Journal of Global Biosciences
ISSN 2320-1355
Volume 6, Number 5, 2017, pp. 4966-4970
Website: www.mutagens.co.in

Research Paper

EFFECT OF EMS ON M_1 PARAMETERS OF FIELD PEA (*Pisum sativum* L. *var. arvense*)

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INTRODUCTION

Field pea is one of the most important cool season crop among the pulses grown in India. But lack of well adapted high yielding varieties resistance to various stresses is a major constraint in increasing the area and productivity of Field pea in India. Induced mutagenesis can play an important role in improvement of Field pea. It requires handling of large populations to increase the chances of induction and detection of a mutation in a particular gene of interest. The various effects of mutagen in M_1 often used as an indicator of the effective mutagenesis. It also helps to setup the $L.D._{50}$ value of the mutagen for the varieties and plant species under study. The M_1 parameters (pant injury, sterility, etc.) may guide breeders to identify effective treated populations in M_1 generation to reduce unnecessary load of ineffective populations and provide better scope of selection in subsequent generation (Singh and Mohapatra, 2004). Keeping this in view the present experiment was conducted to induce and study various characters in M_1 generation indicating biological effect of EMS on three varieties of Field pea.

MATERIALS AND METHODS

In present investigation three field pea varieties *i.e.*, HFP-554, Prakash and Rachna were used as experimental materials. Pure well dried, fully matured, disease and insect free seeds with uniform shape, size and colour, as far as practicable, were chosen from the seed lot of each varieties for EMS treatment. The seeds of each varieties were divided into 4 seed lots and allowed to presoak in distilled water for 6 hours. 1 seed lot from each variety was kept as control rest of three lots were treated with 0.05%, 0.10% and 0.15% EMS for another 6 hours. The treated seeds were kept under running tap water for 2 hours to wash the residual of the EMS from the seeds. A sample of seeds from each of the treated seed lot including control were placed in petridishes in three replications inside laboratory for taking observations on germination percentage and length of seedling shoot and root. Rest of the treated materials of different varieties including controls were immediately sown in a factorial randomized block design (FRBD) with three replications at PBG experimental field of College of Agriculture (CAU), Imphal. The sowing was done on December 21st, 2012.

To make necessary interference the observations for the characters under study were treated statistically using analysis of variance for FRBD as directed by Gomez and Gomez (2010). For determining LD_{50} dose of EMS, data of Germination percentage were subjected to probit analysis.

RESULTS AND DISCUSSION

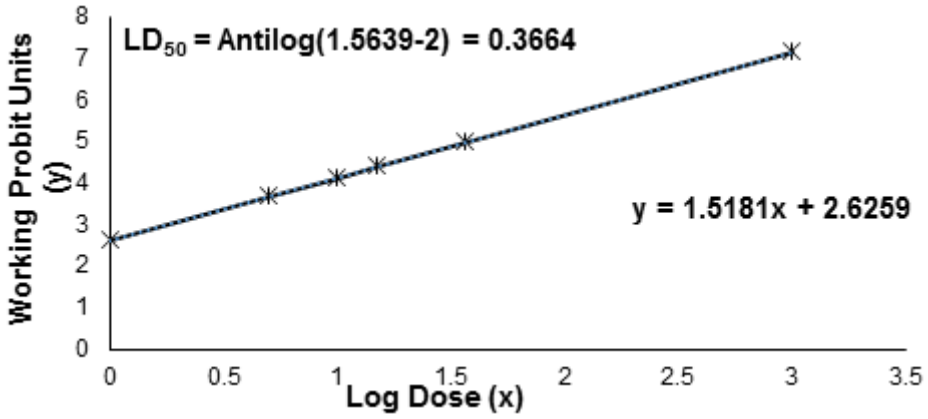
The results of mean effect on seed germination from the present study as presented in table 1 indicate that, mean percent seed germination decreased with increasing concentration of EMS indicating a dose dependent response of the treatment on field pea. This clearly shows that EMS have exerted an inhibitory effect on seed germination. This response was not dependent on the genetic background of the population. This result is in close agreement with the earlier results of Shrivastava *et al.* (2008) and Govardhan and Lal (2013).

Seedling height is widely used as an index in determining the biological effects of various mutagens in M_1 generation (Konzak *et al.*, 1965). From the table is evident that seedling injury is negatively correlated with the concentration of EMS. The sensitivity of the field pea for seedling height is very much dependent on the genetic background as indicated from the significant variation due to interaction between variety and the concentration of EMS. Similar decrease in seedling height with increasing concentration of mutagen has been reported from Shrivastava *et al.* (2008) and Govardhan and Lal (2013).

