



The effect of fast neutron radiation on meiosis in pollen mother cells of *Capsicum annuum* var. *abbreviatum*

Olamide Ahmed Falusi*, Oladipupo Abdulazeez Yusuf Daudu, Kolo Josephine Teni & Thomas Tanko

Department of Biological Sciences, Federal University of Technology, Minna, Niger State, Nigeria

*e-mail: falusiolamide@gmail.com

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ABSTRACT

In order to assess the effect of fast neutron irradiation (FNI) on pmc meiosis of *Capsicum annuum* var. *abbreviatum*, dry seeds of the variety were exposed to fast neutron irradiation (FNI) from an Americium Beryllium source with a flux of 1.5×10^4 n.cm⁻²s⁻¹. Five irradiation treatments, 0, 30, 60, 90, and 120 min. have been tried. The treated seeds were sown with their respective controls and the effects on the meiosis of the plants were studied. The results obtained showed that all irradiation treatments caused meiotic abnormalities, such as chromosome clumping, presence of univalents, multivalents, triads and micronuclei compared to the control plants. There was an increase in aberrant cells with increase in the duration of fast neutron irradiation (FNI); 120 minutes FNI treatment was found most potent in inducing cytological aberrations in pollen mother cells of treated pepper plants.

Keywords: *C. annuum* var. *abbreviatum*, fast neutron, irradiation exposure period

INTRODUCTION

Pepper (*Capsicum annuum*) is one of the most varied and widely used foods in the world. It belongs to genus *Capsicum* L. (Solanaceae) which includes 27 species (Rodriguez *et al.* 1999, Onus & Pickersgill 2004, Vostava & Bosland 2002, Ince *et al.* 2009). Five of these, namely *Capsicum annuum* L., *Capsicum baccatum* L., *Capsicum chinensis* Jacq., *Capsicum frutescens* L. and *Capsicum pubescens* Ruiz and Pavan are domesticated. In Nigeria, the most important species, *C. annuum* L., bears both pungent (hot) and

sweet fruits which are in high demand because of pungence and good flavour (Falusi 2007, Idowu-agida *et al.* 2010). Although, pepper is widely cultivated throughout the country, the fruit yields are often very low (Adigun 2001). Production constraints such as low soil fertility, non availability of suitable cultivars/hybrids, biotic and abiotic stresses and development of new disease causing pathogens, as reported by Sharma & Singh (2009), are the major problems of pepper crop in Africa. The fruit yield in developing countries is 10 – 30% that in the developed countries (Erinle 1989, Grubben & Tahir 2004). Therefore, there is need for improvement of the crop by creating additional

genotypic variability through mutation breeding. Mutation technology has been used to produce cultivars of improved economic value (Adamu & Aliyu 2007, Poornananda & Hosakatte 2009) in many crops. Fast neutron irradiation (FNI) has been used to induce notable mutations in many crops such as Soyabean (Sodkiewicz & Sodkiewicz 1999) and onion (Zhang *et al.* 2002). The degree of cytological aberrations induced in mitosis or meiosis is regarded as one of the dependable parameters for estimating the effect of a mutagen. Thus, the present study was undertaken to assess the impact of FNI on pollen mother cell meiosis in *Capsicum annum*.

MATERIALS & METHODS

Fresh fruits of pepper (50 fruits each) were bought from a local farmer in Minna, Niger State, Nigeria. The plants raised therefrom were identified using taxonomic key provided by Simmond (1976), Hutchinson & Dalziel (1963), Schippers (2000) and Abdullahi *et al.* (2003). Each fruit was cut open to remove the seeds which were sun-dried separately for 8 h. The sun-dried seeds were tested for viability using the floatation method, before subjecting them to FNI treatment. They were later irradiated at the Centre for Energy and Research Training (CERT), Ahmadu Bello University, Zaria with FNI using an Americium-Beryllium source with a flux of 1.5×10^4 n cm⁻² s⁻¹ for five different durations: 0, 30, 60, 90, and 120 minutes. The equipment used was a Miniature Neutron Source Reactor (MNSR) designed by the China Institute of Atomic Energy (CIAE) and licensed to operate at a maximum power of 31 kW (SAR 2005).

Treated seeds (100 from each treatment) were sown in nursery trays to raise seedlings. Four weeks old seedlings were transplanted into 3.5-l - plastic pots containing garden soil; three seedlings per pot. No fertilizer was applied. When the plants came to flower, an insecticide - Pyrethroids cypermethrin at a rate of 10-15l/ha was applied using spinning disc sprayers to prevent insect-borne diseases. The seeds and plants were watered once every day between 5 and 6.30 pm using bore-hole water.

For meiotic studies, flower buds from control as well as irradiated plants were fixed between 7.00 to 9.00 am in freshly prepared 3:1(v/v) ethanol-acetic acid mixture for 24 hours, and then stored in 70% alcohol to which few drops of glycerin were added to prevent hardening. Squashes were made in FLP orcein (Olorode 1973) and selected cells photomicrographed.

RESULTS & DISCUSSION

It was observed that all radiation treatments caused chromosome clumping and occasional formation of univalents, multivalents, triads and micronuclei. Chromosomal abnormalities with different frequencies were observed in all treated plants. The frequencies of meiotic anomalies have been presented in Table 1. While univalents, multivalents and triads were observed in high frequency, chromosome clumping and micronuclei were rare in all treated plants (Table 1). The multivalent formation is in all probability caused by translocations which suggest that FNI causes rearrangement of chromosomes. Similar observation was reported in *Vigna radiata* by Grover & Tejpal (1982).

The presence of micronuclei in treated plants suggests breakage of chromosomes and formation of acentric fragments as a result of fast neutron irradiation. Similar type of meiotic abnormality has been reported by Azad *et al.* (2002) in *Cestrum diurnum*. The occurrence of triads and micronuclei could affect fertility of the treated plants. The frequency of meiotic abnormalities registers increase with increase in the duration of treatment. The highest frequency was recorded in 120 min FNI treatment. It emerges that the most potent FNI treatment for inducing meiotic aberrations in pollen mother cells of pepper is 120 minutes. In higher plants, chromosome aberrations induced by radiation have been utilized for many years in classical genetic studies (McClintock 1984) and more recently in providing starting material for gene isolation and mapping (Bhatt *et al.* 2001). According to Azad (2011), the degree of chromosome aberrations in meiosis is one of the most reliable indices for estimating the effects of mutagen. The present study shows that FNI has significant effect on the pmc meiosis of pepper.

Table 1— Induced meiotic chromosomal abnormalities (expressed as percentage pollen mother cells (PMC) showing different kinds of abnormalities at a specific stage) in *Capsicum annuum* with different irradiation treatments

Treatments (irradiation period/min)	Nos of PMC observed	Univalents %	Multivalents %	Triads %	Chromosome Clumping %	Presence of Micronuclei %
0 (control)	520	-	-	-	-	-
30	550	0.24	0.28	0.32	0.20	0.10
60	540	0.56	0.48	0.50	0.34	0.37
90	560	0.62	0.76	0.65	0.52	0.46
120	530	1.12	1.32	1.14	0.76	0.63

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