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RESEARCH PAPER

# Impact of Light Intensity, Organic Fertilizer, NPK and Their Interaction on Lantana Camara L. Growth.

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**A B S T R A C T:**

*Lantana camara* L. is a species of flowering plant, very adaptable species, which can inhabit a wide variety of ecosystems and it is widely planted in the city park as a bedding plant. In most of the countries responsible for infesting many economical crops and has some toxic effect by accidental ingestion among the livestock. A study conducted in a factorial experiment with a completely randomized block design to investigate three levels of light intensity on vegetative growth and reproductive characteristics of *L. camara* including [100 % (L1; received natural sunlight), 80 % (L2; the glass house covered with one layers of tulle fabric to minimize the light intensity to 80 % and 120 % (L3; where electric light was added to make the light intensity to 120%)], two levels of organic fertilizer [OF1; control and OF2; 5 %] and three levels of chemical fertilizer; [NPK (20: 20: 20); CF1; control, F2; 0.2 and CF3; 0.3 g.ha$^{-1}$] (3×2×3) with three replications.. The results showed the best growth regrading to many vegetative properties at 100% light intensity. Organic fertilizer 5% showed best growth in most plant properties, except for leaf and shoot fresh and dry weights. Moreover, adding of 0.2-0.3 kg.ha$^{-1}$ of NPK enhanced the growth of *L. camara.* Generally, combinations among these three factors revealed significant effects on vegetative growth characteristics of *L. camara.* The combination L1OF2CF3 [L1:100 %; OF2:5 %; CF3: 0.3 g.ha$^{-1}$] detected more effects on number of branches and leaves. However, the combination L3OF1CF3 [L3:120 %; OF1:0 %; CF3: 0.3 g.ha$^{-1}$] uncovered the best effects on flowering date, stem diameter, leaves fresh and dry weights as well as shoot fresh weight indicating that combining of these three factors will increase productivity, biological yield and biological active chemicals in plant tissues of *L. camara.*

KEY WORDS: *Lantana camara* L. Growth, Light Intensity, Organic Fertilizer, NPK.
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## 1.INTRODUCTION:

*Lantana* is a genus belongs to family Verbenaceae which has about 150 species of herbs, shrubs and shrubs 0.5–2 m in tall. The genus *Lantana*, as described by Linnaeus in 1753 in Species Plantarum contains seven species, six from South America and one from Ethiopia (Munir, 1996). This plant is mostly indigenous to subtropical and tropical America, but a few taxa are native to tropical Asia and Africa (Negi et al., 2019). It is also known as Wild Sage, Surinam Tea Plant, Spanish flag and West Indian lantana. *L. camara* is a well-known traditional medicinal plant and recent scientific studies have emphasized the possible use of *L. camara* modern medicine (Sivakumar et al., 2022).

*Lantana* plant is a vigorous, low, erect or sub scandent, triangular stemmed shrub and, when green, it is covered with bristly hairs. It is also armed or covered with tiny spines. The height of the weed range from 1 to 3 m, while the width can widen to 2.5 m. Leaves on both sides are acute or subacute, crenate, ovate, scabrid serrate and rugose above, and have a heavy fragrance (Ntalo et al., 2022). Lantana plant has aromatic leaves, orange, blue, red, yellow and bright red flowers, dark blue and black fruits (drupes). The ripe fruit is benign and heavily consumed by birds and frequently eaten by humans in some countries (Lonare et al., 2012). Lantana leaves contain active compounds of flavonoids, saponins, tannins, alkaloidsessential oils, carbohydrates, proteins, glycosides, oligosaccharides, kinins, steroids, triterpenoids, and sesquiterpenes.

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Saponins, flavonoids, and essential oils have anti-inflammatory effects such as the mechanism of action of saponins which is able to interact with many lipid membranes (Apriliana et al., 2021).

*L. camara* plants do not grow well in shaded places because lantana requires a place with high light intensity. In fact, lantana plants in city parks are often planted in shaded places. Placement of lantana plants in a shaded place allowing the received light intensity will be reduced. Lantana plants placed in full intensity with reduced light intensity have different responses to the growth and flowering of the plants. Plants that are placed in shaded places tend to grow faster (etiolation) and the number of flowers decreases compared to plants in a place that are not shaded (Muthahara et al., 2018).

