

Induced Sodium Azide Effect on Seedling Characters in M_1 Generation of Chickpea (*Cicer arietinum* L.)

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Abstract: An experiment was conducted to assess the mean performance on induced mutagenic effect of different concentrations of sodium azide (0.01, 0.02, 0.04, 0.06, 0.08) along with control on biological characters in M_1 generation of chickpea. The mean performance of 0.01 concentration of BRC - 1055 - 155 genotype was found best in biological characters with highest seedling length, germination percentage and seed vigour index. Treated seeds showed variation in biological characters as compared to control (no treatment). This conclude that treatment with sodium azide is more effective in inducing variability and treated seeds of each genotype in M_1 generation should be investigate for further generations to observe variation and it can be effectively utilized for development of yield in chickpea.

Keywords: Induced mutagenic effect, Sodium azide, M_1 generation, Chickpea, Seedling length, Germination percentage, Seed vigour index

1. Introduction

Chickpea is an autogamous diploid ($2n=16$) legume. It belongs to family Fabaceae sub - family Papilionoideae. The genus *Cicer* includes 43 species, nine of which are annual, 33 are perennial and one with unspecific life cycle. Chickpea is a self - pollinating legume that requires a cool climate during its initial growth period. The demand of chickpea is high in today's market, so there is a need to enhance the productivity and area under cultivation. Mutations have played a great role in increasing world food security, since new food crop varieties embedded with various induced mutations have contributed to the significant increase of crop production (Kharkwal and Shu, 2009). The mutation approach was superior to other methods of crop improvement especially in cases where the required amount of variation could be produced rapidly and economically with least investment of land and labour. Chemical mutagenesis is regarded as an effective and important tool in improving the yield and quality characters of crop plants. In general alkylating agents are very effective mutagens in higher plants. Sodium azide (SA) has been reported to be mutagenic in several crop species. It is perhaps the least dangerous and the most efficient mutagen as its yields of mutations are achieved at moderate sterility rates in M_1 generations. Physiological effects of azides are weak, few chromosomal aberrations are induced, and it delays germination and growth (Fahad, A. Q. and K. Salim, 2009). However, mutagenic effect of sodium azide on biological parameters (G. Roopa Lavanya et al., 2011) is ideal to understand the response of this genotype with respect to mutagen dose to be used for its improvement.

2. Materials and Methods

The present experiment was carried out during Rabi - 2019 under laboratory conditions of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. Three chickpea genotypes were treated with 5 different concentrations (0.01, 0.02, 0.04, 0.06, 0.08) of sodium azide each along with control (no treatment). Data of 20 seedlings from each treatment and control (no treatment) of each genotype were collected for analyzing mean performance of biological characters namely Radicle length (cm), Plumule length (cm), Seedling length (cm), germination percentage (%) and Seed vigour index.

Table 1: List of Chickpea genotypes with their Pedigree and Source

S. No.	Genotypes	Pedigree	Source
1	BRC - 1055 - 155	ICCV93952 (JAK 19218) x ICCV97105	BAU, Sabour
2	BG 3043	DG 5016 x FLIP 94 - 509 C	IARI, New Delhi
3	BRC - 1074 - 183	ICCV96970 (JG16) x ICCV00108	BAU, Sabour

3. Experimental Setup

Seeds of chickpea viz; BRC - 1055 - 155, BG 3043, BRC - 1074 - 183 genotypes were pre - soaked for overnight and they were treated with 0.01, 0.02, 0.04, 0.06 and 0.08 concentrations of sodium azide for 4 hr. at $28 \pm 1^\circ \text{C}$ at pH 3 and control (distilled water). At the end of the treatment were washed with distilled water and transferred into petri dishes (10 seeds in a petri dish) containing a layer of

Whatman No.2 filter paper. These petri dishes are placed in a germination chamber to obtain germination in the dark condition at $22 \pm 2^\circ \text{C}$. Root length (cm), Shoot length (cm), Seedling length (cm) and Germination percentage (%) values are taken on the 8th day of the experiment.

