academicresearchJournals

Vol. 5(5), pp. 329-335, September 2017
DOI: 10.14662/ARJASR2017.033

ISSN: 2360-7874
http://www.academicresearchjournals.org/ARJASR/Index.htm

Academic Research Journal of Agricultural Science and Research

Full Length Research

Identification of suitable transplanting time for optimum growth, yield and yield components of Rose Scented Geranium (Pelargonium graveolens L. Herit var. SHITO)

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Accepted 14 August 2017

The field experiment was conducted for two years from 2015 to 2016 to determine appropriate transplanting time for growth, yield and yield components of Rose Scented Geranium (Pelargonium graveolens L. Herit var. SHITO) at Wondo Genet. The experiment comprised twelve levels of transplanting time (from February to January) were used on a plot size of 3.6 cm length and 3.6 cm width arranged in Randomized Complete Block Design (RCBD) with three replications. SAS (version 9) software was used to compute the analysis of variance. The result showed that treatments differed markedly on growth, yield and yield components of Rose Scented Geranium var. SHITO. The highest dry leaf yield and essential oil yield/ha were obtained when the tested variety was transplanted at the beginning of March followed by April. In contrast, the least dry leaf yield and essential oil yield/ha were obtained when it was transplanted at the beginning of November. On the other hand, the remaining parameters such as plant height, number of branches/plant, number of leaves/plant and fresh leaf yield/ha were superior when the tested variety was transplanted at the beginning of April. In contrast, the inferior plant height, number of branches/plant, number of leaves/plant and fresh leaf yield/ha were obtained when it was transplanted at the beginning of December, October, January and November, respectively. Therefore, in order to get the highest essential oil yield/ha it is better to transplant the tasted variety at the beginning of March and April on Wondo Genet and areas having the same agro-ecologies with Wondo Genet.

Keywords: Pelargonium graveolens L. Herit var. SHITO, transplanting time, Essential Oil Yield

Cite this article as: Degu B, Lire H, Mengesha B (2017). Identification of suitable transplanting time for optimum growth, yield and yield components of Rose Scented Geranium (Pelargonium graveolens L. Herit var. SHITO). Acad. Res. J. Agri. Sci. Res. 5(5): 329-335

INTRODUCTION

Rose-scented geranium (*Pelargonium graveolens* L. Herit) is an important high value perennial, aromatic shrub which belongs to the family of Geraniaceae (Shawl *et al*., 2006). It is an important, high-value perennial, aromatic shrub that can reach a height of up to 1.3 m and a spread (lateral growth) of 1 m. Its hairy stems are

herbaceous when young and become woody with age, and the plant's leaves are deeply incised, soft to the touch, and strongly rose scented (Farukh *et al*., 2014). Rose- scented geranium is a highly, adaptable crop and can be cultivated in tropical, Sub tropical, temperate and Mediterranean climates; at altitudes ranging from 120 - >2400 meters above sea level; in well drained, light to medium textured sandy, sandy loam and peat soils having pH 5.0-8.5 (Angadi and Kumar, 1995; Aravindakshan and Aslam, 1986). It grows well at a temperature range of 10 to 33 °c, and it needs enough sunshine for the development of oil in the plant. The plant is sensitive to cold weather and cannot withstand frost. The favorable rainfall for dry land growing of rose geranium should range from 700 to 1500 mm per year, uniformly distributed throughout the season. In areas where rainfall is less, it can be grown with supplementary irrigation (Production guide line for rose geranium, 2012).

The essential oil of *P. graveolens* extensively used in the perfumery and cosmetic industries (Misra and Srivastava, 2010; Rao *et al*., 2002; Rao, 2002). It is an indispensable aromatherapy oil since geranium oil, as well as its major constituents (citronellol, geraniol, and linalool), have shown smooth muscle relaxant (guinea pig ileum) properties (Lis-Balchi *et al*., 1998). The essential oil of rose-scented geranium, extracted by steam distillation of freshly harvested shoot biomass, is widely used in the fragrance and flavor industries, and also has widespread use in aromatherapy (Guarav *et al*., 2014).

