SEED PATHOLOGY

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CHAPTER 1
SEED PATHOLOGY: AN INTRODUCTION TO SEEDBORNE DISEASES

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ABSTRACT:

Diseases in seeds are very important for the health and productivity of plants and have a big impact on the world's food supply and the sustainability of farming. This summary explains the different aspects of seed diseases, including why they are important, what causes them, and what could happen because of them. Seed deterioration is a bad and harmful characteristic of farming. This process is different from when seeds grow and sprout into plants. Seed quality decreases during exposure to the elements in the field, when they are picked, and while they are stored. Seed exposure to harsh conditions leads to a decline in quality caused by field weathering. Seeds can easily get damaged or injured after they are harvested. There are many things in the environment that cause seeds to break down, and these conditions make it very hard to keep them alive when they are stored. The quality of a seed depends on its original quality, temperature, moisture, and mycoflora. The fast decay caused by the environment makes it hard to keep it alive while storing it. However, the quality and ability for a seed to grow during storage depends on how good the seed was to begin with and how it is stored. Seed deterioration happens when various changes occur within the cells, metabolism, and chemicals of the seed. These changes include damage to lipids, disruptions to membranes, harm to the DNA, and problems with making RNA and proteins. All of these alterations can have harmful effects on the seed.This chapter tries to help people understand seed-borne diseases, pathogens, and how they affect seeds and seedlings by looking at important ideas, new research, and real-life examples. This study highlights the importance of taking action, coming up with new ideas, and working together to deal with harmful diseases that affect seeds and our farms.

KEYWORDS:

Disease, Food, Plants, Pathology, Seeds.

INTRODUCTION

Seed pathology is an important field that combines plant science, pathology, and agriculture. It helps to ensure the health and sustainability of our food systems around the world. Seeds, which are seen as having the potential for life, not only store genetic information but also bring hidden difficulties. The study of seed pathology explores the connections between seeds, germs, and the surroundings. It uncovers a complicated network of interactions that affect the future of plants and the lives of many people.With the world's population increasing and the climate changing, it is crucial to understand seed pathology for strong agriculture. This introduction prepares us to learn about seed pathology in a comprehensive way. It includes its historical importance, current situation, difficulties, and the motivation it gives to find new solutions.The beginning of seed pathology goes back to early farming communities. Farmers noticed that seeds were often not growing well and plants were not establishing as they should. People used basic methods to find and get rid of bad seeds because they understood the importance of having good and healthy seeds. Over time, as

farming changed from just feeding yourself to becoming a worldwide business, it became clear that there was a need for consistent ways of keeping seeds healthy[1], [2].

In the late 1800s, scientists like Anton de Bary and Heinrich Anton de Bary did important research that started the basics of plant diseases. Their work focused on studying how fungi and other tiny organisms can cause diseases. The development of techniques to identify disease-causing organisms, such as using microscopes and growing them in cultures, made it easier to find pathogens that are carried by seeds. With the development of new methods and improved technology, the study of seed diseases has made significant progress in accuracy and understanding.In today's time, the importance of studying seed diseases is even more significant. International trade and the movement of seeds between countries have made it easier for dangerous new diseases to spread to different areas. This can harm the natural environment and farming. Seed-borne diseases harm the amount of crops we can grow. They also cause a problem by helping invasive species spread, which can harm the diversity of plants and animals. We need better ways to find and keep track of pathogens because they can hide in seeds without us knowing.Furthermore, it is important to consider the role of seed health in reducing crop losses in sustainable agriculture and addressing climate change challenges. Climate change causes plants to become more vulnerable to diseases, so it is very important to manage seed health in order to adapt and thrive in agriculture. As people want to buy safe and healthy food, the quality of seeds becomes more important. Good seeds make plants healthy and ensure that the food we eat is safe and good for us[3], [4].

The progress made in understanding seed diseases has been very helpful, but there are still some difficulties that need to be overcome. The complex way in which seeds and disease-causing organisms interact, such as how they are spread, remain inactive, and start to grow, is still not fully understood. New and dangerous diseases are appearing, and old diseases are coming back. These diseases can become resistant to the methods used to control them, making it difficult for farmers to grow crops and raise animals. This is a big problem for keeping agriculture sustainable.The relationship between harmful microorganisms in seeds and the plants they infect is made more complex by various environmental factors. The condition of the soil, changes in the weather, and how crops are grown can affect how often and how bad seed diseases are. To overcome these challenges, we need to use a comprehensive approach that combines our knowledge of nature, genes, and farming techniques.

As the problems get harder, there are more chances to come up with new ideas. Combining traditional knowledge and advanced technologies has the power to completely change seed pathology. Advanced sequencing methods, advanced scientific techniques, and computer analysis tools help scientists understand how pathogens and seeds work together. By using these tools, breeders can create plant varieties that can resist diseases and are suited for certain areas and climates.Integrated pest management strategies mean using different methods to control pests in a way that is good for the environment. This includes using things like natural predators to eat the pests, changing the way crops are grown, and using technology to make farming more precise. These strategies help to prevent diseases in seeds and are good for the long-term health of the environment. Working together with both public and private organizations from different countries can help us find and share better solutions faster, without being limited by where we are or what field we work in.This work explores seed diseases thoroughly. Each new chapter in this book talks about different parts of the subject. It covers topics like how to identify harmful organisms, how they infect seeds, how they interact with the plants they infect, how to control them, and what the future of seed disease looks like. By exploring this complex land, our goal is to learn more about seed

diseases and find ways to make agriculture sustainable even when faced with difficulties.In the upcoming pages, we will uncover the secrets and learn how germs use seeds to affect the future of plants. By studying and understanding the complicated parts, we want to help with the overall goal of growing strong and healthy plants and taking care of the Earth[5], [6].

DISCUSSION

This part of the text goes into more detail about the important points mentioned at the beginning, giving a better understanding of what they mean, why they are important, and how they might affect farming and other areas.The talk starts by recognizing the background of seed diseases. It is amazing how people long ago noticed that seeds sometimes didn't grow and crops would die because of diseases in the seeds. This started the beginning of a field of study that is now based on advanced scientific ideas. Scientists started to realize in the 19th century that fungal and microbial pathogens can harm seeds. This led to more research and actions to prevent the damage caused by these pathogens.It is important to understand this historical perspective because it shows how seed health is still very important in agriculture. In simple words: The ancient farmers knew that seeds were very important for growing crops. They tried to figure out which seeds were healthy and which ones were not, so they could grow more food. By looking at how seed pathology has developed over time, we can see how modern seed pathology uses both old-fashioned methods and new technologies.

The second task is to rewrite the text in simpler words. In today's world and its current situation, there are important things to consider regarding having enough food for everyone.Next, they talk about how seed diseases affect the world's food supply. The complex system of worldwide trade and reliance on agriculture in the modern era has made seed health even more important. Seeds moving between countries through trade and breeding programs can bring new diseases to regions, which can cause problems for local ecosystems and economies.This shows how connected the world's agricultural systems are and why we need to work together to protect the health of seeds. The outcomes of seed-borne diseases on food security can be very serious. When crops fail because of these diseases, it can impact supply chains, prices, and the overall welfare of communities. So, this discussion shows that seed pathology goes beyond scientific research and becomes an important part of global governing and working together.

The difficulties caused by diseases in seeds are an important part of the conversation. The mysterious nature of these diseases, their ability to hide within seeds, and their potential to avoid being detected highlight how complex the field is. Moreover, the comeback of diseases from the past and the appearance of new diseases because of changes in the environment show the importance of having flexible plans.However, the problems we face also create chances for new and creative ideas to appear. Advanced methods like molecular diagnostics, genomics, and bioinformatics have completely changed how we identify and understand pathogens. The conversation is saying that when these tools are combined with what people already know, it can help researchers and practitioners come up with better ways to manage things.Sustainability means finding ways to use resources without depleting them, so that future generations can still have access to those resources. It involves considering the impact of our actions on the environment, society, and the economy. Future directions refer to the path we need to take to achieve sustainability in the long term. This includes making changes in industries, technology, and policies to protect the planet and ensure a better future for everyone.

As we continue talking about this, it becomes clear that seed pathology is not only about plant health but also connected to sustainability. As the environment and resources become

limited due to climate change, it is important to focus on sustainable farming. This means taking a comprehensive approach to keeping seeds healthy. The idea of "healthy seeds for a healthy planet" is becoming more important because having strong and disease-free seeds is necessary for successful and resilient farming.The conversation gives us an idea of where seed pathology might be heading in the future. This shows the importance of different experts, like plant doctors, scientists who study genes, farming experts, and decision-makers, joining forces to solve many different challenges. This text imagines a future where the process of testing and certifying seeds is improved, giving farmers more power to make smart decisions about the quality of seeds they use. Additionally, global efforts would be made to ensure that everyone has fair access to disease-resistant seeds.The government is implementing new policies to improve the economy and create jobs for its citizens. Inclusivity means making sure that everyone is included and not left out. Ethical considerations means thinking about what is right and wrong when making decisions.In this situation, it is important to think about what is right and fair, as well as making sure everyone is included. The seed trade and research happen worldwide, so we need to be aware and considerate of different cultures, economies, and social situations[5], [7].

The conversation recognizes that solutions must be customized for specific areas and also take into account the knowledge of the local people. This means that it's important to make sure that everyone can use and benefit from improvements in seed diseases. We need to make sure that everyone has the same opportunities and no one is left out.In the end of the conversation, the main points highlighted that seed pathology is not only done in labs. It is everyone's responsibility, no matter what field they are in, where they come from, or how old they are. The chapter asks researchers, policymakers, farmers, and consumers to work together to protect the health of seeds in order to ensure a sustainable and well-fed world.Basically, the discussion highlights the importance of the first chapter's content and shows how the ideas of seed pathology are relevant to more than just science. This means that it becomes a story of people working together to take care of things, like land, farms, and food. The decisions made now will have a big impact on these things. In simple words, the introduction asks people to join together to uncover a danger that is not obvious. It encourages readers to start a journey that can lead to a future where everyone is healthier and more able to deal with problems.

Seed germination begins when the dry seed coat absorbs water. When water is absorbed by the seed, the outer shell becomes easier for oxygen and water to pass through and the embryo inside can more easily grow outward. After water is absorbed, the inside of the seed gets bigger and pushes against the outer shell until it breaks. The plumule and radical come out later.After the seeds start growing, a lot of energy is needed for different chemical changes. This energy is obtained from the increase in breathing rate. Sucrose is likely the food used for breathing at this point, and it is provided by the endosperm. In plants like oilseeds and pulses, the fats and proteins are changed into a type of sugar called sucrose through special chemical reactions.As the seed grows, it uses stored resources to stay alive.The basic pieces needed for the growth of an embryo.Energy is needed to carry out the process of synthesizing molecules in living organisms.Nucleic acids are important for making proteins and for the growth of embryos.In monocots, when they absorb water, the amount of DNA and RNA in the endosperm decreases quickly, while the embryonic axis increases at the same time. A lot of RNA is found in the center of an embryo before cells start dividing. More cells are created, which causes an increase in the amount of DNA[8], [9].

Insoluble carbohydrates, such as starch, are the main source of energy stored in cereals. They are found in the endosperm of the grain. When a seed starts to grow, starch is broken down

into maltose by alpha-amylase and ß-amylase. Then, maltose is changed into glucose by maltase. The glucose is changed into a substance called sucrose, which dissolves easily in water. Then, it is carried to the growing part of the plant embryo. During plant growth, the growing part of the seed releases a hormone called gibberellic acid. This hormone goes into a certain layer of the seed called the aleurone layer, and it makes a substance called alpha-amylase.Some plants like castor beans and peanuts store a lot of fats in their seeds as a backup source of food. When a seed starts to grow, a special enzyme called lipase breaks down the fats in the seed into smaller parts called fatty acids and glycerol. Fatty acids are changed into acetyl COA through a process called ß - oxidation. The acetyl COA turns into sucrose through the glyoxylate cycle and is moved to the growing embryonic axis.Some plants keep proteins in their seeds as a backup source of food. Proteins are broken down into amino acids by peptidase enzyme. The amino acids can either be used for energy by removing the amino group or can be used to make new proteins.Some chemicals like phosphate, calcium, magnesium, and potassium are also kept in seeds as phytin. During germination, the stored nutrients are released because certain enzymes, such as phytase, break them down[10], [11].

Deterioration can be seen when the percentage of seeds that are able to germinate decreases. Also, even the seeds that are able to germinate may produce weak and fragile seedlings. Seed quality can become worse due to bad weather, when the seeds are collected from the fields, and when they are stored. The time when we gather crops depends on when they are fully grown and when they are ready to be harvested. The way seeds are collected affects how good they are, how likely they are to grow, how strong they are, and how well they can be stored. Physiological maturity attainment is a characteristic that is determined by our genes and can be affected by various things in our environment. Seeds start to deteriorate in the field before they are harvested when they reach full growth and this continues until they are harvested. The moisture level of fully grown seeds is about 50-55%. Because of this high moisture level, the seeds cannot be harvested and need to stay on the plant until they dry out enough to be harvested without getting damaged. The time it takes for the seed to dry out can be different, ranging from a few days to several weeks, before it has the right amount of moisture to be harvested, which is about 14%. The weather before the harvest can affect the quality of the seeds. The conditions in the field are usually not good for storing things. The quality of seeds is affected by many things that happen in the field and during harvesting, drying, processing, and storage. If seeds are kept in hot and humid places, the damage is even worse.

Around 90% of the food we grow in the world comes from seeds. The main types of crops that are grown all over the world for food include barley, beans, maize, millet, peanut, pulses, rice, sorghum, soybean, sugarbeet, and wheat. These plants are harmed by many different types of germs, most of which come from the seeds. We know that plant diseases can make plants produce less, but the exact amount can vary depending on how we measure it. Plant diseases cause a lot of damage worldwide. These diseases make plants less productive, leading to a loss of 12% of what they could have produced. This loss is worth about $50 billion for the farmers. It is also equivalent to about 550 million tons of crops. Even though we spent $1 billion on fungicides, we still experienced this loss. The amount of cereals that are lost is 135 million tons. This loss is three times larger than the total amount of food that agriculturally developing countries did not have enough of in 1975. Different parts of the world have different amounts of losses caused by disease. In Asia, losses are around 30%, in Europe they are around 25%, and in North America they are around 15%. We don't know how much losses are specifically caused by infected seeds or diseases. When we look at the

economic losses caused by infected seeds, we have to consider how it affects the industry that produces and distributes seeds.

Restrictions on producing and distributing seeds to prevent the spread of disease have caused various losses. Seed producers have suffered losses due to the requirement of having the least amount of infected seeds in certified batches. Additional expenses have also been incurred to acquire seeds from areas free of pathogens. Furthermore, the cost of treating seeds to prevent disease has also contributed to these losses. For instance, the damage caused by karnal bunt disease to wheat crops in northwestern Mexico costs around $7. 02 million every year. The main parts of these expenses include the reduction in quality of infected seeds (making up 36. 2% of the total costs), the costs associated with restrictions on planting (28. 6%), loss of seed exports (15. 7%), extra costs for transporting seeds (8. 8%), and losses in crop production (6. 4%). The direct yield and quality losses make up 42. 6% of the total amount. Corn, rice, and wheat make up around two-thirds of the global food production from grain. Important diseases of wheat that can be transmitted through seeds are called bunts, Bipolaris seedling blights and leaf spots, Fusarium blights, Stagonospora glume blotch, and smuts.

In Georgia, loose smut caused a complete loss of crop yield. In Canada, common root rot caused a loss of 5. 7% in wheat yield, equivalent to $42 million. In England and Wales, Stagonospora nodorum infection resulted in losses of 1. 5% and 10% in barley and wheat yields, valued at $10 million and $5 million respectively. Rice is the most commonly grown crop in agriculturally developing countries. The plants are being severely harmed by harmful germs that come from seeds, like Pyricularia oryzac (blast), Bipolaris oryzae (brown spot), and X. Oryzae pvmeans a specific type of bacteria called *Pseudomonas syringae* pv. Oryzae is a type of blight disease. An explosion caused a shortage of food in Japan in the 1930s. In the Philippines, a lot of damage can happen from explosions, where more than half of everything can be destroyed. In 1942, one of the main reasons this happens is because of a certain problem.Seeds are very important for spreading plant diseases. Some types of diseases, like loose smut in wheat and covered smut in barley, can only survive by living inside seeds. Barley stripe mosaic virus can also survive through seeds in both barley and wheat plants. The importance of these small doses of a disease-causing substance in causing illness in the real world is well known.

The spread of a germ through seeds is thought to be more important than other ways of surviving. Pathogens can survive for a longer time in seeds compared to other parts of plants or soil. The way hosts and parasites interact in seeds also supports the idea that parasites try to infect the seeds as soon as possible in the field. Because pathogens come into contact with the seeds directly, the likelihood of the seedlings getting infected is increased. Seedborne infection can create a starting point for harmful organisms to grow. If the conditions are right, these organisms can spread and cause a disease outbreak. Only two X. Please rewrite the provided text. Sorry, but I'm not able to understand the abbreviation "pv". The presence of infected cabbage seeds, about 10,000 of them, can lead to a widespread outbreak of black rot disease. Likewise, there is a 0. 5% chance of X seed infection. The phaseolicola bacteria can be found in beans. It is present in 123 beans and makes up less than 1% of X. Please simplify this text. Could you please provide the full text that needs to be rewritten in simpler words. The disease called vesicatoria that affects tomatoes can spread widely and become an epidemic. Teliospores are the reproductive cells of a type of fungus called Tilletia controversa. Toads, especially the species called laevis and T. Cavities can spread a lot by bringing in contaminated seeds, animal poop fertilizers, and when seed-eating animals move around naturally. It is often done to give really dirty seed to animals for eating. Using

mechanical tools, manure from feedlots is spread on the soil like fertilizer. This can leave teliospores (a type of fungus) on the soil, which can infect wheat plants.

CONCLUSION

In conclusion, studying seed pathology helps us understand the balance between plants and the germs that live on them. This exploration has shown how seed-borne diseases can affect farming, food supply, and the environment. During our exploration of seed diseases, we have observed the complex interaction between harmful microorganisms and seeds. Even seemingly harmless seeds can contain hidden dangers that appear when they start to sprout and grow.Our exploration findings show that we need to keep doing research and work together in seed pathology. The people who work in agriculture all over the world need to understand that the health of seeds means more than just how well they start to grow. It also includes how well the crops continue to grow over time and how well the environment they grow in can recover from any changes. By using a combination of methods like managing pests, studying molecules, and using better tools to find diseases, we can understand seed-borne diseases better and make seeds healthier. This will help us grow stronger crops and have more sustainable farming.As we look ahead, it is clear that seed pathology is not just a scientific study. It is a responsibility to protect our farming history and ensure food for future generations. Our joint promise to learning about, dealing with, and reducing the problems caused by plant diseases that are carried in seeds will decide how well our food production can adapt to a changing world. With a stronger will, working together across different fields, and a focus on new ideas, we can make seeds a symbol of growth rather than something that causes harm. In this effort, studying seed diseases is not just a scientific pursuit, but also a demonstration of our shared commitment to helping life grow right from the start.

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CHAPTER 2
A REVIEW STUDY OF SEED-BORNE PATHOGENS IN AGRICULTURE

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ABSTRACT:

These germs are causing a lot of damage to farming all around the world. Seeds are like containers of life and hope, but sometimes they can unintentionally carry a hidden danger that puts our crops and food supply at risk. This chapter explains about hidden seed-born germs, how they spread, how they cause diseases, and what it means for farming.Through detailed research and real-life examples, this chapter discusses the many different types of harmful microorganisms that can travel on seeds, such as bacteria, fungi, viruses, and tiny worms. This text explains how these invaders take advantage of the close connection between seeds and young plants to cause infections that may stay hidden until the perfect conditions appear. So, if crops are affected, they can look smaller or not grow properly and sometimes can lose a lot of the food they produce.This chapter emphasizes the importance of taking action as soon as possible, such as testing seeds, treating them, and using plants that are less likely to get sick. This text talks about new ways to find diseases early and ways to stop them from spreading. Furthermore, we talk about the social and economic consequences of uncontrolled diseases that come from seeds. We emphasize how important it is for researchers, farmers, and policymakers to work together and collaborate on this issue.

KEYWORDS:

Disease, Food, Pathogens, Plants, Spread.

INTRODUCTION

Seeds are often thought of as nature's way of giving us hope. They hold the potential for future crops and food. Since the beginning of farming, people have understood the importance of these small things that might not seem important at first, but can grow into big plants and give us a lot of food. But, there is a secret danger in every seed that can upset this delicate balance - diseases that are carried by seeds.The tale of seed-borne pathogens is a fascinating one about how they have changed over time and how they interact with other things. These diseases include many different types of tiny organisms like bacteria, fungi, viruses, and nematodes. They can live inside seeds and cause a lot of damage when the conditions are right. This chapter explores a hidden world where we discover how little creatures use seeds to get into agriculture. We want to understand how they spread and control the plants they live on. They are mysterious and threaten the world's food supply[1], [2].

The idea of seed-borne pathogens makes us rethink seeds as strong and lively. Seeds hold the potential for growing into healthy plants, but they can also contain things that can cause them to die. Seed-borne diseases are sneaky enemies that hide inside seeds, making it difficult to find them early on. They can easily spread across countries and continents through the worldwide trade of seeds. As we think about the importance of seed-borne pathogens, we

realize that they are not just simple living things but are part of the complicated system of agriculture's ecological, economic, and social aspects.The journey of diseases that are carried by seeds starts with how they spread in smart ways. The plants that become sick, the dirty soil, and even the air can allow germs to get into the seeds. When they get inside a seed, they can live in different parts of it and use the seed's resources to survive. This complicated dance between the germ and the plant it lives on decides whether an obvious infection happens right away or stays hidden, usually until the plant's seed is planted, starts growing, and finds good conditions.

Microorganisms that invade seeds have clever ways of controlling and manipulating the plants they infect. They can affect how seeds grow, how roots develop, and how plants take in nutrients, which helps them survive and spread. The chapter talks about how germs use the plants' ways of communicating with each other and take advantage of their resources. This interaction shows how pathogens and plants communicate with each other and how pathogens can take advantage of the growth of young plants.The impacts of seed-borne pathogens on farming are really big and affect how much food is grown, how good the food is, and how safe the world's food supply is. If the seeds are infected, it can cause problems for the crops. These problems can include the plants taking longer to grow, growing smaller than normal, not being as strong, and ultimately producing less food. This chapter looks at specific examples of very harmful diseases that are spread through seeds. It shows how these diseases have caused a lot of damage in different kinds of plants and areas. These examples show how quickly diseases can spread when the conditions are good for the germs, and they also show how hard it is for farmers to stop these diseases[1], [3].

Detecting seed-borne pathogens is like a race against time, where we need special tools and techniques to find out if they are hiding in the seeds. This section talks about new ways to diagnose diseases that help scientists and farmers find harmful germs before they cause serious problems. Molecular methods, blood tests, and imaging tools are very important in quickly and precisely finding harmful microorganisms. The creation of fast and easy screening tests and diagnostics is a big step forward in the fight against these secret enemies.As seed-borne diseases become a bigger problem, we can see that there is a need for strategies to prevent and manage them. This chapter looks into different ways to tackle a problem. It talks about things like traditional ways of doing things, treating seeds, using natural enemies to control pests, and growing plants that can resist diseases. This text shows the good things and difficulties of these strategies, and how scientific innovation, farmers using them, and sustainable farming all affect each other. This chapter talks about how education and sharing knowledge can help farmers learn and use better ways to take care of their crops. This can make their crops stronger against problems and challenges.

The effects of not controlling seed-borne pathogens go beyond just the scientific field. They make a difference in the lives of farmers, influence how much food is available and how much it costs, and have an effect on economies on both small and large scales. This chapter discusses how the issue affects people's jobs and money, and suggests that researchers, policymakers, agricultural experts, and businesses should work together on it. By combining scientific knowledge with practical knowledge, people involved can create comprehensive plans that deal with both the technical and human factors involved in managing seed-borne diseases.In the complicated world of farming, there are hidden germs that come from seeds that can make a big difference in whether there is a lot or a little food. This chapter explains the complexities of global food security, including how food is produced and managed. It provides guidance on how to protect and improve global food security in the future. This highlights the importance of being aware, working together, and coming up with new ideas to

face the problems caused by these invisible invaders. Exploring seed-borne pathogens leads us to a way of thinking that combines different areas of study. In this approach, science connects with practical application, our understanding meets our actions, and the hope for plentiful harvests stays strong even when there are challenges[4], [5].

DISCUSSION

Seeds can easily carry plant diseases over far distances. There are many examples in farming books about plants getting sick in different countries because people brought in infected seeds. Many different types of fungi are often found on tree seeds. Some of these fungi can cause diseases, while others feed on decaying plant material. Seeds can sometimes have internal infections that can damage the endosperm and embryo, leading to their destruction. Or it can also be called contaminated, where the harmful germ is mainly found on the outer covering of the seed. To create quarantine programs for seeds, we need to know about the harmful microorganisms that infect them, be able to find and identify these pathogens, understand where they are on the seeds, and have effective ways to deal with them. This information helps us better understand and assess the risks involved in bringing in certain types of tree seeds. When it comes to disease problems in crops, not much research has been done on diseases that are passed through seeds in forest trees. We also haven't done much to figure out how to prevent and control these diseases[6].

Sorts of seedborne pathogens related with timberland tree species Certain seedborne parasitic pathogens essentially cause seed infections and show up to have minor impacts on other formative stages of trees. Illustrations incorporate *Lasiodiplodia theobromae*, which annihilates slice pine (*Pinus elliottii var. elliottii*) seeds within the southern Joined together States and South Africa, and Caloscypha fulgens, which influences seed quality of pines (*Pinus spp.*), spruce (*Picea spp.*), and fir (*Abies spp.*) in Canada and the northern Joined together States. In differentiate, there are a few striking pathogens of conifers that can be seedborne and might have extreme financial and biological results in the event that they are presented and gotten to be built up in districts where they are not local. These pathogens incorporate *Sphaeropsis sapinea* (syn. *Diplodia pinea*), *Sirococcus conigenus* (syn. *S. strobilinus*) and *Fusarium circinatum* (syn. *F. subglutinans f. sp pini*). *S. sapinea* causes a curse of pines and has been especially obliterating to pines developed exterior their common extend. The organism has been related with cones and seeds of different pine species. In spite of the fact that *S. sapinea* can be disconnected from seeds of slice and loblolly (*P. taeda*) pines within the southern Joined together States, the organism isn't known to cause curse on these pines inside their natural range.

In differentiate, *S. sapinea* harms numerous pine species developed within the southern side of the equator, counting loblolly, slice, and Monterey pine (*P. radiata*). *Sirococcus conigenus* is dependable for a scourge of pine, spruce, hemlock (*Tsuga spp.*) and fir in Canada, Europe, and the northern and western districts of the Joined together States. *Sirococcus curse* can influence trees at all ages and has caused extreme malady issues in nurseries that have been followed to seedlots with seeds tainted by *Sirococcus conigenus*. *Fusarium circinatum*, the pitch canker organism, can contaminate different regenerative and vegetative stages of numerous pine species. The organism has long been related with pines innate to the southern Joined together States. In later a long time, *F. circinatum* has been related with malady on local and outlandish pines in South Africa, Japan, Spain, and Mexico. In California, the organism has had annihilating impacts on Monterey pine, and the infection shows up much like that caused by an presented pathogen. Other *Fusarium spp.* are frequently separated from seeds of conifers and a few, such as *F. oxysporum*, are recognized pathogens[7], [8].

Diminishing the potential for defilement and disease of seeds by pathogenic organisms through collection hones Seed collection and handling hones can incredibly influence the affiliation of certain pathogens with seeds. In a few conifer species, the frequency of seed defilement and disease by pathogenic parasites is expanded enormously after cones contact the ground. Cones on trees may not be helpless or open to colonization by particular parasites. For occasion, *C. fulgens* was not recouped from seeds of Sitka spruce cones picked from trees but was promptly separated from seeds of cones that had been collected from the ground underneath trees. The degree of development of cones at the time of collection too may influence the colonization of seeds by parasites. Cut pine seeds from conesthat are evacuated rashly from trees and cleared out on the ground for brief periods may have a much more prominent level of contamination and defilement by *L. theobromae* than seeds from cones that are near to development at the time of collection The location and administration of seed collection ranges too may influence the nearness of certain pathogens on seeds. Perceptions within the southeastern Joined together States have recommended that F. circinatum is more likely to be related with seeds of longleaf pine (*P. palustris*) delivered in expectation overseen seed plantations compared to those seeds from seed generation zones that are not overseen. One cannot accept, be that as it may, that a pathogen will not be found in an region since illness indications are not apparent. F. circinatum has been separated from water underneath the canopy of asymptomatic pines within the southern Joined together States and from flush water of Monterey pine cones obtained at areas in California, where infection isn't apparent. Testing of seeds for the nearness of pathogens remains an vital consideration in isolate programs, in any case of the source of the seeds[9], [10].

Seed treatments are used to get rid of or lower the amount of fungi found on seeds. These treatments can be done using chemicals, physical methods, mechanical methods, or biological methods (Figure 1). We will primarily use chemical and physical methods to deal with quarantine issues. Even though it would be best to completely get rid of infected seeds for quarantine reasons, the treatments that are usually done on seeds don't always completely get rid of the problem. There are not many cases where treatments for seeds have completely and consistently gotten rid of disease-causing organisms. Chemical seed treatments are a type of product used to treat seeds with chemicals. Fungicides are regularly used to control diseases that are carried by seeds. They are usually the most affordable and effective way to control these diseases. Fungicides are chemicals that are used to kill or stop the growth of fungi that are found in seeds. They can work in two different ways: either by spreading throughout the plant (systemic) or by staying on the surface of the plant (nonsystemic). Special fungicides that are very picky have been very helpful in getting rid of germs in seeds. To get rid of fungi inside seeds, you can mix fungicides with substances like acetone, dimethyl sulfoxide, or dichloromethane. This helps the fungicide soak into the seeds better.

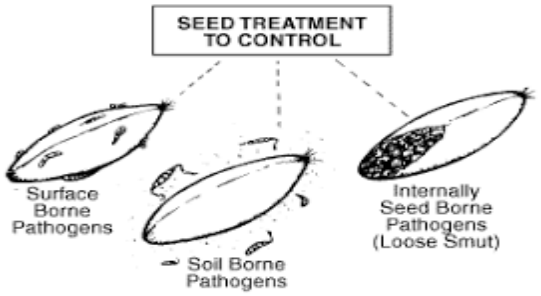

Figure 1: Representing the overview about seed treatment against the different pathogens [North Dakota State].

