FULL LENGTH RESEARCH ARTICLE

MORPHOGICAL EFFECTS OF SODIUM AZIDE ON TOMATO *(Lycopersicon esculentum* Mill)

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ABSTRACT
Dry seeds of tomato (*Lycopersicon esculentun* Mill), varieties T106, T244 and T420 obtained from the Institute of Agriculture Research, Ahmadu Bello University Zaria, Nigeria were treated with sodium azide at concentrations of 1.0, 2.0 and 4.0 mM aimed at determining the effects of the mutagen on the morphological features of tomato. Highly significant differences (P<0.01) were observed in the varieties and treatments with respect to the studied traits (seed germination, seedling survival, seedling height, root length, number of leaves per seedling, height at maturity, number of branches per plant and fruits per plant). Treatment and variety interactions were similarly highly significant (P<0.01) with respect to all traits except height at maturity. Variety T106 showed better performance when compared to T244 and T420. It is concluded that sodium azide could be utilized to induce variability for the improvement of tomato.

Keywords: Sodium azide, chemical mutagen, induced mutation, tomato.

INTRODUCTION
Mutations are the tools used by the geneticist to study the nature and function of genes which are the building blocks and basis of plant growth and development, thereby producing raw materials for genetic improvement of economic crops (Adamu *et al*. 2004). Induced mutations have great potentials and served as a complimentary approach in genetic improvement of crops (Mehandjiev *et al*. 2001). Various mutagenic agents are used to induce favourable mutations at high frequency that include ionizing radiation and chemical mutagens (Ahloowalia & Maluszynski 2001). Induced mutations have been used to improve major crops such as wheat, rice, barley, cotton, peanut and cowpea, which are seed propagated. A number of workers (Coe & Neuffer 1977, Mashencov 1986, Ricardo & Ando 1998, Oiejniczak & Patyna 1985) have reported on the role of chemical mutagens in enhancing variability in higher plants. The mutants so produced facilitate the isolation, identification and cloning of genes used in designing crops with improved yields, increase stress tolerance, longer shelf life and reduced agronomic input (Ahloowalia & Maluszynski 2001).

Tomato suffers from several problems that include high disease incidence, pest infestations, and adverse effects of environmental stress e. t. c. that greatly affects its production (Encarta 2005). The results of a study on the effectiveness of sodium azide in inducing mutations in tomato are presented.

MATERIALS AND METHOD
Acquisition and preparation of seeds: Air dried seeds of tomato varieties T106, T244 and T420 were obtained from the Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria and treated with different concentrations of sodium azide (1.0, 2.0 and 4.0 mM) in 0.1M phosphate buffer pH 3 for 4 hrs. The treatments were periodically agitated at room temperature. The seeds were then thoroughly rinsed in tap-water to remove excess mutagens. The control seeds were soaked in buffer solution pH 3.

Planting of seeds: The treated seeds were planted both in the laboratory and the field. In the laboratory, sowing involved planting seeds in lunch boxes. Planting in the field involved germinating the seeds in pots to obtain the seedlings, which were transplanted in beds after 4 weeks. Each treatment was replicated five times using completely randomized design (CRD).

Parameters measured: Data were collected on germination percentage, seedling height, root length, seedling survival, and number of leaves per seedling, height at maturity, number of leaves per plant, maturity (number of days to 50% flowering) and yield per plant in each M1 generation and analyzed using analysis of variance (ANOVA). Duncan's multiple range test was used to separate the means.

RESULTS
The M1 generation indicated highly significant differences (P<0.01) for all traits studied in the three varieties of tomato exposed to sodium azide (Table 1). There was general decrease in germination percentage, seedling height, root length, number of leaves per seedling, seedling survival, height at maturity and fruit yield per plant, with increase in mutagen concentration (Table 2). Variety and treatment interactions were also highly significant (P<0.01) for traits studied except height at maturity (Table 3). There was a highly significant difference in the performance of the 3 varieties in response to sodium azide treatment with T106 performing better in all the traits studied (Table 4). Seedling survival in T244 and T420 was nill, therefore other characters such as height at maturity, number of branches per plant and number of fruits were not obtained since the plants could not survive to those stages. There were highly significant differences (P<0.01) between the concentration of sodium azide and all the traits studied, with 4.0mM being the most effective for germination percentage, seedling height, root length, number of leaves per seedling and number of fruits per plant (Table 5).

