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Effects of Cow Urine and Medicinal Plants as Seed Treatment on Germination Rate and Growth of Cluster bean (*Cyamopsis tetragonoloba*) and Fenugreek (*Trigonella foenum graecum*)

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ABSTRACT

The cow is considered a divine animal in the Hindu culture. Many useful products like Milk, Cow dung, urine of the cow is used for various purposes. In Vedas, (Ancient Hindu texts), Cow urine has been given a lot of importance. It isalso called as Amrita, The beverage of Immortality. Cow urine and extract of the leaves of medicinal plants have a very positive effect on overall growth of the plants and as a result, there is an increase in the height of the plant, stem girth, number of branches and number of plants leaf if subjected to their treatment.

The plant chosen for this study were Cluster bean(*Cyamopsis tetragonoloba)*and Fenugreek(*Trigonella foenum graecum*).The plants were grown for 15 days using different concentration of mixture of cow urine and medicinal plants i.e control, 1: 9, 2:8, 3:7, 4:6, 5:5. Seeds of both the plants were soaked for different time period, i.e 12 hours,24 hours,36 hours, 48 hours, 60 hours.

The result observed after the experiments were as follows

1:9 concentration solution and seeds soaked for 12 hours showed maximum growth as compared to others. Also 2:8 concentration solution and seeds soaked for 12 hours showed maximum growth in Fenugreek. This study concludes that mixture of cow urine and medicinal plants can be used as a plant growth enhancer and produces healthy seedlings.

Keywords : Cow Urine, Medicinal Plants, Cluster Bean, Fenugreek, Germination Growth.

I. INTRODUCTION

Seed produces the next generation of plant or new plant. Seed plays an important role in plant's lifecycle. Seed is considered as the ripped ovule which comes out due to proper fertilization. A mature seed consists of seed coat and embryo which is the young plant enclosed within the seed coat. But seeds required the

vital condition for germination such as supply of oxygen, water and favourable temperature and sunlight. Germination of seed is the process of development of embryo and ultimately gives rise to a new plant. Seed treatment is priming methods which helps the seed to germinate faster and increase the ratio of seed germination. Seed priming method is known as seed treatment. Low costly seed priming method can improve the seed germination.

Germination and seedling establishment are critical stages in the plant lifecycle. Seed germination is affected by so many factors as soil, water, air, temperature, sunlight, nutrients and most important climate, weather and many more factors. In the process of seed germination, water is absorbed by the embryo, which results in the rehydration and expansion of the cells. Shortly after the beginning of water uptake, or imbibitions, the rate of respiration increases, and various metabolic processes, suspended or much reduced during dormancy, resume. These events are associated with structural changes in the organelles (membranous bodies concerned with metabolism) in the cells of the embryo(John Heslop-Harrison). Primed seed emerged 12h earlier than non primed seeds.(Dell-Aquila and Tritto 1990). Seed priming method helps in break-down of macromolecules for growth and development of embryo that resulted in early and higher seedling emergencesss(R.Subedi et al,2015).

About Cow and its Importance

Cow, often called Kamadhenu, has been considered as a sacred animal in India. Right from ancient period, various products of cow have been emloyed in medicine. In Veda, cow's urine was compared to the nectar. In Susrut Samhitha, several medicinal properties of cow's urine have been mentioned and are known to cause weight loss, reversal of certain cardiac and kidney problems, indigestion, stomach ache, edema, etc... (Dharma et al.,2005).

In different research and studies conducted in India, it has been found out that cow urine play a significant role in production of vegetables and control of diseases. From time immemorial, India has been an agrarian country and the cow has been the backbone of their agriculture. During the last several decades, especially after green revolution the use of chemical fertilizers, pesticides and tractors have dealt a severe blow to the importance of cows in the society. The products of cow; dung, milk and leather are used for different purposes. In a cow based economy, milk is the major resource where it is used for drinking, for making curd, cheese and other milk products. Cow dung was used in the olden days as a building material for houses and home decorations. Leather is mostly used to make traditional blankets, clothes and shoes. Cow urine ingredients are capable of treating many diseases as it has several medicinal properties and it is the best remedy to cure fungal and bacterial diseases.

About Medicinal plants

The term " **medicinal plant** " include various type of plants used in herbalism ("herbology" or "herbal medicine") It is the use of plants for medicinal purposes, and the study of such uses.

The word "**herb**" has been derived from the Latin word, *"herba"* and an old French word *"herbe",* Nowadays, herb refers to any part of the plant like fruit, seed, stem, bark, flower, leaf, stigma or a root, as well as a non-woody plant, earlier, the term "herb" was only applied to non-woody plants, including those that come from trees and shrubs. These medicinal plants are also used as food, flavanoid, medicine or perfume and also in certain spiritual activities.

Apart from that, these plants play a critical role in the development of human cultures around the whole word. Moreover, some plants are considered as important source of nutrition and as a result of that

they are recommended for their therapeutic value. Some of these plants include ginger, green tea, walnuts, aloe pepper and turmeric etc.Apart from the medicinal uses, herbs are also used in natural dye, pest control, food, perfume, tea and so on. In many countries different kinds of medicinal plants/herbs are used to keep ants, flies, mice and flee away from homes and offices. Medicinal plants such as Aloe, Tulsi, Neem, Turmeric and Ginger cure several common ailments. These are considered as home remedies in many parts of the country. It is known fact that lots of consumers are using Basil (Tulsi) for making medicines, black tea, in puja(religious rituals) and other activities in their day to day life.

Plants due to the high content of various bioactive compounds are the main raw materialsfor production of valuable and useful bio-products (e.g.,food,cosmetics,medicine,bio stimulants, bio pesticide sand feed). Different plant parts, for instance: seeds, fruits, flower, steams, leaves and roots can be used for their manufacture. Nowadays, there is a clear need to develop new, efficient and environmentally safe methods of stimulation of plant, growth and crop protection. They possess antifungal, antimicrobial,antiparasitic, antiprotozoal,antioxidant, medicinal, aromatic and anti-inflammatory properties. The application of these bio-products could be beneficial for sustainable production, due to several advantages, such as low toxicity to humans and the environment, enhanced resistance of cultivated plants to biotic and abioticstress, increased yield and quality of crops, as well as the reduction in the use of mineral fertilizers and pesticides. However, deeper cooperation between industrial and academic research is required to accelerate the development of new environmentally safe solution for future agriculture.

Here, two plant species were taken for the experiment:

First is - Guar or cluster bean (*Cyamopsis tetragonoloba*). It is an annual legume plant in the family of Fabaceae and the source of guar gum. It is also known as gavar, gawar or guvar bean. The origin of *Cyamopsis tetragonoloba* is unknown, since it has never been found in the wild. It is assumed to have developed from African species *Cyamopsis senegalensis*. It was further domesticated in South Asia, where it has been cultivated for centuries. Guar grows well in semi arid areas, but frequent rainfall is necessary. This legume is a valuable plant in a crop rotation cycle, as it lives in symbiosis with nitrogen-fixing bacteria. Agriculturists in semi-arid regions of Rajasthan follow crop-rotation and use guar to replenish the soil with essential fertilizers and nitrogen fixation, before the next crop. Guar has many functions for human and animal nutrition, but the gelling agent in its seeds (guar gum) is its most important use. Demand is rising due to the use of guar gum in hydraulic fracturing (oil shale gas). It is also a major ingredient of the toy slime. About 80% of world production occurs in India, but due to strong demand, the plant is being introduced elsewhere.

