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A study on two different kinds of seeds germination under various natural conditions

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Abstract

Seeds are the embryonic form of plants kept inside a protective shell called seed coat. The seeds develop into a new plant under suitable conditions and the processes called germination. The seeds of different plants species has specific environment and requirements for germination. The seeds are variously influenced by different environmental factors Such as light, moisture, pH, salinity or salt stress and seed burial depth. The present study was conducted to determine the effects of temperature, light and salt stress, on seed germination of two plants which are naturally propagated through seeds namely, *Vigna radiata and Vigna mungo*. Along with this an attempt has also been done to compare the relation between seed size and germination. Biochemical characteristics were also done. A better understanding of germination of these four seeds could facilitate development of effective control options. The information would also be helpful in predicting its potential for spreading into new areas.

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Introduction

The seeds of different plants species has specific environment and requirements for germination. The seeds are variously influenced by different environmental factors Such as light, moisture, pH, salinity or salt stress and seed burial depth. Temperature and light are considered the most important environmental signals regulating germination, species distribution and ecological interaction (Mayer and Poljakoff-Mayber, 1989; Bewley and Black, 1994; Baskin and Baskin, 1998). Some seeds germinate similarly in light and darkness, while others do it more readily either under light (Colbach *et al.*, 2002) or dark conditions. The maximum temperature for most species is between 30°C and 40°C. Salinity imposes serious environmental problems that affect grassland cover and the availability of animal feed in arid and semiarid regions (El-kharbotly *et al.*, 2003).

Seed size directly influences the germination time (Murali, 1997), germination percentage and seedling vigour (Yanlong *et al.*, 2007), which can indirectly determine plant distribution and abundance across different habitats (Silveira *et al.*, 2012). Biochemical change is a necessity foe the process of seed germination. Greater amount of stored reserves allow a higher probability of seedling establishment at sites with lower resource availability (Geritz, 1995).

Similar work was carried out by Shereen *et al.* (2011) rice experiments to study the effects of salinity on seed germination of six rice varieties differing in salt tolerance by treating them with 0, 50, 75, 100, 200 mM NaCl solutions. Jamil *et al.* (2012) investigated the effects of salinity on seed germination of three different rice genotypes and found that the rice cultivars differed in their germination response to salt stress. Increase in salinity from 0 to 150 mM adversely affected the seed germination percentage and significantly delayed seed germination. Bybordi (2010) reported that with the increasing salt concentration the rate of seed germination decreases in *Brassica napus*.

Seeds and the way of germination is an excellent analogy for plant life on earth. Planting seeds is a noble work, because we dig, lay in the seeds, watering, fertilize and expect to harvest for our future generation is known as sustainable development. Plantation not only business, hobby etc., it's a kind of encouragement for our future generation.

Materials and methods

Plant materials

The plant materials selected for the present study are *Vigna radiata and Vigna mungo.*

Vigna radiata (L.) R. Wilczek (green gram): Mungbean (*Vigna radiata* (L.)) is one of the most important legumes in the tropics and subtropics. It is alternatively known as the moong bean/ green gram and is a plant species in the legume family. The mung bean plant is an annual, erect or semi-erect; reaching a height of 0.15-1.25 m. The stems are many-branched, sometimes twining at the tips. The leaves are alternate, trifoliolate with elliptical to ovate leaflets, 5-18 cm long × 3-15 cm broad.

Vigna mungo (L.) Hepper (black gram): *Vigna mungo*, is also known as Urid or Black gram is a bean grown in the Indian subcontinent. It is an erect, fast-growing annual, herbaceous legume reaching 30-100 cm in height. It has a well-developed taproot and its stems are diffusely branched from the base. Occasionally it has a twining habit and it is generally pubescent. The leaves are trifoliate with ovate leaflets, 4-10 cm long and 2-7 cm wide.

Methods

The present investigation on seed germination of two different seeds was conducted under laboratory conditions during 2023-2024. High quality seeds of *Vigna radiate and Vigna mungo,* were collected at maturity from Kerala Agro Industries Corporation Limited, Trivandrum. The seeds were cleaned and stored in paper bags at room temperature until used in the experiments.

The experiment was conducted under laboratory conditions at room temperature. The seeds were treated with different environmental factors with control. The experiment was carried out in triplicate. The seeds were kept for germination in petri dishes. Each Petri dish was lined with sterilized cotton and five seeds of *Vigna radiata* and *Vigna mungo*. The petri dishes were covered with transparent sheets in order to prevent water loss. The seeds were kept under observation for a period of 4 days.

Percentage of germination

Percentage of germination was calculated on the basis of number of seedlings emerged out of total number of seeds kept for germination. The germination % was calculated using the following formula:

Germination (%) = $No.of\ Germinated\ seeds\ x$ 100/$Total\ number\ of\ seeds\ sown$

Effect of temperature

In order to test the effect of temperature on seed germination three conditions has been created including high, normal and low temperature. Five seeds of *Vigna radiata* and *Vigna mungo*.

Effect of salinity

Salinity levels were selected for the present investigation due to increasing salt concentration in our soils. For analysing salt stress on germinating seeds three conditions were considered -high salt concentration, medium concentration and no salt at all. Sodium chloride solutions of 1 and 0.1 M were prepared and for no salt stress distilled water was used. The saline solutions were made by dissolving 5.8g NaCl in distilled water in 100 ml flask and 0.58g in 100 ml distilled water. This gave 1M and 0.1 M NaCl solution respectively. After that Sodium chloride (NaCl) solution of known concentration was applied in Petri dishes for salt stress.

