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Comparative assessment of the mutagenic effects of sodium azide on some selected growth and yield parameters of five accessions of cowpea – Tvu-3615, Tvu-2521, Tvu-3541, Tvu-3485 and Tvu-3574

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ABSTRACT

The results of the present study demonstrate that at lower doses (0.016 % and 0.031 %) significant changes in vegetative and yield parameters were obtained. Higher doses (0.125 % and 0.25 % NaN_3) of the mutagen were deleterious. There was significant reduction in percentage germination compared to the control. No germination was however recorded in 0.125 % and 0.25 % NaN_3 respectively. Shoot length increased in 0.016 % NaN_3 treatment but decreased in the 0.031 % NaN_3 treatment in cultivars TVU-3541 and TVU-3574 respectively, while TVU- 3615 and TVU-2521 showed decreases. Lower levels (0.016 % and 0.013 %) of NaN_3 significantly increased leaf area in TVU-3615, TVU-2521, TVU-3541, and TVU-3485. No significant changes in chlorophyll content of leaves was recorded as a result of mutagenic treatments compared with control experiment. No significant changes in number of root nodules in the cowpea cultivars were recorded at 100 days after planting as a result of NaN_3 treatments. However, sodium azide significantly enhanced the development nodules in TVU-3574. There were significant decreases in total dry weight of mutant plants compared to the control. No. of Pods/plant increased with increase in the concentration of NaN_3 among all the cultivars.Since yield per plant is the most desirable character, at 0.031 % NaN_3, TVU-3541 showed the highest number of pod/plant. Genetic parameters of some yield parameters of cowpea showed that observed changes resulting from NaN_3 treatments are necessarily genetic rather environmental.

Keywords: Cowpea, genetic variability, heritability, mutagen, mutation, sodium azide

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INTRODUCTION

Induced mutations have been used to generate genetic variability and have been successfully utilized to improve yield and yield components of various crops like *Oryza sativa* [1], *Hordeum vulgare* [2], *Vigna unguiculata* [3,4], *Cajanus cajan* [5], *Vigna mungo* [6, 7]; and *Lens culinaris* [8, 9]. These reports show that mutagenesis is a potential tool to be employed for crop improvement. Kleinhofs *et a*l. [10] reported that sodium azide is a very potent mutagen in barley and induced chlorophyll deficiency as well as a wide range of morphological and physiological mutants. The chemical induces genetic sterility in rice without changes in vigour [11]. Mutation induction has become a proven way of creating variation within a crop variety. It offers the possibility of inducing desired attributes that either cannot be found in nature or have been lost during evolution. When no gene, or genes, for resistance to a

particular disease, or for tolerance to stress, can be found in the available gene pool, plant breeders have no obvious alternative but to attempt mutation induction. Mutation breeding supplement conventional plant breeding as a source of increasing variability and could confer specific improvement without significantly altering its acceptable phenotype [12]. The successful utilization of sodium azide to generate genetic variability in plant breeding has been reported in barley [10] and other crops [13]. Mutation breeding is the most useful and vital technology of sunflower [13]. Induction of mutations by gamma-rays and sodium azide are widely used in plant breeding programmes including *Vigna unguiculata* [3, 11].

Cowpea, *Vigna unguiculata* (L) Walpers, also known as black-eyed or southern pea, belongs to the genus *Vigna*, section *Catiang*, species *unguiculata*. The seeds are a major source of dietary protein in most developing countries [14]. More than 8 million hectares of cowpea are group in west and central Africa. Nigeria is the largest producer with 4 million hectare, followed by Niger with 3 million hectare. Other producers are Mali, Burkina Faso and Senegal. The main objectives of the present study therefore are to assess the mutagenic effects of sodium on some growth and yield parameters of four selected varieties of cowpea. It is also important to see if this mutagenic treatment may impose phenotypic changes in growth and yield parameters of the crops.

MATERIALS AND METHODS

Five (5) different cultivars of cowpea *Vigna unguiculata* were obtained from International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria. The cultivars include Tvu-3615, Tvu-2521, Tvu-3541, Tvu-3485 and Tvu-3574. The seeds were collected and stored in glass jars under room temperature void of moisture until required for use.

Top soil (0-10cm) was collected for use in the present study from an area measuring 50 m x 50 marked on a fallow land. The plot consisted mainly of Guinea grass (*Panicum maximum*) prior to cultivation. Soil physicochemical parameters prior to experiment include the following; pH (1:1) H_2O 5.63; Carbon 3.87 %; total nitrogen 20.62ppm; phosphate 36.54ppm; potassium 3.54 meq/100g; Ca 2.33 meq/100g; cation exchange capacity 8.42 meq/100g; Sand 64.46 %; Silt 24.38 % and Clay 11.16 %.

The soil was sun-dried to constant weight, and thereafter 5kg of soil was measured into into palm nursery polybags 30 cm in height and 23 cm in diameter. These were perforated at the bottom. They were left for one week before made ready for sowing of seeds.

The bags were buried three-quarters into the soil in the Screen House. The bags were irrigated with 200ml water daily at dusk, and also cleared of any unwanted weeds during the period under *fallow* until the bags were ready for cultivation on the 7^{th} day. The bags were placed on the field at a spacing of 60 cm x 30 cm, as proposed by Ikhajiagbe [15], amounting to 55,000 stands/ha.

Preparation of Mutagenic Solution

Sodium Azide solution was preferred in the present study as mutagenic agent. Four levels of mutagen were prepared on weight basis, viz: 0.031 %, 0.016 %, 0.125 %, and 0.250 % w/w NaN_3 in solution. These were labeled in the field as S1, S2, S3, and S4 respectively. The control was distilled water (0 %), designated S0.