Root Length

Root length was measured on the 8th day of the experiment and as expressed in centimetres. The growth of the radicle is measured by using transparent ruler.

Shoot Length

Shoot length was measured on the 8th day of the experiment and as expressed in centimetres. The growth of the plumule is measured by using transparent ruler.

Seedling Length

The seedling length was measured from the collar region to the tip of the primary leaf. The mean seedling length was expressed in centimetres.

$$\text{Seedling length} = \text{Root length} + \text{Shoot length}$$

Germination Percentage (%)

Seed germination count was taken after seven days from sowing date and expressed as percentage according to the following equation described by (Ellis and Roberts, 1981 and Ruan *et al.* 2002).

$$\text{Germination percentage (\%)} = \frac{\text{Number of germination seeds} \times 100}{\text{Total number of seed tested}}$$

Seed vigour Index

Seedling vigour index was calculated as the following equation according to Abdel Baki and Anderson (1973).

$$\text{Seed vigour index} = (\text{Average shoot length} - \text{Average root length}) \times \text{Germination \%}$$

4. Results

The present investigation entitled “Effect of sodium azide induced biological characters in M_1 generation of Chickpea (*cicer arietinum* L.) ” was carried out to study the mean performance of biological characters.

The highest root length was observed in 0.02 concentration of BRC - 1055 - 155 genotype (1.75 cm) followed by 0.01 concentration of BRC - 1055 - 155 (1.375 cm), 0.02 concentration of BG 3043 (1.37 cm), 0.08, 0.04 concentrations of BRC - 1055 - 155 (1.08, 0.98 cm), control of BRC - 1055 - 155, 0.06 concentration of BG 3043 and 0.01 concentration of BRC - 1074 - 183 (0.86), 0.08, 0.01, control and 0.04 concentrations of BG 3043 (0.85, 0.81, 0.79 and 0.755 cm), 0.06 concentration of BRC - 1055 - 155

(0.75 cm), 0.04, control, 0.08 and 0.02 concentrations of BRC - 1074 - 183 (0.7, 0.65, 0.60 and 0.33 cm).

The highest shoot length was observed in 0.08 concentration of BRC - 1055 - 155 (3.28 cm) followed by 0.01 concentration and control of BRC - 1055 - 155 (3.18, 3.02 cm) 0.02 concentration of BG 3043 (2.84 cm), 0.04 concentration of BRC - 1055 - 155 (2.73 cm), 0.06 concentration of BG 3043 (2.72 cm), 0.01 concentration of BRC - 1074 - 183 (2.70 cm), 0.08, 0.04 and 0.01 concentrations of BG 3043 (2.60, 2.56 and 2.32 cm), 0.02 concentration of BRC - 1055 - 155 (2.2 cm), 0.04 concentration of BRC - 1074 - 183 (2.14 cm), control of BG 3043 (2.11 cm), 0.06, 0.08, control and 0.02 concentrations of BRC - 1074 - 183 (1.98, 1.60, 1.5 and 1.31 cm).

The observed data depicted that the highest seedling length was observed in 0.01 concentration of BRC - 1055 - 155 (4.56 cm) followed by 0.08 concentration of BRC - 1055 - 155 (4.37 cm), 0.02 concentration of BG 3043 (4.21 cm), 0.02, control and 0.04 concentrations of BRC - 1055 - 155 (3.95, 3.88 and 3.71 cm), 0.06 concentration of BG 3043 (3.58 cm), 0.01 concentration of BRC - 1074 - 183 (3.56 cm), 0.08, 0.04 and 0.01 concentrations of BG 3043 (3.46, 3.32 and 3.13 cm), control of BG 3043 and 0.06 concentration of BRC - 1074 - 183 (2.9 cm), 0.04 concentration of BRC - 1074 - 183 (2.84 cm), 0.06 concentration of BRC - 1055 - 155 (2.8 cm), 0.08, control and 0.02 concentrations of BRC - 1074 - 183 (2.21, 2.15 and 1.64 cm).

