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Review Article

Effect of Ems on Seed Germination, Seedling Height and Plant Survival of Horsegram [*Macrotyloma Uniflorum* (Lam.) Verdc] Cv. Rayat-1

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Abstract: Seeds of horsegram (*Macrotyloma uniflorum* (Lam.) Verdc) cv. Rayat-1 were treated with various concentrations of EMS (0.3, 0.4 and 0.5%). The effects on seed germination, seedling height (7 days) and plant survival at 45 days after sowing were investigated. Gradual reduction in seed germination, root length, shoots length, seedling height and plant survival was recorded with increase in concentration of EMS. Lower conc. of EMS 0.3% (81.2%) showed highest germination percentage in cv. Rayat- 1. The survival percent in cultivar of horsegram was decreased as the Conc. of EMS increased. Significant reduction in survival percentage was observed at the higher conc. (0.5%EMS).

Key words: Horsegram, germination, EMS, plant survival.

INTRODUCTION

Horsegram is good source of proteins, thus supplementing the staple cereal based diet, a good source of energy, minerals and vitamins. It is used in Ayurvedic medicine for treating several ailments. The

horse gram is a high nutritional legume and become a staple food for people living in dry and rural regions. It is one of the most nutritious, high in proteins, and easily digestible and it has been suggested as an alternative protein source to soybean^{1,2}.

The whole seeds of horsegram are generally utilized as cattle feed and the seed sprout, or whole meal of horsegram can be used by large populations in rural areas of southern India³. The legume seeds have high protein content to develop as ingredients for health-promoting functional foods or pharmaceutical preparations⁴.

There are many potential cosmetic and technical uses for legume proteins such as to use proteins in paper-coating treatments, adhesives and in cosmetic sectors². In spite of all these, the cultivation of this pulse crop has not received due attention.

MATERIALS AND METHODS

The authentic seeds of horsegram (*Macrotyloma uniflorum* (Lam.) Verdc) cv. Rayat-1 were obtained from Department of Botany, P.G. Research Centre, Rayat Shikshan Sanstha's Annasaheb Awate Arts, Commerce and Hutatma Babu Genu science College, Manchar, Tal- Ambegaon, Dist- Pune 410503 (M.S.) India. These seeds were soaked in water for 10 hours. Wet seeds were treated with 0.3, 0.4 and 0.5% Ethyl Methane Sulphonate (EMS) for four hours. Treated seeds washed thoroughly with tap water for two hours and then used for raising M₁ generation. A total of 75 seeds from each treatment with three replications was used for seed germination in laboratory. 25 seeds / replication were kept on moist germination paper in petri plates for recording seed germination percentage, seedling height on 7th day. Treated and control seeds were sown in a field at a spacing of 30 x 15 cm in randomized block design replicated thrice. 675 seeds for each treatment were used to raise M₁ generation. The field experiment was conducted at Research field of P.G. Research Centre, Department of Botany, Rayat Shikshan Sanstha's Annasaheb Awate Arts, Commerce and Hutatma Babu Genu Science College, Manchar, Tal- Ambegaon, Dist- Pune 410503 (M.S.) India. Randomly 10 plants from each treatment of M₁ populations were observed for mutations at regular intervals from seedling stage to maturity of the crop. Mean values of survival percentage at 45 DAS were recorded in the table. All the M₁ plants were harvested individually.

STATISTICAL ANALYSIS

The data were summarized as the means of three replicates with standard deviation as the measures of variability. One-way ANOVA test was performed to determine significant differences due to various treatments. Fisher's LSD (Least significant difference) was used as post hoc test to ascertain significant differences among treatments at $p = 0.05$. Statistical analysis and graphical data presentations were carried out by using Sigma stat (ver.3.5).

