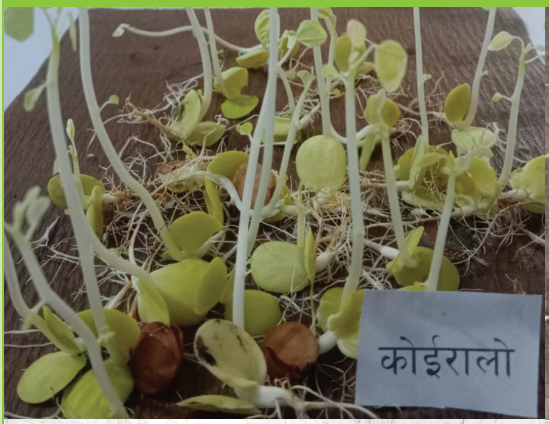
A Report on

Germination and Viability Test of Forest Seed



Prepared by
Government of Nepal
Ministry of Forests and Environment
Department of Forest and Soil Conservation
Forest Seed Laboratory and Storage Center
Nepalgunj, Banke
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2025

Cover Photo:

Germination of Koiralo (*Bauhinia variegata*) and Barro (*Terminalia bellirica*) in FSLSC Lab, Nepalgunj, Banke, Nepal © Maharaji Chaudhary

Viability test of Jacaranda (*Jacaranda mimosifolia*) in FSLSC Lab, Hattisar, Kathmandu, Nepal© Sanish Maharjan

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Citation:

FSLSC, Banke 2025. "*Germination Test and Viability Test of Forest Seed, (Khatri.A*, 2025*)*. Forest Seed Laboratory and storage center (FSLSC), Nepalgunj, Banke, Nepal

FOREWORD

Its my pleasure to offer the report of the Germination and Viability Test on Forest Seed, which highlights the accomplishment of test findings performed in the FSLSC Banke and Kathmandu laboratory during fiscal year 2081/82. It is Nepal's first seed institution, operating under the Department of Forest and Soil Conservation, with the goal of acquiring and distributing quality forest seed to help Division forest offices and other forest related agencies with plantation initiatives. It continues to provide seed quality testing for forest seeds. It collaborates and coordinates with collector, producers, distribution agencies, and seed users. FSLSC has been involved in seed collecting, procurement, and distribution, seed germination testing, seed viability testing, nursery setup, seedling production, germination trail testing and distribution, and administration of existing Breeding Seedling Orchards (BSO), Seed Production Areas (SPAs) which are being efficiently implemented by forest technicians.

The availability of high-quality seed is prerequisite and crucial for success of any afforestation, reforestation project. In terms of seed germination and viability testing, useful information on local tree species has been obtained. This study aimed to document the results of seed viability and germination tests conducted in the laboratory and in the nursery during Fiscal Year (F/Y) 2081/82.

This report will benefit readers from all sectors, particularly seed collectors, DFOs and academics who have worked on seed quality testing of various forest seeds.

I am grateful to the FSLSC, Banke employees for their tireless hard work and thorough efforts to complete the study report and laboratory work

on schedule. My particular thanks goes to Ashok Khatri (Ranger) for his guidance and completion of the assigned duty, as well as Mr. Resham lal Sharma (Forester), Ms. Maharaji Chaudhary (Lab Assistant, FSLSC, Banke) for their continuous effort. I would also like to thank Ms. Manu Tandukar (Lab Assistant, FSLSC, Kathmandu) and Mr. Sanish Maharjan (Lab Technician, NARC, Lalitpur) for their outstanding contributions for viability testing in the laboratory.

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ABBREVIATIONS & ACRONYMS

BP	Between of Paper
BSO	Breeding Seedling Orchards
DANIDA	Danish International Development Agency
DFOs	District Forest Offices
DoF	Department of Forest
F/Y	Fiscal Year
FSLSC	Forest Seed Laboratory and Storage Centre
ft.	feet
g	gram
GA_3	Gibberellic acid
GIS	Geographic Information System
GoN	Government of Nepal
ISTA	International Seed Testing Association
kg	Kilogram
KH_2PO_4	Potassium dihydrogen phosphate
KNO_3	Potassium nitrate
l	litre
m	meter
mg	milligram
ml	millilitre
mm	millimeter
MSFP	Multi Stakeholder Forestry Programme
$Na_2HPO_4.2H_2O$	di-sodium hydrogen phosphate

NARMSAP	Natural Resources Management Sector Assistance Program
NTSP	National Tree Seed Project
pH	Potential of hydrogen
RH	Relative Humidity
RSC	Regional Seed Centre
S	Sand
TIP	Tree Improvement Program
TISC	Tree Improvement and Silviculture Component
TISU	Tree Improvement Support Unit
TP	Top of Paper
TTC	Triphenyl Tetrazolium Chloride
TZ	Tetrazolium
^{o}C	Degree Celsius
°F	Fahrenheit scale

CONTENTS

Abstract

This study pertains to the techniques of capturing the best genetic quality seeds a seed source can produce at the optimal time of high physiological maturity and maintaining these qualities throughout the handling processes, all at a minimum cost. Different collection and processing techniques apply to different species, seed types, situations, and purposes. Yet the collection and processing toolbox contains a number of "standard" methods for most of these groups. Records and documentation help in evaluating "best practice" for future method improvement, and it helps in linking offspring to seed source. Conditions are set for short and long term seed storage by their inert storability physiology. The potential storage life of seed may for some robust "orthodox" species be several decades, while no available storage conditions can maintain viability for sensitive "recalcitrant" seed. Seed testing aims at quantifying seed quality parameters such as seed weight, moisture content, purity, and germination. The methods contain a set of standard procedures for preparation and evaluation. Special types of evaluation contain, e.g., health teats and indirect methods of measuring seed viability. Information gathered through seed testing are used as a general quality documentation during seed trade and as a guide for subsequent handling. Due to recalcitrant seed behaviours and poor germination some of the seed do not germinate leading to empty nursery bag phenomenon, escalating production cost and time. Studies were undertaken to determine the seed viability by quick biochemical test (TZ test) as it helps in predicting field emergence. Based on the staining patterns it was possible to categorize stained embryonic axis into four distinct patterns as a) completely stained, b) completely stained with weak tissue (hypocotyl unstained, attachment scar unstained), c) abnormal color or texture (plumule/radicle tip unstained), d) completely unstained. Completely unstained and abnormal color or texture (plumule/radicle tip unstained) were considered non-viable, while completely stained with weak tissue (hypocotyl unstained, attachment

scar unstained) and completely stained embryos are considered viable. Therefore, the present study was carried out with specific objectives to determine the imbibition **capacity of the seeds**, evaluate the effect of various chemical treatments on germination, to understand the viability characteristics and to assess the prevailing dormancy in seeds.

Keywords: Collection, Seed storage, Storability, Orthodox, Seed viability, Germination, Moisture, Purity, Seed weight, Biochemical test, Viable, Non-viable, Dormancy.

TERMINOLOGY

Viability:

Viability is the ability of a thing (a living organism, an artificial system, an idea, etc.) to maintain itself or recover its potentialities. Viability or viable may refer to the selection of individual organisms who can survive until they are able to reproduce. In general, **Viability** refers to the ability of something to work successfully, function effectively, or continue to exist.

Seed Viability:

Seed viability refers to **the ability of a seed to germinate and develop into a healthy plant** under suitable conditions. It's a key measure of seed quality and is influenced by several factors such as seed age, Moisture content, temperature, oxygen exposure, seed maturity ar harvesting time and genetic factors.

Seed Germination:

Seed germination may be defined as the fundamental process by which different plant species grow from a single seed into a plant. Germination is the resumption of growth of the embryo plant inside the seed.

Germination capacity:

Germination capacity is defined as the percentage, by number, of seeds in a given sample that actually germinate, irrespective of time.

Germination energy:

Germination energy is defined as the percentage, by number, of seeds in a given sample that have germinated up to the time when the rate of germination (number of seeds germinating per day) reaches its peak.

Seed germinator:

A seed germinator is a electric device for germinating seeds. Typically, these create an favourable environment in which light, humidity and temperature are controlled to provide optimum conditions for the germination of seeds.

Dormancy:

Dormancy refers to the state in which viable seeds fail to germinate even under conditions normally favorable for germination.

Triphenyl Tetrazolium Chloride (TTC):

Triphenyl Tetrazolium Chloride, or simply tetrazolium chloride (with the formula 2,3,5-triphenyl-2H-tetrazolium chloride) is a redox indicator commonly used in biochemical experiments especially to indicate cellular respiration (example: to check for the viability of seeds). It is a white crystalline salt, soluble in water, ethanol and acetone but insoluble in ether.

1. INTRODUCTION

1.1 Background

Trees are crucial for forest ecosystems and have high ecological, socioeconomic, and cultural importance. Globally, over 8000 tree taxa are threatened with extinction. Conservation status of rare species is unclear due to lack of geographical distribution information. Low abundance of species exploited for timber and forest products complicates assessment. Thus, Conservation action is needed to protect tree species, as trees with economic potential are typically propagated through seeds. Seed germination and viability testing are crucial in forestry for successful forest regeneration, afforestation, and reforestation programs. Variable germination rates, influenced by genetics, environmental conditions, and handling practices, can be predicted through accurate testing. Studies show that using seeds with viability rates above 70% increases seedling establishment rates, directly impacting forest restoration success.

Seed germination testing in forestry assesses seed readiness and identifies dormancy-breaking requirements for forest tree species like Pinus spp. and Quercus spp., preventing losses in seedling production and delays in afforestation efforts. It also helps select the best quality seed lots for nurseries, ensuring uniform and vigorous growth before outplanting. Seed testing is crucial globally for sustainable forestry practices, particularly in climate change. The FAO's Forest Reproductive Material programs emphasize the use of high-quality seeds, which are essential for selecting species and provenances best suited to future environmental conditions. Seed viability and germination are critical aspects of plant science, ensuring successful crop production, forest regeneration, and conservation of plant biodiversity. These tests form the foundation for effective forestry practices, ensuring long-term health, productivity, and sustainability of forests.

Seed viability and germination are crucial for plant species propagation, agriculture, forestry, horticulture, and biodiversity conservation. High viability ensures healthy plants, supporting food security and re-

establishing native plant communities. In conservation, it is essential for long-term preservation of genetic diversity. Seed banks and conservation programs rely on viable seeds to protect rare, endangered, and economically valuable plant species. Accurate germination assessments help determine optimal storage conditions, sowing times, and cultivation techniques. Understanding factors influencing germination helps develop effective management strategies for both cultivated and wild species. Ensuring high seed viability and successful germination contributes to global efforts to combat climate change, habitat loss, and desertification. Viable seeds serve as a foundation for resilient ecosystems and stable food systems.

Forest Seed Laboratory and Storage Center (FSLSC) is established in 2075 under the Department of Forest and Soil Conservation, Ministry of Forest and Environment, Nepal. It plays a crucial role in the conservation, propagation, and sustainable management of forest genetic resources by supporting in Seed testing and quality control, Seed collection and distribution, management of Breeding Seed Orchard (BSO), Seed Production Area (SPA), Species Conservation Plot (SCP), Provincial Fruit Garden (PFG), Multiyear seedling production and distribution. It continued those activities which was started by Australian Government in 1982 as a National Tree seed Project (NTSP) followed by DANIDA/ NARMSAP in 1998 as Tree Improvement and Silviculture Component (TISC) under Tree Improvement Section of Community Division, Department of Forest (DoF). From 2005 onward Tree Improvement Support Unit (TISU) has been running under the financial source of the Government of Nepal (GoN). Later TISU is converted into one of the important SIlviculture Division out of 4 major Division with improvement because of restructureing of Forest Department in 2071.

With reinstitution of fedral system of Nepal, Forest Department is converted into Forest and Soil Conservation Department and Silviculture Division to Silviculture section by which Seed and Tree Improvement Programs could not be included. So, Forest Seed Laboratory and Storage Center (FSLSC) is established in Hattisar, Kathmandu, Pokhara, Biratnagar and Nepalgunj, Banke. Seed collection, procurement and distribution, seed germination testing, seed viability testing, nursery establishment, seedlings production and distribution, management of existing BSO, by forest guards are implementing effectively. There are 50 breeding seed orchards, 122 seed production areas, 50 demonstration

plots, 18 in-situ conservation plots, 6 province level fruit gardens all over country. Under working area of Seed Centre, Banke (Banke, Bardiya of Lumbini Provinces, Karnali Province and Sudurpaschim Province) there are 4 breeding seed orchards, 8 seed production areas, 6 demonstration plots, 6 in-situ conservation plots, 1 province level fruit gardens.

1.2 Goal

The goal of the Forest Seed Laboratory and Storage Center, Nepalganj, Banke, is to contribute to the prosperity of the country by conserving biological diversity by conserving the genetic resources of tree species and improving the management of natural forests.

1.3 Objectives

- Establish and manage seed production areas.
- Prepare manpower for collection of healthy seeds.
- Produce healthy and quality seeds.
- To produce healthy and quality seeds.
- To modernize the forest seed laboratory for quality testing of seeds.
- To provide quality seeds to the concerned bodies easily.
- Establish and manage fruit and forest seed orchards.
- Operate a quality nursery for testing available seeds.
- Conduct ex-situ and in-situ gene conservation of endangered and threatened tree species.

1.4 Major activities of Seed Centre

- Seedling production.
- Seed collection, procurement and distribution.
- Seed laboratory maintenance and Seed cold store maintenance.
- Seed collection of threatened species, distribution and seed bank establishment.
- Green house and store house establishment in nursery.
- Nursery management and protection.
- Existing seed production area management.

- Breeding seed orchard protection by forest watcher.
- Seed collection training.
- Seed laboratory management training.
- Annual Progress Report preparation and publication.
- Extension materials related to forest seed preparation and publication.
- Assessment of current status of BSO, demonstration plots, seed production areas, in-situ conservation plots.
- Seed Germination and Seed viability test report preparation and publication.

1.5 Staff Allocation of Forest Seed Laboratory and Storage Centre (FSLSC), Hattisar, Kathmandu

Table 1. Staff Allocation of FSLSC, Nepaljung, Banke

S.N.	Designation	Class	Number	Vacant No.	Remarks
1	Forest Officer	Gazetted III	1		Kaj
4	Ranger	Non gazetted I	2	0	
5	Forester	Non gazetted II	1	0	
6	Lab Assistant		1		Karar
8	Forest Guard			2	Vacant
9	Office Assistant		1		Karar
10	Office Guard		1		Karar
11	Sweeper		1		Karar
	Total		8		

2. SEED VIABILITY TEST

Seed viability test is a scientific procedure used to assess the proportion of live seeds within a seed lot by evaluating their ability to germinate or through biochemical methods that detect seed vitality. It is a method used to determine whether seeds collected from forest trees and plants are alive and capable of germinating. In simple terms, it checks how many seeds in a batch are healthy enough to grow into seedlings under the right conditions.

2.1 What is seed viability?

Seed Viability means the ability of a seed to stay alive and capable of germinating into a healthy seedling under suitable conditions. If a forest seed is viable, it is alive and can grow into a new plant when given water, air, and the right temperature. Viability is important because not all seeds collected from trees are alivebut also some may be dead, damaged, or too old to grow. Testing seed viability helps in knowing how many seeds will successfully grow if planted.

2.2 Why should seed viability be determined?

Seed viability should be determined to know how many seeds are alive and capable of growing into healthy plants**.** It is very important that seeds stored in the genebank and Storage Center are capable of producing plants when sown in the field. They must be highly viable at the outset of storage and maintained during storage. Seeds with a high initial viability will last longer in storage. Seed viability drops gradually at first, then dramatically as the seeds mature. It is critical to understand when this drop happens in order to take steps to rejuvenate the accession. Excessive deterioration will result in material loss. Reasons for determining seed viability are:

- **To ensure good germination**: Only viable seeds will sprout, so testing helps predict how successful planting will be.

- **To save time and resources**: Planting dead seeds wastes effort, land, and money.
- **To plan for proper sowing**: If viability is low, more seeds can be planted to make up for it.
- **To check seed quality**: It helps assess the health and quality of seeds collected or stored.
- **For forest restoration**: In forestry, using viable seeds is crucial to regrow healthy forests and ecosystems.