The highest germination percentage was observed in 0.01, 0.08 concentrations of BRC - 1055 - 155 and 0.02 concentration of BG 3043 (95%) followed by 0.02, 0.04 concentrations and control of BRC - 1055 - 155 (90%), 0.01, 0.04, 0.06, 0.08 concentrations of BG 3043 and 0.01 concentration of BRC - 1074 - 183 (85%), 0.06 concentration of BRC - 1055 - 155 and control of BG 3043 (80%), 0.04, 0.06 concentrations of BRC - 1074 - 183 (75%), 0.08 concentration and control of BRC - 1074 - 183 (70%), 0.02 concentration of BRC - 1074 - 183 (60%).

The highest seed vigour index was observed in 0.01 concentration of BRC - 1055 - 155 (433.2) followed by 0.08 concentration of BRC - 1055 - 155 (415.15), 0.02 concentration of BG 3043 (400.42), 0.02, control and 0.04 concentrations of BRC - 1055 - 155 (355.95, 349.65 and 333.9), 0.06 concentration of BG 3043 (304.3), 0.01 concentration of BRC - 1074 - 183 (303.02), 0.08, 0.04 and 0.01 concentrations and control of BG 3043 (294.1, 282.2, 266.05 and 232), 0.06 concentration of BRC - 1055 - 155 (224), 0.06, 0.04, 0.08 concentrations, control and 0.02 concentration of BRC - 1074 - 183 (217.5, 213.37, 154.7, 150.5 and 98.4).

Table 2: Mean performance of 3 chickpea genotypes for biological characters during rabi (2019 - 2020)

S. No	Genotypes	Radicle length (cm)	Plumule length (cm)	Seedling length (cm)	Germination percentage (%)	Seed vigour index
1	BRC - 1055 - 155 (control)	0.86	3.025	3.885	90	349.65
2	BRC - 1055 - 155 (0.01)	1.375	3.185	4.56	95	433.2
3	BRC - 1055 - 155 (0.02)	1.755	2.2	3.95	90	355.95
4	BRC - 1055 - 155 (0.04)	0.98	2.73	3.71	90	333.9
5	BRC - 1055 - 155 (0.06)	0.75	2.05	2.8	80	224
6	BRC - 1055 - 155 (0.08)	1.08	3.285	4.37	95	415.15

7	BG 3043 (control)	0.79	2.11	2.9	80	232
8	BG 3043 (0.01)	0.81	2.32	3.13	85	266.05
9	BG 3043 (0.02)	1.37	2.845	4.215	95	400.425
10	BG 3043 (0.04)	0.755	2.565	3.32	85	282.2
11	BG 3043 (0.06)	0.86	2.72	3.58	85	304.3
12	BG 3043 (0.08)	0.855	2.605	3.46	85	294.1
13	BRC - 1074 - 183 (control)	0.65	1.5	2.15	70	150.5
14	BRC - 1074 - 183 (0.01)	0.86	2.705	3.565	85	303.025
15	BRC - 1074 - 183 (0.02)	0.33	1.31	1.64	60	98.4
16	BRC - 1074 - 183 (0.04)	0.7	2.145	2.845	75	213.375
17	BRC - 1074 - 183 (0.06)	0.92	1.98	2.9	75	217.5
18	BRC - 1074 - 183 (0.08)	0.605	1.605	2.21	70	154.7

