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COMPARISON OF GROWTH AND YIELD PERFORMANCE OF (UC-82B & LOCAL) VARIETIES OF TOMATOES (*Lycopersicum esculentum Mill.*) BY GRAFTING, MUTATION AND SEASONAL VARIATIONS

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ABSTRACT: *The Comparison of Growth and Yield Performance of (UC-82B & Local) Varieties of Tomatoes (Lycopersicum esculentum Mill.) by Grafting, Mutation and Seasonal Variations was investigated with the aim of inducing variability that could be exploited in the improvement of some quality traits in Tomato plants. The seeds of two varieties of tomato: UC-82B and Local varieties were treated at three different concentrations of sodium azide (1.0mM, 1.5 mM, 2.0 mM and 0.0 mM as control). The results obtained revealed highly significant difference (P≤0.01) in the effects of sodium azide on survival rates, number of fruits, and fruit weight. Similarly, highly significant differences (P≤0.01) was found between the treatments in Survival rate, except on the number of fruits and fruit weight, where no significant differences exist. More so, significant differences were found in the traits between the seasons except in fruit number. The result shows that 1.0 mM concentration of Sodium Azide and grafting improves some important quality traits of tomato that could be utilized for further improvement of tomato crop. However, the response of variety UC to grafting was higher. Highly significant difference (P≤0.01) was found among the seasons in terms of fruit weight, and significant difference (P≤0.05) was found among the seasons on survival rate, while no significant difference was found among the seasons in terms of fruits number. More so, highly significant difference (P≤0.01) was found in the interaction of varieties with seasons on Survival rate and number of fruit tomato varieties except on fruit weight, where no significant difference was found.*

KEYWORDS: *Grafting, Mutation, Season, Variation, UC, 82B, Local variety.*

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INTRODUCTION

Tomato (Lycopersicon esculentum Mill.) constitutes one of the most valuable horticultural crops, not only because of its economic importance, but also for its sensory qualities and nutritional value. It is consumed in the form of fresh as well as processed products. More than 80% of tomatoes grown throughout the world are processed into products such as sauce, juice, ketchup, canned tomato, stew and soup (Viskelis P., Radzevicius A., Urbonaviciene D., Viskelis J., Karkleliene R., Bobinas C., 2015). Epidemiological studies have proved the importance of tomato and its products in reducing various ailments because they contain high amounts of antioxidants such as carotenoids, polyphenols, ascorbic acid and many others (Perveen R., Suleria H.A., Anjum F.M., Butt M.S., Pasha I.,Ahmad S., 2015). Lycopene is the most plentiful carotene in the tomato fruit, comprising up to 90% of the total carotenoids present (Viskelis et al., 2015), and is the most important antioxidant with a high oxygen free radical-scavenging and quenching capacity, and thus provides protection against chronic diseases, such as several types of cancer, including cancer in the mouth, pharynx, esophagus, stomach and large intestine, and cardiovascular diseases (Perveen et al., 2015).

Lycopene is also the pigment mainly responsible for the red colour of tomato fruits. Various studies have reported that the lycopene content in tomatoes is most notably influenced by various genetic and environmental factors, such as the cultivar, growing season, cultivation conditions and harvesting stage (Toor et al., 2006; Rickman Pieper and Barrett, 2008).

Successful production of processing tomato requires to increase both yield and fruit quality. There has been a substantial research effort devoted to the processing tomato; however, it is not clear how the environment, cropping techniques and crop management affect each of the fruit characteristics measured at harvest to estimate the quality of processed products. In addition, during the last decades, the demand for organically grown products has increased because many people are concerned about the environment and believe that organic products are healthier than the conventional ones (Riahi A., Hdider C., Sanaa M., Tarchoun N., Kheder M.B., Guezal I., 2009). This study aimed to investigate and determine the effects of sodium azide, Grafting and Seasonal Variations on Some Growth Parameters on Two Varieties of Tomato (Solanum lycopersicum).

Materials and Method

The research was conducted in the Botanical Garden of the Department of Biological Sciences, Ahmadu Bello University, Zaria. (Lat11^0 12^1N, Long 7^0,37^1E, Alt 550-700 m above sea level) (Anonymous, (2014).

Sources of the Seeds

Seeds of two varieties of cultivated tomato (*UC*-82B and a *local variety*) were collected from the Institute for Agricultural Research (I.A.R), Ahmadu Bello University Zaria, Nigeria.

