Journal of
Current Opinion in Crop Science
Journal homepage:: www.jcocs.com

RESEARCH ARTICLE

Study of mutation induced by Sodium Azide in field pea (*Pisum sativum* L.)

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Article history:

Received: November 24, 2020
Accepted: December 25, 2020
Published: December 30, 2020

Citation:

Singh, T.N., Jeberson, M.S., Devi, Y. S., Singh N.B., Sinha, B., Shashidhar, K.S. & Sharma, P.R. (2020). Study of mutation induced by Sodium Azide in field pea (*Pisum sativum* L.). *Journal of Current Opinion in Crop Science, 1*(1), 11-15.

ABSTRACT

The present study was conducted to determine the effect of Sodium Azide's sensitivity (0.1%, 0.3% and 0.5%) on three genotypes of field pea viz., Makhyatmubi, Makuchabi, and Rachna. In M_1 generation, a dose-dependent decrease was observed for seed germination. The pollen fertility showed a negative dependence on Sodium Azide's dose proportionate decrease in fertility with the mutagen's increasing concentration in all the three varieties. The loweest pollen fertility was noted in a Makuchabi (83.76%) at 0.5% Sodium Azide. The four types of chlorophyll mutation (chlorina, xantha, albina, and viridis) were screened from the M_2 population. Chlorina type of mutation was induced with the highest frequency at all the concentrations regardless of the variety studied. The greater concentration of Sodium Azide was observed to induce an extensive range of chlorophyll mutation in all the genotypes. However, the overall spectrum of chlorophyll mutation induced in field pea was in the following order; chlorina > viridis > xantha > albina. The magnitude of mutagenic effectiveness exposed a variety of response; it decreased with the increasing concentration of Sodium Azide on the varieties Makhyatmubi and Rachna, while on the other hand a rising trend of it was observed in the case of Makuchabi. Sodium Azide's efficiency for most of the treatment decreased with increase in the concentration in genotypes of Makhyatmubi and Rachna but for Makuchabi, it increased with the concentration in a decreasing trend.

Keywords: Mutation; Generation; Sodium Azide; *Pisum sativum*

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INTRODUCTION

Creation of genetic variation is a pre-requisite for any plant breeding programme; however, pulses like pea, commonly, lack the genetic variability due to their autogamous nature. Moreover, enough variability does not exist but genetic variation can be created by various methods, out of which, hybridization and induced mutation are the most important.

Furthermore, creation of variation over hybridization is challenging a task, because of the highly self-pollinated, small, fragile flowers, difficult to carry out emasculation. Therefore, the conventional breeding methods have acquired a restricted application in field pea. Hence, mutation breeding seems to play an important role in successful generation of variation in this important pulse.

MATERIALS AND METHODS

In the present study, three field pea varieties, namely, Makhyatmubi, Makuchabi and Rachna, were used to evaluate Sodium Azide's sensitivity. A chemical mutagen, sodium azide, was used at three different concentrations for induction of mutation. In Sodium Azide treatment, selected seeds of each genotype were divided into four lots of cloth bags that contain 375 seeds per lot (Nepolian et al., 2019). Among the four lots, one lot of seeds in every cloth bag for each variety were kept as control, i.e., without treatment. However, the three remaining lots of each variety were used for Sodium Azide treatment. In chemical assays, seed lots were presoaked in dH2O for 6 hours before the treatment (Nepolian et al., 2019). One lot of presoaked seeds from each variety was exposed to 0.1%, 0.3% and 0.5% of Sodium Azide for 6 hours with discontinuous shaking at RT. The treated seeds of three field pea varieties along with the control were planted on raised beds with single seed per hill. The seeds were sown at 3-5 cm depth (Nepolian et al., 2019). Fertilizers applied at the rate of 20: 40: 20 kg/ha NPK in 46% N, 16% P_2O_5, and 60% K_2O, one day before planting in raised beds for the better initial growth of the plant (Nepolian et al., 2019).

RESULT AND DISCUSSION

The data on the survival of Sodium Azide administered to the M_1 plants at maturity is presented in table 1. A similar finding has been reported by Karthika and Lakshmi (2007) in soybean and Srivastava et al. (2008) in pea. This result is also in close agreement with the earlier works of Girija and Dhanavel (2009) in cowpea. Similar effects on plant survival have been reported by Balai and Krishna (2009) in mungbean and Govardhan and Lal (2013) in field pea (*Pisum sativum* L.) and Rai et al. (2013) in Linseed. Ramya et al. (2014) carried out an experiment in black gram in M_1 population and found the same results in pea. In the present study, the number of branches per plant of Sodium Azide administered M_1 plants at maturity are presented in table 1. This indicates that the dose of Sodium Azide increases; the number of branches is decreased compared to the control. A similar finding has been reported by Amjad et al. (1993) in dry seeds of" Green Feast" pea variety. There was a difference in 50 percentage flowering between the three varieties of field pea but sensitive to various Sodium Azide varieties.

