AICRP on Floriculture, ICAR
Database on Rose (2010-11 to 2013-14)

ICAR- Directorate of Floricultural Research, Pune

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Content

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Foreward

Floriculture is a fast emerging and highly competitive industry. With the continuous introduction of new cultivars and new crops, cultural techniques are changing and hence new products are developing. Ornamental crop culture technology is improving with the availability of equipments and there is a sea change in the trend of consumers. A new generation of growers are coming forward to employ modern technologies for maximizing production and offer quality produce for consumer acceptability, thus fetching a better price. The increased growing of contemporary cut flowers like rose, gladiolus, tuberose, carnation, etc, has led to their use for bouquets and arrangements for gifts, as well as decoration of both home and work place. Availability of diverse agro-climatic conditions in this country facilitates production of all major flowers throughout the year in some part or the other, and improved transportation facilities, have increased the availability of flowers all over the country

The All India Coordinated Research Project (AICRP) on Floriculture since its inception has contributed significantly for the development of floriculture in India. The technologies and improved varieties of commercial flower crops developed under AICRP has helped in increasing the area under flower crops to 2.42 lakh ha during 2013-14 from a meager 4000 ha and production of 1.847 million tonnes of loose flowers and 79432 million number of cut flowers at present (National Horticulture Database, 2013-14).

Collection of comprehensive and reliable data is essential to assess the demand and supply for floriculture produce and to address the problems and constrains in the growth of floriculture. Generating of comprehensive crop wise floriculture database is crucial for ensuring effective planning to facilitate the systematic development of floriculture sector in the country. Seeing the importance of database, the Research Advisory Committee of our Directorate rightly recommended to prepare the recent database on commercial flowers. I hope this publication on "Database on Roase (2010-11 to 2013-14)" surely help to producers, consumers, traders, importers, exporters, extension workers, researchers and other stakeholders to increased rose production and consumption..

Pune
2015

(K P Singh)

Introduction

Flowers are inseparable from the social fabric of human life. Flowers being adorable creation of God, befits all occasions, be it at birth, marriage or death. In the past, flowers were not of much economic importance. One would grow flowers to fulfill his or her aesthetic desire. At times, flowers were offered for sale to meet the special requirements of people. With the passage of time drastic changes have come about in the life style of people leading to commercialized cultivation of flowers. Today, flower plants are no longer meant for only window garden but play an important role in the decoration of the living houses and office establishments. The science and art of commercial floriculture has been recognized as an economic activity with the potential for generating employment and earning valuable foreign exchange. In several countries of the world, floricultural products are amongst the main export items of agricultural origin. For any country to diversify its agricultural base geared towards export, the ornamental crop industry presents one of the most interesting and viable options. The aesthetic value of flowers and ornamental plants, their use in social events, overall satisfaction in working with them and high income generating power are attracting modern entrepreneurs to invest money in the floriculture industry. The demand for flowers and ornamental plants for different needs like religious, official ceremonies, parties, house decoration, weddings, funerals, etc, is on the rise. This demand for fresh flowers and plants is increasing world-wide over the coming years. The recent liberalization policy of the Government of India has given Phillip to commercialized agriculture particularly horticultural crops. Growing of flowers is in vogue in India since long time. Nevertheless, growing of cut-flowers has emerged as an important industry mainly to cater to the needs of the demand in the overseas market. It is being viewed as a high growth industry in our economy. There is a tremendous transformation in floriculture sector mainly due to the entry of corporate who are producing cut-flowers to meet the emerging demand in the developed countries for floricultural products.

Roses for the longest time have enjoyed the honor of being the most popular flowers in the world. The reason for popularity of the rose flower may be its wide variety in terms of color, size, fragrance and other attributes. It has been a symbol of love, beauty, even war and politics from way back in time. It is most popularly known as the flower of love, particularly Red Rose. Roses have been the most popular choice of flowers for the purpose of gifting across the world. They also act as a great addition to home and office decor. A bunch of roses or even a single rose works wonders aesthetically and considerably enlivens a place. Besides fresh cut roses, artificial flowers like silk roses in different colors are also widely used as decoration.

Rose is the principal cut flower grown all over the country, even though in terms of total area, it may not be so. The larger percentage of the area in many states is used for growing scented rose, usually local varieties akin to the Gruss en Tepelitz, the old favourite to be sold as loose flowers. These are used for offerings at places of worship, for the extraction of essential oils and also used in garlands. For cut flower use, the old rose varieties like Queen Elizabeth, Super Star, Montezuma, Papa Meilland, Christian Dior, Eiffel Tower, Kiss of Fire, Golden Giant, Garde

Henkel, First Prize, etc. are still popular. In recent times, with production for export gaining ground in the country, the latest varieties like First Red, Grand Gala, Konfitti, Ravel, Tineke, Sacha, Prophyta, Pareo, Noblesse. Virsilia, Vivaldi etc. are also being grown commercially.

Some Interesting Facts about Roses

- The birth place of the cultivated rose was probably Northern Persia, on the Caspian, or Faristan on the Gulf of Persia.
- Historically, the oldest rose fossils have been found in Colorado, dating back to more than 35 million years ago.
- Roses were considered the most sacred flowers in ancient Egypt and were used as offerings for the Goddess Isis. Roses have also been found in Egyptian tombs, where they were formed into funeral wreaths.
- Confucius, 551 BC to 479 BC, reported that the Imperial Chinese library had many books on roses.
- Ancient Sumerians of Mesopotamia (in the Tigris-Euphrates River Valley) mentioned Roses in a cuneiform tablet (a system of writing) written in approximately 2860 BC.
- The English were already cultivating and hybridizing roses in the 15th Century when the **English War of Roses** took place. The winner of the war, Tudor Henry VII, created the Rose of England (Tudor Rose) by crossbreeding other roses.
- While no **Black Rose** yet exists, there is some of such a deep Red color as to suggest Black.
- Roses are universal and grown across the world.
- The Netherlands is the world's leading exporter of roses.

Classification of Roses

Broadly, Roses are divided into three classes-

1. Species Roses

Species Roses are often called Wild Species Roses. There are more than 120 species of Roses plant.

Species Roses often have relatively simple, **5-petaled flowers followed by very colorful hips** that last well into the winter, providing food for birds and winter color. *Rosa acicularis, Rosa x alba, Rosa pendulina, Rosa anemoniflora, Rosa arkansana, Rosa arvensis, Rosa nutkana, Rosa gigantea, Rosa omeiensis, Rosa oxyacantha, Rosa palutris, Rosa nutkana, Rosa gigantea, Rosa sharardii, Rosa oxyacantha, Rosa palustris* are some of the related species of Rose.

2. Old Garden Roses

Old Garden Roses have a delicate beauty and wonderful perfume, not often found in modern hybrid tea roses. Old Garden Roses are a diverse group from those with a wonderful fragrance and great winter hardiness to the tender and lovely tea roses, which are best suited for warm climates.

Old Garden Roses comprise a multifaceted group that in general is easy to grow, disease-resistant and winter-hardy. Old Garden Roses grow in several shrub and vine sizes. Although colors do vary, these classes of roses are usually white or pastel in color. These "antique Roses" are generally preferred for lawns and home gardens. Several groupings of roses classified as Old Garden Roses are China Roses, Tea Roses, Moss Roses, Damask Roses, Bourbon Roses, etc.

3. Modern Roses

Any rose identified after 1867, is considered a Modern Rose.

Old Garden Roses are the predecessors of Modern roses. This group of Roses are very popular. The Modern Rose is the result of crossbreeding the hybrid tea with the polyanthus (a variety of primrose).

The colors of Modern Roses are varied, rich and vibrant. The most popular roses found in the class of Modern Roses are the Hybrid Tea Roses, Floribunda Roses, and Grandiflora Roses. Although Modern Roses are adored by florists and gardeners, they do require proper care, and do not adapt well to colder environments.

Popular Hybrid Varieties of Roses

Species Involved	**Hybrid Product**
Hybrid Perpetual Rose and Chinese Tea Rose	Hybrid Tea Rose
Hybrid Perpetual Rose and Australian Brier Rose	Yellow Permet Rose
R. multiflora and *R. chinensis*	Hybrid/Dwarf Polyanthas or Poly Pompon roses
Hybrid Tea Rose and Floribundas	Grandifloras
R. wichuriana, R. multiflora & Hybrid Tea Rose	Dorothy Perkins, American Pillar, Excelsa
R. canina and *R. gallica*	Albas
R. phoenica and *R. gallica*	Damaskas Rose
R. damascena and *R. alba*	Centifolia Rose
Autumn Damask Rose and China Rose	Bourbons

Growing Roses

- Roses may be grown in any well-drained soil with optimum sunlight.
- Most rose varieties are grown by budding on an rootstock (lower portion of a plant) propagated from seeds or cuttings. Order rose seeds online and let your garden be filled with the marvellous color and fragrance of roses.
- Clay soils, warm temperatures are always preferred, and the rose plants grow best when not set among other plants.
- Cow manure is the preferred fertilizer for rose cultivation, but other organic fertilizers, especially composts, are also used.
- Rose plants usually require severe pruning, which must be adapted to the intended use of the flowers.
- Trim off all broken and bruised roots on the rose plant, cut top growth back to 6 to 8 inches.
- Dig planting holes at least 6 inches deeper to accommodate the roots of the rose plant without crowding or bending.
- Mix 1 tablespoonful of fertilizer with the soil placed over the drainage material.
- Cover this mixture with plain soil, bringing the level to desired planting depth.
- Make a mound in the center to receive the Rose plant.
- Set Rose plant roots over this mound, spread the roots, and fill in with soil.
- Firm the soil tightly 2 or 3 times while filling the hole.

Cultivation methods : Rose plants are propagated by the seeds, cuttings, layers and budding. Roses require loamy, well drained soil. Budding is considered as the best method for propagating rose plants. They are planted in the circular pits about 60- 90 cm across and 60 -75 cm deep. Remove all the broken and bruised leaves while planting the plant. Roses require at least six hours of direct sunlight for the growth. The best time to plant the Rose plants rests between September to October. The rose plant needs cutting from time to time. It requires manures and fertilizers at the time of planting.

Medicinal uses : Gulkand made by the mixture of Rose petals and white sugar in equal proportion acts as the tonic and laxative. Hips, the fruit of roses are the good source of Vitamin C. Rose petals are used to make skin healthy and glowing. It cures dry and patchy skin. The rose scent has been used in pill making for centuries. Its herbal tea is used in the treatment of cold and cough.

Other uses : Dried rose petals called Pankhuri are used during the hot weather for preparing cool drinks. Roses are also used in the preparation of rose water and rose vinegar. Rose hips are sometime eaten. They are used for making herbal tea, jam and jellies. Rose plantss are generally

used for beautifying the gardens and walkways. Rose petals are used in cooking, which increases its flavour and make it even more delicious. Relaxing therapies with rose smells are used in candles, lotion, bath oils and perfumes.

Botanical Classification

Kingdom	**:**	Plantae
Division	**:**	Magnoliophyta
Class	**:**	Magnoliopsida
Order	**:**	Rosales
Family	**:**	Rosaceae
Subfamily	**:**	Rosoideae
Genus	**:**	*Rosa*

All India Coordinated Research Project on Floriculture was established during IV Five-Year Plan in the year 1970-71, to carryout nation-wide interdisciplinary research by linking ICAR Institutes with State Agricultural Universities (SAU's). The necessity of the project has been examined from time to time in view of growing importance and potential for floriculture in different regions of the country and the number of Coordinated Centers as well as the research programmes were modified accordingly. At present the Coordinated Project has 25 centers which include 15 budgetary, 5 Institutional and 5 Voluntary Centers.

1. Crop Improvement

The germplasm were collected within the country as well as from abroad. An Accession Register of the germplasm collected, with all details was maintained at each centre for permanent record. The concern centres have a complete list of the total collections including those made during the year and those made earlier.

Germaplasm collected, maintained and evaluated at different centres

i. Bhubaneswar

Rose germplasm collection comprised of 64 Hybrid Tea (presently shifted to OUAT Bhubaneswar) roses, 26 Floribunda roses, 9 Miniature roses and 2 Climbers till 2013-2014 at Chiplima centre. Out of 101 cultivars evaluated hybrid Tea rose cultivars 'High Esteem'. 'AlexRed', 'Wilfred Noris', 'Papa Meilland' and 'Pigali' can be grown as cut flower. These cultivars produced long stems during winter under open cultivation. Cultivars like 'Caramousine', 'Caribean', 'Angelique', 'City of Belfast', 'Kentuky Derby, and 'Montreal' were found to be highly suitable for loose flower production. Among the Floribunda, cultivars 'Castle Manheim', 'Neelambari' 'Iceberg' and 'Shocking Blue' were found to be ideal for loose flower production. Floribunda cultivars like, 'Sadabahar', 'Red Pinch' Valentine' and ''Harkness Marigold' were found suitable for borders and garden display. Miniatures like 'Dandenong', 'Magic Carrousel', 'Calpolly' and 'Gypsy Towel' and Climber cultivars 'Delhi White Pearl' and 'Whisky' can be used for garden display.

Table 1.1. Rose germplasm collected, maintained and evaluated at Bhubaneswar centre till 2013-14

Sl. No.	Cultivar	Growth habit	Plant height (cm)	Floriferousness	Fragrance	Foliage	
						Glossiness	Size
Hybrid Tea							
1	Alex Red	Upright	117.37	Good	S. Fragrant	Normal	Large
2	Alinka	Upright	69.6	Good	N .Fragrant	Normal	Large
3	Angelique	Upright	91.73	Good	S. Fragrant	Glossy	Large
4	Bicollase	Upright	141.3	Good	N. Fragrant	Glossy	Large
5	Black Delight	Upright	151.24	Good	S. Fragrant	Normal	Large
6	Caramia	Upright	100.63	Good	S. Fragrant	Normal	Large
7	Caramousin	Upright	178.66	Good	S.Fragrant	Normal	Large
8	Caribean	Upright	112.6	Good	S. Fragrant	Glossy	Large
9	Chardony	Upright	90.67	Good	S.Fragrant	Glossy	Large
10	City of Belfast	Upright	128.83	Medium	S. Fragrant	Glossy	Large
11	First Prize	Upright	107.42	Good	S.Fragrant	Normal	Large
12	Granada	Upright	125.63	Good	H.Fragrance	Normal	Large
13	High Esteem	Upright	127.57	Good	H. Fragrant	Normal	Large
14	Lady-X	Upright	160.45	Good	N. Fragrant	Normal	Large

Table 1.1. *Contd.*

Sl. No.	Cultivar	Growth habit	Plant height (cm)	Floriferousness	Fragrance	Foliage	
						Glossiness	Size
15	Love in Tender	Upright	105.67	Good	N.Fragrant	Normal	Large
16	Soma Sila	Upright	103.52	Good	N.Fragrant	Normal	Large
17	Sophia Loren	Upright	133.97	Good	N.Fragrant	Normal	Large
18	Spice Twice	Upright	94.97	Good	S.Fragrant	Normal	Large
19	Stainless Steel	Upright	99.6	Medium	S.Fragrant	Glossy	Large
20	Super Song	Upright	109.53	Good	Fragrant	Glossy	Large
21	Wilfred Noris	Upright	107.07	Good	M. Fragrance	Normal	Large
Floribunda Rose							
1	Assembly Jubulie	Upright	80.2	Good	N.Fragrant	Normal	Large
2	Bergen-De-Ice	Upright	57.7	Good	S. Fragrant	Glossy	Large
3	Iceberg	Upright	92.8	V.Good	S. Fragrant	Normal	Large
4	Mascara	Upright	118.2	V.Good	N.Fragrant	Normal	Large
5	Pillow Talk	Upright	76.4	Good	S.Fragrant	Glossy	Large
6	Red Pinch	Upright	84.4	V.Good	N.Fragrant	S.Glossy	Large
7	Soma	Upright	98.2	Good	S.Fragrant	Glossy	Large
8	Super Snow	Upright	61.05	Good	S. Fragrant	S. Glossy	Large
9	Valentine	Spreading	49.1	V.Good	S. Fragrant	Normal	Large
Minature Rose							
1	Calpolly	Upright	71.9	Good	N. Fragrant	Normal	Large
2	Gypsy Towel	Upright	41.3	Good	N. Fragrant	S.Glossy	Small

ii. Ludhiana

Ludhiana centre is maintaining 204 cultivars of rose which include 120 Hybrid Teas, 59 Floribunda, 19 Miniatures and 6 Polyanthas. Three new cultivars of Hybrid Teas (Pusa Gaurav, Pusa Ajay and Lavender Dew) and one floribunda (Jantar Mantar) were added to the existing collection during 2013-2014. The centre has evaluated 200 cultivars of rose which include 117 Hybrid Teas, 58 Floribunda, 19 Miniatures and 6 Polyanthas till 2013-2014. On the basis of their performance for growth, flowering and tolerance to extremes of temperatures cultivars Impertrice Farah, Marcopolo and Headliner (among HT), Summer Snow , Brown Velvet and Charleston (among Floribundas) and Small Virtue , Cal Poly and Hoke Pokey (among Miniatures) performed better.

Table 1.2. Rose germplasm collected, maintained and evaluated at Ludhiana centre till 2013-14

Sl. No.	Cultivar	Growth habit	Plant height (cm)	T/M/D	Foliage		No. of flowers per plant	Tolerance to disease and insect	Flower colour	Fragrance	Bud form
					Glossiness	Colour					
Hybrid Tea											
1	Taj Mahal	U	95.63	T	N	NG	7.66	G	Pink	Y	P
2	Paradise	U	84.42	T	N	NG	4.33	G	Lavender-opalescent, edges magenta	N	P
3	First Prize	U	64.33	M	N	DG	5	G	Pink-deep rose	N	P
4	Peter Franken Feld	S	86.26	T	N	NG	4.33	G	Pink	N	P
5	Admiral Rodney	S	74.55	T	G	NG	3.33	G	Pink-with pale lilac flush	N	P
6	Fragrant Plum	U	72.35	T	G	NG	6.33	G	Mauve	Y	P
7	Ingrid Bergman	U	63.11	T	N	NG	1.66	G	Crimson-scarlet	N	G
8	Matt God	S	53.23	D	N	NG	2.33	P	Cerise	Y	G
9	Ace of Heart	S	94.65	T	N	NG	4.66	G	Red-crimson with sheen of velvety scarlet	N	G
10	Papa Meiland	U	97.87	T	N	NG	14.33	G	Crimson	Y	G
11	Taboo	U	83.64	T	N	DG	2.66	G	Red-dark	N	P
12	Oklahoma	U	85.27	T	N	NG	2.33	G	Red-blackish	Y	G
13	Lager Feld	U	54.26	D	N	NG	7. 67	G	Mauve-lavender	Y	P
14	Svhawarz Madona	U	96.64	T	N	NG	6.66	G	Red-dark	N	G
15	Golden Medallion	U	93.46	T	N	NG	9	M	Yellow-lemon	N	P
16	Helmut Schmidt	S	73.29	T	N	LG	5.66	G	Yellow	Y	P
17	Landora	U	93.89	T	N	NG	7	G	Yellow	N	G
18	St. Patrick	U	75.86	T	N	NG	2.66	G	Yellow with a tint of green	N	P
19	Cherry Parfait	U	126.82	T	N	NG	6.33	G	White with red edges	N	P
20	Double Delight	S	85.42	T	N	NG	19.33	G	red-cherry, creamy white edges	Y	P
21	Garden of The World	U	75.29	T	N	DG	6.66	G	white with edges deep pink to red	N	G
22	Impertice Farah	U	123.47	T	N	NG	31.33	G	White-edges pink and red	N	P
23	Kiss of Fire	U	55.66	M	N	NG	8.66	G	Cream-edges deep pink, yellow base	N	G
24	Milestone	U	62.23	T	G	DG	5.33	G	Pink-coral, changing to coral red	N	O

Table 1.2. *Contd.*

Sl. No.	Cultivar	Growth habit	Plant height (cm)	T/M/D	Foliage		No. of flowers per plant	Tolerance to disease and insect	Flower colour	Fragrance	Bud form
					Glossi-ness	Colour					
25	Moncheri	S	67.72	T	N	NG	8.66	G	Pink changing to red	N	P
26	Alinka	U	66.55	T	N	NG	6.66	G	Yellow-bright red edges	N	G
Floribunda rose											
1	Banjaran	U	76.42	T	G	NG	116.28	G	Multicolour, gold and flame pink	Y	P
2	Scentimental	S	88.25	T	N	LG	96.35	M	White with burgundy and cream stripes	Y	G
3	Parfait	U	54.69	M	N	NG	58.1	G	Mangenta with ivory white centre	N	G
4	Gold Cup	U	88.52	T	N	NG	57.65	P	Deep Yellow	Y	G
5	Junior Miss	U	76.66	T	N	LG	103.65	G	Pink	N	G
6	Green Sleeves	U	42.56	T	N	NG	59.67	G	Greenish white	N	P
7	Brown Velvet	S	118.46	T	G	NG	196.33	G	Reddish Brown	N	P
8	Sexy Rexy	S	66.33	M	N	NG	65.33	P	Pink	N	P
9	Sambha	U	49.25	D	N	LG	48.33	G	GoldenYellow	N	P
10	Valentine	S	63.24	T	N	LG	67.66	G	Mauve	N	P
11	Rumba	U	74.66	T	N	NG	76.67	M	Yellow with bright red edges	N	P
12	Red Gold	S	54.68	T	N	NG	35.67	G	Yellow with red edges	N	P
13	Double Talk	U	88.43	T	N	LG	54.66	G	Dark red	N	P
14	Pillow Talk	S	56.84	M	N	LG	45.33	G	Mauve ruby	N	P
15	Charleston	U	94.48	T	N	LG	269.66	G	Red chrome and yellow	N	P
16	Sparton	S	89.66	T	N	NG	55.66	G	Salmon orange	N	P
17	Zorina	S	64.83	T	N	NG	38.33	G	Bright orange	N	P
18	Thorless Beauty	S	82.24	T	N	NG	46	G	Orange	N	G
19	Hot Cocoa	U	85.55	T	N	LG	74.67	G	Orange	N	P
20	Show Biz	S	97.56	T	G	NG	55	M	Crimson	Y	P
22	Plan Talk	S	55.29	M	N	NG	93.67	G	Bright red	N	P
23	Princess De Monaco	U	56.27	M	N	NG	45.33	G	Deep Rose With Red Bordered edges	Y	P
24	Judi Garland	U	65.58	T	N	NG	56.66	P	Deep Yellow	N	G

Table 1.2. *Contd.*

Sl. No.	Cultivar	Growth habit	Plant height (cm)	T/M/D	Foliage		No. of flowers per plant	Tolerance to disease and insect	Flower colour	Fragrance	Bud form
					Glossiness	Colour					
25	Gipsy	S	76.58	T	N	NG	37.67	P	Bicolor-Crimson and Yellow	Y	G
26	White Junior Miss	U	54.33	M	N	NG	86.33	G	White	Y	P
27	Mercedes	U	59.65	M	N	NG	47.66	M	Granada Red	N	G
28	Nimes	U	73.28	T	G	NG	48.66	G	Scarlet orange	N	G
29	Ice Berg	U	68.87	T	N	DG	175.67	G	White	N	P
30	Summer Snow	U	78.15	T	N	LG	566.33	G	White	N	P
31	Eureka	S	73.26	T	N	LG	155.33	P	Coppery Gold	N	P
32	Fancy Talk	S	52.36	M	N	LG	77.66	G	Pink	N	P
33	First Edition	U	40.29	D	N	NG	104.67	G	Coral with orange pink blend	N	P
34	Lambada	S	96.65	T	N	NG	82.33	G	Apricot orange	N	O
35	Tiara	S	40.25	D	N	NG	64.33	M	White	Y	P
36	Charisma	U	48.63	D	N	NG	84.66	G	Red	Y	P
37	Bordurevive	S	76.51	T	N	NG	119.67	G	Rose	Y	P
38	Jhon Jhon	U	44.57	T	N	NG	59.33	M	Yellow	N	P
39	Sartoga	U	70.86	T	G	LG	78.66	G	White	N	P
40	Maery Jean	U	86.94	T	N	DG	54.33	P	Red	N	G
41	Park Palace	S	73.24	T	N	NG	96.67	G	White and red Blend	N	P
42	Fantasia	S	83.29	T	N	NG	88.67	G	Bicolor-light red and white	Y	P
43	St Boniface	S	86.14	T	N	NG	45.66	G	Vermillion	Y	P
44	Himangini	S	72.59	T	N	LG	114.67	G	White	N	G
45	Arunima	U	54.83	M	N	NG	128.67	G	Deep pink	N	P
46	Lilac Charm	U	84.25	T	N	LG	119.33	G	Mauve	N	P
47	Nordia	U	58.35	M	N	NG	157.33	M	Orange	N	P
48	Singing In The Rain	U	65.46	M	N	NG	72.66	M	Apricot with coppery orange reverse	N	P
49	Laminuette	U	78.46	T	N	LG	99.66	G	White with light red border	N	G
50	Arina 93	S	54.79	M	N	NG	80	G	White	Y	P
51	Zembra	U	58.16	M	N	NG	59.33	G	Orange	N	P

