



Effect of Integrated Nutrient Management on Growth Parameters of Citronella (*Cymbopogon winterianus* Jowitt.)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The aim of the study is to identify a suitable nutrient management practice for enhancing the growth characteristics viz. plant height (cm), plant spread (cm), number of tillers per plant and number of leaves per plant of citronella. The study was carried out in Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, between 2023-2024. The experiment comprised of 10 treatments each replicated thrice was executed following the principles of Randomized Block Design. They are (T1) 100% RDF (NPK 75:40:40 kg/ha) (Basal Dose N: 25 kg/ha), (T2) 75% RDF+ Vermicompost 5 t/ha, (T3) 75% RDF+ Vermicompost 5 t/ha + Biofertilizer consortium 2 kg/ha, (T4) 75% RDF+ Vermicompost 5 t/ha + Sea weed extract 2%, (T5) 75% RDF+ Goat Manure 5 t/ha, (T6)

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75% RDF + Goat Manure 5 t/ha+ Biofertilizer consortium 2 kg/ha, (T7) 75% RDF + Goat Manure 5 t/ha + Sea weed extract 2%, (T8) 75% RDF + FYM 10 t/ha, (T9) 75% RDF + FYM 10 t/ha + Biofertilizer consortium 2 kg/ha and (T10) 75% RDF + FYM 10 t/ha + Sea weed extract 2 % . The data collected were subjected to statistical analysis. This was done by standard procedure of Panse and Sukhatme (1985) and the results were interpreted. The level of significance are used in “F” and “t” tests at P=0.05. Critical differences (CD) were worked out whenever F test was found significant. The WASP 2.0 software was used for the statistical analysis of data. The study showed significant difference in the growth, yield and quality among the different treatments. The highest plant height (cm) (128.30, 131.32 and 132.20), plant spread (cm) (109.80, 112.03 and 115.75), number of tillers per plant (43.78, 45.90 and 48.16), number of leaves per plant (208.46, 212.15 and 210.00) of citronella were recorded with the application of 75% Recommended dose of fertilizer with vermicompost 5 t/ ha and 2% foliar spray of seaweed extract improved the growth, yield and quality of citronella. The application of 75% Recommended dose of fertilizer with vermicompost 5 t/ha and 2% foliar spray of seaweed extract has been identified as the best treatment for maximizing the growth characters of citronella. Hence, could be recommended for satisfactory growth, yield and quality of citronella (*Cymbopogon winterianus* Jowitt.).

Keywords: *Citronella*; integrated nutrient management; growth; plant height; tillers.

1. INTRODUCTION

Citronella (*Cymbopogon winterianus* Jowitt. 2n=20) belongs to Poaceae family. Citronella is a robust, aromatic, evergreen, perennial, clump-forming grass with numerous erect culms arising from a short rhizome. Citronella is a tufted aromatic multi-harvest perennial herb with fibrous roots. Citronella leaves on distillation gives a yellowish-brown essential oil with citrus odour. *Cymbopogon winterianus* is originated from Sri Lanka. In India, major producing areas are the tea gardens in Assam and to a limited extent in states like Uttar Pradesh, Maharashtra, Karnataka, Gujarat, Manipur, Meghalaya, Tamil Nadu, Nagaland, Uttaranchal, Andhra Pradesh and Tripura where it is commercially cultivated and distilled for its oil [1]. The production of Java citronella much out numbers that of other essential oils. The citronella oil from Java is of exceptional grade. As a result, farmers can make a lot of money by growing citronella grass. The southern part of India contains a diverse range of soil types and agro-climatic conditions, making citronella growing a viable option [2]. Recently, several investigators reported that integrated use of chemical fertilizers with organic manure is becoming a quite promising practice not only for maintaining higher productivity but also for greater stability to crop production. In addition, INM acts as a source of energy, organic carbon, and available nitrogen for the growth of soil microbes and improvement of physical properties of soil, and also have great residual effect on subsequent crops. In India practice of integrated nutrient management is not very much popular, but now the concept has been changed radically

over the years. Integrated nutrient management takes care of physical, chemical and biological needs of the soil from the use of organic and inorganic fertilizers. It increases water holding capacity and the amount of nutrient in the soil. It is established that organic manure improves the physical and biological properties of the soil including supply of almost all the essential nutrients for growth and development of plants. Under favourable environment integrated nutrient management might have helped in the production of new tissue and development of new shoot and ultimately increased the growth, yield attributes and finally yield of the crops [3].

