



# Biomass yield, essential oil yield and quality of geranium (*Pelargonium graveolens* L. Her.) as influenced by intercropping with garlic (*Allium sativum* L.) under subtropical and temperate climate of India

Man Singh\*, U.B. Singh, Muni Ram, Anju Yadav, C.S. Chanotiya

Central Institute of Medicinal and Aromatic Plants (CSIR), Lucknow 226 015, India

## ARTICLE INFO

### Article history:

Received 17 October 2012

Received in revised form 15 January 2013

Accepted 19 January 2013

### Keywords:

Rose scented geranium (*Pelargonium*

*graveolens*)

Garlic (*Allium sativum*)

Intercropping

Essential oil yield

Land use efficiency

Net return

## ABSTRACT

Rose scented geranium (*Pelargonium graveolens* L. Her.), a perennial herb is grown for the production of high value essential oil that finds extensive use in flavouring and fragrance industries. Geranium is propagated through rooted stem cuttings or fresh terminal stem cuttings at a row spacing of 60 cm. Its initial growth rate is very slow, to utilize the uncovered inter row space and other applied and natural growth resources and to enhance the productivity, attempts were made to work out the optimum row ratio of garlic (*Allium sativum* L.) intercropped with geranium to get bonus yield of garlic without affecting oil yield of geranium. Field experiments were conducted for two growing seasons (October–June) of 2007–2008 and 2008–2009 under subtropical climate at Lucknow and temperate climate at Purara. Intercropping of two rows of garlic between the two rows of geranium planted at 60 cm row spacing and 30 cm plant spacing produced 1860 and 2400 kg ha<sup>-1</sup> bonus yield of garlic bulb without any significant reduction in geranium essential oil yield. It resulted in 59 and 60.5% increase in land use efficiency and 29.3 and 81.3% increase in net return over sole geranium at Lucknow and Purara, respectively.

© 2013 Elsevier B.V. All rights reserved.

## 1. Introduction

Rose scented geranium (*Pelargonium graveolens* L. Her.), a perennial herb is grown for the production of high value essential oil that finds extensive use in flavouring and fragrance industries. India is a net importer of geranium oil as demand far exceeds its production; therefore, excellent potential exists for extending its cultivation. Geranium is propagated through rooted stem cuttings. However, under subtropical climatic conditions, geranium can also be grown using fresh terminal stem cuttings in mid December (Singh et al., 2008). It is planted at a row spacing of 60 cm and its initial growth rate is very slow (Rajeshwara Rao, 2002). In earlier studies Ram and Kumar (1998) and Singh et al. (2011a) tried three and four rows of garlic (*Allium sativum* L.) as intercrop with geranium planted at 60 and 80 cm row spacing, respectively but reported about 20% reduction in oil yield of geranium as compared to sole crop.

To utilize the uncovered inter row space and other applied and natural growth resources more efficiently and to enhance productivity, experiments were planned at two locations to work out the optimum plant population/row ratio of garlic intercropped with

geranium to get bonus yield of garlic without affecting essential yield of geranium.

## 2. Materials and methods

### 2.1. Experimental site and soil

Field experiments were conducted for two seasons (October–June) of 2007–2008 and 2008–2009 at two locations; I. Research farm of the Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow, India situated at 26° 5'N latitude, 80° 5'E longitudes with an elevation of about 120 m above mean sea level. The experimental site of Lucknow is classified as semi-arid sub-tropical with severe hot summers and fairly cool winters. In this region monsoon normally sets from last week of June and continues until the end of September with an average annual precipitation of 700 mm. About 80% of the monsoon rains are received in July and August. Winter also experience some rains due to cyclonic disturbances in the Arabic sea. Mean maximum temperature fluctuated from 26.1 to 44.5 °C; where as mean minimum temperature varied from 7.8 to 29.5 °C. The soil (pH 7.7) of the experimental field was a sandy loam (Typic ustifluent), having organic carbon 0.4%, available N (alkaline KMnO<sub>4</sub> extractable) 168 kg ha<sup>-1</sup>, available P (0.5 M Na HCO<sub>3</sub> extractable) 14.0 kg ha<sup>-1</sup> and available K (1 M NH<sub>4</sub>OAc extractable) 160 kg ha<sup>-1</sup>.

\* Corresponding author. Tel.: +91 9453020644; fax: +91 522 2342666.

E-mail addresses: mansingh@cimap.res.in, mansingh.2003@yahoo.co.in (M. Singh).

II. CIMAP research station, Purara situated in western Himalayan region at 28° 5'N latitude, 78° 5'E longitudes with an altitude of about 1250 m above mean sea level. Climatologically, Purara is categorized as sub temperate zone. Valleys are hot during summers and very cool during winters. In this region also monsoon normally sets from last week of June and continues until the end of September with an average annual precipitation of 1100 mm. About 80% of the monsoon rains are received in July and August. Winter also experience some rains. Mean maximum temperature fluctuated from 19.1 to 34.5 °C; where as mean minimum temperature varied from 1.0 to 17.8 °C. The temperature remain lowest during December and January, resulting in frost during nights and an increasing trend in mean temperature is noticed from the first week of February and reaches to highest in mid- May and it declines only after the onset of the monsoons in the last week of June. The soil (pH 6.7) of the experimental field was a sandy loam having organic carbon 0.35%, available N (alkaline KMnO<sub>4</sub> extractable N) 155 kg ha<sup>-1</sup>, available P (0.5 M Na HCO<sub>3</sub> extractable) 12.0 kg ha<sup>-1</sup> and available K (1 M NH<sub>4</sub>OAc extractable) 150 kg ha<sup>-1</sup>.

