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Time-Course Moisture Content Studies and Water Diffusivity of Chickpea and Soybean Seed.

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Abstract

Seed priming simply involves soaking seeds in water, usually 'overnight', surface-drying them to facilitate easy handling, then sowing them in the normal fashion. Crop plants grown from primed seeds generally emerge earlier and in greater numbers, grow more vigorously, flower and\mature earlier and often yield better than those from non-primed seeds. This helps in minimising the use of fertilisers and can help in controlling the menace of soil and water pollution caused by fertilisers. Time course moisture content studies were conducted with soybean (PK-416) and chickpea (L-550) seeds at 35^{o} C. The targeted moisture contents were 30%, 35%, 40%, and 45% while single seed of each crop variety was taken during investigation. Results indicate that the targeted moisture content are obtained in just 6 hrs. The results of diffusion coefficient indicate that there is a continuous decrease in the values of diffusion coefficient with time. The % germination is 100% and 90% which is maximum with 45% moisture content for chickpea and for soybean seed respectively

.**Keywords:** seed priming, moisture content, diffusion etc.

Introduction Seed priming simply involves soaking seeds in water, usually 'overnight', surface-drying them to facilitate easy handling, then sowing them in the normal fashion. Crop plants grown from primed seeds generally emerge earlier and in greater numbers, grow more vigorously, flower and mature earlier and often yield better than those from non-primed seeds[1-3]. This simple, low-cost, low-risk technology has been developed, tested. The studies of the transport and uptake of water in germinating seeds are of prime importance[4]. Water uptake in geminating seed occurs by diffusion phenomena and therefore for a complete understanding of the germination process a thorough knowledge of the phenomena is essential. We developed earlier a diffusion theory concerning electrolytes/non-electrolytes and a diffusion cell apparatus[5]. Diffusion coefficients for a number of simple valence salts indicate that the seed membrane/coat acts as a very sensitive selective barrier for the transport of solute particles [6]. Keeping in view the importance of transport studies in germinating seeds an attempt was made to determine diffusion rates of water uptake by performing time-course moisture content studies in single chickpea and soybean seed at 30^{0} C and diffusion coefficients were determined at different intervals of time by employing an empirical relation developed earlier[7].

Material and Method Soybean (PK-416) and chickpea (L-550) seeds were procured from Department of Plant Breeding. Punjab Agricultural University, Ludhiana, India and preserved in air-tight containers. Initial moisture contents in seeds were determined by a moisture meter. Single seed was placed in a small air-tight plastic container and pre calculated amount of water was added to achieve the desired targeted

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moisture content. There were three replications for each targeted moisture content and experiments were set-up after every 2h upto 24h in new containers. An air thermostat (35 ± 0.1^0) was employed. From the initial and final seed weights percent moisture contents were estimated. Due care was taken to keep the weight of seeds within the above stated range, and containers were also properly scaled in order to avoid any loss of water by evaporation. Pure water with a conductance of $\sim10^6\,\Omega^{-1}$ was employed. The empirical relation employed for the determination of $\overline{D}$ from moisture content is

$$\overline{D}\beta_{seed}\,t = \ln(MC_f - MC_i)$$

Where, $\overline{D}$ is the integral diffusion coefficient, βseed the seed constant, t the time of diffusion and (MCf-MCi) is the difference between final and initial moisture contents of the seed. βseed determined by the procedure discussed else where were found to be 61.3×10^{-3} and 233.03×10^{-3} for the varieties used of soybean and chickpea seed, respectively. The equation differs from that given by the theory that moisture contents are substituted in place of respective solute concentrations. This was necessary since during the time-course moisture content studies, the external amount of water diffused into the seeds and the very basic driving force for diffusion phenomena, namely a concentration (chemical potential) equalization process becomes invalid. The values of $\overline{D}$ obtained from this new empirical relation, despite units of g $cm^2\,s^{-1}$ would still provide a good estimate of the amount of water diffused into the seeds. This may be considered as a limitation of obtaining $\overline{D}$ in the usual units of $cm^2\,s^{-1}$, but the approach nonetheless provides a reliable method for water uptake studies when moisture contents are taken into consideration

.Results and Discussion

Plots of moisture contents vs time (Fig. 1 and 2), and $\overline{D}$ vs time(Fig. 3 and 4) for both the crop varieties are shown, respectively.The results reveal that in both the seed varieties,the initial moisture contents steeply increased initially with time, thereafter this trend somewhat decreased and at the duration of 6h and beyond it became constant, showing thereby that the seed has acquired the desired moisture content at the above time period. It is surprising that for both the seed varieties constancy in targeted moisture contents occurred at nearly 6h and remained constant for 24h(total duration of experiment).It is inferred that rather than sowing seeds after a lapse of 24h,which is a general practice, hydro- primed seed of these varieties can be sown after 6h.