Table 1.2. *Contd.*

Sl. No.	Cultivar	Growth habit	Plant height (cm)	T/M/D	Foliage		No. of flowers per plant	Tolerance to disease and insect	Flower colour	Fragrance	Bud form
					Glossiness	Colour					
52	Golden Holstien	U	79.54	T	G	LG	98.66	G	Yellow	N	P
53	Sonora	S	56.5	T	N	NG	78.67	G	Orange	N	G
54	Canadian Centinary	U	43.84	D	N	NG	43	G	Orange	N	G
55	Lenturner	U	84.56	T	N	NG	105.33	M	Pink	N	G
56	Ahalya	U	43.26	D	G	LG	201.66	G	Pale pink	N	P
57	Sheer Delight	S	65.42	M	N	NG	68.66	G	Vermillion red	N	G
58	Shocking Blue	S	70.29	T	N	DG	74.33	G	Magenta	N	P
Miniature rose											
1	Over The Rainbow	S	37.66	M	N	NG	176.33	G	Blend of red pink and gold	N	P
2	Wild Plum	U	58.35	T	G	NG	185.66	G	Lavender	N	P
3	Royal Baby	S	34.76	T	N	NG	98.67	G	Red orange	Y	G
4	Rosy	U	32.48	M	N	NG	95.33	G	Pink	N	G
5	Sweet Chariot	U	25.35	D	N	NG	251.66	G	Magenta	N	G
6	Torch of Liberty	S	42.26	T	N	DG	135	G	Red orange	N	G
7	Black Jade	U	27.26	M	N	DG	56.67	G	Blackish red	N	P
8	Centre Piece	S	27.09	D	N	DG	68.33	G	Velvety red	Y	G
9	My Valentine	S	46.33	M	G	DG	129.67	G	Red	N	G
10	New Beginning	U	37.24	T	N	NG	77.67	G	Blend of red orange and yellow	Y	P
11	Small Virtue	U	55.55	T	N	LG	389.66	G	White	N	G
12	Maidy	S	48.28	D	G	DG	86	G	Red	N	G
13	Cup Cake	S	36.65	D	N	NG	105.33	G	Pink	N	P
14	Red Ace	S	33.72	D	N	NG	49.66	G	Velvety red	N	G
15	Red Flush	S	31.46	M	N	DG	131.66	G	Red	N	G
16	Rise N Shine	U	38.37	T	N	LG	136.33	G	Yellow	N	G
17	Hokey Pokey	U	43.59	T	N	NG	229.67	G	Crimson red	N	P
18	Cal Poly	U	45.66	T	N	NG	298	G	Deep yellow	N	P
19	Rainbow's End	S	34.48	M	N	NG	90.66	G	Golden yellow	N	P

Table 1.2. *Contd.*

Sl. No.	Cultivar	Growth habit	Plant height (cm)	T/M/D	Foliage		No. of flowers per plant	Tolerance to disease and insect	Flower colour	Fragrance	Bud form
					Glossi-ness	Colour					
Polyantha rose cultivar											
1	Border King	U	45.6	T	G	NG	250.33	G	Red	N	P
2	Red Triumph	S	52.39	T	N	NG	176.66	G	Red	N	P
3	Bellerina	U	38.54	T	N	NG	134.33	G	Pink with white centre	N	P
4	Red Butterfly	S	36.52	D	N	NG	61.67	G	Velvety Red	N	P
5	Starri Night	S	38.36	D	N	NG	118	G	White	N	P

Plant Height-T-Tall, D-Dwarf, M-Medium Growth habit, U-Upright. S-Spreading, Foliage- Glossiness- G- Glossi: N- Normal, S-Small: L-Large: :LG- Light Green, DG- Dark Green, NG- Normal Green
Floriferrousness- G-Good: M-Medium: P-Poor, Fragrance- Y-Fragrant: N-Non Fragrant

Germaplasm collected, maintained and evaluated at Hessaraghatta centre

A total germplasm consists of 275 genotypes were maintained at Hessarghatta centre. Germplasm collection consists of named varieties, species and breeding stocks (Table 1.3). List of all genotypes maintained under germplasm is presented in Table 1.4 found to be heat tolerant.

Table 1.3. Passport data of rose germplasm collected at Hessaraghatta centre

Sl. No.	Genus	Species	Cultivar	Place of collection	District	Latitude	Longitude
1.	Rosa	Rosa spp.	Avalanche	Bangalore	Bangalore North	12° 58' N	77° 38' E
2.	Rosa	Rosa spp.	Bonhair	Bangalore	Bangalore North	12° 58' N	77° 38' E
3.	Rosa	Rosa spp.	Tajmahal	Bangalore	Bangalore North	12° 58' N	77° 38' E
4.	Rosa	Rosa spp.	Gold Strike	Bangalore	Bangalore North	12° 58' N	77° 38' E
5.	Rosa	Rosa spp.	Corvet	Bangalore	Bangalore North	12° 58' N	77° 38' E
6.	Rosa	Rosa spp.	Pilgrim	Chettahalli, Mercara,	Coorg	13° 22' N	75° 28' E
7.	Rosa	Rosa spp.	Orange Home	Chettahalli, Mercara,	Coorg	13° 22' N	75° 28' E
8.	Rosa	Rosa spp.	Vasanth	Chettahalli, Mercara,	Coorg	13° 22' N	75° 28' E
9.	Rosa	Rosa spp.	Bridal Bless	Chettahalli, Mercara,	Coorg	13° 22' N	75° 28' E
10.	Rosa	Rosa spp.	Our Love	Chettahalli, Mercara,	Coorg	13° 22' N	75° 28' E
11.	Rosa	Rosa spp.	Summer Sunshine	Chettahalli, Mercara,	Coorg	13° 22' N	75° 28' E
12.	Rosa	Rosa spp.	Ideal Home	Chettahallii, Mercara	Coorg	13° 22' N.	75° 28' E.
13.	Rosa	Rosa spp.	Orange Home	Chettahallii, Mercara	Coorg	13° 22' N.	75° 28' E.

Table 1.4. List of rose germplasm collection available at Hessaraghatta centre

Abhisarika	Rose Anil	Bridal Blush	Via Mala	Atoll	IIHR 11_3
Abhishek Jantar	Rose Mary Harkness	Brinessa	Victor Huna	Avon	IIHR 2_28_1
Adair Roche	Roshaness	Cabanet	Vimal	Christian Dior	IIHR 204
Adoloseine	Roundalay	Captain Harry Stebbings	Coffee home	City of Glargoro	IIHR 3_18_2
Agnihotri	Sakeera	Carol Anne	Confetti	CLG Aurie Dombasai	IIHR 7_1
Ahalya	Sand Over	Casanova	Coral Princess	CLG Paradise	IIHR 7_2
Aishwarya	Sandego	Catalonia	Crifty Duty	Cocktail	IIHR 7_7
Akash Sundari	Sandra	Chandrama	Diane De Poitiers	Golden Giant	IIHR 7-5
Akebono	Sandra Ghum Genemeas	Charisma	Diplomat	Golden Mediate	IIHR 7-8
Alliance	Sangai Autumn	Cherry Parfait	Doris Tystermann	Granada	IIHR 7-9
Amar Amar	Sarvesh	Chingari	Durgapur Jubilee	Grand Cycle	IIHR P-147
Amber	Seala	Chipper	Double Folk	Grand Gala	IIHR P-30
American Heritage	Searlet	Srinivasa	Dr. G.S.Randhawa	Jantar Mantar	IIHR P-7
American Home	Senteur Royale	Sterling Silver	Dr. M.S. Randhawa	Jass	Imperfee Tava
Amouruse	Shantaraj	Sugandha	Dr.B.P.Pal	Jawani	Jack O Lantern
Anbar	Shanthi Pal	Summer Sunshine	Dr.Kane	Jogan	Solo-97
Andromeda	Sharada	Sun Song	Dream cloud	John F. Kennedy	Sontr Hawaith
Anena	Silva	Sunanda	Duke of Windsor	Nishkant (Thornless)	Sophia Loren
Angkor	Babylon	Super Star	Easy Going	Nobless	Spaths Jubilim
Anke Bone	Battallion	Suprabatha	Eiffel Tower	Oklahoma	Speaks Yellow
Anna Sorden	Belarge	Surekha	Flirtacious	Only You	Viva rose
Annte Marry	Berries N Cream	Sylvia	Folklore	Grand Pesdeli	Vivaldi
Anurag	Bagathi	Tropical Amazon	Fordal Durky	Granda Opera	War Dance
Apricot Spice	Bhavani	Tempo	Friendship	Green Rose	Weekend
Arjun	Big John	The Master	FUA Harkness	Hakuun	White Magic
Arka Parimala	Birendranath	Timeless	Garden of the world	Happiness	RC
Arka Swadesh	Blue Delight	Tipu's Flame	Gayathri	Harkness	Reace Yellow
Red Cascade	Blue Ocean	Touch of Heart	General Vaidya	Hasina	Red Bunch
Red Chief	Blue River	Vasanth	Girija	Iceberg	Woubern Gold
Red Lady	Bobo	Vasavi	Gladiator	Ico Ambassador	Orange Flame
Red Recker	Bodisattwa	Vatertag	Arthur Bell	Ico Delight	Queen Mother
Regensburg	Brass Band	Venpes	Arunima	Ideal Home	Rakthima
Roin Dorroin	Brazies	Versiles	Asha	IIHR 11_2	Vino Delicado

Table 1.4. *Contd.*

Viola	Komala	Moliter	Rosa rubiganisa	Pink Panther	Pusa Sonora
Violon D'Ingress	Kulakarni	Morientuder	Rosa stanceria	Pink Simprene	Pusa Vihangana OR Virangana
Simon Boliar	Lady	Moritta	Rosa stylosa	Precious Platinum	Pushkar Pink
Siveka Vastar	Lady X	Mrinalini	Rosa tomentosa	Prema	Pushkar Red
Softly	Lalima	Muttertag	Rosa wichuriana	President Meria	Queen Aishwarya
Joseph	Manasi	Narthaki	Orton	Preyasi	Queen Elizabeth
Kanchani	Maria Callas	Species	Our Love	Prince Claus	New varieties added in 13-14
Kanva	Marine Dowell	Rosa bankcsia	Panner Rose	Princess Margaret of England	Avalanchi
Kasturi Rangan	Marryantomate	Rosa damascena	Papapi Rosha	Pristine	Carvetty
Khushali	Mary Kittrl	Rosa indica	Paradise	Pusa Bahadhur	Taj Mahal
Kiran	Meduse	Rosa lilia	Pastel Delight	Pusa Baramasi	Bonhair
Kiss of Fire	Minister	Rosa macrophylla	Pilgrim	Pusa Gaurav	Gold Strike
Knock Out	Miss Elizabeth	Rosa multifloria	Pink Bunch	Pusa Prema	

Germaplasm collected, maintained and evaluated at Delhi centre

A total of 350 cultivars and 15 species are maintained in rose germplasm at IARI New Delhi Centre.

Table 1.5. List of rose species available at New Delhi

Sl. No.	Name of species	Sl. No.	Name of species
1.	*Rosa indica major*	9	*Rosa canina*
2.	*Rosa tomentosa*	10	*Rosa bourboniana*
3.	*Rosa slancensis*	11	*Rosa banksiae*
4.	*Rosa macrophylla*	12	*Rosa rubiginosa*
5.	*Rosa brunonii*	13	*Rosa rubrifolia*
6.	*Rosa wichuraiana*	14	*Rosa multiflora*
7.	*Rosa glutinosa*	15	*Rosa dumalis*
8.	*Rosa moschata*		-

2. Crop Management

Experiment No.1 : Standardization of media composition for pot grown roses

Duration : Three years (2011-12 onwards)

Centres : Ludhiana, Pune, Ranchi, Chiplima, Yercaud and Periyakulum

Technical programme:

No. of treatments : Seven

T_1 : Soil + Sand + FYM (2:1:1)

T_2 : Soil + Sand + FYM + Leaf mould (2:1:0.5:0.5)

T_3 : Soil + Sand + Vermicompost (2:1:1)

T_4 : Soil + Sand + Cocopeat + FYM (2:1:0.25:1)

T_5 : Soil + Sand + Cocopeat + Leaf mould (2:1:0.25:1)

T_6 : Perlite + Cocopeat + FYM (1:0.5:1)

T_7 : Soil + Vermiculite + FYM (1:1:1)

No. of replications : Four

No. of pots per replication : Ten

Design of experiment : CRD

Cultivar : Any one cultivar belonging to miniature group should be taken. Only one plant of one year old per pot should be planted in 20 cm size plastic pot.

Observations recorded

1. pH, bulk density and EC of media
2. Plant height at the time of first flower bud appearance (cm)
3. Plant spread, NXS & EXW (cm)
4. Number of branches per plant
5. Days to flowering
6. Duration of flowering (day)
7. Number of flowers per plant at weekly interval
8. Flower diameter (cm)

9. Flower bud length (cm)

10. No. of flowers per plant – per season (3- seasons)

11. No. of flowers per m2 - per season (3- seasons)

Report

Centre

Coimbatore (Yercaud)

Miniature rose cultivarSuper Star was planted in the plastic pot of 20 cm size (Tables 2.1abc). Significant differences were observed for all the characters studied. The results of the three years experiment indicated that among the media T_6 (Perlite + Cocopeat + FYM @ 1:1:1) recorded increased plant height, number of branches, plant spread, increased flower number, diameter and shoot length followed by T_6 (vermiculite). In addition, the weed growth was lower in the treatments T_5 and T_6.

Table 2.1.a. Effect of media composition on pot grown rose cv. Superstar at Yercaud centre during 2011-12

Treatment	Plant height (cm)	Plant spread (cm)		No of branches per plant	Flower diam. (cm)	Flower bud length (cm)
		East-West	North-South			
Soil + FYM (1:1)	16	22.3	13	6.3	11	3.1
Soil + FYM + leaf mould(1:1;1)	25	29	22.7	7.7	7.8	2.5
Soil + Vermicompost (1:1)	27	23	20.3	7.3	18	4.2
Soil + FYM + Cocopeat (1:1:1)	24.3	24.7	21.3	5	5	2.3
Soil + FYM + leaf mould (1:1:1)	23.3	18.7	20	4.7	10	2
Perlite + Cocopeat + FYM (1:1:1)	31.3	17	20	7	27	5.2
Soil+Vermiculite+ FYM (1:1:1)	16	13.3	13	5.3	8	2
Mean	24	21.14	19.95	6.19	4.14	3.04
CD (P = 0.05)	9.89	12.33	11.99	2.61	2.25	1.24

Table 2.1.b. Effect of media composition on pot grown rose at Yercaud centre during 2012-13

Treatment	Plant height (cm)	Plant spread (cm)		No of branches per plant	Flowering duration (day)	No of flowers / plant / season	Flower bud length (cm)	Flower bud diam. (cm)	Shoot length (cm)
		East-West	North-South						
Soil + FYM (1:1)	28.1	45.6	32.9	4.1	132.1	20.1	1.6	0.86	19.9
Soil + FYM + leaf mould(1:1;1)	25	46.9	34.1	4.1	136.2	22.2	1.2	0.97	17.6
Soil + Vermicompost (1:1)	27	46.2	38	4.3	136.7	28.4	1.4	0.94	17.3
Soil + FYM + Cocopeat (1:1:1)	34.3	48.1	30.6	4.6	138.9	26.7	1.6	0.94	21.1
Soil + Cocopeat + leaf mould (1:1:1)	29.5	48.3	31.2	4.9	140.4	28.5	1.8	1.2	16.8
Perlite + Cocopeat + FYM (1:1:1)	41.8	54.8	41	5.3	148.9	36.5	1.8	1.1	20.3
Soil+Vermiculite+FYM (1:1:1)	36.9	53.1	31.3	5	141.3	30.3	1.6	0.91	19.4
CD (P = 0.05)	2.35	4.63	3.29	0.44	13.19	2.07	0.12	0.04	0.7

Ranchi

Based on four (2010 to 2014) year data it was concluded for above trail on pot culture of miniature roses under Ranchi climatic conditions that the maximum pH (7.0) and EC of the media was in Perlite + Cocopeat + FYM combination. Maximum plant height was recorded in Soil + Cocopeat + FYM which was *at par* with Soil + Vermiculite + FYM, Soil + Vermicompost, and Perlite + Cocopeat + FYM) respectively. The plant spread was maximum in the composition Soil + Vermiculite + FYM in N-S and in E-W direction. The number of branches, flowers and flower diameter was maximum in the media composition Soil + Vermiculite + FYM and followed by Soil + Cocopeat + FYM and Perlite + Cocopeat + FYM (Table 2.2 abc).

Table 2.2a. Standardization of media composition for pot grown rose at Ranchi centre during 2010-11

Treatment	pH	Plant spread E-W (cm)			No. of branches		No. of flowers			Flower diam. (cm)			Plant height (cm)			Plant spread N-S (cm)		
		Red	Pink	White	Red	Pink	White	Pink	White	Red	Pink	White	Red	Pink	White	Red	Pink	White
Soil + FYM(1:1)	5.6	25.75	27.7	22	2.3	2.55	12.2	13.1	12.9	2.55	2.55	2.1	21.95	19.25	18	22	25.7	22
Soil + FYM + Leaf Mould (1:1:1)	5.8	25.1	28.1	28.1	2	2.75	12.5	14.82	14.75	2.75	2.75	2.15	21.75	20.1	19.1	22.72	25.75	24.2
Soil + Vermi Composed (1:1)	6	28.7	30.72	30.1	3.25	2.9	13.3	15	14.9	2.9	2.9	2.55	27.25	24.1	23	28.75	27	24.1
Soil + Cocopeat + FYM (1:1:1)	6.1	33.2	29.2	31.7	3.75	3.55	14.1	16.3	15.55	3.55	3.55	2.8	28.75	26	24.75	31.75	29.75	30.2
Soil + Cocopeat + Leaf mould (1:1:1)	6.1	28.2	27	25	2.75	2.09	13.1	14	14	2.8	2.09	2.1	28	20	21.1	26.79	27.1	25.2
Perlite + Cocopeat + FYM (1:1:1)	7	31	27.1	26.75	3.35	2.35	14	16	15.35	3.1	2.35	2.5	26	22	22.65	30.1	28.25	28
Soil + Vemiculite + FYM (1:1:1)	6.7	34.1	29.7	32	4.5	2.9	14.2	16.5	15.6	3.62	2.9	3	26.75	21.9	23.75	33.25	30	30.25

Table 2.2b. Standardization of media composition for pot grown rose at Ranchi centre during 2011-12

Treatment	Plant height (cm)	Plant spread (ExW) cm	Plant spread (NxS) cm	No. of branches/ plant	Days to flowering	Flower dia. (cm)	Flower bud length (cm)	No of flowers/ plant/season	Stem length (cm)
Soil + FYM(1:1)	31.8	25.6	27.8	4.5	13.77	1.9	0.25	55.2	19.8
Soil + FYM + Leaf Mould (1:1:1)	33.7	23.8	30.4	5	16.57	2.3	0.35	64.8	20
Soil + Vermi Composed (1:1)	32.5	24.5	29.6	4.8	14	1.8	0.45	56.7	17.4
Soil + Cocopeat + FYM (1:1:1)	35.27	27.8	33.5	5.5	19.7	2.5	0.58	69.5	20.77
Soil + Cocopeat + Leaf mould (1:1:1)	30.8	24.8	28.7	4	15.73	2.3	0.28	60.3	16.17
Perlite + Cocopeat + FYM (1:1:1)	28.9	21.5	23.3	3.8	10.57	1.6	0.18	29.37	18.3
Soil + Vemiculite + FYM (1:1:1)	31	25.2	30.5	5	12.53	1.8	0.27	49.9	20.5
C D P=0.05	1.58	0.9	0.86	0.32	1.52	0.19	0.02	8.11	1.81

Table 2.2c. Standardization of media composition for pot grown rose at Ranchi centre during 2012-13

Treatment	pH	Plant spread E-W (cm)			No. of branches		No. of flower			Flower Diam. (cm)			Plant height (cm)			Plant spread N-S (cm)		
		Red	Pink	White	Red	Pink	White	Pink	White	Red	Pink	White	Red	Pink	White	Red	Pink	White
Soil + FYM(1:1)	5.6	45.75	47.7	42	6.3	6	2.2	2.1	2.9	2.65	2.55	2.1	31.95	29.25	28	32	35.7	32
Soil + FYM + Leaf Mould (1:1:1)	5.8	45.1	48.1	48.1	6	5.95	2.5	2.82	2.75	2.75	2.75	2.15	31.75	30.1	29.1	32.72	35.75	34.2
Soil + Vermi Composed (1:1)	6	48.7	50.72	50.1	7.25	6.85	3.3	3	3.9	3	2.9	2.55	37.41	34.6	33.4	38.75	37	34.1
Soil + Cocopeat + FYM (1:1:1)	6.1	53.6	49.25	51.75	8.8	8.1	4.15	3.3	3.6	3.6	3.55	2.8	38.8	36.25	34.7	41.8	39.78	40.25
Soil + Cocopeat + Leaf mould (1:1:1)	6.1	48.2	47	45	6.75	6	2.1	2	2	2.8	2.09	2.1	36	30	31.1	36.79	37.1	35.2
Perlite + Cocopeat + FYM (1:1:1)	7	51	47.1	46.75	7.35	7	4	3	3.35	3.3	2.35	2.5	36.36	32	32.65	30.1	38.25	38
Soil + Vemiculite + FYM (1:1:1)	6.7	54.1	49.75	52.1	8.55	8.1	4.25	3.6	3.65	3.62	2.9	3	37.33	34.57	33.75	43.25	40	40.25

Table 2.2d. Effect of media composition on pot grown rose at Ranchi centre

Treatment	pH	BD (g/cm^2)	EC (dsm^{-1})	Plant height (cm)	E-W (cm)	No. of branches/ plant	Avg. no. of flowers at weekly intervals	Flower diam. (cm)	Days for flower-ing	Flower-ing duration (day)	No. of flowers/ plant/ season	Flower bud length (cm)
Soil +Sand+ FYM (2:1:1)	5.6	0.214	0.418	29.74	45.15	6.08	2.4	2.44	51.47	151.2	22.74	1.51
Soil + Sand + FYM + Leaf Mould (2:1:0.5:0.5)	5.8	0.213	0.44	30.32	47.1	5.9	2.69	2.55	51.85	150.75	24.04	1.03
Soil + Sand+ Vermi Compost (2:1:1)	6	0.229	0.425	35.13	51.98	8.51	3.84	3.17	50.11	153	34.98	1.57
Soil + Sand +Cocopeat + FYM (2:1:0.2.5:1)	6.1	0.212	0.527	36.58	51.54	8.4	3.68	3.31	50.33	149.86	33.7	1.85
Soil + Sand +Cocopeat + Leaf mould (2:1:0.25:1)	6.1	0.214	0.497	30.34	46.66	6.35	2.03	2.33	49.36	152.4	23.7	1.43
Perlite + Cocopeat + FYM (1:0.5:1)	7	0.082	0.53	33.67	48.08	7.45	3.45	2.71	42.4	150	32.78	1.39
CD P=0.05		1.46	1.54	1.04	0.3	NS	NS	0.46	1.44	NS	1.68	0.27

Periyakulum

The above trail was conducted from 2011 to 2014 on three cultivarsof miniature roses viz., Red (Red Kudthki), Pink and White (Snow White) in different nutrient media at HC&RI, Periyakulam. Growth and yield performance were observed from 2012 onwards and the pooled data are presented (Table 2.3abc). Data revealed that, cultivar Pink ranked first for plant height, number of branches per plant, flower duration, number of flowers per plant at weekly interval, number of flowers per plant per year and number of flowers per m2. Among the growing media, Soil + FYM (T_1) recorded the increased plant height and plant spread (E x W) and (N x S).

The growing media, Soil + Coco peat + Leaf mould (T_5) registered the highest flower diameter, flower bud length , days to early flowering and flower stem length. However, the growing media, Soil + FYM + Leaf mould (T_2) recorded the highest number of branches per plant, longer flowering duration, the highest number of flowers per m^2, highest number of flowers per plant at weekly interval and number of flowers per plant per year . It can be concluded that,

cultivar Pink (V_2) showed better performance for most of the important traits. Similarly, the growing media Soil + FYM + Leaf mould (T_2) recorded the highest value for the most important economic traits like early flowering, number of flowers and flowering duration. The same growing media recorded the highest benefit cost ratio (3.4).