2. MATERIALS AND METHODS

The present study on “Effect of Integrated Nutrient Management on growth parameters of citronella (*Cymbopogon winterianus* Jowitt.)” was carried out in the farmer’s field at Anaikudam, Ariyalur district during rabi season from 17.10.2023 to 20.6.2024. The experiment comprised of 10 treatments each replicated thrice was executed following the principles of Randomized Block Design. The treatments consist of different inputs viz., 100% RDF (75:40:40 NPK kg/ha) (Basal Dose N: 25 kg/ha), 75% RDF + Vermicompost 5 t/ha, 75% RDF+ Vermicompost 5 t/ha + Biofertilizer consortium 2 kg/ha, 75% RDF+ Vermicompost 5 t/ha + Sea weed extract 2% (foliar application @ 15 days interval), 75% RDF+ Goat Manure 5 t/ha, 75% RDF + Goat Manure 5 t/ha+ Biofertilizer consortium 2 kg/ha, 75% RDF + Goat Manure 5 t/ha + Sea weed extract 2% (foliar application @ 15 days interval), 75% RDF + FYM 10 t/ha, 75%

RDF + FYM 10 t/ha + Biofertilizer consortium 2 kg/ha and 75% RDF + FYM 10 t/ha + Sea weed extract 2 % (foliar application @ 15 days interval). Inorganic fertilizers such as NPK was applied in form of urea, Single Super Phosphate and Muriate of Potash. Organic inputs such as FYM, vermicompost, goat manure and biofertilizer consortium were collected from AR Gosha Organic, Cuddalore. Inorganic fertilizers such as NPK was collected from local fertilizer store in T. Palur. Sea weed extract was bought from online store.

Observations on growth parameters were recorded at 120, 180 and 240 days after planting and totally three harvests were taken at 2 months intervals after first clipping of leaves. Forst harvest were taken after four months of planting. Observations were recorded on plant height (cm), plant spread (cm), number of tillers per plant and number of leaves per plant. The statistical analysis of data was done using Panse and Sukhatme [4]. The critical differences was worked out for 5 percent level of significance. The WASP 2.0 software was used for statistical analysis of data.

3. RESULTS AND DISCUSSION

The data on plant height (cm) were recorded at 120, 180 and 240 days after planting respectively and are presented in Table 1. The plant height (cm) of citronella was significantly influenced by the combination of organic manures, inorganic fertilizers, seaweed extract and biofertilizer consortium at different stages of crop growth.

The plants supplied with 75% RDF+ vermicompost 5 t/ha + sea weed extract 2% (T₄) recorded the highest plant height (cm) of 128.30, 131.32 and 132.20 cm at 120, 180 and 240 days after planting respectively. The least values of plant height (108.00, 110.04 and 108.69 cm) were observed in 100% RDF (75:40:40 kg/ha) (T₁) at 120, 180 and 240 days after planting respectively.

Plant height and other growth attributes were reported maximum where integration of organic manures was done with inorganic fertilizers. This might be due to fertilizer source that fulfilled the requirements at early growth stages, while organic manures facilitated crop at later stages by providing uniform and continuous supply of nutrients which has a role in cell division and other physiological processes. Similar results were observed with Elansary et al. [5], Mubarak et al. [6], Devi et al. [7] and Nandapure et al. [8] where integrated nutrient management showed significant impact on the growth of plants.

The data on the plant spread (cm) were recorded at 120, 180 and 240 days after planting respectively and are presented in Fig. 2. The treatment 75% RDF + vermicompost 5 t/ha + sea weed extract 2% (T₄) recorded the highest plant spread (cm) of 109.80, 112.03 and 115.75 cm at 120, 180 and 240 days after planting respectively. The least values of plant spread (90.89, 91.67 and 91.40 cm) were observed in 100% RDF (75:40:40 kg/ha) (T₁) at 120, 180 and 240 days after planting respectively.

Table 1. Effect of Integrated Nutrient Management on plant height (cm) of citronella (*Cymbopogon winterianus* Jowitt.)

TREATMENTS	Plant height (cm)		
	120 DAP	180 DAP	240 DAP
T ₁ - 100% RDF	108.00	110.04	108.69
T ₂ - 75% RDF + Vermicompost 5 t/ha	113.33	115.50	116.70
T ₃ - 75% RDF + Vermicompost 5 t/ha + Biofertilizer consortium 2 kg/ha	117.00	118.20	120.74
T ₄ - 75% RDF + Vermicompost 5 t/ha + Sea weed extract 2%	128.30	131.32	132.20
T ₅ - 75% RDF + Goat Manure 5 t/ha	115.67	117.30	116.00
T ₆ - 75% RDF + Goat Manure 5 t/ha + Biofertilizer consortium 2 kg/ha	118.00	119.68	120.07
T ₇ - 75% RDF + Goat Manure 5 t/ha + Sea weed extract 2%	121.33	121.01	121.30
T ₈ - 75% RDF + FYM 10 t/ha	117.33	117.05	115.80
T ₉ - 75% RDF + FYM 10 t/ha + Biofertilizer consortium 2 kg/ha	119.33	119.38	119.02
T ₁₀ - 75% RDF + FYM 10 t/ha + Sea weed extract 2%	125.00	126.00	126.10
S. Ed	2.24	2.25	2.27
CD (P=0.05)	4.71	4.73	4.78

