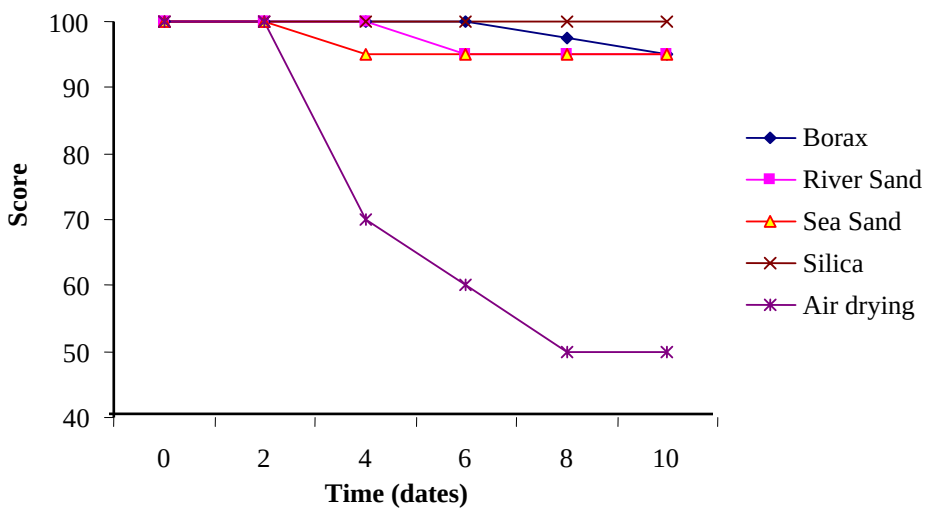

Figure 2. Shape retention of flowers during drying time.

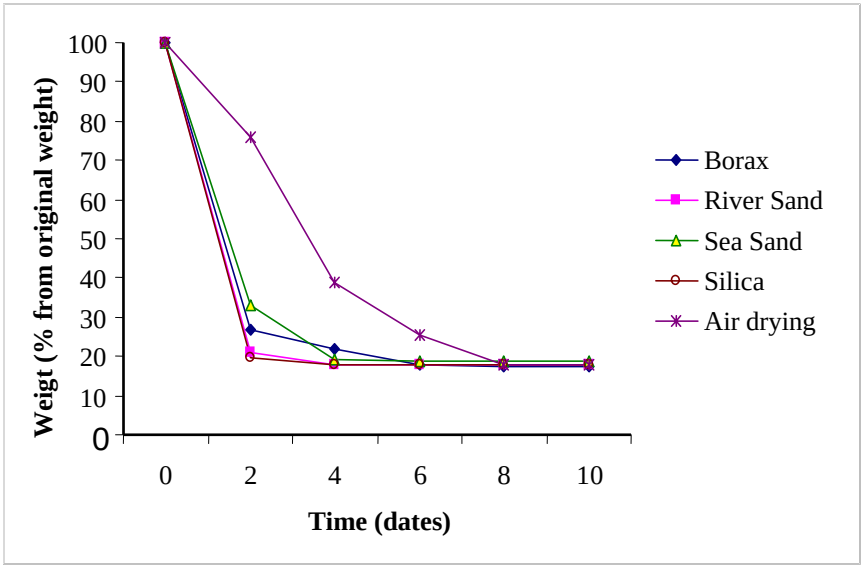

Figure 3. Weight reduction of flowers during drying time.

Plate 1. Status of dried *P. rubra* flowers 10 days after treatments.