Table 2.3a. Effect of media composition on pot grown rose (Pooled mean) at Periyakulam centre

Cultivar	Vegetative growth parameters				Flowering parameters						
	Plant height (cm)	Plant spread ExW (cm)	Plant spread NxS (cm)	No. of branches per plant	Days to flowering	No. of flowers per plant at time weekly Interval	No. of flowers per plant per year	Flower diameter (cm)	Flower bud length (cm)	Length of flower stalk (cm)	No. of flowers per m^2
V_1	33.48	19. 33	18.66	8.43	31.56	6.22	84.98	3.53	1.03	3.7	101.2
V_2	36.11	21.32	20.09	11.1	32.92	8.72	92.46	3.42	1.1	3.65	108.43
V_3	33.1	19.52	19.98	8.7 3	30.74	7.04	79.12	3.3	1.08	3.49	99.81

Table 2.3b. Effect of media composition on pot grown rose (Pooled mean) at Periyakulam centre

Treatment	Vegetative character				Flowering parameters						
	Plant height (cm)	Plant spread		No. of branches per plant	Duration of flowering (day)	Flowers/ plant at time weekly Interval	No. of flowers/ plant/ year	Flower diam. (cm)	Flower bud length (cm)	Length of flower stem (cm)	No. of flower/ m^2
		E x W (cm)	NxS (cm)								
Soil + FYM (1:1)	38.12	22.32	22.41	7.95	99.45	5.02	74.42	2.88	0.96	2.51	70.83
Soil + FYM + leaf mould(1:1:1)	36.15	21.36	22	11.96	136.23	10.72	109.2	3.98	1.15	3.96	126
Soil + Vermicompost (1:1)	31.2	19.07	18	8.31	101.2	6.6 2	77.5	3.14	1	2.77	78
Soil + FYM + Cocopeat (1:1:1)	34.2	19.11	19.93	9.49	126.25	7.38	88	3.96	1.24	4.09	117.33
Soil + FYM + leaf mould (1:1:1)	32.7	22.7	20.33	11	134.41	9.2	97.34	4.16	1.37	4.36	107.16
Perlite + Cocopeat + FYM (1:1:1)	28.9	16.14	17.6	8.48	119.5	6.83	80.5	3.55	1.12	3.74	97.08
Soil+Vermiculite+FYM (1:1:1)	34.19	16.51	17	8.69	108.41	7.11	79.9	3.44	1.05	3.51	87.25

Table 2.3c. Economics of growing media for miniature rose grown under pot culture at Periyakulam centre

Tr. No.	Treatment	Cost of production for pot mixture (10 kg per pot)	Cultivar	Yield per pot/year (No. of flowers)	BCR ratio
T_1	Soil + Farmyard Manure (1:1 v/v)	16.25	V_1	61	1.87
			V_2	75	2.3
			V_3	68	2.09
T_2	Soil + Farmyard Manure + Leaf mould (1:1:1 v/v)	17.49	V_1	110.75	3.16
			V_2	124	3.4
			V_3	96	2.74
T_3	Soil + Vermicompost (1:1 v/v)	30	V_1	74.25	1.23
			V_2	81.25	1.35
			V_3	68	1.13
T_4	Soil + Coco peat + Farmyard Manure (1:1:1 v/v)	23.49	V_1	81.25	1.73
			V_2	95.25	2.02
			V_3	81.5	1.73
T_5	Soil + Coco peat + Leaf mould (1:1:1 v/v)	22.62	V_1	96	2.12
			V_2	110.25	2.43
			V_3	89.75	1.98
T_6	Perlite + Coco peat + Farmyard Manure (1:1:1 v/v)	60.16	V_1	75	0.62
			V_2	88.25	0.73
			V_3	81.25	0.67
T_7	Soil + Vermiculite + Farmyard Manure (1:1:1 v/v)	39.96	V_1	68	0.85
			V_2	81.25	1.01
			V_3	68.5	0.85

Chiplima

Rose cultivar 'Rainbow End' was selected for this experiment. Planting was done in 20 cm pots as per the technical program and ten plants were planted in each treatment. Observations of various growth parameters were taken are presented in Table 2.4a. Growth parameters namely, plant height, plant spread, number of branches per plant, days to flowering, duration of flowering, flower diameter, bud length, number of flowers per plant did not vary significantly in first year. From second year treatment T_4 (Soil+ Cocopeat +FYM @ 1:1:1) recorded highest plant height (22.85cm) at the time of first flower bud appearance, plant spread (NXS) & (EXW) , number of branches per plant and number of flowers per plant. Treatment T4 is significantly different from all other treatments with respect to number of flowers per plant. The treatments found significant were plant height, plant spread, number of branches per plant and number of flowers per plant. All other characters viz-a-viz days to flowering, duration of flowering, no of flowers per plant flower diameter, bud length were non significant. Plants exhibited good performance in the treatment T_4 (Soil+ Coco peat + FYM @ 1:1:1) with respect to plant height, plant spread, number of branches per plant and number of flowers per plant and number of flowers per week. (Table 2.4bc).

Table 2.4a. Effect of media composition on pot grown rose cv. Rainbow End at Chiplima centre

Tr. No	Treatment	pH	BD	EC	Plant height (cm)	Plant spread (cm)	No. of branches per plant	Days to flowering	Flowering duration (day)	No. of flowers per plant at weekly interval	Flower diam. (cm)	Bud length (cm)
						N X S						
T_1	Soil + FYM(1:1)	6.83	1.3	0.77	20.13	15.76	3.08	42.5	7.25	1.69	3.5	1.98
T_2	Soil + FYM + Leaf Mould (1:1:1)	6.94	1.3	0.62	20.15	15.88	3.42	41	7.5	1.48	3.56	1.95
T_3	Soil + Vermi Composed (1:1)	6.14	1.4	0.92	19.16	14.45	3.17	38	7.75	1.58	3.4	2.03
T_4	Soil + Cocopeat + FYM (1:1:1)	7.36	1.4	0.71	20.39	15.74	3.67	38.25	7.25	1.77	3.53	2.23
T_5	Soil + Cocopeat + Leaf mould (1:1:1)	7.1	1.3	0.55	18.85	15.31	2.92	40	7.5	1.6	3.46	2.23
T_6	Perlite + Cocopeat + FYM (1:1:1)	7.2	1.2	0.73	19.1	15.31	3.25	39.5	7.75	1.69	3.55	2.15
T_7	Soil + Vemiculite + FYM (1:1:1)	7.64	1.3	0.68	19.93	14.51	3.33	39.5	7.25	1.83	3.61	2.08
	CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2.4b. Effect of media composition on pot grown rose cv. Rainbow End at Chiplima centre

Treatment	pH	BD g/cm3	EC dsm-1	Plant height at 1st flower bud appearance	Plant spread NXS	No. of branches per plant	Days to flower-ing	Flower-ing duration (day)	No. of flowers per plant at weekly interval	Flower diam (cm)	Bud length (cm)	No. of flowers per plant
T_1	6.72	0.271	0.476	21.13	17.77	4.08	42.5	107.25	1.69	3.5	1.98	20.25
T_2	6.84	0.223	0.426	21.14	17.82	3.42	41	107.5	1.48	3.56	1.95	17.75
T_3	6.77	0.178	0.526	20.26	16.46	4.17	38	107.75	1.58	3.4	2.03	19
T_4	7.86	0.183	0.498	22.35	20.7	5.67	38.25	107.25	1.77	3.53	2.23	21.24
T_5	6.82	0.217	0.51	19.8	18.35	3.92	40	107.5	1.6	3.46	2.23	19.23
T_6	7.3	0.198	0.32	20.1	17.32	3.25	39.5	107.75	1.69	3.55	2.15	20.25
T_7	7.12	0.176	0.229	20.91	17.51	3.33	39.5	107.25	1.83	3.61	2.08	22
CD(P=0.05)	--	--	--	1.02	1.46	1.03	NS	NS	NS	NS	NS	1.84

T_1 = Soil + FYM(1:1), T_2 = Soil + FYM + Leaf Mould (1:1:1), T_3 = Soil + Vermi Composed (1:1), T_4 = Soil + Cocopeat + FYM (1:1:1), T_5 = Soil + Cocopeat + Leaf mould (1:1:1), T_6 = Perlite + Cocopeat + FYM (1:1:1), T_7 = Soil + Vemiculite + FYM (1:1:1)

Table 2.4c. Effect of media composition on pot grown rose cv. Rainbow End at Chiplima centre

Treatment	pH	g/cm^3	dsm^{-1}	Plant height at 1st flower bud appearance	NXS	No. of branches/ plant	Days to flowering	Flowering duration (day)	No. of flowers/ plant at weekly interval	Flower diam (cm)	Bud length (cm)	No. of flowers/ plant
T_1	6.72	0.271	0.476	21.15	17.75	4.17	42.53	107.11	1.72	3.51	2	20.35
T_2	6.84	0.223	0.426	21.18	17.8	3.48	41.33	107.23	1.53	3.57	1.9	18.18
T_3	6.77	0.178	0.526	20.23	16.32	4.23	38.12	107.75	1.81	3.42	2.13	19.75
T_4	7.86	0.183	0.498	22.85	20.81	5.51	38.58	107.5	2	3.51	2.23	36.21
T_5	6.82	0.217	0.51	19.83	18.28	4.11	40.31	107.75	1.61	3.44	2.32	19.6
T_6	7.3	0.198	0.32	20.14	17.36	3.32	39.51	107.51	1.72	3.54	2.14	20.22
T_7	7.12	0.176	0.229	20.95	17.54	3.4	39.33	107.35	1.93	3.6	2.11	22.12
CD(P=0.05)	--	--	--	1.23	1.36	0.75	NS	NS	NS	NS	NS	1.84

T_1 = Soil + FYM(1:1), T_2 = Soil + FYM + Leaf Mould (1:1:1), T_3 = Soil + Vermi Composed (1:1), T_4 = Soil + Cocopeat + FYM (1:1:1), T_5 = Soil + Cocopeat + Leaf mould (1:1:1), T_6 = Perlite + Cocopeat + FYM (1:1:1), T_7 = Soil + Vemiculite + FYM (1:1:1)

Pune

Based on four year experiments it was concluded that treatment T_4 (Soil + Cocopeat + FYM @ 1:1:1) showed significantly more plant height, number of flowers per plant, number of branches per plant, flower diameter, flower bud length and stem length of flower than other treatments (Table 2.5abcd).

Table 2.5a. Effect of media composition on pot grown roses (Pink colour miniature) at Pune centre

Treatment	Plant height (cm)	Plant spread (ExW) cm	Plant spread (NxS) cm	No. of branches/ plant	Days to flowering	Flower diam. (cm)	Flower bud length (cm)	No of flowers/ plant/season	Stem length (cm)
T_1	33.47	23.5	25.46	3.73	57.6	1.8	0.3	41.5	20.4
T_2	36	22.7	28.9	4.03	53	2	0.4	42.7	21
T_3	34.6	23	27.63	4.53	57.8	1.9	0.5	40.4	19.87
T_4	38.53	26.5	31.6	4.83	50.5	2.4	0.6	42.56	22.6
T_5	33	25.7	27	3.9	60.8	2	0.3	40.5	19
T_6	30.4	20	24.8	3.3	59.3	1.2	0.2	34.86	17.77
T_7	33.9	24	28.8	4.5	55.4	1.5	0.3	38.7	21.6
C D (P=0.05)	1.26	0.57	1.12	0.52	1.59	0.26	0.22	4.52	0.68

T_1 = Soil + FYM(1:1), T_2 = Soil + FYM + Leaf Mould (1:1:1), T_3 = Soil + Vermi Composed (1:1), T_4 = Soil + Cocopeat + FYM (1:1:1), T_5 = Soil + Cocopeat + Leaf mould (1:1:1), T_6 = Perlite + Cocopeat + FYM (1:1:1), T_7 = Soil + Vemiculite + FYM (1:1:1)

Table 2.5b. Effect of media composition on pot grown rose (Pink colour miniature) at Pune centre

Sl. No.	Treatment	Bud length (cm)	Bud breadth (cm)	Flower diam. cm)	Flower shootlength (cm)	EC dsm^{-1}	pH
1	Soil + FYM(1:1)	1.52	0.89	3.89	3.32	0.492	7.75
2	Soil +FYM +Leaf Mould (1:1:1)	1.14	0.99	5.02	3.15	0.445	8.18
3	Soil+ Vermicompost(1:1)	1.42	0.94	5	3	0.422	7.8
4	Soil+ Cocopeat+ FYM(1:1:1)	1.41	0.94	5.25	3.12	0.524	8.07
5	Soil+ Cocopeat + Leaf mould (1:1:1)	1.67	1.07	5.25	2.89	0.496	8.34
6	Perlite+ Cocopeat +FYM (1:1:1)	1.48	1.1	5.6	3	0.53	8.1
7	Soil +Vermiculite+ FYM (1+1:1)	1.5	0.89	5.28	3.12	0.432	8..07
	CD(P=0.05)	0.15	0.08	0.07	NS	0.01	0.01

Table 2.5c. Effect of media composition on pot grown rose (Pink colour miniature) at Pune centre

Treatment	Plant height (cm)	Plant spread (ExW) cm	Plant spread (NxS) cm	No. of branches/ plant	Days to flowering	Flower diam. (cm)	Flower bud length (cm)	No of flowers/ plant/season	Stem length (cm)
T_1	29.9	23.4	29.03	4.8	16.8	1.5	0.3	58.4	17.5
T_2	30.53	21.83	28	5.4	18.5	2	0.37	66.83	16.7
T_3	28.7	22.5	27.4	4.7	18.33	1.7	0.48	58.77	15.6
T_4	32.4	24.7	31.5	6	22.4	2	0.6	71.5	21.8
T_5	28.8	20.8	24.7	4.2	18.4	1.8	0.29	62.4	14
T_6	26.73	22	23	3.7	14.5	1	0.2	31.8	16.5
T_7	29.4	23.93	28.6	4.8	15.6	1.6	0.28	52.7	18.7
C D (P=0.05)	0.22	1	4.23	0.38	3.69	0.18	0.02	1.11	0.86

T_1 = Soil + FYM(1:1), T_2 = Soil + FYM + Leaf Mould (1:1:1), T_3 = Soil + Vermi Composed (1:1), T_4 = Soil + Cocopeat + FYM (1:1:1), T_5 = Soil + Cocopeat + Leaf mould (1:1:1), T_6 = Perlite + Cocopeat + FYM (1:1:1), T_7 = Soil + Vemiculite + FYM (1:1:1)

Table 2.5d. Effect of media composition on pot grown rose (Pink colour miniature) at Pune centre

Tr. No.	Treatment	Plant height (cm)	Plant spread		No. of branches/ plant	No of flowers/ plant	Flower dia. (cm)	Flower bud length (cm)	No of flowers/ plant/ season	Stem length (cm)
			(ExW) cm	(NxS) cm						
T_1	Soil + FYM (1:1)	30.68	24.6	26.7	4.27	14.8	1.6	0.28	50.7	19.03
T_2	Soil + FYM + leaf mould(1:1:1)	32.25	22.5	27.8	4.7	17.7	1.8	0.36	56.4	17.5
T_3	Soil + Vermicompost (1:1)	31.63	21.8	25.5	3.5	15.6	1.5	0.45	54.9	16.4
T_4	Soil + FYM + Cocopeat (1:1:1)	34.46	26.13	29.6	5.4	21.6	2.7	0.56	60.8	20.8
T_5	Soil + FYM + leaf mould (1:1:1)	30.9	23.5	26	3.8	16.4	2	0.27	53.2	15.7
T_6	Perlite + Cocopeat + FYM (1:1:1)	28.5	20.6	22.7	4	10.8	1.3	0.17	33.6	17.6
T_7	Soil+Vermiculite+ FYM (1:1:1)	31.6	22	24.5	3.9	13.5	1.5	0.31	46.5	18.4
	C D (P=0.05)	2.43	1.77	1.56	1.02	1.29	0.37	0.02	0.6	1.38

Ludhiana

Four years trial was conducted as per the suggested technical programme of work with Cv. Centre Piece. Data pertaining to all the parameters are tabulated in table 2.6 a-d. It was observed that maximum plant height, plant spread duration of flowering and number of flowers per plant in treatment T6 (Perlite+ Cocopeat +FYM (1:0.5:1). However, flowering at weekly interval showed non significant results. Bulk density was exhibited lowest in T6 (Perlite+ Cocopeat +FYM (1:0.5:1) while the pH was recorded more than seven in all the treatments. However in the treatment T3 soil, sand and vermicompost (2: 1:1) high plant mortality was recorded. Among various media compositions, T6 (Perlite + Cocopeat +FYM (1:0.5:1) was effective in improving plant growth and flower parameters.

Table 2.6a. Effect of media on growth and flowering of pot grown miniature rose cv. Centre Piece at Ludhiana centre during 2010-11

Treatment	Plant height (cm)	Plant spread (cm)	No. of branches per plant	Days to flower	No of flowers						Bud length	Bud breadth (cm)	Flower diam. (cm)	Flower shoot length (cm)	pH
					1st week Nov.	1st Week Dec.	1st Week Jan	1st Week Feb	1st Week March	Last Week March					
Soil + FYM(1:1)	22.27	25.78	5.3	51.41	2.03	2.67	3.67	5.33	9.66	19.5	1.63	0.93	4.93	3.38	7.85
Soil +FYM +Leaf Mould (1:1:1)	15.3	25.64	5.67	52.27	3.1	4	4.67	6.67	10.53	20.87	1.04	1.04	5.22	3.23	8.14
Soil+ Vermicompost (1:1)	18.67	22.72	5.67	50.14	2.33	3	3.67	5.33	11.3	21.2	1.53	0.96	5.15	2.98	7.91
Soil+ Cocopeat+ FYM(1:1:1)	19.07	27.6	3.4	50	3.33	3.8	4.67	7.33	11.13	21.1	1.45	0.99	5.6	3.02	8
Soil+ Cocopeat + Leaf mould (1:1:1)	20.8	24.25	4.9	49.67	3.67	3.67	3.67	5.66	9.99	20.07	1.57	0.92	5.44	2.97	8.25
Perlite+ Cocopeat + FYM (1:1:1)	19.73	27.2	3.83	42	2.0	2.0	3.0	6.66	10.37	22.33	1.38	0.85	5.7	3.18	8.08
Soil + Vermiculite+ FYM (1+1:1)	20.63	25.82	3.73	42.33	2.33	3.0	4.33	6.0	11.03	23.37	1.43	1.03	5.37	3.26	8.09
CD (P=0.05)	1.58	1.06	0.39	6.25	NS	NS	NS	NS	0.69	1.05	0.22	0.19	0.189	0.14	0.019

Table 2.6b. Effect of media on growth and flowering of pot grown miniature rose cv. Centre Piece at Ludhiana centre during 2011-12

Treatment	Plant height (cm)	Plant spread (cm)	No. of branches per plant	Days to flower	No of flowers						Bud length	Bud breadth (cm)	Flower diam. (cm)	Flower shoot length (cm)	pH
					1st week Nov.	1st Week Dec.	1st Week Jan	1st Week Feb	1st Week March	Last Week March					
Soil + FYM(1:1)	24.47	23.51	4.25	50.12	2.56	2.67	4.56	5.85	12.35	29.66	1.52	0.89	3.89	3.32	7.75
Soil +FYM +Leaf Mould (1:1:1)	16.25	24.74	4.69	54.21	2.68	3.65	4	7.58	17.65	24.28	1.14	0.99	5.02	3.15	8.18
Soil+ Vermicompost(1:1)	17.56	18.65	5.02	51	2.41	3.22	3.78	5.04	14.52	32.52	1.42	0.94	5	3	7.8
Soil+ Cocopeat+ FYM(1:1:1)	21.25	23.51	4.12	51.26	3	4.21	4.68	6.58	13.85	28.56	1.41	0.94	5.25	3.12	8.07
Soil+ Cocopeat + Leaf mould (1:1:1)	21.52	24.52	5.21	48.56	3.45	3.12	3.58	5.02	10.25	41.25	1.67	1.07	5.25	2.89	8.34
Perlite+ Cocopeat +FYM (1:1:1)	24.52	27.2	5.25	45.45	3.65	4.12	4.25	6.74	21.32	59.78	1.48	1.1	5.6	3	8.1
Soil +Vermiculite+ FYM (1+1:1)	21.23	27.58	3.78	47.56	2	4	4.89	5.42	17.25	54.52	1.5	0.89	5.28	3.12	8..07
CD (P=0.05)	0.58	1.06	0.89	3.71	NS	NS	NS	NS	0.69	8.05	0.15	0.08	0.076	NS	0.009

Table 2.6c. Effect of pot media on growth and flowering of pot grown miniature rose cv. Centre Piece at Ludhiana centre during 2012-13

Treatment	Bud length (cm)	Bud breadth (cm)	Flower diam. (cm)	Flower shoot length (cm)	EC dsm-1	pH
Soil + FYM(1:1)	1.52	0.81	4.85	3	0.494	7.7
Soil +FYM +Leaf Mould (1:1:1)	1..45	0.85	5.12	3.32	0.444	8
Soil+ Vermicompost(1:1)	1.44	0.78	3.56	3.21	0.419	7.8
Soil+ Cocopeat+ FYM(1:1:1)	1.39	0.84	5.12	3.24	0.522	8.1
Soil+ Cocopeat + Leaf mould (1:1:1)	1.52	0.99	5.02	2.25	0.486	8.4
Perlite+ Cocopeat +FYM (1:1:1)	1.54	0.87	5.75	3.25	0.532	8.1
Soil +Vermiculite+ FYM (1+1:1)	1.53	0.87	5.29	3.25	0.434	8..0
CD (P=0.05)	NS	NS	0.076	NS	0.003	NS

Table 2.6d. Effect of pot media on growth and flowering of pot grown miniature rose at Ludhiana centre 2013-14

Treatment	Plant height (cm)	Plant spread (cm)	No. of branches per plant	Days to flower	No of flowers						Bud length	Bud breadth (cm)	Flower diam. (cm)	Flower shoot length (cm)	pH
					1st week Nov.	1st Week Dec.	1st Week Jan	1st Week Feb	1st Week March	Last Week March					
Soil + FYM(1:1)	20.33	24.56	5.36	45.66	3.36	3.28	5.8	4.26	14.24	34.55	1.75	0.86	4.86	3.66	7.8
Soil +FYM +Leaf Mould (1:1:1)	25.68	22.16	5.48	52.48	3.24	4.16	3.14	6.55	17.75	32.47	1..49	0.82	5.15	3.33	7.9
Soil+ Vermicompost(1:1)	17.35	12.29	6.35	56.25	2.28	2.04	3.64	3.27	14.56	23.03	1.82	0.64	3.58	4.28	7.2
Soil+ Cocopeat+ FYM(1:1:1)	25.58	24.46	3.99	54.8	3.24	4.88	5.44	5.43	16.28	28.87	1.65	0.25	6.13	3.26	7.8
Soil+ Cocopeat + Leaf mould (1:1:1)	27.59	16.84	4.24	59.73	4.19	2.16	2.16	6.16	18.29	45.12	1.34	0.89	5.07	2.28	7.8
Perlite+ Cocopeat +FYM (1:1:1)	28.87	27.68	6.94	47.64	4.37	6.34	8.88	12.94	32.43	106.27	1.48	0.9	5.76	3.24	7.6
Soil +Vermiculite+ FYM (1+1:1)	0.79	0.54	NS	2.09	NS	NS	NS	NS	0.72	4.52	NS	NS	0.076	NS	NS

Experiment 2 : Studies on mulching in rose.

