

Original Research Article

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Studies on Mutagenic Efficiency and Effectiveness of Sodium Azide on Indian mustard in M₂ Generation

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ABSTRACT

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Mutagenic efficiency and effectiveness is an important factor for the selection of a mutagen for a mutation breeding program. The mutagenic efficiency gives an idea of the proportion of mutation on relation to the other associated undesirable biological effects such as lethality, sterility and meiotic aberrations while mutagenic effectiveness is a measure of the frequency of the mutation induced by unit dose of mutagens. The usefulness of any particular mutagen in crop breeding depends not only on its mutagenic effectiveness but also on the mutagenic efficiency of the mutagen. Studies on mutagenic efficiency and effectiveness of chemical mutagen sodium azide (NaN₃) on variety Pusa mustard 21 of Indian mustard have been reported. The treatments included three concentrations of sodium azide (0.03%, 0.06% and 0.09%)

Introduction

Rapeseed-Mustard are important oilseed crop of the world being grown in around 50 countries across the six continents. The crop is grown both in sub-tropical and tropical countries. Among different oilseed crops grown in India, the Rapeseed-Mustard (*Brassica* spp.) contributes 29.5% in the total production of oilseeds. In India, it is the second most important edible oilseed after groundnut sharing 27.8% in the India's oilseed economy (Anonymous, 2015). Indian mustard, *Brassica juncea* (L.) Czern and Coss (2n = 2x = 36, genome AABB) is the oldest of the cultivated amphidiploids. It is called as "rai", "raya" or "laha" is one of the important

oilseed crops belonging to family cruciferae (Syn. Brassicaceae) and genus *Brassica*. The available evidences indicate that *B.juncea* was under cultivation in Indus valley in around 3000 BC. The species probably evolved in the Middle East, where its putative diploid progenitors *Brassica rapa* and *Brassica nigra* are sympatric (Prakash and Hinata, 1980). Mustard is largely self-pollinated crop but certain amount (5 - 18%) of cross pollination may take place (Labana and Banga, 1984).

Complementing the conventional method, mutation breeding can play a unique role in crop improvement which provides a novel approach to plant breeders for raising the productivity and obtaining acquired result,

when it is desired to rectify small defects in any crop variety. Mutation breeding techniques has been used to produce many cultivars with improved economic value (Van *et al.*, 1990 and Bertagne, 1996). Induced mutations have great potentials and serve as a complimentary approach in genetic improvement of crops (Mahandjiev *et al.*, 2001). Sodium azide is a chemical mutagen that creates point mutations, A. T-G. C, base pair transition and transversion in the genome of plants by producing metabolite and thus produced protein in mutant plant has different function from the normal plant (Khanand Fahad, 2009).

Materials and Methods

The present study is undertaken to estimate efficiency and effectiveness using different concentrations of sodium azide (NaN₃) in M₂ generation of Indian mustard *Brassica juncea* var. Pusa mustard 21.P M 21 is a variety, low in erucic acid and well adapted to Vidarbha region of Maharashtra. Dry, healthy and genetically pure seeds of *Brassica juncea* cv. Pusa mustard 21 were divided into 4 lots of 300 seeds each for giving the sodium azide treatment, and one lot (300 seeds) among them was control. The three seed lots were treated with 0.03%, 0.06%, 0.09% aqueous solution of sodium azide for 18 hrs. After washing with sterilized water, the treated seeds were sown after one hour along with control. The sowing of M₁ generation was done in November 2015 at research farm, college of agriculture, Nagpur. The treated seeds were used to raise M₁ generation along with control. No observations were recorded in M₁ generation except for germination and mortality percentage. M₁ plants were harvest plant wise. Mutagenic frequency was calculated as percent of M₂ plants as given by Gaul (1958). Mutagenic efficiency and effectiveness were calculated based on the formulae given by Konzak *et al.*, (1965).

Results and Discussion

Mutation frequency of each visible mutant in M₂ generation was calculated as suggested by Gaul (1958) and is represented in table 1. The table revealed that the treatment T₃ induced the highest mutation frequency (2.01%) followed by T₁ (1.30%) and the lowest in T₂ (1.26%). The frequency of mutation was comparable in all the treatments.

Sathawane (2012) undertook mutagenic studies to produce yellow seed in Indian mustard. Yellow seed coat colour mutants were selected in M₁ and M₂ generations. Upon analysis of M₁ and M₂ mutation frequencies of data for yellow seed coat colour mutant, it was observed that sodium azide induced comparatively higher frequency than ethyl methane sulfonate. Sangsir *et al.*, (2005) observed increase in frequencies over 430 characters with increase in doses of gamma rays and EMS in combination in mustard, and similar result found by Jain (2010) in *Brassica juncea*.

The concept of mutagenic efficiency and effectiveness was given by Ehrenberg (1960). From the table 1, it was noticed that the highest mutagenic efficiency was exhibited by T₁ (0.472%) followed by T₃ (0.423%), while the lowest efficiency was found in T₂ (0.387%). It was observed that in the variety P M 21, the lower concentration 0.03% SA has recorded highest mutagenic efficiency as compared other treatments. It does not follow a specific trend.

Mutagenic effectiveness is a measure of the frequency of the mutation induced by unit dose of mutagens (Konzak, 1965). Table 1 depicted that, among different treatments the highest mutagenic effectiveness was observed in T₁ (0.024%) followed by T₃ (0.013%), while the least effectiveness was recorded in T₂ (0.012%).

Table.1 Mutagenic efficiency and effectiveness of different concentrations of sodium azide in *Brassica juncea* (L.)

Sr. No.	Treatments	% Lethality (L)	% Mutation 100 M ₂ Plants (MP)	Mutagenic efficiency (MP/L)	Mutagenic effectiveness (MP/tc)
1	T ₁ (0.03%)	2.75	1.30	0.472	0.024
2	T ₂ (0.06%)	3.25	1.26	0.387	0.012
3	T ₃ (0.09%)	4.75	2.01	0.423	0.013
4	T ₄ (Control)	1.5	-	-	-

The lower concentration i.e. 0.03% of SA showed highest mutagenic effectiveness in PM 21 as compared to other higher doses of SA. The mutagenic effectiveness does not follow a specific trend.

Sangle and Kothekar (2013) assessed the relative effectiveness and efficiency of the three mutagens in pigeon pea, from the data on biological damage in M₁ generation and frequency of chlorophyll mutants in M₂ generation. The effectiveness values decreases with the increasing concentration of gamma ray and SA treatments. In SA treatments the effectiveness values ranged from 0.372 to 0.754 and 0.470 to 1.066 in both the varieties respectively.

The mutation frequency did not follow a specific trend in any of the treatments. Mutagenic efficiency and effectiveness of a mutagen does not follow a specific trend. The mutagenic effectiveness was more in lower concentration of SA i.e. 0.03%. The mutagenic effectiveness did not follow a specific trend.

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