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Impact of He-Ne Laser Irradiation on Three Varieties of Groundnut Seeds (Tag_{24} , Sb_{11} & G_2)

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Abstract: In this study, the groundnut seeds (*Arachis hypogaea* L.) were exposed to He-Ne laser irradiation. We had taken three varieties of groundnut seeds (Tag_{24} , Sb_{11} & G_2), each varieties were divided into four groups. First group was the controlled group and received no radiation. Second, third and fourth group were irradiated 2, 4 and 6 minutes respectively by He-Ne laser with wavelength 632.8nm. from a distance of 45cm. Exposure with He-Ne laser gave significant results in increasing of germination percentages and vigour index but electrical conductivity has been decreased.

Keywords: Laser irradiation, germination percentage, vigour index and electrical conductivity.

I. INTRODUCTION

Laser can emit a high density of photons at small solid angle. The characteristics of the laser radiation, such as monochromatic, polarization, coherence and high density, can be used not only in all spheres of engineering but also in biology and plant growth[1-3]. Light plays a major role in growing of plant. The effect of light during plant growth and germination process is undeniable. The growing need for ecological agricultural products together with the increased demand of crop materials for food production as well as for other branches of industry imposes the necessity for searching new, safer decisions for raising the agricultural production[4-7]. Physical factors such as microwave and laser radiation are useful for plants enable to vegetable at higher energy level. Sustainable agriculture is a management system for renewable natural resource for food production income and livelihood for present and future generations[7-9]. It is based on the fact that physical methods increase the energy account by internal transformation of energy[10]. The germination of seed is dependent on both internal and external conditions. One of the most important external factors is light, which plays vital role in photosynthesis and non-photosynthesis processes involving action of light[11-15].

The previous studies showed that magnetic field, microwave, LED light and He-Ne laser presented a positive role in acceleration the plant growth, metabolism and increase their resistance to diseases, which suitable applications of laser irradiation improved germination capacity of plant seeds[4,16,17].

Laser irradiation is considered as a new branch in agriculture. This work aimed to study the effect of laser irradiation and exposure time on germination, vigour index and electric conductivity of groundnut seeds. Groundnut are the most important commercial crop playing a key role in economical and social affects of world continues to be acclaimed as king of oil seed.

II. MATERIALS AND METHODS

A. Seed Materials

Groundnut seeds (*Arachis hypogaea* L.) used in this work were supplied by college of agricultural engineering and technology, Marathwada Krishi Vidyapeeth, Parbhani, India. The experiment were carried out at the department of physics, Shri Shivaji College, Parbhani.

B. Treatments

Continuous laser irradiation at $\lambda = 632.8\text{nm}$ was obtain from He-Ne and intensity of beam is 5mW/mm^2 . The groundnut seeds of three varieties (Tag_{24} , Sb_{11} , G_2), each having 800 seeds were taken. Each varieties of seeds were divided into four groups. The first is the controlled (no irradiation) and rest of were irradiated to 2, 4, 6 minutes to He-Ne laser. The irradiation treatment of the seeds were performed in the dark room to avoid the influence of the Sun rays.

C. Germination Test

After the treatments, irradiated and controlled seeds were placed in water saturated towel paper. In each towel paper contained 200 seeds which were treated with time period of 0 min., 2min., 4min. and 6min. Sprayed the distilled water two times in a day to germination of groundnut seeds and count daily the number of seeds were germinated.

D. Seed Vigor Index

Seed vigor index were calculated by determining the germination percentage and seedling length of the same seed lot. We were selected randomly 10 germinated seeds and measured seedling length.

The seed vigor index was calculated by using the formula

Vigor Index=germination % x Average seedling length (in mm)

E. Electrical Conductivity Test

A seed sample of 10gm was sterilized with distilled water for 2-3 minutes. The clean sample was immersed in 100ml of water at $25\pm 1^{\circ}\text{C}$ temperature for 10-12hr. After that the seeds were removed by a clean forcep. The steep water left was decanted and was termed as leachate. The conductivity meter was warmed about 30 minutes before testing by deeping in distilled water. First the conductance of distilled water was measured, then leachate was measured. The formula for calculate the electrical conductivity of seed extract was as follows.