Duration : Three years (2011-12 onwards)

Centres : Ludhiana, Pune, Udaipur, Ranchi, Pantnagar and Chiplima

Technical Programme

No. of treatments : Eight

T1 : Black polythene – 200 micron thick

T2 : Black polythene – 300 micron thick

T3 : Black polythene – 400 micron thick

T4 : White polythene – 200 micron thick

T5 : White polythene – 300 micron thick

T6 : White polythene – 400 micron thick

T7 : Paddy straw – 6 tonn/ha

T8 : Control (without mulch)

No. of replications : Three

Design of experiment : Randomized Block Design

Plot size : 2 m × 1.8 m

Spacing (row × plant) : 60 cm × 45 cm

No. of plants per plot : 12-13

Cultivar : Hybrid Tea Group – Raktagandha / Gladiator

Observations recorded

1. Soil temperature at weekly interval
2. Weed count per m2 at 25 days intervals non destrictive sample
3. Fresh weight of weed at 25 days intervals (g)
4. Dry weight of weed at 25 days intervals (g)
5. Plant height at first flower bud appearance stage (cm)
6. Plant spread, NXS & EXW (cm)
7. Number of branches per plant

8. Days to flowering

9. Flowering duration (day)

10. Number of flowers per plant

11. Flower diameter (cm)

12. Length of flower bud (cm)

13. Vase life (day)

14. No. of flowers per plant per season – 3 Seasons

15. No. of flowers per plant per unit area per season – 3 Seasons

16. Flower grade

Grade Minimum stalk length overall (cm)

Blue - 56

Red - 36

Green - 25

Report

Centre

Pantnagar

Experiment on mulching in rose was conducted for three years in randomized block design with eight treatments and three replications. Two years old budded plants of rose cv. Laher were selected for study. planting was done at 60 cm × 45 cm and plot size was 2.0 m × 1.8 m. (Tables 2.7a-e)

Regulation in soil temperature was harnessed with the use of different mulch materials. The plots with the white polythene mulching, irrespective of thickness recorded relatively warmer temperature than control or without mulching in the cooler months. However, the soil temperature regulation capacity of mulching materials was found as in the following order: black polythene mulch (200 μ ≥ 100 μ > 50 μ) followed by paddy straw mulch and white polythene sheet (200 μ ≥ 100 μ > 50 μ). Significant reduction of weeds (without any weed) was observed in black polythene mulch, irrespective of different thickness. However, in the plots covered with clear/white mulch and paddy straw mulch, weeds were seen. Maximum number of weeds (3733.00) in month of August, fresh weight of the weed (2466.03 g) in the month of August and dry weight of the weeds (471.70 g) was recorded in un-mulched plots (mean data at 25 days intervals). The maximum plant height during both spring and winter seasons was recorded in the plants mulched with 100 μ black polythene and in both the seasons the maximum plant spread was recorded with the use of 200 μ black polythene mulching. Number of branches/plant was recorded

maximum in plants growing under 200 µ black polythene mulch. However, plant spread and number of branches/plant under 100 µ black polythene mulch and 200 µ black polythene mulch were found *at par* during both the season. Plants mulched with 50 µ black polythene registered minimum days required to flowering. Maximum duration of flowering exhibited by the plants growing under 200 µ black polythene mulch in both the seasons. Maximum number of flowers/plant, flower diameter and length of flower bud were recorded in the 100 µ black polythene mulch treatment. Flower vase life in tap water was noted excellent in black polythene mulch treatment irrespective of thickness than the flowers from without mulched plot. All the flowers harvested under different mulch treatments were in between Green (25 cm) to Red (36 cm) or below green categories. The maximum length of flowering stalk (30.00 cm) was exhibited by the plants grown under 100 µ black polythene mulch.

Table 2.7a. Effect of various mulches on weed count/m^2 at 25 days interval in rose cv. Laher at Pantnagar centre

Month	Mulch treatment										
	T1		T2		T3	T4		T5		T6	
	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr
Jan.	0	0	0	0	0	903	871	659	634	1017	984
Feb.	0	0	0	0	0	552	530	474	458	611	590
Mar.	0	0	0	0	0	755	73	842	812	1126	1089
Apr.	0	0	0	0	0	540	521	680	657	520	496
May	0	0	0	0	0	506	524	662	557	422	401
Jun.	0	0	0	0	0	450	431	600	578	512	495
Jul.	0	0	0	0	0	750	421	1120	1082	1250	1207
Aug.	0	0	0	0	0	1785	1722	2696	2593	2202	2129
Sep.	0	0	0	0	0	1611	1555	2138	2063	1796	1734
Oct.	0	0	0	0	0	1240	1192	2004	1941	1956	1889
Nov.	0	0	0	0	0	1432	1381	2862	2774	2014	1947
Dec.	0	0	0	0	0	1333	1283	2466	2381	1703	1647
Mean	0	0	0	0	0	988	875.33	1434	1377.5	1261	1217.33

Table 2.7b. Effect of various mulches on fresh weight (g) of weed/m^2 at 25 day interval in rose cv. Laher at Pantnagar centre

Month	Mulch treatment															Mean		CD (P=0.05)	
	T1		T2		T3	T4		T5		T6		T7		T8					
	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr
Jan.	0	0	0	0	0	855.13	821.4	696.17	664.8	541.59	520.8	49.4	47.29	812.18	779.7	369.31	354.24	11.5	94.08
Feb.	0	0	0	0	0	523.27	500.1	379.93	360.7	464.34	443.3	27.17	26.22	476.04	447.6	233.84	222.24	8.11	59.88
Mar.	0	0	0	0	0	490.55	464.8	614.49	586	764.82	728	42.32	40.32	770.49	730.4	335.33	318.69	12.25	78.29
Apr.	0	0	0	0	0	504.7	485.6	530.11	508.1	333.46	316.6	136.91	129.6	1318.05	126.7	352.9	195.82	55.03	104.27
May	0	0	0	0	0	548.41	511.7	503.1	480.6	413.91	394.2	163.91	157.1	1006.39	1104	329.47	330.95	26.35	140.19
Jun.	0	0	0	0	0	381.51	385.4	407.54	387	292.95	280.1	338.42	338.3	919.57	1023	292.5	301.72	115.33	117.28
Jul.	0	0	0	0	0	583.46	557	718.23	687.5	760.75	724.4	361.25	342.3	694.86	708.4	389.82	377.45	225.63	81.02
Aug.	0	0	0	0	0	1418.32	1361	1809.34	1732	2029.61	1956	612.19	587.7	2478.53	2466.03	1043.5	1000.33	142	235.16
Sep.	0	0	0	0	0	1499.69	1443	1752.21	1674	1378.7	1316	457.37	436	2194.04	2096	910.25	870.62	156.25	209.58
Oct.	0	0	0	0	0	1157.32	1108	1832.03	1762	1662.29	1570	199.23	186.4	1979.29	1876	853.77	812.8	85.24	202.65
Nov.	0	0	0	0	0	1539.46	1473	2713.28	2339	1788.18	1716	91.8	88.12	2015.53	1941	1018.53	978.51	22.33	261.88
Dec.	0	0	0	0	0	1429.6	1215	2466	2071	1576.85	1511	96.03	91.05	2414.5	2324	997.87	926.5	44.01	278.76
Mean	0	0	0	0	0	910.95	860.5	1201.87	1143.64	1000.62	956.36	214.67	205.86	1423.29	1293.56	593.92	557.49		

Table 2.7c. Effect of various mulches on dry weight (g) of weed/m^2 at 25 day interval in rose cv. Laher at Pantnagar centre

Month	Mulch treatment															Mean		CD (P=0.05)	
	T1		T2		T3	T4		T5		T6		T7		T8					
	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr
Jan.	0	0	0	0	0	152.61	141.8	119.82	113.6	96.4	90.08	8.94	7.85	148.13	141.3	65.74	61.82	4.6	15.67
Feb.	0	0	0	0	0	98.48	91.17	61.47	58.26	73.95	73.22	4.89	5.17	86.84	82.96	40.7	38.84	2.42	11.88
Mar.	0	0	0	0	0	90.65	84.33	108.17	102.6	157.91	147.9	7.69	6.74	140.1	133	63.06	59.32	6.05	13.92
Apr.	0	0	0	0	0	91.35	87.26	96.52	91.7	59.74	54.87	24.93	22.8	243.56	230.3	64.51	60.86	22.5	18.06
May	0	0	0	0	0	98.63	91.92	91.66	86.91	74.77	68.77	29.9	25.86	182.15	199.4	59.64	59.1	15.23	25.03
Jun.	0	0	0	0	0	69.3	69.56	74.34	70.34	53.26	50.99	61.74	61.67	165.37	176.2	53	53.59	15	18.16
Jul.	0	0	0	0	0	106.24	100.7	131	125.2	138.62	131.4	65.69	62.56	126.22	128.1	70.97	68.49	11.31	13.99
Aug.	0	0	0	0	0	258.12	246.6	330.07	314.1	367.54	543.3	99.05	94.99	445.74	471.7	187.56	201.58	26.99	37.86
Sep.	0	0	0	0	0	263.62	294.6	318.61	302.8	251.11	238.9	80.51	75.54	398.54	377	164.05	161.1	7.06	40.85
Oct.	0	0	0	0	0	209.47	200	331.86	318.8	301.91	287.4	36.28	33.56	360.4	342.6	154.99	147.79	10.52	34.53
Nov.	0	0	0	0	0	279.11	267	490.78	413.2	324.3	310	16.72	15.38	366.8	351.4	184.71	176.87	3.12	46.2
Dec.	0	0	0	0	0	257.19	238.3	444.42	412.6	284.18	273.4	15.29	14.74	424.42	400.3	178.19	167.41	6.02	33.47
Mean	0	0	0	0	0	164.56	159.43	216.56	205.67	181.97	189.18	37.64	35.57	257.36	248.02	107.26	104.73	-	-

Table 2.7d. Effect of various mulches on vegetative and floral characters in rose cv. Laher at Pantnagar centre

Mulch treatment	Plant height (cm)				Plant spread (cm)			No. of branches/ plant			
	Spring		Winter		Spr-ing	Winter		Spring		Winter	
	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr
T1 : 50 µ Black polythene	56.65	60.74	40.31	45.59	43.36	29.72	32.74	4.00	4.67	3.8	4.33
T2 : 100 µ Black polythene	58.57	61.57	44.34	48.04	44.97	31.31	34.62	4.18	4.67	3.95	3.67
T3 : 200 µ Black polythene	55.13	58.65	37.96	41.32	48.06	34.32	37.52	4.44	5.00	4.11	3.67
T4 : 50 µ White polythene	49.6	53.28	32.35	36.23	40.84	26.31	30.19	3.89	4.33	3.73	3.33
T5: 100 µ White polythene	51.52	54.59	35.31	39.22	42.00	28.27	31.84	3.89	4.33	3.62	3.33
T6 : 200 µ White polythene	50.89	53.94	33.22	37.54	41.12	25.85	29.12	3.77	4.33	3.11	3.33
T7: Paddy straw	51.25	54.91	34.5	38.82	39.59	24.03	27.84	3.55	4.00	3.14	3.00
T8: Control/ Open plot	47.23	50.54	29.43	32.54	32.37	21.13	24.85	3.00	3.33	2.57	2.33
CD (P=0.05)	2.42	1.19	3.03	1.71	1.27	1.23	6.3	0.55	0.98	0.53	0.89

Table 2.7d. Effect of various mulches on vegetative and floral characters in rose cv. Laher at Pantnagar centre (continue...)

Mulch treatment	Days to flowering				Flowering duration (day)			
	Spring		Winter		Spring		Winter	
	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr
T1 : 50 µ Black polythene	29.55	30.00	30.17	30.00	14.35	13.67	14.55	14.33
T2 : 100 µ Black polythene	30.00	30.00	31.22	32.00	17.00	16.33	19.99	18.00
T3 : 200 µ Black polythene	32.66	30.33	35.01	35.00	17.00	16.67	18.32	20.00
T4 : 50 µ White polythene	37.89	36.00	39.47	38.67	15.52	15.00	15.66	15.33
T5: 100 µ White polythene	29.61	33.66	40.57	39.67	15.13	14.67	17.1	16.67
T6 : 200 µ White polythene	33.66	32.67	41.48	40.67	15.72	15.00	16.03	15.67
T7: Paddy straw	36.58	35.67	32.73	31.67	14.5	14.00	13.51	13.00
T8: Control/ Open plot	32.66	33.00	43.85	42.33	11.5	11.00	11.33	11.00
CD (P=0.05)	1.36	1.96	1.41	1.52	0.75	0.75	1.01	1.61

Table 2.7e. Effect of various mulches on vegetative and floral characters in rose cv. Laher at Pantnagar centre

Mulch treatment	No. of flowers per plant				Flower diam. (cm)			Length of flower bud (cm)			
	Spring		Winter		Spr-ing	Winter		Spring		Winter	
	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr
T1 : 50 µ Black polythene	29.55	30	38.61	38	7.83	6.58	6.72	3.42	3.06	1.96	1.99
T2 : 100 µ Black polythene	32.66	33	45.1	45	8.33	7.28	7.41	3.57	3.52	2.2	2.31
T3 : 200 µ Black polythene	31.22	32	41.22	42.67	8.25	6.81	6.75	3.54	3.35	2.41	2.45
T4 : 50 µ White polythene	27.89	29	35.38	34.67	6.58	5.28	5.36	3.2	3.11	1.93	1.89
T5: 100 µ White polythene	26.61	28	32.77	33	7.32	6.38	6.57	3.39	3.36	2.09	2.18
T6 :200 µ White polythene	25.66	26.67	31.05	32.33	6.2	5.6	5.92	3.1	3.15	1.89	1.94
T7: Paddy straw	26.58	27	33.44	34.67	7	4.77	4.71	3.1	3.16	1.58	1.67
T8: Control/ Open plot	22.66	22.33	29.37	29.33	5.36	4.25	4.39	1.98	2.42	1.44	1.47
CD (P=0.05)	1.36	1.72	2.22	2.15	0.36	0.53	0.29	0.16	0.44	0.11	0.11

Table 2.7e. Effect of various mulches on vegetative and floral characters in rose cv. Laher at Pantnagar centre (continue...)

Mulch treatment	Vase life (day)				Flower grade** (cm)			
	Spring		Winter		Spring		Winter	
	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr
T1 : 50 µ Black polythene	8	8.15	7.53	7.34	30.15	30.05	32.52	32.92
T2 : 100 µ Black polythene	8.75	8.76	8.33	8.39	30	30.33	34.85	34.78
T3 : 200 µ Black polythene	8.5	8.48	7.31	7.35	30	30	30.67	30.31
T4 : 50 µ White polythene	7.5	7.36	7.14	7.09	26.5	25.98	28.03	28.26
T5: 100 µ White polythene	6.5	6.38	6.78	7.96	28.5	28.08	29.18	29.26
T6 :200 µ White polythene	6.12	6.12	6.41	6.42	27.15	26.97	27.85	27.46
T7: Paddy straw	5.85	5.54	5.78	5.48	26.15	26.43	29.74	29.37
T8: Control/ Open plot	5.55	5.18	5.08	5.21	20.5	20.5	25.57	25.57
CD (P=0.05)	0.62	0.29	0.94	0.71	2.22	1.25	3.12	0.72

Udaipur

Out of eight mulching treatments in roses cv. Gladiator tried, black polythene 200 micron thickness mulch (T_3) recorded minimum weed count/m^2, fresh weight, dry weight were found better for growth and flowering parameters followed by black polythene of 100 micron thickness (T_2) (Table 2.8a & b).

Table 2.8a. Studies on mulching in rose cv. Gladiator at Udaipur centre during 2012-13

Treatment	Soil temp (mini.) ^{0}C	Soil temp (maxi.) C	Weed count/m^2 at 25 days	Weed count/m^2 at 50 days	Weed count/m^2 at 75 days	Fresh wt of weeds at 50 days (g)	Fresh wt of weeds at 75 days (g)	Dry wt of weeds at 25 days (g)	Dry wt of weeds at 50 days (g)	Dry wt of weeds at 75 days (g)
T1-Black Polythene 50 micron	19.27	30.47	14	10.67	8.67	58.97	29.27	34.77	22.03	17.93
T2- Black Polythene 100 micron	20.57	32.17	10	7.33	5.67	41.07	18.93	25.4	15.23	11.23
T3- Black Polythene 200 micron	22.07	32.67	7	5.33	3.33	29.63	11.67	18.37	11.7	6.83
T4- White Polythene 50 micron	20.3	31.63	43.67	36.67	34	200.67	111.37	111.47	73.93	68.17
T5- White Polythene 50 micron	19.2	28.7	29.67	25.67	23.33	141.4	76.77	75	54.27	47.37
T6- White Polythene 50 micron	19.17	32.73	23.33	23.67	21.33	132.13	75.67	59.87	48.73	43.8
T7- Paddy Straw 6t/ha	18.83	27.03	52.67	48.33	49	263.33	159.37	129.9	98.37	98.97
T8- Weedy Control	18.97	28.77	81	77.67	69.67	386.97	226.37	206.5	157.23	141.57
C.D. (P=0.05)	1.06	3.81	8.89	6.98	7.07	68.60	19.14	20.31	15.17	13.66

Table 2.8b. Studies on mulching in rose cv. Gladiator at Udaipur centre during 2012-13

Treatment	Plant height at Ist flower bud appear (cm)	Plant spread N x S (cm)	Plant spread E x W (cm)	Branches/plant	Days to flowering (day)
	12	13	14	15	16
T1-Black Polythene 50 micron	33.78	21.57	22.67	2.97	54.67
T2- Black Polythene 100 micron	36.43	23.27	23.3	3.67	53
T3- Black Polythene 200 micron	39.34	25.33	25.8	4.63	42
T4- White Polythene 50 micron	31.89	18.23	21.23	2.63	56.33
T5- White Polythene 50 micron	33.55	20.43	21.8	2.83	55.67
T6- White Polythene 50 micron	34.7	21.33	22.67	3.3	54.33
T7- Paddy Straw 6t/ha	35.67	21.43	21.97	3.3	61
T8- Weedy Control	26.73	16.97	18.1	2.97	64
C.D. at 5%	4.89	4.03	1.85	0.85	10.69

Table 2.8b. Studies on mulching in rose cv. Gladiator at Udaipur centre during 2012-13 (continue...)

Treatment	No. of fowers/ plant	Flower diam. (cm)	Flower bud length (cm)	Vase life (day)	No. of flowers/ unit area (2x1.8 m^2)	Flower stalk length (cm)
	18	19	20	21	22	
T1-Black Polythene 50 micron	4.97	6.8	4.97	6.33	74.5	29
T2- Black Polythene 100 micron	5.13	6.87	5.03	6.5	77	31.33
T3- Black Polythene 200 micron	7.17	8	5.23	7	107.5	36.67
T4- White Polythene 50 micron	4.17	6.33	4.8	5.33	62.5	23
T5- White Polythene 50 micron	4.5	6.73	4.9	5.5	67.67	26.33
T6- White Polythene 50 micron	4.67	6.93	5	6.17	70	30
T7- Paddy Straw 6t/ha	4.83	7	5.03	6.33	72.5	29.33
T8- Weedy Control	3.5	6.47	4.2	5.5	52.5	26
C.D. (P=0.05)	1.16	0.51	0.36	0.71	17.44	5.23

Table 2.8c. Studies on mulching in rose cv. Gladiator at Udaipur centre during 2013-14

Tr. No.	Treatment	Soil temp		Weed count/ m^2 at 25 days	Weed count/ m^2 at 50 days	Fresh wt of weeds at 25 days (g)	Fresh wt of weeds at 50 days (g)
		min. ^{0}C	max. ^{0}C				
T1	Black Polythene 50 micron	19.32	30.54	14.05	10.69	120.71	29.32
T2	Black Polythene 100 micron	20.61	31.94	10.01	7.35	85.86	19.01
T3	Black Polythene 200 micron	21.9	32.65	6.98	5.32	58.06	11.66
T4	White Polythene 50 micron	20.16	29.95	43.46	36.46	557.37	110.71
T5	White Polythene 50 micron	19.39	30.3	29.95	25.93	258.82	77.45
T6	White Polythene 50 micron	19.16	32.08	23.34	23.72	199.71	75.78
T7	Paddy Straw 6t/ha	18.89	27.12	52.87	48.53	446.58	159.8
T8	Weedy Control	18.84	28.86	80.5	77.19	678.67	227.14
	C.D. (P=0.05)	1.35	3.27	8.79	7.02	188.68	18.91

Table 2.8c. Studies on mulching in rose cv. Gladiator at Udaipur centre during 2013-14 (continue...)

Tr. No.	Treatment	Fresh wt of weeds at 75 days (g)	Dry wt of weeds at 25 days (g)	Dry wt of weeds at 50 days (g)	Dry wt of weeds at 75 days (g)	Plant height at 1st flower bud (cm)
T1	Black Polythene 50 micron	29.32	34.86	22.06	18.06	33.8
T2	Black Polythene 100 micron	19.01	25.43	15.26	11.26	36.61
T3	Black Polythene 200 micron	11.66	18.33	11.66	6.82	39.00
T4	White Polythene 50 micron	110.71	110.94	73.55	68.32	32.04
T5	White Polythene 50 micron	77.45	75.69	54.83	47.94	33.88
T6	White Polythene 50 micron	75.78	59.88	48.89	44.23	35.02
T7	Paddy Straw 6t/ha	159.80	130.41	98.78	99.40	35.76
T8	Weedy Control	227.14	206.95	157.54	141.89	26.85
	C.D. (P=0.05)	18.91	18.62	14.49	13.07	5.26

Table 2.8d. Studies on mulching in rose cv. Gladiator at Udaipur centre during 2013-14

Tr. No.	Treatment	Plant spread N x S (cm)	Plant spread E x W (cm)	No. of branches /plant	Days to flower-ing (day)	No. of flowers/ plant	Flower diam. (cm)	Flower bud length (cm)	Vase life (day)	Flowers/ unit area (2x1.8 m^2)	Flower stalk length (cm)	Flower grade
T1	Black Polythene 50 micron	21.66	22.7	2.99	54.98	14.97	6.81	4.99	6.35	74.88	29.15	Green
T2	Black Polythene 100 micron	23.39	23.4	3.7	53.13	15.13	6.89	5.06	6.54	77.23	31.42	Green
T3	Black Polythene 200 micron	25.19	26.06	4.69	42.55	17.17	8.11	5.3	7.09	109.08	37.15	Red
T4	White Polythene 50 micron	18.31	21.32	2.64	56.38	14.17	6.36	4.82	5.36	62.68	23.07	Green
T5	White Polythene 50 micron	20.66	22.02	2.86	56.21	14.5	6.81	4.94	5.56	68.05	26.59	Green
T6	White Polythene 50 micron	21.53	22.89	3.34	54.99	14.67	7.01	5.05	6.24	70.8	30.26	Green
T7	Paddy Straw 6t/ha	21.42	22.04	3.31	61.3	14.83	7.03	5	6.29	72.05	29.12	Green
T8	Weedy Control	17.03	18.18	2.97	64.16	9.5	6.49	4.22	5.51	52.65	26.1	Green
	C.D. (P=0.05)	4.74	2.25	0.90	10.66	1.16	0.70	0.41	0.85	17.70	5.62	-

Ranchi

On the basis of data of the experiment on mulching in rose Cv. Gladiator (Table 2.9) the minimum number of weed (15.15/sq. mt.) was noted in the treatment T_3 (black polythene 400 micron) which was *at par* with treatment T2 (black polythene 300 micron) i.e. 15.20/sq.mt and T_1 (black polythene with 200 micron) while the maximum number of weed was found in the treatment T_4 (white polythene 200 micron) (145/sq. mt.). The fresh and dry weight of weed was also found minimum in treatment T3 (black polythene 400 micron) of about 3.45 g and 0.55 g respectively. The plant spread was also found maximum (47.80 cm N-S) in the treatment T_1 (black polythene 200 micron) and 45.20 cm in the treatment T_2 (black polythene 300 micron). The number of branches (14.15) and flowers (41.00) was counted maximum in treatment T_1 (black polythene 200 micron). The flower diameter and vase life were found to be maximum in treatment T_1 (black polythene 200 micron).