Pre-treatment of Seeds with Sodium Azide

Seeds of the various cowpea accessions were subjected to varying concentrations of sodium azide (S0 – S4) for 6 hrs. The treated seeds were washed in running water to remove excess chemicals and exudates from the seeds and sown in Petri dishes containing distilled water to observe germination. The seeds were observed daily until maximum germination was attained on the 7th day after sowing (DAS).

Sowing

The other set of pre-soaked seeds were sown directly into soil. Planting was done in the evening, just beyond sunset following the methods of Ikhajiagbe [15]. Seeds were sown at the rate of 4 seeds per hole and at a depth of 3cm. When seedlings had attained 2-leaf stage (8-12cm long), they were thinned down to 2 seedlings per bag. The plot, including the soil bags, was weeded thrice before harvest. Because the bags were placed in the screen house (covered), water requirements by the crop were supplemented by the addition of 200ml tap water applied per bag beyond sunset. When plants were long enough, they were staked on poles.

Experimental Design

The experimental design chosen was the completely randomized design (CRD) following assumption of homogeneity of the experimental plot in use. As a result, treatments were randomized over the whole plot. Each treatment consisted of 4 replicates.

In other to avoid bias and misidentification, treatments bags were properly labeled according to a given treatment name and replicate number. Treatment bags were then randomized over the whole plot, each bearing an identification tag.

For example,

1	TVU-3615 + S0	x 4 replicates
2	TVU-3615 + S1	x 4 replicates
3	TVU-3615 + S2	x 4 replicates
4	TVU-3615 + S3	x 4 replicates
5	TVU-3615 + S4	x 4 replicates
6	TVU-2521 + S0	x 4 replicates
7	TVU-2521 + S1	x 4 replicates
8	TVU-2521 + S2	x 4 replicates
9	TVU-2521 + S3	x 4 replicates
10	TVU-2521 + S4	x 4 replicates
11	TVU-3541 + S0	x 4 replicates
12	TVU-3541 + S1	x 4 replicates
13	TVU-3541 + S2	x 4 replicates
14	TVU-3541 + S3	x 4 replicates
15	TVU-3541 + S4	x 4 replicates
16	TVU-3485 + S0	x 4 replicates
17	TVU-3485 + S1	x 4 replicates
18	TVU-3485 + S2	x 4 replicates
19	TVU-3485 + S3	x 4 replicates
20	TVU-3485 + S4	x 4 replicates

Parameters Considered

On the field, plants were assessed for both vegetative and yield parameters like plant height, number of primary shoot branches, number of leaves, total leaflet area, length of main root, number and weight of root nodules per plant, number of days to 50 % maturity, as well as estimated grain yield.

RESULTS AND DISCUSSION

Percentage germination in the control experiment was 100 % in TVU-3615. In 0.031 % NaN_3, germination reduced to 91.23 %. No germination was recorded in 0.125 % and 0.25 % NaN_3 respectively. Germination percentage was lowest in TVU-3574 (90.12 %). In agreement with the previous reports of Chandra and Tarar [16], the present study demonstrates that the germination is inversely proportional to the dosage. It is apparent that the control plants had the highest survival percentage when compared with other concentrations of the mutagen. There were reductions in the germination and survival percentages with increasing concentrations for the sodium azide. This was clearly seen among mutagenic levels that were of higher concentrations. This is consistent with results of previous studies [3, 11, 17].

Tvu-3615 pretreated with 0.016 % NaN_3 showed highest germination and survival rate (90.23 %) with Tvu-3574 having the least percentage (65.63 %). This could be due to difference in response to the mutagen by the different cultivars of *Vigna*. The reduction in seed germination in mutagenic treatments had been explained due to delayed or inhibition of physiological and biological processes necessary for seed germination which include enzyme activity, and inhibition of mitotic process [18, 19]. The inhibitory effect of NaN_3 on germination could be azide anions which are strong inhibitors of cytochrome oxidase, which in turn inhibits oxidative phosphorylation [10]. In addition, it is a potent inhibitor of the proton pump and alters the mitochondrial membrane potential [20]. These effects together may hamper ATP biosynthesis resulting in decreased availability of ATP which may slow the germination rate and reduce the germination percentage. Cheng and Gao [21] treated barley seeds with NaN_3 and significant reduction

was found in the % germination. In the present study, maximum reduction (12.43 %) was recorded in cultivar TVU-3541 at 0.125 % mutagenic level.

Radicle length in 0.016 % and 0.031 % pretreated seeds respectively were not significantly different from the control (4.3cm) at 6 days after sowing. However, no radical formation was recorded in higher doses of NaN_3 (0.125 % and 0.25 % respectievly). Khan *et al*. [9] reported significant reductions in radical length in *Erusca sativa L*.

Table 1: Effects of mutagenic treatments on some germination parameters of selected cowpea cultivars at 6 days after planting (DAP)

