P.K.M. COLLEGE OF EDUCATION

MADAMPAM

PROJECT

ON

"GERMINATION STAGES OF DIFFERENT SEEDS IN SOIL"

SUBMITTED BY

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2021-2023 BATCH

31/3/22

CERTIFICATE

This is to certify that the project entitled **"*Germination stages of different seeds in soil*"** is a bonafide work carried out by the Natural Science Optional students (2021-2023) of PKM college of Education, Madampam under my supervision and guidance.

Vismaya C

Optional teacher

Madampam

27/03/2022

DECLARATION

This is to declare that the subject matter of this report entitled "**Germination stages of different seeds in Soil**" is the outcome of the project work carried out by us under the guidance and supervision of Mrs.Vismaya C, optional teacher Natural Science, PKM college of Education, Madampam.

Natural Science Optional Students (2021-2023)

ACKNOWLEDGEMENT

We take the opportunity to express our sincere gratitude to Dr. Jessy NC and Mrs. Vismaya C for rendering valuable support for the completion of this project. We also take this opportunity to thank our parents, Friends, Non-teaching staff, Well-wishers and above all, the Almighty for their support and wishes, which was most needed during this project.

Natural Science Optional Students (2021-2023)

CONTENT

INTRODUCTION

Seed germination is a crucial process in the seed plant life cycle and the basis for crop production. It is the stage when the plant enters natural or agricultural ecosystems. The germination of freshly produced seeds are inhibited by dormancy, which helps the seeds to adjust with unfavourable conditions. The process of seed germination includes imbibition, respiration, activity of light, mobilisation of reserves during seed germination, activity of growth regulators and development of the embryo axis into a seedling. Seed germination is a checkpoint to avoid unsuitable weather and unfavourable environments during plant establishment.

The seed germination of different species was influenced by soil water status and the species response to it. Some showed germination responses that correlated with their native soil water conditions (Evans and Etherington, 1990). The balance between dormancy and germination is regulated by a wide range of endogenous and environmental factors, including light, temperature, soil moisture, bacteria and phytohormones such as ABA (abscisic acid) and GA (gibberellic acid) (Shu et al., 2015). Seed germination is a crucial process that influences crop yield and quality. Therefore, understanding the molecular aspects of seed dormancy and germination is of a great significance for the improvement of the same. Seed germination determines plant availability necessary for human survival with regards to the supply of medicinal plants, feed for animal grazing, and food security. The propagation of some plants is only possible by seed, and if they are difficult to germinate which in return threatens their continuous existence. Some seeds remain in the soil until favourable weather conditions stimulate germination, other seeds do not germinate because of physical seed dormancy or poor seedling vigour.

REVIEW OF LITERATURE

The term seed germination indicates the processes that lead to the initiation of growth in seeds (Koller et al.,2014). Growth is an irreversible process of increase in cell size as well as number of cells (Koller et al.,2014,). In dry seeds, the metabolic activity for the enzymes and production of energy is almost absent or inactive (Koller et al.,2014). For germination, various factors of this metabolic process must be activated or synthesised (Koller et al.,2014). The respiratory process of dry seeds is very low or cannot be detected. Water plays an important role in germination for hydrolysis, as a medium, diffusion, hydration of enzymes, shape of cell membranes and organelles and driving force for cell expansion.

High soil moisture was found to decrease the rate of seed germination (Mendel et al., 1971). Decrease in seed germination was not found at equivalent osmotic potentials. Decrease in germination was found by thickening of the water films around the seeds, which interfered with oxygen diffusion (Mendel et al., 1971). The seeds have an ability to germinate fast at low water potentials (Bochet et al., 2007). Soil water availability after rainfalls during the germination period plays a major role in the germination of seeds (Bochet et al., 2007). Soil water potential is one of the main factors in addition to temperature that influences seed germination (Bochet et al., 2007)

Soil water potential is an important factor that influences seed germination (Eevans and Etherington, 1999). In a collection of 15 species of British plants, each showed different responses according to the potential level of soil and water. High potential is preferred by wetland plants and some need dry (1.0-1.5 MPa) conditions. While dry conditions are unfavourable for some other species. So, the process of germination is sensitive to the soil-water potential.

