

## Effect of EMS, SA and Gamma Radiation on Seedling Development of *Vigna radiata*, Ahmednagar (M.S.) India

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**Received** : 25.02.2020; **Accepted** : 22.04.2020

### ABSTRACT

The present experimental work has been done on *Vigna radiata*, Cultivar Naval. The effects of Chemicals and Physical Mutagens were studied on seedling development. The EMS, SA and Gamma Radiation affected the seedling growth at the time of development on its root and shoot. Seeds were treated with various concentrations of Chemical Mutagens and Gamma Radiation. The result showed variation in Root and Shoot Length, Vigour index (Length, Mass), Dry weight as compared to control.

Figures : 06

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KEY WORDS : EMS, Gamma Irradiation, Growth Parameters, SA.

### Introduction

Plant Mutation Breeding Plays a Crucial Role in Agricultural Sector to increase crop productivity by improving cultivar against disease, insect, drought, salinity. *Vigna radiata* (2n=22) from Legume family is cultivated throughout the world for its nutritional value.

Chemical and Physical Mutagens are widely used in the Plant Mutation Breeding to create genetic variability in crop plants to increase crop productivity and resistance to diseases, insects, drought, salinity. The *Vigna radiata* is cultivated throughout the year *i.e.* in Kharif, Rabi and summer. India is the Origin of *Vigna radiata* and it is cultivated all over the world.

During 2017-2018, the total coverage under Mungbean was about 41 L. ha with a production of 19 Lt. There has been phenomenal increase in area of

Mungbean in the country from 2015-2016 onwards. Rajasthan with more than 42 percent area and 39 percent of production outshined in the total Mungbean contribution in the country. More than 80 percent of mungbean production comes from 10 states Rajasthan, Madhya Pradesh, Maharashtra, Bihar, Karnataka, TN, Gujrat, Andhra Pradesh, Odisha and Telangana<sup>5</sup>.

Root, Shoot Length and Percent Seed germination was induced by Gamma Radiation<sup>11</sup>. The Gamma rays have been widely used for the improvement of various traits of crops<sup>1,2,15,16</sup>. The Sodium Azide concentrations affect the biological parameters<sup>12</sup>.

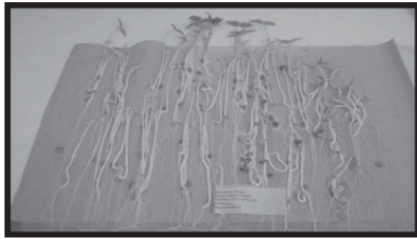
The effect of Mutagens depend on the dose of that chemical concentration which is applied on seed material and time for soaking. The Present experiment was carried out to investigate the effects of Chemical and Physical Mutagens on seedling development of *Vigna radiata*.

**ACKNOWLEDGEMENTS** : We are heartly thankful to Dr. B. H. Zhawre Principal New Arts, Commerce and Science College Ahmednagar, Dr. C. S. Arsule Head Department of Botany, New Arts College who encouraged and inspired us to conduct the research work and provided the Research Laboratory Facility.

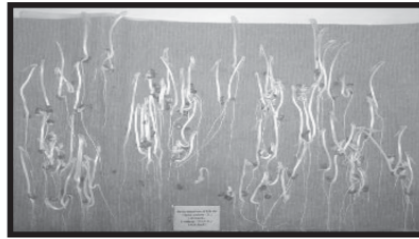
**TABLE-1: Growth Parameters of *Vigna radiata* Cultivar- Naval Generation-M<sub>1</sub>**

