THE POTENTIALS OF SUPER GRO BIO-FERTILIZER ON POD GROWTH RATE (PGR), PARTITIONING COEFFICIENT AND DRY MATTER YIELD OF THREE OKRA VARIETIES UNDER DIFFERENT LEVELS OF LIGHT INTENSITIES

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Abstract
The study was conceptualized to evaluate three Okra varieties under different levels of light intensities. Thirty six (36) Plastic buckets of 7 liter capacity were perforated at the bottom and were filled with top soil. The experiment was a 3x4 factorial combination where okra plant was subjected to four (4) different levels of light intensities; (L0: control at 100% light intensity, L1: at 30% light reduction, L2: at 50% light reduction and L3: at 70%, light reduction) while 3 okra varieties examined were Clemson spineless,(a day neutral plant),' 'NH47-4'(a short-day plant) and Dogo, (a long day plant and an indigenous variety). There were 12 treatments fitted into a randomized complete block design and replicated three times. The Pod growth rate and partitioning coefficient was estimated throughout the entire crop duration. It is however concluded that optimal performance of okra all the year round could be enhanced with low light intensity (L3). Low light intensity (70% light reduction) increased the growth parameters of the three tested okra varieties but delayed flowering. High light intensity (L0) though enhanced leaf area formation and early flowering, but hastened leaf senescence and abscission. The trend was such that the higher the light intensity, the shorter the number of days required for flowering and vice-versa. As the level of light reduction increased, the growth and yield of the okra plants decreased. However, even under the highest light reduction level (L3), the application of the super Gro bio fertilizer still positively influenced the growth and yield parameters of the plants. This is due to the fact that under shading light conditions, photosynthesis actively deteriorated and carbohydrate production was therefore inadequate and this adversely affected dry matter yield of crops. The plants growth, the length of active life and energy derived from photosynthesis depended on the amount of light it received. The use of super Gro can be beneficial for farmers and gardeners, as it can positively impact crop productivity. Additionally, the study demonstrated the importance of selecting suitable okra varieties. Among the three okra varieties, Clemson spineless proved to be the most advantageous in terms of overall performance under low light intensity (L3). Further research could be conducted to explore the specific mechanisms through which the bio fertilizer enhances plant growth and yield, as well as to investigate its effects on other crop varieties and under different growing conditions.

Key words: Super Gro, Okra Varieties, Light Intensities, Pod Growth Rate, Partitioning Coefficient, Dry Matter Yield

