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RESEARCH ARTICLE

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COMPARATIVE STUDY OF *ABELMOSCHUS ESCULENTUS* L. AND *BRASSICA NIGRA* (L.) W.D. KOCH SEED GERMINATION UNDER VARYING P^H AND NaCl CONCENTRATIONS

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ABSTRACT

This study examined the germination behaviour of *Abelmoschus esculentus* (okra) and *Brassica nigra* (mustard) seeds under an array of environmental conditions to dispense information on basic plant growth requirements, germination capacity at different pH and salinity levels, and other associated effects on growth parameters during seedling development. Seeds were sown into Petri dishes containing various concentrations of PH and sodium chloride solutions .In the experiment, distilled water served as control. Germination percentage, root length, shoot length, whole seedling length, root/shoot ratio, shoot/root ratio, and vigour index were assessed by day 7, at 20°C. The study found that germination levels significantly influence vigour and yield performance. Salinity affects both water potential and water availability to germinating seeds. An evaluation of the germination environment revealed that okra differs from mustard in its optimal conditions for germination, with okra exhibiting greater sensitivity to environmental stressors. This research indicates how such findings can enhance our comprehension of the ecological requirements for these economically significant crops and illuminate the impact of abiotic stress factors on seed germination and initial seedling development. These two aspects play a crucial role in establishing crop stands, enhancing agricultural productivity, and building resilience in the face of shifting climate patterns.

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INTRODUCTION

Seed germination is a very complex phenomenon. Germination means the capacity of seeds to give rise to normal sprouts within a definite period, fixed for each crop under optimum conditions. Normally seeds germinate immediately after the appropriate conditions are fulfilled such are recognized to be (i) a supply of oxygen (which permits respiration of proceed), (ii) a supply of water (which will dissolve or put into suspension into the cell contents. So that chemical and specially enzymatic reaction can occur), and (iii) a suitable temperature (to allow the chemical reactions to go on at an adequate rate). When these requirements are not satisfied, seeds fails to germinate. The requirements for these conditions various according to the species and variety. The process of seed germination, under the above mentioned favourable conditions, triggers the seed to undergo a rapid expansion growth of the embryo by culminating in rupture of the covering layers and emergence of the radical. The seed must be viable (the embryo must be alive and capable of germination). Low seed germination (vigor) is a function of the age and storage conditions of the planted seed as well as the health and maturity of the plant from which the seed was harvested.

Some of the important requirements which are essential for a seed to germinate into a seedling and to a plant include water, temperature and light. Water is extremely necessary and it plays an important role in seed germination. Seeds need a moderate temperature of around 25-30ºCto germinate. Different seeds have different optimum temperatures. Light is also essential for seed germination. Many seeds refuse to germinate until sunlight falls on them. However, most seeds require some aeration so that the bests should not be kept too wet. Alkalinity impairs plant growth by restricting water supply to the roots, thus obstructing root development. It results to phosphorous and zinc deficiency and boron toxicity. Plants have less ability to extract essential nutrients from the soil when damaged by alkalinity. As a broad generalization, every seed consists of three essential parts (i) an embryo, which will in due course give rise to the new plant (2) storage tissues which contain the substance which will nourish the embryo during its development prior to and for some time after, germination, and (3) a protective covering , or seed coat which shields the embryo and endosperms and may also play an important part in controlling factors which initiate germination of the seed in particular entry of moisture and gaseous exchange. Certain qualities are necessary in the media providing moisture for seed germination.

