

AICRP on Floriculture, ICAR
Database on Tuberose (*Polianthes tuberosa* Linn.)
(2010-11 to 2013-14)



ICAR- Directorate of Floricultural Research, Pune



**AICRP on Floriculture, ICAR
Database on Tuberose (*Polianthes tuberosa* Linn.)
(2010-11 to 2013-14)**

K. P. Singh

A. K. Tiwari

T. N. Saha



ICAR-Directorate of Floricultural Research
College of Agriculture Campus, Shivajinagar, Pune - 411 005 (Maharashtra)

Citation

Singh, K.P., A.K. Tiwari, and T.N. Saha (2015). AICRP on Floriculture, ICAR. Database on Tuberose (*Polianthes tuberosa* Linn.) (2010-11 to 2013-14). ICAR-DFR Technical Bulletin No. 17. Director, ICAR- Directorate of Floricultural Research, College of Agriculture Campus, Shivajinagar, Pune-411005 (Maharashtra), India

Published by

Director

ICAR- Directorate of Floricultural Research

College of Agriculture Campus, Shivajinagar, Pune-411005

© 2015, ICAR-DFR, Pune

Compiled and Edited by

Dr. K. P. Singh, Director (Acting), Dr. A. K. Tiwari, Senior Scientist (Present address: Dr. A. K. Tiwari, Senior Scientist, ICAR-DSR, Mau (Uttar Pradesh)) and Dr. T. N. Saha, Scientist, ICAR- Directorate of Floricultural Research, College of Agriculture Campus, Shivajinagar, Pune-411005

Acknowledgements

The Directorate acknowledges the contribution of all the scientific/technical/supporting staff of the AICRP (Floriculture) centers for the execution of experiments and compilation of data for the Annual Report. We also acknowledge the help received from all the Scientific and Administrative staff of ICAR-Directorate of Floricultural Research, Pune in successfully bringing out this information.

Published

July, 2015

Designed and Typesetting at

Flamingo Business System, 19, Laxminagar Commercial Complex-I, Shahu College Road, Pune-411009. Tel: 020-24214636, 09049400137

E-mail: srgupta.tej@gmail.com, flamingo.b.s@gmail.com

Content

Foreword	v
1. Introduction	1-3
2. Crop Improvement	4-58
3. Crop Management	59-75
4. Postharvest Technology and Value Addition	76-153
5. Crop Protection	154-169



भा.कृ.अनु.प.-पुष्प विज्ञान अनुसंधान निदेशालय

कृषि महाविद्यालय परिसर, शिवाजीनगर, पुणे - 411 005

ICAR- DIRECTORATE OF FLORICULTURAL RESEARCH

College of Agriculture Campus, Shivajinagar, Pune - 411 005

डॉ. कृष्ण पाल सिंह
निदेशक (कार्यवाहक)

Dr. K. P. Singh
Director (Acting)



Foreward

In India, floriculture is emerging as an important commercial business. The production of flowers is an age-old occupation. Until last three decades, the growing and selling of flowers was confined only to particular group of society/families. They grew variety of flowers on the same lands which were close to their house, as they could not survive a long journey. The situation in the last decade has however changed. Now, large number of farmers are growing different flowers both for domestic market and export purposes. The flower traders were until 1960s confined to domestic markets. A lot of importance has been given to this sector due to its multiple uses, satisfying the aesthetic needs of the people, creating more employment, ensuring higher rate of returns to rural people and facilitating earning more foreign exchange. Commercial floriculture has been of recent origin though the traditional flower cultivation has been going on for centuries. Emphasis has been shifting from traditional flowers to cut flowers for domestic and export purposes. The liberalisation of economy since 1991-92 has given an impetus to the Indian entrepreneurs for establishing export oriented floriculture units under controlled climatic conditions. States like Maharashtra, Karnataka, West Bengal, Tamil Nadu, Andhra Pradesh and Uttar Pradesh have emerged as major floriculture centres in recent times.

The All India Coordinated Research Project (AICRP) on Floriculture established by Indian Council of Agricultural Research (ICAR) since its inception has contributed significantly for the development of floriculture in India. Collection of comprehensive and reliable data is essential to assess the demand and supply for floriculture produces 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 this Directorate recommended for preparation of the recent database on commercial flowers. Precise, up-to-date and robust crop wise data will be helpful for the producers, consumers, traders, importers, exporters, extension workers, researchers and other stakeholders.

I compliment Dr A.K. Tiwari and Dr. T. N. Saha for their sincere efforts in bringing out this valuable publication entitled "AICRP on Floriculture, ICAR, Database on tuberose (*Polianthes tuberosa* Linn.)"

Pune
June, 2015

(K P Singh)

1. Introduction

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, flowering 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. 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.

Tuberose (*Polianthes tuberosa* Linn.) is a perennial bulbous flowering plant. Its common name derives from the Latin *tuberosa*, meaning swollen or tuberous in reference to its root system. *Polianthes* means many flowers in Greek. It is a night-blooming plant native to Mexico. It grows in elongated spikes up to 90 cm long that produce clusters of fragrant waxy white flowers that bloom from the bottom towards the top of the spike. It has long, bright green leaves clustered at the base of the plant and smaller, clasping leaves along the stem.

Scientific classification

Kingdom	:	Plantae
Clade	:	Monocot
Order	:	Asparagales
Family	:	Asparagaceae
Subfamily	:	Agavaceae
Genus	:	<i>Polianthes</i>
Species	:	<i>Tuberosa</i>
Binomial name	:	<i>Polianthes tuberosa</i>

It is commonly known as Rajnigandha. It produces waxy, white and fragrant flowers on long spikes, which are mostly used as cut flowers; for making garlands and extraction of essential oils. Its cultivation is getting popular in North India where it blooms during May-October. This period is devoid of other cut flowers and loose flowers.

1. Climate

Tuberose grows well in sunny situations. In India, commercial cultivation is just confined to warm, humid areas with average temperature ranges from 20-35°C.

2. Soil

Loam and sandy loam soil having pH range from 6.5-7.5 with good aeration and well drained are considered suitable for its cultivation. Field should be well prepared by giving 2-3 deep ploughings and incorporating 25-30 tones/ha of well rotten FYM before planting.

3. Commercial cultivars

Single petalled – Mexican Single, Phule Rajani, Prajwal, Shringar, Hyderabad Single and Arka Nirantra

Double petalled – Hyderabad Double, Pearl Double, Suvasini and Vaibhav.

4. Planting time

March –April (in northern India)

June–July (in Andhra Pradesh, Tamil Nadu, Kerala and Maharashtra)

5. Spacing

30 cm x 30 cm or 40 cm x 40 cm

6. Planting Depth

5-7cm deep

7. Nutritional requirement

Manuring can be done with FYM at 25 t/ha and NPK 200:200:200 kg/ha. Full P and K can be applied during the final preparation of plots, while N can be applied in 3 equal split doses i.e., at the final preparation of plot, 60 and 90 days after planting of bulbs. Foliar spray of ZnSO₄ 0.5% + FeSO₄ 0.2% + Boric acid 0.1% may be applied.

8. Growth regulators

Foliar application of GA₃ at 50 to 100 ppm thrice at 40, 55 and 60 days after planting is beneficial.

9. Irrigation

Tuberose requires sufficient soil moisture for its vegetative growth and flower production. Weekly irrigation is required during April-June whereas during October – March irrigation at the interval of 15 days is sufficient to meet its requirement.

10. Crop duration

It extends up to 2 years. The crop can be maintained for one more year with good management practices.

11. Harvest

For loose flower and concrete extraction: Individual florets are plucked during early morning hours before 8 am daily, when they start to open.

For cut flower: Whole spike is cut leaving 4 to 6 cm basal portion of spike.

12. Plant protection

Insects

Thrips : Spray Dimethoate @ 1.5 ml/lit or Fipronil 5 % SC @ 1.5 ml/ l

Aphids : Spary Dimethoate @ 1.5 ml/lit or Imidacloprid @ 1.5ml/1

Root knot nematode : Apply Carbofuran 3 G 1 g/plant near the root zone and irrigate immediately to control nematode infestation.

Diseases : Basal rot (or) stem rot: Soil drenching with Carbendazim @ 0.2 %

2. Crop Improvement

Project No. 1.1: Genetic enhancement in tuberose.

Technical Programme

1. Germplasm collection of identified cultivars. In case of promising unknown genotype, accession number may be maintained.
2. Passport data of all new germplasm must be prepared by all the centres for all cultivars and should be sent to Project Coordinator/Director. The passport data should include name of species/cultivar, form and colour, source and date, salient features, remarks, name of the person collected the cultivar and photograph.
3. Collection of different cultivars from various indigenous and exotic sources.
4. Evaluation of collected germplasm and selection of promising cultivars.
5. Single and Double types genotype to be evaluated separately.
6. List of recommended cultivars (on the basis of evaluation at respective centres) for commercial cultivation in respective regions should be submitted to the Project Coordinator/Director every year.
7. The concerned scientists are advised to maintain passport data of newly collected cultivars and obtain the IC/EC number from ICAR-NBPGR, New Delhi for records.

The experiment was laid out in RBD with three replications. Thirty six plants were raised per plot of 2x2m at a spacing of 30 x 30 cm. One planting to be done and each crop was observed for 2 years.

Observations were recorded on plant height (cm), no. of leaves per plant, days to spike emergence, days to opening of first floret, flowering duration (day), spike length (cm), rachis length (cm), number of florets per spike, length of floret (cm), diameter of floret (cm), diameter of cut spike (cm), weight of individual floret (g), weight of florets per spike (g), number of spikes per clump, number of spikes per plot / ha, weight of florets per plot / ha, number of bulbs per clump, number of bulblets per column, diameter of bulb (cm), length of bulb (cm), weight of individual bulb (g), diameter of bulblet (cm) and weight of bulblet (g).

Report

Kalyani

Cultivars Calcutta Single had maximum number of shoots per clump. Highest number of spikes per clump, whereas highest spikes yield per unit area were noticed in cultivars Hyderabad Single followed by Hybrid GKTC 4. Monthly variation in spike yield starting from the month of November to March, 2011 to March 2014 is presented in the various Tables. All the 14 genotypes were found to differ significantly with respect to the growth and flowering characters studied.

High heritability, GCV and PCV were noticed for most of the characters indicating scope for improvement of these characters. Low GCV and PCV were observed for length and diameter of florets and number of florets per spike.

Cultivar Calcutta Single recorded highest spike yield which was followed by cvs. Hyderabad Single, Prajwal and Shringar . Cultivars Rajat Rekha and Swarna Rekha recorded very poor yield. Highest number of bulbs per clump was noticed in Hyderabad Double and the lowest in Rajat Rekha. These two cultivars also recorded highest and lowest bulb weight per clump. Individual bulb weight was the maximum in c.v. Prajwal indicating maximum number of good size bubs for planting.

Table 1.1a. Comparative performance of tuberose genotypes at Kalyani centre (2010-11)

Genotype	Plant height (cm)	No. of shoots per clump	Spike length (cm)	Rachis length (cm)	No. of florets per spike	Floret length (cm)	Florets diam. (cm)	Wt.of cut spike (g)	No. of spikes per clump	No. of spikes/ m ²
Calcutta Single	50	19	108.3	33.3	36	6	3.6	51.3	4.2	46.3
Hyderabad Single	52.3	17.3	100	30.3	54.7	6	4.5	67.7	6.3	70.3
Phule Rajani	57	9.3	92.7	36.3	52.7	5.4	5	83.7	3.4	38
Shringar	59	10.3	98.3	44.7	52.7	5.7	4.3	66.3	4.2	47
Sikim Selection	111.7	7.7	142.3	36.7	41.3	5.9	4.4	85.3	4.4	49
Rajat Rekha	26	9.7	0	0	0	0	0	0	0	0
GKTC-4	51.3	14	75.7	26.3	54	5.8	5.2	83.7	5.4	60.3
Swarna Rekha	48.3	9	0	0	0	0	0	0	0	0
Prajwal	74.7	7.3	121	44.7	51.3	6.4	5.3	158.7	5	55.3
Suvasini	76.3	8	120	46	52	6.3	5.3	147.3	4.6	51
Calcutta Double	48.3	9.7	101	27	36.7	4.8	4.8	110.7	4.2	47
Vaibhav	60	10	90	38	51.3	5	5	63.3	4.8	53.3
Hyderabad Double	85.2	13.7	118.3	39.7	47.3	5.5	5.3	111	4.5	50.3
Arka Nirantara	81.7	13.3	120	45.7	53.3	6.5	5.3	131.3	4.8	53.7
Mean	63	11.31	107.3	37.4	48.6	5.78	4.84	96.7	4.66	51.8
CD at 5%	13.7	1.05	2.6	2.5	2.38	0.3	0.12	5.69	0.57	6.3
CV (%)	13.4	5.78	1.5	4.12	3.03	3.26	1.48	3.64	7.52	7.52
GCV (%)	32.6	31.77	16.71	18.8	13.81	8.71	11.01	36.1	14.91	14.91
PCV (%)	35.3	32.29	16.78	19.3	14.14	9.03	11.11	36.2	16.7	16.7
Heritability (%)	85.5	96.8	99.2	95.4	95.4	87.7	98.2	98.9	79.7	79.7

Table 1.1b. Monthly variation in spike yield (no. of spikes per sq m) at Kalyani centre (2010-11)

Genotype	Spike yield per/ sq m (No.)					
	November	December	January	February	March	Total
Calcutta Single	1.7	7.3	8.7	12.3	16.3	46.3
Hyderabad Single	13.7	12	12.7	14.7	17.3	70.3
Phule Rajani	1.7	7.3	8.3	8.3	12.3	38
Shinger	6.3	9.3	9.7	9.7	12	47
Sikim Selection	3	11.3	17.3	11.7	5.7	49
Rajat Rekha	0	0	0	0	0	0
GKTC-4	4.7	9.3	14.3	13	19	60.3
Swarna Rekha	0	0	0	0	0	0
Prajwal	4	16.3	15	11.7	8.3	55.3
Suvasini	7	12	12.7	11	8.3	51
Calcutta Double	3.7	3.7	14.7	13	12	47
Vaibhav	7	12.7	15.7	11.7	6.3	53.3
Hyderabad Double	0	11.7	16.3	13.3	9	50.3
Arka Nirantara	2.3	13.7	12.7	13	12	53.7
Mean	4.58	10.6	13.2	11.94	11.56	51.8
C.D at 5%	3.85	5.22	3.03	2.27	1.76	6.3
CV (%)	51.9	30.6	14.2	11.7	9.39	7.52

Table 1.1c. Comparative performance of tuberose genotypes at Kalyani centre (2012-13)

Genotype	Plant height (cm)	No. of shoots per clump	Spike length (cm)	Rachis length (cm)	No. of florets per spike	Floret length (cm)	Floret diam. (cm)	Wt. of cut spike (g)	No. of spikes/m ²
Shringar	59.5	25	93.4	32	46	5.7	3.9	93	58
Phule Rajani	57	27	91.7	34.8	48	5.7	4.7	93	47.7
Calcutta Double	51.7	26	66.7	28.5	48.7	5.5	4.3	122	47.7
Rajat Rekha	32.7	21	69.7	33	34	5.7	4.3	45.3	33.3
Prajwal	69.7	23	120.8	32.4	48	6.7	4.8	170.7	58.8
Vaibhav	62	26	98.3	41.4	47.7	6.1	4.3	85	53
Suvasini	36.3	13	85	24	45	6	6	116	43.8
Calcutta Single	57	36	71.8	23.7	33.3	6.1	4	70.7	84.7
Swarna Rekha	33.4	16	86.3	44.3	44	4.9	3.5	131	9.1
Sikim Selection	68.3	26	136.4	34	43.3	5.6	4.2	91.7	54.6
Hyderabad Single	51.3	33	91.7	31.7	34.7	5.7	4.1	95	73.2
GKTC-4	47.3	33	94.3	35	50	4.8	3.4	92.3	57.8
Hyderabad Double	57.7	33	117	46.3	45.3	5.1	4.1	125	52.7
Arka Nirantara	52	22	81	26.8	50	6.2	4.3	131.7	52.1
Mean	52.56	15.48	93.2	33.4	44.1	5.7	4.3	104.5	51.9
CD at 5%	2.74	3.06	4.05	2.18	3.1	0.2	0.25	9.08	5.03
CV (%)	3.23	12.2	2.7	4	4.3	2.2	3.6	5.4	6
GCV (%)	22.32	24.42	21.42	20.38	13.05	9.16	14.35	29.37	33.34
PCV (%)	22.55	27.32	21.59	20.78	13.75	9.42	14.79	29.86	33.87
Heritability (%)	97.95	79.94	98.44	96.22	90.01	94.51	94.15	96.76	96.87

Table 1.1d. Comparative performance of tuberose genotypes with respect to bulb production at Kalyani centre (2013-14)

Genotype	Total no. of bulbs	No. of bulbs >7.5 cm	No. of bulbs 5-7.5 cm	No. of bulbs 5-7.5 cm	Total wt. of bulbs (g)	Wt. of bulbs >7.5 cm	Wt. of bulbs 5-7.5 cm	Wt. of bulbs 5-7.5 cm	Wt. of single bulb (g)
Shringar	41.5	13.5	11.5	16.5	235.5	166.9	36.9	31.8	5.7
Phule Rajani	60.9	18.7	11.1	31.1	358.7	274.1	44.4	40.3	5.9
Calcutta Double	37.3	11.1	9.7	16.5	233.3	144.9	39.5	49	6.3
Rajat Rekha	16.1	4.5	5.1	6.5	57.5	23.1	21.1	13.3	3.6
Prajwal	37.1	23.6	6.2	7.3	553.5	485.9	56.1	11.5	15.1
Vaibhav	55	11.9	16.2	26.9	414	322	63.2	28.8	7.5
Suvasini	40.4	12.5	11.3	16.6	256.4	159	47.6	49.7	6.3
Calcutta Single	54.9	18.5	23.1	13.2	427.5	251.3	135.4	40.9	7.8
Swarna Rekha	37.1	12.2	11	13.9	140.5	94.2	34	12.3	3.8
Sikim Selection	54.9	17.5	7.7	29.8	369.8	273	45.2	51.6	6.7
Hyderabad Single	48.9	15.4	8.2	25.3	493.4	366.8	83	43.7	10.1
GKTC-4	57.8	11.7	15.8	30.3	421.9	225.3	121.3	75.3	7.3
Hyderabad Double	105	27	13.7	64.3	583.4	380.2	83.5	119.7	5.6
Arka Nirantara	31.7	12.1	6.6	13	276	205.9	40.2	29.9	8.7
Mean	48.5	15	11.2	22.2	344.4	240.9	60.8	42.7	7.2
CD at 5%	3.5	1.56	1.22	2.26	29.4	25.3	6.73	7.12	0.98
CV (%)	4.4	6.4	6.7	6.3	5.3	6.5	6.8	10.3	8.5
GCV (%)	41.95	37.77	42.72	66.02	44.16	50.82	55.15	66.04	39.57
PCV (%)	42.18	38.31	43.25	66.32	44.48	51.23	55.57	66.84	40.47
Heritability (%)	98.89	97.19	97.6	99.1	98.59	98.39	98.48	97.62	95.6

Table 1.1e. Monthly variation in spike yield (no. of spikes per sq m) at Kalyani centre (2013-14)

Genotype	Spike yield per sq m from Nov, 2011 to March, 2013																
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Shringar	6.3	9.3	9.7	9.7	12	16	18.7	15	13.7	19	13.7	12.7	10.7	8.3	5.7	5	19
Phule Rajani	1.7	7.3	8.3	8.3	12.3	7	10.3	8.7	11	16	11	12.3	11.3	4.7	5.3	5	8.3
Calcutta Double	3.7	3.7	14.7	13	12	21	22.3	20.7	13	11.3	13	6.3	7.3	1.7	0	4	7.7
Rajat Rekha	0	0	0	0	0	6.3	8.7	10.7	9.3	5	9.3	8.3	8.3	1.7	2.7	3	16.7
Prajwal	4	16.3	15	11.7	8.3	19.7	21	19.7	10.7	12	10.7	12.7	11.7	9	6	5.7	20.3
Vaibhav	7	12.7	15.7	11.7	6.3	20.3	18	15	13	12	13	10.3	9.8	3.7	5.3	4.3	18.3
Suvasini	7	12	12.7	11	8.3	12	13.3	15.3	13	10.3	13	7	10.3	3.3	4.7	2.7	12.3
Calcutta Single	3.7	3.7	14.7	13	12	51	50	42	9.7	9	9.7	9	9	3	7.7	6.7	22
Swarna Rekha	0	0	0	0	0	0	0	0	0	6.7	10.7	7.3	7.3	0	0	0	0
Sikim Selection	3	11.3	17.3	11.7	5.7	25	35	28	10.3	8	10.3	8.3	8.6	3.7	5	7.3	22
Hyderabad Single	13.7	12	12.7	14.7	17.3	27	36.3	27.3	10	12.3	10	11	10	9.3	8	9.7	27
GKTC-4	4.7	9.3	14.3	13	19	31	30.7	25	11.3	15.7	11.3	9	9.8	7.3	4	5	31
Hyderabad Double	0	11.7	16.3	13.3	9	41.7	45	38.7	9	12.3	9	9	7	2.7	2.3	2.3	41
Arka Nirantara	2.3	13.7	12.7	13	12	17	14	16.7	12	18	12	7.7	8.7	4.3	3	3.7	23.3
Mean	4.58	10.6	13.2	11.94	11.56	21.1	23.1	20.2	10.4	11	11.2	9.45	8.71	4.48	4.26	4.6	19.2
C.D at 5%	3.85	5.22	3.03	2.27	1.76	4.86	3.93	5.81	3.6	4.6	3.81	2.4	2.9	3.03	2.25	1.7	2.93
CV (%)	51.9	30.6	14.2	11.7	9.39	14.3	10.5	17.8	21.4	23.7	21	16	20.6	41.9	32.7	22.9	9.42

Hessaraghatta

Tuberose cultivar Swarna Rekha performed poorly in respect of flowering. Cultivars Rajat Rekha and Sikkim Selection collected from Lucknow failed to survive. Efforts were made to collect cv. Sikkim Selection from NBRI, Lucknow. Cultivars Hyderabad Single and 'Hyderabad Double' collected from ANGRAU, Hyderabad and Phule Rajani collected from ZARP (PZ) Pune were multiplied. Few bulbs of GK TC-4 were received from Pune Centre. Cultivars Calcutta Single and Calcutta Double were collected from Kalyani, (West Bengal). Cultivars Hyderabad Single and Hyderabad Double were collected from Hyderabad centre. Bulbs of GKTC-4 were received from Pune Centre and planted for multiplication.

Table 1.2. Monthly variation in spike yield (no. of spikes per sq m) at Hesaraghatta centre (2013-14)

Cultivar	Wt. of florets /spike(g)	No. of spikes /plant	No. of spikes /plot	Wt. of florets /plot	No. of bulbs /clump	No. of bulblets/ clump	Diam. of bulb (cm)	Length of bulb (cm)	Wt. of bulb (g)	Diam. of bulblet (cm)	Wt. of bulblets /clump
Phule Rajani	48.3	9.6	289	1.32	24.5	17.5	3.2	4.3	33.2	1.6	164.6
Shringar	38.6	10.5	322	1.05	22.6	15.6	3.1	4	32	1.5	158.4
Prajwal	42.8	6.4	196	0.79	20.4	11.7	4.3	5.2	42.5	2	167.7
Hyderabad Single	34.4	8.5	258	0.82	23.2	15.5	3.2	3.5	23.6	1.3	153.4
Calcutta Single	17.6	11.8	364	0.64	18.7	16.7	2.3	3.4	15.8	1.2	140.2
Arka Nirantara	39.2	9.2	260	0.84	20.7	15.6	3.3	4.3	24.4	1.5	14.62
Local Double	44.3	6.4	160	0.72	17.5	11.4	4.5	4.8	33.3	2.5	142.6
Suvasini	49.7	7.2	189	1.02	21.7	14.3	4.3	5	40.7	2.7	139.8
Vaibhav	46.5	6.8	168	0.8	22.3	11.3	3.9	5.1	39.8	1.8	135.3
Hyderabad Double	52.2	6	139	0.79	11.5	10.6	4.1	5	44.7	2.4	137.8
Variegated	21.4	8.4	262	0.56	24	15.7	2.4	3.3	17.6	1.3	135.3

Pune (Ganeshkhind)

Amongst Single type cv. Phule Rajani found early and produced more number of florets per spike and bulbs per plant. Among the Double type cultivars, Vaibhav found early in flowering and recorded more bulbs per plant. The highest number of florets per spike and maximum number of bulbs per plant were recorded in cultivar Phule Rajani. However, minimum florets per spike was recorded in cultivar Variegated and minimum bulbs per plant was recorded by Local Double.

Table 1.3a. Performance of different hybrids of tuberose at Pune centre

Character	GK-T-C-1	GK-T-C-2	GK-T-C-4	GK-T-C-7	GK-T-E-2
Days to flowering	128	120	112	132	110
Plant height(cm)	110.8	76.8	83.7	90.4	48.7
Spike length (cm)	97.6	72.4	78.2	83.7	44.3
Rachis length (cm)	32.2	23.4	32.4	26.2	24.5
No. of florets/spike	38	36.2	40	36	28
Spike weight(g)	105.6	82.6	98.7	102.4	58.2
No. of spikes/plant	8.7	9	9.8	7.4	8.2
No. of leaves /plant	46	38	4.2	40	44
Days to spike emergence	88.5	92.6	89.7	92.4	85.5
Flowering duration (day)	222	218	224	218	215
Length of floret (cm)	4.5	4.2	5.2	4.7	4.3
Diam. of florate (cm)	3.2	3.3	4.2	3.3	4.2
Diam. of cut spike (cm)	0.8	0.7	0.7	1.2	0.6
Wt. of individual floret (g)	1.6	1.5	1.7	1.2	1.3
Wt. of florets/spike(g)	45.8	38.9	48.5	38.6	30.4
No. of spikes/plot	250	198	253	148	234
Wt. of florets/ plot (kg)	11.4	7.7	12.2	5.71	7.11
No. of bulbs/ clump	26	24	28	20	24
No. of bulblets/ clump	18	17	16	10	18
Diam. of bulb (cm)	3.3	2.8	3.2	3.3	2.4
Length of bulb (cm)	3.4	3.8	3.7	3.5	3.3
Wt. of bulblets per clump (g)	162.8	110.5	160	134.7	158.8
Diam. of bulblets (cm)	1.3	1.3	2.5	1.6	1.3

Table 1.3b. Preliminary assessment of of tuberose hybrids at Pune centre

Observations /Crosses	Variegated (Single) X Vaibhav (Double)								
	L3P1	L4P9	L3P2	L4P5	L4P6	L4P7	L5P1	L5P5	L5P7
Days to spike emergence	50	48	48	52	53	55	48	42	41
Flowering duration (day)	129	132	126	128	130	133	127	124	126
Days to flowering	78	75	80	80	75	80	76	74	74
Plant height (cm)	138.5	103.5	166.2	160	75	86.7	116.7	116.5	128
Spike length (cm)	135.3	93.7	159.5	148	69	78.5	110.4	107.6	121
Rachis length (cm)	90.4	28.4	52.3	52	31	40.2	43.5	39.7	59.2
No. of florets/ spike	49	32	32	29	25	24	30	26	44
No. of spikes/plant	4	4	3	3	5	5	4	3.5	4
No of leaves/plant	46	44	42	40	39	34	46	45	42
No of whorls / florets	3	3.5	3	3	5	4	4	4	5
No of petals/ florets	16	17	13	12	23	20	19	20	22
Colour tinch on flower bud	Greenish White	Pinkish	Pinkish	pinkish	Greenish	Pinkish	Pinkish	Pinkish	Greenish
Floret length (cm)	5.8	6.1	6.1	5.8	8.2	6.7	6	7.1	7.6
Floret diam. (cm)	4.1	4.3	3.2	4.2	2.9	4.7	3.5	4.2	5.3
Diam. of cut spike (cm)	1.4	1.3	1.5	1.3	1.4	1.5	1.3	1.4	1.3
Floret wt. (g)	3.01	3.17	3.3	3.05	5.17	4.5	3.5	3.2	5.2
No. of bulbs/clump	5	5	4	4	6	5	5	5	6
No. of bulblets/clump	12	10	14	13	10	11	11	12	10
Diam. of bulb cm)	2.5	2.7	2.6	2.8	2.7	2.6	2.7	2.6	2.5
Length of bulb (cm)	4.3	4.5	4.7	3.9	4	4.4	4.6	4.3	4.5
Diam. of bulblet (cm)	1.6	1.7	1.5	1.7	1.8	1.6	1.5	1.6	1.7
Weight of bulblet (g)	19.2	17.4	21	22.1	18.2	17.6	16.5	19.2	17.3
Wt. of bulbs/plant(g)	280	250	300	270	300	170	254	278	282
Node at 1st flower emergence	7th	8th	14th	8th	7th	7th	8th	10th	9th
Flower type	Double	Double	Double	Double	Double	Double	Double	Double	Double

Table 1.3b. Preliminary assessment of tuberose hybrids at Pune centre

Observations /Crosses	Variegated X Phule Rajani				Vaibhav X Phule Rajani					Phule Rajani X Suvasini
	L9P7	L1P4	L9P2	Mean	L1P2	L2P4	L1P1	L2P2	Mean	
Days to spike emergence	51	42	44	45.67	68	63	47	58	59	56
Flowering duration (day)	128	124	126	126	132	130	132	128	130.5	133
Days to flowering	71	70	75	72	82	78	77	73	77.5	64
Plant height (cm)	56.5	123.5	127.6	102.53	80.7	82.4	85.6	68.4	79.28	60.7
Spike length (cm)	52.7	110.4	115.7	92.93	74.4	71.6	75.2	60.7	70.48	55.8
Rachis length (cm)	18.7	30.2	34.6	27.83	54.3	26.5	41.7	28.5	37.75	36.3
No. of florets/ spike	24	36	38	32.67	38	30	38	24	32.5	30
No. of spikes/clump	8	7	7	7.33	4	5	4	4	4.25	5
No of leaves/clump	42	46	38	42	43	46	44	37	42.5	47
No of whorls / floret	Single	Single	Single	--	3	4	4	4	3.75	Single
No of petals/ florets	5	6	5	5.33	16	18	16	18	17	5
Colour tinch on flower bud	Dark Pink	Greenish	Pinkish	---	White	White	Greenish	Greenish	----	White
Floret length (cm)	5.2	4.8	4.7	4.9	7.2	5.4	6.8	6.7	6.53	5.3
Floret diam. (cm)	3.7	3.3	3.4	3.47	5.3	5.2	4.3	4.2	4.75	3.7
Diam. of cut spike (cm)	1.4	1.5	1.3	1.4	1.3	1.2	1.4	1.3	1.4	1.5
Floret wt. (g)	1.1	1.2	1.1	1.13	3.4	5	4.8	7	5.05	1.3
No. of bulbs/clump	9	7	8	8	5	6	5	5	5.25	6
No. of bulblets/plant	14	12	14	13.33	11	12	13	11	11.75	13
Diam. of bulb (cm)	2.6	2.7	2.5	2.6	3.4	3.5	3.6	3.4	3.48	3.7
Length of bulb (cm)	4.2	4	3.8	4	4.4	4.2	4.3	3.8	4.18	4
Diam. of bulblet (cm)	1.7	1.8	1.5	1.6	1.7	1.5	1.6	1.7	1.6	1.9
Wt. of bulblet (g)	23.8	21.1	21	21.9	18.7	18	20.8	19	19.1	24.7
Wt. of bulbs/clump (g)	178.5	267.6	283	243.03	287	294	286	278	286.25	26.7
Node at 1st flower emergence	-	-	-	-	5th	8th	12th	6th	-	-
Flower type	Single	Single	Single	----	Double	Double	Double	Double	---	Single

Pantnagar

Tuberose cv. Mexican Single took minimum days to spike emergence whereas cv. Prajwal took maximum days . Cultivar Sikkim Selection produced the longest spike length whereas, the shortest spike length was produced by GKTC-4. Cultivar Single produced maximum number of florets which was statistically *at par* with cv. Suvasini whereas, it was least in GKTC-4.

Table 1.4. Performance of tuberose genotype under Pantnagar conditions

Genotype/ Parameter	No. of leaves/ clump	Plant height (cm)	Days to spike emergence	Rachis length (cm)	No. of unopened florets	No. of opened florets	Total no. of florets/ spike	Floret diam. (cm)	Spike length (cm)
Single	26.44	34.69	108	27.66	23.33	21.33	44.66	3.5	76
Vaibhav	25.22	29.11	120	41.33	20	17.33	37.33	3.43	65.89
Sikkim Selection	18.25	32	103.66	23.33	9.66	20	29.66	3.5	97
Hyderaba d Double	25	29.94	120	26.66	10.66	22.66	32.66	3.3	69.55
Double	21.41	29.38	120	25.66	9.33	20	29.33	3.5	66.55
Swarna Rekha	20	29.16	110	29.33	12.67	16.66	29.33	3.46	79.89
Hyderaba d Single	21.86	29.5	120	29	8.67	19.33	28	3.33	58.55
Mexican Single	18.3	30.27	90	24.33	10.67	17.33	28	3.6	84.66
Pearl	23.08	29.33	105	26.66	9.67	28.66	38.33	3.43	74.33
GKTC-4	16.97	26	104	13.33	10.67	8.66	19.33	3.86	51.66
Kalyani Single	16.86	27.86	106	17	10.66	12	22.66	3.5	76
Shringar	21.41	27.94	105	20.66	9.67	18.66	28.33	3.16	70.55
Prajwal	16.58	32.38	180	24	11	18	29	3.43	69.22
Suvasini	92.83	66.65	115.83	42.55	8.33	34.33	42.66	4.09	73.66
CD at 5%	6.3	2.3	0.53	3.9	1.66	5.34	4.78	0.14	5.49

Table 1.4. Performance of tuberose genotypes under Pantnagar conditions (continue..)

Genotype	No. of leaves at 60 days	Plant height at 60 days	Days to spike emergence	No. of leaves at 90 days	Plant height at 90 days	No. of leaves at 120 days	Plant height at 120 days
Single	96.1	28.9	108	105.9	33.1	112.2	37.4
Vaibhav	71.9	19.8	120	84.5	32.9	96	37
Sikkim Selection	68.3	21	103.7	80.1	34.2	89.5	38.8
Hyderabad Double	80.9	21.7	120	93.9	30.7	104.5	35.5
Calcutta Double	82.7	21.6	120	94.8	28.4	111	33.2
Swarna Rekha	68.1	22.7	110	81.8	29.4	90.6	34.2
Hyderabad Single	67.9	17.8	120	79.5	30.3	91.1	35.1
Mexican Single	50.3	24.7	90	65.5	32.8	72.2	37
Pearl Double	46.6	27.5	105	56.4	32.8	69.9	34.8
GKTC-4	55.1	21.2	104	66.5	31	79.1	35.7
Kalyani Single	48.6	18.4	106	59	26.9	72.4	31.8
Shringar	52.2	19	105	64	30	78.5	34.4
Prajwal	51.3	20.4	180	64	31	77..30	35.6
CD at 5%	18.49	2.67	0.536	18.69	2.5	17.66	2.59

Table 1.4b. Performance of tuberose genotypes under Pantnagar conditions (continue..)

Genotype	Spike length (cm)	Rachis length (cm)	No. of florets/spike	No. of opened florets	No. of unopened florets	Floret diam. (cm)	Floret weight (g)	Floret length (cm)	Total spike/year/ plant (no.)
Single	69.3	21	18.3	11.5	6.8	1.94	0.534	5.24	2.1
Vaibhav	38.2	17.6	16.6	8.4	8.4	1.86	0.747	3.15	1.3
Sikkim Selection	69.1	16.4	18.4	14.1	4.3	2.04	0.383	3.63	1.2
Hyderabad Double	41.6	15.9	15.5	6.1	9.4	1.94	0.642	3.28	1.2
Calcutta Double	47.3	18.5	21.2	13.3	7.9	2.16	0.877	3.38	1.3
Swarna Rekha	51.9	28.5	21.2	9.3	11.8	2.44	0.715	2.81	1.3
Hyderabad Single	43.9	13.7	16.7	13	3.7	2.07	0.456	3.43	1.5
Mexican Single	88.6	28	30.6	17.9	13.1	3.02	0.647	5.17	1.7
Pearl	57.2	25.8	24.6	15.6	9.2	2.2	0.9	3.63	1.5
GKTC-4	69.1	27.8	24.9	20.4	3.9	3.2	0.61	5.22	1.5
Kalyani Single	58	22.9	31.1	28.8	2.4	3.15	0.652	5.31	1.7
Shringar	46.6	14.9	20.5	13.4	6.9	2.35	0.514	1.03	1.1
Prajwal	82.6	27	33.5	24	9.5	3.08	1.014	5.61	1.7
CD at 5%	26.56	10.84	9.9	6.06	4.72	1.09	0.37	1.78	0.22

Among the Single petalled cultivars, Prajwal showed superiority with respect to bulb weight, number of leaves per plant, earliness in spike emergence, flowering duration, rachis length, number of florets/ spike, length of floret, weight of florets per spike, number of spikes/ m², yield of florets/ plot. The genotype Variegated Single excelled others in plant height and spike length.

Among the Double petalled, cv. Suvasini showed its superiority with respect to number of leaves per plant, earliness in spike emergence, flowering duration, spike length, number of florets/ spike, length of floret , weight of florets per spike, number of spikes/ m² and yield of florets/ plot of 2x2 m . In case of rachis length and bulb weight cv. Vaibhav showed its superiority over others.

Table 1.5. Evaluation of tuberose genotypes for morphological, flowering and yield parameters at Pantnagar centre

Genotype	Bulb weight at planting (g)	Plant height (cm)	No. of leaves per clump	Days to spike emergence	Flowering duration (day)	Spike length (cm)	Rachis length (cm)	No. of florets/ spike	Length of floret (cm)	Wt. of florets per spike (g)	No. of spikes/ m ²	Yield of florets/ plot (2x2 m)
Calcutta Single	10.08	78.89	245	83	8.26	63.89	16.75	25	6.3	29.25	31	2.53
Hyderabad Single	11.71	80.96	220	82	6.37	65.96	15.3	28	6.2	32.76	34.5	2.72
Kahikuchi Single	5.64	77.3	253	83	9.12	62.3	18.38	38	6.3	44.46	33	4.01
Mexican Single	18.05	91.77	238	89	7.67	76.77	21.27	24	6.2	28.32	32.2	2.51
Navsari Local	7.37	92.85	242	83	8.98	77.85	27.3	29	6.3	33.93	25.75	2.79
Phule Rajani	14.28	72.5	251	83	8.9	52.5	23.48	40	6.3	47.2	35	4.06
Prajwal	28.07	113.05	260	78	10.17	98.05	28.52	44	6.4	74.8	47	4.4
Pune Single	15.38	110.07	232	82	9.28	95.07	35.75	37	6.1	43.66	39	3.9
Shringar	7.39	91.77	245	83	8.49	76.77	22.32	42	6.3	51.48	40	4.26
Variegated Single	18	117.5	253	81	7.12	102.5	20.86	34	6.2	39.78	33.65	3.78
SE(D)	1.2	1.4	0.63	1.8	1.82	1.09	0.61	1.01	0.11	1.98	0.78	0.14
CD (5%)	2.34	4.12	1.85	2.48	2.43	3.21	1.82	3.03	0.32	3.25	2.32	0.41
Calcutta Double	13.36	73.92	246	88	10.48	58.92	38.75	35	7.1	112.36	32	2.57
Hyderabad Double	7.04	68.87	235	89	9.12	53.87	33.95	34	6.7	108.56	21.01	2.48
Pearl Double	12.32	69.7	238	86	10.39	54.7	42.67	30	7.4	109.32	31.5	2.42
Suvasini	14.1	86.25	270	84	12.4	71.25	44	54	7.5	146.88	34.1	3.42
Vaibhav	25.38	81.38	250	85	11.43	66.38	54	44	7.2	119.24	33.75	2.96
CD (P=0.05)	2.45	3.11	2.67	2.56	2.57	2.8	2.8	2.48	0.34	1.65	2.69	0.31

Udaipur

In tuberose, 13 cultivars were evaluated for growth and flowering attributes. Among them Single petalled cv. Prajwal was found better for maximum duration of flowering, spike length , number of florets per spike, number of bulbs, vase life in plain water , spikes per plant and number of florets remain open at a time followed by cv. Phule Rajani. Among Double petalled types cv. Suvasini was found to be better for maximum duration of flowering, spike length, total number of florets per spike and vase life in plain water.

Table 1.6. Enrichment of tuberose germplasm at Udaipur centre

Genotype	Days taken to first flowering	Flowering duration (day)	Plant height (cm)	Spike length (cm)	Spike weight (g)	No. of florets/ spike	Size of floret (cm ²)	No. of bulbs /clump	Wt. of bulbs/ plant (g)
Calcutta-Double	102	26	78.33	63.67	77.4	38.33	3.03	28.67	403.62
Calcutta-Single	101.67	26	78	64.27	52.33	29.67	3.47	28	450
Hyderabad-Double	125.33	24.33	75.67	63.53	77	39.67	3.43	35	682
Hyderabad-Single	113.67	24	71.67	58.5	74.2	38	3.9	30.67	670.67
Phule-Rajani	121	26.33	79.33	66.73	78.67	41.33	4.33	40.33	689
Prajwal	130.33	28.67	88.67	77.07	95.83	45.67	4.4	45.33	722
Pune Local Double	129	24	77.33	65.77	65.33	31	4	38.33	576.67
Pune Local Single	117	22.67	75	57.6	44.83	29.33	3.4	37.33	582
Sawarn Rekha	120	23.33	56	41.63	35	24.33	3.07	22.33	458.33
Shringar	112	24.33	70.67	52.8	71.83	37.33	4.03	23	674
Sikkim Selection	119	25.67	73.33	61.9	56.33	26	3.2	40	549.67
Suvasini	130.33	35	83.33	71.53	88.67	43	4.27	42.33	735.33
Vaibhav	127	28.67	83.33	71.5	87.2	41.33	4	42	708
C.D. (P=0.05)	7.28	5.95	7.73	7.04	9.49	5.29	0.45	6.24	165.30

Ludhiana

Single petalled tuberose: Seven cultivars of Single petalled tuberose namely, Phule Rajni, Local Single, Pune Local Single, Calcutta Single, Hyderabad Single, Shringar, Prajwal, Mexican Single and Sikkim Selection were evaluated. All the genotypes differed significantly with most of the growth and flowering parameters. Cultivar Prajwal exhibited maximum plant height, duration of flowering, spike length and produced maximum number of spikes per plant. This cultivar was also early in flowering and more vase life. Cultivar Prajwal is also good multiplier as it produced significantly more bulbs and bulbets.