## 2.2. Treatment and experimental design

Six treatments consisting of geranium sole, intercropping of one row of garlic and two row of garlic with normally planted geranium, two row of garlic and three row of garlic with paired (80/40 × 30 cm) planted geranium and garlic sole were tested in randomized block design with four replications at both the locations.

## 2.3. Raising of crops

At Purara fresh terminal stem cutting of 9–10 cm in length having 4–6 nodes and 3–4 leaves of geranium var. CIM- Pawan were grown in polythene bags (10 cm diameter and 16 cm length), filled with native soil, kept under partial shade and regularly watered. One cutting was planted in each bag for rooting in first week of September, 2007 and 2008. Healthy rooted cuttings were planted in the field in mid October. At Lucknow 15 cm long fresh terminal stem cuttings having 4–6 nodes were directly planted at 4–5 cm depth in mid December, 2007 and 2008 and irrigated immediately after planting. Other irrigations were applied at 10–15 days interval. Row to row spacing for geranium was 60 cm for sole and normal planting in intercropping, where as in paired row arrangement distance between pair and within pair were 80 cm and 40 cm, respectively. Plant to plant spacing was 30 cm in both normal and paired row system. Garlic cloves were planted at a spacing of 15 × 15 cm in sole and intercropping system in mid October of 2007 and 2008 at both the locations. Individual plot size at each location was 3.6 m × 3.6 m accommodating 72 plants in six rows having 12 plants in each row. A uniform basal dose of 25 kg N, 60 kg each of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O ha<sup>-1</sup> through urea, single super phosphate and mutate of potash, respectively were applied as basal dose in sole and intercropping and mixed in the soil before planting. Nitrogen @ 80 kg ha<sup>-1</sup> through urea was top dressed in two equal splits, 60 and 90 days after planting. No additional dose of fertilizer was applied to intercrop. Geranium crop was harvested once in first and last week of June and garlic bulbs were dug in last week of April and mid May at Lucknow and Purara, respectively.

## 2.4. Plant sampling and biometric observations

Observations on plant height and number of branches per plant in geranium were taken at the time of harvesting from five randomly selected plants in each plot. To estimate average weight of each bulb twenty randomly selected shade dried bulbs of garlic were taken in each plot. Biomass yield of 40 geranium plants (Four

rows and 10 plants in each row), leaving one row and one plant both side of bund as border row and border plant, in each plot was recorded after harvest and distilled separately in an experimental field distillation unit operating on water cum steam distillation principle.

To assess the advantage from intercropping, land equivalent ratio (LER) and area time equivalent ratio (ATER) were calculated from the mean yield of geranium and garlic following the methods of Mead and Willey (1980) and Hiebsch and McCollum (1987); respectively.

$$LER = \frac{Y_{ab}}{Y_{aa}} + \frac{Y_{ba}}{Y_{bb}}$$

where LER is the land equivalent ratio for the intercrop; Y<sub>ab</sub> and Y<sub>aa</sub> is the oil yield of geranium in intercropping and sole cropping and Y<sub>ba</sub> and Y<sub>bb</sub> are the bulb yield of garlic in intercropping and sole cropping, respectively.

$$ATER = \frac{(Y_{ab}/Y_{aa}) \times ta + (Y_{ba}/Y_{bb}) \times tb}{t}$$

where *ta* is the duration of geranium in days; *tb* the duration of garlic in days and *t* is the total duration of intercropping system in days.

By using LER and ATER values, the land utilization efficiency (LUE) was calculated:

$$LUE(\%) = \frac{LER + ATER}{2} \times 100$$

Economics of various treatments were calculated taking into account the current costs of inputs and produce

$$\text{Net return} = \text{Gross return} - \text{Cost of cultivation}$$

## 2.5. Statistical analysis

The analysis of variance was done in randomized block design for various observations recorded during experimentation as described by Panse and Sukhatme (1985). The treatment means were compared by critical difference (CD) values at 5% (*p* = 0.05) level of significance.

## 2.6. Chemical analysis of essential oil

Essential oil samples were analyzed using a Perkin-Elmer AutoSystem XL gas chromatograph (USA) fitted with Equity-5 column (60 m × 0.32 mm, film thickness 0.25 μm, Supelco, USA), column temperature 70–250 °C was programmed at 3 °C/min with initial and final hold of 2 and 10 min, respectively, using H<sub>2</sub> as carrier gas at 10 psi constant pressure, split ratio 1:30, injection size 0.03 μl; injector and detector temperatures were 250 °C and 280 °C, respectively. Characterization of constituents was done on the basis of retention indices using index calculating software, co injection with standards (Sigma), MS Library spectra (NIST/NIH Version 2.1 & Wiley-Registry of mass spectral data–7th edition) and by comparing with mass spectral literature data.

## 3. Results and discussion

### 3.1. Rose scented geranium

#### 3.1.1. Plant height and branching

Geranium plants grown under subtropical climate of Lucknow attained more plant height (58.5–63.5 cm) than (46.7–50.3 cm) at Purara. Similarly number of primary branches per plant was higher (9.3–10.5) at Lucknow than (6–6.7) at Purara. Intercropping of garlic

Download English Version:

<https://daneshyari.com/en/article/4513850>

Download Persian Version:

<https://daneshyari.com/article/4513850>

[Daneshyari.com](https://daneshyari.com)