2.3 When should viability be determined?

Viability should be tested at critical moments to ensure that seeds are still alive and ready for usage. Basically test should be conducted in following time:

- **Right after seed collection**: To check the quality of freshly collected seeds.
- **Before storage**: To know if seeds are worth storing and how well they might survive storage.
- **During storage**: To monitor if seed quality is dropping over time.
- **Before sowing or planting**: To make sure seeds will germinate well in nurseries or in the field.
- **Before seed distribution**: If seeds are being given to others (like farmers or forest related offices), viability testing ensures they are still good.

Viability testing can take from a few days to weeks, depending on the species. If possible, the results of viability tests should be made available before seeds are packaged and placed in the genebank so that poor-quality seeds can be identified and regenerated.

While awaiting the results of viability tests or if there is a delay in conducting the viability tests before storage, seeds should be placed in a cool environment to minimize their deterioration.

2.4 How should viability be determined?

Viability should be assessed by particular tests that verify whether the seeds are alive and capable of growing. Many different methods are available to test seed viability. The most frequent approaches include:

- **Germination Test:**

  Seeds are placed under optimal circumstances (moisture, temperature, and light) to determine how many sprout. The percentage of seeds that germinate indicates viability.

- **Tetrazolium (TZ) Test:**

  Seeds are steeped in tetrazolium chloride. Living tissues become crimson or pink, indicating that the seed is alive, even if it does not sprout immediately.

- **Cut Test:**

  The seeds are gently cut open and studied within. A healthy, solid, and white embryo typically indicates that the seed is viable, whereas shrivelled or discoloured embryos do not.

- **X-Ray Test:**

  Seeds are X-rayed to swiftly determine whether they contain a whole, healthy embryo without hurting the seed.

The most accurate and reliable method is the germination test. Tetrazolium test have the advantage of being quicker, but are not as accurate as the germination test. They also require special skills to conduct and interpret. These tests are not usually recommended for general use to test for seed viability in gene banks.

3. GERMINATION TEST

Seed germination is the process by which a seed emerges from dormancy and begins to develop into a new plant when given the proper conditions. A germination test assesses the capacity of seeds to sprout and grow into healthy seedlings under optimal circumstances.

3.1 What is a germination test?

A germination test is performed to determine what proportion of seeds in an accession will germinate under favourable conditions and produce normal seedlings (seedlings that have the essential structures - roots, shoots and sufficient food reserves) capable of development into reproductively mature plants.

Basic requirements for seed germination are water, oxygen, light and suitable temperature. Seeds of different species have different requirements and no general set of conditions can be relied upon to germinate seeds of all species. Seeds of some species are more tolerant and germinate in a wide range of conditions but complete germination can only be achieved under optimum conditions.

All the seeds that fall to the ground do not germinate. As per the percentage of seeds that germinate, affects natural regeneration, it is important to know the germination capacity and germination energy of the seeds of the species. Germination capacity is defined as "the percentage, by number, of seeds in a given sample that actually germinate, irrespective of time." The total number of seeds that germinate in a germinator, plus the number of sound seeds remaining at the end of the test, expressed as a percentage of the total sample.

The most reliable test of seed viability is to germinate a representative sample (four replicates of 100 seeds each) under laboratory conditions. Under field conditions, cutting the seeds into two equal parts can test viability. Seeds having fully grown, firm and undamaged embryo can be

presumed to be good. However, this is not a reliable test for stored seeds because loss of viability in storage may not produce immediate visible changes.

In seed laboratory, seeds are placed in folded germination paper towels moistened with distilled water. Germination paper towels are 'squeezed' to remove excess water prior to seed placement. The paper towel units are placed in plastic tubs covered with clear plastic wrap to help maintain moisture. These are put in a seed germinator machine. Temperatures alternate between 30°C with light for 12 hours and 20°C in darkness for 12 hours per 24 hour cycle. Replication and sample size: 4 replications of 50 seeds each for a total of 200 seeds. Counts are done 7, 10, and 14 days after start of test. Abnormal are not scored until the last count of the test. Because of inbreeding depression in inbred lines, more relaxed parameters are used to classify seedlings as normal.

Germination paper should preferably possess a creped surface. The paper should have an open, porous formation and be free from impurities or toxic substances that may affect seed germination. It should be free of fungi or bacteria which might interfere with the growth or evaluation of seedlings. It should hold sufficient moisture during the period of test and should possess sufficient strength to resist wear and tear during handling. The texture should be such that the roots of germinating seedlings will grow on and not into the paper.

3.2 Methods of germination test:

Although several methods are available to test germination, the five methods described below are suggested; they can be used for most species and give uniform results:

- Top of Paper Method (TP)
- Between Paper Method (BP)
- In Paper Towel Method (Roll Towel)
- Sand method (S)
- Soil Method

3.2.1 Top of Paper Method (TP):

This method is most suitable for species with seeds smaller than 2 mm in diameter such as small-seeded vegetables and forage grasses. The seeds are germinated on top of moist absorbent paper in containers with close-fitting lids to prevent moisture loss. Commonly used containers include 9 cm glass or plastic Petri dishes.

- Place the paper substrate at the bottom of the container or Petri dish.
- Label containers with accession number, number of replicate and testing date; use a pencil or permanent marker for labelling.
- Add the required volume of distilled water. If distilled water is not available, boiled and cooled tap water can be used. The volume of distilled water depends on the thickness of the paper substrate and the size of container.
- Spread the seeds uniformly on the surface of the paper so that they are not touching. It is recommended that the distance between seeds should be at least three to five times the seed diameter.
- Cover the petri dishes and place the petri dishes in a germinator or incubator maintained at the recommended temperature for germination of the species.
- Check the moisture level of the substrate regularly, especially when humidity inside the cabinets is not controlled or when the temperature is set at 25°– 30°C.
- Run the test for the recommended period and count the number of seeds that have germinated.
- If some seeds have not germinated and appear to be dormant, treat with appropriate techniques to stimulate germination and continue the test until all seeds have germinated or until no further germination has occurred after.
- Make a note of the seeds that did not germinate but are firm and sound at the end of the first count, and those that failed to germinate and are presumed dead at the end of the germination test.

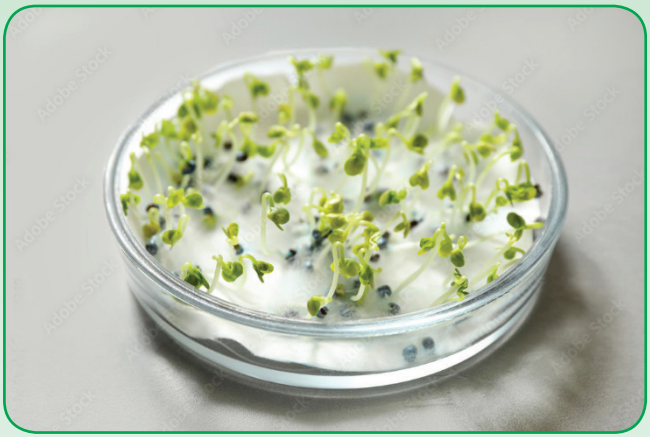


Figure 1. Testing germination on filter paper absorbent paper in Petri disc

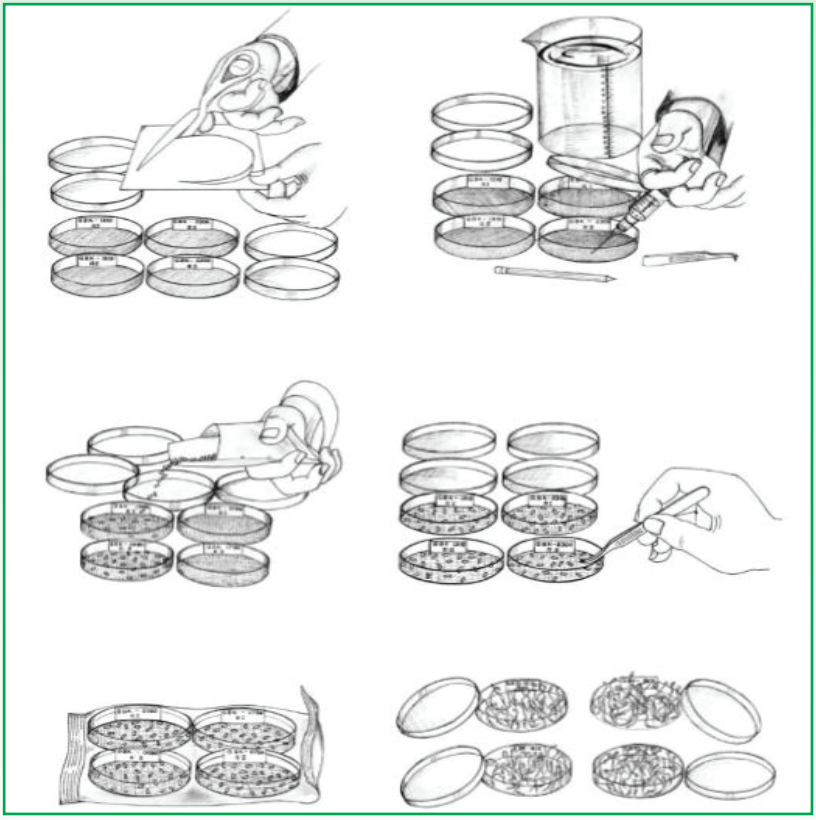


Figure 2. Seed germination testing by Top of Paper method (TP)

3.2.2 Between of paper germination method (BP):

This method is most appropriate for species with medium and large seeds between 2 mm and 1 cm in diameter, including many cereals, grain legumes, vegetables and forest seeds. Seeds are germinated between two layers of moist paper.

- Cut the paper to a convenient size to hold one replicate of the seeds.
- Moisten the paper with distilled water.
- Arrange the seeds in rows at regular intervals—about 4 cm from the top edge, leaving a 3–4 cm gap on the sides. Ideally, the distance between seeds should be at least three to five times the seed diameter.
- Cover the seeds with another sheet of moist paper towel and roll the paper loosely from opposite the label end.
- Use a paper clip or rubber band to hold the rolled papers and prevent them from falling apart.
- Place the tray in an incubator or germinator maintained at the recommended temperature and run the test for the recommended period
- Keep the towels moist by spraying with water (use spray bottles) if necessary, especially when temperatures are high (25°–30°C).
- Count the germinated seeds by unrolling the paper carefully to avoid tearing it or damaging the roots of young seedlings.
- If some seeds have not germinated and appear to be dormant, treat with an appropriate technique to stimulate germination. Continue the test until all seeds have germinated or until no further germination has occurred after two consecutive counts.
- Make a note of the seeds that did not germinate but are firm and sound at the end of first count, and those that failed to germinate and are presumed dead at the end of the germination test.

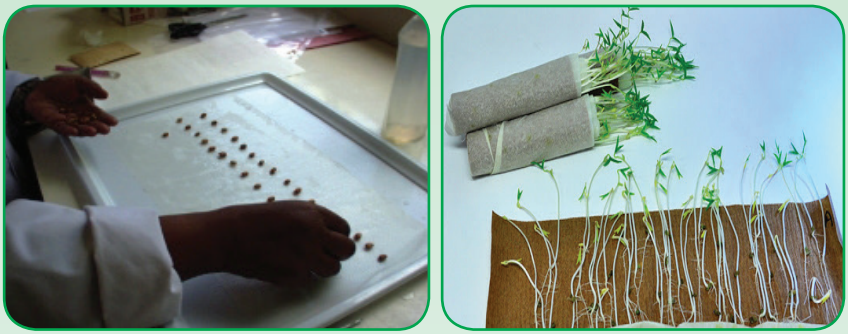


Figure 3. Testing germination on filter paper in tray

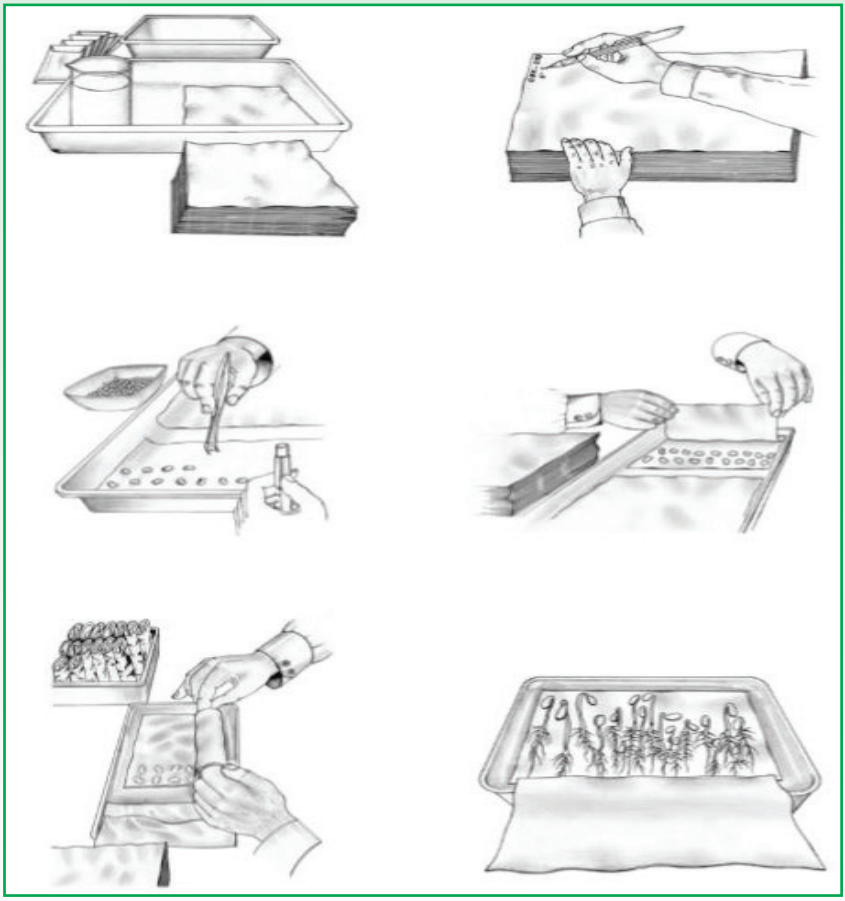


Figure 4. Seed germination testing by Between of Paper method (BP)

3.2.3 Sand method (S):

This method is most appropriate for large seeds (with a diameter greater than 1 cm), which are difficult to germinate in Petri dishes or too heavy for the between-paper method.

- Pack sterile, moist sand into deep-bottom plastic trays with drainage. A single sheet of paper can be placed in the base of the tray to keep the sand from pouring out through the drainage holes.
- Water the sand until it is moist. Do not use excess water.
- Make holes in a regular equidistant pattern at about the same depth as the size of the seeds. Ideally, the distance between holes should be at least three to five times the seed diameter.
- Prepare a wooden label with the date and replicate number, and place it in each tray.
- Place one seed in each hole and cover the holes with sand and water the sand again by sprinkling to ensure that the seeds are not disturbed when watering.
- Place the trays in appropriate light and temperature for the species.
- Keep the substrate moist during tests by adding water, but do not over-water.
- Run the test for the period recommended for the species and count the number of seeds that have sprouted.