Studying *L. camara* production in controlled environments is necessary, regardless of the period of the year. Its propagation usually occurs by sexual reproduction, and the seeds are able to germinate at any time of the year, if there is germinate at any time of the year, if there is sufficient soil moisture and light, and ideal temperature for emergence and development of the embryo (Duggin and Gentle, 1998). However, seed germination rate in *L. camara* is considered low (4-45%) due to dormancy, low viability and meiotic instability (Sahu et al., 1998) thus justifying the vegetative propagation that can replace the sexual reproduction (Raizada and Raghubanshi, 2010). Vegetative propagation, especially cutting, is a very common practice.

The primary nutrients required by any plants for proper growth and development includes Nitrogen (N), phosphorus (P) and potassium (K). Lack of any of these nutrients during the life cycle has an adverse effect on the growth and development of plants. Chlorophyll production, and consequently photosynthesis, depend heavily on nitrogen. It also plays a critical role in vegetative growth of plants; thus, should remain available during vegetative stage. The mineral phosphorus (P) speeds up cell division and promotes blooming and root growth. The P plays a role in the storage and transfer of energy created during photosynthesis and is located in plant parts with high metabolism and rapid cell division. As a result, its absence causes plants to mature more slowly. It is possible to raise crop yield and change the C and N input from crop residues by rational or artificial fertilization. Fertilization also improves the accumulation of soil C and N by altering soil structure, soil organic C and N contents, and soil aggregation (Khalofah et al., 2022). Enzyme activation, protein synthesis, stomatal regulation, plant–water relations, and cation–anion balance in the plant are critically affected by potassium (K), this migh infleunce crop growth progression when it is deficient by distrupting the ezymatic and protein synthesis activities, deacreasing plant grwoth, leaf senescence acceleration, and even early maturity (Liu et al., 2021). High fertile soil results in optimal grwoth, therefore, K fertilizers application to soil with low amount, which is required in augmentation biomass yield (Kering et al., 2012).

This study was conducted to determine the effects of NPK combination, light intensity, organic fertilizer and their interactions on some plant growth characteristics of *Lantana,* to increase biological yeild of plant productivity and to increase the biological active chemical constituents of plant tissues.

## 2.MATERIALS AND METHODS

A study conducted under in the greenhouse condition at the Department of Biology, College of Science, Salahaddin University- Erbil, Iraq to determine the effects of light intensity, organic fertilizer and NPK at different levels on *L. camara L*. plant growth. Three levels of light intensity; 100 % (L1; received natural sunlight), 80 % (L2; the glass house covered with one layers of tulle fabric to minimize the light intensity to 80 % and 120 % (L3; where electric light was added to make the light intensity to 120%). A light meter was used for measuring the light intensity in the three parts. Two levels of organic fertilizer OF1; control and OF2; 5 % and Two levels of NPK (20; 20; 20%); CF1; control, F2; 0.2 and CF3; 0.3 $g.ha^{-1}$. The study conducted in a factorial experiment in a completely randomized block design (RCBD) of (3×2×3) with three replications. The mean comparison done using Duncan’s Multiple Range Test (DMRT).

Black plastic pots were used 25 cm diameter, 17 cm for the top and lower (bottom) base, and 30 cm high filled with hour kilograms of air-dried soil. The soil prepared by mixing the (108) Kg soil with 5% of peat moss and (108) Kg soil without peat moss, then air-dried, grinded and passed through a 2 mm sieve. The characteristics of the studied soil was [N: 42.7 ppm; P: 12.8 ppm; K: 21.4 ppm; Ca: 21.7 ppm; Fe: 3.6 %; Cu: 0.35

ppm; Cr: 78.5 ppm; Zn: 56.5 ppm; Mn: 84.5 ppm; V: 85.7 ppm; pH: 7.76 and EC 2.15 $mS.cm^{-1}$].

Lantana plants were obtained from a garden in Erbil city in October 2022 from healthy–looking plants and planted by inserting three pieces to a 4 cm deep in each pot.

The studied parameters were: plant height (cm), no. of branches, no. of leaves, relative water content, days to 50% flowering, stem diameter, root diameter, leaves fresh weight, leaves dry weight, shoots fresh weight, shoots dry weight and biological yield.

The relative water content of a leaf (RWC) was calculated from the following parameters:

$$RWC = (FW - DW) / (TW - DW) \ldots\ldots (1)$$

FW= leaf fresh weight
DW = leaf dry weight
TW = leaf target (re-saturated) weight (El Naim et al., 2015).