Introduction

Plant has adaptations to help them survive in different areas. Adaptations are special features that allow a plant or animal to live in a particular place or habitat (Belkov et al, 2019). These adaptations might make it very difficult for the plant to survive in a different place. This explains why certain plants are found in one area, but not in another. Essentially, all stages of okra growth are affected by different light intensities (Ballaré and Pierik, 2017). It is one of the most critical factors of the environment that exerts a profound influence on all physiological activities via the control of the rate of chemical reaction, rate of leaf appearance, branching, plant height and duration of the vegetative growth period (Ballaré and Pierik, 2017). Okra is cultivated for its fibrous fruits or pods and the fruits are harvested when immature and eaten as a vegetable. They are a good source of carbohydrate, protein, fats, vitamins and minerals (Akintoye et al., 2011). In 2020, approximately 10 million tons of okra pods were produced globally, with Nigeria accounting for approximately 1.82 million tons (about 20%) of global okra pod production (FAOSTAT, 2020; Edafeadhe and Uguru, 2020). Okra pods and leaves have numerous nutritional and pharmaceutical benefits due to their high concentrations of essential vitamins and antioxidants (Zaharuddin et al., 2014; Oghenerukewve and Uguru, 2018; Liu et al., 2019). As a result, they're used to treat conditions like diarrhea, acute inflammation, gonorrhea and dysuria, diabetes, dental problems, bronchitis, and pneumonia, among other things (Oghenerukewve and Uguru, 2018). However, despite the nutritional values of okra and its geographical distribution, as well as adaptability to varying climatic conditions, the yield of okra is still very low. This was attributed to continuous decline in soil fertility, especially in the tropics, and unstable climatic conditions. Normally, okra, being a tropical plant, grows well under warm conditions with sufficient moisture levels and light intensities (Ajimi et al 2018). With the recent change in climate and the problem of soil fertility, the yield of okra has been reduced. Unfavorable climatic conditions such as drought, edaphic factors, excess or low light intensity can damage the quality and reduce the yield (Ajimi et al 2018). Light is an absolute requirement for plant growth and development, next to water. This is because an increase in the light intensity will result to an increase in the rate of photosynthesis. Light modifies the anatomy and physiology of leaf (Ajimi et al 2018). It is reported that plants grown under high light intensity are capable of stronger photosynthesis than those grown under weaker light (Ballaré and Pierik, 2017). Leaves formed in shade are also thinner than those formed under sun or high light intensity. Meanwhile, different plants have optimum light requirements for optimum performance and both low and high/excessive light intensities are injurious to plant growth (Fan et al 2018). When in excess, light inhibits stem growth due to its effect on gibberellins while deficit in light intensities tends to reduce plant growth, development and yield (Ajimi et al 2018). This is because low amount of solar energy is said to reduce the rate of photosynthesis and below a certain/minimum light intensity, the plant growth will fall below what is called the 'compensation point' (Fan et al 2018). Optimum light requirement by a particular crop must therefore be determined. However, with the optimum light intensity, crop performance can also be limited by inadequate availability of essential nutrients in the soil (Liu et al 2019). Super Gro is 100% new generation organic liquid fertilizer that is made from poultry droppings, sea bird guano and organic matter with absolutely no chemicals was added to it for the improvement of agricultural development (Nwanze and Uguru, 2020). It is 100% safe to use on any vegetables and of course the rest of your garden. Super Gro can be applied to any plant, tree, vegetable and even grass that required fertilization (Ijabo et al., 2019). Super Gro assists more water to reach the roots of the plant and stays there, optimizing plant growth in less time. It's a source of fertilizer to protect and for healthy growth of Agricultural and farm products (Ijabo et al., 2019). It's also a naturally wetting agents, penetrable, spreader and sticker that have no chemical. It increases the production of food and cash crops. The application of Super Gro to the soil will improve soil fertility, crop productivity, and crop engineering qualities (Ijabo et al., 2019; Nwanze and Uguru, 2020; Bratte and Uguru, 2021). Organic liquid bio-fertilizer such as Super Gro is most widely used soil amendments and pre-harvest treatment therapies, improves soil pH, fertility, and structure, hence improving crop productivity and biochemical characteristics (Eboibi et al., 2018).

Materials and methods

Experimental location

The experiment was conducted in the screen house of the Department of Crop, Soil and Pest Management, Federal University of Technology Akure, located in the rain forest area of South Western Nigeria between February and April, 2018. Temperature and relative humidity fluctuated between 25-31¬oC and 28-350C respectively, during the period of the experiment.

Planting materials

Seeds of three Okra varieties were obtained from the Agricultural Seed Processing Unit, Ministry of Agriculture, Ado-Ekiti while Super Gro were procured from registered agro inputs shop at Neo-Life selling outlet in Ado-Ekiti.

Treatments and experimental design

Thirty Six (36) plastic buckets of 7 liter capacity were perforated at the bottom and were filled with top soil. The experiment was a 3x4 factorial combination where three (3) okra plant were subjected to four (4) different light intensities (L0: control at 100% light intensity, L1: at 30% light reduction, L2: at 50% light reduction and L3: at 70%, light reduction). The two major cultivated okra species in Nigeria were considered due to their affinity for light for growth and development. There were 12 treatment fitted into a randomized complete block design and replicated three times. Clemson spines are a day-neutral plant while NH47-4is a short-day plant. The indigenous variety (Dogo) is a long-day plant. (Sathish Kumar et al., 2013). The plastic containers were watered to field capacity while planting was done after a week. The light intensity was reduced with the use of net wire mesh of 0.5 mm, one layer is 30% reduction (L1), two layers (40%) reduction (L2) and three layers (70%) reduction (L3) respectively, while no light reduction (L0) served as control. Light meter model SQ-500 Full Spectrum Quantum Meter was used to determine the intensity of the light for the three tested okra varieties. Super Gro treatment was applied to the tested okra varieties by foliar application method by spraying 200mls of the solution to 250 liters of water per hectare (Eboibi et al., 2018). Soil samples were randomly taken at 0-30cm depth using soil auger before land preparation and analyzed for physical and chemical properties in the laboratory Standard procedure. Weeding was carried out manually at two weeks interval after planting to circumvent competition between the plant and weeds for sunlight, space, nutrients and air in the greenhouse which was geared towards obtaining optimum growth and yield.

