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Effect of Variation in Cutting Height of Planting Slips of Two Lemmon Grass (*Cymbopogon Citratus*) Varieties on Growth, Yield and Yield Components

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Abstract:

The current study was conducted at Wondo Genet Agricultural Research Center in order to evaluate the effect of cutting height of planting slips of two lemongrass varieties at different harvest cycles during the 2017-2019 cropping season. The design of the experiment was factorial RCBD in three replications and the treatments of the experiment include a combination of two varieties (Lomisar-I and Lomisar-Java) with four levels of cutting height of planting slips (15cm, 20cm, 25cm, and 30cm). Data of yield and yield components were collected and subjected to analysis of variance SAS software version 9.3. The difference between means was assessed using the least significant difference at a 5% probability level. Results of the experiment showed significant variation in survival count between the two-lemongrass varieties. Lomisar-I showed better survival. While the first harvesting resulted in better essential oil yield, the second harvest cycle resulted in better herbal yield. The essential oil yield obtained at the first harvest cycle was 1.045t/ha while it was 0.90t/ha at the second harvest cycle. The higher fresh leaf yield obtained at the second harvest cycle was 74.12% higher than the value obtained at the first harvest. Variation of cutting height of planting slips showed no variation in yield and yield components.

Key words: Essential oil, Harvesting cycle, Variety

1. INRODUCTION

Lemongrass (*Cymbopogon citratus* (DC) Stapf) is one of the perennial aromatic grasses grown in tropical and subtropical areas for essential oil and for herbal yield. The name lemongrass is obtained from the lemon-like odor of the leaves and essential oil. Kumari *et al.* (2007) reported as lemongrass comprises 140 species. The essential oil of lemongrass is widely used in industries producing scenting soaps, detergents, and many kinds of

technical products. According to Carlson *et al*. (2001), lemongrass oil is used to cleanse oily skin, used in aromatherapy and it is used as a relaxant. Furthermore, lemongrass oil is used in the production of soaps, perfumes, cosmetics, and disinfectants, and is a raw material for manufacturing ionone and vitamin A (Purnima, 1999). Lemongrass is produced mainly by using the vegetative propagation method. Disease-free and uniform slips (tillers) used for production. However, lemongrass production, either for herbal or for its oil, is influenced by many factors among which genotype, growing, and drying conditions are primarily important. In their experimental report, Kassahun *et al*., (2014) indicated yield variation among lemongrass varieties in Ethiopia. Besides, Bekele (2017) showed the importance of harvesting and drying conditions for lemongrass herbal and essential oil yield. Zawislak (2011) added the importance of agronomic practices including spacing, harvesting schedules, and harvesting time that have an effect on quantitative and qualitative herbal and essential oil yield. Furthermore, the number of planting slips per hole, pests as well as soil factors are some of the factors that affect lemongrass production.

In Ethiopia, lemongrass is one among various prioritized aromatic plants being studied nationwide. Wondo Genet Agricultural Research Center, under the administration of the Ethiopian Institute of Agricultural Research, leads the nationwide agricultural and quality research being conducted. So far, various agronomic studies conducted. However, the effect of variation in the heights of planting slips (tillers) of different lemongrass varieties remains unknown. A producer has no information height of planting slips. Therefore, the present study was conducted to assess the effect of cutting height of planting slips (tillers) on herbal and essential oil yield of two lemongrass varieties at Wondo Genet, Southern Ethiopia.

2. MATERIAL AND METHODS

The experiment was conducted at Wondo Genet Agricultural Research Center, Southern Ethiopia during the 2017 to 2019 cropping season. The experimental site was geographically located at 07° 19.1' North latitude, 38° 30’ East longitude, and an altitude of 1780m.a.s.l. The site receives mean annual rainfall of 1128 mm with minimum and maximum temperatures of 11 and 26°c, respectively. The soil texture of the testing location was sandy clay loam with a soil PH of 8.84 (Jimayu *et al*., 2016).

Disease-free uniform planting materials of two lemongrass varieties, Lomisar-I and Lomisar Java were used for the evaluation. Two lemongrass varieties and four cutting heights of planting

slips(tillers) (15cm, 20cm, 25cm, and 30cm) were factorial arranged in three replications and evaluated under two harvesting cycles.