Biological yield was calculated according to (El Naim et al., 2015) as follow:

$$Harvest\ index = \frac{\text{Economical Yield (seed yield / plant )}}{\text{Biological Yield (shoot dry weight)}} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Statistical Analysis Package (SPSS) for Windows® (version 26) and Microsoft Excel (2019) were used to analysis of the results.

## 3.RESULTS AND DISCUSSION

### 3.1Vegetative growth:

#### 3.1.1Plant Height (cm):

Plant height data are presented in Table 1. The tallest plants 45.22 ± 3.347 cm were observed in 80% light intensity. Shaded places enhanced *Lantana* stem elongation positively (Eva and and Sitawati, 2018). However, organic and chemical fertilizers showed no significant effects on plant height, and these results may be supported the results observed by (Duggin and and Gentle, 1998). Combined treatments among light intensity, organic and chemical fertilizers showed different effects. The tallest plants were (60.66±6.385 cm) and were observed in the combined treatment (L2OF2CF3).

#### 3.1.2Number of branches/plants:

Minimum temperature and photosynthetic photons flux density were the most significant factors for growth of *Lantana camara* plant. In this study, both 100% and 80% light intensity showed more branches per plant 5.55 ± 0.413 and 5.33 ± 0.517 respectively (Table 1). In a study of (Mastsoukis and Chronopoulou-Sereli, 2003), found that there were an inverse relation between both light intensity and plant growth parameters, while others recorded that 75% and 100% light intensity could yield more branches than 50 %, (Eva and and Sitawati, 2018). Organic fertilizer 5% showed a greater number of branches per plant 5.40 ± 0.393. Moreover, 0.2 $kg.ha^{-1}$ of chemical fertilizer has shown the greatest branch number per plant 5.27 ± 0.510. Significant differences among the combined treatments were observed, and the combination L2OF2CF2 revealed the greatest branch number per plant (7.33±1.452).

#### 3.1.3Number of leaves per plant:

Organic fertilizer 5% has shown the greater number of leaves 90.29 ± 5.655 (Table 1). However, light intensity and chemical fertilizer have shown no significant effects on number of leaves. The combination L1OF2CF3 has shown the greater number of leaves per plant 123.00±34.770.

#### 3.1.4Relative water content:

Highest relative water content was 0.4967 ± 0.023 observed due to the combined treatment L3OF2CF2 and the lowest relative water content was 0.2867±0.014 observed in the combined treatment L2OF1CF2 (Table 1).

**Table (1):** Effect of Light intensity, Organic fertilizer, chemical fertilizer and their interaction on plant height, number of branches and leaves and leaves relative water content of *L. camara* plant.

| Factors and their levels | | Plant height (cm) | No. of Branches | No. of Leaves | Relative water content |
|---|---|---|---|---|---|
| **Light Intensity** | **L1** | 34.72± 1.544[b] | 5.55±0.413[a] | 84.05±8.698[a] | 0.3867±0.019[a] |
| | **L2** | 45.22±3.347[a] | 5.33±0.517[a] | 75.72±6.370[a] | 0.3844±0.031[a] |
| | **L3** | 40.55±2.174[ab] | 3.72±0.359[b] | 71.83±6.350[a] | 0.4039±0.024[a] |
| **Organic Fertilizer** | **OF1** | 38.70±2.065[a] | 4.33±0.350[b] | 64.11±5.008[b] | 0.3715±0.021[a] |
| | **OF2** | 41.62±2.229[a] | 5.40±0.393[a] | 90.29±5.655[a] | 0.4119±0.018[a] |
| **Chemical Fertilizer** | **CF1** | 36.94±2.239[a] | 4.33±0.442[a] | 65.55±6.211[a] | 0.4122±0.020[a] |
| | **CF2** | 42.16±2.573[a] | 5.27±0.510[a] | 82.55±6.413[a] | 0.3817±0.028[a] |
| | **CF3** | 41.38±3.000[a] | 5.00±0.450[a] | 83.50±8.333[a] | 0.3811±0.026[a] |