Tigist and Dejene (2015) reported that March and April are the recommended transplanting time for cultivation of common sage due to the presence of moderate warm temperature and light rainfall. However, in Ethiopia there is no finding regarding to transplanting time of Rose Scented Geranium. Therefore, the objective of this study was to determine suitable transplanting time for optimum growth, yield and yield components of rose scented geranium.

MATERIALS AND METHODS

The study was conducted at Wondo Genet Agricultural Research Center experimental field for two years from 2015 to 2016. Rose Scented Geranium (*P. graveolence* L. Herit var. SHITO) was used for this particular study. Wondo Genet is located between 7°19' N latitude and 38°38' E longitude; it is found at an altitude of 1780 m.a.s.l (meter above sea level) and receives mean annual rainfall of 1128 mm with minimum and maximum temperature of 11 °C and 26 °C, respectively. The soil textural class of the experimental area is sandy loam with pH of 6.4 (Abayneh *et al*., 2006).

Seedlings were raised at nursery site by taking cuttings from healthy mother plants and planted on the polyethylene tubes which were filled with soil. Seedlings were transplanted to the main field after two months in one month interval for twelve months of the year started from February. The treatments were arranged in a randomized complete block design with three replications. For each species a plot having six rows and six plants per row will be maintained. The size of the plot was 3.6 m length and 3.6 m width. Respective spacing of 60, 60cm, 1 and 1.5m were used between plants, rows, plots and replications. Chemical or fertilizer was not applied during its growth cycle. The agronomic practices and data to be collected for each species are different. The whole plant was cut 15 cm above the ground while harvesting. The harvested herb (the leaves) and flowers was distilled for the production of essential oil using hydro distillation in a clavenger type apparatus according to Gunter (1972).

Data on plant height, number of branches/plant, number of days to reach full blooming (>50% of the plant in a plot bear flower), number of leaves/plant, leaf weight/plant, above ground biomass/plant, number of flower/plant, flower yield/plant, leaf to stem ratio, leaf yield/plot, flower yield/plot, leaf yield/ha, percent essential oil content and composition of the leaves and the flowers, essential oil yield/ha for leaves and flowers were recorded critically.

Data on quantitative traits was subjected for statistical analysis using SAS computer software program following the procedures for the general linear model ANOVA. Comparisons between means were done using LSD at probability level of 0.05.

RESULTS AND DISCUSSION

Plant height (cm)

The analysis of variance table revealed that, planting time had a very highly significant ($p<0.001$) effect on plant height (Table 1). The highest plant height was obtained when transplanting of Rose scented geranium at the beginning of April while, the least value was obtained when transplanting it at the beginning of December (Figure 1). Plant height was increased by 146.34% when it was transplanted on April as compared to transplanted on December. This could be due to the favorable environmental conditions like rainfall and temperature of the transplanting time which enable the crop to grow well. Thereby, the height of the crop was increased.

Number of branches per plant

The analysis of variance table revealed that, planting time had a very highly significant ($p<0.001$) effect on number of branches/plant (Table 1). The highest number of

Table 1. Analysis of Variance table for yield and yield components of Rose Scented Geranium (*P. graveolence* L. Herit var. SHITO) at Wondo Genet during 2015 to 2016

Statistics and Parameters	Source of variance			R-square	CV (%)
	Replication	Treatment	Error		
DF	2	11	22	-	-
PH	143.18	1021.37***	66.31	0.89	13.19
NBPP	502.69	5492.51***	338.04	0.89	20.15
NLPP	91534.8	18466.7***	9331.57	0.84	13.9
FLYPH	665204466	25755423***	89459476	0.79	31.62
DLYPH	1295046.8	26733432.7***	4442615.8	0.75	34.98
EOYPH	4.2	86.62***	14.39	0.75	34.98

Where, DF= Degree of freedom, CV= Coefficient of variance, PH= Plant height (cm), NBPP= Number of branches/plant, NLPP= Number of leaves/plant, FLYPH= Fresh leaf yield/hectare (kg), DLYPH= Dry leaf yield/hectare (kg), EOYPH= Essential oil yield/hectare (kg) and ***= statistically significant at 0.001 probability level.