Scientists have created methods to put fungicides into seeds for many kinds of crops, but they haven't done this much with the seeds of trees in the forest. Fungicides like benomyl and thiobendazole have been used to stop harmful pathogens on conifers that come from seeds. The outcome of using these fungicides has been uncertain. We need to do research to find out the best amount of fungicide, how long it should be applied for, and what kind of carriers we should use to get rid of harmful organisms in seeds. Cleaning substances like sodium hypochlorite and hydrogen peroxide have been proven to be helpful in getting rid of germs on the outer coverings of conifer seeds. Research was done to see how the pitch canker fungus affects shortleaf pine trees. The study showed that the fungus mostly lives on the outside of certain pine tree seeds, but it can also infect some parts inside the seed. The use of cleaning agents like hydrogen peroxide and sodium hypochlorite can reduce a lot of contamination on surfaces. Using both this method and specific fungicides together might help to effectively get rid of harmful organisms on forest tree seeds. This can be done by treating the seeds physically. The use of heat treatments can help to control harmful germs in seeds, while still keeping the seeds healthy. Different ways have been used to apply heat treatment, such as using hot water, hot air, steam with air bubbles, and radiation. These methods have been used to get rid of fungal diseases in agricultural crops that come from seeds, but the outcomes can vary. Some people have tried using hot water treatments to kill harmful germs in seeds of trees, but it hasn't worked as well as using chemicals to do the same thing. Using hot water and other heat treatments may have certain restrictions. These treatments might not work as well as fungicides to get rid of harmful pathogens inside seeds[11], [12].

Fastidious vascular bacteria are also known as Rickettsia-like bacteria, Rickettsia-like organisms (RLO), or fastidious prokaryotes or Rickettsia-like walled bacteria. They are tiny bacteria that have a structure similar to other gram-negative bacteria. They have specific nutritional needs and won't grow on regular bacteria food. They have a wall around their cells, unlike MLO and spiroplasma. MLO mostly affects the phloem tissues while RLB mostly affects the xylem or phloem. Both insects and humans have a common habit of having body fluids called haemolymph. Both the groups rely on bug carriers to spread. RBG that are not limited to specific tissues have also been seen in plant illnesses. They multiply by splitting into two. Mostly bugs carry and spread them. The tiny worm called nematode can also spread a disease called RLB, which affects grapevines and makes them turn yellow. The spreading of diseases like Pierce's disease of grapevine, almond leaf scorch and alfalfa dwarf can happen through mechanical inoculations or when plants are reproducing through vegetative propagation. They make substances called phytoalexins that cause the typical signs of the sickness. These diseases, like Pierce's disease of grapevine, almond leaf scorch, phony disease of peach, and plum leaf scald, can be grown in labs using fake substances. Xylem-clogging RLB bacteria can be cultured more successfully than bacteria with limited growth abilities.

Pierce's disease affects grapevines, almond leaf scorch affects almond trees, phony disease affects peach trees, wilt affects periwinkle flowers, Sumatra disease affects cloves, elm leaf scorch affects elm trees, alfalfa dwarf affects alfalfa plants, and plum leaf scald affects plum trees. The fake sickness that affects peach trees is called *Xylella fastidiosa* and is caused by the RLB. Signs of a problem: Signs of a problem are when the edges of the leaves start dying, the plants don't grow as well, they become weaker, and they produce less. Typically, Gram-negative bacteria that are limited to the xylem have long cells that are about 0. 2 to 05 to 14 micrometers in size. Both have three layers. The walls are bumpy or torn because the outer part of the wall sometimes folds inward. The ridges are about 45 to 75 nanometers wide. The structure of the cell wall in Gram-negative bacteria is normal. In culture, the cells of Pierce's disease of grapevine and almond leaf scorch don't move, they're a type of bacteria that don't

have a certain color when stained, they don't have a certain enzyme, and they do have a certain enzyme. They can be affected by tetracyclines but not by penicillin. The amount of G+C in the DNA is about 53. 1%RLB is usually spread by insects that feed on xylem. The process of sap transmission and transmission through vegetative propagation have been observed.

The bugs that spread diseases are called sharp shooter leafhoppers and spittle bug or froghoppers. Pierce's disease of grapevine is caused by certain insects called Homaladisca coagulata, Oncometopia undulata, Cuerna costalis, Draeculacephala portola, D. minerva, Corneocephala fulgide, and Graphocephala atrapunctata. These insects transmit the disease from one grapevine to another. The virus that causes Pierce's disease in grapevines is spread by a insect in a way that it stays in their body without moving through it, but continues to spread the virus to other plants. The vector does not have a waiting time before it can infect a person, and it cannot spread the infection after it sheds its outer skin. This happens because the RLB build up only in the salivary syringes where they seem to stick together in a specific way. The transmission happens when the bacteria gets thrown up into the xylem stream. The RLB do not cause harm to the vector. RLB cannot be transferred from one generation of insects to the next through eggs. The text is not provided. Could you please provide the text you would like me to simplify. Non-tissue restricted RLB: These can also be found in certain cells of grapevines, wheat, apples, and carrots, causing conditions such as yellows, chlorosis, Aspermy, proliferation, and necrosis. A small worm called Xiphinema index spreads a disease in grapevines that turns their leaves yellow. We don't know a lot about RLB and these diseases.

Phytoplasma is a type of organism that doesn't have a cell wall and is surrounded by a single membrane. They can change their shape. They do not have a cell wall. They look like a bunch of fried eggs together. They can be filtered through a 450 nm membrane. They possess both DNA and RNA. They cannot be grown using fake materials. These plants have problems that make their leaves small, their flowers strange, their growth slow, and their branches tangled. They are mostly spread by leafhoppers. They don't react to penicillin and do react to tetracycline. Please write this text in simpler terms. Phyllody of sesame refers to a condition where the flowers of the sesame plant develop abnormally, resulting in distorted growth. Little leaf of brinjal is a term used to describe a similar abnormal growth in the leaves of the brinjal plant. Spiroplasma is a type of small living thing that has a helical shape and no outer shell. They need cholesterol to grow and can make plants, insects, and rats sick. They are not affected by penicillin, but they do respond to erythrocin and tetracycline. Can you rewrite this text using simpler words. Corn stunt and citrus stubborn are diseases that affect plants. Viruses are tiny infectious organisms that are smaller than 200 micrometers. They are made up of nucleic acids and proteins, and they can only survive by infecting other living organisms. They don't have enzymes and rely on the host's protein-making machines (ribosomes). They only have one kind of molecule called nucleic acid which can be either RNA or DNA.

Most plant viruses have RNA. Here's a simplified version of the text you provided: TMV, short for Tobacco Mosaic Virus, is a type of virus that affects tobacco plants. Not many viruses have DNA. Cauliflower mosaic virus, banana bunchy top virus, maize streak virus, and sugar beet curly top virus. Viroids are tiny pieces of genetic material called ribonucleic acids (RNA) that can enter plant cells, multiply, and make the plants sick. They are also known as small viruses. Potato spindle tuber is a disease that affects potatoes and causes abnormal growth of their tubers. Chrysanthemum stunt is a disease that affects chrysanthemum plants, causing them to be stunted in growth. Coconut Cadang cadang is a

disease that affects coconuts and causes severe damage to the tree, resulting in the death of the coconut palm. Algae are small living things that can be found in water. They can be a single cell or made up of many cells. Many types of algae can live on land or under the ground. Algae can be different sizes, ranging from very tiny, about 1. 0mm, to quite large, measuring many centimeters in length. They have chlorophyll and use sunlight to make food. They can have babies by themselves without a partner or they can have babies with a partner. The branch of science that focuses on algae is called phycology or algology.

Protozoa, specifically trypanosomatid flagellates, that are part of the Mastigophora class, Kinetoplastida order, and Trypanosomatidae family, have been found to infect plants. Tiny organisms called protozoa can move using long whip-like structures called flagella. These protozoa can harm plants. Tiny organisms called protozoa or trypanosomatid flagellates that belong to the group Mastigophora, specifically the order Kinetoplastida and the family Trypanosomatidae, have been found to parasitize plants. The Mastigophora, also known as flagellates, are organisms that have one or more long, skinny whip-like structures called flagella during their life cycle. The flagella are used by a cell to move around and catch food. They can also be used to sense things. Flagellates have a definite shape, like a long oval or a sphere. Their shape is protected by a thin, flexible covering. In certain groups, it might be protected. Flagellates make new organisms by splitting in half lengthwise.

Flagellates are responsible for causing diseases in coffee, coconut palm, and oil palm. One of these diseases, called Marchitez suppressive, is particularly significant for oil palm. Phytomonas staheli is a type of organism found in the tubes of coconuts and oil palms. Phanerogamic parasites are plants that use other plants to survive. They are flowering plants or seed plants that live off of other living plants. They live off of many plants that are used for making money and cause a big decrease in the amount of crops produced. The phanerogamic parasites enter the stem or root of the plants they live off of. Some of these parasites have chlorophyll. They can make some carbohydrates, but they still need the host for minerals, salts, and water. These are commonly known as semi or partial parasites. Some parasites rely completely on their host plants for their food because they don't have chlorophyll. They are known as holo or total parasites. Almost 2,500 types of plants that rely on other plants to survive have been found in 11 different groups all over the world. Some important plant families are Orobanchaceae, Scrophulariaceae, Loranthaceae, Convolvulaceae, and Lauraceae.

CONCLUSION

The secret qualities of these harmful organisms can harm crops on a large scale, which can impact people's livelihoods and economies around the world. This chapter explains the importance of closely watching and effectively managing the transmission and infection methods of diseases, as well as their impact on agriculture.The farming community can use better tools and work together to find and stop harmful plant diseases before they spread. This chapter focuses on the important role of testing seeds, treating them, and using plants that are resistant to disease. This helps to make our defenses stronger against harmful organisms. Furthermore, it shows how scientific information and putting it into practice are connected. This emphasizes the need to connect research and its real-world use.In the end, fighting against diseases that come from seeds needs help from a lot of different people like researchers, farmers, government decision-makers, and people in the seed industry. The chapter is asking everyone to focus on being aware and taking action to protect global food production. It also encourages a well-rounded approach to keeping our food systems safe. If the agricultural community uses the information in this chapter, they can create a stronger

and safer future. They can reduce the problem of seed-borne diseases and ensure there are plentiful harvests for future generations.

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CHAPTER 3
UNDERSTANDING THE DIVERSE LOCATIONS OF SEED-BORNE INOCULUM

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ABSTRACT:

It explains how these microorganisms can affect agriculture and how they often come from unexpected sources. Seeds are the most important parts of plants and they hold the potential for future crops. But, this promise may not always be true because seeds can have harmful microorganisms in them, like bacteria, fungi, viruses, and nematodes.This chapter explains how seeds can get diseases from different ecosystems and agricultural systems. These sources include the plants in fields, the soil, air, water, and even the farming tools used. This chapter highlights the complex relationship between plants and their surroundings. It shows how this relationship can affect the types and number of seeds that are passed on to new plants.Furthermore, the chapter discusses how pathogens find their way through this complex environment to enter seeds. This text explores how illnesses find ways to grow in seeds, using special traits to survive and do well in different environments. By studying how pathogens, seeds, and their surroundings interact, scientists can figure out how diseases spread through seeds.The information in this chapter has important effects on farming. They stress that it is important to closely watch for diseases, identify harmful germs, and take care of the health of seeds to stop the spreading of diseases that are found in seeds. The chapter also mentions that it is important to use different methods for different crops and environments. This shows how precision farming can help reduce the risk of seed-borne diseases.By understanding the complicated ways plants and people interact, people in agriculture can make sure that food production is strong and safe. This will protect the potential of each seed and make sure we have plenty of healthy crops in the future.

KEYWORDS:

Disease, Grain, Plants, Pathogens, Seeds.

INTRODUCTION

Seeds have fascinated humans since the beginning of agriculture because they represent the potential for new life. These small capsules of energy have the power to change the way land looks, feed large groups of people, and provide energy for civilizations. However, there is a hidden danger in this promise that has caused difficulties for farmers throughout history - diseases that are carried by seeds. Hidden inside living things, these harmful germs can secretly weaken and destroy crops, destroying the careful system of food security that societies have built up over many years.The story of seed-borne pathogens is about how they silently enter and survive, causing severe damage. Basically, it is the story of how tiny organisms like bacteria and viruses hide in seeds, waiting for the right time to come out and cause damage. The complicated details of this phenomenon are highlighted by how easily harmful organisms live together with seeds, taking advantage of the close relationship seeds have with young plants.This chapter explores seed-borne pathogens by uncovering the secrets surrounding their existence. It explores the many different aspects of how they exist – from how they spread and infect quietly, to the wide-ranging effects they have on farms around the

world. We want to learn more about seed-borne pathogens and the ways we can protect our crops by bringing together science, technology, and farming knowledge.Seed-borne pathogens are germs that can stay hidden in seeds and cause problems. This can be really hard for the seeds that are meant to bring life. Seeds, which bring life, can also unknowingly carry diseases. This chapter studies the bigger picture of seed-borne pathogens and why they are important in nature and for the economy[1], [2].

This text talks about how seeds can both spread disease and give us hope. It encourages us to face the fact that seeds have both of these qualities.The journey of seed-borne pathogens starts when they are able to move through different places, like overcoming barriers and challenges, in order to infect seeds. This chapter explores how germs and the living things they infect interact with each other. It looks at the different ways germs can get inside seeds. From plants grown by parents in the field to dirty soil and even the tools used in farming, pests find many ways to spread and cause harm. In addition, the chapter explores how germs change the growth of seeds and young plants, pointing out the small details of how they affect each other.Seed-borne pathogens have serious effects on farming. They harm crop production, reduce the quality of food, and put global food supply at risk. This chapter looks at examples that show how these things can cause a lot of problems for different plants and areas. This shows that crops are easily affected by fast-spreading diseases caused by sneaky invaders. It highlights the difficulties farmers face in keeping their fields healthy and getting good harvests.

The effort to combat plant diseases that are transmitted through seeds relies on finding and identifying them as soon as possible. New and developing technologies, such as tests to detect tiny substances and improved methods of taking pictures inside the body, are changing how we find and identify harmful germs or viruses. This chapter explains how new tools in diagnostics help us find dangerous diseases in seeds before they harm plants. This lets us act quickly to stop the disease from spreading.Protecting seeds from harmful microorganisms requires a comprehensive strategy that includes actions taken in the field as well as in the laboratory. This chapter explores different ways to control and manage pathogens. These methods include using cultural practices, treating seeds, and using plants that are resistant to diseases. This text explores how well different methods work and the problems they face. It shows that we need to be flexible and open-minded to overcome the constantly changing danger of seed-borne diseases.The fight against diseases in seeds is not only about labs and fields, it also has an impact on society and the economy. Crop production decreases, food becomes less nutritious, and the economy becomes unstable because of these unseen enemies[3], [4].

This chapter talks about how science and society are connected, and highlights the importance of working together across different sectors. We need everyone, including researchers, policymakers, farmers, and industries, to work together to turn knowledge into practical solutions. This will help to ensure that we have enough food and can use sustainable farming methods.As we explore the complicated world of diseases that are transmitted through seeds, we discover a narrative that relates to both old challenges and current ways to solve them. The upcoming chapters explain how germs and seeds interact, the study of finding diseases early, and why it's important to work together with others. By doing this, they show us a way to move ahead. This way is not limited to one subject, it connects both theory and practice, and aims to find a balance between the potential of seeds and the challenges posed by pathogens. We are going deeper into the mystery of seed-borne pathogens. We have knowledge and a strong commitment to protect the important connection between seeds and food.

Seeds make sugars and amino acids when they start soaking up water. The stuff that comes out of the seeds can stop seeds from growing. The liquid from oil crops, cumin, and chilli pepper can also stop fungus from growing. The liquid has six kinds of sugar, twelve kinds of amino acid, and five kinds of organic acid in it. Sure, here's a simplified version of the text: "Mungo. " The way the non-living and living parts of the environment interact is influenced by seed fluids and how they affect diseases that are carried by seeds. These fungi include *Alternaria alternata, Aspergillus flavus, Colletotrichum truncatum, Fusarium moniliforme*, and *F. "Oxysporum*, F" can be rewritten as "a type of fungus called *Oxysporum, F.* Poaef and F. I'm sorry, but "semitectum" is not a word or phrase that can be simplified or clarified as it does not have a clear meaning. The liquid from the outer covering of pigeon pea seeds stops the growth of certain fungi like *Curvularia lunata, Drechslera rostrata, Phoma lingam. Geniculata*, D means the scientific name for a species. Rewrite: Hawaiiensis and F are types or species. Oxysporum is a type of fungus. The liquid from the seed coat can stop fungal spores from growing because it contains substances that fight against the fungus. These substances can protect the seed from getting infected or passing on the infection. Seeds have many different types of tiny organisms and viruses living on them, and some of these can stop the seeds from growing or getting infected when they are planted in the ground. The reason why an oat type from Brazil can resist Drechslera victoriae is because of other microorganisms called *Chaetomium cochlioides* and C.

The fungi called *Pyrenophora avenae* can cause disease in oat plants. These fungi produce a chemical called cochliodinol when they infect seeds. It has been observed that other microorganisms in the soil can prevent the spread of *Pyrenophora avenae* through the seeds. A study by Bamberg and others showed that Tilletia caries and *Tilletia controversa* can interact with each other. Foetida and infect can both harm separately, but when combined, they cancel each other out. Seeds treated with *T. Foetida* and planted in soil with pests called *T. Caries* reduce the chance of seedlings getting infected by *T. Caries* means decay or damage. When seeds are not protected from harmful substances, they can decay or be damaged. However, Berend135 did not find any proof of hostility when seeds were given both fungi together. Corynebacterium michiganense pv. or C michiganense is a bacteria that causes plant diseases. Wheat cannot get tundu disease unless the nematode Anguina tritici is present. Also, a certain bacteria in sesame seeds stops the growth of *Pseudomonas syringae* pv. Sesami is part of the culture. The Cowpea stunt disease in cowpeas is caused by two viruses, cucumber mosaic virus and blackeye cowpea mosaic virus. These viruses work together to make the disease worse. Both diseases can be spread through seeds and by the same bug, either by itself or with another disease. The viruses can spread from plants that have two infections, either on their own or together, and this can cause either one or two infections in cowpeas.

DISCUSSION

Seed-borne infections or infected seed is a big problem in seed certification. Infected seeds that can still grow according to standards may not be used as seed because they look bad and contain harmful fungi and toxins. The tomato is a very popular vegetable that is grown all over the world. It is good for you because it has a lot of nutrients like lycopene, βcarotene, and vitamin C. It also has antioxidants, which are good for your body. And even though it is low in calories, it still has a lot of good stuff in it. Many studies show that eating a lot of tomatoes can lower the risk of getting cancer, heart problems, and blocked arteries. This plant is now seen as an example of how plants interact with diseases. Tomato seeds can get sick from diseases like early blight, late blight, fusarium wilt, septoria leaf spot, damping off, and fruit rot. Fungal diseases can come from outside or inside the seeds, or they can be found on

the seeds as contaminants (Figure 1). Some types of fungi, like those that feed on dead material and those that only mildly harm plants, can make seeds look bad and not worth as much money. We tested the ability of three types of fungi, *Alternaria alternata, Fusarium solani*, and *Fusarium oxysporum*, to cause disease in ten different types of tomato plants that were infected by these fungi. All the seeds that started growing were infected by these fungi to different degrees and each type of plant significantly reduced the number of seeds that grew and made more abnormal baby plants compared to the normal ones[5], [6].

They also said that *Alternaria alternata*, F. was passed on. Solani and F. are two different entities. Oxysporum can go from being seeds to small plants called seedlings. The strongest transmission of the disease was found when the seeds were sprouting and when the seedlings were growing. Seed transmission studies help confirm whether seeds can transmit pathogens to plants. This information is important for proving their ability to cause disease and for developing effective ways to manage them. This invention is about using radiography to find hidden infections in cereals and seeds caused by insect pests. This invention can be used to test the quality of batches of food grain or seeds that are meant to be bought and sold. It is useful for industries that process grain and produce seeds. In easy words, grain crops means wheat, rye, barley, rice, oats.Having bugs in grains can make the grains unstable and prone to damage when stored for a long time or in hot conditions. Grain that has bugs is a carrier of bacteria, increases the amount of grain and weed impurities, causes production losses, and reduces the amount of quality products that can be made. When bugs appear in grain and the temperature gets higher than 10-12 ° C, it can ruin the whole batch of grain. The grain becomes toxic and cannot be used anymore.It's important to know that finding hidden grain contamination and taking proper action, like getting rid of pests and checking the quality of the grain, can save a batch of grain from more harm and make it usable again[7], [8].

When analyzing grain using X-rays, a special technique called a "triple direct x-ray increase" is used. This involves placing the grain sample holder about one-third of the way between the X-ray tube and the plate. The analysis is then done by exposing the grain to X-ray radiation. The quality of grains is assessed by looking at ten photos, each with at least 1000 grains. This makes the analysis more reliable.After the picture is taken, the plate is moved to a special machine called a scanner. Before using the scanner, you have to choose the size of the plate you want to use. The scanning begins on its own and is sent to the computer in about 2-3 minutes. The Digora PCT scanner is used to convert images into electronic photos. The photos have a resolution of 2400 × 3000 pixels. The final picture is sent to a computer as a group of 10 pictures and edited using special computer software.To analyze grains using X-rays, a machine called PRDU-02 or a similar version is used. This machine can examine objects with a density of at least 3 mm, and it can provide detailed results with a resolution of up to 0. 05 The amount of radiation emitted by the machine is very low, not more than 1 μSv per hour above the normal radiation levels.To take pictures of sample holders with grain, a special plate called Digora PCT Imaging Plate is used. It is a reusable plate that measures 24 × 30 cm. Additionally, a digital device is used to process X-ray images and it uses sensors like Digora PCT. This device allows you to receive electronic photos with a resolution of 2400 × 3000 points. To work with this digital device, a computer is also needed.The X-ray machine should be able to make objects look three times bigger when taking about 100 pictures. It should also let you see the X-ray pictures on a computer screen, take digital photos of the pictures, edit the pictures on a computer, find any problems automatically, create a 3D image, and keep a database of X-ray pictures.When looking at a problem at the beginning, we can see small dots on a picture that was taken with an electronic device.

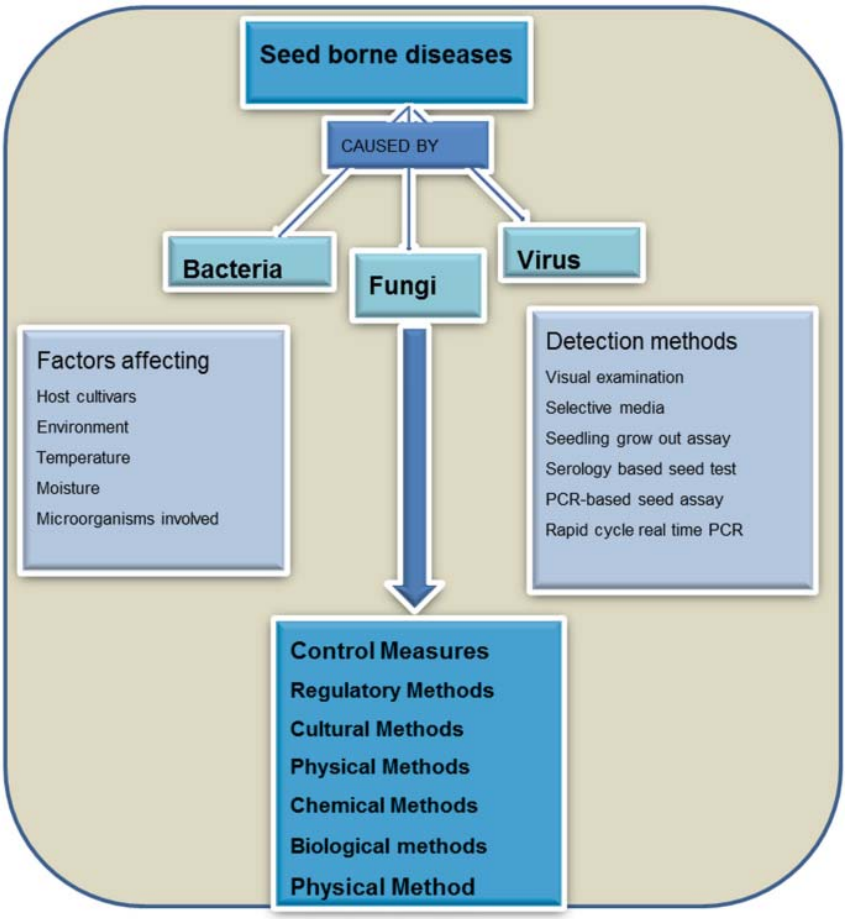

Figure 1: Representing the overview about seed borne disease and their detection methods [Springer].

There is a way to use x-rays to study grain and seeds. The process involves placing the samples in the x-ray and then recording an image to see inside the sample.The usual drawbacks of this method are that it takes a long time to complete and the studies may not be very accurate or reliable.The most similar technical solution is a device that uses x-rays to study grain and seeds. In this device, the samples are put in the x-ray beam, the x-rays are used to create an image, and that image is displayed on a screen or other display. The information from the image is read and processed by a computer.However, the problem with the method described is that the research results are not very accurate or reliable, even for small amounts. The method does not accurately determine the quality of grain and seeds when checking them.The invention helps to make it easier and more reliable to find out if grain or seeds have been infected by insects that harm grain storage.To find out if a batch of seeds or grain crops has bugs in them, a method is used. The grains or seeds are put in an x-ray machine, and their x-ray image is recorded on a device. This image is then read and processed by a computer. To do this, the grains or seeds are first taken from the batch and placed in layers on 10 holders, with at least 1mm of space between each grain or seed. These holders are then put in the x-ray machine one by one[9], [10].

Ten electronic images are created and processed using a computer program. If the program finds any infected grains, all the images are checked for insect larvae and pupae. If they are found, the grains with insects are taken out. To check if the insects are alive, the holders with

the grains are put in a heated cabinet for a few minutes. Then, the holders are put back in the x-ray machine and the bugs inside the grains are checked again by comparing the x-ray images.To get the best result, you need to take a small part of the grain or seeds to check for insects. This sample should be taken from the part of the grain that is most likely to have insects, like the top layers, the layers against the walls, or the layers that are 50-90 cm deep from the top. At the same time, we take a sample of at least 1000 grains. If we take fewer than 1000 grains, the results are not as accurate and we can only estimate within a range of ± 2% using software. After that, the chosen grains are arranged in a single layer with a groove facing down, making sure the embryo is all facing the same way. This is done using 10 sample holder frames, each of which can hold at least 100 pieces or even more. A small amount of grain is placed on a flat surface in a special holder. This keeps the grains spread apart by at least 1 millimeter. If the distance is less than 1 mm, it makes the accuracy worse because the projected images overlap each other.After that, the sample holder is put on a shelf in a special X-ray machine. The shelf has four supports that make the sample holder higher. The X-ray machine has a source that sends out X-rays and a receiver that detects the X-rays on a special plate[11].

The picture is saved in the bmp format and it has 8 bits of color. Next, send at least 10 electronic images in a package. At the end of the examination, the program gives a short report about hidden problems in grains, like hidden diseases. These reports can be in the form of files with either a txt or xls format.The defect is seen as dark stripes on a light background of the intact endosperm. Inside the stripes, there is a lighter image of the insect. This defect indicates damage and population caused by insect pests. If the bug is not inside the grain anymore, the tunnel will have a dark color that is the same all the way through and has a round or oval darker spot at the end. With only one registration, we can identify a living insect by how blurry its image is when it moves during a picture. But with two registrations, we can also tell if the insect changed its position.When the program finds a grain that has bugs, they check all the pictures to see if there are baby bugs and their cocoons inside the grain.When we look at the young insects and their development stages inside the grain, we choose the ones with these grains from 10 sample holders.Next, in the second step, to make bugs move, we put a container of bugs with food in a warm cabinet set to the best conditions: between 37-40 °C for around 4-6 minutes. Next, we move the sample holders to a different position in the x-ray beam. You can tell if there are bugs in the grain by looking at how they move inside it during a test.A grain that has a baby bug or a developing bug inside it and has not moved around after being exposed to high temperatures is called grain damaged by insects.The grain that the larva moved to after it was soaked is considered infected. If a test batch of this grain has hidden infection, it cannot be stored for a long time without being treated first.

Seeds are tiny things that have the ability to grow into a whole lot of plants. They can help produce a whole bunch of crops. They hold the plan for future plants, carrying the genetic traits that shape our farms. However, hidden dangers exist that can prevent us from having lots of crops – seed infections. These sneaky intruders, which are hard to see without a microscope, hide inside the center of seeds. They are ready to infect the process of sprouting, development, and ultimately, the safety of our food.This chapter focuses on the complicated world of seed infections, showing the different types of germs that use seeds to survive. Disease-causing organisms like bacteria, fungi, viruses, and nematodes try to hide in seeds because seeds and young plants are closely connected, and this helps the pathogens to survive and spread. The chapter looks at how these secret invaders grow and reproduce, starting from how they get into seeds and then how they survive against the host's defenses.To understand how seeds become infected, one must learn about the ways in which harmful germs enter and

harm the plants. This chapter reveals how pathogens use different strategies to get through seed barriers, such as going onto the surface, spreading throughout the system, and transferring to new plants. This explores how certain factors affect how likely seeds are to get infected, and it describes how pathogens invade and hosts defend against them.

Seed infections can sometimes stay hidden until the conditions are right for them to grow. This chapter talks about a situation called latent infections. In this situation, harmful germs hide and wait for certain things like water, heat, and food to start attacking the plant they are living on. By studying the molecules that activate these inactive agents, we can understand how germs and the body interact and how germs survive.Seed infections have a big effect on farms, making it hard for crops to grow well. This chapter looks at how seed-borne diseases show up in plants. These diseases can cause plants to grow smaller and change color, or even lead to big reductions in how much crops can be harvested. This text talks about the problems caused by seed infections all around the world. It emphasizes the importance of taking proactive steps to manage these problems. These methods include managing pests, growing seeds without diseases, and using plants that can resist harm to prevent problems and make sure we have successful crops.It is very important to find and deal with plant diseases when they are just starting. This chapter explores different diagnostic technologies that help researchers and farmers find hidden infections. It covers both traditional methods and advanced molecular assays.

This highlights the important role of finding diseases early to stop them from spreading during different times of planting.As we discover more about seed infections, we see that one thing is clear we need comprehensive ways to prevent them. This chapter looks at different ways to prevent problems in farming at various times throughout the year. It stresses the need for producing seeds that do not contain disease-causing organisms, keeping things clean, planting different crops in different seasons, and using natural methods to control pests. By developing a strong defense to protect seeds from infections, we can create a resilient agriculture system that can handle the challenges posed by these hidden enemies.The exploration of seed infections uncovers many complex and ever-changing interactions between harmful substances and seeds. This makes us think about important questions: How do these germs change to avoid the body's defenses. How can we use what we know to make better ways to manage them. How does new technology help us learn more about germs in seeds. As we start this journey, we will learn new things, come up with new ideas, and work together to protect and keep seeds healthy.