Moumita et al., (2019) conducted a study to determine effects of water quality on seed germination and seedling growth of ***Cicer arietinum*** and ***Brassica juncea*** under laboratory conditions at Haldia, West Bengal. They used water samples from four different water bodies including one control. They fixed the treatment period as fifteen days for both plant seed and seedling; and this was carried for 3 times in a year with each type of water. The germination and growth were observed for 2 weeks and mean readings were taken in the result. Shoot length, Root length, Number of root hairs, Root hair length and some biochemical assessment

such as total carbohydrate, reducing sugar, total non- reducing sugar, protein content and total DNA were determined. Through their study they concluded that seed germination and growth of seedlings were highly sensitive to quality of water and the polluted water exerted a kind of stress level to their growth.

Barbara *et al.*, (2014) conducted a study on the effect of soil type on pyrethrum seed germination. Pyrethrum or *Tanacetum cinerariifolium (Trevor)Sch.Bip* is a worldwide grown autochthonous insecticidal plant, mostly seen widespread in Africa and Australia. The present study was conducted using the pyrethrum of Dalmatia(Croatia), inside a greenhouse to determine the effect of soil type on its germination. According to their study the highest percentage of germination was found on white clay loam, soil type 2. Lowest percentage of seed germination was found on red clay or Terra Rossa soil, Type 1&6. They found seed germination was greatly influenced by soil texture, Foremost soil percentage and soil pH among which positive correlation was confirmed among germination percentage, silt content and soil pH. The present study suggested that pyrethrum seed germination is best on slightly alkaline clayey loam of moderate nutrients.

Indian mustard (*Brassica juncea*) is cultivated for its seeds, the source of commercial table-mustard. Seeds contain essential oil, used as a condiment, lubricant, and soap constituent. It is an upright plant, with large stalked leaves. They are covered with hairs or bristles at the base, but on the stem smoother. It can reach up to 1.2 tall in moist fertile soil. It blooms in summer. The flowers have four yellow petals, which are twice as long as the sepals. Each stem has around four flowers at the top, forming a ring around the stem. Later, the plant forms long seed pods that contain four rounded seeds. *Brassica juncea* plays an important role in global agriculture, horticulture, health and wellness aspects due to its culinary and medicinal values (De Zoysa et al,2021).

Keyong-Ho Lee, Chang-Hankim(2005) conducted a study on seeds of *Benincasa hispida*. *B. hispida* are defined as the Seed and nutshells of *Benincasa hispida Cogniaux*, which belongs to the family of Cucurbitaceae. It was used mainly in diabetes and diuresis diseases. This study was carried out to evaluate the anti-angiogenic effect of the Seed extract of *Benincasa hispida* Cogniaux. They found that the Seed extract of *Benincasa hispida* Cogniaux decreased bFGF-Induced endothelial cell proliferation and tube formation in a dose dependent manner. The Seed extract of *Benincasa hispida* Cogniaux showed a potent

inhibitory effect on bFGF-Induced angiogenesis in vivo. These results suggest that the Seed extract of *Benincasa hispida* Cogniaux inhibits the proliferation of endothelial cells induced by bFGF, which may explain its anti-angiogenic properties.

Proper seed germination is carried out in an ideal soil temperature and moisture (Wagenvoort, 1981). It aims to find out the optimum level of moisture and temperature for a favourable germination. According to the texture of soil, the soil moisture tension curve had been constructed which provides an idea about suitable water level required for the process. Imbibition of the seed is shown by a high curve and moist level between 0.5-2.0 can be affected by seed rotting.

An ideal soil temperature and soil moisture conditions are essential for the favourable germination of any seed. A greenhouse study was undertaken by Griffith A.B and Forseth I.N (2003) USA, to test the effect of water level on seed germination and seedling establishment. They cultivated seeds in three water levels.

1) Submerged - Soil surface 12 cm below the water level.

