"Geranium Cultivation, Extraction, Application and Marketing; A Multidisciplinary R & D Project"

- **Institute Participated and Responsibility**–

Sr. No.	Institute	Responsibility
1.	**K. K. Wagh College of Agriculture, Nashik**	Standardize cultivation practices and multi-location evaluation of different available varieties of geranium crop
2.	**K. K. Wagh College of Agricultural Biotechnology, Nashik**	Genetic diversity analysis and *in-vitro* regeneration of different geranium varieties
3.	**K. K. Wagh Institute of Engineering Education and Research, Nashik** 1. Department of Chemical Engineering 2. Department of Masters of Business Administration (MBA)	1. Extraction of oil by different methods and chemical analysis of oils components. 2. Market analysis and available oil buyer and requirements of them.
4.	**K. K. Wagh College of Pharmacy, Nashik**	Different value added products and pharmaceutical usage of geranium oils

- **Timeline of Project** – December 2020 to April 2022

- **Objectives of Agriculture & Agriculture Allied Group**–

1. To standardize cultivation practices of geranium (*Pelargonium graveolens*) for maximization of essential oil yield.
2. Multi-location evaluation of oil yield in different genotypes of Geranium (*Pelargonium graveolens*).
3. Genetic diversity analysis and population structure of different geranium (*Pelargonium graveolens*) varieties using molecular markers.

- **Introduction -**

Geranium (*Pelargonium graveolens* L.) commonly known as rose-scented pelargonium, rose-scented geranium or rose geranium is one of the many fragrant species of *Pelargonium*, belonging to the family *Geraniaceae*.

Geranium oil is one of the top 20 essential oils in the world, which has wide application in perfumery, cosmetics and flavor industry.

It forms a part of many high-grade perfumes, antifungal, insect repellant and antibacterial activity; thus, it has extensive use in medicinal and agrochemical field.

India purchase Geranium Oil more than 200 Mt per year from;
1) Germany
2) France
3) Switzerland
4) USA
But all are synthetic with price range from Rs.1200 to Rs.3000 per kg. So there vast scope for production and export of Geranium oil. World Production of Geranium Oil is between 350 to 400 tonnes. Over the past 5 to 6 years Egypt has substantially increased its production into the range 200 to 230 Tonnes. China has remained in the range 50 to 80 tonnes, Madagascar around 5 tonnes. South African Countries 5 to 10 tonnes. Other Central and Southern African origins providing another 10 tonnes.

- **Selected plots details, dimensions, area -**

Sr. No	Name of Farm	Plot No.	Dimension and Details	Total Area
1	Babhaleshwar Farm	09	**146 x 186 Feet** Soil red colour, Well drained, Sandy to silt clay	**24.93** R
2	Sukene Farm	09	**188 x 150 Feet** Soil Well drained, Sandy coarse soil with small pebbles	**26.00** R
3	Makhmalabad Farm	-	**1 plot** (in mango orchard top) **50 x45 Feet** coarse soil with small pebbles **2 plot** (mango orchard near gate) **50 x45 Feet** coarse soil with small pebbles **3rd plot** (near cactus) Soil Well drained	**2.00** R **1.00** R **3.00** R **Total= 6.00** R