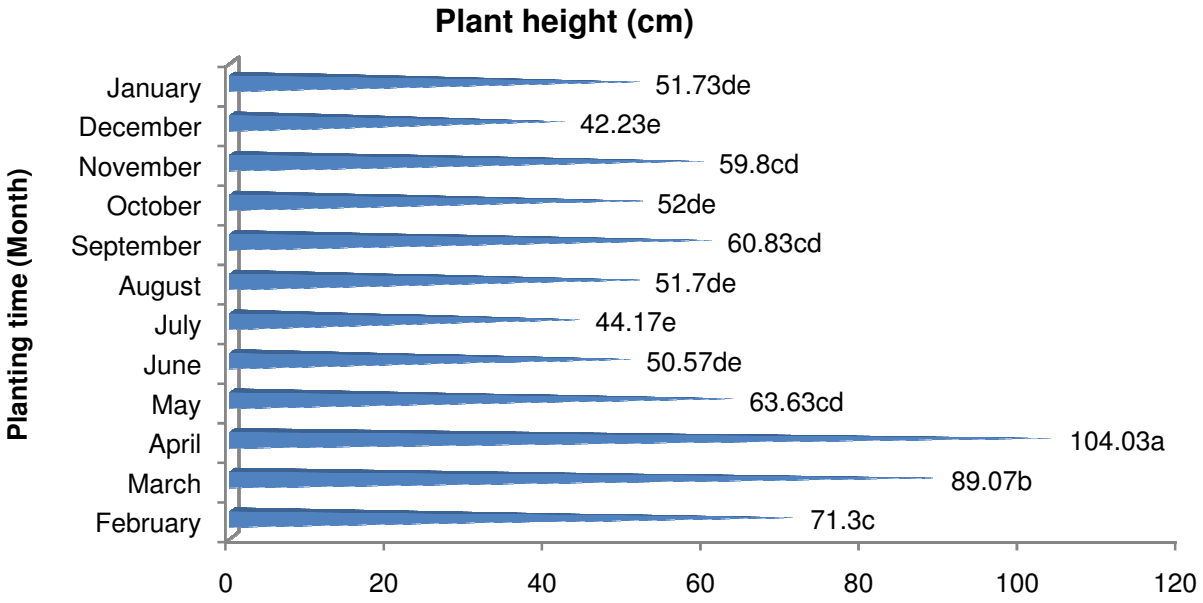

Figure 1. Effects of transplanting time on plant height of Rose Scented Geranium (*Pelargonium graveolens* L. Herit var. SHITO)

branches/plant was obtained when transplanting of Rose scented geranium at the beginning of April while, the least value was obtained when transplanting it at the beginning of October (Figure 2). Number of branches/plant was increased by 262.56% when it was transplanted on April as compared to transplanted on October. This might be due to the presence of favorable environmental conditions such as rainfall and temperature for the growth and development of Rose Scented Geranium which enables it to develop more number of branches/plant as compared to other transplanting times.

Number of leaves per plant

The analysis of variance table revealed that, planting time had a very highly significant ($p<0.001$) effect on number of leaf/plant (Table 1). The highest number of leaves/plant was obtained when transplanting of Rose