| | | | | |
|---|---|---|---|---|
| **L1OF1CF1** | 36.66±6.119$^{bcd}$ | 3.67±0.333$^{ab}$ | 59.66±4.484$^{cd}$ | 0.4233±0.068$^{ab}$ |
| **L1OF1CF2** | 30.33±2.905$^{d}$ | 5.00±0.577$^{ab}$ | 56.66±3.527$^{cd}$ | 0.4033±0.069$^{ab}$ |
| **L1OF1CF3** | 30.66±2.962$^{d}$ | 5.33±0.333$^{ab}$ | 55.33±4.702$^{cd}$ | 0.3967±0.061$^{ab}$ |
| **L1OF2CF1** | 36.00±4.041$^{bcd}$ | 6.33±1.201$^{ab}$ | 92.66±1.855$^{abc}$ | 0.3800±0.040$^{ab}$ |
| **L1OF2CF2** | 38.33±2.848$^{bcd}$ | 6.00±1.527$^{ab}$ | 117.00±13.000$^{ab}$ | 0.3567±0.026$^{ab}$ |
| **L1OF2CF3** | 36.33±3.756$^{bcd}$ | **7.00±1.000$^{a}$** | **123.00±34.770$^{a}$** | 0.3600±0.035$^{ab}$ |
| **L2OF1CF1** | 48.00±7.505$^{abcd}$ | 4.67±1.452$^{ab}$ | 58.66±13.872$^{cd}$ | 0.4300±0.077$^{ab}$ |
| **L2OF1CF2** | 41.66±8.666$^{bcd}$ | 6.00±1.000$^{ab}$ | 91.66±15.898$^{abc}$ | 0.2867±0.014$^{b}$ |
| **L2OF1CF3** | 34.66±7.881$^{bcd}$ | 5.00±1.527$^{ab}$ | 63.00±26.210$^{cd}$ | 0.3033±0.092$^{ab}$ |
| **L2OF2CF1** | 37.00±5.000$^{bcd}$ | 4.33±0.881$^{ab}$ | 74.33±20.019$^{abcd}$ | 0.3667±0.049$^{ab}$ |
| **L2OF2CF2** | 49.33±9.207$^{abc}$ | **7.33±1.452$^{a}$** | 85.00±7.234$^{abcd}$ | 0.4767±0.081$^{ab}$ |
| **L2OF2CF3** | **60.66±6.385$^{a}$** | 4.67±1.452$^{ab}$ | 81.66±8.333$^{abcd}$ | 0.4433±0.104$^{ab}$ |
| **L3OF1CF1** | 32.66±3.527$^{bcd}$ | 2.67±1.201$^{b}$ | 37.00 ±11.789$^{d}$ | 0.4100±0.055$^{ab}$ |
| **L3OF1CF2** | 44.00±3.785$^{abcd}$ | 3.67±1.201$^{ab}$ | 71.66±21.880$^{abcd}$ | 0.2700±0.078$^{b}$ |
| **L3OF1CF3** | 49.66±2.603$^{ab}$ | 3.00±0.577$^{b}$ | 83.33±8.838$^{abcd}$ | 0.4200±0.025$^{ab}$ |
| **L3OF2CF1** | 31.33±4.666$^{cd}$ | 4.33±0.666$^{ab}$ | 71.00±18.502$^{bcd}$ | 0.4633±0.008$^{ab}$ |
| **L3OF2CF2** | 49.33±4.0551$^{abc}$ | 3.67±0.881$^{ab}$ | 73.33±7.623$^{abcd}$ | **0.4967±0.023$^{a}$** |
| **L3OF2CF3** | 36.33±0.881$^{bcd}$ | 5.00±0.577$^{ab}$ | 94.66±5.044$^{abc}$ | 0.3633±0.057$^{ab}$ |

### 3.1.5Stem diameter:

Light intensity, organic and chemical fertilizers have shown no significant effects on stem diameters (Table 2). However, wider stems were observed in the combined treatment L1OF1CF3 with mean value of 7.366 ± 0.088 mm.

### 3.1.6Root diameter:

Highest root diameters were observed in the treated pots with: 100 % light intensity with value of 0.0594 ± 0.003 mm, 0 % organic fertilizer with value of 0.0571 ± 0.002 mm and 0.3 kg.ha$^{-1}$ chemical fertilizer with value of 0.0605 ± 0.003 mm (Table 2). The combined treatment L2OF1CF2 has shown the greatest root diameters of 0.0803 ± 0.002 mm.

