iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** VII **Month of publication:** July 2017

DOI:

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, July 2017- Available at www.ijraset.com

He-Ne Laser Irradiation Study on Cotton Seeds

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Abstract*: *Non photosynthesizing cells and materials are capable of accumulating sunlight energy. Seeds can absorb photons from concentrated sunlight, transform light quantum energy into chemical energy, store and use it during further growth and development of the plants. Cotton seeds were exposed to He-Ne laser radians of wavelength 6328 A.U. for different durations before sowing. The chlorophyll content of the full grown plant was estimated. It is observed that the chlorophyll content in the leaves showed an increasing trend with the exposure time of seeds to the laser radiations. The increase in the chlorophyll content of the leaves increases food and nutrition generation capacity and food circulation capacity of the leaves.
Keywords: Laser irradiation, Chlorophyll Content.

I. INTRODUCTION

Laser is an acronym for Light Amplification by Stimulated Emission of Radiation. Lasers have wide range of application in almost all walks of life. One of the important applications of lasers is in agriculture. Effects of various kinds of radiations on different parameters of plant growth have been studied. In this work we have studied the effect of He-Ne laser irradiation on cotton seeds and studied the chlorophyll content in the leaves. Pre soaked seeds of cotton were exposed to He-Ne laser radiations for different durations and the chlorophyll content in the full grown plants from these seeds was estimated.

II. MATERIALS AND METHODS

The amazing characteristics of the laser , such as monochromatism, polarization, coherence and high intensity can be used not only in the spheres of engineering but also in biology and plant growing. The changes that occur in the physiological state of the seeds and plants can stimulate their development and depend closely on the laser radiation type, its wavelength λ and intensity [1]. The experiments carried out by the institute of Physiology (Academy of Sciences, Russia) in 1980's and later as well by the agrobiologists from Italy, Hungary and other countries show that non photosynthesizing cells and materials are capable of accumulating sunlight energy. Seeds can absorb photons from concentrated sunlight, transform light quantum energy into chemical energy, store and use it during further growth and development of the plants. The additionally absorbed light energy accelerates plant growth and increases their productivity [2].

We, in this experiment used He-Ne laser emitting laser radiations of wavelength λ = 632.8 nm. and power 5 mW. We experimented with three varieties of cotton viz. Bunny, Vinayak and Turab. Spectrophotometer was used to study absorption spectrum of the chlorophyll.

The He-Ne laser and the seed holder were arranged on a stable platform such that the laser beam falls exactly at the centre of the seeds. The distance between the seed and the laser source was kept fixed to 25 cm. The cotton seeds to be exposed to laser irradiation were presoaked for 12 hours in water. The three varieties of seeds were exposed to He-Ne laser radiations for different durations like 1min, 2 min, 3 min, 4 min, 5 min. These seeds were sowed along with some unexposed seeds for comparison. The saplings were administered fertilizers and pesticides periodically as per requirement.

III.PAGE DETERMINATION OF CHLOROPHYLL CONTENT IN THE LEAVES

In order to determine the chlorophyll content in leaves ie Chlorophyll A, Chlorophyll B and total Chlorophyll following procedure was adopted.

A fresh leaf mass was determined for the leaf sample prior to the Chlorophyll measurement. The Chlorophyll was extracted in 80% Acetone. The absorption of extracts at wavelengths of 663nm (A663) and 645nm (A645) were measured with a spectrophotometer. The concentrations of Chlorophyll A, Chlorophyll B and total Chlorophyll were calculated using the following equations[3].

For Chlorophyll A = { 12.72 (A663) -2.59 (A645) } V/1000 x W x A
For Chlorophyll B = { 22.9 (A645) - 4.67 (A663) } V/1000 x W x A
For Total Chlorophyll = { 20.31 (A645) -8.05 (A663) } V/1000 x W x A
Where

W = Fresh weight of tissue extracted = 10 mg
A = Path length = 10 mm
V = Final volume of Chlorophyll extracted in 80 % Acetone = 7 ml

IV. RESULT AND DISSCUSSION

The Chlorophyll content as calculated from above formula is given below.

TABLE I
FOR TURAB VARIETY

Sr.No.	Variety	Chlor A	Chlor B	Total Chlorophyll
1	T_0	0.854×10^{-3}	0.596×10^{-3}	1.301×10^{-3}
2	T_1	1.238×10^{-3}	0.973×10^{-3}	1.992×10^{-3}
3	T_2	0.674×10^{-3}	0.529×10^{-3}	1.085×10^{-3}
4	T_3	1.497×10^{-3}	1.130×10^{-3}	2.363×10^{-3}
5	T_4	1.547×10^{-3}	1.142×10^{-3}	2.418×10^{-3}