Data collection

Two weeks after planting, data on growth parameters were collected while data on yield and yield characters were collected at the end of the experiment. The following data were monitored throughout the crop growth stage of study.

Days to emergence: This was estimated by measuring the number of days from the date the seeds were sown to the emergence of the seedlings. A daily observation was made and recorded until the seedlings emerged (Tiyagi, 2020)

Plant height: This was estimated using a measuring tape or ruler from the ground level to the topmost point of the plant (Philip, 2019)

Leaf area development: Leaf area was measured using a leaf area meter or by taking a leaf and using image analysis software to calculate the leaf area (Ogunniyan, 2018).

Number of fruits per plant: This was estimated by counting and recording the number of fruits produced on each individual plant (Bhale, 2017)

Number of leaves and branches: This was estimated by counting and recording the number of leaves and branches on each individual plant (Jat, 2016)

Stem girth: This was estimated by measuring the circumference of the stem using a measuring tape or a caliper (Adeyemi, (2015)

Days to First fruiting: This was estimated by measuring the number of days from sowing the seeds to the first appearance of fruit on the plant. A daily observation was made and recorded until the first fruit developed. (Pandey, 2021)

Number of pods per plant: This was estimated by counting and recording the number of pods produced on each individual plant (Adekiya, 2019).

Pod diameter: This was estimated by measuring the diameter of the pod using a caliper or ruler. (Patel, 2020)

Pod length: This was done by measuring the length of the pod using a ruler or measuring tape (Kumbhar, 2017)

Pod weight (kg/ha): This was estimated by weighing a representative sample of pods from individual plants and extrapolating the weight to kilograms per hectare (Joseph, 2019).

Number of senescence and abscissions: This was estimated by counting and recording the number of senesced or abscised leaves or branches on each individual plant (Dubey, 2018).

Determination of Dry matter accumulation

At plant maturity, the plants were uprooted and taken to the laboratory. The uprooted plants were partitioned into leaf stem and root. The fresh weight and dry weight of the plants were obtained and they were separately packed into envelopes and oven dried at 80 °C until constant weights were obtained, the fresh fruit after weighing were also dried for determination of dry matter accumulation.

Calculation of Mean Germination Time and Percentage germination

Germination counts were taken every three days and the final cumulative figure was expressed as a percentage of the total seed germinated. Germination of seeds was calculated to determine the mean germination time (MGT) for each treatment as described by Oyedeji et al (2015). The mean germination time was determined using the expression;

$$t = \frac{\Sigma ni \times ti(days)}{\Sigma n}$$

Where:
t- Mean germination time,
ti- Given time interval,
ni- Number of germinated seeds during a given time interval
n- Total number of germinated seeds.

The germination percentage was calculated as follows

$$\text{Germination \%} = \frac{\text{Number of seed germinated}}{\text{Number of seed tested}} \times 100$$

The numbers of seedling emergence were recorded on daily basis, starting from the third day after sowing until 14 days after sowing. Seedling was scored as emerged when the cotyledons break through the surface and the percentage seedling emergence was calculated by dividing the total number of seedlings that emerged by the number of seeds sown and multiplied by hundred. The result obtained from the laboratory was used on the field for a period of 40 days to determine the crop and pod growth effect and asses the performance of the three varieties of okra under different levels of light intensities in the study area

Determination of Crop and Pod Growth Rate

Crop Growth Rate (CGR), was calculated throughout the entire crop duration. The CGR was calculated as CGR=T/DH
Where T=Total Biomass
DH is number of days to maturity. The Pod Growth Rate (PGR) was estimated as PGR=Y/RD

Where Y is the pod or fruit yield
RD is reproductive duration. The Partitioning coefficient (PR) was estimated as the ratio of pod growth rate to crop growth rate. (Agele et al, 2017, Oyewusi et al, 2020).