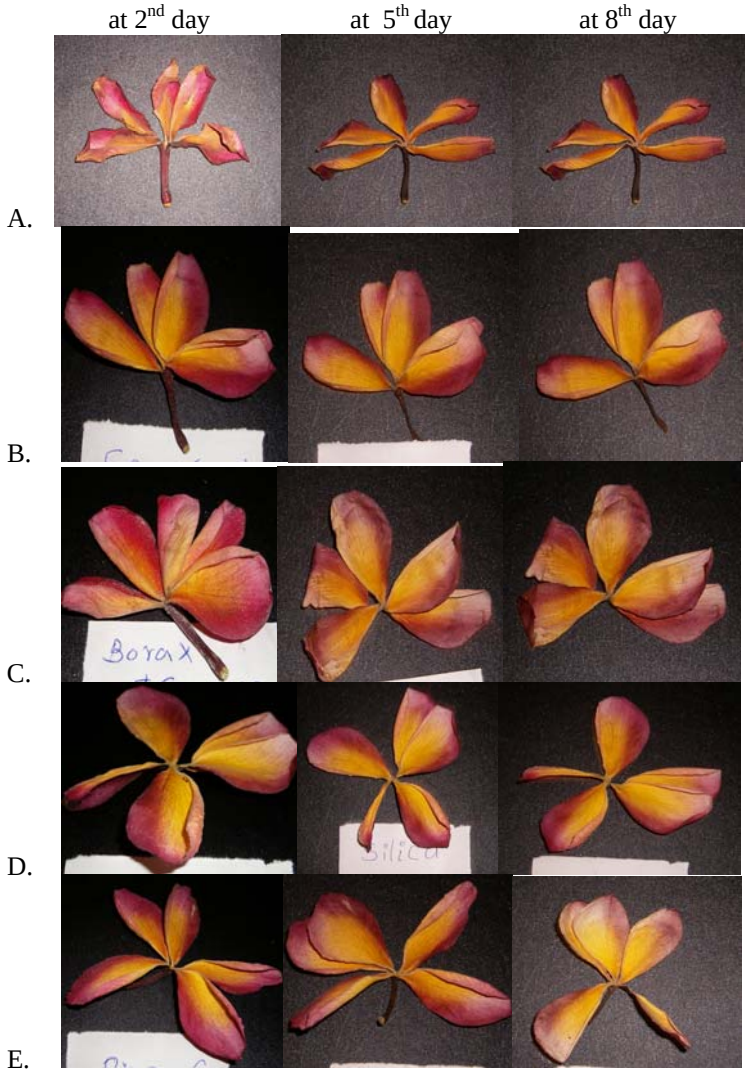

Plate 2. Colour change of flowers with progressing of drying.
Note: A: air drying, B: sea sand, C: borax+ corn meal, D: silica gel, E: river sand

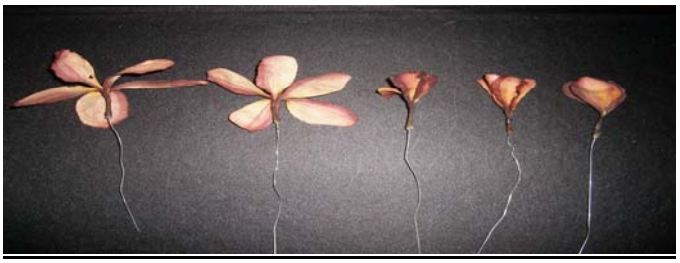

Plate 3. Dried *P. rubra* flowers by silica gel method after 10 days of treatment.
Note: Flowers were fixed on metal wires before applying the treatment

DISCUSSION

Drying gives long lasting results for some flowers, those having strong tissues. *P. rubra* also retained original colour and texture of the flower in desiccant drying as same as the other well known dried flowers such as roses, chrysanthemum and statice *etc.* and these flowers can be stored more than six months in concealed containers with original colours. (Karunananda, 2007). In the preservation, weight (water content) reduction of *P. rubra* was 81 - 82% from total weight of flowers but still retained the colour, showing the suitability for the dry flower arrangements.

Plumeria showed promising results in color retention as well as texture retention when dried in the silica gel and it gave most quick drying for flowers. Silica gel is a colloidal form of silica, and usually resembles coarse white sand. It may be prepared by partial dehydration of metasilicic acid (H_2SiO_3). Because it has many tiny pores in the crystal surface, it has a great adsorptive power. When the flower placed in this medium it adsorbs water quickly from flower and makes the flower dry. The most important advantage of this method is quick drying and easy handling which ensure higher retention of quality after drying.

Borax Powder ($Na_2B_4O_7$) absorbs water and produce $Na_2B_4O_7 \cdot 10H_2O$ therefore, it has become an efficient agent of water absorption. Molecular weight of borax is 201.37 and has 92% of water absorption capacity from it weight. However, heavy nature of Borax crushed the flower when used for flower preservation. Although well dried corn flour and borax mixtures help retain the shape of flower (Smith, 1985), the mixture slow down the rate of water absorption. However, borax and corn meal mixture showed comparatively poor performances in this study. The reason may be the reduction of water absorption power by corn meal.

River sand is mixture of silica, lime stone and rock particles which has comparatively large particles. The silica present in the sand involves in active absorption of water from the flowers but this contribution in drying is relatively low. Removing of water from flowers in river sand drying is very efficient as passive reaction. Thus sand takes out water from the flowers and releases to environment when it placed in well ventilated dry place. Drying *P. rubra* in sand depends on the environmental conditions of experimental site, because the temperature and relative humidity (RH) of the air determine the evaporation of water. Since the experiment was conducted during the drier period of the year (February, March) with low RH, evaporation was successful and the drying was completed within four days.

Drying in sea sands showed poor performances in this study when compared to the river sand. The slow water removed from flower petals may be due to the compact nature of sea sand and low spaces among the particles which limits the circulation.

