EPRA International Journal of Agriculture and Rural Economic Research (ARER)- Peer-Reviewed Journal
Volume: 13 | Issue: 4 | April 2025 | Journal DOI: 10.36713/epra0813| Impact Factor SJIF(2025): 8.733| ISSN: 2321 - 7847

THE EFFECT OF DIFFERENT COLOURS OF LIGHT ON PLANT GROWTH AND DEVELOPMENT ON COWPEA [VIGNA UNGUICULATA (L.) WALP.]

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ABSTRACT----------
The effect of different colours of light on plant growth and development with respect to the plant height, colour and other growth parameters were studied. Vigna unguiculata was the prominent species used to confirm the effects. Vigna unguiculata were sown in a laboratory experiment in Niger Delta Basin. Development Authority; the experiment was done in a closed compartment box with the plants exposed to different light colors for an extended period of 18 hours. Red light was shown to be useful for stem elongation with it having the highest growth value of 18.2cm and blue light having the lowest value of 14.5cm, the blue light were seen to develop more branches which in turn resulted to more flowering and seed formation, it was also shown to have more leaves than other experiment other than the control with a maximum of 3 leaves. Green leaves were shown to possess a higher degree of green colouration both above its leaves and under, this is due to its high penetrating power.
KEYWORDS: *Growth and Development, colours of light, Vigna unguiculata, Leaves*----------

1. INTRODUCTION

Plants are one of the basic necessities for human as they serve as sources of food and other necessary things. The development of plants is necessary for human growth and development. As humans are dependent on plants, plants also depend on sunlight for the production of starch and other by products, which includes its wood for timber, cotton bolls for clothing, and its production of energy source for both food and fuel.

Light is the driving force for photosynthesis (Marcelis *et al*., 2006) as insufficient light can result to death or retardation of growth in green plants due to its inability to produce enough energy. Rehman *et a*l., (2017) had it that light is an important factor affecting plant growth and development. Light quality shows an important role in morphogenesis (Kim *et al.*, 2003).

Plants grown under red light start with a growth spurt and lack of greenish coloration on it leaves with weak stems. The plants that are grown under only red light had stretched and elongated appearance, the leaves were long and thin and plants become tall.

Plant growth and photosynthesis is strongly influenced by blue light (Bula *et al.*, 1991; Yorio et al., 2001), as seeds grown under the blue light are shown to develop sturdier stems and greener leaves although not as fast as the red light in the later weeks. This shows that plants with weaker stems can develop sturdier stems when exposed to blue light. Plants see blue light as well as red light, using a photoreceptor that is called a cryptochrome.

Blue light is also responsible for directing leaves and growth points toward the light. Blue light is necessary for plants to regulate plant growth (Inada, 1976), as it helps to create strong stems and also helps create the chlorophyll necessary for plant processes. Plants use the quantity of blue light to determine how far to open their stomas, the more blue light, the wider they open their stomas, so accelerating their metabolism. High levels of blue light will therefore promote increased metabolism, and by extension accelerate plant growth and development. The effect of stomatal opening are well documented (Talman and Zeiger, 1988; Talbott, 2002).

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Green light is not used very much by mature plants. Some studies have suggested it is useful when a plant is germinating, it plays a major role in controlling plant growth and development (Folta and Maruhnich, 2007). The reason that green plants appear green is that they reflect rather than absorb the green waves in the light spectrum, In other words, the chlorophyll in the plant absorbs the red and blue light much more readily than the green light. The green light have a strong penetrating power (Sun *et al.,* 1998). Green light can penetrate deeper through a leaf to improve photosynthesis in chloroplasts located towards the bottom surface of the leaf and beyond. Since green light penetrates much more effectively to the lower canopy, green light will help drive photosynthesis across the whole plant (Teraahima et al., 2009) as it is absorbed by leaves in the lower canopy not exposed to red or blue light. The effects of LED have been suggested by some studies to depend on the life cycle of the plant where the LED light were applied (Hoffman *et al.,* 2015).

