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Impact of He-Ne Laser Irradiation on Germination and Electrical Conductivity of Soybean Seeds Glacine Max

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Abstract*: *The present study intends to determine the influence of He-Ne Laser on germination and electrical conductivity of soybean seeds revealed suppressive effect compared to non-irradiated seed. In this study, the soybean seeds were exposed to He-Ne laser irradiation with wavelength 632.8nm. facility at Physics laboratory, Shri Shivaji College, Parbhani, Maharashtra, India during month of july2016. Soybean seeds were divided into two groups. First group for germination test and second group for electrical conductivity test were irradiated for 0,5,10,15 ,20 minutes. The electrolyte leakage was measured using the conductivity test. The seeds irradiated with He-Ne laser gave significant results in increasing the germination percentages and vigor index but electrical conductivity was found to decrease. The highest germination percentage (92%) was observed for 15 min. irradiation. Our result indicate that the conductivity method is able to predict the quality of seeds and it may be concluded that soybean crop cultivator could improve seed germination by irradiation of seeds with He-Ne laser.
***Keywords: Laser irradiation, germination percentage, Vigor index, Electrical Conductivity*.**

I. INTRODUCTION

Light play a major role in growing plant. The effect of light during germination process and plant growth is undeniable[1].The characteristics of the laser radiation, such as monochromatic, coherence, polarization and high density, can be used not only in all sphere of engineering but also in medical and plant biology[2],[3]. The growing need for agricultural products together with the increased demand of crop for food production as well as for other branches of industry imposes the necessity for searching new safer technique for raising the agricultural production [3]-[5].The last 50 years different chemical additives are used for fertilizing crops and controlling pests helping to develop highly successful farm system ensuring an abundant food production. Their application causes the contamination of raw material for food production with toxins, decrease soil yielding capacity[3]. Soybean is one of the world's most popular oil seed crops, cultivated in more than 100 countries. It is single largest source of edible oils in India. Soybean seed mainly comprised of protein, fiber, vitamin, minerals and source of organic compound, which are most important factors. Soybean production in United States(32.8%), Brazil(29.3%), Argentina(17.7%), China(4.2%), India(4.2%) percentage of World total production[6]. Establishing the quality of seed lot is a crucial step, whether for cultivation or research activities. In order to obtain the highest crop production yield and quality, seeds of high quality that produce rapid and uniform seedling emergence are required. Germination of seeds depends on seed quality, environment, seed born pathogen and quality of soil. To increase percentage of germination by using medicine and chemical fertilizer are harmful for environment and society. The biostimulating agent such as laser light are best method to increase percentage of germination. Various authors in the world provided possibility of accelerating germination of seeds, plant growth, increase their resistance to disease, enzymatic activities and concentration of chlorophyll in the seeds of several plants using LED light, micro-wave and laser light[7]-[10].

The quality of seeds can be checked by germination method but it takes long time and the results vary according to season. The easy and standard method is electrical conductivity test. This work aimed to study the effect of laser irradiation and expose time on germination and electrical conductivity of soybean seeds.

II. MATERIALS AND METHODS

A. Plant materials

Soybean seeds (Glycine max , Js-335) were purchased from local market. This variety is most cultivated in marathwada region, India.

B. Treatment for Germination

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The standard germination test is the procedure to evaluate the ability of seeds to produce normal seedlings under favorable conditions in the field, but does not always reveal differences in quality and performance among seed lots, which can manifest in storage or in the field[11]. During the germination test optimum conditions are provided and controlled for seeds to encourage the metabolic activity which will result in the seedling.

Treatment were carried out using He-Ne laser, wavelength 632.8nm, power intensity 5mW/mm^2 beam. Twenty five seeds were subjected to laser irradiation for each time interval. The irradiation time 5,10,15,20minutes , each at a time. Well developed seeds with intact seed coat were carefully selected to have the same size and same weight for each time interval[11]. Prior to irradiation, the seeds were washed by distilled water. Petri dishes and germination paper were also washed by distilled water. Treated seeds were placed in Petri dishes and then incubated in a germinator with 25^{0}C temperature for 7 days. Seeds germinated were counted daily for 7 days. After 7 days were measured seedling length. We used three repetitions.

C. Treatment for electrical conductivity

The development of test to find the physiological quality of seeds as well as the standardization of the establishment of an efficient quality control[13]. One of the main requirements for selection of quality of seeds to obtain reliable results in a relatively short period of time, allowing the seed of decision making especially as regards the operations of collection, processing, marketing and cultivation[14] . The literature indicates that rapid tests are most studied early events related to the deterioration of the sequence proposed by Deloche and Baskin et al.[15], as the degradation of cell membranes and biosynthetic respiratory[13]. The measurement of electrical conductivity through the electrolyte amount released by soaking seeds in water has been applied by the individual method were each seed is a sample or more often. For this case, the results represent the average conductivity of a group of seeds affect the conductivity of a batch with high quality seeds. Factors which influence the conductivity values as the size, initial water content, temperature, time of soaking, the number of seeds per sample and quantity of water used for soaking. To minimize this problem, we recommend choosing the seeds carefully to have intact seed coat, same size and same weight for each groups.