The mean number of days to maturity for the genotypes and response to the treatment applied in the present investigation are presented in table 2. The result revealed a reduction in mean days to maturity for the mutagen treated populations than that of the control; the reductions were on par with one another. However, genotypes responded significantly to Sodium Azide treatment. A minimum of 119.33 days to maturity was recorded from Rachna at 0.5% Sodium Azide. The effect of Sodium Azide's on plant height at maturity has been recorded and presented in table 2. .A dose-dependent reduction in the intermediate concentration of the

Sodium Azide was observed in the pea genotypes. The genotypes responded differentially to the dose. Ranchna recorded the lowest plant height (52.33 cm) at 0.5 % Sodium Azide concentration. A gradual decrease in the number of seeds per pod was evident from table 2, which was due to various Sodium Azide treatments.

The therapies had the same effect on all of the genotypes. Makhyatmubi (3) had the lowest mean number of seed per pod at 0.5 percent Sodium Azide. Kumar et al. (2009) observed comparable results in M1 generation EMS treated cowpea variety Co 4. Table 3 shows the mean 100 seed weight (g). The mean 100 seed weight of the M1 generation population shows diversity in genotype responses to various treatments. Kumar et al. (2009) found a similar drop in 100 seed weight (g) in cowpea variety Co 4. Table 3 shows the mean pod per plant for each treatment. Makuchabi (3) and Rachna (3) had the lowest mean number of seed per pod at 0.5 percent Sodium Azide (Kumar et al., 2009). Table 1 shows the days required for initial flowering. The treatment worked on all three genotypes.

Table 1. Effects of NaN_3 on Number of plant survival (%), Number of branches per plant and Days to 50% flowering in M_1 generation of field pea genotypes.

Treatment	Number of plant survival (%)				Number of branches per plant				Days to 50% flowering			
	Makhyat-mubi	Makuch-abi	Rachna	Mean	Makhyat-mubi	Makuch-abi	Rachna	Mean	Makhyat-mubi	Makuch-abi	Rachna	Mean
Control	79.21	71.51	69.22	73.31	15.06	17.33	13.93	15.44	65.33	67.66	70.33	67.77
0.1%NaN_3	67.84	61.25	68.61	65.90	15.00	13.66	13.73	14.13	63.33	66.33	68.00	65.88
0.3%NaN_3	49.93	59.90	66.20	58.67	14.46	12.93	13.26	13.55	61.66	65.33	66.33	64.44
0.5%NaN_3	40.74	56.20	55.20	50.72	13.80	11.93	12.96	12.89	60.33	64.33	64.33	62.99
Mean	59.44	62.21	64.80	-	14.58	13.96	13.47	-	62.66	65.91	6.24	-

Table 2. Effects of NaN_3 on Days to maturity, Plant height (cm) and Number of seed per pod in M1 generation of field pea genotypes

Treatment	Days to maturity				Plant height (cm)				Number of seed per pod			
	Makhyat-mubi	Makuch-abi	Rachna	Mean	Makhyat-mubi	Makuch-abi	Rachna	Mean	Makhyat-mubi	Makuch-abi	Rachna	Mean
Control	129.66	132.66	125.00	129.10	70.66	75.66	64.66	70.32	4.26	4.93	4.06	4.41
0.1%NaN_3	127.66	126.33	123.33	125.77	70.26	74.00	63.33	69.19	3.26	4.33	3.70	3.54
0.3%NaN_3	126.66	124.00	121.33	123.99	67.33	71.80	62.00	67.04	3.23	3.93	3.43	3.53
0.5%NaN_3	121.66	120.33	119.33	120.44	66.46	64.80	52.33	69.19	3.00	3.26	3.20	3.15
Mean	126.41	125.83	122.24	-	68.67	71.56	60.58	-	3.43	4.11	3.59	-

Table 3. Effects of NaN_3 on 100 seed weight (g) and Number of pod per plant M_1 generation of field pea genotypes

Treatment	100 seed weight (g)				Number of pod per plant				Days to first flowering			
	Makhyat-mubi	Makuch-abi	Rachna	Mean	Makhyat-mubi	Makuch-abi	Rachna	Mean	Makhyat-mubi	Makuch-abi	Rachna	Mean
Control	20.33	18.33	19.66	19.44	4.00	4.33	4.06	4.13	58.00	56.66	55.33	56.66
0.1%NaN_3	20.00	16.00	18.50	18.16	3.11	3.66	3.06	3.27	59.66	58.00	56.66	58.10
0.3%NaN_3	19.33	15.66	16.50	17.16	3.26	3.46	4.06	3.59	58.66	57.66	54.66	56.99
0.5%NaN_3	18.00	15.66	17.33	17.21	3.73	3.00	3.00	3.24	58.66	56.33	54.00	56.33
Mean	19.10	16.41	17.99	-	3.52	3.61	3.54	-	58.74	57.24	55.15	-

CONCLUSION

The present study concluded that in M_1 generation character like the number of plant survival percentage, and first flowering could be effectively used for estimating the biological effect of mutagen. Biological effects on M_1 generation can be used as an advance indicator of the mutation taking place in the treated population. The mutagen Sodium Azide is efficient for inducing genetic variability in yield contributing characters in field pea. Hence, induced mutagenesis can successfully be employed to generate genetic variability among field pea genotypes, which can either be used to select superior progenies among the population or be employed in various hybridization programmes

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