Double petalled tuberose: Five Double betalled cultivars *viz.*, Pearl Double, Suvasini, Pune Local Double, Hyderabad Double and Vaibhav were evaluated. Maximum number of spikes per plant and number of florets per spike were maximum in cvs. Vaibhav and Pune Local Double, respectively. However, weight of cut spikes was recorded maximum in Pearl Double. Cultivar Pune Local Double was found to be early flowering and had longest spike.

Table 1.7a. Genetic enhancement of tuberose (Single betalled) at Ludhiana centre

Cultivar	Plant height (cm)	No. of leaves/clump	Days to flowering (day)	Duration of flowering (day)	Spike length (cm)	Wt. of spike (g)	No. of spikes/plant	Floret diam. (cm)	No. of florets/spike	Flower arrangement on spike	Vase life (day)
Phule Rajni	78.9	24.2	116.44	53.61	6.52	100.45	4.39	0.44	32	Compact	5.77
Local Single	98.85	25.36	104.55	64.9	79.5	109.74	5.65	0.42	35.66	Compact	6.78
Pune Local Single	63.2	23.2	130.33	63.69	55.88	96.74	4.22	0.43	36	Loose	5.44
Calcutta Single	88.89	20.81	127.88	58.85	73.44	98.96	3.14	0.43	36.11	Loose	6.11
Hyderabad Single	76.21	24.18	78.11	55.72	58.91	112.68	3.41	0.44	38.55	Compact	7.11
Shringar	78.91	27.03	111.89	64.59	58.89	98.52	4.25	0.42	34.44	Compact	7.11
Prajwal	105.08	39.14	93.77	103.12	89.66	125.97	6.57	0.48	58.22	Compact	7.78
CD (0.05)	0.38	0.54	NS	0.15	0.26	0.16	0.17	0.84	NS		0.21

Table 1.7a. Genetic enhancement of tuberose (Single petalled) at Ludhiana centre continue...

Cultivar	Floret length (cm)	Peak flowering	Spike diam. (cm)	Seed setting	Bulb			Bulblet			Yield		
					Length (cm)	Diam. (mm)	Weight (g)	Length (cm)	Diam. (mm)	Weight (g)	Bulb		Bulblet
											Per clump	Per meter sq.	Per clump
Phule Rajni	0.35	Aug-Sep	0.66	No	4.47	2.04	38.16	2.56	1.1	60.93	3.5	47.33	19.66
Local Single	0.3	July-Sep	0.67	No	4.55	2.08	35.16	3.07	1.19	65.65	2.67	50.9	16.33
Pune Local Single	0.35	Aug-Sep	0.63	No	4.54	2.55	19.49	2.81	1.35	24.81	2.67	44	11.67
Mexican Single	0.37	Aug-Sep	0.6	No	4.83	2.36	33.16	2.81	1.2	78.35	1.67	20.5	16.33
Hyderabad Single	0.34	Aug-Sep	0.64	No	4.35	2.34	29.49	2.64	1.02	64.29	1.67	16.9	17.66
Shringar	0.34	Aug-Sep	0.61	No	4.71	2.46	48.84	2.74	0.92	55.85	1.67	13.8	13.66
Prajwal	0.37	July-Oct	0.73	No	6.02	4.33	87.06	3.85	1.25	132.22	4.67	60.77	29.5
CD (0.05)	0.11		0.63	No	0.2	0.11	0.79	0.23	NS	7.49	NS	4.56	NS

Table 1.7b. Genetic enhancement of tuberose (Double petalled) at Ludhiana centre

Cultivar	Plant height (cm)	No. of leaves/clump	Days to flowering	Flowering duration (day)	Spike length (cm)	Wt. of spike (g)	No. of spikes/plant	Floret diam. (cm)	No. of florets/spike	Flower arrangement on spike	Vase life (day)
Pearl Double	86.55	53.7	99.88	61.78	70.87	98.77	1.48	3.77	28.77	Compact	5.11
Suvasini	92.86	57.09	102.55	59.09	77.53	102.35	1.34	3.7	35.11	Loose	4.44
Pune Double	103.97	58.39	96.21	54.8	87.54	100.76	1.24	3.72	41.11	Compact	3.78
Hyderabad Double	91.55	52.65	99.55	62	76.33	105.73	2.07	3.53	32.11	Loose	5.44
Vaibhav	91.08	62.79	101.55	61.8	75.91	112.51	2.57	3.61	30.77	Compact	6.11
CD (P=0.05)	1.14	1.45	2.98	1.23	1.18	1.88	0.24	0.18	1.22	–	1.31

Table 1.7b. Genetic enhancement of tuberose (Double petalled) at Ludhiana centre continue...

Cultivar	Floret length (cm)	Peak flowering	Spike diam. (cm)	Seed setting	Bulb			Bulblet			Yield		
					Length (cm)	Diam. (mm)	Weight (g)	Length (cm)	Diam. (mm)	Weight (g)	Bulb		Bulblet
											Per clump	Per meter sq.	Per clump
Pearl double	2.92	Aug-Sep	0.65	No	5.81	3.28	69.96	3.69	1.2	12.26	2.33	21.32	34.93
Suvasini	3	July-Sep	0.67	Yes, low	4.79	2.17	33.62	3.25	1.03	114.9	3.44	42.33	30.54
Pune Double	3.13	Aug-Sep	0.65	No.	5.99	3.46	59.46	3.52	1.1	138.25	2.21	31.32	33.21
Hyderabad Double	3.09	Aug-Sep	0.72	No.	5.35	2.76	60.42	3.58	1.1	146.84	2.44	21.28	33.89
Vaibhav	2.99	Aug-Sep	0.65	No.	4.93	2.04	34.72	3.1	0.86	61.9	4.34	45.91	29.04
CD (P=0.05)	0.14	Aug-Sep	0.56		2.99	2.54	2.89	1.45	0.66	1.3	0.29	1.86	1.86

Hyderabad

During three years, 9 Single petalled genotypes and 4 Double petalled genotypes were evaluated. Among the Singles, Gk-T-C-4, a hybrid selection from Pune, recorded more number of florets/spike followed by cv. Arka Nirantara and Hyderabad Single. The floret size was maximum in cv. Prajwal with maximum floret length and diameter and correspondingly it recorded maximum yield followed by GK-T-C-4 and Hyderabad Single. Among Doubles, cv. Suvasini recorded maximum spike length, rachis length, more number of florets/spike and more yield, followed by cvs. Vaibhav and Hyderabad Double.

Among Singles petalled, GK-T-C-4, Arka Nirantara and Prajwal were found to be superior and among Doubles petalled, Suvasini and Hyderabad Double were found to be good.

Table 1.8. Performance of tuberose germplasm at Hyderabad centre

Genotype	Plant height(cm)	No. of leaves/ clump	Spike length(cm)	Rachis length(cm)	Floret length(cm)	Diam. of floret(cm)	No. of florets/ spike
Prajwal	47.35	25.67	83.72	25.73	6.36	4.68	37.93
Hyderabad Single	40.53	27.87	66.7	24.2	4.76	3.56	43.97
Calcutta single	42.31	24.2	77.53	14.63	5.87	3.24	33.4
Shringar	38.37	26.07	58.51	22	4.91	3.23	38.57
GK-T-C-4	37.97	28.27	85.37	32.58	5.53	4.21	52
Phule Rajani	38.7	26.2	79.36	36.07	5.42	4.45	42.1
Arka Nirantara	52.23	28.27	85.7	25.58	6.17	4.39	44.93
Rajath Rekha	50.47	26.33	96.5	19.39	6.36	4.34	37.87
Sikkim Selection	40.57	23.67	93.33	22.65	5.44	3.51	30.93
CD (P=0.05)	1.32	0.07	0.23	0.25	0.11	0.14	1.23
DOUBLE							Yield of spikes/m²
Hyderabad Double	30.42	32.6	89.72	33.14	6.18	4.96	37
Vaibhav	36.72	32.8	90.52	32.8	6.34	3.98	36.4

Project No.1.2: Breeding of tuberose for higher flower, concrete yield and resistance to nematode.

Technical Programme

1. Hybridization as well as mutation breeding to be followed with a specific objective.
2. The details of parents used, crosses made, mutation treatments given, seed collection, performance of the hybrid/ treated progeny, the stage of breeding material at the centre should be reported every year.
3. Proposal for testing of promising hybrids at other coordinated centres should be submitted before annual group meeting to the Project Coordinator/Director DFR.

Report

Kalyani

Out of 14 cultivars very sparse seed setting was noticed in Sikkim Selection, Arka Nirantara, GKTC-4, Hyderabad Single, Phule Rajani, Calcutta Single and Shringar during the winter. In rest of the cultivars no fruit setting was observed. Few seedlings from these crosses were recovered and planted in the field. Seven F₁s were recovered from the last year hybridization programmes. Out of these six F₁s recorded flowering.

Table 1.9a. Cross combinations developed at Kalyani Centre (2011-12)

Name of the Crosses	No. of fruits	No. of seeds	No. of seeds germinated
Calcutta Single x Hyderabad Single	6	80	23
Calcutta Single x Arka Nirantara	5	60	16
Calcutta Single x GK-T-4	4	42	18
Calcutta Single x Phule Rajani	3	36	1
Arka Nirantara x GK-T-4	4	45	18
Prajwal x Arka Nirantara	3	46	6
Phule Rajani x Arka Nirantara	5	62	8

Table 1.9b. Performance of newly developed F₁s at Kalyani centre

Hybrid	Plant height (cm)	Spike length (cm)	Rachis length (cm)	No. of florets/spike	Spike diam. (cm)	Floret length (cm)
BR-11-1	45	77	30.5	48	4.2	6
BR-11-2	55	78	23	44	4	6.4
BR-11-3	43	78.3	29	56	3.1	5.8
BR-11-4	55	136	52	44	3.8	5.6
BR-11-5	50.1	100	36.1	38	2.8	5.9
BR-11-6	51	129.5	49.3	42	4	5.6
BR-11-7	53	0	0	0	0	0

Pune (Ganeshkhind)

Amongst the 11 flowering progenies of cross between Variegated x Vaibhav, seven progenies were observed of Double betalled and four of Single petalled and the stalk length, rachis length and florets per stalk. Out of four flowering progenies of cross between Variegated x Hyderabad Double, two Double petalled and two Single petalled were found and their stalk length, rachis length and florets per stalk. While, in cross between Variegated x Phule Rajani and Phule Rajani x Suvasini in flowering progenies were found to be Single type. The genotype GK – T- C – 4 recorded more florets per spike, spike weight, no. of spikes per plant, no. of bulbs per clump and early flowering. While, genotype GK – T- C – 1 recorded more rachis length and stalk length.

Table 1.10a. Performance of tuberose hybrids with respect to growth and flower parameters at Pune (Ganeshkhind) centre (2011-12)

Parameter	GK-T-A-2	GK-T-C-1	GK-T-C-2	GK-T-C-4	GK-T-C-7	GK-T-E-2
Days to flowering	116	124	118	106	128	108
Plant height(cm)	86.7	107.6	64.5	74.8	84.5	50.7
Spike length (cm)	74.5	94.5	60.3	62.2	74.5	46.8
Rachis length (cm)	28.4	30.5	22.3	30.3	24.4	24.7
No. of florets/spike	28	36	34	38.6	34	28
Spike weight(g)	80.2	98.3	74.6	100.4	82.7	57.6
No. of spikes/plant	8.8	9.6	8.9	10.4	6.2	9
No. of leaves /clump	42.2	44	36.5	43.6	38.6	40.2
Days to spike emergence(day)	90.6	86.5	90.6	86	90.5	80.5
Flowering duration (day)	216.4	220	212	220	212.6	210.6
Length of floret (cm)	4.8	4.6	4	5.8	4.6	4.2
Diam. of floret (cm)	3.8	3	3.2	4	3.2	4
Diam. of cut spike (cm)	1.2	0.7	0.6	0.8	1.3	0.5
Wt. of individual floret (g)	1.5	1.8	1.6	1.7	1	1
Wt. of florets/spike(g)	30.4	46.4	37.8	46.6	36.5	28.5
No of spikes/plot	194	248	195	250	143	230
Wt. of florets/ plot	0.75	1.25	0.85	1.3	0.6	0.63
No. of bulbs/ clump	7.2	10	9.8	10.8	5.6	7.7
No. of bulblets/ clump	14.6	20	16.7	15.5	13.7	17.5
Diam. of bulb (cm)	2.8	3.2	2.6	3	3	2
Length of bulb (cm)	2	3.3	3.8	3.6	3.6	3.2
Wt. of bulblets	140.6	160.6	108	156.7	130.74	160.5
Diam. of bulblet (cm)	1	1.2	1.2	2.4	1.4	1.2

Table 1.10b. Preliminary assessment of tuberose hybrids with respect to growth and flowering parameters at Pune (Ganeshkhind) centre (2011-12)

Crosses	No. of progeny planted	No. of genotypes in flowering	No. of selected genotypes	Sl. No.	Plant height (cm)	Stalk length (cm)	Rachis length (cm)	No. of florets /stalk	Remarks
Vaibhav(D) X Phule Rajani(S)	9	7	3	1	79.6	76.5	40.2	34	Double
				2	71.7	68.4	42.5	32	Double
				3	71.6	66.5	40.2	32	Double
				4	75.2	69.8	40.6	20	Single
				5	70.8	66.3	38.4	20	Single
				6	73.7	70.2	37.4	22	Single
				7	70.6	67.4	40.4	22	Single
Variegated(S) X Vaibhav(D)	27	11	8	1	140.5	136.7	96	58	Double
				2	67.6	60.4	27.5	40	Double
				3	116.4	105.7	45.6	40	Double
				4	85.6	78.2	61.4	58	Double
				5	99	93.7	40.3	27	Double
				6	108.2	88.6	58.2	42	Single
				7	109.4	95.6	64.2	52	Double
				8	115.7	97.6	50.8	50	Double
				9	87.3	82.4	39.5	32	Single
				10	94	87.6	40.3	27	Single
				11	98.5	89.2	42.6	34	Single
Variegated(S) X Hyderabad Double (D)	16	4	1	1	69	91.7	22.4	38	Double
				2	104.5	94.1	24.5	34	Double
				3	94	87.6	22.8	32	Single
				4	92.2	84.7	20.3	29	Single

S = Single betalled, D = Double betalled

Table 1.10c. Performance of tuberose hybrids with respect to growth and flower parameters at Pune (Ganeshkhind) centre (2012 -13)

Parameter	GK-T-C-1	GK-T-C-2	GK-T-C-4	GK-T-C-7	GK-T-E-2
Days to flowering	128	120	112	132	110
Plant height(cm)	110.8	76.8	83.7	90.4	48.7
Spike length (cm)	97.6	72.4	78.2	83.7	44.3
Rachis length (cm)	32.2	23.4	32.4	26.2	24.5
No. of florets/spike	38	36.2	40	36	28
Spike wt. (g)	105.6	82.6	98.7	102.4	58.2
No. of spikes/plant	8.7	9	9.8	7.4	8.2
No. of leaves /clump	46	38	4.2	40	44
Days to spike emergence(day)	88.5	92.6	89.7	92.4	85.5
Flowering duration (day)	222	218	224	218	215
Length of floret (cm)	4.5	4.2	5.2	4.7	4.3
Diam. of florata (cm)	3.2	3.3	4.2	3.3	4.2
Diam. of cut spike (cm)	0.8	0.7	0.7	1.2	0.6
Wt. of individual floret (g)	1.6	1.5	1.7	1.2	1.3
Wt. of florets/spike(g)	45.8	38.9	48.5	38.6	30.4
No. of spikes/plot	250	198	253	148	234
Wt. of florets/ plot (kg)	11.4	7.7	12.2	5.71	7.11
No. of bulbs/ clump	26	24	28	20	24
No. of bulblets/ clump	18	17	16	10	18
Diam. of bulb (cm)	3.3	2.8	3.2	3.3	2.4
Length of bulb (cm)	3.4	3.8	3.7	3.5	3.3
Wt. of bulblets/ clump (g)	162.8	110.5	160	134.7	158.8
Diam. of bulblet (cm)	1.3	1.3	2.5	1.6	1.3

Table 1.10d. Preliminary assessment of tuberose hybrids with respect to growth and flowering parameters at Pune (Ganeshkhind) centre (2012-13)

Observations /Crosses	Variegated (Single) X Vaibhav (Double)									Mean
	L3P1	L4P9	L3P2	L4P5	L4P6	L4P7	L5P1	L5P5	L5P7	
Days to spike emergence	50	48	48	52	53	55	48	42	41	48.56
Flowering duration (day)	129	132	126	128	130	133	127	124	126	128.33
Days to flowering	78	75	80	80	75	80	76	74	74	76.89
Plant height (cm)	138.5	103.5	166.2	160	75	86.7	116.7	116.5	128	121.23
Spike length (cm)	135.3	93.7	159.5	148	69	78.5	110.4	107.6	121	113.67
Rachis length (cm)	90.4	28.4	52.3	52	31	40.2	43.5	39.7	59.2	48.52
No. of florets/ spike	49	32	32	29	25	24	30	26	44	32.33
No. of spikes/plant	4	4	3	3	5	5	4	3.5	4	3.94
No. of leaves/clump	46	44	42	40	39	34	46	45	42	43.11
No. of whorls / floret	3	3.5	3	3	5	4	4	4	5	3.83
No. of petals/floret	16	17	13	12	23	20	19	20	22	18
Colour tinch on flower bud	Greenish White	Pinkish	Pinkish	pinkish	Greenish	Pinkish	Pinkish	Pinkish	Greenish	--
Floret length (cm)	5.8	6.1	6.1	5.8	8.2	6.7	6	7.1	7.6	6.6
Floret diam. (cm)	4.1	4.3	3.2	4.2	2.9	4.7	3.5	4.2	5.3	4.04
Dia. of cut spike (cm)	1.4	1.3	1.5	1.3	1.4	1.5	1.3	1.4	1.3	-
Floret wt. (g)	3.01	3.17	3.3	3.05	5.17	4.5	3.5	3.2	5.2	3.79
No. of bulbs/plant	5	5	4	4	6	5	5	5	6	5
No. of bulblets/plant	12	10	14	13	10	11	11	12	10	11.44
Diam. of bulb (cm)	2.5	2.7	2.6	2.8	2.7	2.6	2.7	2.6	2.5	2.63
Length of bulb (cm)	4.3	4.5	4.7	3.9	4	4.4	4.6	4.3	4.5	4.36
Diam. of bulblet (cm)	1.6	1.7	1.5	1.7	1.8	1.6	1.5	1.6	1.7	1.63
Wt. of bulblet (g)	19.2	17.4	21	22.1	18.2	17.6	16.5	19.2	17.3	18.72
Wt. of bulbs/plant(g)	280	250	300	270	300	170	254	278	282	48.56
Node at 1st flower emergence	7th	8th	14th	8th	7th	7th	8th	10th	9th	76.89
Flower type	Double	Double	Double	Double	Double	Double	Double	Double	Double	-

Table 1.10d. Preliminary assessment of tuberose hybrids with respect to growth and flowering parameters at Pune (Ganeshkhind) centre (2012-13) continue...

Observations /Crosses	Variegated X Phule Rajani				Vaibhav X Phule Rajani					Phule Rajani X Suvasini
	L9P7	L1P4	L9P2	Mean	L1P2	L2P4	L1P1	L2P2	Mean	
Days to spike emergence	51	42	44	45.67	68	63	47	58	59	56
Flowering duration (day)	128	124	126	126	132	130	132	128	130.5	133
Days to flowering	71	70	75	72	82	78	77	73	77.5	64
Plant height (cm)	56.5	123.5	127.6	102.53	80.7	82.4	85.6	68.4	79.28	60.7
Spike length (cm)	52.7	110.4	115.7	92.93	74.4	71.6	75.2	60.7	70.48	55.8
Rachis length (cm)	18.7	30.2	34.6	27.83	54.3	26.5	41.7	28.5	37.75	36.3
No. of florets/ spike	24	36	38	32.67	38	30	38	24	32.5	30
No. of spikes/clump	8	7	7	7.33	4	5	4	4	4.25	5
No. of leaves/clump	42	46	38	42	43	46	44	37	42.5	47
No. of whorls / floret	Single	Single	Single	--	3	4	4	4	3.75	Single
No. of petals/ floret	5	6	5	5.33	16	18	16	18	17	5
Colour tinch on flower bud	Dark Pink	Greenish	Pinkish	---	White	White	Greenish	Greenish	-----	White
Floret length (cm)	5.2	4.8	4.7	4.9	7.2	5.4	6.8	6.7	6.53	5.3
Floret dia. (cm)	3.7	3.3	3.4	3.47	5.3	5.2	4.3	4.2	4.75	3.7
Diam. of cut spike (cm)	1.4	1.5	1.3	1.4	1.3	1.2	1.4	1.3	1.4	1.5
Floret wt. (g)	1.1	1.2	1.1	1.13	3.4	5	4.8	7	5.05	1.3
No. of bulbs/plant	9	7	8	8	5	6	5	5	5.25	6
No. of bulblets/clump	14	12	14	13.33	11	12	13	11	11.75	13
Diam. of bulb (cm)	2.6	2.7	2.5	2.6	3.4	3.5	3.6	3.4	3.48	3.7
Length of bulb (cm)	4.2	4	3.8	4	4.4	4.2	4.3	3.8	4.18	4
Diam. of bulblet (cm)	1.7	1.8	1.5	1.6	1.7	1.5	1.6	1.7	1.6	1.9
Wt. of bulblet/clump (g)	23.8	21.1	21	21.9	18.7	18	20.8	19	19.1	24.7
Wt. of bulbs/clump (g)	178.5	267.6	283	243.03	287	294	286	278	286.25	267
Node at 1st flower emergence	-	-	-	-	5th	8th	12th	6th	-	-
Flower type	Single	Single	Single	---	Double	Double	Double	Double	---	Single

Hessaraghata

Hybridization was attempted among various genotypes and seedlings have been raised. Arka Nirantara a hybrid recommended for release by the Institute Cultivar Identification Committee was multiplied and given for testing under AICRP (Floriculture). Arka Nirantara was found to be tolerant to nematodes & possessed highest concrete content.

Table 1.11a. Evaluation of genotypes of tuberose (Single) for pollen output, pollen viability and pollen germination at Hesaraghata centre (2011-12)

Genotype	Pollen output / 10 anthers	Pollen viability (%)	Pollen germination (%)
Calcutta Single	5.35	88.08	72.31
Hyderabad Single	6	87.23	76.99
Kahikuchi Single	5.87	79.93	63.08
Mexican Single	5.87	89.11	71.27
Pune Single	6.31	75.23	74.42
Navsari Local	6	88.38	78.52
Variegated Single	7.98	96.73	99.21
Shringar	7.33	89.21	90.96
Prajwal	7.76	79.83	52.12
Phule Rajani	6.5	90.52	86.74
CD (P=0.05)	0.33	3.45	2.05

Table 1.11b. Studies on Pollen tube length (microns) in tuberose genotypes (Single) at Hyderabad centre (2011-12)

Treatment	Hours after dehiscence of anther					
	1	5	10	15	20	25
Calcutta Single	43.84	160.93	242.61	383	473.52	500.78
Hyderabad Single	12.66	36.88	53.27	97.34	113.88	126.76
Kahikuchi Single	35.15	70.31	151.84	216.85	389.14	446.03
Mexican Single	4.98	18.64	25	46.27	78.36	72.55
Pune Single	6.62	16.95	26.68	49.81	76.72	78.25
Navsari Local	65	181.5	240.53	410.63	581.55	636.32
Phule Rajani	76.82	98.18	210.44	452.23	625.756	726.07
Shringar	4.73	10.35	18.94	23.52	29.78	36.94
Prajwal	24.34	174.67	238.07	500.18	580.41	611.55
Variegated Single	118.85	520.43	839.33	1020.63	1292.64	1234.95
CD (P=0.05)	0.17	12.66	36.88	53.27	97.34	113.88

Table 1.11c. Studies on pollen tube length (microns) in tuberose genotypes (Single) at Hessaraghatta centre (2011-12)

Name of the Crosses	No. of fruits	No. of seeds	No. of seeds germinated
Crosses made 2011-12			
Calcutta Single x Hyderabad Single	6	80	23
Calcutta Single x Arka Nirantara	5	60	16
Calcutta Single x GKTC 4	4	42	18
Calcutta Single x Phule Rajani	3	36	1
Arka Nirantara x GKTC 4	4	45	18
Prajwal x Arka Nirantara	3	46	6
Phule Rajani x Arka Nirantara	5	62	8
Crosses made 2012-13			
Sikim Selection x Prajwal	3	36	32
Hyderabad Single x Sikim Selection	5	45	47
Hyderabad Single x Prajwal	3	46	14
Hyderabad Single x Calcutta Single	6	62	11
Hyderabad Single x Baibhav	2	28	6
Arka Nirantara x Calcutta Single	6	112	18
Arka Nirantara x Hyderabad Single	4	86	14
Arka Nirantara x Phule Rajani	4	74	20
Arka Nirantara x Suvasini	2	24	11
Arka Nirantara x Vaibhav	1	12	22
Arka Nirantara x Prajwal	3	48	8
Phule Rajani x Vaibhav	2	19	6
Phule Rajani x Calcutta Single	3	36	14
Phule Rajani x Hyderabad Single	3	32	12
Phule Rajani x Sikim Selection	3	32	24
Phule Rajani x Prajwal	3	16	8
Phule Rajani x Arka Nirantara	3	28	8

Table 1.11d. Performance of newly developed tuberose hybrids at Hessaraghatta centre

Hybrids	Plant height (cm)	Spike length (cm)	Rachis length (cm)	No. of florets /spike	Diam. of spike (cm)	Length of floret (cm)	Wt of single floret (g)
BR-11-1	45	77	30.5	48	4.2	6	-
BR-11-2	55	78	23	44	4	6.4	-
BR-11-3	43	78.3	29	56	3.1	5.8	-
BR-11-4	55	136	52	44	3.8	5.6	-
BR-11-5	50.1	100	36.1	38	2.8	5.9	-
BR-11-6	51	129.5	49.3	42	4	5.6	-
BR-11-7	53	0	0	0	0	0	-
BR 12-1-1	24	99.5	31	62	4	5	1.38
BR 12-1-3	37.2	101.1	30	34	3.5	6	1.58
BR 12-1-4	35	82	28	40	2.9	5.6	1.62
BR 12-1-5	47.4	97.2	37.1	60	3.5	7	1.64
BR 12-7-1	51	91	29	46	4	6	2.1
BR 12-7-2	47	80.1	30	66	3.8	6.7	1.58
BR 12-7-3	54.2	107.1	52	46	4.2	7.7	1.52
BR 12-7-4	27	122	26	34	4	6.2	1.54
BR 12-7-5	47.3	88	31	58	4.5	6.8	1.58
BR 12-7-6	38	95	34	34	4	6.2	1.56
BR 12-7-7	48	84	31	48	4.7	7.9	1.58
BR 12-11-1	33	98.5	35	54	3.8	6.1	1.64
BR 12-11-2	43	85.1	34	48	3.2	6.1	1.62
BR 12-11-3	30	80	27	38	3.1	7.2	1.84
BR 12-11-4	26	52	24	38	3.2	5.5	1.5
BR 12-11-5	27	67	20	34	3	5.7	1.6
BR 12-11-6	33	107	27	36	4.2	6.5	1.9
BR 12-11-7	22	87	35	38	4	5.5	-
BR 12-11-8	15	60	23	32	3.6	5.3	-
BR 12-11-9	33	57	22	3	3	6.8	2.04
BR 12-11-10	31	88	42	40	4	5.5	2.06
BR 12-11-12	22	50	23	50	3.1	5.5	1.98
BR 12-14-2*	35	90	40	39	3	5.5	1.78
BR 12-14-3	37	65	32.2	38	3.1	5.8	1.6
BR 12-14-4	35.5	100	41	44	3.2	6	1.58
BR 12-14-5	31	97	31	40	3.1	5.5	1.56
BR 12-14-7	40	75.2	31	46	3.3	6	1.58
BR 12-14-8	40	102	35	44	4	6.2	1.6
BR 12-14-9	31	93	31	46	3.3	5.7	1.58
BR 12-14-10	34	55	20	36	4.2	5.2	1.6
BR 12-14-11	30	145	45	32	3.8	5.9	1.58

Coimbatore

Crossing studies were carried out in all the Single petalled genotypes by using four testers (Prajwal, Shringar, Phule Rajani and Suvasini). But none of the crosses made, set seeds till three months after crossing. However, fruit set was noticed in Hyderabad Single, Kahikuchi Single, Navsari Local and Pune Single when Variegated Single was used as a tester. Likewise, selfing attempted for the above four genotypes, resulted in successful seed set. But for the other seven genotypes, both selfing and crossing techniques failed to set seed. This may be due to the poor pollen germination and /or due to the mechanism of self and cross incompatibility. Both the hybrid and selfed seeds failed to germinate in the sand: soil: FYM (1:1) and in the cocopeat medium. This may be due to chaffiness of seeds and poor endosperm development in seeds.

Table 1.12. Breeding of tuberose for higher flower, concrete yield and resistance to nematodes at Coimbatore centre

Seedling Populations	Variant	Plant height (cm)	Leaf length (cm)	Leaf base width (cm)	Leaf mid width (cm)	Leaf tip width (cm)	Avg. leaf width (cm)
		1	2	3	4	5	6
Sikkim Selection Variant	SSVP1	102	39.2	1.5	1	0.3	0.93
Sikkim Selection Variant	SSVP2	94.5	39	1.1	1.2	0.4	0.9
Sikkim Selection Variant	SSVP3	126	35.2	1.9	1.5	0.4	1.26
Phule Rajani Variant P1	PRSV1	119	53	1.5	1.7	0.4	1.13
Pune Local Single Variant V1	PLSV1T	116.5	51.5	1	1	0.4	0.8
Pune Local Single D	PLSV2D	55	43	1.2	1.1	0.3	0.86
Maxican Single Dwarf Variant	MSDV1	65	46	1.4	1.5	0.4	1.1
Shringar S Tall Variant	SSTV1	100	42	1.2	1.1	0.4	0.9
PRS Variant	MPUAT S7	42.5	37	1	2	0.2	1.06

Table 1.12a. Breeding of tuberose for higher flower, concrete yield and resistance to nematodes at Coimbatore centre (continue...)

Parents	Variant	Spike length (cm)	Rachis length (cm)	Floret diam. (cm)	Florets opened at a time	No. of florets/ spike	Floret length (cm)
		7	8	9	10	11	12
Sikkim Selection Variant	SSVP1	92	24	3.4	4	28	5
Sikkim Selection Variant	SSVP2	88	15	3.5	3	32	4
Sikkim Selection. Variant	SSVP3	117	30	3.8	5	46	6
Phule Rajani Variant P1	PRSV1	107	28.3	4.1	6	38	6.6
Pune Local Single Variant V1	PLSV1T	104	20	3.1	3	29	6
Pune Local Single D	PLSV2D	44	15	3.1	6	30	5.5
Maxican Single Dwarf Variant	MSDV1	57	15	4	9	32	6
Shringar S Tall Variant	SSTV1	90	22	3.6	3	35	5.5
PRS Variant	MPUAT S7	34	13	3.5	6	33	5

Project No. 1.3: Testing of new genotypes in tuberose

Report

Hessaraghatta

Bulbs of tuberose cv. Arka Nirantara were distributed to 10 centres for testing under AICRP trials. The centres are Lucknow, Kalyani, Kahikuchi, Pune, Hyderabad, Ludhiana, DFR, Pant-Nagar, Pusa and Udaipur. Under the experiment, six Single petalled cultivars namely, Mexican Single, Variegated, Hyderabad Single, Shringar, Prajwal, Arka Nirantara and five Double petalled cultivars namely, Pearl Double, Suvasini, Hyderabad Double, Swarna Rekha and Vaibhav were evaluated as per the approved technical programme. Cultivars Suvasini, Prajwal, Arka Nirantara and Vaibhav performed better than other cultivars. Cultivars Vaibhav recorded maximum spike yield among Double petalled. Cultivar Arka Nirantara recorded maximum loose flowers yield among Single types. Weight of florets was highest in Prajwal. Cultivar Arka Nirantara exhibited early flowering.

Table 1.13a. Performance of tuberose cultivars (Single type) at Hessaraghatta Centre (2011-12)

Cultivar	Plant height (cm)	No. of leaves/clump	Days to flower	Spike length (cm)	No. of florets/spike	Spike Yield /m ²	Bud length (cm)	Floret length (cm)	Flower diam. (cm)	Rachis length (cm)	Inter nodal distance (cm)	100 flower wt. (g)	Loose flowers yield/ ha/ year (kgs)
Mexican Single	40.55	95.55	110	110.62	28.27	24.65	6	5.3	3.82	16.08	3.4	118.76	8275.85
Prajwal	55.3	112.25	112	98.85	55.15	20.03	6.5	6.2	4.3	35.07	4.68	238.05	26296.3
Shringar	41.7	102.35	105	65.45	46.26	18.22	5.89	5.92	4.01	25.8	3	142.62	12020.82
Hyderabad Single	32.5	63.57	117	68.72	44.15	17.51	5.63	5.89	4.02	27.02	3.65	121.05	9358
Variegated	25	42.58	130	115.22	33.48	10.66	5.28	5.62	4.09	22.2	4.59	108.47	3871.26
Arka Nirantara	52.4	105.6	93	92.55	56.44	35	6.3	6	4.82	32.42	4.58	162.07	32015.31
C.D. (P=0.05)	1.4	12.4	6.61	3.83	3.51	6.21	0.14	0.09	0.06	1.35	0.34	14.34	1806.48

Table 1.13b. Performance of tuberose cultivars (Single type) at Hessaraghatta Centre (2011-12)

Cultivar	Plant height (cm)	No. of leaves/clump	Days to flowering	Spike length (cm)	No. of florets/spike	Spike Yield/m ² (No.)	Bud length (cm)	Floret length (cm)	Floret diam. (cm)	Rachis length (cm)	Spike yield/ha/year
Pearl Double	29.8	68.5	146	90.2	48.15	11.87	4.85	5.69	5.12	32.6	118700
Swarn Rekha	24.48	36	166	88.6	49.37	2.87	5.98	5.87	4.02	42.37	28700
Suvasini	38.92	100.6	141	98.75	62.6	15.28	6.55	6.81	5.3	43.39	152800
Hyderabad Double	33.8	92.6	148	75.8	53.6	13.03	6.03	5.92	3.87	38.65	130300
Vaibhav	35.27	115.9	124	72.05	42.58	32.58	5.21	5.92	4.01	34.33	325800
C.D. (P=0.05)	2.01	5.42	4.38	3.31	3.81	3.15	0.18	0.1	0.04	1.91	8976.28

Table 1.13c. Evaluation of Single petalled tuberose genotype for growth parameters at Hessaraghatta centre (2013-14)

Genotype	Plant height (cm)	No. of leaves / plant	Days to spike emergence	Days to flowering	Flowering duration (day)
Shringar	46.25	39.82	67.50	89.54	19
Prajwal	42.76	42	64.9	91.65	19
Arka Nirantara	46.4	42.55	71.54	83.35	19.65
Phule Rajani	48.86	47.52	64.75	80.96	21.32
GKT C4	42.54	43.55	67.65	83.54	19.23
Mexican Single	41.31	40.65	69.65	85.65	18.05
Nilakottai Local	38.65	39.35	75.45	88.4	17.77
CD (P=0.05)	2.83	3.11	3.22	2.01	1.28

Table 1.13d. Evaluation of single betalled tuberose genotype for spike parameters at Hessaraghatta centre (2013-14)

Genotype	Spike length (cm)	Spike diam. (cm)	Rachis length (cm)	No of florets / spike
Shringar	96.35	4.01	30.24	42.34
Prajwal	94.59	4.11	30.01	40.74
Arka Nirantara	97.4	4.15	33.14	42.75
Phule Rajani	100.32	4.22	32.25	40.94
GKT C4	96.45	4.09	30.33	40.22
Mexican Single	92.8	4.06	32.75	42.65
Nilakottai Local	90.85	4	28.25	41.5
CD (P=0.05)	3.19	0.51	2.53	3.04

Table 1.13e. Evaluation of tuberose genotype for flower parameters at Hessaraghatta centre

Genotype	Florets diam. (cm)	Floret length (cm)	Weight of individual floret (g)	Weight of florets/ spike (g)	No. of spikes / clump	No. of spikes / plot	Yield/ plot (kg)
Single type							
Shringar	3.39	7.13	1.53	71.45	3.45	85.5	6.1
Prajwal	3.27	7.42	1.46	80.5	4.13	98	7.88
Arka Nirantara	3.45	7.32	1.47	71.65	4.28	103	7.37
Phule Rajani	3.52	7.35	1.59	72.5	4.32	111.3	8.06
GKT C4	3.36	7.23	1.57	70.85	3.2	78.6	5.56
Mexican Single	3.25	6.7	1.48	69.84	3.95	76.6	5.34
Nilakottai Local	3.46	6.56	1.49	71.65	3.45	73.4	5.25
CD (P=0.05)	0.22	0.21	0.08	3.73	0.38	2.42	0.11

Kalyani

Observations on various parameters of the experiment based on the performance of two years data are reported here. Two new entries viz. GKTC -4 from Pune and Arka Nirantara from IIHR were tested with 5 standard cultivars viz., Calcutta Single, Prajwal, Phule Rajani, Shringer and Hyderabad .Highest spike yield was noticed in Calcutta Single followed by Prajwal. However, highest floret yield was noticed in Prajwal. This was followed by Phule Rajani and GKTC 4 . Highest bulb weight per clump was recorded in Prajwal which was followed by Arka Nirantara . Performance of both the test entries was moderate in comparison to that of prajwal.

Table 1.14a. Comparative performance of new tuberose genotypes for vegetative traits at Kalyani centre

Genotype	Plant height (cm)	No. of leaves/clump	No. of shoots/clump	Spike length (cm)	Rachis length (cm)	Florets length (cm)	Floret diam. (cm)
Calcutta Single	70.3	273.3	29	103	38	6	3.8
Phule Rajani	50.3	130	19.7	100	39.3	5.6	4.8
Shinger	51.2	129.3	21	107.3	43	6	4.5
GKTC-4	56.8	85.3	22	81.7	26.7	5.7	4.7
Prajwal	69.9	60	18.3	124	43.3	6.5	5.4
Arka Nirantara	71.8	125.3	22	124	45.7	6.5	4.6
Hyderabad Single	67	112	18	113.3	40	5	3.9
Mean	62.5	130.8	21.4	107.6	39.4	5.9	4.52
CD at 5%	4.71	18.2	4.39	5.67	3.1	0.14	0.27
CV (%)	4.67	8.59	12.7	3.14	4.85	1.45	3.66

Table 1.14b. Comparative performance of new tuberose genotypes for floral traits at Kalyani centre

Genotype	No. of florets per spike	Wt. of floret (g)	Floret yield /m ²	Spike yield /m ²	Wt. of spike (g)	No. of bulbs per clump	Wt. of bulbs per clump (g)
Calcutta Single	36.7	0.84	3332	107.4	51.7	52	160
Phule Rajani	54.7	1.11	4074	66.7	82.3	40.3	196.6
Shinger	52.7	1.02	3574	66.7	67	35	182.2
GKTC-4	54	1.09	3912	66.7	84	41	200
Prajwal	51.3	1.74	6292	70.4	158.3	33.7	433.3
Arka Nirantara	55.3	1.03	3785	66.7	126.3	42.3	240
Hyderabad Single	54	1.12	3805	63	69.3	44.7	163.9
Mean	51.2	1.13	4111	72.5	91.3	41.3	225.2

Table 1.14c. Cross combinations developed in 2011-13 at Kalyani centre

Name of the Cross	No. of fruits	No. of seeds	No. of seeds germinated
Crosses made 2011-12			
Calcutta Single x Hyderabad Single	6	80	23
Calcutta Single x Arka Nirantara	5	60	16
Calcutta Single x GKTC 4	4	42	18
Calcutta Single x Phule Rajani	3	36	1
Arka Nirantara x GKTC 4	4	45	18
Prajwal x Arka Nirantara	3	46	6
Phule Rajani x Arka Nirantara	5	62	8
Crosses made 2012-13			
Sikim Seleccion x Prajwal	3	36	32
Hyderabad Single X Sikim Seleccion	5	45	47
Hyderabad Single X Prajwal	3	46	14
Hyderabad Single X Calcutta Single	6	62	11
Hyderabad Single X Vaibhav	2	28	6
Arka Nirantara x Calcutta Single	6	112	18
Arka Nirantara X Hyderabad Single	4	86	14
Arka Nirantara x Phule Rajani	4	74	20
Arka Nirantara x Suvasini	2	24	11
Arka Nirantara x Baibhav	1	12	22
Arka Nirantara X Prajwal	3	48	8
Phule Rajani X Baibhav	2	19	6
Phule Rajani X Calcutta Single	3	36	14
Phule Rajani X Hyderabad Single	3	32	12
Phule Rajani X Sikim Seleccion	3	32	24
Phule Rajani X Prajwal	3	16	8
Phule Rajani X Arka Nirantara	3	28	8

Table 1.14d. Performance of newly developed F₁s of tuberose at Kalyani centre

F ₁	Plant height (cm)	Spike length (cm)	Rachis length (cm)	No. of florets /spike	Spike diam. (cm)	Floret length (cm)	Wt of single floret (g)
BR-11-1	45	77	30.5	48	4.2	6	
BR-11-2	55	78	23	44	4	6.4	
BR-11-3	43	78.3	29	56	3.1	5.8	
BR-11-4	55	136	52	44	3.8	5.6	
BR-11-5	50.1	100	36.1	38	2.8	5.9	
BR-11-6	51	129.5	49.3	42	4	5.6	
BR-11-7	53	0	0	0	0	0	
BR 12-1-1	24	99.5	31	62	4	5	1.38
BR 12-1-3	37.2	101.1	30	34	3.5	6	1.58
BR 12-1-4	35	82	28	40	2.9	5.6	1.62
BR 12-1-5	47.4	97.2	37.1	60	3.5	7	1.64
BR 12-7-1	51	91	29	46	4	6	2.1
BR 12-7-2	47	80.1	30	66	3.8	6.7	1.58
BR 12-7-3	54.2	107.1	52	46	4.2	7.7	1.52
BR 12-7-4	27	122	26	34	4	6.2	1.54
BR 12-7-5	47.3	88	31	58	4.5	6.8	1.58
BR 12-7-6	38	95	34	34	4	6.2	1.56
BR 12-7-7	48	84	31	48	4.7	7.9	1.58
BR 12-11-1	33	98.5	35	54	3.8	6.1	1.64
BR 12-11-2	43	85.1	34	48	3.2	6.1	1.62
BR 12-11-3	30	80	27	38	3.1	7.2	1.84
BR 12-11-4	26	52	24	38	3.2	5.5	1.5
BR 12-11-5	27	67	20	34	3	5.7	1.6
BR 12-11-6	33	107	27	36	4.2	6.5	1.9
BR 12-11-7	22	87	35	38	4	5.5	-
BR 12-11-8	15	60	23	32	3.6	5.3	-
BR 12-11-9	33	57	22	3	3	6.8	2.04
BR 12-11-10	31	88	42	40	4	5.5	2.06
BR 12-11-12	22	50	23	50	3.1	5.5	1.98
BR 12-14-2*	35	90	40	39	3	5.5	1.78
BR 12-14-3	37	65	32.2	38	3.1	5.8	1.6
BR 12-14-4	35.5	100	41	44	3.2	6	1.58
BR 12-14-5	31	97	31	40	3.1	5.5	1.56
BR 12-14-7	40	75.2	31	46	3.3	6	1.58
BR 12-14-8	40	102	35	44	4	6.2	1.6
BR 12-14-9	31	93	31	46	3.3	5.7	1.58
BR 12-14-10	34	55	20	36	4.2	5.2	1.6
BR 12-14-11	30	145	45	32	3.8	5.9	1.58

Kahikuchi

The trial was carried out with two new genotypes, *viz.*, Arka Nirantara and GK-T-4 with four check cultivars *viz.*, Prajwal, Phule Rajani, Shringar and Local Single, for three years. Data revealed significant differences amongst the tested cultivars in respect of plant height, days to spike emergence, days to first flowering, number of florets per spike, length of spike, rachis length, diameter of spike, length of florets, weight of individual floret, weight of florets per spike, number of spikes per clump, flowering duration, spike yield, number of bulbs per clump, number of bulblets per clump, diameter and weight of individual bulb. Amongst the cultivars, Prajwal registered maximum plant height, number of leaves/clump, floret number, spike length, rachis length, diameter of spike, diameter of floret, weight of individual floret, flowering duration, diameter of bulbs and bulblets. Whereas, the cultivar Arka Nirantara recorded maximum individual bulb and bulblet weight. GK-T-C-4 registered significantly highest spike yield and the least by Phule Rajani. GK-TC-4 also recorded least days to flower emergence and days to first

Table 1.15. Growth and flowering parametrs of tuberose genotypes at Kahikuchi centre

Genotype	Plant height (cm)	No of leaves/clump	Days to spike emergence	Days to flowering	No of florets per spike	Spike length (cm)
Arka Nirantara	81.4	29.55	62.35	76.5	44.25	79.57
GK-T-C-4	79.35	29.4	50.57	64.45	43.25	71.6
Prajwal	86.35	31.9	64.45	73.5	44.35	80.85
Phule Rajani	67.2	28.35	57.05	68.15	33.9	62.4
Shringar	78.4	30	59.9	73.55	43.9	72.1
Calcutta Single	84.72	31.05	55.35	71.7	34.1	80.85
C.D. (P=0.05)	5.68	1.8	3.9	3.21	1.95	1.58

Table 1.15. Growth and flowering parametrs of tuberose genotypes at Kahikuchi centre (continue..)