DISCUSSION
The result of this work showed that all the traits studied were affected by sodium azide treatment. The decrease in seedling emergence, seedling height, root length, and seedling survival, height at maturity and fruit yield per plant with increasing mutagen concentration has been reported in mutagenesis studies (Adamu *et al*. 2002) when groundnut was treated with gamma rays.

The effects of ionizing radiation on tomato also revealed that these traits were dose dependent (Adamu *et al*. 2004). Similar result was obtained by Sheeba *et al*. (2005) when gamma rays

TABLE1: MEAN SQUARE ESTIMATE OF EFFECTS OF SODIUM AZIDE ON TOMATO (*Lycopersicon esculentum* Mill)

Source of variation	df	Germination % 5days	Germination % 8days	Seedling height (cm)	Root length (cm)	Number of leaves/ seedling	Percentage seedling survival	Height at maturity (cm)	Number of Branches/ Plant.	50 % Flowering (Days)	Number Of Fruits /plant
Treatment	15	2220.9**	2533.88 **	50.22**	55.44 **	26.29**	3608.60 **	1252.91 **	59.89 **	7756.62 **	295.36**
Error	44	17.28	19.06	1.86	1.08	1.06	28.05	52.49	1.058	1.67	3.84

*=Significant (p<0.05) ns=non-significant (P<0.05)
**= significant (P<0.01)

TABLE 2: MORPHOLOGICAL EFFECT OF SODIUM AZIDE ON TOMATO *Lycopersicon esculentum* (Mill)

Variety		Germination % 5days	Germination % 8days	Seedling height (cm)	Root length (cm)	Number of leaves/ seedling	Percentage seedling survival	Height at maturity (cm)	Number of Branches/ plant.	50% Flowering (days)	Number Of Fruits /plant
T106	0mM	80.00[a]	89.60 [a]	10.00 [b]	8.12 [c]	7.00 [c]	80.00 [a]	49.00 [a]	10.00 [a]	85.80 [b`]	30 [a`]
	1mM	44.60 [c]	76.40 [b]	10.38 [b]	10.92 [b]	9.00 [b]	62.80 [b]	39.38 [b]	6.00 [b]	89.20 [a]	12 [d]
	2mM	53.60 [b]	71.80 [b]	12.80 [a]	14.22 [a]	9.00 [b]	58.20 [b]	32.44 [b]	6.00 [b]	82.80 [a]	7 [e]
	4mM	39.60 [d]	47.00 [c]	6.32 [c]	7.44 [c]	7.00 [c]	61.20 [b]	24.40 [b]	4.00 [c]	89.20 [a]	4 [f]
T224	0mM	19.00 [e]	68.40 [b]	13.10 [a]	5.50 [c]	11.00 [a]	33.40 [c]	23.40 [b]	9.00 [a]	88.40 [a]	20 [b]
	1mM	6.80 [h]	47.20 [c]	5.22 [c]	3.36 [d]	4.00 [d]	0.00	-	-	-	-
	2mM	0.00 [i]	43.80 [c]	3.74 [d]	3.24 [d]	3.00 [d]	0.00	-	-	-	-
	4mM	2.00 [h]	24.40 [d]	3.44 [d]	2.36 [d]	3.00 [d]	0.00	-	-	-	-
T420	0mM	20.20 [e]	87.00 [a]	9.12 [b]	6.52 [c]	4.00 [d]	38.80 [c]	23.28 [b]	9.00 [a]	85.80 [c]	16 [c]
	1mM	11.20 [f]	22.20 [d]	7.36 [c]	2.46 [d]	5.00 [d]	0.00	-	-	-	-
	2mM`	13.20 [f]	20.20 [d]	3.38 [d]	2.18 [d]	4.00 [d]	0.00	-	-	-	-
	4mM	6.60 [h]	21.80 [d]	3.10 [d]	2.50 [d]	3.00 [d]	0.00	-	-	-	-

Means with the same letter within the same column are not significantly different.

TABLE3: MEAN SQUARE OF THE EFFECTS OF SODIUM AZIDE ON TOMATO (*Lycopersicon esculentum* Mill).