Figure 5. Testing germination in sand

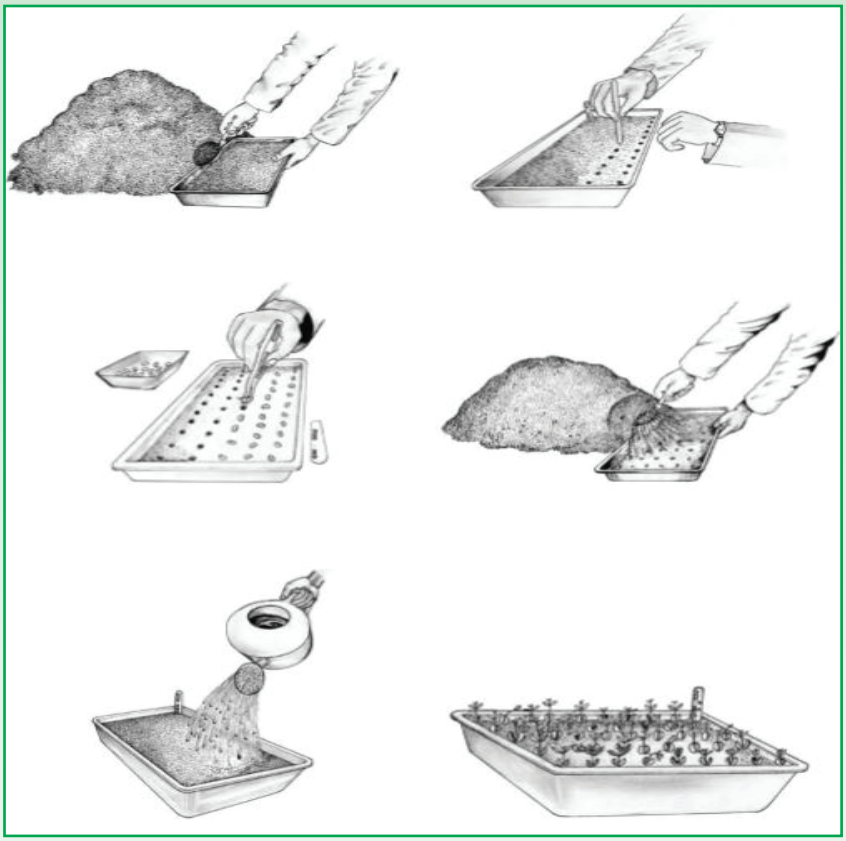


Figure 6. Seed germination testing in Sand method (S)

3.3 Why do some seeds fail to germinate?

Seeds fail to germinate either because they are dead or dormant. Dead seeds usually soften and rot during testing. To determine if seeds are dead or dormant, inspect the un-germinated seeds with a pair of tweezers to establish whether they are soft or firm. Un-germinated seeds found to have firm embryos are potentially viable. A high percentage of these seeds indicates that germination conditions were not optimal or that seeds are dormant.

4. DORMANCY

Dormancy refers to the state in which viable seeds fail to germinate even under conditions normally favourable for germination.

4.1 How to determine if seeds are dormant?

Seeds that remain hard, or absorb water but remain firm and in good condition, during germination tests are probably dormant. Seed dormancy is common in freshly harvested seeds and in many wild species of crop plants.

4.2 Types of dormancy

- **Seed-coat dormancy:** Physical, chemical or mechanical conditions prevent uptake of moisture. Examples of seed-coat dormancy can be found in the *Anacardiaceae, Burseraceae, Cistaceae, Fabaceae, Geraniaceae, Malvaceae*, and *Rhamnaceae* families.
- **Embryo dormancy:** Inhibiting substances usually within the embryo or surrounding tissues prevent germination. Examples of embryo dormancy can be found in the *Apiaceae, Iridaceae, Liliaceae, Papaveraceae* and *Ranunculaceae* families.

Dormancy can be also caused by a combination of impermeable seed or fruit coats and physiologically dormant embryos. For germination to occur, both types of dormancy must be broken. The order in which each type of dormancy must be broken depends on the species. Examples are Ceanothus *(Rhamnaceae)*, Tilia *(Tiliaceae)* and Rhus *(Anacardiaceae)*.

4.3 How to determine the type of dormancy?

If removal of the seed coat does not result in germination, the dormancy mechanism is located in the embryo itself.

4.4 Dormancy-breaking treatments

In some seeds that are dormant at harvest, dormancy breaks down naturally over time. Other species require some form of pretreatment. There are several methods used for specific genera.

4.4.1 Breaking seed-coat dormancy: Puncturing or scarifying the seed coat by piercing, nicking, chipping or filing with a knife, needle or sand paper are preferred procedures to overcome seed-coat dormancy.

4.4.2 Breaking embryo dormancy: There are several recommended treatments to overcome embryo dormancy. These include pre-chilling (also called cold stratification) for temperate and high-altitude species from the tropics; preheating; application of gibberellic acid (GA_3) at low concentrations; addition of potassium nitrate (KNO_3) to the substrate; and light.

- **Pre-chilling (cold stratification)**

  Seeds are placed in containers on a moistened germination substrate and kept at 3° to 5°C in a refrigerator for seven days. For more dormant seeds, the treatment may be extended to 14 days. Once the stratification is complete, the containers are removed to incubators and seeds are allowed to germinate in recommended conditions.

- **Preheating**

  Seeds are treated at a temperature not exceeding 40˚C for up to seven days with free air circulation before germination in recommended conditions.

- **Gibberellic acid**

  Germination test paper is moistened with a 0.05% solution of gibberellic acid (GA_3), prepared by dissolving 500 mg of GA_3 in 1 litre (l) water. Germination is then continued in recommended conditions.

➢ Potassium nitrate

A 0.2% solution of potassium nitrate (KNO_3) prepared by dissolving 2 gram (g) KNO_3 in water. Water is used to moisten the germination paper at the beginning of the test. Germination is continued in recommended conditions.

➢ Light

Light may or may not be required for germination, depending on the species. When using constant temperatures for germination of species where light is required, the tests should be illuminated for at least eight hours of every 24-hour cycle. When alternating temperatures are used, any necessary application of light should coincide with the high-temperature cycle. Light intensity should be 750–1250 lux from cool, white lamps.

5. SEED BANK

A seed bank stores seeds to preserve genetic diversity. Hence it is a type of gene bank. Seed banks are considered seed libraries, containing valuable information about evolved strategies to combat plant stress, and can be used to create genetically modified versions of existing seeds. The work of seed banks often span decades and even centuries. Most seed banks are publicly or government funded and seeds are usually available for research that benefits the public.

5.1 Storing seeds using cold storage

Seeds are living plants and keeping them viable over the long term requires adjusting storage moisture and temperature appropriately. As they mature on the mother plant, many seeds attain an innate ability to survive drying. Survival of these so-called 'orthodox' seeds can be extended by dry, low temperature storage. The level of dryness and coldness depends mostly on the longevity that is required and the investment in infrastructure that is affordable. Storing genetic diversity as seed is the best researched, most widely used and most convenient method of ex situ conservation.

James Harrington, are known as 'Thumb Rules'. The 'Hundreds Rule' guides that the sum of relative humidity (RH) and temperature (°C) should be less than 100 for the sample to survive five years. Another rule is that reduction of water content by 1% or temperature by 10 °F (5.6 °C) will double the seed life span. Research showed that there is a limit to the beneficial effect of drying or cooling, so it must not be overdone.

Much is known about the optimum treatment of the seeds of most major crops. Requirements include adequate drying; appropriate storage temperature (-18°C is recommended for long-term storage); and careful production of quality seed to ensure the greatest longevity (storing them in hermetically-sealed containers). Like everything, seeds eventually

degrade with time. It is hard to predict when seeds lose viability and so most reputable seed banks monitor germination potential during storage. When seed germination percentage decreases below a prescribed amount, the seeds need to be replanted and fresh seeds collected for another round of long-term storage.

5.2 Orthodox seeds

It is the principal conservation method for species producing orthodox seeds that withstand desiccation to low moisture content and storage at very low temperatures. Most arable and forage species, and many tree species, produce seeds in this category.

5.3 Recalcitrant seeds

Several important tropical and sub-tropical tree species produce seeds that do not survive desiccation and cannot tolerate low temperatures, and which are therefore not easy to store; these are known as recalcitrant seeds. Techniques exist for storing some recalcitrant seeds, but the seeds are usually short-lived and each species requires its own method.

5.4 Intermediate seeds

A third category of seeds showing intermediate behaviours has also been recognized: these seeds tolerate combinations of desiccation and low temperatures. There is, in fact, a gradient from orthodox to recalcitrant, with no sharp boundaries between categories. Although research has been conducted to overcome problems associated with seed conservation, little progress has been 5.5 made beyond short-term storage of non-orthodox seeds.

5.5 Principles of seed storage

The underlying principle of successful seed storage is to maintain genetic integrity of accessions as seeds with high viability for long periods. Seeds of the original sample should be stored under the best possible conditions to ensure safe long-term survival, while seeds of accessions that are frequently requested by breeders or other users should be stored in the active collection. Gene banks may maintain both base and active

collections or focus on only one. Such decisions are based on the purpose and needs of the genebank and economics of conservation.

For orthodox seeds, low temperatures and low moisture content are used to extend longevity and reduce regeneration intervals with related risks to loss of diversity and genetic integrity.

Genebank requirements differ for crops and it is important to select a combination of temperature and seed moisture content specific for the species that will retain high viability for many years of conservation.

5.6 Organization of space

The organization of storage space depends on the type of storage facility and the type of containers used in the genebank. In view of the cost of maintaining cold storage, the space should be optimized so that a maximum number of seed accessions can be stored.

- For a walk-in cold store, use moveable racks that maximize storage space.
- Arrange the distance between each shelf according to the size of containers, leaving a gap of about 10 cm above the containers to allow cold air circulation.
- Arrange small containers or aluminium foil bags in boxes or trays to keep them together and save space on the shelves.
- Use a coding system based on the location for sample entry and retrieval.

6. TETRAZOLIUM TEST FOR SEED VIABILITY

The tetrazolium test can be used as a backup procedure to identify viable but dormant seeds that have failed to germinate at the end of a germination test. The procedure for this test is indicated below.

- Remove the seed-covering structures
- Precondition the seeds by soaking in water or by placing them in a moist medium at 30°C. No preconditioning is necessary when un-germinated seeds are evaluated at the end of a germination test.

6.1 Preparing tetrazolium chloride solution

The tetrazolium solution should be between pH 6 and 8 to achieve best results. To prepare 1 litre of buffered 1% tetrazolium chloride solution:

- Dissolve 3.631 g of potassium dihydrogen phosphate (KH_2PO_4) in 400 millilitre (ml) of distilled water.
- Dissolve 7.126 g of di-sodium hydrogen phosphate ($Na_2HPO_4.2H_2O$) in 600 ml of distilled water.
- Mix the two solutions to prepare the buffer. 4. Dissolve 10 g of 2,3,5,-triphenyl tetrazolium chloride in the 1 litre of buffer solution.

To produce 0.5% tetrazolium solution, mix one part stock solution with one part distilled water. Tetrazolium chloride solution should be stored in dark and cold conditions for short periods.

Germination test is the best indication of the potential of a seed lot to emerge under field conditions. However, it takes from days to weeks and in some cases even months to complete. Tetrazolium test, commonly known as the TZ test for seed viability have, therefore, been developed to furnish quick estimates of seeds germinability. The test is very useful in processing, handling, storing and marketing. Large quantities of seed

in a short time, testing dormant seed lots, vigor rating of the seed lots, supplementing germination test results and diagnosing the cause of seed deterioration.

6.2 Mechanism of the reaction:

The TZ test is reliable and widely utilized. The method was pioneered by the German scientist Lakon during the mid-nineteens' (1939-1958), who recognized that all living tissues, which respire, are capable of reducing a colorless chemical or bromide) into a red colored compound formazen by H transfer reactions catalyzed by the enzyme dehydrogenases.

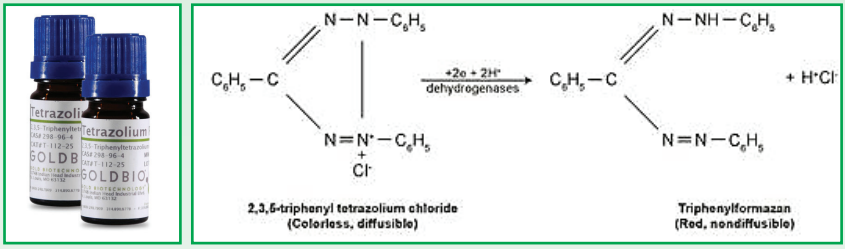


Figure 7. 2,3,5 Triphenyl Tetrazolium Chloride

Formazan being non-diffusable, stains the living tissues red. Thus, the living parts of a viable seed should be stained red when incubated in the solution of this chemical.

The immense significance and practical utility of this test was realized by the scientists and technologists the world over and it was suitably modified and improved to assess the seed quality in terms of its viability.

Since the tissues within a seed could be at different states of viability they would be stained differently. Moore (1973) described the use of TZ staining more efficiently on the basis of the topographic pattern of the seed. The accuracy of the tetrazolium test requires:

- A sound knowledge of the seed and seedling structures
- An understanding of the mechanisms of the reactions leading to the staining of the seed.

- Ability to interpret the staining pattern by critically examining the seed topography and by keeping other visible seed qualities such as tissue turbidity, abnormal or missing structures etc.
- Experience gained through keen interest and natural skill.

6.3 Essential seed structures for tetrazolium test evaluation

Seeds can be grouped into monocots, dicots and polycots on the basis or the presence of one, two or more than two cotyledons. Embryo structures or structure primordia arc. relatively similar for embryos within each groups though they are differ in shape, size and differentiation/ development of embryo structures. The critical features of the seeds of these groups are described below.

Monocotyledons

Seeds of Gramineae family are a classical example of this class. The most critical features are the growing root and shoot tips and the scutellum. 1be root region comprise; mainly of the radicle which may be the only root primordia in some cases e.g. small seeded grasses or it may have several seminal root primordia besides the radicle e.g. wheat, maize. Barley etc. The radicle ties below the mesocotyl region covered under a sheath coleorhiza. The shoot region or the plumule consists of the shoot meristem along with one or more leaf primordia near the base, enclosed within the coleoptile. Mesocotyl separates plumule from the point of attachment to the scutellum.

Dicotyledons

In the dicot seeds with a low degree of differentiation the embryo is embedded in nutritive tissues and consists of a radicle and two cotyledons. In the seeds with a higher degree of differentiation. Embryo occupies 210 a larger portion of the seed. The radicle is well recognizable part of the embryo while the shoot meristem with the primary leaf primordia generally lies compressed between the two cotyledons.

Polycotyledons

This type of seed is found in Pinaceae and other conifers. The embryo is not very well differentiated except for a radicle and more than two

cotyledons. Living nutritive storage tissues encircle the embryo while the shoot meristem is encircled by the base of the cotyledons.

6.4 Equipments required for conduction tetrazolium test

- 2,3,5 Triphenyl Tetrazolium Chloride
- Autoclaved distilled water
- Weighing balance
- Staining dished e.g. petri dishes
- Beakers of 500 to 1000 ml capacity
- Single edge razor blade/surgical blade
- Needles
- Forceps
- Magnifying devices
- Medicine dropper
- Dispensing bottle
- Germinating blotter filter paper and paper towel
- Oven or incubator

6.5 Tetrazolium test method

- Seed should be soaked overnight in water at room temperature.
- Bisect the seeds longitudinally through the embryo with a razor blade to expose the embryo.
- Discard half of each seed and place the other half in the staining solution at the recommended concentration in a glass vial.
- Place the vials in an incubator in a dark area at the recommended temperature and duration for each species. Temperature influences the reaction .i.e. at staining will be twice as fast as at 20°C. It is preferable not to conduct the test above 40°C. If the acidity of the tetrazolium solution is much higher, the color will not be develop even on viable embryos. Solution with pH values progressively higher then optimum reflects progressively darker staining. There may be problems with evaluation at exceedingly

high pH values. So distilled water (pH value 6-7) should be used while preparing the solution.