Genotype	Weight of floret q/ha	No. of spikes/clump	Flowering duration (day)	Spike yield (lakh/ha)	No. of bulbs /clump	No. of bulblets/clump
Arka Nirantara	19.09	2.8	17.5	4.48	62.35	11.25
GK-T-C-4	18.6	3.16	16.92	5.48	50.57	18.64
Prajwal	21.7	3.2	18.9	5.04	64.45	27.37
Phule Rajani	10.74	2.7	16.6	4.13	57.05	62
Shringar	19.24	2.97	17.55	4.62	59.9	46.5
Calcutta Single	11.49	2.61	16.4	4.18	55.35	35.97
C.D.(P=0.05)	3.42	0.41	2.31	0.71	3.9	13.44

Table 1.15. Growth and flowering parameters of tuberose genotypes at Kahikuchi centre (continue..)

Cultivar	Length of bulb (cm)	Diam. of bulbs(cm)	Diam. of bulblets (cm)	Weight of individual bulb(g)	Weight of individual bulblets(g)	% disease (Sclerotial rot)
Arka Nirantara	6.92	3.51	1.65	13.81	2.56	20.87
						-27.13
GK-T-C-4	5.6	3.05	1.56	6.87	1.82	7.1
						-15.45
Prajwal	6.79	4.56	1.65	7.4	2.05	19
						-25.84
Phule Rajani	5.97	2.79	1.58	6.65	1.44	2.55
						-9.1
Shringar	6.77	3.28	1.58	4.1	1.69	5.65
						-13.69
Calcutta Single	5.87	2.88	1.58	3.98	1.96	21.3
						-27.49
C.D. (P=0.05)	0.9	1.32	0.22	4.19	0.4	2.53

*Figures in parenthesis are angular transformed values

Pune (Ganeshkhind)

Perusal of data indicated that the cultivar Local Single produced more flower stalk per plant and is significantly superior over the rest of cultivars followed by cultivar Shringar and Phule Rajani. The cultivars Shringar, Phule Rajani, Arka Nirantara and Local Double were *at par* with each other in respect of no. of florets per stalk. Cultivars Local Double, Suvasini and Arka Nirantara recorded significantly longer stalk length over rest of the genotype.

Table 1.16a. Performance of tuberose hybrids with respect to growth and flowering parameters at Pune (Ganeshkhind) centre (2012 -13)

Parameter	GK-T-C-1	GK-T-C-2	GK-T-C-4	GK-T-C-7	GK-T-E-2
Days to flowering	128	120	112	132	110
Plant height(cm)	110.8	76.8	83.7	90.4	48.7
Spike length (cm)	97.6	72.4	78.2	83.7	44.3
Rachis length (cm)	32.2	23.4	32.4	26.2	24.5
No. of florets/spike	38	36.2	40	36	28
Spike weight(g)	105.6	82.6	98.7	102.4	58.2
No. of spikes/clump	8.7	9	9.8	7.4	8.2
No. of leaves /plant	46	38	4.2	40	44
Days to spike emergence	88.5	92.6	89.7	92.4	85.5
Flowering duration (day)	222	218	224	218	215
Length of floret (cm)	4.5	4.2	5.2	4.7	4.3
Diam. of floret (cm)	3.2	3.3	4.2	3.3	4.2
Diam. of cut spike (cm)	0.8	0.7	0.7	1.2	0.6
Wt. of individual floret (g)	1.6	1.5	1.7	1.2	1.3
Wt. of florets/spike(g)	45.8	38.9	48.5	38.6	30.4
No of spikes/plot	250	198	253	148	234
Wt. of florets/ plot	11.4	7.7	12.2	5.71	7.11
No. of bulbs/ clump	26	24	28	20	24
No. of bulblets/ clump	18	17	16	10	18
Diam. of bulb (cm)	3.3	2.8	3.2	3.3	2.4
Length of bulb (cm)	3.4	3.8	3.7	3.5	3.3
Wt. of bulblets/ clump	162.8	110.5	160	134.7	158.8
Diam. of bulblets (cm)	1.3	1.3	2.5	1.6	1.3

Table 1.16a. Performance of tuberose hybrids with respect of growth and flowering parameters at Pune (Ganeshkhind) centre (2012 -13) (conitinue...)

Observations /Crosses	Variegated X Phule Rajani				Vaibhav X Phule Rajani					Phule Rajani X Suvasini
	L9P7	L1P4	L9P2	Mean	L1P2	L2P4	L1P1	L2P2	Mean	
Days to spike emergence	51	42	44	45.67	68	63	47	58	59	56
Flowering duration (day)	128	124	126	126	132	130	132	128	130.5	133
Days to flowering	71	70	75	72	82	78	77	73	77.5	64
Plant height (cm)	56.5	123.5	127.6	102.53	80.7	82.4	85.6	68.4	79.28	60.7
Spike length (cm)	52.7	110.4	115.7	92.93	74.4	71.6	75.2	60.7	70.48	55.8
Rachis length (cm)	18.7	30.2	34.6	27.83	54.3	26.5	41.7	28.5	37.75	36.3
No. of florets/ spike	24	36	38	32.67	38	30	38	24	32.5	30
No. of spikes/plant	8	7	7	7.33	4	5	4	4	4.25	5
No. of leaves/plant	42	46	38	42	43	46	44	37	42.5	47
No. of whorls/ Floret	Single	Single	Single	--	3	4	4	4	3.75	Single
No of petals/ Floret	5	6	5	5.33	16	18	16	18	17	5
Colour tinch on flower bud	Dark Pink	Greenish	Pinkish	---	White	White	Greenish	Greenish	----	White
Floret length (cm)	5.2	4.8	4.7	4.9	7.2	5.4	6.8	6.7	6.53	5.3
Floret diam. (cm)	3.7	3.3	3.4	3.47	5.3	5.2	4.3	4.2	4.75	3.7
Diam. of cut spike (cm)	1.4	1.5	1.3	1.4	1.3	1.2	1.4	1.3	1.4	1.5
Floret wt. (g)	1.1	1.2	1.1	1.13	3.4	5	4.8	7	5.05	1.3
No. of bulbs/clump	9	7	8	8	5	6	5	5	5.25	6
No. of bulblets/ clump	14	12	14	13.33	11	12	13	11	11.75	13
Diam. of bulb (cm)	2.6	2.7	2.5	2.6	3.4	3.5	3.6	3.4	3.48	3.7
Length of bulb (cm)	4.2	4	3.8	4	4.4	4.2	4.3	3.8	4.18	4
Diam. of bulblet (cm)	1.7	1.8	1.5	1.6	1.7	1.5	1.6	1.7	1.6	1.9
Weight of bulblet (g)	23.8	21.1	21	21.9	18.7	18	20.8	19	19.1	24.7
Wt. of bulbs/clump (g)	178.5	267.6	283	243.03	287	294	286	278	286.25	267
Node at 1st flower emergence	-	-	-	-	5th	8th	12th	6th	-	-
Flower type	Single	Single	Single	----	Double	Double	Double	Double	---	Single

Table 1.16b. Preliminary assessment of tuberose hybrids with respect of growth and flowering parameters at Pune (Ganeshkhind) centre (2012-13)

Observations /Crosses	Variegated (Single) X Vaibhav (Double)									Mean
	L3P1	L4P9	L3P2	L4P5	L4P6	L4P7	L5P1	L5P5	L5P7	
Days to spike emergence	50	48	48	52	53	55	48	42	41	48.56
Flowering duration (day)	129	132	126	128	130	133	127	124	126	128.33
Days to flowering	78	75	80	80	75	80	76	74	74	76.89
Plant height (cm)	138.5	103.5	166.2	160	75	86.7	116.7	116.5	128	121.23
Spike length (cm)	135.3	93.7	159.5	148	69	78.5	110.4	107.6	121	113.67
Rachis length (cm)	90.4	28.4	52.3	52	31	40.2	43.5	39.7	59.2	48.52
No. of florets/ spike	49	32	32	29	25	24	30	26	44	32.33
No. of spikes/plant	4	4	3	3	5	5	4	3.5	4	3.94
No of leaves/plant	46	44	42	40	39	34	46	45	42	43.11
No. of whorls / Fls	3	3.5	3	3	5	4	4	4	5	3.83
No. of petals/ Fls	16	17	13	12	23	20	19	20	22	18
Colour tinch on flower bud	Greenish White	Pinkish	Pinkish	pinkish	Greenish	Pinkish	Pinkish	Pinkish	Greenish	--
Floret length (cm)	5.8	6.1	6.1	5.8	8.2	6.7	6	7.1	7.6	6.6
Floret diam. (cm)	4.1	4.3	3.2	4.2	2.9	4.7	3.5	4.2	5.3	4.04
Diam. of cut spike (cm)	1.4	1.3	1.5	1.3	1.4	1.5	1.3	1.4	1.3	-
Floret wt. (g)	3.01	3.17	3.3	3.05	5.17	4.5	3.5	3.2	5.2	3.79
No. of bulbs/plant	5	5	4	4	6	5	5	5	6	5
No. of bulblets/plant	12	10	14	13	10	11	11	12	10	11.44
Diam. of bulb (cm)	2.5	2.7	2.6	2.8	2.7	2.6	2.7	2.6	2.5	2.63
Length of bulb (cm)	4.3	4.5	4.7	3.9	4	4.4	4.6	4.3	4.5	4.36
Diam. of bulblet (cm)	1.6	1.7	1.5	1.7	1.8	1.6	1.5	1.6	1.7	1.63
Weight of bulblet (g)	19.2	17.4	21	22.1	18.2	17.6	16.5	19.2	17.3	18.72
Wt. of bulbs/plant(g)	280	250	300	270	300	170	254	278	282	48.56
Node at 1st flower emergence	7th	8th	14th	8th	7th	7th	8th	10th	9th	76.89
Flower type	Double	Double	Double	Double	Double	Double	Double	Double	Double	-

Hyderabad

Two new tuberose genotype *viz.*, Arka Nirantara and GK-T-C-4 were evaluated along with Phule Rajani, Shringar, Prajwal and Hyderabad Single (local check). Maximum plant height and number of leaves were observed in cultivar Prajwal while minimum plant height and number of leaves per clump were observed in Calcutta Single. Early spike emergence and flowering was noticed in cv. Prajwal. While late flowering was observed in cv. Arka Nirantara. Genotypes Prajwal and GK-T-C-4 produced maximum spike length and rachis length, respectively. The cultivar Arka Nirantara produced maximum number of florets per spike followed by cv. Hyderabad Single and maximum floret length and floret diameter were noticed in cvs. Phule Rajani and Prajwal, respectively. Further no major pests and diseases were observed in these cultivars.

Table 1.17. Performance of new genotype of tuberose at Hyderabad centre (2011-12)

Genotype	Plant height (cm)	No of leaves/clump	Days to spike emergence	Days to flowering	No of florets/spike	Spike length (cm)	Rachis length (cm)	Floret length (cm)	Floret size (cm)	Av. floret wt. (g)
Arka Nirantara	55.92	20.12	79.8	81.76	46.48	68.36	21.93	6.23	4.46	2.4
GK-T-C-4	38.75	16.87	63.47	72.93	36.4	80.56	24.28	6.06	4.59	2.1
Prajwal	56.69	26.23	63.01	68.43	28.1	86.11	23.61	6.08	4.79	2.55
Phule Rajani	31.05	17	63.8	72.53	23.53	68.02	21.31	6.3	4.4	2.77
Shringar	35.73	17.33	64.8	73.5	27.07	70.13	22.45	6.26	4.18	2.37
Hyderabad Single	51.82	16.2	65.13	74.67	41.07	77.77	23.24	5.24	4.03	1.83
Calcutta Single	30.87	12.47	63.2	70.67	21.6	75.81	14.53	6.22	4.27	1.77
CD (P=0.05)	5.77	4.55	2.72	8.21	8.99	7.25	8.37	0.59	0.68	0.36

Pantnagar

Tested genotypes showed significant differences for most of the characters studied but for total number of unopened florets/ spike which was statistically *at par*. Spike length was higher in cv. Prajwal, check cultivar whereas, the two hybrids had non-significant differences in spike length. The total number of florets per spike was also higher in check cultivars followed by GK-TC-4 and it was minimum in Hybrid-1. The other floral parameters like rachis length, diameter of florets, number of opened florets were also higher in cultivar Prajwal than the other hybrids/ cultivars.

Table 1.18. Performance of tuberose genotype in respect of growth and flowering parameters at Hyderabad centre

Treatment	No of leaves/clump	Plant height (cm)	Days taken to spike emergence	Flowering duration (day)	No. of opened florets/spike	No of unopened florets/spike	No. of florets/spike	Rachis length (cm)	Spike length (cm)	Spike weight (g)	Floret diam. (cm)
GK-TC-4	70	52	81	16	11.33	11.33	22.67	15.5	51.66	54.34	3
Hybrid-1	60	54.5	132	12.33	9	8	17	15.33	56.33	50	2.54
Prajwal	74	60.66	88	19.66	22	6.67	28.67	17.5	97.33	59.67	3.46
Shringar	94	64.1	90.5	14	28.83	0	28.83	14.33	69.36	61.33	2.99
CD (5%)	0.97	0.77	1.45	1.82	1.74	1.38	0.92	0.97	1.65	1.86	1.25

Pusa

Performance of six genotypes of tuberose including one local strain was evaluated. Cultivar Prajwal differed significantly with respect to plant height, number of leaves, days to flowers, days to spike emergence, flowering duration, spike length, rachis length and other floral characters, bulb or bulblet quality and its performance was better than other entries. Hybrid-1 was the next superior cultivar with respect to vegetative and floral characters. The performance of other genotypes was markedly poor.

Table 1.19. Vegetative parameters of five tuberose genotypes at Pusa centre

Genotype	Plant height (cm)	No. of leaves/clump	Days to flowering	Days to spike emergence	Flowering duration (day)
Hybrid-1	82.21	33.5	115.9	95	22
Phule Rajani	65.34	32	104	85.5	15.6
Shringar	72.32	30	106.5	90.5	17
Prawal	84.43	36.5	120.5	97.5	24.5
Local	58.21	26	100	87	10.5
GKT-4	75.15	31	110.5	93.5	14.5
CD (P=0.05)	15.25	5.53	21.76	18.51	3.41

Udaipur

Genotype GK-T-4 recorded earliest spike emergence and days taken for flowering while, Arka Nirantara (Hybrid-1) was late in flowering than Prajwal and Phule Rajani and flowered in January under winter condition at Udaipur centre.

Table 1.20. Testing of new genotypes in tuberose at Udaipur centre (2011-12)

Genotype	Plant height (cm)	No. of leaves per clump	Days to spike emergence	Days to flowering	Flowering duration (day)	Spike length (cm)	Rachis length (cm)	No. of florets / spike	Floret length (cm)
GK-T-4	55	23.67	81.67	95	24	44	26	24.33	2.87
Arka Nirantara	65.5	24	116.67	125.67	23.67	51.4	33.07	29	3.13
Prajwal	83.67	35.33	86.67	100	27.33	70.03	54.83	43	3.4
Phule Rajani	77.67	35.67	100.33	112	26.67	67.23	50.67	38.67	3.2
Shringar	69.33	31.67	111.33	123.33	25.33	56.9	38.17	37.67	3.03
C.D. at 5%	8.6	3.55	4.45	3.75	2.29	5.31	4.50	3.22	0.26

Project No. 1.4: Collection, evaluation and maintenance of tuberose germplasm.

Technical Programme

1. Germplasm collection of named cultivars only, but in case of promising lines/accession, accession number may be maintained.
2. Passport data of the existing and new collections must be prepared by the centres and should be sent to the Project Coordinator/Director DFR, Pune. The passport data should include name of species/cultivar, parental details, year of release, country of origin, name of the breeder, form and colour, source and date, salient features, remarks, name of the person who has collected the cultivar and a photograph.
3. Collection of different cultivars from various indigenous and exotic sources.
4. Evaluation of collected germplasm and identification of promising cultivars.
5. Single and Double petalled genotypes to be evaluated separately.
6. Recommendation of a cultivar for commercial cultivation in respective region based on extensive evaluation should be submitted to the Project Coordinator/Director DFR, Pune every year along with the proposal for testing in the other centres, if any.
7. The concerned scientists are advised to maintain passport data of newly collected cultivars and obtain the IC/EC number from ICAR-NBPGR, New Delhi for records.

Observations recorded

1. Plant height (cm)
2. No. of leaves/clump
3. Days to spike emergence
4. Days to opening of first floret
5. Flowering duration (day)
6. Spike length (cm)
7. Rachis length (cm)
8. Number of florets/spike
9. Length of floret (cm)
10. Diameter of floret (cm)
11. Diameter of cut spike (cm)
12. Weight of individual floret (g)

13. Weight of florets per spike (g)
14. Number of spikes per clump
15. Number of spikes/plot / ha
16. Weight of florets/plot / ha
17. Number of bulbs per clump
18. Number of bulblets per clump
19. Diameter of bulb (cm)
20. Length of bulb (cm)
21. Weight of individual bulb (g)
22. Diameter of bulblet (cm)
23. Weight of bulblet (g)

Report

Udaipur

Cultivars Pearl Double, Mexican Single and Arka Nirantara were collected from ICAR-IIHR, Bengaluru and G-K-T-C-4 from ZARPC (PZ), Pune and planted at AICRP on Floriculture centre, Udaipur. Thus total collection existing is 17 at this centre.

Hyderabad

During the year, 13 genotypes were evaluated, out of which 9 are of Single petalled and 4 are of Double petalled. Among the Singles, Arka Nirantara recorded more number of florets/spike followed by Hyderabad Single. The size of the individual floret was maximum in cv. Prajwal with maximum floret diameter. Among Doubles, Hyderabad Double recorded maximum spike length with more number of florets/spike. Among Singles, GK-T-C-4, Arka Nirantara and Prajwal were found to be superior and among Double type, Suvasini and Hyderabad Double were found to be good.

Table 1.21. Performance of tuberose genotype at Hyderabad centre (2013-14)

SINGLE PETALLED								
Genotype	Plant height (cm)	No.of leaves /clump	Days of spike emergence	Days of flowering	Spike length (cm)	Floret length (cm)	Floret diam. (cm)	No. of florets /spike
Hyderabad Single	39.2	25.8	57.33	71.33	64.47	4.81	3.51	38.6
Calcutta Single	41.08	22.33	63.3	78.5	77.74	5.29	3.3	34.2
Shringar	38.66	25.37	59	73.67	72.29	4.53	3.36	35.6
Phule Rajani	37.64	27.2	63.37	77.27	68.47	5.26	3.34	31.7
Prajwal	56.16	24.47	63.8	77.57	84.6	5.48	3.87	35.57
GK-T-C-4	37.6	25.8	60.77	74.4	80.43	5.23	3.44	33.23
Arka Nirantara	52.95	28.57	75.6	80.8	85.66	5.85	3.52	41.67
Rajath Rekha	51	25.27	64.23	79.47	95.63	5.41	3.23	33.64
CD (P=0.05)	1.4	1.66	1.79	1.73	1.75	0.22	0.21	1.77

DOUBLE PETALLED								
Cultivars	Plant height (cm)	No.of leaves /clump	Days of spike emergence	Days of flowering	Spike length (cm)	Floret length (cm)	Floret diam. (cm)	No. of florets /spike
Hyderabad Double	44.01	25.8	43	53.16	82.17	5.47	4.4	44.33
Vaibhav	40.46	26.6	47.33	61.33	81.18	5.41	4.46	43.73
Calcutta Double	34.21	26	49.65	66.65	74.56	5.43	4.3	37.07
Suvasini	37.58	23.8	52.15	71	71.28	5.55	4.35	37.47
CD (P=0.05)	4.19	NS	4.61	3.99	0.33	NS	NS	2.56

Coimbatore

In this study, Prajwal (Single) and Suvasini (Double) showed its superiority over other genotypes with respect to growth and yield parameters *viz.*, number of florets/ spike, length of floret, weight of florets per spike, number of spikes/m², yield of florets/ plot. Based on the mean performance and genetic divergence these two genotypes have been identified for commercial cultivation.

The estimates of genetic parameters showed that high heritability coupled with high genetic advance as per cent of mean was observed for flowering duration, weight of florets per spike, number of florets per spike and rachis length in Single types and in Double types high heritability coupled with high genetic advance was observed for number of florets per spike, number of spikes/m², rachis length and yield of florets per plot. Hence, these characters can be considered for selection in further improvement.

Table 1.22a. Performance of tuberose genotypes (Single) for growth and yield parameters at Coimbatore centre (2013- 2014)

Genotype	Days to sprouting of bulb	Plant height (cm)	No. of leaves per clump	Days to spike emergence	Flowering duration (day)	Spike length (cm)	Rachis length (cm)	No. of florets/spike (Nos.)	Floret length (cm)	Wt. of florets per spike (g)	Yield of florets/plot (2 x 2 m) (kg)
Calcutta Single	14.12	75.35	241	95.12	8.36	65.31	17.67	26.78	6.32	29.12	4.68
Hyderabad Single	15.46	86.27	226	91.23	6.48	68.45	16.23	43.05	6.21	35.12	4.82
Kahikuchi Single	13.02	72.16	251	87.45	15.03	61.23	18.92	39.98	6.31	45.57	6.09
Mexican Single	15.89	92.16	238	89.67	7.15	78.76	20.12	18.19	6.22	25.96	4.67
Navsari Local	14.38	99.77	239	93.78	10.12	79.96	28.53	46.13	6.3	35.66	4.86
Phule Rajani	13.56	70.17	249	86.12	9.23	59.45	22.42	42.23	6.31	48.32	6.12
Prajwal	12	114.56	262	77.67	18	99.67	29.72	48.23	6.42	75.89	7.1
Pune Single	15.97	112.32	236	83.89	12.01	96.52	36.52	38.12	6.11	44.23	5.95
Shringar	13.89	90.21	243	84.43	16.78	75.12	21.33	42.97	6.32	53.49	6.29
Variiegated Single	12.75	120.12	254	82.12	7.24	112.5	19.21	29.96	6.2	39.98	5.82
CD (P=0.05)	0.86	5.42	14.23	5.43	0.59	4.58	1.42	2.43	0.39	2.45	0.19

Table 1.22b. Performance of tuberose genotypes (Double) for growth and yield parameters at Coimbatore centre (2013-14)

Genotype	Days to sprouting of bulb	Plant height (cm)	No. of leaves per clump	Days to spike emergence	Flowering & duration (day)	Spike length (cm)	Rachis length (cm)	No. of florets/ spike	Floret length (cm)	Wt. of florets per spike (g)	No. of spikes/ m ² (Nos.)	Yield of florets/ plot (2 x 2 m) (No. of stems)
Calcutta Double	13.78	78.76	246.12	88.02	10.53	58.99	38.82	38.14	7.26	175.78	18.02	52.78
Hyderabad Double	16.58	67.76	236.02	89.56	9.15	53.78	36.92	35.18	6.71	162.36	15.48	65.64
Pearl Double	14.56	69.96	237.02	86.01	10.45	54.77	42.72	32.08	7.46	169.59	16.15	60.14
Suvasini	12.13	87.97	276	84.12	12.42	71.56	44.98	54.23	7.58	200.98	20.78	80.12
Vaibhav	12.72	83.14	252.01	85.67	11.47	66.57	54.12	48.12	7.35	180.14	18.12	68.78
CD (P=0.05)	0.78	0.86	4.52	13.49	2.98	0.73	2.59	2.96	0.45	26.98	3.82	11.18

Table 1.22c. Estimates of variability and genetic parameters for flower yield and its components (Single and Double cultivars) at Coimbatore centre

Character	GCV		PCV		HERT		GA (%) of Mean	
	Single	double	Single	double	Single	double	Single	double
Days taken for sprouting of bulbs	9.12	11.12	9.78	11.82	89.83	91.92	17.52	22.42
Plant height	17.15	9.67	18.1	10.39	97.12	90.58	34.79	20.19
Number of leaves per plant	4.38	5.38	5.89	6.42	63.23	73.05	17.55	10.01
Days to spike emergence	5.58	1.52	6.72	3.69	72.91	78.02	19.82	1.35
Flowering duration	36.72	11.26	35.82	11.78	99.18	93.33	73.54	23.41
Spike length	22.79	12.12	21.98	12.89	97.69	94.81	44.84	25.12
Rachis length	27.82	17.34	27.98	17.89	98.53	96.98	54.58	35.23
No. of florets/ spike	32.69	24.42	33.06	24.62	98.76	98.48	68.02	49.9
Floret length	1.58	3.98	3.15	5.06	78.36	60.72	15.92	6.71
Wt. of florets per spike	33.53	13.32	32.49	13.72	99.03	94.72	67.52	26.78
No. of spikes/ m ²	17.42	17.82	16.82	17.98	96.72	96.98	33.12	36.81
Yield of florets/ plot	22.01	14.99	21.98	15.39	98.89	96.82	45.86	32.12

Table 1.22d. Number of pollen tubes at stigmatic and stylar regions and entry of ovary in Single genotypes of tuberose upon crossing at Coimbatore centre

Cross combination	Stigmatic region	Middle of style	Entry of ovary
Variegated Single x Calcutta Single	180- 250	116-192	46-65
Variegated Single x Kahikuchi Single	206- 216	106-159	40-52
Variegated Single x Mexican Single	198- 258	127-175	50-55
Variegated Single x Navsari Local	219- 278	127-173	41-61
Variegated Single x Pune Single	229- 265	138-170	37-64
Variegated Single x Phule Rajani	180- 250	116-192	46-65
Phule Rajani x Kahikuchi Single	212- 247	102-157	42-55
Phule Rajani x Mexican Single	229- 265	138-170	32-55
Phule Rajani x Hyderabad Single	202- 271	123-177	56-79
Phule Rajani x Variegated Single	296-318	175-212	73-95
Shringar x Kahikuchi Single	180- 250	116-192	46-65
Shringar x Variegated Single	198- 258	127-173	41-61
Hyderabad Single x Variegated Single	190- 290	135-182	55-82
Navsari Local x Variegated Single	197-247	133-172	37-64
CD (P=0.05)	28.16	27.52	6.96

Pune (Ganeshkhind)

Data indicated that days to flowering varied from 118 to 148 day with an average of 135.50 day. Maximum days were recorded by cultivar Prajwal while, minimum days were recorded by cultivar Phule Rajani. Maximum stalk length was recorded in cultivar Variegated and minimum in cv. Phule Rajani. The highest number of florets per stalk was recorded by cultivar Phule Rajani. However, minimum number of floret per stalk was recorded by cultivar Variegated.

Table 1.23. Genetic enhancement in tuberose at Pune (Ganeshkhind) centre (2013-14)

Cultivar	Plant ht. (cm)	No. of leaves /plant	Days to flowering	Flowering duration (day)	Days to spike emergence	Spike length (cm)	Rachis length (cm)	No. of floret /spike	Floret length (cm)	Diam. of floret (cm)	Diam. of cut spike (cm)	Wt. of floret (g)
Phule Rajani	125.3	52.6	118	118.7	220.4	117.1	31.7	46.6	3.7	4.2	1.6	1.8
Shringar	122.4	48.5	116	122.4	223.5	117.2	25.2	45.3	3.5	4	1.5	1.6
Prajwal	142.2	43.4	148	130.2	228.7	137.1	31.2	38.2	4.2	3.6	1.8	1.4
Hyderabad Single	130.2	47.5	129.33	120.5	223.4	126.1	24.5	36.84	3.5	3.2	1.3	1.2
Local Single	128.6	41.3	128	132.4	224.6	123.2	17.4	32.1	4.1	3.7	1	1
Arka Nirantara	137.5	40.7	137	136.6	226.5	131.4	23.6	46.3	3.8	3.8	1.3	1.5
Local Double	142	42.6	154	146.7	230.6	137.13	32.6	45.93	3.4	3.5	1.4	1.6
Suvasini	138.3	43.5	147	138.5	224.7	133.1	36.4	36.4	3.8	4.2	1.6	1.2
Vaibhav	136.1	46.2	136	134.6	236.4	132.2	37.6	38.2	3.6	4.5	1.5	1.4
Hyderabad Double	136.2	42.4	140	136.2	230.8	131.3	32.7	38.2	3.4	3.7	1.2	1.5
Variegated	152.3	37.2	136	132.4	220.6	147.2	16.8	34.2	3.7	3	0.8	1
Mean	135.5	44.2	135.4	131.7	226.4	130.3	28.2	39.8	3.7	3.8	1.4	1.9

Table 1.23. Genetic enhancement in tuberose at Pune (Ganeshkinf) centre (2013-14) continue...

Cultivar	Wt. of florets /spike(g)	No. of spikes /plant	No. of spikes /plot	Wt. of florets /plot (kg)	No. of bulbs /clump	No. of bulblets /clump	Diam. of bulb (cm)	Length of bulb (cm)	Wt. of bulb (g)	Diam. of bulblet (cm)	Wt. of bulblets/clump (g)
Phule Rajani	45.3	9.7	291	103.2	10.4	20.6	3.5	4.5	34.7	1.6	175.6
Shringar	43.5	10.8	324	94.1	11.8	15.2	3.2	4.6	32.2	1.5	168.5
Prajwal	47.6	7.2	216	108.9	8.7	11.7	3.8	5.4	37.8	2.2	172.2
Hyderabad Single	38.6	8.6	258	105.2	9.4	14.5	3.2	4.7	26.7	1.5	158.7
Local Single	18.2	13.2	396	96.17	14.6	12.2	3	3.9	19.4	1	153.6
Arka Nirantara	48.7	8.7	261	103.5	9.8	19.7	3.5	3.6	30.2	2	148.8
Local Double	49.8	6.2	186	113.43	7.8	14.2	4.3	4.2	32.6	2.6	140.5
Suvasini	54.5	6.8	204	106.2	7.4	15.3	4.2	4.5	38.4	2.3	138.6
Vaibhav	49.8	7.8	234	106.2	8.7	13.4	3.8	5.2	37.5	2.2	136.7
Hyderabad Double	50.4	6.2	186	107.2	7.7	11.8	3.9	4.6	36.7	1.9	144.3
Variegated	21.2	8.6	258	111.7	9.6	16.7	2.6	2.9	20.2	1.4	136.5
Mean	42.5	8.5	255.8	101.5	9.6	15	3.5	4.4	31.5	1.8	152.2

Table 1.24a. Genetic enhancement in tuberose at Pune (Ganeshkhind) centre (2013-14) continue...

Cultivar	Plant height (cm)	No. of leaves/clump	Days to flowering	Flowering duration (day)	Spike length (cm)	Wt. of spike (g)	No. of spikes/plant	Floret diam. (cm)	No. of florets/spike	Flower arrangement on spike	Vase life (day)
Phule Rajni	69.96	27.25	108.4	52.6	55.53	93.44	4.4	0.47	33.33	Compact	4.75
Local Single	83.53	24.33	116.56	65.93	76.55	102.77	4.6	0.43	37.67	Compact	5.76
Pune Local Single	77.39	21	127.38	63.71	69.92	79.75	4.25	0.45	35	Loose	5.43
Calcutta Single	74.56	23.86	121.84	69.87	77.4	87.93	4.16	0.43	39.66	Loose	6.15
Hyderabad Single	86.78	26.14	96.16	57.74	67.89	112.78	2.44	0.46	34.33	Compact	7.13
Shrinagar	87.95	29.08	104.9	66.6	66.9	95.61	5.27	0.47	36.67	Compact	6.14
Prajwal	93.23	41.19	92.81	109.15	86.67	127.98	7.56	0.48	55	Compact	7.79
CD (P=0.05)	0.25	0.59	NS	0.2	0.31	0.21	0.16	0.8	NS	-	0.26

Ludhiana

Single petalled: The Centre maintains a collection of nine cultivars of Single types of tuberose *viz.*, Phule Rajni, Local Single, Pune Local Single, Calcutta Single, Hyderabad Single, Shrinagar, Prajwal, Mexican Single and Sikkim Selection. Seven cultivars were evaluated for various growth and flowering parameters. It was found that all genotypes differed significantly with most of the growth and flowering parameters. After evaluating these cultivars it was found that cultivar Prajwal and Suavasini (Double) performed better over the other cultivars in terms of growth, flowering and bulb production.

Double petalled: The Centre maintains five cultivars of Double petalled tuberose *viz.*, Pearl Double, Suavasini, Pune Local Double, Hyderabad Double and Vaibhav. These cvs. were evaluated for various growth and flowering parameters. Results indicated that parameters were affected significantly with respect to growth and flowering and cultivar Suavasini performed better over other cultivars in terms of growth, flowering and bulb production. Based on the above results it is concluded that Prajwal (Single) and Suavasini (Double) performed better over other cultivars in terms of growth, flowering and bulb production.

Table 1.24. Collection, evaluation and maintenance of tuberose (Single types) germplasm at Ludhiana centre

Cultivar	Plant height (cm)	No. of leaves/clump	Days to flowering	Duration of flowering (day)	Spike length (cm)	Wt. of spike (g)	No. of spikes/clump	Floret diam. (cm)	No. of florets/spike	Flower arrangement on spike	Vase life (day)
Phule Rajni	69.96	27.25	108.4	52.6	55.53	93.44	4.4	0.47	33.33	Compact	4.75
Local Single	83.53	24.33	116.56	65.93	76.55	102.77	4.6	0.43	37.67	Compact	5.76
Pune Local Single	77.39	21	127.38	63.71	69.92	79.75	4.25	0.45	35	Loose	5.43
Calcutta Single	74.56	23.86	121.84	69.87	77.4	87.93	4.16	0.43	39.66	Loose	6.15
Hyderabad Single	86.78	26.14	96.16	57.74	67.89	112.78	2.44	0.46	34.33	Compact	7.13
Shrinagar	87.95	29.08	104.9	66.6	66.9	95.61	5.27	0.47	36.67	Compact	6.14
Prajwal	93.23	41.19	92.81	109.15	86.67	127.98	7.56	0.48	55	Compact	7.79
CD (P=0.05)	0.25	0.59	NS	0.2	0.31	0.21	0.16	0.8	NS	-	0.26

Table 1.24. Collection, evaluation and maintenance of tuberose (Single type) germplasm at Ludhiana centre (continue)

Cultivar	Floret length (cm)	Peak flowering	Spike diam. (cm)	Seed setting	Bulb			Bulblet			Yield		
					Length (cm)	Diam. (mm)	Weight (g)	Length (cm)	Diam. (mm)	Weight (g)	Bulb		Bulblet
											Per clump	Per meter sq.	Per clump
Phule Rajni	0.37	Aug-Sep	0.33	No	6.45	3	36.14	3.57	1.15	62.92	4.53	48.66	20.67
Local Single	0.32	July-Sep	0	No	6.56	3.05	38.18	3.09	1.2	63.66	3.66	52.67	17
Pune Local Single	0.33	Aug-Sep	0.66	No	4.53	3.59	16.51	3.83	0.34	26.84	3.66	43	13.66
Calcutta Single	0.36	Aug-Sep	0.67	No	4.84	3.33	32.13	3.82	2.22	77.37	1.33	21.33	18
Hyderabad Single	0.38	Aug-Sep	0.66	No	3.37	3.38	27.47	3.67	2.04	68.3	2.67	15.66	16.66
Shrinagar	0.37	Aug-Sep	0.66	No	4.73	3.44	49.85	3.76	1.96	56.88	2	15.33	15.67
Prajwal	0.39	July-Oct	0.33	No	6.06	5.31	85.09	4.87	2.27	134.26	3.33	62.67	28.33
CD (P=0.05)	0.15		0.33	No	0.25	0.16	0.82	0.22	NS	6.47	NS	5	NS

Table 1.24. Collection, evaluation and maintenance of tuberose (Single type) germplasm at Ludhiana centre (continue)

Cultivar	Plant height (cm)	No. of leaves/clump	Days to flowering	Duration of flowering (day)	Spike length (cm)	Wt. of spike (g)	No. of spikes/plant	Floret diam. (cm)	No. of florets/spike	Flower arrangement on spike	Vase life (day)
Pearl Double	82.58	54.62	94.89	52.7	82.88	101.76	2.48	3.72	26.75	Compact	4.15
Suvasini	104.46	56.19	90.57	66	89.55	102.25	4.85	3.75	36.12	Loose	5.46
Pune Double	93.77	57.4	91.25	67.85	87.56	96.78	2.25	3.76	43.14	Compact	2.79
Hyderabad Double	98.56	53.68	98.54	65.06	85.35	97.74	2.09	3.55	34.15	Loose	6.43
Vaibhav	95.1	65.74	91.45	53.87	86.92	95.55	4.59	3.64	32.78	Compact	5.12
CD (P=0.05)	1.23	1.55	3	1.22	1.2	1.89	0.27	0.21	1.23		2.34

Table 1.24. Collection, evaluation and maintenance of tuberose (Single types) germplasm at Ludhiana centre (continue)

Cultivar	Floret length (cm)	Peak flowering	Spike diam. (cm)	Seed setting	Bulb			Bulblet			Yield		
					Length (cm)	Dia. (mm)	Weight (g)	Length (cm)	Diam. (mm)	Weight (g)	Bulb		Bulblet
											Per clump	Per meter sq.	Per clump
Pearl Double	3.95	Aug-Sep	0.64	No	6.84	4.3	70.9	2.7	2.26	14.28	3.35	20.3	33.9
Suvasini	4.33	July-Sep	0.32	low	5.76	3.19	34.66	4.26	2.08	115.94	5.46	44.36	32.55
Pune Double	2.16	Aug-Sep	0.69	No.	4.98	4.48	58.45	3.59	2.14	136.26	2.28	30.34	31.26
Hyderabad Double	4	Aug-Sep	0.65	No.	6.33	3.73	64.48	4.57	2.15	147.85	3.47	22.28	35.84
Vaibhav	3	Aug-Sep	0.37	No.	5.96	1.08	32.77	2.16	1.89	62.94	3.39	48.94	31.09
CD (0.05)	0.18	Aug-Sep	0.68		3.01	3.57	3.86	1.47	0.67	1.33	0.26	1.87	1.87

Pantnagar

It is evident from the data that there were significant differences in different traits among different cultivars. Plant height was maximum in cultivar Suvasini whereas, it was minimum in cultivar Shringar. Days to spike emergence was earliest in cultivar Phule Rajani which was statistically *at par* with Prajwal and Kalyani Single whereas, it was maximum in Sikkim Selection which was statistically *at par* with cvs. Vaibhav, Hyderabad Double, Double and Swarn Rekha.