Table 2.9a. Studies on mulching in rose cv. Gladiator at Ranchi centre during 2012-13

Treat-ment	Soil temp		Weed count per sq. ft. at 25 days interval destructive sample	Fresh wt of weed at 25 days interval (g) (Av.)	Dry wt. of weed at 25 days interval (g) (Av.)	Plant spread (cm)		No. of branches per plant	Days to flowering	Flowering duration (day)	No of flowers/ plant
	Min 0 ^{0}C	Max 0 ^{0}C				N-S	E-W				
T1	22.8	33.0	18.0	2.1	1.3	47.8	44	9.7	72.5	14.7	35.3
T2	22.2	32.1	5.2	1.5	0.61	34.5	45.2	14.1	73.2	17.0	47.0
T3	21.4	32.5	5.1	1.4	0.5	35.2	43.7	13.8	72.1	15.1	44.5
T4	23.9	35.0	145.0	52.7	21.4	33.8	43.6	9.5	69.7	14.7	23.0
T5	22.8	32.1	99.5	20.5	8.7	34.9	44.1	9.8	70.0	14.0	33.2
T6	22.6	34.0	88.0	18.0	6.7	34.9	44.2	9.9	70.0	13.8	27.1
T7	20.8	24.9	25.1	13.6	4.1	34.1	44.2	8.7	80.7	14.2	20.0
T8	21.6	27.1	104.0	45.9	16.2	31.2	40.1	7.2	78.2	12.1	15.5
CD (P=0.05)	-	-	1.02	0.78	0.6	2.12	2.3	0.78	2.15	2.55	3.0

T1 = Black Polythene 50 micron, T2 = Black Polythene 100 micron, T3 = Black Polythene 200 micron, T4 = White Polythene 50 micron, T5 = White Polythene 50 micron, T6 = White Polythene 50 micron, T7 = Paddy Straw 6t/ha, T8 = Weedy Control

Table 2.9b. Studies on mulching in rose cv. Gladiator at Ranchi centre during 2013-14

Treat-ment	Soil temp		Weed count per sq. mt. at 25 days interval	Fresh wt of weed at 25 days interval (g)	Dry wt. of weed at 25 days interval (g)	Plant spread (cm)		No. of branches per plant
	Min ^{0}C	Max ^{0}C				N-S	E-W	
T1	22.8	33	17.85	4.1	1.1	47.8	44.0	14.15
T2	22.2	34.1	15.2	3.5	0.6	34.5	45.2	10.75
T3	21.4	34.5	15.1	3.4	0.5	35.2	43.7	9.8
T4	23.9	35.1	145.0	52.7	21.4	33.8	43.6	9.5
T5	22.8	32.1	99.5	20.5	8.7	34.9	44.1	9.8
T6	22.6	34.0	88.0	18.0	6.7	34.9	44.2	9.9
T7	20.8	24.9	25.1	13.6	4.1	34.1	44.2	8.7
T8	21.6	27.1	104.0	45.9	16.2	31.2	40.1	7.2
CD (P=0.05)	-	-	2.2	0.7	0.6	2.1	2.3	0.7

T1 = Black Polythene 50 micron, T2 = Black Polythene 100 micron, T3 = Black Polythene 200 micron, T4 = White Polythene 50 micron, T5 = White Polythene 50 micron, T6 = White Polythene 50 micron, T7 = Paddy Straw 6t/ha, T8 = Weedy Control

Table 2.9b. Studies on mulching in rose cv. Gladiator at Ranchi centre during 2013-14 (continue...)

Treat-ment	Days to flowering	Flowering duration (day)	No of flowers/plant	Flower diam. (cm)	Length of flower bud (cm)	Vase life (day)	No. of flowers/ plant/ season	No. of flowers/ plant/ unit area/ season
T1	72.54	17.0	41.0	14.1	5.6	8.2	23.0	82.0
T2	72.2	15.0	35.6	12.2	4.0	6.6	15.0	71.2
T3	71.1	13.1	33.1	12.0	3.9	6.6	14.2	66.2
T4	69.7	14.7	33.0	13.15	4.9	7.8	20.1	66.0
T5	70	14.0	30.0	12.5	4.1	7.0	16.0	66.5
T6	70	13.8	27.1	11.0	3.0	6.9	15.2	54.2
T7	80.7	14.2	20.0	13.5	4.2	7.3	19.8	40.0
T8	78.2	12.1	15.5	12.7	3.5	6.2	13.5	31.0
CD (P=0.05)	2.1	2.5	3.0	1.3	0.7	0.8	1.4	4.1

T1 = Black Polythene 50 micron, T2 = Black Polythene 100 micron, T3 = Black Polythene 200 micron, T4 = White Polythene 50 micron, T5 = White Polythene 50 micron, T6 = White Polythene 50 micron, T7 = Paddy Straw 6t/ha, T8 = Weedy Control

Chiplima

Results presented in Table 2.10a-b indicated that the weed count/m^2, fresh weight and dry weight of weeds varied significantly among treatments. No weeds grew under black polythene mulch irrespective of its thickness. Profuse weed growth was observed under transparent polythene irrespective of its thickness. The parameters like plant height, plant spread, days to flowering, duration of flowering, number of flowers/plant, flower diameter, vase life, etc. did not vary significantly between treatments. The yield attributing characters like duration of flowering (10.73 day) and number of flowers per plant (30.70) was highest in treatment T_2 (black polythene 100 micron). Thus, black polythene 100 micron may be used for rose plants to control weed.

Table 2.10a. Effect of different mulches on Hybrid Tea rose cv. Mainu Parle at Chiplima centre during 2011-12

Treatment	Weed count/m²*	Fresh wt (g)*	Dry wt. (g)*	Plant height (cm)	Plant spread N X S	No. of branches per plant	Days to flowering	Flowering duration (day)	No. of flowers per plant
Black Polythene 50µ	0(0.71)*	0(0.71)	0(0.71)	74.73	73.36	3.67	51.67	7.33	21.33
Black Polythene 100µ	0(0.71)	0(0.71)	0(0.71)	69.4	70.36	3.00	50.00	7.33	15.00
Black Polythene 200µ	0(0.71)	0(0.71)	0(0.71)	67.76	70.29	3.45	48.33	7.67	20.00
White Polythene 50µ	12.33(3.42)	304.67(14.46)	43.23(5.69)	75.2	68.02	4.22	49.67	7.00	24.33
White Polythene 100µ	11.67(3.45)	200.33(13.69)	26.80(5.09)	75.94	74.03	3.44	50.33	8.00	19.00
White Polythene 200µ	16.67(3.87)	550.0(20.32)	76.57(7.57)	73.19	70.65	3.33	52.33	7.33	19.33
Paddy Straw	2.33(1.64)	15.0(3.83)	2.87(1.79)	64.2	64.37	3.33	50.33	7.67	22.00
Weedy Control	12.67(3.61)	184.67(13.49)	29.43(5.42)	70.88	64.17	3.33	52.67	7.33	18.33
CD (P=0.05)	1.58	12.76	4.64	NS	NS	NS	NS	NS	NS

Table 2.10b. Effect of different mulches on Hybrid Tea rose cv. Mainu Parle at Chiplima centre during 2012-13

Treatment	Weed count/m²*	Fresh wt (g)*	Dry wt. (g)*	Plant height (cm)	Plant spread N X S	No. of branches per plant	Days to flowering	Flowering duration (day)	No. of flowers per plant
Black Polythene 50µ	0.00	0.00	0.00	72.33	67.06	6.66	52.67	10.64	24.3
Black Polythene 100µ	0.00	0.00	0.00	67.4	64.26	6.00	51.00	10.73*	27.12*
Black Polythene 200µ	0.00	0.00	0.00	65.78	64.22	6.54	49.33	10.64	25.2
White Polythene 50µ	4.34	13.89	5.75	73.22	62.02	7.28	50.67	9.82	22.43
White Polythene 100µ	4.42	12.95	5.12	73.93	68.13	6.43	51.00	10.13	23.45
White Polythene 200µ	16.67(3.87)	550.0(20.32)	76.57(7.57)	73.19	70.65	3.33	52.33	7.33	19.33
Paddy Straw	2.33(1.64)	15.0(3.83)	2.87(1.79)	64.2	64.37	3.33	50.33	7.67	22
Weedy Control	12.67(3.61)	184.67(13.49)	29.43(5.42)	70.88	64.17	3.33	52.67	7.33	18.33
CD (P=0.05)	1.58	12.76	4.64	NS	NS	NS	NS	NS	NS

Table 2.10c. Effect of different mulches on Hybrid Tea rose cv Mainu Parle at Chiplima centre

Treatment	Weed count/m^{2*}	Fresh wt (g)*	Dry wt. (g)*	Plant height (cm)	Plant spread N X S
T1	0	0	0	74.53	70.23
T2	0	0	0	68.53	68.13
T3	0	0	0	66.55	69.38
T4	4.44	13.8	5.72	74.34	65.02
T5	4.4	12.98	5.2	74.87	70.65
T6	4.71	19.57	7.32	72.08	68.89
T7	2.6	2.89	1.9	63.41	60.58
T8	4.51	12.82	5.39	69.72	61.2
CD (P=0.05)	1.65	18.23	8.27	NS	NS

T1 = Black Polythene 50 micron, T2 = Black Polythene 100 micron, T3 = Black Polythene 200 micron, T4 = White Polythene 50 micron, T5 = White Polythene 50 micron, T6 = White Polythene 50 micron, T7 = Paddy Straw 6t/ha, T8 = Weedy Control

Table 2.10c. Effect of different mulches on Hybrid Tea rose cv Mainu Parle at Chiplima centre (continue....)

Treatment	No. of branches per plant	Days to flowering	Flowering duration (day)	No. of flowers per plant
T1	6.66	52.67	10.64	27.89
T2	6.00	51.00	10.73*	30.70*
T3	6.00	49.33	10.64	25.25
T4	7.33	50.67	9.82	25.54
T5	6.33	51.00	10.13	24.56
T6	6.00	53.33	10.51	26.52
T7	6.00	51.33	10.48	22.00
T8	6.33	53.67	10.62	19.28
CD (P=0.05)	NS	NS	NS	6.40

T1 = Black Polythene 50 micron, T2 = Black Polythene 100 micron, T3 = Black Polythene 200 micron, T4 = White Polythene 50 micron, T5 = White Polythene 50 micron, T6 = White Polythene 50 micron, T7 = Paddy Straw 6t/ha, T8 = Weedy Control

Table 2.10d. Effect of different mulches on Hybrid Tea rose cv Mainu Parley on soil temperature at weekly interval at Chiplima centre

Treatment →	T1	T2	T3	T4	T5	T7	T8
Week ↓	Black polythene (50 micron thick)	Black polythene (100 micron thick)	Black polythene (200 micron thick)	White polythene (50 micron thick)	White polythene (100 micron thick)	Paddy straw (6 tonne/ha)	Control (weedy control)
1	20.3	22	23.5	25.2	2.5	20.1	18.3
2	22.9.	24	27.5	25.5	22.2	25.2	18.2
3	24.5	24.5	27	25.3	21.3	25.2	24.8
4	25.3	25.3	26.5	24.8	27.1	24.1	25.9
5	24.7	25.8	26	24.7	26.1	24.3	24.8
6	25.6	25.3	25.8	24.4	25.4	24	23.7
7	24.2	25.2	25.2	24.8	21.3	21	22.5
8	23.1	24.3	25.1	25	25.2	21.8	24.3
9	24.8	25	26.2	25.4	24	24.3	24.6
10	23.6	24	26.4	25.7	25.8	23.5	25.1
11	23.8	25.1	27	26.1	26.3	24.1	22.8
12	23.4	25.2	26.8	25.9	26.8	21.3	21.6
13	24.6	27.6	27.4	26.4	27.1	21.2	24.2
14	24.1	26.2	27	26.7	26.7	22.3	23.8
15	24.8	26	26.9	27	26.3	21.5	21.3
16	24	27.3	27.4	26.9	25.9	22.3	23
17	25.4	27.1	27.4	27.2	25.3	24.6	21.4
18	25.3	27.3	27.6	26.5	24	25.6	22.8
19	25.1	27.2	28	26.4	24.4	25	24.7
20	25.8	27	28.2	25.9	25.7	27.2	24

Pune (Ganeshkhind)

Data presented in Table 2.11 showed significant results of mulching treatment on weed control. In respect of weed parameters, significantly less weed bud count/m^2 (97.47), and more plant height (88.80 cm), branches/plant (4.50), flowers/plants (36.50), flower diameter (6.80), bud length (4.86 cm) and flower stem length (56.60 cm) were found in treamment T3 (black plythene 200 micron thick) than other treatments.

Table 2.11a. Studies on mulching in rose cv. Gladiator at Pune centre during 2011-12

Treat-ment	Weed count/ M2	Fresh wt. of weed(g)	Weed dry wt. (g)	Plant ht. cm)	Plant spread (ExW)	No. of branches / plant	Days to flowe-ring	No. of flowers/ plant	Flow. diam. (cm)	Bud length (cm)	Vase life (day)	Flower stem length (cm)
T-1	160	270.2	43.8	80.5	25.6	3.3	180.4	34.6	6.5	3.8	7	40.8
T-2	122.3	176.8	28.5	82.6	30.5	4	183.6	40.8	6.9	4.5	6.5	50.6
T-3	100.3	168.47	26.3	85.8	27.8	3.5	185.67	36.9	6.7	4.4	6	49.6
T-4	209.33	350.6	58.03	81.7	24.3	3	185.07	33.5	5.4	3.5	5.47	43.5
T-5	200	310	50.8	84.3	26.4	3.47	186.47	35.7	6	3.9	6	50.07
T-6	125.8	211.7	31.2	83.8	24.8	4	191	38	6.7	4.3	5.6	44.7
T-7	138.23	266.8	38.6	70.4	28.3	3.7	187.6	31.8	5.8	3.5	5	38.47
T-8	238.3	395.67	67.9	75.9	22.7	3	192.6	30.4	5	3	5.33	38.6
C D (P=0.05)	21.1	31.92	3.83	3.63	1.8	NS	3.42	4.47	NS	NS	NS	6.25

T1 = Black Polythene 50 micron, T2 = Black Polythene 100 micron, T3 = Black Polythene 200 micron, T4 = White Polythene 50 micron, T5 = White Polythene 50 micron, T6 = White Polythene 50 micron, T7 = Paddy Straw 6t/ha, T8 = Weedy Control

Table 2.11b. Studies on mulching in rose cv. Gladiator at Pune centre during 2012-13

Treat-ment	Weed count/ M2	Fresh wt. of weed(g)	Weed dry wt. (g)	Plant ht. cm)	Plant spread (ExW)	No. of branches / plant	Days to flowe-ring	No. of flowers/ plant	Flow. diam. (cm)	Bud length (cm)	Vase life (day)	Flower stem length (cm)
T-1	100.8	165.47	30.4	82.6	27.5	3.6	175.6	32.7	5.4	3.6	6	42.5
T-2	98.7	140.3	28.13	84.5	32.6	4.53	178.4	38.5	6	4.7	6.5	54.7
T-3	96.9	130.4	21.7	86.4	29.7	4.13	180.7	34.8	5.8	4	5.5	51.4
T-4	180.5	295.5	50.6	80.67	29.83	3.53	179.93	30.4	5.5	3.8	5	45.8
T-5	170.5	260.8	46.63	83.4	28.8	3.77	181.7	32.5	5	3.5	6.5	52.6
T-6	118.4	240.73	40.7	80.5	26.8	4.5	186	35.8	6	4.4	5.8	48.5
T-7	130.47	270.5	49.4	74.8	30	3.27	182.4	30.4	5.4	3.7	5.4	40.6
T-8	200.3	320.7	58.4	78.9	50.4	3.5	187.6	29.8	5.3	3.5	5	39.9
C D (P=0.05)	1.07	1.18	3.86	0.65	3.66	0.8	1.49	0.88	0.26	0.29	0.33	1.07

T1 = Black Polythene 50 micron, T2 = Black Polythene 100 micron, T3 = Black Polythene 200 micron, T4 = White Polythene 50 micron, T5 = White Polythene 50 micron, T6 = White Polythene 50 micron, T7 = Paddy Straw 6t/ha, T8 = Weedy Control

Table 2.11c. Studies on mulching in rose cv. Gladiator at Pune centre during 2013-14

Treat-ment	Weed count/ M2	Fresh wt. of weed(g)	Weed dry wt. (g)	Plant ht. cm)	Plant spread (ExW)	No. of branches / plant	Days to flowe-ring	No. of Flowers/ plant	Flow. diam. (cm)	Bud length (cm)	Vase life (day)	Flower stem length (cm)
T1	125.6	190.5	34.2	81.8	28.4	3.8	171.8	30.6	5.9	3.26	5.0	42.13
T2	104.37	150.6	25.8	85.5	30.7	4.0	180.5	34.8	6.17	4.77	5.0	53.27
T3	97.47	134.3	24.3	88.8	27.5	4.5	185.9	36.5	6.8	4.86	6.5	56.6
T4	160.5	197.8	36.1	82.6	30.6	3.9	175.8	31.4	5.8	3.4	5.4	49.7
T5	155.8	180.4	33.4	84.8	26.5	3.0	176.6	30.8	6.0	2.26	6.0	50.6
T6	110.8	236.9	37.5	82.7	24.7	4.0	180.5	33.0	5.6	4.01	5.3	52.3
T7	134.5	240.7	44.7	71.6	27.8	3.4	179.5	32.4	5.3	3.3	5.4	43.6
T8	225.6	280.5	52.6	80.9	28.4	3.0	185.2	27.8	5.7	3.0	5.0	40.5
C D (P=0.05)	6.7	48.7	7.2	3.8	NS	0.9	NS	4.9	0.4	0.3	NS	2.9

T1 = Black Polythene 50 micron, T2 = Black Polythene 100 micron, T3 = Black Polythene 200 micron, T4 = White Polythene 50 micron, T5 = White Polythene 50 micron, T6 = White Polythene 50 micron, T7 = Paddy Straw 6t/ha, T8 = Weedy Control

Ludhiana

The experiment was laid out as per the guideline and the data are tabuled in Table 2.12 and 2.12b. Tallest plants were observed in paddy straw (63.29 cm) different polyfilms and paddy straw affected the temperature to varying degree. Themperatures were recorded more in case of black polythene as compared to white polythene and paddy straw. Black polythene was found to be very effective in complete suppression of weed flora while paddy straw mulching induced more plant height, spread, number of branches and number of flowers. Common weed flora found were *Chenopodium ablum, coronopus didmus, (jungle halon, Cyprus rotundus, Digitaria sanguinalis, Eragrosts teneullo, Gnaphalium sp. Malva parviflora, Melilootus alba, Onethera spp., Poa annua, Rumex dentatus, Solanum nigrum, Spergula arvensis, Veronica sp.*

Table 2.12a. Effect of mulching in rose on soil temperature at weekly intervals at Ludhiana centre during 2010-11

Treatment → / Week ↓	Black polythene 50µ	Black polythene 100µ	Black polythene 200µ	White polythene 50µ	White polythene 100µ	Paddy straw	Weedy control
01-Oct	25.3	25.3	27.3	25	24.3	25.1	26.3
2	25.2	26.1	24.2	25.3	22.2	25.3	25.3
3	25	25	26.8	26.3	21	25.4	24.5
04-Nov	26	24.5	27.4	24.3	27	25	26.8
5	25	25.3	26.1	26	26.1	25.6	23.3
6	24	24	27	24.3	25.4	25.2	22.1
7	24	24.3	25.3	22.3	21.3	24.1	24.3
08-Dec	23	23.5	25.6	24.3	25.2	24.3	24.6
9	24	24.3	25.3	24.1	24.1	24	25.1
10	22	25.3	24.3	23.1	25	21	23.6
11	23	24.2	24	23	24	21.8	21.6
12-Jan	24.2	25.6	26	24.2	26	24.3	23.6
13	23.3	25.3	26	25.1	27	23.5	24.1
14	24.2	25.1	26.1	24.1	21	24.1	24.3
15	24	26	27	23	25	21.3	21.3
16	24.6	26.3	26.3	21	24	21.2	23
17	24	26.4	27.4	25	25.3	22.3	21.4
18	24.3	26	27.2	24	21	22	23.5
19	25	27.1	27	26.3	21.3	21.5	24.3
20	25	26.3	27.6	24	24.5	22.3	24
21	26	27.5	28	25	24	24.6	24.3
22	25.5	27.2	28.1	24.1	24.7	25.6	26
23	26	27.3	28.3	27	24.2	25	24
24	26	27.3	28	25.2	25.8	25.9	24

Table 2.12b. Effect of mulching in rose on weed count, fresh and dry weight of weeds at Ludhiana during 2010-11

Treatment	Weed count				Fresh weight (g)			Dry weight (g)			
	Day				Day			Day			
	25	50	75	100	25	75	100	25	50	75	100
Black Polythene 50µ	0.00	2.00	4.33	0.00	0.00	2.00	0.00	0.00	0.01	0.02	0.00
Black Polythene 100µ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black Polythene 200µ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White Polythene 50µ	2.33	8.33	9.33	9.33	1.12	5.63	2.35	0.025	0.203	1.002	0.12
White Polythene 100µ	4.33	7.00	7.00	7.33	2.01	3.23	1.02	0.092	0.123	0.362	0.02
White Polythene 200µ	1.33	3.66	4.33	4.33	0.65	2.00	1.95	0.002	0.023	0.235	0.05
Paddy Straw	6.33	29.66	32.33	52.33	4.67	5.98	12.56	0.102	1.023	1.102	2.10
Weedy Control	18.66	96.66	253.67	302.66	6.42	20.32	26.52	1.002	1.324	3.13	3.20
CD (P=0.05)	0.01	0.01	0.01	0.01	0.21	1.10	1.36	0.02	0.01	0.01	0.03

Table 2.12c. Effect of mulching in rose on growth and flowering parameters.at Ludhiana centre during 2010-11

Treatment	Plant height (cm)	Plant spread (cm)	No. of branches	Days to flowering	Flowering duration (day)	Flower diam. (cm)	Bud length (cm)	No of flowers per unit area
Black Polythene 50µ	55.32	42.00	10.23	52.36	45.23	5.62	2.95	24.00
Black Polythene 100µ	54.36	46.12	9.34	50.12	42.00	5.32	2.85	25.00
Black Polythene 200µ	57.32	45.23	9.36	43.56	44.10	6.12	2.88	32.00
White Polythene 50µ	52.36	41.2	8.23	50.14	43.12	6.23	3.01	28.00
White Polythene 100µ	52.23	45.36	8.00	42.52	44.36	5.89	2.89	28.00
White Polythene 200µ	53.25	42.52	9.02	42.00	44.15	5.42	2.87	21.00
Paddy Straw	56.65	42.11	9.00	45.36	44.52	5.26	2.95	20.00
Weedy Control	53.21	45.36	8.23	56.25	41.00	5.01	3.25	20.00
CD (P=0.05)	2.01	NS	NS	2.30	NS	0.03	NS	2.30

Table 2.12d. Effect of mulching in rose on soil temperature at weekly intervals at Ludhiana centre during 2011-12

Treatment Week	Black Polythene 50µ	Black Polythene 100µ	Black Polythene 200µ	White Polythene 50µ	White Polythene 100µ	Paddy straw	Weedy Control
01-Oct	23.2	25.3	27.5	25	24.3	25.1	26.3
2	24.2	26.1	24.4	25.3	22.2	25.3	25.3
3	24.8	25	26	26.3	21	25.4	24.5
04-Nov	25.1	24.5	27.2	24.3	27	25	26.8
5	25	25.3	26	26	26.1	25.6	23.3
6	24	24	27.1	24.3	25.4	25.2	22.1
7	24	24.3	25.2	22.3	21.3	24.1	24.3
08-Dec	24.2	23.5	25.6	24.3	25.2	24.3	24.6
9	23.2	24.3	25.3	24.1	24.1	24	25.1
10	24.2	25.3	24	23.1	25	21	22.8
11	23	24.2	24.4	23	24	21.8	21.6
12-Jan	23.5	25.6	26.5	24.2	26	24.3	24.2
13	23.3	25.3	26.3	25.1	27	23.5	24.2
14	24.2	25.1	26.1	24.1	21	24.1	23.8
15	24	26	27.2	23.2	25	21.3	21.3
16	24.6	27.2	26.3	27.2	24	21.2	23
17	24	26.4	27.4	25	25.3	22.3	21.4
18	24.3	26.8	27.2	24	21	22	22.8
19	25.2	27.1	27	26.3	21.3	21.5	24.7
20	25.8	26.3	27.6	24	24.5	22.3	24
21	25.9	27.5	28	25	24	24.6	24.7
22	25.5	27.2	28.1	24.1	24.7	25.6	26
23	26	27.3	28.3	27	24.2	25	24
24	26	27.3	30.2	25.2	25.8	27.2	24

Table 2.12e. Effect of mulching in rose on weed count , fresh and dry weight of weeds at Ludhiana centre during 2011-12

Treatment	Weed count				Fresh weight (g)			Dry weight (g)			
	Day				Day			Day			
	25	50	75	100	25	75	100	25	50	75	100
Black Polythene 50µ	0	2	0	0	0	0	0	0	0.002	0	0
Black Polythene 100µ	0	0	0	0	0	0	0	0	0	0	0
Black Polythene 200µ	0	0	0	0	0	0	0	0	0	0	0
White Polythene 50µ	5.33	7.33	10.33	12.62	1.82	15.37	13.65	0.007	0.136	2.005	2.004
White Polythene 100µ	4.67	6.33	8.33	10.25	2.2	9.17	9.27	0.057	0.283	0.21	1.025
White Polythene 200µ	0.33	2.33	4.33	5	0.081	2.38	1.87	0	0.086	0.094	0.089
Paddy Straw	4.33	9.33	30.67	42.65	3.971	35.42	52.16	0.082	1.004	2.361	2.011
Weedy Control	20.67	86.33	201.67	289.33	12.05	221.34	327.73	0.987	1.001	2.561	5.62
CD (P=0.05)	2.28	4.11	0.52	7.25	0.75	5.81	8.36	0.031	0.002	0.21	1.02

Table 2.12e. Effect of mulching in rose at Ludhiana centre during (Continue...)

