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Pelargonium graveolens L. (Rose-scented geranium): New hope for doubling Indian farmers' income

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Abstract

***Pelargonium graveolens* is a species in the *Pelargonium* genus and falls within the plant family of Geraniaceae. The total production of essential oil is estimated at 300-350 tone, whereas the world market demands more than 400 t per year. Now geranium crop has been cultivated for commercial purpose in areas with high altitude and milder climate. *P. graveolens* is also come up very well mainly in the Nilgiris and Kodaikanal Hilly region of Tamil Nadu and around the Bangalore in Karnataka in an area of 2000 ha. At medium altitude, rose scented geranium is an important high-value perennial crop but grown as seasonal in plain areas. This aromatic shrub can reach up to the height of 70 cm and lateral of 90cm. In-spite of this the commercial cultivation of Rose-scented geranium still scanty being it's a high economic value in per unit area and time crops as compared to other medicinal and aromatic plants (MAPs). Because, rose-scented geranium is sensitive to rainy season and noted 100% mortality in open field condition during rainy season. Hence the major bottleneck in its popularization seems to be saving of quality planting material in rainy season. Hence, there is an urgent need to develop new approach or way through agronomic, breeding, acclimatization, etc to save quality planting material during rainy season. If, we are able to develop this type approach, then Rose-scented geranium can play a beneficial role in doubling the income of Indian farmers.**

Keywords: ***Rose-scented geranium, Doubling farmers income, essential oils, high value crops, aromatic crops***

Introduction

Rose-scented geranium (*Pelargonium graveolens)* is a species known as rose scented geranium and genus Pelargonium has more than 200 species. It was originated in South Africa; where over 700 varieties of cultivated geranium are exist. Scented geranium was introduced in India in 20th century but cultivation and oil production was restricted to the hilly region of Southern India (Anonymous, 1992; Rao *et al.,* 1992b). Geranium crop is a native to Cape Province, the southern parts of Africa. Rose-scented geranium on commercial scale cultivated in different parts of the world like middle east, France, Spain, Madagascar, Morocco, Egypt, Congo, China, Helena Island, India and the Russia. Geranium crop has been cultivated under the environment which should allow high photosynthesis rate since the oil yield is obtained from herb yield and oil content. Young stems have hair on them become rough and brown in color with age, and the leaves are soft, sharp margin and strong rose like aroma. The geranium essential oil has wide range used in flavour and perfumery industries, aromatherapy, cosmetic industries, food and pharmaceutical industries. Its oil is good in opening pores and reduce oil clean complexion of skin makes oil a best skincare product. Geranium essential oil also used to control mite, eczema and athlete foot problems (Jalali-Heravi *et al.*, 2006; Jeon *et al.,* 2008). Rose-scented geranium is a high economic value with higher demand in national and international market. Geranium oil are rich source of secondary metabolites citronellol and geraniol, which are used for the synthesis of a great number of high grade and superior quality perfumes. Presences of terpenoids compositional quality in essential oil fetch higher prices value in market. Previous studies were examined to standardize the economic production of rose scented geranium and

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its essential oil in the Indo-Gangetic plains, Northern part of Himalaya and Nilgiris and Palni hilly region of south India (Kulkarni *et al.*, 1997; Kumar *et al.*, 2001; Ram and Kumar., 1998; Ram *et al.,* 2003; Rao, 2002).

