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Research

Study on the effect of chemical and physical mutagen on seed germination of Indian mustard

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Abstract
Indian mustard [*Brassica juncea (L)* Czern & coss.] is considered as one of the most important vegetable oil and protein meal crops in the Indian subcontinent. Seeds of Indian Mustard *Brassica juncea (L)* cultivars Shivani and Pusa Bold were treated with EMS (0.3%) and gamma rays (900-1100 Gy) to study germination and other quantitative traits. Gamma rays as a kind of ionizing radiation represent a physical mutagen that induces mutations and may be effectively used in plant breeding. Ethyl methanesulfonate (EMS) is a chemical extensively used to set off mutations at loci that adjust economically vital traits. During these experiments, we observed seed germination percentage in the M1 generation was highest in Pusa Bold then followed by Shivani. An increase in doses of gamma rays and the concentration of EMS reduced the percentage of germination.

Keywords: gamma rays, chemical mutagen, Mustard, Shivani, Pusa bold

Introduction

Indian mustard [*Brassica juncea* (L) Czern & Coss.] is considered as one of the most important vegetable oil and protein meal crops in the Indian subcontinent. To fulfil the ever-increasing demand for soil, seed and oil, yield needs to improve. Yield is one of the most important economic characteristics and is the product of the multiplicative interaction of contributing characters. Hence, the important objective in mustard improvement is oriented to develop varieties which have high-yielding potential (Bhatia et al., 1999) Also there is a compelling need to increase and stabilize the productivity of Indian mustard (Jambhulkar, 2007). The other objectives are oriented to develop new varieties with wider adaptability, early maturity, disease resistance and high oil content along with high yield potential mutation breeding is one of the approaches to enhance the spectrum of variability for characters of agronomic and economic importance (Jambhulkar, 2015) the objective of this study was to induce mutation and to find the germination percentage of seeds.

Material and Methodology

Dry, healthy and genetically pure seeds of *Brassica juncea* cultivars Shivani & Pusa bold were divided into six lots of seeds each for giving the gamma rays treatment separately. The seeds of the selected variety were subjected to irradiation with 900, 1000, and 1100 Gy (Co-60 at BARC Mumbai). The 1000 seeds of each treatment were treated with 0.5% aqueous solution of EMS after pre-soaking with sterilized distilled water for 12 hours. The treated seeds along with one control of dry, another of water soaked and buffer soaked were sown in the field to raise M1 generation in Agriculture field of Birsa Agricultural University during 2015-2016 Rabi season dated on 12 october 2015 and 50 seeds of all treatment in three replications were shown in laboratory conditions in PG laboratory of Department Genetics and Plant Breeding Birsa Agricultural university. M_1 genration was raised and Germination was calculated in both field and laboratory conditions when radical and plumule emrges. (Chopra, 2005)

Result

In Shivani and Pusa Bold, the maximum number of seeds germinated four to five days after sowing in laboratory conditions and eight to 10 days in field conditions. In control, the germination percentage was found in Pusa bold 95.3 per cent in the laboratory and 51.3 per cent in the field. In Shivani variety Control, it was 99.3 per cent whereas in the laboratory and in the field conditions it was 54.7. An inhibitory effect on seed germination was seen after the mutagenic treatments in both varieties viz Shivani and Pusa Bold. Mutagenic treatment showed a gradual decreasing trend in germination from lower doses to higher doses. The seed germination percentage in the M1 generation was highest in Pusa Bold then followed by Shivani. An increase in doses of gamma rays and the concentration of EMS reduced the percentage of germination. (Ariraman et al., 2014; Roychowdhury et al., 2011)

Table 1. Laboratory Germination of Shivani

	SHIVANI					
Treatment	**R1**	**R2**	**R3**	**Total**	**Avg**	**Germination percentage in Lab**
900 Gy	44	43	47	134	44.7	89.33
1000 Gy	42	43	42	127	42.3	84.67
1100 Gy	41	39	39	119	39.7	79.33
900 Gy+ 0.3 % EMS	43	43	44	130	43.3	86.67
1000 Gy+ 0.3 % EMS	40	41	40	121	40.3	80.67
1100 Gy+0.3% EMS	38	39	39	116	38.7	77.33
Control 1(0 Gy)	49	49	49	147	49.0	98.00
Control 2 Buffer soaked	50	49	50	149	49.7	99.33
Control 3 Water soaked	50	48	49	147	49.0	98.00