Treat-ment	Soil temp		Weed count per sq. ft. at 25 days interval destructive sample	Fresh wt of weed at 25 days interval (g) (Av.)	Dry wt. of weed at 25 days interval (g)	Plant spread (cm)		No. of branches per plant	Days to flowering	Flowering duration (day)	No of flowers/ plant
	Min	Max				N-S	E-W				
T1	00C	00C	17.5	2.05	1.35	47.7	44	9.75	72.54	14.75	35.3
T2	22.9	32.92	4.2	1.42	0.51	34.5	45.1	11.7	73.2	16.8	46.5
T3	22.3	32	5.15	1.75	0.93	35.2	43.75	10.98	72.1	15.1	43.5
T4	21.5	32.5	143	52.7	21.4	33.87	43.62	9.5	69.7	14.7	23
T5	23.95	35.1	99.0	20.5	8.75	34.9	44.1	9.8	70.0	14.0	33.25
T6	22.8	32.1	88.0	18.0	6.72	34.9	44.2	9.9	70.0	13.8	27.1
T7	22.67	34.05	25.1	13.65	4.1	34.1	44.2	8.7	80.7	14.2	20.0
T8	20.85	24.9	104	45.9	16.25	31.25	40.1	7.25	78.2	12.1	15.5
CD (P=0.05)			1.02	0.8	0.61	2.1	2.35	0.78	2.15	2.5	3.1

T1 = Black Polythene 50 micron, T2 = Black Polythene 100 micron, T3 = Black Polythene 200 micron, T4 = White Polythene 50 micron, T5 = White Polythene 50 micron, T6 = White Polythene 50 micron, T7 = Paddy Straw 6t/ha, T8 = Weedy Control

Table 2.12g. Effect of mulching in rose on weed count , fresh and dry weight of weeds at Ludhiana centre during 2012-13

Treatment	Plant height (cm)	Plant spread (cm)	No. of branches	Days to flowering	Flowering duration (day)	Flower diam. (cm)	Bud length (cm)	No of flowers per unit area
Black Polythene 50µ	55.96	44.25	8.99	54.52	99.23	9.65	2.75	28
Black Polythene 100µ	56.32	45.36	9.36	52.36	99.26	9.62	2.85	26
Black Polythene 200µ	58.74	44.85	8.26	51.26	100.23	8.95	2.86	27
White Polythene 50µ	59.63	49.36	9.75	55.26	93.02	9.02	2.74	24
White Polythene 100µ	56.35	44.77	9.63	47.69	99.25	9.45	2.25	27
White Polythene 200µ	58.64	47.28	8.02	53.12	99.85	8.56	2.66	26
Paddy Straw	61.25	46.58	9.45	54.85	94.85	8.96	2.75	29
Weedy Control	52.36	46.25	8.85	56.32	88.26	7.12	2.23	14
CD (P=0.05)	0.82	NS	NS	NS	NS	NS	NS	2.42

Table 2.12h. Effect of mulching in rose on weed count, fresh and dry weight of weeds at Ludhiana centre during 2012-13

Treatment	Weed count				Fresh weight (g)			Dry weight (g)			
	Day				Day			Day			
	25	50	75	100	25	75	100	25	50	75	100
Black Polythene 50µ	0	0	1	1	0	0	0	0	0.002	0	0
Black Polythene 100µ	0	0	0	0	0	0	0	0	0	0	0
Black Polythene 200µ	0	0	0	0	0	0	0	0	0	0	0
White Polythene 50µ	7.56	9.69	12.4	15.36	3.56	8.69	10.36	0.027	0.123	1.98	3.69
White Polythene 100µ	5.62	6	8.67	9.23	2.22	5.97	6.78	0.251	0.298	0.312	0.956
White Polythene 200µ	0.58	2.33	4.56	5.63	0.078	0.785	2.025	0.002	0.012	0.0942	0.091
Paddy Straw	3.68	6.36	26.67	40.25	2.96	18.36	54.26	0.725	1.002	2.036	3.12
Weedy Control	12.25	86.33	222.36	291.56	8.56	247.62	361.42	0.789	1.654	3.842	6.541
CD (P=0.05)	2.05	3.96	0.75	6.98	0.77	4.96	8.02	0.002	0.12	0.0258	0.42

Table 2.12i. Effect of mulching in rose on soil temperature at weekly intervals at Ludhiana centre during 2012-13

Treatment Week	Black Polythene 50µ	Black Polythene 100µ	Black Polythene 200µ	White Polythene 50µ	White Polythene 100µ	Paddy straw	Weedy Control
1	19.3	19	17.6	18.6	19	19.6	18.3
2	17	16.3	15.6	16	15.6	16.3	16
3	14	13.6	13.6	14.6	13.3	13.6	13.3
4	15.3	14.6	14.3	14.2	14.6	15.3	14.3
5	12.3	12	12	12	11.3	12.3	12
6	12.3	12	11.3	12.1	12	11.6	11.6
7	14.6	14.3	14	14.6	14	14.3	13.3
8	14	13.6	13.3	13.6	13.3	14	13
9	14	10.6	10	10.6	10.6	10.6	10.3
10	7	7	7.6	6	6.6	7	6.6
11	21	13.3	13	14.3	12.7	14	14
12	13	13.3	12.6	13	12.6	12.3	12.3
13	13.1	13.2	13.4	13.2	13.2	12.4	12
14	13	13.4	13.3	13	13.7	13.1	13.1
15	13.4	13.2	13.7	13.1	13.1	12.9	14.1
16	13.7	13.4	13.3	14.2	14.2	13.1	13.3
17	13.2	13.1	14.8	14.2	14.7	13.4	14.2
18	13.8	13.7	15.1	14.4	14.3	13.2	15.1
19	13.9	14.3	16.8	15.6	15.7	18.2	17.8
20	13.9	14.5	17.1	15.8	15.9	18.6	17.9

Table 2.12j. Studies on mulching in rose at Ludhiana centre

Treatment	Plant height (cm)	Plant spread (cm)	Number of branches	Days to flowering	Flowering duration (day)	Flower diam. cm)	Bud length	No of flowers per unit area
Black Polythene 200µ	60.89	46.28	7.95	56.57	99.25	9.87	2.98	29
Black Polythene 300µ	55.35	42.34	7.35	54.35	98.26	8.63	2.89	26
Black Polythene 400µ	56.77	43.86	6.24	53.56	102.33	7.99	2.87	28
White Polythene 200µ	58.66	48.37	6.79	58.24	95.08	8.07	2.77	26
White Polythene 300µ	57.34	46.73	8.17	48.68	98.24	8.49	3.23	24
White Polythene 400µ	55.67	44.24	6.06	52.2	97.86	9.52	2.69	25
Paddy Straw 6Ton/hac	63.29	47.55	8.47	56.89	96.87	7.93	1.74	28
Weedy Control	54.38	48.29	7.89	54.37	87.28	6.14	3.26	16
CD (P=0.05)	0.84	NS	NS	NS	NS	NS	NS	2.42

Table 2.12k. Studies on mulching in rose at Ludhiana centre

Treatment	Weed count				Fresh weight (g)			Dry weight (g)			
	Day				Day			Day			
	25	50	75	100	25	75	100	25	0	75	100
Black Polythene 200µ	0	0	0	0	0	0	0	0	0	0	0
Black Polythene 300µ	0	0	0	0	0	0	0	0	0.143	0	0
Black Polythene 400µ	0	0	0	0	0	0	0	0	0.297	0	0
White Polythene 200µ	6.66	8.68	15.3	17.33	4.58	7.68	9.35	0.035	0.023	1.99	4
White Polythene 300µ	6.62	7.07	8.66	8.66	2.25	5.96	5.79	0.256	1.004	0.316	0.958
White Polythene 400µ	0.57	3.66	5.67	5.68	0.088	0.789	2.065	0.005	1.659	0.094	0.095
Paddy Straw 6Ton/hac	4.69	5.33	27.33	43.26	3.97	16.36	56.29	0.727	0.125	2.039	3.125
Weedy Control	13.35	85.33	225.66	295.58	7.53	248.6	371.43	0.786		3.856	6.547
CD (P=0.05)	2.09	3.67	0.79	7.99	0.75	4.98	7.07	0.004		0.025	0.44

Project No. 3 : Integrated nutrient management in rose (open / polyhouse).

Centres : Chiplima, Ludhiana and Pune

Technical Programme

No. of treatments : Seven

1 - 100% Recommended dose of inorganic fertilizers (RDF) + FYM (2 kg/m^2/y)

2 - 75% RDF + FYM (2 kg/m^2/y)

3 - 75% RDF + FYM (1 kg/m^2) + Vermicompost (300 g/m^2)

4 - 75% RDF + FYM (1 kg/m^2) + Vermicompost (300 g/m^2) + *Azospirillum* + PSB

5 - 50% RDF + FYM (1 kg/m^2)

6 - 50% RDF + FYM (1 kg/m^2) + Vermicompost (300 g/m^2)

7 - 50% RDF + FYM (1 kg/m^2) + Vermicompost (300 g/m^2) + *Azospirillum* + Phosphate Soluble Bacterial (PSB)

Note

1. Recommended dose of fertilizer means location specific recommendations.
2. *Trichoderma* – 20 g/m^2/y (this is applied after mixing with FYM (Farm yard Manure)slightly moist and covered with polythene sheet for a week.
3. Any oil cake – 200 g/m^2/y.
4. FYM – 2 kg/m^2/y.
5. Biofertilisers: *Azospirillum* and PSB each @ 2g/plant.
6. In treatment 3, 4, 6 & 7, FYM is supplied at 50% of the recommended dose i.e., 2kg / m^2/ y and remaining 50% is through Vermicompost.
7. FYM, Vermicompost and biofertilisers are applied as per the treatments at the time of planting and once in a year.

Cultivar	:	Any commercial cultivar of the region
No. of treatments	:	Seven
No. of replications	:	Three
No. of plants/treatment	:	6-7
Statistical design	:	Randomized Block Design (RBD)

Observations recorded

1. Plant height (cm)
2. Length of flowering shoots (cm)
3. Length of flower bud (cm)
4. Flower diameter (cm)
5. Days taken for flowering
6. Yield of flowers per plant and per m^2

Vase life at room temperature in tap water (day)

Report

Centre

Ludhiana

The experiment was conducted as per the suggested technical programme of work. Data pertaining to various parameters are tabulated in Table 2.14. It is clear from the data that none of the parameters was affected significantly.

Table 2.14. Integrated nutrient management (INM) in rose (Open/Polyhouse) cv Rakatgandha at Ludhiana centre (2010-11)

Treatment	Plant height cm)	Flower shoot length (cm)	Bud size (cm)	Flower size (cm)	Days to flowering	Yield per m^2	Vase life (day)
T1 100% RDF + FYM (2kg/m^2/year)	70.23	48.36	5	6.98	48.36	48	5.67
T2 75% RDF + FYM (2kg/m^2/year)	71	47.63	4.65	7	47.52	42	6
T3 75% RDF + FYM (1kg/m^2 + Vermicomopost (300g/m^2)	74.33	49.68	4.02	7.56	48.95	51	7.33
T4 75% RDF + FYM (1kg/m^2 + PSB	65..23	47.32	3.85	8.25	47.25	42	6
Vermicomopost (300 g m^2) + *Azospirillum*							
T5 50% RDF+FYM (1kg/m^2)	73.64	49.69	3.45	6.74	48.45	48	6.67
T6 50% RDF+FYM (1kg/m^2 + Vermicomopost (300g/m^2)	72.65	46.21	3.84	6.98	45	36	5.67
T7 50% RDF+FYM(1kg/m^2+) + Vermicomopost (300g/m^2) + *Azospirillum* + PSB	71.25	45.98	3.45	8.02	49.87	49	5.22
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS

Centre : Pune (Ganeshkhind)

In Integrated nutrient management (INM) experiment treatment T_4 (75 % RDF + FYM (1kg/m^2) + Vermicompost (300g/m^2) + *Azospirillum* + PSB @ 2g/plant/year) and T_1 (2kg FYM, 140:70:70g/m^2/year) were *at par* with each other and recorded significantly more plant height (107.71 cm and 106.40 cm), yield per plant (30.33 flowers and 30.13 flowers) and per square meter (212.33 flowers and 210.93 flowers) as compared to other treatments (Table 2.15). Treatment T_4 exhibited significantly more flower stalk length (65.5 cm), bud size (2.56cm) and vase life (6.56 days) as compared to rest of the treatments.

Table 2.15. Integrated nutrient management in rose cultivar Passion at Pune centre (2010-11)

Treatment	Plant height (cm)	Flower stalk Length (cm)	Bud size (cm)	Yield/pl/y	Yield/m^2/y
T1	106.4	59.47	2.16	30.13	210.93
T2	96.35	52.73	2.1	25.36	177.56
T3	99.5	55.43	2.2	27.7	193.9
T4	107.71	65.56	2.56	30.33	212.33
T5	92.48	48.65	1.93	22.6	158.2
T6	96.5	52.65	2.1	24.53	171.73
T7	100.53	55.31	2.06	26.36	184.56
CD (P=0.05)	3.07	4.39	0.18	4.49	31.47

T1 = 100% RDF + FYM (2kg/m^2/year), T2 = 75% RDF + FYM (2kg/m^2/year), T3 = 75% RDF + FYM (1kg/m^2 + Vermicomopost (300g/m^2), T4 = 75% RDF + FYM (1kg/m^2 + PSB Vermicomopost (300 g m^2) + *Azospirillum*, T5 = 50% RDF+FYM (1kg/m^2), T6 = 50% RDF+FYM (1kg/m^2 + Vermicomopost (300g/m^2), T7 = 50% RDF+FYM(1kg/m^2+) + Vermicomopost (300g/m^2) + *Azospirillum* + PSB

Chiplima : No Report

3. Postharvest Technology and Value Addition

Experiment 3.1 : Effect of pre-transit pulsing treatments on keeping quality of cut roses.

Objective : To work out suitable postharvest pulsing treatments for cut roses

Cultivar : Any available commercial cultivar of the region (preferably export)

Stage of harvest : Commercial stage

No. of treatments : Seven

1. Aluminium sulphate - 300 ppm
2. Aluminium sulphate - 600 ppm
3. Aluminium sulphate - 900 ppm
4. Chlorine - 100 ppm
5. Chlorine - 200 ppm
6. Chlorine - 300 ppm
7. Control: Double Distilled water

Duration of simulated transit : 24h

No. of replications : Three

No. of stems/replication : Ten

Statistical design : CRD

The harvested cut flowers, immediately put in buckets containing solutions of aluminium sulphate and chlorine and held at 2.5 – 3°C for 6h for precooling. The leaves from the lower 1/3rd portion of the cut stem were removed and the stems were made to uniform length of 60cm. The stems were made into bundles of 10 each and the basal ends were tied with the rubber bands. The buds will be wrapped in corrugated paper and the bunches were inserted in cellophane sleeves and packed in the precooled telescopic cardboard boxes (106 cm × 35 cm × 20 cm or any other convenient size). The boxe were kept at ambient temperatures for 24h to simulate transit conditions. After simulated transit, the stems were rehydrated by putting neck deep water for 30 minutes. The basal 2 cm portions of the stems were recut and the vase life were evaluated at 23 ± 2°C and 16h illumination (1000 lux intensity provided by 40 w fluorescent tubes), under laboratory conditions.

Observations recorded

1. Final stage of opening that the bud acquires in the base (based on the numerical scale 1-4 i.e. 1. harvesting stage; 2. half open; 3. 3/4th open & 4. Fully open).

2. Vase life (day), when the petals show signs of wilting, bluing or bent neck; the vase life were evaluated in distilled water at ambient conditions.

3. Final flower diameter (that the bud attains in the vase).

4. Total water absorbed per stem (ml).

Report

Centre

Pune (Ganeshkhind)

Data presented in Table 3.1 revealed that the pulsing solution of Aluminium Sulphate 300 ppm found significantly superior over rest of the treatments in respect of vase life of rose flowers (7.10 day), flower diameter (3.73cm) and water absorbed per stem (26.46 ml).

Table 3.1 Standardization of pulsing solution for improving keeping quality of cut rose cv. Passion at Ganeshkhind (2010-11)

Treatment	Vase life (day)	Flower dia. (cm)	Water absorbed /stem (ml)	Final bud opening (day)
Aluminium sulphate - 300ppm	7.1	3.73	26.46	3.5
Aluminium sulphate - 600ppm	5.7	3.16	22.96	4
Aluminium sulphate - 900ppm	5.26	3.06	21.76	6
Calcium hypochlorite 100ppm	5.43	3.43	23.9	3.8
Calcium hypochlorite 200ppm	5	3.23	20.06	5
Calcium hypochlorite 300ppm	5.1	3.16	21.9	5.6
Control (Tap water)	4.8	3.26	20	3
CD (P=0.05)	0.49	0.21	1.73	-

Ludhiana

Cutflowers of rose cv. First Red were harvested at tight bud stage and placed in solutions of aluminum sulphate (300, 600 and 900 ppm) and chlorine (100, 200 and 300 ppm) prepared from bleaching powder, for 6 h. The stems were pre-cooled at 2.5 –3°C in a refrigerated chamber and cut to a uniform length of 60 cm. After wrapping the buds with corrugated paper, the stems were inserted in cellophane sleeves, packed in pre-cooled tele-boxes and placed under ambient

conditions for 24 h. to simulate transit. The stems were, thereafter rehydrated in water and their vase life was evaluated at 23±2°C and 16 h illumination.

The results presented in Table 3.2a &b show that the buds showed more than ¾th opening in case of treatment with aluminium sulphate (300-900 ppm) and chlorine (100 ppm). High concentrations of chlorine (200 and 300 ppm) inhibited opening of the buds. Similarly, high concentration of chlorine also reduced vase life, flower diameter and absorption of water/stem. The studies showed that the pre-transit treatment with aluminium sulphate significantly improved vase life of the stems, all the concentrations (300-900 ppm) being equally effective. The experiment was conducted for three consecutive years (2008-09 to 2010-11) and the pooled data are presented in Table 3.2ab

Table 3.2a. Effect of pre-transit pulsing treatments on keeping quality of cut rose stems cv. First Red at Ludhiana centre (2010-11)

Treatment	Final stage of opening	Vase life (day)	Flower diam. (cm)	Total water absorbed/stem (ml)
$Al_2(SO_4)3.16H_2O$, 300 ppm	3.33	7.33	7.57	40.00
$Al_2(SO_4)3.16H_2O$, 600 ppm	3.33	7.78	7.73	38.04
$Al_2(SO_4)3.16H_2O$, 900 ppm	3.89	7.00	7.64	39.13
Chlorine, 100 ppm	3.33	6.00	7.23	41.06
Chlorine, 200 ppm	2.67	4.33	6.12	29.30
Chlorine, 300 ppm	2.22	3.56	5.15	23.90
Control	3.67	5.11	4.49	21.72
CD (P=0.05)	0.49	0.49	0.31	3.61

Table 3.2b. Effect of pre-transit pulsing treatments on keeping quality of cut rose stems cv. First Red at Ludhiana centre (Pooled data for 2008-09 to 2010-11)

Treatment	Final stage of opening				Vase life (day)		
	2008-09	2009-10	2010-11	Mean	2008-09	2010-11	Mean
$Al_2(SO_4)3.16H_2O$, 300 ppm	3.73	3.67	3.33	3.58	6.53	7.33	7.06
$Al_2(SO_4)3.16H_2O$, 600 ppm	3.8	3.78	3.33	3.64	7.27	7.78	7.57
$Al_2(SO_4)3.16H_2O$, 900 ppm	3.53	3.67	3.89	3.70	7.00	7.00	7.07
Chlorine, 100 ppm	3.53	3.56	3.33	3.43	6.67	6.00	6.19
Chlorine, 200 ppm	2.87	3.00	2.67	2.85	4.93	4.33	4.79
Chlorine, 300 ppm	2.53	2.44	2.22	2.40	3.53	3.56	3.66
Control	3.8	3.78	3.67	3.75	5.13	5.11	5.12
CD (P=0.05)	0.25	0.4	0.49	-	0.51	0.49	-

Ranchi

On the basis of Table 3.3, the vase life, final flower diameter and water absorption of rose cv. First Red was found to be maximum (7.20 day, 7.65 cm, 26.90 ml, respectively) at 300 ppm of $Al_2(SO_4)316H_2O$ this was significantly superior than.

Table 3.3. Effect of pre-transit pulsing treatment on keeping quality of cut rose at Ranchi centre (2010-11)

Treatment	Vase life (day)	Flower diam. (cm)	Total water absorbed (ml)
$Al_2(SO_4)316H_2O$-300ppm	7.2	7.6	26.9
$Al_2(SO_4)316H_2O$-600ppm	5.0	6.0	25.0
$Al_2(SO_4)316H_2O$-900ppm	3.9	5.5	22.1
Bleaching powder-100ppm	4.6	6.5	23.7
Bleaching powder-200ppm	5.1	7.2	26.4
Bleaching powder-300ppm	4.0	6.1	21.0
Control	6.29	6.0	24.0
CD (P=0.05)	0.9	0.7	3.5

Experiment 3.2 : Studies on the wet storage of cut roses.

Duration : Three years (Ongoing)

Centre : Bhubaneswar, Hessaraghatta, Ludhiana, Pune and Ranchi

Objective : To work out the duration for which the cut roses can be wet stored.

Cultivar : Any available export cultivar of the region

Stage of harvest : Tight bud stage

No. of treatments : Four

1. Aluminium sulphate [Al_2 (SO_4)3.16 H_2O] (300 ppm)
2. Aluminium sulhpate [Al_2 (SO_4)3.16 H_2O] (600 ppm)
3. Aluminium sulphate [Al_2 (SO_4)3.16 H_2O] (900 ppm)
4. Control: Double Distilled water

Storage durations : Four (0, 3, 6, 9 day)

No. of replications : Five

No. of stems/replication : Five

Statistical designs : Factorial CRD

The freshly harvested stems were put in bucket containing solutions of aluminium sulphate and stored at 2.5-3°C for 0, 3, 6, 9 day. After the storage for different durations, the basal 2-3 cm portion of the stems were recut under water and vase life was evaluated in plain distilled water at 23 ± 2°C and 16h illumination (1000 lux intensity provided by 40 W fluorescent tubes), under laboratory condition.

Observations recorded

1. Final stage of opening that the bud acquires in the base (based on the numerical scale 1-4 as mentioned under Experiment 1)
2. Vase life (day) when the petals show signs of wilting, bluing or bent neck; the vase life was evaluated in distilled water at ambient conditions.
3. Final flower diameter (that the bud attains in the vase).
4. Total water absorbed per stem (ml).

Report

Centre

Pune (Ganeshkhind)

Data presented in Table 3.4 showed the significantly higher vase life(4.78day), flower diameter (2.98cm) and water absorbed per stem (33.17ml) in Aluminium sulphate 300 ppm

treatment than other treatments. However, 0 day storage duration showed significantly more final stage of bud opening (3.69), vase life (5.48 day), flower diameter (3.42 cm) and water absorbed per stem (43.92 ml) than rest of storage duration. The interaction between Aluminium sulphate 300 ppm and 9 day storage duration showed significantly maximum vase life (3.03 day), having (9+3.03 day) 12.03 day vase life of cut roses under wet storage.

Table 3.4. Studies on wet storage of cut rose cv. Passion at Pune centre (2010-11)

Treatment	**Final stage of bud open**	**Vase life (day)**	**Flower diam. (cm)**	**Water abs. /stem (ml)**
V1 Aluminium sulphate - 300ppm	3.3	4.78	2.98	33.17
V2 Aluminium sulphate - 600ppm	3.15	3.78	2.57	37.91
V3 Aluminium sulphate - 900ppm	3.05	3.28	2.32	39.66
V4 Control	3.1	3.45	2.83	39.49
CD (P=0.05)	NS	0.18	0.17	1.25
Storage duration (S)				
S1 0 day	3.69	5.48	3.42	43.92
S2 3 day	3.29	4.27	2.77	40.34
S3 6 day	3.06	3.18	2.42	35.48
S4 9 day	2.57	2.37	2.09	30.43
CD (P=0.05)	0.2.0	0.18	0.17	1.25

Table 3.4. Studies on wet storage of cut rose cv. Passion at Pune (Ganeshkhinf) centre (2010-11) (continue...)

