

# Original Research Article

## Effect of Integrated Nutrient Management in Growth parameters of citronella (*Cymbopogon winterianus* Jowitt.)

### ABSTRACT

**Aims:** 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.

**Study design:** Randomized Block Design.

**Place and Duration of Study:** Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, between 2023-2024.

**Methodology:** The experiment comprised of ten treatments under three replications. They are (T<sub>1</sub>) 100% RDF (75:40:40 kg/ha) (Basal Dose N: 25 kg/ha), (T<sub>2</sub>) 75% RDF + Vermicompost 5 t/ha, (T<sub>3</sub>) 75% RDF+ Vermicompost 5 t/ha + Biofertilizer consortium 2 kg/ha, (T<sub>4</sub>) 75% RDF+ Vermicompost 5 t/ha + Sea weed extract 2%, (T<sub>5</sub>) 75% RDF+ Goat Manure 5 t/ha, (T<sub>6</sub>) 75% RDF + Goat Manure 5 t/ha+ Biofertilizer consortium 2 kg/ha, (T<sub>7</sub>) 75% RDF + Goat Manure 5 t/ha + Sea weed extract 2%, (T<sub>8</sub>) 75% RDF + FYM 10 t/ha, (T<sub>9</sub>) 75% RDF + FYM 10 t/ha + Biofertilizer consortium 2 kg/ha and (T<sub>10</sub>) 75% RDF + FYM 10 t/ha + Sea weed extract 2 % .

**Results:** 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.

**Conclusion:** 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 (Shiva *et al.*, 2002). 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 (Lal *et al.*, 2022). 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.

## 2. MATERIAL AND METHODS

The present study on "Effect of Integrated Nutrient Management on growth, yield and quality of citronella (*Cymbopogon winterianus* Jowitt.)" was carried out in the farmer's field at Anaikudam, Ariyalur district 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 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).

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. First 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 (1985). 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% (T<sub>4</sub>) 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) (T<sub>1</sub>) 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 Saha *et al.* (2005) in aloe vera and Munnu *et al.* (2011) in geranium.

The data on the plant spread (cm) were recorded at 120, 180 and 240 days after planting respectively and are presented in Table 2. The treatment 75% RDF + vermicompost 5 t/ha + sea weed extract 2% (T<sub>4</sub>) 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) (T<sub>1</sub>) at 120, 180 and 240 days after planting respectively.

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 Punam *et al.* (2012) and Sastry *et al.* (2014) 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 3. The highest number of tillers per plant was registered by 75% RDF + vermicompost 5 t/ha + sea weed extract 2% (T<sub>4</sub>) 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) (T<sub>1</sub>) 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.* (2016) in lemongrass and Shadap *et al.* (2018) 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 Table 4. The plants supplied with 75% RDF + vermicompost 5 t/ha + sea weed extract 2% (T<sub>4</sub>) 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) (T<sub>1</sub>) at 120, 180 and 240 days after planting respectively.

Tripathi *et al.* (2013) revealed that application of vermicompost along with inorganic fertilizers significantly increased the plant height, number of leaves per plant, number of tillers per plant with minimum number of days taken to maturity. The results also fit well with the findings of Mubarok *et al.* (2017), and Devi *et al.* (2018), where integrated nutrient management showed significant impact on the growth of plants.

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

**Table 2. Effect of Integrated Nutrient Management on plant spread (cm) of citronella (*Cymbopogon winterianus* Jowitt.).**

TREATMENTS	Plant spread (cm)		
	120 DAP	180 DAP	240 DAP
T <sub>1</sub> - 100% RDF	90.89	91.67	91.40
T <sub>2</sub> - 75% RDF + Vermicompost 5 t/ha	95.50	96.69	98.20
T <sub>3</sub> - 75% RDF + Vermicompost 5 t/ha + Biofertilizer consortium 2 kg/ha	96.00	97.05	98.90
T <sub>4</sub> - 75% RDF + Vermicompost 5 t/ha + Sea weed extract 2%	<b>109.80</b>	<b>112.03</b>	<b>115.75</b>
T <sub>5</sub> - 75% RDF + Goat Manure 5 t/ha	97.78	98.01	98.78
T <sub>6</sub> - 75% RDF + Goat Manure 5 t/ha + Biofertilizer consortium 2 kg/ha	99.67	100.20	102.20
T <sub>7</sub> - 75% RDF + Goat Manure 5 t/ha + Sea weed extract 2%	100.09	104.01	107.05
T <sub>8</sub> - 75% RDF + FYM 10 t/ha	96.20	98.20	100.67
T <sub>9</sub> - 75% RDF + FYM 10 t/ha + Biofertilizer consortium 2 kg/ha	97.67	99.90	105.78
T <sub>10</sub> - 75% RDF + FYM 10 t/ha + Sea weed extract 2%	105.00	108.00	111.21
<b>S. Ed</b>	<b>1.85</b>	<b>1.89</b>	<b>1.96</b>

<b>CD (P=0.05)</b>	<b>3.89</b>	<b>3.98</b>	<b>4.12</b>
--------------------	-------------	-------------	-------------

**Table 3. Effect of Integrated Nutrient Management on number of tillers per plant of citronella (*Cymbopogon winterianus* Jowitt.).**

