Solute Diffusion in Single Germinating Seed: Experimental Determination of Diffusion Coefficients of Nacl in PBW-343 Wheat Variety at 25° And 45°C .

Abstract

Diffusion coefficients of sodium chloride in HD-2329 wheat variety were experimentally determined by employing the theory and methodology developed earlier in this laboratory. In the present study, diffusion coefficients of NaCl in single seed of PBW-343 wheat variety rater than bulk were determined by using a diffusion cell of 10ml capacity. The concentration range was from 0.03 – 1.0M and temperature selected were 298.16K and 318.16K. The results are compared at these two temperatures

Keyword: Sodium Chloride, Concentration, Diffusion Coefficients , Germinating , Determinatio

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Introduction

A survey of literature reveals that in spite of many attempts experimental determination of diffusion coefficients in germinating seeds has remained a challenge. Water diffusivity in germinating seeds were, however, determined by Phillip, and autoradiographic technique developed by Jackson and Marston and a model proposed and tested by Waggoner an Parlange We have earlier developed a theory of diffusion and carried out extensive studies of diffusion of simple valence salts in wheat seeds and pollen grains1.In the present paper we have extended our study to seeds of a promising wheat variety,PBW-343 and diffusion coefficients of sodium chloride were determined at 298.16K and 318.16K.

Methodology

Seeds of a promising wheat variety,PBW-343 were procured from department of Plant Breeding,PAU,Ludhiana. Sodium Chloride (NaCl) and KCl of AnalaR grade were used. In our earlier studies2-4 ,wheat and corn seeds in bulk were employed in diffusion experiments and the volume of the diffusion cell was 23 ml. In the present work volume of the diffusion cell was reduced to10 ml and single was employed for all diffusion experiments.With the reduction in volume,the change in solution concentration with time during diffusion process becomes measurable.Except for the above change in volume of the diffusion cell, the methodology employed for determining seed constant and diffusion coefficients from experimental data was the same as reported earlier2-4.

Result And Discussion

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Curves of $\overline{D}$ vs $\sqrt{c}$ (Graphs 1 and Graphs 2) show the variation of differential diffusion coefficient of wheat variety with concentration at two temperatures viz.25^{0}C and 45^0 C. A glance at the graph 20 show that the diffusion coefficient of NaCl in PBW-343 (wheat) variety at 25^0 C decreases from 3.6059×10^{-4} cm^2 sec^{-1} to 1.730×10^{-4} cm^2 sec^{-1} as the concentration increases from .03 to .3M and then increases from 2.2356×10^{-4} cm^2 sec^{-1} to 3.5579×10^{-4} cm^2 sec^{-1} as the concentration increases from .5M to 1M.

On the other hand, in the case of NaCl-PBW 343 (wheat) system at 45^0 the D values decreases from 2.0500×10^{-4} cm^2 sec^{-1} to 1.2000×10^{-4} cm^2 sec^{-1} as the conc. increases from .03M to .5M and then increases upto 3.1000×10^{-4} cm^2 sec^{-1} from .7M to 1M except at .1m concentration when the trend is not regular. The maximum and minimum values of diffusion coefficients at 45^{0}C were, however, found to be 3.1000×10^{-4} cm^2 sec^{-1} and 1.2000×10^{-4} cm^2 sec^{-1} at 1M and .5M respectively. A comparison of NaCl diffusion rates at 25^{0}C and 45^{0}C (cf Tables 25 and 30) clearly show that the diffusion coefficients at 25^{0}C are higher as compared to 45^{0}C at all concentrations. This is due to various factors such as changing viscosity
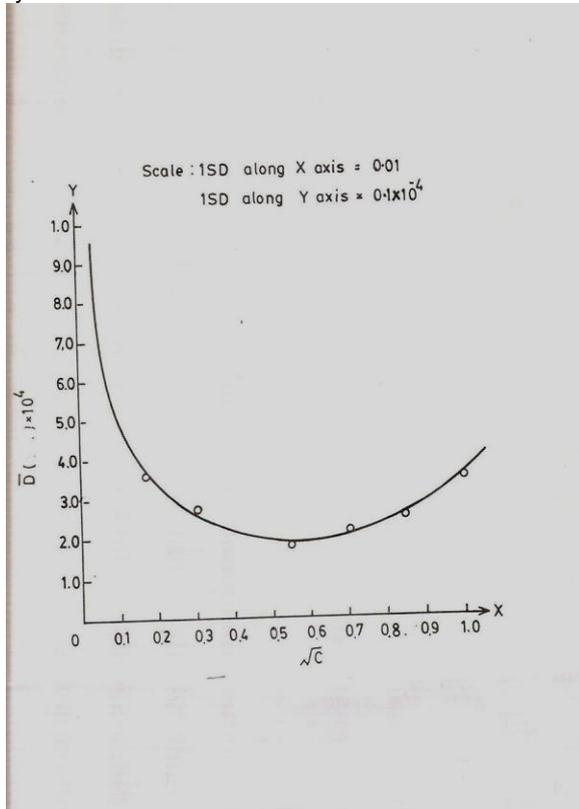
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and dielectric constant of the medium, hydration effect and to the physiological nature of seed coat.

Graph1-Plotof $\overline{D}$ and $\sqrt{c}$ for NaCl-PBW343(Wheat) system at 25^0C

Graph2-Plotof $\overline{D}$ and$\sqrt{c}$ for NaCl-PBW343(Wheat) system at 45^0C
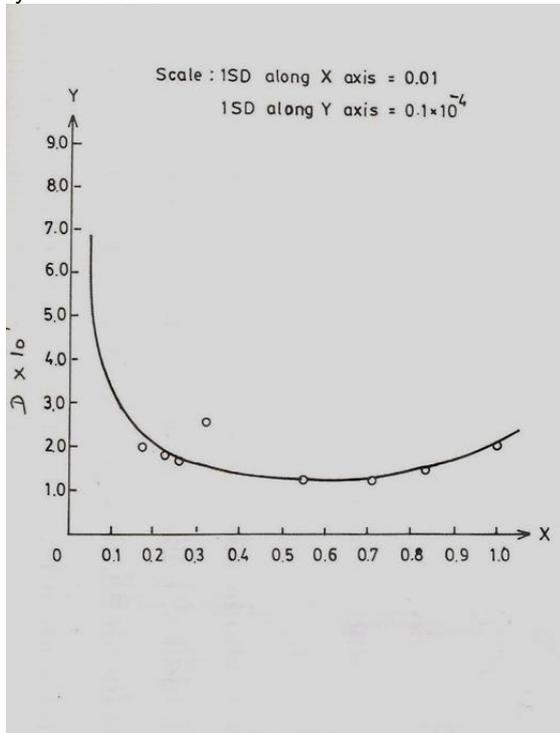
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