Treatment	Final stage of bud open	Vase life (day)	Flower diam. (cm)	Water abs. /stem (ml)
Interactions VXS				
V1S1	3.86	6.77	3.86	40.53
V1S2	3.03	5.50	3.03	36.63
V1S3	3.46	3.83	2.66	30.70
V1S4	2.83	3.03	2.36	24.60
V2S1	3.77	5.60	3.23	44.13
V2S2	3.63	4.00	2.80	41.36
V2S3	2.80	3.60	2.20	36.10
V2S4	2.43	2.47	2.06	30.03
V3S1	3.66	4.76	3.06	43.63
V3S2	3.50	3.60	2.23	41.73
V3S3	2.70	2.80	2.03	38.70
V3S4	2.33	1.96	1.96	34.56
V4S1	3.46	4.80	3.53	47.36
V4S2	3.00	4.00	3.03	41.63
V4S3	3.27	3.03	2.80	36.43
V4S4	2.67	2.00	1.96	32.53
CD (P=0.05)	0.42	0.36	0.34	2.51

Ludhiana

Flower stems of rose cv. First Red were harvested at tight bud stage and re-cut to a uniform length of 60 cm. The stems were placed in solutions of aluminium sulphate [$Al_2(SO_4)3.16\ H_2O$] (300, 600 and 900 ppm) and stored for 3, 6 and 9 day at 2-3°C. After storage, the keeping quality was evaluated in distilled water.

The stems placed in alumininum sulphate solution during storage exhibited slight improvement in degree of bud opening and significant improvement in vase life (Table 3.5a), the effect increasing slightly with increase in concentration of the chemical. Similarly, aluminium sulphhate treated stems exhibited improvement in water uptake (Table 3.5b).

The studies revealed that stems of rose placed in solution of aluminium sulphate during storage showed improvement in post-storage keeping quality. The experiment was conducted for three consecutive years (2008-09 to 2010-11).

Table 3.5a. Effect of wet refrigerated storage on keeping quality of cut rose stems cv. First Red at Ludhiana centre (2010-11)

Storage duration (day)/treatment	Final stage of opening					Aluminium sulphate		Control	Mean
	Aluminium sulphate								
3	300 ppm	600 ppm	900 ppm	Control	Mean	600 ppm	900 ppm		
6	3.33	3.78	3.67	3.33	3.53	6.56	6.78	4.78	6.11
9	3.56	3.78	3.67	3.22	3.56	6.22	6.44	4.11	5.86
0 (Control)	3.00	3.11	3.89	2.89	3.22	5.11	5.33	3.33	4.64
Mean	3.55	3.78	3.89	3.78	3.75	6.89	7.11	4.89	6.36
CD (P=0.05)	3.36	3.61	3.78	3.30	-	6.2	6.42	4.78	-

Storage duration (A)=0.23; Treatment (B)=0.23; AxB=NS

Table 3.5b. Effect of wet refrigerated storage on keeping quality of cut rose stems cv. First Red at Ludhiana centre (2010-11)

Storage duration (day)/treatment	Final flower diam. (cm)					$Al_2(SO_4)316H_2O$		Control	Mean
	$Al_2(SO_4)316H_2O$			Control	Mean	600 ppm	900 ppm		
3	300 ppm	600 ppm	900 ppm						
6	7.23	7.68	7.62	6.62	7.29	42.2	38.07	35.53	41.48
9	7.04	6.46	6.58	6.04	6.53	38.73	38.07	32.57	38.26
0 (Control)	6.12	7.07	6.3	5.39	5.97	34.83	33.07	25.83	33.08
Mean	7.41	6.53	6.14	6.77	6.71	49.1	42.67	26.97	43.33
CD (P=0.05)	6.95	6.68	8.97	6.71	-	41.22	37.97	30.23	-

Storage duration (A)=0.25; Treatment (B)=0.25; AxB=0.50

Centre : Ranchi

Table 3.6 showed that the final flower diameter of rose Cv. First Red was found to be maximum (7.10cm) at 3 day storage duration of 300ppm $Al_2(SO_4)316H_2O$ solution which was *at par* with 300ppm $Al_2(SO_4)316H_2O$ at 0 day and 6 day storage period and 600 ppm of $Al_2(SO_4)316H_2O$ at 3 day storage period. According to this Table, the vase life of rose was found to be maximum (7.25 day) at 300ppm of $Al_2(SO_4)316H_2O$ after 3 day of storage period which was *at par* with 300ppm $Al_2(SO_4)316H_2O$ after 0 day (6.10day) and 600ppm $Al_2(SO_4)316H_2O$ at 3 day (6.80) of storage. On the basis of data, the maximum water absorbed (41.50 ml) at 300ppm of $Al_2(SO_4)316H_2O$ when rose bud were kept for 3 day storage period which was significantly superior over all treatments.

Table 3.6. Studies on wet storage of cut rose cv. First Red at Ranchi centre (2010-11)

Total water absorbed(ml)	$Al_2(so_4)316H_2O$			Water	Mean	Vase life (day)				
Storage duration (day)						$Al_2(so_4)316H_2O$			Water	Mean
	300ppm	600ppm	900ppm			300ppm	600ppm	900ppm		
0	30.5	27.6	25.5	33.8	29.3	6.1	5.1	3.8	3.6	4.6
3	41.5	40.4	40.1	38.2	40.0	7.2	6.9	4.0	4.9	5.7
6	28.45	23.8	20.2	29.1	25.3	4.5	4.1	3.4	3.0	3.7
9	21.8	13.0	9.7	24.5	17.2	2.0	1.9	1.2	2.0	1.7
Mean	30.4	26.3	21.4	31.4	-	4.9	4.4	3.1	3.1	
Factor A	NS					0.481				
Factor B	0.49					0.481				
AXB	0.98					0.96				

Experiment 3.3 : Standardization of holding solutions for improving keeping quality of cut flower of rose.

Duration : Three years (Ongoing)

Objective : To work out the most effective holding solution for improving keeping quality of cut roses.

Cultivar : Any available export or commercial cultivarof the region

Stage of harvest : Commercial stage (tight bud stage)

No. of treatments : Nine

1. Aluminium sulphate [Al_2 (SO_4)3.16 H_2O] (300 ppm)
2. Calcium hypochlorite (bleaching powder) @50 ppm chlorine
3. Sodium benzoate (100 ppm)
4. Propyl gallate (25 ppm)
5. Sucrose (1.5%) + [Al_2 (SO_4)3.16 H_2O] (300 ppm)

6. Sucrose (1.5%) + Calcium hypochlorite (bleaching powder) @50 ppm chlorine
7. Sucrose (1.5%) + Sodium benzoate (100 ppm)
8. Sucrose (1.5%) + Propyl gallate (25 ppm)
9. Control (Double distilled water)

No. of replications : Three

No. of stems/ replication : Three

Flower stems were harvested and e precooled for 6h at 2.5-3°C. Leaves from the lower 1/3rd portion of the stems were removed. Basal 2-3 cm portion of the stem was given recut and then the stem was put in vase solutions. Vase life parameters were evaluated in plain distilled water at 23 ± 2°C and 16h illumination (1000 lux intensity provided by 40 W fluorescent tubes), under laboratory conditions.

Observations recorded

1. Final stage of opening that the bud acquires in the vase (based on the numerical scale 1-4 as mentioned under Experiment 1)
2. Vase life (day) when the petals show signs of wilting, bluing or bent neck; the vase life was evaluated in distilled water at ambient condition.
3. Final flower diameter (that the bud attains in the vase).
4. Total water absorbed per stem (ml).
5. Observations of any phytotoxic symptom of the chemical.

Report

Centre

Pune

Data presented in Table 4.1.3.1 revealed that the holding solution Sucrose 1.5 % + Aluminum Sulphate 300 ppm found significantly superior over rest of the treatments in respect of vase life of rose flowers (8.26 day), flower diameter (4.60 cm) and solution absorbed per stem (25.90 ml).

Table 3.7. Effect of holding solution for improving keeping quality of cut rose cv Passion at Pune (Ganeshkhind) centre (2010-11)

Treatment	Vase life (day)	Flower diam. (cm)	Water absorbed / stem (ml)	Final bud opening (day)	Phytotoxic symptom
Aluminium sulphate - 300ppm	6.7	3.6	22.4	3.8	Nil
Calcium hypochlorite - 50ppm	5.2	3.3	19.8	4.0	Nil
Sodium benzoate 100ppm	5.0	3.1	19.2	3.6	Nil
Propyl gallate 25 ppm	4.8	3.1	17.3	3.8	Nil
Sucrose 1.5 % + Aluminium sulphate - 300ppm	8.2	4.6	25.9	4.5	Nil
Sucrose 1.5 % + Calcium hypochlorite - 50 ppm	6.3	4.0	21.8	3.7	Nil
Sucrose 1.5 % + Sodium benzoate 100ppm	5.8	3.3	20.4	3.4	Nil
Sucrose 1.5 % + Propyl gallate 25 ppm	5.4	3.0	18.6	3.0	Nil
Citric acid 300 ppm	6.0	3.5	20.1	4.5	Nil
Control (Tap water)	4.6	3.0	17.9	3.0	Nil
CD (P=0.05)	0.34	0.22	1.05	NS	-

Ludhiana

Cut flowers of rose cv. First Red were harvested at tight bud stage and placed in vase solutions containing aluminium sulphate [$Al_2(SO_4)3.16H2O$], 300 ppm; calcium hypochlorite ($CaOCl_2$), 50 ppm chlorine; sodium benzoate, 100 ppm; propel gallate, 25 ppm individually as well as in combination with sucrose, 1.5%. The cut stems placed in water were taken as control.

The vase solution containing aluminium sulphate (300ppm) and calcium hypochlorite (50, ppm chlorine) showed significant improvement in opening of bud as well as vase life over the control (Table 3.8a). The effect synergized when these chemicals were used in combination with sucrose (1.5%). These treatments also improved final size of the bud and water uptake. Sodium benzoate was slightly effective when used along with sucrose.

The studies revealed, holding solution containing aluminiinium sulphate or calcium hypochlorite (50 ppm chlorine) in combination with (50 ppm chlorine) in combination with sucrose (1.5%) were best suited for cut rose stems. The experiment was conducted for three consecutive years (2008-09 to 2010-11) and the pooled data are presented in Table 3.8b.

Table 3.8a. Effect of holding solutions on keeping quality of rose cv. First Red at Ludhiana centre (2010-11)

Treatment	Final stage of opening	Vase life (day)	Flower diam. (cm)	Total water absorbed/stem (ml)
$Al_2(SO_4)3.16H_2O$, 300 ppm	3.78	7.00	7.11	45.87
$CaOCl_2$, 50 ppm	3.89	6.67	7.08	51.70
Sodium benzoate, 100 ppm	3.00	4.67	5.50	35.40
Propyl gallate, 25 ppm	2.56	4.78	5.65	34.60
Sucrose (1.5%)+ $Al_2(SO_4)3.16H_2O$	4.00	7.67	8.09	44.07
Sucrose (1.5%)+%)+$CaOCl_2$	4.00	7.44	8.03	47.30
Sucrose (1.5) + Sodium benzoate	3.11	5.45	6.78	30.93
Sucrose (1.5%)+Propyl gallate	2.89	4.89	5.59	34.77
Control (water)	3.44	4.89	6.68	39.27
CD (P=0.05)	0.33	0.73	0.33	5.57

Table 3.8b. Effect of holding solutions on keeping quality of rose cv. First Red at Ludhiana centre (Pooled data for 2008-09 to 2010-11)

Treatment	Final stage of opening				Vase life (day)			
	2008-09	2009-10	2010-11	Mean	2008-09	2009-10	2010-11	Mean
$Al_2(SO_4)3.16H_2O$, 300 ppm	3.44	3.56	3.78	3.59	6.89	6.89	7.00	6.93
$CaOCl_2$, 50 ppm	3.67	3.89	3.89	3.82	6.78	6.78	6.67	6.74
Sodium benzoate, 100 ppm	2.89	3.00	3.00	2.96	5.11	5.22	4.67	5.00
Propyl gallate, 25 ppm	2.67	2.67	2.56	2.63	4.89	5.00	4.78	4.89
Sucrose (1.5%)+ $Al_2(SO_4)3.16H_2O$	3.89	4.00	4.00	3.96	8.11	7.67	7.67	7.82
Sucrose (1.5%)+%)+$CaOCl_2$	3.78	3.89	4.00	3.89	8.00	8.22	7.44	7.89
Sucrose (1.5) + Sodium benzoate	3.22	3.11	3.11	3.15	5.55	5.56	5.45	5.52
Sucrose. (1.5%)+Propyl gallate	3.44	3.22	2.89	3.18	5.44	5.22	4.89	5.18
Control (water)	3.44	3.45	3.44	3.44	5.44	5.22	4.89	5.18
CD (P=0.05)	0.48	0.38	0.33	-	0.53	0.44	0.73	-

Ranchi

On the basis of Table 3.9, data revealed that the maximum vase life of rose Cv. First red (8.50day) of cut roses was observed in the solution Sucrose (1.5%)+ $Al_2(So_4)316H_2O$ 300ppm *at par* with $Al_2(So_4)316H_2O$ 300ppm (10.00 days).Similarly, the total water absorbed was found to be maximum (25.00 ml) in Sucrose (1.5%)+ $Al_2(So_4)316H_2O$ 300ppm at par with sucrose (1.5%)+Sodium benzoate 100ppm (24.70ml) and Sodium benzoate 100ppm (24.40ml).

Table 3.9. Standardization of holding solution for improving vase life quality of cut roses cv. First Red at Ranchi centre during 2010-11

Treatment	Final stage of opening of bud	Vase life (day)	Flower diam. (cm)	Water absorption (ml)	Phytotoxic Symptoms
$Al_2(So_4)316H_2O$ 300ppm	4.0	7.1	4.3	22.3	---------
Bleaching Powder @50ppm chlorine	4.0	5.0	3.3	20.4	Wilting of leaves
Sodium Benzoate 100ppm	3.0	5.85	3.9	24.4	Wilting of leaves
Propyl gallate 25ppm	3.0	5.75	3.7	21.1	Wilting and drying of leaves
Sucrose(1.5%)+ $Al_2(So_4)316H_2O$ 300ppm	4.1	8.5	5.1	25.0	Wilting and drying of leaves
Sucrose (1.5%)+ Bleaching Powder @50ppm chlorine	3.0	6.6	5.1	22.2	Wilting and drying of leaves
Sucrose(1.5%)+ Sodium Benzoate 100ppm	3.0	6.8	3.85	24.7	-------
Sucrose (1.5%)+ Propyl gallate 25ppm	3.0	6.0	3.35	22.1	-------
Control (water)	3.0	5.1	3.2	20.4	Bent neck and drying of leaves
CD (P=0.05)		1.44	1.16	1.68	-------

Experiment 3.4 : Standardization of postharvest package technology in rose for local marketing.

Duration : Three years (2010-11 onwards)

Centres : Hessaraghatta, Ludhiana, Pune, Ranchi and Chiplima

Cultivar : First Red / any commercial cultivar of the region

Stage of harvest : Commercial stage

No. of treatments : Two

1. Water

2. Bleaching powder (50 ppm chlorine)

Packaging materials : Four
i. LDPE 100 gauge
ii. PP 100 gauge
iii. Cellophane
iv. No packaging material

Transit time in cardboard : 6 h under ambient conditions

No. of stems/ treatment : Ten

No. of replications : Three

Design of experiment : Factorial CRD

Observations recorded:

1. Degree of bud opening in vase (based on numerical scale 1-4 (1-harvesting stage; 2-half open; 3 - 3/4th open & 4 - fully open)
2. Vase life, till petals show signs of wilting, bluing – (day)
3. Final flower diameter (cm)
4. Total water absorbed/stem (ml)
5. Bacterial count (cf4)/ ml vase water at the time the termination of vase life
6. Cost of preservative, packaging boxes, packing material/stem
7. Percent weight loss after simulated transit

Report

Centre

Pune (Ganeshkhind)

Data presented in Table 3.9 revealed that the treatment bleaching powder 50 ppm showed significantly more vase life (5.85 day), flower diameter (3.77cm) and water absorbed / stem (40.97 ml). The package material LDPE 100gaguage showed maximum vase life (7.00 day) water absorbed /stem (48.05 ml). The interaction between bleaching powder 50 ppm and package material LDPE100 gauge found significantly superior in respect of vase life (7.50 day), flower diameter (3.90 cm) and water absorbed /stem (49.50 ml) compared to all other treatment.

Table 3.9. Effect of postharvest package technology for local marketing in rose cultivar Passion at Pune (Ganeshkhind) centre (2010-11)

Treatment	Final stage of bud open	Vase life (day)	Flower diam. (cm)	Water absorbed /stem(ml)	% decrease in fresh wt. (g)
A1 Water	2.95	5.3	3.42	38.82	-
A2 Bleaching powder – 50ppm	2.72	5.85	3.77	40.97	-
CD (P=0.05)	0.09	0.16	0.19	0.55	-
Package material (P)					
P1 LDPE 100 gauge	2.3	7.0	3.7	48.0	-
P2 PP 100 gauge	3.0	4.8	3.3	33.3	-
P3 Cellophane	2.4	6.0	3.5	41.5	-
P4 No packaging	3.6	4.5	3.8	36.7	-
CD (P=0.05)	0.12	0.23	0.27	0.78	-
Interactions VXS					
A1P1	2.6	6.5	3.6	46.6	13.5
A1P2	3.2	4.6	3.0	31.8	16.0
A1P3	2.5	5.6	3.2	40.2	12.8
A1P4	3.5	4.5	3.9	36.7	15.7
A2P1	2.0	7.5	3.9	49.5	11.5
A2P2	2.8	5	3.6	34.9	13.0
A2P3	2.3	6.4	3.8	42.8	10.6
A2P4	3.8	5.5	3.7	36.7	14.6
CD (P=0.05)	0.2	0.3	0.4	1.1	-

Ludhiana

Flower stems of rose cv. First Red harvested at tight bud stage were pre-cooled in solution of chlorine (50 ppm) and water (control). The stems were placed under refrigerated condition (2-3°C) for 24 h. and then packed in LDPE, PP and cellophane sleeves open at the top and then packed in cardboard boxes at ambient conditions for 16 h to simulate transit conditions. Thereafter, basal 2-3 cm portions of flower stems were re-cut and vase life was evaluated in distilled water.

Flower stems treated with chlorine (50 ppm) showed improvement in vase life (7.12 day) as compared to control (4.65 day). Similarly stems packed in LDPE, PP and cellophane showed only slight improvement in vase life (Table 4.1.4.2). The final bud diameter and water uptake /stem were also improved with treatment with chorine (Table 4.1.4.3). The stems showed increased water loss when kept unwrapped during simulated transit (Table 4.1.4.4). The studies revealed that stems placed in solution of chlorine (50 ppm prepared from bleaching powder) during storage /pre-cooling showed significant improvement in their vase life.

Table 3.10a. Standardization of postharvest technology of rose cv. First Red for local marketing at Ludhiana centre during 2010-11

Polymeric sleeve/ Treatment	Final stage of opening			Vase life (day)		
	Bleaching powder (50 ppm chlorine)	Water (control)	Mean	Bleaching powder (50 ppm chlorine)	Water (control)	Mean
LDPE-100	3.33	3.07	3.20	8.00	5.20	6.60
PP-100	3.33	3.10	3.22	7.17	4.80	5.98
Cellophane	2.97	2.87	2.92	6.73	4.57	5.65
Without packing material	3.00	2.80	2.90	6.57	4.03	5.30
Mean	3.16	2.95	-	7.12	4.65	-
CD (P=0.05)	Polymeric sleeve (A)=0.13; Treatment (B)= 0.95; AxB=NS			Storage duration (A)=0.25; Treatment (B)=0.18; AxB=NS		

Table 3.10b. Standardization of postharvest technology of rose cv. First Red on final flower dia. and total water absorbed/stem at Ludhiana centre during 2010-11

Polymeric sleeve/ Treatment	Final flower diam. (cm)			Total water absorbed/stem (ml)		
	Bleaching powder (50 ppm chlorine)	Water (control)	Mean	Bleaching powder (50 ppm chlorine)	Water (control)	Mean
LDPE-100	7.60	6.90	7.25	59.44	49.67	54.55
PP-100	7.38	6.77	7.07	59.355	50.55	55.05
Cellophane	6.78	6.41	6.59	57.78	47.67	52.72
Without packing material	6.54	5.88	6.21	54.11	44.44	49.28
Mean	7.07	6.49	-	57.72	48.08	-
CD (P=0.05)	Polymeric sleeve (A)=0.31; Treatment (B)=0.22; AxB=NS			Storage duration (A)=NS; Treatment (B)=3.16; AxB=NS		

Table 3.10c. Standardization of postharvest technology of rose cv. First Red on per cent weight loss after simulated transit at Ludhiana centre during 2010-11

Polymeric sleeve/Treatment	Final flower diam. (cm)		
	Bleaching powder (50 ppm chlorine)	Water (control)	Mean
LDPE-100	1.28(6.43)	1.50(6.97)	1.39(6.70)
PP-100	1.26(6.35)	1.41(6.75)	1.34(6.55)
Cellophane	1.23(6.21)	1.29(6.41)	1.26(6.31)
Without packing material	3.57(10.84)	2.93(9.57)	3.25(10.21)
Mean	1.84(7.46)	1.78(7.42)	2.02(7.44)
CD (P=0.05)	Polymeric sleeve (A)=2.02 ; Treatment (B)= NS ; AxB=NS		

Hessaraghatta

Standardization of packaging technology for rose to local market was carried out as per the technical programme with cv. First Red cut flowers harvested at tight bud stage. Observations revealed that maximum vase life of 8.5 day having larger flower diameter (7.6cm) and 19.8 ml of water uptake was obtained with cellophane package compared to flowers of other packages and control (7.2 day of vase life). Cellophane package maintained least percent moisture loss of 15.4 as compared to control and ether packages tried (Table 3.11).

Table 3.11. Effect of pre treatment and packaging on keeping quality of rose cv. First Red cut flower for local market at Hessaraghatta centre (2010-11)

Packaging treatment	Pretreatment with water					
	Vase life (day)	Flower diam. (cm)	Water absorbed (ml)	Bacterial count (cfu)/ ml vase water at the time the termination of vase life	Cost of preservative, and packing material/ stem	Percent weight loss after simulated transit
LDPE 100 gauge	8.2	7.4	18.6	$2x10^5$	25paise	15.8
PP 100 gauge	8	7.2	18.0	$2x10^5$	30 paise	15.6
Cellophane	8.5	7.6	19.8	$2x10^5$	35 paise	15.4
No package	7.2	7.0	16.6	$2x10^4$	0 paise	22.6
CD (P=0.05)						
Pretreatment	0.4	0.3	0.7	3.2	0.7	1.2
Packaging	0.7	0.4	0.1	3.6	0.1	1.7
Packaging x pretreatment	0.4	0.3	6.2	2.4	0.5	1.3

Table 3.11. Effect of pre treatment and packaging on keeping quality of rose cv. First Red cut flower for local market at Hessaraghatta centre (2010-11) (continue...)

Packaging treatment	Pretreatment with bleaching powder					
	Vase life (day)	Flower diam. (cm)	Water absorbed (ml)	Bacterial count (cfu)/ ml vase water at the time the termination of vase life	Cost of preservative, packaging boxes, packing material /stem	Percent weight loss after simulated transit
LDPE 100 gauge	8.8	7.6	22.6	$2x10^2$	40 paise	14.9
PP 100 gauge	8.5	7.3	23.0	$2x10^2$	50 paise	15.2
Cellophane	9.6	7.8	24.8	$2x10^2$	60 paise	16.0
No package	7.8	7.2	19.6	$2x10^3$	10 paise	19.4
CD (P=0.05)						
Pretreatment	0.3	0.3	1.1	1.9	0.6	0.1
Packaging	0.9	0.3	0.8	1.2	0.4	0.7
Packaging x pretreatment	0.5	0.2	0.6	1.1	0.3	0.4

Ranchi

Table 3.12 showed that the final flower diameter of rose Cv. First Red was found to be maximum (7.25 cm) in the solution of bleaching powder wrapped with PP (100 gauge) which was *at par* with the flower kept in bleaching powder and wrapped with cellophane paper i.e. 6.90 cm. The vase life and water absorption was also found to be maximum (12.50 day and 43.00 ml respectively) in the solution bleaching powder wrapped with PP (100 gauge). The percent weight loss and bacterial count was calculated minimum i.e. 11.10% and 2.00 / ml, respectively in the solution of bleaching powder with lining material PP (100 gauge).

Table 3.12. Standardization of postharvest package technology in rose cv. First Red for local marketing at Ranchi centre during 2010-11

Treatment	Vase life (day)			Flower diam. (cm)			Total water absorbed (ml)		
	Water	Bleaching powder	Mean	Water	Bleaching powder	Mean	Water	Bleaching powder	Mean
LDPE(100 gauge)	9	9.1	9	5	6.1	5.55	35	38	36.5
PP(100 gauge)	10.15	12.5	11.32	5.4	7.25	6.32	39.5	43	41.25
Cellophane	10	11.65	10.82	5	6.9	5.95	38.5	41.25	39.87
No Packaging	7.25	7.5	7.37	4.1	4.5	4.3	30	31.25	30.62
Factor A	0.59	-	-	0.49	-	-	NS	-	-
Factor B	0.59	-	-	0.49	-	-	0.52	-	-
A*B	1.18	-	-	0.98	-	-	1.04	-	-

Table 3.12. Continued.....