Treatments(ppm)	Percentage germination (%)	Radical length(cm)	Fresh weight of sprouted seeds	Dry weight of sprouted seeds (g).
TVU-3615 + S0	100	4.3(0.19)	0.801 (0.154)	0.233 (0. 067)
TVU-3615 + S1	90.23 (8.12)	4.6(0.23)	0.855 (0.124)	0.266 (0. 043)
TVU-3615 + S2	61.02 (5.21)	4.1(0.23)	0.968 (0. 218)	0.218 (0. 098)
TVU-3615 + S3	0	0	0	0
TVU-3615 + S4	0	0	0	0
TVU-2521 + S0	100	4.7 (0.15)	1.148 (0. 112)	0.174 (0. 053)
TVU-2521 + S1	89.98 (9.12)	4.2(0.18)	0.979 (0. 134)	0.164 (0. 034)
TVU-2521 + S2	60.32 (7.20)	4.3 (0.28)	1.249 (0. 172)	0.149 (0. 077)
TVU-2521 + S3	0	0	0	0
TVU-2521 + S4	0	0	0	0
TVU-3541 + S0	98.12 (5.12)	4.3 (0.12)	1.099 (0. 132)	0.161 (0. 051)
TVU-3541 + S1	71.32 (4.12)	4.6 (0. 23)	1.114 (0. 234)	0.162 (0. 099)
TVU-3541 + S2	59.82 (6.21)	4.0 (0. 26)	1.258 (0. 273)	0.188 (0. 063)
TVU-3541 + S3	12.43 (5.29)	4.3 (0. 18)	0.953 (0. 124)	0.1687 (0.109)
TVU-3541 + S4	0	0	0	0
TVU-3485 + S0	100	4.6 (0. 32)	1.015 (0. 142)	0.203 (0. 076)
TVU-3485 + S1	68.63 (9.12)	4.4 (0. 17)	0.894 (0. 125)	0.223 (0. 040)
TVU-3485 + S2	54.97 (5.88)	4.1 (0. 19)	1.079 (0. 142)	0.199 (0. 054)
TVU-3485 + S3	48.08 (7.44)	3.7 (0. 24)	0.867 (0.103)	0.187 (0.098)
TVU-3485 + S4	0	0	0	0
TVU-3574 + S0	90.12 (2.12)	4.3 (0. 23)	0.901 (0.123)	0.235 (0. 067)
TVU-3574 + S1	65.63 (7.37)	4.3 (0. 24)	1.217 (0.211)	0.164 (0. 032)
TVU-3574 + S2	58.77 (4.32)	3.6 (0. 21)	0.831(0.143)	0.236 (0. 039)
TVU-3574 + S3	0	0	0	0
TVU-3574 + S4	0	0	0	0

Values presented are mean and standard deviations (in parentheses) for 5 determinations. Mutagenic levels represented as S0, S1, S2, S3 and S4 are 0 %, 0.016 %, 0.031 %, 0.125 %, and 0.250 % NaN_3.

Fig. 1 shows progressive change in plant height in response to NaN_3 pretreatment. During 5 WAP, average plant height in TVU-2521 (control) was 87cm, in comparison to 47.6cm obtained in TVU-3485 at the same time under the control level. Plant height was 118.2cm in TVU-3541 pretreated in 0.016 % NaN_3 solution and 78.6cm in TVU-3485. At 15 WAP, plant height in TVU-3541 pretreated in 0.016 % NaN_3 solution was 188.4cm compared to 116.0 cm obtained in TVU-3574 (control). TVU-3574 pretreated in 0.016 % NaN_3 solution was 124.5cm in height, while TVU-3541 pretreated in 0.016 % NaN_3 solution was 211.5cm at 15 WAP. In general, all the cultivars recorded steady increase in plant height from the 1st to 15th WAP with increase in concentration of sodium azide. No seed germination was observed in 0.250 %., this may be as a result of higher dose of sodium azide which causes disturbance in genetic and physiological activities leading to the death of the cells [22].