Seeds were divided into five groups. First is the controlled (no irradiation) and rest of were irradiated to 5,10,15,20 minutes to He-Ne laser. Seeds were carefully selected to have intact seed coat, same size and same weight for each groups. Prior to irradiation, seeds were washes with distilled water then seeds were soaked in 25 ml distilled water at 25^{0}C for 24 hours in a beaker [12]. After this period seeds were removed by a clean forceps and the conductivity of the soak solution was tested with the help of a EC meter. The results were expressed in $\mu Scm^{-1}g^{-1}ml^{-1}$.

III.RESULTS AND DISCUSSION

A. Germination Test

The percentage of seed germination, control and treated were shown in table I and fig. 1. The germination percent was significantly increased by higher irradiation time of He-Ne laser. The data presented in table I indicated that maximum germination percentage 92% was noted at 15min. irradiation. Similar results were reported by Mkarska et al.[16] and Jun Lin etal.[17].

TABLE I

FONT SIZES FOR PAPERS NO. OF SEEDS GERMINATED PER DAY FOR CONTROLLED AND IRRADIATED SEEDS.

No. of days	No. of seeds germinated per day				
	Controlled	Irradiation time			
		5min.	10min.	15min.	20min.
1	0	2	02	05	03
2	8	9	11	17	10
3	20	21	25	20	23
4	7	6	06	04	07
5	3	3	--	--	02
6	--	--	--	--	--
7	--	--	--	--	--
Total	38	41	44	46	45
Germination%	76	82	88	92	90

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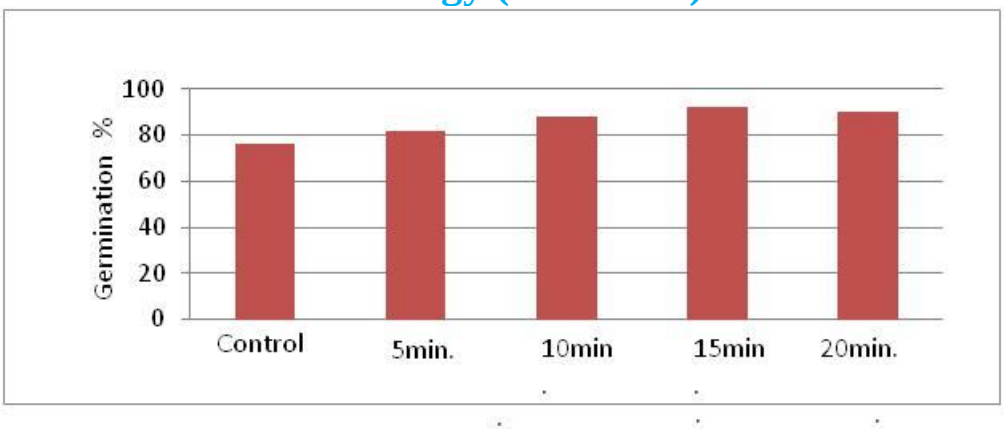

Fig. 1: Irradiation time Vs % of germination

TABLE III
EFFECTS OF PRE-GERMINATION EXPOSURE TO DIFFERENT DOSES OF HE-NE LASER ON SOYBEAN SEED

Treatment	Germination %	Mean germination Time (day)	Speed of germination	Seedling Length(cm)	Vigor Index
Control	76	3.5	13	11.6	881.6
5 min.	82	3	15.6	13.5	1107
10 min.	88	2.5	17.33	14.3	1258.4
15 min.	92	2.5	21.16	16.6	1527.2
20min.	90	3	17.81	16.8	1512

The maximum germination percentage, mean germination time, speed of germination and vigor index were observed for 15 minutes and higher seedling length for 20 minutes treated seeds were observed. But germination percentage decreases for 20 minutes treated seeds. The results obtained here demonstrated clearly that the germination percentage and vigor index was significantly enhanced by laser treatment. This results is consistent with those of previous studies dealing that laser treated different seeds like wheat seeds, marigold seeds, groundnut seeds enhance germination, growth and increase their resistance to disease[5],[7],[8].

B. Electrical conductivity test

The electrical conductivity results were obtained for different irradiation time of laser on soybean seeds as shown in Table III

TABLE IIIII
ELECTRICAL CONDUCTIVITY OF DIFFERENT EXPOSURE TIME OF LASER ON SOYBEAN SEED.

