Int.J.Curr.Microbiol.App.Sci (2020) *9*(4): 64-69

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 4 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.904.009

Studies on the Effect of Sodium Azide on the Germination Percentage and Yield Product in Tomato Variety (*Solanum lycopersicum*, LINN) Pusa Sadabahar

Sarvagya Nand Mishra[1], Prakash Chandra Pradhan[2], Anil Kumar[1] and Mukesh Kumar[3]*

[1]Department of Botany, Magadh University, Bodhgaya, Bihar- 824234, India
[2]Central Instrumentation Laboratory, SDAU Sardarkrushinaga Gujarat- 385506, India
[3]Deparment of Plant Pathology, Janta Vedic College, Baraut, Baghpat, U.P. – 250611, India

**Corresponding author*

Keywords

Tomato, Sodium Azide, Chemical mutagen, Germination percentage, Pusa Sadabahar

Article Info

Accepted:
04 March 2020
Available Online:
10 April 2020

A B S T R A C T

Tomato (*Solanum lycopersicum Linn*) is one of the most consumed vegetables in the world and is a dietary source of vitamin, minerals, and fiber, which are important for human nutrition and health. It is extensively grown throughout the world. Sodium Azide is a chemical mutagen that has become an important tool to enhance agronomic traits of crop plants. It is being used to produce resistance in various susceptible crops to improve their yield and quality traits against harmful pathogens. Generally SA is very effective in increasing mutations with respect to germination percentage, root length, seedling height per plants, the most effective concentration being 2.0mM. The cultivar Pusa sadabahar responds to the treatment differently with different concentration of SA, therefore could be utilise to increase variability in isolating beneficial mutants for improvement of tomato production.

Introduction

Tomato (*Solanum lycopersicum Linn*) is one of the most consumed vegetables in the world and is a dietary source of vitamin, minerals, and fiber, which are important for human nutrition and health. It is extensively grown throughout the world. However, its sensitivity to low temperature limits the geographic distribution and the time of year for planting in open field cultivation. The cultivated genotype displays limited growth and development at temperatures under 12°C (Hu *et al.*,). Depending on the intensity and duration of exposure to the chilling temperatures, photosynthesis, respiration,

membrane integrity water relation and hormones balance of the plants may be affected (Graham and Patterson). In North Indian plains the temperature goes below 10°C especially during December–January, which drastically affects the fruits of tomatoes.

Tomato (*Solanum lycopersicum* Linn) is native to south America. It is now grown worldwide for its edible fruits with thousands of cultivars having been selected with varying fruit types and for optimum growth in different growing conditions. Tomato contain carotene, lycopene one of the most powerful natural antioxidants lycopene had been reported to prevent prostate cancer, breast cancer, head and neck cancer, increase the skin's ability to protect against harmful UV radiation and protect against oxidative damage in many epidemiological and experimental studies (Freedman.et.al 2010).

Sodium Azide is a chemical mutagen that has become an important tool to enhance agronomic traits of crop plants. It is being used to produce resistance in various susceptible crops to improve their yield and quality traits against harmful pathogens. There are several mutagens available for crop improvement and each mutagen has an important role as positive or negative effects on the crop. Sodium azide creates point mutation in the genome of plants through metabolites and thus produced protein in mutant plants has different functions compared to the normal plants. The mutant plants produced by the treatment of SA are capable to survive under various adverse conditions and have improved yields, increased stress tolerance, longer shelf life and reduced agronomic input in comparison to normal plants. The selection of plant mutants is based on morphological biochemical and DNA-based markers. Sodium Azide (NaN_3) is a chemical mutagen and has been one of the most powerful mutagens in crop plants. It has been reported that Sodium Azide affects plant physiology and decreases cyanide resistant respiration in tobacco callus (Wen and Liang, 1995). It is known to be highly mutagenic in several organisms, including plants and animals (Rines, 1985; Raicu and Mixich, 1992; Grant and Salamone, 1994) and its mutagenic potential has been reported in several screening assays.

The mutagenicity is mediated through the production of an organic metabolite of the Azide compound (Owais and Kleinhofs, 1988). This metabolite enters into the nucleus, interacts with DNA, and creates point mutation in the genome. Being a strong mutagen in the plant, it affects the different parts of the plants and their growth developmental phenomena by disturbing the metabolic activities. Seeds have high regenerative potential and are advantageous for use in mutagenesis.

Materials and Methods

The tomato hybrid (*Solanum lycopersicum, Linn*), Pusa Sadabahar was used in this investigation. Tomato hybrid seeds were treated with the SA as a chemical mutagen.