$\text{E.C.} = [\text{Actual E.C. meter reading} - \text{E.C. of distilled water}] \times \text{Cell constant factor.}$

III.RESULTS AND DISCUSSION

A. Germination Percentage

The results of germination test for all varieties based on irradiation time as shown in table.

TABLE I

NO. OF SEEDS GERMINATED PER DAY FOR CONTROLLED AND IRRADIATED SEEDS OF TAG₂₄ VARIETY

No. of Days	No. of seeds germinated per day			
	Controlled	Irradiation time period		
		2 min.	4 min.	6 min.
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	15	22
5	26	32	31	39
6	39	31	45	34
7	47	56	34	33
8	49	49	48	57
Total	161	162	172	175
%	80.5%	81%	86%	87.5%

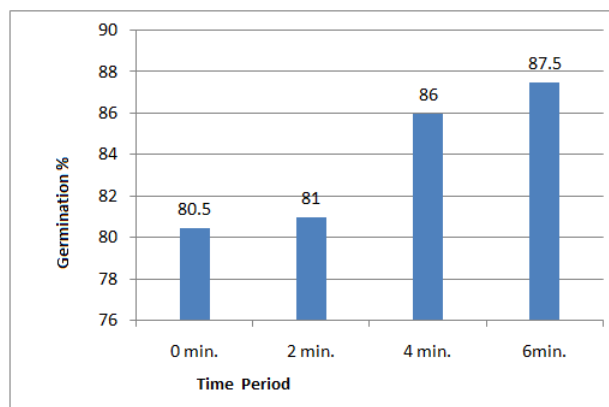


Fig. 1 Germination % for TAG₂₄ Variety Vs irradiation time

From graph it was seen that as the time period of irradiation increases the germination percentage also increased from 80.5% for controlled seed to 87.5% for 6min. irradiated seed.

TABLE III

NO. OF SEEDS GERMINATED PER DAY FOR CONTROLLED AND IRRADIATED SEEDS OF SB₁₁ VARIETY

No. of Days	No. of seeds germinated per day			
	Controlled	Irradiation time period		
		2 min.	4 min.	6 min.
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	12	14
5	19	28	25	26
6	24	25	24	34
7	40	42	41	38
8	48	47	46	42
Total	131	142	148	154
%	65.5%	71%	74%	77%

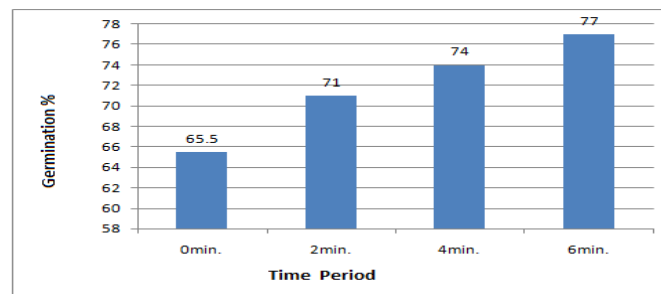


Fig. 2 Germination % for SB₁₁ Variety Vs irradiation time

From graph it was seen that as the time period of irradiation increases the germination percentage also increased from 65.5% for controlled seed to 87.5% for 6min. irradiated seed.

TABLE IIIII

NO. OF SEEDS GERMINATED PER DAY FOR CONTROLLED AND IRRADIATED SEEDS OF G₂ VARIETY

No. of Days	No. of seeds germinated per day			
	Controlled	Irradiation time period		
		2 min.	4 min.	6 min.
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	9	12	15
5	21	26	32	24
6	26	33	31	30
7	36	34	28	35
8	42	36	32	40

Total	125	128	135	144
%	62.5%	64%	67.5%	72%

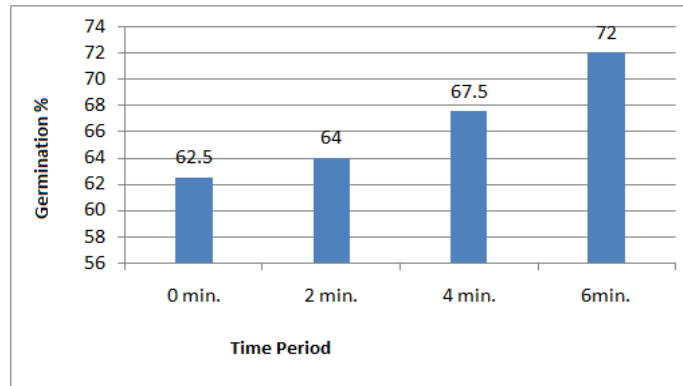


Fig. 3 Germination % for G2 Variety Vs irradiation time

From graph it was seen that germination % increases from 62.5% for controlled seed to 72% for 6min. irradiated seed.