Second is - Fenugreek (*Trigonella foenum-graecum*). It is an annual plant in the family Fabaceae, with leaves consisting of three small obovate to oblong leaflets. It is cultivated worldwide as a semiarid crop. Its seeds and leaves are common ingredients in dishes from the Indian subcontinent, and have been used as a culinary ingredient since ancient times. Its use as a food ingredient in small quantities is safe.Commonly used in traditional medicine, fenugreek can increase the risk of serious adverse effects, including allergic reactions. India is a major producer of fenugreek, and over 80% of India's output is from Rajasthan.

STUDY AREA:

Chikhli is a Town in Chikhli Taluka in Navsari District of Gujarat State, India. It is located 30 Km towards South from District head quarters, Navsari. It is a Taluka head quarter. Chikhli Taluka Pin code is 396521 and postal head office is Chikhli (Navsari).Thala (2 KM) Malwada (2 KM) , Majigam (3 KM) , Samaroli (3 KM) , Talavchora (3KM) are the nearby Villages to Chikhli Taluka. Chikhli Taluka is surrounded by Gandevi Taluka towards West,

Valsad Taluka towards South, Navsari Taluka towards North,Mahuva Taluka towards North Valsad.Navsari, Dharampur, India, Pardi are the nearby cities to Chikhli Taluka. It is near to Arabian Sea. There is a chance of humidity in the weather.

GPS Coordinates:

- **Locality :** Vankal
- **Latitude :**20.7513507˚N
- **Longitude :**73.0060065˚E

Fig.1. Map of study area

Climate:

Chikhli Taluka has a Sub- humid climate with little to no rainfall from October to May and extremely heavy rainfall from June to September. The rainfall is much heavier than nearby Valsad due to the orographic lift of the Western Ghats.

Flora of Chikhli:

A total of 72 species were recorded which were represented by 40 families and 67 genera. Out of 72 species, 36 tree species, 34 herb and 2 orchids. The maximum IVI recorded for *Tectona grandis (76.385)* and followed by *Adina cordifolia (21.978), Terminalia tomentosa (19.682), Syzygium cumini (14.929) and Oroxylum indicum (13.293),* respectively. Among the herbs species, the highest Shannon - Wiener index recorded for *Commelina benghalensis, Curculi goorchioides, Phaseoluss pecies, Sonchus oleraceus (0.162)* and followed by *Blainvillea acmella, Blumea wightii, Canscor adiffusa, Curcuma odorata, Desmodium gangeticum, Hibiscus lobatus and Tridax procumbens (0.124)*, respectively.

II. METHODS AND MATERIAL

COW URINE AND MEDICINAL PLANTS COLLECTION:

- Collection of fresh cow urine (gomutra) early in the morning from village Vankal followed by its filtration.
- Collection of medical plants from the same village.
- After that, collection of 50 grams Tulsi(*Ocimum sanctum*), 50 grams Neem(*Azadirachta indica*), 50 grams Adhatoda(*Adhatoda vasica*), 50 grams Negundo(*Vitex negundo*) and 50 grams of Rosary pea(*Abrus precatorious*).The leaves of all the plants were thoroughly checked if they are suffering from any disease and they are healthy.
- The leaves were subjected to running tap water to make sure there was no impurity left on the

surface.After that, the leaves were dried and then made into small pieces.

- After that the measured leaves of the plants were kept in a air tight container containing 1 litre of cow urine. This solution was stirred with a stick on daily basis clockwise and anticlockwise.
- After 10 to 15 days, the solution was filtered. The filtered solution is known as a stock solution.

By using distilled water, solution of different concentration was prepared from stock solution.

Fig.2. Collection of Cow urine

Fig. 3. Collection of Medicinal plant

Fig.4. Leaves are soaked in cow urine for 10-15 days and then the solution was filtered.

PREPARATION OF DIFFERENT CONCENTRATION SOLUTION FROM STOCK SOLUTION:

Various concentration solution were prepared i.e 1:9, 2:8, 3:7, 4:6, 5:5

1) 1: 9 > 10 ml stock solution in 90 ml distilled water
2) 2:8 > 20 ml stock solution in 80 ml distilled water
3) 3:7 > 30 ml stock solution in 70 ml distilled water
4) 4:6 > 40 ml stock solution in 60 ml distilled water
5) 5:5 > 50 ml stock solution in 50 ml distilled water

Fig.5 Solutions of different concentrations

SEED COLLECTION:

2 type of seeds were collected

1) *Cyamopsis tetragonoloba*- Cluster bean (Guwar Neelam- 51)
2) *Trigonella foenum graecum*- Fenugreek

Fig. 6. Seeds of Cluster bean Fig.6.Seeds of Fenugreek

Table.1. SEED PARAMETERS

No.	Plant species	Seed length	Seed width	Seed colour	Seed coat
1	Cluster bean(*Cyamopsis tetragonoloba*)	0.5 cm	0.4 cm	Brownish black	Hard
2	Fenugreek(*Trigonella foenum graecum*)	0.4cm	0.3 cm	Yellowish brown	Hard

PREPARATION OF SOIL:

Collection of the soil from Vankal village followed by its sieving.

- After sieving, the soil was mixed with cocopeat, vermicompost and sand in a proportion of 5:3:1:1(50%soil, 30%cocopeat, 10%vermicompost and 10%sand)
- After that the mixed soil is filled in different pots(The pots selected should have drainage holes)

SEEDS SOAKED IN SOLUTION OF DIFFERENT CONCENTRATION

All the seeds were dipped in the solution of different concentration following different time intervals

DIFFERENT TIME PERIODS:

1) 12 hours
2) 24 hours
3) 36 hours
4) 48 hours
5) 60 hours

Table.2. EXPERIMENTAL DESIGN AND TREATMENT COMBINATION

Five solutions with different concentration were prepared and then seeds were dipped in it. The treated and non treated seeds were then compared.

	Different time period				
Different concentrations of the solution	12 hours	24 hours	36 hours	48 hours	60 hours
	1:9	1:9	1:9	1:9	1:9
	2:8	2:8	2:8	2:8	2:8
	3:7	3:7	3:7	3:7	3:7
	4:6	4:6	4:6	4:6	4:6
	5:5	5:5	5:5	5:5	5:5
	Control	Control	Control	Control	Control

Control ↑ non treated seeds

SOWING OF SEEDS:

The non treated seeds were sowed and after that the treated seeds were dipped in solution having different concentration followed by sowing them in pots.

- Here, 10 seeds were sowed in each pot
- The experiment was under observation for 15 days
- Experiment of 1:9 - 5:5 treatment were done under normal temperature (19° to 34° Celsius)
- Ph value of the soil is 6.82

Fig.7. Sowing of seed

STATISTICAL METHOD:

Statistical methods that are using in the experiments are as follows:

- Germination percentage (GP)=$\frac{Number\ of\ seeds\ germinated}{total\ number\ of\ seeds\ sown} \times 100$

Germination percentage is an estimate of the viability of a population of seeds.

- Mean Germination Time (MGT) =$\frac{\sum(n \times d)}{N}$

Here; n = number of seeds germinated on each day

d = number of days from the beginning of the test

N = total number of seeds germinated at the end of the experiment

- Germination Rate Index (GRI)

$$= \frac{\frac{Number\ of\ germinated\ seed}{(first\ count)}}{Day\ of\ first\ count} + \text{------} + \frac{\frac{Number\ of\ germinated\ seeds}{(final\ count)}}{Day\ of\ final\ count}$$

III. ESULTS AND DISCUSSION

RESULTS AND DISCUSSION

The germination behaviour was recorded by daily counting of germinated from the date of seed sown to end of seed germination. Seed germination and seedling growth was observed up to 15 days after sowing. Germination percentage, germination rate index and mean germination time (MGT) were calculated and shoot length was also measured on daily basis. From all these results, the speed of germination and growth of seedlings can be compared in each treatment.As a result, the suitable treatment can be derived for each plant species.

