Gurukul International Multidisciplinary Research Journal (GIMRJ)*with* International Impact Factor 8.357
Peer Reviewed Journal
https://doi.org/10.69758/GIMRJ/2504I5VXIIIP0035

e-ISSN No. 2394-8426
Monthly Issue
APR-2025
Issue–IV, Volume–XIII

Comparative study of Imbibition Rates in *Zea mays, Trigonella foenum-graecum and Cajanus cajan* Plant Seeds

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ABSTRACT

Imbibition is a special type of diffusion since water movement is along the concentration gradient that takes place when liquid is absorbed by solids-colloids causing an increase in volume.Imbibition is the first and essential step in seed germination. This paper deals with Comparative study of Imbibition Rates in *Zea mays, Trigonella foenum-graecum and Cajanus cajan* plant Seeds.

The main objectives of this study are- To investigate the rate of water absorption (imbibition), helps to understand the importance of imbibition in seed germination and how different factors influence the water absorption process. In agriculture, understanding imbibition is very important because it directly impacts seedling establishment and overall plant water relations, all of which are vital for these crops' success. Imbibition can be used to assess the quality of seeds and to optimize seed storage conditions.

For present study, first we collected seeds from 'Seed Bank' of Department of Botany, Jijamata Mahavidyalaya, Buldhana (M.S.). Before going through actual experiment, 25 viable seeds of each plant were chosen after seed viability test. Then Initial Weight of all seeds of each type taken using a digital weighing balance and record their initial mass (IW). Seeds were soaked in separate test tubes.Removed at regular intervals of 1 Hr. Blot them dry gently using a blotting paper.Weighed them again and record their mass (FW) at each time interval. We Repeat this process for 3–5 hours to get constant value and observe the trend of imbibition.Then rate was calculated using formula.

From the observation and result it is concluded that, Initially, seeds absorb water rapidly. All seeds exhibit varying imbibition rates based on seed size, composition, and coat permeability. Hard-coated seeds of *Cajanus cajan* takes longer to imbibe water compared to soft-coated ones *Zea mays, Trigonella foenum-graecum*.

Key Words: Imbibition Rate, *Zea mays, Trigonella foenum-graecum, Cajanus cajan,* Plant Seeds

INTRODUCTION:

This paper deals with Comparative study of Imbibition Rates in *Zea mays, Trigonella foenum-graecum and Cajanus cajan* plant Seeds. The main objectives of this study are- To investigate the rate of water absorption (imbibition), helps to understand the importance of imbibition in seed germination and how different factors influence the water absorption process. In agriculture, understanding imbibition is very important because it directly impacts seedling establishment and overall plant water relations, all of which are vital for these crops'

success. Imbibition can be used to assess the quality of seeds and to optimize seed storage conditions.

So far,Katchalsky A, S Lifson, H Eisenberg (1951), David J. Parrish and A. Carl Leopold (1977), A. Carl Leopold (1983), Barry G. Swanson, Joe S. Hughes and H. Paul Rasmussen (1985), Obroucheva NV (1999), M. M. Shimizu and P. Mazzafera (2000), Boniface M. Mwami & All (2017), Jean-Francois Louf& all (2018) and Burrows GE, Alden R, Robinson WA (2019) etc. authors worked on imbibition.

We measure weight of seeds before (Initial weight IW) and after soaking (Final weight FW) in water in regular interval of time. value and observe the trend of imbibition. Then rate was calculated using formula. From the observation and result it is concluded that, Initially, seeds absorb water rapidly. All seeds exhibit varying imbibition rates based on seed size, composition, and coat permeability. Rate of imbibition depends on water availability, seed structure and composition, water permeability of seed coat layers and temperature (Obroucheva, 1999). Hard-coated seeds of *Cajanus cajan* takes longer to imbibe water compared to soft-coated ones *Zea mays, Trigonella foenum-graecum*.

MATERIAL AND METHOD:

Collection of Seeds: For present study, first we collected seeds from 'Seed Bank' of Department of Botany, Jijamata Mahavidyalaya, Buldhana (M.S.) (Plate-1).

Selection of Seeds: Before going through actual experiment, 25 viable seeds of each plant were chosen after seed viability test.

Measurement of Weight: Initial Weight of all seeds of each type taken using a digital weighing balance and record their initial mass (IW). Seeds were soaked in separate test tube (Plate Fig. 1-4). Removed at regular intervals of 1 Hr. Blot them dry gently using a blotting paper. Weighed them again and record their mass (FW) at each time interval (Table-1). We Repeat this process for 3–5 hours to get constant value and observe the trend of imbibition. Then rate was calculated using formula (Table-2).