Determination of leaf area (LA) and leaf area index (LAI)

The following equation was used to calculate the leaf area (LA) of each leaf:
$LA\ (m2) = L \times W \times k$ (1)
Where,
L =leaf length (m)
W = leaf width (m).
k= 0.62 for okra (Musa and Usman, 2016)
To obtain the total leaf area per plant, the specific leaf area was multiplied by the number of leaves counted. The LAI was then determined by dividing the leaf area by the ground area of the plant (Tunca et al., 2018)

Statistical analysis

Data collected were subjected to analysis of variance, standard deviation and standard error to estimate the reliability of the sampled data while the treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability with the aid of Gestate Discovery Software (L.A.T., 2017)

Result and Discussion

Table 1 showed the result of soil chemical and physical properties before the experiment. The pH of the soil was 4.16 which is acidic. Organic matter contents analyzed was 1.35%. Nitrogen content was low 0.10 g/kg. The available P content in the soil was low 4.16 mg/kg, K was also low (0.14 cmol/kg), Na (0.22 cmol/kg), Ca (1.80cmol/kg) and Mg (0.70 cmol/kg). The result showed that the soil was sandy loam in texture with high proportion of sand (56.80%). This implies that basic cations such as Ca, K, Na and Mg would be leached more easily as texture determines the degree of retention or ease of leaching of basic cations (Wapa and Oyetayo, 2014).

The result of Super Gro bio liquid organic fertilizer effect on vegetative growth and development of three okra varieties under different levels of light intensities at harvest is presented in Table 2. The result shows that significantly higher number of seeds germinated under L0 and L1 levels of light intensities for all the three tested okra varieties while lower germination percentage was observed under the L2 and L3 levels of light intensities. Germination was significantly slow under L3 levels of light intensities for Clemson spineless and NH47-4 okra varieties (8days) while early germination was observed under L1and L2 levels of light intensities for all the tested okra varieties. (5 days) which had the highest percentage germination of 100%?

Table 3 shows the effect of Super Gro organic fertilizer on vegetative growth and development of three Okra varieties under different levels of Light Intensities at harvest. The result indicated that under L3 light intensity, significantly higher values were recorded for plant height for the three tested okra varieties. Clemson spineless had 33.56cm at L3; NH47-4 had 33.78cm while Dogo had 37cm. This shows that at low light intensities, (70%), okra varieties performed optically with plant height. High light intensities inhibited significantly plant height for the three okra varieties under L0, LI and L2. The result further revealed that there was no significant difference in number of branches and stem girth for all the tested okra varieties under different light intensities; however, higher number of leaves were recorded under low light intensities for NH47-4 and Dogo varieties respectively (10.09 and 9.15). Similarly, leaf area development was significantly better under high light intensities at L0 and L1 levels for all the tested okra varieties. Leaf area plays an important role in biomass accumulation in plants and a decrease in light intensity significantly reduces the rate of photosynthesis in plants leading to a less amount of biomass production. With increasing light intensities, leaf thickness, leaf density and mesophyll cell surface area and volume per leaf surface area increases (Fan et al., 2013). The leaf area development in this study was significantly better under Clemson spineless at L0, 39.00 cm2, L1, 37cm2, NH47-4 for L0, 35.94cm2, L1 33.66cm2 and Dogo at L0, 34.10cm2 and L1 at 31.11cm2 respectively.