- After staining, wash the seeds several times in distilled water to remove excess stain.
- Evaluate the seeds for a staining pattern under a low-powered binocular microscope; viable tissues stain bright red. Pink and very dark red stains indicate dead tissue.
- Classify the seeds into three categories depending on staining pattern:
    - ➢ completely stained seeds that are viable;
    - ➢ completely unstained seeds that are nonviable; and
    - ➢ partially stained seeds that will produce either normal or abnormal seedlings, depending on the intensity and pattern of staining

Source: *International Seed Testing Association (ISTA), 2011-2023*

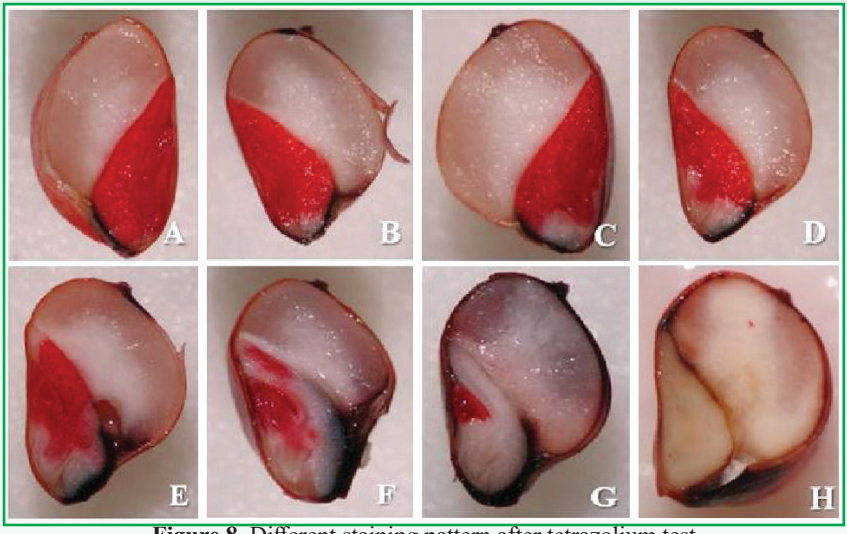


Figure 8. Different staining pattern after tetrazolium test

Viable = A,B,C and D (stained with bright red or pink)

Non-Viable = E,F,G and H (partially stained with light red or pink and completely unstained-colorless)

Figure 9. Staining pattern after tetrazolium test (completely stained seeds - Viable)

Figure 10. Staining pattern after tetrazolium test (completely unstained and partially stained seeds - Non-viable)

7. RESULTS

Germination Test Using Between of Paper Method

7.1 Objectives:

The purpose of testing is to determine the seed germination percentage of the different forest seed collected from Forest Seed Laboratory and Storage Centre (FSLSC), Nepalgunj, Banke. This process helps to determine germination potential (percentage) of the seeds, ensuring they remain suitable for plantation or conservation purposes and efficient distribution of forest seed from the office and provide assurance of seed germination to seed distributed agencies. Such tests play a crucial role in seedling production in forest nusery and support restoration and afforestation efforts.

The germination test offers a long duration (7 days to 52 days) regular observation process to assess seed germination percentage by utilizing germination paper, distilled water, trays ot containers, germinator machine (chember). In laboratory, seeds are placed in between folded germination paper towels moistened with distilled water. Germination paper towels are 'squeezed' to remove excess water prior to seed placement. The paper towel units are placed in plastic tubs covered with clear plastic wrap to help maintain moisture. These are put in a seed germinator machine. Temperatures alternate between 30°C with light for 12 hours and 20°C in darkness for 12 hours per 24 hour cycle. Number of seed are used as per thier size and weight, differ from species to species Counts are done from 7 days upto 52 days in different interval after start of test . Abnormal are not scored until the last count of the test.

A total of 19 forest seed samples were collected from FSLSC, Nepalgunj, Banke, for germination testing. The seeds were initially soaked in water for 24 hours, though harder seeds soaked up to 2 days, moistering the germination paper is done after the pre-treatment of seed. Treated seed was placed evenly on one half of the germination paper without touching each other and fold the another half paper over the seeds and pressed gently to ensure contact seed and paper, Stacking the

flat germination paper along with seed in plastic containers and sealed. The sealed containers were kept in germinator and adjusted appropriate temperature, moisture and humidity. containers were mointered daily to check moisture and fungal contamination and remove infected seeds as per needed. After the proper test period depends upon specieswise (7-52 days) counting of normal seed and abnormal seed and dead seeds were done and germination percentage was calculated using following formula.

$$Germination\ Percentage = \frac{(\text{No. of Normal seedlings})}{\text{Total no. of seeds tested}} \times 100$$

7.2 List of Seed proceed for Germination testing in FSLSC Lab, Nepalgung, Banke

S.N.	Name of Forest Seed		S.N.	Name of Forest Seed
1	Bakaino (*Melia azedarach*)		11	Shrikhanda (*Santalum album*)
2	Lapsi (*Choerospondias axillaris)*		12	Palas (*Butea monosperma*)
3	Sugandhakokila (*Cinnamomum glaucescens)*		13	Sitalchini (*Moringa oleifera*)
4	Mayurpanki Dhupi (*Platycladus orientalis*)		14	Barro (*Terminalia bellirica*)
5	Kapoor (*Cinnamomum camphora)*		15	Parijat (*Nyctanthes arbor-tristis*)
6	Siris (*Albizia lebbeck*)		16	Ritha (*Sapindus mukorossi*)
7	Sissoo (*Dalbergia Sissoo*)		17	Gulmohar (*Delonix regia*)
8	Jacaranda (*Jacaranda mimosifolia*)		18	Khair (*Acacia catechu*)
9	Ipil Ipil (*Leucaena leucocephala*)		19	Amala (*Phyllanthus emblica*)
10	Koiralo (*Bauhinia variegata*)		20	Bijayasal (Pterocarpus marsupium)

7.3 Germination Test Result of Forest Seeds

Bakaino

Common Name: Indian Lilac, Chinaberry, Persain Lilac, Bead tree
Scientific Name: *Melia azedarach*

It is a deciduous tree with multiple uses, typically reaching heights of 20-40 feet, with a rounded crown. It has compound leaves, fragrant flowers, and small, yellow, drupe-like fruits that persist on the tree throughout the winter. leaves are alternate, twice to three-times compound, with leaflets that are serrate or crenate. Parts of the tree, including the root, leaves, and flowers, have been traditionally used for various ailments, including fever, skin conditions, and intestinal parasites. Leaves are used as fodder for livestock, especially goats and also used as a natural insecticide and mosquito repellent.

Seed Name: **Bakaino**	Collection Place: **Banke**	Used seed for germination purpose: **50**
Seed treatment method		
Date:**2081/09/04**	Method: **Mild Hot Water Soak**	Time: **48 hrs**
Seed placed in Germinator date: **2081/09/6**	Set temperature in Machine: **34^0 C (day) and 25^{0}C (night)**	
Germination started date: **2081/09/18**	Germination ended date: **2081/10/09**	

Observation						
Days	13	19	33	Total germinated seed	Dead	Abnormal
Replication A	15	3	3	21	4	0
Replication B	7	5	7	19	6	0
Total	22	8	10	**40**	10	0

$$Germination\ Percentage = \frac{40}{50} \times 100 \quad = 80\%$$

Result:

The study indicates that the germination percentage of Bakaino seeds is 80%, with 20% dead seed. Out of the 50 seeds tested (25 seeds per replication across two replicates), 40 seed germinate well and 10 seeds seems dead during germination period. Seed starts to germinate after 13 days and continue up to 33 days.

The test indicate that the germination period of Bakaino seed is from 2 weeks to 5 weeks with 80% germination percentage treating seed with mild hot water for 48 hrs.

Lapsi

Common Name: Nepali hug plum, labsi, laus
Scientific Name: *Choerospondias axillaris*

Lapsi is native to the hilly regions of Nepal, particularly at altitudes between 850 and 1900 meters. It›s a large, deciduous tree known for its sour-sweet fruit, which is used in various culinary preparations, including pickles, jams, and candies. Lapsi fruits are greenish-yellow when ripe, with a white, slightly sour pulp that encloses a large oval seed. They are often described as having a pleasant tart flavor. Lapsi fruits are a good source of vitamin C and minerals like potassium, calcium, and magnesium. They also contain essential amino acids. Lapsi is an important underutilized fruit in Nepal, with potential for generating income and improving livelihoods in rural communities.

Seed Name: **Lapsi**	Collection Place: Makawanpur	Used seed for germination purpose: **20**
Seed treatment method		
Date:**2081/09/04**	Method: **Mild Hot Water Soak**	Time: **48 hrs**
Seed placed in Germinator date: **2081/09/06**		Set temperature in Machine: **34^0 C (day) and 25^{0}C (night)**
Germination started date: **2081/09/16**		Germination ended date: **2081/10/15**

Observation

Days	11	20	39	Total germinated seed	Dead	Abnormal
Replication A	2	2	2	6	4	0
Replication B	3	3	4	10	0	0
Total	5	5	6	**16**	4	0

$Germination\ Percentage = \frac{18}{50} \times 100 = 36\%$

Result:

The study indicates that the germination percentage of Lapsi seeds is 80%, with 20% dead seed. Out of the 20 seeds tested (10 seeds per replication across two replicates), 16 seed germinate well and 4 seeds was dead during germination period. Seed starts to germinate after 11 days and continue up to 39 days.

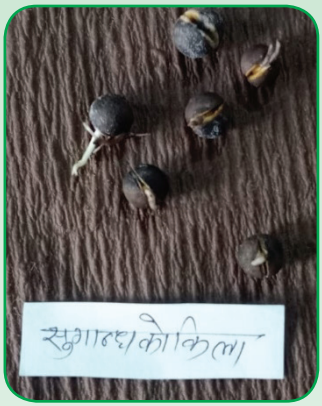
The test indicate that the germination period of Lapsi seeds is from 2 weeks to 6 weeks with 80% germination percentage treating seed with mild hot water for 48 hrs.

Sugandhakokila

Common Name: Malagedi, Telkaulo, Nepalese Cinnamomum
Scientific Name: *Cinnamomum glaucescens*

It is an aromatic tree native to Nepal, Bhutan, and parts of India.It's a medium-sized evergreen tree that can grow up to 20 meters tall, commonly found in the central and western districts of Nepal, at

elevations ranging from 1000 to 2500 meters. The leaves are elliptic, with a prominent mid-rib and several veins. The black, spherical fruits of this plant are the source of Sugandha Kokila oil, which is used in perfumery, cosmetics, and traditional medicine. The oil is known for its camphoraceous and spicy aroma. It has been successfully cultivated and promotes species conservation.



Seed Name: Sugandhakokila	Collection Place: Salyan	Used seed for germination purpose: 50
Seed treatment method		
Date:2081/09/04	Method: Mild Hot Water Soak	Time: 24 hrs
Seed placed in Germinator date: 2081/09/05	Set temperature in Machine: 34^0 C (day) and 25^0C (night)	
Germination started date: 2081/09/29	Germination ended date: 2081/10/22	
Observation		

Days	25	36	40	47	Total germinated seed	Dead	Abnormal
Replication A	2	5	5	-	12	13	
Replication B	1	-	1	4	6	19	
Total	3	5	6	4	18	32	

$$Germination\ Percentage = \frac{18}{50} \times 100 = 36\%$$

Result:

The test shows that the germination percentage of Sugandhakokila seeds is 36%, with 64% dead seed. Out of the 50 seeds tested (25 seeds per replication across two replicates), 18 seed germinate well and 32 seeds was dead during germination period. Seed starts to germinate after 25 days and continue up to 47 days.

The test indicate that the germination period of Sugandha Kokila seed is from 4 weeks to 7 weeks with 36% germination percentage treating seed with mild hot water for 24 hrs.

Mayurpanki dhupi

Common Name: Mor pankh, Mayur panki
Scientific Name: *Platycladus orientalis*

Platycladus orientalis is a much-branched, evergreen tree with a conical crown when young, becoming broadly rounded or irregular when old that can grow 20 metres or more tall. The striaght, cylindrical bole can be 100cm or more in diameter. A commonly used medicinal herb in China, where the plant is harvested from the wild and also cultivated. Found in steep dry rocky valley slopes; at elevations from 300 - 3,300 metres. The plant is also valued for its wood and is often grown as an ornamental, where it can be used to make a hedge.This is also one of the most commonly planted amenity and ornamental conifers, a tradition that goes back many centuries. It is therefore a common tree in parks of towns and cities in much of temperate Asia. The leaves are antibacterial, antipyretic, antitussive, astringent, diuretic, emmenagogue, emollient, expectorant, febrifuge, haemostatic, refrigerant and stomachic. They are used internally in the treatment of coughs, haemorrhages, excessive menstruation, bronchitis, asthma, skin infections, mumps, bacterial dysentery, arthritic pain and premature baldness

Seed Name: **Mayur-panki dhupi**	Collec-tion Place: Makawanpur	Used seed for germination pur-pose: **100**
Seed treatment method		
Date:**2081/09/04**	Method: **Mild Hot Water Soak**	Time: **24 hrs**
Seed placed in Germinator date: **2081/09/05**		Set temperature in Machine: **34^0 C (day) and 25^0C (night)**
Germination started date: **2081/09/14**		Germination ended date: **2081/10/11**

Observation						
Days	10	21	36	Total germinated seed	Dead	Abnormal
Replication A	2	5	8	15	10	
Replication B	9	7	5	21	4	
Replication C	5	7	4	16	9	
Replication D	5	5	7	17	8	
Total	4	9	6	**69**	31	

$$Germination\ Percentage = \frac{69}{100} \times 100 = 69\%$$

Result:

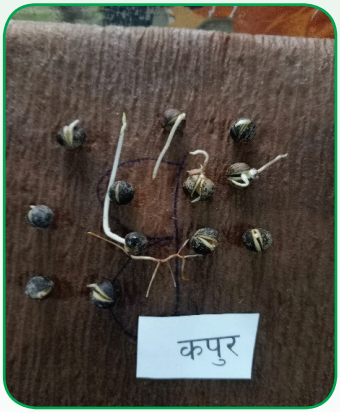
The test shows that the germination percentage of Mayurpanki seeds is 69%. Out of the 100 seeds tested (25 seeds per replication across four replicates), 69 seeds germinate. Seed starts to germinate after 10 days and continue up to 36 days.

The test indicate that the germination period of Mayurpanki Dhupi seed is from 2 weeks to 5 weeks with 69% germination percentage treating seed with mild hot water for 24 hrs.

Kapoor

Common Name: Kapur
Scientific Name: *Cinnamomum camphora*

It is an evergreen tree grow up to 15 m tall. Branches terete, glabrous, terminal and axillary buds covered by imbricate bracts, young twigs with clusters of scars from fallen bracts. Leaves alternate, petiole to 3 cm. Leaf blade ovate to elliptic or elliptic-lanceolate, with 1-3 primary veins, 7-12 × 3-5 cm, base rounded to cuneate, apex sharply acute; surfaces glabrous except for pubescent domatia in axils of main lateral veins. It bears tiny,



inconspicuous flowers. These greenish-white blossoms measure only 1-2 millimeters and lack petals. It produces a drupe measuring to 9 mm. The tree flowering time is from April to May and fruitig is generally occur from August to November. Leaves produces essential oil and used to production of commercial champor for manufacturing soap and perfume. In Nepal, it is mainly planted in gardens and at the entrances of houses for religious reasons, and as an ornamental tree, though the wood is valuable

Seed Name: **Kapoor**	Collection Place: Salyan	Used seed for germination purpose: **50**
Seed treatment method		
Date:**2081/9/4**	Method: **Soak in Mild Hot Water**	Time: **48 hrs**
Seed placed in Germinator date: **2081/9/6**	Set temperature in Machine: **34^0 C (day) and 25^{0}C (night)**	
Germination started date: **2081/10/2**	Germination ended date: **2081/10/27**	

Observation						
Days	26	39	51	Total germinated seed	Dead	Abnormal
Replication A	9	11	2	22	3	
Replication B	3	4	12	19	4	
Total	12	15	14	**41**	9	

$$Germination\ Percentage = \frac{69}{100} \times 100 = 69\%$$

Result:

The test shows that the germination percentage of Kapoor seeds is 82%, with 18% dead seed. Out of the 50 seeds tested (25 seeds per replication across two replicates), 41 seed germinate well and 18 seeds was dead during germination period. Seed starts to germinate after 26 days and continue up to 51 days.

The test indicate that the germination period of Kapoor seed is from 4 weeks to 8 weeks with 82% germination percentage treating seed with mild hot water for 48 hrs.