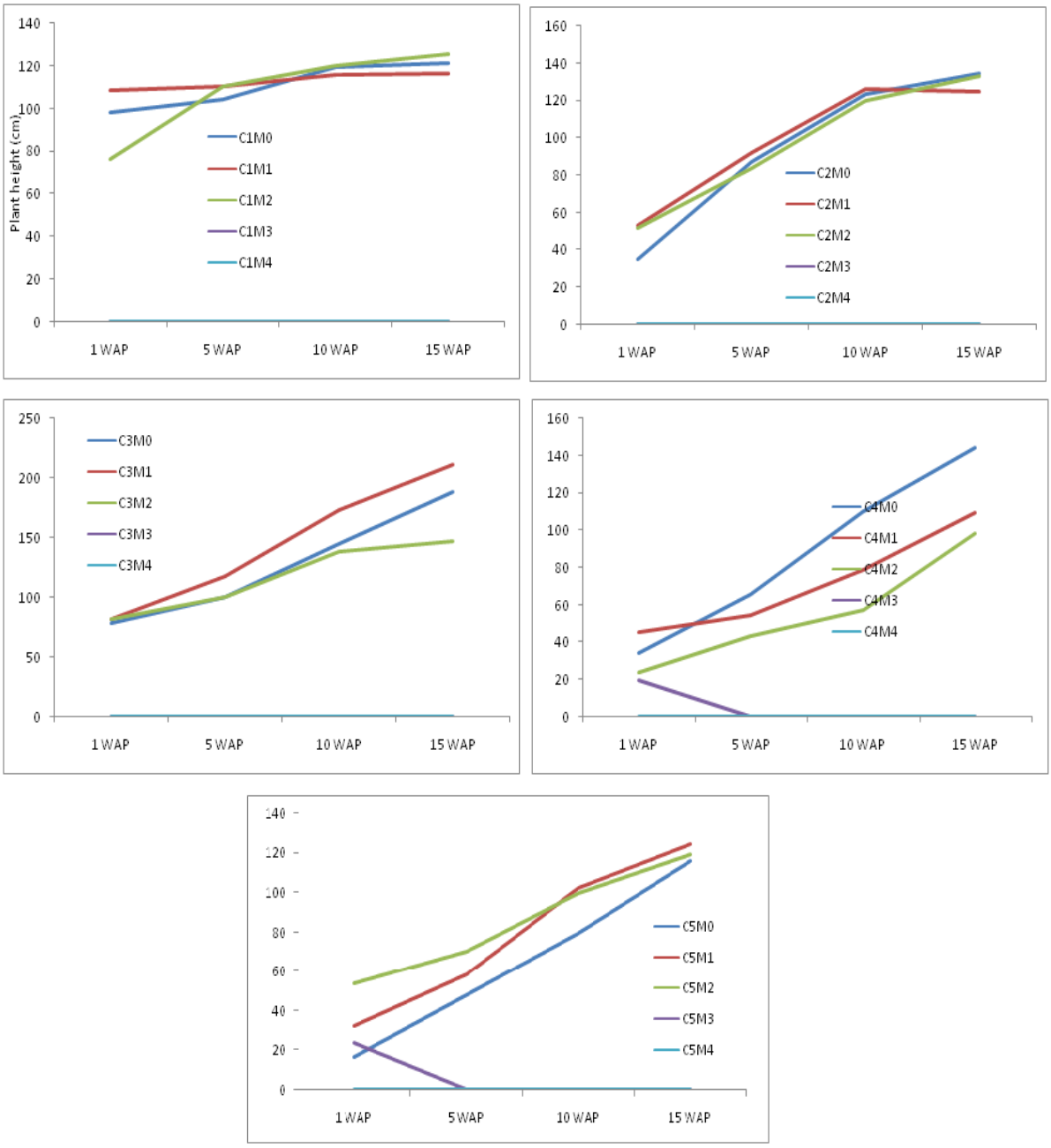

Figure 1: Effects of mutagens on Plant height of the cowpea accessions. Tvu-3615, Tvu-2521, Tvu-3541, Tvu-3485 and Tvu-3574 are represented by C1, C2, C3, and C4 respectively in the figure. Mutagenic levels represented as S0, S1, S2, S3 and S4 are 0 %, 0.016 %, 0.031 %, 0.125 %, and 0.250 % NaN_3.

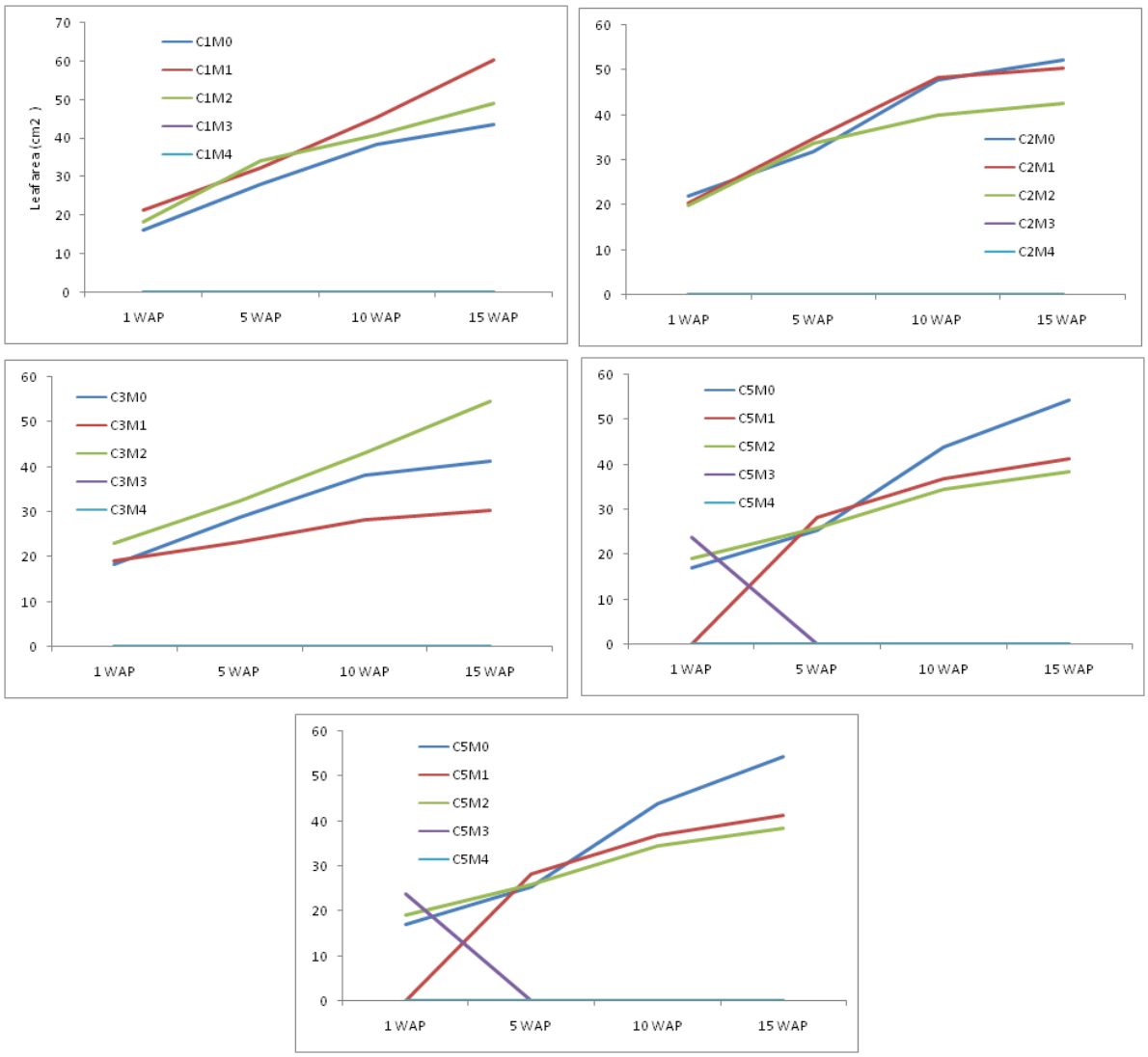

Figure 2: Effects of mutagens on Leaf area (cS2) of the cowpea accessions. Tvu-3615, Tvu-2521, Tvu-3541, Tvu-3485 and Tvu-3574 are represented by C1, C2, C3, and C4 respectively in the figure. Mutagenic levels represented as S0, S1, S2, S3 and S4 are 0 %, 0.016 %, 0.031 %, 0.125 %, and 0.250 % NaN_3.