Treatment	Percent wt. loss			Degree of bud opening in Vase		Bacterial count/ml		
	Water	Bleaching powder	Mean	Water	Bleaching powder	Water	Bleaching powder	Mean
LDPE(100 gauge)	19.75	15.5	17.62	2	3/4th	4.35	4.1	4.22
PP(100 gauge)	13.5	11.1	12.3	3/4th	4	3.1	2	2.55
Cellophane	15.2	11.9	13.55	3/4th	4	4	3	3.5
No Packaging	21.25	19.33	20.29	2	2	5.4	5	5.2
Factor A	0.51	-	-	-	-	0.25	-	-
Factor B	NS	-	-	-	-	0.25	-	-
AxB	1.02	-	-	-	-	0.5	-	-

Experiment 3.5	**:**	**Standardization of postharvest technology of rose for distant marketing**
Cultivar	:	First Red
Stage of harvest	:	Tight bud stage
No. of treatments	:	Five 1. Water 2. Aluminium sulphate (300ppm) 3. Aluminium sulphate (300ppm) + Sucrose (4%) 4. Bleaching powder (50 ppm) 5. Sucrose (4%) + acetyl salicylic acid (200 ppm)
Duration of cold storage	:	Three day
Time of simulated transit	:	16 h in pre-cooled boxes under refrigerated conditions
No. of stems/treatment	:	Ten
No. of replications	:	Five
Observations to be recorded	:	Same as given in Experiment 1.4.3

Report

Centre

Pune (Ganeshkhind)

Data presented in Table 3.13 a&b indicated that the treatment Alluminium sulphate 300 ppm + Sucrose 4 % found significantly superior in respect of vase life (6.80day) than all other treatments. While flower diameter (3.8cm) was found significantly more in treatment Sucrose 4 % + Actylsalicylic acid 200 ppm than other treatment.

Table 3.13a. Effect of postharvest package technology in rose cv. Passion for distant marketing at Pune (Ganeshkhind) centre (2010-11)

Treatment	Vase life (day)	Flower diam. (cm)	Solution absorbed / stem (ml)	Final bud opening (day)	Percent weight loss (g)
Water	5.5	3.4	40.7	2.9	0
Alluminium sulphate 300 ppm	6	3.3	33.5	2.8	13.5
Alluminium sulphate 300 ppm + Sucrose 4 %	6.8	3.7	38.6	2	11.6
Bleching powder 50 ppm	5	3.4	33.8	3	15.5
Sucrose 4 % + Actylsalicylic acid 200 ppm	6.5	3.8	39.5	2.5	10.67
CD (P=0.05)	0.18	0.18	0.84	0.3	0.77

Table 3.13b. Standardization of postharvest package technology in rose cv. Passion for distant marketing at Pune (Ganeshkhind) centre (2012-13)

Treatment	Vase life (day)	Flower diam. (cm)	Water absorbed / stem (ml)	Final bud opening (Day)
Aluminium sulphate 300 ppm	5.30	3.70	40.7	2.4
Aluminium sulphate 300 ppm + Sucrose 4 %	7.18	3.88	39.8	2.62
Calcium hypochlorite 50 ppm	4.32	3.02	41.6	2.18
Sucrose 4 % + Acetylsalicylic acid 200 ppm	5.88	3.22	30.7	2.42
Water	4.00	3.00	42.5	2.20
CD (P=0.05)	0.12	0.12	1.37	0.12

Ludhiana

Flower stems of rose cv. First Red harvested at tight bud stage were placed in solution of aluminium sulphate (300 ppm) and chlorine (50 ppm prepared from bleaching powder) and water (control) and stored at 2-3°C for 3 day. The buds were wrapped in corrugated paper, packed in pre-cooled boxes and placed in a cold room for 16 h. to simulate transit conditions. The keeping quality was evaluated in distilled water. The results presented in Table 3.14 a & b show that stems placed in solution of aluminium sulphate (300 ppm) and chlorine (50 ppm) showed improvement in bud opening scores (3.46 and 3.87) and vase life 6.73 and 7.13 day) as compared to control (2.80 and 5.33 day), respectively. Likewise, these treatments also exhibited improvement in water absorption/stem. The studies showed that for distant marketing, flower stems placed in solution of aluminium sulphate (300 ppm) or chlorine (50 ppm) during storage before transit showed significant improvement in vase life.

Table 3.14a. Standardization of postharvest technology of rose for distant marketing: Effect of chemical treatments and simulated transit in rose cv. First Red at Ludhiana centre during 2010-11

Treatment	Final stage of opening	Vase life (day)	Final flower diam. (cm)	Total water absorbed/stem (ml)	Weight loss after simulated transit (%)
$Al_2(SO_4)3.16H_2O$, 300 ppm	3.46	6.73	7.43	55	1.42(6.73)
Chlorine, 50 ppm	3.87	7.13	7.49	64.4	1.78(7.63)
Water (control)	2.80	5.33	6.81	41.67	1.81(7.68)
CD (P=0.05)	0.41	0.56	0.31	16.81	NS

Table 3.14b. Standardization of postharvest technology of rose for distant marketing: Effect of chemical treatments and simulated transit in rose cv. First Red at Ludhiana centre (2013-14)

Treatment	Final stage of opening	Vase life (day)	Final flower diam. (cm)	Total water absorbed/stem (ml)	Weight loss after simulated transit (%)
$Al_2(SO_4)3.16H_2O$, 300 ppm	3.92	7.88	7.62	51.6	3.37(10.49)
Chlorine, 50 ppm	3.76	7.52	7.74	53.06	2.79(9.44)
Water (control)	3.2	4.96	7.84	48.24	3.74(11.12)
CD (P=0.05)	0.28	0.63	NS	NS	NS

Figures in parentheses are arc sine transformed values

Hessaraghatta

Standardization of packaging technology for rose to local market was carried out as per the technical programme with cv. First Red cut flowers harvested at tight bud stage. Observations revealed that maximum vase life of 9.5 day having larger flower diameter (8.6cm) and 22.2 ml of water uptake was obtained with aluminium sulphate (300ppm) pre treatment as compared to flowers of bleaching powder (50ppm) pretreatment and control (8.4 day and 7.2 day of vase life, respectively). Aluminium sulphate (300ppm) pre treatment also maintained least growth of bacteria ($2x10^2$ cfu) and percent moisture loss of 14.6 as compared to control and bleaching powder pre treatment tried (Table 3.15a&b).

Table 3.15a. Effect of pre treatment on keeping quality of rose cv. First Red cut flowers for distant market at Hessaraghatta centre (2010-11)

Pre treatment	Vase life (day)	Flower diam. (cm)	Water absorbed (ml)	Bacterial count (cfu)/ ml vase water at the time the termination of vase life	Cost of preservative /stem	Percent weight loss after simulated transit
Water	7.2	7.4	17	$2x10^5$	Nil	18.6
Aluminium sulphate (300ppm)	9.5	8.6	22.2	$2x10^2$	25 paise	14.6
Bleaching powder (50 ppm)	8.4	8.2	20.4	$2x10^3$	20 paise	16.4
CD (P=0.05)	1.2	0.8	1.4	24.7	2.0	3.6

Table 3.15b. Effect of pre-treatment on keeping quality of rose cv. First Red cut flowers for distant market at Hessaraghatta Centre (2013-14)

Pre treatment	Vase life (day)	Flower diam. (cm)	Water absorbed (ml)	Bacterial count (cfu)/ ml vase water at the time the termination of vase life	Cost of preservative /stem	Percent weight loss after simulated transit
Water	7.6	7.2	16.4	$2x10^4$	Nil	17.5
Aluminum sulphate (300ppm)	9.8	8.5	21.0	$2x10^2$	30 paise	15.0
Bleaching powder (50 ppm)	8.6	8.0	19.2	$2x10^3$	25 paise	16.2
CD (P=0.05)	1.2	0.72	1.3	23.6	1.9	3.5

Centre : Ranchi

The experiment was conducted in rose cv. First Red. Data presented in Table 3.16a reveald that the maximum vase life, (8.75 day), flower diameter (8.25 cm) and water absorption (28.25 ml) was recorded in treatment Aluminium sulphate 300 ppm + sucrose 4 % which was significantly superior than others. The minimum percent of weight loss was observed in the treatment Aluminium sulphate 300 ppm + sucrose 4 % (10.00%) and minimum bacterial count 1.04/ ml was also found in the same treatment. On the basis of three years pooled data, the solution bleaching powder wrapped with PP (100 gauge)was found to be good for the final flower diameter and vase life of rose in which the bacterial count was calculated minimum (Table no.3.16b).

Table 3.16a. Standardization of postharvest technology of rose cv. First Red for distant marketing at Ranchi centre during 2010-11

Treatment	Vase life (day)	Flower diam. (cm)	Total water absorbed (ml)	Percent of wt. loss	Degree of bud opening in vase	Bacterial count/ml
Water	6.5	6.1	23.75	12.1	2.0	5.2
$Al_2(So_4)316H_2O$ (300ppm)	7.1	7.0	26.7	10.2	4.0	1.1
$Al_2(So_4)316H_2O$ (300ppm)+Sucrose(4%)	8.7	8.2	28.2	10.0	4.0	1.0
Bleaching Powder (50ppm)	7.0	6.8	26.0	11.6	3/4th	2.5
Sucrose (4%)+acetyl Salicylic acid (200ppm)	6.8	6.7	23.5	11.7	2.0	3.1
CD (P=0.05)	1.0	1.0	1.5	2.0	-	-

Table 3.16b. Standardization of postharvest technology of rose cv. First Red for distant marketing at Ranchi centre during 2012-2013

Treatment	Vase life (day)	Flower diam. (cm)	Total water absorbed(ml)	Percent of wt. loss	Degree of bud opening in vase	Bacterial count/ml
Water	6.7	6.15	23.8	12.05	2	5.3
Al2(So4)316H2O (300ppm)	7.15	7	26.7	10.15	4	1.09
Bleaching Powder (50ppm)	7.1	6.8	26	11.5	3/4th	2.53
CD (P=0.05)	0.84	0.82	1.5	1.8	N. S.	N. S.
Water	3	3.8	6.68	17.98	13	0.18
Aluminum sulphate (300 ppm)	4	5.6	7.59	33.81	13.5	0.22
Chlorine (50 ppm)	3	5.2	6.86	20.12	12.6	0.19
CD (P=0.05)	N. S.	1.12	0.32	2.91	N. S.	N. S.

Chiplima

The maximum vase life (5.6 day), flower diameter (7.59 cm) and water uptake (33.81 ml) were recored when the stems were treated with aluminium sulphate (300 ppm) for 4 day and subjected to simulated transit for 16 h. The vase life of stems were minimum (3.8 day) in control (Table 3.17).

Table 3.17. Effect of chemicals used during storage on vase life of rose cv. Mainu Parle. at Chiplima centre (pooled data of 3 years)

Treatment	Degree of bud opening in vase	Vase life (day)*	Flower diam. (cm)*	Total water absorbed/stem (ml)*	% weight loss after simulated transit	Cost of preservative, packaging material/stem
Water	3.0	3.9	6.8	18.1	12.9	0.2
Aluminum sulphate (300 ppm)	4.0	5.4	7.6	32.5	13.4	0.2
Chlorine (50 ppm)	3.0	5.5	7.0	20.1	12.3	0.2
CD (P=0.05)	-	1.1	0.4	3.1	NS	-

Experiment 3.6 : Standardization of postharvest package technology in rose for local marketing.

Duration : Three years (2011-12 onwards)

Centres : Hessaraghatta, Ludhiana, Pune, Ranchi and Chiplima

Cultivar : First Red / any commercial cultivar of the region

Stage of harvest : Commercial stage

No. of treatments : Two
1. Water
2. Bleaching powder (50 ppm chlorine)

Packaging materials : Four
i. LDPE 100 gauge
ii. PP 100 gauge
iii. Cellophane
iv. No packaging material

Time of transit in cardboard : 6 h under ambient conditions

No. of stems / treatment : Ten

No. of replications : Three

Design of experiment : Factorial CRD

Observations recorded

1. Degree of bud opening in vase (based on numerical scale 1-4 (1-harvesting stage; 2-half open; 3 - 3/4th open & 4 - fully open)
2. Vase life, till petals show signs of wilting, bluing – (day)
3. Final flower diameter (cm)
4. Total water absorbed/stem (ml)
5. Bacterial count (cf4)/ ml vase water at the time the termination of vase life
6. Cost of preservative, packaging boxes, packing material/stem
7. Percent weight loss after simulated transit

Report

Centre

Chiplima

Data presented in Table 3.18a,b indicated that packaging material had significant effect on keeping quality of cut roses over control. The vase life was maximum (8.37 day) when the stems were pulsed with bleaching powder (50 ppm chlorine), packed in LDPE sheet (100 gauge) and kept in simulated transit for 6 hours. The final flower diameter (7.28 cm) and water uptake (42.95 ml) were also maximum in the same treatment. The vase life of stems was minimum (5 day) in simulated transit without any packing material.

Table 3.18a. Effect of chemical and packing material on keeping quality of cut rose cv. Mainu Parle. at Chiplima centre

Packing material	Vase life (day)*		Flower diam. (cm)*		Total water absorbed/ stem (ml)*		% weight loss after simulated transit	
	Water	Bleaching powder (50 ppm chlorine)	Water	Bleaching powder (50 ppm chlorine)	Water	Bleaching powder (50 ppm chlorine)	Water**	Bleaching powder (50 ppm chlorine)**
Polyethylene	5.9	8.37	6.43	7.28	31.46	42.95	5.98 (2.44)	6.21 (2.49)
Polypropylene	5.8	7.93	5.12	6.84	32.19	39.77	5.33 (2.31)	6.25 (2.50)
Cellophane	5.7	8.1	5.72	6.8	29.04	31.12	5.71 (2.40)	6.15 (2.48)
Without	5	6.17	4.75	5.78	24.17	40.99	6.12 (2.63)	6.67 (2.58)
Mean	5.6	7.64	5.51	6.68	29.22	38.71	5.79 (2.41)	6.32 (2.51)
	SE	CD	SE	CD	SE	CD	SE	CD
Treatment	0.09	0.26	0.04	0.14	0.49	1.5	0.03	0.1
Packing material	0.15	0.45	0.08	0.23	0.86	2.6	0.06	0.18
Interaction	0.17	0.52	0.09	0.27	0.99	3	0.07	0.2

*Significant at 5% **Square root transformed data are in parenthesis

Table 3.18b. Effect of chemical and packing material on keeping quality of cut rose cv. Mainu Parle at Chiplima centre (pooled data of 3 years)

Packing material	Vase life (day)*		Flower diam. (cm)*		Water absorbed/ stem (ml)*		% weight loss after simulated transit	
	Water	Bleaching powder (50 ppm chlorine)	Water	Bleaching powder (50 ppm chlorine)	Water	Bleaching powder (50 ppm chlorine)	Water**	Bleaching powder (50 ppm chlorine)**
Polypropylene	5.93	8.62	6.39	7.28	31.86	43.23	5.97 (2.63)	6.20 (2.47)
Cellophane	5.83	7.88	5.09	6.82	32.73	40.11	5.32 (2.31)	6.24 (2.50)
Without	5.73	8.00	5.69	6.81	29.44	31.49	5.72 (2.43)	6.16 (2.48)
Mean	5.1	6.21	4.53	5.78	24.4	41.27	6.10 (2.89)	6.67 (2.58)
	5.65	7.68	5.42	6.67	29.61	39.03	5.78 (2.41)	6.32 (2.51)
Treatment	SE	CD	SE	CD	SE	CD	SE	CD
Packing material	0.08	0.24	0.03	0.13	0.42	1.48	0.1	0.13
Interaction	0.16	0.48	0.06	0.22	0.83	2.59	0.15	0.20
*	0.15	0.51	0.10	0.25	0.97	3.03	0.18	0.23

*Significant at 5% **Square root transformed data are in parenthesis

Ranchi

On the basis of three years pooled data, the solution bleaching powder wrapped with PP (100 gauge) was found to be good for the final flower diameter and vase life of rose in which the bacterial count was calculated minimum (Table 3.19).

Table 3.19. Standardization of postharvest package technology of rose for local marketing at Ranchi centre during 2012-13

Treatment	Vase life (day)			Flower diam. (cm)			Total water absorbed (ml)		
	Water	Bleaching Powder	Mean	Water	Bleaching Powder	Mean	Water	Bleaching Powder	Mean
LDPE(100 gauge)	9.05	9.15	9.10	4.95	6.00	5.47	35.05	38.10	36.57
PP(100 gauge)	10.1	12.75	11.42	5.35	7.25	6.30	40.00	42.60	41.30
Cellophane	10.0	11.5	10.75	5.15	6.90	6.02	38.8	41.00	39.90
No Packaging	7.15	7.25	7.20	4.05	4.45	4.25	29.5	31.20	30.35
Factor A	0.57			0.48			0.5		
Factor B	0.57			0.48			NS		
A*B	1.14			0.96			1		

Table 3.19. Standardization of postharvest package technology of rose for local marketing at Ranchi centre during 2012-13 (continue...)

Treatment	Percent wt. loss			Degree of bud opening in Vase		Bacterial count/ml		
	Water	Bleaching Powder	Mean	Water	Bleaching Powder	Water	Bleaching Powder	Mean
LDPE(100 gauge)	19.70	15.50	17.60	2.00	3/4th	4.35	4.30	4.32
PP(100 gauge)	13.00	10.75	11.87	3/4th	4.00	3.05	2.00	2.52
Cellophane	15.00	11.50	13.55	3/4th	4.00	4.10	3.15	3.62
No Packaging	21.25	19.35	20.30	2.00	2.00	5.35	5.25	5.30
Factor A	0.5	-	-	-	-	0.25	-	-
Factor B	NS	-	-	-	-	0.25	-	-
A*B	1.01	-	-	-	-	0.5	-	-

Pune (Ganeshkhind)

Data presented in Table 3.20 revealed that the treatment Calcium hypochlorite (50 ppm) showed significantly more vase life (4.87 day), flower diameter (3.42 cm) and water absorbed per stem (34.12 ml). The package material PE (100 gauge) showed maximum vase life (5.85 day) and water absorbed per stem (42.15 ml). The interaction between Calcium hypochlorite (50ppm) and package material PE (100 gauge) was significantly superior in respect of vase life (6.50 day), flower diameter (3.70 cm) and water absorbed per stem (48.10 ml).

Table 3.20. Standardization of postharvest package technology for local marketing cv. Passion at Pune centre 2013-14

Treatment				
Holding solution (A)	**Final stage of bud open**	**Vase life (day)**	**Flower diam. (cm)**	**Water abs. /stem(ml)**
A1 Water	0	0	0	0
A2 Calcium hypochlorite – 50ppm	2.8	4.42	3.4	30.41
CD (P=0.05)	0.02	0.05	0.04	0.11
Package material (P)	NS	0.16	NS	0.34
P1 Polyethylene 100 gauge				
P2 Poly Propylene 100 gauge	2.5	5.85	3.65	42.15
P3 Cellophane paper	3.3	4.15	3.25	24.04
P4 No packaging (Control)	2.25	5.05	3.3	36.63
CD (P=0.05)	0.02	0.08	0.06	0.16

Table 3.20. Standardization of postharvest package technology for local marketing of rose Cv. Passion at Pune centre 2013-14 (continue...)

Treatment	Final stage of bud open	Vase life (day)	Flower diam. (cm)	Water absorbed/ stem (ml)
Interactions AxP	0.06	0.23	0.18	0.48
A1P1	2.6	5.2	3.6	36.2
A1P2	3.3	4.3	3.2	24.9
A1P3	2.2	4.6	3.4	33.73
A1P4	3.1	3.6	3.5	26.8
A2P1	2.4	6.5	3.7	48.1
A2P2	3.3	4	3.3	23.19
A2P3	2.3	5.5	3.2	39.53
A2P4	3.23	3.5	3.4	25.67
CD (P=0.05)	0.09	0.33	NS	0.68

PAU Ludhiana

The cut stems placed in solution of chlorine (50 ppm) showed better degree of bud opening (3.48) than the control (2.85) and also showed higher vase life (6.54 day) than the control (5.15 days). The stems packed in LDPE and PP also showed slight increase in vase life (Table 3.21). Non significant improvement in flower diameter as well as water absorption/stem was observed with the treatments. Per cent loss of fresh weight was found higher in case of stems kept unwrapped during simulated transit. The studies showed that stems placed in solution of chlorine (50 ppm prepared from bleaching powder) during pre-cooling for 24 h showed significant improvement in degree of bud opening as well as vase life. The stems packed in sleeves of LDPE or PP during simulated transit also showed considerable decrease in loss of per cent fresh weight. The pooled data of the experiment have been presented in.

Table 3.21. Standardization of postharvest package technology for local marketing in rose cv. Passion at Pune centre 2013-14

Polymeric sleeve/Treatment	Final stage of opening			Vase life (day)			Flower diam. (cm)		
	Bleaching powder (50ppm chlorin)	Water (control)	Mean	Bleaching powder (50ppm chlorin)	Water (control)	Mean	Bleaching powder (50ppm chlorin)	Water (control)	Mean
LDPE-100	3.76	2.92	3.34	6.6	5.8	6.2	7.88	6.96	7.42
PP-100	3.88	3.28	3.58	7.6	5.56	6.58	8.28	7.68	7.98
Cellophane	3.28	2.38	2.83	6.1	4.68	5.42	7.6	7.52	7.56
Control (without packing material)	3	2.84	2.92	5.8	4.56	5.18	7.68	7	7.34
Mean	3.48	2.85		6.54	5.15		7.86	7.52	

Table 3.21. Standardization of postharvest package technology for local marketing in rose cv. Passion at Pune centre 2013-14 (continue...)

Polymeric sleeve/Treatment	Total water absorbed/stem (ml)			Decrease in fresh weight after simulated transit (%)		
	Bleach-ing powder (50 ppm chlorin)	Water (control)	Mean	Bleach-ing powder (50 ppm chlorin)	Water (control)	Mean
LDPE-100	50.02	46.82	48.42	0.96	1.04	1
PP-100	46.48	48.58	47.53	0.81	0.93	0.87
Cellophane	49.66	48.82	49.24	1.24	1.32	1.28
Control (without packing material)	49.28	44.56	46.92	5.88	5.75	5.82
Mean	48.86	47.19		2.22	2.26	

Hessaraghatta

Maximum vase life (9.2 day) with larger flower diameter (8.2 cm) and water uptake (25.1 ml) was obtained with cellophane package compared to other packages and control (7.3 days) in cultivar First Red. Cellophane package showed least moisture loss (15.8 %) as compared to control and other packages tried (Table 3.22).

Table 3.22. Effect of pre-treatment and packaging on keeping quality of rose cv. First Red cut flower for local market at Hessaraghatta centre (2013-14)

Packaging treatment	Pretreatment with water					
	Vase life (day)	Flower diam. (cm)	Water absorbed (ml)	Bacterial count (cfu)/ ml vase water at the time the termination of vase life	Cost of preservative, and packing material/stem	Percent weight loss after simulated transit
LDPE 100 gauge	8.1	7.4	18.2	$2x10^4$	32paise	15.4
PP 100 gauge	7.8	7.2	17.4	$2x10^4$	37paise	15.2
Cellophane	8.4	7.6	19	$2x10^4$	42 paise	15
No package	7.3	7.1	16.2	$2x10^3$	10 paise	22
Pretreatment	0.39	0.24	0.64	3.2	0.64	0.98
Packaging	0.6	0.44	0.5	3.62	0.9	1.4
Packaging x pretreatment	0.32	0.2	42	2.44	0.46	1.22

Table 3.22. Effect of pre-treatment and packaging on keeping quality of rose cv. First Red cut flower for local market at Hessaraghatta centre (2013-14) (continue...)

Packaging treatment	Pretreatment with bleaching powder					
	Vase life (day)	Flower diam. (cm)	Water absorbed (ml)	Bacterial count (cfu)/ ml vase water at the time of termination of vase life	Cost of preservative, packaging boxes, packing material/ stem	Per cent weight loss after simulated transit
LDPE 100 gauge	8.4	7.8	**22.4**	$2x10^2$	40paise	14.5
PP 100 gauge	8.2	7.4	**23.2**	$2x10^2$	50paise	15
Cellophane	9.2	8.2	25.1	$2x10^2$	60paise	15.6
No package	7.5	7.2	19.4	$2x10^3$	20paise	19.2
Pretreatment	0.22	0.24	0.66	1.72	0.54	0.9
Packaging	0.72	0.32	0.44	0.94	0.42	0.62
Packaging x pretreatment	0.4	0.18		0.82	0.24	0.38

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