Sr No	Dose	Ger. %	Wt of Plumule (g)	Wt of Radical (g)	Total Mass Wt (g)	Length of Plumule (cm)	Length of Radical (cm)	Total Length (cm)	Vigour Index length	Vigour Index Mass	Root-Shoot Ratio	Dry Wt (g)	Remark
1	Control(Nil)	83.00	0.393	0.068	0.461	8.7	21.0	29.7	2465.10	26.63	241.38	0.3208	
2	EMS-5mM	76.00	0.353	0.069	0.422	8.5	11.7	20.2	1535.20	21.65	137.65	0.2849	
3	EMS-10mM	70.00	0.349	0.065	0.414	8.5	11.6	20.1	1407.00	19.07	136.47	0.2724	
4	EMS-15mM	64.00	0.345	0.060	0.405	8.3	11.3	19.6	1254.40	16.76	136.14	0.2618	
5	EMS-20mM	54.00	0.335	0.061	0.396	7.9	9.9	17.8	961.20	13.99	125.32	0.2590	
6	EMS-25mM	46.00	0.325	0.060	0.385	7.6	9.5	17.1	786.60	11.66	125.00	0.2534	
7	SA-1mM	75.00	0.368	0.064	0.432	8.2	11.2	19.4	1455.00	23.27	136.59	0.3103	
8	SA-2mM	70.00	0.367	0.060	0.427	8.0	10.9	18.9	1323.00	20.36	136.25	0.2909	
9	SA-3mM	65.00	0.359	0.063	0.422	8.0	10.5	18.5	1202.50	18.30	131.25	0.2816	
10	SA-4mM	58.00	0.358	0.062	0.420	7.7	9.9	17.6	1020.80	15.73	128.57	0.2712	
11	SA-5mM	49.00	0.359	0.051	0.410	8.1	9.0	17.1	837.90	13.15	111.11	0.2683	
12	GR-150GY	73.00	0.381	0.065	0.446	8.6	12.4	21.0	1533.00	22.94	144.19	0.3142	
13	GR-250GY	66.00	0.380	0.058	0.438	8.2	11.3	19.5	1287.00	19.98	137.80	0.3028	
14	GR-350GY	61.00	0.376	0.055	0.431	7.9	10.6	18.5	1128.50	18.33	134.18	0.3005	
15	GR-450GY	55.00	0.372	0.053	0.425	7.8	10.1	17.9	984.50	16.03	129.49	0.2915	
16	GR-550GY	49.00	0.365	0.050	0.415	7.4	9.4	16.8	823.20	14.14	127.03	0.2885	
	<b>SD±</b>	<b>10.89</b>	<b>0.02</b>	<b>0.01</b>	<b>0.02</b>	<b>0.37</b>	<b>2.76</b>	<b>3.02</b>	<b>408.37</b>	<b>4.12</b>	<b>28.43</b>	<b>0.02</b>	
	<b>SE±</b>	<b>2.72</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.09</b>	<b>0.69</b>	<b>0.76</b>	<b>102.09</b>	<b>1.03</b>	<b>7.11</b>	<b>0.01</b>	

PHOTO PLATE



Control (Untreated)