Respective spacing of 1.5 m and 1 m was maintained between replications and plots respectively. Spacing of 60cm was used between any two rows and 60cm between two plants in a row. Five rows each having five plants were maintained in an experimental plot. No chemical and pesticide was applied during the study. Supplementary irrigation was given during the dry period. In addition, all cultural practices like weeding hoeing were conducted as needed. The first harvesting was conducted four months after planting lemongrass varieties slips (tillers) and the second harvest was conducted after the preceding harvest.

Data on plant height, number of leaves per plant, survival count, number of tillers/plant, fresh herbage yield (kg/ha), essential oil (EO) content (%), EO yield (t/ha) were recorded critically from five central plants of each plot selected randomly. EO content was determined on a fresh weight basis from 300 g composite leaves harvested from the three middle rows of a plot. Then laboratory analysis was performed at Wondo Genet Agricultural Research Center using hydro-distillation. The experimental data was statistically analyzed by analysis of variance (ANOVA) using SAS PROC GLM 18 at $P < 0.05$. Differences between means were assessed using the least significance difference (LSD) test at $P < 0.05$.

3. RESULTS AND DISCUSSION

The analysis of variance (ANOVA) showed that the main factors, variety and planting slips cutting height, and their interaction did not affect plant height, number of tillers per plant, number of leaves per hill, fresh leaf weight per hectare, essential oil content and essential oil yield ton per hectare (Table 1). However, survival count was very highly significantly ($p<0.001$) affected by lemongrass variety but not by cutting height of planting slips (Table 1). The higher survival count (19) was obtained from Lomisar-I and the lower survival count (12) from the Lomisar-Java variety (Table 2). The more survival rate of Lomisar-I lemongrass variety might be due to variation growth resource utilization such as moisture and temperature initially after planting that might be due to genotype difference between the varieties for root initiation. On the contrary, Jimayu et al. (2016) reported significant variation in the number of leaves per hill, number of tiller per hill, and herbal and essential oil yield among lemongrass varieties. These differences from the present study might be due to differences in lemongrass varieties used for the experiments.

Table 1. ANOVA of two Lemmon grass varieties evaluated for two-harvest cycle and four cutting heights of planting slips

Source	DF	PH	NOL	SUC	EOC	NOT	LFW	EOY
Rep	2	450.74^{NS}	697.00^{NS}	18.08^{NS}	0.004^{NS}	68.97^{NS}	56290763^{NS}	0.03^{NS}
CL	1	1270.93^{NS}	86739.43^{***}	00.00^{NS}	0.028^{*}	2961.54^{***}	177080360^{*}	0.25^{*}
VAR	1	29.97^{NS}	581.00^{NS}	616.33^{***}	0.006^{NS}	371.35^{NS}	35985048^{NS}	0.06^{NS}
CH	3	630.19^{NS}	1433^{NS}	22.44^{NS}	0.007^{NS}	207.99^{NS}	21793769^{NS}	0.06^{NS}
CL*VAR*CH	10	5372.60^{NS}	2855.17^{NS}	10.17^{NS}	0.004^{NS}	427.84^{NS}	23830296^{NS}	0.04^{NS}
Error	30	2947.36	4719.74	20.71	0.01	196.30	37145821	0.06
CV		36.63	39.63	29.04	25.26	32.79	35.46	25.26

NS=not significant; *, **, and *** significant at P≤0.05, P≤0.01 and P≤0.001 probability levels respectively; Rep= Replication; DF = degree of freedom; CL= Harvest cycle; VAR =Variety; CH=Cutting height of planting slips; CV= coefficient of variance; PH= Plant height(cm); NOL=Number of leaf per hill; SUC= Survival count; EOC=Essential oil content(%); NOT=Number of tillers; LFW=Fresh leaf weight (kg/ha); EOY= Essential oil yield (t/ha)