Spike length was recorded maximum in cultivar Sikkim Selection which was significantly higher than all other cultivars studied, whereas it was minimum in case of cultivar Kalyani Single. Rachis length was found maximum in cultivar Swarna Rehka which was followed by cultivar Suvasini whereas the rachis length was found minimum in cultivar Single. The total number of florets in cultivar Suvasini which was statistically higher than rest of the cultivars, whereas it was minimum in cultivar Single.

Table 1.25. Performance of different genotypes of tuberose at Pantnagar centre

Genotype	No. of leaves at 120 days	Plant height at 120 days	Days to spike emergence	Spike length (cm)	Rachis length (cm)	No. of opened florets	No. of unopened florets
Mexican Single	147.7	32.7	65.9	74.8	20.2	15.8	3.9
Vaibhav	147.1	26.4	89	60.8	25.3	14.8	8.8
Sikkim Selection	128.5	32.1	91.1	131.2	24	19.6	6.5
Hyderabad Double	153.9	28.7	88	68.1	25.6	8.6	14.9
Double	152	27.4	87.2	74.9	26.2	16.8	12.1
Swarna Rekha	89.6	26.9	86.8	85.3	41.4	16.4	18.3
Hyderabad Single	125.7	22.8	76.5	66.5	21	18.6	3.1
Mexican Single	120.8	27.5	73.5	95.9	31.9	19.7	16.5
Pearl Double	127.8	25.5	77.3	81.1	36.2	21.4	11.7
GKTC-4	135.8	23.2	67.8	66.6	26.6	20.1	2.9
Kalyani Single	99.3	30.3	65.4	56.5	23.4	27.6	3.4
Shringar	109.8	22.6	71.2	57	21.4	15.7	8
Prajwal	103.4	27.3	65.2	84	26.9	22.8	9.9
Phule Rajni	107.7	28.4	64.9	70.7	22.9	29.1	1
Suvasini	146.1	41.3	82.9	91.4	38.2	30.3	14.1
CD (P=0.05)	14.59	2.54	4.74	22.67	2.47	1.74	1.2

Table 1.25. Performance of different genotypes of tuberose at Pantnagar centre (conitinue..)

Cultivar	No. of florets/ spike	Floret diam. (cm)	Floret length (cm)	Floret weight (g)	Days to 50% flowering	No. of spikes / year/ plant
Mexican Single	19.9	2.4	5.24	0.61	3.5	2.6
Vaibhav	23.6	3.17	3.15	1.07	5.3	2
Sikkim Selection	26.1	2.97	3.63	0.52	8.1	1.6
Hyderabad Double	23.2	3.18	3.28	1.02	5.3	1.9
Double	28.9	3.04	3.38	1.26	5.4	2
Swarna Rekha	34.7	4.08	2.81	1.13	8.2	1.4
Hyderabad Single	21.7	2.94	3.43	0.07	3	3.1
Mexican Single	35.9	3.29	5.17	0.71	3.5	1.9
Pearl Double	32.5	3.2	3.63	1.01	6.6	2.8
GKTC-4	23	3.27	5.22	0.62	3.6	2.7
Kalyani Single	31	3.08	5.31	0.65	3.9	2.8
Shringar	23.7	2.91	3.03	0.64	4	2
Prajwal	31.5	3.25	5.61	1.06	3.5	3.3
Phule Rajni	30.1	3.89	6.37	1.04	3.2	1.3
Suvasini	44	3.86	5.27	1.06	8.1	2.5
CD (P=0.05)	2.24	0.13	11.41	0.75	0.55	0.76

3. Crop Management

Project No. 2..1: Integrated nutrient management in tuberose.

Technical Programme

No. of treatments: Seven

T1 - 100% Recommended dose of inorganic fertilizers (RDF) + FYM (2 kg/m²/Y)

T2 - 75% RDF + FYM (2 kg/m²/Y)

T3 - 75% RDF + FYM (1 kg/m²) + Vermicompost (300g/m²)

T4 - 75% RDF + FYM (1 kg/m²) + Vermicompost (300g/m²) + *Azospirillum* + PSB

T5 - 50% RDF + FYM (1 kg/m²)

T6 - 50% RDF + FYM (1 kg/m²) + Vermicompost (300g/m²)

T7 - 50% RDF + FYM (1 kg/m²) + Vermicompost (300g/m²) + *Azospirillum* + PSB

Note:

1. Recommended dose of fertilizer means location specific recommendations.
2. *Trichoderma*-20 g/m²/y (this is applied after mixing with FYM, slightly moist and covered with polythene sheet for a week).
3. Decomposed coir compost – 200g/m²/y or any oil cake – 200g/m²/y.
4. FYM – 2kg/m²/y.
5. In treatments 3, 4, 6 and 7, FYM is supplied 50% of the recommended dose i.e., 2kg/m²/y and remaining 50% is through Vermicompost.
6. FYM, Vermicompost and biofertilizers are applied as per the treatments at the time of planting.

Cultivar : One Single petalled and one Double petalled

Statistical design : RBD

No. of replications : Three

No. of treatments : Seven

No. of plants/treatment : Eighteen

Observations recorded

1. No. of leaves per clump at flowering stage.

2. No. of side shoots / clump at flowering stage.
3. Days taken for flowering.
4. Duration of flowering (day).
5. Length (cm) and weight (g) of spike.
6. No. of spikes / plant.
7. Number of florets / spike.
8. Weight of florets (g).
9. Yield of flowers / m²
10. Keeping quality of spikes (spike were harvested when first one or two basal florets open and observations recorded till 50% of florets are wilted)-day.
11. Yield of spikes/m²
12. Size (cm) and weight (g) of bulbs.
13. Diameter (cm) and weight of bulbs (g).
14. Yield of bulbs/m²

Report

Hessaraghatta

Integrated nutrient management (INM) studies in tuberose comprised of seven treatment combinations of organic nutrients, inorganic nutrients and biofertilisers in two cultivars *viz.*, Prajwal (Single) and Vaibhav (Double) was conducted. In cv. Prajwal, significant differences were recorded among the treatments (Table 2.7.1.1) for number of leaves per clump, yield of spikes and number of florets per spike. 75% RDF + 1 kg per m² FYM+300 g per m² Vermicompost+2g/plant *Azospirillum* + 2g/pl PSB recorded the maximum number of leaves per clump and number of florets per spike. Application of 75% RDF+ 1 kg per m² FYM + 300 g per m² Vermicompost recorded maximum yield of flowers per m². The weight of bulblets per plant was maximum in plants treated with 50% RDF +1 kg per m² FYM (43.33). In cv. Vaibhav, 50% RDF + 1 kg per m² FYM+300 g per m² Vermicompost +2g/plant *Azospirillum* +2g/plant PSB recorded the maximum yield of spikes per m² and maximum number of florets per spike. Maximum spike length was recorded by control and it was *at par* with 50% RDF+1 kg per m² FYM+300 g per m² Vermicompost +2g/plant *Azospirillum* +2g/plant PSB. The bulb and bulblet yield did not differ significantly among the different treatments .

Table 2.1a. Effect of integrated nutrient management treatments on growth and flowering in tuberose cv. Prajwal at Hessaraghatta centre (2010-11)

Treatment	No. of leaves per clump	No. of side shoots per clump	Yield of spikes per m ²	No. of florets per spike	Yield of flowers per m ² (g)	Weight of flowers (100 bud weight) (g)	Length of spike (cm)	Wt. of spike (g)	Keeping quality of spikes (day)
T1-100%RDF+2kg FYM /sqm/yr	15.3	4.05	15.32	37.32	42.7	109.3	90.2	98.35	7.8
T2--75%RDF+2kg FYM/sqm/yr	24.5	5.83	23.33	37.12	40.11	117.5	93.2	94.32	8.4
T3-75%RDF+1kg FYM/sqm/yr +300VC/sqm	28.3	5.56	21.36	37.15	51.36	119.3	85.36	111.32	7.99
T4-75%RDF+1kg FYM/sqm/yr +300VC/sqm+Azo+PSB	30.32	5.34	22.78	40	50.15	130.5	79.98	132.12	8.25
T5-50%RDF+1kg FYM/sqm/yr	24.56	4.3	23.52	33.12	37.87	115.3	87.15	88.35	8.33
T6-50%RDF+1kg FYM/sqm/yr +300VC/sqm	24.88	4.44	18.33	38.32	42.38	125.8	92.25	135.2	8.26
T7-50%RDF+1kg FYM/sqm/yr +300VC/sqm+Azo+PSB	26.32	3.15	20.56	38.2	43.25	120.6	83.56	95.6	8.1
CD (P=0.05)	1.5	NS	3.89	5.23	5.32	4.32	NS	NS	NS

Table 2.1b. Effect of integrated nutrient management treatments on bulb and bulblet production in tuberose cv. Prajwal at Hessaraghatta centre (2010-11)

Treatment	No. of bulbs/ plant	No. of bulblets/ plant	Girth of bulb (cm)	Wt. of bulblets/ plant
T1-100%RDF+2kg FYM /sqm/yr	5.33	25.53	6.75	30.8
T2--75%RDF+2kg FYM/sqm/yr	6.2	24.33	7.05	31.33
T3-75%RDF+1kg FYM/sqm/yr +300VC/sqm	8.13	23.73	7.21	32.07
T4-75%RDF+1kg FYM/sqm/yr +300VC/sqm+Azo+PSB	7.2	30.6	6.03	35.53
T5-50%RDF+1kg FYM/sqm/yr	5.67	30.73	6.67	43.33
T6-50%RDF+1kg FYM/sqm/yr +300VC/sqm	5.6	23.27	7.86	31.53
T7-50%RDF+1kg FYM/sqm/yr +300VC/sqm+Azo+PSB	5.73	26.6	7.6	32.5
CD (P=0.05)	NS	NS	NS	8.03

Table 2.1c. Effect of integrated nutrient management treatments on growth and flowering parameters in tuberose cv. Vaibhav at Hesaraghatta centre (2010-11)

Treatment	No. of leaves per clump	No. of side shoots per clump	No. of spikes per clump	No. of florets per spike	Length of spike (cm)	Wt. of spike (g)	Keeping quality of spikes (day)	Yield of spikes per m ²
T1-100%RDF+2kg FYM /sqm/yr	33.2	9.15	3.26	33.75	71.23	58.36	7.5	25.36
T2-75%RDF+2kg FYM/sqm/yr	29.51	9.33	4.2	32.98	68.85	63.52	7.6	29.36
T3-75%RDF+1kg FYM/sqm/yr +300VC/sqm	31.12	9.32	3.26	34.3	59.23	67.36	7.3	25.36
T4-75%RDF+1kg FYM/sqm/yr +300VC/sqm+Azo +PSB	29.32	9.22	3.82	34.54	68.95	60.12	7.32	25.93
T5-50%RDF+1kg FYM/sqm/yr	31.2	8.04	4.23	31.51	65.23	68.35	7.22	30.33
T6-50%RDF+1kg FYM/sqm/yr +300VC/sqm	30.11	9.36	3.25	32.87	65.33	66.49	7.6	28.35
T7-50%RDF+1kg FYM/sqm/yr +300VC/sqm+Azo+PSB	32.5	9.58	3.75	36.64	69.73	73.26	7.4	31.52
CD (P=0.05)	NS	NS	NS	2.88	4.95	NS	NS	2.58

Table 2.1d. Effect of integrated nutrient management treatments on bulb and bulblet production in tuberose cv. Vaibhav at Hesaraghatta centre (2010-11)

Treatment	No. of bulbs/clump	No. of bulblets/clump	Girth of bulb (cm)	Wt. of bulblets/plant
T1-100%RDF+2kg FYM /sqm/yr	3.83	26.8	9.19	23.13
T2--75%RDF+2kg FYM/sqm/yr	3.67	25.33	9.37	22.8
T3-75%RDF+1kg FYM/sqm/yr +300VC/sqm	3.73	28.53	7.63	27.27
T4-75%RDF+1kgFYM/sqm/yr +300VC/sqm+Azo+PSB	4.53	22.73	8.35	22.93
T5-50%RDF+1kg FYM/sqm/yr	3.33	20.87	8.36	19.07
T6-50%RDF+1kg FYM/sqm/yr +300VC/sqm	3.33	20.8	8.47	29.07
T7-50%RDF+1kg FYM/sqm/yr +300VC/sqm+Azo+PSB	3.4	23.87	9.35	25.53
CD (P=0.05)	NS	NS	NS	NS

Table 2.1e. Effect of integrated nutrient management treatments on growth and flowering in tuberose cv. Prajwal at Hesaraghatta centre (Pooled data of two crop seasons i.e. 2010 to 2012)

Treatment	No. of leaves per clump	No. of side shoots per clump	Yield of flowers/ m ² (g)	No. of florets/ spike	Yield of flowers/ ha (t)	100 bud weight in g	Length of spike (cm)	Wt. of spike (g)	Keeping quality of spikes (day)
T1-100%RDF*+2kg FYM / m ² /yr	18.3	3.67	1063.78	35.87	10.64	210.13	91.03	97.35	7.26
T2-75%RDF+2kg FYM/ m ² /yr	17.35	3.05	1340.81	39.43	13.41	216.52	95.3	92.55	7.84
T3-75%RDF+1kg FYM/ m ² /yr +300VC/ m ²	25.61	4.13	1494.41	36.76	14.94	220.47	88.54	107.85	7.72
T4-75%RDF+1kg FYM/ m ² /yr +300VC/ m ² +Azo+PSB	27.29	4.16	1764.74	41.01	17.65	233.54	82.11	129.67	7.56
T5-50%RDF+1kg FYM/ m ² /yr	23.63	3.89	1436.38	36.67	14.36	213.53	88.49	85.84	7.77
T6-50%RDF+1kg FYM/ m ² /yr +300VC/ m ²	20.76	2.48	1280.8	34.21	12.81	227.37	95.54	130.78	7.54
T7-50%RDF+1kg FYM/ m ² /yr +300VC/ m ² +Azo+PSB	22.42	3.03	1350.58	37.71	13.51	223.13	88.1	93.7	7.55
CD (P=0.05)	NS	0.79	184.93	2.96	1.84	6.34	6.31	8.11	NS

* RDF-200:200:200 Kg/ha NPK

Table 2.1f. Effect of integrated nutrient management treatments on bulb and bulblet production in tuberose cv. Prajwal at Hesaraghatta centre (Pooled data of two crop seasons)

Treatment	No. of bulbs/ clump	No. of bulblets/ clump	Girth of bulb (cm)	Weight of bulblets/ plant (g)
T1-100%RDF+2kg FYM / m ² /yr	3.86	18.5	8.76	26.02
T2--75%RDF+2kg FYM/ m ² /yr	4.49	20.12	9.17	28.45
T3-75%RDF+1kg FYM/ m ² /yr +300VC/ m ²	5.88	18.51	10.11	27.07
T4-75%RDF+1kg FYM/ m ² /yr +300VC/ m ² +Azo+PSB	5.6	24.2	9.4	28.93
T5-50%RDF+1kg FYM/ m ² /yr	4.51	24	9.11	35.38
T6-50%RDF+1kg FYM/ m ² /yr +300VC/ m ²	4.51	19.32	9.3	26.77
T7-50%RDF+1kg FYM/ m ² /yr +300VC/ m ² +Azo+PSB	4.53	21.13	9.89	26.75
CD (P=0.05)	NS	3.41	0.8	4.74

Table 2.1g. Effect of integrated nutrient management treatments on growth and flowering parameters in tuberose cv. Vaibhav at Hessaraghatta centre (Pooled data of two crop seasons)

Treatment	No. of leaves per clump	No. of side shoots per clump	No. of spikes per clump	No. of florets per spike	Length of spike (cm)	Wt. of spike (g)	Keeping quality of spikes (day)	Yield of spikes per m ²
T1-100%RDF+2kg FYM / m ² /yr	30.58	6.4	1.83	31.53	76.49	63.61	7.7	16.45
T2--75%RDF+2kg FYM/ m ² /yr	26.09	6.63	2.21	31.12	73.77	70.2	8.48	19.91
T3-75%RDF+1kg FYM/ m ² /yr +300VC/ m ²	27.15	6.69	1.78	32.19	64.94	79.38	8.66	16
T4-75%RDF+1kg FYM/ m ² /yr +300VC/ m ² +Azo+PSB	24.64	6.64	1.84	32.15	71.87	73.93	8.42	16.57
T5-50%RDF+1kg FYM/ m ² /yr	27.07	6.06	2.33	29.6	73.6	68.43	9.4	20.95
T6-50%RDF+1kg FYM/ m ² /yr +300VC/ m ²	26.53	6.78	2.15	30.54	71.36	81.91	8.31	19.33
T7-50%RDF+1kg FYM/ m ² /yr +300VC/ m ² +Azo+PSB	29.31	6.97	2.26	34.53	75.36	78.23	8.18	20.32
CD (P=0.05)	NS	NS	NS	2.08	6.28	NS	NS	2.03

Table 2.1h. Effect of integrated nutrient management treatments on bulb and bulblet production in tuberose cv. Vaibhav at Hessaraghatta centre (Pooled data of two crop seasons)

Treatment	No. of bulbs/ clump	No. of bulblets/ clump	Girth of bulb (cm)	Wt. of bulblets/ clump (g)
T1-100%RDF+2kg FYM / m ² /yr	2.79	19.83	9.43	27.35
T2--75%RDF+2kg FYM/ m ² /yr	2.63	17.82	9.15	26.75
T3-75%RDF+1kg FYM/ m ² /yr +300VC/ m ²	2.59	19.98	8.1	27.92
T4-75%RDF+1kg FYM/ m ² /yr +300VC/ m ² +Azo+PSB	3.1	16.63	9.1	26.12
T5-50%RDF+1kg FYM/ m ² /yr	2.48	15.36	8.87	25.27
T6-50%RDF+1kg FYM/ m ² /yr +300VC/ m ²	2.7	15.86	8.25	27.73
T7-50%RDF+1kg FYM/ m ² /yr +300VC/ m ² +Azo+PSB	2.53	17.41	8.93	31.45
C.D (P=0.05)	NS	NS	NS	NS

Table 2.1i. Economics of tuberose cv. Prajwal cultivation under integrated nutrient management at Hesaraghatta centre

Treatments	Total Cost (Rs.)	Total Returns (Rs.)	Net returns (Rs.)	BCR
T1-100%RDF+2kg FYM / m ² /yr	167115.2	425600	258484.8	2.55
T2--75%RDF+2kg FYM/ m ² /yr	180366.4	536400	356033.6	2.97
T3-75%RDF+1kg FYM/ m ² /yr +300VC/ m ²	194346.4	597600	403253.6	3.07
T4-75%RDF+1kg FYM/ m ² /yr +300VC/ m ² Azo+PSB	219246.4	706000	486753.6	3.22
T5-50%RDF+1kg FYM/ m ² /yr	180760	574400	393640	3.18
T6-50%RDF+1kg FYM/ m ² /yr +300VC/ m ²	178197.6	512400	334202.4	2.88
T7-50%RDF+1kg FYM/ m ² /yr +300VC/ m ² +Azo+PSB	191037.6	540400	349362.4	2.83

Table 2.1j. Economics of tuberose cv. Vaibhav cultivation under integrated nutrient management at Hesaraghatta centre

Treatment	Total Cost (Rs.)	Total Returns (Rs.)	Net returns (Rs.)	BCR
T1-100%RDF+2kg FYM / m ² /yr	139275.2	197400	58124.8	1.42
T2--75%RDF+2kg FYM/ m ² /yr	135906.4	238920	103013.6	1.76
T3-75%RDF+1kg FYM/ m ² /yr +300VC/ m ²	140706.4	192000	51293.6	1.36
T4-75%RDF+1kg FYM/ m ² /yr +300VC/ m ² Azo+PSB	149346.4	198480	49133.6	1.33
T5-50%RDF+1kg FYM/ m ² /yr	137337.6	251400	114062.4	1.83
T6-50%RDF+1kg FYM/ m ² /yr +300VC/ m ²	137337.6	231960	94622.4	1.69
T7-50%RDF+1kg FYM/ m ² /yr +300VC/ m ² +Azo+PSB	145977.6	243840	97862.4	1.67

Pune (Ganeshkhind)

Data revealed that the treatment T4 (75 % RDF + FYM (1kg/m²) + Vermicompost (300g/m²) + *Azospirillum* + PSB@ 2g/pl./y) recorded significantly more plant height, length of stalk, number of florets per spike, weight of 100 florets and vase life over rest of treatments. In respect of number of spikes per clump and bulbs per clump T₁ was found significantly superior over all the

treatments. Data revealed that in cultivar Suvasini, treatment T₁ (100 % RDF + FYM 2 kg/m²/year) recorded maximum number of flower stalk per plant in respect of weight of flower which is *at par* with T₄. While in case of number of flowers per stalk treatment T₁ found significantly superior than other treatment and followed by treatment T₄.

Table 2.2a. Integrated nutrient management in tuberose cultivar Phule Rajani at Pune (Ganeshkhind) centre (2010-11)

Treatment	Plant height (cm)	Length of stalk (cm)	No. of stalk /plant/y	No. of florets /stalk	Wt. of 100 flowers (g)	Vase life (day)	No. of bulbs /clump
T ₁	85.35	75.01	8.9	41.5	72.1	6.1	31.16
T ₂	83.75	74.5	7.18	39.6	65.6	6.15	26.7
T ₃	84.05	73.8	7.82	41.4	68.4	6.6	27.66
T ₄	85.9	76.41	8.86	43.3	77.91	7.16	28.5
T ₅	80.8	71.22	5.13	33.5	52.6	5.3	25.66
T ₆	81.45	71.61	6.05	35.4	59.5	5.5	23.33
T ₇	83.05	73.4	6.34	37.5	49.6	5.7	25.34
CD (P=0.05)	0.27	2.05	0.1	1.74	2.8	0.38	0.74

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Table 2.2b. Integrated nutrient management in tuberose cultivar Phule Rajani at Pune (Ganeshkhind) centre (2010-11)

Treatment	Plant height (cm)	Length of stalk (cm)	No. of stalks /plant/y	No. of florets /stalk	Wt. of 100 flowers (g)	Vase life (day)	No. of bulbs /clump
T ₁	96.7	93.6	6.5	37	158	5	23
T ₂	88.4	87	6	31.2	121.4	6.7	20.6
T ₃	92	89.4	5.7	33.5	127.8	5.6	22
T ₄	87.8	91.5	5.4	32	153	7.2	23.4
T ₅	84.9	79.7	4	30.7	115.8	5.4	20.8
T ₆	83	84.6	4.5	26.8	114	5	22.5
T ₇	81.8	80.7	5	37.4	126.5	6.7	21.7
CD (P=0.05)	NS	9.8	NS	5.1	10.7	1.6	6.4

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Kahikuchi

Three years pooled data revealed a significant effect of treatments in respect of number of leaves, side shoots, duration of flowering, length of spike, average weight of spike, number of spikes per m², number of bulbs per m² and average weight of bulbs. The maximum number of leaves, side shoots, duration of flowering, least days taken for flowering, number of florets, and yield of spikes and bulbs were recorded while the plants were fertilized by 75% of RDF along with 1kg FYM /m²/yr, 300g Vermicompost /m², 2g *Azospirillum* and phosphate solubilizing bacteria (PSB) per plant/yr which was followed by the treatment containing 100% recommended dose of fertilizer (RDF) along with 20 t of FYM per hectare.

Pooled results: Among the nutrient management combinations, treatment T7 (50% RDF + 2 kg/m² FYM + 300g/m² Vermicompost + *Azospirillum* + PSB) was the most superior in respect of number of leaves/plant (33.47), side shoots/plant(3.61), spike length (81.13 cm), spike fresh weight (108.79g), flower yield (18.69/m²), bulbs/clump (43.38) and bulb yield (391.0 nos./m²). The next best was T₄ (75% RDF + FYM 1 kg + Vermicompost 300g/ m² + *Azospirillum* + PSB), followed by T₁ (100% Recommended dose of inorganic fertilizers + FYM 2kg/ m²/yr). T₆ recorded the longest flowering duration (18.89day), followed by T₂ & T₅.

Table 2.3a. Effect of INM on growth attributing characters of tuberose Cv. Vaibhav at Kahikuchi centre (2008-10)

Treatment	Number of leaves at flowering stage				Number of side shoots at flowering			
	2008-09	2009-10	2010-11	Pooled	2008-09	2009-10	2010-11	Pooled
T ₁	21.26	24.9	22.53	22.89	10.76	4.73	7.36	7.96
T ₂	22.73	22.3	22.67	22.56	8.36	6.06	7.8	7.87
T ₃	22.46	22.5	21.33	22.09	7.1	6.77	7.63	7.25
T ₄	24.46	23.7	24.33	24.16	10.33	5.93	8.73	8.05
T ₅	22.23	21.6	20.3	21.37	6.1	6.73	5.93	6.07
T ₆	21.2	21.3	19.26	20.58	5.33	5.13	5.76	5.32
T ₇	22.4	21.9	22.67	22.32	7.16	8.73	6.5	7.59
C.D. (P=0.05)	NS	1.94	3.76	2.35	3.16	2.04	2.28	2.4

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m²/yr +300VC/ m² +Azo+PSB

Table 2.3b. Effect of INM on flower characters of tuberose Cv. Vaibhav at Kahikuchi centre (2010-11)

Treatment	Days taken for flowering				Duration of flowering (day)			
	2008-09	2009-10	2010-11	Pooled	2008-09	2009-10	2010-11	Pooled
T ₁	109.6	101.33	89.33	100.08	24.4	22.8	21.5	22.73
T ₂	108.16	101.66	90.33	100.15	20.7	21.3	22.67	21.55
T ₃	108.93	103	88.33	100.08	20.93	19.3	21.65	20.62
T ₄	105.2	103.33	80.66	96.39	22.06	21.3	23	23.12
T ₅	101.73	103.33	85	96.68	21.76	22.7	19.67	21.37
T ₆	104.96	99.67	83.33	95.98	21.53	20.03	20	20.52
T ₇	104.56	102	83	96.52	19.86	20.6	20.16	20.2
C.D. (P=0.05)	NS	NS	8.47	NS	4.5	2.23	NS	2.6

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Table 2.3c. Effect of INM on flower characters of tuberose Cv. Vaibhav at Kahikuchi centre (2010-11)

Treatment	Length of spike (cm)				Weight of spike (g)			
	2008-09	2009-10	2010-11	Pooled	2008-09	2009-10	2010-11	Pooled
T ₁	105.33	104.5	95.66	101.83	95.33	99.06	101.33	98.57
T ₂	96.3	95.55	93	94.95	106.56	98.86	94.33	99.91
T ₃	99.46	100.05	91.33	96.94	95.66	98.26	99.33	97.75
T ₄	94.66	96.05	104.33	98.34	92.66	96.8	103	97.48
T ₅	99.06	99.05	89	95.7	87	96.33	91.33	91.55
T ₆	105.35	104.7	92	100.68	98.66	97.8	97	97.82
T ₇	110.9	106.25	96	104.38	95	98.47	97.2	96.89
C.D.(P=0.05)	12.34	4.74	10.42*	NS	NS	3.8	9.54	NS

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Table 2.3c. Effect of INM on flower characters of tuberose Cv. Vaibhav at Kahikuchi centre (2010-11) continue..

Treatment	Number of spikes per clump				Number of florets per spike			
	2008-09	2009-10	2010-11	Pooled	2008-09	2009-10	2010-11	Pooled
T ₁	2.43	1.6	3.2	2.41	55.33	52.79	53.33	53.81
T ₂	2.56	1.93	2.3	2.26	55.1	51.76	51.67	52.84
T ₃	1.9	1.8	2.5	2.06	55.93	49.96	52.67	52.85
T ₄	2.33	2.45	3.5	2.76	55.23	51.53	54.65	53.9
T ₅	1.7	1.53	1.66	1.61	51.4	48.66	49.3	49.78
T ₆	1.93	1.26	1.4	1.53	53.52	51.6	50.65	51.92
T ₇	2.2	1.67	1.95	1.95	54.69	52.46	51.33	52.82
C.D. (P=0.05)	NS	0.54	1.21	0.91	NS	3.13	4.44	2.38

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Table 2.3d. Effect of INM on flower yield attributing characters of tuberose Cv. Vaibhav at Kahikuchi centre (2010-11)

Treatment	Avg. weight of 10 flowers (g)				Yield of loose flower per m2 (kg)			
	2008-09	2009-10	2010-11	Pooled	2008-09	2009-10	2010-11	Pooled
T ₁	19.69	20.83	18.7	18.99	2.29	2.36	2.11	2.25
T ₂	20.5	19.57	21.5	20.66	2.02	2.53	1.89	2.14
T ₃	21.46	20.6	20.33	20.26	2.6	2.61	2.02	2.41
T ₄	21.3	21.9	22.53	22.14	2.48	2.26	2.31	2.35
T ₅	20.07	19.13	16.66	17.91	2.12	2.13	1.6	1.95
T ₆	21.63	20.83	18.66	19.76	2.15	2.3	1.75	2.06
T ₇	22.91	20	20.33	21.08	2.38	2.26	1.9	2.18
C.D. (P=0.05)	NS	NS	3.6	2.56	NS	NS	NS	0.36*

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Table 2.3d. Effect of INM on flower yield attributing characters of tuberose Cv. Vaibhav at Kahikuchi centre (2010-11) continue..

Treatment	Vase life (day)				Yield of spike/m ²			
	2008-09	2009-10	2010-11	Pooled	2008-09	2009-10	2010-11	Pooled
T ₁	7.4	8.53	5.4	7.11	21.66	26.13	39.73	29.17
T ₂	7.2	8.43	5.03	6.88	20.33	25.43	40	28.58
T ₃	7.6	7.66	5.76	7	20.66	24.93	38.4	27.99
T ₄	8.4	8.23	7.46	8.03	21	22.36	46.44	29.94
T ₅	8	7.36	5.1	6.82	18.66	20.13	28.66	22.48
T ₆	8	8.36	5.06	7.14	18.66	21.16	32	23.94
T ₇	8.2	8	6.4	7.53	21.66	22.43	39	27.69
C.D. (P=0.05)	NS	NS	0.74	NS	NS	4.83	7.79**	6.31*

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m²/yr +300VC/ m² +Azo+PSB

Treatment	Size of bulb (cm)				Weight of bulbs (g)			
	2008-09	2009-10	2010-11	Pooled	2008-09	2009-10	2010-11	Pooled
T ₁	7.5	7.4	7.16	7.35	28.33	27.8	27.63	27.92
T ₂	8.08	7.56	6.4	7.34	30	30.53	29.53	30.02
T ₃	7.41	7.1	7.3	7.27	30	28.66	30.19	29.6
T ₄	7.5	7.43	7.7	7.54	36.67	36	37.26	36.64
T ₅	8	6.96	5.46	6.8	33.3	26.86	25.53	28.5
T ₆	8.16	7.5	6.56	7.4	36.67	29.13	28.43	31.41
T ₇	8.17	7.36	6.57	7.36	38.33	30.73	30.33	33.13
C.D. (P=0.05)	NS	NS	1.29	NS	NS	3.57	2.36	5.73

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m²/yr +300VC/ m² +Azo+PSB

Table 2.3e. Effect of INM on bulb yield attributing characters of tuberose Cv. Vaibhav at Kahikuchi centre (2010-11)

Treatment	Avg yield of bulbs/m ²			
	2008-09	2009-10	2010-11	Pooled
T ₁	305.06	292.33	299	298.79
T ₂	300.8	285	297	294.26
T ₃	250.13	287	295.66	277.59
T ₄	282.66	268.67	353.33	301.44
T ₅	224	259	275.33	252.77
T ₆	252.6	281.33	289	274.31
T ₇	230.4	276.33	292	266.24
C.D. (P=0.05)	NS	32.10*	26.54*	46.44

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Table 2.3f. Effect of INM on vegetative and flower characters at Kahikuchi centre

Treatment	No. of leaves per clump	No. of side shoots /plant	Days to flowering	Flowering duration (day)	Spike length (cm)
T ₁	37.8	3.73	68.53	16.31	83.4
T ₂	33.7	2.93	63.6	17.74	73.27
T ₃	40.7	3.73	62.87	15.88	76.53
T ₄	42.37	3.6	60.17	16.27	85.43
T ₅	34.03	2.87	52.37	17.83	73.37
T ₆	38	3.27	61.8	18.89	76.03
T ₇	40.67	3.53	67.27	16.81	80.73
CD (P=0.05)	2.93	0.2	4.05	1.27	3.06

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Table 2.3f. Effect of INM on vegetative and flower characters of tuberose at Kahikuchi centre (continue..)

Treatment	Spike weight (g)	No. of spikes /plant	No. of florets/ spike	Vase life (day)	100 flowers wt. (g)	Flower yield (no/m ²)
T ₁	109.13	2.27	44.83	7.27	112.47	20.4
T ₂	102.23	1.73	37.93	6.87	113.43	15.6
T ₃	106.77	1.67	39.13	7.07	114.8	15
T ₄	117.5	2.4	41.9	6.6	114.8	21.6
T ₅	96.83	1.5	35.53	7.27	113.9	13.5
T ₆	105.5	1.5	38.93	7.4	114.73	13.5
T ₇	119	2.47	46.4	7.33	114.17	22.2
CD (P=0.05)	6.13	0.5	3.78	0.48	NS	4.47

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Table 2.3g. Effect of INM on bulb characters of tuberose at Kahikuchi centre (2010-11)

Treatment	Bulbs/clump	Bulb diameter (cm)	Bulb weight (g)	Bulb yield (no/m ²)
T ₁	51.7	3.42	5.73	465.3
T ₂	38.47	3.55	5.7	346.2
T ₃	37.53	3.71	3.71	337.8
T ₄	51.77	4.46	6.05	465.9
T ₅	46.47	4.25	4.82	418.2
T ₆	45.3	4.43	4.66	407.7
T ₇	53.57	4.3	5.65	482.1
CD (P=0.05)	9.26	0.28	1.88	83.3

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Kalyani

A perusal of data reveals that more number of leaves were recorded with treatment T₄ where 25% of inorganic fertilizer was supplemented with the Vermicompost (300 g/m²) and biofertilizer (*Azospirillum* + PSB) as compared to T₂, T₃, T₆ and T₇ treatments.

Table 2.4. Effect of integrated nutrient management in tuberose on vegetative and floral characters at Kalyani centre

Treatment	No. of leaves /clump	Length of spike (cm)	Wt. of spike (g)	No. of spikes/ clump	No of florets /spike	Wt. of floret (g)	Yield of florets (g/m ²)	Yield of spike/ m ²	Vase life (day)
T ₁	58	109.4	154.4	8.1	52.8	1.87	7184	73	7.47
T ₂	52.4	111.8	148.1	6.8	49.7	1.85	5730	62	7.87
T ₃	58.2	113.3	164.6	7.4	53.5	2.02	6809	63	8.63
T ₄	61.9	123.6	173.4	8.6	50	2.07	7041	68	8.4
T ₅	49.1	110.5	150.2	4.7	52.9	1.87	5148	52	8.13
T ₆	56.3	118.3	165.4	7.9	53.3	2	7132	67	8.22
T ₇	54.2	117	161.8	7.5	52.2	2.05	6954	65	8.13
Mean	55.8	114.8	159.7	7.3	52.1	2	6571	64.2	8.13
C.D. (P=0.05)	4.86	6.71	NS	1.15	2.69	0.13	NS	NS	NS

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Table 2.4. Effect of integrated nutrient management of tuberose on vegetative and floral characters at Kalyani centre (continue..)

Treatment	No. of leaves/plant	Length of spike (cm)	Wt. of spike (g)	No. of spikes/ plant	No of florets /spike	Wt. of floret (g)	Yield of florets (g/m ²)	Yield of spike/ m ²	Vase life
T ₁	58	109.4	154.4	8.1	52.8	1.87	7184	73	7.47
T ₂	52.4	111.8	148.1	6.8	49.7	1.85	5730	62	7.87
T ₃	58.2	113.3	164.6	7.4	53.5	2.02	6809	63	8.63
T ₄	61.9	123.6	173.4	8.6	50	2.07	7041	68	8.4
T ₅	49.1	110.5	150.2	4.7	52.9	1.87	5148	52	8.13
T ₆	56.3	118.3	165.4	7.9	53.3	2	7132	67	8.22
T ₇	54.2	117	161.8	7.5	52.2	2.05	6954	65	8.13
Mean	55.8	114.8	159.7	7.3	52.1	2	6571	64.2	8.13
C.D. (P=0.05)	4.86	6.71	NS	1.15	2.69	0.13	NS	NS	NS

T1-100%RDF+2kg FYM / m² /yr, T2-75%RDF+2kg FYM/ m² /yr, T3-75%RDF+1kg FYM/ m² /yr +300VC/ m², T4-75%RDF+1kg FYM/ m² /yr +300VC/ m² Azo+PSB, T5-50%RDF+1kg FYM/ m² /yr, T6-50%RDF+1kg FYM/ m² /yr +300VC/ m², T7-50%RDF+1kg FYM/ m² /yr +300VC/ m² +Azo+PSB

Hyderabad

Earliest flowering and maximum number of shoots per plant were recorded with treatment T₂ (75%RDF +FYM -2kg/m²/yr) while maximum duration of flowering was recorded in treatment T₄ (75%RDF + FYM -1kg/m²/yr) + Vermicompost (300g/m²+ *Azospirillum* +PSB. Maximum spike weight, number of spikes per clump and spikes per m² were recorded in treatment T₄-75%RDF + FYM (1kg/m²/yr) + Vermicompost (300g/m² + *Azospirillum* + PSB. Maximum number of florets per spike was recorded in treatment T₁ -100%RDF +FYM(2kg/m²/yr) followed by treatment T₄ -75%RDF +FYM (1kg/m²/yr)+ Vermicompost (300g/m²+ *Azospirillum* + PSB. The vase life of flowers was also maximum in T₄ treatment.

Table 2.5a. Performance of tuberose under INM treatment at Hyderabad centre (2010-2011)

Treatment	No of leaves/ clump	No. of side shoots/ /pl.	Days taken for flowering	Duration for flowering (day)	Spike		No. of spikes/ bulb	No. of florets/ spike	Wt. of florets (g)	Yield of spikes/ m ²	Keeping quality of spikes (day)
					Length (cm)	Weight (g)					
T ₁ - 100% RDF+FYM	20.7	9.67	63.73	162	75.37	90.33	1.15	49.83	1.65	58.33	7.17
T ₂ - 75% RDF+FYM	19.73	12.47	59.67	170	75.24	92.67	1.53	45.63	1.65	58	7.1
T ₃ - 75% RDF+FYM+ Vermicompost	21.18	9.15	70.07	175	66.27	90.63	1.28	44.42	1.41	58	7.07
T ₄ - 75% RDF+FYM+ VC+Azo+PSB	22.13	10.13	71.8	185	71.3	96.33	1.73	47.2	1.1	60	8.1
T ₅ - 50% RDF+FYM	19	9.43	62.53	165	71.28	92.67	1.6	42.88	1.38	54.67	6
T ₆ - 50% RDF+FYM+ VC	21.8	9.43	61	170	69.79	94.8	1.5	45.64	1.12	54.02	7
T ₇ - 50% RDF+FYM+ VC+Azo+PSB	24.17	10.9	70.67	165	68.8	95	1	39.95	0.93	56.2	8
CD (P=0.05)	NS	0.6	7.12	3.56	5.08	3.36	0.26	5.34	NS	1.84	0.15

Table 2.5b. Performance of tuberose cv. Hyderabad Double under INM at Hyderabad centre (2011-2012)

Treatment	Plant height (cm)	No of leaves/clump	Days taken for flowering	Duration for flowering (day)	Spike Length (cms)	Rachis length (cm)	No. of spikes/clump	No. of florets/spike	Floret length (cm)	Floret diam. (cm)	Yield of spikes/m ²
T ₁ - 100% RDF+FYM	53.63	20.33	67.33	166	99.29	25.79	1.8	44.53	6.25	4.29	22.33
T ₂ - 75% RDF+FYM	48.74	18.6	57.96	172	93.97	26.85	1.67	44.47	6.32	4.27	21.33
T ₃ - 75% RDF+FYM+ Vermicompost	48.8	18.9	70.12	177	90.17	26.37	1.6	45.8	6.41	4.23	19.67
T ₄ - 75% RDF+FYM+ VC+Azo+PSB	50.73	19.13	74.38	189	94.41	29.07	2	47.53	6.21	4.13	25
T ₅ - 50% RDF+FYM	46.05	18.07	63.52	167	86.63	22.51	1.27	39.27	6.31	4.19	17.67
T ₆ - 50% RDF+FYM+ VC	45.99	17.27	62.12	172	86.07	25.11	1.6	39.47	6.03	4.04	20
T ₇ - 50% RDF+FYM+ VC+Azo+PSB	46.15	18.8	70.73	167	87.79	25.29	1.73	39.8	6.21	4.22	17.33
CD (P=0.05)	3.25	1.68	7.12	3.56	3.48	3.44	0.24	2.89	0.19	0.13	5.03

4. Postharvest Technology and Value Addition

Experiment 3.1	: Effect of holding solutions on keeping quality of cut tuberose flowers.
Objective	: To work out suitable holding solutions for improving vase life of cut tuberose stems at the consumer level.
Duration	: Three years (Ongoing)
Centres	: Hyderabad, Kahikuchi, Kalyani, Ludhiana, Udaipur and Pune
Cultivar	: Srinagar
Stage of harvest	: Fully developed unopened buds
No. of treatments	: Eleven <ol style="list-style-type: none">1. $\text{Al}_2(\text{SO}_4)_3 \cdot 16\text{H}_2\text{O}$, 300 ppm2. Cobalt chloride, 100 ppm3. Citric acid, 200 ppm4. BAP, 25 ppm5. Sucrose (5%) + (source CaOCl_2)6. Sucrose (5%) + $\text{Al}_2(\text{SO}_4)_3 \cdot 16\text{H}_2\text{O}$7. Sucrose (5%) + Cobalt chloride8. Sucrose (5%) Citric acid, 200 ppm9. Sucrose (5%) + BAP10. Sucrose (3%) + chlorine11. Control (Double distilled water)
No. of replications	: Three
Statistical design	: CRD
No. of stems/replication	: Three

The freshly harvested stems were cooled at 2.5-3°C for 6h. After recutting the basal 2 cm portion, the will be put in vase solution as mentioned above. The vase life evaluated in plain water at $23 \pm 2^\circ\text{C}$ and 16h illumination (1000 lux intensity provided by 40 W fluorescent tubes), under laboratory conditions.