Siris

Common Name: Indian siris, East Indian walnut, frywood, koko, woman's tongue tree

Scientific Name: *Albizia lebbeck*

Albizia lebbeck is a deciduous, unarmed tree to 100 ft (30 m) tall, with a rounded, spreading crown and with grey fissured corky bark. Usually multi-stemmed, it can be grown as a single straight stem. *Albizia lebbeck* is found in a wide range of climates. The variety can be semi-desert, to humid regions. It is probably native to Asia, but has now been introduced to Florida, the Pacific Islands, Australia, Japan, China, Indonesia, Malaysia, New Zealand and Indian Ocean islands. Its uses include environmental management, forage, medicine and wood. It is cultivated as a shade tree. Lebbeck is an astringent, also used by some cultures to treat boils, cough, to treat the eye, flu, gingivitis, lung problems, pectoral problems, is used as a tonic, and is used to treat abdominal tumors.[12] The bark is used medicinally to treat inflammation.

Seed Name: **Siris**	Collection Place: Banke	Used seed for germination purpose: **50**
Seed treatment method		
Date:**2081/10/14**	Method: **Mild Hot Water Soak**	Time: **24 hrs**
Seed placed in Germinator date: **2081/10/15**	Set temperature in Machine: **37^0 C (day) and 25^{0}C (night)**	
Germination started date: **2081/10/18**	Germination ended date: **2081/10/22**	

Observation							
Days	4	8			Total germinated seed	Dead	Abnormal
Replication A	17	2			19	6	
Replication B	17	4			21	4	
Total	34	6			**40**	10	

$$Germination\ Percentage = \frac{40}{50} \times 100 = 80\%$$

Result:

The test shows that the germination percentage of Siris seeds is 80%, with 20% dead seed. Out of the 50 seeds tested (25 seeds per replication across two replicates), 40 seed germinate well and 10 seeds was dead during germination period. Seed starts to germinate after 4 days and continue up to 8 days.

The test indicate that the germination period of Siris seed is from 1 weeks with 80% germination percentage treating seed with mild hot water for 24 hrs.

Sissoo

Common Name: Indian Rosewood or Sheesham
Scientific Name: *Dalbergia sissoo*

Dalbergia sissoo is a medium to large deciduous tree with a light crown, which reproduces by seeds and suckers.[4] It can grow up to 25 m (82 ft) in height and 2 to 3 m (6 ft 7 in to 9 ft 10 in) in diameter, but is usually smaller. Trunks are often crooked when grown in the open. Leaves are leathery, alternate, pinnately compound, and about 15 cm (5.9 in) long. Flowers are whitish to pink, fragrant, nearly sessile, up to 1.5 cm (0.59 in) long, and in dense clusters 5 to 10 cm (2.0 to 3.9 in) in

length. Pods are oblong, flat, thin, strap-like, 4 to 8 cm (1.6 to 3.1 in) long, 1 cm (0.39 in) wide, and light brown. They have a long taproot and numerous surface roots that produce suckers. *It* is native to the foothills of the Himalayas ranging from Afghanistan in the west to Bihar, India, in the east. It is primarily found growing along river banks above 200 m (700 ft) elevation, but can range naturally up to 1,400 m (4,600 ft). It is the best known economic timber species of the rosewood genus sold internationally, but it is also used as fuel wood and for shade and shelter. The tree›s seed oil and powdered wood are used in the treatment of skin ailments.

Seed Name: **Sissoo**	Collection Place: Banke	Used seed for germination purpose: **50**
Seed treatment method		
Date:**2081/10/14**	Method: **Mild Hot Water Soak**	Time: **24 hrs**
Seed placed in Germinator date: **2081/10/15**	Set temperature in Machine: **37^0 C (day) and 25^{0}C (night)**	
Germination started date: **2081/10/20**	Germination ended date: **2081/10/27**	
Observation		

Days	13				Total germinated seed	Dead	Abnormal
Replication A	23				23	2	
Replication B	25				25	-	
Total	48				**48**	3	

$$Germination\ Percentage = \frac{48}{50} \times 100 = 96\%$$

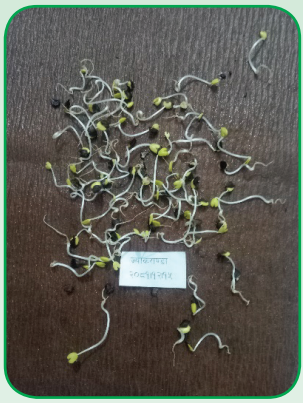
Result:

The test shows that the germination percentage of Sissoo seeds is 96%, with 4% dead seed. Out of the 50 seeds tested (25 seeds per replication across two replicates), 48 seed germinate well and 2 seeds was dead during germination period. Seed starts to germinate with in 13 days.

The test indicate that the germination period of Sissoo seed is 1 to 2 weeks with 96% germination percentage treating seed with mild hot water for 24 hrs.

Jacaranda

Common Name: Blue Jacaranda, Fern Tree, or Black Poui
Scientific Name: *Jacaranda mimosifolia*



Jacaranda mimosifolia is a sub-tropical tree native to south-central South America that has been widely planted elsewhere because of its attractive and long-lasting violet-colored flowers. The tree grows to a height of up to 20 m (66 ft).[4] Its bark is thin and gray-brown, smooth when the tree is young but eventually becoming finely scaly. The twigs are slender and slightly zigzag; they are a light reddish-brown. The flowers are up to 5 cm (2 in) long, and are grouped in 30 cm (12 in) panicles. They appear in spring and early summer, and last for up to two months. They are followed by woody seed pods, about 5 cm (2 in) in diameter, which contain numerous flat, winged seeds. The blue jacaranda has been cultivated in almost every part of the world where there is no risk of frost; established trees, however, tolerate brief spells of temperatures down to around 7 °C (19 °F).

Seed Name: **Jackranda**	Collection Place:	Used seed for germination purpose: **100**
Seed treatment method		
Date:**2081/12/04**	Method: **Soak in Cold Water**	Time: **24 hrs**
Seed placed in Germinator date: **2081/12/05**	Set temperature in Machine: **37^0 C (day) and 25^{0}C (night)**	
Germination started date: **2081/12/8**	Germination ended date: **2081/12/11**	

Observation							
Days	4	7			Total germinated seed	Dead	Abnormal
Replication A	11	10			21	4	
Replication B	9	10			19	6	

Replication C	16	7			23	2	
Replication D	21	3			24	1	
Total	57	30			**87**	13	

$$Germination\ Percentage = \frac{87}{100} \times 100 = 87\%$$

Result:

The test shows that the germination percentage of Jacaranda seeds is 87%, with 13% dead seed. Out of the 100 seeds tested (25 seeds per replication across four replicates), 87 seed germinate well and 13 seeds was dead during germination period. Seed starts to germinate with in 4 to 7 days.

The test indicate that the germination period of Jacaranda seed is below 1 weeks with 87% germination percentage treating seed with soaked in clod water for 24 hrs.

Ipil Ipil

Common Name: white Lead Tree, White Popinac, and Horse Tamarind
Scientific Name: *Leucaena leucocephala*

Ipil-ipil is a small tree growing up 8 meters high. Leaves are compound, 15 to 25 centimeters long, with hairy rachis. Pinnae are 8 to 16, and 5 to 8 centimeters long. Leaflets are 20 to 30, linear oblong, and 7 to 12 millimeters long. It was also considered a boon-and-bane tree, both for its forage use and propensity to spread. It has also been described as a "conflict tree" because it is used for forage production but spreads like a weed in some places. The legume provides an excellent source of high-protein cattle fodder. *Leucaena leucocephala* has been considered for biomass production because its reported yield of foliage corresponds to a dried mass of 2,000–20,000 kg/ha/year. It is also efficient in nitrogen fixation, at more than 500 kg/

ha/year. It has a very fast growth rate: young trees reach a height of more than 20 ft in two to three years.

Seed Name: **Ipil Ipil**	Collection Place:	Used seed for germination purpose: **50**
Seed treatment method		
Date:**2081/12/09**	Method: **Soaked in cold water**	Time: 48 **hrs**
Seed placed in Germinator date: **2081/12/11**	Set temperature in Machine: **37⁰ C (day) and 25⁰C (night)**	
Germination started date: **2081/12/15**	Germination ended date: **2081/12/18**	

Observation							
Days	5	8			Total germinated seed	Dead	Abnormal
Replication A	8	10			18	7	
Replication B	6	11			17	8	
Total	14	21			**35**	15	

$$Germination\ Percentage = \frac{35}{50} \times 100 = 70\%$$

Result:

The test shows that the germination percentage of Ipil Ipil seeds is 70%, with 30% dead seed. Out of the 50 seeds tested (25 seeds per replication across two replicates), 35 seed germinate well and 15 seeds was dead during germination period. Seed starts to germinate with in 1 week.

The test indicate that the germination period of Ipil Ipil seed is 1 week with 70% germination percentage treating seed with soaked in cold water for 48 hrs.

Koiralo

Common Name: Mountain Ebony, Orchid Tree, or Camel's Foot Tree
Scientific Name: *Bauhinia variegata*

It is a small to medium-sized tree growing to 10–12 metres tall, deciduous in the dry season. The leaves are 10–20 centimetres obcordate shaped, long and broad, rounded, and bilobed at the base and apex. The flowers are

conspicuous, bright pink or white, 8–12 centimetres diameter, with five petals. Pollens are elongated, approximately 75 microns in length. The fruit is a seedpod 15–30 centimetres long, containing several seeds. The seedpod dries completely on the tree, and when mature begins to twist into a helix or corkscrew shape. This is a very popular ornamental tree in subtropical and tropical climates, grown for its scented flowers and also used as a food item in many South Asian cuisines. The flower and the buds are used to make Nepalese style achaar.

Seed Name: **Koiralo**		Collection Place:			Used seed for germination purpose: **50**		
Seed treatment method							
Date:**2081/12/20**		Method: **Soaked in cold water**			Time: 24 **hrs**		
Seed placed in Germinator date: **2081/12/21**					Set temperature in Machine: **37⁰ C (day) and 25⁰C (night)**		
Germination started date: **2081/12/25**					Germination ended date: **2081/12/28**		
Observation							
Days	5	8			Total germinated seed	Dead	Abnormal
Replication A	22	3			25	-	
Replication B	20	3			23	2	
Total	42	6			**48**	2	

$$Germination\ Percentage = \frac{48}{50} \times 100 = 96\%$$

Result:

The test shows that the germination percentage of Koirala seeds is 96%, with 4% dead seed. Out of the 50 seeds tested (25 seeds per replication

across two replicates), 48 seed germinate well and 2 seeds was dead during germination period. Seed starts to germinate within 8 days.

The test indicate that the germination period of Koiralo seed is 1 weeks with 96% germination percentage treating seed with cold water for 24 hrs.

Shrikhanda

Common Name: White Sandalwood, Indian Sandalwood, Srigandha, Chandana

Scientific Name: Santalum album

Shrikhanda is an evergreen tree with medium-sized tree gaining highest of 20m and girth up to 2.4m, mainly grown for extraction of timber and essential oil. The tree has slender, drooping branchlets. Its bark is typically dark brown, grey, or nearly black, smooth in young trees and rough in older ones. Flowers purplish-brown, small, straw coloured, reddish, green or violet, about 4-6 mm long, up to 6 in small terminal or axillary clusters, unscented in axillary or terminal, paniculate cymes. Fruit a globose, fleshy drupe; red, purple to black when ripe, about 1 cm in diameter, with hard ribbed endocarp and crowned with a scar, almost stalkless, smooth, single seeded. Santalum album's heartwood is steam-distilled to produce sandalwood oil, which is known for its distinctive, sweet, and lasting fragrance. Sandalwood oil has been used traditionally in Ayurvedic medicine and is known for its anti-inflammatory, antibacterial, and antifungal properties.

Seed Name: **Shrikhanda**	Collection Place: Pyuthan	Used seed for germination purpose: **50**
Seed treatment method		
Date:**2081/09/4**	Method: **Soaked in mild hot water**	Time: 48 **hrs**
Seed placed in Germinator date: **2081/09/06**		Set temperature in Machine: **34^0 C (day) and 25^{0}C (night)**
Germination started date: **2081/10/18**		Germination ended date: **2081/10/30**

Observation							
Days	42	54			Total germinated seed	Dead	Abnormal
Replication A	9	13			22	3	
Replication B	8	8			16	9	
Total	17	21			**38**	12	

$$Germination\ Percentage = \frac{38}{50} \times 100 = 76\%$$

Result:

The test shows that the germination percentage of Shrikhanda seeds is 76%, with 24% dead seed. Out of the 50 seeds tested (25 seeds per replication across two replicates), 38 seed germinate well and 12 seeds was dead during germination period. Seed starts to germinate from 42 days upto 54 days.

The test indicate that the germination period of Shrikhanda seed is 6 weeks to 8 weeks with 76% germination percentage treating seed with mild hot water for 48 hrs.

Palas

Common Name: Flame of the Forest, Palash
Scientific Name: *Butea monosperma*

The Palash tree, scientifically known as Butea monosperma, is a deciduous tree native to the Indian subcontinent. It is commonly called "Flame of the Forest" due to its vibrant orange-red flowers that bloom in the dry season. The tree is known for its slow growth and can reach heights of 15-25 meters. It has pinnate leaves with three leaflets and produces pods containing seeds. The Palash tree is a valuable resource in traditional medicine, with various parts of the tree used for different ailments. It is also used in the

preparation of natural dyes for festivals like Holi, where the vibrant red flowers are used to create a natural color. The tree's ability to tolerate dry conditions and salt-affected soils makes it suitable for environmental restoration projects.

Seed Name: Palas	Collection Place:	Used seed for germination purpose: 5
Seed treatment method		
Date:2081/12/13	Method: Soaked in cold water	Time: 24 hrs
Seed placed in Germinator date: 2081/12/14	Set temperature in Machine: 34^0 C (day) and 25^0C (night)	
Germination started date: 2081/12/19	Germination ended date: 2081/12/21	

Observation							
Days	6	8			Total germinated seed	Dead	Abnormal
Replication A	2	1			3	-	
Replication B	1	-			1	1	
Total	3	1			4	1	

$Germination\ Percentage = \frac{4}{5} \times 100 = 80\%$

Result:

The test shows that the germination percentage of Palash seeds is 80%, with 20% dead seed. Out of the 5 seeds tested (2 and 3 seeds across two replicates), 4 seed germinate well and 1 seeds was dead during germination period. Seed starts to germinate after 6 days and continue up to 8 days.

The test indicate that the germination period of Palas seed is from about 1 weeks with 80% germination percentage treating seed with cold water treatment for 24 hrs.

Sital chini

Common Name: Morinda, Drumstick tree, horseradish tree, ben oil tree.
Scientific Name: *Moringa oleifera*

Sital chini is a fast-growing tree native to the terai and inner terai area of Nepal. It is a small, graceful, deciduous tree with sparse foliage, often resembling a leguminous species at a distance, especially when in flower, but immediately recognized when in fruit. The tree grows to 8 m high and 60 cm dbh. Bole crooked, often forked from near the base. Moringa trees grow quickly and are well-adapted to dry, tropical environments. It's commonly called the "miracle tree" due to its high nutritional value and medicinal properties, and it's widely cultivated in tropical and subtropical regions. Moringa is used for various purposes, including nutritional supplementation, medicine, and even industrial applications. All parts of the tree, especially the leaves, are packed with nutrients like vitamins, minerals, and protein. Moringa has been traditionally used to treat various ailments, including inflammation, paralysis, and hypertension. Moringa leaves are used as a vegetable, while seeds yield ben oil, which is used in cooking and as a lubricant.

Seed Name: **Sitalchini**	Collection Place:	Used seed for germination purpose: **20**
Seed treatment method		
Date:**2081/12/20**	Method: **Soaked in cold water**	Time: 24 **hrs**
Seed placed in Germinator date: **2081/12/21**		Set temperature in Machine: **37^0 C (day) and 25^{0}C (night)**
Germination started date: **2081/12/25**		Germination ended date: **2081/12/31**

Observation							
Days	5	8	11		Total germinated seed	Dead	Abnormal
Replication A	5	4			9	1	
Replication B	1	6	3		10	-	
Total	6	10	3		**19**	1	

$$Germination\ Percentage = \frac{19}{20} \times 100 = 95\%$$

Result:

The test shows that the germination percentage of Sital chini seeds is 95%, with 5% dead seed. Out of the 20 seeds tested (10 seeds per replication across two replicates), 19 seed germinate well and 1 seeds was dead during germination period. Seed starts to germinate after 5 days and continue up to 8 days.