It must be easy to handle and use, good water holding capacity, cheap, non- toxic, free from pathogens, easily sterilized and it is to be used again. Germination potential of seeds of many plants can be influenced by various environmental and the seed internal factors. Without understanding of such factors and appropriate knowledge of plant propagation techniques and their seed biology of indigenous trees, production of seedlings from seeds would be difficult. This is due to the existence of unique survival and developmental strategy of each indigenous tree species through long time of evolutionary processes. One of the major strategies in seed physiology is: some seeds of indigenous tree species undergo the period of dormancy to pass unfavorable environmental or internal situations. The germination of seeds in a particular situation and season is determined by the interaction between the dormancy releasing factors, which influence on the termination of dormancy or initiation of germination and seedling growth in many plant species. Salinity is a major abiotic stress limiting growth and productivity of plants in many areas of the world due to increasing use of poor quality of water for irrigation and soil salinization. Plant adaptation or tolerance to salinity stress involves complex physiological traits, metabolic pathways, and molecular or gene networks. A comprehensive understanding on how plants respond to salinity stress at different levels are imperative for the development of salt tolerant varieties of plants in salt affected areas. Traditional vegetables are often considered as key assets for supporting more nutrition-sensitive agriculture and building more resilient production systems under climate change as they are often better adapted to poor quality soils, have higher resistance to pests and diseases, and higher nutritional values as compared to global vegetables. However, despite the wealth of traditional knowledge existing about traditional vegetables, many remain underutilized due to lack of appropriate seed production, drying, storage, and processing technologies, as well as availability and access to quality seed. One of the factors responsible for low okra yield is poor stand establishment, resulting from poor and non-synchronous germination with commercial cultivars reaching only up to 66% initial germination in India. The successful establishment of plants largely depends on successful seed germination. The germination response of plants to environmental parameters determines the distribution of the plants in saline environments, and seed germination in a saline substrate is a legitimate criterion for selecting for tolerance in saline environments . Moreover, high levels of alkalinity can be a limiting factor for seed germination . Plants can synthesize compatible organic solutes, proline and soluble sugar in the cytoplasm to survive and maintain their growth in saline conditions. This phenomenon is known as salinity tolerance . Salinity affects seed germination and crop establishment worldwide, leading to significant reductions in yield and crop quality. While the effects of various environmental conditions during development on germination have been studied the mediating effect of parental genetics and growth conditions during seed development on seed metabolism and germination has not been entirely grasped.

***Brassica nigra* (Mustard):** Brassica nigra, or black mustard, is referred to as true mustard. It is an annual herbaceous plant belonging to the family Brassicaceae. Its leaves are petiolate, alternate, and dark green, with a hairy texture. The lower leaves are large, rough, irregularly dentate, and pinnate with terminal large and small lower lobes. The upper leaves are smooth and moderately lobed. The flowers are small, bright yellow, and cruciform with four petals; the stamens are tetradynamous, and the pistil is bicarpellate. The fruit is a quadrangular siliqua, smooth with a short, slender beak. The seeds are small, red-brown to black in colour, and minutely pitted. Mustard seeds are small round seeds of three different plants: - Black mustard, brown Indian mustard, and white mustard. Mustards have been used in traditional as a stimulant, diuretic and purgatives and treat a variety of ailments including peritonitis to treat rheumatism arthritis, chest congestions, back pains and muscular ache. Mustard in spice that contain essential oil with strong antimicrobial activity against a wide range of microbes.

***Abelmoschus esculentus* (Okra or Lady's finger):** *Abelmoschus esculentus* or Okra commonly known as lady's finger belongs to family Malvaceae. Okra is a flowering plant in the mallow family. The plant is cultivated in tropical, subtropical and warm temperate regions of the world. Okra is an erect herbaceous plant with 1.2m tall, leaves alternate, 3-7 lobed, hirsute and serrate. The flowers are solitary, axillary and with long apical peduncle. The staminal column is united to base of petals with numerous stamens. Ovary is super in position. The fruit of okra is capsule. Okra is an economically important vegetable crop grown in tropical and subtropical parts of the world. Okra is an important vegetable crop with diverse content of nutritional quality and potential health benefits. Okra is a multipurpose crop due to its various uses fresh buds, flower, steams and seed. Okra seed is known to be rich in high quality protein especially with regards to its content of essential amino acids relative to other plant protein sources like soybean. The insoluble fibre of Okra helps to keep the intestinal tract healthy. Okra is also abundant with sever as carbohydrates minerals and vitamins which plays a vital role in human diet and health. Okra is rich in phenolic compounds also. Traditional vegetables are often considered as key assets for supporting more nutrition-sensitive agriculture and building more resilient production systems under climate change as they are often better adapted to poor quality soils, have higher resistance to pests and diseases, and higher nutritional values as compared to global vegetables. However, despite the wealth of traditional knowledge existing about traditional vegetables, many remain underutilized due to lack of appropriate seed production, drying, storage, and processing technologies, as well as availability and access to quality seed.

Objectives of the study

1. Students will be able to understand the basic requirements for plant growth.
2. To understand the scientific method by carrying out the expt.
3. To determine the germination ability of the two seeds.
4. To observe germination ability of seeds at different Ph levels
5. To determine the effect of salinity which is helpful for cultivation in the field.