Babhaleshwar Farm plot no. 9

Sukene Farm plot no. 9

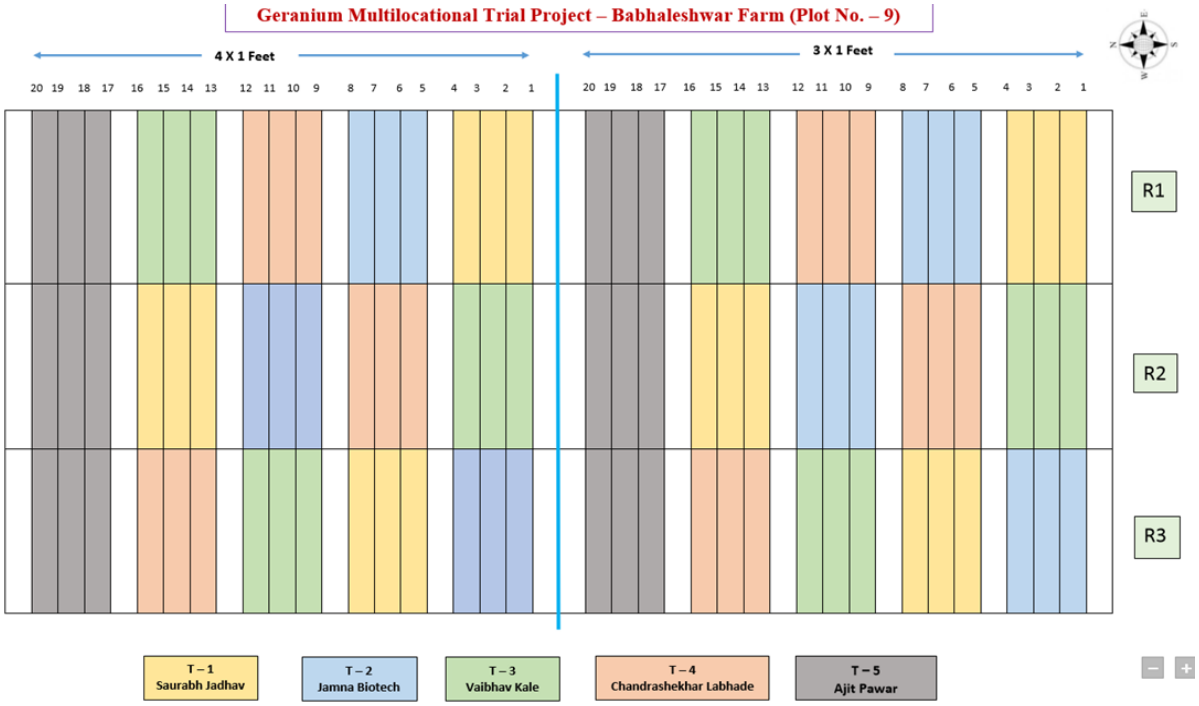
- **Soil analysis report for the selected plots**

Sr. No.	Crop/Survey No	pH	EC dSm^{-1}	Organic Carbon (%)	$CaCO_3$ (%)	Ava.N Kg/ha.	Ava.P Kg/ha.	Ava.K Kg/ha.
1	**Geranium Babhaleshwar (Plot - 9)**	7.6	0.3	0.16 (Very low)	5.4	141.12 (Low)	3.36 (Very low)	270 (High)
2	**Geranium Sukene (825/09)**	7.34	0.3	0.58 (Moderate)	3.7	125.44 (Very low)	5.82 (Very low)	293 (High)
3	**Geranium Makhmalabad 269**	7.05	0.17	0.62 Moderately High	2.9	125.44 Very low	7.2 low	148.0 (low)
4	**Geranium Makhmalabad 270**	7.35	0.32	0.65 Moderately High	3.5	141.1 low	7.3 low	151.05 Medium

- **List of 5 resources for cutting/sapling supply**

Sr. No	Name of Supplier	Contact Details	Cost Claimed (Rs. / saplings)	Our Price (After Post Negotiation)	No. of Saplings / Cuttings Received
1	Mr. Chandrashekhar Labhade, Adgaon, Nashik	9623498523	9/sapling	9/sapling	3500
2	Mr. Saurabh Jadhav, Niphad	7350500417	7/sapling	5/sapling	3500
3	Mr. Vaibhav Kale, Ahmednagar	9860802064	6/sapling	5/sapling	3500
4	Mr. Ajit Pawar, Satara	7722035111	4/cutting	4/cutting	3500
5	Jamna Biotech, Pune	9860528774	6/sapling	5/sapling	3500
				Total =	17500