The estimated production of geranium oil around the world is about 400 metric tons annually, with an economical value ranging from 20-30 million US$. The major user countries of this oil are USA (65 tonnes), France (95 tonnes), UK (20 tonnes), West Germany (15 tonnes) and Japan (20 tonnes). Other useful properties in which oil easily can be used like antibacterial and insecticidal, healing of wounds, skin disorders, (Shawl *et al.*, 2006). Geranium leaves can be used as herbal tea which ease tension, reduce anxiety and for the improvement of blood circulation (Peterson *et al.* 2005). Various types of research and development activities were done in India and abroad on various aspects like agrotechnology, crop production, breeding approach, quality control of Rose-scented geranium. Previous studies indicate that the harvesting frequency affect the growth, herb and oil yield of geranium and population density and seasonal changes (Demarne *et al.,* 2002), age of plant shoot (Ram *et al.*, 2003), plant distilled (Mallavarapu *et al.,*1997), temperature (Ram *et al.*, 2003; Kumar & Kumar*,* 2013), humidity, length to sunlight exposure, availability of water and light, climate and the presence of fungal diseases and insects (Ramakrishna & Shankar*,* 2011). The harvesting methods used can change the oil content and herb yield, the techniques to isolate the moisture content of the plants at the time of harvest and the prevailing distillation unit conditions (Hussain, 2009). In-spite of this the commercial cultivation of Rose-scented geranium still scanty being it's a high economic value in per unit area and time crops as compared to Menthol-mint, Lemongrass, Citronella, Palmarosa, Vetiver, Ocimum, Ashwagandha, Sarpgandha, Stevia, Chamomile, etc. Rose-scented geranium is sensitive to rainy season and noted 100% mortality in open field condition during rainy season. Hence the major bottleneck in its popularization seems to be saving of quality planting material in rainy season. Hence, there is an urgent need to develop new approach or way through agronomic, breeding, acclimatization, etc to save quality planting material during rainy season. If, we are able to develop this type approach, then Rose-scented geranium can play an important role in doubling the income of Indian farmers. Several researchers done various type of research on various aspect to increasing the production and quality of essential oil of geranium, which made oil economically strong in the market.

Agronomic and Crop Production:

Sastry *et al.* (2001), study the prospects of cultivation of geranium (*Pelargonium sps*) in India. Geranium essential oilobtained by steam distillation is a versatile essential oil with a fine rose like odour, which is stable in slightly alkaline medium. Commercial rhodinol ex-geranium used in many high grade perfumes. To commercialize this crop and to produce economically viable yields the agro-technology was developed by the CIMAP. Geranium is propagated by terminal and medium woodcuttings. The cuttings were treating with 2000 ppm IBA in plains and 100 ppm IBA in hilts was found to hasten root initiation as well as the number and length of roots formed. CSIR-CIMAP had released three different chemo types which is Bipuli (rich in both geraniol and citronellol), Hemanthi (found rich in citronellol) and Kunthi (rich in geraniol). The oil content and chemical composition varies with changes in weather conditions. The oil content was high in summer months and low during winter months. Similarly, Low night temperature resulted in low geraniol content in the essential oil of Hemanthi whereas low night temperatures resulted in higher geraniol content in the essential oils of both Bipuliand Kunthi.The inter cropping systems resulted in land equivalent ratios of 1.52 and 1.53. Intercropping initially with pulses was also found to be beneficial. Singh *et al.*, (2008) studied the effect for optimum growth and oil production of geranium by Standardization of planting time under north Indian plains. At 15 days interval starting from 31 October 2002 to March 2003, cuttings of fresh stem were planted. Mid-December planted cuttings recorded significantly higher survival rate (93.5%) with fresh biomass (539.7 qha^{-1}) and essential oil yield (54.9 kg ha^{-1}) in the agro-climatic condition of north Indian plains. Result also showed the drop in essential oil yields (11.5 kg ha^{-1} oil) and (10.5 kg ha^{-1} oil) in15 February 2003 and 1 March 2003, respectively. Kassahun *et al.* (2012) conducted an experiment in six locations quantifying the effect of

population density of plant on agronomic and chemical characters of *P. graveolens* during the year 2010/2011. Experiment consist of three population densities 111111, 27777 and 12345 plants/ha which was managed and transplanted with spacing of 30x30 cm, 60x60 cm and 90x90 cm between plants rows. Data on plants height, number of branch/plant, herb yield/plants and internodes/plant, biomass yield/plant, fresh leaf yield/ha, essential oil content and oil yield were collected and analysed. Population density of plant expends a significant influence on different parameters studied, except on stem to leaf ratio, internodes/ plant and essential oil content. The overall fresh herb yield and essential oil yield were calculated 14 - 34 t/ha and 7 - 19 kg/ha over the tested location, respectively. Significantly increase were recorded in fresh herb/ha and essential oil yield/ ha at plant population density of 1111.11 plants/ ha.