### 3.1.7Leaves fresh weight:

Light intensity and organic fertilizer have shown no significant effects on leaves fresh weight. While 0.2 kg.ha$^{-1}$ of chemical fertilizer has shown the greatest fresh weight of leaves with value of 24.39 ± 1.887 mg (Table 3). The combination effect of L3OF1CF3 has shown the greatest leaves fresh weight with value of 29.39 ± 4.990 mg.

### 3.1.8Leaves dry weight:

Light intensity and organic fertilizer have shown no significant effects on leaves fresh weight, whereas, 0.3 kg.ha$^{-1}$ of organic fertilizer has shown the greatest dry weight of leaves with value of 8.457±0.949 mg (Table 5). However, the combined treatment L3OF1CF3 has shown the greatest dry weight of leaves (11.25±3.125 mg).

### 3.1.9Shoots fresh weight:

Generally, light intensity, organic and chemical fertilizers as well as the combination comparisons haven't shown any significant effects on shoots fresh weight (Table 3).

### 3.1.10Shoots dry weight:

The chemical fertilizer 0.2 kg.ha$^{-1}$ has shown the greatest shoot dry weight 13.442 ± 1.027 mg (Table 3). The combined treatment L1OF1CF2 has shown the greatest shoot dry weight 15.403 ± 5.930 mg. A significant increase was recorded in biomass when chemical fertilization alone was used and compared with the control, and this significant influence of nutrient addition alone may be elucidated by the ability of *L. camara* to render subsoil nutrients inaccessible and this might be attributed to the relatively shallow root system of *L. camara*. Therefore, an increase in surface nutrients should disrupt competitive interactions. This effect is dependent on the rooting features of nearby species and potential root changes: shoot ratios (Gentle and and Duggin, 1997).

### 3.1.11Biological yield:

The light intensity of 100 %, organic fertilizer 0 % and the chemical fertilizer 0.2 kg.ha$^{-1}$ have shown the greatest biological yield with values of 90.48 ± 8.133, 86.10 ± 6.314 and 92.31 ± 6.594 respectively (Table 3). The combined treatment L1OF1CF2 has shown the greatest biological yield 140.47 ± 15.522. A higher rate of organic and chemical fertilizers may result in a slower rate of cell division, which inhibits vegetative development and encourages the plant to enter the generative phase, when flowers and seeds are formed.

**Table (2):** Effect of Light intensity, Organic fertilizer, chemical fertilizer and their interaction on days to 50 % flowering, stem and root diameters of *L. camara* plant.

| Factors and their levels | | Stem diameter (mm) | Root diameter (mm) |
|---|---|---|---|
| **Light Intensity** | **L1** | 6.269±0.248$^{a}$ | 0.0594±0.003$^{a}$ |
| | **L2** | 6.594±0.280$^{a}$ | 0.0527±0.003$^{b}$ |
| | **L3** | 6.063±0.253$^{a}$ | 0.0479±0.002$^{c}$ |
| **Organic Fertilizer** | **OF1** | 6.240±0.253$^{a}$ | 0.0571±0.002$^{a}$ |
| | **OF2** | 6.377±0.167$^{a}$ | 0.0495±0.001$^{b}$ |
| **Chemical Fertilizer** | **CF1** | 5.847±0.217$^{a}$ | 0.0476±0.002$^{c}$ |
| | **CF2** | 6.4944±0.242$^{a}$ | 0.0519±0.003$^{b}$ |
| | **CF3** | 6.586±0.295$^{a}$ | 0.0605±0.003$^{a}$ |
| **L1OF1CF1** | | 5.433±0.284$^{ab}$ | 0.0590±0.002$^{cd}$ |
| **L1OF1CF2** | | 5.716±0.608$^{ab}$ | 0.0520±0.001$^{ef}$ |
| **L1OF1CF3** | | **7.366±0.088**$^{a}$ | **0.0800±0.001**$^{a}$ |
| **L1OF2CF1** | | 5.866±0.176$^{ab}$ | 0.0453±0.002$^{gh}$ |
| **L1OF2CF2** | | 6.400±0.832$^{ab}$ | 0.0470±0.001$^{fg}$ |
| **L1OF2CF3** | | 6.833±0.783$^{ab}$ | 0.0730±0.001$^{b}$ |
| **L2OF1CF1** | | 6.583±0.906$^{ab}$ | 0.0350±0.000$^{k}$ |
| **L2OF1CF2** | | 6.966±0.683$^{ab}$ | **0.0803±0.002**$^{a}$ |
| **L2OF1CF3** | | 5.700±1.307$^{ab}$ | 0.0513±0.000$^{ef}$ |
| **L2OF2CF1** | | 6.633±0.272$^{ab}$ | 0.0523±0.002$^{ef}$ |
| **L2OF2CF2** | | 6.800±0.076$^{ab}$ | 0.0523±0.002$^{ef}$ |
| **L2OF2CF3** | | 6.883±0.623$^{ab}$ | 0.0447±0.001$^{ghi}$ |
| **L3OF1CF1** | | 4.933±0.240$^{b}$ | 0.0553±0.000$^{de}$ |
| **L3OF1CF2** | | 6.283±0.945$^{ab}$ | 0.0403±0.000$^{hij}$ |
| **L3OF1CF3** | | **7.183±0.484**$^{a}$ | 0.0610±0.001$^{c}$ |
| **L3OF2CF1** | | 5.633±0.480$^{ab}$ | 0.0383±0.000$^{jk}$ |
| **L3OF2CF2** | | 6.800±0.200$^{ab}$ | 0.0397±0.002$^{ijk}$ |
| **L3OF2CF3** | | 5.550±0.150$^{ab}$ | 0.0530±0.002$^{e}$ |