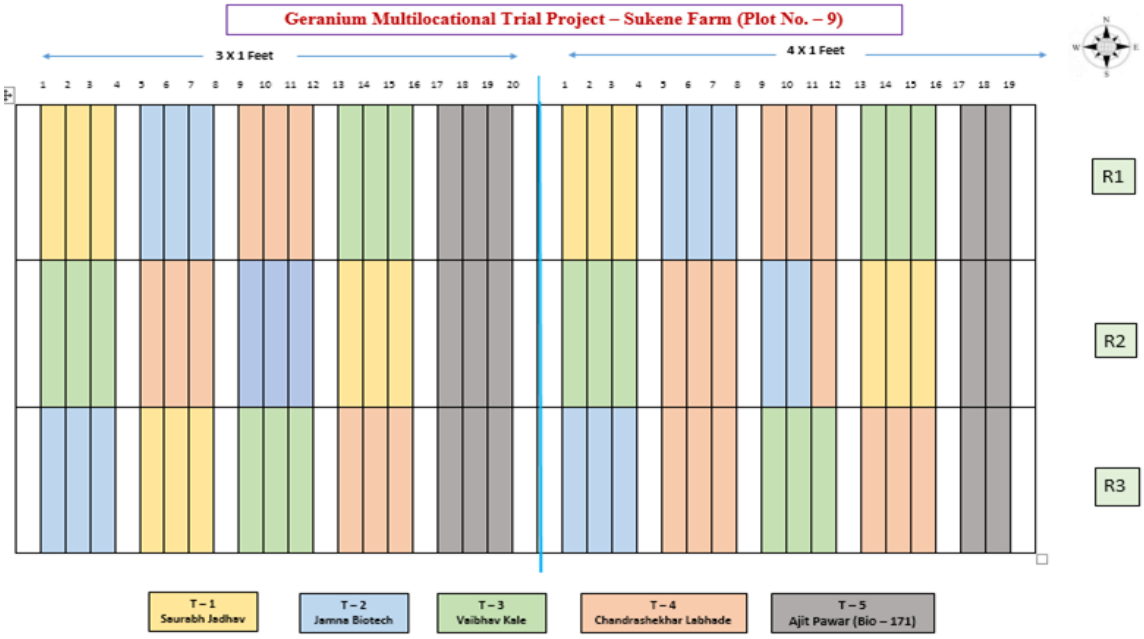
- **Planting Layout of Babhaleshwar Farm –**



Geranium Plantation at Babhaleshwar Farm (Plot No – 9)





Geranium Plantation at Sukene Farm (Plot No – 9)

Geranium Plantation at Makhmalabad Farm

- **List of cultivation practices -**
  1. Soil Preparation
  2. Layout and drip installation
  3. Saplings Transplanting
  4. Regular Irrigation and Fertigation
  5. Weeding as per required
  6. Spraying as per required
  7. Biomass Harvesting
  8. Cutting Preparation and oil extraction

- **Geranium Plot at Babhaleshwar Farm after 1 week of plantation -**


- **Geranium Plot at Babhaleshwar Farm after 1 Month of plantation -**


- **Geranium Plot at Babhaleshwar Farm after 2 Month of plantation -**

- **Geranium Plot is maturity stage and ready to harvest –**

Achievement:

Per acre yield of geranium herbage is above the average standard of 10 tonnes per acre and successfully standardize the cultivation practices of geranium.

***In-Vitro* Plant Regeneration of Geranium (*Pelargonium graveolens* L.)**

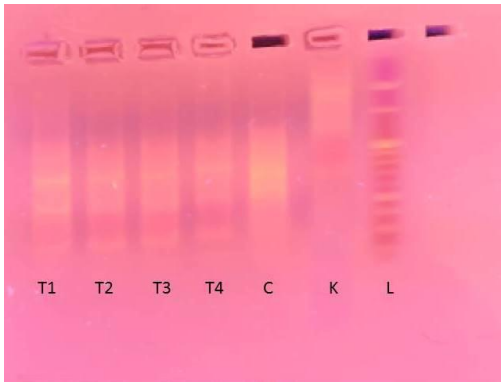
Plate: (A) Inoculation on MS media, (B) Shoot induction on MS media supplemented with BAP and IAA, (C) Shoot induction after 13 days, (D) Shoot multiplication on MS media supplemented with BAP and NAA, (E) Shoots with well developed roots on MS medium with IBA, (F) Primary hardening of regenerated plants in medium containing Cocopeat: Soil (1:1)