DATA OBSERVED IN CLUSTER BEAN:

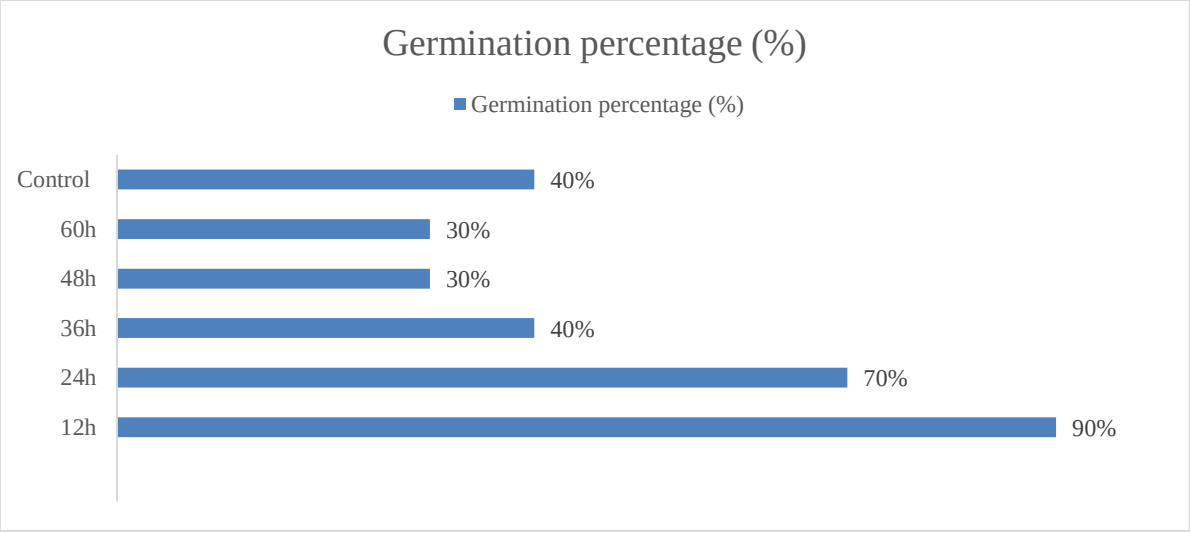
1) 1:9 Concentration solution with different time period

Table-3. Seed germination counting on each day.

Time	Number of seeds germination on each day (days)															Total number of seeds germinated at the end of the experiment(out of 10)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
12h	-	-	-	-	1	5	3	-	-	-	-	-	-	-	-	9
24h	-	-	-	-	3	1	3	-	-	-	-	-	-	-	-	7
36h	-	-	-	-	3	1	-	-	-	-	-	-	-	-	-	4
48h	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
60h	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	3
Control	-	-	-	-	1	-	3	-	-	-	-	-	-	-	-	4

Table-4. Germination parameter

Time	Germination Percentage(%)	MGT (day)	Germination rate index(GRI)	Seedling height(After germination)	Seedling height(at the end of experiment)
12h	90%	4.55	1.45	1.3 – 1.5 cm	6 – 8.5 cm
24h	70%	6	1.18	1.2 - 1.3 cm	8 – 9.5 cm
36h	40%	5.25	0.76	1 – 2 cm	4.5 – 5.2 cm
48h	30%	6	0.5	1 – 1.5 cm	6.2 – 7.5 cm
60h	30%	6.66	0.44	1 – 1.3 cm	5.5 – 8 cm
Control	40%	6.5	0.62	1 – 1.6 cm	6.9 – 10 cm



Graph-1. Comparison effects of various time period on Germination Percentage in 1:9 concentration solution

Fig.8. Seed germination and shoot development

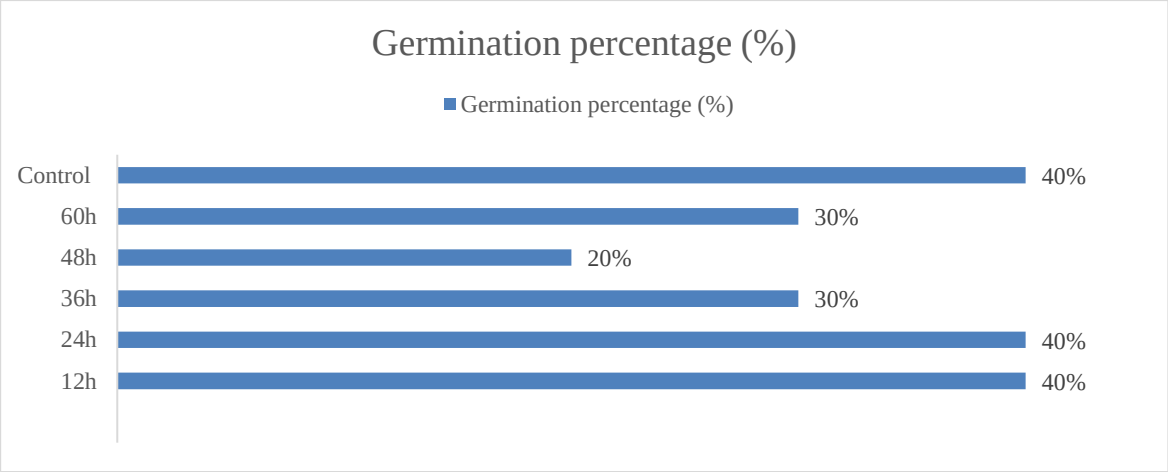
2) 2:8 Concentration solution with different time period

Table-5. Seed germination counting on each day.

Time	Number of seeds germination on each day (days)															Total number of seeds germinated at the end of the experiment(out of 10)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
12h	-	-	-	-	1	2	1	-	-	-	-	-	-	-	-	4
24h	-	-	-	-	1	2	1	-	-	-	-	-	-	-	-	4
36h	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	3
48h	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2
60h	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	3
Control	-	-	-	-	1	-	3	-	-	-	-	-	-	-	-	4

Table-6. Germination parameter

Time	Germination Percentage(%)	MGT (day)	Germination rate index(GRI)	Seedling height(After germination)	Seedling height(at the end of experiment)
12h	40%	6	0.67	1 – 1.3 cm	5.7 – 7 cm
24h	40%	6	0.67	1 – 1.3 cm	3 – 7.5 cm
36h	30%	5.66	0.54	1 – 1.1 cm	1.5 – 8 cm
48h	20%	7	0.28	1 – 1.2 cm	1 – 1.7 cm
60	30%	5.66	0.53	1 – 1.2 cm	2.5 – 9.3 cm
Control	40%	6.5	0.62	1 – 1.6 cm	6.9 – 10 cm



Graph-2 Comparison effects of various time period on Germination Percentage in 2:8 concentration solution