**Table (3):** Effect of Light intensity, Organic fertilizer, chemical fertilizer and their interaction on leaves fresh and dry weights, shoots fresh and dry weights and biological yield.

| Factors and their levels | | Leaves fresh weight (g) | Leaves dry weight (g) | Shoots fresh weight (g) | Shoots dry weight (g) | Biological Yield (%) |
|---|---|---|---|---|---|---|
| **Light Intensity** | **L1** | 23.55±2.109$^{a}$ | 7.893±0.912$^{a}$ | 41.18±3.773$^{a}$ | 12.304±1.511$^{a}$ | 90.48±8.133$^{a}$ |
| | **L2** | 20.65±2.077$^{a}$ | 7.082±0.644$^{a}$ | 39.03±3.670$^{a}$ | 11.540±0.867$^{a}$ | 70.23±5.494$^{b}$ |
| | **L3** | 18.22±1.957$^{a}$ | 6.256±0.868$^{a}$ | 35.53±3.920$^{a}$ | 9.618±1.375$^{a}$ | 73.02±4.399$^{b}$ |
| **Organic Fertilizer** | **OF1** | 20.93±1.936$^{a}$ | 7.478±0.806$^{a}$ | 40.21±3.715$^{a}$ | 11.694±1.283$^{a}$ | 86.10±6.314$^{a}$ |
| | **OF2** | 20.68±1.450$^{a}$ | 6.675±0.494$^{a}$ | 37.01±2.190$^{a}$ | 10.613±0.759$^{a}$ | 69.60±3.388$^{b}$ |
| **Chemical Fertilizer** | **CF1** | 14.53±1.384$^{b}$ | 4.890±0.496$^{b}$ | 34.50±3.755$^{a}$ | 7.659±0.726$^{b}$ | 59.60±4.022$^{b}$ |
| | **CF2** | 24.39±1.887$^{a}$ | 7.885±0.708$^{a}$ | 40.31±2.338$^{a}$ | 13.442±1.027$^{a}$ | 92.31±6.594$^{a}$ |
| | **CF3** | 23.50±2.111$^{a}$ | 8.457±0.949$^{a}$ | 41.25±4.880$^{a}$ | 12.361±1.567$^{a}$ | 82.35±6.270$^{a}$ |
| **L1OF1CF1** | | 15.60±2.139$^{abcd}$ | 5.426±0.75$^{abc}$ | 39.90±18.69$^{a}$ | 8.000±1.41$^{ab}$ | 45.94±4.749$^{f}$ |
| **L1OF1CF2** | | 28.38±9.598$^{abc}$ | 9.746±3.955$^{ab}$ | 40.32±3.350$^{a}$ | **15.403±5.930**$^{a}$ | **140.47±15.522**$^{a}$ |
| **L1OF1CF3** | | 26.13±5.772$^{abc}$ | 8.533±3.57$^{abc}$ | 50.56±10.07$^{a}$ | 14.21±6.243$^{ab}$ | 117.37±7.485$^{ab}$ |
| **L1OF2CF1** | | 18.23±3.368$^{abcd}$ | 5.770±1.43$^{abc}$ | 30.67±6.017$^{a}$ | 9.290±2.476$^{ab}$ | 75.54±5.887$^{cdef}$ |
| **L1OF2CF2** | | 24.13±2.336$^{abc}$ | 7.906±0.84$^{abc}$ | 42.78±6.328$^{a}$ | 12.566±1.723$^{ab}$ | 94.46±4.708$^{bc}$ |
| **L1OF2CF3** | | 28.82±2.290$^{ab}$ | 9.980±1.140$^{ab}$ | 42.84±9.209$^{a}$ | 14.356±2.947$^{ab}$ | 69.13±6.819$^{cdef}$ |