Treatment and Experimental Design

The treatments used in the research are Grafting and mutation, three concentrations of Sodium Azide and three varieties of tomatoes (*Roma*, *UC*82B and a *local variety*) with three different concentrations of sodium azide (0.1mM, 1.0mM, 2.0Mm). These were laid out in a Completely Randomized Design (CRD) with three replications. The seeds of the three tomato

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varieties were soaked//treated with three different concentrations of Sodium Azide (0.1mM, 1.0mM, 2.0Mm) for 4hours while 0.0mM as control. The seeds used for rootstocks were planted 2 days prior to that of the shoots. Tongue grafting approach was used. This is due to the relative advantage of the method over others such as its being used on larger plants, three times faster than other techniques, high success rate and is easy to handle.

After two weeks of planting, and a day prior to grafting, the plants used for grafting were watered fully to make them turgid. One-fourth of the plants used for rootstock were cut at slant early in the morning. The shoots were also cut in the same way. The two cut ends were placed in direct contact and use a small clip was used to hold the cut surfaces together. This was repeated in the 3rd and 4th week of planting, while the remainders were left as control as described in McVoy (2005) protocol.

Data Collection

Data were observed and collected on number of Survival rate, number of fruits/plant, and fruit weight.

Survival Rate (%)

The number of grafts that survive during the emergence of first flower were determined and their percentages taken and recorded. Leafless grafts were considered as dead.

Number of Fruits/Plant

The number of fruits produced per plant was determined through counting per treatment for each variety after twelve weeks of planting and recorded.

Dry Weights of the Fruits (g)

The weights of 100 fruits dried in the oven at 90 ^{0}C for 48 hours were determined in grams using a balance and recorded. (Mettier, PS15. Max- 15000g).

Data Analysis

All the data collected were analyzed using Analysis of Variance, and the means were separated using Duncan's Multiple Range Test, (DMRT).

RESULTS

The results from the combined analysis of variance on the effects of mutation and grafting on some selected traits of three tomato varieties are presented in the table below. The results showed highly significant difference ($P \leq 0.01$) in the effect of concentrations of sodium azide on all the selected traits of the two varieties of Tomato. Similarly, high significant difference ($P \leq 0.01$) was found among the varieties in terms of all the selected traits. However, no significant difference was found in the effect of the treatments on fruits number and fruit weight, except on survival rate where the effect is significant ($P \leq 0.05$). Highly significant difference ($P \leq 0.01$) was found among the seasons in terms of fruit weight, and significant difference ($P \leq 0.05$) was found among the seasons on survival rate, while no significant difference was found among the seasons in terms of fruits number.

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However, no significant difference in the interactions of sodium Azide with varieties and between sodium azide with the treatments on all the selected traits of the two tomato varieties. Similarly, no significant difference was found in the interactions of sodium azide with seasons in almost all the selected traits. However, highly significant difference (P≤0.01) was found in the interaction of varieties with treatments on fruit number and fruit weight, while no significant difference was found in the interaction of varieties with treatments on the other remaining selected trait. More so, highly significant difference (P≤0.01) was found in the interaction of varieties with seasons on Survival rate and number of fruit tomato varieties except on fruit weight, where no significant difference was found.

Furthermore, highly significant difference (P≤0.01) was found in the interaction of the treatments with seasons on the fruit weight except on fruit number; where the interaction is significant (P≤0.05) and on survival rates, where no significant difference was found in the interaction. However, no significant difference was found in the interaction of sodium azide concentrations with varieties and treatments and interaction of sodium azide with varieties and seasons on the selected traits of the tree tomato cultivars.

Combined Effects of Grafting and Sodium Azide Interactions on Some Growth Parameters on Three Varieties of Tomato in Two Different Seasons

Sources of Variation	dF	Survival Rate (%)	Number of Fruits	Fruit Weight (g)
Replication	2	74.54^{ns}	11.87*	55.92**
Concentration	3	14265**	188.59**	383**
Variety	2	3803.53**	37.26**	564.34**
Treatments	2	878.43*	5.26^{ns}	21.68^{ns}
Seasons	1	874.67*	0.01^{ns}	189.84**
Conc. x Trt.	6	72.30^{ns}	1.36^{ns}	6.23^{ns}
Conc. x Var.	6	44.73^{ns}	3.19^{ns}	14.17^{ns}
Conc. x Seas	3	35.35^{ns}	0.91^{ns}	9.67^{ns}
Var. x Trt.	4	164.47^{ns}	14.79^{xx}	70.64^{xx}
Var. x Seas.	2	4860.2^{xx}	95.36^{xx}	12.12^{ns}
Trt. x Seas.	2	138.49^{ns}	12.22^{x}	45.54^{xx}
Conc. x Var. x Trt. x Seas.	18	153.02^{ns}	2.82^{ns}	1.63^{ns}
Error	142	148.56	2.78	7.53