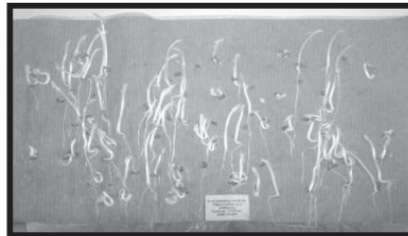
EMS-5mM



EMS-10mM



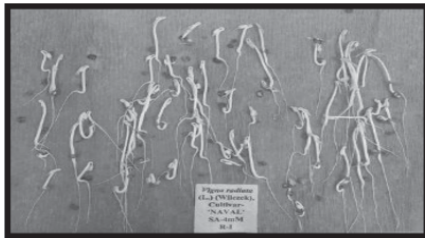
EMS-15mM



EMS-20mM



EMS-25mM



SA-1mM



SA-2mM



SA-3mM



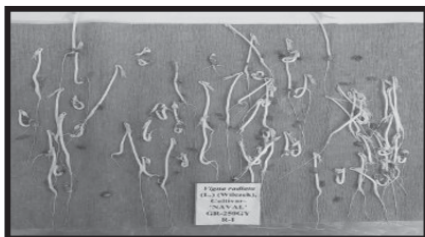
SA-4mM



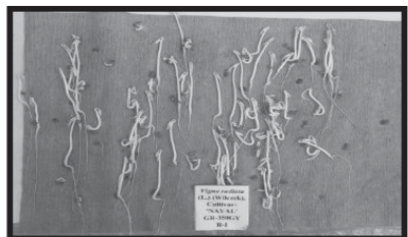
SA-5mM



GR-150GY



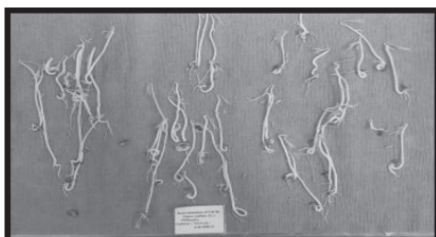
GR-250GY



GR-350GY

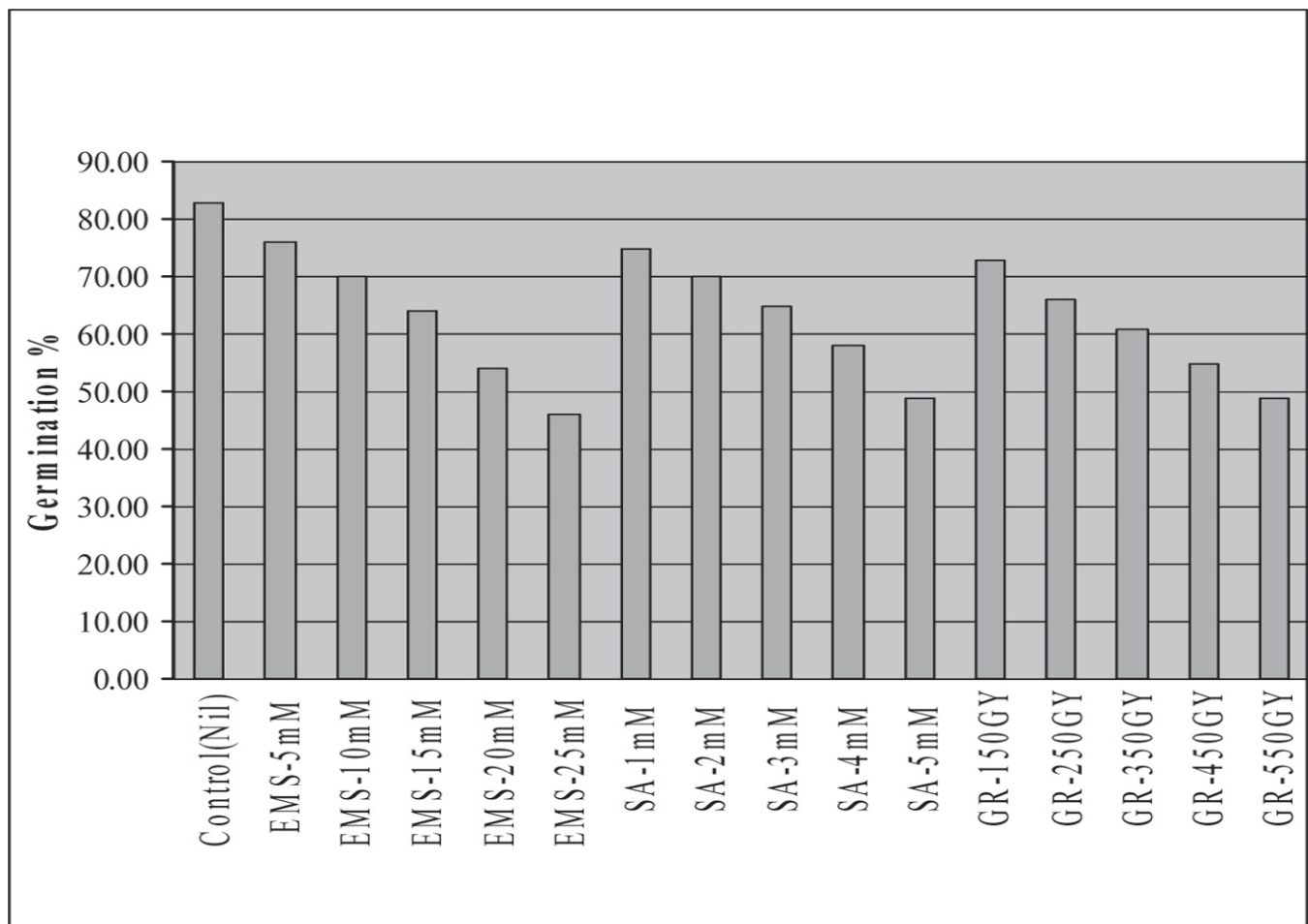


GR-450GY



GR-550GY

Fig. 1 : Different dosages for *Vigna radiata* seeds



**Fig.2 : Graph showing Germination % of Treatment Doses**

### Materials and Methods

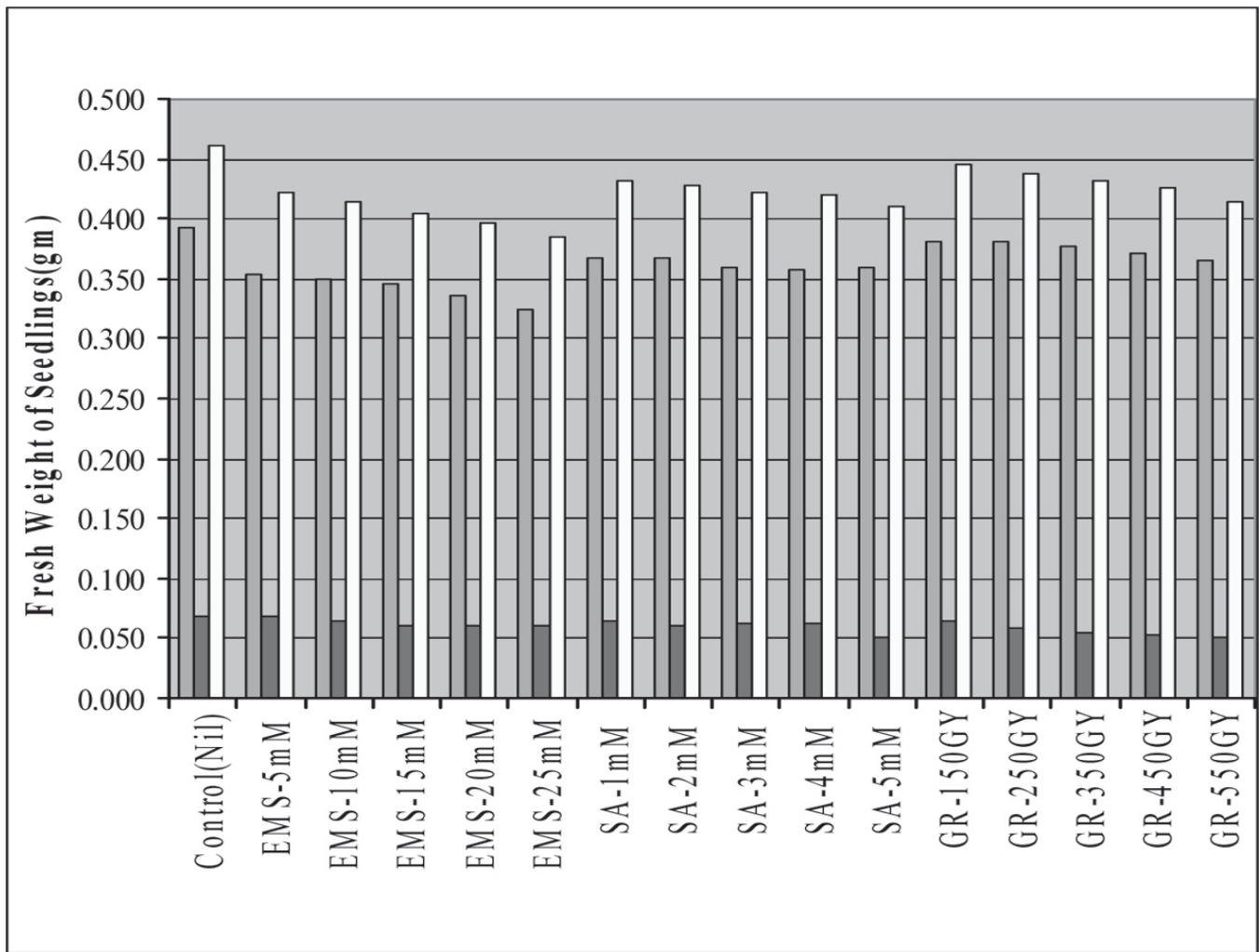
Experimental seeds selected for the present study of *Vigna radiata*, Cultivar-Naval were procured from Nirmal Seeds Pvt. Ltd. Pachora, Jalgaon MS, India. The cultivar is determinate in habit and not suitable for cultivation in summer season and widely cultivated in Maharashtra. EMS and SA Chemicals (Sigma- Aldrich) were availed from Research Center, Department of Botany, New Arts, Commerce and Science College Ahmednagar, MS, India. The doses employed were 5mM, 10mM, 15mM, 20mM and 25mM of EMS, while 1mM, 2mM, 3mM, 4mM and 5mM of SA. Gamma Irradiated seeds with ( $Co^{60}$ )150GY, 250GY, 350GY, 450GY and 550GY were treated from BARC Mumbai, MS, India. Untreated seeds without treatment were used as a control. The experiment was conducted in the year 2018-2019 at Department of Botany, New Arts, Commerce and Science College Ahmednagar.