Observations recorded

1. Vase life (till half of the florets show wilting).
2. Maximum floret diameter attained in vase (mean of basal 3 florets/stem).
3. Maximum florets open at one time.

4. Total water absorbed/stem (ml).
5. Any phytotoxic symptom of the chemical.

Report

Kahikuchi

Three years (2008-11) pooled data revealed significant differences among the treatments in respect of vase life, maximum floret opening at a time and total water absorbed by the spikes and maximum floret diameter. Among the holding solutions Citric acid, 200 ppm along with 5% sucrose registered maximum vase life at 50 per cent florets showed withering symptom. This was closely followed by 100ppm of cobalt chloride and 300ppm $Al_2(SO_4)_3$ while combined with 5% sucrose solution. These three treatments are statistically on par. However, maximum water uptake was recorded either in the holding solution containing 300ppm of $Al_2(SO_4)_3$ in combination with sucrose 5 % or $Al_2(SO_4)_3$ alone . The BAP (25 ppm) treated spikes showed the least response for all the characters under observation.

Table 3.1a. Effect of holding solutions on keeping quality of tuberose cut spike Cv.Prajwal at Kahikuchi centre (2008-10)

Treatment	Vase life at 50% floret shows withering symptom(day)			
	2008-09	2009-10	2010-11	Pooled
T ₁ = $Al_2(SO_4)_3$ 300ppm	5.24	6.1	6.9	6.08
T ₂ =Cobalt chloride 100ppm	4.33	5.59	4.17	4.69
T ₃ =Citric acid 200ppm	4.66	4.63	4.33	4.54
T ₄ =BAP 25ppm	4	4.27	4.34	4.2
T ₅ =Chlorine 50ppm	5	4.6	5.2	4.93
T ₆ =Sucrose 5%	5.1	5.26	6.24	5.53
T ₇ = $Al_2(SO_4)_3$ 300ppm+ Sucrose 5%	6.22	6.56	6.71	6.49
T ₈ = Cobalt chloride 100ppm + Sucrose 5%	6.34	6.23	7.05	6.54
T ₉ = Citric acid 200ppm + Sucrose 5%	6.83	6.3	7	6.71
T ₁₀ = BAP 25ppm + Sucrose 5%	5.28	5.03	6.5	5.6
T ₁₁ = Chlorine 50ppm + Sucrose 5%	5.1	5.1	7.13	5.77
T ₁₂ =Control (plain water)	4.22	4.76	4.5	4.49
C.D. (P=0.05)	2.02	1.99	1.33	1.08

Table 3.1b. Effect of holding solutions on keeping quality of tuberose Cv. Prajwal cut spike at Kahikuchi centre (2008-10)

Treatment	Total water absorbed(ml)			
	2008-09	2009-10	2010-11	Pooled
T ₁ =Al ₂ (SO ₄) ₃ 300ppm	34.6	31.63	46.66	37.63
T ₂ =Cobalt chloride 100ppm	40.4	23.63	26.33	30.12
T ₃ =Citric acid 200ppm	31.2	21.86	33	28.68
T ₄ =BAP 25ppm	28.6	19.3	25.66	24.52
T ₅ =Chlorine 50ppm	23.4	22.5	23.33	23.07
T ₆ =Sucrose 5%	32.7	30.3	35	32.66
T ₇ =Al ₂ (SO ₄) ₃ 300ppm+ Sucrose 5%	36.7	39.76	62.33	46.26
T ₈ = Cobalt chloride 100ppm + Sucrose 5%	29.4	34.06	25	29.48
T ₉ = Citric acid 200ppm + Sucrose 5%	38.7	28.63	27.33	31.55
T ₁₀ = BAP 25ppm + Sucrose 5%	26.7	8.86	20.33	18.63
T ₁₁ = Chlorine 50ppm + Sucrose 5%	33.6	14.43	31.33	26.45
T ₁₂ =Control (plain water)	30.4	20.16	22.33	24.29
C.D. (P=0.05)	3.59	12.25	13.2	13.68

Table 3.1c. Effect of holding solutions on keeping quality of tuberose cv. Prajwal cut spike at Kahikuchi centre (2008-10)

Treatment	Maximum number of florets open at a time			
	2008-09	2009-10	2010-11	Pooled
T ₁ =Al ₂ (SO ₄) ₃ 300ppm	5.6	5.36	9	6.65
T ₂ =Cobalt chloride 100ppm	5.2	4.9	7.66	5.92
T ₃ =Citric acid 200ppm	4.6	4.73	6.33	5.22
T ₄ =BAP 25ppm	4.33	4.2	5	4.51
T ₅ =Chlorine 50ppm	5	4.93	6	5.31
T ₆ =Sucrose 5%	5	5	4.7	4.9
T ₇ =Al ₂ (SO ₄) ₃ 300ppm+ Sucrose 5%	5.74	5.33	7.66	6.24
T ₈ = Cobalt chloride 100ppm + Sucrose 5%	5.7	5.6	6	5.76
T ₉ = Citric acid 200ppm + Sucrose 5%	5.29	5	6.66	5.65
T ₁₀ = BAP 25ppm + Sucrose 5%	5.2	4.93	4.66	4.93
T ₁₁ = Chlorine 50ppm + Sucrose 5%	4.82	4.56	6.33	5.23
T ₁₂ =Control (plain water)	4.82	4.56	6.33	4.39
C.D. (P=0.05)	0.82	0.51	2.73	1.76

Table 3.1d. Effect of holding solutions on keeping quality of tuberose Cv. Prajwal cut spike at Kahikuchi centre (2008-10)

Treatment	Maximum floret diameter(cm)			
	2008-09	2009-10	2010-11	Pooled
T ₁ =Al ₂ (SO ₄) ₃ 300ppm	3.25	3.13	3.47	3.28
T ₂ =Cobalt chloride 100ppm	3.3	3.2	3.77	3.42
T ₃ =Citric acid 200ppm	3.2	3.46	3.47	3.37
T ₄ =BAP 25ppm	3.2	2.96	2.6	2.92
T ₅ =Chlorine 50ppm	3.25	3.3	3.5	3.35
T ₆ =Sucrose 5%	3.33	2.97	3.63	3.31
T ₇ =Al ₂ (SO ₄) ₃ 300ppm+ Sucrose 5%	3.2	3.17	3.63	3.33
T ₈ = Cobalt chloride 100ppm + Sucrose 5%	3.4	3.37	1.77	2.84
T ₉ = Citric acid 200ppm + Sucrose 5%	3.45	3.06	3.2	3.23
T ₁₀ = BAP 25ppm + Sucrose 5%	3.28	2.9	2.7	2.96
T ₁₁ = Chlorine 50ppm + Sucrose 5%	3.25	3.03	3.07	3.11
T ₁₂ =Control (plain water)	3.2	3	3.07	3.09
C.D. (P=0.05)	NS	0.04	0.26	NS

Ludhiana

Flower stems of local cultivar tuberose with Single flowers were harvested at bud stage and placed in holding solutions comprising of Al₂(SO₄)₃.16H₂O, 300 ppm; cobalt chloride (CoCl₂), 100 ppm; citric acid, 200 ppm; BAP, 25 ppm; chlorine (prepared from CaOCl₂), 50 ppm individually as well as in combination with sucrose (5%). The control stems were placed in water. Among the various holding solutions, aluminium sulphate followed by chlorine significantly increased vase life as compared to control. The effect of these chemicals was further enhanced when used in combination with sucrose (5%).

Table 3.2. Effect of holding solutions on keeping quality of cut stems of tuberose local cultivar at Ludhiana centre (Pooled data for 2008-09 to 2010-11)

Treatment	Vase life (day)				Maximum florets open at one time			
	2008-09	2009-10	2010-11	Mean	2008-09	2009-10	2010-11	Mean
Al ₂ (SO ₄)3.16H ₂ O, 300	6.44	6	7.03	6.49	9.33	7	6.89	7.74
Cobalt chloride, 100	4.78	4.78	4.78	4.78	6.11	6.77	5.89	6.26
Citric acid, 200	5.44	5.33	5.67	5.48	6	7.11	5.56	6.22
BAP, 25	4.89	4.89	4.44	4.74	4.89	6.44	5.78	5.7
Chlorine (CaOCl ₂), 50	3.44	4.67	6.22	4.78	4.11	7.22	6.67	6
Sucrose, 5%+Al ₂ (SO ₄)3.16H ₂ O, 300	8	7.67	8.11	7.93	8.33	9.22	8.44	8.66
Sucrose, 5%+ Cobalt chloride, 100	6.22	6.11	6.11	6.15	6.67	8.89	7.22	7.59
Sucrose, 5%+ Citric acid, 200	6.78	5.11	6.22	6.04	7.44	8.44	7.78	7.89
Sucrose, 5%+ BAP, 25	5.67	4.67	4.78	5.04	6	6.55	5.78	6.11
Sucrose, 5%+ Chlorine (CaOCl ₂), 50	6.11	6.44	7	6.52	5.55	7.67	8.33	7.18
Control (water)	6	4.89	5	5.3	5.33	6.22	6.78	6.11
CD (P=0.05)	0.93	0.74	0.72	–	NS	NS	1.33	–

Pune

Among the 11 holding solutions tried Sucrose 5%+citric acid 200ppm found significantly superior in respect of vase life , flower diameter and solution absorbed / stalk in tuberose.

Table 3.3. Effect of holding solution on keeping quality of cut flowers of tuberose cv. Phule Rajani at Pune centre (2010-11)

Treatment	Vase life (day)	Floret dia. (cm)	Solution absorb / stalk (ml)	Phytotoxicity symptoms
Aluminium sulphate 300 ppm	6.07	3.3	24.06	Nil
Cobalt chloride 100 ppm	5.37	3	19.66	Nil
Citric acid 200 ppm	5.8	3.56	23.13	Nil
BAP 25 ppm	5.87	3.13	19.8	Nil
Sucrose 5 % + Caocl ₂ 100 ppm	5.96	3.06	21.23	Nil
Sucrose 5 % + Aluminium sulphate 300 ppm	8.1	3.53	26.16	Nil
Sucrose 5 % + Cobalt chloride 100 ppm	5.86	3.13	20.56	Nil
Sucrose 5 % + Citric acid 200 ppm	8.77	3.86	27.46	Nil
Sucrose 5 % + BAP 25 ppm	5.03	3.03	20.7	Nil
Sucrose 5% + Calcium hypochlorite 70ppm	5.8	2.9	21.1	Nil
Control (Tap water)	4.67	0.09	22	Nil
CD (P=0.05)	0.42	NS	1.19	-

Hyderabad

Among different holding solutions, the treatment T6 i.e. sucrose 5% + Al₂ (SO₄)₃ 16H₂O 300 ppm recorded significantly maximum vase life and total water absorbed per stem. Chlorine at 50 ppm showed leaf yellowing and wilting. The holding solution of Sucrose 5% + Al₂ (SO₄)₃ 16H₂O 300 ppm increased vase life of cut tuberose stems.

Table 3.4. Effect of holding solutions on keeping quality of cut flowers of tuberose cv. Hyderabad Single at Hyderabad centre (2010-11)

Treatment	Vase life (day)	Floret diam. in vase (cm)	No. of florets opened at one time	Total water absorbed ml/stem	Any phytotoxic symptoms
Al ₂ (SO ₄) ₃ 16 H ₂ O 300 PPM	6.2	4	5.8	21	Nil
Cobalt choride 100 ppm	5.4	3.9	5	21.7	Nil
Citric acid 200ppm	5.5	3.7	4	23.5	Nil
BAP 25ppm	5.9	3.9	5.1	26.1	Nil
Chlorine (Source CaOCl ₃) 50 ppm	5.4	4	4.9	21	Yellowing of leaves
Sucrose 5%+ Al ₂ (SO ₄) ₃ 16 H ₂ O 300 ppm	7	4.1	5	29	Nil
Sucrose 5% + Cobalt chloride 100 ppm	5.8	3.8	5.7	21.8	Nil
Sucrose 5% + Citric acid, 200ppm	5.6	3.6	5	21.1	Nil
Sucrose 5% +BAP 25 ppm	5.9	3.7	5.1	20.5	Nil
Sucrose 3% +Chlorine 50 ppm	5.2	3.8	5.2	21	Yellowing & Wilting of leaves
Control (water)	5.5	3.9	5.1	21.5	Nil
C.D (P=0.05)	1.03	NS	NS	3.1	-

Kalyani

Data exhibited that among different vase solutions, T₉ (Sucrose 5% + BAP,25 ppm) was the best resulted into maximum vase life. Largest size of flowers in vase was found in T₂ (Cobalt chloride, 100 ppm). Maximum flowers opened at a time and maximum amount of water absorbed per stem was found in T₈ (Sucrose 5% + Citric acid, 200 ppm).

Table 3.5. Effect of different vase solutions on post harvest behavior of tuberose cv. Shringar at Kalyani centre (2010-11)

Treatment	Vase life (day)	Maximum floret diam. (cm)	No. of florets open at a time	Total water absorbed / stem(ml/100 g of stem)	Any phyto toxic symptom
T ₁	5	2.8	7.67	65.01	No such
T ₂	6.33	2.9	9.67	102.76	
T ₃	6	2.5	9	90.63	
T ₄	6.67	2.47	7.67	104.04	
T ₅	5	2	5	47.8	
T ₆	5	2.67	8	44	
T ₇	5.67	2.57	6.67	65.74	
T ₈	6.67	2.43	10.33	131.43	
T ₉	7	2.03	4	67.33	
T ₁₀	5	1.8	6	39.74	
T ₁₁	4.33	1.4	2.67	57.01	
CD (P=0.05)	1.21	0.73	NS	NS	

T1 = Al₂ (SO₄)₃ 16 H₂O 300 PPM, T2 = Cobalt choride 100 ppm, T3 = Citric acid 200ppm, T4 = BAP 25ppm, T5 = Chlorine (Source CaOCl₃) 50 ppm, T6 = Sucrose 5%+ Al₂ (SO₄)₃ 16 H₂O 300 ppm, T7 = Sucrose 5% + Cobalt chloride 100 ppm, T8 = Sucrose 5% + Citric acid, 200ppm, T9 = Sucrose 5% +BAP 25 ppm, T10 = Sucrose 3% +Chlorine 50 ppm, T11 = Control (water)

Udaipur

Data revealed that various holding solutions have significant effect on keeping quality of cut spikes in tuberose cv. Shringar. Among various treatments, Sucrose 5%+ Alumunium Sulphate @ 300ppm (T6) recorded the highest value for vase life, floret diameter , number of floret open at one time and total water absorbed per spike followed by Sucrose(5%)+ BAP @ 25ppm (T9) and better over the control. No phytotoxic symptoms were observed under all the treatment.

Table 3.6. Effect of holding solutions on keeping quality of cut flowers of tuberose cv. Shringar at Udaipur centre (2010-11)

Treatment	Vase life (day) 50% floret show wilting	Floret diam. in vase (cm)	No. of florets open at one time	Total water absorbed per stem (ml)	Any phytotoxic symptoms of the chemical
	1	2	3	5	6
T ₁	6.5	3.73	3.33	26.66	-Nil-
T ₂	6	3.63	3.66	26.33	-Nil-
T ₃	5.69	3.6	3.66	26	-Nil-
T ₄	6.03	3.83	4	24.66	-Nil-
T ₅	5.08	3.73	3	24.33	-Nil-
T ₆	7.19	4.06	4.33	30	-Nil-
T ₇	5.91	3.5	2.66	22.66	-Nil-
T ₈	5.83	3.5	2.66	23.33	-Nil-
T ₉	6.83	3.96	4	28	-Nil-
T ₁₀	5.05	3.63	2.66	21.66	-Nil-
T ₁₁	4.61	3.06	2.66	19	-Nil-
CD (P=0.05)	0.56	0.44	NS	2.53	-

T1 = Al₂ (SO₄)₃ 16 H₂O 300 PPM, T2 = Cobalt choride 100 ppm, T3 = Citric acid 200ppm, T4 = BAP 25ppm, T5 = Chlorine (Source CaOCl₃) 50 ppm, T6 = Sucrose 5%+ Al₂ (SO₄)₃ 16 H₂O 300 ppm, T7 = Sucrose 5% + Cobalt chloride 100 ppm, T8 = Sucrose 5% + Citric acid, 200ppm, T9 = Sucrose 5% +BAP 25 ppm, T10 = Sucrose 3% +Chlorine 50 ppm, T11 = Control (water)

Experiment 3.2 : Studies on refrigerated storage of cut tuberose stems.

Objective : To work out the storage life of tuberose stems for regulating marketing.

Duration : Three years (Ongoing)

Cultivar : Shringar

Stage of harvest : Fully developed buds (unopened)

No. of treatments : Seven

(Storage duration) : (0, 3, 6, 9, 12, 15 and 18 day)

No. of stems/replication : Ten

No. of replications : Five

Statistical design : CRD

Harvested stems were immediately put in water and pre-cooled at 2.5-3°C in cool chamber for 0, 3, 6, 9, 12, 15 and 18 day. After storage, the basal 2-3 cm portions recut. Vase life parameters evaluated in plain distilled water at $23 \pm 2^\circ\text{C}$ and 16h illumination (1000 lux intensity provided by 40 W fluorescent tubes), under laboratory conditions.

Observations recorded

1. Vase life (till half of the florets show wilting)
2. Maximum floret diameter attained in vase (mean of basal 3 flowers/stem)
3. Maximum florets open at one time
4. Total water absorbed/stem (ml)
5. Percent loss/gain in fresh weight after storage.

Report

Hyderabad

Increase in duration of refrigerated storage of cut tuberose stems beyond 3 days significantly decreased the vase life. Total water absorbed per stem initially increased but declined drastically with prolonged storage. Refrigerated storage of cut stems of tuberose beyond 3 days significantly reduced the vase life.

Table 3.7. Effect of storage duration on refrigerated storage of cut stems of tuberose cv. Hyderabad Double at Hyderabad centre (2010-11)

Storage duration (day)	Vase life (day)	Floret diam. (cm)	No. florets opened at one time	Total water absorbed ml/Stem	Any phytotoxic symptoms
0	5	3.9	4	23.4	Nil
3	4.9	4	5.1	26	Nil
6	3.9	3.8	5	21.2	Nil
9	3	3.7	4.9	18	Nil
12	2.5	3.8	5	16	Nil
15	0.5	3.7	5.8	12	Nil
18	0.3	3.7	5.7	10	Nil
C.D (P=0.05)	0.61	NS	NS	3.3	-

Kalyani

Storage for 3 days was the best treatment resulting minimum weight loss, maximum vase life with maximum floret diameter and also causing maximum water uptake) and maximum number of florets opened at a time compared to other durations of storage.

Table 3.8. Effect of refrigerated storage on post harvest behaviour of tuberose at Kalyani centre (2010-11)

Treatment (day)	Weight loss during simulated transit	Vase life (day)	Floret diam. (cm)	No. of florets opened at a time	Total water absorbed /stem (ml/100 gm of stem)
0	0	6.6	4.18	4.67	81.13
3	5.61	4.95	3.83	4.33	45.64
6	4.72	3.33	3.17	3.67	42.05
9	-2.18	0	0	0	0
12	-4.33	0	0	0	0
15	-6.62	0	0	0	0
18	-12.06	0	0	0	0
C.D. (P=0.05)	9.68	0.76	1.21	1.36	41.98

Kahikuchi

Exposure of tuberose cv. Prajwal spikes with fully developed unopened buds to cold storage (2.5 – 3 deg. C) duration of 3 & 6 days had significant positive influence on vase life, floret diameter, florets open at a time & were *at par* with control (D₀). Pooled analysis also revealed the same trend. Treatment for 3 day (D₃) produced the best effect, followed by D₆ but exposure for longer duration reduced the flower quality significantly.

Table 3.9a. Effect of cold storage duration on post harvest characters of tuberose cv. Prajwal (spikes wrapped in plastic film) at Kahikuchi centre (2008-10)

Cold storage duration (day)	Vase life (day)				Floret diameter (cm) in vase			
	08-Sep	09-Oct	10-Nov	Pooled	08-Sep	09-Oct	10-Nov	Pooled
SD ₀	6.4	5.9	5.8	6.03	5.12	5.22	5.1	5.15
SD ₃	5.37	5.7	5.5	5.52	5.02	4.82	5.22	5.02
SD ₆	4.87	4.5	4.6	4.66	4.65	4.8	4.78	4.74
SD ₉	3.51	3.7	3.4	3.54	4.16	4.22	4.32	4.23
SD ₁₂	2.65	2.8	2.7	2.72	3.87	2.64	2.66	3.06
SD ₁₆	0.67	1.2	1.1	0.99	0	1.32	1.28	0.87
SD ₁₈	0.67	0.7	0.6	0.66	0	1.24	1.26	0.83
CD (P=0.05)	0.37	0.71	1.8	0.96	0.14	1	1.86	1.01

* spikes were covered with plastic film before putting in cold storage.

Table 3.9b. Effect of cold storage duration on post harvest characters of tuberose cv. Prajwal at Kahikuchi centre (2008-10)

Cold storage duration (day)	Florets opened at a time				Water uptake / stem (ml)			
	08-Sep	09-Oct	10-Nov	Pooled	08-Sep	09-Oct	10-Nov	Pooled
SD ₀	4.8	5.1	4.9	4.93	90	88	24.74	67.58
SD ₃	4	4.9	4.5	4.46	81	80	19.94	60.31
SD ₆	3.5	4.2	4.3	4	78	77.5	13.67	50.39
SD ₉	3	3.4	3.2	3.2	72	74	7.81	51.27
SD ₁₂	2.65	1.7	1.8	2.05	70	75.5	6.87	50.79
SD ₁₆	0	0.8	0.7	0.5	56	55	4.74	38.58
SD ₁₈	0	0.6	0.5	0.37	25	24.5	3.74	17.75
CD (P=0.05)	0.11	0.4	1.5	1	1.15	10.04	1.16	4.12

Table 3.9c. Effect of cold storage duration on post harvest characters of tuberose cv. Prajwal at Kahikuchi centre (2008-10)

Cold storage duration (day)	Weight gain during storage (%)			
	08-Sep	09-Oct	10-Nov	Pooled
SD ₀	2.15	2.22	2.35	2.24
SD ₃	3.05	2.86	2.34	2.75
SD ₆	2.55	2.43	2.64	2.54
SD ₉	2.33	2.39	2.46	2.39
SD ₁₂	0.79	0.86	0.95	0.87
SD ₁₆	0.5	0.45	0.52	0.49
SD ₁₈	0	0.22	0.23	0.15
CD (P=0.05)	0.82	0.33	0.26	0.47

Ludhiana

Freshly harvested stems of tuberose Local cultivar, Single petalled were placed in distilled water and stored at 2.5-3.0°C for 0, 3, 6, 9, 12, 15 and 18 day. Keeping quality of cut stems was evaluated in plain distilled water. The increase in storage duration decreased vase life of the stems, the maximum vase life was observed in freshly-harvested stems. Vase life of the stems showed marginal decrease after 3 days of storage. The stems did not exhibit opening of florets after 12 day of storage onwards. The stems also showed decline in water absorption with increase in storage duration. Stems of tuberose could only be wet-stored for 3 day. Thereafter, the vase life showed considerable decline and the buds failed to open.

Table 3.10. Effect of refrigerated storage on keeping quality of cut stems of tuberose Local cultivar at Ludhiana centre (2010-11)

Storage duration (day)	Vase life (day)	Floret diam. (cm)	No. of Florets open at one time	Total water absorbed/stem (ml)	Per cent increase in fresh weight
3	5.45	3.2	6.44	36.78	10.10(18.52)
6	3.33	2.9	3.22	28.44	8.13(16.54)
9	1.44	2.97	2.22	20.78	10.00(18.43)
12	0	0	0	0	10.04(18.46)
15	0	0	0	0	8.70(17.12)
18	0	0	0	0	9.14(17.57)
0 day (Control)	6.33	3.2	7.67	44.89	-
CD (P=0.05)	0.45	0.18	1.51	4.53	NS

Figures in parentheses are arc sine transformed values

Pune (Ganeshkhind)

Data revealed that the maximum self life of flowers , floret diameter and water absorbed per stem was observed at zero days duration and also less number of florets open at one time and per cent loss or gain of weight after storage as well as stimulate transit). However, more self life was recorded in 12 day cold storage (12+2.0 day).

Table 3.11. Studies on refrigerated storage of cut stem of tuberose cv. Shringar at Pune (Ganeshkhind) centre (2010-11)

Treatment (day)	Vase life (day)	Floret diam. in vase (cm)	No. of florets open at one time	Total water absorbed (ml)	Percent gain in fresh wt.
	1	2	3	4	5
0	4.53	3.26	3.2	35.2	4.3
3	4.36	3.26	3.4	33	5.19
6	4.2	3.24	3.2	29.4	4.09
9	3.8	3.1	2.6	27.6	-0.44
12	3.06	3	2.6	23.4	-3.26
15	2.76	2.66	2.2	19.2	-10.48
18	2.13	2.48	2	17.8	-17.43
CD (P=0.05)	0.56	0.34	NS	1.81	5.59

Experiment 3.3 : **Standardization of postharvest technology for short distant market of tuberose**

Duration : Three years (2010-11 Onwards)

Centres : Hyderabad, Kahikuchi, Kalyani, Ludhiana, Pantnagar, Pune and Udaipur

Cultivar : Suvasini or any Double petalled cultivar specific for the region.

Stage of harvest : Well developed buds (before opening)

Packaging materials : Four
i. LDPE-100 gauge
ii. PP-100 gauge
iii. Cellophane
iv. Control (without packing).

Duration of simulated transit : At ambient condition for = 16h.
CFB boxes with vents.

Observations recorded

1. Vase life (till ½ of florets show wilting)-(day)
2. Diameter of basal floret (cm)
3. Total water absorbed/(ml)
4. Percent loss in weight after simulated transit

Report

Hyderabad

Studies on standardization of post harvest technology for short distant market of tuberose cv.Hyderabad Single were carried out as per suggested technical programme. Data revealed that different packing materials did not differ as regard to vase life and floret size and water absorption /stem. Minimum weight loss was recorded in LDPE 100 guage (3.6%) and maximum in control (5.6%).

Table 3.12. Standardization of post harvest technology for short distant market of tuberose cv. Hyderabad Double at Hyderabad centre (2011-12)

Treatment	Vase life (day)	Diam. of basal floret(cm)	Total Water absorbed/ stem(ml)	% wt. loss after simulated transit
T ₁ LDPE 100	5	3.6	41	3.6
T ₂ PP 100	5.2	3.4	46	3.9
T ₃ Cellophane	5.3	3.7	39	4.1
Control	4.8	3.5	44	5.6
CD (P=0.05)	NS	NS	NS	0.6

Kahikuchi

It has been observed that polypropylene 100 gauge when used as packaging material for tuberose cv. Vaibhav spikes recorded the highest basal floret diameter which was closely followed by the control treatment, which was statistically *at par*. Maximum vase life was registered by both PP 100 gauge and control. Total water absorbed and total water loss after simulated transit was found to be significantly higher in control.

Table 3.13. Effect of packaging material on vase life of tuberose cv. Vaibhav at Kahikuchi centre (2010-11)

Treatment	Basal floret diam. (cm)	Vase life (day)	Total water absorbed (ml)	Total water loss after simulated transit (%)
T ₁ : LDPE	4.1	4.6	14.26	1.28
T ₂ : PP 100 gauge	4.34	4.8	13.83	2.09
T ₃ : Cellophane	3.81	4.3	13.63	0.81
T ₄ : Control	4.21	4.8	18.84	3.42
CD (P=0.05)	0.24	0.33	1.63	1.22

Pune

Data showed significantly higher vase life, flower diameter and less water absorbed / stalk when cut tuberose flower stalks packed in LDPE-100gauge material than rest of packaging materials.

Table 3.14a. Studies on refrigerator storage of cut spikes of tuberose cv. Suvasini at Pune (Ganeshkhind) centre (2010-11)

Treatment	Vase life (day)	Floret diam. (cm)	No. of floret open at one time	Water Absorb / stalk (ml)	Percent or gain in wt. (g)
Packing material					
LDPE 100 gauge	6.5	3.9	3.5	59.5	15.8
PP 100 gauge	6	3.7	5.6	63.4	18.6
Cellophane paper	5.6	3.3	3.7	64	19.4
Control	4	3.5	6.42	60.8	0
CD (P=0.05)	0.21	0.21	1.68	0.51	0.7

Table 3.14b. Studies on post harvest technology for short distant market in tuberose cv. Suvasini at Pune (Ganeshkhind) cente (2011-12)

Treatment	Vase life (day) till ½ of florets show wilting	Diam. of basal floret (cm)	Total water absorbed (ml)	Percent loss in weight after simulated transit
	1	2	3	4
LDPE-100 gauge	9.73	3.3	36.8	9.51
PP-100 gauge	10.25	3.74	38.2	4.82
Cellophane	8.96	3.28	32.8	10.77
Control (without packing)	8.02	2.92	35.6	14.71
CD (P=0.05)	0.76	0.51	NS	NS

Table 3.14c. Effect of packaging and storage temperature on weight and percent weight loss of tuberose cv. Suvasini at different intervals at Pune (Ganeshkhind) cente

Treatment	Weight of tuberose florets at different intervals						Percent weight loss					
	At 3day after packing			At 12day after packing			At 3day after packing			At 12day after packing		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
T ₁	1.35	1.56	1.45	0.05	0.42	0.24	10.24	7.94	9.09	96.3	73.08	84.69
T ₂	1.21	1.5	1.36	0.07	1	0.54	13.96	6.65	10.3	94.21	33.33	63.77
T ₃	1.19	1.44	1.32	0.06	1.09	0.57	11.67	5.88	8.77	94.96	24.31	59.64
T ₄	0.5	0.98	0.74	0.02	0.13	0.08	49.16	1.8	25.48	96	86.73	91.37
Mean	1.06	1.37		0.05	0.66		21.26	5.57		95.37	54.36	
	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)
T	0.05	0.11	0.15	0.03	0.07	0.09	1.74	3.7	5.11	0.66	1.39	1.91
S	0.03	0.07	0.1	0.02	0.05	0.07	1.23	2.62	3.61	0.46	0.98	1.36
T×S	0.07	0.15	0.21	0.04	0.1	0.14	2.47	5.24	7.22	0.93	1.97	2.71

T-Packaging material, S-Storage temperature, T1-Gunny bag, T2-Bamboo basket, T3-CFB box, T4-Control(without packaging), S1-Room Temperature, S2-Cold Storage(4°C)

Table 3.14c. Effect of packaging and storage temperature on weight and percent weight loss of tuberose cv. Suvasini at different intervals at Pune (Ganeshkhind) cente (continue...)

Treatment	Length of florets at different intervals (cm)						Freshness index					
	At 0day after packing			At 12day after packing			At 0day after packing			At 12day after packing		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
T1	5.39	6.36	5.87	1.12	2.1	1.61	48.85	81.52	65.18	0	0	0
T2	5.33	6.01	5.67	2.14	5.32	3.73	52.18	81.71	66.95	0	26	13
T3	5.63	6.13	5.88	2.18	6.01	4.1	59.61	81.05	70.33	0	23.52	11.76
T4	4.81	6.36	5.59	0.83	1.08	0.96	46.85	81.62	64.23	0	0	0
Mean	5.29	6.21		1.57	3.63		51.87	81.47		0	12.38	
	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)
T	0.18	0.38	0.52	0.07	0.15	0.2	1.04	2.22	3.06	0.4	0.86	1.19
S	0.12	0.27	0.37	0.05	0.1	0.14	0.74	1.57	2.16	0.28	0.61	0.84
T×S	0.25	0.54	0.74	0.1	0.21	0.29	1.48	3.14	4.33	0.57	1.22	1.69

T-Packaging material, S-Storage temperature, T1-Gunny bag, T2-Bamboo basket, T3-CFB box, T4-Control(without packaging), S1-Room Temperature, S2-Cold Storage(4°C)

Table 3.14d. Effect of packaging and storage temperature on length and diameter of tuberose cv. Suvasini floret at different intervals at Pune (Ganeshkhind) cente

Treatment	Diameter of floret (cm)						Moisture content (%)					
	At 0day after packing			At 12day after packing			At 0day after packing			At 12day after packing		
	S1	S2	Mean	S1	S2	S1	S2	S1	S2	S1	S2	Mean
T1	2.36	3.24	2.8	0.08	0.9	0.49	57.66	55.71	56.69	8	17	12.5
T2	2.18	3.4	2.79	0.2	1.1	0.65	57.66	65.16	61.41	22	58.51	40.26
T3	2.25	3.32	2.78	0.3	1.26	0.78	57.66	63.6	60.63	22	65.37	43.69
T4	1.79	3.48	2.64	0.06	0.46	0.26	60	71.29	65.64	6	12	9
Mean	2.14	3.36		0.16	0.93		58.25	63.94		14.5	38.22	
	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)
T	0.08	0.18	0.26	0.03	0.07	0.09	2.2	4.66	6.43	2.26	4.79	6.61
S	0.06	0.13	0.18	0.02	0.05	0.06	1.55	3.3	4.54	1.6	3.39	4.67
T×S	0.12	0.26	0.36	0.04	0.1	0.13	3.11	6.6	9.09	3.2	6.78	9.34

T-Packaging material, S-Storage temperature, T1-Gunny bag, T2-Bamboo basket, T3-CFB box, T4-Control (without packaging), S1-Room Temperature, S2-Cold Storage(4°C)

Table 3.14d. Effect of packaging and storage temperature on length and diameter of tuberose cv. Suvasini floret at different intervals at Pune (Ganeshkhind) cente (continue...)

Treatment	Membrane permeability (%)						Color retention index					
	At 0day after packing			At 12day after packing			At 0day after packing			At 12day after packing		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
T1	4.97	10.76	7.87	0	0	0	86.73	99.63	93.18	0	0.07	0
T2	6.74	11.95	9.34	0	7.29	3.64	86.96	99.18	93.07	0	10.44	5.22
T3	3.52	8.05	5.78	0	5.74	2.87	89.18	99.55	94.36	0.08	11.77	5.88
T4	2.78	10.66	6.72	0	0	0	81.25	99.04	90.14	0	0	0
Mean	4.5	10.35		0	3.25		86.03	99.35		0.02	5.55	
	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)	S.ED	CD (0.05)	CD (0.01)
T	1.48	3.14	4.33	1.01	2.14	2.95	0.46	0.98	1.35	0.16	0.35	0.48
S	1.04	2.22	3.06	0.71	1.51	2.08	0.32	0.69	0.95	0.11	0.24	0.34
T×S	2.09	4.44	6.12	1.42	3.03	4.17	0.65	1.38	1.91	0.23	0.49	0.68

T-Packaging material, S-Storage temperature, T1-Gunny bag, T2-Bamboo basket, T3-CFB box, T4-Control (without packaging), S1-Room Temperature, S2-Cold Storage(4°C)

Kalyani

Data revealed that among different packaging materials, PP-100 gauge was found to be most effective causing maximum number of florets opened at a time , maximum water uptake , long vase life and minimum weight loss. But maximum floret diameter was obtained in LDPE – 100 gauge packaging.

Table 3.15a. Standardisation of postharvest technology for short distant market of tuberose at Kalyani centre (2010-11)

Treatment	Weight loss during simulated transit	Vase life (day)	Floret diam. (cm)	No. of florets opened at a time	Total water absorbed (ml / 100 g stem)
LDPE-100	6.53	4.8	4.02	3.8	50.15
PP-100	5.12	5.2	3.84	4	90.58
Cellophane	5.91	4.2	3.7	3.6	39.32
Control	8.72	4	3.64	2.8	41.71
C.D (P=0.05)	NS	0.85	NS	0.38	NS

Table 3.15b. Standardisation of postharvest technology in tuberose for short distant market at Kalyani centre

Treatment	Vase life (day)	Diam. of basal floret (cm)	Total water absorbed (ml / 100 g stem)	Percent loss in weight after simulated transit
LDPE-100	6.2	5.22	57.49	0.29 (2.65)
PP-100	6.6	5.11	60.14	0.50 (4.02)
Cellophane	6	4.76	56.8	0.57 (4.28)
Control	5.4	4.57	50.64	7.24 (15.58)
C.D (P=0.05)	NS	NS	NS	1.53

Ludhiana

Flower stems of tuberose Local cultivar with Single flowers were harvested at bud stage packed in LDPE-100, PP-100 and cellophane sleeves. The stems were packed in cardboard boxes and subjected to simulated transit for 16h and ambient conditions. The keeping quality was evaluated in plain water. Vase life of stems packed in LDPE, PP or cellophane sleeves did not differ significantly from those placed unpacked or freshly harvested stems, not subjected to simulated transit. Similar trends were observed with regard to floret diameter and water absorption / stems. The studies showed that the packaging sleeves (LDPE and PP) did not improve vase life of the stems after simulated transit at ambient conditions.

Table 3.16. Effect of packaging films on keeping quality of cut stems of tuberose cv. Local Single for short distant markets at Ludhiana centre (2010-11)

Packaging material	Vase life (day)	Diam. of basal floret (cm)	Total water absorbed/stem (ml)	% loss in FW after simulated transit
LDPE-100	7	3.17	58.89	3.56(10.86)
PP-100	6.89	3.13	55.89	4.03(11.57)
Cellophane	6.56	3.43	53.67	5.37(13.38)
Without packaging	6.78	3.27	55.33	5.67(13.76)
Control (without simulated transit)	6.67	3	50.67	-
CD (P=0.05)	NS	NS	NS	0.93

Pantnagar

The simulated transit for 16 h. at ambient conditions and different packaging materials had non-significant effect on diameter of basal florets and vase life of cut tuberose cv. Vaibhav spikes Vaibhav.

Table 3.17. Effect of packaging films on keeping quality of cut stems of tuberose cv. Vaibhav for short distant markets at Pantnagar centre

Treatment	Vase life (day) till ½ of florets show wilting	Diameter of basal floret (cm)	Total water absorbed (ml)	Percent loss in weight after simulated transit
	1	2	3	4
LDPE-100 gauge	9.46	3.26	35.8	9
PP-100 gauge	10.16	3.82	36.2	4.19
Cellophane	8.83	3.22	31.4	10.03
Control (without packing)	7.91	2.85	34.8	14.01
CD (P=0.05)	0.91	0.53	NS	NS

Udaipur

Data indicated that post harvest technology for short distant market significant effect among various packaging materials for 16 h. simulated transit in tuberose cut spikes cv. Suvasini. Whereas, Polypropylene-100 gauge was recorded maximum vase life, basal floret diameter, total water absorbed with minimum percent loss in fresh weight after 16 h. simulated transit followed by LDPE-100 gauge and over the control means without packing. Although the observed values were non- significant for total water absorbed and percent loss in fresh weight after simulated transit in various packaging material

Table 3.18. Studies on post harvest technology for short distant market in tuberose cv. Suvasini at Udaipur centre (2010-11)

Treatment	Vase life (day) till ½ of florets show wilting	Diam. of basal floret (cm)	Total water absorbed (ml)	Percent loss in weight after simulated transit
	1	2	3	4
LDPE-100 gauge	9.46	3.26	35.8	9
PP-100 gauge	10.16	3.82	36.2	4.19
Cellophane	8.83	3.22	31.4	10.03
Control (without packing)	7.91	2.85	34.8	14.01
CD (P=0.05)	0.91	0.53	NS	NS

Experiment 3.4 : Studies of MA storage of tuberose cut stems.

Cultivar : Suvasini / other cultivated cultivar with Double petalled specific for the region.

Stage of harvest : Well developed buds.

Polymeric packaging : Five
LDPE = 100, 200 gauge

Films treatments : PP 100, 200 gauge
Control (without film).

No. of stems/ treatment : Ten

No. of replications : Three

Storage durations : Four
0, 3, 6, 9 and 12 day

Storage temperature : 10°C

Simulated transit after storage : 16h

Observations recorded

1. Vase life (day)
2. Diameter of basal floret (cm)
3. Total water absorbed / stem (ml)
4. Percent weight loss after storage / simulated transit
5. CO₂ / O₂ level in the packages. After storage + simulated transit (only those centres having facility)

Report

Hessaraghatta

Studies of modified atmosphere (MA) storage of tuberose cut stems were carried out as per the technical programme with cv. Suvasini. Observations revealed that maximum vase life was obtained by packaging in 100 gauge polyethylene. Among two packages tried, polyethylene package was found most suitable for packaging of tuberose. Increased storage period decreased the vase life of cut flower. Floret diameter was maximum in control as compared to the floret size of the tuberose evaluated.