Source of variation	df	Germination percentage 5days	Germination percentage 8days	Seedling height (cm)	Root length (cm)	Number of leaves/ seedling	Percentage seedling survival	Height at maturity (cm)	Number of Branches/ Plant	50% Flowering (days)	Number of Fruits /plant
Replication	4	10.39^{ns}	66.56^{ns}	1.04^{ns}	1.32^{ns}	58.61^{ns}	2.06^{ns}	173.37*	2.57^{ns}	5.39*	4.06^{ns}
Variety	2	13417.32**	5969.02**	99.17**	295.95**	21309.62	88.72**	6189.48**	109.35**	29683.62**	1179.27**
Treatment	3	1605.73**	6892.7**	107.35**	21.57**	3491.96**	20.72**	1748.20**	204.42**	12126.95**	228.33**
Treatment/ variety	6	267.98**	854.2**	38.13**	28.28v	133.24**	24.38**	79.59^{ns}	9.35**	3429.95**	223.83**
Error	44	17.28	19.06	1.85	1.084	28.05	1.06	52.49	1.52	1.67	3.84

*=Significant (p<0.05) ns=non-significant (p<0.05)
**= significant (p<0.01)

TABLE4: MEAN SQUARE VALUES OF EFFECTS OF SODIUM AZIDE ON TOMATO (*Lycopersicon esculentum* Mill).

Variety	Germination percentage 5days	Germination percentage 8days	Seedling height (cm)	Root length (cm)	Number of leaves/ seedling	Percentage seedling survival	Height at maturity (cm)	Number of Branches/ Plant.	50% Flowering (days)	Number Of Fruits /plant
T106	54.45^{a}	71.29^{a}	9.87^{a}	10.17^{a}	65.55^{a}	8.00a	36.30^{a}	6.00^{a}	88.85^{a}	13.00^{a}
T224	6.95^{c}	45.95^{b}	6.37^{b}	3.62^{b}	9.70^{b}	5.00^{b}	5.85^{b}	2.00^{b}	22.10^{b}	0.00
T420	12.80^{b}	38.15^{c}	`5.74^{b}	3.41^{b}	8.35^{b}	4.00^{c}	5.82^{b}	2.00^{b}	21.45^{b}	0.00

Means with the same letter within the same column are not significantly different.

TABLE 5: THE EFFECTS OF SODIUM AZIDE ON THREE VARIETIES OF TOMATO (*Lycopersicon esculentum* Mill)

Treatment	Germination percentage 5days	Germination percentage 8days	Seedling height (cm)	Root length (cm)	Number of leaves/ seedling	Percentage seedling survival	Height at maturity (cm)	Number of Branches/ plant.	50% Flowering (days)	Number of Fruits /Plant
0mM	39.73^{a}	81.80^{a}	10.74^{a}	6.71^{a}	50.73^{a}	7.00^{a}	31.89^{a}	9.00^{a}	86.69^{a}	10.00^{a}
1mM	20.89^{b}	48.60^{b}	7.65^{b}	5.58^{b}	20.93^{b}	6.00^{b}	13.13^{b}	2.00^{b}	29.73^{b}	4.00^{b}
2mM	22.27^{b}	45.60^{b}	6.64^{c}	6.54^{a}	20.40^{b}	5.00^{bc}	10.81^{b}	2.00^{b}	29.93^{b}	2.00^{c}
4mM	16.07^{c}	31.07^{c}	4.28^{d}	4.10^{c}	19.40^{b}	4.00^{c}	8.13^{b}	1.00^{b}	29.73^{b}	1.00^{c}

Means with the same letter within the same column are not significantly different.

and EMS were used to treat *Sesanum indicum* L where seed germination, seedling survival, plant height and pollen fertility were reduced significantly with an increase in dosage levels of both mutagens. Sasi *et al.* (2005) similarly showed that all plant mutant types registered lower yields compared to their parents in the study of the effects of diethylsulphate and EMS on Okra (*Abelmoschus esculentum* (L.) var. MDU-1).

Generally, sodium azide was very effective in inducing mutations with respect to germination percentage, root length, seedling height, seedling survival, number of branches per plant, and yield per plant in tomato. The most effective concentration being 4.0 mM. The three varieties similarly responded to treatment differently with T106 being most stable. Sodium azide therefore could be utilized to increase variability in tomato that ultimately increases the possibility of isolating beneficial mutants for improvement of tomato production.

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