### Experimental Set up

The seeds were pre-soaked in Distilled water

for 2 hours. The pre-soaked seeds were dried and placed in the prepared concentrations of EMS (5mM, 10mM, 15mM, 20mM and 25mM and SA (1mM, 2mM, 3mM, 4mM and 5mM) for 6 hours. Gamma Irradiated seeds were treated with 150GY, 250GY, 350GY, 450GY and 550GY as a dry. After treatment, seeds were removed and washed three times with running distilled water and dried. The 100 seeds in each concentration including control were kept for germination in between paper in two replications and paper with seeds were rolled with plastic paper covering sheet to maintain water content. The rolls were placed in an upright position and kept in germination chamber for  $25 \pm 1^\circ C$  temperature with relative humidity  $80 \pm 1\%$ . The germination percentage was recorded on 5<sup>th</sup> day after treatment period. After evaluation, 15 seedlings were removed separate from each dose. Shoot and Root Length was measured in terms of cm. and seedlings weighed in g as fresh seedling weight. After this these seedlings were kept for Oven drying for 24 hours at  $100 \pm 1^\circ C$  temperature.





**Fig.3 : Graph showing Fresh Weight of Seedlings (g)**

The growth parameters were calculated as per ISTA rules. The final percentage of seed germination and parameters were calculated using formulae.

$$\text{Percent Seed Germination} = \frac{\text{Number of Seeds Germinated}}{\text{Total Number of Seeds kept for Germination}} \times 100.$$

$$\text{Vigour Index (Length)} = \frac{\text{Germination \%}}{\text{Mean Seedling Length}}$$

$$\text{Vigour Index (Mass)} = \frac{\text{Germination \%}}{\text{Seedling Dry Weight (g)}}$$

$$\text{Root- Shoot Ratio} = \frac{\text{Root Length (Mean)}}{\text{Shoot Length (Mean)}} \times 100.$$