REVIEW OF LITERATURE

In the life of a higher plant, seed is the string organ which is viable for months or even year. The seed germinates to give rise to the seedling and eventually into a plant. According to Bhagat S. and Singh V. (1995), seed is the miniature of the plant body which is resistant to extreme conditions of climate and can persist ever a considerable period of time without apparent morphological changes successful establishment of a plant is largely determined by time, place and nutrient reserves available upon germination, thus the seed is a critical phase in the life history of plant. [Bewley, 1997] In angiosperms a seed develops from a fertilized ovule and it contains endosperm, cotyledons and embryo. Germination studies are fundamental to any plant which is propagated by seeds [ISTA 1985] According to [Bewley.1997] "germination can be defined as those events that being with water uptake by the seed and end with the elongation of the embryonic axis and penetration by the radicle of the structure surrounding the embryo". According to Perry, D.A. (1977), germination being with the uptake of water by seeds and ends with the initiation of elongation by the embryonic axis, usually the radicle. Germination process begins with the absorption of water involving imbibitions and osmosis. Hydration is followed by enzyme activities. Aerobic respiration on occurs during the initial stage of germination. The storage reserves present in the form of carbohydrates, proteins and lipids are hydrolyzed during germination and the products are used by the embryonic axis for metabolic process and the growth. The hydrolytic enzymes like amylases, proteases, lipases and nucleases are present. Germination levels significantly influence the vigour, yield performance of several crops. Decline in germination levels resulting in reduction in vigour, yield components and yield has been reported in sunflower (Sharma S. 1997) rice (Raghavendr Rao et al. 1990) and sorghum (Cooper P. 1986). When appropriate conditions are available the seed is reanimated and from it a fully active, metabolising .organism is established* This process involving the reanimation of; the quiescent but viable system is termed as germination (Brown, 1965). Steward (1961) has clearly stated that growth and development of a plant seem to be regulated by a delicately balanced system of chemical controls. Kefford and Goldacre (1961) support Steward (1961). Sachs and Thimann (1964) have suggested that the production of lateral buds in plants may depend on the balance between auxin from the shoot apex and kinetin-like factor acting locally. The effect of ions like chloride, sodium, and magnesium on seed germination and plant growth is well documented (Hardegree and Emmerich, 1990). This could be the result of the effects of salts on water potential, there by affecting the availability of water to the germinating seed. Bhindi *[Abelmoschus esculentus* (L.) Moench] is one of the most important vegetable crops of the world. It is a popular vegetable in India grown extensively all the year round. Yawalkar (1969) stated that Bhindi or Okra is native to India where its wild forms am met with. Vavilov (1951) suggested on the basis of phytogeo graphical studies that it is of Abyssinian origin for *A. esculentus.* The roots and stems of Bhindi are used for cleaning the cane juice from which sugar or brown sugar is prepared (Chauhan, 1972).

MATERIALS AND METHODS

In this study, we used two seeds –seed of a vegetable (okra) and an oil seed (mustard). Seeds were brought from District Agricultural Farm, Mavelikkara. Seeds were air dried and stored in air tight bottles for conducting experiment studies. The selection of material was carried out on the basis of sorts. For the germination studies, okra seeds 6 in numbers and mustard seeds 20 in numbers were germinated in three replicates, using sterilized petridishes lined with cotton and whatman No:1 filter paper ,moistened with various buffers (P^H2, P^H4, P^H8 and P^H10) and different solutions of sodium chloride, (0.1N,0.2N and 0.3N). Experiment was carried out at room temperature (28+/-2 degree celsius) under laboratory conditions up to 7days. In this experiment., distilled water was used as control and water with various P^H levels were used as variables. P^H Solutions were prepared adding NaOH and HCl. Triplicates of petridishes were taken and observed the experiment daily. 0.1N NaCl was prepared by adding 58.5gm NaCl in 1000ml distilled water, 0.2 N NaCl was prepared by adding 117 gm in 1000ml distilled water and 0.3N NaCl was prepared by adding 175.5 gm in 1000ml distilled water.