Table 4 shows the effect of Super Gro organic fertilizer on crop growth rate and dry matter yield of three Okra varieties under different levels of Light Intensities. The result shows that days to first flowering (DFF) were significantly shorter under the L0 and L1 levels of light intensities for all the tested okra varieties while it took longer days to attain first flowering under the L2 and L3 levels of light intensities. The result shows that Clemson spineless at L0 and L1 had 31.14 and 32.04 days on the average to attain first flowering respectively. Similarly, NH47-4 for L0 and L1 levels of light intensities had 37.78days and 33.69days on the average respectively to attain first flowering while Dogo had 40.23 days and 35.33days on the average for L0 and L1 levels of light intensities respectively. In contrast, it took longer days at low light levels of light intensities at L3 levels to attain first flowering on the tested okra varieties. The plants growth, the length of active life and energy derived from photosynthesis depend on the amount of light it receives; Low light levels can result in few or no flowers and spindy lanky growth as the plant stretches towards the sun (Ballaré and Pierik, 2017). Low light intensity can also delay flowering and early pod formation in plants (Fan et al., 2013). Similar result was recorded for days to first fruiting with L0 and L1 having shorter days to attain first fruiting while it took longer days for fruit initiation under the L2 and L3 levels of light intensities. Conversely, number of fruits per plant was significantly better under the L1 levels of light intensities for Clemson spineless L1, (15.02), NH47-4 L1, (13.89), while Dogo recorded a higher result at L0, (12.50). The trend was such that the higher the light intensity, the shorter the number of days required for flowering and vice-versa. This was also reflected in the number of fruits with lower light intensity, plants producing less fruits than the ones exposed to higher light intensity. There was no significant difference in the fruit diameter for all the test okra varieties under different levels. 39 numbers of senescence and abscissions. The result further revealed that under high light intensities, number of leaf senescence and abscission significantly increased. At L1 levels of light intensities, Clemson spineless had 6.45; NH47-4 had 6.30 while Dogo had 10.00 numbers of senescence and abscission while lower values were recorded at the L3 levels of light intensities for Clemson spineless, L3,2.92, NH47-4,3.34 and Dogo, 2. Similarly, fruit fresh weight was significantly higher at the L1 levels of light intensities for all the tested okra varieties. For Clemson spineless, L1 was recorded at 311.12kg/ha, while NH47-4 was 293kg/ha. Dogo variety was lowest at 274.07kg/ha. This was in contrast to the low values recorded for the three test crop at the L3 levels of light intensities. This is due to the fact that under shading light conditions, photosynthesis actively deteriorated and carbohydrate production was therefore inadequate. In addition, this adversely affected dry matter yield of crops. The negative effect was more pronounced at the 75% light reduction. Shading treatment resulting in insufficient sunshine had a detrimental impact on plant productivity and growth. The result of effect of Super Gro on Pod Growth Rate (PGR), partitioning coefficient of three okra varieties is presented in Table 5. The result shows that there was no significant difference in the CGR for all the tested okra varieties under different light intensities while significant difference was recorded for PGR for Clemson spineless under L1 level of light intensity (6.18g/mg/day), NH47-4 at L1 (5.67g/mg/day) while at L0, PGR was significantly higher (4.21g/mg/day). In addition, lower values were obtained at L2 and L3 for Clemson spineless and NH47-4.In this experiment, the partitioning coefficient was significantly highest for Clemson spineless over other varieties. The dry matter partitioning coefficient (PR) reflects the distribution and accumulation of dry matter in crop organs. This distribution of harvestable organs was significantly better for Clemson spineless at all the four levels of light intensities and this reflected in the final fresh fruit weight. Reduction in light intensity as well as application of Super Gro organic bio fertilizer also had positive effect on fresh and dry matter yield among the tested okra varieties. The positive influence of super Gro organic bio fertilizer on okra dry matter production and partitioning was in accordance with what has been reported previously on it ability on enhancing proper physiological processes in crop plants (Ajmi et al 2018; Adejumo et al., 2010;). The higher dry matter production by the okra plants under Super Gro application and different levels of light intensities could have resulted from availability of enough nutrients, which consequently enhanced plant metabolic processes. When nutrient is in the right proportion, the photosynthetic activity of the plants will also be considerably favored, as a result of improved light interception (Fan et al., 2013). This was linked to the availability of adequate amount of nutrients for plant use that improves their vegetative growth and efficient translocation of photosynthates from source to sink. Reduction in light intensity prolonged the number of days to flower and this agreed with the previous report that light reduction reduces the rate of photosynthesis, which in turn would have affected the growth and developmental processes (Fan et al 2018). Growth of pollen tube was reportedly impaired with reduction in light intensity, thereby delaying fertilization and fruiting (Ballaré and Pierik, 2017) as observed in this study. The okra plants grown under reduced light intensities were still fruiting later than those ones under high light intensity have started shedding their leaves. This accounted for the increase in number of fruits recorded in reduced light intensities despite the fact that those under 100% light intensity started fruiting earlier. Excessive light intensity has been reported to scorch/burn the leaves and reduce crop yields (Liu et al 2019). It also reduces the chlorophyll content, which in turn reduces the rate of light absorption and the rate of photosynthesis. This is because excess light intensity is associated with increase in the temperature of leaves and this will lead to rapid transpiration and water loss.