The test indicate that the germination period of Sital chini seed is 1 weeks with 95% germination percentage treating seed with cold water for 24 hrs.

Barro

Common Name: Beleric myrobalan, Bahera (Hindi), Bibhitaki (Sanskrit)
Scientific Name: *Terminalia bellirica*

The barro tree is a large deciduous tree native to the Indian subcontinent and Southeast Asia. It can grow up to 50 meters tall and 3 meters in diameter, with a thick brownish-gray bark and buttressed trunk. The tree is known for its medicinal properties, with both the fruits and bark used in traditional medicine in India and Thailand. It is used in traditional medicine for various ailments, including digestive problems, and for wound healing. The fruits are used in tanning hides, dying cloth, and

making ink. The kernels can be eaten, but have narcotic properties. The oil from the seeds is used in hair oil and soap making. The fruits of the barro tree are subglobose to broadly ellipsoid drupes, 2-3.5 cm long, and five angular. The tree can grow on various soils, including dry and clayey soils. In Sanskrit, the tree is known as Vibhita and Vibhitaka, which translates to "fearless" and is avoided by some Hindus in Northern India due to a belief that it is inhabited by demons.

Seed Name: Barro	Collection Place:	Used seed for germination purpose: 20
Seed treatment method		
Date:2081/12/5	Method: Soaked in cold water	Time: 48 hrs
Seed placed in Germinator date: 2081/12/07	Set temperature in Machine: 37^0 C (day) and 25^0C (night)	
Germination started date: 2081/12/16	Germination ended date: 2081/12/28	

Observation							
Days	10	16	22		Total germinated seed	Dead	Abnormal
Replication A	6	3	1		10	-	
Replication B	7	2	-		9	1	
Total	13	5	1		19	1	

$$Germination\ Percentage = \frac{19}{20} \times 100 = 95\%$$

Result:

The test shows that the germination percentage of Barro seeds is 95%, with 5% dead seed. Out of the 20 seeds tested (10 seeds per replication across two replicates), 19 seed germinate well and 1 seeds was dead during germination period. Seed starts to germinate after 10 days and continue up to 22 days.

The test indicate that the germination period of Barro seed is from 1 weeks to 3 weeks with 95% germination percentage treating seed with cold water for 48 hrs.

Parijaat

Common Name: Coral Jasmine, Night Jasmine, and Queen of the Night.
Scientific Name: Nyctanthes arbor-tristis.

The Parijat tree is a small to medium-sized tree or shrub native to South and Southeast Asia. It's renowned for its fragrant, white flowers that bloom primarily at night, hence the name "Night Jasmine". The flowers have a distinctive orange-red center and are known for their delicate appearance and strong scent. The fruit is brown, round to heart-shaped capsules containing a single seed. It prefers dry hill shades, dry deciduous forests, and loamy soils. In Ayurvedic, the Parijat plant is used in traditional Ayurvedic medicine for various health applications. In Hindu mythology, the Parijat is considered a divine tree, said to have originated in heaven and brought to Earth by Lord Krishna. The flowers are often used in religious offerings and rituals, symbolizing eternal love and beauty. The flowers are cultivated for their fragrance, which is used in perfumes and dyes.

Seed Name: **Parijaat**	Collection Place:	Used seed for germination purpose: **50**
Seed treatment method		
Date:**2081/12/20**	Method: **Soaked in cold water**	Time: 24 **hrs**
Seed placed in Germinator date: **2081/12/21**	Set temperature in Machine: **37⁰ C (day) and 25⁰C (night)**	
Germination started date: **2081/12/27**	Germination ended date: **2081/12/31**	

Observation

Days	7	11			Total germinated seed	Dead	Abnormal
Replication A	17	7			24	1	
Replication B	15	10			25	-	
Total	32	17			**49**	1	

$$Germination\ Percentage = \frac{49}{50} \times 100 = 98\%$$

Result:

The test shows that the germination percentage of Parijaat seeds is 98%, with 2% dead seed. Out of the 50 seeds tested (25 seeds per replication across two replicates), 49 seed germinate well and 1 seeds was dead during germination period. Seed starts to germinate after 7 days and continue up to 11 days.

The test indicate that the germination period of Parijaat seed is from 1 weeks to 2 weeks with 98% germination percentage treating seed with cold water for 24 hrs.

Ritha

Common Name: Ritha, Reetha, Soapberry, Soapnut, Washnut.

Scientific Name: Sapindus mukorossi.

The Ritha tree is a deciduous tree often reaching heights of 12-20 meters. It›s a significant plant in tropical and subtropical Asia, including regions of India, Nepal, and China. The fruits are leathery-skinned drupes, yellow when unripe and turning black when ripe. The tree's fruits, commonly called soapnuts or washnuts, are known for their natural cleansing and cleaning properties due to the presence of saponins. The tree is known for its shade-providing capabilities and tolerance to various soil types, making it suitable for planting around homes and in gardens.

Seed Name: **Ritha**	Collection Place: Baitadi	Used seed for germination purpose: **20**
Seed treatment method		
Date:**2081/12/8**	Method: **Soaked in cold water**	Time: **7 days**
Seed placed in Germinator date: **2081/12/15**		Set temperature in Machine: **37^0 C (day) and 25^{0}C (night)**

Germination started date: **2081/12/23**					Germination ended date: **2082/1/3**		
Observation							
Days	10	15	20		Total germinated seed	Dead	Abnormal
Replication A	4	2	3		9	1	
Replication B	5	1	4		10	-	
Total	9	3	7		**19**	1	

$Germination\ Percentage = \frac{19}{20} \times 100 = 95\%$

Result:

The test shows that the germination percentage of Ritha seeds is 95%, with 5% dead seed. Out of the 20 seeds tested (10 seeds per replication across two replicates), 19 seed germinate well and 1 seeds was dead during germination period. Seed starts to germinate after 10 days and continue up to 20 days.

The test indicate that the germination period of Ritha seed is from 1 weeks to 3 weeks with 95% germination percentage treating seed with cold water for 7 days.

Gulmohar

Common Name: Flame Tree, Royal Poinciana, or Flamboyant Tree, Peacock Tree
Scientific Name: *Delonix regia*

The Gulmohar tree is a striking ornamental tree native to Madagascar, often called the "Flame Tree" or "Royal Poinciana". It's known for its beautiful, vibrant red-orange flowers and fern-like leaves, making it a popular choice for landscaping in tropical and subtropical regions worldwide. Gulmohar trees are known for their impressive size,

reaching heights of 10-18 meters (30-60 feet). They have a fast growth rate and develop a broad, umbrella-shaped crown. The tree's most striking feature is its flamboyant, orange-red flowers, which bloom in large clusters from April to June. Gulmohar is primarily grown as an ornamental tree, appreciated for its shade-giving properties and aesthetic value. It's also used in urban and agroforestry settings. Traditional medicinal uses have been documented for the plant, including potential anti-diabetic, anti-bacterial, and anti-inflammatory properties.

Seed Name: Gulmohar	Collection Place:	Used seed for germination purpose: 20
Seed treatment method		
Date:2081/12/5	Method: Soaked in cold water	Time: 24 hrs
Seed placed in Germinator date: 2081/12/06	Set temperature in Machine: 37^0 C (day) and 25^0C (night)	
Germination started date: 2081/12/20	Germination ended date: 2081/12/28	
Observation		

Days	15	23			Total germinated seed	Dead	Abnormal
Replication A	5	3			8	2	
Replication B	4	5			9	1	
Total	9	8			17	3	

$Germination\ Percentage = \frac{17}{20} \times 100 = 85\%$

Result:

The test shows that the germination percentage of Gulmohar seeds is 85%, with 15% dead seed. Out of the 20 seeds tested (10 seeds per replication across two replicates), 17 seed germinate well and 3 seeds was dead during germination period. Seed starts to germinate after 15 days and continue up to 23 days.

The test indicate that the germination period of Gulmohar seed is from 2 weeks to 3 weeks with 85% germination percentage treating seed with cold water for 24 hrs.

Khair

Common Name: Black Cutch, Catechu, or Cutch tree in English, and Khair or Kachu

Scientific Name: *Acacia catechu*

Khair is a medium-sized, deciduous tree growing up to 15 meters (50 feet) in height found in Asia, including Nepal. The pale yellow flowers grow in spikes and fruit is a flat, straight pod. It is known for its durable wood and various uses, including traditional medicine, tanning, and dyeing. The tree is also a source of cutch, an extract used in industries like tanning and dyeing. The tree's heartwood, bark, and wood extract have been used in traditional Ayurvedic and Unani medicine for centuries. The leaves are lopped for use as fodder, particularly for sheep and goats. Khair wood is considered sacred and used in religious ceremonies.

Seed Name: **Khair**	Collection Place:	Used seed for germination purpose: **50**
Seed treatment method		
Date:**2081/12/4**	Method: **Soaked in cold water**	Time: 24 **hrs**
Seed placed in Germinator date: **2081/12/05**	Set temperature in Machine: **37^0 C (day) and 25^{0}C (night)**	
Germination started date: **2081/12/10**	Germination ended date: **2081/12/15**	

Observation

Days	6	11			Total germinated seed	Dead	Abnormal
Replication A	8	5			13	12	
Replication B	10	7			17	8	
Total	18	12			**30**	20	

$$Germination\ Percentage = \frac{30}{50} \times 100 = 60\%$$

Result:

The test shows that the germination percentage of Khair seeds is 60%, with 40% dead seed. Out of the 50 seeds tested (25 seeds per replication across two replicates), 30 seed germinate well and 20 seeds was dead during germination period. Seed starts to germinate after 6 days and continue up to 11 days.

The test indicate that the germination period of Khair seed is from 1 weeks to 2 weeks with 60% germination percentage treating seed with cold water for 24 hrs.

Amala

Common Name: Indian gooseberry, emblic, emblic myrobalan, myrobalan, Malacca tree Scientific Name: Emblica officinalis

The amla tree is a small to medium-sized deciduous tree native to the Indian subcontinent including Nepal. It's prized for its edible fruits, which are a rich source of vitamin C and antioxidants, and its various traditional medicinal uses. The tree typically reaches heights of 3-8 meters (10-26 feet) and has a wide, low-hanging canopy. Its leaves are narrow, light green, and closely packed along long branchlets. Flowers are Greenish-yellow, with six petals, and grow between the leaves and branchlets. The fruit is round, light greenish-yellow, and has a sour, astringent taste.

Seed Name: **Amala**	Collection Place:	Used seed for germination purpose: **50**
Seed treatment method		
Date:**2081/12/20**	Method: **Soaked in cold water**	Time: 48 **hrs**
Seed placed in Germinator date: **2081/12/23**	Set temperature in Machine: **37^0 C (day) and 25^{0}C (night)**	

Germination started date: **2081/12/31**					Germination ended date: **2082/1/6**		
Observation							
Days	9	15			Total germi-nated seed	Dead	Abnormal
Replication A	11	10			21	4	
Replication B	9	13			22	3	
Total	20	23			**43**	7	

$$Germination\ Percentage = \frac{43}{50} \times 100 = 86\%$$

Result:

The test shows that the germination percentage of Amala seeds is 86%, with 14% dead seed. Out of the 50 seeds tested (25 seeds per replication across two replicates), 43 seed germinate well and 7 seeds was dead during germination period. Seed starts to germinate after 9 days and continue up to 15 days.

The test indicate that the germination period of Amala seed is from 1 weeks to 2 weeks with 86% germination percentage treating seed with cold water for 48 hrs.

Bijayasal

Common Name: Malabar Kino or Kino tree
Scientific Name: *Pterocarpus marsupium*

Bijaysal is a medium to large deciduous tree native to Nepal and other parts of South Asia. It is found in the foothills of the Siwalik range, up to an altitude of 100-500 meters, as well as in the Terai region. It is a valuable species, both for its timber and the «kino» gum it produces, which has been used in traditional medicine and as a natural adhesive. The tree is also known for

its medicinal properties, particularly its potential for treating diabetes. Tree is valued for its timber, "kino" gum (used as a natural adhesive and in traditional medicine), and potential medicinal properties. Tree is listed as "Near Threatened" by the IUCN Red List and considered a priority species by the Nepal government.

Seed Name: **Bijayasal**	Collection Place: Kanchanpur	Used seed for germination purpose: **20**
Seed treatment method		
Date:**2081/12/11**	Method: **Soaked in cold water**	Time: 48 **hrs**
Seed placed in Germinator date: **2081/12/13**	Set temperature in Machine: **37^0 C (day) and 25^{0}C (night)**	
Germination started date: **2081/12/19**	Germination ended date: **2081/12/29**	

Observation

Days	7	17			Total germinated seed	Dead	Abnormal
Replication A	3	4			7	3	
Replication B	4	1			5	5	
Total	7	5			**12**	8	

$$Germination\ Percentage = \frac{12}{20} \times 100 = 60\%$$

Result:

The test shows that the germination percentage of Bijayasal seeds is 60%, with 40% dead seed. Out of the 20 seeds tested (10 seeds per replication across two replicates), 12 seed germinate well and 8 seeds was dead during germination period. Seed starts to germinate after 7 days and continue up to 17 days.

The test indicate that the germination period of Bijayasal seed is from 1 weeks to 3 weeks with 60% germination percentage treating seed with cold water for 48 hrs.

8. Seed Viability Test using Triphenyl Tetrazolium Chloride

8.1 Objectives:

The purpose of testing is to determine the seed viability percentage of the different forest seed collected from Forest Seed Laboratory and Storage Centre (FSLSC), Nepalgunj, Banke. This process helps evaluate the quality and germination potential of the seeds, ensuring they remain suitable for plantation or conservation purposes. Such tests play a crucial role in forest management and regeneration efforts.

The tetrazolium test offers a rapid and efficient way to assess seed viability by utilizing a biochemical reaction. When the living embryo of a seed is exposed to a colorless tetrazolium solution, it converts it into a red-colored compound called formazan. This transformation occurs because respiratory enzymes (dehydrogenases) reduce the tetrazolium, indicating metabolic activity.

Initially, the tetrazolium solution is water-soluble and colorless, but active seeds stain red, signaling respiratory activity and viability. The intensity of the color correlates with metabolic vigor—a dark red shade reflects high viability, whereas light pink suggests diminished vitality. Seeds with little to no color change are considered non-viable. This method provides a simple yet reliable measure of a seed's potential to germinate.

A total of 8 forest seed samples were collected from FSLSC, Nepalgunj, Banke, for viability testing. The seeds were initially soaked in water for 24 hours, though harder seeds required up to 3 days of soaking. Each seed was carefully bisected longitudinally, exposing one-third of the embryo. For the test, only one half of each seed was used and treated with a 0.2% tetrazolium solution.

The treated seeds were incubated in a dark place at a temperature of 25–30°C for 24 hours. After incubation, the seeds were analyzed to assess their viability based on the color change indicating respiratory activity.

This method ensures an accurate determination of seed viability while maintaining a streamlined process.

8.2 List of seed collected from Forest Seed Laboratory and Storage Centre, Nepalgunj, Banke

S.no.	Name of Forest Seed
1	Siris *(Albizia lebbeck)*
2	Kapur *(Cinnamomum camphora)*
3	Shri Khanda *(Santalum album)*
4	Gulmohar/Gold mohar *(Delonix regia)*
5	Birendra Phul *(Jacaranda mimosifolia)*
6	Raktachandan/Red sandalwood *(Pterocarpus santalinus)*
7	Mayurpankhi Dhupi *(Platcladus orientalis)*
8	Mayurpankhi Dhupi *(Platcladus orientalis)*

8.3 Viability Test Reports of Forest Seeds

Siris

Common Name: Karoi tree, Shak Shak tree
Scientific Name: *Albizia lebbeck*

A medium size tree reaching 15-20 m in height with a spreading canopy. The tree is very widespread due to its high tolerance of drought, heat and salt. The flowers are white and very fragrant. The plant is fully but briefly deciduous in the dry season.

