

Effect of Salinity on Autocatalytic Ion Efflux Constant of *Vigna Radiata* (Mung bean) Seed

M. A. Hakeem¹, M. K. M. Zafar²Research Scholar, Department of Physics, Dravidian University, Kuppam, India¹Associate Professor, Maulana Azaad Urdu University, Hyderabad, India²

ABSTRACT: The paper reports autocatalytic ion efflux constant of seed *Vigna radiata* (Mung bean) placed in imbibition medium of NaCl solution of different concentration in the range of 0.9 to 0.056 % in water. The method of ion efflux involving the measurement of specific conductance of imbibition medium is more advantageous than the measurement of the water content of the seed.

KEY WORDS: Ion Efflux, Autocatalytic Ion Efflux Constant, Mung Bean, Electrical Conductivity.

I. INTRODUCTION

The biological studies on seed germination attempt to treat the seed through the use of experimental and theoretical models that are amenable to physical approaches. Biological systems are Complex in nature. In order to understand biological system, the principles of physics and techniques of mathematics at different levels of complexity are usually applied. In view of this, the study of seed germination is considered to be useful biophysical phenomenon to understand the seed kinetic which may be assessed from knowledge of the electrical behavior of the imbibition medium. The process of germination is mainly governed by Autocatalytic ion efflux. Hence, the present study is an attempt to assess the effect of salinity of the imbibition medium on autocatalytic ion efflux constant. Here, *Vigna radiate* (Mung bean) is selected for the study.

II. RELATED WORK

Studies on seed germination are usually confined to the changes in mass or volume of the seed as a function of time during the process of imbibition to evaluate the time of germination [1, 2]. Studies on the electrical properties of the imbibition medium are scanty in literature. Pitman [3] reviewed the work on ion uptake and electrical properties of plant root; the interaction of water; and solute flows. Pandey [4] developed a useful, rapid simple inexpensive and highly predictive vigor test of French beans. Williams et al [5] studied the effect of weathering on Mung beans. Shanmuga Sundaram et al [6] reported that the ion efflux from whole seedling increases the specific conductance of the bathing medium. Simon [7] reported the increase in electrical conductivity in leachates of imbibing seeds is due to the increased leakage of electrolytes. Blacklow [8] proposed a mathematical equation to predict germination in corn based on the rate of water uptake in relation to time. Blackman [9] altered the index parameter effectively for plant growth from simple mathematical function, fitted to series of experimental observation. Gregovy [10] discuss the review article of Williams on relative growth rate and the process of increased dry weight in short affix end leaf growth. Tinker [11] studied, on an empirical basis, uptake rate of Potassium, Aluminum, and water in roots, in order to determine the nutrient ion efflux and water flux into the root. Gopala Krishna and Latha [12] showed that water uptake by seeds resulted in an efflux of ion into the imbibition medium, causing an increase in the specific conductance of water from its initial value. Maguire [13] observed high conductivity of imbibitions medium and poor germination in the case of bleached pea seeds, compared to unbleached seeds.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

III. MATERIAL AND METHODS

Vigna rariadiata (Mung bean) seeds were cleaned with wet cloth and dried at room temperature then allowed to imbibe in water. Then specific conductance of imbibition medium (water) was measured for a period of time 3 hours with an interval of 0.25 hour. From the data on specific conductance of imbibition medium as a function of time, autocatalytic ion efflux constant can be calculated using that differential equation,