Bansal *et al.*, (2014) developed a technology for the economic production of propagules of *Pelargonium graveolens* at large-scale. Experiment carried out when cuttings (split shoots) were planted in the soil which developed into rooted propagules in 6weeks. Two treatments, cuttings planted in polybags contain soil and FYM mixture (1:1) and in other treatments cuttings were directly planted in the prepared field applied with FYM. After six weeks the all cuttings were taken out from polybags and the field plots. These excavated roots were washed and examined for their rooting parameters. Cutting in the field developed root and root systems faster than in polybags. Further, the denser the planting of cuttings in the field provided a faster means of developing propagules than the planting of cutting in the polybags. He also identified the medium for the cuttings growing roots faster and better in polybags. Five media (soil, FY Manure, Vermi Manure, VG, Soil mix with FY Manure (1:1), and soil with NPK at 60:40:40 $kg.ha^{-1}$. Cutting were planted in all kind of medium filled in polybags and kept for 45 d. After 45 d, the plant was dig out and washed to free from rooting medium and observed. Roots were grown fastest in the cuttings on VG medium, with 100% rooted cuttings by 31 days from planting. The medium used with additive synthetic fertilizers help cuttings rooted 93% of by 38 d and 100% by 45 d.

Gebremeskel (2014) investigates the different harvesting stages effect on growth, herb and oil yield of *P. graveolens*. Harvesting stages of five levels (90, 105, 120, 135 and 150 days after transplanting) which arranged in RCBD with replications. Uniformly grown seedlings were selected, hardened and transplanted to the experimental field after 90 days of planting in the nursery site. Nitrogen (in the form of urea) was applied at the rate 120 kg/ha uniformly in three splits, one during transplanting and the other 30 and 60 days from the date of transplanting. All appropriate agronomic practices such as weeding, watering and hoeing were conducted manually both at the nursery and experimental field uniformly. Average plant height, branches $plant^{-1}$, leaves $plant^{-1}$, leaf area index, fresh leaf yield per ha, fresh stem yield per ha, harvest index, essential oil content (%) and essential oil yield per ha were collected randomly from the planted two middle rows at the harvest stages (days after transplanting). The results had positive effect of harvesting however, calculated moisture content (%) was not clearly affected by harvesting stage. The highest essential oil yield per ha at harvesting stage of 120 days after transplanting (DAT) was recorded 77.10 kg per ha. Significantly lower essential oil yield (36.32 kg per ha) was recorded at the harvesting stage of 150 DAT. Upadhyay *et al.*, (2016) performed an experiment for the development of low cost and novel agro-technology for quality planting material production of *P. graveolens* through utilization of natural resources available during summer season 2014–15. As per the treatment, the fresh cutting of geranium stem planted in field (T1), root trainer at open field (T2), root trainer placed beneath the net house (green) (T3), root trainer kept beneath *Putranjiva roxburghii* (T4), root trainer beneath *Bischofia javanica* (T5), root trainer beneath *Ficus religiosa* (T6). Result confirmed that the quality planting material technique was cost effective, as treatment, T_4 (cutting raised beneath *Putranjiva roxburghii*) and T_3 (cutting raised beneath green net house) recorded significantly higher survival rate (60%) and vitality of geranium nursery as compared to other provided treatments. Lower survival rate was recorded in control (cutting raised in field). Hence, farmers may raise geranium cutting in summer season using non expensive methods i.e. raising of cutting beneath of *P.*

roxburghii and save the rooted plant during rainy season. Method for quality planting production of *P. graveolens* may be provided a new direction adoptable practices of geranium for affordable and economical. Keeping in-view of above, we can say that with the adaptation of multiple approach of agronomic practices as quality planting material production methods, nutrient management, pest management, integrated weed management, agrotechnology, natural resources management, etc. we can save quality planting material of rose scented geranium in rainy season with affordable and adoptable in manner and able to cultivate commercial scale cultivation of rose-scented geranium in sustainable manner as well as ultimately its helps in doubling the farmers income.