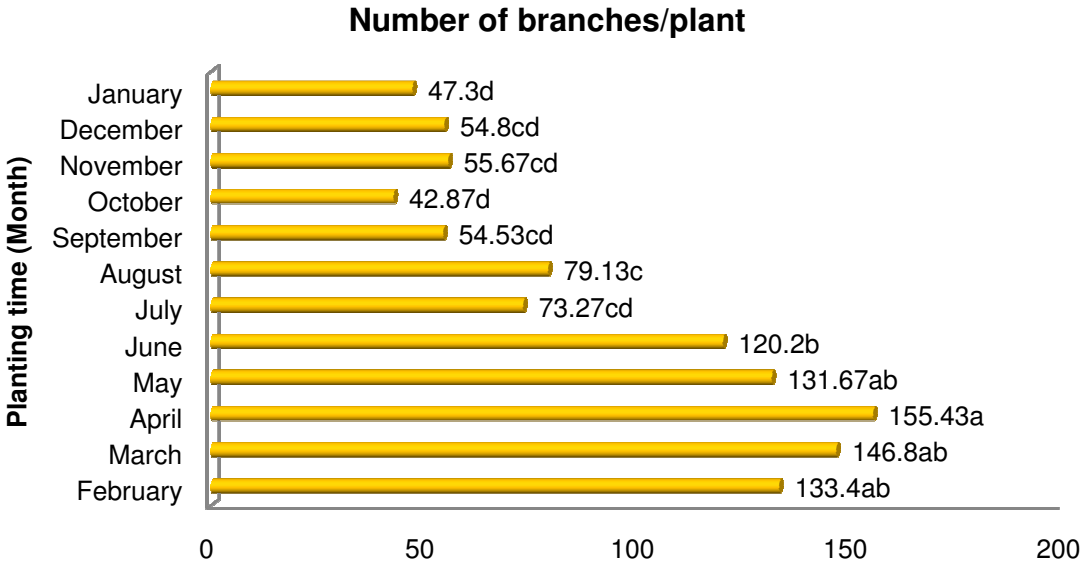

Figure 2. Effects of transplanting time on number of branches/plant of Rose Scented Geranium (*Pelargonium graveolens* L. Herit var. SHITO)

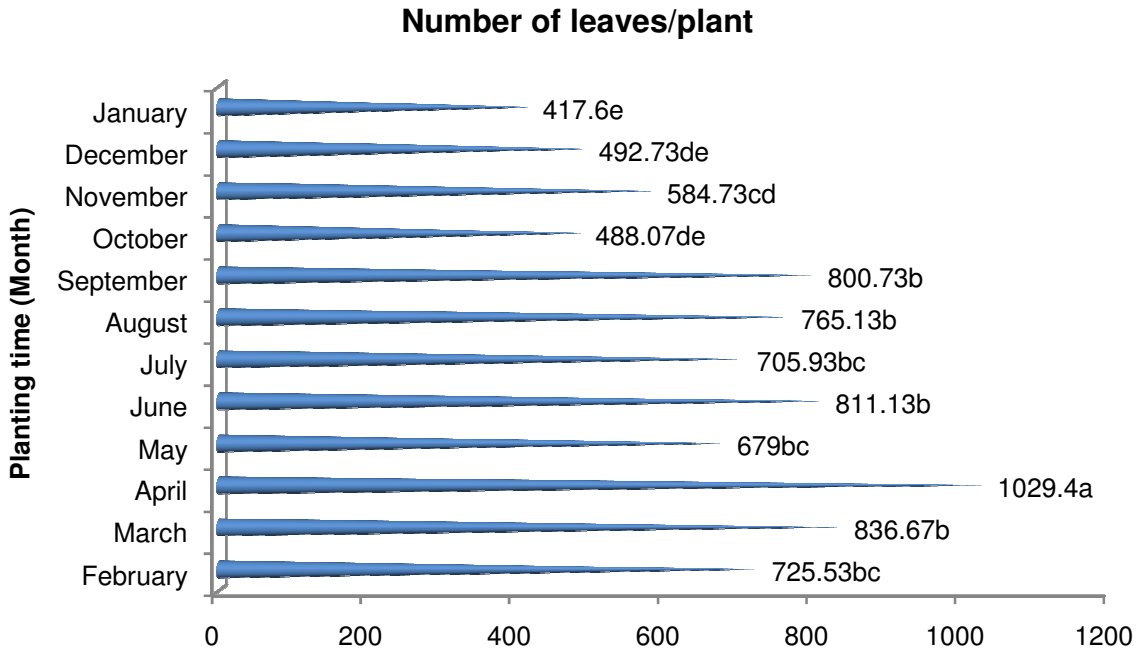

Figure 3. Effects of transplanting time on number of leaves/plant of Rose Scented Geranium (*Pelargonium graveolens* L. Herit var. SHITO)