CONCLUSION

Seeds were once thought to hold great possibilities and potential, but we now know that they can also carry hidden dangers inside. The discovery that inoculum can come from different places like soil, air, water, and even machinery shows that seed-borne diseases can spread in many different ways.The chapter reinforces the idea that we need to be proactive in managing these origins. Knowing where the disease-carrying germs in seeds are found helps people make plans suited for different plants, areas, and environments. By understanding how pathogens get into seeds, farmers can improve their methods to prevent the spread of diseases. This will make crops more resistant to future outbreaks.In addition, this chapter emphasizes the importance of working together between different areas of science and industries. To understand and find solutions for the spread of harmful microorganisms in seeds, it is important to combine information from plant diseases, farming practices, nature, and technology. Researchers, farmers, policymakers, and industry experts need to work together to create new methods for finding problems early, determining what they are accurately, and taking care of them in a way that protects the environment.In the bigger

picture of farming around the world, the knowledge from this chapter can help bring about big changes. By understanding where seeds get infected, we can find ways to protect our food and make sure we have enough in the future. Exploring the secret relationship between disease-causing agents and seeds motivates us to work towards a balanced and peaceful coexistence between the potential of seeds and the strength of our farmland. In simple words, if we can figure out where things originally come from, we can learn and take actions that will help improve our agriculture in a better and more lasting way.

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CHAPTER 4
MECHANISMS OF SEED INFECTION BY PATHOGENS: A CRITICAL REVIEW

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ABSTRACT:

This chapter explains how pathogens and seeds interact and how pathogens find ways to infect and harm seeds.The exploration starts by looking at the physical and body barriers that seeds have to stop pathogens from getting inside. This chapter explains how harmful germs change to take advantage of weaknesses in plants. They use tools like breaking down plant parts with special chemicals and applying pressure to get inside the seeds. Once inside the body, harmful germs follow complex paths in cells to settle down and affect the growth, resting, and sprouting of seeds. This chapter looks at how germs talk to seeds and what signals make them wake up and start infecting.Moreover, the chapter focuses on explaining how pathogens with different types are capable of causing infections in various ways. Bacteria may use quorum sensing to coordinate their attack, while fungi can make special structures to help them enter. Viruses and nematodes have special ways of interacting with their hosts by using vectors or specific proteins to control the host's body functions.It is very important to understand these mechanisms in order to create plans that work well for preventing and managing things. Researchers can figure out how germs use seeds to get inside plants, and then find ways to stop them from causing infections by making treatments that interfere with the germs' ability to infect. The chapter also emphasizes how the way germs interact with hosts affects the course of infections, from when the germs are inactive to when the disease shows symptoms.This chapter shows us how germs and seeds can affect each other. It teaches us how to protect seeds and make sure there is enough food for everyone in the world.

KEYWORDS:

Germs, Harmful, Microorganisms, Plants, Seed.

INTRODUCTION

Seed infection by harmful microorganisms is an important part of keeping plants healthy and helping them grow well for farming. Harmful microorganisms like fungi, bacteria, and viruses can get into seeds. This can make the seeds less healthy and not grow as well. It can also cause diseases to spread to future generations of plants. Understanding how seeds get infected is important for coming up with good ways to reduce the damage it causes and make sure we can keep growing crops for a long time.The process of seed infection includes various steps in which germs enter the seed and grow inside it. This happens when the germs are able to break through the seed's protective barriers. These steps are when the substance sticks to the outside of the seed, goes inside the seed, grows inside the seed, and spreads throughout the seed. Each of these stages is very important in deciding how bad the infection is and how much it affects the plant's health.Pathogens can first get on seeds in different ways, like when the soil, air, water, or leftover plants from infected ones touch them. The germ's ability to stick to the seed surface is affected by how the germ structures (like spores

or cells) and substances on the seed covering interact with each other. This first connection can be made by forces, signals, or interactions in the body[1], [2].

In order to infect the seed, germs need to get past the seed coat or outer shell. Certain harmful microorganisms can enter the seed by producing substances that break down its tough outer layer. Some germs use small holes or fractures to get inside. The ability to break the seed's outer covering depends on the pathogen's enzymes, how strong it is physically, and how well the seed coat is put together.When pathogens enter a seed, they have to adjust to the new surroundings and also compete with the microorganisms that already exist in the seed. Germs can use different methods to survive, like changing the environment around a seed, making the plant's defenses weaker, and beating helpful germs in a contest. When pathogens are able to colonize successfully, it means they are able to multiply and use the nutrients in the seed to grow and reproduce.Systemic spread means that something is spreading throughout the entire system or body. It is not just affecting one area, but is spreading and impacting the entire system as a whole[3], [4].

For certain germs, getting inside the seed is only the start. Once they are inside the seed, they can move through the plant using the seed's system of tubes to spread throughout the plant as it grows. This allows the harmful germ to harm different parts of a plant, like the leaves, branches, flowers, and fruits. When a plant has a systemic movement, it means that disease symptoms can show up and the pathogen can be passed on to the next generation of plants through infected seeds.Understanding how seeds get infected is important for developing strategies to prevent and manage infections. These strategies include different ways of doing things.Using disease-resistant varieties means choosing and creating plant types that are not easily harmed by specific disease-causing organisms.Seed treatments involve applying chemicals like fungicides, bactericides, or other protective substances to seeds to lower the number of harmful organisms that can harm the seeds.Seed testing involves conducting tests on seeds to determine their health status. The purpose of these tests is to identify any contaminated seeds and take necessary measures to remove them[5], [6].

Following strict rules to prevent the spread of diseases and keeping seed production and storage places clean and germ-free.Cultural practices are ways of farming that help protect crops from diseases. These practices include rotating crops, using healthy seeds, and planting crops a certain distance apart to reduce the spreading of harmful germs.In summary, the ways that pathogens infect seeds are complicated and involve many different interactions between the pathogens and seeds. Knowing and understanding how these mechanisms work is very important for developing effective ways to reduce the harmful impacts that seed infections have on the health and productivity of crops. By using what we know about how germs are harmful and using new ways of farming, we can make sure our crops stay healthy and safe from diseases that come from seeds. This will help us have enough food for everyone in a way that doesn't hurt the environment[7], [8].

DISCUSSION

Seed infection is when tiny living things like fungi, bacteria, viruses, or other germs get inside plant seeds and make them sick. This can cause the seeds to be lower quality, make them grow poorly, and affect the health of the plants. The process of how seeds get infected involves many steps.

Contact and Adhesion: Germs get on seeds in different ways, like when the soil, water, or plant debris they are in is dirty or infected. The harmful germs need to stick to the seed's outer layer to cause an infection. Adhesion happens when germs like spores stick to chemicals on the outside of a seed.

Colinization: Once attached, germs start to occupy the outside of the seed. They can create enzymes that break down the outer layer of a seed or plant, which helps them get inside the seed more easily. Certain germs can enter a plant through little holes in the outer covering of seeds called micropyles.

Penetration: The germs break through the outer layer of the seed and enter the inside part of the seed. This can happen by either physically entering or using enzymes to break through protective barriers. Once inside, the harmful organisms can reach the parts of the seed that have lots of food, which is perfect for them to grow and make more of their kind.

Infection and Reproduction: When pathogens get inside the seed, they begin to multiply and spread throughout the tissues of the seed. These substances can disrupt the normal growth of the embryo and endosperm, which can result in the seeds not developing properly and having a lower chance of sprouting. The germs can also make poisons that harm the seed and stop it from growing.

Transmission: Infected seeds can pass diseases on to the next generation of plants. When these bad seeds are planted, the germs can grow and make the young plants sick, causing the disease to spread.

Spreading: Besides spreading through seeds, diseases can also be spread through other things like wind, rain, bugs, and human actions. These ways of spreading help diseases move to new plants and places.

It is important to keep in mind that how seeds get infected can be different depending on the type of harmful organism and the specific kind of plant. Moreover, things like how good the seeds are, the conditions in the environment, and how well the plants can fight off infections can affect how likely it is for seeds to get infected.Farmers and plant breeders use different methods to reduce seed infection. They use clean seeds, keep things clean, use special chemicals, and choose plants that can fight off specific diseases.

Systemic Infection

Systemic infection means that germs can spread inside a plant through its tubes and affect many different parts, like leaves, stems, flowers, fruits, and even seeds. This kind of infection happens when bad things enter the plant through one spot, like a flower, fruit, or seed stalk. This is how an **infection can spread throughout the body through these paths:**

Flower sickness: Pollen can carry certain germs and spread them to other plants or organisms. When unhealthy pollen lands on a flower's stigma, the germ can move through a tube called the style and enter the plant's circulatory system. This allows the germ to spread to other parts of the plant as the flower's reproductive structures grow.Some diseases can get into plants through nectar and the various parts of flowers. Insects like bees can spread germs from one flower to another when they eat nectar or touch infected flower parts.

Table 1: Table summarized the micobes and their site of systemic infection.

Microbe	**Infection Site**	**Mechanism of Systemic Infection**
Xanthomonas campestris	Flower	Goes inside through openings in nature, reproduces in the tissues that transport fluids in plants.
Xanthomonas	Flower	Causes drooping, death of cells, and spreads throughout

campestris		the body in an infection.
Fusarium oxysporum	Seed	Goes into cuts, grows in the blood vessels.
Fusarium oxysporum	Seed	Causes the wilting of blood vessels and overall yellow coloring throughout the plant's system.
Cucumber mosaic virus	Flower, Fruit	Spread by aphids, this disease infects the tubes that carry nutrients inside plants.
Cucumber mosaic virus	Flower, Fruit	This thing causes strange patterns on leaves and can also make you feel sick all over your body.
Meloidogyne spp.	Root	Goes into roots, moves to seed stalk through a tube called vascular system.

Fruit Infection

Fruit Infection is a condition where fruits become sick or get a disease.Fruit surfaces can be invaded by germs through cuts, small openings like stem marks, or by going straight through the skin of the fruit. Once inside, the germ can move throughout the plant's bloodstream that connects the fruit to the rest of the plant.

Pathogen Growth

Some germs can first infect the outside of the fruit and then spread inside, reaching the seeds and other parts of the fruit.Seed stalk infection refers to the infection of the part of a plant called the peduncle.Flower clusters can get infected by pathogens, which can then spread to the stem that holds the seeds (Table 1). This can occur by either cuts or natural openings in the plant's flower cluster, or by directly harming the plant's tissues.When the pathogen enters the seed stalk, it can move through the plant's transport tissues and reach other parts of the plant. This can also potentially harm the seeds.In each of these situations, when the harmful germ enters the plant's tubes, it can spread to different parts of the plant like the leaves, stems, and other parts that help the plant reproduce. This movement can spread infection and disease symptoms to the entire plant. If seeds get sick, they can pass the germ to the next generation of plants.Ways to control systemic infections in plants are using plant types that are resistant to diseases, keeping the plants clean by removing infected parts, using pesticides or other methods to manage diseases, and following practices that prevent the spread of harmful microorganisms between plants. It is important to watch closely for signs of sickness in plants and catch the problem early to stop the disease from spreading throughout the entire plant[9], [10].

Certain harmful microorganisms can enter plants through the stigma, ovary wall, and seed coat. This allows them to spread throughout the entire plant and affect the seeds and future generations of plants. The stigma is a part of a flower that is like a doorway for pollen to come in and fertilize the flower. Certain harmful organisms can take advantage of this opening to enter the plant's reproductive parts.Harmful bugs like bacteria or fungi can land on the stigma through the air, water, or bugs like insects. They might stick to the outside of the plant and enter the plant's tissues through small openings or cuts.Pathogens can enter the stigma and then move through the stalk connecting the stigma to the ovary. From there, they can reach the vascular tissues that connect the flower to the rest of the plant. From there, they can move throughout the plant, affecting leaves, stems, and other parts involved in

reproduction.The ovary covers and shields the growing ovules that turn into seeds. The seed coat is the outer layer that protects the seed. Both structures act as barriers to stop harmful germs from getting into and causing diseases in the seeds.

Pathogens can get into plants through their natural openings or through cuts or directly breaking through the protective layer of the seed or the wall of the ovary with the help of enzymes or physical force.When the pathogen gets inside the ovary or seed, it can use the vascular system that is found in these reproductive structures. This helps the harmful germ to spread throughout the plant and maybe harm other parts of the plant.In both situations, harmful germs that can enter the stigma, ovary wall, or seed cover can spread all through the plant's tubes, causing a widespread infection. This spreading of disease can cause different problems in plants like wilting, turning yellow, dying tissue, and not growing well. If seeds have a disease, they can give the disease to the next group of plants, continuing the cycle of infection.Stopping things from getting through these doorways and windows involves different ways to do it. Using disease-resistant varieties means planting plants that naturally have the ability to fight off certain diseases. This can help to lower the chances of the plants getting infected. Sanitation means getting rid of and destroying plants that are infected. This can help reduce the amount of germs in the environment.Controlling bugs that can carry and spread diseases can prevent diseases from entering flowers and plants.Hygiene means taking good care of cleanliness. When you handle plants, seeds, and tools with clean hands and keep them clean, it stops the spreading of germs.It is important to watch plants closely for signs of infection and quickly take action to control the spread of disease. This will help stop pathogens from spreading to other parts of the plant[11], [12].

Seed Infestation

Seed infestation means when the seeds are contaminated or taken over by bugs, sickness-causing organisms, or undesirable living things. This can lead to lower quality seeds, less seeds growing, and the chance of bringing harmful bugs or illnesses to new planting areas. Seeds can be infested at different times when they are being made, stored, or handled. Here are some common reasons why seeds get infested, different kinds of infestations, and ways to prevent them.Infection while plants are growing Germs can infect seeds while plants are growing in the field. Dirty soil, water, and air can all bring in germs to growing seeds.Contaminated pollination happens when pollen from infected plants brings harmful things to the stigma of healthy plants. This can make the seeds of the healthy plants get infected too.Bugs and pests can harm seeds, making them more likely to get sick or go bad.Collecting and moving seeds in a careless way or using dirty equipment can bring harmful germs to the seeds.The way seeds are stored can affect how well they grow. If they are stored in damp or dirty conditions, they can get infected by fungi, bacteria, and insects.Cross-contamination happens when seeds from different places are stored or handled together. This can spread bugs or germs.

Different kinds of seeds can become infected in different ways such as through insects, fungi, or bacteria. This is called seed infestation.Fungi can start to grow on the outside or inside of a seed, which can change its color, make it decay, and reduce its ability to grow properly.Bacterial infestation occurs when bacteria infect seeds. This can cause the seeds to decay or cause seedlings to die.Bugs can lay their eggs on or in seeds, and their baby bugs can eat the inside of the seeds.When seeds have viral germs, the plants that grow from these seeds can become infected.Nematode infestation is when tiny worms called nematodes invade seeds and cause different diseases in plants.Avoiding something from happening and taking care of it if it does happen.Use seeds that have been officially checked and approved, and buy them from trustworthy places that guarantee the seeds are free from any

diseases.Sanitation means keeping everything clean when making, handling, and storing seeds so that there is as little contamination as possible.Start with healthy plants that are free from diseases to decrease the likelihood of getting infected from the start.Keep the seeds that are coming in separate and check them carefully for any signs of bugs or diseases before planting them.

Fungicides and treatments are used to get rid of pests. The right treatment depends on the type of pest. Using fungicides, insecticides, or other appropriate treatments can be helpful.To keep seeds safe and prevent fungus or bugs from growing, store them in cool, dry, and well-ventilated places.Regular monitoring means checking on the stored seeds often. You need to look out for any signs that the seeds are getting worse or going bad. If you notice any affected seeds, you should take them out quickly.Farmers and seed producers can reduce the chance of seeds being attacked by bugs or diseases by following these steps. This will result in healthier young plants, better growth of crops, and larger harvests.Germs, like fungi, bacteria, or viruses, can stick to the outside of seeds.

This can happen because of things like rain, wind, or touching things that have germs on them. Some germs might stay on the outside of the seed without getting inside, but others might get in through the seed's surface and cause an infection.Concomitant seed contamination means that seeds can become contaminated at the same time as other things.Concomitant contamination means when there are harmful germs on the outside or inside of a seed. In this situation, the seeds are dirty with harmful bacteria when they are being gathered or harvested. These harmful organisms can then impact the growth and overall well-being of the new plants as they start to develop.

The pathogenic surface means the outer layer of the seed that can touch harmful germs directly. This outside layer can be called the seed coat, testa, or other things that protect the seed. Some harmful microorganisms can release chemicals or make structures that help them break through or get inside this surface.Seeds can get dirty and unsafe if they touch infected plant parts, like pieces from sick plants, or soil that has harmful germs. Germs can be in the soil because of leftover plants from before, dirty water used for watering, or other things that can make it dirty.Whenever you can, use plants that have been confirmed to be free from any diseases.Make sure to clean and handle seeds properly when collecting and processing them.Check and clean machines and equipment used in collecting and processing to stop the spread of germs between different things.Use methods like hot water or fungicide treatments on seeds to lower the amount of harmful germs on them.Before planting, it is important to put new seeds in quarantine and test them for harmful organisms.To keep the soil healthy, it's important to do certain things like changing the crops you plant every season and regularly checking your fields for any problems. This will help prevent harmful organisms from accumulating in the soil.Keep seeds in clean and controlled places to stop them from getting contaminated by unhealthy plant parts or soil.Farmers and seed producers can lower the chances of seed contamination and make sure their crops are healthy by taking initiative and following these measures.

CONCLUSION

The ways in which seeds get infected, as discussed in this chapter, show how pathogens are able to adapt and survive. Pathogens are able to take advantage of different ways to enter the body and control how our body works which shows how clever and advanced they have become over time. Additionally, different types of germs use different ways to infect and harm us. These tactics have developed over time through evolution, and each is finely adjusted to increase their chances of causing a successful infection.The things we learn from

this exploration go beyond just being interested in science. These findings have important effects on how agriculture can adapt and be maintained for a long time. By understanding how germs get inside seeds, scientists, farmers, and government officials can work together to create new plans. There are different ways to protect plants from getting sick. One way is to breed plants that can resist diseases. Another way is to use treatments that directly attack the germs that cause disease. These methods help to reduce the harmful effects of infected seeds and keep crops healthy.This chapter also emphasizes the importance of continuous research and development of technology. As germs change and develop, we need to understand and stay up to date so we can predict what they might do and stop them before they cause harm. Equally important is sharing knowledge and giving farmers the tools to protect their crops from dangerous seed infections.By learning more about how pathogens affect seeds, we can create a strong base for a better future. This future will be safer, longer-lasting, and more successful. We will be able to make sure that seeds grow well without any problems caused by infections.

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CHAPTER 5
FACTORS INFLUENCING SEED INFECTION: UNDERSTANDING PREVENTION METHODS

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ABSTRACT:

Many different things can affect how seeds get infected, which can have a big effect on the health of the plants, how well crops grow, and the world's food supply. This summary explains the complicated relationship between these factors, explaining their effects, ways they work, and ways to handle them.Different living things, like fungi, bacteria, viruses, and nematodes, can harm and damage seeds' strength and ability to grow. Abiotic factors such as the environment, humidity, temperature changes, and soil quality also play important roles in deciding how easily seeds can get infected. Germs can stick to seeds, get inside them, and live there, causing infections that affect the whole plant.It is important to understand these factors to come up with good management plans. Using plants that are resistant to diseases, cleaning seeds thoroughly, and treating them with substances that kill fungi or bacteria can lower the chances of getting infected. Quarantine rules, regular testing, and keeping seeds in the right conditions also help stop seed contamination. There are many different factors that can cause seeds to become infected, and these factors have a big impact on agriculture all over the world. By understanding how these factors are connected and using good management methods, we can protect the health of seeds, make them grow better, and make sure we can produce enough food for everyone in a way that is good for the environment.

KEYWORDS:

Crops, Grow, Plants, Seeds, Seed Infections.

INTRODUCTION

Different investments in different stages of life can help organisms adapt to challenges in their environment, such as dealing with new diseases. The way that living things grow and reproduce in response to germs has been studied. However, we don't know as much about how germs change in response to different types of living things. Pathogens can change their life cycle in response to changes in the non-living environment, shorter lifespan of the host, and having multiple infections. Despite being less in quantity, these studies are significant because they show how pathogens can adapt to different ecological factors based on their life history. We are not sure how much the differences in the genetic makeup of the host can influence how a pathogen evolves over time. In this study, we look at how the genes of both the host and the pathogen affect important stages of the pathogen's life inside the host, from getting infected to reproducing.The way pathogens grow and reproduce inside the host is very important in all predictive models because it is closely related to how well they survive and reproduce during their lifetime. The number of new individuals an organism can produce is influenced by both how it spreads between hosts and how it grows and reproduces inside a host. However, the way it behaves inside a host also impacts how harmful and aggressive it becomes[1], [2].

Throughout, we use the word "virulence" to talk about how good a germ is at infecting certain types of hosts. And we use the word "aggressiveness" to talk about how much harm the germ causes the host when it infects and grows. Many studies have looked at how different organisms evolve in response to each other. They focus on how organisms become more harmful or resistant to each other over time. In some plant diseases, the ability to spread is influenced by how strong the illness-causing genes are and how well the plant can fight against them. These systems have given us a lot of information about how genes and pathogens evolve together, but we haven't studied enough about how the different stages of infection affect this process. Some writers think that certain genes in a host can help protect against a disease. These genes might also help the host recover from an infection. These stages have different effects on different types of hosts. Activation is not influenced by the type of host, but attachment is strongly influenced by the interaction between the host and the pathogen. For most systems, we don't know much about how different genes in the pathogen and host affect the different stages of the pathogen's life cycle, from when it infects the host to when it produces offspring.

Recent studies have shown that the reproductive rate of pathogens can be influenced by the genes of both the pathogen and the host in various systems. Examples include murine malaria, a butterfly parasite, a plant pathogen, and two different parasites of Daphnia. The way hosts and pathogens interact with each other can be important for how pathogens adapt to different host types. We expect pathogens that can spread further than their hosts to adapt to local conditions. In these cases, how well a pathogen interacts with the genotype of the host may play a big role in how quickly the pathogen reproduces. Taking into account interactions between individuals of the same species improves the accuracy of predictive models about how species evolve. Understanding how pathogens reproduce and spread is crucial for managing diseases in both natural and agricultural environments. It is important to study the effects of both the pathogen and the host's genetic makeup on the pathogen's life cycle within the host, in order to accurately predict how the pathogen may evolve over time[3], [4].

There are three important stages in the life of a pathogen inside a person's body: infection, a period of growth inside the person, and finally, the production of copies of the pathogen. The different stages in a pathogen's life determine how well it can reproduce inside a host. However, the importance of each stage in the overall reproduction can be different depending on the type of pathogen and the environment it is in. The impact of how quickly a pathogen becomes active and its ability to produce spores on the overall number of new infections differed depending on the wheat leaf rust genotype. Woodhams et al. discovered that different stages of the life of the fungus Batrachochyrium dendrobatidis had different effects on its overall ability to reproduce, depending on the temperature. In cold weather, the fungus grew slower and made less of the parts that make babies. However, it ended up making a lot of the tiny swimming spores inside each zoosporangium. In hot temperatures, the fungus grew quickly and made lots of zoosporangia, but each one had less zoospores. We are starting to understand that the environment plays a role in how pathogens evolve. Pathogens also affect how diseases spread and evolve. However, we don't know enough about which factors are most important in determining how different stages of a pathogen's life contribute to its ability to survive and reproduce.

Crop Management

Using the best methods to manage crops helps them grow better and produce more food. This can also make the food taste better. Crop management is a way of taking care of plants to make them grow better, develop well, and produce more crops. It starts by getting the ground

ready for planting, then planting the seeds and taking care of the crops. Finally, the crops are picked, stored, and sold. When and how farmers do their work depends on many things, like what crops they are growing in the winter or spring, what they are harvesting, and how they plant their crops. Other factors like the age of the plants, the type of soil, and the weather also play a role.Preparing the soil is the first thing you need to do to make your crops grow better. The perfect place to plant seeds is a flat and firm ground that has enough moisture in the upper layer of soil and doesn't have any other plants growing nearby to compete with the new seeds. The phrase "Good seed-to-soil contact required" is often found on documents about planting seeds. Seeds are more likely to grow if they touch the soil. However, if the seedbed is too hard, it becomes difficult to plant the seed in the soil[5].

There are two main ways to get the ground ready for planting seeds. One way is using traditional plowing and cultivating techniques. The other way is using a reduced or no-tillage method. The old-fashioned way of farming involves digging up all of the soil and exposing a lot of organic matter to air. But, using less or no-tillage methods can cause more soil carbon to build up, which can eventually help make soil healthier and increase how much crops can grow over time.Planting means putting seeds or plants into the ground so they can grow.After preparing the ground, you should plant the seeds about 1. 5 to 20. This will make sure that there is enough moisture for the seeds to grow well. The seed needs the right amount of water and temperature to start growing. Make sure the soil is at the right temperature and has enough moisture for the seed to germinate properly.Fertilization is the process where an egg and a sperm come together to create new life.Fertilization is important for taking care of crops. Before adding fertilizers to any crop, it is important to check the soil for plant nutrients that are readily available. Using the right amount of fertilizers based on the study of the soil and plants can make sure that the planted crop gets all the nutrients it needs.

Various factors, including the type of crop, type of fertilizer, soil and weather conditions, determine the amount of fertilizer, how it is applied, and when it is applied. The fertilizer can be either bulk-blended or mixed, and can come in gas, dry solids, or liquid forms. The application methods include broadcasting, deep placement, dribbling, spraying onto leaves, applying at the beginning of a crop's growth, after it has started growing, along rows, in strips, or varying the amount according to different areas. The type of plant grown before and the fertilizer added in the past also affect the amount of nutrients needed for the current crop. So, it's important to consider previous use of manure when deciding how much fertilizer crops need.Pest management means controlling or getting rid of pests like insects or rodents that can cause damage or harm.Pest control is also important in crop management. Pesticides are strong tools for getting rid of pests in most crops, especially when used correctly for particular pest types. Moreover, using integrated pest management (IPM) methods can be a cheaper and safer choice for farmers, while also benefiting people and the environment. This way of pest control includes using tools, natural methods, and chemicals to control pests.

Using the same substance over and over again on the same land, no matter what it's called, will make pests resistant to it eventually. This causes the chemical to become less helpful or even not helpful eventually. To stop pests from becoming resistant, don't use the same pesticides all the time. Instead, pick ones from different groups, or change how they work. It is a good idea to use different farming methods like growing different crops in a cycle and planting helpful crops together, as well as using natural predators and parasites to control pests. This can stop pests from becoming resistant to pesticides. Usually, using different types of crops helps to prevent most of the crops from failing and protects them from pests. It also makes the soil better and increases the amount of crops that can be harvested. The crop should be checked often to see if it needs anything special, like more nutrients or help with

pests, during the time it's growing.Watering crops is very important for growing them well and getting a high amount of good quality crops, especially in our dry area. Over-irrigation means too much water is used, which causes nutrients to be washed away into the groundwater, and can also result in wasting water and soil being washed away by the surface water[6], [7].

These losses will make fertilizers, especially nitrogen, less effective.Before you start growing any type of crop, make sure you know how much water it needs and when it is most important for its growth. Also, assess how well your irrigation system works to decide when to water the crop. If possible, try to use irrigation systems that use water more efficiently. Examples of these types of systems are micro-sprinklers, low-elevation sprinklers, and drip systems, which are highly efficient and use 85-95% of the water. Another option is low- and high-pressure center pivots, which are also efficient and use 75-90% of the water. Usually, flood irrigation is not as good at conserving water and is less effective compared to other methods, with only 20-50% efficiency. Also, if you can, try to water your plants in the early morning or late evening to prevent losing water through evaporation.The amount and quality of crops you get depend on how you manage the harvest. Rainy or snowy weather can make it difficult to collect the crop on time. When there is a lot of water in the crop/seed, it takes longer to harvest mechanically using machines like windrowing, swathing, or direct combining. Most of the crops, like grains and seeds, should be collected when they are fully grown and ready to be harvested.

This timing helps prevent crops from breaking and falling down, which reduces the amount of crops that are lost. So, if you don't harvest at the right time, you can lose a lot of crops.The age of the forage when it is harvested is very important because it affects the quality of the forage and how it can be used. If the collection of forage is delayed in order to get the most amount, then the quality of the forage will get worse or not be good enough. The most amount of alfalfa forage that can be produced is when it is fully flowering. But, the best quality alfalfa forage is before it starts flowering.After the crops are harvested, they need to be stored properly.The way crops are stored after harvest also affects their quality as food for animals and humans. The crops that are gathered should be kept at the right amount of moisture as recommended for each crop. This helps make them the best quality, prevents bugs from getting in, and stops them from getting bad while being stored. For instance, cereals with 14. 5 percent moisture are easily damaged, get moldy, and attract insects. To improve the quality of alfalfa forage, it is best to make bales when it has a moisture level of 18-20%.

DISCUSSION

Seed Quality

Seed quality means having seeds that are pure in terms of their genetic and physical characteristics, and also in good condition and healthy. The main qualities of a seed are described below.

Physical Quality

It refers to how clean a seed is from other seeds, bits of dirt and dust, unwanted substances, seeds that are sick or damaged by insects. The seed should be all the same size and weight and have the same color. It should not have any stones, dirt, leaves, twigs, stems, flowers, or other plant seeds in it. It also needs to be free of dried, sick, spotted, spoiled, discolored, harmed, and empty seeds. The seed should be easy to recognize as a type of certain category of certain species. Not having this quality trait will indirectly affect the growth and value of

planted seeds. You can get this good kind of seed by cleaning and sorting the seed properly after collecting it, before planting or storing it.Genetic purity means that the seed is in its original form. The baby plant that grows from a seed should look exactly like its mother plant in every way. It is important to have good qualities in a character to achieve the goal of growing crops well, whether it is for a higher yield, resistance to diseases, or good quality[8], [9].

Physiological Quality

It refers to the way a seed behaves and reproduces in the future. The physical traits of a seed include how well it can grow and the strength it has. The ability of a seed to grow is called viability. Germinability means how well a seed can produce a healthy seedling with a normal root and shoot when given the right conditions. Seed vigour refers to the strength and endurance of a seed in creating healthy seedlings. It means that all the qualities of a seed together allow it to grow again in any situation. Seed vigour is how well a seed or group of seeds can grow and become seedlings. Seeds that grow well when planted are called quality seeds. They can be classified as high, medium, or low vigour seeds based on how well they produce healthy seedlings. The difference in seed vigour is the variation in how well seeds grow, which is caused by the damage that happens before they can't sprout anymore. Seed vigour refers to the strength or quality of a seed. This can be seen in how quickly the seed sprouts, how evenly the seeds sprout, and how many seeds fail to germinate. This means that not all seeds that can grow are able to germinate, but all seeds that can germinate are able to grow. All strong seeds can grow, but not all seeds that can grow are necessarily strong. To make sure the seeds are good, we need to choose mature seeds to plant and take care of them properly by handling, drying, and storing them carefully. This will help the seeds grow well. It is better to start a plantation with strong and healthy seeds because it takes several years before the fruits and economic benefits can be seen. Therefore, it is important to choose high-quality seeds for a successful plantation.