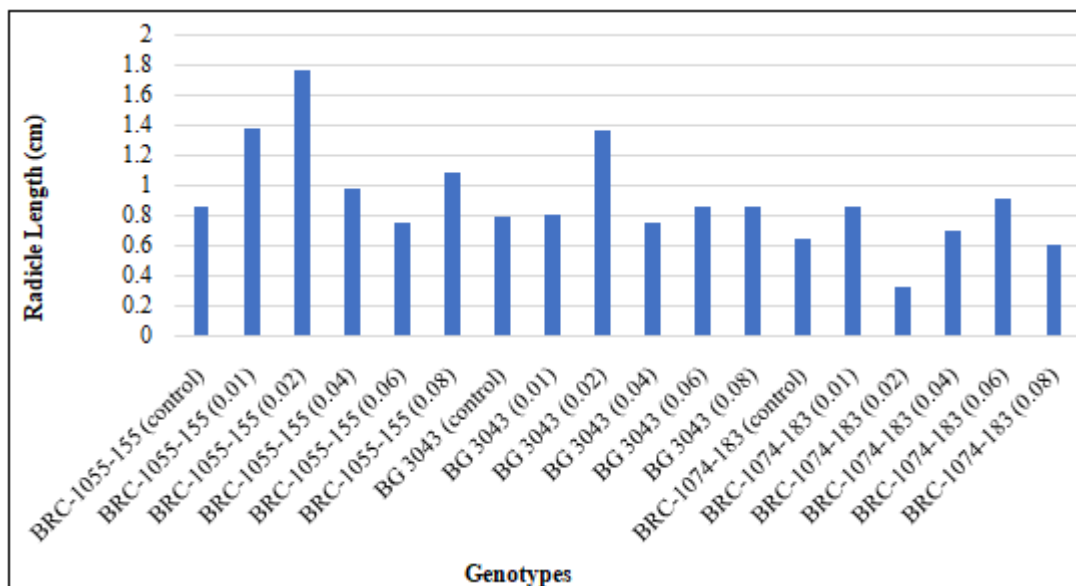


Figure 1: Mean performance of chickpea genotypes for radicle length

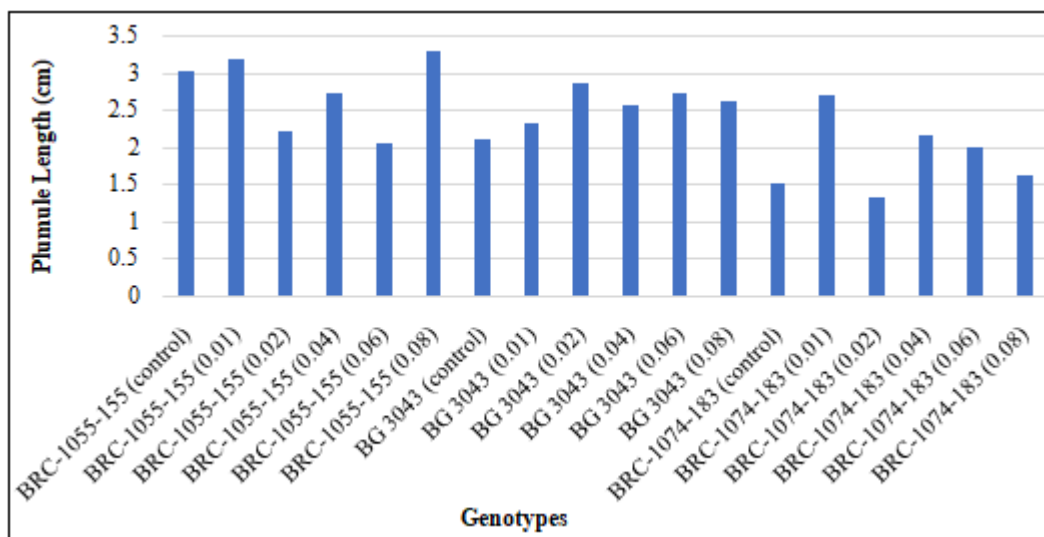


Figure 2: Mean performance of chickpea genotypes for plumule length

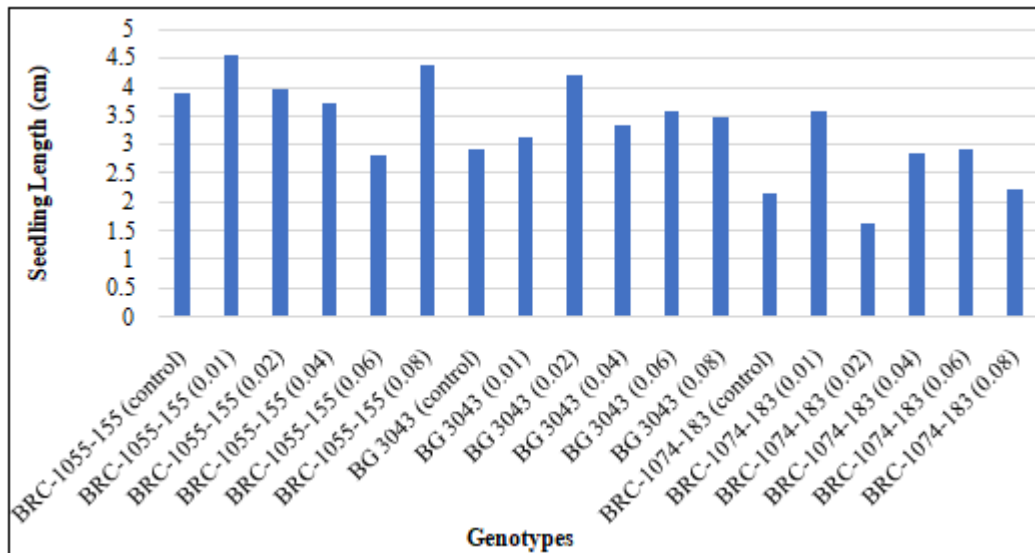


Figure 3: Mean performance of chickpea genotypes for seedling length

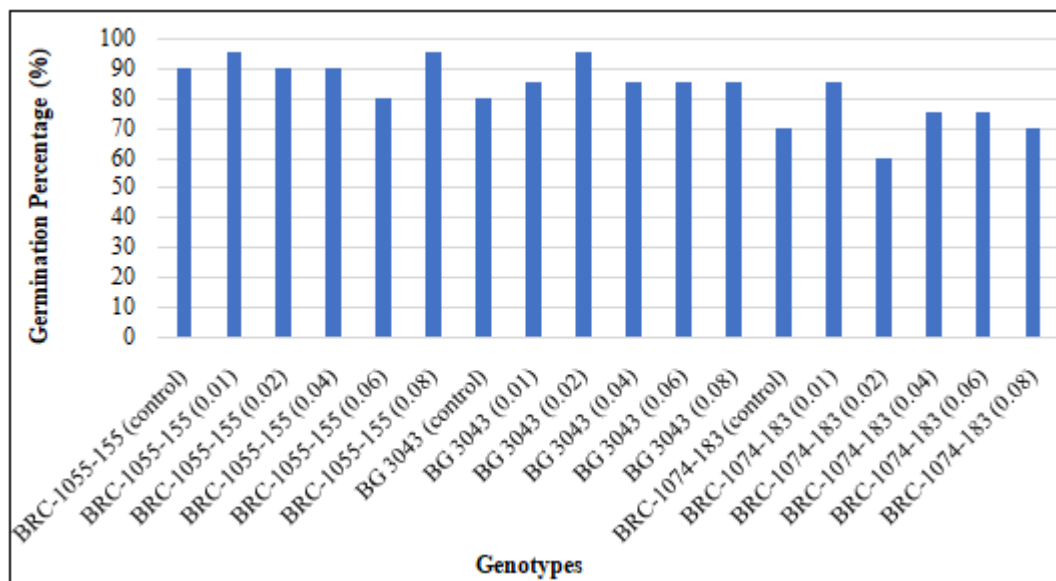


Figure 4: Mean performance of chickpea genotypes for germination percentage

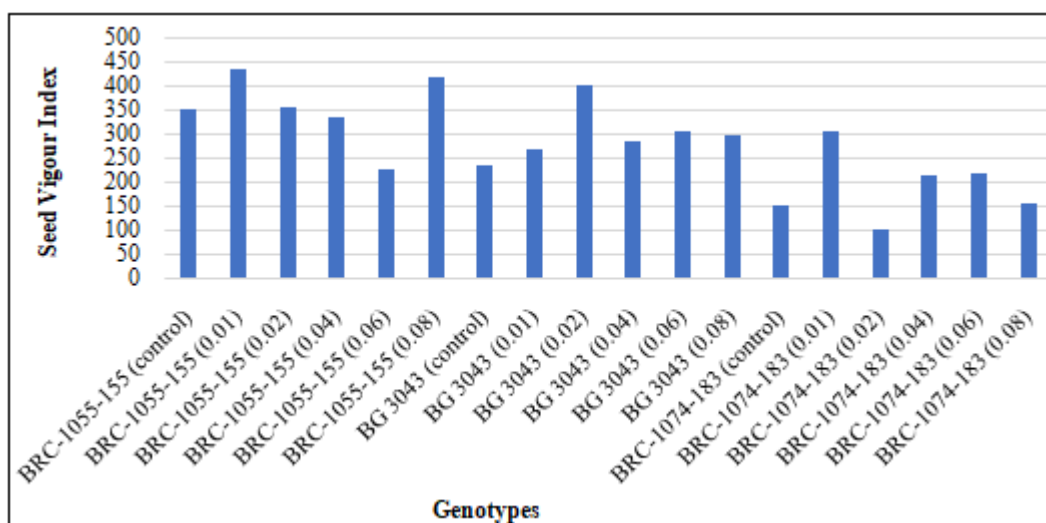


Figure 5: Mean performance of chickpea genotypes for seed vigour index

5. Conclusion