| **L2OF1CF1** | | 13.12±3.699$^{cd}$ | 3.943±1.152$^{bc}$ | 35.14±12.74$^{a}$ | 8.7100±1.096$^{ab}$ | 47.27±4.526$^{f}$ |
| **L2OF1CF2** | | 22.38±5.844$^{abcd}$ | 7.013±2.20$^{abc}$ | 42.74±9.216$^{a}$ | 13.200±0.94 $^{ab}$ | 87.91±9.191$^{cd}$ |
| **L2OF1CF3** | | 19.39±8.145$^{abcd}$ | 8.860±2.071$^{ab}$ | 37.02±15.43$^{a}$ | 12.383±4.669$^{ab}$ | 94.14±7.429$^{bc}$ |
| **L2OF2CF1** | | 17.87±5.059$^{abcd}$ | 7.446±0.24$^{abc}$ | 39.05±4.205$^{a}$ | 10.033±0.948$^{ab}$ | 47.05±4.623$^{f}$ |
| **L2OF2CF2** | | 27.68±3.507$^{abc}$ | 7.190±0.93$^{abc}$ | 46.66±7.191$^{a}$ | 12.580±0.266$^{ab}$ | 84.65±14.36$^{cd}$ |
| **L2OF2CF3** | | 23.48±2.204$^{abcd}$ | 8.040±1.65$^{abc}$ | 33.57±8.465$^{a}$ | 12.333±2.401$^{ab}$ | 60.35±4.934$^{def}$ |
| **L3OF1CF1** | | 13.92±2.937$^{bcd}$ | 4.236±1.107$^{bc}$ | 29.81±7.961$^{a}$ | 6.0933±1.735$^{ab}$ | 69.97±13.91$^{cdef}$ |
| **L3OF1CF2** | | 20.12±3.501$^{abcd}$ | 8.296±0.63$^{abc}$ | 34.16±4.289$^{a}$ | 14.560±3.105$^{ab}$ | 81.34±3.886$^{cde}$ |
| **L3OF1CF3** | | **29.39±4.990**$^{a}$ | **11.25±3.125**$^{a}$ | 52.23±19.12$^{a}$ | 12.693±6.090$^{ab}$ | 90.42±16.26$^{bc}$ |
| **L3OF2CF1** | | 8.470±1.156$^{d}$ | 2.516±0.217$^{c}$ | 32.42±6.674$^{a}$ | 3.830±0.587$^{b}$ | 71.81±5.389$^{cdef}$ |
| **L3OF2CF2** | | 23.66±0.746$^{abc}$ | 7.156±0.61$^{abc}$ | 35.21±3.801$^{a}$ | 12.343±1.082$^{ab}$ | 65.02±3.891$^{cdef}$ |
| **L3OF2CF3** | | 13.79±1.465$^{bcd}$ | 4.076±0.540$^{bc}$ | 26.31±0.005$^{a}$ | 8.190±0.743$^{ab}$ | 52.81±0.810$^{ef}$ |

## 4.CONCLUSIONS

This study concluded that light intensity, NPK combination, and their combinations have significant effects on vegetative growth characteristics of *L. camara* indicating that the use of combinations among light intensity, organic fertilizer and NPK fertilizer will increase the biological yield, plant productivity.

## References

APRILIANA, R., ALDI, Y. & OKTAVIA, S. 2021. EFFECTS OF ANTI-INFLAMMATORY AND ANTIOXIDANT ACTIVITIES OF LANTANA (Lantana Camara L). *International Journal of Pharmaceutical Sciences and Medicine,* 6**,** 144-151.