He-Ne laser irradiation enhanced the germination percentage of groundnut seed, after eight days germination % increases 7-11% of irradiated seed as compared to controlled seed. Germination rate of TAG₂₄ variety were more than SB₁₁ and G₂ varieties.

B. Vigour Index

The vigour test of the groundnut seed also shows the deflection in the vigour index of the controlled and irradiated seed. The seeds treated for more time period were more vigours than the controlled seed.

TABLE IVV

VIGOUR INDEX FOR TAG₂₄ VARIETY

Seed sample	Controlled (0min.)	2min.	4min.	6min.
Germination %	80.5	81	86	87.5
Seedling Length (mm)	75	80	82	85
Vigour Index	6037.5	6480	7052	7437.5

TABLE V

VIGOUR INDEX FOR SB₁₁ VARIETY

Seed sample	Controlled (0min.)	2min.	4min.	6min.
Germination %	65.5	70	74	77
Seedling Length (mm)	68	77	76	79
Vigour Index	4454	5467	5624	6083

TABLE VI
VIGOUR INDEX FOR G₂ VARIETY

Seed sample	Controlled (0min.)	2min.	4min.	6min.
Germination %	62.5	62	67.5	72
Seedling Length (mm)	62	70	73	77
Vigour Index	3875	4340	4927.5	5544

The vigour index in all varieties i.e. TAG₂₄, SB₁₁ and G₂ increases with the irradiation time period. For TAG₂₄, the vigour index was increased from 6037.5 to 7437.5. For SB₁₁, the vigour index was increases from 4454 to 6083. For G₂, the vigour index was increases from 3875 to 5544. It was seen that as irradiation time increases Vigour index also increases.

C. Electrical Conductivity Test of Leachates

The electric conductivity (E.C.) of the groundnut seed extract was measured by a digital electrical conductivity meter in $\mu\text{mhos/cm/gm.}$

Electrical conductivity of distilled water=3.8 ($\mu\text{mhos/cm/gm.}$).

Cell constant factor=1.28

TABLE VII
ELECTRICAL CONDUCTIVITY OF LEACHATES FOR TAG₂₄, SB₁₁ AND G₂ VERITIES OF GROUNDNUT SEED.

Variety	Sample	Actual meter reading	Calculated E.C.
TAG ₂₄	0min.	6.0	2.816
	2min.	5.8	2.56
	4min.	5.2	1.792
	6min.	4.9	1.408
SB ₁₁	0min.	5.8	2.56
	2min.	5.5	2.176
	4min.	5.0	1.536
	6min.	4.8	1.28
G ₂	0min.	5.9	2.688
	2min.	5.4	2.408
	4min.	5.2	1.792
	6min.	4.7	1.152

Weakening of cell membrane in poor vigour seeds causes leakage of water soluble compounds like sugar, amino acids electrolytes etc. when immersed in distilled water. It was seen that irradiation time increases, electrical conductivity goes on decreasing. It means that less water soluble compounds leakage for more time of irradiation.

IV. CONCLUSION

In the irradiation process the nucleus cell membrane of the DNA stands break and repairs the DNA stand. Because of reassembling of DNA stand the germination capacity and seed vigour index increases. Many researchers observed that irradiation of laser reduces seed born pathogen. Due to that significant increases in germination percentage and vigour index of all varieties of groundnut seed. The time period of irradiation increases the electrical conductivity of irradiated seed was decreases. If the electrical conductivity is less the germination capacity of seed is more. The groundnut is one of the important oil seed. The area under groundnut is decreases day by day. To increase the groundnut production the irradiation treatment is used.



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