scented geranium at the beginning of April while, the least value was obtained when transplanting it at the beginning of January (Figure 3). Number of leaves/plant was increased by 146.5% when it was transplanted on April as compared to transplanted on January. As to number of branches/plant, this might be due to the presence of favorable environmental conditions such as rainfall and temperature for the growth and development of Rose Scented Geranium which enables it to develop more number of leaves/plant as compared to other transplanting times.

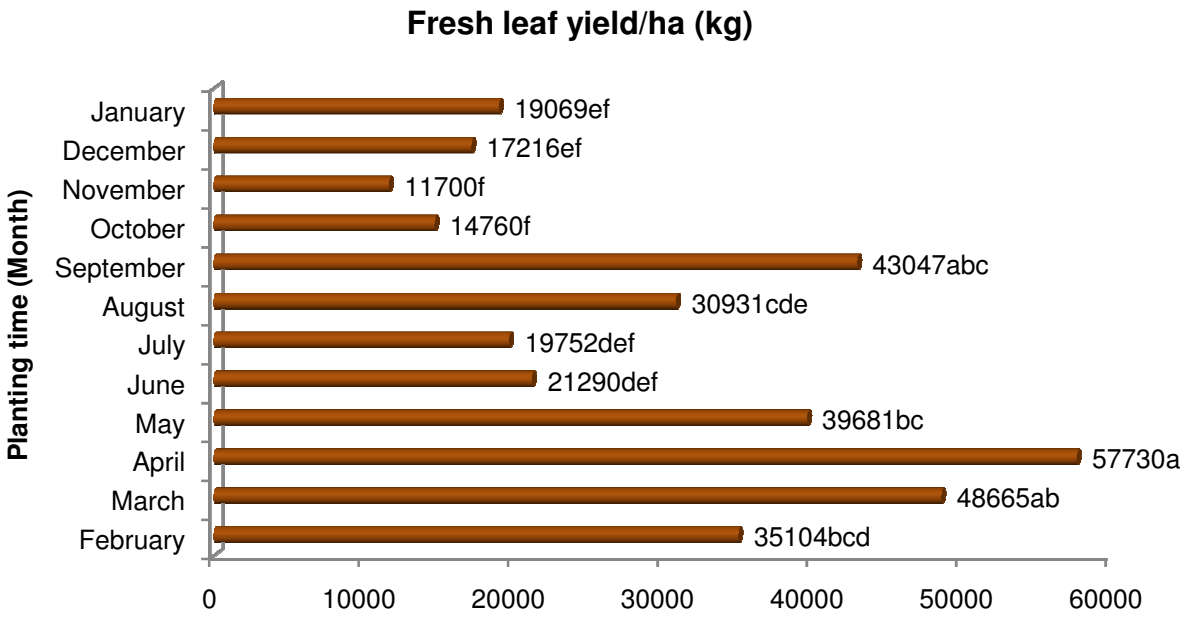

Figure 4. Effects of transplanting time on fresh leaf yield/ha of Rose Scented Geranium (*Pelargonium graveolens* L. Herit var. SHITO)

Fresh leaf yield per hectare (kg)

The analysis of variance table revealed that, planting time had a very highly significant ($p<0.001$) effect on fresh leaf yield/ha (Table 1). Supporting result was reported by Tigist and Dejene (2015) on common sage. The highest fresh leaf yield/ha was obtained when transplanting of Rose scented geranium at the beginning of April while, the least value was obtained when transplanting it at the beginning of November (Figure 4). Fresh leaf yield/ha was increased by 79.73% when it was transplanted on April as compared to transplanted on November. This could be due to the favorable environmental conditions of the transplanting time which enable the crop to develop the highest fresh leaf yield/ha.