$$d\sigma/dt = k_i \sigma_t (\sigma_\infty - \sigma_t)$$

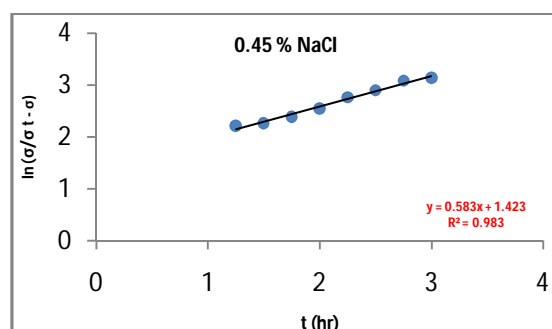
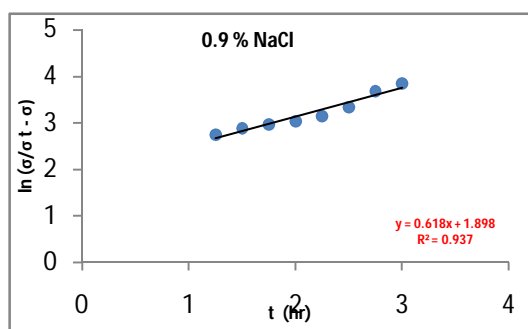
where σ_t is the specific conductance at any time t , and σ_∞ is the specific conductance at infinite time.

10gm of *Vigna Radiata* (Mung Bean) seeds were taken. They were cleaned with wet muslin cloth and dried at room temperature and were allowed to imbibe in 40 ml of NaCl solution of different concentration in the range of 0.9 to 0.056 % in water. The specific conductance of imbibition medium was determined with the help of electrical conductivity meter (ELICO – CM 180), at an interval of 0.25 hour of imbibition. The increase in the specific conductance at every 15 min. was determined as a percentage of the conductance of taken NaCl solution at time at $t = 0$.

IV. RESULTS & DISCUSSION

The rate of water uptake (dw/dt) was assumed to be controlled by osmosis and at the rate of ion efflux ($\frac{d\sigma}{dt}$) from the seed system to the imbibition medium could be a differential equation. A plot of $\log(\sigma_t / (\sigma_\infty - \sigma_t))$ against time 't' should be a straight line Fig. 1. from the slope of which the value of k_i , the auto catalytic ion efflux constant is calculated.

Fig.1. shows plots between $\ln(\frac{\sigma}{\sigma_\infty - \sigma})$ and t , when the seeds are placed in water and NaCl solutions of concentrations in % of 0.9, 0.45, 0.225, 0.112, 0.056, and 0.028 as imbibition medium so that the effect of salinity autocatalytic ion efflux constant can be assessed. The graphs are straight lines and slopes of which are used for the calculation of k_i . It is interesting to note that the values of k_i in the present salinity range is more or less the same. But k_i value of seeds in water is more than that in NaCl solution (Table 1). It seems that the small concentration of NaCl solution has no effect on k_i of the seeds of the investigation.