2) Waterlogged - Water level 3 cm below the soil surface.

3) Wet – Water level 15 cm below the soil surface.

They found that wet soil germination rate (83%) will be much higher than the waterlogged (56%) and submerged (44%) treatments. The wet treatment group had greater seedling establishment (94%) than the waterlogged treatment (84%).

Cucumber seed germination: Most germination methods for cucumbers will show root growth and even sprouts in as little as one to three days. Cucumbers are very sensitive to cold. They need warm soil and air, whether direct-seeded or transplanted. Seed will not germinate if soil temperature is below 50 F, and germinates only slowly at 68 F (Nowicki et al., 2013). Paul and Mikal, 1994, studied the temperature effect on imbibition and germination of cucumber seeds. According to them the chilling tolerance gradually lost during the initial stages of germination following imbibition.

Maize (*Zea mays*), an annual grass growing up to 4 m tall, is an important crop in the world; it is widely used for feed and as industrial raw material (Yu Tian et.al., 2014). Corn kernels or seeds vary in size and shape in different kinds and varieties. They may be only an eighth inch long and near round in popcorn to a half inch long and flattened cylindrical shape in some other kinds (Kumar, 2009). Maize has very specific water and climatic condition requirements to thrive. Most importantly for the plants to germinate it needs a suitable temperature ranging from 15 to 20 degree Celsius. The rapid and synchronous germination rate as well as good field establishment will be characteristic of vigorous seeds (Zakeyeldinn et.al., 2018).

Pisum sativum has Anticancer activity. *P. sativum,* known as green pea or garden pea, is important in diet due to its content of fibre, protein, starch, trace elements, and many phytochemical substances. It has been shown to possess antibacterial, antidiabetic, antifungal, anti- inflammatory, anti-hypercholesterolemia, and antioxidant activities and also shown anticancer properties. Its non-nutritive biologically active components include alkaloids, flavonoids, glycosides, phenols, phytic acid, saponins and tannins. This plant is rich in apigenin, hydroxybenzoic, hydroxycinnamic, luteolin, and quercetin, all of which have been reported to contribute to its remedial properties including anticarcinogenic property (Rungruangmaitree et al., 2017).

Green gram (*Vigna radiata* (L.) Wilczek) is an economically important pulse crop, it is also known as mung bean, golden gram or moong (Deshmukh et al., 2016). Green gram is considered to be native of India and widely cultivated in Central Asia. The seed contains several macro and micro nutrients such as protein, oil, fibre, ash and carbohydrates etc., (Deshmukh et al., 2016). Seed treatment with biocontrol agents along with priming agents and seed pre-treatment may serve as an important means of managing many of the soil and seed-borne diseases, the process often known as bio priming (Taylor and Harman, 1990). These methods are an effective technique to improve seed germination performance, seedling growth and seed yield (Tian et al., 2014).

Temperature and Salinity has great importance on seed germination and seedling emergence of *Trichosanthes cucumerina* (Sittampalam et al., 2015). Percentage of germination, germination index, mean time to germination and the length of germ tube these

are the parameters used to understand the germination rate of Snake Gourd. The proper seed germination and growth takes place only when it gets suitable temperature and salinity. Germination takes place within 6-7 days if there is optimum temperature and salinity available. The optimum germination characteristics were observed at 35°C temperature and 50mM Nacl concentration and moderate moisture condition.

Light and soil have greater importance on the quality of cultivated plants (Lau et al., 2019). So far, very few studies have been done on red amaranth microgreen. Even though it can grow in different soil conditions, neutral pH with loose soil is the best. Yield has increased while it grows in black soil. Sunlight is essential for all steps of development. Germination takes only 5-8 days if good light sources are available. Artificial light also can be used instead of sunlight to induce germination and promote growth. The usage of compost improves the growth rate very much. Antioxidants and mineral Content in *Amaranthus cruentus* microgreen also had been analysed. Stem length, root length, fresh weight and dry weight of microgreen are different according to different soil and light conditions.