Germination Studies: The daily germination count was recorded at equal intervals of 24 hours and final count was recorded at 168 hours. (7th Day)

Germination Percentage: Viability was expressed as percentage of germination and was calculated using the following formula.

$$\text{Germination percentage} = \frac{\text{Number of the seed germinated}}{\text{Total number of seed soaked}} \times 100$$

RESULTS AND DISCUSSION

Germination Result

Effect of seed treatment with different Ph: The seed had started germination after 24 hours of treatment. It was found that control (for both Okra and Mustard) had higher germination percentage compare to acidic and alkaline P^H treatments. An exceptionally low percentage of germination, was noticed at P^H 2 and P^H 10 for both the cases. The germination percentage is higher in P^H 8 than P^H 4 but lesser than control. A considerably greater percentage was observed in P^H 8

Effect of seed treatment with various NaCl concentrations: In the salinity study, it was found that control has a greater percentage of seed germination for both the seeds compare to different treatments with NaCl. Among the three concentration taken, 0.1N and 0.2N treatments show a good germination percentage. Treatment with 0.3 N NaCl shows lesser germination.

Table 1. Percentage of germination of seeds in different P^H solutions

Type of Seed	Control	P^H2	P^H4	P^H8	P^H10
Seed 1(Okra)	100	44.4	83.33	94.44	Nil
Seed 2(Mustard)	83.33	Nil	38.33	76.66	nil

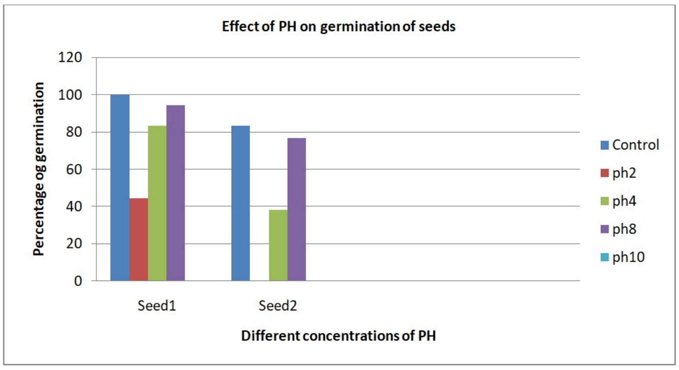
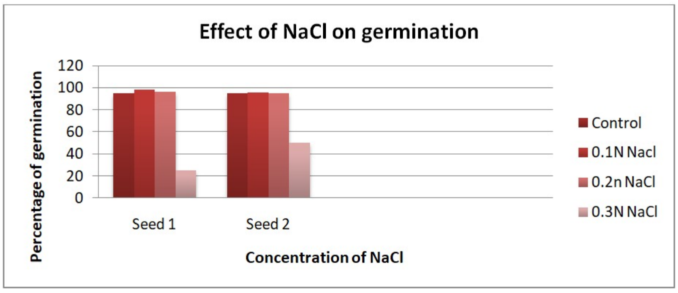


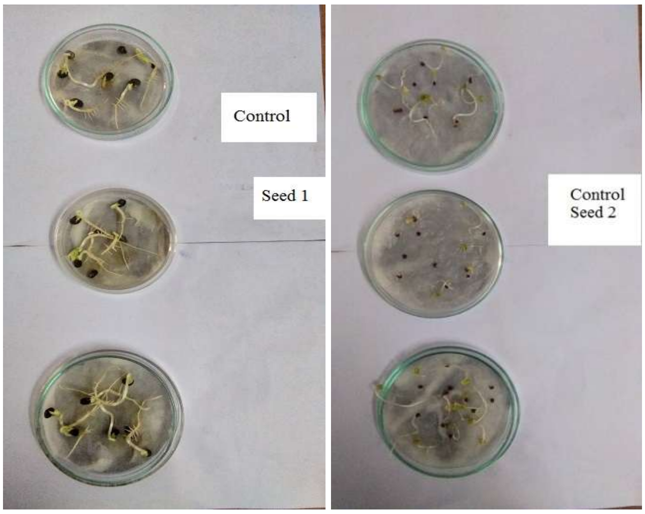
Table 2. Percentage of germination of seeds on treating with different concentrations NaCl

Type of seed	Control	0.1N NaCl	0.2N NaCl	0.3N Nacl
Seed 1(Okra)	95	98.333	96.666	25
Seed 2(Mustard)	95	95.6	95	50