International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

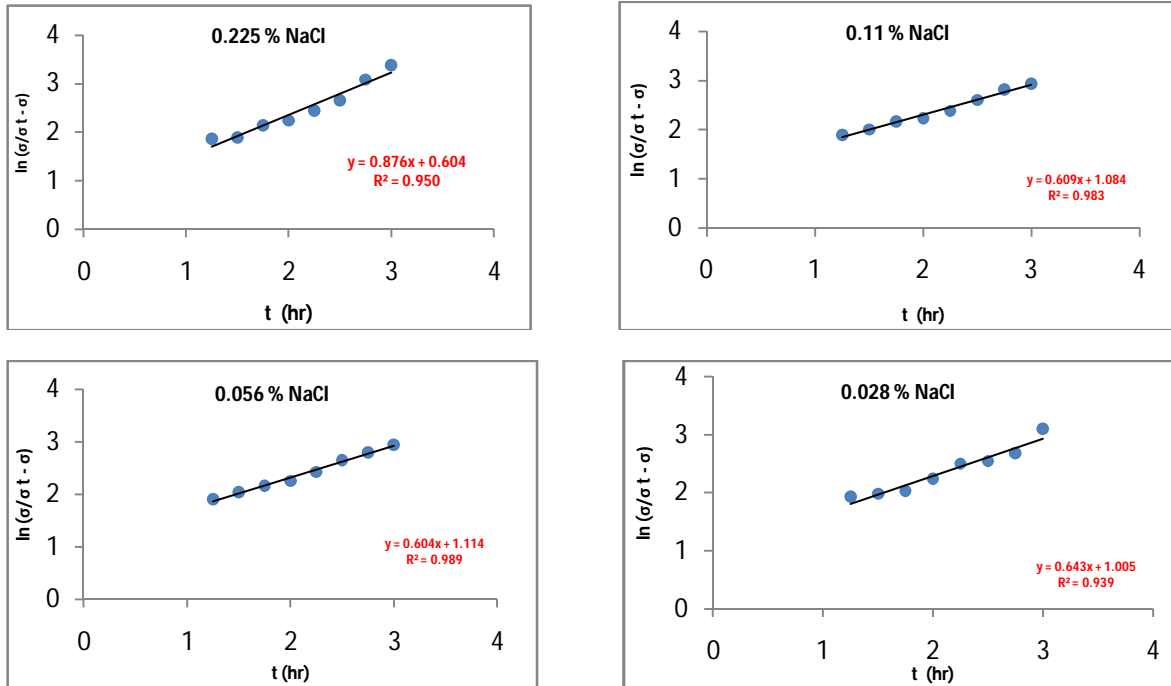


Table 1 - Autocatalytic Ion Efflux Constant of *Vigna Radiata* (Mung Bean) with different NaCl solutions.

NaCl solution (%)	Autocatalytic ion efflux constant (hr ⁻¹)
Distilled water	2.157
0.028	1.005
0.056	1.114
0.113	1.084
0.225	1.184
0.450	1.423
0.900	1.028

The study suggests when seeds are immersed in distilled water for imbibition, water enters the seed due to osmotic imbalance. Due to this entry of water, seeds being polyelectrolyte, electrolysis takes place resulting in the efflux of ions from the seed to the imbibitions medium. This is detected as a variation in the specific conductance of the imbibition medium further, the phenomenon of autocatalytic ion efflux may perhaps depends on chemical composition of imbibitions medium.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

REFERENCES

- [1] Dewez, J., "Water uptake and heat evolution by germinating cotton seed. Plant physiology", Vol.39, pp. 240, 1964.
- [2] Kellar, W., and Bleak, A. T., "Factors influencing water absorption by seeds of the Crusted wheat grass complex", Crop science, vol.10, pp.422, 1970.
- [3] Pitman, M.G., "Transport across plant roots. Quarterly Reviews of Biophysics", vol.15 (3), pp. 481-554, 1982.
- [4] Pandey, D. K., "Priming induced repair in French bean seeds seed Sci. and Technol", vol.16, pp. 527-532, 1988.
- [5] Williams, R. W. R. J., Lawn, B. C., Imrie and D. E., Byth. "Studies on water damage in mung bean. II. Electrical conductivity of seed damage as an assay of level of damage", Aust. J., Agric. Res. pp. 901-907, 1995.
- [6] Shanmuga Sundaram, E. R. B., Sivasithamparam, N. Janardana Rao, G., and Govindaraju, C. "Effect of culture filtrates of Aspergillus terric acid on cell permeability of green gram (Vigna radiate (Linn) Wilczek) seedlings", Current Science 51:370-1, 1982.
- [7] Simon, E. W., "Early events in germination". In Murray R (ed), The living seed, Academic Press, Australia. Vol.2, pp. 77-115, 1984.
- [8] Blacklow, W. M., "Mathematical description of the influence of temperature and seed quality on imbibitions by seed of corn". Crop Science, vol.12, pp.643-6, 1972.
- [9] Blackmann V.H., Ann. Bot., Vol. 33, pp.353, 1919.
- [10] Williams R.F., "The short Apex and leaf growth", Cambridge Universty press, London.
- [11] Tinker P.B., "Ecological aspects of plants", blackwell publications, oxford, 1969.
- [12] Gopal Krishna, G., and L.Latha, "Assesment of time of germination in pulses and cereals by ion efflux And water uptake method", Idian J.Ari.sci. vol.56(2), pp. 107-14, February 1986.
- [13] Maguire J.D., "In Seed Ecology", Butterworth & Co (publishers) Ltd, London, 1972.