Effect of light

Four different light conditions were considered for the present study, *ie.*, high light intensity, artificial light, day light and dark. Here also five seeds of *Vigna radiata* and *Vigna mung*.

Biochemical study

1. Estimation of Total Carbohydrate – Anthrone method(Yemm and Wills, 1954)
2. Estimation of Protein – Lowry's method (Lowry *et al.*, 1951)
3. Estimation of Phenol - Mallick and Singh, 1980.

Results and discussion

The relationship between environmental factors, seed size and germination of seeds was evaluated under lab conditions. The performance of two different seeds of high quality characters stored under ten different conditions formed the basis for a discussion of germination percentage and radical length. Some seedlings died even after emergence which may be due to physiological disorder, fungal infection and insect attack which usually prevail during sowing season.

Germination percentage

For calculating the germination percentage, data were collected on the 1^{st} and 2^{nd} day. Emergence of radicle was taken as criteria for germination. As a whole the large seeds showed increased percentage of germination on the 1st day itself while small seeds showed delayed germination.

Effect of light

Germination was higher in light exposure treatments than in total darkness. While the percentage of germination were 100%, 93%, 83% in light exposure treatments of high light and artificial light respectively, and that of seeds germinated in total darkness were 100%, 87% and 80%. Shade light also showed these percentages of germination. Thus, a minimal exposure to light is required to stimulate germination of all selected seeds (Table 1).

Table 1. Showing the seed germination percentage of the light treated seeds

Seed type	Light			
	Dark	Shade	artificial	High
V. radiata	100	100	100	100
V. mungo	100	100	100	100

Effect of temperature

Temperature significantly affected the germination %, time to start germination. The data presented in (Table 2) showed that the effect of temperature on germination percentage was significant. Large seeds showed 100% germination in high and normal room temperature, but small seeds showed variation in germination. Both small and large seeds show no germination at very low temperature. Germination was inhibited by decreased temperature.

Table 2. Showing the seed germination percentage of the temperature treated seeds

Seed type	Temperature		
	Normal	High	Low
V. radiata	100	100	0
V. mungo	100	100	0

Effects of salinity

Salinity significantly affected the germination traits (Table 3). Increase in salinity showed zero germination percentage. At highest NaCl concentration (1 M) no seeds showed germination.

Table 3. Showing the seed germination percentage of the salt treated seeds

Seed type	Salinity		
	Medium	High	Low
V. radiata	87	0	93
V. mungo	93	0	100

However, germination of *V.mungo* was 93% at 0.1 M NaCl solution and that of *V.radiata* was 87%. When V.*mungo* showed 100% germination, *V.radiata* gave 93%.These results showed that germination percentage of the selected seeds decreased as concentration of NaCl solution increased. The data presented in Table 3 show that maximum germination percentage (100%) of *V.mungo* was found where distilled water was applied.

Biochemical studies

Biochemical studies included estimation of proteins, carbohydrates and phenol in the seeds of selected plants. It was observed that the protein, carbohydrate and phenol content were almost same for the large seeds and that of small seeds. The protein content was higher for all the seeds (Table 4).

Table 4. Showing the biochemical parameters

Plant material	Carbohydrate (mg/g)	Protein (mg/g)	Phenol (mg/g)
Vigna radiata	14.55	33.20	.0003
Vigna mungo	12.74	32.30	.0005

In the present study, an experiment was designed to assess the effect of three types of environmental factors on seed germination of four selected seeds and also on its radicle and plumule growth. There were ten treatments in this experiment. Data on different germination parameters were recorded after germination at one day interval until no further germination occurred. The seeds were inspected every day and were considered to be germinated when the radicle penetrated the seed coat and attained about 1mm in length. Radicle and plumule length (in cm), were measured on the 4th day. From this study it could be understand that stressful conditions, i.e., extremely saline, light and low temperature can limit germination of seeds. After germination, seedlings originated from larger seeds retained its cotyledons for longer time. Large seeds have higher amount of reserves in its cotyledons and need longer time to incorporate these nutrients in seedling tissues. Thus, seedlings originated from larger seeds have both more time for development and nutrients available for growth. Thus, the result observed in this study agrees with the general prediction that larger seeds produce seedlings with larger initial size as reported by other authors (Yanlong *et al.*, 2007). In this scenario it would be reasonable to think that larger seeds/seedlings have higher competitive ability relative to small seeds. However, several other forces act synergistically to shape seed size. For example, nutritionally stressed habitat acts in favour of larger seeds/seedlings because larger seedlings (originated from larger seeds) have more nutritional reserves (Mendes *et al.*, 2011). It could also be pointed out that high variability in seed size also affects its geographic distribution (Souza and Fagundes, 2014). Biochemical studies revealed that the four seeds were rich in proteins and carbohydrates, but showed variation in phenol content. Phenol content was more in small seeds and inhibition of germination by the phenolic compounds may be due to the role of this compound in the seed which affected the physiological process such as water uptake and synthesis of amylase enzyme (Politycka, 2002).

Conclusion

This present study suggests that the cultivation of the selected seeds in saline areas affects its germination and development. The seeds of *Vigna radiata and Vigna mungo* are rich in proteins, as well as carbohydrates which play a key role in the growth of embryonic axis. The future perspective of this work is to know the role different enzymes involved in germination of these and its related seeds and the purification of enzymes by different methods.

Recommendations

This study will be helpful in predicting suitable environment for germination of these seeds and then it would be quite easier to cultivate it and spreading it into new areas.

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