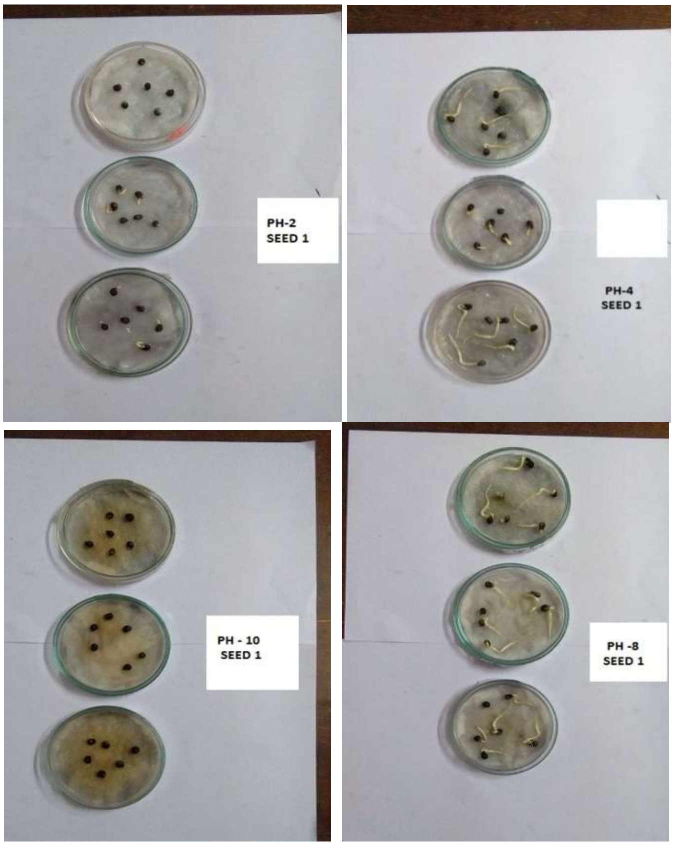
Salinity is one of the major abiotic factors that limits plant growth and productivity in many regions of the world due to increasing use of poor quality of water for irrigation and soil salinization. The combined effects of salinity and pH and the interactions between them should be considered when evaluating the strength of salt-alkaline mixed stress. The successful establishment of plants largely depends on successful seed germination. The germination response of plants to environmental parameters determines the distribution of the plants in saline environments and seed germination in a saline substrate is a legitimate criterion for selecting for tolerance in saline environments Moreover, high levels of alkalinity can be a limiting factor for seed germination Plants can synthesize compatible organic solutes, proline and soluble sugar in the cytoplasm to survive and maintain their growth in saline conditions. The effects of mixed salts, especially mixed salt and alkali conditions, are more complex than those of a simple neutral salt or a simple alkali salt The effects of salinity and alkali mixed stresses mainly include salinity stress (S), pH stress (P) and the interaction between them (SP). Soil salinity cause severe problems in agriculture worldwide, and salt tolerance in crops is an extremely important trait and a major focus of research. Detrimental effects of high salinity on crops are multifaceted and affect plants in several ways: drought stress, ion toxicity, nutritional disorders, oxidative stress, alteration of metabolic processes, membrane disorganization and reduction of cell division and expansion in order to counteract the detrimental effects of salinity on agricultural production, extensive research on plant screening for salt tolerance has been conducted, with the aim of providing more tolerant cultivars. However, these studies have mainly focused on conventional crops, screening criteria and investigating how plants tolerate salts.