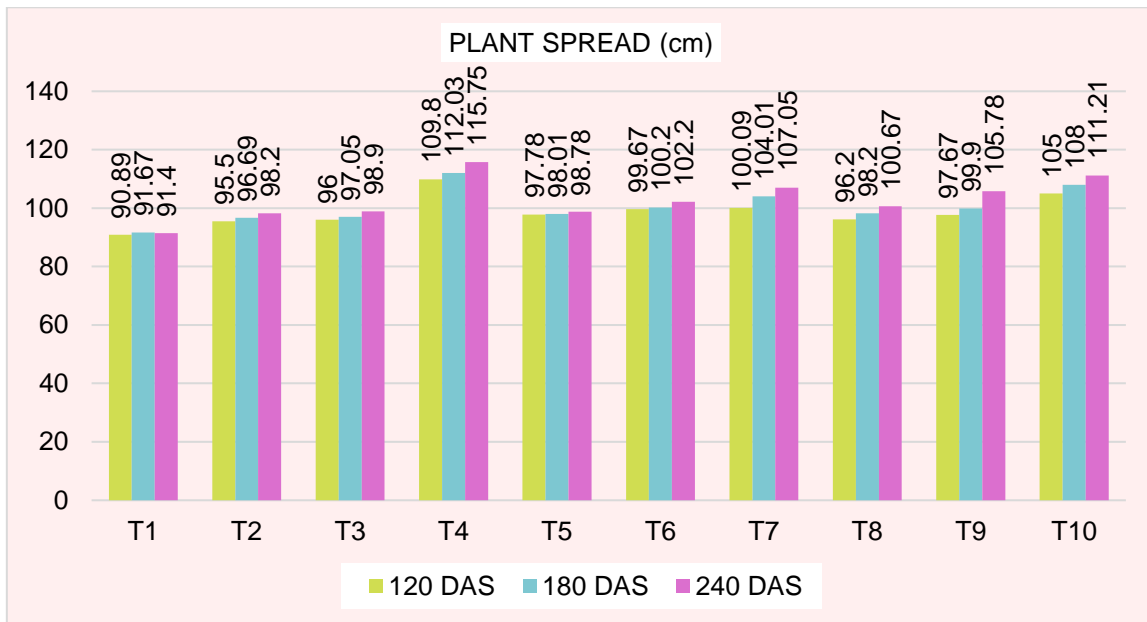


Fig. 1. Effect of Integrated Nutrient Management on plant spread (cm) of citronella (*Cymbopogon winterianus* Jowitt.)

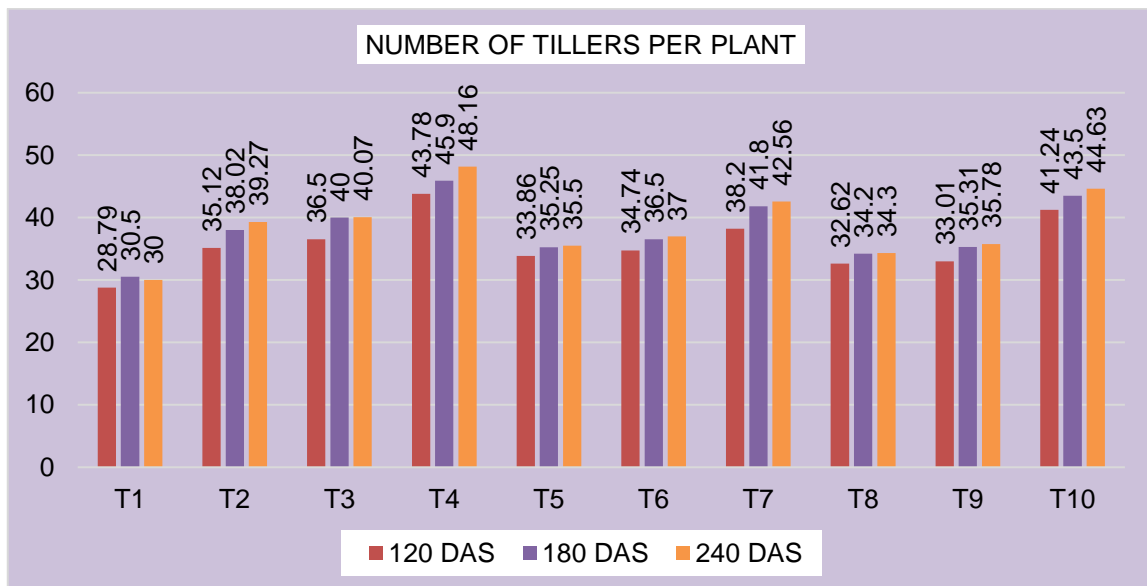


Fig. 2. Effect of Integrated Nutrient Management on number of tillers per plant of citronella (*Cymbopogon winterianus* Jowitt.)