Table 3.19a. Effect of modified atmosphere packaging and duration of storage on vase life of tuberose cv. Suvasini at Hessaraghatta centre (2010-11)

Packages	0 day of storage	3 day of storage	6 day of storage	9 day of storage	12 day of storage
Polyethylene 100 gauge	8.6	7.2	5.8	3.6	-
Polyethylene 200 gauge	8.2	6.8	5.5	3.3	-
Poly propylene 100 gauge	7.5	7	5.4	3.2	-
Polypropylene 200 gauge	7	6.5	5.2	3	-
Control	6.8	4.8	-	-	-
CD (P=0.05)	1.12	1.44	-	-	-

Table 3.19b. Effect of modified atmosphere packaging and duration of storage on basal floret diameter of cut flowers of tuberose cv. Suvasini at Hessaraghatta centre (2010-11)

Packages	0 day of storage	3 day of storage	6 day of storage	9 day of storage	12 day of storage
Polyethylene 100 gauge	4.5	4.3	4	-	-
Polyethylene 200 gauge	4.3	4.1	3.8	-	-
Poly propylene 100 gauge	4.2	4	3.6	-	-
Polypropylene 200 gauge	4	3.8	3.4	-	-
Control	4.6	3.5	-	-	-
CD (P=0.05)	0.28	0.32	-	-	-

Table 3.19c. Effect of modified atmosphere packaging and duration of storage on percent weight loss after transit of cut flowers of tuberose cv. Suvasini at Hessaraghatta (2010-11)

Packages	0 day of storage	3 day of storage	6 day of storage	9 day of storage	12 day of storage
Polyethylene 100 gauge	2.6	5.8	26.8	-	-
Polyethylene 200 gauge	1.8	3.6	22.6	-	-
Poly propylene 100 gauge	2.2	4.6	24.4	-	-
Polypropylene 200 gauge	1.6	2.8	18.8	-	-
Control	12.6	46.2	-	-	-
CD (P=0.05)	1.62	1.22	-	-	-

Table 3.19d. Effect of pre cooling, packaging and storage on size of garland of tuberose flower at Hessaraghatta centre (2011-12)

Package	Control 0 day storage	Pre cooled										Without pre cooled									
		3 day storage		6 day storage		9 day storage		12 day storage		15 day storage		3 day storage		6 day storage		9 day storage		12 day storage		15 day storage	
		RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C
Gunny bag	3.6	3.3	3.1	3.2	1.8	-	2	-	2	-	-	3.6	2.2	-	2.6	-	2.8	-	3	-	-
bamboo basket	3.5	3.2	3	3	1.6	-	1.8	-	2	-	-	3.4	2	-	2.4	-	2.6	-	2.8	-	-
CFP boxes with 100 gauge Polyethylene lining	3.3	3	2.8	2.8	1.4	-	1.6	-	1.8	-	-	3.2	2	-	2.2	-	2.4	-	2.6	-	-
CD (P=0.05)																					
Packaging(P)	1.14																				
Pre cooling (PC)	0.76																				
PXPC	0.32																				

Table 3.19e. Effect of pre cooling, packaging and storage on percent opening of garland of tuberose flowers at Hessaraghatta centre (2011-12)

Package	Control 0 day storage	Pre cooled										Without pre cooled									
		3 day storage		6 day storage		9 day storage		12 day storage		15 day storage		3 day storage		6 day storage		9 day storage		12 day storage		15 day storage	
		RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C
Gunny bag	60	95	25	100	47	-	71	-	100	-	-	100	36	-	57	-	94	-	100	-	-
bamboo basket	58	93	22	100	44	-	67	-	95	-	-	100	30	-	53	-	90	-	96	-	100
CFP boxes with 100 gauge Polyethylene lining	53	61	11	84	27	100	43	-	55	-	-	62	18	-	29	-	40	-	60	-	76
CD (P=0.05)																					
Packaging (P)	2.76																				
Pre cooling (PC)	2.14																				
PXPC	1.42																				

Table 3.19f. Effect of pre cooling, packaging and storage on shelf life (day) of garland of tuberose flower at Hessaraghatta centre (2011-12)

Package	Control 0 day storage	Pre cooled										Without pre cooled									
		3 day storage		6 day storage		9 day storage		12 day storage		15 day storage		3 day storage		6 day storage		9 day storage		12 day storage		15 day storage	
		RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C
Gunny bag	3.3	1	3	-	2	-	1	-	-	-	-	1	2	-	1	-	-	-	-	-	-
bamboo basket	3.5	1	3	-	2	-	1	-	-	-	-	1	2	-	1	-	-	-	-	-	-
CFP boxes with 100 gauge Polyethylene lining	5.3	2	4	-	3	-	2	-	1	-	-	2	4	-	2	-	1	-	-	-	-
CD (P=0.05)																					
Packaging(P)	1.66	0.78	0.48	-	0.58	-	0.78	-	-	-	-	0.78	0.62	-	0.78	-	-	-	-	-	-
Pre cooling(PC)	1.08	0.66	0.36	-	0.36	-	0.66	-	-	-	-	0.66	0.46	-	0.66	-	-	-	-	-	-
PXPC	0.88	0.46	0.24	-	0.24	-	0.46	-	-	-	-	0.46	0.32	-	0.46	-	-	-	-	-	-

Table 3.19g. Effect of modified atmosphere packaging and duration of storage on vase life of tuberose cv. Suvasini cut flowers at Hessaraghatta centre (2012-13)

Packages	0 day of storage	3 day of storage	6 day of storage	9 day of storage
Polyethylene 100 gauge	8.6	7	5.5	2.5
Polyethylene 200 gauge	8.2	7	5.2	2.2
Poly propylene 100 gauge	7.6	7.2	5	2.1
Polypropylene 200 gauge	7	6.6	4.8	1.9
Control	6.8	1.8	-	-
CD (P=0.05)	0.72	0.94	-	-

Table 3.19h. Effect of modified atmosphere packaging and duration of storage on basal floret diameter of tuberose cv. Suvasini cut flowers at Hesaraghatta centre (2012-13)

Packages	0 day of storage	3 day of storage	6 day of storage
Polyethylene 100 gauge	4.8	4.3	3.7
Polyethylene 200 gauge	4.6	4.1	3.5
Polypropylene 100 gauge	4.5	4	3.3
Polypropylene 200 gauge	4.1	3.8	3.1
Control	4.7	3.5	-
CD (P=0.05)	0.36	0.4	-

Table 3.19i. Effect of modified atmosphere packaging and duration of storage on water uptake (ml) of tuberose cv. Suvasini cut flowers at Hesaraghatta centre (2012-13)

Packages	0 day of storage	3 day of storage	6 day of storage	9 day of storage	12 day of storage
Polyethylene 100 gauge	68	61	53	43	31
Polyethylene 200 gauge	66	57	50	37	29
Polypropylene 100 gauge	65	55	49	41	27
Polypropylene 200 gauge	61	53	45	35	23
Control	70	57	-	-	-
CD (P=0.05)	1.32	1.22	-	-	-

Table 3.19i. Effect of modified atmosphere packaging and duration of storage on water uptake (ml) of tuberose cv. Suvasini cut flowers at Hesaraghatta centre (2012-13)

Packages	0 day of storage	3 day of storage	6 day of storage	9 day of storage	12 day of storage
Polyethylene 100 gauge	68	61	53	43	31
Polyethylene 200 gauge	66	57	50	37	29
Polypropylene 100 gauge	65	55	49	41	27
Polypropylene 200 gauge	61	53	45	35	23
Control	70	57	-	-	-
CD (P=0.05)	1.32	1.22	-	-	-

Table 3.19j. Effect of modified atmosphere packaging and duration of storage on percent weight loss after transit of tuberose cv. Suvasini cut flowers at Hesaraghatta centre (2012-13)

Packages	0 day of storage	3 day of storage	6 day of storage
Polyethylene 100 gauge	2.8	6.9	25.6
Polyethylene 200 gauge	2.4	4.6	21.4
Poly propylene 100 gauge	2.1	4.6	23.2
Polypropylene 200 gauge	1.4	3.8	16.6
Control	12.8	44.2	-
CD (P=0.05)	4.62	17.66	-

Table 3.19k. Effect of modified atmosphere packaging and duration of storage on concentration of CO₂ (mg/kg/h) evolved during storage of Double tuberose cv. Suvasini cut flowers at Hesaraghatta centre (2012-13)

Packages	0 day of storage	3 day of storage	6 day of storage
Polyethylene 100 gauge	662	410	192
Polyethylene 200 gauge	860	668	260
Polypropylene 100 gauge	704	556	252
Polypropylene 200 gauge	986	814	342
Control	309	230	–
CD (P=0.05)	35.62	22.5	–

Table 3.19l. Effect of modified atmosphere packaging and duration of storage on vase life, basal floret diameter and water uptake (ml) of Double tuberose cv. Suvasini cut flowers at Hesaraghatta centre (2012-13)

Packages	Vase life (day of storage)					Basal floret diameter (day of storage)					Water uptake (ml) (day of storage)				
	0	3	6	9	12	0	3	6	9	12	0	3	6	9	12
Polyethylene 100 gauge	8.7	7.1	5.4	2.4	–	4.5	4.2	3.6	–	–	66	60	52	42	30
Polyethylene 200 gauge	8.3	7	5.2	2.2	–	4.5	4.1	3.5	–	–	64	56	48	36	28
Poly propylene 100 gauge	7.7	7.3	5	2.1	–	4.4	4	3.3	–	–	63	54	48	40	26
Polypropylene 200 gauge	7.1	6.7	4.8	1.9	–	4	3.6	3	–	–	60	53	44	34	22
Control	6.9	1.9	–	–	–	4.6	3.4	–	–	–	69	58	–	–	–
CD (P=0.05)	0.7	0.92	–	–	–	0.36	0.38	–	–	–	0.92	1.12	–	–	–

Table 3.19m. Effect of modified atmosphere packaging and duration of storage on percent weight loss and concentration of CO₂ (mg/kg/h) evolved during storage of Double tuberose cv. Suvasini cut flowers at Hesaraghatta centre (2013-14)

Packages	Percent weight loss					Concentration of CO ₂ (mg/kg/h) evolved during storage				
	0 day of storage	3 day of storage	6 day of storage	9 day of storage	12 day of storage	0 day of storage	3day of storage	6 day of storage	9 day of storage	12 day of storage
Polyethylene 100 gauge	2.6	6.8	24.6	-	-	660	409	190	-	-
Polyethylene 200 gauge	2.2	4.5	20.4	-	-	858	668	260	-	-
Poly propylene 100 gauge	1.9	4.5	22.2	-	-	702	554	252	-	-
Polypropylene 200 gauge	1.3	3.7	15.8	-	-	984	812	342	-	-
Control	12.6	43.2	-	-	-	304	230	-	-	-
CD (P=0.05)	4.62	17.66	-	-	-	34.52	21.48	-	-	-

Ludhiana

Flower stems of local cultivar Single petalled tuberose with were sealed in LDPE-100, 200 and PP-100 and 200 gauges sleeves and stored horizontally at 10°C. the post-storage keeping quality was evaluated at ambient conditions in plain distilled water. The stems showed considerable declines in vase life after 3 and 6 day of storage as compared to 6.45 day in control. The buds failed to open after 9 day of storage onwards. LDPE- and PP-100 gauge sleeves improved post storage vase life of the stems. The studies showed that there was sharp decline in vase life of tuberose stems after 3 day in MA storage. The buds failed to open after 9 day in storage onwards. LDPE-100 and PP-100 films were superior for MA storage

Table 3.20a. Effect of MA packaging on keeping quality of cut stems of tuberose at Ludhiana centre (2010-11)

Packaging material	Vase life (day) Storage duration (day)					Floret diam. (cm) Storage duration (day)					Water absorbed /stem (ml) Storage duration (day)				
	3	6	9	12	Mean	3	6	9	12	Mean	3	6	9	12	Mean
LDPE-100	3.78	2.78	0	0	1.64	3.1	2.93	0	0	1.51	29.34	33	-	-	15.59
LDPE-200	1.78	1.67	0	0	0.86	2.77	3.17	0	0	1.49	19.78	12.56	-	-	8.09
PP-100	3.22	1.11	0	0	1.08	2.97	2.9	0	0	1.47	19.68	12.33	-	-	8
PP-200	2.22	1	0	0	0.81	2.93	3.07	0	0	1.5	16	13.55	-	-	7.39
Without packaging	2.11	0	0	0	0.53	2.67	0	0	0	0	20.33	12.78	-	-	8.29
Mean	2.62	1.31	0	0		2.89	2.41	0	0		21.03	16.84			
Control (0 day storage)	6.45±0.51					3.23 ±0.06					45.78±5.84				
CD (P=0.05)	Packaging material (A)=0.27; Storage duration (B)=0.24 ; AxB=0.54					Packaging material (A)=NS; Storage duration (B)=0.06; AxB=0.13					Packaging material (A)=0.73; Storage duration (B)=1.55; AxB=3.46				

Table 3.20b. Effect of MA packaging on keeping quality of cut stems of tuberose at Ludhiana centre (2011-12)

Packaging material	Vase life (day) Storage duration (day)					Floret diam. (cm) Storage duration (day)					Water absorbed /stem (ml) Storage duration (day)				
	3	6	9	12	Mean	3	6	9	12	Mean	3	6	9	12	Mean
LDPE-100	4.33	2.78	0	0	1.78	3.07	2.7	-	-	1.44	65.11	29.82	-	-	23.73
LDPE-200	4.44	2.89	0	0	1.83	2.97	2.7	-	-	1.42	58.54	27.53	-	-	21.52
PP-100	4.44	3.33	0	0	1.94	3.1	2.6	-	-	1.43	59.33	25.11	-	-	21.11
PP-200	4.67	2.89	0	0	1.89	3.03	2.5	-	-	1.38	57.44	22.78	-	-	20.06
Without packaging	3.89	1.89	0	0	1.45	2.9	2.5	-		1.35	51.89	22.22	-		18.53
Mean	4.35	2.76	0	0		3.01	2.6	-	-		58.46	25.49	-	-	
Control (0 day storage)	5.41±0.32					3.10±0.06					56.89±2.71				
CD (P=0.05)	Packaging material (A)=NS; Storage duration (B)=0.45 ; AxB=NS					Packaging material (A)=NS; Storage duration (B)=0.14; AxB=NS					Packaging material (A)=5.02; Storage duration (B)=3.17; AxB=				

Table 3.20c. Effect of MA packaging on keeping quality of cut stems of tuberose at Ludhiana centre (2012-13)

Packaging material	Vase life (day) Storage duration (day)					Floret diam. (cm) Storage duration (day)					Water absorbed /stem (ml) Storage duration (day)					Per cent weight loss after simulated transit				
	3	6	9	12	Mean	3	6	9	12	Mean	3	6	9	12	Mean	3	6	9	12	Mean
LDPE-100	3.32	2.89	-	-	3.11	3.32	3.12	-	-	3.22	36	22.89	-	-	29.45	2.04	3.14	3.14	3.62	2.99
																-8.2	-10.19	-10.18	-10.94	-9.88
LDPE-200	3.11	3	-	-	3.06	3.18	2.93	-	-	3.05	34.9	20	-	-	27.45	1.91	2.16	3.04	3.43	2.64
																-7.93	-8.42	-10.04	-10.64	-9.26
PP-100	3.44	3.11	-	-	3.28	3.31	2.99	-	-	3.15	30.11	20.78	-	-	25.45	1.51	1.76	2.9	3.57	2.43
																-7.04	-7.56	-9.79	-10.87	-8.81
PP-200	3.33	2.78	-	-	3.06	3.18	3	-	-	3.09	36	25.33	-	-	30.67	1.4	2.15	2.87	3.88	2.58
																-6.78	-8.37	-9.72	-11.35	-9.06
Without packaging	2.67	2	-	-	3	3.18	2.97	-	-	3.07	32.78	21	-	-	26.89	3.51	4.83	7.32	9.82	6.37
																-10.77	-12.65	-15.65	-18.25	-14.33
Mean	3.17	2.36	-	-		3.23	3	-	-		33.96	22	-	-		2.07	2.81	3.85	4.86	
																-8.14	-9.44	-11.07	-12.41	
Control (0 day)	4.44±0.84					3.11±0.22					40.67±1.020									
CD (P=0.05)	Packaging material (A)=NS; Storage duration (B)=0.16; AxB=NS					Packaging material (A)=0.18; Storage duration (B)=0.22; AxB=NS					Packaging material (A)=NS; Storage duration (B)=3.41; AxB=NS					Packaging material (A)=0.71; Storage duration (B)=0.63; AxB=1.41				

Table 3.20d. Effect of MA packaging on keeping quality of cut stems of tuberose at Ludhiana centre (2013-14)

Packaging material	Vase life (day) Storage duration (day)					Floret diam. (cm) Storage duration (day)					Water absorbed /stem (ml) Storage duration (day)					Per cent weight loss after simulated transit				
	3	6	9	12	Mean	3	6	9	12	Mean	3	6	9	12	Mean	3	6	9	12	Mean
LDPE-100	3.32	2.89	-	-	3.11	3.32	3.12	-	-	3.22	36	22.89	-	-	29.45	2.04	3.14	3.14	3.62	2.99
																-8.2	-10.19	-10.18	-10.94	-9.88
LDPE-200	3.11	3	-	-	3.06	3.18	2.93	-	-	3.05	34.9	20	-	-	27.45	1.91	2.16	3.04	3.43	2.64
																-7.93	-8.42	-10.04	-10.64	-9.26
PP-100	3.44	3.11	-	-	3.28	3.31	2.99	-	-	3.15	30.11	20.78	-	-	25.45	1.51	1.76	2.9	3.57	2.43
																-7.04	-7.56	-9.79	-10.87	-8.81
PP-200	3.33	2.78	-	-	3.06	3.18	3	-	-	3.09	36	25.33	-	-	30.67	1.4	2.15	2.87	3.88	2.58
																-6.78	-8.37	-9.72	-11.35	-9.06
Without packaging	2.67	2	-	-	3	3.18	2.97	-	-	3.07	32.78	21	-	-	26.89	3.51	4.83	7.32	9.82	6.37
																-10.77	-12.65	-15.65	-18.25	-14.33
Mean	3.17	2.36	-	-		3.23	3	-	-		33.96	22	-	-		2.07	2.81	3.85	4.86	
																-8.14	-9.44	-11.07	-12.41	
Control (0 day)	4.44±0.84					3.11±0.22					40.67±1.020									
LSD (P=0.05)	Packaging material (A)=NS; Storage duration (B)=0.16 ; AxB=NS					Packaging material (A)=0.18; Storage duration (B)=0.22; AxB=NS					Packaging material (A)=NS; Storage duration (B)=3.41; AxB=NS					Packaging material (A)=0.71; Storage duration (B)=0.63; AxB=1.41				

Kalyani

Under modified atmosphere (MA) storage, tuberose cv. Shringar could be stored successfully till 3 day. The stem did not show opening of florets and buds started to drop from the stems after 3 day of MA storage and onwards. The stems also showed higher loss of fresh weight as the storage period progressed.

Among different packaging treatments, LDPE -200 gauge was found to be the best in terms of maximum vase life and minimum weight loss after 3 days storage. However, maximum floral diameter and maximum flower open at a time was found in case of PP- 100 gauge after 3 day storage. Maximum water uptake was observed in LDPE-100 gauge after 3 day storage.

Table 3.21a. Vase life of tuberose cv. Shringar as affected by MA storage at Kalyani centre (2011-12)

Storage duration(S) (Day)	Packaging (P)					Mean
	LDPE 100	LDPE200	PP100	PP200	Control	
0	9	9	9	9	9	9
3	8	8	8	8	8	8
6	8	8	8	8	6	7.6
9	6	6	6	6	0	4.8
12	5	5	5	5	0	4
Mean	7.2	7.2	7.2	7.2	4.6	-
	Packaging (P)		Storage (S)		P × S	
CD (P=0.05)	0.71		0.71		1.60	

Table 3.21b. Maximum diameter (cm) of tuberose cv. Shringar as affected by MA storage at Kalyani centre

Storage duration(S) (Day)	Packaging (P)					Mean
	LDPE 100	LDPE200	PP100	PP200	Control	
0	5.5	5.37	5.37	5.53	4.97	5.35
3	5.47	5.63	5.33	5.63	5.2	5.45
6	5.43	5.43	5.53	5.5	4.3	5.24
9	5.4	5.47	5.47	5.4	0	4.35
12	5.2	5.3	5.33	5.4	0	4.25
Mean	5.4	5.44	5.41	5.49	2.89	
	Packaging (P)		Storage (S)		P × S	
CD (P=0.05)	0.13		0.13		0.29	

Table 3.21c. Total water uptake (ml) of tuberose cv. Shringar as affected by MA storage at Kalyani centre

Storage duration(S) (Day)	Packaging (P)					Mean
	LDPE 100	LDPE200	PP100	PP200	Control	
0	101.7	94.7	94	97.1	84.47	94.39
3	68.5	71.07	67.17	83.8	64.8	71.07
6	69.13	71.53	70.63	71.2	43.33	65.17
9	62.33	67.3	65.9	63.67	0	51.84
12	50.47	51.4	50.97	55.1	0	41.59
Mean	70.43	71.2	69.73	74.17	38.52	
	Packaging (P)		Storage (S)		P × S	
CD (P=0.05)	4.43		4.43		9.92	

Table 3.21d. Percent weight loss after storage of tuberose cv. Shringar as affected by MA storage at Kalyani centre

Storage duration(S) (Day)	Packaging (P)					Mean
	LDPE 100	LDPE200	PP100	PP200	Control	
0	0.71	0.57	0.63	0.45	1.2	0.71
3	0.71	0.68	0.9	0.44	9.38	2.42
6	1.51	1.5	0.97	0.99	15.51	4.1
9	2.23	2.3	1.95	2.35	26.38	7.04
12	3.04	2.4	2.98	2.3	40.91	10.33
Mean	1.64	1.49	1.49	1.31	18.68	
	Packaging (P)		Storage (S)		P × S	
CD (P=0.05)	0.97		0.97		2.17	

Table 3.21e. Vase life of tuberose cv. Shringar as affected by MA storage at Kalyani centre (2012-13)

Treatment	Vase life (day)	Maximum diameter (cm)	Total water absorption(ml)	%age loss after storage
Packing (P)				
P ₁	6.3	5.39	64.48	1.79
P ₂	6.3	5.32	65.98	1.729
P ₃	6.7	5.4	68.88	1.59
P ₄	7	5.43	68.52	1.52
P ₅	3.7	3.06	31.36	18.95
CD (P=0.05)	0.64	0.15	4.49	0.754
Storage (S)				
S ₁	8.6	5.45	93.60	0.76
S ₂	7.6	5.61	69.57	2.66
S ₃	6.4	5.32	58.96	4.43
S ₄	4.4	4.17	47.86	7.22
S ₅	2.4	4.05	29.20	10.50
CD (P=0.05)	0.64	0.15	4.49	0.75

Table 3.21e. Vase life of tuberose cut spike as affected by MA storage at Kalyani centre (2012-13)
(continued...)

Treatment	Vase life (day)	Maximum diam. (cm)	Total water absorption(ml)	%age loss after storage
Interaction P X S				
P ₁ S ₁	9	5.53	93.87	0.68
P ₁ S ₂	8	5.83	73.17	0.98
P ₁ S ₃	7	5.43	66.47	1.95
P ₁ S ₄	5	5.23	60	2.27
P ₁ S ₅	3	4.93	28.9	3.08
P ₂ S ₁	8	5.33	94.6	0.28
P ₂ S ₂	8	5.6	76.07	0.84
P ₂ S ₃	7	5.47	66.53	1.42
P ₂ S ₄	5	5	54.63	2.65
P ₂ S ₅	3	5.23	38.07	3.46
P ₃ S ₁	9	5.57	96.67	0.76
P ₃ S ₂	8	5.63	74.5	1.14
P ₃ S ₃	7	5.33	66.63	0.97
P ₃ S ₄	6	5.33	65.9	2.08
P ₃ S ₅	3	5.13	40.7	3.03
P ₄ S ₁	9	5.6	94.43	0.52
P ₄ S ₂	8	5.7	82.47	0.95
P ₄ S ₃	7	5.6	68.53	1.07
P ₄ S ₄	6	5.3	58.8	2.46
P ₄ S ₅	3	4.97	38.37	2.62
P ₅ S ₁	8	5.23	88.47	1.57
P ₅ S ₂	6	5.3	41.67	9.44
P ₅ S ₃	4	4.77	26.67	16.74
P ₅ S ₄	0	0	0	26.68
P ₅ S ₅	0	0	0	40.35
CD (P=0.05)	1.43	0.33	10.04	1.68

Table 3.21f. Vase life of tuberose spike as affected by MA storage at Kalyani centre (2013-14)

Treatment	Vase life (day)	Maximum diameter (cm)	Total water absorption(ml)	%age loss after storage
Packing (P)				
P ₁	6.3	5.39	64.48	1.79
P ₂	6.3	5.32	65.98	1.72
P ₃	6.7	5.4	68.88	1.59
P ₄	7	5.43	68.52	1.52
P ₅	3.7	3.06	31.36	18.95
CD (P=0.05)	0.64	0.15	4.49	0.75
Storage (S)				
S ₁	8.6	5.45	93.60	0.76
S ₂	7.6	5.61	69.57	2.66
S ₃	6.4	5.32	58.96	4.43
S ₄	4.4	4.17	47.86	7.22
S ₅	2.4	4.05	29.20	10.50
CD (P=0.05)	0.64	0.15	4.49	0.75
Interaction P X S				
P ₁ S ₁	9	5.53	93.87	0.68
P ₁ S ₂	8	5.83	73.17	0.98
P ₁ S ₃	7	5.43	66.47	1.95
P ₁ S ₄	5	5.23	60	2.27
P ₁ S ₅	3	4.93	28.9	3.08
P ₂ S ₁	8	5.33	94.6	0.28
P ₂ S ₂	8	5.6	76.07	0.84
P ₂ S ₃	7	5.47	66.53	1.42
P ₂ S ₄	5	5	54.63	2.65
P ₂ S ₅	3	5.23	38.07	3.46
P ₃ S ₁	9	5.57	96.67	0.76
P ₃ S ₂	8	5.63	74.5	1.14

Table 3.21f. Vase life of tuberose cut spike as affected by MA storage at Kalyani centre (2013-14)
(continue...)

Treatment	Vase life (day)	Maximum diameter (cm)	Total water absorption (ml)	%age loss after storage
P ₃ S ₃	7	5.33	66.63	0.97
P ₃ S ₄	6	5.33	65.9	2.08
P ₃ S ₅	3	5.13	40.7	3.03
P ₄ S ₁	9	5.6	94.43	0.52
P ₄ S ₂	8	5.7	82.47	0.95
P ₄ S ₃	7	5.6	68.53	1.07
P ₄ S ₄	6	5.3	58.8	2.46
P ₄ S ₅	3	4.97	38.37	2.62
P ₅ S ₁	8	5.23	88.47	1.57
P ₅ S ₂	6	5.3	41.67	9.44
P ₅ S ₃	4	4.77	26.67	16.74
P ₅ S ₄	0	0	0	26.68
P ₅ S ₅	0	0	0	40.35
CD (P=0.05)	1.43	0.33	10.04	1.68

Pantnagar

Data show that among the different wrapping materials and storage conditions, vase life of cut spikes of cv. Kalyani Double was found to be maximum in the treatment combinations of PP 200 gauge stored for 48 h. at 10 °C temperature. This treatment combination also resulted in higher percent water loss at wilting and average percent water uptake at senescence.

Table 3.22a. Studies of MA storage of tuberose cv. Kalyani Double cut stems at Pantnagar centre (2010-11)

Treatment	Initial weight (g)	wt 3rd day	wt sense (total wilting of all florets)	%wt loss (at wilting)	% water uptake at senescence	% florets opened	Days to wilting of lowest florets	Vase life (when 50% florets wither)
W0S0 Control	37.33	36.33	29.66	20.92	15.77	54.99	3.5	7.83
W0S1	47.83	43.5	33.83	29.29	11.22	49.57	3.16	7.16
W0S2	35.83	31.83	25.5	30.27	7.44	34.89	3.66	7.66
W1S0	47	45.16	40.5	13.76	23.66	73.74	3.5	8.33
W1S1	41	37.5	33.16	19.57	10	66.01	2.83	7.5
W1S2	32.83	25.83	22.5	31.19	9.22	54.43	4	7.16
W2S0	40.33	40.66	38.66	4.56	22.88	61.88	3.33	7.33
W2S1	34.66	30.33	26	25.58	10.11	58.53	3.33	8.16
W2S2	36.66	31	26	28.28	4.88	60.85	4	7.5
W3S0	42.66	30.16	30.16	28.65	15.11	48.35	4	8.33
W3S1	39.16	37.5	31.66	18.68	18.33	62.39	3.5	7.66
W3S2	39.83	40	34.66	12.29	9.88	43.39	4	8
W4S0	41.83	49.5	33.5	18.57	23.66	47.94	3.16	7.83
W4S1	39.66	35.33	25.5	35.88	16.44	46.7	3.83	8
W4S2	45	37	30.5	32.67	14.77	45.58	4.33	8.5
W5S0	39.66	37.5	30.33	23.71	13.11	50.76	3.8	7.83
W5S1	40.16	36.66	28.66	19.91	11.55	53.5	2.83	6.66
W5S2	33.33	30.83	23.5	29.76	8.44	38.52	3	6.33
W6S0	46.66	52.33	42.5	8.74	20.55	62.07	3.33	7.83
W6S1	39	36.16	29.33	29.71	13.22	58.42	4.16	6.33
W6S2	38	33.5	29	22.78	8.44	36.19	3.5	7.33
W7S0	49.83	41.33	35	29.94	15.77	58.21	3.33	7.66
W7S1	4	38	32	20.48	15.22	57.01	3.33	7.66
W7S2	39.83	39.33	32.66	18.06	14.77	32.23	3.5	7.16
CD (P=0.05)	9.25	9.95	9.29	14.22	0.42	10.46	NS	0.73

Table 3.22b. Studies of MA storage of tuberose cut stems cv. Kalyani Double at Pantnagar centre (2011-12)

Treatment	Initial Weight (g)	wt 3rd day	wt (total wilting of all florets)	%wt loss (at wilting)	% water uptake at sene-scence	% florets opened	days wilting lowest florets	vase life (when 50% florets wither)
W0S0	37.33	36.33	29.66	20.92	15.77	54.99	3.5	7.83
W0S1	47.83	43.5	33.83	29.29	11.22	49.57	3.16	7.16
W0S2	35.83	31.83	25.5	30.27	7.44	34.89	3.66	7.66
W1S0	47	45.16	40.5	13.76	23.66	73.74	3.5	8.33
W1S1	41	37.5	33.16	19.57	10	66.01	2.83	7.5
W1S2	32.83	25.83	22.5	31.19	9.22	54.43	4	7.16
W2S0	40.33	40.66	38.66	4.56	22.88	61.88	3.33	7.33
W2S1	34.66	30.33	26	25.58	10.11	58.53	3.33	8.16
W2S2	36.66	31	26	28.28	4.88	60.85	4	7.5
W3S0	42.66	30.16	30.16	28.65	15.11	48.35	4	8.33
W3S1	39.16	37.5	31.66	18.68	18.33	62.39	3.5	7.66
W3S2	39.83	40	34.66	12.29	9.88	43.39	4	8
W4S0	41.83	49.5	33.5	18.57	23.66	47.94	3.16	7.83
W4S1	39.66	35.33	25.5	35.88	16.44	46.7	3.83	8
W4S2	45	37	30.5	32.67	14.77	45.58	4.33	8.5
W5S0	39.66	37.5	30.33	23.71	13.11	50.76	3.8	7.83
W5S1	40.16	36.66	28.66	19.91	11.55	53.5	2.83	6.66
W5S2	33.33	30.83	23.5	29.76	8.44	38.52	3	6.33
W6S0	46.66	52.33	42.5	8.74	20.55	62.07	3.33	7.83
W6S1	39	36.16	29.33	29.71	13.22	58.42	4.16	6.33
W6S2	38	33.5	29	22.78	8.44	36.19	3.5	7.33
W7S0	49.83	41.33	35	29.94	15.77	58.21	3.33	7.66
W7S1	4	38	32	20.48	15.22	57.01	3.33	7.66
W7S2	39.83	39.33	32.66	18.06	14.77	32.23	3.5	7.16
CD (P=0.05)	9.25	9.95	9.29	14.22	0.42	10.46	NS	0.73

Udaipur

Data indicated that 3 day storage duration x PP-100 gauge interaction was statistically significant for vase life, percent gain in fresh weight after simulated transit, with ideal total level of carbon dioxide percent and oxygen % better over rest of the storage duration 6-12 X packaging interaction. Although, floret diameter and total water absorbed values were non-significant among storage duration x packaging material interaction in tuberose cv Suvasini. Data revealed that among various packaging materials LDPE-100 gauge have significant influence on vase life parameters and resulted in maximum vase life, percent gain in fresh weight after simulated transit, with ideal level of percent total CO₂ and O₂ followed by PP-100 gauge in modified storage of tuberose cut spike cv. Suvasini. The floret diameter and total water absorbed values were non – significant among various packaging material.

Data indicated significant effect among various storage durations in tuberose cv. Suvasini cut spikes. The maximum vase life was recorded in 0 day storage followed by 3 day storage treatment with vase life, floret diameter and percent gain in fresh weight with an ideal level of total percent CO₂ and O₂ in 3 day storage duration which is better than rest other storage duration. After storage of cut spikes also faces starvation resulted in un-opening of flower buds, abscission of floret without opening in Double type tuberose in vase hence it is not recommended for storage as compared to without storage. Moreover, after modified atmospheric storage duration increases from 6-12 day resulted in drastic reduction in vase life, floret diameter and fresh weight gain.

Table 3.23a. Interaction effect of storage durations and packaging material on MA storage of tuberose cut stems cv. Suvasini at Udaipur centre (2010-11)

Storage duration →	Vase life (day)					Diameter of basal floret (cm)					Total water absorbed per stem (cm)				
	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
0 day	12.36	12.86	13.58	13.58	12.41	2.76	2.93	3.3	3.2	3.43	33.33	33.33	33	35.33	33.66
3 day	10.55	10.02	12.03	6.39	8.19	3.6	3.4	3.5	3.53	3.53	33.33	30.66	31.66	29.33	33.66
6 day	10.05	9.64	9.3	5.97	6.58	3.4	3.13	3	3.26	3.33	33.33	31.66	32.66	32.66	32.66
9 day	9.8	8.69	8.8	6.41	6.22	2.96	3	3	2.93	3.1	31.66	32	33	31.66	30.66
12 day	8.94	7.02	6.86	6.33	6.02	2.9	2.8	2.4	2.7	2.76	30.33	33.33	33	30	31.66
CD (P=0.05)	1.38					NS					NS				

Note:

a: LDPE-100 gauge,
d: Cellophane,

b: LDPE-200 gauge,
e : Control (without packaging)

c: PP-100 gauge,

Table 3.23b. Interaction effect of storage durations and packaging material on MA storage of tuberose cut stems cv. Suvasini at Udaipur centre (2010-11)

Storage duration →	% loss or gain of weight after simulate transit					CO ₂ level in packages during storage					O ₂ level in packages during storage				
	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
0 day	4.75	4.22	4.8	3.41	3.03	-	-	-	-	-	-	-	-	-	-
3 day	4.9	6.35	7.29	1.62	-7.33	27.2	34.8	23.1	26.3	41.4	38.5	34.2	40.4	19.35	40.4
6 day	6.63	2.17	-0.11	-2.27	-15.17	30.7	26.3	26.3	29	41.8	37.4	39.2	40.1	19	41.8
9 day	8.86	7.35	-1.27	-3.42	-18.86	27.3	26.3	25	26	38.9	39.7	39.9	40.7	20.15	38.9
12 day	3.12	0.386	-2.31	-2.3	-28.62	39.1	37.6	34.5	36.5	39.4	35.1	36.4	37.5	18.4	39.4
CD (P=0.05)	5.12					0.61					0.90				

Note:

a: LDPE-100 gauge,
d: Cellophane,

b: LDPE-200 gauge,
e : Control (without packaging)

c: PP-100 gauge,

Table 3.23c. Effect of packaging materials on MA storage of tuberose cut stems cv. Suvasini at Udaipur centre (2010-11)

Packaging material	Vase life (day)	Diameter of basal floret (cm)	Total water absorbed per stem (cm)	% loss or gain of weight after simulate transit	CO ₂ level in packages	O ₂ level in packages
LDPE-100 gauge	10.45	3.12	32.4	5.65	24.86	30.14
LDPE-200 gauge	9.65	3.05	32.2	4.09	25	29.94
PP-100 gauge	10.11	3.04	32.66	1.67	21.78	31.74
Cellophane	7.73	3.12	31.8	-0.59	23.56	15.38
Control	7.88	3.23	32.46	-13.39	32.3	32.3
Mean	9.14	3.11	32.3	-0.51	25.5	27.9
CD (P=0.05)	0.61	NS	NS	2.29	0.27	0.40

--: All values are mean value of harvesting stages

Table 3.23d. Interaction effect of storage duration and packaging material on MA storage of tuberose cut stems cv. Suvasini at Udaipur centre (2011-12)

Packaging material ↓	Vase life (day)					Diameter of basal floret (cm)					Total water absorbed per stem (cm)					Percent decrease or gained in weight (%)				
	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
LDPE-100 gauge	11.96	10.36	9.93	9.69	8.88	2.83	3.63	3.47	2.87	2.87	35.33	36	32.33	32.67	31.33	5.11	6.32	6.91	9.35	4.62
LDPE-200 gauge	12.67	9.91	9.47	8.5	7.19	3	3.47	3.2	3.07	2.9	34.67	31.67	33	33.67	34.67	4.69	6.62	2.77	7.18	0.84
PP-100 gauge	13.03	11.25	9.47	8.97	6.75	3.37	3.57	3.07	3.03	2.5	35	33.33	34	33.67	34	5.13	7.72	0.47	-1.88	-1.34
PP-200 gauge	10.43	6.27	5.83	6.23	5.88	3.27	3.57	3.3	2.97	2.77	34	30.33	33.33	32.67	31.33	3.78	1.25	-2.91	-2.72	-3.09
Control	11.88	7.86	6.36	6.12	5.87	3.5	3.6	3.4	3.17	2.9	35.33	34.67	31.33	32	32.33	3.3	-7.89	-	-	-
CD (P=0.01)	1.17					0.26					NS					3.65				

Note: a=0 day, b=3 day, c=6 day, d= 9 days, e=12day

Table 3.23e. Interaction effect of storage durations and packaging material on MA storage of tuberose cut stems cv. Suvasini at Udaipur centre (2011-12)

Packaging material ↓	CO ₂ level after storage					CO ₂ level after simulated transit					Total CO ₂ level (after storage + simulated transit)				
	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
LDPE-100 gauge	0	12.17	15.5	11.4	13.78	0	14.88	14.94	15.39	23.89	0	27.04	30.44	26.79	37.66
LDPE-200 gauge	0	15.78	13.73	12.53	14.34	0	18.79	13.52	14.25	22.41	0	34.56	27.25	26.79	36.75
PP-100 gauge	0	11.7	12.95	12.53	14.55	0	11.62	13.83	13.29	19.64	0	23.32	26.79	25.82	34.19
PP-200 gauge	0	13.65	13.51	12.39	14.51	0	12.29	15.58	13.82	20.61	0	25.94	29.09	26.21	35.12
Control	0	20.19	21.68	19.88	21.79	0	21.18	19.92	19.24	17.34	0	41.36	41.6	39.12	39.13
CD (P=0.01)	1.63					1.64					2.31				

Note: a=0 day, b=3 day, c=6 day, d= 9 day, e=12day

Table 3.23f. Interaction effect of storage duration and packaging material on MA storage of tuberose cut stems cv. Suvasini at Udaipur centre (2011-12)

Packaging material ↓	O ₂ level after storage					O ₂ level after simulated transit					Total O ₂ level (after storage + simulated transit)				
	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
LDPE-100 gauge	0	19.22	18.28	20.91	18.05	0	17.94	17.8	17.73	16.03	0	37.16	36.08	38.64	34.09
LDPE-200 gauge	0	17.05	19.61	20.29	18.92	0	16.17	18.97	18.23	16.27	0	33.22	38.58	38.52	35.19
PP-100 gauge	0	19.21	19.99	20.21	18.68	0	19.67	18.57	19.2	17.27	0	38.88	38.55	39.41	35.94
PP-200 gauge	0	17.85	18.98	20.34	18.52	0	19.57	17.53	18.83	16.93	0	37.42	36.51	39.18	35.45
Control	0	20.32	21.58	19.52	21.6	0	19.7	18.83	18.33	16.33	0	40.02	40.41	37.85	37.93
CD (P=0.05)	1.98					2.03					2.67				

Note: a=0 day, b=3 day, c=6 day, d= 9 day, e=12day

Hyderabad

Studies on MA storage of tuberose cut stems cv. Hyderabad Double was carried out as per technical programme. Increase in duration of storage decrease vase life, diameter of basal floret and total water absorbed. The decrease was drastic after 3 day of storage and cut stems lost their firmness after 9 day of storage. Different packing materials did not vary with regards to vase life, floret diameter or water absorption. Increase in duration of storage decreased water absorption/stem and thereby declined vase life, floret size and fresh weight. The buds failed to open beyond 6 day of storage. Among different packing materials, pp100 recorded maximum vase life. Floret size and fresh weight were not affected by packing materials and non significant variation noticed in water absorption.

