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RESPONSE OF TWO VARIETIES OF CHILLI PEPPER (*Capsicum annuum* L.) TO MUTATION AND SEASONAL VARIATIONS

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ABSTRACT
The impact of Colchicine induced mutation and seasonal variations on the growth and yield of two varieties of Chilli papper was investigated with the aim of inducing variability that could be exploited in the improvement of some quality traits in Chilli papper plants. The seeds of the two varieties of Chilli pepper: Aji chili and Aji cristal varieties were treated with three different concentrations of Colchicine (0.1mM, 0.2 mM, 0.4 mM and 0.0 mM as control). The results obtained revealed highly significant difference (P≤0.01) in the effects of Colchicine on survival rates, number of fruits, and fruit weight. Similarly, highly significant differences (P≤0.01) were found between the treatments in Survival rate in rainy season, except on the number of fruits and fruit weight, where no significant differences exist. Higher, significant differences were found in the traits between the seasons except in fruit number. Similarly, 0.1 mM concentration of Colchicine improve some important quality traits of Chilli pepper that could be utilized for further improvement of Chilli papper crop. However, the response of variety Aji cristal to colchicine was higher in dry season. Based on the findings, the study concluded that, colchicine improves some important quality traits of Chilli papper that are of high economic value and possible recommendations that could be made. The mutants Chilli pepper could be grown in both the rainy and dry seasons.
Key words: Mutation, Seasons, Variation, Interaction, Aji chili, Aji cristal, Cholchicine.

INTRODUCTION

Chilli (*Capsicum spp.)* is one of the most important commercial crops of India and grown almost throughout the country. There are more than 400 different varieties of chillies found all over the world. It is also called as hot pepper, sweet pepper, bell pepper. It botanical name is "*Capscum annuum*". Chili is fruit of the plant „*Capsicum annuum*" and „*Capsicum frutecens*" (Banerjee *et al.,* 2014) that come from the genus capsicum belonging to the family of Solanaceace which also includes tomato, and potato (Meghavansi *et al.,* 2010). There are more than 200 common names in use for these spices. The fruit of chilli plants have a variety of names depending on place type (Kalloo *et al.,* 2005). It is commonly called chilli pepper, red or green pepper or sweet pepper in Britain, and typically just capsicum in Australian and Indian English (ref). The large mild form is called bell pepper in the US and Canada, and paprika in some other countries (although paprika can also refer to the powdered spice made from various capsicum fruit) (ref). Chilli pepper (Capsicum frutescens L.) is a high value crop that is grown for cash by farmers all over the world. In Nigeria, the crop has responded positively to improved nutrition and appropriate agronomic practices (Aliyu, 2000; 2001; 2002; 2003;)

Colchicine is a chemical toxic that is often used to induce polyploidy in plants. It prevents the microtubules formation during cell division, thus the chromosome does not put apart like they normally do. Colchicine has been one of the most powerful mutagens in crop plants. The mutagencity is mediated through the production of an organic metabolite of azide compound. This metabolite enters into the nucleus, interacts to DNA and creates point of mutation in the genome (Kubota *et al.*,2008). It has also proved its worth as chemical mutagens to induce genetic variability. Thus, this chemical mutagen has become important tool to enhance agronomic traits of crop plants (Khan, 2006).

In view of the increasing concern for the environment, attempts to further increase yield by increased inorganic fertilizer applications has not met with favorable response. The global demand for organic produce has also added to the decline in the use of inorganic fertilizers and other agrochemicals for increased agricultural productivity (Aliyu, 2003). Most farmers have no definite pattern or procedure for harvesting chilli pepper. Whereas some harvest regularly till the end of the rains, others allow the crop to fruit and dry before harvesting at the end of the rainy season. The frequency of harvesting as it affects different varieties of chilli pepper has not been documented. The scope of this research was to determine the best harvesting frequency for two chilli pepper varieties that could be used to increase yield in both dry and rainy seasons.

MATERIALS AND METHODS

The research was conducted in September(2013) at the Green House of the Botanical Garden of the Department of Biological Sciences, Ahmadu Bello University Zaria, Kaduna State. (Lat11^0 12^{1}N, Long 7^0,37^{1}E, Alt 550-700 m above sea level).

Sources of the Seeds

Seeds of three varieties of cultivated tomato (*Aji amarillo*, *Aji chili* and *Aji cristal*) 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 is Mutation, three concentrations of Colchicine (0.1mM, 0.2mM, 0.4mM) and two varieties of Chilli pepper (*Aji chili* and *Aji cristal*). These were laid out in a Completely Randomized Design (CRD) with three replications. The seeds of the two Chilli pepper varieties were soaked/treated with three different concentrations of Colchicine (0.1mM, 0.2mM, 0.4mM) for 4-hours while 0.0mM as control (ref).

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).

RESULTS

The results from the combined analysis of variance on the effects of mutation on some selected traits of three Chilli varieties are presented in (Table 1) below. The results showed highly significant difference (P≤0.01) in the effect of concentrations of Colchicine on all the selected traits of the two varieties of Chilli. Similarly, high significant difference (P≤0.01) was found among the varieties in terms of all the selected traits. 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.