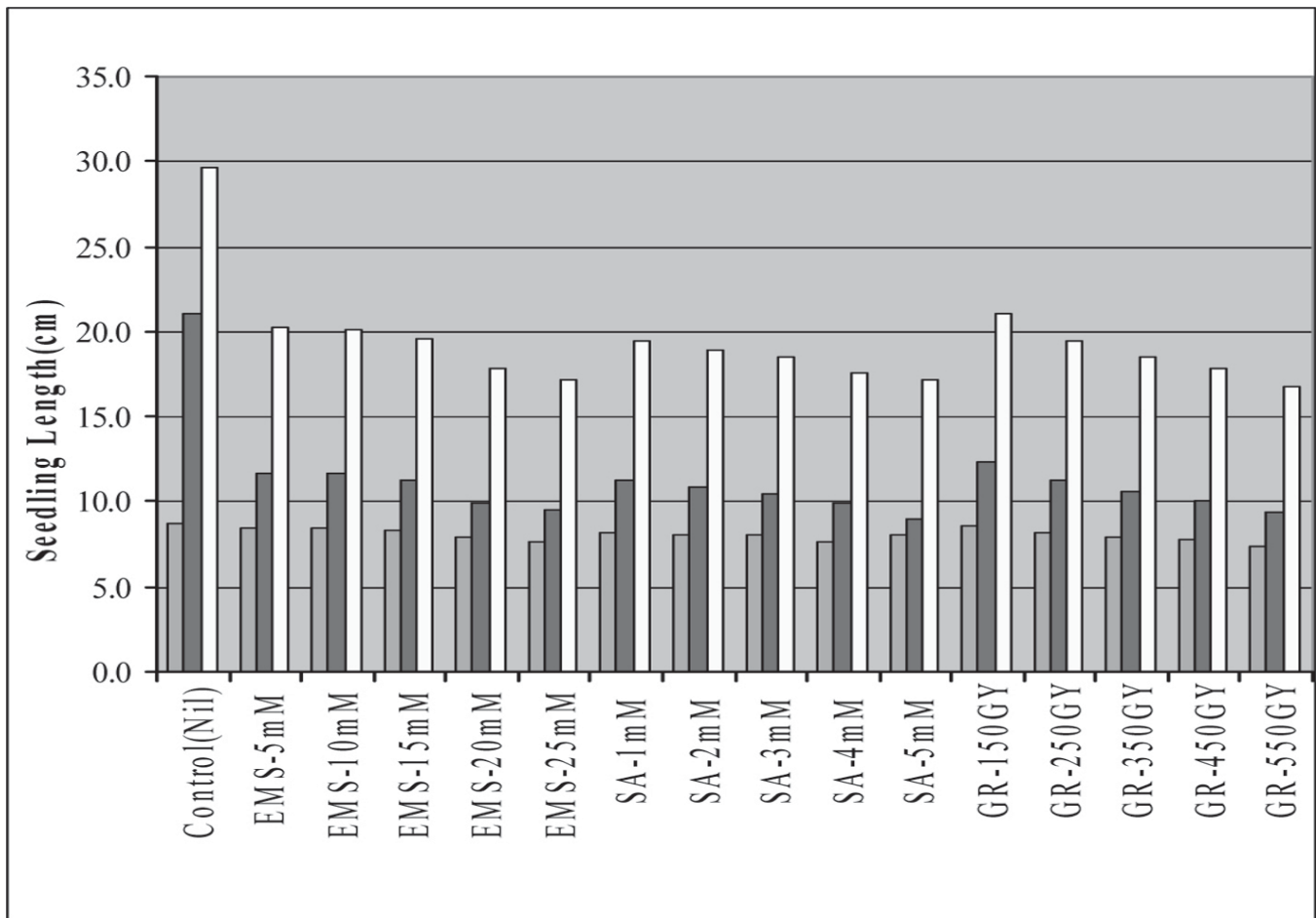


Fig. 4 : Graph Showing Seedling Length (cm)

### Result and Discussion

The germination count was taken on 5<sup>th</sup> day and fresh seedlings (15) were evaluated for the growth parameters (shoot/ Root- length, Fresh mass wt., Dry mass wt., Vigour Index (Length, Mass). Table and Fig.1. Showed the germination % of Treatments including control. The control with germination 83% (Table-1, Fig.1.) showed high in all the growth parameters (0.461 g) fresh weight, 29.7cm mean seedling length, 2465.10 Vigour index (Length), 26.63 Vigour index (Mass), 241.38 Root-Shoot Ratio, Oven dry weight of 0.3208g. The germination percentage decreased with increase in concentration in all the treatments. As compared to all the treatments, EMS 5mM dose showed 0.422g fresh weight of seedling which is 0.039g less than control.

The lowest seedling weight showed by EMS 25mM dose is 0.385g. EMS 10, 15 and 20mM dose showed 0.414, 0.405 and 0.396g weight respectively (Table-1, Fig.2.). SA with 0.432, 0.427, 0.422, 0.420 and 0.410g weight in 1mM, 2mM, 3mM, 4mM and 5mM dose respectively (Table-1, Fig.2.). SA Showed highest weight than that of EMS in all doses except 10mM. GR Showed 0.446, 0.438, 0.431, 0.425 and 0.415g weight in 150GY

to 550GY respectively (Table-1, Fig.2.). Highest weight was found in GR 150GY treatment. The seedling total length was found decreased in higher dose of EMS-25mM (17.1cm) and increased in EMS-5mM (20.2cm). The same results were found in the SA and GR treatments *i.e.* reduced total seedling length with increased in chemical concentration ; SA-1mM Showed 19.4cm, SA-5mM Showed 17.1cm, GR-150GY Showed 21.0cm, GR-550GY showed 16.8cm length respectively (Table-1, Fig.3). Similar results were obtained<sup>3</sup>.

The highest Vigour index (length) was showed by EMS-5mM (1535.20) among all the treatments, while lowest was showed by EMS-25mM (786.60) dose which is higher dose in EMS. SA-1mM showed 1455.00 and SA- 5mM showed 837.90. Similar results were reported<sup>14</sup>. Gamma treatment showed 1533.00 and 823.20 Vigour length index in GR-150GY and 550GY. All the treatments showed lower length index as compared to control (Table-1, Fig.4). Same results were reported<sup>9</sup>. The mass index was decreased with increase in concentration in all treatments as compared to control. 21.65, 19.07, 16.76, 13.99 and 11.66 in EMS-5 to 25mM dose respectively. SA Showed 23.27, 20.36, 18.30, 15.73 and 13.15 in 1 to