MATERIALS AND METHODS

1. SELECTION OF SEEDS

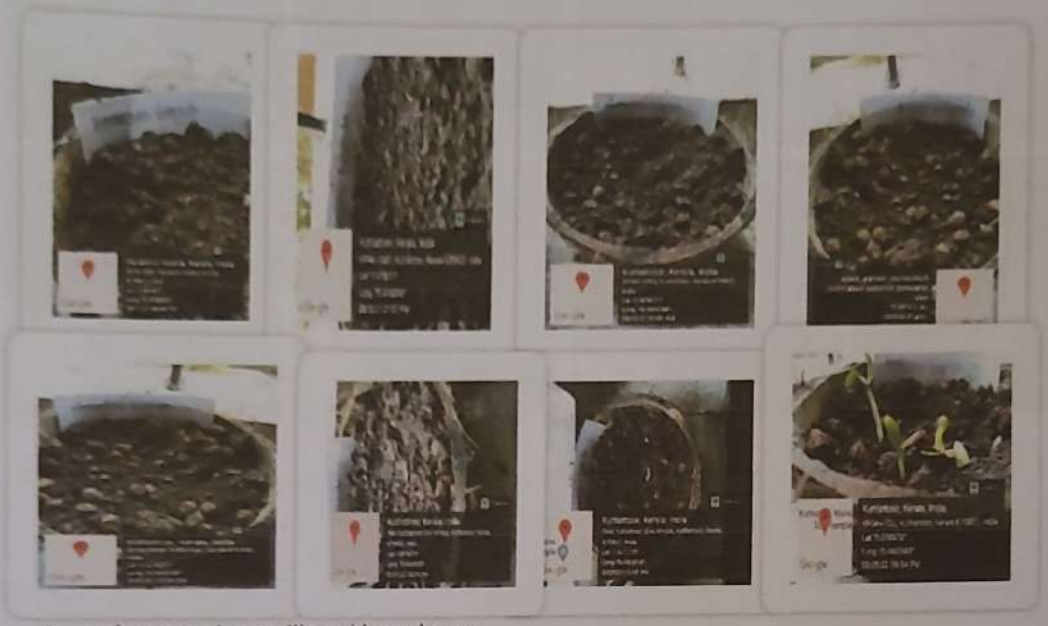
First step is election of mature and healthy seeds of eight species of six families. Selected seeds are, *Tagetes erecta* (Asteraceae), *Amaranthus cruentus* (Amaranthaceae), *Zea mays* (Poaceae), *Benincasa hispida* and *Cucumis sativus* (Cucurbitaceae), *Brassica juncea* (Brassicaceae) *Vigna radiata* and *Vigna unguiculata* (Fabaceae).

2.OBSERVATION OF GERMINATION STAGES OF EACH SEED IN SOIL

Mature and healthy seeds of each species were collected and placed on soil. It was watered slightly and kept for incubation at room temperature. Germination was monitored for one to two weeks. The different stages of germination of each seed was noted down and their photographs were also taken using mobile camera.