Kumari and Peries (2000) reported that the air drying is suitable for small flowers such as statice. Continuous circulation of dry air among the flowers having low water content and papery petals or sepals such as bougainvillea is preserved by this method for 1-2 months (Royal Botanic Garden, Peradeniya, unpublished data). Different types of grass flowers that are used in Christmas decorations are dried by hanging in open air but colour retention of those flowers is also poor. Different artificial dyes are used to colour these flowers according to the occasion. Air dried *P. rubra* in this experiment resulted shrunken

flowers with poor colour retention while showing air drying is not suitable for preservation of *P. rubra* for floral arrangements but still there are some possibilities to use air dried *P. rubra* in potpourri as commercial product.

It is undeniable fact that time taking for drying and colour retention is greatly influenced by the absorption power of the desiccant. The experiment proves that colour retention is high in the flowers when they dry as quickly as possible. In the method where the drying process is slow the colour retention is also poor. The colour intensity of reddish part of the *P. rubra* flowers varied along the petal therefore dark yellow centre of the *P. rubra* flower was used in this study to observe colour changes during drying.

Pigments responsible for flower colour can be present in vacuole or in cytoplasm. Carotinoids can be found in the cytoplasm but flovonoid compounds are present in the vacuole. Mainly carotinoids and some flovonoids such as aurones and 6' deoxychalcones are often responsible for yellow and orange colours (Yu *et al.*, 2006). One or few of them may present in the *P. rubra* too and behavior of these pigments in the process of drying was observed in the study.

In the process of flower senescence the pigment oxidation and hydroxylation enzymes are activated and denature the pigment. This reaction leads to gradual reduction of colour of the petals (Rogers, 2006). Most of oxidation and hydroxylation reactions take place within the cells when they are alive. In the desiccant drying removes water quickly and leads to death of cells due to water scarcity. The high water potential within the cell seizes the biological reactions before cell death and remains the colour compounds in dried form. In the slow drying the pigments are destroyed gradually due to action of senescing enzymes and retention of colour after drying is lowered. Hence colour retention of quick dried *P. rubra* is higher than the slow dried *P. rubra.*

However, quick drying of *P. rubra* resulted colorful dried product which can play a significant role in dry flower industry but need to pay much attention in the storing of these product because re-absorption of water which is common in tropics leads to colour reduction of dried products.

CONCLUSIONS

Feasibility of using dried *P. rubra* in flower arrangements was investigated in this study. Quick drying methods such as drying with silica gel and river sand can be used to preserve colour and improve lasting quality of *P. rubra* flowers. Shape of *P. rubra* can be preserved using silica gel, river sand, sea sand and, borax and corn meal (1:2) mixture. Attractive and durable flower arrangement can be produced with these flowers and flower arrangements can be made available even for export markets. Thus the flower arrangements using dried tropical flowers such as *P. rubra* would be a good avenue to earn foreign exchange.

ACKNOWLADGEMENT

Authors wish to express their sincere thanks to the Head and the staff of Floriculture and home gardening division, HORDI, Gannoruwa, and to Dr. Mrs. J.P.

Eeshwara, Department of Crop Science Faculty of Agriculture, University of Peradeniya for the help given for this research study.

REFERANCES

Anonyms, (2004). UWR prolabo reagents and chemicals for laboratory use, A chemical catalogue 2004 - 2005.

http:// www. Ipm. Isatate. Edu/ ipm/ hortnews/1998/7-10-1998/ dryflower.html. (2007/03/02).

Karunananda, D.P. (2007). Application of preservation techniques for common garden flowers and foliage. Report submit for the Directed study of the M.Sc. in Floriculture and Landscape Architecture, Postgraduate Institute of Agriculture, University of Peradeniya.

Kumari, D.L.C. and Peiris, S.E. (2000). Preliminary investigation of preservation methods to produce dried flowers of rose and statice. Trop. Agric. Res. 12: 416 -422.

Ranjan, J.K. and Misra, S. (2002). Dried flowers: a way to enjoy their beauty for a long period. Indian Horti. 18: 32 - 34.

Rogers, H.J. (2006). Programmed cell death in floral organs: How and why do flower die. Annals of Botany, 97: 309 - 315.

Simioni, C., Schifino-Wittmann, M.T. and Paim, N.R. (1998). A model for floral color inheritance in *Leucaena* (Leguminosae). Genetics and molecular biology. 21(3): 344 - 349.

Smith, R.C. (1985). Everlastings, the complete book of dried flowers, Houghton Mifflin Company, Quarto Marketing Limited, 15 West 26th Street, New York, NY 10010.

Yu, O., Matsuno, M. and Subramanian, S. (2006). Flavonoid compounds in flowers: Genetic and Biochemistry. Floriculture, Ornemental and Biotechnology, Global Science Book, UK 1: 282 - 292.