Conclusion and recommendations

It is however concluded that optimal performance of okra all the year round could be enhanced with low light intensity (L3). Low light intensity (70% light reduction) increased the growth parameters, but delayed flowering. In addition, while low light reduction at 70% may cause prolonged fruiting and leaf formation in the three tested okra varieties, high light intensity (L1) though enhanced leaf area formation and early flowering, hastened leaf senescence and abscission. The trend was such that the higher the light intensity, the shorter the number of days required for flowering and vice-versa while significant difference was recorded for PGR for Clemson spineless under L1 level of light intensity. In this experiment, the partitioning coefficient was significantly highest for Clemson spineless over other varieties. The dry matter partitioning coefficient (PR) reflects the distribution and accumulation of dry matter in crop organs. This distribution of harvestable organs was significantly better for Clemson spineless at all the four levels of light intensities and this reflected in the final fresh fruit weight. Reduction in light intensity as well as application of Super Gro organic bio fertilizer also had positive effect on fresh and dry matter yield among the tested okra varieties. Between the three varieties, 'Clemson spineless' performed better than 'NH47-4' and the indigenous Dogo variety in terms of yield. It grows faster and produces more fruits especially with application of Super Gro bio-organic fertilizer.

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Table 1: Physical and chemical properties of the soil at experimental site

Properties	Value
Ph (water) %	4.16
Total N (%)	0.10
Available P (mg/kg)	12.76
Ca^{2+} (Cmol/kg)	1.80
Mg^{2+} (Cmol/kg)	0.70
K^{+} (mg/kg)	0.14
Na^{2+} (Cmol/kg) 0.22	
Organic carbon (%)	0.78
Organic matter (%)	1.35
Particle size distribution	-
Sand	56.80
Silt	20.00
Clay	23.20
Total porosity (g/g) Water holding capacity (g/g) Texture	35.30 0.061 Sandy loam
Bulk density)g/cm^{3})	1.32

Table 2.Effect of Super Gro bio liquid organic fertilizer on Mean Germination Time (GMT) and Germination Percentage (GP) of three Okra varieties under different levels of Light Intensities

Treatment		Number of okra seeds planted	Number of okra seeds that germinated	Percentage germination (%)	MGT In Hours	MGT in days
Varieties	Light intensity					
Clemson spineless	LO	10.00	10.00	100	120	5.00
	L1	10.00	10.00	100	120	5.00
	L2	10.00	8.00	80	168	7.00
	L3	10.00	7.00	70	192	8.00
NH47-4	LO	10.00	10.00	100	120	5.00
	L1	10.00	10.00	100	120	5.00
	L2	10.00	8.00	80	168	7.00
	L3	10.00	7.00	70	192	8.00
Dogo	LO	10.00	10.00	100	120	5.00
	L1	10.00	10.00	100	120	5.00
	L2	10.00	9.00	90	144	6.00
	L3	10.00	9.00	90	168	7.00

Table 3. Effect of Super Gro bio liquid organic fertilizer on vegetative growth and development of three Okra varieties under different levels of Light Intensities at harvest