PLATE-1

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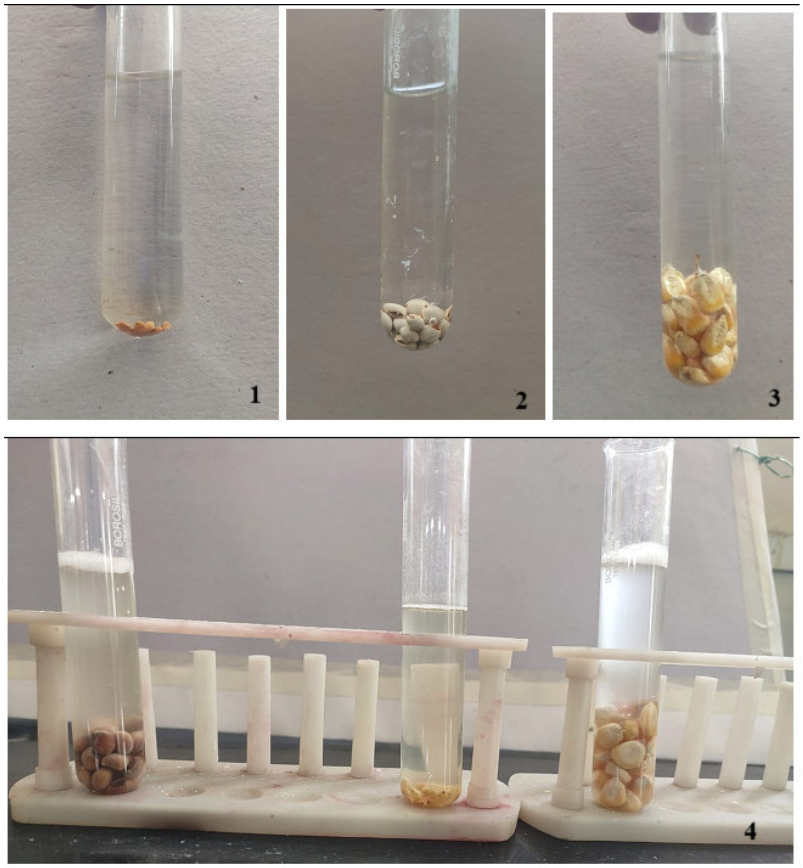

PLATE

OBSERVATION:

Following observation recorded

Table-1

Sr. No.	Name of Plant Seed	No. of Seeds	Initial Weight (in gm) (Dry Seed) IW	Weight (in gm) after soaking at regular interval of 1 Hr					
				W1	W2	W3	W4	W5	W6
1	*Trigonella foenum-graecum*	25	0.38	0.42	0.56	0.65	0.81	1.36	1.36
2	*Cajanus cajan*	25	2.63	2.72	2.89	3.17	3.68	5.60	5.64
3	*Zea mays*	25	7.55	8.60	9.07	9.34	9.74	11.02	11.25

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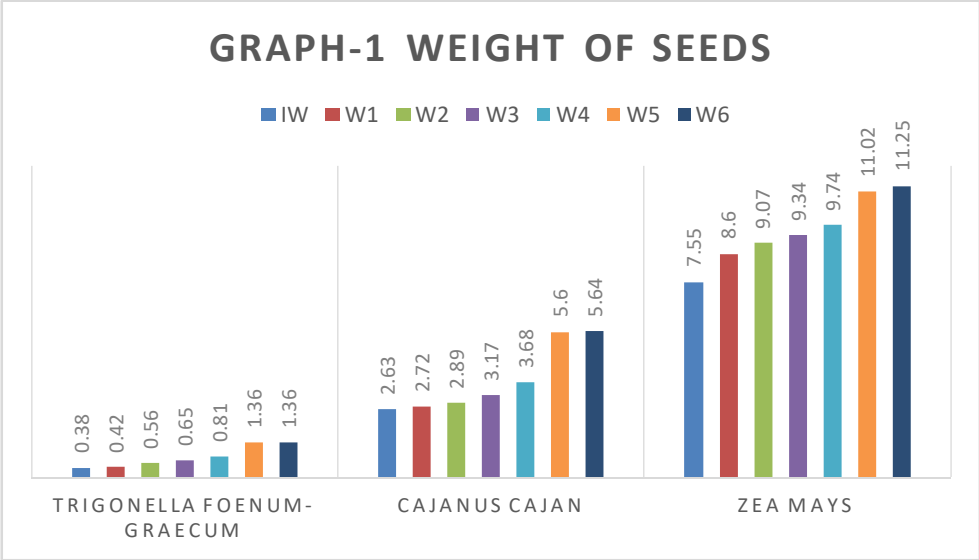