2.0 MATERIALS AND METHODS

2.1 AREA OF EXPERIMENT

This experiment was carried out in NDBDA (Niger Delta Basin development Authority) in Port Harcourt Local Government Area of Rivers State. The study involved the use of *Vigna unguiculata* as the specimen to capture the effect of light on plant growth and development
A control box were used to control outside sunlight from altering the growth rate of the plants.

2.2 MATERIALS

The materials used in the experiment include

POLYTHENE BAG

This is where the soil for the planting of the seedlings where placed.

LIGHT BULBS

Green, Blue and Red; these different colours of light bulbs where used to serve as a source of lights for the plant seedlings.

***Vigna unguiculata* Seeds**

This is the specie of plant that was used to determine and confirm the effect of the light colours

SOIL

The soil used were sourced from Obio/Akpor local government, in farm-site that was uncontaminated.

COMPARTMENT BOX

A 1.5m x 0.9m compartment box was designed having six compartments each having a space of 0.5m x 0.3m to house the polybags and the seedlings

2.3 METHOD

Soil were gathered in 19 polythene bags where *Vigna unguiculata* seeds where planted.

2.4. PARAMETERS USED FOR THE EXPERIMENT

PLANT HEIGHT: The plant height were determined by the use a meter rule of 30cm. This was used to determine which plant would have a faster growth

NUMBER OF LEAVES: The leaves of the plants were manually counted.

COLOUR OF LEAVES: This is a qualitative check that were verified with eyes using a colour match.

NUMBER OF BRANCHES: This parameter were determined by manual count

3.0 RESULTS AND DISCUSSION

Bean seeds where planted in each polythene bag and there growth rate monitored and recorded. These seeds were placed in the different compartment containing the different colours of light bulb. The experiment was designed to show the effect of these three colours of light used; their growth rate, colouration, buds formed and overall wellbeing to effectively show the effect.

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The plants from the three light colours (green, red and blue) were examined based on their phenotypic appearance (plant height, number of leaves, number of branches, color of leaf). The result is represented in Fig1. To 3.

3.1. PLANT HEIGHT

The results of the plant height of the seedlings seven days after germination under red light and controlled soils is shown in figure 1. From the result it was observed that red light had the highest value of the plants height of 5.7 cm with blue light and green light having the lowest height value of 4.1cm respectively. 14 days after germination, from the result, it was observed that red light still had the highest growth value of 8.8 cm with green light having a growth spurt with blue light still having the lowest value of 7.3 cm. 21 days after germination, from the result it was observed that blue light still had the lowest growth value of 10.1 cm, while red, green and the control had their height value at 14.8 cm, 12.2cm and 12.5 cm respectively 28 Days after germination red light attained the highest growth value at 18.2 cm, green light with an increased growth rate at 16.2 cm, overtaking the control to show that green light is also very important during the growth of plants, blue remaining squat in height as it attained a height of 14.5 cm during the last week of observation.