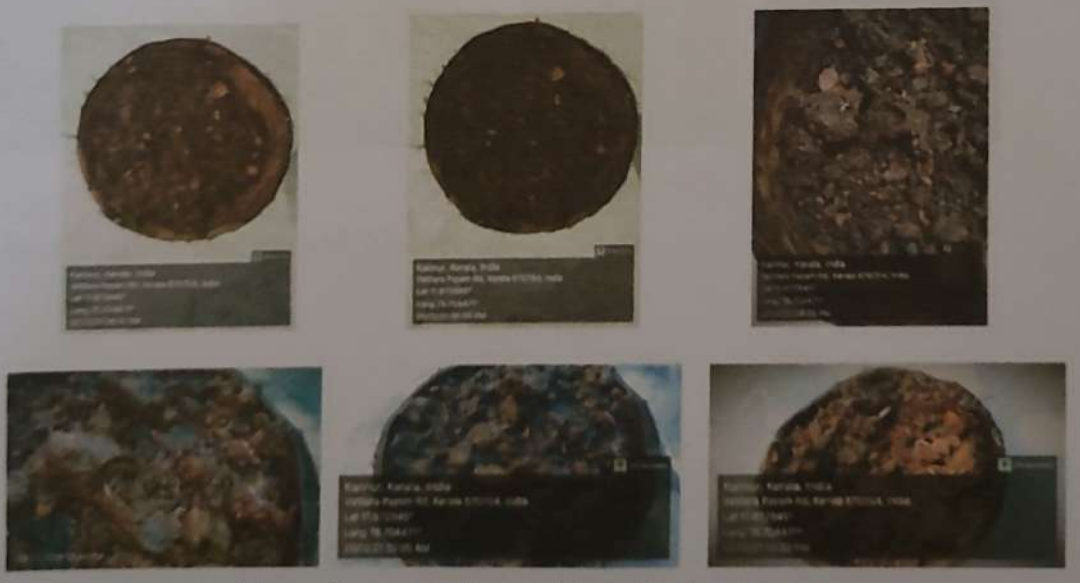
OBSERVATION

1.*Benincasa hispida* seed germination stages



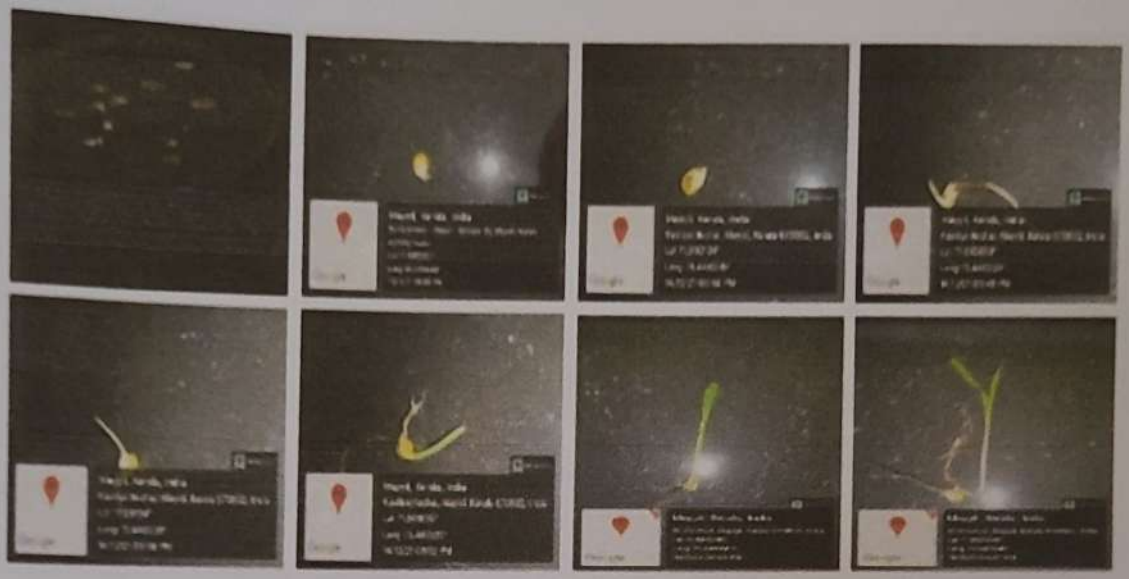
Stages from a Seed to seedling with two leaves

2. *Amaranthus cruentus* Seed Germination stages



Stages from a seed to seedling with two leaves.

