



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(12): 3395-3397
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www.thepharmajournal.com
Received: 07-09-2023
Accepted: 13-10-2023

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Standardization of harvesting stages of Lemongrass for herbage and oil yield

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Abstract

Lemongrass (*Cymbopogon flexuosus* Nees), is an important aromatic crop. Considering the importance of information regarding the harvesting stages of lemongrass, the present study was aimed to standardize the harvesting stages of lemongrass, thereby an investigation was carried out at Medicinal and Aromatic Plant Research Station, Rajendranagar, Hyderabad under Sri Konda Laxman Telangana State Horticultural University, Mulugu (V & M), Siddipet (Dist.), Telangana State. The experiment was conducted for three years (2019-22) which was laid out in randomized block design with six treatments viz (60 days, 70 days, 80 days, 90 days, 100 days, 110 days interval) and three replications. Among the treatments studied, T₅ -100 days interval gave similar yields as compared with T₆ 110 days interval. The parameters were significantly differed. The maximum Plant height (162.52 cm), Number of slips/plant (34.03) were found in T₆. Herbage yield was found in T₅ (28.83 t/ha) and Oil yield was found in T₆ (5.83 ml/kg), while the minimum Plant height (134.02 cm), Number of slips/plant (12.16), Herbage yield (11.54 t/ha) and Oil yield (4.23ml/kg) were found in T₁.

Keywords: lemongrass, harvesting stages, herbage yield, oil yield

Introduction

Lemongrass (*Cymbopogon flexuosus* Nees) belongs to the family Graminae. It is the source of lemongrass oil obtained from the leaves and shoots of plant. The oil has strong lemon-like odour, due to high percentage (over 75%) of citral in the oil. The characteristic smell of oil makes its use in scenting of soaps, detergents, medicines, hair oils, insect repellent preparations etc. Lemongrass is one such plant whose essential oil is widely used as a flavoring due to its lemon scent (Maswal *et al.*, 2014) ^[10]. Harvesting age affected yield and yield-related traits of lemongrass (Jimayu *et al.*, 2016; Jimayu and Gebre, 2017) ^[5, 4]. Lemongrass leaves accumulates essential oils in specific oil cells that are present in parenchyma tissues (Lewinsohn *et al.* 1998; Luthra *et al.* 2007) ^[7, 8]. Essential oil and citral contents were influenced by factors such as temperature, light intensity, soil moisture, fertilizer, and maturity stage (Miyazaki, 1965) ^[11]. It is clearly indicated that in aromatic crops, the chemical composition of the essential oil is related to the age of the leaves, thus emphasizing the importance of the growth stage at which harvesting takes place (Motsa, 2006) ^[12]. Harvesting stage of plant has an influence on quantity and quality of essential oil in most essential oil bearing plants (Ramezani *et al.*, 2009) ^[13].

Materials and Methods

The experiment entitled "Standardization of harvesting stages of Lemongrass for herbage and oil yield" was carried out for three years (2019-2022) at Medicinal and Aromatic Plant Research Station, Rajendranagar, under Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet (district). The meteorological data was collected from the Agricultural Research Institute, Rajendranagar for the experimental period of three years (2019-2022). It comes under sub tropical zone and is situated at latitude of 17°30' N and longitude of 78°42' E. The weather data recorded normal on total rainfall, maximum and minimum temperature, relative humidity, that prevailed during the period of experimentation. The land used under the experimental layout was red with good drainage and low water holding capacity with uniform texture. The soil characteristics were, pH-7.20, electrical conductivity 0.67 dSm⁻¹, organic carbon 0.32%, available Nitrogen 120 kg/ha, available Phosphorus 48 kg/ha and available Potassium 60 kg/ha. Good soil fertility management ensures adequate nutrient availability to plant and improve their growth.

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The experiment was designed in Randomized Block Design with three replications with the spacing of 60 X 45 cm. Complete dosage of farmyard manure and vermicompost were applied at the time of final ploughing. Nitrogen, Phosphorus and Potassium were applied in the form of Urea, Single super phosphate and Muriate of potash respectively as basal doses. Nitrogen was applied in three split doses, before transplanting add 50% of Nitrogen and full dose of Phosphorous and Potassium to the field. Remaining nitrogen (50 kg) was applied as top dressing in 3 split doses during the each growing season.

The treatments consisting different harvesting stage intervals were as follows T1 – (60 days interval), T2 – (70 days), T3 – (80 days), T4 – (90 days), T5 – (100 days) and T6 – (110 days). The plant height was recorded before each harvest from ground level to the tip of plant with the help of measuring tape and was expressed in centimeters (cm). No. of slips/plant, Fresh herbage yield (kg/plot) was estimated by harvesting the crop 15cm above the ground level with sickle and immediately weighed for obtaining plot yield. Then plot yield (t/ha) was transformed to yield per hectare which was expressed in terms of tones. After recording the fresh herbage yield, the plants were sent to distillation unit to obtain oil yield (ml/kg).

Results and Discussion

Plant height (cm)

The effect of treatments on plant height of lemongrass recorded at 60, 70, 80, 90, 100 and 110 days interval after transplanting has been presented in Table 1. The plant height of lemongrass increased with advancement of crop age. Highest plant height of lemongrass was recorded in T6(162.52 cm) as compared to other treatments like T1, T2, T3, T4 and T5 at 60, 70, 80, 90 and 100 days interval after transplanting. While the treatment T5 (161.53 cm) was statistically at par with T6 (162.52 cm). Similarly, Kassahun *et al.* (2011) ^[2] also discovered that location and different seasons can significantly affect lemongrass height consistently throughout several years. Apart from location and harvesting period, Yeshita (2019) ^[16] found out that lemongrass height could also be affected by varieties and the number of slips per planting point.