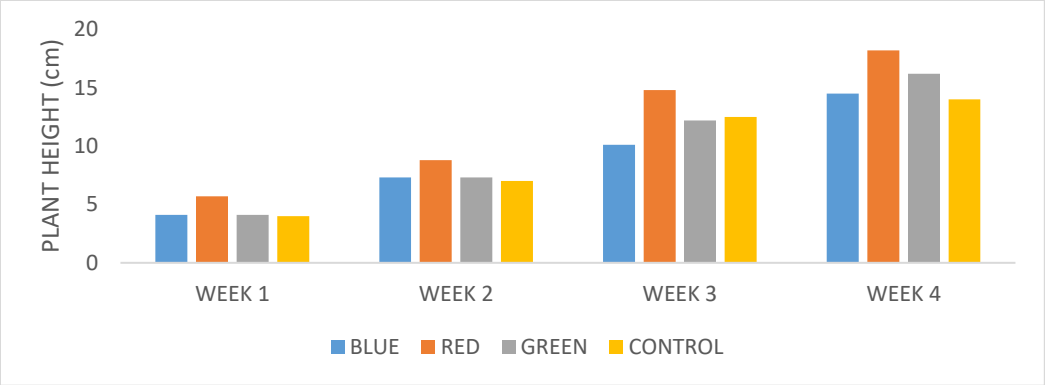

Fig. 1. COMPARISON WITH PLANT HEIGHT

3.2. NUMBER OF LEAVES

The number of plant leaves of the plants sowed under the different colours of light showed in fig.2. From the result it was observed that blue light and green light demonstrated to be the colors responsible for the promotion of foliage in the light spectrum. 7 days after germination, from the result, it was observed that apart from the cotyledons, no leaves were counted on plants grown in red light, green light and blue light respectively 14 days after germination, Plants from the control, green and blue colours developed leaves while red light still remained on its cotyledons while its height increased. 21 days after germination, the number remained the same as the previous week. 28 days after germination, the control and plant grown under blue light added extra leaves to their growth, with the tally of the leaves coming to a total of three leaves respectively, while the plants grown under green light remained at two leaves within this week with red not having extra leaves added.

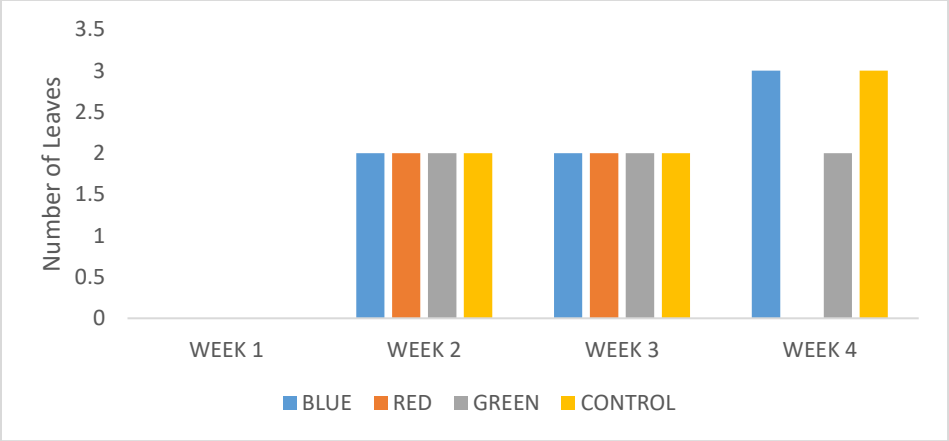

FIG. 2: COMPARISON OF NUMBER OF LEAVES

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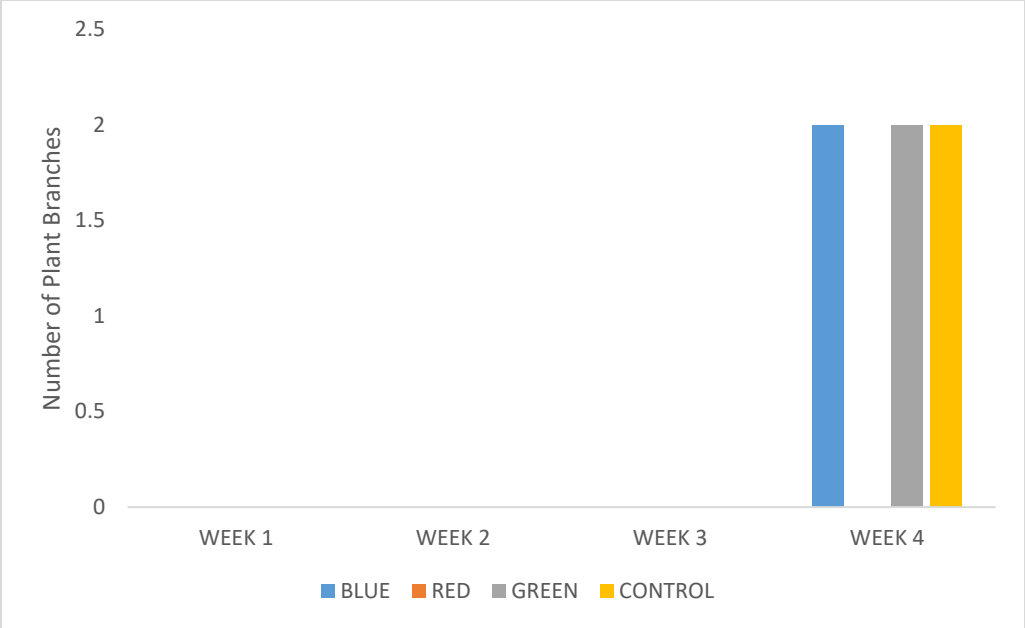
3.3 NUMBER OF PLANT BRANCHES