Types of Seed

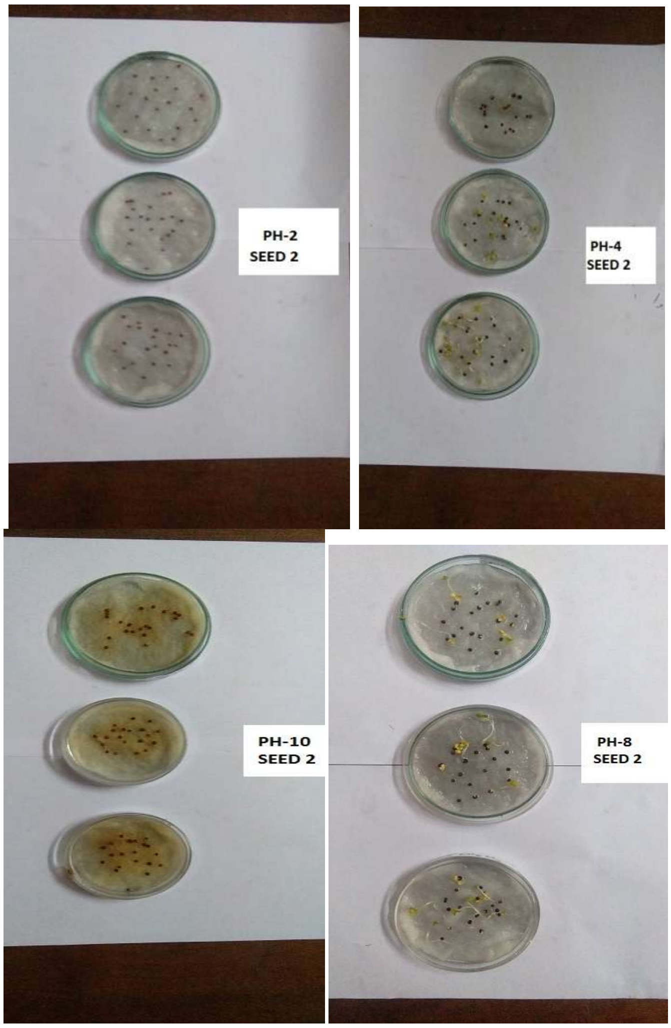


Control for p^h Studies

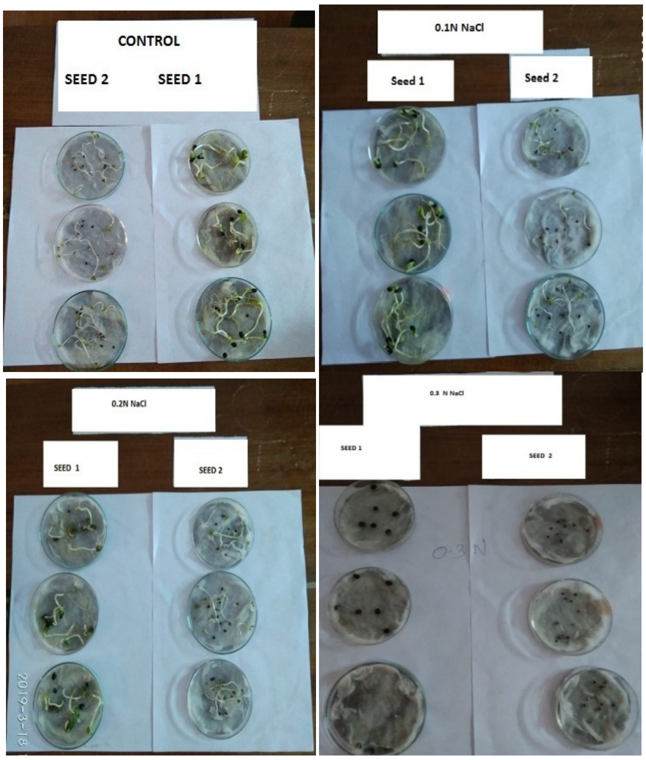
Seeds grown in different ph solutions



Effect of P^H on germination of okra seed



Effect of p^h on Germination of Mustard seed



Effect of Sodium Chloride on Germination of okra and mustsrd seed

SUMMARY AND CONCLUSION

Seed germination is a complex process influenced by various environmental and internal factors. This study explored the key requirements for successful seed germination, including water, temperature, light, and aeration. The effects of salinity and alkalinity on seed germination and plant growth were investigated. The germination potential of seeds can be influenced by unique survival and developmental strategies, such as dormancy, which is determined by the interaction between dormancy-releasing factors and environmental conditions. Salinity is a major abiotic stress that limits plant growth and productivity worldwide, affecting more than 20% of the cultivated land. Traditional vegetables, which are often better adapted to poor quality soils and more resistant to pests and diseases, are considered key assets for supporting nutrition-sensitive agriculture and building resilient production systems under climate change. The successful establishment of plants largely depends on successful seed germination, and the germination response of plants to environmental parameters determines their distribution in saline environments. Research on germination conditions has shown that okra and mustard have distinct optimal environments for sprouting, with okra demonstrating higher susceptibility to environmental challenges. This study highlights how such discoveries can improve our understanding of the ecological needs of these economically valuable crops and shed light on how abiotic stress factors influence seed germination and early seedling growth. These two elements are vital for establishing robust crop populations, boosting agricultural output, and developing resilience in the context of changing climate conditions.

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