Breeding

For evaluation of essential oil yield of *Pelargonium* and their composition, Saxena *et al.*, (2008) observed the performance of somaclones of *P. graveolens* planted in field. Somaclones are those plant which was produced by tissue culture by a single cell and having similar characteristics of their plant or we can say identical to mother plants. *In vitro* 85 calliclones from multiplied *P. graveolens* cv. Hemanti with their parent cultivar were regenerate in glasshouse and transferred to the field for evaluation. Calliclones are those plants which are produced or regenerated from the stem callus. The calliclones were grown in field and made primarily distinguished on the basis of morphology of leaf into two broad categories. Highly dentated leaf (HDL) phenotype was first categories (31 in number, i.e. 36.5%) and other one was less dentated leaf (LDL) with phenotype (54 in number, i.e. 63.5% clones). For 3 consecutive years of repeated field-testing, the HDL clones resembling the parent cultivar with respect to their quantity and quality determining different traits, while the LDL group was found no resemblance with parental cultivar. The LDL somaclones established in field, possessed higher branches, herb and essential oil yield attributing traits as compared to the HDL clones and the control. Chemical analysis of the essential oil showed the significant variance between the LDL clones, the HDL clones and the control. Somaclones selection superior to the parental in quantitative and qualitative traits which shows better adaptability to different areas of cultivation will help commercialization of geranium in India. Through breeding approach we can able to develop water logging resistant, pest resistant, drought resistant, high yielding variety, etc. of rose-scented geranium in for its wider scale cultivation and adaptation by the farmers to enhance their income.

Quality control

Sharopov *et al.*, (2014) analysed the chemical composition of *Palargonium graveolens* essential oil obtained from Tajikistan by hydro distillation and analysed by GC-MS. It contains seventy nine compounds accounted for 95.1% of the total oil. *P. graveolens* oil was examined primarily of citronellol (37.5%), geraniol (6.0%), linalool (3.0%), menthone (3.1%), caryophyllene oxide (3.7%), β-bourbonene (2.7%), geranylformate (2.0%), iso-menthone (2.1%), *cis*-rose oxide (1.9%) and geranyltiglate (1.8%). The cultivars of geranium mainly 3 type include the African type, Island type and the Chinese type, when compared to geranium oil it lacks components that are found in cultivated essential oils, such as citronellyl formate, 10-*epi*-γ-eudesmol and guaia-6,9-diene. The most remarkable difference was the higher quantities of caryophyllene derivatives in Tajik geranium oil, especially caryophyllene oxide (3.7%). The quality essential oil is the need of nations/industry/entrepreneurs. Hence, we have maintain the quality of rose-scented geranium essential oil as per standards, its provide premium/sustainable manner to the growers and farmers. It's make clear that quality of essential oil have lots of potential to provide premium price as well as easily marketable.

Conclusion

Keeping in view of the above, it is clear that different researcher/scientist/academia persons did numbers research and development activities on agronomic, breeding, and chemicals prospects of rose-scented geranium during main season crops. Rose-scented geranium is a high economic value crop that is very sensitive to rainy season/kharif season, because approximately 100% mortality was noticed in open field during rainy season. Due, to this reason a well equipped ACs glass house are mandatory to save mother plant during rainy season; and its requires huge cost, infrastructure, space etc to save large scale quality planting

materials, as well as it seems to be un-affordable by most of the famers. It is a major bottleneck in expansion of rose-scented geranium area at farmer filed at wider scale. The efficacy and application of the rose-scented geranium oil for various industries was based on its chemical composition that varies with geographic origin and various agricultural inputs/practices. Geranium oil is being used extensively in cosmetics, perfumery, pharmaceuticals, and in food-flavouring industry. Moreover, the aroma molecules and their derivatives and value added products such as absolute, terpeneless oil etc. are also mostly used in fragrance, flavour, and aromatherapy. In addition, the geranium oil and its aroma or flavour molecules possessed wide range of activities that is biological and therapeutically. Keeping in view of wide applications of essential oil of geranium in various industries, the demands of *P. graveolens* oil are increasing day-by-day at national and international market. To fill the huge demands of geranium essential oil it is necessary to cultivate rose-scented geranium at large scale to meet the demand in sustainable manner. Therefore, the major challenge in front of researchers is, to develop eco-friend, cheaper, sustainable, and affordable agro-technology for saving the mother plants of rose-scented geranium during rainy season. Instead of this, we can develop new clone/strains/variety i.e. able to perform in open field during rainy season. In over all, if, we are able to develop affordable agro-technology or variety of rose-scented geranium for rainy season, then the definitely farmers get benefited more by growing rose-scented geranium in sustainable manner.

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