Dry leaf yield per hectare (kg)

The analysis of variance table revealed that, planting time had a very highly significant ($p<0.001$) effect on dry leaf yield/ha (Table 1). The highest dry leaf yield/ha were obtained when transplanting of Rose scented geranium at the beginning of March followed by April; while, the least value was obtained when transplanting it at the beginning of November (Figure 5). Dry leaf yield/ha was increased by 75.63% and 75.6% when it was transplanted on March and April, respectively as compared to transplanted on November. As to fresh leaf yield/ha, this might be due to the favorable environmental conditions of the transplanting time which enable the crop to develop the highest dry leaf yield/ha.

Essential oil yield per hectare (kg)

The analysis of variance table revealed that, planting time had a very highly significant ($p<0.001$) effect on essential oil yield/ha (Table 1). Supporting result was reported by Tigist and Dejene (2015) on common sage. The highest essential oil yield/ha were obtained when transplanting of Rose scented geranium at the beginning of March followed by April while, the least value was obtained when transplanting it at the beginning of November (Figure 6). Essential oil yield/ha was increased by 310% and 307% when it was transplanted on March and April, respectively as compared to transplanted on November. This could be due to an increasing of leaf yield/ha attributed to the increment of essential oil yield/ha.

CONCLUSION

This study demonstrated that, treatment exerted a very highly significant effect on the studied parameters such as plant height, number of branches/plant, number of leaves/plant, fresh leaf yield/ha, dry leaf yield/ha and essential oil yield/ha. The highest dry leaf yield and essential oil yield/ha were obtained when Rose Scented Geranium variety SHITO was transplanted at the

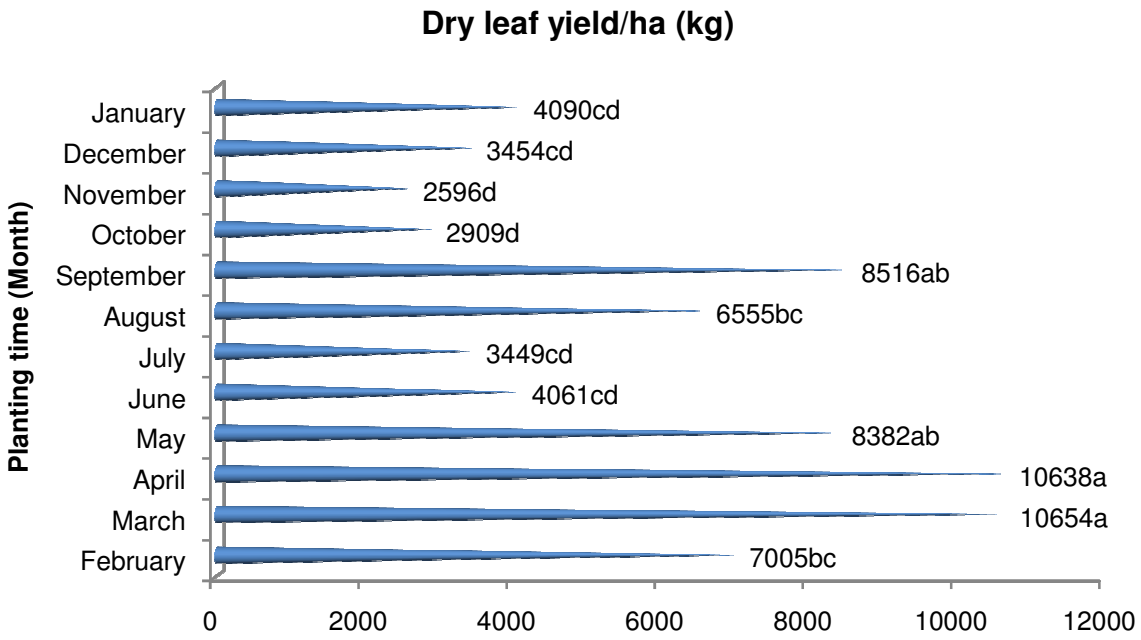

Figure 5. Effects of transplanting time on dry leaf yield/ha of Rose Scented Geranium (*Pelargonium graveolens* L. Herit var. SHITO)