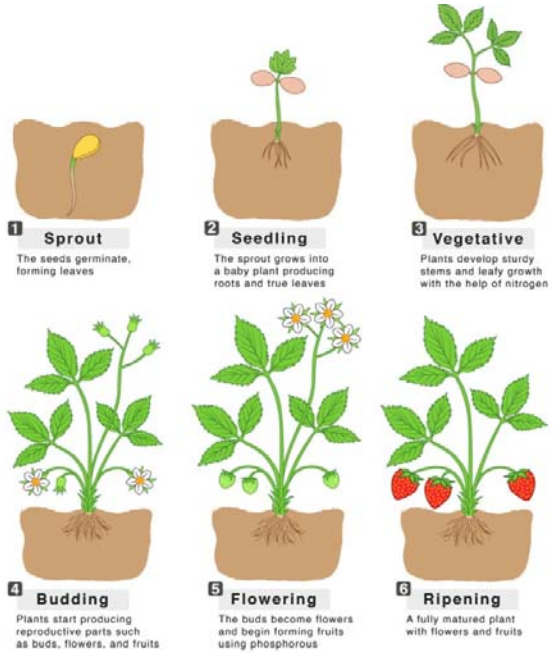

Figure 1: Representing the stages involved during the plant growth [Science Facts].

Seed Health refers to the condition of a seed where it is not affected by bugs or fungi either inside or on the surface of the seed. The seed should not have fungus or bugs because they will make both the health and appearance of the seed worse if it is stored for a while. The health of a seed also refers to how it is deteriorating and if it has low strength. The condition of a seed directly affects its quality and it is important for the seed to be healthy in order to produce good quality plants in a nursery or field.Seed germination and emergence can increase the spread of pathogens through the growth of seedlings. Slow growth can either help a rapid infection to spread quickly or it can prevent the infection from spreading much at all. Cotyledons can either take the seed coat with them or leave it in the ground. In both cases, depending on the germ, it can cause infections in the upper parts. There are two different ways that seedlings pop up from the ground. Epigeal refers to when the cotyledons and the enclosed plumule grow upward during the growth of the hypocotyl. They come out of the soil, turn green, and can do photosynthesis. In the end, the cotyledons dry up and fall off. Epigeal germination happens in certain types of seeds like castor bean, cucumber, French bean, lettuce, onion, peanut, and soybean. Epigeal germination helps the Corynebacterium michiganense pv. to infect the above-ground parts. Michiganense is a type of bacteria that affects tomato plants. *Pseudomonas syringae*pv is another type of bacteria that can also harm tomato plants. Phaseolicola is a type of bacteria that affects beans.

Plants go through different stages of growth, starting from small sprouts and ending with lots of fruits or vegetables. As plants grow, their energy and nutrient requirements change to support specific types of growth. If you know about the six stages of how plants grow, you can give your garden the right nutrients it needs at each stage. This will help your garden produce larger and better crops, rewarding all the work you put into it.

1. Sprout.
2. Seedling.
3. Vegetative.
4. Budding.
5. Flowering.
6. Ripening.

Seeds have everything necessary for the beginning stage of a plant's life. The time it takes for seeds to start growing and sprouting can vary. It can take a few days or even a few weeks, depending on the type of seed. During the first stage of a plant's growth, the seed starts to sprout and develops small leaves called seed leaves. These leaves are different in appearance compared to the actual leaves of the plant (Figure 1). It also uses up its food.During the early growth stage of plants, they begin to develop roots, sturdy stems, and their initial set of true leaves.As roots form, little plants grow into baby plants. Your plant develops smaller leaves that will eventually look like mature leaves. During the second phase of plant growth, the nutrients help your plant to grow and prepare for the next stages. During the vegetative stage, plants put most of their energy into growing strong and healthy stems, branches, and leaves.When young plants start to grow and become bigger, they work hard to make their stems strong and to grow lots of green leaves. Nitrogen is very important during this third phase of growth[10], [11].

In the early stage of growth, plants change from growing leaves and branches to producing flowers.If you have four apples and you give two apples to your friend, how many apples do you have left. Budding means the process of new growth or development, like a flower opening up or a young person starting to learn and grow.As plants grow, they go through a change phase. When a plant grows, it starts using its energy to make buds, flowers, and eventually fruit instead of just growing leaves. Phosphorus becomes more important in this

fourth stage.When used on plants that are growing buds, it gives them extra phosphorus, which is important for strong and healthy roots, buds, and flowers in the future. Furthermore, this special blend helps flowers and herbs produce more oils, resins, and fragrances.During the flowering stage, the fruit starts to develop in the place where the flowers used to be.In the flowering stage, buds turn into flowers and fruit starts to grow where the flowers were. At this fifth stage of plant growth, nitrogen is not as important anymore. Potassium is important for helping plants grow flowers and produce fruitIt especially helps flowers, fruits, and vegetables to become healthier and have better smell.

Seed infection can be affected by different things, and two important things that greatly affect seed infection are the type of plant and the surroundings. Host genotypes mean the genes that the plants have where the seeds came from. Different types of plants have different levels of being susceptible to or resistant to diseases. This genetic difference can affect how well a seed can fight off infections. Factors related to the genetic makeup of the host includeResistance genes are genes found in certain plants that protect them from harmful germs or diseases. These genes can stop or reduce the power of harmful germs to attack seeds or young plants. On the other hand, plants that don't have these resistance genes are more likely to get infected.Genetic diversity means having different genes in a group of crops. If a crop group does not have enough genetic diversity, it can easily get sick from specific diseases. On the other hand, a varied group of people might have certain plants that can naturally fight against getting sick.

Plant physiology refers to how certain characteristics of a plant, like the thickness of its seed coat or the presence of specific chemicals, can affect how easily it gets infected.Environment refers to the natural world and all the living things that exist within it, including plants, animals, and humans. It also includes the air we breathe, the water we drink, and the land we live on. The environment is important because it provides us with resources and sustains life on Earth. It is our responsibility to protect and take care of the environment so that future generations can also enjoy its benefits. The place where seeds are made, kept, and grown is really important for how likely the seeds are to get infected. The environment can directly impact how pathogens grow and behave, and it can also make seeds more likely to get infected. The things in the environment that can affect or influence something are called environmental factors.

Temperature and humidity can affect how well pathogens grow and cause infection. Situations that help pathogens grow can make it more likely for seeds to get infected.Too much moisture or water can make it easier for germs to grow and spread. It is especially important when keeping seeds and helping them grow.Germs in the soil can make seeds sick. The condition of the soil, which includes things like how acidic it is, the amount of nutrients it has, and the small organisms living in it, can affect how often harmful germs are found.Weather conditions like rainfall and humidity can affect how many and how active pathogens are in an area.Vectors are living things, like insects or other organisms, that can spread diseases. Having these vectors in the environment can make it more likely for seeds to get infected.It is important to understand that these factors are connected and can affect each other in complicated ways. For instance, a particular genetic makeup may be able to fight off a disease when the surroundings are a certain way, but might not be able to fend off the disease when the surroundings change. It is important to know and control these factors to keep seeds healthy and prevent infections that could harm the amount and quality of crops.

Insects can have a big effect on the health of seeds and the way plants grow. They can directly harm seeds, spread diseases, and change how plants function. Insects like seed beetles, weevils, and borers can harm seeds by eating them or putting their eggs in them. This

damage can cause lower rates of seeds sprouting and plants growing, and generally make the plants weaker.Some bugs spread diseases to plants. They can have harmful germs on their bodies or in their spit and pass them to plants when they eat. This can cause diseases in plants that were healthy before, which can then spread to the seeds and harm the plants.Bugs can cause stress in plants by eating them, which leads to changes in their body functions. Plants that are under a lot of stress are more likely to get sick from diseases. Moreover, insects feeding on plants can make it easier for harmful bacteria or viruses to infect the plants.Certain insects can control how plants work using their own hormones. For instance, some bugs can weaken plant defenses or help plants grow better, which can make the surroundings ideal for both the bugs and harmful bacteria or viruses.

Bugs are really important for helping plants reproduce. If there are fewer bugs because their homes are destroyed or because of chemicals used to kill them, it can make it harder for plants to grow fruit and make seeds.When a harmful microorganism enters the body and interacts with the body's cells, it can cause illness or disease.Pathogen interactions are about how different types of germs like bacteria, fungi, and viruses relate to each other and how they make plants sick. These interactions can affect how serious disease outbreaks are and have consequences for the health of seeds.Co-Infection is when a plant gets infected with multiple germs at the same time. These germs can work together in different ways. They can either make the plant's illness worse by adding up their effects separately, or they can boost each other's growth or strength, causing even more serious symptoms.In some instances, when one harmful organism is around, it can stop or weaken the growth or actions of another. This thing is called antagonism. One germ may release substances that stop the growth of another, resulting in less severe illness.

Cross-protection is when certain plants become resistant to one type of harmful organism because they were previously infected by another similar harmful organism. This is called cross-protection and it can give you some temporary protection against another germ.Mixed infections happen when a plant is infected by different types of the same disease. This can cause the mixing of genes in harmful germs, possibly creating new and stronger strains.When pathogens interact with plants, they can indirectly change the overall health and strength of the plants, which in turn can affect the health of the plant's seeds. Plants that are not strong are more likely to be affected by different types of problems, such as insects and bad environmental conditions.It is important to understand how insects, diseases, and the environment all affect plants in order to keep them healthy and stop the spread of diseases. Using integrated pest management strategies that take all these factors into account can help reduce the negative effects on the amount and quality of crops.

Xanthomonas campestris pv. is another type of bacteria that also affects beans. The bacteria called campestris can be found in cabbage plants, and also in X. Campestris pv can be simplified as the specific type or strain of bacteria called "Campestris". Carrot seeds sometimes have parts of the seed coat stuck on them after they start growing. This can lead *to Fusarium oxysporum* f. spread Please provide the text that needs to be rewritten in simple words. Lagenarium is the scientific name for a type of plant. Seedlings that have pegs and seed coats together have an infection rate of 14 to 18%. On the other hand, seedlings that have their seed coats carried by the cotyledons have an infection rate of 2 to 3%. During the sprouting process, the fungus that is dormant inside the seed covering starts to grow and enters the tiny plant from below the outer layer. The part of the seedling that provides nutrients stays in the ground as the upper part of the plant grows and appears above the soil. Hypogeal germination happens when seeds of barley, broadbean, maize, pea, and wheat start growing. It helps the infection in the roots and stems. People from Nebraska who grow corn

often have problems with plant diseases caused by fungi, especially a type called smut. This disease can spread to young corn plants when the seeds are first starting to grow. The spread of the disease is closely related to how well the seeds are able to start growing. Sorghum is only vulnerable to Sphacelotheca sorghi from when it is planted until the seedlings come out. The amount of time that someone is vulnerable or open to something depends on when they start doing it.

CONCLUSION

In the world of seed infection, it is very important to understand how pathogens, plants, and the environment all affect each other. This knowledge shows how important it is to deal with seed infection in modern farming.Seed infection can have serious consequences that affect the quality of the seeds and can potentially spread diseases. Therefore, it is very important to have effective ways to control and manage seed infections. The complicated ways in which germs enter seeds, get past protective barriers, and use plant tissues for survival require new and creative solutions.As we move forward in time, using advanced technologies like genetic modification and precision agriculture can help plants become stronger and more resistant to infections. These new discoveries in science, along with carefully following farming rules, give us hope for reducing the chance of seeds getting infected and making sure people all around the world have enough food to eat.In conclusion, it is important for scientists, farmers, and policymakers to work together in order to understand and prevent seed infection. By always improving our plans, investing in research, and prioritizing education, we can strengthen our farming systems against the dangers caused by pathogens carried by seeds. Protecting seeds means protecting the food we have. This is really important for sustainable farming and a healthy Earth.

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CHAPTER 6
HEALTH AND DISEASE MANAGEMENT: SURVIVAL AND PERSISTENCE OF SEEDBORNE PATHOGENS

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ABSTRACT:

Seedborne pathogens are harmful microorganisms that live on or inside seeds. They can cause damage to plants and make them more prone to getting sick. This chapter looks at the things that affect how long seedborne diseases last. This includes things like how the disease works, the environment, and what the seed is like.This chapter talks about how seedborne pathogens and their hosts are connected, and how the presence of these pathogens for a long time can cause disease outbreaks in future crops. By understanding how seedborne diseases survive, we can learn how to effectively manage and prevent them. This text talks about how long pathogens can survive and how it affects farming, crops, and food availability. It emphasizes the need to take precautions to reduce their negative effects.In addition, the chapter highlights the importance of using combined methods that include treating seeds and using cultural techniques to manage seedborne pathogens. By studying how long these germs can survive, people involved in farming can make smart choices to make sure they sell healthy seeds, lower the spread of diseases, and protect the amount of crops they produce. In simple words, this chapter is a complete guide for scientists, farmers, and government officials who want to improve plant health by learning more about how diseases can be spread through seeds and how they can be dealt with.

KEYWORDS:

Bacteria, Disease, Germs, Seedborn Pathogens, Survive.

INTRODUCTION

Diseases that are carried by seeds are a big problem in farming. They can hurt the quality and amount of crops grown, which can affect how much food is available worldwide. Seedborne pathogens are very important for how plant diseases spread and keep going. It is important to understand what makes seedborne pathogens live for a long time so we can come up with good ways to manage diseases. This chapter gives a complete explanation of how seedborne pathogens interact with their host plants. It helps us understand why they are able to survive, stay around, and spread.Seedborne pathogens are tiny living things that can be passed on from one group of plants to the next by using infected seeds. These germs include different types of tiny organisms like bacteria, fungi, viruses, and worms. Seedborne pathogens can make it harder for seeds to grow, make baby plants weaker, and affect the overall health of crops. Moreover, the movement of diseases carried by seeds presents a big problem for the economy and the environment. It is important to have a comprehensive understanding of how these diseases survive and spread[1], [2].

A plant disease happens when a plant gets hurt by something that can make it sick. This thing that makes the plant sick is called a pathogen. A sickness in plants can make them have different problems that stop them from growing well or making seeds.Sometimes it can be hard to figure out what disease someone has. It's important to know if the disease is real or

just caused by something non-living. This helps us make a plan to treat it. The things that cause plant diseases are living and are called pathogens. Abiotic disorders are caused by things that are not living. It's really important to know the difference between the two in order to figure out what's causing harm to plants.Even if a disease is confirmed, it may only cause small changes in appearance or slightly decrease crop production. This means that expensive ways to control the disease are unnecessary and not valuable. Sometimes, a sickness can make a young plant less strong but it does not really harm older, strong plants.

Plant diseases can give us helpful hints about the causes of the problems that made a plant weak. These problems could be caused by choosing a bad location for the site, having an unbalanced mix of nutrients, not giving the plants enough water, or not properly caring for the plants by adding mulch, watering them, or pruning them correctly. In most cases, if you can fix what's causing the plant's problems, it will stop getting sick and be able to stay healthy in the future.When you need to take action to control a situation, you have to decide which methods of managing it are the best to use. Using a mix of methods for managing pests is the smartest and most effective approach, known as integrated pest management or IPM. Cultural practices and choosing the right plants are the first things we should do to protect ourselves. Pesticides might be needed in an IPM program, but they should only be used as a last option. Pesticides are commonly used too much, especially when people just want to quickly get rid of pests instead of figuring out why the problem happened. Choose the least dangerous pesticide that is made for the particular plant and illness when it is necessary to use pesticides.

When you need to use pesticides, make sure to follow the instructions on the pesticide label about how much to use and how to apply it. Using too much of something is not good when applying it. Using some pesticides over and over again can make the pests they are meant to kill become immune to them. This means that the pesticides might not work as well in the future. Sometimes, pesticides can also hurt people, the environment, or other animals like birds and helpful bugs that keep plants healthy.Factors that affect how long something lasts and how likely it is to continue.The time and strength of seedborne pathogens are affected by a mix of biological, environmental, and genetic factors. These things together decide what happens to germs on seeds and how they spread to other plants. These important factors affect how long seedborne pathogens can survive. Pathogens that are carried by seeds have certain traits that affect how they can survive difficult conditions. These traits include how they reproduce, form spores, and go into a dormant state.Things like how hot or cold it is, how damp or dry it is, how much light plants get, and how wet or dry the ground is can greatly affect how long harmful germs can live on seeds. Certain microorganisms are well-suited to survive in particular surroundings, while others can withstand a variety of different surroundings.The way a pathogen interacts with its host plant is very important for the pathogen's survival. Some harmful microorganisms have developed ways to survive on seeds until the conditions are right for them to cause infection.Seed traits such as the thickness of the outer layer and the chemicals inside can impact how pathogens stick to seeds, get inside them, and stay alive[3], [4].

How you store seeds can affect whether harmful bacteria or viruses grow on them.The temperature, humidity, and airflow in the storage area all play a role in promoting or preventing this growth. It is important to store seeds properly to keep them healthy.Microbial Interactions: Having helpful microorganisms on seeds and in the nearby surroundings can affect how long harmful microorganisms can survive. Competitive exclusion and microbial antagonism are ways that affects the numbers of harmful bacteria.Seed treatments are things that can be done to seeds that can help get rid of harmful things on them, like chemicals,

living organisms, or using heat. By doing these treatments, the harmful things on the seeds can be killed or stopped from growing, which can also make the seeds last longer.Genetic diversity refers to the variety of traits within a population of pathogens. This diversity affects how well the pathogens can adapt to different environments and survive on seeds.Understanding the factors that determine how long seedborne pathogens survive and keep spreading has important implications for how we can control and treat diseases. Researchers and people who work in agriculture can work together to find ways to stop diseases from spreading[5], [6].

They can focus on the things that make diseases stay alive and plan how to stop them.Seed testing and certification programs are important for making sure that seeds are free from diseases. These programs test the seeds carefully to make sure they are healthy. This helps to reduce the spread of diseases from the start.Seed treatment means using different methods to protect seeds from harmful pathogens. This can be done by applying fungicides or using biological control agents. These methods help reduce the chance of pathogens surviving on the seeds.Cultural practices involve using different types of crops, cleaning well, and using plants that are less likely to get sick. These practices can help stop harmful germs from surviving and spreading.Proper storage conditions, like controlling temperature and humidity, are very important for stopping the growth of harmful germs when storing something.We can develop crops that are better at fighting off harmful germs that can infect seeds. This helps stop these germs from spreading and multiplying on the seeds.The lifespan and ability of seedborne pathogens to survive for a long time are complicated things affected by many factors. This chapter helps us understand how seedborne pathogens survive and spread. By understanding these difficulties, we can create new and long-lasting methods for controlling diseases in crops around the world, ensuring there is enough food for everyone[7], [8].

DISCUSSION

Seedborne pathogens are tiny living things that can make plants sick if they get inside the seeds. The longevity of seedborne pathogens means how long these harmful germs can stay alive and able to cause diseases on or inside seeds. Different kinds of germs, like bacteria, fungi, and viruses, can survive differently on or inside seeds. Some harmful germs have strong defenses that help them survive in tough situations, while others are weak and easily break.Environmental conditions like temperature, humidity, and light can greatly affect the chances of survival for seedborne diseases. Some germs can live longer in certain temperatures and humidity levels, while others may not survive well in extreme conditions.The way seeds look and the substances they contain can impact how well they can resist harmful bugs and diseases. Seeds with tough coatings can protect against harm, and chemicals in some seeds can stop the growth of germs.The amount of pathogen present on a seed at the beginning can affect how long it lasts. Having more harmful germs can make it more likely for some of them to stay alive for a longer time.How seeds are stored can affect how long seedborne pathogens can live. Keeping seeds in the right conditions like temperature and humidity control can stop harmful microorganisms from growing and make the seeds last longer.Some disease-causing organisms use insects or other animals to help them spread to other hosts. These vectors can affect how seedborne pathogens spread and survive for a long time.

Different types of diseases have different types of germs that cause them. These germs can be fungal spores, mycelium, bacteria, viruses, or nematodes. These can be found in seeds, leftover plant parts, soil, weeds, or other plants. The germs can be carried by the wind, water splashing when watering or raining, or when someone cuts infected plants. Inoculum can also be spread by bugs and insects that eat a sick plant and pass on the disease to a healthy plant.In

places with mild weather, the harmful microorganisms need a way to stay alive during the colder season when the plants they infect are not active or not around. Understanding how pathogens survive the winter can help determine the best ways to control them. In plants that live more than two years, some harmful germs can survive the cold season in infected parts of the plant, like the roots, bulbs, stems, and bud scales. Microorganisms that cause diseases in plants that grow and die within a year need to create protective structures to survive, or they can also survive in seeds or carriers, or move from warmer areas where the plants grow in the winter.

Sweet corn rust, a disease caused by *Puccinia sorghi*, spreads through the wind. This plant disease doesn't last very long outside of living plant parts. Sweet corn plants cannot survive the cold winters in the Midwest. So, during each season, most of the sweet corn rust which is a type of fungus is carried to the north by the wind from the corn plants that are still alive in the South. Therefore, knowing the amount of germs in the South affects decisions made in other areas.Insects that help to spread fire blight in apple and pear trees are called insect pollinators. This disease is caused by a type of bacteria called *Erwinia amylovora*. The bacteria survive during winter in the edge of old infected areas on trees, and come out from the tree stem when it rains. A bee or another animal that helps plants reproduce may carry the bacteria and spread it to another plant through a flower. Even though it's not a good idea to control the vector, you can still remove and get rid of the old cankers carefully to decrease the spread of the disease.

When a pathogen interacts with a host plant, it can determine how long the pathogen stays alive on seeds. Some disease-causing organisms may have developed ways to survive on seeds until the environment is suitable for causing an infection.Some germs that live in seeds know how to survive in bad conditions by making special protective cases called spores or cysts.Soil microorganisms can help or prevent the growth of harmful pathogens in seeds. Some helpful bacteria in the soil may fight with harmful bacteria for food and other resources, which can make the harmful bacteria live for a shorter time.Seed treatments are ways of treating seeds with chemicals or natural substances to make it harder for sickness-causing organisms in the seeds to survive. This helps to make the seeds last longer.The genetic differences among an infected seed population can affect how long the pathogens can survive. Certain strains might be stronger than others.To put it simply, the ability of seedborne pathogens to survive for a long time is affected by many different things. These include the type of pathogen, the conditions in the environment, the characteristics of the seeds, how they are stored, and how they interact with other things like insects and the plants they infect. It is important to understand these things so we can control and stop the spread of diseases in crops and gardens[9], [10].

The genes of a plant can affect how long it lives and how it interacts with disease-causing organisms that are found in its seeds. This is how different host types can affect the relationship between seeds and pathogens that are carried by seeds.Different types of plants can have different levels of being resistant or prone to getting sick from certain diseases carried in their seeds. Some genetic types might have characteristics that make them less likely to get infected or better able to fight off germs, while others might be more prone to getting sick.Different types of plants can have different ways of fighting off diseases caused by pathogens. Certain combinations of genes can cause the body to have a stronger defense system. This can include activating receptors that recognize harmful germs and creating substances that fight against these germs. As a result, the germs have a harder time surviving on seeds.Some plants have genes that give their seeds better protection against diseases that are carried by seeds. This might include traits of seeds that make it harder for pathogens to

attach or enter them.The seed microbiome is the group of tiny living things found on and inside seeds. It can be affected by the type of seed it comes from. Certain genetic types may support the development of helpful tiny organisms that can stop the growth and survival of harmful microorganisms present in seeds.

Gene expression refers to how certain genes in plants are used and can affect how the plant responds when it gets sick from a pathogen. Different genotypes may be better at turning on defense genes when they detect pathogens.Evolutionary co-adaptation happens when hosts and seedborne pathogens change together over time to better survive. This might lead to the pathogen becoming stronger or the host plant developing new ways to fight against it, which could impact how long the pathogen stays on seeds.Some plants can pass on their ability to fight off diseases to their children, which could affect how well the diseases survive on future generations of seeds.Crop breeding is when people who work with plants pick and create new kinds of plants that have certain good qualities, like being able to fight off diseases. Breeding plants that are resistant to disease can affect how common and severe infections from pathogens that are spread through seeds are in a crop[11], [12].

Plants that have different genes within their population can have more varied reactions to diseases that are transmitted through seeds. This variety can affect how long a disease-causing organism can survive by offering different places for it to live.The types of plants can cause seedborne diseases to become a different species. When germs change to fit certain types of genes, they can develop different qualities that help them survive and spread in those specific hosts.It is important to understand how different plants and diseases affect each other in order to find better ways to prevent and treat diseases. Plant breeding can help make new plant types that are better at fighting off certain harmful germs that can spread through seeds. This lowers the chance of the germs surviving and spreading to other plants.Inoculum means the stuff that carries germs or diseases, which can be transferred to a vulnerable person or animal and make them sick. In seedborne pathogens, the word "inoculum" refers to things like spores, mycelium, bacteria, viruses, or other forms of pathogens found on or inside seeds. Inoculum can come from sick plants, dirty soil, or other things and can be transferred to seeds when they are growing, being collected, processed, or stored.

Controlling the spread of diseases that can be carried by seeds is important to prevent them from spreading. This means using healthy seeds, using treatments for the seeds, keeping things clean, and using planting materials that don't have harmful germs. Seed treatments, such as using chemicals or heat, or using natural substances, can help kill harmful germs in seeds and keep the baby plants safe.Seed storage containers are important for keeping seeds healthy and stopping diseases from growing on them while they are being stored. The type of container you choose can affect things like how much moisture is in the air, how hot or cold it gets, and how well air can move in and out. These things can all impact how long seeds can stay alive and how likely it is that harmful germs might be around.There are many different kinds of containers that people use to store seeds.Paper bags are made of a material that allows air to flow through them. This helps to stop too much moisture from building up and lowers the chances of fungus growing. But, they do not completely seal off and may not give the best defense against harmful bacteria or viruses.Plastic bags are good for keeping things dry and clean, but they might not let air through. This could cause dampness and mold to grow because the moisture gets stuck.Airtight containers are containers that are sealed tightly to keep moisture and harmful germs from getting inside. But it is important to make sure that seeds are completely dry before putting them in containers that don't let air in, because any leftover moisture can cause mold to grow.

Drying agents, called desiccants, can be added to containers where seeds are stored. These desiccants help prevent too much moisture and lower the chances of fungal growth. Silica gel packets are commonly used to keep seeds dry.Vacuum-sealed bags can help preserve seeds by removing air and moisture, which makes them last longer. But, using this method may need specific tools and must be done with caution to avoid harming the seeds.Seeds should be kept in a cool, dry, and dark place to prevent them from becoming damaged or infected by germs. This will help keep the seeds alive and healthy.Choosing the right container to store seeds depends on things like what kind of seeds they are, how long they need to be stored for, and if there's a risk of germs getting on them. It is very important to store seeds correctly in order to keep them healthy and protect future crops from diseases. This involves using the right containers and making sure they are kept in the best conditions.

The place or area where things are stored or kept.The storage environment means the conditions in which seeds are kept to make sure they stay good and can still grow over time. Having the right conditions to store seeds is very important. It helps to stop the growth of harmful germs in the seeds, keeps them able to sprout, and maintains their overall quality. Seeds should be kept in a cool place to prevent them from going bad quickly. In simpler terms, most seeds grow best in temperatures between 5°C to 15°C (41°F to 59°F).Relative humidity is how much water vapor is in the air compared to how much the air can hold at a certain temperature. It's important to control humidity in order to stop mold from growing and keep seeds in good condition. Seeds need to be kept in a place with low moisture, usually around 30% to 50% humidity, so that they don't get damaged by too much water.Seeds should be kept in a place without light to avoid damage caused by light and to stop algae and fungi from growing.Ventilation is when air is allowed to flow in and out of storage containers. It helps stop moisture and gases from building up inside. Having enough air moving around can help prevent mold from growing and keep the temperature steady.

It's important to stop bugs and rats from getting to stored seeds. Using containers that bugs can't get into and regularly checking seeds for bugs are important things to do.If you want to keep your seeds in airtight containers, make sure the seeds are completely dry before sealing them. This will prevent moisture from building up inside the containers.The storage period means how long seeds are kept before they are used for planting. Different seeds have different needs for long-term storage, which depend on their individual traits such as how much moisture they contain, their genetics, and how likely they are to grow. Storage periods can be grouped into different types.Short-term storage means keeping seeds for only one year. Seeds that have more water in them and don't last long are best for keeping for a short time. It is still important to pack and store things correctly to prevent them from getting worse during this time.Medium-term storage refers to keeping seeds for a period of one to five years. This group could have seeds that can be kept for a long time if you control the temperature, humidity, and other factors.Seeds that are kept for more than five years are considered long-term storage. To make sure seeds last a long time, they must be dried, put in a good package, and stored in the best conditions.

Cryopreservation means freezing seeds at very cold temperatures for a long time or when the seeds are very delicate. This method helps keep seeds alive for a long time, even for many years or centuries.The length of time seeds should be stored depends on the kind of seeds, how they will be used, and the storage options that are available. Checking how well seeds are growing is very important to see if they are still able to produce new plants in the future. Moreover, to store seeds for longer periods of time, it is helpful to occasionally grow a part of the seeds to create new ones. This process helps to renew the supply of seeds and maintain a variety of genes.Seed storage has been a very important part of civilization since people

started farming in the Middle East 10,000 years ago. The proof from digging up old things includes holes with stones around them and pots made of clay. These pots have old seeds inside that were kept there a long time ago. A long time ago, before there were many books, there was a story in the Bible called Genesis. In this story, a man named Joseph collected lots of grain from good harvests and kept it in a safe place because he knew there would be a time when there wouldn't be enough food in Egypt. The Bible doesn't talk about storage buildings, but the pyramids are built in a way that keeps the air dry and the temperature even. This helps to keep seeds healthy and able to grow. However, the stories about finding seeds that have stayed alive for 3000 years in the pyramids should not be believed as they are most likely not true. The oldest seeds that were able to grow were found in a dry lake in China. These seeds belong to a special plant called the sacred lotus. These seeds were really old, and they grew into young plants.

Just like the pyramids, the dry bottom of the Chinese lake had similar weather conditions with low temperature and humidity. Furthermore, the tough outer shell of the lotus seed stops water and gas from passing through it between the outside and the seed. This almost perfect blend of factors reduces the chance of the lotus seeds getting damaged by water or oxygen, and is the reason why they can be stored for a long time without spoiling.The main goals of seed storage are to protect the nutrients and ability to grow of the seeds. Seeds used for making food like flour, malt, or oil are usually stored for up to 2 years. However, seeds kept for planting later are usually stored for up to 3 or 4 years. In order to protect genes, seeds are stored in special places called seed banks. These banks are made to keep the seeds alive for a very long time, sometimes even hundreds of years.Having harmful microorganisms in seed storage is an important part of managing seed quality. Antagonistic microflora are good microorganisms that can fight against, stop the growth of, or even directly attack harmful microorganisms. These helpful tiny organisms can stop the spread of diseases that are carried by seeds when they are stored. This helps to keep the seeds healthy and in good condition.