From the present investigation it is concluded that the mean performance of 0.01 concentration of BRC - 1055 - 155 genotype was found best in biological characters with highest seedling length, germination percentage and seed vigour index. The results showed a differential sensitivity among the genotypes. Where, all the biological parameters have showed gradual significant increase or decrease in their values with increase in concentration of sodium azide in each genotype but in every genotype the treated seeds have showed better performance over control (no treatment). This shows that treatment with sodium azide seems to be more effective in inducing variability. So, the sodium azide treated seeds in each genotype of M_1 generation should be investigated for further generations to observe variation and it can be effectively utilized for yield improvement in chickpea.

Pictorial Plate

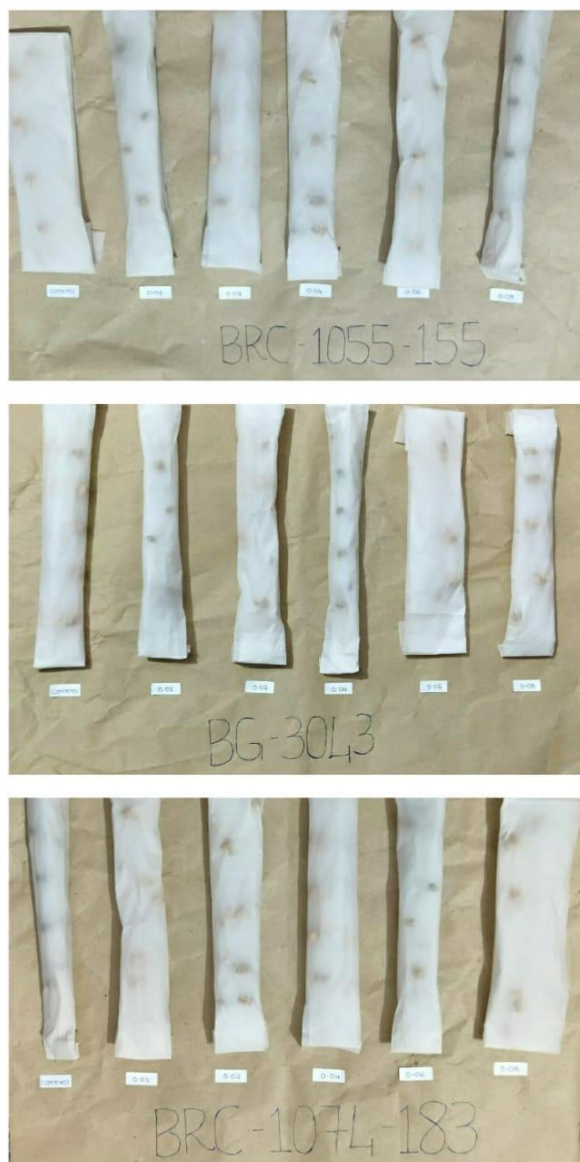


Plate 1: Seeds of different concentration of three genotypes were wrapped in butter paper for germination.



Plate 2: Seedlings of different concentration of three genotypes

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