However, no significant difference in the interactions of Colchicine with varieties on all the selected traits of the two Chilli varieties. Similarly, no significant difference was found in the interactions of Colchicine with seasons in almost all the selected traits. Moreover, highly significant difference (P≤0.01) was found in the interaction of varieties with seasons on Survival rate and number of fruit, except on fruit weight, where no significant difference was found.

Table 1: Mean Squares for the Combined Effects of Colchicine Interactions on Some Growth Parameters on Two Varieties of Chilli 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**
Seasons	1	874.67*	0.01 ^{ns}	189.84**
Conc. x Var.	5	44.73^{ns}	3.19^{ns}	14.17^{ns}
Conc. x Seas	3	35.35^{ns}	0.91^{ns}	9.67^{ns}
Var. x Seas.	2	4860.2^{xx}	95.36^{xx}	12.12^{ns}
Conc. x Var. 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)

The result of the analysis of variance ANOVA on the effects of mutation, and seasons on some growth parameters on three varieties of Chilli was shown in (Table 2) below. Mutation was found to be more efficient during the dry season in terms survival rate, except on number of fruit and fruit weight where it was found to be efficient. Hence , mutation was found to be more efficient during the rainy season on fruit number, fruit weight, except on survival rate, where it was found to be efficient. This was due to effect of concentration of Colchicine on the selected trait in the two chilli varieties.

Table 2: Response of Mutation and Seasons on Some Growth Parameters on Two Varieties of Chilli

Treatment	Season	Survival rate (%)	Number of fruit	Fruit weight
Mutation	DRY	51.62[a]	3.30[b]	12.72[b]
	RAINY	50.75[b]	4.22[a]	13.20[a]

NB:Means within the columns with the same letter(s) are not significantly different using 5% DMRT

The result of the analysis of variance ANOVA on the effects of mutation, and on some growth parameters on three varieties of Chilli was shown in (Table 3) below. The interactive effect of mutation was more pronounced during the dry season with regard to survival rate and number of fruits, while with respect to fruit weight, it was found to be higher during the rainy compared to dry season.

Table 3: Response of Mutation and seasons on Some Growth Parameters on Two Varieties of Chilli

Treatment	Season	Survival rate (%)	Number of fruit	Fruit weight
Mutation				
	DRY	47.51[a]	4.33[a]	11.69[a]
	RAINY	41.43[b]	4.00[b]	15.27[a]

NB: Means within the columns with the same letter(s) are not significantly different using 5% DMRT

DISCUSSION

The differences observed in most of the quantitative and qualitative traits among the Colchicine induced mutants of Chilli evaluated showed significant improvements in the selected traits. Although there were few traits with no significant differences in responses to the applied treatments; the ability of the mutants to germinate faster after one and two weeks of planting in respect to the controls showed that the mutagenic treatments induced increase enzymatic activities, which could be responsible for the early germination. This finding is in agreement with the findings of Mensah *et al*. (2007) who reported a decrease in germination with increase in the dose of chemical mutagens. In the present investigation, germination, survival percentage, plant heights and leaf number and area decreased with increasing concentration of Colchicine. This finding conformed to the earlier report by Ahloowalia and Maluszynski (2001) that, the viable mutants observed are mainly dependable measure of genetic effect in mutagen. The increased in the number of leaves, plant heights and number of fruits per plant due to Colchicine treatments was also in conformity with the work of Adamu and Aliyu (2007) who reported increased in growth and yield parameters of tomato due to Colchicine treatments. There were reductions in the germination and survival percentages with increasing concentrations for both chemicals in the C_1 generation. Reductions in germination and survival percentages due to the effects of mutagens on various crop plants have earlier been documented by Mensah *et al*. (2005).

Furthermore, the improvement in the growth and yield components of chilli due to Colchicine 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 seed germination, seedling survival, was reduced significantly with an increase in dosage levels of both mutagens. However, 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 (*Abelmoschuse*

sculentum (L.) var. MDU-1). The increased in fruit quality (such as juice and fruit weight) and number due to induced mutagenesis by Colchicine signifies the vital role of the mutagen in improving the quality traits of Chlli.

CONCLUSION

The effect of Colchicine and season interactions was found to be beneficial in improving certain qualitative traits of Chilli varieties. More so, Induced mutation using various concentrations of Colchicine technique were employed singly and in combination on the two varieties of Chilli with the aim of improving the growth and yield parameters of the plants in both the wet and dry seasons. Significant improvements were found among the grafted and mutant tomatoes in both the dry and wet seasons. It was concluded that, Colchicine via mutation improves some important quality traits of Chilli that are of high economic value and possible recommendations made.

RECOMMENDATIONS

Since chilli pepper production in the study area has been shown to be very profitable and has huge potential for income generation, it is recommended that farmers should go into chilli pepper production to make income and enhance their livelihoods.

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