Table 3.24a. Vase life of tuberose cv. Hyderabad Double cut spike as affected by MA storage at Hyderabad centre (2011-12)

Storage duration(S) (Day)	Packaging (P)					Mean
	LDPE 100	LDPE200	PP100	PP200	Control	
0	9	9	9	9	9	9
3	8	8	8	8	8	8
6	8	8	8	8	6	7.6
9	6	6	6	6	0	4.8
12	5	5	5	5	0	4
Mean	7.2	7.2	7.2	7.2	4.6	
	Packaging (P)		Storage (S)		P × S	
CD (P=0.05)	0.71		0.71		1.60	

Table 3.24b. Maximum diameter (cm) of tuberose cv. Hyderabad Double as affected by MA storage at Hyderabad centre (2011-12)

Storage duration(S) (Day)	Packaging (P)					Mean
	LDPE 100	LDPE200	PP100	PP200	Control	
0	5.5	5.37	5.37	5.53	4.97	5.35
3	5.47	5.63	5.33	5.63	5.2	5.45
6	5.43	5.43	5.53	5.5	4.3	5.24
9	5.4	5.47	5.47	5.4	0	4.35
12	5.2	5.3	5.33	5.4	0	4.25
Mean	5.4	5.44	5.41	5.49	2.89	-
	Packaging (P)		Storage (S)		P × S	
CD (P=0.05)	0.13		0.13		0.2	

Table 3.24c. Total water up take (ml) of tuberose cv. Hyderabad Double cut spike as affected by MA storage at Hyderabad centre

Storage duration(S) (Day)	Packaging (P)					Mean
	LDPE 100	LDPE200	PP100	PP200	Control	
0	101.7	94.7	94	97.1	84.47	94.39
3	68.5	71.07	67.17	83.8	64.8	71.07
6	69.13	71.53	70.63	71.2	43.33	65.17
9	62.33	67.3	65.9	63.67	0	51.84
12	50.47	51.4	50.97	55.1	0	41.59
Mean	70.43	71.2	69.73	74.17	38.52	
	Packaging (P)		Storage (S)		P × S	
CD (P=0.05)	4.43		4.43		9.92	

Table 3.24d. Percent weight loss after storage of tuberose cv. Hyderabad Double cut spike as affected by MA storage at Hyderabad centre

Storage duration(S) (Day)	Packaging (P)					Mean
	LDPE 100	LDPE200	PP100	PP200	Control	
0	0.71	0.57	0.63	0.45	1.2	0.71
3	0.71	0.68	0.9	0.44	9.38	2.42
6	1.51	1.5	0.97	0.99	15.51	4.1
9	2.23	2.3	1.95	2.35	26.38	7.04
12	3.04	2.4	2.98	2.3	40.91	10.33
Mean	1.64	1.49	1.49	1.31	18.68	-
	Packaging (P)		Storage (S)		P × S	
CD (P=0.05)	0.97		0.97		2.17	

Table 3.24e. Studies on MA storage of tuberose cv. Hyderabad Double cut stems at Hyderabad centre (2012-13)

Treatment	Vase life (day)	Diameter of basal floret(cm)	Total Water absorbed/ stem(ml)
LDPE 100	2	2	16
LDPE 200	1.7	1.7	16.4
PP 100	1.9	1.8	19.2
PP 200	1.6	1.6	17
Control	1.7	1.7	15.8
CD (P=0.05)	NS	NS	NS
Storage Duration			
Control 0 days	3.7	3.4	31.8
3 days	3.4	3	29
6 days	1.7	2.4	23.6
9 days	–	–	–
12 days	–	–	–
CD (P=0.05)	NS	NS	4.5
Interactions (T x D)			
T ₁ x D ₀	3.9	3.6	30
D ₁	3.9	3.4	28
D ₂	2	2.9	22
D ₃	–	–	–
D ₄	–	–	–
T ₂ x D ₀	3.5	3.2	32
D ₁	3.5	3	26
D ₂	1.6	2.5	24
D ₃	–	–	–
D ₄	–	–	–
T ₃ x D ₀	3.9	3.3	35
D ₁	3.7	3.1	33
D ₂	1.9	2.4	28
D ₃	–	–	–
D ₄	–	–	–
T ₄ x D ₀	3.5	3.3	31
D ₁	2.8	2.9	30
D ₂	1.6	2	24
D ₃	–	–	–
D ₄	–	–	–
T ₅ x D ₀	3.5	3.4	31
D ₁	3.3	3	28
D ₂	1.6	2	20
D ₃	–	–	–
D ₄	–	–	–
CD (P=0.05)	NS	NS	NS

Table 3.24f. Studies of MA storage of tuberose cv. Hyderabad Doublecut stems at Hyderabad centre (2013-14)

Treatment	Vase life (day)	Diameter of basal	Total water absorbed/	Percent wt. loss after
LDPE 100	3.3	3.2	27.3	2.5
LDPE 200	3	2.9	26.6	2.3
PP 100	3.4	3.1	30.3	2.2
PP 200	3.2	2.7	28	2.1
Control	2.9	2.7	26.3	-
CD (P=0.05)	0.4	NS	NS	NS
Storage Duration				
Control 0 days	3.9	3.3	27.3	-
3 days	3.5	3.1	28.6	1.6
6 days	2.1	2.4	23.2	1.8
9 days	-	-	-	2.5
12 days	-	-	-	3.2
CD (P=0.05)	0.4	0.4	NS	0.4
Interactions (T x D)				
T ₁ x D ₀	3.9	3.5	30	1.9
D ₁	3.8	3.3	30	2
D ₂	2.3	2.8	22	2.8
D ₃	-	-	-	3.5
D ₄	-	-	-	-
T ₂ x D ₀	3.8	3.2	30	1.6
D ₁	3.3	3	26	1.8
D ₂	2	2.5	24	2.6
D ₃	-	-	-	3.3
D ₄	-	-	-	-
T ₃ x D ₀	3.9	3.5	35	1.5
D ₁	3.7	3.3	30	1.7
D ₂	2.5	2.7	26	2.5
D ₃	-	-	-	3.3
D ₄	-	-	-	-
T ₄ x D ₀	3.9	3.2	31	1.5
D ₁	3.5	2.9	29	1.8
D ₂	2.2	2	24	2.2
D ₃	-	-	-	3
D ₄	-	-	-	-
T ₅ x D ₀	3.8	3.3	31	-
D ₁	3.3	3	28	-
D ₂	1.6	2	20	-
D ₃	-	-	-	-
D ₄	-	-	-	-
CD (P=0.05)	0.4	0.4	NS	NS

Experiment 4.7.5 : Effect of packaging and storage on keeping quality of garland flowers of tuberose.

Technical Programme

Cultivar : Locally grown Single tuberose cultivar
Harvest stage : Fully developed unopened buds
Pre-cooling : Pre-cooling at 4°C (PC) and no pre-cooling (NPC)
Packages : Three
 1. Gunny/fertilizer bag,
 2. Round bamboo basket with newspaper lining
 3. CFP boxes with 100 gauge Polyethylene lining
Storage : Two (Room Temperature and 4°C)
Treatments : 12 (2×2×3)
Replication : Three
Sample size : 5kg/replication
Design : Factorial CRD

Observation recorded

Fresh weight on initial and subsequent storage intervals (0,3,6,9,12 and 15 day), size, %PLW, % moisture content, membrane permeability test (wherever facility is available), colour (Royal Horticulture Colour Chart) %freshness, %florete opened, shelf life (days) is terminated when fading/wilting/dicoloration/florete shedding occurs.

Report

Hessaraghatta

Experiment on effect of packaging and storage on keeping quality of garland flowers of tuberose was carried out as per the technical programme with cv. Mexican Single. Observations revealed that pre cooling before packaging was found beneficial in extending the shelf life of tuberose by 3 day over control. Pre cooling helped in extending the shelf life by one during the initial period of storage and had no effect during the subsequent storage. Storage up to 6 day at 4°C was found optimum in florete opening. During the subsequent storage period florete opening decreased and caused chilling injury to the floretes. Tuberose floretes stored in CFB boxes in polyethylene 100gauge had maximum shelf life of 5.2 day.

Table 3.25a. Effect of pre cooling, packaging and storage on size of garland tuberose cv. Mexican Single flower at Hessaraghatta centre (2010-11)

Package	Control 0 day storage	Pre cooled (day storage)										Without pre cooled (day storage)									
		3		6		9		12		15		3		6		9		12		15	
		RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C
Gunny bag	3.5	3.3	3.1	3.2	1.8	-	2	-	2	-	-	3.6	2.2	-	2.6	-	2.8	-	3	-	-
Bamboo basket	3.4	3.2	3	3	1.6	-	1.8	-	2	-	-	3.4	2	-	2.4	-	2.6	-	2.8	-	-
CFP boxes with 100 gauge Polyethylene lining	3.2	3	2.8	2.8	1.4	-	1.6	-	1.8	-	-	3.2	2	-	2.2	-	2.4	-	2.6	-	-

Table 3.25b. Effect of pre-cooling, packaging and storage on percent opening of garland in tuberose cv. Mexican Single flowers at Hessaraghatta centre (2010-11)

Package	Control 0day storage	Pre cooled (day storage)										Without pre cooled (day storage)									
		3		6		9		12		15		3		6		9		12		15	
		RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C
Gunny bag	62	96	26	100	48	-	72	-	100	-	-	100	38	-	58	-	96	-	100	-	-
Bamboo basket	60	94	22	100	45	-	68	-	96	-	-	100	32	-	54	-	92	-	98	-	100
CFP boxes with 100 gauge Polyethylene lining	55	62	12	84	28	100	44	-	56	-	-	64	18	-	28	-	42	-	62	-	78

Table 3.25c. Effect of pre cooling, packaging and storage on shelf life (day) of garland in tuberose cv. Mexican Single flowers at Hesaraghatta centre (2010-11)

Package	Control 0 day storage	Pre cooled (day storage)										Without pre cooled (day storage)									
		3		6		9		12		15		3		6		9		12		15	
		RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C
Gunny bag	3.2	1	3	-	2	-	1	-	-	-	-	1	2	-	1	-	-	-	-	-	-
bamboo basket	3.4	1	3	-	2	-	1	-	-	-	-	1	2	-	1	-	-	-	-	-	-
CFP boxes with 100 gauge Polyethylene lining	5.2	2	4	-	3	-	2	-	1	-	-	2	4	-	2	-	1	-	-	-	-
CD (P=0.05)																					
Packaging (P)	2.26	0.78	0.48	-	0.58	-	0.78	-	-	-	-	0.78	0.62	-	0.78	-	-	-	-	-	-
Pre cooling (PC)	1.18	0.66	0.36	-	0.36	-	0.66	-	-	-	-	0.66	0.46	-	0.66	-	-	-	-	-	-
PXPC	0.98	0.46	0.24	-	0.24	-	0.46	-	-	-	-	0.46	0.32	-	0.46	-	-	-	-	-	-

Table 3.25d. Effect of pre cooling, packaging and storage on size of garland in tuberose cv. Mexican Single flower at Hesaraghatta centre (2011-12)

Package	Control 0 day storage	Pre cooled (day storage)										Without pre cooled (day storage)									
		3		6		9		12		15		3		6		9		12		15	
		RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C
Gunny bag	3.6	3.3	3.1	3.2	1.8	-	2	-	2	-	-	3.6	2.2	-	2.6	-	2.8	-	3	-	-
bamboo basket	3.5	3.2	3	3	1.6	-	1.8	-	2	-	-	3.4	2	-	2.4	-	2.6	-	2.8	-	-
CFP boxes with 100 gauge Polyethylene lining	3.3	3	2.8	2.8	1.4	-	1.6	-	1.8	-	-	3.2	2	-	2.2	-	2.4	-	2.6	-	-

Table 3.25e. Effect of pre cooling, packaging and storage on percent opening of garland in tuberose cv. Mexican Single flowers at Hesaraghatta centre (2011-12)

Package	Control 0 day storage	Pre cooled (day storage)										Without pre cooled (day storage)									
		3		6		9		12		15		3		6		9		12		15	
		RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C
Gunny bag	60	95	25	100	47	-	71	-	100	-	-	100	36	-	57	-	94	-	100	-	-
bamboo basket	58	93	22	100	44	-	67	-	95	-	-	100	30	-	53	-	90	-	96	-	100
CFP boxes with 100 gauge Polyethylene lining	53	61	11	84	27	100	43	-	55	-	-	62	18	-	29	-	40	-	60	-	76

Table 3.25f. Effect of pre cooling, packaging and storage on shelf life (day) of garland in tuberose cv. Mexican Single flowers at Hesaraghatta centre (2011-12)

Package	Control 0 day storage	Pre cooled (day storage)										Without pre cooled (day storage)									
		3		6		9		12		15		3		6		9		12		15	
		RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C
Gunny bag	3.3	1	3	-	2	-	1	-	-	-	1	2	-	-	1	-	-	-	-	-	
bamboo basket	3.5	1	3	-	2	-	1	-	-	-	1	2	-	-	1	-	-	-	-	-	
CFP boxes with 100 gauge Polyethylene lining	5.3	2	4	-	3	-	2	-	1	-	2	4	-	-	2	-	1	-	-	-	
CD (P=0.05)																					
Packaging (P)	1.66	0.78	0.48	-	0.58	-	0.78	-	-	-	0.78	0.62	-	-	0.78	-	-	-	-	-	
Pre cooling (PC)	1.08	0.66	0.36	-	0.36	-	0.66	-	-	-	0.66	0.46	-	-	0.66	-	-	-	-	-	
PXPC	0.88	0.46	0.24	-	0.24	-	0.46	-	-	-	0.46	0.32	-	-	0.46	-	-	-	-	-	

Table 3.25g. Effect of modified atmosphere packaging and duration of storage on vase life of tuberose cv. Suvasini cut flowers at Hessaraghatta centre (2012-13)

Packages	0 day of storage	3 day of storage	6 day of storage	9 day of storage
Polyethylene 100 gauge	8.6	7	5.5	2.5
Polyethylene 200 gauge	8.2	7	5.2	2.2
Poly propylene 100 gauge	7.6	7.2	5	2.1
Polypropylene 200 gauge	7	6.6	4.8	1.9
Control	6.8	1.8	–	–
CD (P=0.05)	0.72	0.94	–	–

Table 3.25h. Effect of modified atmosphere packaging and duration of storage on basal floret diameter of tuberose cv. Suvasini cut flowers at Hessaraghatta centre (2012-13)

Packages	0 day of storage	3 day of storage	6 day of storage
Polyethylene 100 gauge	4.8	4.3	3.7
Polyethylene 200 gauge	4.6	4.1	3.5
Poly propylene 100 gauge	4.5	4	3.3
Polypropylene 200 gauge	4.1	3.8	3.1
Control	4.7	3.5	–
CD (P=0.05)	0.36	0.4	–

Table 3.25i. Effect of modified atmosphere packaging and duration of storage on water uptake (ml) of tuberose cv. Suvasini cut flowers at Hesaraghatta centre (2012-13)

Packages	0 day of storage	3 day of storage	6 day of storage	9 day of storage	12 day of storage
Polyethylene 100 gauge	68	61	53	43	31
Polyethylene 200 gauge	66	57	50	37	29
Polypropylene 100 gauge	65	55	49	41	27
Polypropylene 200 gauge	61	53	45	35	23
Control	70	57	-	-	-
CD (P=0.05)	1.32	1.22	-	-	-

Table 3.25j. Effect of modified atmosphere packaging and duration of storage on percent weight loss after transit of tuberose cv. Suvasini cut flowers at Hesaraghatta centre (2012-13)

Packages	0 day of storage	3 day of storage	6 day of storage
Polyethylene 100 gauge	2.8	6.9	25.6
Polyethylene 200 gauge	2.4	4.6	21.4
Poly propylene 100 gauge	2.1	4.6	23.2
Polypropylene 200 gauge	1.4	3.8	16.6
Control	12.8	44.2	-
CD (P=0.05)	4.6	17.6	-

Table 3.25k. Effect of modified atmosphere packaging and duration of storage on concentration of CO₂ (mg/kg/h) evolved during storage of tuberose cv. Suvasini cut flowers at Hesaraghatta centre (2012-13)

Packages	0 day of storage	3 day of storage	6 day of storage
Polyethylene 100 gauge	662	410	192
Polyethylene 200 gauge	860	668	260
Polypropylene 100 gauge	704	556	252
Polypropylene 200 gauge	986	814	342
Control	309	230	–
CD (P=0.05)	35.62	22.5	–

Table 3.25l. Effect of modified atmosphere packaging and duration of storage on vase life, basal floret diameter and water uptake (ml) of tuberose cv. Suvasini cut flowers at Hesaraghatta centre (2013-14)

Packages	Vase life (day of storage)					Basal floret diameter (day of storage)					Water uptake (ml) (day of storage)				
	0	3	6	9	12	0	3	6	9	12	0	3	6	9	12
Polyethylene 100 gauge	8.7	7.1	5.4	2.4	–	4.5	4.2	3.6	–	–	66	60	52	42	30
Polyethylene 200 gauge	8.3	7	5.2	2.2	–	4.5	4.1	3.5	–	–	64	56	48	36	28
Poly propylene 100 gauge	7.7	7.3	5	2.1	–	4.4	4	3.3	–	–	63	54	48	40	26
Polypropylene 200 gauge	7.1	6.7	4.8	1.9	–	4	3.6	3	–	–	60	53	44	34	22
Control	6.9	1.9	–	–	–	4.6	3.4	–	–	–	69	58	-	–	–
CD (P=0.05)	0.7	0.92	–	–	–	0.36	0.38	–	–	–	0.92	1.12	–	–	–

Table 3.25m. Effect of modified atmosphere packaging and duration of storage on percent weight loss and concentration of CO₂ (mg/kg/h) evolved during storage of tuberose cv. Suvasini cut flowers at Hessaraghatta centre (2013-14)

Packages	Percent weight loss (day of storage)					Concentration of CO ₂ (mg/kg/h) evolved during storage (day of storage)				
	0	3	6	9	12	0	3	6	9	12
Polyethylene 100 gauge	2.6	6.8	24.6	-	-	660	409	190	-	-
Polyethylene 200 gauge	2.2	4.5	20.4	-	-	858	668	260	-	-
Poly propylene 100 gauge	1.9	4.5	22.2	-	-	702	554	252	-	-
Polypropylene 200 gauge	1.3	3.7	15.8	-	-	984	812	342	-	-
Control	12.6	43.2	-	-	-	304	230	-	-	-
CD (P=0.05)	4.62	17.66	-	-	-	34.52	21.48	-	-	-

Hyderabad

Effect of packing and storage on keeping quality of garland flowers of tuberose was carried out as per technical programme. The results revealed that increase in storage duration decreased shelf life. Different packing materials varied in shelf life. Tuberose florets stored in CFB boxes with 100 gauge polyethelene lining performed better. Precooling helped in extending shelf life.

Table 3.26a. Effect of package and storage on floret size and shelf life of garland flowers of tube rose at Hyderabad centre (2011-12)

a. Floret Size (cm)

Package material	control 0 day	Precooled (day storage)										Without precooled (day storage)									
		3		6		9		12		15		3		6		9		12		15	
		RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C
Gunny bag	3.4	3.3	3.2	3.1	3.2	-	2.5	-	-	-	-	3.2	3.1	3	3.2	-	2.1	-	-	-	-
Bamboo basket	3.6	3.6	3.5	3.5	3.4	-	2.5	-	-	-	-	3.2	3	3.1	3.2	-	2	-	-	-	-
CFB boxe with 100 guage PE lining	3.5	3.6	3.4	3.5	3.2	-	2.8	-	-	-	-	3.3	3	3.3	3.1	-	2.4	-	-	-	-

b. Shelf life (day)

Package material	control 0 day	Precooled (day storage)										Without precooled (day storage)									
		3		6		9		12		15		3		6		9		12		15	
		RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C	RT	4°C
Gunny bag	3	1.5	2.5	1	2	-	1	-	-	-	-	1.2	2.2	0.6	1	-	0.5	-	-	-	-
Bamboo basket	3.1	1.5	2.2	1	1.8	-	0.8	-	-	-	-	1.3	2.3	0.7	1	-	0.5	-	-	-	-
CFB boxe with 100 guage PE lining	4.1	2	4	1.5	3.2	-	1.6	-	-	-	-	1.5	3.5	1	2	-	1	-	-	-	-

Table 3.26b. Studies of MA storage of tuberose cut stems at Hyderabad centre (2012-13)

Treatment	Vase life (day)	Diameter of basal floret(cm)	Total Water absorbed/ stem(ml)
LDPE 100	2	2	16
LDPE 200	1.7	1.7	16.4
PP 100	1.9	1.8	19.2
PP 200	1.6	1.6	17
Control	1.7	1.7	15.8
CD (P=0.05)	NS	NS	NS
Storage Duration			
Control 0 days	3.7	3.4	31.8
3 day	3.4	3	29
6 day	1.7	2.4	23.6
9 day	–	–	–
12 day	–	–	–
CD (P=0.05)	NS	NS	4.5
Interactions (T x D)			
T ₁ × D ₀	3.9	3.6	30
D ₁	3.9	3.4	28
D ₂	2	2.9	22
D ₃	–	–	–
D ₄	–	–	–
T ₂ × D ₀	3.5	3.2	32
D ₁	3.5	3	26
D ₂	1.6	2.5	24
D ₃	–	–	–
D ₄	–	–	–
T ₃ × D ₀	3.9	3.3	35
D ₁	3.7	3.1	33
D ₂	1.9	2.4	28
D ₃	–	–	–
D ₄	–	–	–
T ₄ × D ₀	3.5	3.3	31
D ₁	2.8	2.9	30
D ₂	1.6	2	24
D ₃	–	–	–
D ₄	–	–	–
T ₅ × D ₀	3.5	3.4	31
D ₁	3.3	3	28
D ₂	1.6	2	20
D ₃	–	–	–
D ₄	–	–	–
CD (P=0.05)	NS	NS	NS

Table 3.26c. Studies of MA storage of tuberose cut stems at Hyderabad centre (2013-14)

Treatment	Vase life (day)	Diam. of basal floret(cm)	Water absorbed/ stem(ml)	Wt. loss after storage (%)
Packages				
LDPE 100	3.3	3.2	27.3	2.5
LDPE 200	3	2.9	26.6	2.3
PP 100	3.4	3.1	30.3	2.2
PP 200	3.2	2.7	28	2.1
Control	2.9	2.7	26.3	-
CD (P=0.05)	0.4	NS	NS	NS
Storage Duration				
Control 0 days	3.9	3.3	27.3	-
3 day	3.5	3.1	28.6	1.6
6 day	2.1	2.4	23.2	1.8
9 day	-	-	-	2.5
12 day	-	-	-	3.2
CD (P=0.05)	0.4	0.4	NS	0.4
Interactions (T x D)				
T ₁ x D ₀	3.9	3.5	30	1.9
D ₁	3.8	3.3	30	2
D ₂	2.3	2.8	22	2.8
D ₃	-	-	-	3.5
D ₄	-	-	-	-
T ₂ x D ₀	3.8	3.2	30	1.6
D ₁	3.3	3	26	1.8
D ₂	2	2.5	24	2.6
D ₃	-	-	-	3.3
D ₄	-	-	-	-
T ₃ x D ₀	3.9	3.5	35	1.5
D ₁	3.7	3.3	30	1.7
D ₂	2.5	2.7	26	2.5
D ₃	-	-	-	3.3
D ₄	-	-	-	-
T ₄ x D ₀	3.9	3.2	31	1.5
D ₁	3.5	2.9	29	1.8
D ₂	2.2	2	24	2.2
D ₃	-	-	-	3
D ₄	-	-	-	-
T ₅ x D ₀	3.8	3.3	31	-
D ₁	3.3	3	28	-
D ₂	1.6	2	20	-
D ₃	-	-	-	-
D ₄	-	-	-	-
CD (P=0.05)	0.4	0.4	NS	NS

Kalyani

On an average, pre-cooled flowers, kept in CFB boxes at 4°C were the best performer among all the treatment combinations. Storage of garland flowers of tuberose for 6 day was the best compared to the other storage durations that is 9 day, 12 day and 15 day. Percent weight loss was minimum, freshness, moisture content, fresh weight were higher and maximum number of floret were opened. Shelf life was maximum of those pre-cooled flowers kept in CFB boxes at both room temperature and 4°C.

At 6 day storage duration, percent loss in weight was varied significantly among different packaging materials, two storage conditions and pre-cooling and non pre-cooling temperature. Percent loss in weight was maximum in non pre-cooled loose tuberose flowers which were kept in gunny bag at room temperature. But freshness, moisture content and fresh weight were maximum in pre-cooled flowers kept in CFB boxes at 4°C. maximum floret was opened in the same treatment also.

Comparing the other storage durations i. e. 9 day, 12 day and 15 day, 6 day storage duration gave better result than others. Because at 6 day storage duration, percent weight loss was minimum, freshness, moisture content, fresh weight were higher in that treatment and maximum number of florets was opened in that storage duration. Shelf life was maximum of those pre-cooled flowers kept in CFB boxes at both room temperature and 4°C. According to Horticulture Royal Colour Chart, after 15 day of storage at both room temperature and 4°C of both pre-cooled and non pre-cooled flowers took Erythrite red 180/4.

Table 3.27a. Effect of packaging and storage of garland flowers on Percent loss in weight, freshness (%), fresh weight (g), moisture content (%) and floret open (no.) at 6 day at Kalyani centre (2010-11)

Treatment	Wt. loss at 6 day (%)			Freshness at 6 day (%)			Fresh wt. at 6 day (g)			Moisture content at 6 day (%)			Floret open at 6 day (no.)		
	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean
S ₁ T ₁	12	21.92	16.96	64.67	55.33	60	3.81	3.39	3.6	76.25	68.14	72.19	15.33	11.33	13.33
S ₁ T ₂	10.82	16.65	13.74	70.67	64	67.33	4.05	3.47	3.76	81.47	69.76	75.61	15.33	14	14.67
S ₂ T ₁	9.91	18.22	14.07	52	50.67	51.33	4.18	3.74	3.96	83.94	75.05	79.5	11.33	10	10.67
S ₂ T ₂	6.72	15.43	11.08	63.33	57.33	60.33	4.35	3.86	4.1	89.37	77.84	83.61	14.67	11.33	13
S ₃ T ₁	5.94	11.63	8.79	70.67	66	68.33	4.25	3.77	4.01	85.66	75.74	80.7	20.67	15.33	18
S ₃ T ₂	3.29	9.9	6.6	74.67	70.67	72.67	4.5	4.27	4.39	90.07	85.07	87.57	21.33	16.67	19
Mean	8.11	15.63		66	60.67		4.19	3.75		84.46	75.27		16.44	13.11	
	C	Sx T	Cx Sx T	C	Sx T	Cx Sx T	C	Sx T	Cx Sx T	C	Sx T	Cx Sx T	C	Sx T	Cx Sx T
CD (P=0.05)	1.267	NS	NS	2.53	NS	NS	0.03	0.05	0.08	1.49	2.57	3.64	1.36	NS	NS

C₁ = pre-cooled, C₂ = non pre-cooled, S₁ = gunny bag, S₂ = bamboo basket, S₃ = CFB, T₁ = room temperature, T₂ = 4°C.

Table 3.27b. Effect of packaging and storage of garland flowers on per cent loss in weight, freshness (%), fresh weight (g), moisture content (%) and floret open (no.) at 9 day at Kalyani centre (2010-11)

Treatment	Wt. loss at 9 day (%)			Freshness at 9 day (%)			Fresh wt. at 9 day (g)			Moisture content at 9 day (%)			Floret open at 9 day (no.)		
	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean
S ₁ T ₁	31.82	43.19	37.51	29.67	23.67	26.67	3.38	2.82	3.1	68.18	56.81	62.49	9.33	5.33	7.33
S ₁ T ₂	31.36	41.72	36.54	35.67	29	32.33	3.43	2.9	3.16	68.64	58.28	63.46	9.33	8	8.67
S ₂ T ₁	28.18	44.84	36.51	17	15.67	16.33	3.58	2.76	3.17	71.82	55.16	63.49	5.33	4	4.67
S ₂ T ₂	19.61	40.37	29.99	28.33	22.33	25.33	4.02	2.99	3.51	80.39	59.47	69.93	8.67	5.33	7
S ₃ T ₁	24.12	42.55	33.34	35.67	27.67	31.67	3.83	2.87	3.35	75.88	57.45	66.67	15.33	9.33	12.33
S ₃ T ₂	16.23	30.94	23.59	39.67	29	34.33	4.16	3.45	3.8	83.77	69.06	76.42	15.33	10.67	13
Mean	25.22	40.6		31	24.56		3.73	2.96		74.78	59.37		10.56	7.11	
	C	S x T	Cx Sx T	C	S x T	Cx Sx T	C	S x T	Cx Sx T	C	S x T	Cx Sx T	C	S x T	Cx Sx T
CD (P=0.05)	1.16	2.00	2.84	2.94	NS	NS	0.03	0.05	0.07	1.16	2.01	2.85	1.30	NS	NS

C₁ = pre-cooled, C₂ = non pre-cooled, S₁ = gunny bag, S₂ = bamboo basket, S₃ = CFB, T₁ = room temperature, T₂ = 4°C.

Table 3.27c. Effect of packaging and storage of garland flowers on percent loss in weight, freshness (%), fresh weight (g), moisture content (%) and florets open (no.) at 12 day at Kalyani centre (2010-11)

Treatment	Wt. loss at 2 day (%)			Freshness at 12 day (%)			Fresh wt. at 12 day (g)			Moisture content at 12 day (%)			Floret open at 12 day (no.)		
	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean
S ₁ T ₁	40.94	54.6	47.77	12.33	9	10.67	2.9	2.25	2.58	59.06	45.4	52.23	3.67	0.33	2
S ₁ T ₂	36.93	47.52	42.23	15.67	14.33	15	3.18	2.62	2.9	63.07	52.48	57.77	3.33	1.33	2.33
S ₂ T ₁	37.72	57.93	47.82	4.67	5.33	5	3.09	2.14	2.62	62.28	42.07	52.18	1	0	0.5
S ₂ T ₂	32.54	55.18	43.86	12.33	6.33	9.33	3.33	2.25	2.79	67.46	44.82	56.14	2.33	0.67	1.5
S ₃ T ₁	34.08	54.53	44.3	15	8.67	11.83	3.3	2.87	3.09	65.92	45.47	55.7	5.33	3	4.17
S ₃ T ₂	32.21	41.77	36.99	20.33	11.33	15.83	3.37	2.85	3.11	67.79	58.23	63.01	4.67	3.33	4
Mean	35.74	51.92		13.39	9.17		3.2	2.5		64.27	48.08		3.39	1.44	
	C	S x T	Cx Sx T	C	S x T	Cx Sx T	C	S x T	Cx Sx T	C	S x T	Cx Sx T	C	S x T	Cx Sx T
CD (P=0.05)	2.006	NS	4.91	2.45	NS	NS	0.04	0.07	NS	2.00	NS	4.91	0.91	NS	NS

C₁ = pre-cooled, C₂ = non pre-cooled, S₁ = gunny bag, S₂ = bamboo basket, S₃ = CFB, T₁ = room temperature, T₂ = 4°C.

Table 3.27d. Effect of packaging and storage of tuberose garland flowers on percent loss in weight, fresh weight (g) moisture content (%) and at 15 day at Kalyani centre (2010-11)

Treatment	Wt. loss at 15 day (%)			Self life at 15 day (day)			Fresh wt. at 15 day			Moisture content at 15 day (%)		
	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean
S ₁ T ₁	49.23	73.81	61.52	3	2.33	2.67	2.52	1.31	1.92	50.77	26.19	38.48
S ₁ T ₂	48.81	65.75	57.28	3.33	2.33	2.83	2.53	1.72	2.13	51.19	34.25	42.72
S ₂ T ₁	44.37	69.23	56.8	2.67	2.33	2.5	2.77	1.53	2.15	55.63	30.77	43.2
S ₂ T ₂	40.86	65.07	52.97	2.67	2	2.33	2.91	1.73	2.32	59.14	34.93	47.03
S ₃ T ₁	44.58	61.86	53.22	3.67	2.67	3.17	2.75	1.93	2.34	55.42	38.14	46.78
S ₃ T ₂	37.87	56.85	47.36	3.67	3	3.33	3.1	2.15	2.63	62.13	43.15	52.64
Mean	44.29	65.43		3.17	2.44	-	2.76	1.73	-	55.71	34.57	-
	C	Sx T	Cx Sx T	C	Sx T	Cx Sx T	C	Sx T	Cx Sx T	C	Sx T	Cx Sx T
CD (P=0.05)	1.29	NS	3.16	0.40	NS	NS	0.05	NS	0.12	1.29	NS	3.16

C₁ = pre-cooled, C₂ = non pre-cooled, S₁ = gunny bag, S₂ = bamboo basket, S₃ = CFB, T₁ = room temperature, T₂ = 4°C.

Table 3.27e. Effect of packaging and storage of tuberose garland flowers on Shelf life (day) at Kalyani centre (2010-11)

Treatment	Shelf life (day)		
	C ₁	C ₂	Mean
S ₁ T ₁	3	2.33	2.67
S ₁ T ₂	3.33	2.33	2.83
S ₂ T ₁	2.67	2.33	2.5
S ₂ T ₂	2.67	2	2.33
S ₃ T ₁	3.67	2.67	3.17
S ₃ T ₂	3.67	3	3.33
Mean	3.17	2.44	-
	C	Sx T	Cx Sx T
CD (P=0.05)	0.40	NS	NS

C₁ = pre-cooled, C₂ = non pre-cooled, S₁ = gunny bag, S₂ = bamboo basket, S₃ = CFB, T₁ = room temperature, T₂ = 4°C.

Table 3.27f. Effect of packaging and storage on fresh weight of garland flowers of tuberose at Kalyani centre (2011-12)

Treatment	Fresh weight at				
	3 day	6 day	9 day	12 day	15 day
Pre-cooling (C)					
C ₁	187.49	167.07	108.43	32.38	31.38
C ₂	186.56	166.13	57.91	31.57	30.07
CD (P=0.05)	0.75	0.93	0.82	NS	NS
Package (P)					
P ₁	185.66	163.28	76.24	0	0
P ₂	178.08	142.71	29.08	0	0
P ₃	197.33	193.81	144.19	95.93	92.18
CD (P=0.05)	0.92	1.14	1.00	1.41	1.66
Temperature (T)					
T ₁	188.31	170.23	135.09	63.96	61.46
T ₂	185.74	162.97	31.25	0	0
CD (P=0.05)	0.75	0.93	0.82	1.15	1.36
C x P					
C ₁ P ₁	185.92	164.62	76.47	0	0
C ₁ P ₂	179.13	142.68	58.15	0	0
C ₁ P ₃	197.43	193.9	190.67	97.15	94.15
C ₂ P ₁	185.4	161.93	76.02	0	0
C ₂ P ₂	177.03	142.73	0	0	0
C ₂ P ₃	197.23	193.72	97.72	94.72	90.22
CD (P=0.05)	NS	1.61	1.42	NS	2.36

Table 3.27f. Effect of packaging and storage on fresh weight of garland flowers of tuberose at Kalyani centre (2011-12) (continue...)

Treatment	Fresh weight at				
	3 day	6 day	9 day	12 day	15 day
C x T					
C ₁ T ₁	188.37	170.81	154.36	64.77	62.77
C ₁ T ₂	186.62	163.32	62.5	0	0
C ₂ T ₁	188.26	169.64	115.82	63.14	60.14
C ₂ T ₂	184.86	162.61	0	0	0
CD (P=0.05)	1.06	NS	1.16	NS	NS
P x T					
P ₁ T ₁	187.05	168.23	152.48	0	0
P ₁ T ₂	184.27	158.32	0	0	0
P ₂ T ₁	179.13	145.38	58.15	0	0
P ₂ T ₂	177.03	140.03	0	0	0
P ₃ T ₁	198.75	197.07	194.63	191.87	184.37
P ₃ T ₂	195.92	190.55	93.75	0	0
CD (P=0.05)	NS	1.61	1.42	2	2.36
CxPxT					
C ₁ P ₁ T ₁	187.07	169.07	152.93	0	0
C ₁ P ₁ T ₂	184.77	160.17	0	0	0
C ₁ P ₂ T ₁	179.37	146.57	116.3	0	0
C ₁ P ₂ T ₂	178.9	138.8	0	0	0
C ₁ P ₃ T ₁	198.67	196.8	193.83	194.3	188.3
C ₁ P ₃ T ₂	196.2	191	187.5	0	0
C ₂ P ₁ T ₁	187.03	167.4	152.03	0	0
C ₂ P ₁ T ₂	183.77	156.47	0	0	0
C ₂ P ₂ T ₁	178.9	144.2	0	0	0
C ₂ P ₂ T ₂	175.17	141.27	0	0	0
C ₂ P ₃ T ₁	198.83	197.33	195.43	189.43	180.43
C ₂ P ₃ T ₂	195.63	190.1	0	0	0
CD (P=0.05)	NS	2.28	2.01	NS	3.33

Table 3.27g. Effect of packaging and storage on flower size (cm) of garland flowers of tuberose at Kalyani centre

Treatment	Flower size(cm) at				
	3 day	6 day	9 day	12 day	15 day
Pre-cooling (C)					
C ₁	2.01	1.68	0.83	0.39	0.19
C ₂	2	1.54	0.56	0.31	0.22
CD (P=0.05)	NS	NS	0.09	0.04	NS
Package (P)					
P ₁	1.95	1.63	0.51	0	0
P ₂	1.95	0.65	0	0	0
P ₃	2.12	2.55	1.58	1.05	0.61
CD (P=0.05)	NS	0.20	0.11	0.05	0.06
Temperature (T)					
T ₁	2	1.82	1.23	0.7	0.41
T ₂	2.01	1.4	0.16	0	0
CD (P=0.05)	NS	0.16	0.09	0.04	0.05
C x P					
C ₁ P ₁	2.07	1.78	0.52	0	0
C ₁ P ₂	1.97	0.67	0	0	0
C ₁ P ₃	2	2.58	1.98	1.18	0.57
C ₂ P ₁	1.83	1.47	0.5	0	0
C ₂ P ₂	1.93	0.63	0	0	0
C ₂ P ₃	2.23	2.52	1.18	0.92	0.65
CD (P=0.05)	NS	NS	0.16	0.07	NS

Table 3.27g. Effect of packaging and storage on flower size (cm)of garland flowers of tuberose at Kalyani centre (contine...)

Treatment	Flower size(cm) at				
	3 day	6 day	9 day	12 day	15 day
C x T					
C ₁ T ₁	2.12	1.73	1.34	0.79	0.38
C ₁ T ₂	1.9	1.62	0.32	0	0
C ₂ T ₁	1.88	1.9	1.12	0.61	0.43
C ₂ T ₂	2.12	1.18	0	0	0
CD (P=0.05)	NS	0.23	NS	0.05	NS
P x T					
P ₁ T ₁	1.85	2.2	1.02	0	0
P ₁ T ₂	2.05	1.05	0	0	0
P ₂ T ₁	2.23	0.7	0	0	0
P ₂ T ₂	1.67	0.6	0	0	0
P ₃ T ₁	1.92	2.55	2.68	2.1	1.22
P ₃ T ₂	2.32	2.55	0.48	0	0
CD (P=0.05)	0.49	0.28	0.16	0.07	0.09
C x P x T					
C ₁ P ₁ T ₁	1.97	2.13	1.03	0	0
C ₁ P ₁ T ₂	2.17	1.43	0	0	0
C ₁ P ₂ T ₁	2.4	0.67	0	0	0
C ₁ P ₂ T ₂	1.53	0.67	0	0	0
C ₁ P ₃ T ₁	2	2.4	3	2.37	1.13
C ₁ P ₃ T ₂	2	2.77	0.97	0	0
C ₂ P ₁ T ₁	1.73	2.27	1	0	0
C ₂ P ₁ T ₂	1.93	0.67	0	0	0
C ₂ P ₂ T ₁	2.07	0.73	0	0	0
C ₂ P ₂ T ₂	1.8	0.53	0	0	0
C ₂ P ₃ T ₁	1.83	2.7	2.37	1.83	1.3
C ₂ P ₃ T ₂	2.63	2.33	0	0	0
CD (P=0.05)	NS	NS	NS	0.10	NS

Table 3.27g. Effect of packaging and storage on weight loss of garland flowers of tuberose at Kalyani centre

Treatment	Flower size(cm) at				
	3 day	6 day	9 day	12 day	15 day
Pre-cooling (C)					
C ₁	2.01	1.68	0.83	0.39	0.19
C ₂	2	1.54	0.56	0.31	0.22
CD (P=0.05)	NS	NS	0.09	0.04	NS
Package (P)					
P ₁	1.95	1.63	0.51	0	0
P ₂	1.95	0.65	0	0	0
P ₃	2.12	2.55	1.58	1.05	0.61
CD (P=0.05)	NS	0.20	0.11	0.05	0.06
Temperature (T)					
T ₁	2	1.82	1.23	0.7	0.41
T ₂	2.01	1.4	0.16	0	0
CD (P=0.05)	NS	0.16	0.09	0.04	0.05
C x P					
C ₁ P ₁	2.07	1.78	0.52	0	0
C ₁ P ₂	1.97	0.67	0	0	0
C ₁ P ₃	2	2.58	1.98	1.18	0.57
C ₂ P ₁	1.83	1.47	0.5	0	0
C ₂ P ₂	1.93	0.63	0	0	0
C ₂ P ₃	2.23	2.52	1.18	0.92	0.65
CD (P=0.05)	NS	NS	0.16	0.07	NS

Table 3.27g. Effect of packaging and storage on weight loss of garland flowers of tuberose at Kalyani centre (continue...)

Treatment	Flower size(cm) at				
	3 day	6 day	9 day	12 day	15 day
C x T					
C ₁ T ₁	2.12	1.73	1.34	0.79	0.38
C ₁ T ₂	1.9	1.62	0.32	0	0
C ₂ T ₁	1.88	1.9	1.12	0.61	0.43
C ₂ T ₂	2.12	1.18	0	0	0
CD (P=0.05)	NS	0.23	NS	0.05	NS
P x T					
P ₁ T ₁	1.85	2.2	1.02	0	0
P ₁ T ₂	2.05	1.05	0	0	0
P ₂ T ₁	2.23	0.7	0	0	0
P ₂ T ₂	1.67	0.6	0	0	0
P ₃ T ₁	1.92	2.55	2.68	2.1	1.22
P ₃ T ₂	2.32	2.55	0.48	0	0
CD (P=0.05)	0.49	0.28	0.16	0.07	0.09
C x P x T					
C ₁ P ₁ T ₁	1.97	2.13	1.03	0	0
C ₁ P ₁ T ₂	2.17	1.43	0	0	0
C ₁ P ₂ T ₁	2.4	0.67	0	0	0
C ₁ P ₂ T ₂	1.53	0.67	0	0	0
C ₁ P ₃ T ₁	2	2.4	3	2.37	1.13
C ₁ P ₃ T ₂	2	2.77	0.97	0	0
C ₂ P ₁ T ₁	1.73	2.27	1	0	0
C ₂ P ₁ T ₂	1.93	0.67	0	0	0
C ₂ P ₂ T ₁	2.07	0.73	0	0	0
C ₂ P ₂ T ₂	1.8	0.53	0	0	0
C ₂ P ₃ T ₁	1.83	2.7	2.37	1.83	1.3
C ₂ P ₃ T ₂	2.63	2.33	0	0	0
CD (P=0.05)	NS	NS	NS	0.10	NS

Table 3.27h. Effect of packaging and storage on weight loss of garland flowers of tuberose at Kalyani centre

Treatment	Weight loss at				
	3 day	6 day	9 day	12 day	15 day
Pre-cooling (C)					
C ₁	6.27	16.47	5.48	0.48	0.98
C ₂	6.73	16.94	11.2	6.25	1.63
CD (P=0.05)	0.38	0.46	0.44	0.59	NS
Package (P)					
P ₁	7.18	18.36	11.88	8.06	0
P ₂	10.97	28.65	10.23	0	0
P ₃	1.35	3.1	2.9	2.03	3.91
CD (P=0.05)	0.46	0.57	0.54	0.72	0.83
Temperature (T)					
T ₁	5.85	14.89	15.63	6.73	2.61
T ₂	7.14	18.52	1.04	0	0
CD (P=0.05)	0.38	0.46	0.44	0.59	0.68
C x P					
C ₁ P ₁	7.05	17.69	11.77	0	0
C ₁ P ₂	10.44	28.66	0	0	0
C ₁ P ₃	1.3	3.05	4.67	1.43	2.93
C ₂ P ₁	7.3	19.03	11.99	16.12	0
C ₂ P ₂	11.49	28.63	20.46	0	0
C ₂ P ₃	1.4	3.14	1.14	2.64	4.89
CD (P=0.05)	NS	0.80	0.76	1.02	1.17

Table 3.27h. Effect of packaging and storage on weight loss of garland flowers of tuberose at Kalyani centre (continue...)

