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EFFECT OF VARYING UV IRRADIATION ON GERMINATION AND GROWTH OF COWPEA (*Vigna unguiculata* (L.) Walp).

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ABSTRACT
This study was carried out to investigate the effect of different UV exposure time on the germination and early seedling growth of cowpea in order to ascertain the exposure time that affects these developmental stages of plant. The study was laid out in a randomized complete block design of six exposure times including control as treatments with five replicates. Growth parameters of cowpea such as plant height stem girth and number of leaves was determined daily after germination has taken place. All the cowpea seeds in all the treatments exhibited 100% germination at the end of the 9th day. It was observed that the UV irradiation never had any significant negative effect on any of the growth parameters compared with control. This could be due to the short period of exposure or the resistance of the cowpea plant to UV irradiation.

Keywords: Cowpea, Growth, Mutation, UV Irradiation.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is one of the cultivated species in the Genus *Vigna*. Cowpea is the most economically important in the indigenous African legume crop (Ou *et al.*, 2018). Zanakis *et al.* (1994) described cowpea as an annual herb reaching height of up to 80cm with a strong tap root and many spreading lateral roots in the surface soil. Growth forms vary and many are erect, trailing, climbing or bushy (Al-Qurainy & Khan, 2009). In terms of drought cowpea can grow a tap root as long as eight (8 feet) to reach moisture deeper in soil profile. Cowpeas are of importance to the livelihood of several millions of people in West and central Africa (Lamberth, 2002). Cowpea is a most versatile African crop because it feeds people and their livestock. Cowpea is a high nutritive food, and is referred to as the "hungry-season crop" (Okike *et al.*, 2002).

The study of mutation is also a major source of information and the theory of the gene (Stadler, 1994). It was discovered in the Late 1920s that genetic make-up is amenable to change by induced mutagenesis. This has since been applied as an established method for increasing genetic variability in many crop plants. Induced mutation has been used to generate genetic variability and have been successfully utilized to improve yield and yield component of many crops (Singh *et al*., 2001; Sakin and Yindirim, 2004). Mutation rates can be increased by conditions that damage DNA. Any chemical and physical agents that increases mutation is referred to as a mutagen. Mutagens introduce some chemical changes to the DNA such as altering based or perhaps breaking the sugar phosphate back bone. These reports show that mutagenesis is potential tool to be employed in crop improvement (Ismail and Ginclaces, 1997).

Gamma rays have been used for both, intact plants and parts of plant as well as seeds. Fast neutrons, known to be strongly harmful to chromosomes, have been used for seed treatment. UV-light-causing formations of T-T dimmers and lasers have been used recently. There is an on-going assessment on the potential use of mutants in agriculture. Considering the fact that induced mutations are generally deleterious, such as large number of mutant cultivars and lines released in major crops is impressive (Khan *et al*., 2006).

The aim of this study is to investigate the effect of different UV exposure time on the germination and early growth of cowpea seeds and to determine the UV wavelength exposure time that is beneficial for increase in growth of cowpea.

MATERIALS AND METHOD

Study Area

The experiment was carried out in the Biological Laboratory of American University of Nigeria (AUN) Yola, Adamawa State (9°11'57.37"N and 12°29'55.71"E) and the field work was carried out in the Agricultural Garden of Federal College of Education Yola (9°14'25.44"N and 12°27'31.38"E). The vegetation of Yola-South Local Government falls within the southern savannah belt of Nigeria vegetation zone. It is made up of grasses, valleys and dry land. Weed interspaced by shrubs and muddy plants, grasses and weeds collectively make up about 70% of the vegetation (Tukur *et al.*, 2004). The temperature is

relatively hot throughout the year. The average rainfall ranges between 700mm to 100mm.

Sample Collection

The cowpea seeds which were gotten from International Institute for Tropical Agriculture (IITA) Ibadan, Oyo State, were cleansed and sorted to remove all foreign materials such as dirt, dust, small branches and immature seeds.

Treatment of Seeds with UV irradiation

The seeds were exposed at 260 nm and five (5) different hours were used for each treatment as exposure time viz: (3, 6, 9, 12 and 15 hours).

Germination Study

The treated seeds were washed using distilled water. The seeds were subjected to germination study in Petri dishes in the laboratory. The seeds were laid in regular patterns on moist filter papers in the Petri dishes inside the laboratory. The germination percentage, radicle and plumule length were determined after germination.

Field Study

The treated seeds were planted directly on the field. The land to be used was properly cleared and was well irrigated. Two plots were used both at the size of 3 m^2. The treated seeds were sown in the soil, each row containing different treatment and time which was properly tagged. The plots were watered twice daily (morning and evening). The experimental design was randomized complete block design with five replicates per treatment. The treatments include 3 hours (A1), 6 hours (A2), 9 hours (A3), 12 hours (A4), 15 hours (A5) and control. Measurement of plant height, stem diameter and number of leaves per plant were taken daily starting from first day after germination.

Data Analysis

The data collected from various treatments were subjected to one way analysis of variance to show if there is any significant difference between the means. Significance difference between means were separated using Duncan multiple range test (DMRT) at $\alpha \leq 0.05$.

RESULTS AND DISCUSSION

All the treatments showed 100% germination percentage at the end of the 9th day (Figure 1). Treatment A2 had the lowest germination percentage at the end of 3rd day after planting. Cowpea plants exposed to treatments A4 and A5 had the lowest radicle length of 1.6 cm and 1.7 cm respectively (Table 1). The cowpea exposed to A3 has the highest radicle length (2.28 cm). The differences in the cowpea shoot heights among the treatments are significantly different ($P \leq 0.05$) (Table 2). Cowpea under treatment A3 has the highest shoot height (9.18 cm) followed by the control (8.89 cm). Cowpea treated with A4 has the highest stem girth while the lowest was A2. All the cowpea plants under different treatments have the same number of leaves per plant.