3.*Zea mays* Seed germination stages

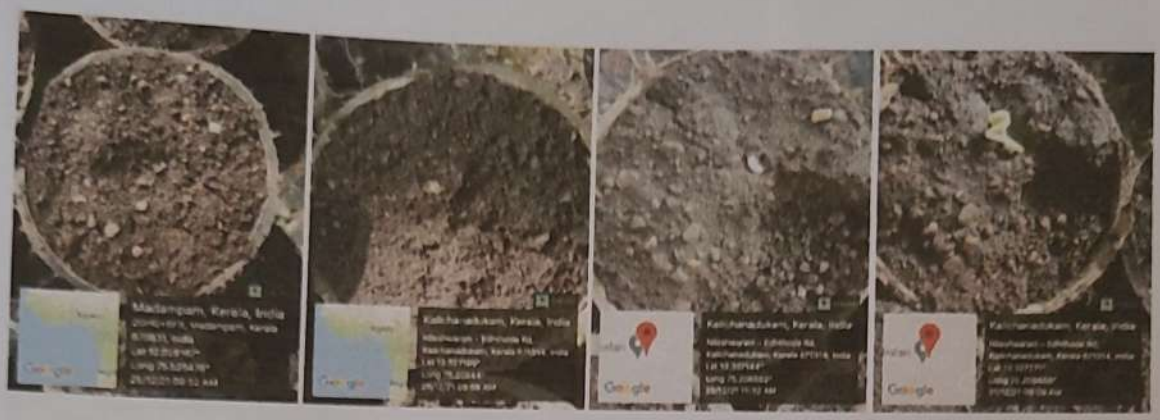


Stages from a seed to a seedling with two leaves

4.*Brassica nigra* seed germination stages

Stages from a seed to seedling with 2 leaves

5. *Vigna radiata* seed germination stages

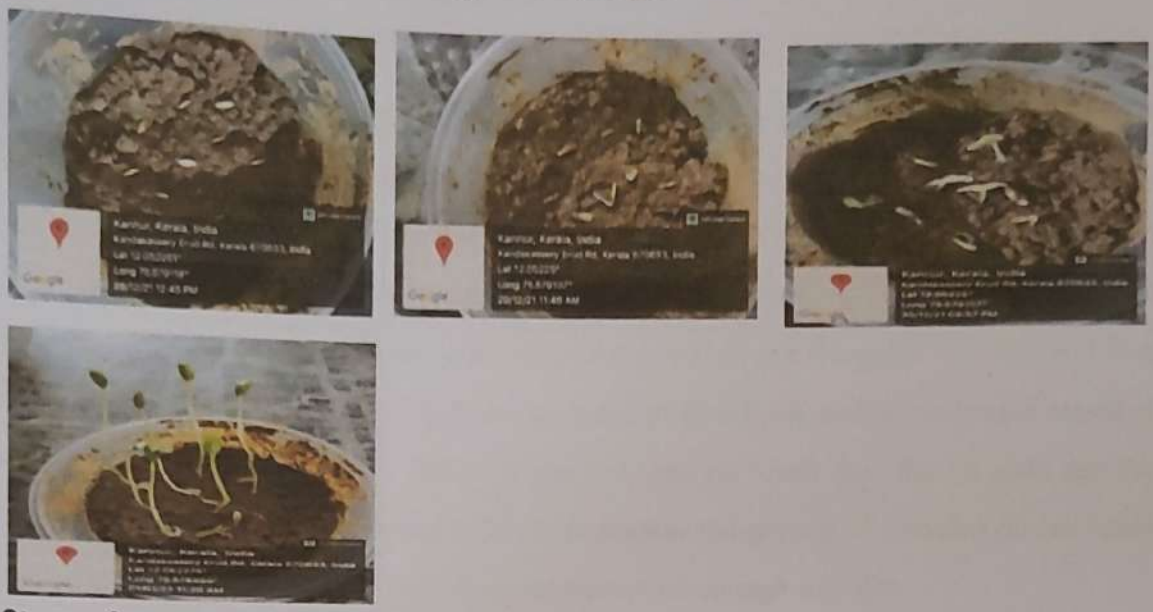


Stages from a seed to a seedling.