Fig 2 showed that average Leaf area at 1 WAP in TVU-2521 (control) was 22.1cm compared to 18.2cS2 obtained in TVU-3485 (control). TVU-3574 pretreated in 0.016 % NaN_3 solution had 16.0cS2 average leaf area while TVU-3485 (control) was 18.2cS2. Pretreatment of seeds with 0.016 % NaN_3 resulted in slightly elevated leaflet area of 21.3cS2 in TVU-3615, and 20.5cS2 in TVU-2521. At 5 WAP however, leaflet area was 28.3cS2 in TVU-3574 and 28.8cS2 in TVU-3541. At 10 WAP, leaflet area was 40.9cS2 in TVU-3615 pretreated in 0.031 % NaN_3 solution compared to 34.4cS2 in TVU-3574

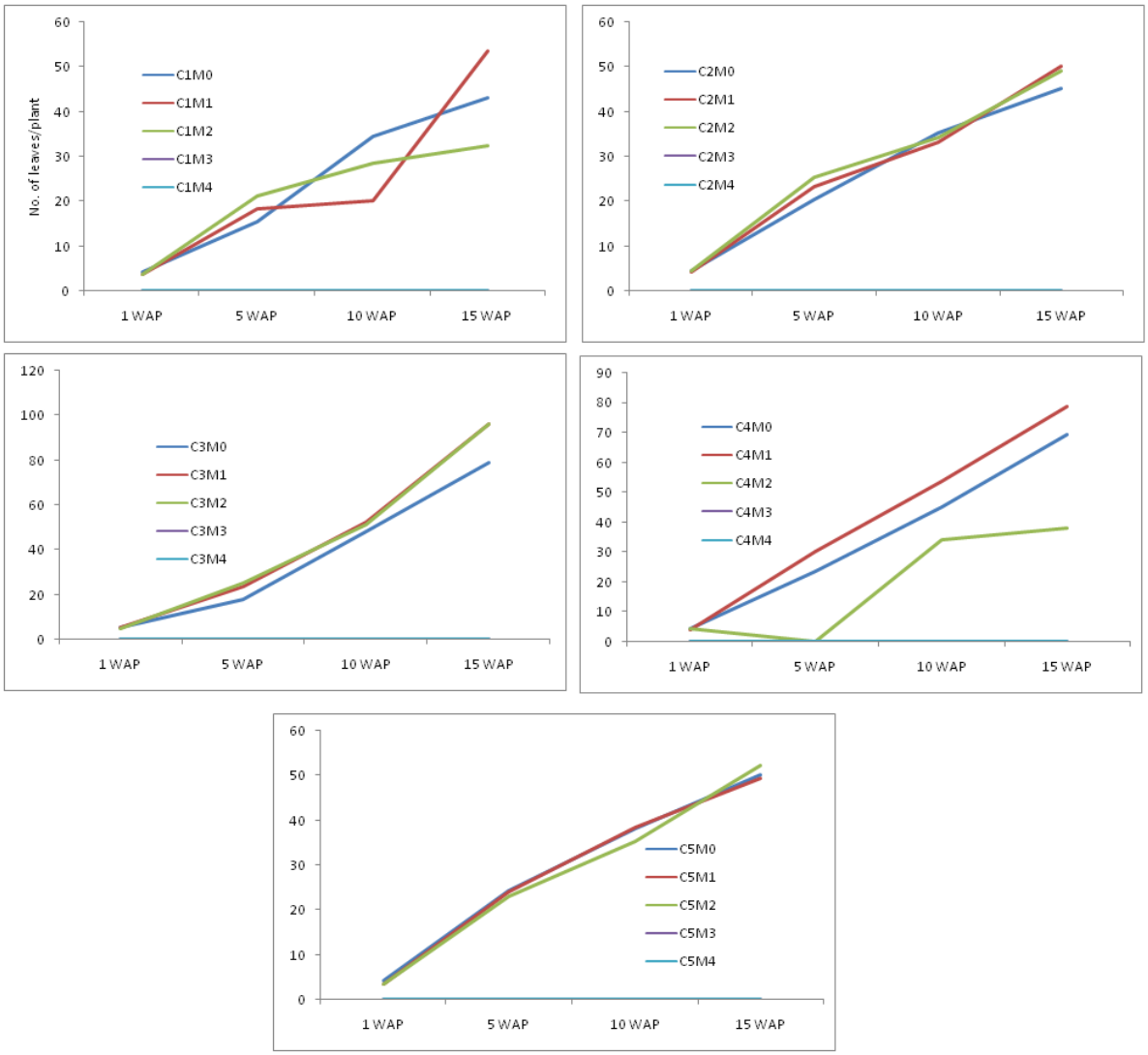

Figure 3: Effects of mutagens on number of leaves per plant of the cowpea accessions. Tvu-3615, Tvu-2521, Tvu-3541, Tvu-3485 and Tvu-3574 are represented by C1, C2, C3, and C4 respectively in the figure. Mutagenic levels represented as S0, S1, S2, S3 and S4 are 0 %, 0.016 %, 0.031 %, 0.125 %, and 0.250 % NaN_3.