The results of the number of plant branches of the plants sowed under the different colour of light as shown in fig 3. From the result it was observed that blue light and green light demonstrated to be the colours responsible for the promotion of branching. 7 days after germination, none of the plants developed branches as this was the initial stage for germination. 14 days after germination, the plants from the different designs were observed to have not developed branches. 21 days after germination, the numbers remained the same as the previous week. 28 days after germination, the control, plant grown under blue light and green light were observed to have developed branches with each of them developing two branches.



COMPARISON OF NUMBER OF PLANT BRANCHES

TABLE 1: COMPARISON OF DIFFERENT COLOURS OF LIGHT

S/N	RED	BLUE	GREEN
1.	Developed buds quicker	Lack buds	No bud development
2.	Leaves are slightly yellow	Has green leaves	Has green leaves
3.	Fast growing stem	Slow growing stem	Slow growing stem

4.1 DISCUSSION

Plants are sensitive to red in the light spectrum, a sensitivity that arises from the plant having what is called a red light photoreceptor. The receptor is a blue-green pigment termed a phytochrome present in the cells of a plant. The phytochrome can be thought of as an eye that only senses red light (Casal, 2000). Red light impacts a plant in many ways. Plants that are grown in plenty of red light are often large but in general are also tall with few branches as discovered in my works. If the photoreceptor picks up a large quantity of natural red light, for example in the summer when there's plenty of natural red light, production of a plant hormone is increased. This hormone prevents the chlorophyll in the plant being broken down, so that it stays green in the spring and summer. And that is only beneficial, for it is precisely at this time that the plant needs its chlorophyll to convert energy coming from the sun into sugar (Erik Tinkle, 2016).

The red color in light also influences flavor because it increases the concentration of special oils in plants. The leaves may have a more bitter taste. Red light is highly effective at regulating growth and development for plants (Smith and Whitelam, 1997). If plants are gown under only red light, they will have a stretched and elongated appearance (Ballare *et al.*, 1991), the leaves are long and thin and plants become tall. The amount of red light relative to the amount of far -red radiation (R:FR) also has a pronounced effect on leaf expansion and stem elongation. As far red is added to red light, the R:FR decreases and extension growth increases (Evans and Poorter, 2001).

Generally, blue light suppresses extension growth: plants grown with blue light are usually shorter and have smaller, thicker and darker green leaves compared to plants grown without blue light. In the production of ornamentals, these attributes can be desirable because in essence, blue light act as a growth regulator (Chavez et al,, 2011).

Similar to blue light, Green light may play a major role in controlling plant development in orchestration with Red light and Blue light, although its role is likely more important at low light conditions found within a canopy or high plant densities (Wang and Folta, 2013). Sun *et al.*, (1998) found that both Red light and especially Blue light drive CO_2 fixation primarily in the upper palisade mesophyll (adaxial portion of the leaf) while Green light penetrates deeper and drives CO_2 fixation in the lower palisade and upper spongy mesophyll (abaxial portion of the leaf), the leaves of the plants were spongy to the feel. For all three colors, direct light penetrated more deeply than diffuse light, and for both direct and diffuse light, green light penetrated much deeper than Red light and Blue light. Green light is likely more beneficial for increasing whole plant photosynthesis than Red light or Blue light (Nishio, 2000).. These results are consistent with findings of Kim *et al.*, (2004) by showing that too much Green light is detrimental, this suggests that response to Green light may be species specific.

CONCLUSION

Plants that get natural sunlight receive all the colours in the spectrum. But if you decide to grow plants using artificial light you need to consider how much blue light, red light and green light are given off by the artificial light. Usually it reflects off into our eyes, making them appear green, The fact that leaves don't usually appear blue or red means that they absorb those parts of the light spectrum and use them to grow. Plants that receive plenty of blue light will have strong, healthy stems and leaves. It is also essential to a plant's early life for seed germination, root growth and bulb development. Red light is needed to have quicker growth rate. Blue light is a must for plants,
red light is also necessary.

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