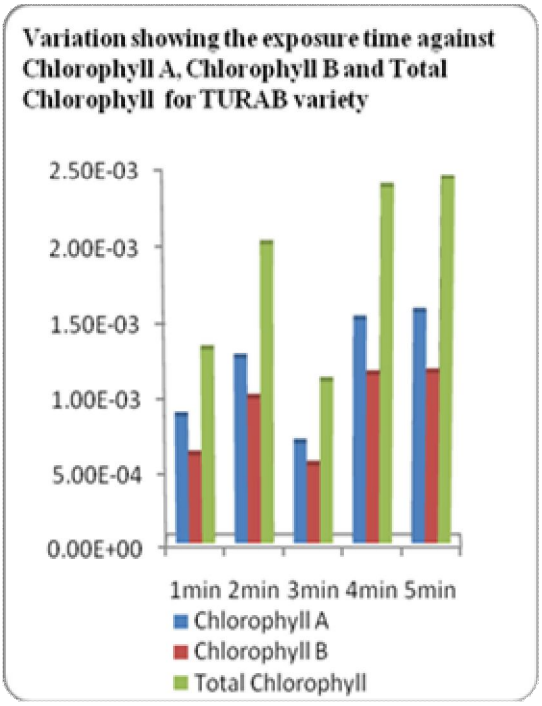

TABLE II
FOR VINAYAK VARIETY

Sr.No.	Variety	Chlor A	Chlor B	Total Chlorophyll
1	V_0	1.242×10^{-3}	0.863×10^{-3}	1.888×10^{-3}
2	V_2	1.275×10^{-3}	2.794×10^{-3}	3.810×10^{-3}
3	V_3	1.233×10^{-3}	2.399×10^{-3}	3.563×10^{-3}
4	V_4	1.270×10^{-3}	2.103×10^{-3}	3.127×10^{-3}
5	V_5	1.437×10^{-3}	1.564×10^{-3}	2.739×10^{-3}

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
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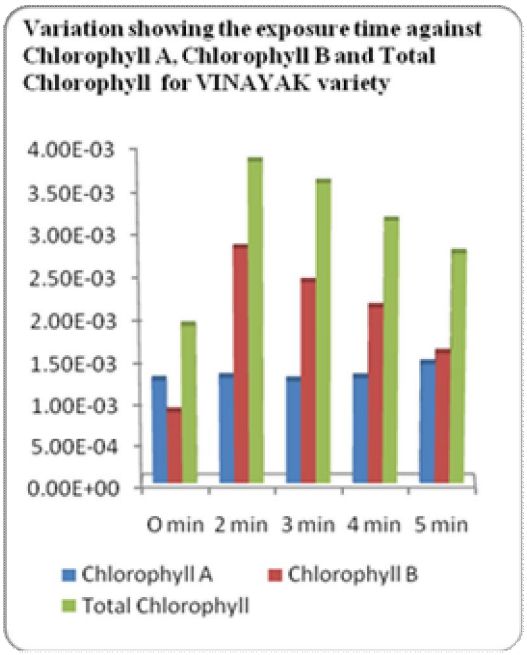
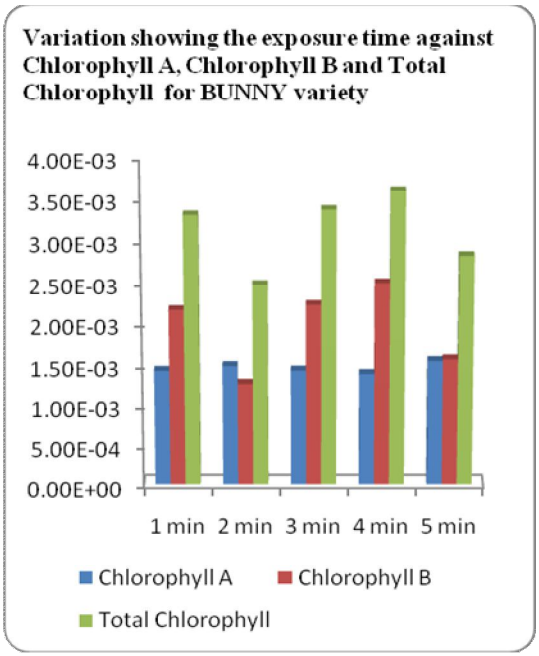


TABLE III
FOR BUNNY BT VARIETY

Sr.No.	Variety	Chlor A	Chlor B	Total Chlorophyll
1	B_1	1.414×10^{-3}	2.163×10^{-3}	3.307×10^{-3}
2	B_2	1.475×10^{-3}	1.242×10^{-3}	2.467×10^{-3}
3	B_3	1.417×10^{-3}	2.225×10^{-3}	3.371×10^{-3}
4	B_4	1.378×10^{-3}	2.491×10^{-3}	3.598×10^{-3}
5	B_5	1.536×10^{-3}	1.559×10^{-3}	2.817×10^{-3}



In the above tables T, V and B represent the varieties Turab, Vinayak and Bunny BT and their subscripts represent their exposure time to He-Ne laser in minutes.