Mutagenic treatment with Sodium Azide (NaN3) was conducted by treatment of tomato seeds with 4 concentration i.e. 0.5, 1.0, 2.0 and 4.0 Mm concentration NaN3 in phosphate buffer solution at PH 3. Tomato seeds mentioned before were soaked in a liter of water for 6 hours prior to soaking in 0.5, 1.0, 2.0 and 4.0 Mm Sodium Azide for 4 hours at room temperature. Then after the treated seeds were followed immediately by thorough washing in running water for four hours. Untreated seeds, as well as those treated with Sodium Azide, were sown in a complete randomized block design (CRBD)

with three replications. Data were recorded on the following traits; seed germination percentage, fruit weight, and fruit weight, and fruit yield per plant, fruit no. were determined by the method of Comar and Zscheile (1942).

Results and Discussion

Effects of sodium Azide on germination percentage of tomato (Pusa Sadabahar)

Out of all four treatment of Sodium azide three had best an effect on germination percentage when compared to control treatment whereas high dose 4.0mM concentration showed inhibitory/reducing effect. In variety Pusa sadabahar the highest germination percentage was showed 83 per cent in Replication iii in M1 generation whereas the same result 83 percentage was showed by Replication 1 in M2 generation at 2.0mM of concentration.

The least germination percentage was showed by Replication 1 in M1 generation and by Replication 2 in M2 generation with 4.0mM concentration. The total no of seeds that emerged per cup tray was recorded 8 days after planting and % calculated using formula:

Germination % = (Number of germinated seeds/Total no of seeds taken)*100.

The germination percentage was observed to decrease with an increase in the concentration of Sodium Azide (NaN_3). The first germination in treated seeds was observed at 7 days as against the untreated seeds. There was a significant difference in germination % observed between the treated plots. The lowest and highest germination % was recorded in tables 1 and 2 at 7 days in M1 and M2 generation (Fig. 1).

Effects of sodium azide on root length in tomato plants

Out of the four treatment of Sodium Azide i.e. 0.5, 1.0, 2.0, and 4.0 the prior three increases the length of root but last one 4.0 mM concentration of SA reduces the length of root in all the replication of plants even in the comparison of the control plant. The longest root, 24 cm was increased by 2.0 mM concentration of SA in M1 generation whereas the least increasement 5 cm was by 4.0 mM concentration of SA in M1 and M2 generation. Though the control plant increases 6 cm to 18 cm in different days interval in M1 and M2 generation (Table 3).

Table.1 Effect of different doses of Sodium Azide (NaN3) on the germination percentage of M1 Generation of Pusa Sadabahar cultivar

Sodium Azide (NaN3) doses in mM	No. of seeds taken	Germination %		
		R1	R2	R3
Control, 0.0mM	100	71	74	76
0.5mM	100	76	77	79
1.0mM	100	78	80	81
2.0mM	100	81	81	83
4.0mM	100	61	64	63

Table.2 Effect of different doses of Sodium Azide (NaN_3) on the germination percentage of M2 Generation of Pusa Sadabahar cultivar

Sodium Azide (NaN3) doses in mM	No. of seeds taken	Germination%		
		R1	R2	R3
Control, 0.0mM	100	77	73	72
0.5 mM	100	79	78	75
1.0 mM	100	78	81	79
2.0 mM	100	83	82	81
4.0 mM	100	64	61	68

Table.3 Effect of different doses of Sodium Azide (NaN_3) on the Root length of Pusa Sadabahar cultivar in M1 and M2 generations at different days intervals (in cm.)

Days	M1 Generation				M2 Generation			
Doses in mM	15	30	45	60	15	30	45	60
0.0	06	10	12	16	07	12	14	18
0.5	08	14	17	20	09	16	18	20
1.0	11	15	19	23	12	18	20	22
2.0	16	19	21	24	15	18	22	23
4.0	05	11	14	16	05	09	13	15

Table.4 Effect of different doses of Sodium Azide (NaN_3) on the Seedling height of Pusa Sadabahar cultivar in M1 and M2 generations at different days intervals (in cm.)