Fig. 9. Seed germination an shoot development

3) 3:7 Concentration solution with different time period

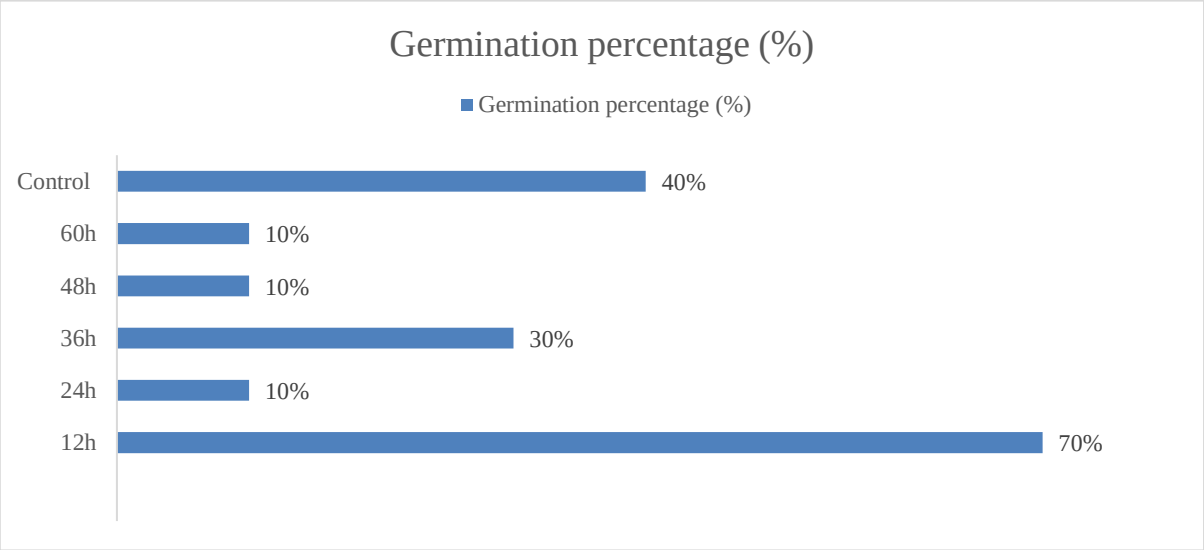
Table-7 Seed germination counting on each day.

Time	Number of seeds germination on each day (days)															Total number of seeds germinated at the end of the experiment(out of 10)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
12h	-	-	-	-	3	-	4	-	-	-	-	-	-	-	-	7
24h	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
36h	-	-	-	-	1	1	-	-	-	1	-	-	-	-	-	3
48h	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1

60h	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Control	-	-	-	-	1	-	3	-	-	-	-	-	-	-	-	4

Table-8. Germination parameter

Time	Germination Percentage(%)	MGT (day)	Germination rate index(GRI)	Seedling height(After germination)	Seedling height(at the end of experiment)
12h	70%	6.14	1.17	1 – 1.3 cm	5.5 – 8.6 cm
24h	10%	6	0.16	1.3 cm	10.5 cm
36h	30%	7	0.46	1 – 1.9 cm	5.2 – 5.9 cm
48h	10%	6	0.16	1.5 cm	8.5 cm
60	10%	6	0.16	1.4 cm	8.3 cm
Control	40%	6.5	0.62	1 – 1.6 cm	6.9 – 10 cm



Graph-3. Comparison effects of various time period on Germination Percentage in 3:7 concentration solution

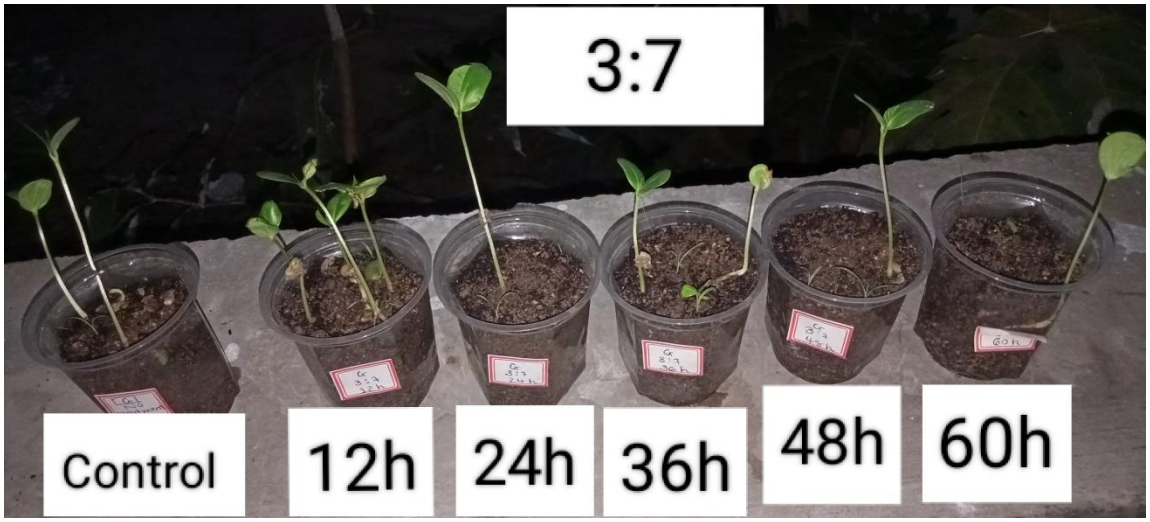


Fig.10. Seed Germination and Shoot development

4) 4:6 Concentration solution with different time period

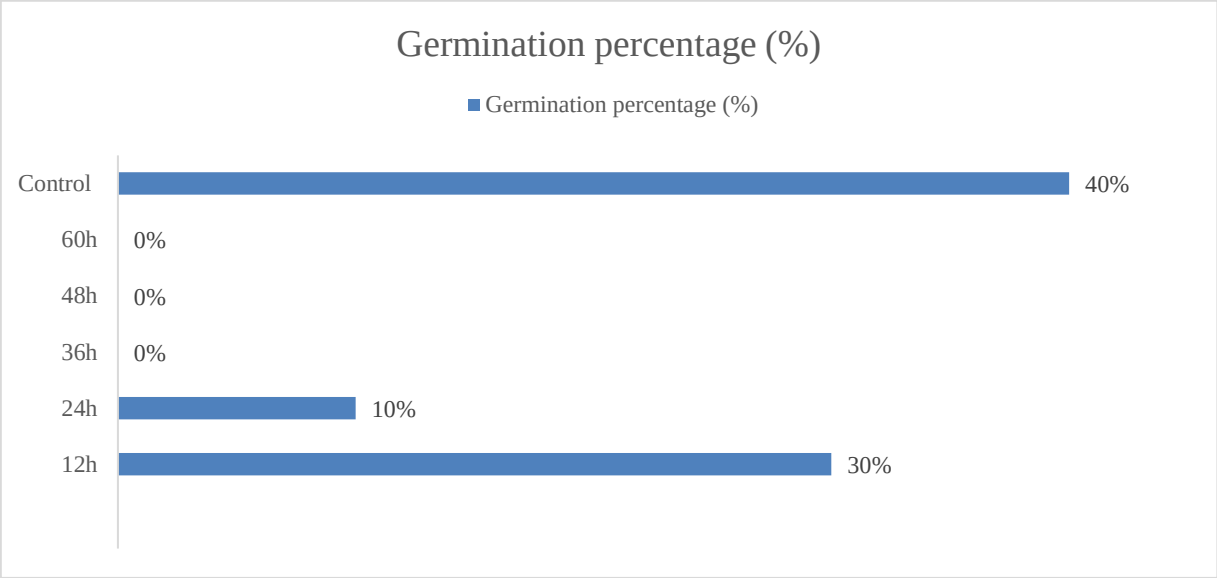
Table-9.Seed germination counting on each day.