Table 2. Field Germination of Shivani

Treatment	**R1**	**R2**	**R3**	**Total**	**Avg**	**Germination Percentage in Field**
900 Gy	14	12	11	37	12.3	24.7
1000 Gy	9	10	9	28	9.3	18.7
1100 Gy	9	9	8	26	8.7	17.3
900 Gy+ 0.3 % EMS	11	12	11	34	11.3	22.7
1000 Gy+ 0.3 % EMS	10	10	11	31	10.3	20.7
1100 Gy+0.3% EMS	9	9	10	28	9.3	18.7
Control 1(0 Gy)	26	29	27	82	27.3	54.7
Control 2 Buffer soaked	26	26	27	79	26.3	52.7
Control 3 Water soaked	24	26	26	76	25.3	50.7

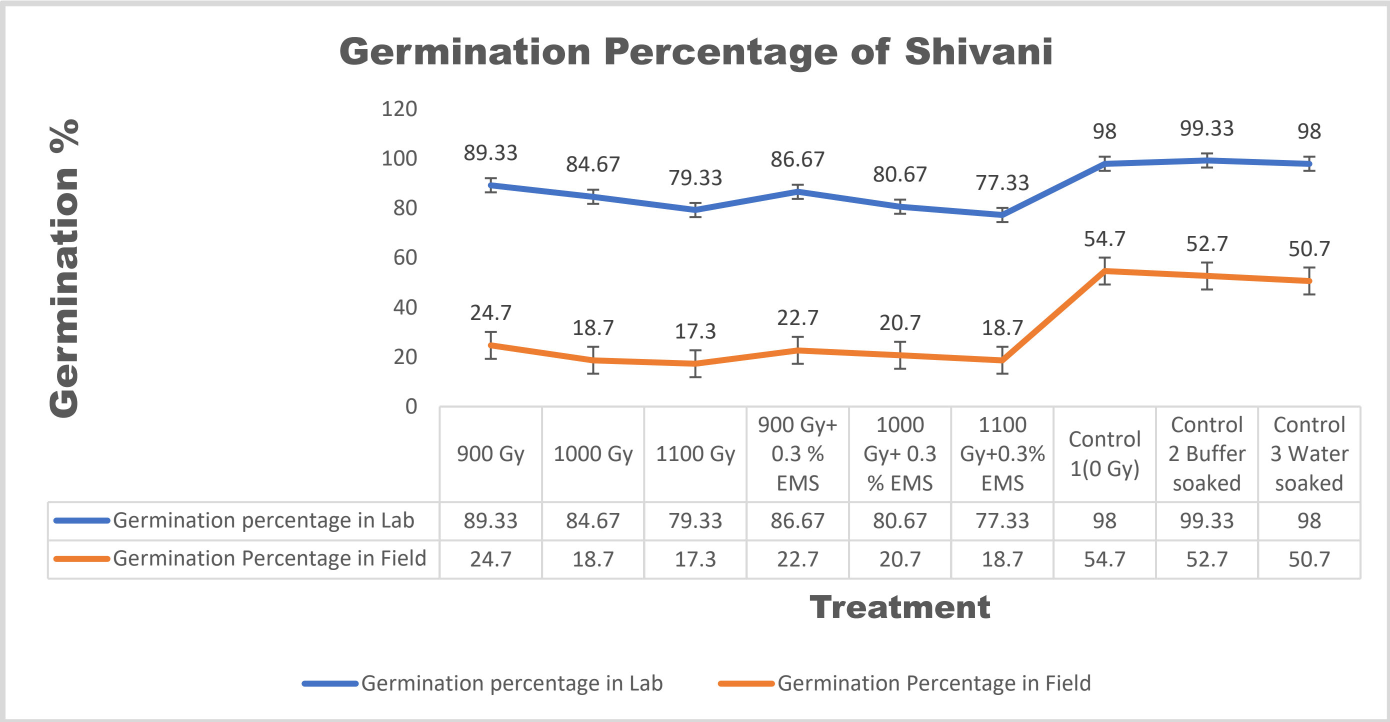

Figure 1. Graph showing germination percentage of Variety Shivani in Lab and field comparatively