Viable	Replications					Remarks
	I	II	III	Total	Percentage	
Completely stained	9	10	8	27		*Entire embryo stained bright red/ Cherry red*
Completely stained with weak tissue	6	4	6	16		
Total	**15**	**14**	**14**	**43**	**95**	

Non- Viable						
Completely un-stained	0	1	0	1		*Entire embryo unstained (col-orless).*
Abnormal color or texture	0	0	1	1		*Stain very faint pink color.*
Total	**0**	**1**	**1**	**2**	**5**	

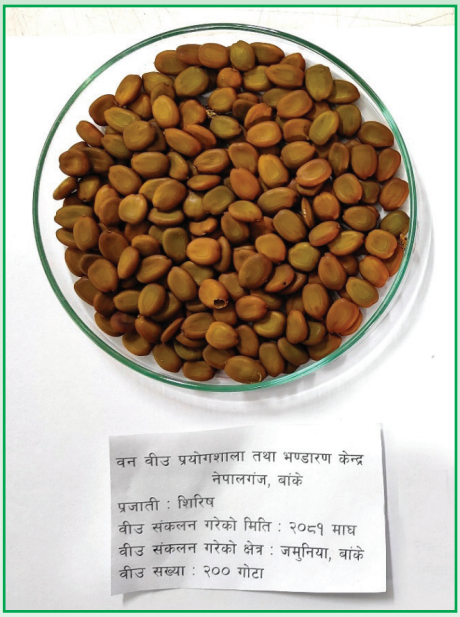
Result:

The collected seed lot revealed a high proportion of empty and dead seeds, resulting in a very low purity percentage. Laboratory tests were conducted on healthy seeds selected from the lot.

The study indicates that the viability percentage of Siris seeds is 95%, with only 5% recorded as non-viable. Out of the 45 seeds tested (15 seeds per replication across three replicates), 43 seeds displayed a bright red or cherry-colored embryo stain, confirming viability, while 2 seeds showed no stain or faint pink coloration, indicating non-viability.

The viability period of Siris seeds is noted to exceed 2 years under proper storage conditions. Pre-sowing treatments, such as soaking seeds in cold water for 24 hours, further enhance germination rates to 50%–80%.

The tetrazolium (TZ) test has confirmed that Siris seeds are viable and can be used as planting material. However, for the best outcomes, it is recommended to enhance the purity percentage of the seed lot before proceeding with sowing.


वन बीउ प्रयोगशाला तथा भण्डारण केन्द्र
नेपालगंज, बांके
प्रजाती : शिरिष
बीउ संकलन गरेको मिति : २०८१ माघ
बीउ संकलन गरेको क्षेत्र : जमुनिया, बांके
बीउ सख्या : २०० गोटा


APISMUHA

Siris

Kapur

Common Name: Camphor tree, Camphorwood
Scientific Name: *Cinnamomum camphora (*L.)

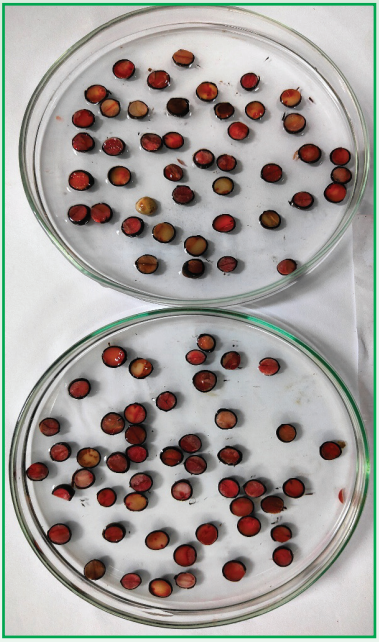
A tree reaching maximum of 20–30 m (66–98 ft) tall evergreen tree indigenous to warm temperate. The leaves have a glossy, waxy appearance and smell of camphor when crushed. In spring, it produces bright green foliage with masses of very small white fragrant flowers from which its common namesake "smells good tree" in Chinese. It produces clusters of black, berry-like fruit around 1 cm (3⁄8 in) in diameter. Its pale bark is very rough and fissured vertically.

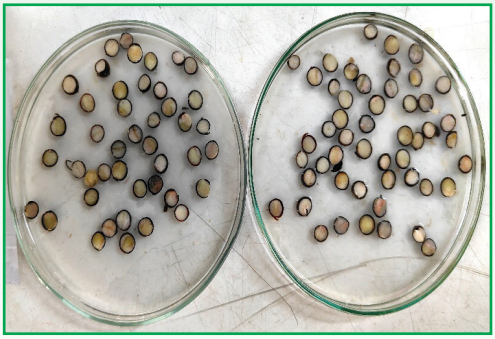
Viable	Replications					Remarks
	I	II	III	Total	Percentage	
Completely stained	29	30	28	87		*Entire embryo stained bright red/ Cherry red*
Completely stained with weak tissue	6	7	6	19		
Total	**35**	**37**	**34**	**106**	**71**	
Non- Viable						
Completely un-stained	3	3	5	11		*Entire embryo un-stained (colorless).*
Abnormal color or texture	12	10	11	33		*Stain very faint pink color.*
Total	**15**	**13**	**16**	**44**	**29**	

Result:

The study indicates that 71% of Kapur seeds were viable, while 29% were non-viable. A total of 150 seeds were analyzed, divided into three replications of 50 seeds each. Among these, 106 seeds displayed bright red or cherry-colored embryos, indicating viability, while 44 seeds showed no staining (colorless) or only a faint pink stain, signifying non-viability.

The viability period of Kapur seeds is recorded to be up to one year. By applying a pre-sowing treatment, such as soaking the seeds in cold water for 24 hours, their germination capacity improves significantly, ranging from 50% to 70%. Based on the results of the Tetrazolium (TZ) test, it has been confirmed that Kapur seeds are suitable for use as planting material.





Kapur

Shri Khanda

Common Name: Sandalwood, Chandan
Scientific Name: *Santalum album*

A small evergreen tropical tree which is the traditional source of sandalwood oil. It is greatly valued for its fragrance, and is considered sacred in some religions like Hinduism. The plant is long-lived, but harvest is only viable after many years.

Viable	Replications					Remarks
	I	II	III	Total	Percentage	
Completely stained	40	43	40	123		*Entire embryo stained bright red/ Cherry red*
Completely stained with weak tissue	2	1	2	5		
Total	**42**	**44**	**42**	**128**	**85**	
Non- Viable						
Completely unstained	2	5	5	12		*Entire embryo unstained (colorless).*
Abnormal color or texture	6	1	3	10		*Stain very faint pink color.*
Total	**8**	**6**	**8**	**22**	**15**	

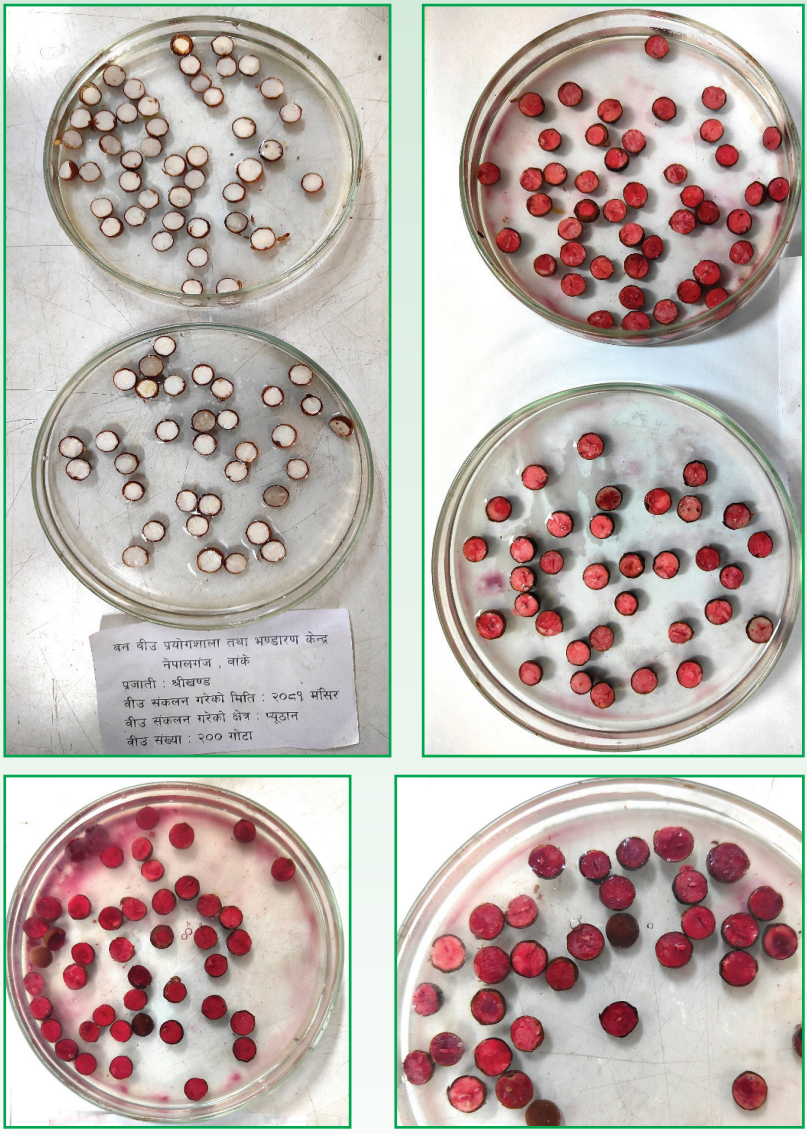
Result:

The study indicates that Shri Khanda seeds exhibit a viability percentage of 85%, while 15% are non-viable. Out of a total of 150 seeds tested (50 seeds in three replications), 128 seeds showed bright red or cherry-colored embryos, signifying viability. The remaining 22 seeds were either unstained (colorless) or displayed a faint pink stain, indicating non-viability.

The viability period of Shri Khanda seeds is recorded as one year. By employing a pre-sowing treatment, such as soaking the seeds in cold

water for 24 hours, the germination capacity can range from 30% to 80%.

Based on the results of the Tetrazolium (TZ) test, it is concluded that Shri Khanda seeds are viable and can be used for sowing.



Shri Khanda (White Sandalwood)

Gulmohar/Gold mohar

Common Name: Flame tree, Phoenix flower, Royal Poinciana
Scientific Name: *Delonix regia*

A medium-sized deciduous tree which has large flowers, with four spreading scarlet or orange-red petals fern-like leaves and flamboyant display of orange-red flowers over summer.

Viable	Replications					Remarks
	I	II	III	Total	Percentage	
Completely stained	43	45	45	133		*Entire embryo stained bright red/ Cherry red*
Completely stained with weak tissue	3	4	3	10		
Total	**46**	**49**	**48**	**143**	**95**	
Non- Viable						
Completely unstained	1	0	1	2		*Entire embryo un-stained (colorless).*
Abnormal color or texture	3	1	1	5		*Stain very faint pink color.*
Total	**4**	**1**	**2**	**7**	**5**	

Result:

The study indicates that Gulmohar seeds have a viability percentage of 95%, with only 5% being non-viable. Among the 150 seeds tested (50 seeds in three replications), 143 seeds exhibited bright red or cherry-colored embryos, indicating viability, while 7 seeds were unstained or showed a faint pink stain, signifying non-viability.

Despite soaking the seeds in normal water for three days, the hard seed coat remained unsoftened, making it challenging to cut through the embryo for Tetrazolium (TZ) testing due to their toughness. The recorded viability period of Gulmohar seeds exceeds two years. Pre-

sowing treatment, such as soaking in cold water for 24 hours, enhances germination capacity to a range of 60% to 85%.

Based on the TZ test results, it can be concluded that Gulmohar seeds are viable and suitable for sowing.

Gulmohar/Gold mohar

Birendra Phul

Common Name: Fern tree
Scientific Name: *Jacaranda mimosifolia*

A large sized tree which is widely grown as ornamental plants valued for their intense flower displays. Flowers are produced in conspicuous large panicles, each flower with a five-lobed blue to purple-blue corolla; a few species have white flowers. The fruit is an oblong to oval flattened capsule containing numerous slender seeds.

Viable	Replications					Remarks
	I	II	III	Total	Percentage	
Completely stained	28	30	29	87		*Entire embryo stained bright red/ Cherry red*
Completely stained with weak tissue	9	7	6	22		
Total	**37**	**37**	**35**	**109**	**73**	
Non- Viable						
Completely un-stained	5	4	6	15		*Entire embryo unstained (color-less).*
Abnormal color or texture	8	9	9	26		*Stain very faint pink color.*
Total	**13**	**13**	**15**	**41**	**27**	

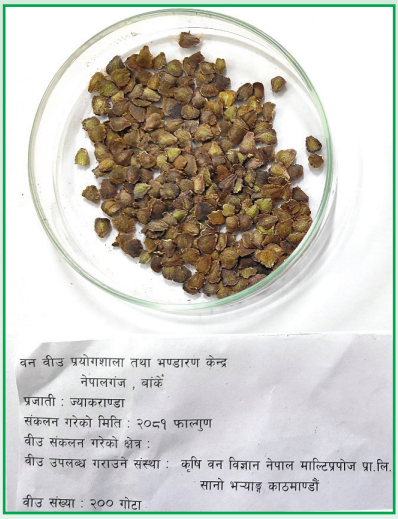
Result:

The study indicates that Birendra Phul seeds have a viability percentage of 73%, with 27% being non-viable. Among the 150 seeds tested (50 seeds in three replications), 109 seeds showed bright red or cherry-colored embryos, indicating viability, while 41 seeds were either unstained (colorless) or faintly pink, signifying non-viability.

The viability period of Birendra Phul seeds is recorded as up to two years. Pre-sowing treatment, such as soaking the seeds in cold water

for 24 hours, enhances their germination capacity to a range of 70% to 80%.

Based on the Tetrazolium (TZ) test results, it is concluded that Birendra Phul seeds are viable and can be used for sowing.



Birendra Phul

Rakta Chandan

Common Name: Red Sandalwood, Red sanders, Ruby wood
Scientific Name: *Pterocarpus santalinus*

A light-demanding small tree, growing to 8 meters (26 ft) tall with a trunk 50–150 cm diameter. Leaves are usually imparipinnate, broadly ovate or round, leathery, tip blunt, slightly notched, undersurface pale and clothed with fine grey hairs. The leaves are alternate, 3–9 cm long, trifoliate with three leaflets.

Flowers are yellow, borne a few together in simple or sparingly branched racemes; flower-stalks about 5 mm long; sepal-cup 5-6 mm long, teeth minute, triangular which are produced in short racemes. The fruit is a pod containing one or two seeds which is reddish-brown, smooth and leathery

Viable	Replications					Remarks
	I	II	III	Total	Percentage	
Completely stained	X	X	X	X		*Entire embryo stained bright red/ Cherry red*
Completely stained with weak tissue	X	X	X	X		
Total	X	X	X	X	X	
Non- Viable						
Completely unstained	X	X	X	X		*Entire embryo unstained (colorless).*
Abnormal color or texture	X	X	X	X		*Stain very faint pink color.*
Total	X	X	X	X	X	

Result:

The study highlights that Rakta Chandan seeds have an extremely hard seed coat (testa), which remained unsoftened even after soaking in cold

water for three days. This made it difficult to access the embryo for Tetrazolium (TZ) testing, and as a result, the test could not be conducted.

The viability period of Rakta Chandan seeds is recorded as up to six months. While there is no mention of specific pre-sowing treatment methods, these seeds demonstrate a germination capacity of 84%.

It is recommended to consider the germination percentage as a critical factor in deciding whether to use Rakta Chandan seeds for sowing.