Time	Number of seeds germination on each day (days)															Total number of seeds germinated at the end of the experiment(out of 10)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
12h	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	3
24h	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
36h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Control	-	-	-	-	1	-	3	-	-	-	-	-	-	-	-	4

Table-10. Germination parameter

Time	Germination Percentage(%)	MGT (day)	Germination rate index(GRI)	Seedling height(After germination)	Seedling height(at the end of experimet)
12h	30%	5	0.6	1.2 – 1.3 cm	8.7 – 9 cm

24h	10%	6	0.16	1 cm	1 cm
36h	-	-	-	-	–
48h	-	-	-	-	-
60	-	-	-	-	-
Control	40%	6.5	0.62	1 – 1.6 cm	6.9 – 10 cm



Graph-4. Comparison effects of various time period Germination Percentage in 4:6 concentration solution

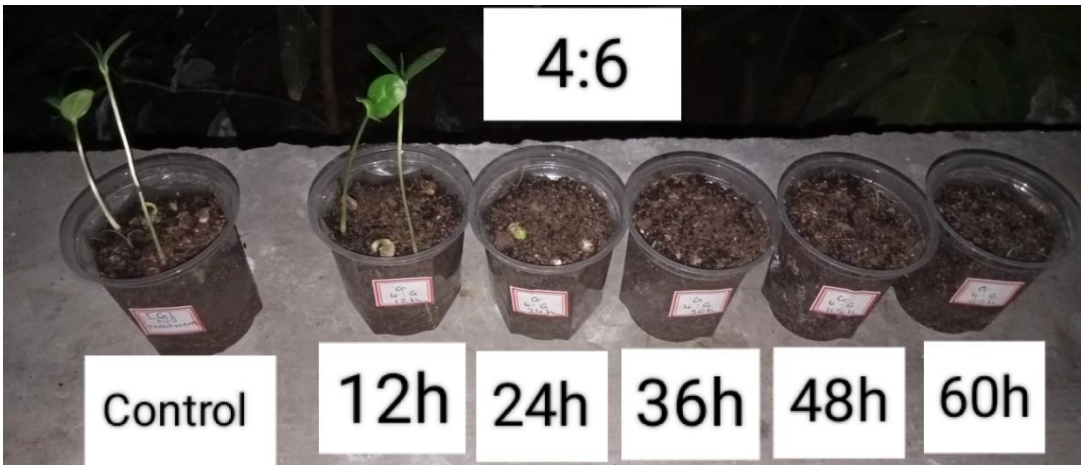


Fig.11. Seed Germination and Shoot development

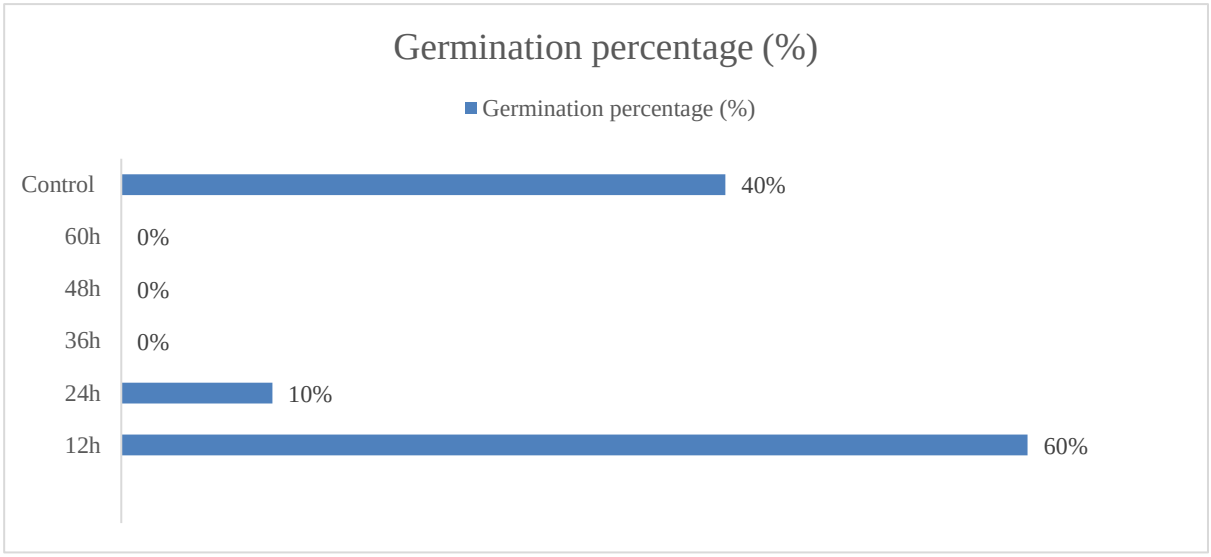
5) 5:5 Concentration solution with different time period

Table-11. Seed germination counting on each day.

Time	Number of seeds germination on each day (days)															Total number of seeds germinated at the end of the experiment(out of 10)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
12h	-	-	-	-	3	1	2	-	-	-	-	1	-	-	-	6
24h	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
36h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Control	-	-	-	-	1	-	3	-	-	-	-	-	-	-	-	4

Table-12. Germination parameter

Time	Germination Percentage(%)	MGT (day)	Germination rate index(GRI)	Seedling height(After germination)	Seedling height(at the end of experiment)
12h	60%	5.83	1.04	1.2 – 1.4 cm	7 – 9 cm
24h	10%	6	0.16	1 cm	8 cm
36h	-	-	-	-	–
48h	-	-	-	-	-
60	-	-	-	-	-
Control	40%	6.5	0.62	1 – 1.6 cm	6.9 – 10 cm



Graph-5. Comparison effects of various time period on Germination Percentage in 5:5 concentration solution

Fig.12. Seed germination and Shoot development

DATA OBSERVED IN FENUGREEK

1) 1:9 Concentration solutions with different time period

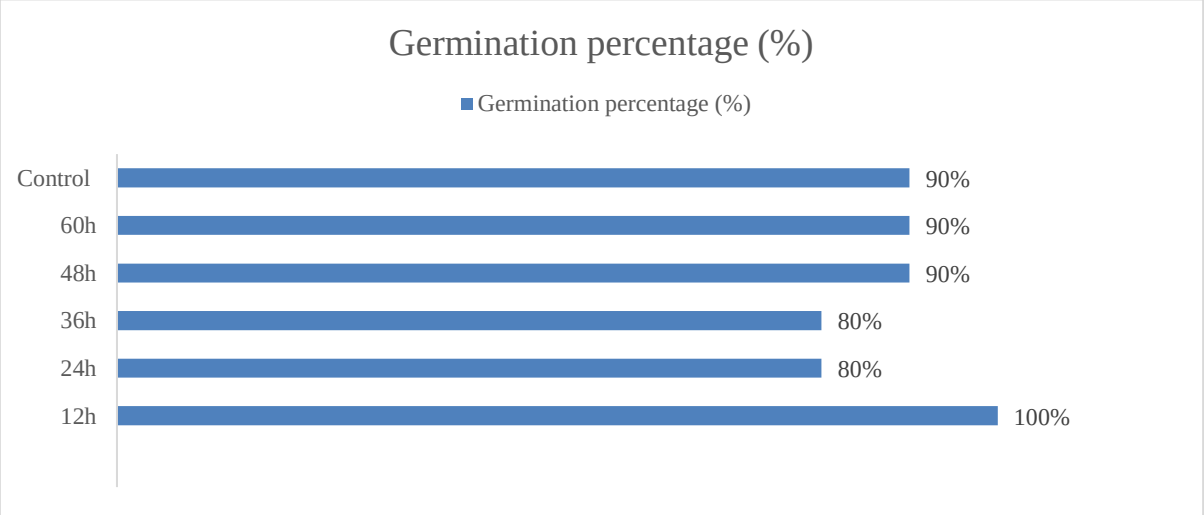
Table-13.Seed germination counting on each day.