TREATMENTS	Number of tillers per plant		
	120 DAP	180 DAP	240 DAP
T <sub>1</sub> - 100% RDF	28.79	30.50	30.00
T <sub>2</sub> - 75% RDF + Vermicompost 5 t/ha	35.12	38.02	39.27
T <sub>3</sub> - 75% RDF + Vermicompost 5 t/ha + Biofertilizer consortium 2 kg/ha	36.50	40.00	40.07
T <sub>4</sub> - 75% RDF + Vermicompost 5 t/ha + Sea weed extract 2%	<b>43.78</b>	<b>45.90</b>	<b>48.16</b>
T <sub>5</sub> - 75% RDF + Goat Manure 5 t/ha	33.86	35.25	35.50
T <sub>6</sub> - 75% RDF + Goat Manure 5 t/ha + Biofertilizer consortium 2 kg/ha	34.74	36.50	37.00
T <sub>7</sub> - 75% RDF + Goat Manure 5 t/ha + Sea weed extract 2%	38.20	41.80	42.56
T <sub>8</sub> - 75% RDF + FYM 10 t/ha	32.62	34.20	34.30
T <sub>9</sub> - 75% RDF + FYM 10 t/ha + Biofertilizer consortium 2 kg/ha	33.01	35.31	35.78
T <sub>10</sub> - 75% RDF + FYM 10 t/ha + Sea weed extract 2%	41.24	43.50	44.63
<b>S. Ed</b>	<b>0.70</b>	<b>0.76</b>	<b>0.78</b>
<b>CD (P=0.05)</b>	<b>1.48</b>	<b>1.60</b>	<b>1.63</b>

**Table 4. 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 <sub>1</sub> - 100% RDF	165.16	166.02	163.90
T <sub>2</sub> - 75% RDF + Vermicompost 5 t/ha	176.90	180.01	178.26
T <sub>3</sub> - 75% RDF + Vermicompost 5 t/ha + Biofertilizer consortium 2 kg/ha	183.40	187.24	185.00
T <sub>4</sub> - 75% RDF + Vermicompost 5 t/ha + Sea weed extract 2%	<b>208.46</b>	<b>212.15</b>	<b>210.00</b>
T <sub>5</sub> - 75% RDF + Goat Manure 5 t/ha	172.53	174.68	170.21
T <sub>6</sub> - 75% RDF + Goat Manure 5 t/ha + Biofertilizer consortium 2 kg/ha	180.70	182.43	180.96
T <sub>7</sub> - 75% RDF + Goat Manure 5 t/ha + Sea weed extract 2%	191.20	195.89	192.62
T <sub>8</sub> - 75% RDF + FYM 10 t/ha	174.62	176.09	175.71
T <sub>9</sub> - 75% RDF + FYM 10 t/ha + Biofertilizer consortium 2 kg/ha	182.25	185.43	182.30
T <sub>10</sub> - 75% RDF + FYM 10 t/ha + Sea weed extract 2%	200.06	204.25	202.42
<b>S. Ed</b>	<b>3.52</b>	<b>3.60</b>	<b>3.55</b>

#### 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

Authors(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

#### REFERENCES

1. Shiva MP, Lehn A, Shiva A. Aromatic & Medicinal Plants: Yielding Essential Oil for Pharmaceutical, Perfumery, Cosmetic Industries and Trade, International Book Distributors. 2002:110-116.
2. Lal RK, Chandan, Chanotiya Frsc S, Singh VR, Ashish Kumar. Biplot investigation for essential oil yield and chemical compositions under the deccan plateau region of southern india in cultivars of java citronella (*Cymbopogon winterianus* Jowitt). IND CROP PROD. 2022;175(12):114-249.
3. Saha R, Palit S, Ghosh BC, Mitra BN. Performance of aloe vera as influenced by organic and inorganic sources of fertilizer supplied through fertigation. Acta Hort. 2005; 676:171-175.
4. Munnu Singh. Effect of integrated nutrient management through vermicompost and inorganic fertilizers on growth, yield, nutrient uptake and oil quality of geranium (*Pelargonium graveolens* L' Her. Ex Ait.) grown on alfisol. JOSAC. 2011;20 (2): 55–59.
5. Punam P, Rameshwar Kumar, Sheetal Sharma, Atul D. The effect of organic management treatments on the productivity and quality of lemon grass (*Cymbopogon citratus*). J. Org. Syst. 2012;7(2):36-48.
6. Sastry K, Srinivas P, Vijaya Padma S, Venugopal S. Effect of different levels of fly ash and vermicompost on herb yield, oil content and oil composition of lemongrass (*Cymbopogon flexuosus* Nees). BEPLS. 2017; 6(3): 27-33.
7. Shadap Arwankie YA. Lyngdoh, Shailesh Kumar Singh. Ginger as an Alternative Medicine to Urban Population - A Review. J. Pure Appl. Microbiol. 2018; 12(2): 1027–1031.
8. Sasikala P, Rattanathorn Intarak, Vijaya Bhaskara Reddy M. Impact of vermicompost on lemon grass (*Cymbopogon flexuosus*) production and oil contents. Res. J. Pharm., Biol. Chem. Sci. 2016; 7(3):870.
9. Tripathi V, Kumar, Sanjeev, Katiyar P, Abu Nayyer Md. Integrated nutrient management in Isabgol (*Plantago ovata* Forsk.). PHC. 2013; 45(2):302-305.

10. Mubarok Syariful, Kusumiyati Kusumiyati, Iman Muhardiono, Anni Yuniarti, Santi Rosniawati, Erni Suminar. Improvement of soil chemical properties of typic hapludult after application of organic and inorganic fertilizers. JTS. 2017. 22(3):131.
11. Devi Meera RS, Spehia, Ankush Mogta, Anjali Verma. Influence of integrated nutrient management on growth and yield of cauliflower (*Brassica oleraceae*) var. *botrytis* and soil nutrient status. Int. J. Chem. Stud. 2018; 6(2): 2988-2991.
12. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research Publication. 1985: 87-89.

UNDER PEER REVIEW