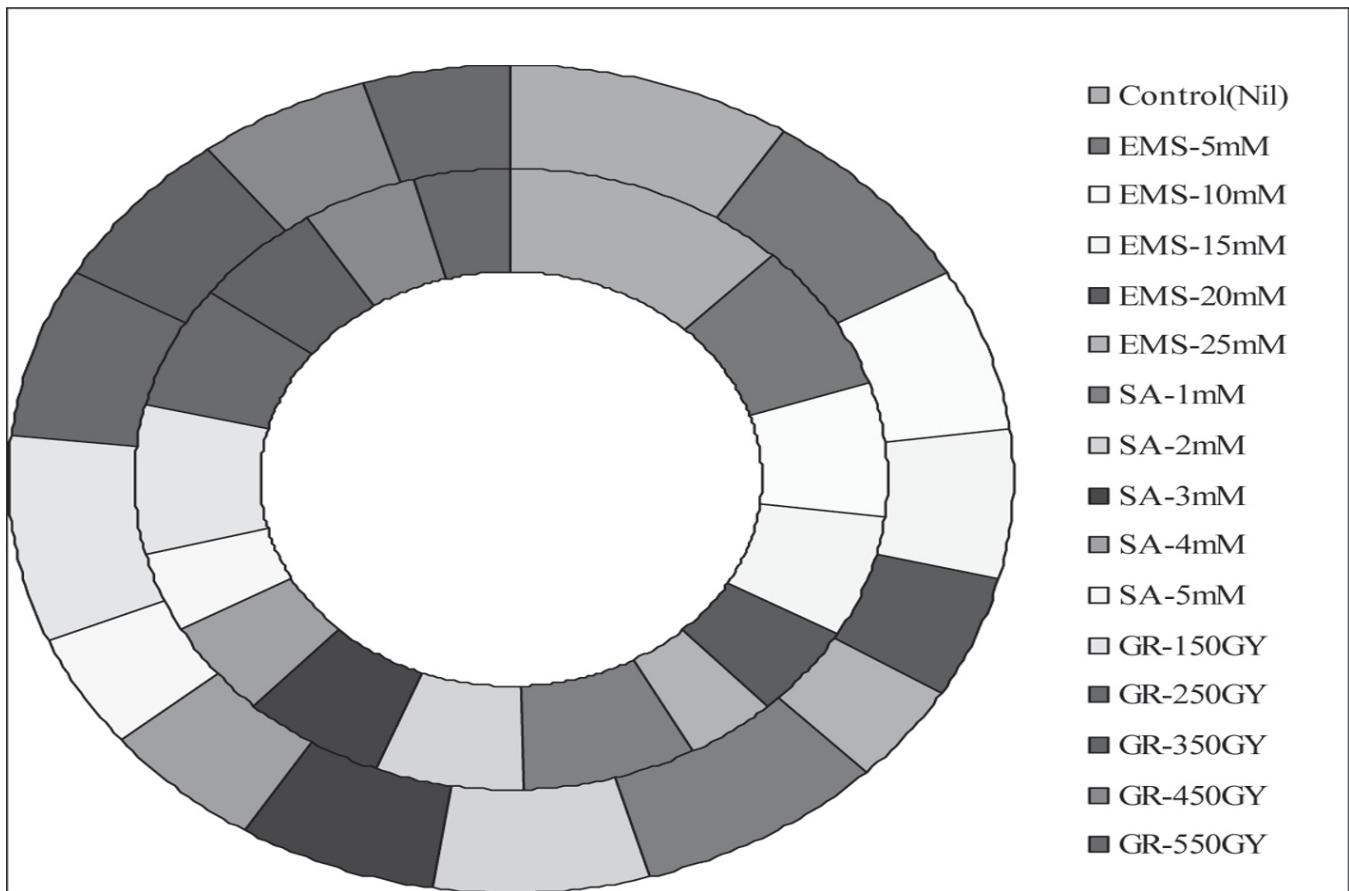


Fig. 5 : Graph Showing Vigour Index (Length and Mass)