Time	Number of seeds germination on each day (days)															Total number of seeds germinated at the end of the experiment(out of 10)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
12h	-	-	9	-	-	1	-	-	-	-	-	-	-	-	-	10

24h	-	-	2	1	2	2	1	-	-	-	-	-	-	-	-	8
36h	-	-	6	1	1	-	-	-	-	-	-	-	-	-	-	8
48h	-	-	4	2	2	1	-	-	-	-	-	-	-	-	-	9
60h	-	-	-	1	8	-	-	-	-	-	-	-	-	-	-	9
Control	-	-	7	1	-	1	-	-	-	-	-	-	-	-	-	9

Table-14. Germination parameter

Time	Germination Percentage(%)	MGT (day)	Germination rate index(GRI)	Seedling height(After germination)	Seedling height(at the end of experiment)
12h	100%	3.3	3.16	1.3-1.5 cm	9.7-10.1 cm
24h	80%	4.87	1.78	1-1.3 cm	4.2-6.5 cm
36h	80%	3.37	2.45	1.2-1.5 cm	7.5-10.6 cm
48h	90%	4	2.39	1.2-1.3 cm	5.5-6.5 cm
60	90%	5.66	1.99	1-1.3 cm	6.3-7.5 cm
Control	90%	3.44	2.74	1-1.4 cm	8.8-10.1cm



Graph-6 Comparison effects of various time period on Germination Percentage in 1:9 concentration solution.

Fig.13. Seed Germination and Shoot Development

2) 2:8 Concentration solutions with different time period

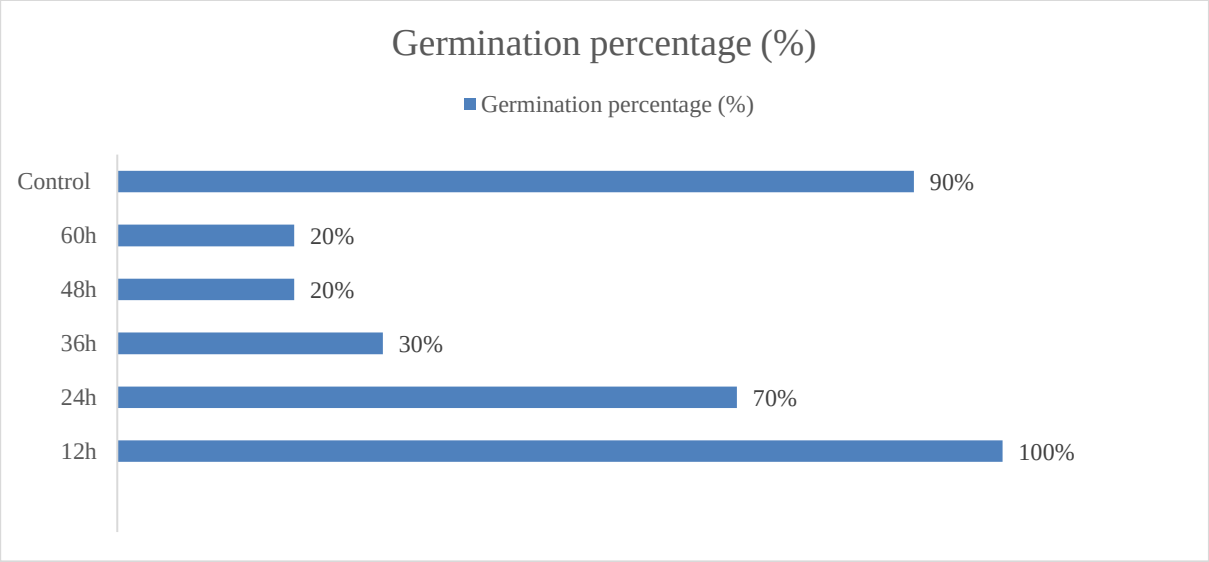
Table-15. Seed germination counting on each day.

Time	Number of seeds germination on each day (days)															Total number of seeds germinated at the end of the experiment(out of 10)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
12h	-	-	8	-	-	1	1	-	-	-	-	-	-	-	-	10
24h	-	-	1	2	1	1	2	-	-	-	-	-	-	-	-	7
36h	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
48h	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	2
60h	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	2
Control	-	-	7	1	-	1	-	-	-	-	-	-	-	-	-	9

Table-16. Germination parameter

Time	Germination Percentage(%)	MGT (day)	Germination rate index(GRI)	Seedling height(After germination)	Seedling height(at the end of experiment)
12h	100%	3.7	0.96	1 - 1.2 cm	7.1 – 8.5 cm
24h	70%	5.14	1.47	1 - 1.2 cm	3.2 – 3.7 cm

36h	30%	6	0.5	1 – 1.1 cm	1 – 1.1 cm
48h	20%	7	0.291	1 – 1.2 cm	1 – 1.2 cm
60	20%	7.5	0.267	1 – 1.1 cm	1 – 2.2 cm
Control	90%	3.44	2.74	1 – 1.4 cm	8.8 – 10.1cm



Graph-7 Comparison effects of various time period on Germination Percentage in 2:8 concentration solution