Table 1. Probit analysis for mean effect of EMS in field pea

EMS Dose (%)	No. of seeds evaluated	Observed mortality (%)	Corrected mortality (%)	Log_{10} of dose (X)	Emperical probit units (Em)	Expected Probit units (Ep)	Working probit units (Y)
0	100	1.778	-	-	-	-	-
0.05	100	10.667	9.055 (9)	0.699	3.66	3.6768	3.6688
0.10	100	22.222	20.814 (21)	1	4.19	4.1446	4.1926
0.15	100	28	26.697 (27)	1.1761	4.39	4.4183	4.3809

A stimulating effect on shoot growth was observed at lower concentration of EMS followed by reduction in shoot length at intermediate and highest concentration of EMS. Whereas, root height of the seedlings in M_1 generation showed a gradual decrease with the increase in the concentration of EMS. The data of mean root/shoot ratio for field pea showed a gradual increase with the increase in the concentration of EMS; the possible reason for this increase was due to high sensitivity of the shoot length.



The analysis of percent survival during early growth stages of Field pea showed an inverse relationship between concentration of EMS and survival of the plants. The interaction between variety and concentration was significantly higher describing the dependence of sensitivity of field pea for survival on the genotype of the treated population. The rapid infusion of chemical mutagen and their ability to produce chromosomal aberration and damage to genetic material can be one of the cause for this reduction in the survival percentage in M_1 generation after mutagen treatment. This finding supports the results of Sharma *et al.* (2010) in pea and Rai *et al.* (2013) in linseed.

There was difference in pollen fertility between the three varieties of field pea but sensitivity to various EMS concentration was more or less identical. EMS has been reported to reduce the reproductive capacity of the plants. Chromosomal aberration (deficiency, duplication, translocation and inversion etc.), gene mutations and other physiological effects may be accounted as cause of this effect (Kharakwal, 1981; Konzak *et al.*, 1965).

In the present investigation, studies conducted on Plant growth components in latter stage of crop growth showed different response to various concentration but there was not any significant effect due to concentration of EMS and interaction between variety and concentration. Even though there was significant effect of EMS treatment in the early growth stage of field pea as evident from the five characters studied earlier, it seems that the crop had recovered from the damage caused in the latter stages of the crop growth. This could be resulted due to activity of various DNA repairs on chromosomal breaks and aberration caused due to mutagen treatment enabling the crop to carry the proper growth and developmental process to complete the life cycle. The present results were in general accordance with the results obtained by Mohna *et al.* (1989) in urdbean and Singh and Devi (2006).

LD_{50} i.e., the dose in which half of the individuals among the treated population dies; is a parameter to decide the effective dose for a mutagen treatment in any crop species. Estimation of LD_{50} value in present investigation was done for percentage reduction in seed germination at M_1 generation using probit analysis as suggested by Sharma (1988). The mean LD_{50} value of EMS dose for the field pea in the present experiment was found to be 0.3664% (0.37%).

Table 2. Mean effect of EMS on 12 different characters of three field pea varieties in M_1 generation

Doses (D)	Germination (%)	Survival (%)	Seedling height (cm)	Pollen fertility (%)	Root length (cm)	Shoot length (cm)	Root/shoot ratio	Plant height (cm)	Days to 50% flowering	Days to maturity	No. of seeds per pod	100 grain weight (g)
Control	98.22 (9.94)	92.89 (9.66)	12.55	83.90 (9.19)	8.51	1.63	5.25	46.77	67.56	118.56	5.12	20.52
0.05% EMS	89.33 (9.48)	85.89 (9.29)	11.68	77.80 (8.85)	8.16	1.74	5.41	46.11	65.22	119.22	4.83	19.54
0.10% EMS	77.78 (8.85)	81.22 (9.03)	10.55	74.45 (8.66)	7.42	1.39	6.05	44.95	67.55	118.76	4.74	19.23
0.15% EMS	72.00 (8.51)	76.89 (8.80)	10.14	71.68 (8.49)	6.65	1.30	5.82	47.86	67.89	120.89	4.71	19.89
C.V. (%)	4.24	1.50	4.26	1.86	9.63	11.14	10.12	5.08	4.63	3.2	5.89	8.43
$C.D._{0.05}$ (V)	NS	0.06	0.41	0.14	0.63	0.16	0.48	1.99	2.63	3.23	0.28	1.41
$C.D._{0.05}$ (D)	0.38	0.07	0.46	0.16	0.72	0.18	0.56	NS	NS	NS	NS	NS

The present study revealed that the growth parameters such as germination (%), survival (%), seedling height (cm), root and shoot length, and pollen fertility is an good indicative of the various injury caused by the mutagen. Whereas, the variation in the growth parameters of crop growth in latter phase such as plant height (cm), days to 50% flowering, etc. is entirely due to the genetic makeup of the varieties, so they cannot be used as an indicator of the sensitivity to the mutagen.

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