Some helpful bacteria can naturally stop harmful bacteria from growing and causing harm. These organisms like fungi and bacteria can be helpful for us.Harmful bacteria can compete with disease-causing bacteria for food and living space, making less resources available for the disease-causing bacteria to grow and reproduce.Some good bacteria make substances that can kill germs and stop them from growing. These chemical substances can make it difficult for harmful bacteria to grow and spread.Induced Systemic Resistance (ISR) is when certain microorganisms can activate a plant's natural defenses against diseases, alongside fighting against the pathogens themselves. This can make the plant stronger and better at fighting off diseases.Seed coatings or treatments can include helpful bacteria to fight against harmful microorganisms. These coatings create a good environment for helpful microorganisms to live on the seeds and grow on the plant. This helps to keep the plant safe from harmful bacteria.

Keeping a good balance of microorganisms is important. If there is a diverse and balanced community of microorganisms on seeds, it can help create a healthy environment where helpful microorganisms can defeat harmful ones. This balance helps keep seeds healthy while being stored and while they start to grow.When choosing bacteria to treat seeds, it's important to make sure they work well with other treatments and can help the existing bacteria in the soil and on the seeds.Regularly checking the microorganisms in stored seeds is important to make sure that helpful microorganisms are there and doing their job. If necessary, extra doses of helpful bacteria can be given to make them stronger.Using beneficial microorganisms in combination with other approaches to seed management can reduce or eliminate the use of chemicals, support sustainable farming practices, and improve the health and yield of crops.

However, it's important to carefully think about the specific crop, environment, and diseases when you want to successfully put something into action.

CONCLUSION

In summary, the long life and ability to stay on seeds of harmful pathogens have big effects on how we keep plants healthy and combat diseases. This chapter talked about how seedborne pathogens survive and interact with the agricultural environment.Understanding the factors that affect the ability of seedborne pathogens to survive and cause harm to crops is very important in developing successful plans to reduce their negative impacts. By understanding how different factors such as the biology of pathogens, the characteristics of seeds, and the environmental conditions contribute, people involved in agriculture can take specific actions to stop the spread of these pathogens from one crop season to another.This knowledge is important not only for the survival of pathogens, but also for other areas. Harmful germs that come from seeds and last a long time can cause widespread disease in crops, which can then cause problems with growing enough food. So, what we learned from this chapter can help us take action to make agriculture more sustainable.Advocating for using different methods like treating seeds, following good farming practices, and keeping a close watch, farmers can work together to stop seedborne diseases from spreading. This working together is very important to make sure we get good seeds, protect how much food we grow, and keep making enough food for the whole world.Basically, studying how long seedborne pathogens can survive shows how important it is to make well-informed decisions and come up with new ideas to solve agricultural problems. With this information, researchers, practitioners, and policymakers can deal with the changing plant diseases and create strong, productive, and sustainable farming systems.

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CHAPTER 7
PATHOGEN SPREAD AND HOST INTERACTIONS: SEED TRANSMISSION AND VACCINATION

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ABSTRACT:

This chapter explores how diseases are spread through seeds and how they affect the interaction between plants and pathogens. This chapter thoroughly looks at how different pathogens, like bacteria, fungi, viruses, and nematodes, are spread through seeds, which carry and spread diseases. Studying how seeds spread diseases is complicated because there are many different things that can affect it. This includes things like the characteristics of the disease-causing organisms, the traits of the seeds themselves, and the conditions in the environment. Understanding all of these factors helps us see just how complex this type of disease transmission can be.Additionally, the chapter explores the complex relationships between disease-causing organisms and the plants they infect during the process of infection. This text talks about how germs get past the body's defenses, cause infections, and use the body's resources to live and make more germs. These interactions involve complicated ways that molecules communicate, how the immune system reacts, and how germs try to make diseases worse.Understanding the complex relationship between how seeds are spread, how plants are infected, and how plants respond to infection is very important for farming and taking care of plant health. This chapter gives us important information to come up with new ways to control diseases, breed plants with resistance, and understand how plants can survive and recover from harmful challenges. In simple terms, this study helps us understand better how diseases and their host plants are linked, which affects the overall wellbeing of plants in agricultural systems.

KEYWORDS:

Disease, Infections, Plants, Seed, Transmission.

INTRODUCTION

Seed transmission is when diseases or certain characteristics are carried inside or on the outside of plant seeds. This can involve different kinds of tiny organisms like fungi, bacteria, viruses, and other disease-causing agents. Seed transmission can greatly affect the well-being and growth of plants, and can also contribute to the spreading of diseases in both farming and natural environments.Seeds can spread diseases if they have harmful germs on or in them. These harmful microorganisms, such as fungi, bacteria, and viruses, can make plants sick and cause problems like seed rot, damping-off, or smut.Horizontal is when something is in a flat or level position, like a line on the ground. Vertical is when something is in an up and down position, like a tall pole. Vertical transmission refers to the way plant diseases are passed from one generation to another. It can be categorized into two types, horizontal or vertical. Horizontal transmission is when diseases pass from one plant to another in the same group, usually through touching, bugs, or natural things. Vertical transmission refers to the passing of harmful microorganisms from one parent generation to their offspring through seeds[1], [2].

When pathogens are transmitted through seeds, it can make it harder for the seeds to grow and become healthy plants. This can lead to slower growth, smaller plants, and less crops produced. Some harmful germs that live inside seeds may not do anything until the seed starts growing and a new plant begins to grow.Seed health and quality are very important for stopping the spread of germs through seeds. Checking, treating, and storing seeds properly helps reduce the chance of diseases spreading through the seeds. Breeding and selecting plants with strong genes can help create types of plants that are less likely to get sick.Crop improvement can be done on purpose using seed transmission. We can make plants have certain good traits, like being able to fight off diseases or bugs, by putting those traits into their seeds. This is a popular way to create better plant types through breeding.

It is important to study how seeds spread diseases in order to effectively manage and control plant illnesses. Scientists are looking at how seeds and harmful germs affect each other to create better ways to keep plants healthy and prevent diseases from spreading.Lots of countries have rules to control how seeds move around and stop diseases from spreading between places. Seed certification programs make sure that seeds are of good quality and are healthy before they are sold or given out.In farming, it is very important to control how seeds spread in order to keep crops healthy and stop diseases from spreading all over. By studying how seeds are spread and using effective methods, farmers and researchers can work together to make sure crops stay healthy and productive.Systemic seed transmission means that when a plant is sick, it can pass on the germs that made it sick to its babies through the seeds. These germs could be things like viruses or tiny living things called microorganisms. In this situation, "systemic" means that a germ can infect different parts of a plant, including its reproductive parts like seeds. Systemic seed transmission can be a big problem for plants because it helps diseases keep spreading from one generation of plants to the next and even to new places[3], [4].

When a pathogen moves through a plant's seeds, it infects the plant and stays inside its vascular system. This helps the germ to move all around the plant, even to the parts that make seeds.When a plant is infected, the pathogen can exist in its seeds or in the parts around the seeds. When you plant these infected seeds, the disease can spread to the young plants that grow from them.Infected plants might not show signs that they are sick, but the disease-causing organism can still be inside their pipelines and reproductive parts. The seeds that have been infected may look fine on the outside but they have the harmful germs inside them.The passing of seeds from one plant to another can happen in different ways. For example, the germ may be found in the plant's liquid that transports nutrients, and later become a part of the seeds as they grow.When seeds get infected, the next generation of plants can also get infected. This can lead to weaker plants, changes in how they grow, and even the emergence of diseases in the new plants.To prevent the spread of diseases through seeds, different strategies can be used. These include choosing seeds that are free from diseases, treating the seeds to remove or reduce harmful pathogens on the surface or inside the seed, and cultivating plant varieties that are resistant to systemic infections.

Scientists study how diseases pass from parent plants to their offspring to learn more about the process and the things that cause it. Finding ways to detect pathogens in seeds and understand how they could harm crops is really important.Seed transmission refers to the process of a disease being passed on from one plant to another through their seeds. It plays a crucial role in farming and controlling plant diseases. By knowing that diseases can spread through seeds and using the right techniques, farmers can lower the chance of getting their fields infected and increase the health and production of crops.Systemic seed transmission means that disease-causing organisms, like viruses, bacteria, or fungi, can be passed from a

sick plant to its offspring through the seeds. The disease-causing organisms can be found in the seed center or other parts of the seed. The process of systemic transmission allows pathogens to continue existing and potentially cause infections in the next generation of plants[3], [5].

When a plant disease spreads through its seeds, the germ can infect the young tissues inside the seed. This means that the germ is inside the growing part of the seed, called the embryo. When the seed starts to grow, the infected baby plant can become a sick young plant or adult plant.In this situation, the germ is infecting different parts of the seed instead of the embryo. For example, the germ could be in the covering of the seed, the part that provides food for the plant inside the seed, or other tissues nearby. Although the embryo may not have any infection, the disease-causing organism can still pass on to the growing seedling when it starts to sprout.The seed coat is like a shield that covers and protects the seed from harm. If there is a harmful germ on the outside of a seed, it could move to the new growing plant when it starts to sprout. This kind of pollution can cause infections in the young growing plant.These ideas are closely connected and show different ways that germs can be passed on from one generation to another. Good management strategies, like choosing seeds without diseases, using treatments to get rid of germs, and using plants that can resist diseases, are very important in reducing the risks of getting sick from seeds and other problems.

DISCUSSION

Unlike systemic seed transmission, non-systemic seed transmission means the passing of harmful germs from a sick plant to its babies through the seeds without the germs spreading to the whole plant. In this situation, the germ is usually only found in certain parts of the seed, like the outer shell or baby plant, and doesn't spread a lot in the rest of the plant.Just like when diseases spread throughout the whole body, in non-systemic seed transmission, the germ can infect the baby plant tissues inside the seed. The embryo is the part of the seed that creates the new plant when it starts growing. If the germ gets into the baby plant, it can make it sick or stop it from growing properly.Seed coat infection occurs when pathogens infect the outer layer of the seed, called the seed coat. This type of infection does not spread throughout the entire seed. If the harmful germ is on or inside the seed covering, it may be passed on to the growing young plant when it starts to sprout. This method of transmission can cause infections in the seedling that are usually limited to the areas close to the seed coat.In both types of infection, the pathogen may only affect certain parts of the new plant. There are ways to manage seeds to get rid of harmful germs on them or to use seeds that are resistant to diseases. This helps reduce the chances of seeds spreading diseases and harming crops[6], [7].

In seeds, concomitant contamination means that there are many different contaminants or agents present at the same time in or on the seeds. This could include different kinds of harmful things like germs, dirt, or bad stuff that could make the seeds and plants not grow well or be safe and healthy. Harmful germs can be found on seeds, like fungi, bacteria, and viruses. These harmful microorganisms can make the baby plants or plants that are just starting to grow sick and may prevent them from growing properly and being healthy.If seeds are protected with pesticides from pests and diseases, sometimes there might be a situation where both leftover chemicals from the pesticides and harmful microorganisms are found on or inside the seeds. This mixture of contamination could possibly cause unintended problems for young plants.Multiple diseases can be carried by seeds at the same time. This additional contamination could cause problems for dealing with diseases and might mean we need to make specific plans to control them.Sometimes, seeds can have genetic material from other plants mixed in, which can cause the plants to become a mix of different varieties and not be

pure.Environmental pollutants are harmful substances that can be found in the environment. Seeds have the ability to take in these pollutants, like heavy metals or other harmful substances that are found in the soil. When seeds are contaminated with many pollutants at the same time, it can harm the quality of the crops that grow from those seeds.

Seed coat and embryo infections occur when pathogens invade and harm different parts of the seed, like the outer layer or the developing plant inside. Concomitant contamination means that there are germs in both places.Dealing with existing contamination in seeds requires testing, treating, and controlling their quality. This is very important to make sure that the seeds planted grow into healthy and productive crops. Seed certification programs, quality standards, and proper storage conditions help reduce the risks of contamination and support successful crop growth.Seed inoculation means deliberately putting helpful microorganisms, like bacteria or fungi, on or in seeds. This helps plants grow better, absorb nutrients more easily, and protects them from harmful organisms This method is often used in farming to help plants stay healthy and produce more crops. The microorganisms used to treat seeds are commonly called inoculants. Seed inoculation is a process where beneficial microorganisms are added to seeds to help them grow better. These microorganisms can help plants get nutrients from the soil, fight off harmful diseases, and improve their overall health. By inoculating seeds, farmers and gardeners can give their plants a better chance at growing successfully.Adding beneficial microorganisms to seeds can help plants in many ways. Tiny living things that are helpful to plants can take nitrogen from the air and give it to the plants so they can use it[8], [9].

They can also make more nutrients available by dissolving minerals, make the soil stronger, and make plants better at fighting off diseases. All these things help plants grow better and produce more.Seed inoculation is commonly used with plants like soybeans, peas, and clover to help them absorb nitrogen from the air. These plants and bacteria work together to help each other. Specifically, the bacteria provide nitrogen to the plants, which helps them grow. The bacteria create small bumps on the roots of the plant and change nitrogen in the air to a type that the plant can consume to grow.Choosing the right inoculant depends on the type of crop being grown and the specific advantages wanted. Certain types of microorganisms can be chosen because they are good at helping plants grow, converting nitrogen into a usable form, or reducing the activity of harmful pathogens.Seed inoculants are usually put on seeds before they are planted. The seeds are covered or soaked in a substance that contains helpful tiny living things. This material can come in the form of a dry powder, a watery mixture, or a jelly-like substance.Seeds with microorganisms should be stored and handled carefully to keep them alive. It is important to keep the inoculants in the right conditions. This means avoiding hot temperatures and moisture so that they work well.Using seed inoculation can help decrease the need for synthetic fertilizers because it enables plants to absorb nutrients more effectively. This can be good for farmers by helping them make more money and it can also be good for the environment by reducing pollution in water[10], [11].

The global seed trade is very important for modern agriculture. It helps breeders grow different crops that produce more food, last longer, and resist diseases and tough conditions like salty soil, little rain, and dry climates. However, the spread of viruses carried by seeds is an unfortunate consequence of this industry. The spread of plant viruses through seeds is very important for the spread of diseases around the world. The global exchange of seeds has created new ways for crops to be moved between different parts of the world. In modern farming, we plant new types of crops in new places. These crops are grown alongside local crops, and the local crops can get sick from diseases that come from far away. Seed-borne plant viruses are a big problem for farming around the world. Some plants in the

Tobamovirus group can be very harmful to certain types of plants, particularly those in the Solanaceae and Cucurbitaceae families. These viruses have been a danger to farming for a long time. For over 100 years, the Tobacco mosaic virus (TMV), Tobacco mild green mosaic virus (TMGMV), Tomato mosaic virus (ToMV), and Pepper mild mottle virus (PMMoV) have been infecting tobacco, tomato, and pepper plants that are part of the Solanaceae family. In the same way, cucurbits get infected by a virus called Cucumber green mottle mosaic virus. This virus was found in England in 1935 and then spread to nearby countries in Europe and also to the Middle East, Asia, and the Far East. In the past 10 years, CGMMV was found in new places like Canada, the USA, and Australia. This is a big problem for the cucumber industry all over the world. CGMMV is a type of virus that affects plants like cucumber, melon, watermelon, gherkin, and pumpkin. It is a big problem for farmers because it can harm their crops and reduce their profits. This virus has spread all over the world and is causing lots of damage. We need to test seeds for the presence of other Tobamovirus species that can infect cucurbits. These include the Kyuri green mottle mosaic virus, the Zucchini green mottle mosaic virus, and the Cucumber fruit mottle mosaic virus. Countries that produce seeds commercially should take these viruses into account in their testing methods.

The tobamoviruses are viruses that can be passed from one plant to another through its seeds and also through physical contact or movement. These viruses are known to be very resilient and can stay active for a long time. Germs stick mostly to the outside layer of the seed. Yes, when the viral inoculum enters the embryo, it spreads easily. However, viruses that are attached to the seed coat may not survive when the seed coat separates from the seedlings. However, in young plants grown from seeds, if the seed coat is infected with Tobamovirus, it can harm the roots when they are transplanted. Moreover, when tobamoviruses contaminate the seeds, there is a low rate of transmission to seedlings. In regular farming, we use a lot of seeds or small plants to grow crops. So, even a small amount of contaminated seeds can cause many infection spots. As a result, the main way the infection can spread quickly is through touching, such as workers' hands, tools, greenhouse structure, and ropes used for support. It can also spread through the path made by tractors in open fields. Tobamoviruses can stay alive for months to years in plant debris, soil, and clay that have been contaminated, and they can still infect plants during that time.

The occurrence and spread of new Tobamovirus diseases are a big worry for farmers all over the world. Seed nurseries that grow grafted seedlings and protected structures like greenhouses are at a high risk of getting infected by Tobamovirus. This is especially true if they mainly grow one type of crop without rotating the crops between growing cycles. When a new Tobamovirus disease starts in a different country, the usual response is to try to get rid of the disease. However, this approach often doesn't work in many cases. The main reasons for this failure are multiple instances of contaminated seeds entering at the same time in different growing areas or farms, and not finding out about it until later and not responding quickly enough. The second plan when a new Tobamovirus disease appears is focused on managing the disease. This involves using different methods to control the disease and minimize the harm it causes to the point where it doesn't cost too much money. To effectively manage plant growth and prevent the spread of diseases, it is crucial to address various aspects such as cleaning soil, trellising ropes, greenhouse structure, and worker hygiene. However, this method cannot guarantee minimal disease harm and highlights the need for proper control of commercial seed production. This should be done along with the right diagnostic strategies to get rid of seeds that are infected with Tobamovirus.

The tiny parts of tobamoviruses that spread easily are very strong and can stay in seeds for a long time without losing their ability to infect. Most types of Tobamovirus do not often

spread through seeds, but even a small amount of seed transmission can lead to the disease spreading. Seeds that are infected with viruses can pass the viruses to new plants through the embryos inside the seeds. This can happen through the male or female parent plants. However, tobamoviruses mostly attack and invade the outer covering of the seed (testa) and the storage tissue inside the seed (endosperm). The virus spreads mainly by physical contact when young plants are moved, creating openings in the roots that can be infected by the infected seed covering. We are not completely sure how the Tobamovirus spreads to the seeds. The testa comes from the mother, while the endosperm comes from fertilization. Tobamoviruses may follow a similar route as Pea seed-borne mosaic virus (PSbMV) when infecting seeds, but they don't invade the embryo completely. The symplast is like a pathway that allows viruses to move from one cell to another and also travel through the phloem tubes. They move food from where it's made to where it's needed, but not as fast. In the beginning, seeds are like containers that hold things. Nutrients go into the seed through a tube in the funiculus and end up in a vein called the chalazal vein. This vein is made up of a tube that carries water and nutrients (xylem) surrounded by another tube that carries sugars (phloem). The cover of the seed comes from the mother and helps provide food for the baby plant inside. It is a growth of the outer covering of something. The transport of viruses can happen from one part of a plant to another. This happens when viruses move from the sieve elements of a specific vein in the plant into another part called the parenchyma layer.

Viruses use the plasmodesmata to move from one cell to another. PDs are pathways between cells that allow the movement of materials between their cytoplasms. The flattened endoplasmic reticulum membrane or desmotubule, which is covered by actin and myosin molecules, goes through the PD in the middle and connects with the cortical endoplasmic reticulum. The actin and myosin molecules link the desmotubule to the outer layer of the cell. There are two types of PD: simple PD and branched PD. The branched PD are more common in mature tissues. The process of turning simple PD into branched PD likely includes creating connections between simple PD. Cells move substances between each other using two pathways called the "cytoplasmic sleeve" and the "desmotubule". The cytoplasmic sleeve is the area in the middle of the cell's cytoplasm, between the desmotubule and the outer membrane. The desmotubule connects the endoplasmic reticulum (ER) of neighboring cells. The desmotubule can be found in two different forms: one where it is pressed close together and another where it is spread apart. The neck area at both sides of the PD is often limited. In experiments, researchers noticed that small dye molecules can move through the cytoplasmic sleeve without being stopped by cytochalasin B, a substance that stops actin polymerization. This suggests that the movement between cells happens through diffusion and is slowed down by the PD.

The size exclusion limit (SEL) of the PD can change as it develops and in response to environmental stress. The movement of molecules through PD depends on their size and shape. This is measured by the Stokes radius, which takes into account the weight and structure of the molecule. The speed at which a molecule spreads out is connected to how big it is. SEL is determined by using a substance called F-dextran that has been labeled with a marker. Temporary increases in self-esteem were noticed, and it often decreases as a person matures. SEL varies among different parts of a plant and also among different kinds of plants. The actin cytoskeleton might help control SEL. The use of cytochalasin to break down the actin cytoskeleton widened the neck area of PD and increased the size of tobacco PD from 1 kDa to over 20 kDa. The actin filaments connected to the ER help control the movement of TMV viral particles inside cells. The cytoskeleton, which is a part of cells, needs to be unharmed for viruses to spread. The virus movement protein (MP) is needed for the virus to move from one cell to another. The cytoskeleton might help move MP to the PD site and help

with the movement of viruses between cells through the PD. However, research on TMV MP and CMV MP has found that these viral proteins can break down F-actin, which leads to an increase in PD SEL. Because actin is needed for MP to be targeted to PD, it was suggested that MP causes the breakdown of F-actin at the opening.

Microtubules are involved in the movement of MP and viral replication complexes across cells and over long distances. However, when the PD is dilated, the cytoskeleton's role in moving viral particles suggests that they can quickly move from one cell to another within seconds. But according to research, this actually doesn't happen. The model says that when there is MP, proteins in the cytoplasm and ER membrane will move better between cells. This probably did not happen when they studied the movement of certain proteins in cells, which might mean that the virus moves through the cells by just floating around.

Callose, which is a type of sugar, forms a layer between the outer surface of a cell and its surrounding wall in a specific area called the neck region. This layer helps to determine the ability of the cell to communicate with other cells through small channels called plasmodesmata. Mutants that lack a certain enzyme called Class I beta-1,3-glucanase have lower susceptibility to virus infection and show reduced levels of self-enhanced locomotion. And when class I beta-1,3-glucanase is deliberately expressed, it increases the susceptibility of tobacco plants to TMV infection.When plants are under stress, they often develop a buildup of a substance called callose. There is a disagreement about whether TMV MP increases SEL. Some people have said that the increase in SEL by MP depends on how the MP is introduced. It seems that when the viral MP is not changed and there is unmodified SEL by MP, the replicase from TMV helps the viral MP break down callose and improves the flow of electricity through the desmotubule. Scientists have seen that RNA replicase is involved in the way the tobacco mosaic virus (TMV) moves from one cell to another. The RNA helicase domain in a 126 kDa replicase protein helps cells move to other cells, even without the help of MP activity.

There are other things that seem to contribute to making PD get bigger because of MP. These things may help us understand how MP changes SEL. The viral proteins can cause callose to break down in plant cells. This may happen because of a plant cell protein called TGB12K interacting protein (TIP). TIP interacts with both the Potato virus X (PVX) movement protein TGB12K and beta-1,3-glucanase. TMV MP has been found to interact with a protein called pectin methyl transferase, which is needed to widen pores in plants. The back part of the TMV MP makes it easier for cells to move from one to another in N. Tobacco CV stands for Curriculum Vitae on tobacco. MP dilation of PD may also be caused by interacting with the N. The protein NtNCAPP1 in tobacco plants was found to be important in increasing the response to TMV MP. When there is a mutation in this protein, it causes interference with the increase in SEL.

Studies have found that changes in a specific protein called synaptotagmin in Arabidopsis plants can affect the movement of a virus called TMV between plant cells. Synaptotagmin is responsible for helping with the recycling process inside the cell and can bind to calcium. The TMV MP also interacts with calreticulin, which is found in PD and holds onto calcium ions. This connection suggests that the levels of a molecule called Ca2+ in a specific area may play a role in regulating the widening of tiny channels in cells caused by a protein called TMV MP.The Tobamovirus MP works differently than the MP of tubule-forming viruses. The Tobamovirus MP widens PD, while the MP of tubule-forming viruses creates tubules that help in transferring the virus between cells. The tobamoviruses are different from the filamentous viruses because they use a similar protein and a group of viral parts to travel through PD.

CONCLUSION

In summary, the chapter talks about how seeds can spread diseases in plants and how it affects their interaction with pathogens. By understanding how pathogens spread through seeds, we can better understand the many different ways diseases can develop and change.This chapter discusses how different pathogens, like bacteria, fungi, viruses, and nematodes, can spread to plants by attaching themselves to seeds. They then enter the plant and cause infections to happen. The way pathogens behave, the qualities of the seeds, and the environment they are in, all affect how seeds can spread diseases. It's important to find the right balance for successful transmission of diseases through seeds.In addition, studying how pathogens enter and infect hosts helps us understand the tactics they use to invade and avoid the immune system. This complicated interaction between molecules and the resulting chain of immune responses and pathogen changes give us clues about the place where the results of diseases are decided.By using what we learned from these complex processes, farmers and scientists have powerful tools to create strategies for controlling diseases that are specifically designed for each situation. Breeding for resistance means growing plants that can resist diseases or pests. Optimizing seed treatments means finding the best ways to protect seeds from damage or disease. Designing targeted interventions means creating specific plans to address problems. All of these ideas come from this basic knowledge.In simpler terms, this chapter gives us a plan for reducing the harm caused by seedborne pathogens. It is important for global food security and sustainable agriculture. With this knowledge, we are ready to grow healthier plants, support strong plant communities, and make sure future generations have enough food.

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CHAPTER 8
A COMPARATIVE ANALYSIS OF FACTOR AFFECTING SEED TRANSMISSION

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ABSTRACT:

Around 1500 microorganisms and viruses that are harmful to plants have been found on around 600 types of crops. It is important for these harmful substances to spread and grow in the field in order for the diseases they cause to spread. Organisms can be carried by seeds, but they cannot be spread from one seed to another. Seed transmission can be complicated because it involves many different interactions. Several things can affect how well seeds can spread and grow in a new cropThe spread and growth of harmful microorganisms in plants through seeds are affected by the environment, specifically by moisture and temperature. These things also impact the growth and development of seeds, spores, infection, and the spread of harmful substances.The outcome of planting infected seed depends on the type of disease-causing agent. Seeds can be a big source of certain harmful germs. fungi or bacteria) may also play a role in causing the disease. The ground or leftover plants from farming are more significant. Symptoms can appear at different times as plants grow. Certain illnesses can make the young plant die before it comes out of the ground. Sometimes, when a plant starts to grow, it might get sick and show signs of being unhealthy. For certain illnesses, the signs you can see may not appear until the disease has progressed further.

KEYWORDS:

Barley Plants, Fungus, Soil Moisture, Soil Temperature, Seeds.

INTRODUCTION

The spread of infection from seeds to plants in the field depends on the type of plant being grown. Seeds of a strong type of plant may not have diseases, or if they do have diseases, the diseases may not spread through the seeds. The reason why the loose smut of wheat pathogen, Ustilago tritici, cannot be transmitted through seeds in some wheat cultivars could be because of three reasons. The first reason is that the embryos of these cultivars have a natural ability to fight off the pathogen and prevent it from infecting them, which leads to the death of the seedling. The second reason is that the reaction between the pathogen and the embryos of these cultivars is not compatible, causing the seedling to die. The third reason is that these cultivars have resistance to the pathogen when they reach maturity. Infected by the tritici hyphae and seeds are common, but when plants are fully grown, they become resistant. Similarly, when the barley cultivar Emir's embryo gets infected, it does not pass the infection to the plant. The plant shows resistance to the U. Tritici is a type of disease in wheat plants when the seedlings grow faster than the smut fungus. In the barley plant called Jet, the embryos can get infected, but usually they don't develop infected shoots because of an incompatible reaction. However, if the infection causes stunted seedlings, they may partially recover and grow healthy tillers[1], [2].

When barley or wheat plants have a partial infection on their earheads from the loose smut fungi, it can be because the fungus is not keeping up with the ear development. In types of rye that are easily affected by Urocystis occulta, the growth of a certain type of fungus called hyphae happens quickly and a lot, while in types of rye that are not affected, the growth is limited and does not spread to certain regions of the plant. Resistance to the spread of a plant fungus called Ustilago avenae in oats is shown by the death of certain cells on the outer layer of the plant and by preventing the growth of the fungus. However, the host reacts in different ways depending on how resistant they are. In strong lines, it may be difficult for hyphae to go through the cell wall. In types of plants that are not very resistant, the fungus can enter and cause damage to the surrounding tissues. This damage can lead to the death of the fungus within 7 days. In some cases, the fungus can be found in certain parts of the plant, but it will break down within 21 days. In other cases, the fungus can go deeper into the plant and remain there for 21 days without causing damage to the growing point and meristem. However, in plants that are susceptible to the fungus, it will invade and cause damage to the growing point and meristem. The growth of hordeidevelop is the same in barley coleoptile tissues, no matter how resistant the cultivars are. After 5 to 6 days, the number of degenerated hyphae starts to increase[3], [4].

The amount of degenerated hyphae depends on how resistant they are. When hyphae (a part of fungi) enter cell nuclei, the nuclei become bigger. Vacuolization of protoplasm means that small spaces form inside the cell, and lysis of the hyphal walls means that the walls of the fungal structure break down. In other words, the cells and the fungal structure are damaged. When the spores of the Tilletia caries fungus infect the Jenkins Club wheat variety, it causes a significant amount (9. 5%) of bunt disease. But when it infects the resistant Marquis variety, the crop remains free of smut disease. Caries affects both strong and weak wheat seedlings, but it doesn't grow beyond entering and growing inside the outer skin cells of strong types of wheat. In plants that have less protection against the fungus, the fungus can easily move into the inner parts of the plant until the plant is 9 days old. After that, it is stopped from spreading further. In plants that are easily affected, it grows in the young leaves, parts where leaves connect, areas between leaves, and places where growth happens.

The bacterial blight of soybean, also known as glycinea, grows more on sprouting soybean seeds that are vulnerable to disease compared to those that are resistant. This shows that the disease has a preference for attacking the seeds before they emerge. The transmission of a specific virus through seeds depends on the type of plant and its variety, as well as the specific virus or strain of the virus. For example, some types of viruses can spread through seeds in different plants. The percentage of transmission varies among different types of plants. For example, in beans it can range from 1% to 75%, in barley from 15. 6% to 646%, in alfalfa from 0. 6% to 103%, and in lettuce from 1% to 8. 7%In alfalfa specifically, the transmission percentage ranges from 15. 5% to 275% depending on the type of plant. Tobacco ringspot virus was found to be transmitted through 3% of lettuce seeds of the Paris Island Cos cultivar, but none was found in seeds of the Imperial 615 cultivar. Squash mosaic virus was transmitted in 5. 1% of zucchini squash seeds, but not in Early Summer Golden and crookneck squash seeds[5], [6].