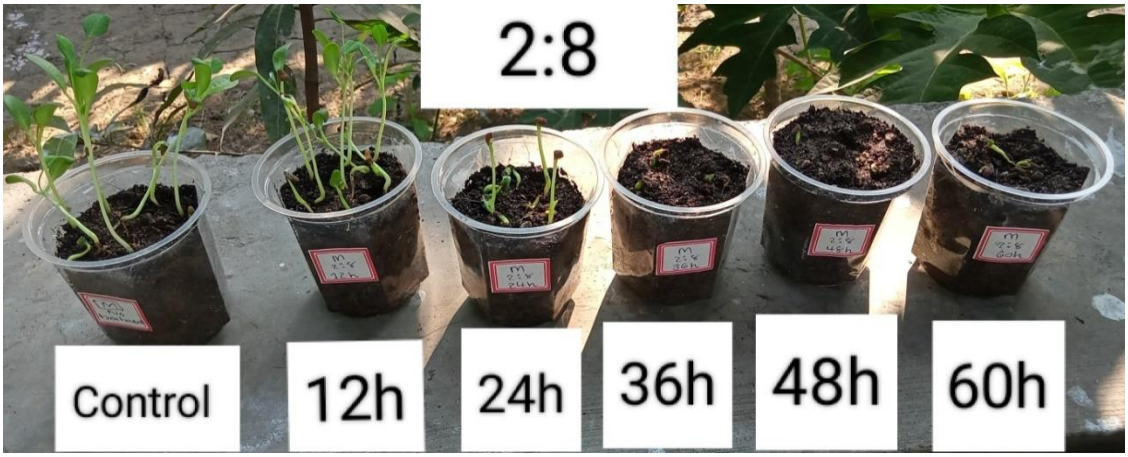


Fig.14. Seed germination and shoot development

3) 3:7 Concentration solution with different time period

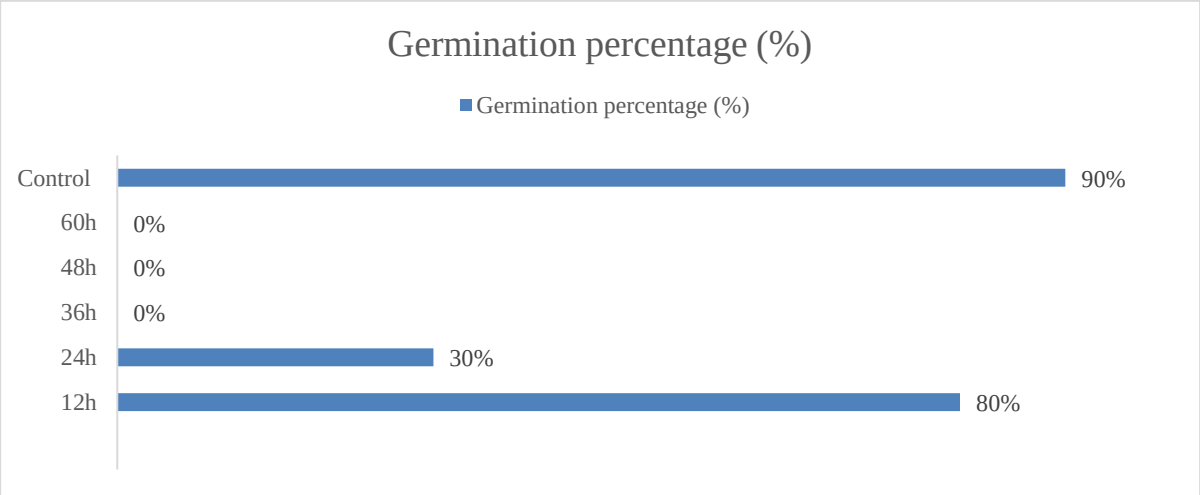
Table-17. Seed germination counting on each day.

Time	Number of seeds germination on each day (days)														Total number of seeds germinated at the end of the experiment(out of 10)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

12h	-	-	6	-	1	1	-	-	-	-	-	-	-	-	-	8
24h	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
36h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Control	-	-	7	1	-	1	-	-	-	-	-	-	-	-	-	9

Table-18. Germination parameter

Time	**Germination Percentage(%)**	**MGT (day)**	**Germination rate index(GRI)**	**Seedling height(After germination)**	**Seedling height(at the end of experimet)**
12h	80%	3.625	2.36	0.9 - 1 cm	7.5 – 8.5 cm
24h	30%	6	0.5	1 - 1.3 cm	1 – 4.7 cm
36h	-	-	-	-	–
48h	-	-	-	-	-
60h	-	-	-	-	-
Control	90%	3.44	2.74	1 – 1.4 cm	8.8 – 10.1cm



Graph-8 Comparison effects of various time period on Germination Percentage in 3:7 concentration solution.

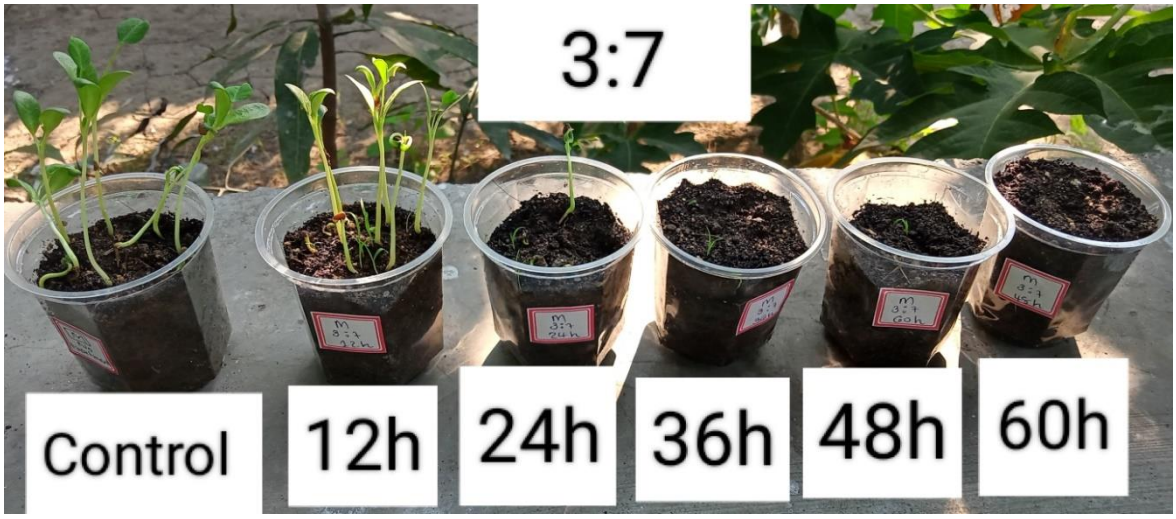


Fig.15. Seed Germination and Shoot development

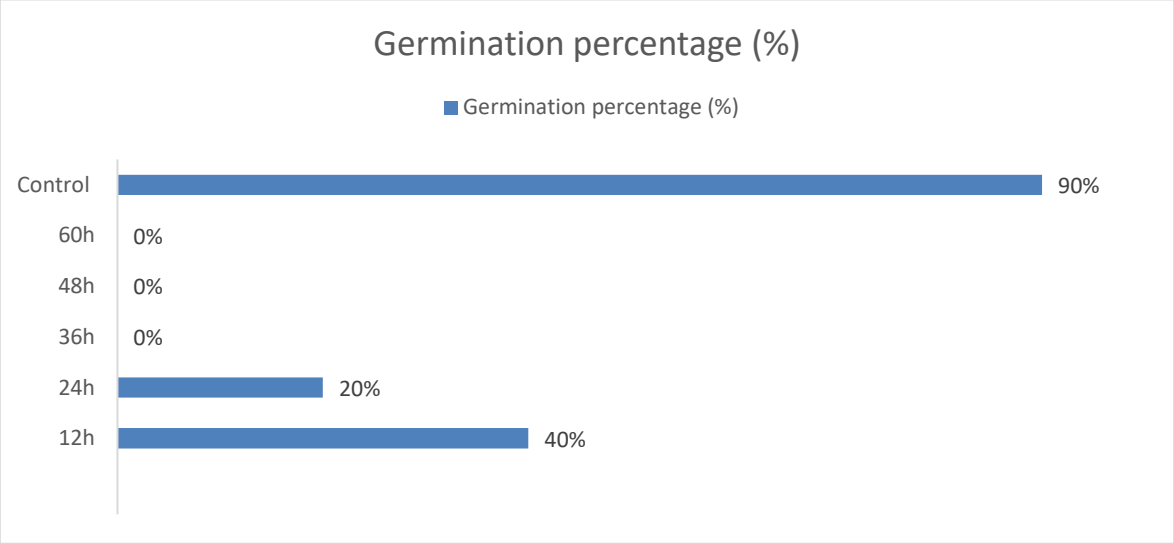
4) 4:6 Concentration solution with different time period

Table-19. Seed germination counting on each day.