Table 3. Pusa Bold Germination data in laboratory

	PUSA BOLD					
Treatment	**R1**	**R2**	**R3**	**Total**	**Avg**	**Germination Percentage in Lab**
900 Gy	46	46	47	139	46.3	92.7
1000 Gy	43	42	42	127	42.3	84.7
1100 Gy	40	39	41	120	40.0	80.0
900 Gy+ 0.3 % EMS	44	46	44	134	44.7	89.3
1000 Gy+ 0.3 % EMS	41	41	42	124	41.3	82.7
1100 Gy+0.3% EMS	39	38	38	115	38.3	76.7
Control 1(0 Gy)	47	48	47	142	47.3	94.7
Control 2 Buffer soaked	47	47	49	143	47.7	95.3
Control 3 Water soaked	47	48	47	142	47.3	94.7

Table 4. Pusa Bold Germination data in Field Condition

	PUSA BOLD					
Treatment	**R1**	**R2**	**R3**	**Total**	**Avg**	**Field Germination Percentage**
900 Gy	21	19	19	59	19.7	39.3
1000 Gy	18	17	17	52	17.3	34.7
1100 Gy	15	15	14	44	14.7	29.3
900 Gy+ 0.3 % EMS	21	18	19	58	19.3	38.7
1000 Gy+ 0.3 % EMS	17	16	16	49	16.3	32.7
1100 Gy+0.3% EMS	15	15	15	45	15.0	30.0
Control 1(0 Gy)	23	24	26	73	24.3	48.7
Control 2 Buffer soaked	25	25	27	77	25.7	51.3
Control 3 Water soaked	24	25	25	74	24.7	49.3

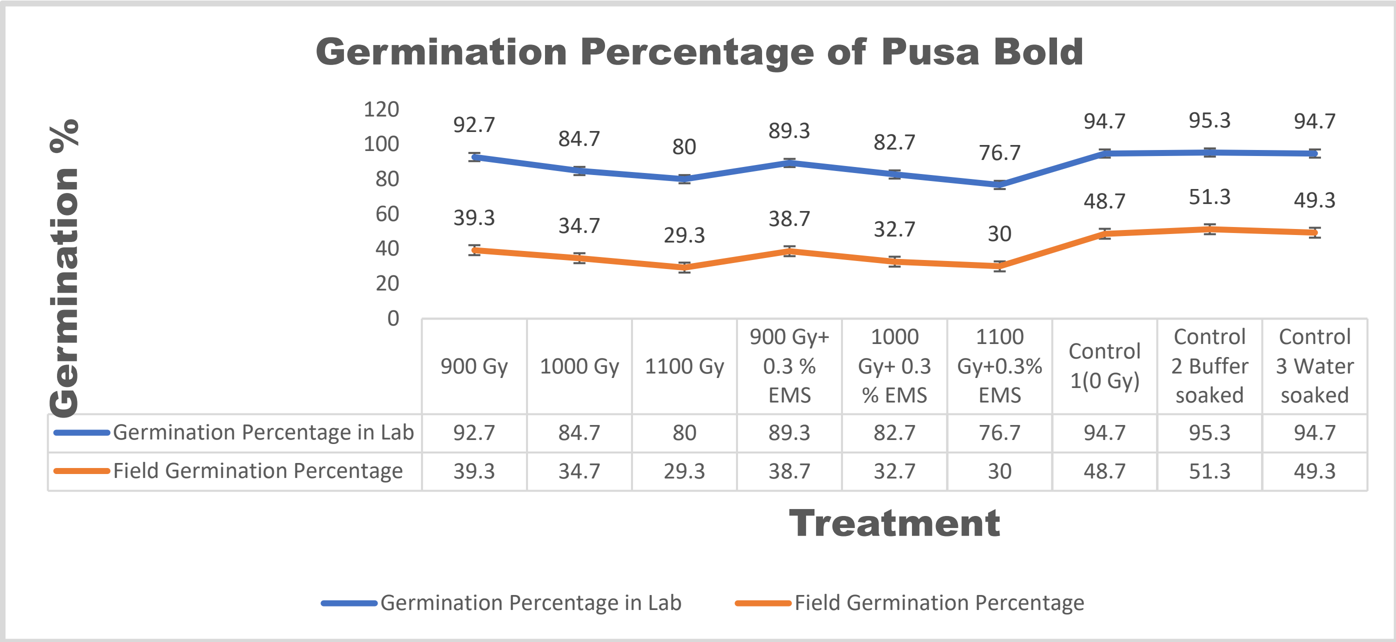

Figure 2. Graph showing germination percentage of Variety Pusa Bold in Lab and field comparatively