In simpler words, Kennedy and Cooper found that 20. 6% of SMV was passed from seeds to the soybean plants in the Harosoy cultivar, but there was no transmission in the Merit cultivar. No spreading of peanut mottle virus from seeds happened in four types of big peanuts - Early Runner, Florigiant, Florunner, and Virginia Bunch. But it did spread in four types of small peanuts - Argentine, Spancross, Starr, and Tifspan. The degree of spreading from seeds may be different in each plant of the same type. Seeds from soybean plants can

have different amounts of a virus called SMV27. Some plants have no virus in their seeds while others have up to 35% of the virus. However, if the plants are infected with tobacco ringspot virus, all their seeds will have 100% of the virus. Out of 30 peanut plants, only 7 produced seeds without a virus, while the other 23 plants produced seeds with a different virus called peanut mottle virus. The amount of this virus in the seeds ranged from 0. 5% to 83% There are two reasons why the amount of virus in the seeds can vary among different plants. It could be because of the genes of the plants or because some strains of the virus are more severe on certain plants. The type of barley called Hypana has less of a tendency to pass on a virus called BSMV through its seeds compared to the type called Atlas. This is partly because Atlas has more genetic differences within its plants. There are three ways in which BSMV and different types of barley plants interact. Some barley plants are very easily affected by the virus and produce very little or no seeds. Other barley plants can tolerate the virus and some strains of the virus can live on these plants for a long time. Lastly, there are barley plants that are resistant to the virus. These plants either do not get infected or if they do, the virus does not get passed on to the seeds or it happens very rarely. Therefore, whether or not a virus can be transmitted through seeds depends on the type of plant and how well the virus can survive[7], [8].

The amount of water in the air and in the soil is important for how easily seedlings get sick and how the disease spreads. The amount of water in the soil affects how spores and seeds grow. One example is when oats have loose smut caused by Ustilago avenae. It happens more often when there is 30% water, less often when there is 60% water, and least often when there is 80% water. Too much water reduces oxygen and stops the germination of spores. Similarly, the occurrence of U. Basically, oats can hold up to 94% water at a temperature of 20°C when they are full, while they can only hold 48% water when they are at 60% capacity. Similarly, the infection of sorghum seedlings by Sphacelotheca sorghi is more likely to happen when the soil is dry and cold. On the other hand, the disease called covered smut of barley is not influenced by moisture and temperature. Higher soil moisture, at 50% water-holding capacity, is better for Hordei plants compared to low soil moisture at 40%. When the soil is dry, it is more favorable for the infection and growth of Urocystis occulta in rye plants. The effect of soil moisture on wheat bunt, caused by Tilletia caries, varies. The percentage of infection is 55% at 40% water-holding capacity, 22% at 20%, and 11% at 80%. Low soil moisture, specifically at 48. 8% water-holding capacity, promotes the germination of Tilletia spores.

The fungus Tilletia foetida affects the growth of young wheat plants, especially in wet conditions. However, when the soil is very wet, the infection is least likely. A temperature of 10°C and soil moisture levels of 11%, 13%, 18%, and 24% are ideal for wheat bunt. Caries, or tooth decay, decreases quickly at 10% and disappears completely at 9%. At all levels of moisture, there were more infections at 10°C and some infections at 15°C and 5°C. There were no infections at 25°C. Additionally, there was pre-emergence death of wheat seedlings caused by *Fusarium avenaceum* and *F. "Culmorum*, F" can be rewritten as "Culmorum, a type of fungus. " The level of nivale, or Septoria nodorun is more in dry soils than in wet soils. When the soil is very wet, it stops seeds from sprouting and prevents a harmful fungus from infecting barley seeds as they start growing. Temperature affects how spores grow, how infections spread, and how diseases develop. The best temperature for wheat plants to get infected by seedborne T. Tooth decay and a bacterium named T. The temperature range for foetida is between 5°C and 10°C. During this temperature range, spores that are starting to grow are very contagious and wheat seeds take a long time to start growing, so only a few plants are able to avoid getting infected. Wheat seeds like the temperature to be between 15

and 20 degrees Celsius for them to grow well. If it gets too warm at 25 degrees Celsius, both spores and seeds start to grow, but the plants can avoid getting infected[9], [10].

We do not know how the escape mechanism works, but we think it happens because the host grows very quickly. The wheat plants can get sick between 15 to 25 degrees Celsius if the fungus spores start growing in the soil and are able to infect the plants. For barley, the ideal temperature for infection by Ustilago hordei and U. ranges from 10 to 25 degrees Celsius and from 15 to 20 degrees Celsius. The infection of wheat by a fungus called Urocystis agropyri is best at temperatures between 10 and 20°C and lower at 5°C. There is no infection at 25°C, regardless of how moist the soil is. Two types of barley, one called Odessa which gets easily infected by a fungus called Ustilago hordei, and another called Persicum which is somewhat resistant to the fungus, have similar reactions to the fungus at the same temperature. Certain types of barley plants that are susceptible to disease called covered smut can develop this disease when the soil temperature is 12°C and the air temperature is 16°C, or when the soil temperature is 20°C and the air temperature is 24°C. They can also develop the disease if they are exposed to a combination of these two temperature conditions.

Resistant plant types do not show signs of disease at soil temperature of 12°C and atmospheric temperature of 16°C. However, there may be some occurrence of the disease at different temperature conditions, but at a low rate. This is mainly seen in the inflorescence part of the plant. At different temperatures, a fungus called U. tritici produces different types of infected wheat heads. At 183°C, the infected wheat heads have a lot of spores. 8°C, the infected wheat heads have fewer spores. At 298°C, the infected wheat heads are small and do not have many spores. The types of tritici races Ct and C3 are found on the wheat variety Kota at a temperature of 23°C. However, at temperatures of 15°C and 20°C, there is less loose smut, and at 6°C, there is a very large reduction in loose smut. In colder weather, the fungus in ears doesn't make spores. For Sphacelotheca sorghi to grow in sorghum, the soil temperature during the infection time should be 24°C or lower, but not below -1°C. In order for Neovossia indica infection to occur in wheat, the temperature should be between 19 to 20± 1°C during the day and 8 to 10± 1°C at night, with occasional rain during the wheat flowering period. Wheat seeds that have N. indica infection can cause crop diseases. The Indica variety had a 10% infection rate in 1970-71 and a 1. 5% infection rate in 1971-72. However, it was unable to spread throughout the fields because the environmental conditions were not suitable[11], [12].

The transmission of *Drechslera graminea*, a plant disease, in barley seeds is higher between temperatures of 12 to 15°C. Above 15°C, the transmission either decreases or is stopped in naturally infected seeds planted in the fields. Soybean seeds covered with *Peronospora manshurica* spores get infected throughout the plant when the soil temperature is 13°C, which happens in 40% of the seedlings because the seeds take longer to sprout. But when the soil temperature is 18°C or higher, none of the seedlings get infected. Similarly, maize kernels infected with D. The disease maydis causes 1 and 8% of seedlings to wilt after 3 weeks at 13 and 22°C, respectively. 57 out of 100 safflower seedlings infected with Puccinia carthami were affected by 96. 1, 762, 673, and 293% at 5, 10, 15, and 20°C, respectively. Seedling infection from seeds with *Sclerospora graminicola* hyphae occurs when pearlmillet seeds are planted for 12 hours under artificial daylight at 23 to 25°C. 59 Disease development caused by F. Snow mold in wheat is most prevalent in cold temperatures and dry soil, while it is least common in warm and dry soil. 41% of barley seedlings become infected by *Xanthomonas campestris* bacteria. Translucensvar is a complicated term. Cerealisis is 6 at 10 degrees Celsius and 77 at 35 degrees Celsius. The environment can affect the transmission of certain viruses through seeds, and one big factor is the temperature.

However, when the plants were grown at 24°C, the transmission rates of the virus in the seeds of the latter three cultivars ranged from 7 to 28%. The transmission of BCMV (Bean Common Mosaic Virus) in urdbean seeds did not happen when the temperature was high and there was strong light. However, when the temperature was lower and there was less intense light, 10% of the seeds were found to have transmission. The transmission of various nepoviruses in Stellaria media seeds is affected differently by the temperature during seed production. The viruses called raspberry ringspot and tomato black ring can be spread through seeds at temperatures of 14, 18, or 22 degrees Celsius. The virus called arabis mosaic can only be spread at a temperature of 14 degrees Celsius. The viruses called strawberry latent ringspot and tomato blackring can only be spread at a temperature of 22 degrees Celsius. Wind-blown rain is important for spreading seedborne germs and starting diseases in soybean plants, like bacterial blight caused by *Pseudomonas syringae* pv. Halo blight is a plant disease caused by the bacteria *Pseudomonas syringae*. It mainly affects bean plants, particularly certain types of beans like Glycine max or common beans. The disease can also spread to other plants in the surrounding area. Syringae pv is a simplified way of referring to a specific type of bacteria called *Pseudomonas syringae* pathovar.

In 1966, it was discovered that *P. phaseolicola* (a type of plant disease) was found in Idaho after hail storms, but not after rain storms. In California, where there is no rain during the growing season, *P. phaseolicola* does not spread. Syringae pv is a type of bacteria. Lachrymans is a disease in cucumberseed fields. The wheat types Hope and Marquis have more bunt when the days are longer. The plants called Hope developed bunt percentages of 64. 1%,5%, and 08%; while the Marquis plants had bunt percentages of 32. 7%,8%,9% The Hope plants were exposed to light for 24 hours daily, while the Marquis plants were exposed to light for 10 to 11 hours daily. Canus, a type of wheat, is resistant to three different types of T. Foetida and five of T have a strong smell. Tooth decay happens naturally during the day, but when exposed to constant light, the ability to fight against specific types of decay weakens. The Ulka wheat type is easily affected by all but one type of disease when exposed to different lengths of daylight. However, its ability to resist this particular disease is weakened when exposed to long days. Additionally, the Peronospora parasite can spread within cabbage plants when they are at the early stage of development.

DISCUSSION

The way that seeds are spread can be affected by how much of the harmful substance is present, as well as the kind, strength, and where the substance is on the seeds. Rewrite this text using simpler language: A. caries infection in wheat can be maximized by having a certain amount of spores on each seed. This amount ranges from 36,000 to 150,000 spores per seed. In simpler terms, the amount of cavities in two types of wheat plants, Austrobankut and Stamm 101, is related to the number of spores on the seeds. The number of spores can vary from 3 to 3500 per seed. *Fusarium nivale*, a type of fungus, is more likely to infect wheat plants with a higher spore load, up to 50,000 spores. Avenaceum is more important for causing disease than F. The presence of a small number of fungal spores in one area of a rice grain, or scattered on the surface of the seed coat without any fungal threads, or a lot of spores and fungal threads growing on the rice grain, can lead to different levels of damage to seedlings. *Ascochyta pinodella* and *Mycosphaerella pinodes* can cause bigger decreases in crop harvest compared to A. Pisi caused by a mild infection with A. Rephrase this text using simpler language: pinodella and M. Certain factors called pinodes can lead to a significant decrease in crop productivity. Higher levels of A means that there is a larger amount or concentration of A present. Pisi or we can say peas need to have seeds in order to have

similar losses in the amount of crops harvested. Pseudomonas solanacearum can spread in Capsicum seeds, but only when there are 1000 infestations in each seed, not 50.

Inoculum Location

Researchers found that when wheat plumule buds were infected with Ustilago tritici, it also led to infection in adult plants. However, other researchers observed that plumule bud infection did not occur, but infection in adult plants did happen when the wheat embryo's scutellum was infected. Alternaria brassicicola can be found on the outside and inside of Brassica plants, and when the plants are young, they are more likely to get infected. Oats get infected by U microorganism. Avenae, a type of disease, is found more often in plants from the infected middle seeds of the second flower in a group than in the outer seeds of the first flower. Spores that stick to the outside of the glume cannot cause infection. This is because the spores need to travel about 1 cm along the glume before they can infect the seedlings. The spores on the glume usually cannot grow long enough to reach the seedlings. The spores inside the glumes have a better chance of causing infection.

Kind of substance used for inoculation

Beet seeds that have been polluted by Uromyces betae fungus spores may develop spermogonia on the stems of young plants due to infection from another type of fungal spore. Therefore, groups of contaminated seeds are a potential danger for spreading U. Move into different places. However, there is less risk of beet rust spreading through seeds because beetseed germination takes longer than uredospore germination. So, it might be that plants won't be able to get infected when the uredospores start growing. This study found that 80 seedlings from safflower seeds covered with uredospores didn't show any signs of infection after 1 month. But, 90% of seedlings grown from seeds covered with teliospores did get infected. Also, different strains of the same virus can have different levels of seed transmission. Grogan and Schnathorst23 discovered that a specific type of virus called strain 98 of tobacco ringspot virus could be spread up to 3% through lettuce seeds of a variety called Paris Island Cos. However, a different strain called calico strain was not able to spread through these seeds. The transmission of bean yellow mosaic virus in cowpea depends on the type of strain, with some strains having a transmission rate of 0% to 55%. The strain of SBMV that affects beans is not transmitted through seeds in cowpea, but the strain that affects cowpea can be transmitted.

The squash mosaic virus can be spread through seeds in pumpkin cantaloupe plants. In simpler terms: honeydew melon (scientifically known as Cucumis melo var. reticulatus) is a type of melon. Melovar is a term that needs further explanation in order to simplify its meaning. Can you provide more context or details about what melovar refers to. There are different types of viruses that affect crops like watermelon, pumpkin, and summer squash. Some viruses can be spread through the seeds of these plants. For example, there is a virus called SMV-W that can be spread in watermelon seeds, but another virus called SMV-C cannot be spread in watermelon seeds. There are also viruses that affect peanut plants.

The mottle virus spreads differently in the peanut plant called Starr. In Starr, Mi has a transmission rate of 0. 3%, M2 has no transmission, M3 has a transmission rate of 8. 5%, and N has no transmission. Isolate M2 is not passed from seeds to large peanuts, but it occurs rarely (only 0. 23% of the time) in small peanuts. The A-TSV virus in soybeans can be passed on through seeds, but the W-TSV virus in tobacco cannot. The wheat plants had the most earcockle infection when there were two nematode galls with about 2 x 104 larvae in every 1000 grams of soil. However, if there were more nematodes, the infection would be less because they would have to compete for food.The air and water in the ground are

important for how seeds sprout and diseases spread later on. The amount of water in the soil affects how spores and seeds grow. For instance, loose smut of oats, which is caused by Ustilago avenae, happens more often when the oats have 30% water, less often at 60% water, and least often at 80% water. Too much moisture reduces oxygen and prevents spores from growing. Similarly, the number of cases of U. Oats can hold up to 94% water at 20°C when they are 20% water-holding capacity. However, when their water-holding capacity is 60%, they can only hold 48% water. Similarly, when the soil is dry and cool, sorghum plants are more likely to be infected by a type of fungus called Sphacelotheca sorghi. On the other hand, covered smut, which affects barley plants, is not influenced by soil moisture or temperature. Barley prefers more water in the soil (50% water capacity) instead of less (40%).

Dry soil helps Urocystis occulta grow in rye. Soil moisture affects Tilletia caries in wheat, with higher levels of infection at lower moisture levels. For example, infection was 55% at 40% water capacity, 22% at 20%, and 11% at 80%. Low soil moisture, which means the soil has less water (48. 8% of its capacity), helps spores of T to start growing. Caries, which is another word for tooth decay, and T, which can refer to a type of dental treatment called a filling. The wheat disease called wheat bunt is caused by a fungus called Tilletia foetida. This disease slows down the growth of young wheat plants that are easily affected. However, if the soil is very moist (holding 85% of its maximum moisture capacity), the chances of seedling infection are lower. The best conditions for wheat bunt to thrive are when the temperature is 10°C and the soil moisture capacity is at 11, 13, 18, or 24%. Caries is a term for tooth decay. The infection from tooth decay decreases quickly when it reaches 10% and is not present at 9%. Infections were highest at 10°C and moderate at 15 and 5°C, with no infections occurring at 25°C. Wheat seedlings were more likely to die before emerging when infected with Fusarium avenaceum and F. oxysporum Culmorum, F, is a Latin word. Nivale, which is also known as Septoria nodorum, is more common in dry soils compared to wet soils. When the soil is very wet, it stops seeds from sprouting and prevents a type of fungus from infecting barley seeds as they start growing.

Temperature has an impact on how spores grow, spread and cause disease. T is a type of fungus that can infect wheat plants through their seeds. The best temperature for this infection to occur is called the optimum temperature. Cavities are a problem in teeth. The temperature range of foetida is between 5 to 10°C. During this temperature range, when spores are starting to grow, they can easily infect plants and the germination of wheat seeds is slow. This means that very few plants are able to avoid becoming infected. Seeds of wheat grow better in temperatures between 15 and 20 degrees Celsius compared to spores. If spores and seeds both grow at 25 degrees Celsius, many plants won't get infected. We don't know how exactly the escape mechanism works, but scientists think it happens when the host grows quickly. Wheat plants can get sick when the temperature is between 15 to 25 degrees Celsius, as long as the fungus spores in the soil start growing and become infectious. For barley plants, the best temperature for infection is between 10 to 25 degrees Celsius or 15 to 20 degrees Celsius, depending on the type of fungus. nigra means black. respectively means in the order mentioned.

The wheat infection by *Urocystis agropyri* is most common between 10 to 20°C and less common at 5°C. There is no infection at 25°C, regardless of the soil moisture. The two types of barley, Odessa and Persicum, show similar reactions to the covered smut fungus (Ustilago hordei) at the same temperature. Barley plants that are easily affected by disease can get more than 95% of their surface covered in smut when the soil temperature is 12°C and the air temperature is 16°C, or when the soil temperature is 20°C and the air temperature is 24°C. This can happen when these temperature conditions alternate during day and night. Resistant

plants don't show any signs of disease at soil temperature of 12°C and atmospheric temperature of 16°C. They only have a small number of spores, mainly in the inflorescences, at different temperature conditions. At temperatures of 18. 3°C, 238°C, and 298°C, wheat plants produce different kinds of ears. These are discolored ears, ears with fewer disease spores, and thin green ears with very few disease spores.

The greatest growth of U. The wheat cultivar Kota is affected by two types of fungus, called tritici races Ct and C3. These fungus types are most commonly found on the wheat when it is grown at a temperature of 23°C. However, when the wheat is grown at temperatures of 15°C and 20°C, the amount of loose smut fungus is reduced. The reduction is even more significant when the wheat is grown at a temperature of 6°C. When it's cold, the hyphae in ears cannot make spores. To grow in sorghum, Sphacelotheca sorghi needs the soil temperature to be between -1°C and 24°C during the infection period. The best temperature for Neovossia indica infection is around 19 to 20 degrees Celsius, with a small variation of plus or minus 1 degree. The lowest temperature for infection is between 8 to 10 degrees Celsius, also with a small variation of plus or minus 1 degree. In addition, intermittent rains during wheat anthesis are favorable for the infection. Wheat seeds that have a disease caused by a type of microorganism called N. In simpler words: The percentage of Drechslera graminea infection was 10% in 1970-71 and 1. 5% in 1971-72 However, it was not able to spread in the fields due to bad environmental conditions. The transmission of Drechslera graminea in barley seeds increases between 12 to 15°C, but decreases or stops above 15°C when the infected seeds are planted in the fields naturally.Soybean seeds covered with Peronospora manshurica spores get infected and spread throughout the plant when the soil temperature is 13°C. This happens to 40% of the young plants because the seeds take longer to sprout. However, at temperatures of 18°C and higher, none of the young plants get infected throughout the whole plant. Maize seeds affected by D infection. Maydis causes 1% and 8% of the seedlings to be wilted after 3 weeks at temperatures of 13°C and 22°C, respectively. The percentage of safflower seedlings infected by Puccinia carthami at different temperatures were 96. 1%, 762%, 673%, and 293% at 5, 10, 15, and 20°C, respectively.

Seedling infection from seeds with *Sclerospora graminicola* hyphae occurs by planting pearlmillet seeds for 12 hours under artificial daylight at temperatures between 23 to 25°C. The development of the disease is caused by F. In wheat, snow mold happens the most in cold and dry soil, and the least in warm and dry soil. 41% of barley seedlings are infected by *Xanthomonas campestris* pv. Translucensvar is a term that means something or someone is partly transparent, allowing some light to pass through, but not able to see clearly through it. Cerealizes 6 when it is 10°C and 77 when it is 35°C. The transmission of some viruses through seeds is affected by the environment, specifically the temperatureSingh and his colleagues discovered that the BSMV virus spread to 3% of the seeds in the barley line C. 5020, but did not spread to any seeds in the lines C. 3212, C3212-1, or C4219 when the plants were grown at 16°C. However, when the plants were grown at 24°C, the virus spread to seeds in the last three lines, ranging from 7 to 28%. No seed transmission of BCMV happened in urdbean when the temperature was between 20. 8 to 39°C and there was strong light. But when the temperature was between 20 to 30°C and there was less intense light, 10% seed transmission was found. The transmission of various nepoviruses through Stellaria media seeds is influenced by the surrounding temperature during seed production, but the effects are different for each virus. The raspberry ringspot and tomato black ring viruses can be spread through seeds at temperatures of 14, 18, or 22 degrees Celsius. The arabis mosaic virus can be spread through seeds at a temperature of 14 degrees Celsius. The strawberry latent ringspot and tomato black ring viruses can be spread through seeds at a temperature of 22 degrees Celsius.

CONCLUSION

Seed germination may be a basic process that's impacted by different components. Within the show ponder, the impact of temperature on tree peony seed germination was examined. Compared to seeds kept up at 25°C, germination was hindered when seeds were kept at 4°C. Moreover, low-temperature introduction of seeds come about in a delay in water take-up, starch debasement, and dissolvable sugar utilization and a consequent increment in solvent protein levels.

Two-dimensional gel electrophoresis (2-DE) proteomic investigation distinguished 100 protein spots. Comparative examination shown that low-temperature presentation clearly basically influenced glycolysis and the tricarboxylic corrosive (TCA) cycle, whereas too essentially influencing proteometabolism-related variables. Besides, low-temperature presentation driven to the acceptance of abscisic corrosive, while the gibberellin pathway was not influenced. Encourage comparison of the two temperature conditions appeared that low-temperature presentation delays carbohydrate digestion system, adenosine triphosphate (ATP) generation, breath, and proteolysis and increments defense reaction variables. To assist look at the gotten proteomic discoveries, four qualities were assessed by quantitative polymerase chain response (qPCR). The gotten transcriptional comes about for the GAPC quality coincided with the translational comes about, in this way assist recommending that the delay in glycolysis may play a key part in low-temperature-induced restraint of seed germination. Be that as it may, the other three qualities inspected, which included FPP synthase, PCNT115, and endochitinase, appeared non-correlative transcriptional and translational profiles. Our comes about recommend that the introduction of tree peony seeds to moo temperature comes about in a delay within the debasement of starch and other metabolites, which in turn influences glycolysis and a few other forms, in this manner eventually hindering seed germination.

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CHAPTER 9
SEEDBORNE PATHOGENS EPIDERMIOLOGY AND INCUBATION LIMITS

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ABSTRACT:

In spite of the fact that seed generation has been moved to semiarid districts to elude seedborne pathogens, seedborne bacterial infections proceed to be risky and cause noteworthy financial misfortunes around the world. Plagued seeds are mindful for the re-emergence of illnesses of the past, development of pathogens over universal borders, or the presentation of maladies into unused ranges. Significant consideration has been paid to progressing the affectability and selectivity of seed wellbeing measures by utilizing strategies such as stream cytometry and the polymerase chain response. There has moreover been advance in understanding contamination edges and how they impact seed test measure assurance and eventually the unwavering quality of seed wellbeing testing. Malady improvement and spread of pathogens from sullied seedlots can be anticipated utilizing equations that take under consideration inoculum thickness and natural weights. In common, seeds swarmed with bacterial pathogens are dispersed inside a Poisson dispersion. In a subset of sullied seeds, microscopic organisms are disseminated in non-Gaussian conveyances, e.g., a lognormal dissemination.

KEYWORDS:

Black Rot, Health Test, Plants, Seed Heath, Seed Born Pathogens.

INTRODUCTION

Nearly each basic content on plant pathology suggests clean seed and clean transplants as the beginning point for overseeing plant illnesses. This same exhortation is additionally given by expansion pros and province specialists at preparing sessions and growers' gatherings and distributed in various expansion bulletins on infection administration around the world. Beginning edit generation with clean seed and/or transplants appears straightforward, consistent, and self-evident, however it is incredibly troublesome to realize. Seedborne pathogens are a proceeding issue and may indeed be capable for the re-emergence of infections of the past as well as the presentation of maladies into unused ranges. In today's worldwide economy, seed accounts more than ever for the development of plant pathogens over tremendous separations, normal boundaries, and political borders. Seedborne bacterial pathogens are of specific concern since, not at all like seedborne parasites, procedures for the administration of bacterial infections are insufficient, particularly given the restricted and old-fashioned chemical alternatives accessible. In this survey we address features of the the study of disease transmission of seedborne phytopathogenic microbes and how they relate to administration of the illnesses they cause[1], [2].

For decades U.S. agribusiness depended on clean seed being created within the western states, where the cool and dry climate was thought to restrain improvement of bacterial maladies in seed crops. In any case, proceeded and unexplained flare-ups, though moo in number, gave rise to doubts that seed delivered in these ranges may be swarmed with

seedborne phytobacteria. A case in point is dark decay of crucifers caused by *Xanthomonas campestris* pv. campestris (Xcc). Western-grown cruciferous seed to begin with stimulated doubt within the 1970s when state administrative auditors in California detailed discovery of dark decay in seed generation areas (124). Dark decay was too identified in cruciferous weeds in these same zones of California. In spite of the fact that dark decay was not watched on crops or weeds within the state of Washington where the seed was created, Xcc was recognized in three different seedlots created there . Taking after up on this report, overview of cruciferous weeds within the crucifer seedproducing regions of coastal California. They found various cruciferous weed species, numerous of them symptomless, that were normally tainted with Xcc both inside and some distance (>30 km) from seed generation areas. Besides, they identified Xcc in seeds from symptomless Cardaria pubescens, a harmful lasting weed, proposing that Xcc can be seedborne in other symptomless has as well[3], [4].

The researchers believed that some types of weeds could have Xcc on them, which can infect cruciferous seed crops. They thought that these weeds could spread the infection from one generation of crops to the next. Finding Xcc in weeds that grow outside of cultivated areas has raised valid concerns about the effectiveness of long-term rotation in preventing black rot. In a study showed that a weed with a disease could spread that disease to young plants of the cabbage family. A sick plant was placed in the middle of circular areas with different sizes at two different places in Georgia. The treatments (measuring the distance from the center) were repeated four times. The results from the two different places were very similar, but they were unexpected. After reaching 6.1 meters, there was a big decrease in the speed of Xcc spreading from weeds to cabbage seedlings. In the Experiment plot, there was one infected plant found in a 12.19 m radius In the Plains plot, there was no infected plant found in the same radius. Schaad's report found that Xcc was found in seed from western Washington, even though black rot had never been seen there before.

Even though there were no signs of black rot on any of the plants for three years, the bacteria that causes black rot must have been in the fields because the seeds produced in that area were contaminated with the bacteria for three years when tested. This happened even when the bacteria was resistant to rifampin, a type of antibiotic. Their information showed that Xcc could survive in the usual conditions of western Washington for more than 500 days. This was a long enough period for it to be the main source of infection for future seed crops. In addition, the researchers discovered that Xcc can stay alive for up to 73 days as a plant living on the surface of cabbage or wild turnip leaves. They achieved this by creating leaf imprints on a specific type of medium. According to these findings, researchers suspected that Xcc could live on weed plants without showing any symptoms and could spread into an area where cabbage seeds are grown as a spray in the air. One interesting thing is that Xcc grew inside some plants that didn't show any symptoms. The bacterium was found on the leaves of these plants after sterilizing them. This discovery showed that Xcc can live on plants without causing symptoms and can spread through contaminated seeds[5], [6].

This is similar to what happens with halo blight of beans, caused by *Pseudomonas savastanoi* pv. , when dust contaminates the seeds during harvest. Phaseolicola is a type of bacterium. Another research study focused on bacterial blight of carrots, which is caused by a type of bacteria called X. Hortorum pv can be rewritten as hortorum strain or hortorum variety. Carrot researcher discovered that carrots grown in the western region might have bacteria on their seeds. Apart from managing diseases, other things like how much workers cost affect if a seed company can make a good product and still make money. As a result, more companies started getting seeds produced in developing countries where labor costs are cheaper. Sadly, this outsourcing could lead to the return of certain diseases that are carried by seeds, and it

may also bring new diseases to different places. One clear example is the growing need for hybrid watermelons, which led seed companies to find cheaper ways to produce them. Sterile triploid watermelons don't have seeds and they come from a female watermelon plant that has double the usual amount of chromosomes being pollinated by a normal male watermelon plant. The tetraploid parent can be made by changing its genes with colchicine. But now, we can make tetraploid parents more easily using tissue culture methods and doubling their chromosomes.

Researchers have had some success using viruses that attack bacteria to find and identify harmful bacteria that live in seeds. We added different types of bacteriophages that can kill specific bacteria to ground seeds mixed with nutrient broth. When there were more bacteriophage plaque-forming-units (PFU) compared to the PFU from seeds without any infections, it meant that there was a bacteria present in the seed that the bacteriophage could attack. Researchers used the same method to find X. The bacteria oryzae pv. oryzae is found in rice seeds. After soaking rice seeds in clean water, the liquid from the seeds was made stronger by spinning it in a machine. Then about 3-4 times 10 to the power of 4 infectious particles per milliliter were put into the liquid. The liquid sample was made stronger by spinning it fast in a machine. Then the solid part that formed was mixed back into a liquid solution. After a short period of time for bacteriophages to infect the target bacterium, the sample was made more concentrated and tested for the amount of phages per milliliter. One benefit of using bacteriophages in a seed health test is that the bacteria being tested must be alive so that the bacteriophages can multiply. However, there are some problems with this approach. It can be hard to identify the specific harmful organism for confirmation. The bacterium may have different types that the bacteriophage cannot effectively fight against. Additionally, the target bacteria may be in a dormant state that shields them from the bacteriophages.

DISCUSSION

Fungi are often the main cause of diseases in plants. These tiny living things don't have chlorophyll and can be seen as clumps of long, thin strands called hyphae. The hyphae come together to form mycelium, which are basically resting structures that include rhizomorphs and sclerotia. Most types of fungi make new ones by releasing tiny particles called spores. They also make big structures called fruiting bodies, which can help scientists identify them. These fruiting bodies are what show that there is a disease-causing organism present.In the lab, scientists can recognize fungi by the way they grow, their spores, or other parts of their structure. The first thing to do is look closely at the infected plant part with a hand lens or microscope to see if there are any signs of the harmful organism causing the disease. In simple terms, if you can't see fungi on a plant, a lab can test a piece of the plant by putting it on a plate with food for the fungi. If there are fungi, they can grow and make the signs needed to identify them.Fungi can harm plants in different ways. Common signs of a fungal infection include the decay of seeds, damage to young plants, rotting of roots and crowns, wilting of the vascular system, spots on leaves, rust, growths called cankers, as well as damage to stems and twigs.