RESULTS AND DISCUSSION

Data obtained on mean percent seed germination in control and mutagen treatments presented in Table- 1 clearly indicated that the percent seed germination was reduced in all the treatments as compared to control. It has clearly indicated that the mutagens had exerted negative effects on seed germination. The percent seed germination decreased from 81.2% to 57.3% in EMS. The maximum (50%) decrease in percent seed germination was observed with EMS 0.5% (57.3%). The results of present study have clearly shown that the cultivar Rayat-1 was sensitive to mutagen.

The inhibitory effect on seed germination was directly proportional to the conc. of EMS (Table-1). Inhibitory effects of EMS on seed germination were reported earlier in horsegram^{5, 6, 7} and in blackgram⁸.

Table 1: Effect of EMS on seed germination, seedling height and plant survival in M₁ Generation of horsegram cv. Rayat-1.

Treatments	Percent Germination	Shoot length (cm)	Root length (cm)	Seedling height (cm)	Percent Survival (45DAS)
Control	96.7±3.87	5.2±0.21	4.1±0.16	9.3±0.37	78.3±3.13
0.3	81.2±4.06	4.3±0.22	3.6±0.18	7.9±0.40	71.9±3.60
0.4	69.5±4.87	3.6±0.25	2.9±0.20	6.5±0.46	62.5±4.38
0.5	57.3±1.72	2.7±0.28	2.2±0.07	4.9±0.15	56.5±1.69
SEM±	3.11	0.16	0.13	0.29	2.73
F-value	58.37	84.49	78.58	81.60	25.60
P-value	0.01	0.01	0.01	0.01	0.01
LSD _{0.05}	6.78	0.35	0.28	0.63	5.95

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Decrease in percent seed germination in horsegram caused by EMS might be due to their effects on genetically and cytological processes coupled with the changes induced in metabolic processes. The decrease in seed germination was mainly due to the interference of mutagens with metabolic activities of the seeds⁹. Disturbance in the formation of enzymes involved in the germination process may be one of the physiological effects caused by mutagenic treatments particularly chemical mutagens¹⁰. EMS is potent mutagen, well known for their action causing point mutations, enzyme inhibitions and chromosomal aberrations¹¹. The observed reduction in seed germination in horsegram as a result of treatments of this mutagen might be due to point mutations or the injuries caused to the genetic material. This may eventually lead to decrease the rate of respiration and energy production, which finally caused decrease in seed germination¹². The physiological damage in terms of reduction in germination and survival percentage revealed that EMS was more deleterious to the cv. Rayat-1.

Results shown in Table-1 indicated that the shoot length was decreased in all treatments as compared to the control (5.2cm). Maximum reduction in shoot length was recorded in 0.5% EMS (2.7cm). Root length in all the treatments of EMS was significantly decreased as compared to control. The root length was gradually decreased as the concentrations of EMS increased. The highest reduction was recorded in 0.5%EMS. All treatments showed inhibitory effect on seedling height. Maximum decrease in seedling height (4.9cm) was noted in 0.5%EMS.

Seedling injury in M₁ generation increased with the increase in concs. of EMS mutagenic treatments (Table-1). The findings in horsegram^{13, 14} are in agreement with present investigation. It was due to chromosomal and extra chromosomal damage of the cells in treated seedlings¹⁵. The inhibitory effect was due to reduction in number of cells contributing to seedling growth¹⁶. Reduction in seedling

growth was due to arresting of mitotic cycle¹⁷. The seedling injury was mainly due to the decreased activity of an amylase and peroxidase in germinating seeds¹⁸.

Reduction in germination percentage was due to weakening and disturbance of growth processes resulting in early elimination of seedlings. The survivals of seedling percentage also gradually decreased with gradual increase in concentration of mutagens¹⁹.

The results on the effects of EMS revealed that in all the mutagenic treatments, survival % was decreased than the control (Table-1). There was linear decrease in the survival % with increasing conc. of EMS. The lowest survival % at the higher treatments was noted (56.5%) in 0.5%EMS as compared to control (78.3%). Decrease in survival percent due to mutagenic treatments was reported in horsegram^{5, 6, 12, 19}.

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