Results:-

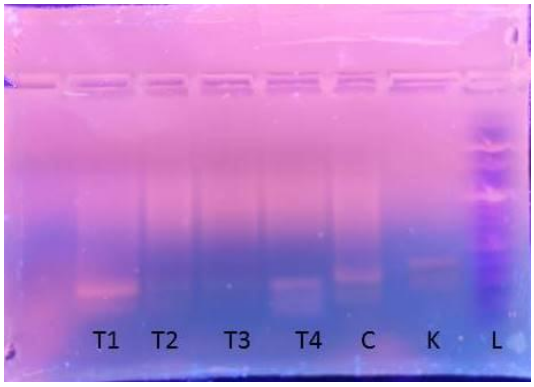
These optimized protocols for surface sterilization, shoot initiation, multiplication, and rooting provide a foundation for large-scale production and commercial cultivation of rose-scented geranium. Implementing these techniques can help meet the demand for geranium oil while ensuring its sustainable supply and conservation.

Genetic diversity analysis and population structure of different geranium (*Pelargonium graveolens*)

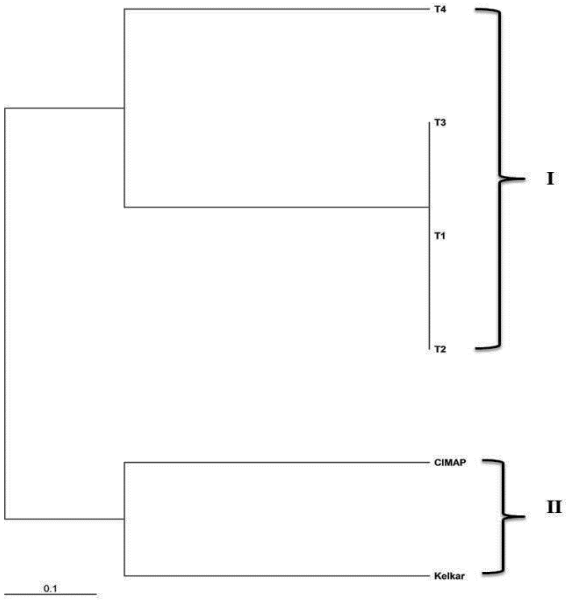
- **Methodology:**
  1) DNA isolation of geranium cultivars was done by CTAB method.
  2) DNA quality and quantity tested by Gel electrophoresis and Spectrophotometer.
  3) DNA amplification was done by molecular markers such as RAPD and ISSR using PCR machine.
  4) Visualization of amplified DNA banding pattern by Gel Documentation unit.



RAPD – G1 PCR Amplification



RAPD – G2 PCR Amplification



Dendrogram of Sources of Geranium by RAPD markers

Results:-

Dendrogram cluster analysis based on RAPD markers classified 6 sources including an improved variety (CIMAP and Kelkar) into two groups (I & II) which detected the similarity between different 4 sources. (T1, T2, T3& T4). These results confirm that only CIMAP and Kelkar varieties are different, rest all sources are similar genetically and they are not varieties.

Outcomes of Project:-

1. **Research paper**

   Vedant R. Kulkarni, Sachin S. Kharade, Roshani B. Narwade, Nupoor R. Ahire, Rutuja R Gawali, Satish S. Bornare. "rapid in vitro plant regeneration of Geranium (Pelargonium graveolens L.)" in An International Refereed, Peer Reviewed & Indexed Quarterly Journal for Applied science, Vol. 13, Issue 47, July 2023 PP-945-949.

2. **Popular article**

   S. S. Kharade, S. S. Bornare and N. S. Pachpor. "Utisavardhanadware Geranium Pikachi Ropnirmiti". (Marathi) in Lokmangal's Sheti Pratik 7:23-24 (2023).

3. **Popular article**

   S. S. Kharade, S. S. Bornare, N. S. Pachpor and S. M. Hadole. "Utisavardhanadware Geranium Pikachi Ropnirmiti". (Marathi) in Poorva Krishidoot, PP 19-20 (2023).

4. **Article published in Daily Agrowon Newspaper**

   S. S. Kharade and S. S. Bornare. "Utisavardhanadware Geranium Pikachi Ropnirmiti" dated on 27/09/2023.

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