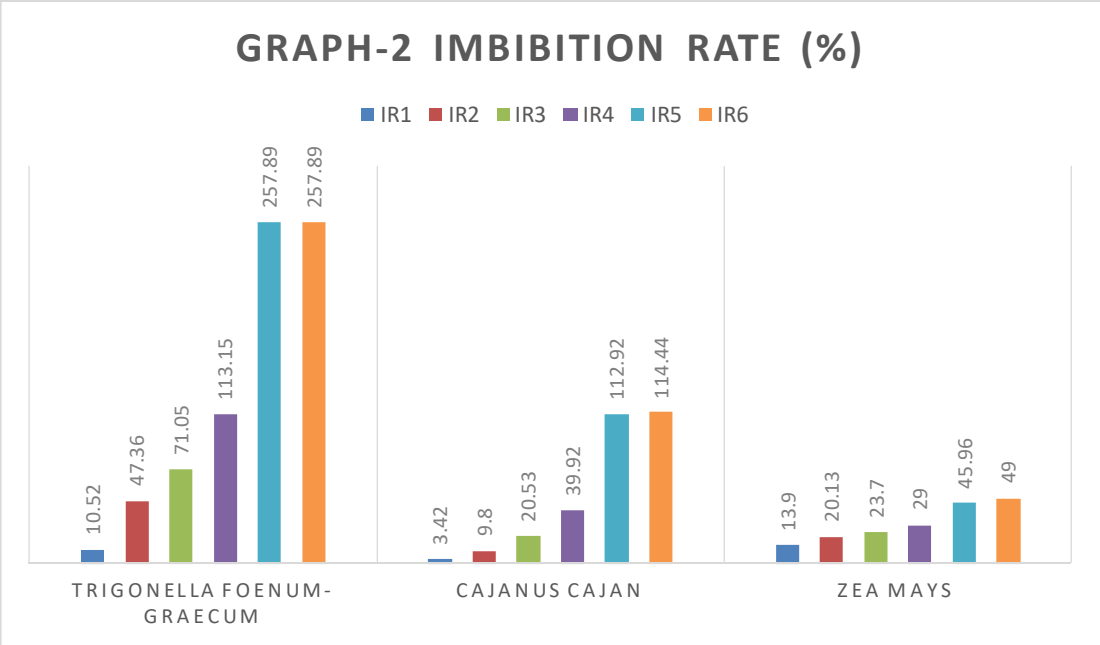
CALCULATION& RESULT

Formula-

$$\text{Imbibition Rate} = \frac{Final\ Weight - Initial\ Weight}{Initial\ Weight} \times 100$$

Table-2

Sr. No.	Name of Plant Seed	No. of Seeds	IW	Imbibition Rate (In Percentage %)					
				IR1	IR2	IR3	IR4	IR5	IR6
				$\frac{W1-IW}{IW}\times 100$	$\frac{W2-IW}{IW}\times 100$	$\frac{W3-IW}{IW}\times 100$	$\frac{W4-IW}{IW}\times 100$	$\frac{W5-IW}{IW}\times 100$	$\frac{W6-IW}{IW}\times 100$
1	*Trigonella foenum-graecum*	25	0.38	10.52	47.36	71.05	113.15	257.89	257.89
2	*Cajanus cajan*	25	2.63	3.42	9.8	20.53	39.92	112.92	114.44
3	*Zea mays*	25	7.55	13.90	20.13	23.70	29.00	45.96	49.00



DISCUSSION:

The swelling of seeds with the entry of water is seen to havemany of the characteristics of the swelling of polymers upon hydration observed by Katchalsky A, S Lifson, H Eisenberg in 1951. Transient Changes During Soybean Imbibition observed by David J. Parrish and A. Carl Leopold in 1977. Swelling parameters for 15 seed species were determined byA. Carl Leopold (1983). Using scanning electron microscopy (SEM), study of seed microstructure and their role in imbibition by legume done by Barry G. Swanson, Joe S. Hughes and H. Paul Rasmussenin 1985. *They observed* microstructural changes occurring in legumes during waterimbibition offers a better understanding of differences that exist between hard and normal beans. A Role for Trigonelline During Imbibition and Germination of Coffee Seeds studied by M. M. Shimizu and P. Mazzafera (2000). Boniface M. Mwami &All (2017) Effects of Water Imbibition of Selected Bean Varieties on Germination. Jean-Francois Louf& all (2018) works on Imbibition in *(Glycine max)*and artificial seeds.And *Burrows GE, Alden R, Robinson WA* (2019)Studied different patterns of imbibition in seeds of 48 Acacia species

CONCLUSION

From the observation and result it is concluded that, Initially, seeds absorb water rapidly (Graph-1&2). All seeds exhibit varying imbibition rates based on seed size, composition, and coat permeability. Hard-coated seeds of *Cajanus cajan* takes longer to imbibe water compared to soft-coated ones *Zea mays, Trigonella foenum-graecum*.

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