Treatment	Weight loss at				
	3 day	6 day	9 day	12 day	15 day
C x T					
C ₁ T ₁	5.82	14.59	8.87	0.95	1.95
C ₁ T ₂	6.71	18.34	2.08	0	0
C ₂ T ₁	5.88	15.18	22.39	12.51	3.26
C ₂ T ₂	7.58	18.69	0	0	0
CD (P=0.05)	0.53	NS	0.62	0.83	NS
P x T					
P ₁ T ₁	6.48	15.88	23.76	16.12	0
P ₁ T ₂	7.87	20.84	0	0	0
P ₂ T ₁	10.43	27.31	20.46	0	0
P ₂ T ₂	11.5	29.98	0	0	0
P ₃ T ₁	0.64	1.47	2.68	4.07	7.82
P ₃ T ₂	2.06	4.73	3.13	0	0
CD (P=0.05)	NS	0.80	0.76	1.02	1.17
C x P x T					
C ₁ P ₁ T ₁	6.48	15.47	23.53	0	0
C ₁ P ₁ T ₂	7.62	19.92	0	0	0
C ₁ P ₂ T ₁	10.32	26.72	0	0	0
C ₁ P ₂ T ₂	10.57	30.6	0	0	0
C ₁ P ₃ T ₁	0.67	1.6	3.08	2.85	5.85
C ₁ P ₃ T ₂	1.94	4.5	6.25	0	0
C ₂ P ₁ T ₁	6.48	16.3	23.98	32.23	0
C ₂ P ₁ T ₂	8.12	21.77	0	0	0
C ₂ P ₂ T ₁	10.55	27.9	40.92	0	0
C ₂ P ₂ T ₂	12.43	29.37	0	0	0
C ₂ P ₃ T ₁	0.62	1.33	2.28	5.28	9.78
C ₂ P ₃ T ₂	2.19	4.95	0	0	0
CD (P=0.05)	NS	1.14	1.07	1.44	1.66

Table 3.27i. Effect of packaging and storage on moisture per cent of garland flowers of tuberose at Kalyani centre

Treatment	Shelf life	Freshness at			
		6 day	9 day	12 day	15 day
Pre-cooling (C)					
C ₁	9.33	93.91	64.89	29.16	10.78
C ₂	8.83	93.14	58.9	20.86	8.46
CD (P=0.05)	NS	0.53	3.66	0.44	0.49
Package (P)					
P ₁	9	92.54	71.56	21.07	0
P ₂	6	88.04	39.93	0	0
P ₃	12.25	100	74.2	53.95	28.86
CD (P=0.05)	0.83	0.65	4.48	0.54	0.60
Temperature (T)					
T ₁	10.67	99.83	80.18	44.39	19.24
T ₂	7.5	87.22	43.62	5.62	0
CD (P=0.05)	0.68	0.53	3.66	0.44	0.49
C x P					
C ₁ P ₁	9	92.93	72.93	22.2	0
C ₁ P ₂	6	88.8	43.3	0	0
C ₁ P ₃	13	100	78.45	65.27	32.33
C ₂ P ₁	9	92.15	70.18	19.93	0
C ₂ P ₂	6	87.28	36.56	0	0
C ₂ P ₃	11.5	100	69.95	42.63	25.38
CD (P=0.05)	NS	NS	NS	0.76	0.85

Table 3.27i. Effect of packaging and storage on moisture per cent of garland flowers of tuberose at Kalyani centre (continue...)

Treatment	Shelf life	Freshness at			
		6 day	9 day	12 day	15 day
C x T					
C ₁ T ₁	11	100	81.34	47.07	21.56
C ₁ T ₂	7.67	87.82	48.44	11.24	0
C ₂ T ₁	10.33	99.67	79.01	41.71	16.92
C ₂ T ₂	7.33	86.62	38.79	0	0
CD (P=0.05)	NS	NS	5.18	0.62	0.69
P x T					
P ₁ T ₁	10	100	88.95	42.13	0
P ₁ T ₂	8	85.08	54.17	0	0
P ₂ T ₁	6	99.5	51.98	0	0
P ₂ T ₂	6	76.58	27.88	0	0
P ₃ T ₁	16	100	99.6	91.03	57.72
P ₃ T ₂	8.5	100	48.8	16.87	0
CD (P=0.05)	1.17	0.92	6.34	0.76	0.85
C x P x T					
C ₁ P ₁ T ₁	10	100	90.4	44.4	0
C ₁ P ₁ T ₂	8	85.87	55.47	0	0
C ₁ P ₂ T ₁	6	100	53.63	0	0
C ₁ P ₂ T ₂	6	77.6	32.97	0	0
C ₁ P ₃ T ₁	17	100	100	96.8	64.67
C ₁ P ₃ T ₂	9	100	56.9	33.73	0
C ₂ P ₁ T ₁	10	100	87.5	39.87	0
C ₂ P ₁ T ₂	8	84.3	52.87	0	0
C ₂ P ₂ T ₁	6	99	50.33	0	0
C ₂ P ₂ T ₂	6	75.57	22.79	0	0
C ₂ P ₃ T ₁	15	100	99.2	85.27	50.77
C ₂ P ₃ T ₂	8	100	40.7	0	0
CD (P=0.05)	NS	NS	NS	1.07	1.20

Table 3.27j. Effect of packaging and storage on flower opening of garland flowers of tuberose at Kalyani centre

Treatment	Flower open at		
	1 day	2 day	3 day
Pre-cooling (C)			
C ₁	93.76	96.37	98.73
C ₂	93.15	96.07	98.29
CD (P=0.05)	NS	NS	NS
Package (P)			
P ₁	92.68	95.06	97.95
P ₂	93.21	96.61	99.05
P ₃	94.48	97	98.53
CD (P=0.05)	1.30	1.15	NS
Temperature (T)			
T ₁	92.51	95.74	98.25
T ₂	94.4	96.71	98.77
CD (P=0.05)	1.06	0.94	NS
C x P			
C ₁ P ₁	92.3	94.6	97.95
C ₁ P ₂	92.82	96.55	99.25
C ₁ P ₃	96.15	97.97	98.98
C ₂ P ₁	93.05	95.52	97.95
C ₂ P ₂	93.6	96.67	98.85
C ₂ P ₃	92.8	96.03	98.07
CD (P=0.05)	NS	1.63	NS

C₁ = pre-cooled, C₂ = non pre-cooled, S₁ = gunny bag, S₂ = bamboo basket, S₃ = CFB, T₁ = room temperature, T₂ = 4°C.

Table 3.27j. Effect of packaging and storage on flower opening of garland flowers of tuberose at Kalyani centre (continue...)

Treatment	Flower open at		
	1 day	2 day	3 day
C x T			
C ₁ T ₁	91.61	94.71	97.79
C ₁ T ₂	95.9	98.03	99.67
C ₂ T ₁	93.4	96.77	98.71
C ₂ T ₂	92.9	95.38	97.87
CD (P=0.05)	NS	1.33	1.08
P x T			
P ₁ T ₁	91.27	93.72	96.8
P ₁ T ₂	94.08	96.4	99.1
P ₂ T ₁	93.45	96.93	99.62
P ₂ T ₂	92.97	96.28	98.48
P ₃ T ₁	92.8	96.57	98.33
P ₃ T ₂	96.15	97.43	98.72
CD (P=0.05)	1.85	1.63	1.32
C x P x T			
C ₁ P ₁ T ₁	89.73	92.3	95.9
C ₁ P ₁ T ₂	94.87	96.9	100
C ₁ P ₂ T ₁	92.8	95.9	99.5
C ₁ P ₂ T ₂	92.83	97.2	99
C ₁ P ₃ T ₁	92.3	95.93	97.97
C ₁ P ₃ T ₂	100	100	100
C ₂ P ₁ T ₁	92.8	95.13	97.7
C ₂ P ₁ T ₂	93.3	95.9	98.2
C ₂ P ₂ T ₁	94.1	97.97	99.73
C ₂ P ₂ T ₂	93.1	95.37	97.97
C ₂ P ₃ T ₁	93.3	97.2	98.7
C ₂ P ₃ T ₂	92.3	94.87	97.43
CD (P=0.05)	NS	NS	NS

Table 3.27k. Vase life of tuberose spike as affected by MA storage at Kalyani centre (2012-13)

Treatment	Vase life (day)	Maximum diam. (cm)	Water absorption(ml)	%age loss after storage
Packing (P)				
P ₁	6.3	5.39	64.48	1.79
P ₂	6.3	5.32	65.98	1.72
P ₃	6.7	5.4	68.88	1.59
P ₄	7	5.43	68.52	1.52
P ₅	3.7	3.06	31.36	18.95
CD (P=0.05)	0.64	0.15	4.49	0.75
Storage (S)				
S ₁	8.6	5.45	93.60	0.76
S ₂	7.6	5.61	69.57	2.66
S ₃	6.4	5.32	58.96	4.43
S ₄	4.4	4.17	47.86	7.22
S ₅	2.4	4.05	29.20	10.50
CD (P=0.05)	0.64	0.15	4.49	0.75
Interaction P X S				
P ₁ S ₁	9	5.53	93.87	0.68
P ₁ S ₂	8	5.83	73.17	0.98
P ₁ S ₃	7	5.43	66.47	1.95
P ₁ S ₄	5	5.23	60	2.27
P ₁ S ₅	3	4.93	28.9	3.08
P ₂ S ₁	8	5.33	94.6	0.28
P ₂ S ₂	8	5.6	76.07	0.84
P ₂ S ₃	7	5.47	66.53	1.42
P ₂ S ₄	5	5	54.63	2.65
P ₂ S ₅	3	5.23	38.07	3.46
P ₃ S ₁	9	5.57	96.67	0.76
P ₃ S ₂	8	5.63	74.5	1.14
P ₃ S ₃	7	5.33	66.63	0.97
P ₃ S ₄	6	5.33	65.9	2.08
P ₃ S ₅	3	5.13	40.7	3.03
P ₄ S ₁	9	5.6	94.43	0.52
P ₄ S ₂	8	5.7	82.47	0.95
P ₄ S ₃	7	5.6	68.53	1.07
P ₄ S ₄	6	5.3	58.8	2.46
P ₄ S ₅	3	4.97	38.37	2.62
P ₅ S ₁	8	5.23	88.47	1.57
P ₅ S ₂	6	5.3	41.67	9.44
P ₅ S ₃	4	4.77	26.67	16.74
P ₅ S ₄	0	0	0	26.68
P ₅ S ₅	0	0	0	40.35
CD (P=0.05)	1.43	0.33	10.04	1.68

Table 3.271. Vase life of tuberose flowers as affected by MA storage at Kalyani centre (2012-13)

Treatment	Vase life (day)	Maximum diam. (cm)	Water absorption(ml)	%age loss after storage
Packing (P)				
P ₁	6.3	5.39	64.48	1.79
P ₂	6.3	5.32	65.98	1.72
P ₃	6.7	5.4	68.88	1.59
P ₄	7	5.43	68.52	1.52
P ₅	3.7	3.06	31.36	18.95
CD (P=0.05)	0.643	0.15	4.49	0.75
Storage (S)				
S ₁	8.6	5.45	93.60	0.76
S ₂	7.6	5.61	69.57	2.66
S ₃	6.4	5.32	58.96	4.43
S ₄	4.4	4.17	47.86	7.22
S ₅	2.4	4.05	29.20	10.50
CD (P=0.05)	0.64	0.15	4.49	0.75
Interaction P X S				
P ₁ S ₁	9	5.53	93.87	0.68
P ₁ S ₂	8	5.83	73.17	0.98
P ₁ S ₃	7	5.43	66.47	1.95
P ₁ S ₄	5	5.23	60	2.27
P ₁ S ₅	3	4.93	28.9	3.08
P ₂ S ₁	8	5.33	94.6	0.28
P ₂ S ₂	8	5.6	76.07	0.84
P ₂ S ₃	7	5.47	66.53	1.42
P ₂ S ₄	5	5	54.63	2.65
P ₂ S ₅	3	5.23	38.07	3.46
P ₃ S ₁	9	5.57	96.67	0.76
P ₃ S ₂	8	5.63	74.5	1.14
P ₃ S ₃	7	5.33	66.63	0.97
P ₃ S ₄	6	5.33	65.9	2.08
P ₃ S ₅	3	5.13	40.7	3.03
P ₄ S ₁	9	5.6	94.43	0.52
P ₄ S ₂	8	5.7	82.47	0.95
P ₄ S ₃	7	5.6	68.53	1.07
P ₄ S ₄	6	5.3	58.8	2.46
P ₄ S ₅	3	4.97	38.37	2.62
P ₅ S ₁	8	5.23	88.47	1.57
P ₅ S ₂	6	5.3	41.67	9.44
P ₅ S ₃	4	4.77	26.67	16.74
P ₅ S ₄	0	0	0	26.68
P ₅ S ₅	0	0	0	40.35
CD (P=0.05)	1.43	0.33	10.04	1.68

5. Crop Protection

Project No. 4.1 : Management of tuberose leaf blight.

Technical Programme:

Number of replications : Four

Cultivar : Single petalled, susceptible

Design : Randomized Block Design (RBD)

Spacing : 30 cm x 30 cm

Plot size : 1.80 m x 1.5 m (flat bed)

Number of treatments : Seven

1. Control
2. Mancozeb – 0.2%
3. Chlrothalonil – 0.2%
4. Tricyclazole-0.1%
5. Iprodione + Carbendazim – 0.1%
6. Difenoconazole – 0.1%
7. Azoxystrobin – 0.1%

Report

Pune

Amongst seven fungicides tested the treatment with Azoxystrobin @ 0.1 % showed significantly the least disease intensity with maximum disease reduction and found significantly superior over rest of the treatments.

Table 4.1a. Effect of different fungicides on leaf blight of tuberose at Pune (Ganeshkhind) centre (2010-11)

Treatment	(PDI)	PDR	No. of flower stalks / plot	Flower stalks / plant	Wt. of flower stalk (g)	Length of flower stalk (cm)	No. of bulbs /plant
Mancozeb 0.2 %	14.33 (22.24)	54.26	308.33	10.28	75.33	63	26.67
Chlorothalonil 0.20%	11.33 (19.68)	63.83	318.33	10.62	77.67	64.67	27.33
Trycylazole 0.1%	9.83 (18.27)	68.62	337.33	11.25	78.67	66	27.67
Iprodine + Carbendazim 0.1%	7.83 (16.24)	75	341	11.37	81	69.67	30.67
Difenconazole 0.1%	6.67 (14.95)	78.71	336	11.2	79	68.67	29.33
Azoxysrobin 0.1%	4.17 (11.71)	86.61	344	11.49	80.33	69	30.67
Control	31.33 (34.02)	-	218.33	7.28	69	60.33	22.67
C.D. (P=0.05)	1.93	-	13.18	0.44	1.83	1.78	2.38

Note : Figures in parentheses are arc sine values. PDR = Percent Disease Reduction, PDI = Percent Disease Intensity

Table 4.1b. Effect of different fungicides on leaf blight of tuberose at Pune (Ganeshkhind) centre (2011-12)

Treatment	(PDI)	PDR	No. of flower stalks / plot	No. of flower stalks / plant	Wt. of flower stalk (g)	Length of flower stalk (cm)	No. of bulbs/ plant
Mancozeb 0.2 %	11.67	41.65	316.67	10.55	77	64.67	27.67
	-19.88						
Chlorothalonil 0.2 %	10	50	321.67	10.72	78	66	27.67
	-18.43						
Trycylazole 0.1%	8.33	58.35	341	11.37	79	68.67	28.33
	-16.59						
Iprodine + Carbendazim 0.1 %	6.67	66.65	346.67	11.56	82	70.33	30.67
	-14.75						
Difencanozole 0.1 %	5	75	344	11.47	80.33	69.33	29
	-12.92						
Azoxysrobin 0.1%	3	85	346.67	11.56	80.67	69.67	29.67
	-8.15						
Control	20	-	293.33	9.77	72.33	61.33	22.33
	-26.44						
C.D. (P=0.05)	6.58	-	6.68	0.22	3.02	1.67	1.41

Note : Figures in parenthesis are arc sin values. PDR = Percent Disease Reduction , PDI = Percent Disease Intensity

Table 4.1c. Effect of different fungicides on leaf blight of tuberose cv. Suvasini at Pune (Ganeshkhind) centre

Treatments	PDI	PDR	No. of flower stalks / plot	No. of flower stalks / plant	Wt. of flower stalk (g)	Length of flower stalk (cm)	No. of bulbs / plant
Control	24.92	-	285	9.5	69.33	61.33	23.33
	-29.88						
Mancozeb 0.2 %	13.13	47.31	315.33	10.51	74.67	64	25.67
	-21.24						
Chlorothalonil 0.2 %	9.75	60.87	319.33	10.64	76	66	26.67
	-18.19						
Trycycloazole 0.1%	9.52	61.8	342	11.4	78.33	69.33	28.33
	-17.96						
Iprodine + Carbendazim 0.1 %	4.97	80	347	11.56	80.33	71.67	30
	-12.87						
Difencanozole 0.1 %	4.73	81.02	342.33	11.41	80	71.33	29.33
	-12.56						
Azoxysrobin 0.1%	3.78	84.83	348	11.6	79.67	69.67	29
	-11.19						
C.D. (P=0.05)	2.23	-	4.87	0.16	1.55	1.81	2.36

Note : Figures in parenthesis are arc sin values. PDI = Percent Disease Intensity, PDR = Percent Disease Reduction

Table 4.1d. Effect of different fungicides on leaf blight of tuberose cv. Suvasini at Pune (Ganeshkhind) centre (2013-14)

Treatments	PDI	PDR	No. of flower stalks/plot	No. of flower stalks/plant	Wt. of flower stalk (g)	Length of flower stalk (cm)	No. of bulbs /plant
Mancozeb0.2 %	4.78	70.58	223	7.43	78.33	67	26
	-12.61						
Chlorothalonil0.2 %	1.41	91.32	237	7.84	81	69.33	27.66
	-5.58						
Trycycloazole0.1%	2.25	86.15	244.66	8.15	81.66	71	28.33
	-8.49						
Iprodine + Carbendazim 0.1%	1	93.85	247.66	8.26	84	73.66	30
	-3.32						
Difencanozole0.1 %	2.16	86.7	245.66	8.18	83.66	74	30
	-8.44						
Azoxysrobin0.1%	1.16	92.86	250.33	8.34	82	70	28.33
	-5.05						
Untreated control	16	-	180.66	6.02	71.66	63	21.67
	-23.55						
C.D. (P=0.05)	6.05	-	7.78	0.2	3.26	1.97	2.58

Note: Figures in parenthesis are arc sin values. PDR = Percent Disease Reduction, PDI = Percent Disease Intensity

Ludhiana

The fungicides were effective to some extent but the severity of leaf blight of tuberose was not significantly reduced by any of the fungicidal treatments. The yield parameters were not influenced in a significant way.

Table 4.2a. Effect of fungicidal treatments on leaf blight of tuberose cv. Single Local at Ludhiana centre (2010-11)

Treatment	Rate of application (%)	Disease intensity (0-4 scale)	No. of flower stalks/plot	Wt. of flower stalk (g)
Control	-	1.5	27.5	33.74
Mancozeb (Dithane M-45)	0.2	1	34	36.46
Chlorothalonil (Kavach)	0.2	1	36	36.5
Tricyclazole (Blast off)	0.1	1	36	33.24
Iprodione+ Carbendazim (Quintal)	0.1	1	32	35
Difenoconazole (Score)	0.1	0.75	30	35.14
Azoxystrobin (Amistar)	0.1	1	30	34.28
CD (P=0.05)	-	NS	NS	NS

Table 4.2b. Effect of different fungicidal treatments on leaf blight of tuberose cv. Single Local at Ludhiana centre (2011-12)

Treatment	Rate of application (%)	Disease intensity (0-4 scale)	No. of flower stalks/plot	Wt. of flower stalk (g)	Length of flower stalk (cm)
Control	-	1.75	24.5	25.05	58.6
Mancozeb (Dithane M-45)	0.2	1.25	28.75	29.2	58.6
Chlorothalonil (Kavach)	0.2	1.25	25.5	28.15	59.2
Tricyclazole (Blast off)	0.1	1.5	24	27.25	58.95
Iprodione+ Carbendazim (Quintal)	0.1	1.25	28.5	28.1	60.6
Difenoconazole (Score)	0.1	1	26	27.6	58.4
Azoxystrobin (Amistar)	0.1	1	25.75	29.9	59.3
CD (P=0.05)	-	NS	NS	1.74	NS

Table 4.2c. Effect of fungicidal treatments on leaf blight of tuberose cv. Single Local at Ludhiana centre (2012-13)

Treatment	Rate of application (%)	Disease intensity (0-4 scale)	No. of flower stalks/plot	Wt. of flower stalk (g)	Length of flower stalk (cm)
Control	-	2	30.5	30.1	58.35
Mancozeb (Dithane M-45)	0.2	1.5	31.75	30.85	59.4
Chlorothalonil (Kavach)	0.2	1.25	30.75	29.5	60.4
Tricyclazole (Blast off)	0.1	1.75	30	29.6	61.2
Iprodione + Carbendazim (Quintal)	0.1	1.25	29.75	30.2	58.95
Difenoconazole (Score)	0.1	1.25	31.5	30.45	59.05
Azoxystrobin (Amistar)	0.1	1.25	31	31.75	61.25
CD (P=0.05)	-	NS	NS	0.98	NS

Table 4.2d. Effect of fungicides on leaf blight of tuberose cv. Single Local at Ludhiana centre

Treatment	Dosage (%)	Disease intensity (0-4 scale)	Number of flower stalks/plot	Weight of flower stalk (g)	Length of flower stalk (cm)
Mancozeb (Dithane M-45)	0.2	1.25	33.25	31.8	60.35
Chlorothalonil(Kavach)	0.2	1	34.25	32.2	59.45
Tricyclazole (Blast off)	0.1	1.5	32.25	31.27	59.95
Iprodione+ Carbendazim(Quintal)	0.1	1	32.75	31.75	60.35
Difenoconazole (Score)	0.1	0.75	33.5	33.25	61.1
Azoxystrobin (Amistar)	0.1	1	33.5	32.75	61.05
Untreated control	-	1.75	32	31.75	60.35
CD (P=0.05)	-	0.62	NS	NS	NS

Kahicuchi

Data indicated that the spraying of Azoxystrobin (Amister) (0.1%) or Difenconazole (Score) (0.1%) or Iprodione + carbendazim (Quintal) (0.1%) were found effective in managing the leaf spot disease of tuberose, which recorded significantly lowest disease incidence per cent with highest per cent disease control. Maximum number of flower stalk per meter square of bed area, maximum weight of fresh flower stalk and length of the flower stalk were also recorded by these two treatments.

Table 4.3a. Effect of fungicidal treatments on leaf blight of tuberose cv. Local Single at Kahikuchi centre (2010-11)

Treatment	Dose (%)	Per cent disease incidence	Per cent disease control	No. of flower stalk/m ²	Length of flower stalk(cm)	Wt.of flower stalk (g)
T ₁ : Control	-	35.03 (32.94)*	-	31	73.1	73.19
T ₂ : Mancozeb	0.2	18.16 (24.47)	48.15	59.83	82.93	74.55
T ₃ : Chlorothalonil	0.2	14.00 (21.95)	60.03	62	82.27	74.47
T ₄ : Tricyclazole	0.1	13.00 (21.12)	62.89	61.08	83.7	74.65
T ₅ : Iprodione + carbendazim	0.1	10.17 (18.64)	70.96	75	85.17	74.8
T ₆ : Difenconazole	0.1	10.08 (18.50)	71.22	76.08	86.47	75.42
T ₇ : Azoxystrobin	0.1	9.25 (16.68)	73.59	76.25	86.72	75.4
CD (P=0.05)		3.77	-	5.78	2.13	0.64

Table 4.3b. Effect of fungicides on tip blight disease severity and flower stick production of tuberose at Kahikuchi centre (2011-12)

Treatment	Percent disease index (PDI) at different dates of observations						Flower yield (no. per plot)
	30.7.11	15.8.11	30.8.11	15.9.11	30.9.11	15.10.11	
Control	3.2	12.7 (3.6)*	20.3 (4.6)*	25.7 (5.1)*	32.8 (38.9)**	36.4 (41.1)**	160.7
	(1.9)*						
Mancozeb	3.1	3.5 (2.0)	5.4 (2.4)	8.1 (2.9)	12.0 (22.5)	10.2 (20.6)	191
	-1.9						
Chlorothalonil	3.9	3.7 (2.1)	7.3 (2.8)	9.1 (3.1)	10.3 (20.8)	9.4	193.7
	-2.1					-19.8	
Tricyclazole	2.5	2.9 (1.8)	3.6 (2.0)	4.6 (2.2)	4.9 (14.2)	4.7	183.3
	-1.7					-13.8	
Iprodione + Carbendazim	2.5 (1.7)	2.4 (1.7)	5.2 (2.4)	5.4 (2.4)	4.8 (14.0)	5.4	185
						-14.5	
Diflufenconazole	2.9	3.2 (1.9)	3.8 (2.0)	3.8 (2.1)	3.2 (11.4)	2.8	203.3
	-1.9					-10.7	
Azoxystrobin	2.6	2.6 (1.8)	2.9 (1.8)	4.1 (2.2)	2.8 (10.7)	2.9	199.3
	-1.8					-11	
CD (P=0.05)	-	0.3	0.3	0.3	1.8	1.9	24.6

* Figure within parenthesis indicates square root transformed value, **Figure within parenthesis indicates arch-sine transformed value

Table 4.3c. Effect of fungicidal treatments on leaf blight of tuberose cv. Local Single at Kahikuchi centre (2012-13)

Treatments	Dose (%)	PDI	PDR	No. of flower stalk/m ²	Length of flower stalk (cm)	Wt. of flower stalk (g)
Control	-	34.81	-	19.35	82.5	73.12
		-36.71				
Mancozeb	0.2	18.17	47.8	22.95	84.25	74.05
		-25.22				
Chlorothalonil	0.2	15.83	54.52	30.11	85.4	73.17
		-23.44				
Tricyclazole	0.1	16.15	53.6	35.18	86.28	73.72
		-23.69				
Iprodione + carbendazim	0.1	9.96	71.38	40.31	87.35	74.17
		-18.39				
Difenconazole	0.1	9.97	71.35	40.8	87.42	74.57
		-17.7				
Azoxystrobin	0.1	8.24	76.32	46.56	88.72	74.87
		-16.68				
CD (0.05)		1.18	-	5.67	1.5	NS

Note: Figures in parenthesis are angular transformed value, PDI = Percent Disease Intensity, PDR = Percent Disease Reduction

Table 4.3d. Effect of fungicidal treatments on leaf blight of tuberose cv. Local Single at Kahikuchi centre (2013-14)

Treatment	Dosage (%)	Per cent disease incidence	Per cent disease control	No. of flower stalk/m ²	Length of flower stalk (cm)	Wt.of flower stalk (g)
Mancozeb	0.2	20.1	39.7	23.8	84.32	73.02
		-26.28				
Chlorothalonil	0.2	16.35	50.94	29.38	84.55	73.8
		-23.86				
Tricyclazole	0.1	17.44	47.68	33.61	85.2	73.98
		-24.68				
Iprodione + carbendazim	0.1	11.04	68.88	38.83	85.75	73.75
		-19.4				
Difenconazole	0.1	9.38	71.86	39.67	86.7	73.78
		-17.82				
Azoxystrobin	0.1	8.12	75.63	43.08	87.75	74.4
		-16.56				
Untreated control	-	33.33	-	19.63	82.62	72.92
		-35.25				
CD (P=0.05)		0.94	-	5.05	1.27	NS

* Figures in parenthesis are angular transformed value

Project No. 4.2 : Control of root knot nematodes in tuberose.

Technical Programme :

Number of replications : Four

Cultivar : One Single petalled and one Double petalled.

Number of treatments : 8 (soil application)

1. Control
2. Neem cake - 100 g/m²
3. Neem seed powder - 5 g/plant.
4. Carbofuran - 1 kg a.i./ac.
5. Carbofuran - 0.5 kg a.i./ac.
6. *Paecilomyces lilacinus* (2 x10⁶/g) - 1 kg /ac + FYM = 2 tons/ac.
7. *Trichoderma harzianum* (2 x10⁶/g) - 2 kg /ac + FYM = 2 tons/ac.
8. *Paecilomyces lilacinus* (2x10⁶/g) - 1 kg /ac + *Trichoderma harzianum* (2x10⁶/g) - 1 kg /ac + FYM = 2 tons/ac.

Report

Hessaraghatta

Application of 2 tons of FYM enriched with 1 kg of each of *Paecilomyces lilaceus* (2×10^6 cfu/g) and *Trichoderma harzianum* (2×10^6 cfu/g) /acre significantly reduced *M. incognita* by 78% in roots of tuberose. This treatment was also found to reduce the root-knot (*M. incognita*) nematodes in soil by 57 % and improve yield of crop by 26%. This treatment was significantly effective in increasing the flower yield and reducing the nematode population and was *at par* with Carbofuran 1 kg a.i./ha treatment).

Table 4.4a. Effect of botanicals and chemicals on the management of nematodes and on flower yield in tuberose at Hessaraghatta centre (2010-11)

Treatment	Nematode population in 100 cc soil	Nematode population in 10 gram roots	No. of damaged roots per bulb	No. of spikes per plot of 1.8 x 1.5 m	Length of spike in (cm)
Neem cake 100 grams/ m ²	132	32	20	103	90
Neem seed powder 5 grams/plant	144	26	16	99	82
Carbofuran 1 kg a.i./ac	68	10	8	112	110
Carbofuran 0.5 kg a.i./ac	78	17	8	103	100
<i>Paecilomyces lilacinus</i> (2×10^6 cfu/g) 1 kg + FYM - 2 tons/acre	92	14	14	114	106
<i>Trichoderma harzianum</i> (2×10^6 cfu/g) 1 kg + FYM - 2 tons/acre	95	15	18	117	115
<i>Paecilomyces lilacinus</i> (2×10^6 cfu/g) - 1 kg + <i>Trichoderma harzianum</i> (2×10^6 cfu/g) - 1 kg + FYM 2 tons/acre	78	8	10	120	120
Control	182	38	26	95	82
C D (P=0.05)	17.42	3.76	2.12	10.15	7.64

Table 4.4b. Effect of botanicals and chemicals on the management of nematodes and on flower yield in tuberose at Hessaraghatta centre (2011-12)

Treatment	Initial population of nematode /200 cc soil	Final Nematode population in 200 cc soil	No. of spikes per plot of 1.5 x 1.2 m	Length of spike (cm)	Root Knot Index on 1-5 scale
Control	216 ± 4 J ₂	398	73	84	4.6
Neem cake @1.0 t/ha (soil application at least 15 days prior to planting)	216 ± 4 J ₂	354	92	93	3
Neem seed powder- 5g/plant (Soil Application)	216 ± 4 J ₂	380	86	84	3.3
Carbofuran 1 kg a.i./ac (soil application)	216 ± 4 J ₂	264	95	108	2.7
<i>Paecilomyces lilacinus</i> (2 × 10 ⁶ cfu/g) @ 5kg mixed with FYM 5t/ha (soil application)	216 ± 4 J ₂	252	98	109	2.4
<i>Trichoderma harzianum</i> (2 × 10 ⁶ cfu/g) @ 5kg mixed with FYM 5t/ha (soil application)	216 ± 4 J ₂	260	110	118	2.2
<i>Pseudomonas fluorescens</i> (2 × 10 ⁸ cfu/g) @ 5kg mixed with FYM 5t/ha (soil application)	216 ± 4 J ₂	258	113	122	2.3
<i>Pochonia chlamydosporia</i> @ 5kg mixed with FYM 5t/ha (soil application)	216 ± 4 J ₂	248	94	113	2.7
C.D. (P=0.05)	-	22.34	9.76	6.53	0.72

Ludhiana

The final nematode population in tuberose cv. Single Local was recorded to be statistically lower in all the treatments than the control. The root galling index was found to be significantly lower in neem seed, carbofuran, *Trichoderma harzianum* and *Paecilomyces lilacinus* + *T. harzianum* treated soils. Neem cake and *P. lilacinus* did not reduce root galling index significantly over the control. The number of bulbs and bulblets produced was not significantly improved by any of the treatments. The weight of bulbs was significantly enhanced in neem cake, carbofuran (1 kg a.i./ac), *T. harzianum* and *P. lilacinus* + *T. harzianum*. The weight of bulblets was significantly better in carbofuran (1 kg a.i./ac) and neem cake than the control, followed by that in *T. harzianum*.

Table 4.5a. Integrated management of root knot nematodes of tuberose cv. Single Local at Ludhiana centre (2010-11)

Treatment*	Final nematode population /250cc soil	Root galling index (0-5 scale)	No. of bulbs per plant	Wt. of bulbs per plant (g)	No. of bulblets per plant	Wt. of bulblets per plant (g)
Neem cake 100g/m ²	60	3.35	1	47.4	7.3	50.45
Neem seed powder 5 g/spot	15	2.95	1	35.05	5.5	24.8
Carbofuran 1 kg a.i./ac	40	2.6	1.05	50.15	8.55	55.15
Carbofuran 0.5 kg a.i./ac	50	2.85	1	40.3	6.05	39.1
<i>Paecilomyces lilacinus</i> (2X10 ⁶ /g) 1 kg/ac+ FYM 2 tons/ac	10	3	1.05	41.8	6.95	38.15
<i>Trichoderma harzianum</i> (2X10 ⁶ /g) 2kg/ac + FYM 2 tons/ac	70	2.6	1	46.75	7.7	50.13
<i>P. lilacinus</i> (2X10 ⁶ /g) 1 kg/ac + <i>T. harzianum</i> (2X10 ⁶ /g) 1 kg/ac + FYM 2 tons/ac	20	2.8	1.05	46.38	6.65	46.9
Control	145	3.6	1	33.45	6.45	32.45
C.D. (P=0.05)	45.67	0.6	NS	10.93	NS	17.87

Table 4.5b. Control of root knot nematodes in tuberose cv. Single Local (2012-13)

Treatment	Initial nematode population/ 200 cc soil	Root galling index	Final nematode population/ 200 cc soil	Spike yield (kg/plot)	Flower stalk length (cm)	Weight of bulbs (kg/plot)	Weight of bulblets (kg/plot)
Control	242	2.67	275	1.65	57.1	1.254	1.33
Neem cake 100g/m ²	230	1.67	240	1.8	56.2	1.5	1.49
Neem seed powder 5 g/spot	215	1.67	220	1.64	52.9	1.43	1.25
Carbofuran 1 kg a.i./ac	217	1	210	2.03	66.4	1.69	1.86
Carbofuran 0.5 kg a.i./ac	250	1.33	225	1.8	63.8	1.46	1.53
<i>Paecilomyces lilacinus</i> (2X10 ⁶ /g) 1 kg/ac+ FYM 2 tons/ac	235	1.67	215	1.76	58.4	1.49	1.37
<i>Trichoderma harzianum</i> (2X10 ⁶ /g) 2kg/ac + FYM 2 tons/ac	225	2	210	1.76	56.8	1.535	1.57
<i>P. lilacinus</i> (2X10 ⁶ /g) 1 kg/ac + <i>T. harzianum</i> (2X10 ⁶ /g) 1 kg/ac + FYM 2 tons/ac	240	1.67	250	1.805	60.4	1.57	1.49
Not conducted	-	-	-	-	-	-	-
C.D. (P=0.05)	NS	0.87	NS	NS	5.49	0.15	0.20

Table 4.5c. Integrated management of root knot nematodes of tuberose cv. Single Local at Ludhiana (2013-14)

Treatment	Initial Nematode population/ 200 cc soil	Root Gallling Index	Final Nematode population/ 200 cc soil	Spike yield (kg/plot)	Flower stalk length (cm)	Weight of bulbs (kg/plot)	Weight of bulblets (kg/plot)
Neem cake 100g/m ²	208	1.75	223	2.198	60	1.753	1.63
Neem seed powder 5 g/spot	200	2	220	2.11	58.5	1.69	1.655
Carbofuran @ 1 kg a.i./ac	228	1.75	215	2.463	62.25	1.933	1.73
Carbofuran @ 0.5 kg a.i./ac	215	1.75	215	2.333	62.5	1.908	1.698
<i>Paecilomyceslilacinus</i> (2X10 ⁶ /g) 1 kg/ac+ FYM 2 tons/ac	213	2.25	235	2.078	59.25	1.732	1.568
<i>Trichoderma harzianum</i> (2X10 ⁶ /g) 2kg/ac + FYM 2 tons/ac	228	2.5	230	2.185	58.25	1.81	1.628
<i>P. lilacinus</i> (2X10 ⁶ /g) 1 kg/ac + <i>T. harzianum</i> (2X10 ⁶ /g) 1 kg/ac + FYM 2 tons/ac	218	2.25	240	2.21	59	1.745	1.6
Untreated control	245	2.75	275	1.913	57.5	1.57	1.216
C.D. (P=0.05)	NS	0.66	33.39	0.25	NS	0.15	0.17

Pune

Tuberose cultivar Phule Rajani was used for the study. The root knot nematodes were not observed either in initial soil count nor after harvest and the galls were also not observed in root system.

Table 4.6a. Control of root knot nematodes in tuberose cv. Phule Rajani at Pune (2012-13)

Treatment	Initial nematode population /200cc soil	Root galling index	Final nematode population / 200 cc soil	Spike yield/plot	Spike length (cm)	Rachis length (cm)
Control	0	0	0	355.67	89.33	35.33
Neem cake @ 1.0 t/ha.(Soil application at least 15 days prior to planting)	0	0	0	357	90.33	36
Neem seed powder 5g/plant(Soil application)	0	0	0	368.33	88.67	36
Carbofuron 1kg a.i./ha (Std. check)	0	0	0	360	91	36.33
<i>Paecilomyces lilacinus</i> (2 x10 ⁶ /g) @ 5kg mixed with FYM 5t/ha (Soil application)	0	0	0	356.33	89	35
<i>Trichoderma harzianum</i> (2 x10 ⁶ /g) @ 5kg mixed with FYM 5t/ha (Soil application)	0	0	0	351.33	90	34.33
<i>Pseudomonas fluorescens</i> @ 5 kg mixed with FYM 5t/ha (Soil application)	0	0	0	350.33	89	35.33
<i>Pochonia chlamydosporia</i> @ 5kg mixed with FYM 5t/ha (Soil application)	0	0	0	352.33	88.67	34.67
C.D. (P=0.05)	-	-	-	NS	NS	NS

Table 4.6b. Control of root knot nematodes in tuberose cv. Single Local at Ludhiana centre (2012-13)

Treatment	Initial nematode population/ 200 cc soil	Root galling index	Final nematode population/ 200 cc soil	Spike yield (kg/plot)	Flower stalk length (cm)	Weight of bulbs (kg/plot)	Weight of bulblets (kg/plot)
Control	242	2.67	275	1.65	57.1	1.254	1.33
Neem cake 100g/m ²	230	1.67	240	1.8	56.2	1.5	1.49
Neem seed powder 5 g/spot	215	1.67	220	1.64	52.9	1.43	1.25
Carbofuran 1 kg a.i./ac	217	1	210	2.03	66.4	1.69	1.86
Carbofuran 0.5 kg a.i./ac	250	1.33	225	1.8	63.8	1.46	1.53
<i>Paecilomyces lilacinus</i> (2X10 ⁶ /g) 1 kg/ac+ FYM 2 tons/ac	235	1.67	215	1.76	58.4	1.49	1.37
<i>Trichoderma harzianum</i> (2X10 ⁶ /g) 2kg/ac + FYM 2 tons/ac	225	2	210	1.76	56.8	1.535	1.57
<i>P. lilacinus</i> (2X10 ⁶ /g) 1 kg/ac + <i>T. harzianum</i> (2X10 ⁶ /g) 1 kg/ac + FYM 2 tons/ac	240	1.67	250	1.805	60.4	1.57	1.49
Not conducted	–	–	–	–	–	–	–
C.D. (P=0.05)	NS	0.87	NS	NS	5.49	0.15	0.20

Kalyani

Nematode sick plot was prepared with infected roots of vegetable crop and soils. Jute was grown as a preferred host for rapid growth of nematode population. After harvesting of jute tuberose cultivar Calicatia Single and Calcattia Double were planted, However, nematode infestation in tuberose was not observed, This year again the jute was grown for the development of sick plot.

Table 4.7. Control of root knot nematodes in tuberose at Kalyani centre (2012-13)

Treatment details	Final nematode population in 200 cc soil	No. of spikes per plot of 1.5 x 1.2 m	Flower stalk Length of spike in cms	Root Knot Index on 1-5 scale
Control	256	71	78	4.2
Neem cake @1.0 t/ha (soil application at least 15 days prior to planting)	212	83	89	2.8
Neem seed powder- 5 g/plant (soil application)	224	81	82	3
Carbofuran 1 kg a.i./ac (soil application)	213	87	103	2.5
<i>Paecilomyces lilacinus</i> (2x10 ⁶ cfu/g) @ 5 kg mixed with FYM 5 t/ha (soil application)	175	89	105	2.3
<i>Trichoderma harzianum</i> (2x10 ⁶ cfu/g) @ 5 kg mixed with FYM 5 t/ha (soil application)	184	95	114	2.1
<i>Pseudomonas fluorescens</i> (2x10 ⁸ cfu/g) @ 5 kg mixed with FYM 5 t/ha (soil application)	179	98	116	2
<i>Pochonia chlamydosporia</i> @ 5 kg mixed with FYM 5 t/ha (soil application)	172	86	110	2.4
C.D. (P=0.05)	18.36	7.34	8.49	0.63

Note: Initial nematode population = 205 ± 6 J₂/200 cc soil

Project No. 4.4 : Control of foliar nematode (*Aphlenchoides besseyi*) in tuberose

Year of report : 2010-11

Centre : PAU, Ludhiana

Report

Ludhiana

Leaf and flower samples were analyzed for the presence of foliar nematode *Aphlenchoides besseyi*. Neither of the samples was found having any stage of the foliar nematode.





हर कदम, हर उगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agr^osearch with a human touch



ICAR-Directorate of Floricultural Research

College of Agriculture Campus, Shivajinagar, Pune - 411 005, Maharashtra, India
Telephone: 020-20252002 E-Mail : director.dfr@icar.gov.in, directordfr@gmail.com