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V. CONCLUSIONS AND FINDINGS

A. The Chlorophyll A and Chlorophyll B are the measures of food and nutrition generation capacity of the leaves.

B. The total Chlorophyll in the leaves is the measure of food circulation capacity.

C. It is observed that as the exposure time of seeds to laser is increased the Chlorophyll A and Chlorophyll B in the leaves is found to increase. This indicates that the food and nutrition generation capacity of the leaves increases.

D. The total Chlorophyll content in the leaves is also found to increase as the exposure time of seeds is increased. This indicates that the food circulation capacity of leaves increases with exposure time.

E. The exposure of seeds to laser radiations can increases the food and nutrition generation capacity of the leaves and food circulation capacity of leaves. Both these components are responsible for healthy plant growth and high yield.

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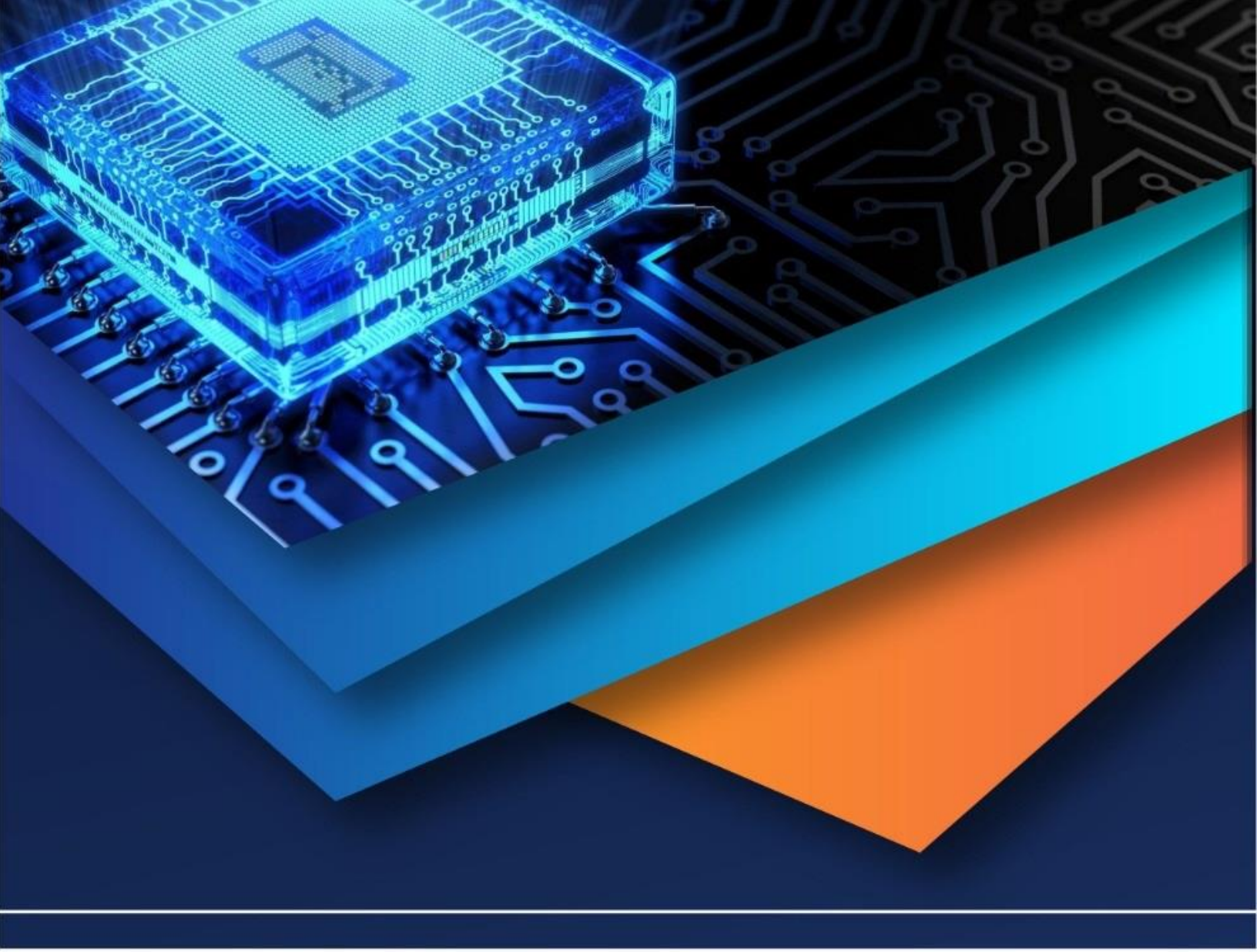

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