Average number of leaves per plant in TVU-3615 (control) was 4.2 as compared to 4.5 in TVU-2521 (control) and 3.5 in TVU-3574 pretreated in 0.016 % NaN_3 solution at 1 WAP. TVU-3615 pretreated in 0.016 % NaN_3 solution had 3.8 average numbers of leaves at 1WAP Compared to 4.2 in TVU-2521 pretreated in 0.016 % NaN_3 solution and 5.2 in TVU-3541, as against 3.9 in TVU-3485. The average number of leaves per plant at 10 WAP 34.2 in TVU-3485 pretreated in 0.031 % NaN_3 solution compared to 35.4 TVU-3574 and 51.2 in TVU-3541. These increments may be due to the physiological stimulation of the chemical mutagen as reported by El-Torky [23] in *Euonymus japonicus*.

Table 2: Effects of mutagenic treatments on some growth parameters of selected cowpea cultivars at 100 days after planting (DAP)

Treatments (ppm)	Shoot length(cm)	Leaf area	Total chlorophyll (mg/g)	Dry wt of root (g)	No. of root nodules per plant	10 dry nodule wt. (g)
TVU-3615 + S0	121.3 (13.6)	43.7 (5.6)	3.28 (0.13)	3.9 (0.2)	23.2 (2.5)	2.5 (0.2)
TVU-3615 + S1	116.3 (15.2)	60.4 (3.5)	3.19 (0.15)	4.3 (0.3)	20.5 (1.8)	2.4 (0.3)
TVU-3615 + S2	125.6 (14.1)	49.1 (2.2)	3.29 (0.16)	4.9 (0.3)	22.3 (2.6)	2.1 (0.4)
TVU-3615 + S3	0	0	0	0	0	0
TVU-3615 + S4	0	0	0	0	0	0
TVU-2521 + S0	134.8 (5.2)	52.3 (9.6)	3.32 (0.25)	4.0 (0.2)	19.5 (2.6)	2.3 (0.6)
TVU-2521 + S1	125.2 (9.3)	50.3(12.2)	3.37 (0.21)	5.2 (0.4)	23.9 (1.8)	2.5 (0.4)
TVU-2521 + S2	132.8 (10.1)	42.7 (9.5)	3.30 (0.15)	4.8 (0.3)	20.4 (3.0)	2.0 (0.2)
TVU-2521 + S3	0	0	0	0	0	0
TVU-2521 + S4	0	0	0	0	0	0
TVU-3541 + S0	188.4 (12.3)	41.4 (6.7)	3.28 (0.16)	4.1 (0.2)	16.6 (2.4)	2.3 (0.3)
TVU-3541 + S1	211.5 (11.3)	50.4(3.6)	3.18 (0.15)	3.9 (0.3)	11.4 (1.8)	2.1 (0.2)
TVU-3541 + S2	146.8 (9.5)	54.6 (5.9)	3.09 (0.15)	4.3 (0.4)	13.6 (1.2)	1.9 (0.4)
TVU-3541 + S3	0	0	0	0	0	0
TVU-3541 + S4	0	0	0	0	0	0
TVU-3485 + S0	144.5 (14.0)	37.4 (5.0)	3.41 (0.12)	3.8 (0.3)	6.9 (0.9)	2.1 (0.3)
TVU-3485 + S1	109.2 (9.5)	40.6 (4.2)	3.30 (0.13)	4.1 (0.4)	9.8 (1.2)	2.0 (0.4)
TVU-3485 + S2	98.5 (9.8)	80.5(16.2)	3.34 (0.13)	4.0 (0.4)	8.9 (1.6)	2.4 (0.2)
TVU-3485 + S3	0	0	0	0	0	0
TVU-3485 + S4	0	0	0	0	0	0
TVU-3574 + S0	116.0 (9.2)	54.3 (2.3)	3.35 (0.16)	3.8 (0.3)	10.4 (1.8)	1.8 (0.2)
TVU-3574 + S1	124.5 (8.6)	41.3 (2.9)	3.37 (0.19)	3.6 (0.2)	11.6 (1.8)	1.9 (0.3)
TVU-3574 + S2	119.5 (15.4)	38.4 (5.2)	3.29 (0.19)	3.0 (0.3)	16.8 (2.1)	2.1 (0.3)
TVU-3574 + S3	0	0	0	0	0	0
TVU-3574 + S4	0	0	0	0	0	0

Values presented are mean and standard deviations (in parentheses) for 5 determinations. Mutagenic levels represented as S0, S1, S2, S3 and S4 are 0 %, 0.016 %, 0.031 %, 0.125 %, and 0.250 % NaN_3.

Table 2 shows the Effects of mutagenic treatments on some growth parameters of selected cowpea cultivars at 100 days after planting (DAP). Shoot length increased in 0.016 % NaN_3 treatment but decreased in the 0.031 % NaN_3 treatment in cultivars TVU-3541 and TVU-3574 respectively, while TVU- 3615 and TVU-2521 showed decreases. No growth was recorded 0.125 % and 0.25 % NaN_3 levels respectively. The present results confirm the earlier report of Mensah *et al.* [18] on Sesame.

Lower levels (0.016 % and 0.013 %) of NaN_3 significantly increased leaf area in TVU-3615, TVU-2521, TVU-3541, and TVU-3485. This is contrary to work done in *Erusca sativa L.* [9] and in *Capsicum annum* [24]. Jabeen and Mirja [24] had performed an experiment and recorded that leaf area decreased with increase of doses of ethyl methane sulphonate (EMS) which is a chemomutagen. However decreased leaf area was recorded in TVU-3574 with increased mutagen in the present study. No significant changes in chlorophyll content of leaves was recorded as a result of mutagenic treatments compared with control experiment. Total leaf chlorophyll ranged from 3.09 mg/g – 3.28mg/g in TVU-3541, and from 3.19 -3.29mg/g in TVU-3615. Comparatively, however, total chlorophyll ranges was highest in TVU-3485 (3.30 -3.41mg/g).