Treatment		Plant height (cm)	Number of leaves	Number of branches	Stem girth (mm)	Leaf area (cm²)
Varieties	Light intensity					
Clemson spineless	LO	22.03ᶜ	8.00ᵃ	7.00ᵃ	3.09ᵃ	39.00ᶜ
	L1	23.05ᶜ	8.09ᵃ	5.66ᵃ	3.10ᵃ	37.66ᶜ
	L2	31.00ᵇ	8.00ᵃ	6.06ᵃ	3.10ᵃ	20.03ᶜ
	L3	33.56ᵇ	8.12ᵃ	6.41ᵃ	3.00ᵃ	23.09ᶜ
NH47-4	LO	22.02ᶜ	7.09ᵃᵇ	6.65ᵃ	2.99ᵃ	35.94ᵇ
	L1	30.12ᵇ	7.66ᵃᵇ	6.00ᵃ	2.98ᵃ	33.66ᵃ
	L2	30.55ᵇ	9.14ᵃ	5.67ᵃ	2.70ᵃ	24.97ᶜ
	L3	33.78ᵇ	10.09ᵃ	5.50ᵃ	2.80ᵃ	32.70ᵇ
Dogo	LO	24.05ᶜ	6.07ᵃᵇ	6.23ᵃ	2.70ᵃ	34.10ᵇ
	L1	30.37ᵇ	7.24ᵃᵇ	5.00ᵃ	2.71ᵃ	31.11ᵇ
	L2	31.64ᵇ	9.00ᵃ	5.16ᵃ	2.70ᵃ	28.00ᶜ
	L3	37.00ᵃ	9.15ᵃ	5.89ᵃ	2.70ᵃ	30.06ᵇ
SD		4.60	1.08	1.00	1.00	5.45
SE±		0.29	0.31	0.29	0.29	1.57

Mean followed by the same superscript significantly different at 0.05% probability on the same row using Duncan's Multiple Test (DMRT)

Table 3. Effect of Super Gro bio liquid organic fertilizer on vegetative growth and development of three Okra varieties under different levels of Light Intensities at harvest

Treatment		Plant height (cm)	Number of leaves	Number of branches	Stem girth (mm)	Leaf area (cm²)
Varieties	Light intensity					
Clemson spineless	LO	22.03ᶜ	8.00ᵃ	7.00ᵃ	3.09ᵃ	39.00ᶜ
	L1	23.05ᶜ	8.09ᵃ	5.66ᵃ	3.10ᵃ	37.66ᶜ
	L2	31.00ᵇ	8.00ᵃ	6.06ᵃ	3.10ᵃ	20.03ᶜ
	L3	33.56ᵇ	8.12ᵃ	6.41ᵃ	3.00ᵃ	23.09ᶜ
NH47-4	LO	22.02ᶜ	7.09ᵃᵇ	6.65ᵃ	2.99ᵃ	35.94ᵇ
	L1	30.12ᵇ	7.66ᵃᵇ	6.00ᵃ	2.98ᵃ	33.66ᵃ
	L2	30.55ᵇ	9.14ᵃ	5.67ᵃ	2.70ᵃ	24.97ᶜ
	L3	33.78ᵇ	10.09ᵃ	5.50ᵃ	2.80ᵃ	32.70ᵇ
Dogo	LO	24.05ᶜ	6.07ᵃᵇ	6.23ᵃ	2.70ᵃ	34.10ᵇ
	L1	30.37ᵇ	7.24ᵃᵇ	5.00ᵃ	2.71ᵃ	31.11ᵇ
	L2	31.64ᵇ	9.00ᵃ	5.16ᵃ	2.70ᵃ	28.00ᶜ
	L3	37.00ᵃ	9.15ᵃ	5.89ᵃ	2.70ᵃ	30.06ᵇ
SD		4.60	1.08	1.00	1.00	5.45
SE±		0.29	0.31	0.29	0.29	1.57

Mean followed by the same superscript significantly different at 0.05% probability on the same row using Duncan's Multiple Test (DMRT)

Table 4. Effect of Super Gro bio liquid organic fertilizer on Crop Growth Rate and Dry matter yield of three Okra varieties under different levels of Light Intensities