Number of slips/plant

The number of slips/plant of lemongrass (*Cymbopogon flexosus*) were recorded during different growth stages of crop at 60, 70, 80, 90, 100 and 110 days interval after transplanting (DAT). The number of slips/plant of lemongrass also increased with advancement of crop age. The maximum number of slips/plant recorded with T6 (34.03) while the minimum tillers with T1 (12.6) at all the growth stages. The T6 and T5 treatments were found statistically superior over the all other treatments T1, T2, T3& T4. While the T5 (32.09) has numerically increased slips/plant number in comparison to T6 in a 10 days interval between different treatments but it was statistically similar in the respect of all the growth stages of plant. (Table 1). The increasing number of slips per

planting point significantly reduced plant height as this is due to higher competition for a nutrient associated with plant growth. (Ahmad Arif Ismail *et al.*, 2022) ^[1].

Fresh herbage yield/plot (kg)

The fresh herbage yield of lemongrass with the presence of different treatments recorded at T1, T2, T3, T4, T5 & T6 harvesting stages of crop growth has been given in Table 1. The fresh herbage yield of lemongrass per plot ranged from 0.89 T1 (0.89 kg) to T5 (2.73 kg), respectively. The effect of treatment was significant during all the stages of crop growth in relation to herbage yield of per plot of lemongrass. The maximum fresh herbage yield of lemongrass kg/ plot recorded its best at treatment T5 (2.73 kg), at 100 days interval after transplanting respectively. This was contradict with Kothari *et al.* (2004) ^[6] who reported that, biomass yield was greater in the first harvest and gradually decline in subsequent harvest of basil.

Fresh herbage yield/ha (t)

The highest fresh herbage yield of lemongrass was found to be significantly superior over all harvesting stage of crops. Highest fresh herbage yield per hectare was observed in the treatment T5 followed by T6, T4, T3, T2 and T1 in all stage of crop harvest. The fresh herbage yield of lemongrass ranged from T1 (11.54), T2(12.46), T3(20.62), T4(28.18), T6(28.80) and T5(28.83) t/ha, respectively. Performance of lemongrass was found to be significantly superior over all the harvesting stages of crops.

Oil yield (ml/kg)

Data related to the oil yield content has been presented in table 1. It is clear from the table that the maximum increase in oil yield was showing significantly high and increased from 90 days to 110 days intervals. Oil yield irrespective of different harvesting stages are ranged from 4.23 (T1) to 5.83 (T6), showing significantly better results when compared with 60-90 days period of interval from days after transplant (DAT). (Table-1). (Mallavarapu *et al.*, 1999) ^[9] reported similar on davana (*Artemisia pallens* W.), in which essential oil content was higher at the full emergence of flower heads than at anthesis and initiation of seed set stages. The higher essential oil yield kg/ha was obtained at prolonged harvesting age is probably due to the maximum above ground biomass at this stage. When harvesting age duration prolonged from 45 to 105 days after planting, the recorded value of essential oil yield was increased by 64.4% and 236% for Lomisar-UA and Lomisar-Java respectively. These findings are in line with those of Solomon and Beemnet (2011a) ^[14] in spearmint and Solomon and Beemnet (2011b) ^[15] in Japanese mint, who reported essential oil yield/ha increased with harvesting age. Contradicted ideas was reported by (Baydar and Erbas, 2005) ^[3] who found that, in lavender (*Lavandula angustifolia*) essential oil contents were decreased from first harvest to the last harvest. Kassahun *et al.* (2011) ^[2] discovered that location can significantly affect lemongrass height consistently throughout several years.

Table 1: Standardization of harvesting stages of Lemongrass on herbage and oil yield

Treatments	Plant height (cm)	No. of slips/ plant	Fresh herbage yield/plot (Kg)	Fresh herbage yield (t/ha)	Oil yield (ml/kg)
T ₁	134.02	12.16	0.89	11.54	4.23
T ₂	138.12	12.23	0.96	12.46	4.31
T ₃	139.48	25.12	1.93	20.62	4.63
T ₄	149.91	26.93	2.03	28.18	5.68
T ₅	161.53	32.09	2.73	28.83	5.72
T ₆	162.52	34.03	2.62	28.80	5.83
S.Em+-	1.29	1.56	0.01	0.30	0.09
C.D @ 5%	1.12	0.11	0.02	0.23	0.03

T1: 60 days interval

T2: 70 days interval

T3: 80 days interval

T4: 90 days interval

T5: 100 days interval

T6: 110 days interval

Conclusion

As the harvesting age duration prolonged from 60 to 110 days after planting the essential oil yield was increased. The fresh herbage yield also showed an increase in the number for a period of 100 days in (T₅) and showed a gradual decrease in the total fresh herbage yield per plot. This may be due to the presence of higher biomass in the early harvesting stages of treatments. Therefore further research needs to identify the optimum harvesting age above 110 days after planting. The present study finds out that the harvesting period significantly affects lemongrass herbage yield and oil yield characteristics especially on plant fresh weight and slip weight. Prolong period spent towards increasing herbage yield of lemongrass may not be beneficial since minimum increment was observed between the 5th and 6th treatments i.e., T₅ and T₆.

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