No significant changes in number of root nodules in the cowpea cultivars was recorded at 100 days after planting DAP) as a result of NaN_3 treatments. However, sodium azide significantly enhanced the development nodules in TVU-3574, where number of root nodules per plant increased from 10.4 in the control to 16.8 in plants pretreated with 0.031 % NaN_3 solution. This confirms with the work done on *Vigna subterranean* [25].

Table 3: Effects of mutagenic agent on the yield parameters of the various assertions of cowpea at 120 days after planting

Treatments (ppm)	No. of flowers /plants	Days to 50 % maturity	Maturity period(days)	No. of Pods/plant	No. of seeds/pod	Dry weight of 100 seeds (g)	Dry weight of plants(g)
TVU-3615 + S0	22.2 (2.6)	88.4 (3.2)	106.4 (5.3)	8.2 (1.8)	7.6 (2.2)	11.8 (2.1)	52.6 (2.0)
TVU-3615 + S1	98 (3)	98.6 (2.8)	112.1 (4.9)	12.6 (2.5)	8.5 (1.6)	9.5 (1.6)	41.1 (3.4)
TVU-3615 + S2	100 (3)	91.5 (3.5)	117.5 (5.1)	19.4 (2.6)	8.6 (2.3)	13.4 (2.1)	43.6 (2.8)
TVU-3615 + S3	0	0	0	0	0	0	0
TVU-3615 + S4	0	0	0	0	0	0	0
TVU-2521 + S0	35.2 (3.5)	93.4 (3.6)	118.1 (3.9)	11.6 (2.1)	8.3 (2.8)	12.6 (2.0)	32.4 (2.8)
TVU-2521 + S1	31.2 (4.2)	94.6 (2.9)	122.5 (2.8)	18.1 (1.9)	9.3 (1.9)	11.4 (1.5)	29.3 (2.6)
TVU-2521 + S2	30.9 (3.5)	98.4 (3.2)	125.4 (4.8)	20.2 (1.5)	9.5 (2.3)	14.2 (1.7)	30.4 (3.8)
TVU-2521 + S3	0	0	0	0	0	0	0
TVU-2521 + S4	0	0	0	0	0	0	0
TVU-3541 + S0	34.8 (3.6)	98.5 (3.6)	119.6 (5.0)	9.4 (1.5)	7.9 (2.1)	11.9 (1.6)	50.1 (3.2)
TVU-3541 + S1	28.5 (2.8)	92.3 (3.2)	116.4 (3.6)	19.6 (2.6)	8.5 (1.8)	13.7 (1.4)	32.5 (3.4)
TVU-3541 + S2	31.3 (2.7)	90.4 (2.8)	120.8 (5.4)	28.2 (2.4)	9.4 (3.0)	13.2 (1.8)	40.4 (2.8)
TVU-3541 + S3	0	0	0	0	0	0	0
TVU-3541 + S4	0	0	0	0	0	0	0
TVU-3485 + S0	28.9 (3.1)	95.4 (3.6)	117.2 (2.3)	11.4 (1.6)	9.0 (1.9)	7.7 (1.8)	19.6 (2.5)
TVU-3485 + S1	36.2 (3.5)	94.4 (3.5)	117.6 (4.2)	22.5 (2.6)	8.9 (1.2)	13.1 (2.0)	53.5 (3.2)
TVU-3485 + S2	30.9 (2.8)	91.6 (4.0)	115.4 (3.2)	27.4 (3.2)	8.5 (0.9)	11.9 (2.4)	47.4 (3.5)
TVU-3485 + S3	0	0	0	0	0	0	0
TVU-3485 + S4	0	0	0	0	0	0	0
TVU-3574 + S0	25.2 (2.8)	93.1 (3.6)	116.8 (3.5)	10.6 (1.9)	7.8 (1.2)	14.1 (2.0)	43.5 (2.8)
TVU-3574 + S1	39.6 (2.9)	95.6 (33.4)	119.6 (2.6)	24.4 (2.4)	8.5 (2.3)	16.5 (2.6)	45.2 (2.9)
TVU-3574 + S2	35.3 (3.1)	98.5 (2.9)	122.7 (6.5)	22.6 (2.6)	8.3 (2.6)	17.2 (1.8)	46.2 (3.4)
TVU-3574 + S3	0	0	0	0	0	0	0
TVU-3574 + S4	0	0	0	0	0	0	0

Values presented are mean and standard deviations (in parentheses) for 5 determinations. Mutagenic levels represented as S0, S1, S2, S3 and S4 are 0 %, 0.016 %, 0.031 %, 0.125 %, and 0.250 % NaN_3.

Sodium azide triggered significant increases in number of flowers per plant in TVU-3615 from 22.2 in the control to 100 in plants pretreated with 0.013 % NaN_3 solution (Table 3). However, no significant effects of NaN_3 were recorded in all the other cultivars. Similarly, NaN_3 treatment had no significant effects on number of days required for 50 % pod maturity except in TVU-3615. It is very possible that TVU-3615 cultivar may be vary sensitive to NaN3 effects compared to the other cultivars. There were significant decreases in otal dry weight of mutant plants compared to the control. Dry weight of TVU-3615 plants decreased from 52.6 – 41.1g. Similar decreases from 32.4 – 29.3g and 50.1 -32.5g were recorded in TVU-2521 and TVU-3541 respectively. However, increases in dry weight of plants were recorded in TVU-3485 (19.6 -53.5g) and TVU-3574 (43.5 – 46.2g) respectively. No. of Pods/plant increased with increase in the concentration of NaN_3 among all the cultivars shown on Table 3. This does agrees with work done by Mensah *et al*. [26] in *Arachis hypogaea*. Since yield per plant is the most desirable character, at 0.031 % NaN_3, TVU-3541 showed the highest number of pod/plant.