The similar germination percentages recorded for the control and all treated cowpea seeds indicated that the treatments had no effect on germination percentage. However, the germination rate per day differed; seeds exposed at 9hours germinated faster than others and the control. In the same vein, the time of exposure to the UV radiation did not affect the number of leaves of the seedlings. Our observation of no significant reduction in growth of cowpea treated with UV irradiation in this study is contrary to the report of Mishra *et al.* (2008) who reported that cowpea treated with UV irradiation exhibited retarded growth and reduced photosynthetic activities. The authors further stated that the negative effects got worsen when combining the UV irradiation with dimethoate. However, our result is buttressed by studies on other plants whereby UV irradiation imposed negative effects on their chlorophyll contents, biomass and yield (Kakani *et al.*, 2003).

In another study, the morphological parameters of cowpea plants, unlike reproductive ones showed positive responses to UV irradiation (Singh *et al.*, 2008). Although at higher doses of UV irradiation, the plant exhibited shorter stem height and lower yield. Our observations might be due to the shorter period of exposure to UV irradiation or could be as a result of tolerance of the cowpea variety to UV irradiation. It may also be possible to have significant negative effects on cowpea if the seeds were subjected to longer period of exposure to UV irradiation.

CONCLUSION

This study revealed that treatment of cowpea seeds with UV light had no effect on the germination percentage and growth parameters as compared with the control. Further experiment on increasing the exposure time and duration of growth up to yield level is recommended for more profound conclusions on the effect of UV irradiation on the plant.

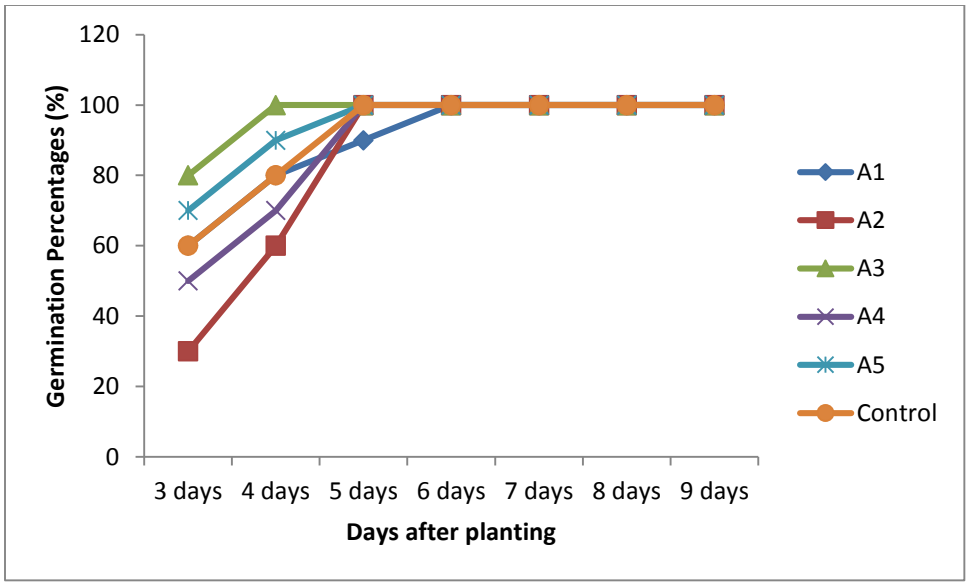

Fig. 1: Effects of UV light on the germination percentage of cowpea
KEY: 3 hours (A1), 6 hours (A2), 9 hours (A3), 12 hours (A4), 15 hours (A5)

Table 1: Effects of UV treatment on the radicle length of cowpea at 9 days after planting

Treatment	Radicle length (cm)
A1	$1.78^{a} \pm 0.02$
A2	$1.88^{b} \pm 0.01$
A3	$2.28^{c} \pm 0.02$
A4	$1.58^{d} \pm 0.02$
A5	$1.68^{e} \pm 0.02$
Control	$1.79^{a} \pm 0.01$

Value represents mean ± standard error. Means with the same superscript across column are not significantly different at $\alpha \leq 0.05$.
KEY: 3 hours (A1), 6 hours (A2), 9 hours (A3), 12 hours (A4), 15 hours (A5)

Table 2: Growth parameters of cowpea seeds treated with UV irradiation

Treatments	Shoot height (cm)	Stem girth (cm)	No. of leaves per plant
A1	$7.48^{a} \pm 0.02$	$1.40^{a} \pm 0.00$	8
A2	$7.29^{b} \pm 0.01$	$1.29^{b} \pm 0.01$	8
A3	$9.18^{c} \pm 0.02$	$1.38^{a} \pm 0.01$	8
A4	$7.58^{d} \pm 0.01$	$1.5^{d} \pm 0.00$	8
A5	$7.78^{e} \pm 0.01$	$1.39^{a} \pm 0.01$	8
Control	$8.89^{f} \pm 0.01$	$1.37^{a} \pm 0.01$	8

Value represents mean ± standard error. Means with the same superscript across column are not significantly different at $\alpha \leq 0.05$.
KEY: 3 hours (A1), 6 hours (A2), 9 hours (A3), 12 hours (A4), 15 hours (A5)

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