***Keys**: ns= No significant difference * = Significant difference (P≤0.05) **= Highly significant difference (P≤0.01)*

DISCUSSION

The differences observed in most of the quantitative and qualitative traits among the sodium azide induced mutants of tomato evaluated showed significant improvements in the selected traits.In the present investigation, survival percentage decreased with increasing concentration of sodium azide. This finding conformed to the earlier report by (Ahloowalia & Maluszynski 2001) that, the viable mutants observed are mainly dependable measure of genetic effect in mutagen. The increased number of fruits per plant due to sodium azide treatments was also in conformity with the work of (Adamu & Aliyu 2007) who reported

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increased in growth and yield parameters of tomato due to sodium azide treatments. There was a reductions in the survival percentages with increasing concentrations for both chemicals in the C_1 generation. Reductions in survival percentages due to the effects of mutagens on various crop plants have earlier been documented by (Mensah & Akomeah1997) and (Mensah *et al*. 2005).

More so, the improvement in the growth and yield components of tomato due to sodium azide treatments stressed the effect of mutation on the growth and yield of plants. This is in agreement with the work of (Adamu *et al*. 2002) who observed when groundnut was treated with gamma rays and (Sheeba *et al*. 2005) who reported the effect of gamma rays and EMS were used to treat *Sesanum indicum* L. where survival was reduced significantly with an increase in dosage levels of both mutagens. However, in contrast, (Sasi *et: al*. 2005) 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). The increased in fruit quality (such fruit weight and number of fruits) due to induced mutagenesis by sodium azide signifies the vital role played by the mutagen in improving the quality traits of tomato.

The distinct differences observed in most of the qualitative traits among the grafted tomato plants compared to the controls showed improvements in fruits quality induced by grafting. The improved fruit characteristics of tomato due to grafting is in agreement with the findings of (Lee, 1994) and (Pogonyi *et.,al* 2005), who independently reported improvements in fruits quality due to grafting. The increase in the number of fruits among the grafted tomatoes was consistent with the work of (Ibrahim *et: al*. 2001) who found that the total number\ of fruits per plant in non- grafted plants was statistically different from those of grafted plants.

In a similar study by (Khah *et: al*. 2006) fruit weight of grafted plants was found to be higher than in non-grafted plants. In the present study, the number of fruits and fruit weights of non - grafted plants were significantly lower than the corresponding values for plants grafted onto both rootstock cultivars.

Higher fruit yield parameters found in this study could be due to the fact that grafting combines novel traits of the two grafted plants after grafting operation. This has also been reported by (Tsouvaltzis *et al*. 2004).

The fruit characteristics of grafted plants were compared with those of non-grafted plants. The results showed that the fruit index (number of fruits and fruit weight) were significantly influenced by grafting. The results agree with those reported by (Lee, 1994) who concluded that fruit shapes are influenced by rootstocks. (Pogonyi *et al*. 2005) reported that when Lemance F_1 was grafted onto Beaufort rootstock, increased yield was caused mainly by higher average fruit weight. (Ibrahim *et al*. 2014) also found that the total number of fruits in non-grafted plants was statistically different from the total for grafted plants. In grafted combinations, the total fruit yield per plant increased significantly in comparison with that of the control plants. (Ibrahim *et al*. 2001) observed similar results in grafted and non-grafted tomato plants.

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CONCLUSION

The effect of grafting, mutation and seasons was found to be beneficial in improving certain qualitative traits of tomato varieties. The use of grafting in crop improvement helps to understand the mechanism of grafting induction and to quantify the frequency as well as the pattern of changes in different selected plants by grafting. Variety UC is therefore recommended for processing industries. More so, Induced mutation using various concentrations of sodium azide and grafting technique were employed singly and in combination on the three varieties of tomato with the aim of improving the growth and yield parameters of the plants in both the wet and dry seasons. It was concluded that, sodium Azide via mutation improves some important quality traits of tomato that are of high economic value and possible recommendations made.

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