Table 4: Genetic parameters of some yield parameters of cowpea

Character	Mean	Phenotypic Variance (δ^2ph)	√(δ^2ph) or δph	Genotypic Variance (δ^2g)	Heritability (%)	Genetic Advance	Genetic Gain
No. of root nodules	15.72	261.106	16.159	260.667	99.83	33.231	211.39
10 root nodule wt (g)	2.160	4.123	2.031	4.087	99.13	4.145	191.91
No. of pods/plant	17.747	321.959	17.943	321.831	99.96	36.95	208.19
100 dry seed wt (g)	12.813	137.460	11.724	137.360	99.93	24.14	188.43
No. of seeds/pod	8.5733	57.430	7.578	57.378	99.91	15.59	181.93

Table 8 showed that the phenotypic variance for the number of root nodules was 261.1 and that for the weight for 10 root nodule was 4.1. The genotypic variance for the number of root nodules was calculated to be 260.7; while pods/plant had 321.8. Heritability of the cultivars was calculated as follows: 99.83 %, 99.13 %, 99.96 %, 99.93 %, and 99.91 % for No. of root nodules, root nodule weight, pods/plant, dry seed weight, and seeds/pod respectively. Genetic advance for number of root nodules was 33.2; while that for root nodule weight was 4.1. Observed changes resulting from NaN_3 treatments are necessarily genetic rather environmental.

The results of the present study demonstrates that at lower doses (0.016 % and 0.031 %) significant changes in vegetative and yield parameters were obtained. Higher doses (0.125 % and 0.25 % NaN_3) of the mutagen were deleterious.

REFERENCES

[1] Rao GM and Siddiq EA. **1977**. *The Indian Journal of Genetics & Plant Breeding* 37(1): 12-21.
[2] Ramesh B, Prasad BK and Singh VP. **2001**. *Mutation Breeding Newsletter* 45: 26-27.
[3] Mensah JK and Akomeah PA. **1992**. *Legume Research* 15(1): 39-44.
[4] Mensah JK, Akomeah PA. **1997**. *Legume Res.* 15:39-44.
[5] Srivastava A and Singh VP. **1996**. *Mutation Breeding Newsletter* 42: 8-9.
[6] Kundu SK and Singh DP. **1981** *Crop Improvement* 8: 71-72.
[7] Singh M and Singh VP. **2001**. *Indian Journal of Pulses Research* 14(1): 60-62.
[8] Rajput MA, Sarwar G and Siddiqui KA. **2001**. *Mutation Breeding Newsletter* 45: 35.
[9] Khan S, Wani MR and Parveen K. **2006**. *Agricultural Science Digest* 26(1): 65-66.
[10] Kleinhofs W, Sander C. **1975**. Azide mutagenesis in Barley. Third Barley Genetics Symp. Garching. Proceedings of Symp. Pp113-122.
[11] Mensah JK, Akomeah PA, Ekpekurede EO. **2005**. *Global J. Pure Appl. Sci*. 11(3): 327-330.
[12] Ojomo OA. **1970**. *Ghana J. Sci*. 10:33-37
[13] Jaya KS and Selva RR. **2003**. *Madras Agric. J.* 90(7-9): 574-576.
[14] Duke L. **1990**.Introduction, In Singh SR (ed.) Insect pests of food legumes, Wiley, New York, p. 1-42 Genetics and Plant Breeding 37(1): 12-21.
[15] Ikhajiagbe B. **2004**. Response of African Yam Bean (Sphenostylis stenocarpa (Hochst ex A Rich) Harms to N, P, and K Fertilizer Effects and to Salinity Stress. M.Sc Thesis, December 2004. Dept. of Botany, University of Benin, Benin City.
[16] Chandra N. and Tarar JL. **1988**. *Indian J. Bot*.,11; 11-18
[17] Mensah JK. **1977**. Effects of chemical mutagens on three variants of cowpea,Vigna unguiculata (L) Walp. (B.Sc. (Hons.) project) Univ. Cape Coast, Ghana, p. 32.
[18] Mensah JK, Obadoni BO, Akomeah PA, Ikhajiagbe B. and Ajibolu, Janet. **2006**. *African Journal of Biotechnology 6*(5): 534-538.
[19] Ananthaswamy HM, Vakil VK, Shrinivas A. **1971**. *Radiat. Bot*., 11: 1-12.
[20] Zhang, B.H. **2000**. *Biochem*.,39:1567.
[21] Cheng X and Gao M. **1988**. *Environ Exp. Bot*., 28: 281-288.
[22] Al-Qurainy F and Khan S. **2009**. *World Applied Sci. J.*, 6: 1589-1601.
[23] El-Torky MG. **1992**. *Alex. J. Agric. Res*., 37: 249-260.
[24] Jabeen C and Mirja K. 2002. *Asian journal of plant sciences*. Volume 1 number 4;.425-428, **2002**.
[25] Mensah JK, Ikhajiagbe B, Edema NE, Emokhor J. **2012.** *Nigeria. J. Nat. Prod. Plant Resour*., 2 (1):107-112 .
[26] Mensah JK, Obadoni BO, Akomeah PA, Ikhajiagbe B.and Ajibolu, Janet. **2007**. *African Journal of Biotechnology* 6(5): 534-538.