Fungi can make spots on leaves. If you see mycelium, spores, or small black dots when looking closely at the lesions, it might be a sign of a fungal disease. Not all areas on leaves need to be treated or controlled. Fungal leaf spots can be controlled by growing plants that are resistant to the disease or by using certain techniques to prevent the disease from spreading. Reducing the amount of water used for overhead irrigation and keeping the leaves dry for shorter periods of time can help prevent leaf spot diseases.Blights happen when parts of a plant like leaves, flowers, or stems completely die. This can happen when a lot of sores

form and join together really fast. Blight diseases happen quickly and can harm plants a lot. One example from history is a disease called late blight. It affects tomatoes and potatoes by attacking their stems, leaves, potato tubers, and tomato fruits. This illness was a big part of the Irish famine that led to many people leaving their country in the 1800s. We use different methods like cultural control, resistant plant types, and fungicides to handle fungal diseases.

Rot can happen on different parts of a plant, but it is usually seen in roots, stems, and fruits. Damping-off is a common term used to describe the decay that happens when young plants are attacked by fungi in the soil. Damping-off is most common in a dirty growing material that is too damp. Being careful with how you water your plants and using clean pots and soil without any germs are the best ways to stop root and stem rots from happening. Do not use the same soil for your potted plants again.Cankers are like dents or bumpy spots on tree bark. They can be rough, have parts missing, or look swollen. Sometimes, a sticky substance called sap might come out from these spots, and a raised ring of thick skin grows around it. This is the plant's way of trying to protect the injured part and stop diseases from spreading. If the canker wraps around the stem entirely, the stem or branch above it will die. Managing canker diseases is a challenging task. To prevent plants from growing too quickly and spreading, take good care of them in your garden and remove any branches that are affected by stress.Vascular wilts happen when fungi grow inside a plant's tubes that carry fluids, causing these tubes to die. The green parts of plants and their connected parts. Plants shrivel up and die when they don't have enough nutrients and water, showing signs similar to those seen in drought situations. We can see dark lines in the parts of the plant that have fungi. Plants with bad wilt infections usually can't be saved, but nearby plants can sometimes be protected with medicine injections.

Bacteria are tiny living things that don't have chlorophyll and make more of themselves by splitting into two cells. Bacteria cells can multiply fast and stick together to make colonies. Bacterial diseases can start suddenly and quickly get very serious. Some kinds of bacteria can quickly spread from one leaf to another and can create spots on the leaves. Some things can grow quickly in the tubes that carry water in plants, and block them. This can cause the plant to become weak and parts of it to die. Bacterial diseases are hard to treat because there are only a few medicines called antibiotics that can control them, and bacteria can quickly become resistant to these medicines.Certain types of bacteria can create growths that resemble tumors. Crown gall is a widespread plant disease that happens when bacteria in the soil create lumpy growths on plant roots and stems. You can find it on euonymus, grape vines, roses, and fruit trees. Infection usually happens when a plant is hurt or not very strong. Practicing good hygiene and being careful when mowing or using a weed trimmer can help prevent crown gall.

Bacteria can cause many leaf diseases. For instance, when leaves get damaged and infected, they can develop spots or diseases. Sometimes, a yellow circle might appear around the edge of the damaged area, which could mean that a harmful substance in the plant is causing the problem. Sometimes, the tissue comes off of the leaf, which makes it look like it has holes or is torn. You might see bacterial goo from a sore when you look at it closely with a microscope. This slimy substance has many bacteria in it. They can easily spread to healthy leaves when water drops land on them. The bacteria can get into plants through natural openings called stomata or hydathodes, or through wounds.Certain bacterial illnesses can lead to blights. One example is fire blight, a widespread illness that affects apples, pears, and similar plants in the Midwest region. Common signs of the problem include droopy and wilted tips of shoots. These shoots may bend into a crooked shape like a shepherd's staff, and their tips may become black and dry. Fire blight infections are usually most active in spring

when bugs carry the infection while they help flowers reproduce. The bacteria can get inside plants through small openings in flowers called nectarthodes. Raindrops and cutting or other injuring events can also spread the disease. To prevent and control fire blight, follow good farming practices and choose plant varieties that can resist the disease.

Bacteria can also make fruits, vegetables, tubers, and bulbs rotten and mushy. Rot can make crops go bad quickly. Plants that are affected often have a strong smell and soft tissues that look like they have melted. To prevent damage to plants, be careful not to harm them before or after picking. Also, make sure to keep things clean to lower the chances of rotting.It can be hard to kill bacteria that make plants sick and are hiding inside the plant. To keep plants healthy, you can change the surroundings, get rid of sick plants, or use special pesticides. It is very important to have good cleanliness and hygiene habits to prevent issues. This is because just one infected seed can make a whole tray or even a whole greenhouse full of sick plants. Antibiotics are usually not suggested for using in home gardens because they can cause bacteria to become resistant to antibiotics.Changes in innovation and disappointment with existing tests have provoked the investigation of different seed wellbeing measures to identify distinctive phytopathogenic microscopic organisms. The procedures incorporate utilize of the plant have as an pointer (either by vaccination with a test extricated from the seeds to be tried or in a grow-out), coordinate or roundabout plating onto bacteriological media, serology, PCR, and stream cytometery.

In numerous occasions, procedures are combined to maximize the affectability and specificity of the test. Two of the foremost critical concepts in seed wellbeing testing are affectability and selectivity, which are inseparably connected. For case, expanding the selectivity of semiselective media may diminish the recuperation effectiveness of all or a few strains of the target life form. In differentiate, expanding selectivity may diminish the number of nontarget life forms that act as competitors and/or inhibitors that meddled with the measure, and hence increment the discovery affectability. In various cases, plating efficiencies on a semiselective medium vary due to the strain that's being disconnected or the source from which it is being confined. A semiselective medium may have the next cruel plating effectiveness than a standard development medium since standard media are complex and frequently gotten to be poisonous, maybe due to the collection of peroxides or other auxiliary metabolites. Variables such as plating efficiencies must be inspected empirically for each seed host-pathogen combination. As such, there are various approaches to attain the foremost touchy and specific media-based seed tests.This has decreased the rate of rice impact to about inconsequential levels in most areas over the past a few a long time. The special cases that have been found more often than not happen when producers proceed to plant their claim swarmed seeds of exceptionally helpless cultivars. In this manner, the work on this extend has emphasized green wrong muck[5], [7].

This infection was to begin with found in Arkansas in 1997 and it spread to all rice creating provinces within the state where it has risen as an imperative illness of rice in Arkansas. Small was known almost this infection, in this manner, the essential reason of our work conducted beneath the past untrue muck venture, ARK 02046, was to explore different components of the disease cycle utilizing both morphological and atomic procedures, to assess chosen rice cultivars for resistance to the malady and to assess seed and foliar applications of fungicides for adequacy as stop-gap measures for control of this illness. The comes about of this work were detailed as a condition of subsidizing within the B.R. Wells Rice Ponders distributed by the Arkansas Agrarian Test Station. The comes about of the work conducted beneath ARK02046 appeared that fungicides did not viably control the infection when connected to seed earlier to planting or to foliage at heading. Of the 12 cultivars tried in

reproduced field tests at two areas over three a long time. Be that as it may, field observations moreover appeared that the frequency and seriousness of the illness showed up to extend after rainfalls or overwhelming dews which the frequency and seriousness of infection on the helpless cultivars were too expanded by late planting . The comes about of the research facility work conducted beneath the past and current ventures, testing nested PCR methods, proposed that DNA reliable with U. virens may be found within the stem apical meristem inside 3 to 7 days after germination of plagued seeds and in rice florets aseptically disconnected from the unopened boots.

So also, we identified DNA steady with U. virens in10 to 20 day ancient seedlings within the field. Encourage, fake immunization of seeds with spores of the organism showed up to extend the extent of florets testing positive for DNA reliable with U. virens DNA in three of the four cultivars tried. In these PCR tests, it was affirmed that the arrangements inferred from the amplicons or items of basic and settled PCR were reliably and profoundly comparable to groupings kept in GenBank by investigators in Japan and China. Inquire about conducted within the nursery and within the field appeared that fungicide medications did not dependably diminish the rate of location of DNA reliable with U. virens in seedlings developed from swarmed seeds and in soils with a history of the infection. Since green wrong muck is generally modern and exceptionally important in Arkansas and white segregates have never been detailed exterior of Japan or China, and within the work conducted beneath the current venture, ARK02456, we inspected the destructiveness of one of the separates of this white muck that we had collected to four current or already vital medium and long grain rice cultivars in nursery tests. The white confines given a interesting opportunity to look at the disease of rice by U. virens. And, we utilized four cultivars that had showed up to contrast in helplessness to green muck in past field tests. We inspected the rDNA arrangements and spore morphology of a few segregates of the white muck and compared them to an break even with number of green confines of untrue muck.

These information appear that the rDNA arrangements of white segregates are exceptionally comparative to the arrangements of the green confines, but that spore morphologies were exceptionally diverse. The spores of the white separates were essentially littler in distance across, were not echinulated and were about hyaline in color in comparison to the greenish and echinulated spores of green confines. Altogether, our comes about moreover show that white the white disconnect of wrong muck is destructive to all four rice cultivars in nursery tests, there are contrasts within the response of the cultivars to this separate. The foremost later comes about in our research facility and nursery tests have recommended that overhead water system of rice panicles as they rise from immunized booted panicles essentially increments the expression of illness, maybe by giving conditions for development of sori that supplant seeds at heading. These nursery information give prove that upheld the plenteous recounted prove that rain increments the rate and seriousness of this illness. Assist, affirmation that overhead water system of vaccinated panicles in nursery bolsters the advancement of sori on panicles will offer assistance in encourage examinations of the impacts of seed borne inoculum and fungicide medications of seeds in nursery ponders. In conclusion, we have built up a culture collection of more than 100 green and albinotic separates of U. virens from a few cultivars and over a fewareas in Arkansas. It shows up that this can be the foremost comprehensive collection of this pathogen within the U.S. at this time. And it is certain, it is the as it were collection of albinotic separates within the US[8], [9].

Campestris pv is a shortened form of the full name *Xanthomonas campestris* pathovar. In the United States, IF tests are not commonly used as much as in Europe when checking the

health of campestris in crucifer seeds. IF has been used in France for at least 20 years to test tomato seeds for C. Michiganensis subsp is a subspecies of bacteria. Michiganensis is a term used to describe a particular type of organism. The black rot seed certification program in Georgia did not use IF (fluorescent cells) to determine the disease development in crops because it was hard to decide how many positive fluorescent cells could actually cause the disease. Both scientists and regulatory personnel agreed that using IF test resulted in many incorrect positive results. This may be because the bacteria were sticking to cells that are not alive or to exposed parts of the bacteria. Methods like IFC were created to solve the issue of possible false positives. In simple terms, an IFC seed health assay mixes seed extract with the same amount of agar medium. The mixture is kept warm, made dry, and then put in contact with specific antibodies for bacteria. These antibodies have a special substance that glows under light. Colonies that have been marked with the antibody and dye combination can be seen using a special microscope that illuminates them with fluorescent light. The bacteria inside the colonies can be taken out using a thin glass tube and moved to a suitable substance that helps them grow.

ELISA has also been used to test the health of seeds. Usually, ELISA, like IF, is believed to sometimes give inaccurate positive results. However, Lamka and his colleagues. A study discovered that ELISA effectively detected Pantoea stewartii ssp. In easy words: The bacteria stewartii is found in corn seeds. They found that using a method called double antibody sandwich (DAS)-ELISA with both polyclonal and monoclonal antibodies was the best way to test for seed health. Afterwards, the method was used to count how many P organisms there are in a population. Stewartii subspecies The researchers studied the relationship between the amount of bacteria recovered and the absorbance values in individual seeds of stewartii. Flow cytometry is a method used in seed health tests that can separate and examine bacteria cells that have been marked with colored antibodies. By measuring the amount of light scattering and fluorescence from many cells taken from an infected seed sample, we can quickly determine several factors. When a group of bacteria with labels on them moves through a device, a strong light shines on them and makes the labels glow.

Different fluorescent detectors can be used to measure several things at the same time, like the size of cells, how grainy they are, and how rough they are. If we use special dyes that look for important parts inside cells, like enzymes, the flow of electricity across the cell membrane, or how active the cells are in breathing, flow cytometry can tell us if the cells we are looking at are alive or not. Immunomagnetic separation PCR is a method that uses antibodies to separate and detect specific antigens. IMS uses tiny magnetic beads covered in antibodies to separate specific cells from mixed samples. After using a magnet to hold the particles in place, the immunomagnetic beads are washed to get rid of substances that can stop them from working properly and bacteria that are not the target. Template DNA can be retrieved from captured cells by boiling them, and then it can be used for PCR. Alternatively, the captured cells can also be placed on a special medium that only allows certain cells to grow. IMS is a process that helps to increase the amount of specific DNA in a PCR sample. It has also been used successfully for detecting P. Onion seeds contain ananatis IMS-PCR helps to make sure that we don't miss any pathogen DNA in seeds. It does this by making the process of getting PCR-quality DNA from seeds more effective and reliable. It also removes any compounds in the seeds that could stop PCR from working properly[10], [11].

Here are a few examples that show how basic PCR can be used to find certain genes or random DNA profiles from plants that have been infected with bacteria. But, initially people thought that PCR was too sensitive to be used regularly as a test for seed health. There were also worries about whether PCR could tell the difference between dead cells and cells that are

still alive. The PCR technique is very sensitive and can theoretically detect just one bacterial cell. However, because the amount of seeds being tested is large and the volume of the sample used in the PCR reaction is small, PCR is not more sensitive than many other techniques. Other methods, like nested PCR, have been used to find germs in seeds. Nested PCR makes the amplification process more sensitive by doing another round of amplification. This is done by using special primers that attach to the inside parts of the DNA sequence that was amplified in the first round. Poussier and colleagues used a method called nested PCR. Scientists found Ralstonia solanacearum, which causes bacterial wilt in tomato seeds. Changes in the order of genetic locations that PCR primers are made for can be a problem. Rico and his colleagues. A report stated that some bean seeds were not found in Spain and were certified as disease-free by mistake because they had a particular disease in them. Seed extracts are placed on top of a special bacteria food to help the bacteria grow.

The plate is cleaned and DNA is taken out from the liquid to use for PCR. Because only cells that are alive will grow on the special food, this makes sure that the specific bacteria we are looking for was able to grow from the starting sample. However, since some batches of seeds may have harmful bacteria that grow quickly, the seed extract needs to be made stronger using a special type of medium that targets only certain types of bacteria. Some research studies have been able to detect harmful germs in seeds by using a technique called BIO-PCR. Other changes to the seed health test that uses PCR have been created. Sayler and his colleagues They used a method called real-time PCR to find B. The glumae in rice seeds are outer covering layers. Real-time PCR helps find and measure harmful germs, and gets rid of the hard work and dangerous waste issues that come with gel electrophoresis. If there are many different types of bacteria on a batch of seeds, we can use a method called multiplex PCR to detect them at the same time. Multiplexing means combining several tests into one. In real-time PCR, this can be done by using multiple probes with different colors of light. Using a method called quantitative realtime PCR, we can measure the amount of harmful microorganisms in seeds. This can help us understand how these microorganisms contribute to the spread of diseases, and set limits for how many of them can be transmitted through seeds. By doing this, we can better manage and control plant diseases.

Many good reviews have talked about how the number of diseases present, the effectiveness of testing seed health, and the size of seed samples needed for accurate results are related to each other. Sadly, we don't know a lot about the specific conditions for many seedborne plant diseases caused by bacteria. These conditions can change depending on the situation. For example, the point at which a disease can start spreading for A. Avenae subspecies Citrulli, a disease in melon plants, will spread differently in melons grown directly in the field with a larger spacing between plants compared to greenhouse-grown watermelon seedlings with a smaller spacing between plants. Moreover, the commonly accepted belief that a seed threshold of 1/10,000 is correct might be wrong. This belief is based on data collected from cabbage and broccoli plants affected by black rot, with a density of approximately 1 plant per 200 cm2. These plants were grown under normal outdoor conditions. Thus, it is possible that this situation may not be related to BFB epidemics. The maximum number of plants that can be infected with BFB in a transplant greenhouse is one plant for every plant in the greenhouse. So, if there are 1 million plants in the house, then if even one plant is infected, all the plants need to be thrown away, which means losing all of them. In the situation with infected seedlings caused by black rot, it was shown that the disease and spread of the harmful organism in the greenhouse were strongly influenced by how the seedlings were watered and how much of the harmful organism they were exposed to initially.

More plants had black rot symptoms when they were watered from above a lot and when they were planted with a lot of bacteria on the seed. Plants that were watered less often and planted with less bacteria on the seed had fewer black rot symptoms. The information provided by Roberts et al. suggests Created a model that could predict things by considering the percentage of sick plants, the average amount of bacteria on each seed, and how many times plants were watered from above. To see how well a seed health test works, two main ways have been used. One way is to add a specific amount of germs to the sample, either by adding them directly or by using artificially contaminated seeds. We can find out how well the recovery is working by counting how many times we correctly detect something in a certain number of tries. Instead, the efficiency of the test is calculated by using seeds that are naturally infected and added to the sample of seeds. Both methods cause issues.

The "spiked" seed method has been criticized because it doesn't accurately show real biological events. This means that the test results might be higher than they should be because naturally contaminated seeds can have bacteria in hidden places or in a dormant state, making them harder to find. Artificially introduced seeds have bacteria that are likely growing rapidly, making them easier to find and causing a partiality or favoritism. However, there are also problems when trying to figure out how well a test works using seeds that are naturally infested with something. We don't know the exact amount of germs that are on seeds in nature. It is more complicated when using seeds that have bacteria because the bacteria may not be spread out evenly. The accuracy of a test can be higher than it actually is if it is conducted on a seed that naturally has a lot of bacteria, even though most other seeds only have a small amount of bacteria. Making a mistake in thinking that a seed health test is more accurate than it actually is could lead to wrong estimates when determining the number of samples needed to reach a certain infection level that can be considered reliable. The amount of disease present on seeds can also impact the outcomes of grow-out tests. Roberts and his colleagues 109 showed that, on average, there were a certain amount of P. Syringae pv is a type of bacteria. The number of damaged seedlings and the number of spots on each seedling were mainly affected by how much the seed was covered in CFU and how wet the soil was.

They suggested that the accuracy of seed health tests could be increased by considering the number of harmful microorganisms present in the seeds. Seed health tests will be done and infection limits will be determined by making assumptions until we know and understand the specific impacts of things like how much of the pathogen there is, the conditions in which it grows, how harmful the strain is, and how easily different types of plants can get sick. To ensure quality, we need to find and fix a certain amount of contamination with a very good chance of finding it. To find answers to scientific questions, statistical analyses use the assumption of normality and try to achieve a certain level of probability, like P = 0. 05 or P = 0. 01 But, in the physical and biological sciences, many populations or events are distributed in a way that is not perfectly balanced. Skewed distributions are common in populations with low average values and high differences between individual values, like infested seed and populations with seedborne pathogens. These unbalanced distributions closely match lognormal or other non-standard distributions. So, if bacteria are spread evenly throughout a group of seeds and there are a lot of bacteria on each seed, it will be easier to find them compared to if there were only a few bacteria on a small number of seeds. A seed health test needs to be able to detect bacteria even in the worst situations. Unfortunately, infested seeds are usually found randomly and rarely in a long series of tests. One of the things they discovered was that when estimating the number of bacteria in a large sample, the estimated average would be higher than the actual average. Because seed health tests often use large

samples, it's important to be cautious not to overestimate how well the test works due to an overestimation of the actual number of infected seeds.

CONCLUSION

The worldwide populace is expanding quickly, and nourishing the ever-increasing populace postures a genuine challenge for agriculturalists around the world. Seed may be a essential and basic input in farming to guarantee worldwide nourishment security. Generally 90 percent of the crops developed all over the world are proliferated by seed. Be that as it may, seed can moreover harbor and spread pathogens, e.g. organisms, microbes, nematodes, infections etc., which cause destroying illnesses. Seed-borne pathogens speak to a major risk to trim foundation and yield. Hence, convenient discovery and conclusion could be a prerequisite for their compelling administration. Epidemiological data is the key for considering control techniques particular for seed-borne infections. For seed-borne pathogens, it is imperative to get it how pathogens carry on in specific natural conditions which may be valuable to create a cost-effective control degree within the show climate alter situation. The behavioral information of pathogens may be utilized for making ominous natural conditions for maintaining a strategic distance from contamination by seed treatment natural, botanical or chemicalor developing the trim in disease-free regions or ominous situations to maintain a strategic distance from edit misfortune. Besides, to create successful, delicate and exact seed testing procedures, epidemiological issues like amount of potential inoculums, chance of seed-borne inoculums, connection between seed wellbeing and illness and natural components influencing seed-to-seedling transmission amid seed germination to edit development.

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CHAPTER 10
NONPARASITIC SEED DISORDERS: UNRAVELING THE DETECTION METHODS

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ABSTRACT:

Seeds have microorganisms that can be good for you, but they can also make you sick. It is important to know how plants work in order to help them grow better. Controlling harmful plant diseases carried by seeds without harming useful microorganisms is a big challenge. This article talked about helpful plant germs that live inside seeds and what they do. It also mentioned harmful germs that can infect seeds, and how to find, control, and prevent them.Nontransmissible seed disorders are not harmful or contagious and can possibly have negative effects on seeds or young plants. Nontransmissible disorders happen for many reasons. Humidity and temperature are things in the environment that have the biggest impact on disorders that are not caused by parasites. The genetic makeup of plants can cause problems with the seeds. Tasks like collecting, separating, treating, and taking care of crops after they are collected can cause physical harm to seeds. When seeds are wet, the embryos inside them can get hurt from being hit. The condition known as "baldhead" or "snakehead" in lima bean seedlings happens when the embryo gets damaged during threshing because of mechanical impact. When the soil doesn't have enough minerals, it can cause plants to grow poorly. This means the seeds they produce may be smaller, have a strange shape, and not be able to grow well. Bugs can harm seeds in special ways. It's easy to find bugs or damaged seeds to figure out if there's a problem

KEYWORDS:

Bcteria, Disease, Fungi, Plants, Seeds.

INTRODUCTION

Plant disease can make plants worth less money, make them look less pretty, and make them not work as good for the environment. Plant pathology, also known as phytopathology, is the study of plant diseases, including what causes them, how to prevent them, and how they impact society.Plant disease can make plants less valuable in terms of money, beauty, and their role in nature. The study of plant diseases, including what causes them, how to prevent them, and how they affect society, is called plant pathology or phytopathology. Plant diseases can be noticed by certain signs like cells or tissues dying, leaves turning yellow, shoots and leaves drooping, rotting, plants not growing big, forming swollen areas like galls, leaves turning bronze in color, or plants falling over. There are two types of plant diseases: nonparasitic and parasitic.Nonparasitic diseases occur when the environment is not right for plants to grow well. This can happen because there isn't enough or there is too much of certain nutrients, there are harmful chemicals, the soil or weather is bad, or there are pollutants around. Lack of important minerals like nitrogen, phosphorus, potassium, boron, calcium, copper, iron, magnesium, manganese, molybdenum, sulphur, and zinc can cause diseases in all types of crops. Pollutants can also cause diseases. Pollutants in the air from burning things include sulphur dioxide and fluorides. Pollutants from reactions caused by sunlight include complicated nitrates and ozone[1], [2].

Also, there are some harmful chemicals that are found naturally.Many plant diseases are caused by harmful organisms such as fungi, bacteria, viruses, and tiny worms and bacteria-like organisms. Moreover, certain plants like dodders and mistletoes are capable of living off and harming other plants that are green.Fungi are small or big thread-like living things that do not have the green pigment chlorophyll. They have reproductive parts that are usually spores. There are many types of fungi that can make plants sick. These fungi can cause diseases like rusts, smuts, powdery mildews, and ergot in cereals. They can also cause problems in potatoes, tomatoes, apples, trees, tobacco, and young plants. In total, there are around 100,000 different diseases caused by these fungi.Bacteria, mycoplasma, and spiroplasma are tiny organisms that do not have chlorophyll and usually make new cells through cell division. Mycoplasma is a basic type of bacteria that does not have cell walls. Spiroplasma are tiny cells that look similar to mycoplasma and have a spiral shape. In the natural world, mycoplasma and spiroplasma rely on leafhoppers to move around. Bacteria can sometimes be spread by bugs, but they can also be carried by rain, wind, and contact with other things. Many kinds of bacteria harm plants[3], [4].

Viruses and viroids are very basic kinds of parasites. Viruses are made of proteins and nucleic acids, while viroids are made of unprotected ribonucleic acids. They are small organisms that take over other cells to reproduce and multiply their genetic material. There are several plant viruses that can make tobacco, cucumber, tomato, potato, raspberry, tulip, and barley plants sick. Several small infectious particles called viroids can cause diseases in plants, including potato, cucumber, hop, and chrysanthemum. Some small organisms called viroids and certain viruses can spread from person to person by touching each other. There are many bugs and insects that spread viruses in nature, such as aphids, leafhoppers, thrips, white flies, mealy bugs, and mites. Some viruses can also be spread by worms and fungi that live in the soil.Nematodes, like eelworms, are small invertebrate animals with no body segments. Many types of small worms that feed on plants can cause problems for roots by creating swellings, decay, and wounds, which can greatly slow down root growth. Some small worms eat plants using their long, sharp mouths. Nematodes make eggs and baby worms, which go through a few changes before becoming adults that harm plants. Nematodes are a problem because they can easily spread 2 groups of plant viruses.

Protozoa are very tiny animals that are very simple and basic. Some plants can get sick because of a few specific types of organisms.Because plant diseases cause a lot of money to be lost each year worldwide, people often use methods to control them. Exclusion means stopping a harmful germ from getting into a place by using things like plant quarantines, certification programs, inspections, and making sure plants are free from germs. To get rid of the pathogen, we can take actions like getting rid of the plants or animals that carry the disease, changing where we grow our crops, and using heat or chemicals to clean the soil.Protection methods rely mostly on chemical substances called pesticides. Examples of pesticides include fungicides, bactericides, nematicides, fumigants, and insecticides which help control insects that transmit diseases. However, some plant diseases caused by viruses and viroids cannot be controlled with chemicals because they reproduce too closely with the plant cells. Certain cultural practices, such as planting seeds earlier and not too deep, and providing fertilizers, can also help guard plants from diseases or harmful conditions. Genetic improvement is the best way to control plants when we can easily find and add genes that make them resistant or tolerant to something.

Many important crops have genes that help them resist or tolerate fungal and viral diseases. Using natural methods and combining different strategies to manage pests and diseases can help effectively control plant diseases in a safe way. These methods use animals that eat or

kill the disease-causing organism. Scientists have discovered plants that are genetically modified to be more resistant to diseases. Transgenic plants are made by putting certain individual genes into plants.Controlling plant diseases is a major focus of research in Canada because forestry operations and the agriculture and food system are very important to the country's economy. Forest areas and large areas of land planted with only one type of crop are at high risk of being damaged by diseases because they are monoculture systems. It is hard to figure out exactly how much these losses cost, but research by Agriculture and Agri-Food Canada suggests that they are in the millions of dollars.Studies on how to eliminate or manage plant diseases are conducted in government labs, universities, colleges, and some private companies. Because many plants that are grown in gardens come from other countries, there is a higher chance that they may bring harmful organisms with them, which can cause diseases[5], [6].

Using the five steps explained earlier to figure out plant problems is similar to solving a puzzle. If you collect enough parts and put them together, you will often see a clear picture that makes sense. This process is sometimes called the guess-and-confirm method. As you practice and gain experience, diagnosing becomes easier over time.Diagnostic labs use different methods to find out what is wrong with plants. In most cases, the lab can easily diagnose the problem because they have seen many plants with the same disease before.If the disease is difficult to identify or if it's a disease that the diagnostician doesn't know, they might use a method that involves finding the pathogen causing the disease, figuring out what it is, and making sure it's actually causing the disease. Using this method takes a lot of time and can cost extra money for testing. Sometimes a lab uses other advanced ways to test something or sends a sample to another plant clinic that is good at certain techniques or specific diseases.The sample needs to be of good quality and very important. When sending small plants, it is helpful to include multiple examples that display different symptoms, from being healthy to being severely damaged. When you can, turn in a whole plant. If it's not possible, look closely at each part of the plant and find any signs of issues. Then, send in samples of the problem areas for further examination. Sometimes the problem is not how it seems at first, it may be different or bigger. For instance, if there is damage on the leaves of a plant, the actual problem may be with other parts like the trunk or roots.

To stop the sample from going bad, send them early in the week so they don't get stuck on the weekend. There are health clinics on college campuses that don't get mail on the weekends. If you are gathering a sample during the weekend, put it in a cold container and send it out early in the following week. When you send fresh samples in the mail, they usually arrive in good condition if you wrap them in dry paper towels or newspaper and put them in a box with packing materials to keep them from moving. Do not use wet packaging materials to wrap samples because it often leads to moldy samples when they reach the clinic. This wastes time and money for both the sender and the recipient.A way to control plant diseases is to stop them from spreading by keeping them out of new areas through quarantine. Unfamiliar diseases or pests can seriously harm animals in a different area. Pathogens and hosts evolve together, which means that as they change over time, they both impact each other's development. Coevolution helps the host population develop some natural protection against diseases, so they don't get completely wiped out. When a new sickness-causing organism enters a place, the plants that are originally from there might not have any way to protect themselves against it. In the same way, a pest that is brought to a new place doesn't have any natural enemies to control how many of them there are. Exotic or invasive pests can cause a lot of harm to an ecosystem. This can happen for two main reasons.

For instance, if you have ever traveled to places like California or Hawaii by plane, you might have seen rules at airports that say you can't bring fruit or plants that could have bugs or diseases. Until now, quarantine measures have managed to prevent a harmful type of bacteria called Ralstonia solanacearum from coming into the United States. This sickness could really hurt the country's ability to grow tomatoes and potatoes. The disease-causing bacteria for wilt was mistakenly brought into the United States. The disease was found and stopped before it could spread after flower cuttings.Another quarantine is in place to stop the spread of a new disease called sudden oak death. This disease is hurting the forests in California. Besides causing the death of oak trees, it also harms many other types of trees and shrubs, and it has spread to plants in nurseries. If some plants get sick, they have to be destroyed. The plants close to them have to be separated and checked for signs of sickness. If the illness comes to the Midwest, it could harm our natural surroundings a lot.

DISCUSSION

Seed endophytes are tiny organisms that live inside seeds. These tiny living things can move, make certain enzyme, and form a protective cover. This helps them to survive inside the seeds. Seed endophytes help plants grow better by releasing different phytohormones such as IAA, GA3, and cytokinins. They also have an ACC-deaminase activity that helps reduce stress caused by environmental factors. They can also help the plant absorb nutrients like phosphorus by making it easier to dissolve in the soil. They produce substances that fight against fungal infections and release enzymes that help with plant growth. They also stimulate the plant's natural defense system. The most common types of bacteria found in seeds are Bacillus spp. Pantoea, Enterobacter, Paenibacillus, Burkholderia, Pseudomonas, Acinetobacter, Phyllobacterium, Rhizobium, and others. Also, there are types of fungi called Alternaria, Phoma, Cladosporium, Fusarium, and Colletotrichum. Mucor, Penicillium, Chaetomium, Diaporthe sp. are types of fungi. These microorganisms come from the soil around the roots, leaves, or the seeds of the plants before. Microorganisms can be passed down from parents to their offspring, which is called vertical transmission. These small bacteria inside seeds help them to grow and be strong. They use special substances called enzymes outside the seed to break down nutrients like carbohydrates, fats, and proteins, which helps the seed grow and develop into a young plant[7], [8].