Days	M1 Generation				M2 generation			
Doses in mM	15	30	45	60	15	30	45	60
0.0	12	22	31	38	15	26	35	43
0.5	16	32	44	49	16	33	43	51
1.0	19	29	51	58	21	37	51	58
2.0	26	42	56	62	25	42	55	62
4.0	11	21	30	34	12	21	32	35

Fig.1 Pot experiment showing treatment difference in tomato seedling to Sodium Azide

Effects of SA on seedling growth of tomato (Pusa sadabahar)

Out of four treatment 0.5, 1.0, 2.0, and 4.0 mM of SA the maximum length of seedling in tomato plant was showed 26 to 62 cm in 2.0 mM concentration of SA whereas the minimum length of tomato plant was showed 11 to 35 cm in 4.0 mM concentration of SA. Even though the control plant showed 12 to 43 cm plant height in M1 and M2 generation (Table 4).

Thus seeds pre-soaking with SA at prior three doses 0.5, 1.0 and 2.0 mM concentration increased significantly root length and seedling height of tomato plant compared with control plant. Our findings are supported by the results of Aldesuany and Ibrahim (2000) who stated that shikimic acid induced an increase in growth and yield of cowpea plants. The beneficial effects of shikimic acid on fruit yield may have been due to photo assimilation of fruits thereby increasing fruit wt. (Gunes *et.al* 2007; Elwan and El-Hamahmy 2009; Favaty *et.al* 2009) In the same direction the significant highest value of fruit juice was increased by 100% with the treatment with 2.0 mM concentration of SA over control plant.

Generally, sodium azide was very effective in inducing mutations with respect to the germination percentage, root length, and seedling height. The most effective concentration being 2.0mM. The result of this work showed that all the trait studied were affected by SA treatment, the decrease in seedling emergence, seedling height, root length and seedling survival height at maturity and fruit yield/plant with increasing mutagen concentration (2.0<4.0) has been reported by mutagenesis studies (Adamu *et al.*, 2002) when groundnut was treated with Gamma rays.

In conclusion, generally SA is very effective in increasing mutations with respect to germination percentage, root length, seedling height per plants, the most effective

concentration being 2.0mM. The cultivar Pusa sadabahar responds to the treatment differently with different concentration of SA, therefore could be utilise to increase variability in isolating beneficial mutants for improvement of tomato production.

References

Adamu, A. K., Clung, S. S. and Abubakar, S. 2004. Effects of ionizing radiation (gamma-rays) on Tomato (*Lycopersicon esculentum* L.). Nigeria Journal of Experimental and Applied Biology, 5(2): 185-193.

Adamu, A. K., Oluranju, P. E., Bate, J. A. and Ogunlade, O. T. 2002. Radiosensitivity and effective dose determination in groundnut (*Arachis hypogaea* L.) irradiated with gamma-rays. Journal Agriculture and Environment, 3(1): 17-84.

Ahloowalia, B. S and Maluszynski, M. 2001. Induced Mutation. A new paradigm in plant breeding. Euphytica, 118(2): 167-173.

Coe, E. H and Neuffer, M. G. 1977. The genetics of Corn. In: G. F. Sprague, (eds). Corn improvement, Agronomy, 18:157-223.

Encarta 2005. Microsoft Encarta encyclopedia Microsoft CD Rom Mashenkov, A. 1986. Induced mutation process as a source of new Mutants. Maize Genetics Cooperation newsletter, 60:70-71

Mahandjiev, A., Kosturkova, G. and Mihov, M. 2001. Enrichment of *Pisum sativum* gene resources through combined use of physical and chemical mutagens. Israel Journal of plant sciences, 49(4):279-284.

Oiejniczak, J. and Patyna, H. 1986. Influence of combined treatment of N-nitroso-N-methylurea and sodium azide on physiological injury and genetic effect in Triticale. Genet polan, 64: 94.

Ricardo, M. and Ando, A.1998. Effects of gamma-radiation and Sodium azide on quantitative characters in rice (*Oryza sativa* L.). Genetics Molecular Biology 21(1): 244-251

Sasi, A., Dhanavel, D. and Paradai, P. 2005. Effect of chemical Mutagensis on bhendi (*Abelmoschus esculentus* (L.) moench var. MDU-1). Resources on.crops, 6(2) 253-256.

Sheeba, A., Abumalarmalhi, J., Babu, S. and Ibrahim, S. NM. 2005. Mutagenic effects of gamma rays and EMS in M1 generation in sesame. Resources on Crops, 6(2): 300-306.

How to cite this article:

Sarvagya Nand Mishra, Prakash Chandra Pradhan, Anil Kumar and Mukesh Kumar. 2020. Studies on the Effect of Sodium Azide on the Germination Percentage and Yield Product in Tomato Variety (*Solanum lycopersicum*, LINN) Pusa Sadabahar. *Int.J.Curr.Microbiol.App.Sci.* 9(04): 64-69. doi: https://doi.org/10.20546/ijcmas.2020.904.009