Rakta Chandan

- Rakta Chandan seeds have an extremely hard seed coat (testa), which remained unsoftened even after soaking in water for three days.
- Accessing the embryo for the Tetrazolium (TZ) test was not feasible due to the hardness of the seed coat.
- Consequently, the Tetrazolium test could not be conducted on the seeds.
- Based on these observations, Rakta Chandan seeds are deemed unsuitable for use as planting material.

Mayurpankhi Dhupi

Common Name: Gold Crest Dhupi or Coniferous tree
Scientific Name: *Platcladus orientalis*

- evergreen trees with stringy-textured reddish-brown bark. The shoots are flat, with side shoots only in a single plane.

Viable	Replications					Remarks
	I	II	III	Total	Percentage	
Completely stained	45	43	45	133		*Entire embryo stained bright red/ Cherry red*
Completely stained with weak tissue	2	6	2	10		
Total	**47**	**49**	**47**	**143**	**95**	
Non- Viable						
Completely unstained	1	0	1	2		*Entire embryo unstained (colorless).*
Abnormal color or texture	2	1	2	5		*Stain very faint pink color.*
Total	**3**	**1**	**3**	**7**	**5**	

Result:

The study confirms that the Mayurpankhi Dhupi seed collected from Surkhet (Surkhet Pahadi Dhupi) exhibits a high viability rate of 95%, with only 5% of seeds classified as non-viable. A total of 150 seeds were selected from available samples, divided into three replications of 50 seeds each. Among them, 143 seeds displayed bright red or cherry-colored staining in their embryos, indicating viability, while 7 seeds remained unstained or showed a faint pink hue.

The research also recorded that the seeds remain viable for up to two years, and pre-sowing treatment is unnecessary before planting. Their storage behavior is classified as orthodox, meaning they retain viability

under appropriate storage conditions. While there is a slight decline in viability after five years of hermetic storage. Hermetic air-dry storage is recommended to maintain seed quality.

Based on the results of the Tetrazolium (TZ) test, it is concluded that Mayurpankhi Dhupi seeds are viable and suitable for sowing.

Mayurpankhi Dhupi, Surkhet Pahadi Dhupi

Mayurpankhi Dhupi

Common Name: Gold Crest Dhupi or Coniferous tree
Scientific Name: *Platcladus orientalis*

evergreen trees with stringy-textured reddish-brown bark. The shoots are flat, with side shoots only in a single plane.

Viable	Replications					Remarks
	I	II	III	Total	Percentage	
Completely stained	45	47	47	139		*Entire embryo stained bright red/ Cherry red*
Completely stained with weak tissue	3	2	1	6		
Total	**48**	**49**	**48**	**145**	**97**	
Non- Viable						
Completely unstained	1	0	1	2		*Entire embryo unstained (colorless).*
Abnormal color or texture	1	1	1	3		*Stain very faint pink color.*
Total	**2**	**1**	**2**	**5**	**3**	

Result:

The collected seed lot contains a high percentage of dead seeds, leading to a low purity level. Laboratory testing was conducted following the selection of healthy seeds.

A study on Mayurpankhi Dhupi seeds collected from Banke indicates a viability rate of 97%, while 3% were found to be non-viable. A total of 150 seeds were selected from available samples (50 seeds in three replications). Among them, 145 seed embryos displayed a bright red or cherry stain, confirming viability, whereas 5 seed embryos were either unstained (colorless) or showed a very faint pink stain.

The research also recorded that the seeds remain viable for up to two years, and pre-sowing treatment is unnecessary before planting. Their

storage behavior is classified as orthodox, meaning they retain viability under appropriate storage conditions. While there is a slight decline in viability after five years of hermetic storage. Hermetic air-dry storage is recommended to maintain seed quality.

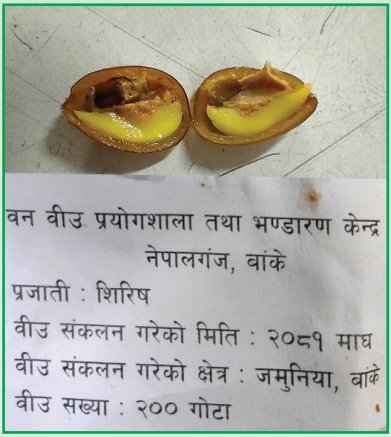
Based on the Tetrazolium (TZ) test results, Mayurpankhi Dhupi seeds are viable and suitable for sowing.

Note: Dead seeds should be removed before sowing to ensure successful germination.

Mayurpankhi Dhupi, Banke

Photos of lab test

Birendra Phul



Siris

Gulmohar

Birendra phul

9. CONCLUSIONS

Trees of economic potential are usually propagated by seeds. The production of high quality seeds is linked to a good quality control system. In this system, germination test accurate methods for estimating the physiological quality of seeds. The seed should be properly dried to maintain the minimum seed moisture percentage and purity percentage also plays important role in maintaining the quality of the seed.

Twenty different forest seeds had choosen for germination test in the center laboratory with close monitoring. Bakaino (*Melia azedarach*), Lapsi (*Choerospondias axillaris),* Sugandhakokila (*Cinnamomum glaucescens),* Mayurpanki Dhupi (*Platycladus orientalis*), Kapoor (*Cinnamomum camphora),* Siris (*Albizia lebbeck*), Sissoo (*Dalbergia Sissoo*), Jacaranda (*Jacaranda mimosifolia*), Ipil Ipil (*Leucaena leucocephala*), Koiralo (*Bauhinia variegata*), Shrikhanda (*Santalum album*), Palas (*Butea monosperma*), Sitalchini (*Moringa oleifera*), Barro (*Terminalia bellirica*), Parijat (*Nyctanthes arbor-tristis*), Ritha (*Sapindus mukorossi*), Gulmohar (*Delonix regia*), Khair (*Acacia catechu*), Amala (*Phyllanthus emblica*) and Bijayasal (Pterocarpus marsupium) were collected from different part of country in this fiscal year and germination test had conducted before they were distributed to DFOs and other concern agencies.

A total number of 8 (eight) different forest seeds namely Siris *(Albizia lebbeck)*, Kapur *(Cinnamomum camphora),* Shri Khanda *(Santalum album),* Gulmohar/Gold mohar *(Delonix regia),* Birendra Phul *(Jacaranda mimosifolia),* Raktachandan/Red sandalwood *(Pterocarpus santalinus),* Mayurpankhi Dhupi *(Platcladus orientalis) and* Mayurpankhi Dhupi *(Platcladus orientalis)* were collected from different regions of the country for viability test.

Germination percentage is a good measure of seed quality. One disadvantage of conventional germination tests is that it requires a waiting period of many weeks or more. In the laboratory of Forest Seed

Laboratory and Storage Centre, Nepalgunj, Banke germination test was also done to know the seed status whether the seed is good or not. The test result of the germination test was mentioned in each seed sample's report.

Viability test was done by using Triphenyl tetrazolium chloride, TTC, or simply tetrazolium chloride (with the formula 2,3,5-triphenyl-2H-tetrazolium chloride) which is commonly used as Tetrazolium test. It is a quick biochemical test that can be conducted in a short period of time with minimal equipment. This test was conducted in the laboratory of Forest Seed Laboratory and Storage Center, Hattisar, Kathmandu because lab expertise and technician for conducting viability test is not available in Banke.

Results included in this report are based on submitted sample. Hence, submitted sample represents whole seed lot. Quality of seed entirely depends upon condition of storage, probable fluctuation of seed moisture, insects and pest damage during storage even though the result of sample is satisfactory during the laboratory testing. So, Seed traders and buyers are responsible for protecting the quality of seed from all these adverse climatic condition during storage. Seed testing reports are only valid for 6 months from the date of laboratory testing, if storage condition of seed lot is appropriate and revalidation must thereafter.

10. SEED COLLECTION CALENDAR

Baisakh (April-May)	**Seed collection:** Tanki, Painyo, Gogan Chilaune, Sal
Jestha (May-June)	**Seed collection:** Kutmiro, Chiuri, Koiralo, Nibaro, Seto-chuletro, Seto siris, Bhimsenpati, Phaledho, Gidheri, Palansh **Seed sowing:** Kutmiro and Chiuri
Ashad (June-July)	**Seed collection:** Baddhar, Chiuri, Kutmiro, Khanayo, Nibaro, Dudhilo, Bhimsenpati, Phaledho, Syalphurso **Seed sowing:** Baddhar, Chiuri, Kutmiro
Shrawan (July-August)	**Seed collection:** Khanayo, Gedulo, Khasreto, Jamun
Bhadra (August-September)	**Seed collection:** Champ, Kharsu, Kagati, Kapur, Drum stick, Dabdabe, Amala **Seed sowing:** Ficus species, Kharsu, Kapur, Drum stick
Asoj (September-October)	**Seed collection:** Champ, Kapur, Katus, Bael **Seed sowing:** Champ, Kapur, Katus
Kartik (October-November)	**Seed collection:** Lapsi, Utis, Kapur, Trifoliate, Khotesalla, Katus, Bhajparsa, Lakuri
Mangsir (November-December)	**Seed collection:** Lime, Utis, Kharsu, Ipil, Lemon, Lapsi, Lankuri, Sissoo, Trifoliate, Khotesall Rato siris, Bael
Poush (December-January)	**Seed collection:** Sissoo, Ipil, Coffee, Khayer, Rato-siris, Panchpate, Utis, Bakaino, Bayer, Rajbrikshya
Magh (January-February)	**Seed collection:** Sissoo, Sesbania, Rajbrikshya, Bakaino, Coffee, Khayar, Rato siris, Bayer, Barro
Falgun (February-March)	**Seed collection:** Sesbania, Papaya, Bakaino, Gogan **Seed sowing:** all remaining species
Chaitra (March-April)	**Seed collection:** Tanki, Gogan, Painyo, Chilaune, Sal **Seed sowing:** all remaining species

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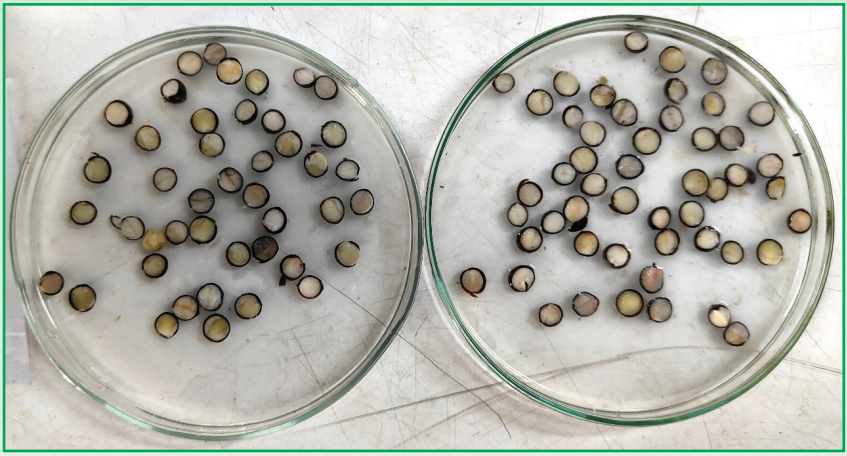
ANNEXES

Annex 1. Germination test of different forest seed samples in laboratory, F/Y 2081/82

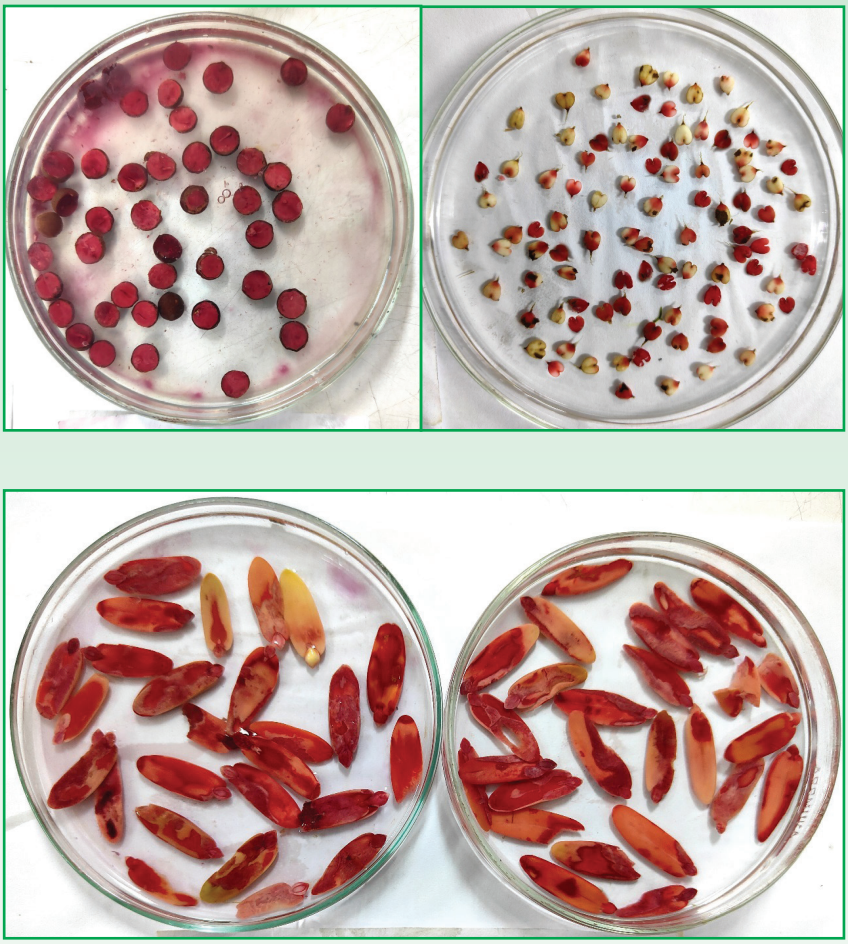
S.no	Nepali name		English name	Botanical name	Germination %
1	बकाईनो	Bakaino	Indian Lilac	*Melia azedarach*	**80%**
2	लप्सी	Lapsi	*Nepali hug plum*	*Choerospondias axillaris*	**80%**
3	सुग्नधकोकिला	Sugandha kokila	Malagedi	*Cinnamomum glau-cescens*	**36%**
4	मयुरपंखी धुपी	Mayur Panki Dhupi	Morpankh	*Platycladus orientials*	**69%**
5	कपुर	Kapoor	Kapur	*Cinnamomum camphora*	**82%**
6	सिरिस	Siris	East Indian Walnut	*Albizia lebbeck*	**80%**
7	सिसौ	Sisso	Indian Rose wood	*Dalbergia sissoo*	**96%**
8	विरेन्द्रफुल	Birendra phool	Blue Jacaranda	*Jacaranda mimosifolia*	**87%**
9	ईपिल ईपिल	Ipil Ipil	White popinac	*Leucaena leucocephala*	**70%**
10	कोइरालो	Koiralo	Camel's foot tree	*Bauhinia variegate*	**96%**
11	श्रीखण्ड	Srikhanda	Seto Chandan	*Santalum album*	**76%**

S.no	Nepali name		English name	Botanical name	Germination %
12	पलास	Palas	Flame of Forest	*Butea monosperma*	**80%**
13	सितल चिनी	Sital chini	Drumstick tree	*Moringa oleifera*	**95%**
14	बर्रो	Barro	Beleric myrcbalan	*Terminalia bellirica*	**95%**
15	पारिजात	Parijaat	Night Jasmin	*Nyctanthes arbor-tristis*	**98%**
16	रिठ्ठा	Ritha	Soapberry	*Sapindus mukorossi*	**95%**
17	गुल्मोहर	Gulmohar	Peacock tree	*Delonix regia*	**85%**
18	खयर	Khair	Black cutch	*Acacia catechu*	**60%**
19	अमला	Amala	Indian goosebery	*Emblica officinalis*	**86%**
20	विजयसाल	Bijayasal	Kino tree	*Pterocarpus mersupium*	**60%**

Annex 2. Photos of seed testing in laboratory.



Seed soaked in distilled water and dissected before viability test



Viability test of forest seed in laboratory

Analyzing viability status of forest seed samples after tetrazolium test

Germination testing of Forest seed by Lab Assisstant

Prepared by
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Department of Forest and Soil Conservation
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Nepalgunj, Banke
Jestha, 2082