6. *Pisum sativum* seed germination

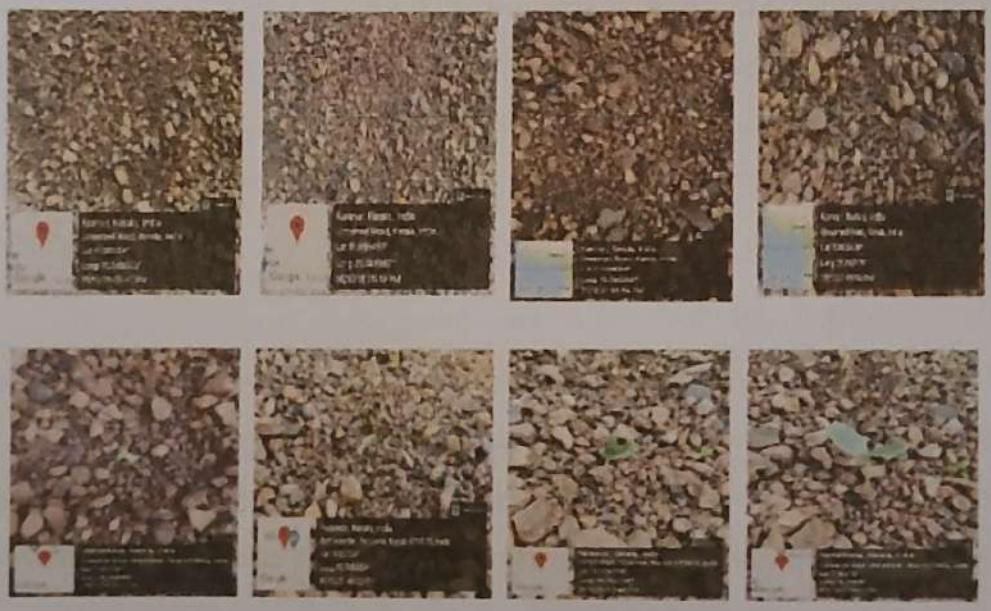
Stages from a seed to a seedling with two leaves

7. *Cucumis sativus* seed germination



Stages from a seed to seedling with 2 leaves.

8. Snake gourd seed germination stages



Stages from a seed to seedling with 2 leaves.

RESULT AND DISCUSSION

In case of *Brassica juncea* seeds, the seeds in soil have shown fast germination as well as fast growth. It was said that seeds germinating in water have some kind of inhibition by surrounding water layers. In case of *Brassica juncea* seeds its germination in soil took within two days. The short radicle was emerged out of seeds on second day. On third day a visible yellowish plumule came out braking the seed coat.The stem got elongated very fast and four leaves came similar to a flower. The roots anchored on fourth day and the yellowish colour of leaves changed to green colour. the stem was not erect on fourth day. But on sixth day the stem got elongated and became erect. The germination and growth of *Brassica juncea* seeds were fast in soil. The plant was kept in a cool place with enough sunlight.

The germination of *Amaranthus cruentus* in soil took 3-5 days. The radicle emerged from hypocotyl on the second day after sowing the seeds. The plumule had begun to appear on the next day. The further growth stages of seedling were very fast. Radicle developed into highly branched root system. At that time plumule gave rise to two red leaves with elongated stalk on the fifth day of observation. This cotyledon of Amaranthus considered as the first leaves of seedling. Within one week the germination stages of seedling completed. For fast growth rate, Amaranthus need a temperature ranging from 20-30 degree Celsius (Steckel et al.,2009) which indicates a warm condition is more preferable for Amaranthus seed germination and also soil should be with enough moisture content to sprout the seeds very fast.

The germination of snake gourd seed on soil took only 7-8 days. A short radicle appeared on the fourth day and a whitish green plumule appeared on the next day. The radicle expanded into a primary root on the sixth day. The further growth stages of the seedling were very fast. The radicle developed into a highly branched root system and the plumule gave rise to an elongated greenish upper body with two leaves on the smooth stalk in just two more days. Temperature and salinity have a great role on seed germination and seedling emergence of snake gourd. The optimum germination characteristics for *Trichosanthes cucumerina* were observed at 35°C temperature, 50Mm Nacl concentration and moderate moisture condition (Thananthika sittampalam *et al.*, November 2015).