Despite plant height and survival count did not significantly influence by the harvesting cycle ($p>0.05$), the number of leaves per hill and the number of tillers per plant were very highly influenced ($p<0.001$). Fresh leaf weight per hectare, essential oil yield per hectare and essential oil content significantly affected by harvesting cycle ($p<0.01$) (Table 1). The higher significant number of leaves per hill, number of tiller per plant, and fresh leaf weight per hectare were obtained at the second harvest cycle while the higher essential oil content and essential oil yield per hectare were obtained at the first harvest cycle (Table 2). Kassahun et al. (2014) also reported the higher significant fresh leaf yield of lemongrass during the second harvest compared to the values obtained at the first harvest. The higher values obtained at the second harvest might be due to the availability of more time for the plants to have more roots that help in nutrient and moisture uptake. This might enhanced plant growth, which could resulted higher significant values of number of leaf per hill, number

of tiller per plant and leaf weight per hectare. Similarly, Bekele (2017) reported lower values of number of leaf, number of tiller and leaf yield at the first harvest time. However, the higher mean values of essential oil yield and essential oil yield per hectare were higher at first harvest that could probably be due to longer period that the leaves remain with the plants before harvest that is four months after planting, while the second harvest was done two months after the first harvest period.

Table 2. Mean performance of yield and yield components of two lemon grass varieties as affected by harvest cycle and cutting height of planting slips.

Source	PH	NOL	SUC	EOC	NOT	LFW	EOY
Lemmon Grass Varieties							
Lomisar-I	117.22[a]	134.96[a]	19.25[a]	0.33[a]	29.96[a]	7973[a]	1.01[a]
Lomisar-Java	115.64 [a]	141.92[a]	12.08[b]	0.31[a]	35.52[a]	6241[a]	0.94[a]
LSD(0.05)	NS	NS	2.68	NS	NS	NS	NS
Harvesting Cycle							
Cycle 1	111.28[a]	95.93[b]	15.67[a]	0.35[a]	24.89[b]	5186[b]	1.045[a]
Cycle 2	121.57a	180.95[a]	15.67[a]	0.30 [b]	40.60[a]	9027[a]	0.900[b]
LSD(0.05)	NS	40.50	NS	0.04	8.26	3593	0.140
Heights of planting slips (Cutting Height)							
15cm	117.29[a]	140.04[a]	15.00[a]	0.35[a]	33.03[a]	8593[a]	1.05[a]
20cm	106.21a	122.69[a]	15.83[a]	0.34[a]	31.53[a]	6456[a]	1.02[a]
30cm	119.04[a]	147.47[a]	14.33[a]	0.30[a]	38.20[a]	5579[a]	0.90[a]
40cm	123.18[a]	143.55[a]	17.50[a]	0.31[a]	28.20[a]	7800[a]	0.92[a]
LSD(0.05)	NS	NS	NS	NS	NS	NS	NS
CV	36.63	39.63	29.04	25.26	32.79	35.46	25.26
CL*VAR*CH	NS	NS	NS	NS	NS	NS	NS

NS = not significant; CV = Coefficient of variance; LSD= Least significant difference; Means followed by the same letters with in a column for a given treatment are not significantly different at p≤ 5% level of significance

4. SUMMARY AND CONCLUSION

Evaluation of crop variety with different management practices widens production options for growers. Lemongrass production in Ethiopia is not well-known due to the lack of full information with respect to agronomic practices. The present study is concerned with analyzing two different varieties for four different cutting heights of planting slips during two harvest cycles. This was assumed to verify the appropriate cutting height of planting slips for the two varieties evaluated for herbal and essential oil yield. The result of the present study showed significant variation in survival count between two-lemongrass varieties with Lomisar-I resulted in higher survival count compared to Lomisar-Java variety. Moreover, the first harvest cycle, which was done at fourth month after planting revealed a higher essential oil yield compared to the second harvest cycle, which was conducted after two months of the preceding harvest. Besides, the second harvest cycle was better in number of leaves per hill, number of tillers per plant, and fresh leaf weight. However, variation in cutting height of planting slips showed no difference in all parameters studied. Hence, this result shows, that growers have to be aware of the difference in survival count between the two-lemongrass varieties. Besides, the higher significant results of tiller number, leaf number and plant height recorded at second harvest cycle have to be seen as an indicator for higher oil yield, and for comprehensive results, this study has to be repeated at different locations and maintaining more than the interval of two months between consecutive harvests.

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