Exposure time (min.)	EC ($\mu S.cm^{-1}.g^{-1}.ml^{-1}$)
Controlled	22.240
5	18.106
10	14.480
15	11.893
20	12.666

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The electrical conductivity depends on amount of solutes will leak from the seeds into the water. The leakage contains various sugars, amino acid, lipid and other organic acid as well as inorganic salts[18]. It was observed that if we increase exposure time then EC was found to decrease.

From table I and table II we have observed that germination percentage was higher for low EC. It is therefore assumed that the degree of leakage is correlated with quality of seed.

IV. CONCLUSIONS

Seed germination of each seed is considered as one of the first and most fundamental life stages of a plant, so that the success in growth and yield production is also dependent on this stage. Based on the results obtained from this study it can be concluded that treated soybean seeds by laser irradiation increases its germination percentage and decreases electrical conductivity. The quality of seeds can be decided using EC test.

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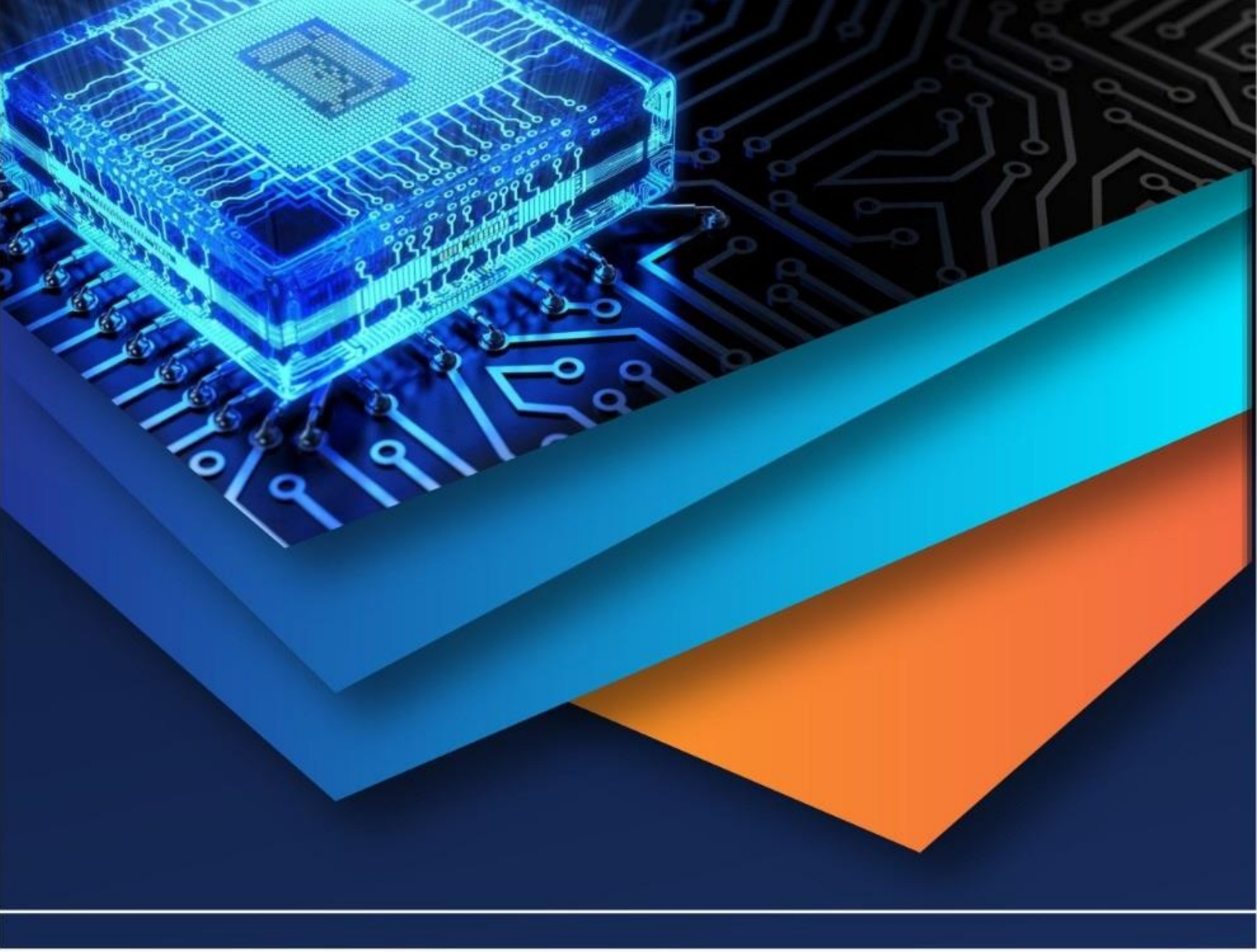

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