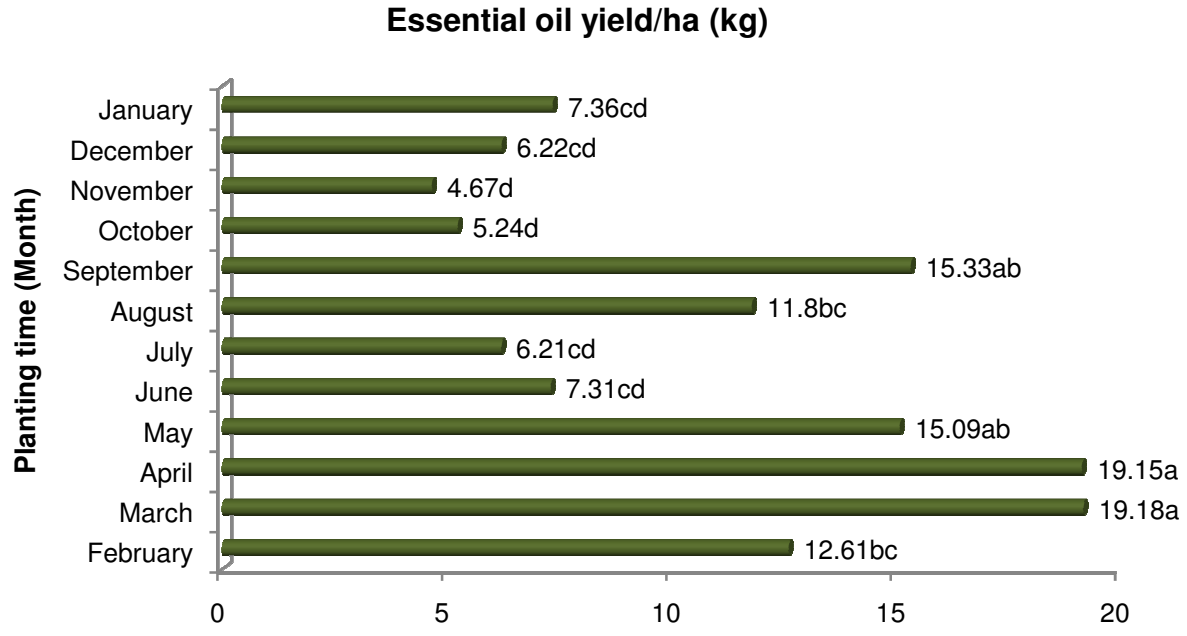

Figure 6. Effects of transplanting time on Essential oil yield/ha of Rose Scented Geranium (*Pelargonium graveolens* L. Herit var. SHITO)

beginning of March followed by April; whereas, the least dry leaf yield and essential oil yield/ha were obtained when it was transplanted at the beginning of November. On the other hand, the highest plant height, number of branches/plant, number of leaves/plant and fresh leaf yield/ha were obtained when the variety was transplanted at the beginning of April; whereas, the least values were obtained when it was transplanted at the beginning of

December, October, January and November, respectively. Generally, the superior transplanting times were characterized by a moderate rainfall and favorable temperature for the growth and development of Rose Scented Geranium. Therefore, in order to get the highest essential oil yield/ha it is better to transplant the tasted variety at the beginning of March and April on Wondo Genet and areas having the same agro-ecologies with Wondo Genet.

ACKNOWLEDGMENTS

We are really grateful to the Ethiopian Institute of Agricultural Research, Wondo Genet Agricultural Research Center for sponsoring us to do this experiment. Our special appreciation also go to our technical assistance Yigermal Molla and Wondimu Manebo; field assistances Abera waritu, and Admasu Usur, to all our drivers, finance officers and all members of Natural Product Research Laboratory staff who contributed a lot while carrying out this experiment.

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