Treatment		DFF	Days to first fruiting	Number of pod/ plant	pod diameter (cm)	Pod length (cm)	Number of seed/ Pod	Number of leaf senescence and abscission	pod fresh weight (kg/ha)
Varieties	Light intensity								
Clemson Spineless	LO	31.14^{c}	41.00^{c}	13.00^{b}	2.45^{a}	10.92^{b}	71.00^{b}	7.00^{e}	288.09^{b}
	L1	32.04^{c}	42.21^{c}	15.02^{a}	3.00^{a}	12.01^{a}	80.91^{a}	6.45^{d}	311.12^{a}
	L2	30.00^{c}	40.34^{c}	12.06^{b}	2.01^{a}	9.56^{c}	73.45^{b}	4.00^{c}	308.40^{a}
	L3	33.81^{c}	41.88^{c}	11.65^{b}	2.23^{a}	9.44b^{c}	70.06^{b}	2.92^{b}	301.00^{a}
NH47-4	LO	37.78^{a}	47.91^{b}	10.67^{b}	3.59^{a}	10.39^{b}	67.44^{c}	8.31^{d}	284.23^{a}
	L1	33.69^{c}	43.45^{c}	13.89^{b}	3.90^{a}	11.00^{b}	74.54^{b}	6.30^{c}	293.11^{b}
	L2	31.55^{c}	41.74^{c}	11.79^{b}	2.23^{a}	8.55^{d}	70.02^{b}	5.00^{b}	274.15^{b}
	L3	33.90^{c}	33.90^{d}	10.00^{b}	3.45^{a}	9.04^{c}	62.05^{c}	3.34a	270.51^{b}
Dogo	LO	40.23^{a}	50.99^{a}	12.50^{b}	2.55^{a}	9.67^{c}	56.21^{d}	10.00^{d}	267.69^{b}
	L1	35.33^{b}	45.03^{b}	11.56^{b}	3.08^{a}	10.05^{b}	74.11^{b}	7.34^{d}	274.07^{b}
	L2	38.49^{a}	49.40^{a}	10.32^{b}	3.78^{a}	9.90^{c}	70.10^{b}	5.23c	256.60^{b}
	L3	38.29^{a}	48.25^{a}	9.00^{b}	2.19^{a}	8.87^{d}	67.46^{c}	2.39^{b}	249.78^{b}
SD		3.18	2.18	1.63	0.76	1.00	5.92	2.40	18.61
SE±		0.92	0.63	0.47	0.22	0.29	1.71	0.69	5.38

Mean followed by the same superscript significantly different at 0.05% probability on the same row using Duncan's Multiple Test (DMRT).DFF-Days to first flowering

Table 5: Effect of Super Gro bio liquid organic fertilizer on Crop Growth Rate (CGR) and partitioning coefficient of three Okra varieties under different levels of Light Intensities

Mean followed by the same superscript significantly different at 0.05% probability on the same row

Treatment	Variety	Total Biomass (g) (T)	Number of days to maturity (DH)	CGR (g/mg/day)	PGR (g/mg/day)	Partitioning Coefficient (PR)
Clemson Spineless	LO	71.00^{d}	51.00^{e}	1.39^{a}	5.65^{b}	3.74^{b}
	L1	79.03^{c}	52.21^{d}	1.51^{a}	6.18^{a}	4.09^{a}
	L2	72.90^{d}	50.34^{d}	1.41^{a}	6.13^{a}	4.35^{a}
	L3	70.00^{d}	51.88^{d}	1.35^{a}	5.80^{b}	3.69^{b}
NH47-4	LO	86.18^{c}	57.91^{d}	1.49^{a}	4.91^{c}	3.30^{b}
	L1	83.88^{c}	53.45^{d}	1.57^{a}	5.67^{b}	3.61^{b}
	L2	89.00^{c}	51.74^{d}	1.49^{a}	5.30b	3.56^{b}
	L3	76.56^{d}	53.90^{d}	1.42^{a}	5.02^{b}	3.53^{b}
Dogo	LO	83.00^{c}	60.99^{c}	1.36^{a}	4.39^{c}	3.22^{b}
	L1	92.35^{b}	65.03^{b}	1.42^{a}	4.21^{c}	2.96^{c}
	L2	104.82^{a}	69.40^{a}	1.51^{a}	3.69^{d}	2.44^{c}
	L3	94.53^{b}	68.25^{a}	1.39^{a}	3.66d	2.75^{c}
SD		11.71	6.67	0.04	0.86	0.52
SE±		3.38	1.93	0.01	0.25	0.15

using Duncan's Multiple Test (DMRT)