Time	Number of seeds germination on each day (days)															Total number of seeds germinated at the end of the experiment(out of 10)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
12h	-	-	2	-	-	1	1	-	-	-	-	-	-	-	-	4
24h	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	2
36h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Control	-	-	7	1	-	1	-	-	-	-	-	-	-	-	-	9

Table-20. Germination parameter

Time	Germination Percentage(%)	MGT (day)	Germination rate index(GRI)	Seedling height(After germination)	Seedling height(at the end of experiment)
12h	40%	4.75	0.99	1 – 1.1 cm	2.6 – 5.1 cm
24h	20%	5.5	0.36	0.9 – 1 cm	1 – 1.1 cm
36h	-	-	-	-	-
48h	-	-	-	-	-
60	-	-	-	-	-
Control	90%	3.44	2.74	1 – 1.4	8.8 – 10.1cm



Graph-9 Comparison effects of various time period on Germination Percentage in 4:6 concentration solution

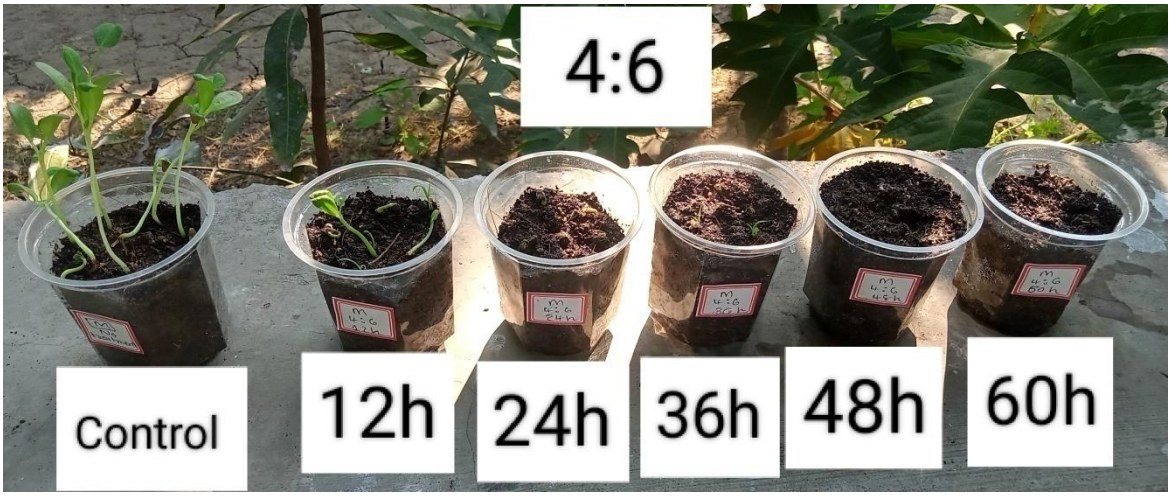


Fig.16. Seed germination and shoot development

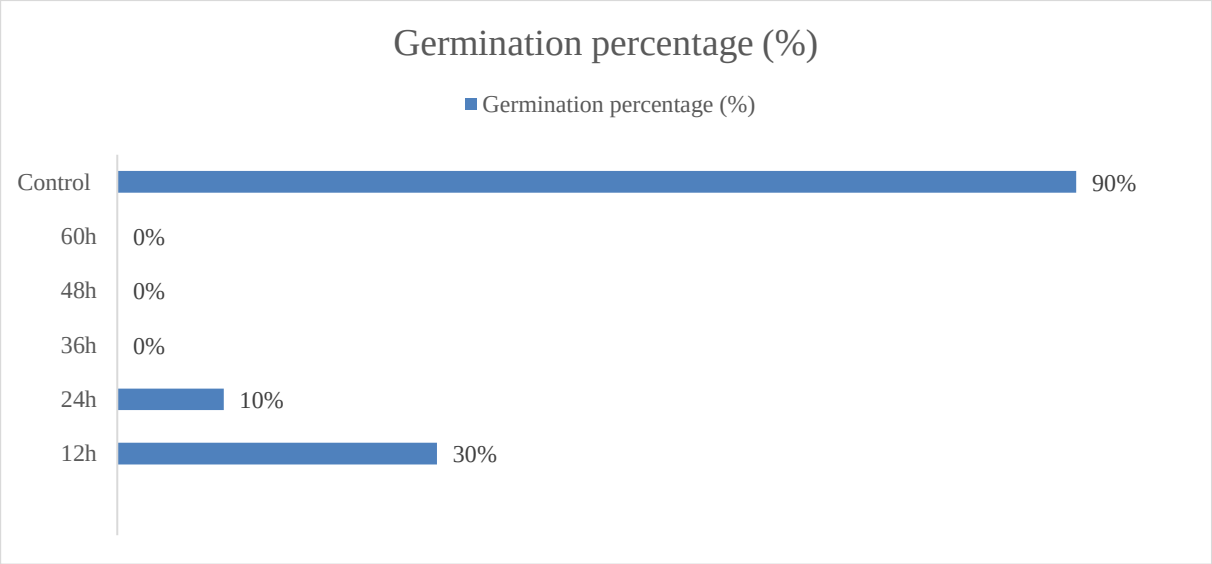
5) 5:5 Concentration solution with different time period

Table-21 Seed germination counting on each day.

Time	Number of seeds germination on each day (days)															Total number of seeds germinated at the end of the experiment(out of 10)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
12h	-	-	1	1	-	1	-	-	-	-	-	-	-	-	-	3
24h	-	-	-	-	1		-	-	-	-	-	-	-	-	-	1
36h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Control	-	-	7	1	-	1	-	-	-	-	-	-	-	-	-	9

Table-22. Germination parameter

Time	Germination Percentage(%)	MGT (day)	Germination rate index(GRI)	Seedling height(After germination)	Seedling height(at the end of experiment)
12h	30%	4.33	0.74	0.9 – 1 cm	5.5 – 7.2 cm
24h	10%	5	0.2	1 cm	2.2 cm
36h	-	-	-	-	–
48h	-	-	-	-	-
60	-	-	-	-	-
Control	90%	3.44	2.74	1 – 1.4 cm	8.8 – 10.1cm



Graph-10 Comparison effects of various time period on Germination Percentage in 5:5 concentration solution

Fig.17. Seed germination and shoot development

IV. CONCLUSION

Pre-sowing treatment may be useful for producing maximum number of quality seedling. The seeds of Cluster bean and Fenugreek that were taken for the experiment, responded differently to all the dormancy breaking seed treatment.

Table 23. More effective treatment for each plant species

No.	Plant Species	More effective Seed Treatment	Germination Percentage(%) in Control(Seed without treatment)	Germination Percentage(%) in more effective Treatment
1.	Cluster bean(Cyamopsis tetragonoloba)	1:9(12 h)	40%	90%
2.	Fenugreek(Trigonella foenum graecum)	1:9(12 h), 2:8(12 h)	90% 90%	100% 100%

Table 24. Comparison of Mean Germination Time(MGT) in Control with other treatment.

No.	Plant species	More effective Seed Treatment	MGT in Control	MGT in more effective Treatment
1.	Cluster bean(Cyamopsis tetragonoloba)	1:9(12h)	6.5	4.55
2.	Fenugreek(Trigonella foenum graecum)	1:9(12h), 2:8(12h)	3.44 3.44	3.3 3.7

According to the Table 23.and Table 24. In Cluster bean(*Cyamopsis tetragonoloba*), The Germination Percentage and germination speed are increased by 1:9 concentration solution and 12 hour soaking seed treatment. In Fenugreek(*Trigonella foenum graecum*), the germination percentage and germination speed are increased by 1:9 & 2:8 concentration solutions and 12 hour soaking seed treatment.

At the end of the experiment, according to the result suitable, pre-sowing seed treatment has found for both plant species that break the dormancy of seed, increased seed germination and produced healthy seedling. The comparison between seeds without any kind of treatment and seed with particular treatment shows that the seeds which provided treatments germinated faster than in control condition. Hence, we can increase plant population by growing plants seeds by giving certain types of seed treatments.

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