The increased plant spread may have been caused by an improvement in morphological parameters brought on by the use of inorganic fertilizers with organic manure. Additionally using organic manures with inorganic fertilizers has a longer-lasting effect on plant species performance and improves the build-up of organic matter in soil. This has favorable effects on the ability of plants to acquire and absorb fundamental nutrients like nitrogen and

phosphorus, as well as their availability which results in better growth. The results share similarities with Sastry et al. [9], Srivastava et al. [10] in lemongrass and Devkota et al. [11] who demonstrated positive impact of nutrient application on plant spread.

The data on the number of tillers per plant were recorded at 120, 180 and 240 days after planting respectively and are presented in Table 2. The

Table 2. Effect of Integrated Nutrient Management on number of leaves per plant of citronella (*Cymbopogon winterianus* Jowitt.)

TREATMENTS	Number of leaves per plant		
	120 DAP	180 DAP	240 DAP
T ₁ - 100% RDF	165.16	166.02	163.90
T ₂ - 75% RDF + Vermicompost 5 t/ha	176.90	180.01	178.26
T ₃ - 75% RDF + Vermicompost 5 t/ha + Biofertilizer consortium 2 kg/ha	183.40	187.24	185.00
T ₄ - 75% RDF + Vermicompost 5 t/ha + Sea weed extract 2%	208.46	212.15	210.00
T ₅ - 75% RDF + Goat Manure 5 t/ha	172.53	174.68	170.21
T ₆ - 75% RDF + Goat Manure 5 t/ha + Biofertilizer consortium 2 kg/ha	180.70	182.43	180.96
T ₇ - 75% RDF + Goat Manure 5 t/ha + Sea weed extract 2%	191.20	195.89	192.62
T ₈ - 75% RDF + FYM 10 t/ha	174.62	176.09	175.71
T ₉ - 75% RDF + FYM 10 t/ha + Biofertilizer consortium 2 kg/ha	182.25	185.43	182.30
T ₁₀ - 75% RDF + FYM 10 t/ha + Sea weed extract 2%	200.06	204.25	202.42
S. Ed	3.52	3.60	3.55
CD (P=0.05)	7.40	7.56	7.46

highest number of tillers per plant was registered by 75% RDF + vermicompost 5 t/ha + sea weed extract 2% (T₄) with the values of 43.78, 45.90 and 48.16 at 120, 180 and 240 days after planting respectively. The least values of number of tillers per plant (28.79, 30.50 and 30.00) were observed in 100% RDF (75:40:40 kg/ha) (T₁) at 120, 180 and 240 days after planting respectively.

The increase in the number of tillers may be attributed to the readily available nutrients from inorganic fertilizers and increase in water holding capacity as well as soil moisture due to organic manure application. The result is similar with the findings of Sasikala et al. [12] in lemongrass and Shadap et al. [13] in ginger.

The data on the number of leaves per plant were recorded at 120, 180 and 240 days after planting respectively and are presented in Fig. 2. The plants supplied with 75% RDF+ vermicompost 5 t/ha+ sea weed extract 2% (T₄) recorded the highest number of leaves per plant of 208.46, 212.15 and 210.00 at 120, 180 and 240 days after planting, respectively. The least number of leaves per plant (165.16, 166.02 and 163.90) were observed in 100% RDF (75:40:40 kg/ha) (T₁) at 120, 180 and 240 days after planting respectively.

The improved growth might be due to better soil physical condition, prolonged

availability of macro and micronutrients to crop during entire growing season. The beneficial effect of vermicompost on these parameters might be due to its contribution in supplying additional plant nutrients and increasing availability of native soil nutrients with increased microbial activity [14]. The results also fit well with the findings of Mubarak et al. [6], and Devi et al. [7], where integrated nutrient management showed significant impact on the growth of plants.

4. CONCLUSION

Based on the above results, it can be concluded that the application of 75% Recommended dose of fertilizer with vermicompost 5 t/ha and 2% foliar spray of seaweed extract has been identified as the best treatment for maximizing the growth characters such as plant height (cm), plant spread (cm), number of tillers per plant and number of leaves per plant of citronella. Hence, could be recommended for satisfactory growth of citronella (*Cymbopogon winterianus* Jowitt.).

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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