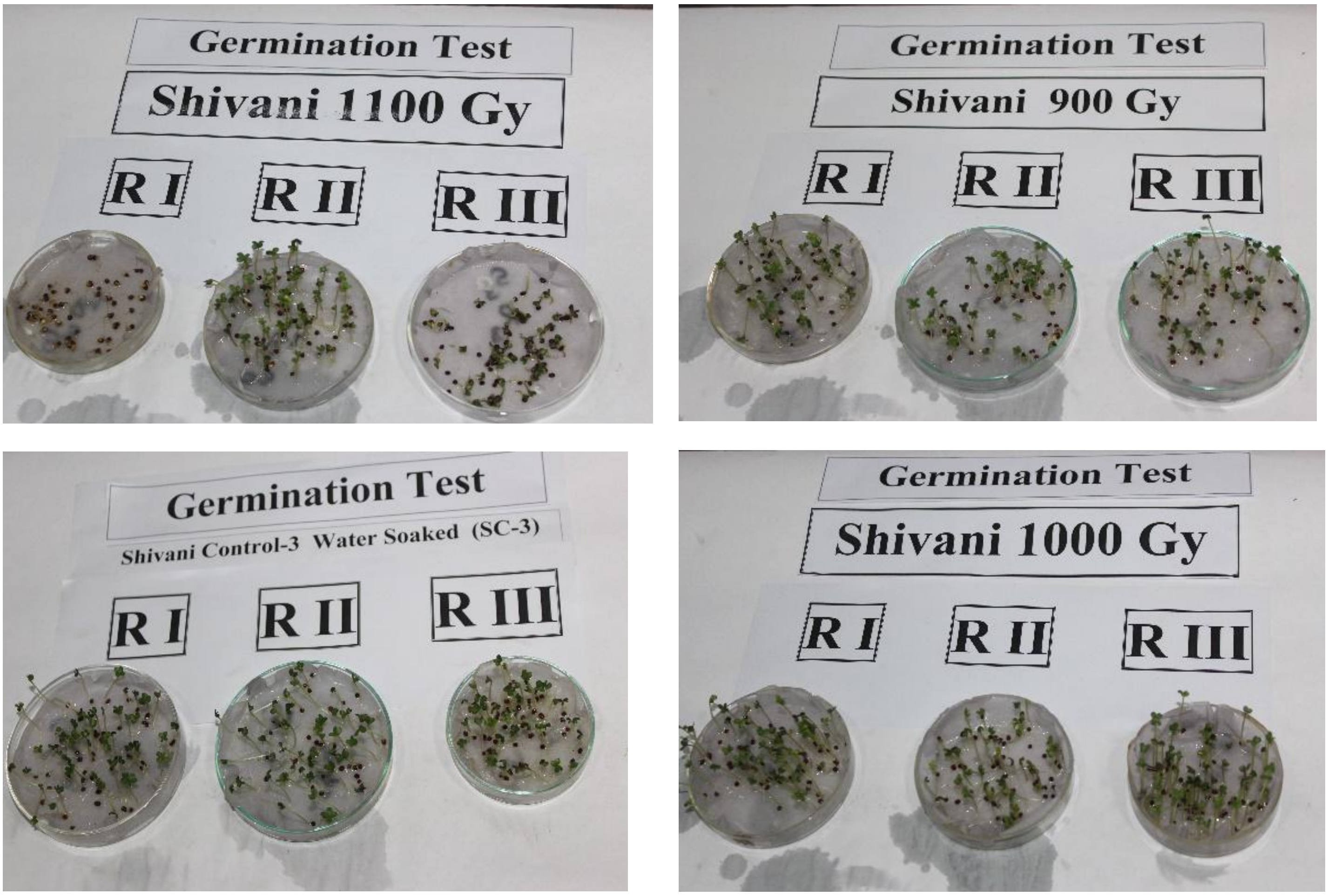

Figure 3. Photos of Experiments

Discussion

It has been observed that both Shivani and Pusa Bold in field conditions and laboratory situations, both Gamma Rays and Gamma Rays + EMS causing significant reduction in the germination when the dose of Gamma radiation and the concentration of EMS is increasing.Previous findings (Fadl ,1983 ; Bajaj 1970) have reported a reduction in seed germination percentage in French beans after mutagenic treatments. Our result showing similar result as finding of Fadl, 1983; Bajaj, 1970.

Conclusion

From the experiment, it can be concluded that all the mutagens showed an inhibitory effect on germination as compared to control plants. The concentration and doses used in the present study will be effective in the induction of a broad range of mutagenic characters for further investigation.

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