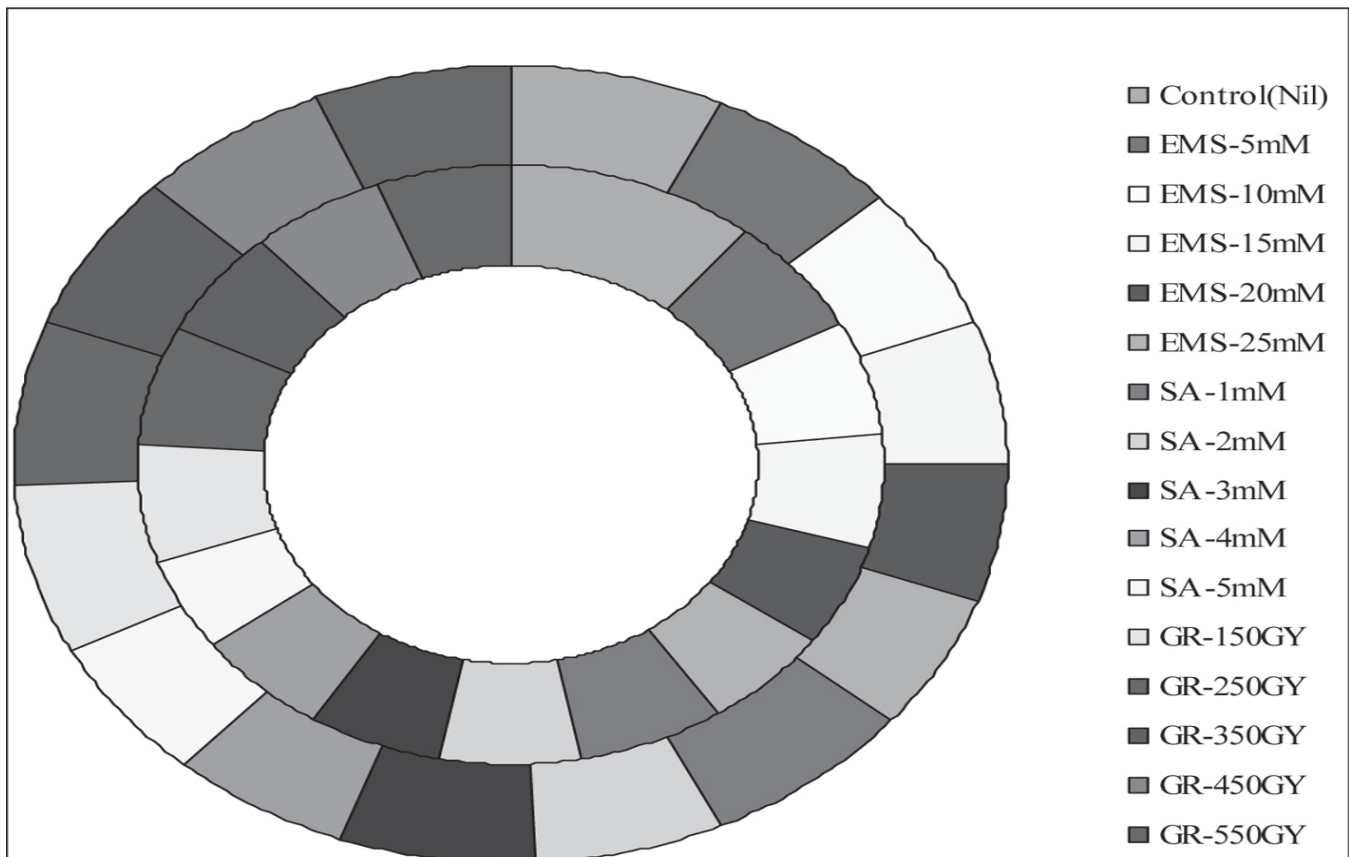


Fig. 6 : Graph Showing Root-Shoot Ratio, Dry Weight (g).

5mM dose respectively; while in GR was 22.94, 19.98, 18.33, 16.03 and 14.14 in 150GY to 550GY dose. The highest mass index was recorded in SA-1mM (23.27) and lowest was in EMS-25mM (11.66) (Table-1, Fig.4). The highest root-shoot ratio was found in lower dose of GR treatment (144.19) and lower in higher dose of SA treatment (111.11). The maximum dry weight was found in control (0.3208g) as compared to all treatments. In EMS the dry weight was reduced from 0.2849g to 0.2534g, in EMS-5 and EMS-25mM; SA reduced from 0.3103 to 0.2683g in 1 and 5mM dose. The highest dry weight was found in GR-150GY (0.3142g) and reduced to 0.3028, 0.3005, 0.2915 and 0.2885 in 250, 350, 450 and 550GY of GR treatment. The dry weight was also reduced with increase in concentration.

## Conclusions

In given experimental studies on Seedling Development (Root and Shoot length, Vigour index (Length, Mass), Dry Weight, the effect of Mutagens on cultivar Naval to EMS, SA and GR were studied for germination as well as growth parameters including control. All the doses showed decrease in growth parameters and germination with increasing concentration of dose excluding control. The higher doses of treatments significantly affected the growth parameters and germination of the seedlings. The study revealed that the EMS-20mM dose was significant at 54% germination, SA-4mM dose was significant at 58% germination and GR-450GY dose was significant at 55% germination. Hence in present research study, the optimum doses have been found out by using concentrations of Mutagens.

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