DUGGIN, J. & GENTLE, C. 1998. Experimental evidence on the importance of disturbance intensity for invasion of Lantana camara L. in dry rainforest–open forest ecotones in north-eastern NSW, Australia. *Forest Ecology and Management,* 109**,** 279-292.

EL NAIM, A., ABDALLA, A., AHMED, M. & TAHA, M. 2015. Biological Yield and Harvest Index of Faba Bean (Vicia faba L.) as Affected by Different Agro-ecological Environments. *World Journal of Agricultural Research, 2015, Vol. 3, No. 2, 78-82,* 3**,** 78-82.

EVA, M. & AND SITAWATI, S. 2018. The Effect of Light Intensity and Paclobutrazol on Flowering of Lantana Plants (Lantana Camara L.). *Russian Journal of Agricultural and Socio-Economic Sciences,* 80**,** 447-451.

GENTLE, C. B. & AND DUGGIN, J. A. 1997. Lantana camara L. invasions in dry rainforest - open forest ecotones: The role of disturbances associated with fire and cattle grazing. *Aiismiliaii Journal of Ecology,* 22**,** 298-306.

KERING, M. K., BUTLER, T. J., BIERMACHER, J. T., MOSALI, J. & GURETZKY, J. A. 2012. Effect of Potassium and Nitrogen Fertilizer on Switchgrass Productivity and Nutrient Removal Rates under Two Harvest Systems on a Low Potassium Soil. *BioEnergy Research,* 6**,** 329-335.

KHALOFAH, A., GHRAMH, H. A., AL-QTHANIN, R. N. & L'TAIEF, B. 2022. The impact of NPK fertilizer on growth and nutrient accumulation in juniper (Juniperus procera) trees grown on fire-damaged and intact soils. *PLoS One,* 17**,** e0262685.

LIU, J., HU, T., FENG, P., YAO, D., GAO, F. & HONG, X. 2021. Effect of potassium fertilization during fruit development on tomato quality, potassium uptake, water and potassium use efficiency under deficit irrigation regime. *Agricultural Water Management,* 250**,** 106831.

LONARE, M., SHARMA, M., HAJARE, S. W. & BOREKAR, V. I. 2012. LANTANA CAMARA: OVERVIEW ON TOXIC TO POTENT MEDICINAL PROPERTIES. *International Journal of pharmaceutical Sciences and research,* 3**,** 3031-3035.

MASTSOUKIS, A., AND & CHRONOPOULOU-SERELI, A. G. 2003. Growth and Flowering of *Lantana camara L.* subsp. camara as Affected by Triapenthenol and Environmental Factors. *HortScience,* 38**,** 173-175.

MUNIR, A. A. 1996. A taxonomic review of Lantana camara L. and L. montevidensis (Spreng.) Briq.(Verbenaceae) in Australia. *Journal of the Adelaide Botanic Garden***,** 1-27.

MUTHAHARA, E., SITAWATI & SURYANTO, A. 2018. The Effect of Light Intensity and Paclobutrazol on Flowering of Lantana Plants (Lantana Camara L.). *Russian Journal of Agricultural and Socio-Economic Sciences,* 80**,** 447-451.

NEGI, G. C. S., SHARMA, S., VISHVAKARMA, S. C. R., SAMANT, S. S., MAIKHURI, R. K., PRASAD, R. C. & PALNI, L. M. S. 2019. Ecology and Use of Lantana camara in India. *The Botanical Review,* 85**,** 109-130.

NTALO, M., RAVHUHALI, K. E., MOYO, B., HAWU, O. & MSIZA, N. H. 2022. Lantana camara: Poisonous Species and a Potential Browse Species for Goats in Southern Africa—A Review. *Sustainability,* 14**,** 751.

RAIZADA, P. & RAGHUBANSHI, A. S. 2010. Seed germination behaviour of Lantana camara in response to smoke. *Tropical Ecology,* 51**,** 347-352.

SAHU, S., PANDA, S., SADAFULE, D., KUMBHAR, C., KULKARNI, S. & THAKUR, J. 1998. Thermal and photodegradation of glycidyl azide polymers. *Polymer degradation and stability,* 62**,** 495-500.

SIVAKUMAR, B., VIVEK GOWDA, V. A., BEERAPPA, D., C. Y & NITHIN, K. P. 2022. A review on medicinal properties of lantana camara linn.