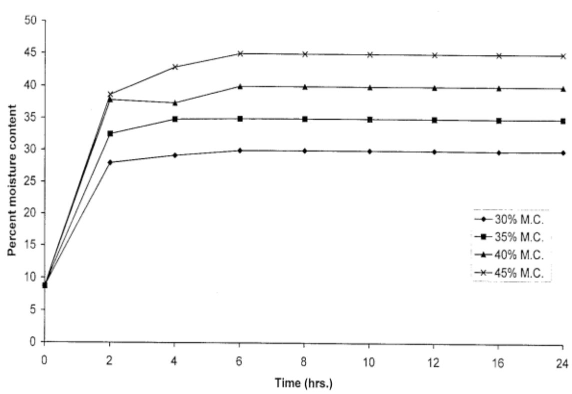

Fig. 1 Plots of time-course moisture content of single seed of chickpea

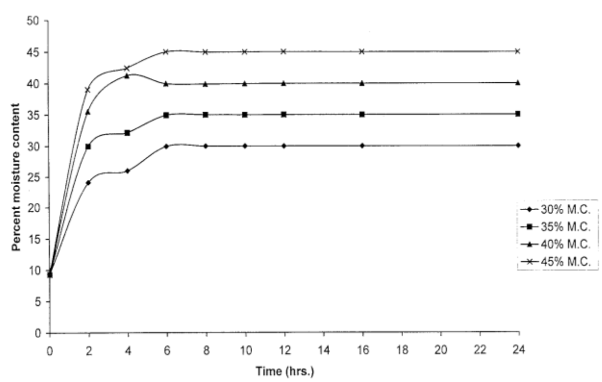

Fig. 2 Plots of time-course moisture content of single seed of soybean

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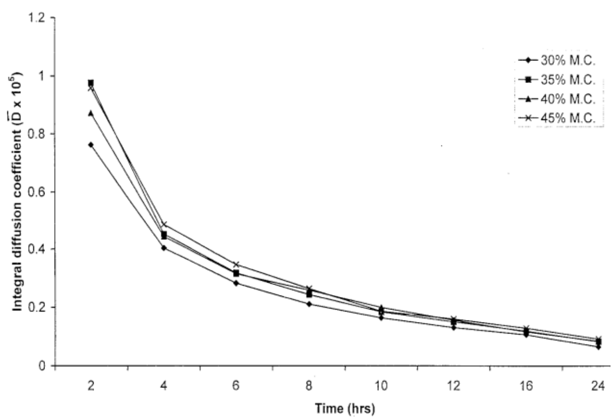
Germination test were also conducted with the seeds of both the varieties after raising there moisture content to the desired values. The results show that seed hydro primed at 45% moisture content had quicker and improved emergence. Likewise, seed priming duration of 6 h resulted in faster and improved emergence of chickpea and soybean varieties.

The data for average diffusion coefficients $\overline{D}$ revealead that with the increase in the initial moisture content there was a continuous decrease in $\overline{D}$ Fig 3 shows that during the first 4h, there is a steep decrease in $\overline{D}$ for both the seed varieties, whereafter this trend is somewhat less marked upto 2.4h when the diffusion rate is the minimum. This is expected and can be explained by the fact that during the initial period, water uptake by the seed is fast giving higher $\overline{D}$ values followed by slower uptake (lower $\overline{D}$)and finally very less absorption of water takes place for which $\overline{D}$ obtained is minimum.



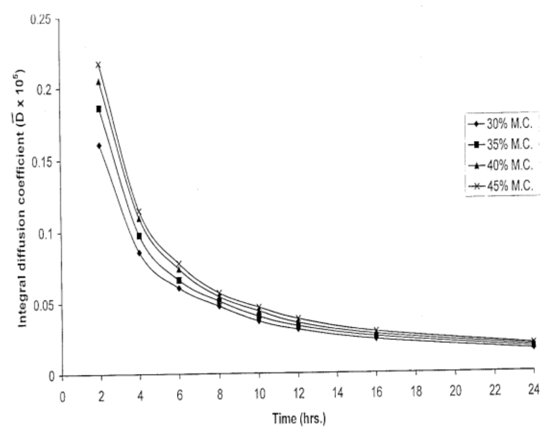


Fig. 3 Plots of integral diffusion coefficient vs time of chickpea at 30^o Fig. 4 Plots of integral diffusion coefficient vs time of soybean at 30^o

Conclusion: It has been concluded from this study that hydro priming of chickpea and soybean seed for6 h improved emergence and grain yield. However, keeping in view the least understood phenomenon of metabolic activities occurring in seed suggests that further studies are required in this area. Hydro priming resulted in improved and early germination as well as enhanced emergence in hydro primed seed. The present study was, therefore, carried out with the objective to evaluate the effects of seed priming treatments on the seedling establishment, quality and yield of chickpea and soybean seed to find out the most promising technique and to help in minimizing the use of fertilizer which cause a lot of environmental pollution.

Importance: Seed priming techniques have been found effective for better germination and seedling establishment in various crops under controlled conditions. These interventions are highly cost-effective because only very dilute solutions of the materials are used for priming seeds.
In addition, seed priming can be used to:

- Add *Rhizobia* inoculum to legume seeds to promote fixation of atmospheric N.
- Provide small amounts of 'starter' P to crop seeds to boost growth in low-P soils and to increase apparent recovery rates of expensive added P-fertilizer.
- Provide Mo to legumes grown in acidic soils where Mo is unavailable so as to increase yield.

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- Provide Zn to crop seeds (maize, wheat, chickpea) in alkaline or other soils where Zn is deficient, to increase yields and Zn nutrient density in grain.
- Provide B to crops (maize, wheat, chickpea) in B-deficient areas to increase yields.
- Improve the performance of seeds germinating in saline-affected soils.

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