In the case of *Zea mays* seed, its germination on soil took only 6-7 days. On the second day, a short radicle emerged out. On fourth day, a visible greenish plumule with coleoptile came out breaking the upper portion of seed. On fifth day, the radicle elongated into primary root and plumule grown further leaving the coleoptile covering behind. Then, the further growth stages were totally fast that within 2 more days the root system, with branches spread firmly into deep soil and the plumule gave rise to an elongated greenish upper body with 2 leaves on a smooth stalk. Frequently, low temperatures and dry surface soil have been found to adversely affect corn germination and consequently plant density (Schneider and Gupta, 1985).

Seeds of *Benincasa hispida* took 10-12 days for germination in soil. After 7 days, a short radicle emerged from the seed. On the tenth day, a visible greenish plumule came out by breaking the seed coat. Then the radicle elongated into primary root and plumule grown further into an elongated upper body with two small green leaves on smooth stalk.

The seeds of cucumber in soil germinated within a period of 3-4 days. Within that short period of time all the seeds of the cucumber developed into seedlings with leaves and an established root system. Species that originated in the tropics or subtropics are especially sensitive to chilling (physiological injury caused by exposure to non-freezing temperatures below ≈ 10°C) that often occurs under early season temperature conditions. (Bennett *et al;* 1992). All tissues in a cucumber plant and fruit are chilling sensitive. (Cabrera *et al.,* 1992; Saltveit, 1994).

Within three days of planting the green gram in the soil, it was observed to germinate. The germination process was completed within four days. One week after germination two leaves appeared. Oghbaei and Prakash, 2017, reported that germination of *Vigna radiata* was carried at room temperature and under normal light. In the case of soak seeds, leaching of nutrients and bioactive components occurs. The degree of leaching may be affected by factors such as the water-to-grain ratio, the temperature of the soak water, and the soaking time (Oghbaei and Prakash, 2017)

In the case of *Pisum sativum*, germination on soil took place within 3 to 4 days. In this period it grew into seedlings with 2 leaves. On the second day, the seeds sprouted with a small radicle followed by a small plumule on upper part on very next day. Within 2 more days a

seedling with two greenish leaves developed. There are several factors necessary for the germination of garden pea. They are considered to be a cool weather crop, as they germinate best at temperatures that range from 45 to 65 degrees F. (Lovejoy, 2021).

The formation of green gram sprouts is a straightforward procedure that does not require sunshine or soil. There are no restrictions on when it can be used. The germination process takes only 4 to 8 days to complete. Green gram seeds germinate in 2 to 3 days with 1 to 2 cm tall shoots after sawing. In 4 to 5 days of sawing, sprouts reach a length of around 5 cm or more. After 6 to 8 days of sawing, the sprouts had grown to a length of around 8 to 9 cm. within one week, two or more leaves are produced and the germination process is complete. After that the growth of each part take place. Well drained sandy to loam soil is required for the germination of green gram. And also, sufficient moisture is essential during germination, flowering and seed filling stages (Kang et al., 2014)

CONCLUSION

Through our study we concluded that germination of *Amaranthus cruentus* in soil takes place within 3-5 days. In case of *Brassica juncea* seeds its germination in soil needs two days. The germination of Snake gourd seeds in soil takes only 7-8 days. In the case of *Zea mays* seed, its germination in soil takes 6-7 days and it contains coleoptile and coleorhiza for protection during germination, since it is a monocot. Seeds of *Beninca hispida* takes 10-12 days for germination. Within 3 days of planting the green gram in soil, it was observed to germinate. In the case of *Pisum sativum*, germination in soil takes place within 3-4 days. The seeds of cucumber in soil germinates within a period of 3-4 days. Even though every seed was sown in soil itself, its germination time varied because every seed is different from the other. Their suitable environment for germination, Seed coat thickness, Water absorbing capacity and many other characteristics varies. On top of that, the soil type and soil components varied here according to the difference in location from where it collected. But the seeds do follow same pattern of seed germination stages, that they established a radicle, then plumule, leaves so on, because an established root system is necessary for a seedling to anchor to soil and survive. So germination of different seeds needs different time period for germination and germination of same type seed on different locations may vary according to the provided environment and growth factors.

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