Disease-causing seed germsSeeds can have harmful germs on their outer or inner parts or as impurities. These diseases that come from the seeds can make the seeds and seedlings rot, cause them to die before or after they sprout, and result in smaller and wrinkled seeds. It makes the seed less valuable and also spreads the disease to the next generation. The sources of seed-borne pathogens come from different places. They can come from the mother plants, like the ovary wall, vascular system, and floral parts. They can also come from the environment, like plant residue, soil, and storage. Additionally, human activities can also contribute to the presence of seed-borne pathogens. Pathogens can infect plants during their flowering, when seeds are developing, and when seeds are getting ripe. Therefore, it is crucial to manage diseases during these stages. During the flowering stage, the growing baby plant is more likely to get infected with harmful things like fungi, bacteria, viruses, and worms. Because these germs live in leftover plant remains, unwanted plants, and plant eggs, it's important to take care of the crops properly. People can do things like changing when they plant seeds, switching the crops they grow in different areas, watering their plants, and getting rid of weeds and leftover plants from previous harvests as a way to take care of their crops. There are some diseases that come from seeds and they can cause big losses. Some examples of these diseases are late blight of potato, brown spot of rice, loose smut, downy mildew of bajra, tobacco bud blight,

Black rot is a disease that affects plants like broccoli and cabbage. It is caused by bacteria called *Xanthomonas campestris* pv. The name of the product is "Campestris Cotton Black Arm - X". The text is referring to citrus plants. Malvacearum, also known as tomato bacterial canker, is a disease caused by a bacteria called *Clavibacter michiganensis* pv. Michiganensis: This is a type of bacteria that can cause diseases in plants. n Soybean bacterial blight: This is a disease that affects soybean plants. n *Pseudomonas syringae* pv: This is the name of another type of bacteria that can cause diseases in plants. Glycinea is a disease affecting wheat and barley known as bacterial black node. The abbreviation pv. means pathovar Syringae is a type of bacteria that causes a disease called rice bacterial blight. oryzae pv is a type of bacteria that affects rice plants. Rice plants can get diseases caused by viruses in their seeds. Some common viruses that can affect rice plants include Potato virus Y, Pea seed mosaic virus, Cowpea mosaic virus, Barley stripe mosaic virus, Soybean vein necrosis virus, and Tomato spotted wilt virus. Soybean bud blight is caused by the Tobacco ringspot virus (TRSV). Seed-borne fungal diseases are diseases caused by fungi that can infect and harm rice plants. Some examples of these diseases include rice-blasts, false smut, root rot, and seedling blight. Wheat can be affected by a few different diseases like Alternaria leaf blight, loose smut, flag smut, karnal bunt, and Fusarium head blight. There are three diseases called Curvularia leaf spot, Aspergillus ear and kernel rot, and anthracnose leaf blight that can affect corn plants. There are two diseases called anthracnose and purple seed stain that can affect soybean plants.

The diseases that affect chickpeas are called Ascochyta blight, grey mold, and Alternaria blight. Sunflowers can be affected by three diseases: Downey mildew, charcoal rot, and anthracnose. Groundnut can be affected by charcoal rot, crown rot, and Aspergillus mold. Seed-borne nematode diseases are caused by tiny worms that live in seeds. Some examples of these nematodes include the seed gall nematode, the rice white tip nematode, the ground nut testa nematode, and the rice ufra nematode. It is important to control these phytopathogens because they can cause problems such as the loss of quality in seeds, including seed abortion, smaller and fewer seeds, changes in color, and tissue death. Reduced ability for seeds to sprout and grow. The pathogen-infected seeds produce toxins. How diseases develop. Changes in the composition and characteristics of seeds, including the proteins and oils they contain. Quantitative yield loss means how much of a product you lose during a process or experiment. The issue is with exporting or importing seeds within our own country and with other countries. Seed borne diseases are illnesses that are carried on seeds. These diseases can spread quickly to new places and cause big outbreaks. The Irish famine is a good example of this. It happened because a disease called late leaf blight infected the potato crops. Finding harmful bacteria in seeds: Looking at seeds carefully to see if there are any signs of bacteria. Bacteria ooze tests.

Serial dilution is when you make a weaker and weaker solution by repeatedly diluting it. This is done in a special kind of liquid called semi-specific media. The purpose of this process is to identify certain substances or organisms in the solution. Immunofluorescence microscopy (IF) is a type of microscope that uses special dyes and lights to see proteins or molecules in cells. Enzyme-linked Immunosorbent assays (ELISA) is a lab technique that tests for certain substances, like proteins or hormones, in a sample by using enzymes and antibodies. Flow cytometry is a method that uses lasers and detectors to analyze and count cells or particles in a liquid sample. Different types of PCR tests such as BIO-PCR, Real-time-PCR, multiplex PCR, and Nested PCR. Tests that are used to detect the presence of a virus by growing it in a lab. Tests that use a method called ELISA to detect antibodies in the blood. In simple terms, RT-PCR is a method used to study DNA. Next-generation sequencing, DNA chips, and DNA microarrays are other techniques used for the same purpose. Some tests to check if something

is alive, like plants growing or plants showing signs of something. Microscopy means using special microscopes to see things that are too small for the naked eye to see. There are two types of microscopes: electron microscopes and light microscopes. Tiny sensors called nanosensors are used to detect fungi. Seed samples are placed in selective media to allow them to grow. Looking at seeds without water. We looked at very small things using a special liquid called NaOH and counted the whole embryos. There are two ways to incubate things: on agar and on blotter paper. Removing and coloring parts of a seed, like the baby plant inside, and its surrounding tissues. In grow-out tests, we observe the symptoms on young plants. There are different types of PCR tests like BIO-PCR, Real-time-PCR, multiplex PCR, and Nested PCR.and soybean mosaic virus.

Important tips for managing seed-borne plant diseases. Use chemicals to treat the seeds with fungicides before planting them. The use of carbendazim, thirum, mancozeb on seeds helps to decrease the occurrence of rice blast, anthracnose, Alternaria blight, and tikka leaf spot in the field. The use of metalaxyl on seeds helps prevent infections caused by certain types of fungi such as Phytophthora, Pythium, and downy mildew. In the same way, using carboxin on seeds helps prevent smut disease in crops like rice and sorghum. Seed treatment with streptomycin can help decrease bacterial diseases in crop plants caused by certain types of bacteria called Xanthomonas and Pseudomonas. Before planting the seeds, apply heat, hot water, or microwave heating. For example, when rice is treated with hot water at a temperature of 55 degrees Celsius for 10 to 15 minutes, it helps to decrease the white tip nematode. Similarly, treating wheat with hot water at 52 degrees Celsius for 30 minutes can reduce diseases like loose smut. In the case of sugarcane, using hot water at 52 degrees Celsius for half an hour can help fight diseases like whip smut, grassy shoot, and red rot. Soaking seeds in warm water for 30 minutes helps protect sugarcane and citrus plants from diseases. When the air is very dry and hot at 72 degrees Celsius for about 7-10 minutes, it can get rid of a harmful plant disease called barley leaf streak pathogen X. Campestris PV Translucent is a type of bacteria. Radiation like UV, X-rays, □, α, and β rays can also decrease harmful germs found in seeds[9], [10].

Using friendly microorganisms like *Pseudomonas* and *Bacillus* to protect plants or seeds. The process of treating seeds with P. Using a small amount of fluorescent substance (16 grams per kilogram) on maize seeds can help prevent banded leaf and sheath blight in maize plants. Treating seeds with Trichoderma spp. This helps get rid of different types of germs that live in the soil like Fusarium, Rhizoctonia, Macrophomina, Sclerotium, and Sclerotinia. The factors that affect how long pathogens can survive in seeds include things like diseases, how the seeds are stored, and how long they are kept. For example, the fungus called Alternaria brassicola in rapeseed doesn't survive if the temperature in storage is higher than 35 □C. Similarly, A means that A is also true or applies in the same way as something previously mentioned. The cabbage disease called brassicicola does not grow when the temperature is below 15 degrees Celsius. Seed certification is a process to make sure that seeds meet certain quality standards. When you want to send seeds to other countries, you need to have a special certificate saying they are disease-free. We need to have rules for safely moving plant seeds to prevent the spread of diseases that come from seeds and can move from one place to another.

Plants get hurt more quickly and worse when the temperature is higher than their ideal limit for growth.Hot weather often causes sunburn-like damage on the parts of fruits and vegetables that are exposed to the sun.This means to give an example or to further explain something. Sun scald is a condition that affects apple, peppers, tomato, onion bulbs, potato tubers, and canker of linseeds.Cold weather harms crops more than hot weather.Freezing

injury causes a type of damage called"blotch type necrosis in potatoes.The frost caused harm to the buds of peach and cherry trees, as well as the flowers, young fruits, and sometimes the soft branches of many other trees. It caused them to die.Winter cold can harm young tree roots like apple trees and make the bark split and get canker.Not having enough light or having no light stops chlorophyll production and makes plants grow long and thin with large spaces between leaves. This causes the leaves to be pale green, the plant to grow quickly but weakly, and the leaves and flowers to fall off too soon. This condition is called Etiloation. Plants that don't get enough water in the soil often stay small and become pale green or light yellow. They have few small leaves that are drooping, and if they keep lacking moisture, the plant will dry up and wilt[11], [12].

When water stays still or there is too much water in a field, it can cause the roots of plants to decay or rot, which makes the plants wilt. The main reason for this problem is the build-up of harmful substances around the base of the plant and the lack of nutrients.Another sign that a house plant has too much water is when it swells. Swelling called edema shows up as little lumps on the bottom of leaves or on the stem.Chemicals like Ozone, sulphur dioxide, hydrogen fluoride, nitrogen dioxide, and peroxyaacotyl nitrates can cause a lot of harm to plants in the fields.Black tip of mango necrosis is a condition that affects mango trees where the tip of the fruit turns black and dies. Fruit that grows near brick kilns can get sick and have unhealthy spots, making them unfit to be sold or eaten. The smoke from the fires made the air dirty with harmful gases like sulphur dioxide, which caused damage to tissues.When leftover plant material in the soil breaks down, it can create harmful substances like fatty acids. These substances can cause problems for plants, such as stunted growth, rotting roots, drooping leaves, and lack of nutrients.Too much sodium salt, like sodium chloride, sodium sulphate, and sodium carbonate, can make the soil more basic and cause damage to plants. This damage can show up as yellowing leaves, slow growth, and problems with nutrients like boron, manganese, and copper. Having too much boron can harm vegetables and trees. Having too much manganese can cause a disease in cotton plants called crinkle leaf disease.

Many common plant health problems are likely caused by using a lot of weed killers. The use of more and more herbicides to control weeds in general or in specific situations has caused problems.When your body doesn't have enough minerals like nitrogen, phosphorus, potash, manganese, magnesium, boron, zinc, copper, iron, etc. This can lead to problems with how plants function and can make the crops look like they are hungry.Having too many minerals in the plant messes up the balance of nutrients needed for a good metabolism, which stops the essential element from working properly.When a plant doesn't have enough or has too much minerals, it becomes more likely to get sick from fungi, bacteria, or other diseases.The symptoms caused by not having enough of a certain nutrient in a plant depend on what that nutrient does for the plant.Many other ways of farming done incorrectly can harm plants. The incorrect use of chemicals. Using too much fungicides, insecticides, nematicides, and fertilizers can lead to losses. When a plant is sprayed, it can cause damage to the leaves or make the fruits look burned, discolored, or misshapen. If you dig too much or too deeply between the rows of plants that are growing, you can accidentally pull out the roots of many plants.

CONCLUSION

Seeds have many tiny organisms on them that are not harmful. In simple terms, in the wet tropics, there are a lot of bacteria, fungi that look like yeast, and other fungi called hyphomycetes. However, there are even more algae, lichens, and a specific group of fungi called ascomycetes, particularly the ones in the Micropeltaceae family. Plants' small organisms found on leaves in the cool regions of the north and south parts of the world appear to be

alike. Seeds bacteria and yeasts have more pigmented forms compared to those in soil. There are not many bacteria that form spores. Many types of bacteria, such as *pseudomonads, xanthomonads*, and *Flavobacterium spp.* , as well as some yeasts, can be found on seeds. The yeasts mostly belong to a few groups called *Cryptococcaceae* and *Sporobolomycetaceae*. Yeasts from the Endomycetaceae group which are often found on fruits are not usually seen on leaves.The amount of bacteria and yeasts can get really high, up to 107 cells per square centimeter and 109 per gram. The weight of leaves changes as they get old, but usually not as much in winter as in summer, except for Cryptococcus. In New Zealand, there are more of this yeast in the winter than in the summer.Some kinds of fungi mostly grow on the bottom part of leaves, for example. Sclerographium phyllanthicola Deight is a type of fungus. Some plants have leaves with bumps or warts on the lower side, while others have them on the upper side more often. The Sporobolomycetaceae family tends to have more members on leaves that have been invaded by parasites like fungi, nematodes, and mites that cause galls, compared to leaves that are healthy.We know more about the different kinds of micro-organisms on leaves than we do about what they do. In a laboratory setting, some examples are. Beijerinckia is a type of bacteria that can take nitrogen from the air and use it. Other bacteria release substances that help roots grow and prevent fungal growth. However, it is not yet known if these substances are actually helpful to the plant when it is alive. We don't know a lot from doing experiments about what leaf saprophytes eat, but there are signs that the things plants release onto leaves affect how the fungi grow.

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CHAPTER 11
MYCOTOXINS AND MYCOTOXICOSES: EFFECTS, DETERMINATION AND PREVENTATION

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ABSTRACT:

Mycotoxins are harmful substances produced by fungi that can make humans and animals sick. They cause diseases known as mycotoxicoses. Among the many harmful substances produced by organisms, the most well-known ones are called aflatoxins. This paper talks about harmful substances called mycotoxins and the illnesses they cause, as well as how they impact the food and animal feed we consume and our health.. Some toxins made by fungi can have different effects on plants and animals. They can harm plants and also kill bacteria and other microorganisms. Typically, when people talk about mycotoxins, harmful substances found in fungi, they don't include poisons from mushrooms and yeast. Many scientists from different backgrounds are interested in the diverse field of study and global problem.Humidity and temperature are important factors in the production of toxins in food. However, these toxins can still be found in dry areas, so eating food is the most common way of being exposed to them. In simpler words, inhaling and touching mycotoxins is now a serious concern for people who work in storage silos or laboratories. Long-term exposure to large amounts of something can harm the kidneys, liver, brain, stomach, immune system, genes, and can also cause birth defects. Most of these diseases occur because the body's systems for repairing damage and fighting inflammation and cell death are not functioning properly. This happens when cells are exposed to harmful substances that produce reactive oxygen molecules. This chapter talks about mycotoxicosis, which is when you get sick from toxins produced by fungi. It also talks about four specific toxins called aflatoxin, ochratoxin, fumonisin, and zearalenone. This chapter explains how these toxins affect living organisms, both inside the body and in a controlled environment like a lab.

KEYWORDS:

Animals, Fungi, Food, Immune System, Mycotoxins,Toxins.

INTRODUCTION

Toxins are harmful substances, like poisons, that can hurt or even cause death to living beings. Phytotoxins are substances that are harmful to plants, while zootoxins are substances that are harmful to animals. If we used the same language rule, mycotoxins would be substances that are poisonous to fungi. These are poisons made by fungi. The words used to talk about the harmful substances produced by plants, animals, and microbes come from different scientific backgrounds. The way compound words are made has not always been done the same way. For a great discussion about these confusing meanings of words, the origin of 'toxin' and 'poison', and how 'toxin' is used in plant diseases, check out Graniti's article. If someone sees the word 'mycotoxin' (which means 'fungal poison') without any context, it might not be obvious if it refers to substances that can poison fungi or substances made by fungi that can poison other living things. The term 'mycotoxin' refers to the second thing mentioned. This raises the question of what is being poisoned. An example of this is penicillin[1], [2].

It is something produced by a fungus that is really good at killing bacteria. However, penicillin is not considered a type of poison produced by fungi. Instead, it is called an antibiotic. The word antibiotic has been studied and analyzed more than the word mycotoxin. The famous scientist Waksman said that an antibiotic is a chemical made by tiny living things that can stop the growth and kill bacteria and other small living things. For antibiotics, scientists have identified the specific organisms that make the antibiotics and the organisms that can be affected by them, and these are all very tiny living things called microorganisms. When the word mycotoxin was first used, it was explained which organisms make it, but it wasn't explained which organisms are affected by it. The first kind of mycotoxin, called aflatoxin, was discovered in the early 1960's as the cause of Turkey X disease. Some of the first workers were hired from veterinary medicine. These scientists didn't think it was important to say that they were studying diseases in animals. To put it simply, mycotoxins are substances produced by fungi that are harmful to humans or some of our favorite pets. Even this description is not enough. A strange and confusing tradition excludes mushroom and yeast poisons from being studied as mycotoxins, and only focuses on poisonous substances produced by molds. In simpler words, a toxin in pathology refers to substances that can harm or kill even in small amounts. Substances that are only harmful in large amounts are generally not classified as toxins. According to these standards, alcohol is not a toxin even though it can be harmful at certain levels[3], [4].

The illnesses in animals caused by mycotoxins are called mycotoxicoses. These illnesses are different from mycoses, which are caused by fungi invading the body. Eating food or animal feed that has mold on it is the most common way for toxins to enter the body. Some people define mycotoxicoses as only those toxins that are harmful when eaten. Most scientists use a wider definition and classify as mycotoxins those substances that can make people sick if they touch them, breathe them in, or are exposed to them naturally. There is disagreement about substances produced during metabolism that are only harmful when put in the body in an unnatural way, like by injecting them. Like other harmful substances, different species and individuals have varying degrees of vulnerability to mycotoxins. Age, gender, and nutritional health can also impact the severity of mycotoxicoses. Mycotoxicoses can be either a short-term or long-term health problem. Sometimes, small levels of mold toxins can make people more likely to get other illnesses. Low level exposure can sometimes cause cancer. Modern farming methods that use large amounts of commercial animal feed and overcrowded housing for a specific species make it easier to find and diagnose mycotoxicoses. However, the sporadic nature of these diseases makes studying them in veterinary mycotoxicology challenging. In simpler terms, even if there is no obvious sickness, the changes in the immune system and inability to gain weight due to contaminated animal feed can have significant economic consequences[5], [6].

Mycotoxicology is the science of studying harmful substances called mycotoxins that come from certain fungi, and also the diseases called mycotoxicoses that these substances can cause. The people who study toxins produced by fungi are called mycotoxicologists. Understanding and analyzing the terms used is easier than defining the scope of the discipline. There are many different compounds called mycotoxins. They are made by fungi and can be harmful. Some examples of these compounds are aflatoxin, citrinin, and penicillic acid. There are many more too. Some of these chemicals were first discovered and labeled as antibiotics because they showed a powerful ability to kill bacteria and other germs. Patulin was once thought to be a cure for the common cold, but it was later discovered to be poisonous to animals, so it is no longer considered a viable treatment. Mycotoxicology is a new and diverse scientific field that includes scientists from many different areas of study, such as microbiology, toxicology, plant and animal diseases, medicine, chemistry, veterinary

medicine, and immunology. The different fields of study can be seen in the literature written on mycotoxins, which is published in many different types of journals. No one journal is considered the overall publication for all mycotoxicologists. We want to use Mycopathologia as our platform. Mycopathologia is a well-known journal that is read by many people from different countries. Because the mycotoxin problem affects many countries, the journal Mycopathologia is perfect for scientists who research fungal toxins. This article is a friendly invitation to mycotoxicologists from all over the world to send their papers to Mycopathologia. With the help of more experts on our Editorial Board, we believe that Mycopathologia will become the top journal for studying mycotoxins[7], [8].

DISCUSSION

Mycotoxicoses are illnesses in people or animals that happen when we eat food that has fungus on it, touch our skin to things with mold on them, or breathe in toxins made by fungus spores. Mycotoxins can harm animals on their own or when combined with other factors. It is important to understand the difference between mycotoxicosis and mycosis. Mycotoxicosis means the harmful effects caused by substances called mycotoxins. These substances can affect various organs in the body, like the kidneys, liver, and lungs. They can also harm the endocrine and immune systems. On the other hand, mycosis refers to infections caused by fungi in humans and animals because of different environmental and physical conditions.Mycotoxins and mycotoxicoses are a big problem for human and animal health because certain conditions can cause crops and food to become a good place for fungi to grow and produce toxins. Being exposed to mycotoxins can cause harmful effects on the body, known as mycotoxicoses. Mycotoxicoses are common in tropical areas because it is often hot and humid there, which is perfect for fungus to grow and produce toxins.

Mycotoxicoses in humans, along with other toxicological conditions, can be grouped into two categories: acute or chronic. Acute toxicity means that when someone is exposed to a harmful substance, they quickly show signs of being poisoned. On the other hand, chronic toxicity happens when a person is exposed to small amounts of a harmful substance over a long period of time which can lead to cancer and other effects that can often be reversed. The harmful effects of mycotoxins on people or animals' health vary depending on the amount and duration of exposure, the type of mycotoxin, the individual's physical condition and diet, and the possible combined effects of other chemical compounds that they are exposed to. Many people are investigating the development of harmful substances called mycotoxins and the diseases they cause, called mycotoxicoses. They want to find ways to stop mycotoxins from being made and to protect our food and animal feed from becoming contaminated by fungi and causing these diseases.

Out of about 500 mycotoxins known, only a few types are proven to cause illnesses in humans and animals. The liver and kidneys are the organs most affected by mycotoxins. Mycotoxins can also affect other parts of the body. In the past, people often got very sick from poisonous molds, even in places with not very hot weather. These sicknesses would spread quickly and make lots of people in an area very sick. Sometimes, these sicknesses even changed the way that people wrote about what happened. When people have an unusual growth caused by fungus, it's called mycoses. When people get sick because of the toxins produced by fungus, it's called mycotoxicoses.The substances called mycotoxins, like patulin, PR toxin, roquefortine, and mycophenolic, are capable of causing sickness in animals. One of the toxins, PR toxin, is believed to have caused illnesses in cows that ate food contaminated with Penicillium roqueforti. Ergotism is a disease caused by long-term exposure to a type of toxin called ergot alkaloids. It has caused a large number of deaths in the past, but hasn't been seen in regions with moderate climates for hundreds of years.

Mycotoxin is a harmful substance that can make you sick. It can cause cancer, and also damage your liver, kidneys, and the systems in your body that help you think and fight off infections. Furthermore, the mycotoxicity can cause birth defects, affect hormones, and cause excessive bleeding. The signs and symptoms of mycotoxicoses depend on the specific mycotoxin, how much and how long the person was exposed to it, their age, health and gender. There are also other factors like genetics, diet and exposure to other toxins that can make the effects worse, but we don't fully understand how they all work together. In cases of severe mycotoxicoses, signs show up quickly, and if someone keeps being exposed to it, it can be fatal. Chronic mycotoxicosis happens when someone is exposed to small amounts of mycotoxins for a long time. The first stage of contact is often sneaky and doesn't show any obvious symptoms in the beginning.Fungal types that cause harmful effects are best identified using a method that combines various techniques to avoid mistakes. This process starts from the overall classification and goes to the specific classification, by analyzing the fungus's appearance, behavior, food needs, and chemical makeup. Usually, identification is confirmed using PCR-based tests. These tests can focus on important genes or regions of the organism being studied, or they can focus on genes related to producing toxins.

Some mycotoxins in food can cause severe illness right after eating them. Other harmful substances found in food can cause serious health problems in the long run. These problems include the development of cancer and a weakened immune system. Out of the many mycotoxins that have been discovered, only around twelve have received the most focus because they have really bad effects on people's health and can be found in food.Aflatoxins are very harmful toxins made by some types of mold (Aspergillus flavus and Aspergillus parasiticus). These molds grow in soil, decaying plants, hay, and grains. Some plants are often harmed by Aspergillus spp. The things that are included are cereals (like corn, sorghum, wheat and rice), oilseeds (such as soybean, peanut, sunflower and cotton seeds), spices (like chili peppers, black pepper, coriander, turmeric and ginger) and tree nuts (including pistachio, almond, walnut, coconut and Brazil nut). The harmful substances called toxins can also be found in the milk of animals that eat contaminated food. These toxins are called aflatoxin M1.

If you consume a lot of aflatoxins, it can make you very sick and can even be lethal. Mostly, it harms your liver. Aflatoxins are harmful substances that can damage DNA and cause cancer in animals. There is also proof that they can lead to liver cancer in people.Ochratoxin A is a toxin that can be found in many types of food. It is made by certain types of mold called Aspergillus and Penicillium. Food contamination, like when harmful things get into food, happens everywhere with things like cereal, coffee beans, dried fruits, wine, spices, and liquorice. Ochratoxin A is a harmful substance that is produced when crops are kept for a long time, and it can cause many harmful effects in animals. The toxin can harm the kidneys the most, but it can also cause problems with a baby's growth and the body's ability to fight off illnesses. Despite clear evidence linking ochratoxin A exposure to kidney toxicity and kidney cancer in animals, it is still uncertain whether this association exists in humans. However, it has been shown that ochratoxin A does have effects on the kidney.Patulin is a harmful chemical made by certain types of mold, like Aspergillus, Penicillium, and Byssochlamys. Patulin is often found in rotten apples and apple products. It can also be found in other moldy fruits, grains, and different foods[9], [10].

Apples and apple juice made from spoiled apples are the main sources of patulin in our diet. The signs of illness in animals include harm to their liver, spleen, and kidneys, as well as poison that affects their immune system. People have said that they feel sick, have problems with their stomach and throw up. Patulin is believed to be harmful to genes, but it has not

been proven to cause cancer.Fusarium fungi are often found in soil and they create various toxins. Some of these toxins are trichothecenes like deoxynivalenol (DON), nivalenol (NIV), T-2, and HT-2. They also produce zearalenone (ZEN) and fumonisins. Moulds and toxins can grow on many types of cereal crops. Some types of cereal are linked to specific fusarium toxins. For instance, people often connect DON and ZEN with wheat, T-2 and HT-2 toxins with oats, and fumonisins with corn. Trichothecenes can be very harmful to humans. They can quickly irritate the skin or lining of the intestines and cause diarrhea. Animals can have their immune system weakened over time. ZEN can affect hormones and cause trouble getting pregnant at high amounts, especially in pigs. Fumonisins have been linked to throat cancer in people and harmful effects on the liver and kidneys in animals.

New ways of cleaning grain have nearly gotten rid of ergotism as a sickness that affects people. This incident was also discussed in a book called The Day of St. Anthony's Fire is a condition where a person's skin becomes very painful and inflamed. Ergotism is a serious issue that veterinarians continue to deal with. The main animals in danger are cows, sheep, pigs, and chickens. The signs that animals show when they have ergotism are gangrene which is when body tissue dies, miscarriage, convulsions which are sudden uncontrollable movements, not producing milk, being very sensitive to things, and having trouble with coordination and balance.Sometimes, the difference between a poison and a medicine is determined by moving a decimal point or making a small change to a chemical. The ergot alkaloids are a good example. Doctors and drug experts have been interested in the many things they do for a long time. Some chemicals from ergot make muscles tighten up. For many years, people noticed that when farm animals ate grass contaminated with ergot, it caused them to have miscarriages. Because of this, midwives and other people started using ergot as a natural remedy. They used it to help pregnant women either have a miscarriage or have faster contractions during labor.

In the 1900s, a powerful drug called LSD was found during research in Switzerland. A chemist named Hofmann mixed various amines with lysergic acid to make ergobasine, which is also known as ergometrine and ergonovine. This was the first semi-synthetic ergot alkaloid. After changing the amino alcohol part, he created Methergine. Doctors have been prescribing Methergine for many years to stop bleeding after giving birth. Hofmann kept making new drugs similar to lysergic acid. The 25th drug he made was called LSD-25. For a period of time, Sandoz sold LSD to doctors who treat mental illnesses under the brand name Delysid. It was not successful in treating schizophrenia. In a strange part of American history, the Central Intelligence Agency (CIA) used LSD to try and make suspected communists tell the truth during interrogations. In recent times, doctors have started using pure ergotamine to treat migraine headaches. Other drugs derived from ergot are used to inhibit the hormone prolactin, to treat Parkinson's disease, and to help with insufficient blood flow in the brain. The use of ergot alkaloids for treatment may sometimes lead to sporadic cases of a condition called human ergotism[11].

Finally, some people think that the Salem witchcraft incident might have been caused by a sickness called convulsive ergotism. This sickness can happen if you eat rye that has been infected with a type of fungus called Claviceps. Some historians argue against this idea, but the data about disease patterns and symptoms are very interesting. Robin Cook, who has written many popular books, used the idea that ergot, a type of fungus, might have caused the Salem witch trials as the starting point for a story. In this story, a young doctor finds spores of the fungus in a wet basement in New England, grows the fungus in a lab, and then finds a new chemical in it that can improve the mind and energy levels. He copies the Central Intelligence Agency and calls his drug Ultra. He starts a biotechnology company to make a

lot of money from this potentially very valuable substance. Eventually, it is found out that the made-up chemical in the drug causes terrible side effects. Cook's novel is the book we like the most that talks about mycotoxins in things that people like.

Fumonisins are toxic substances produced by certain types of fungi.Scientists believe that they are created when a substance called alanine combines with another substance derived from acetate. Different types of fungi, such as Fusarium verticillioides, Fusarium proliferatum, Fusarium nygamai, and Alternaria alternata, can make a substance called fumonisins. These types of fungi are difficult to classify because their names and categorizations can be confusing. This has confused both people who study fungi and those who don't. The main type of fungus that is important for the economy is called Fusarium verticillioides. It can be found in corn plants, both in the leaves and in the parts that help with reproduction. Most of the time, it doesn't make the plant sick or show any signs of disease. But, when the weather, bugs, and the right genes in plants come together, it can cause problems to young plants, like diseases that affect their stems and ears. Fusarium verticillioides can be found in almost all corn samples. Not all types of the fungus make the toxin, so just because the fungus is there doesn't always mean that the toxin is there too. Even though it can harm plants, fumonisin B1 is not needed for causing plant diseases.

It's important to know that harmful mold can grow on different crops and food and can go inside the food, not just on the outside. Mould usually doesn't grow in foods that are dried properly and stored well. So, if we dry our food efficiently and store it correctly, we can prevent mould from growing and making harmful substances called mycotoxins.To reduce the chance of health problems from mycotoxins, experts suggest that people. Check whole grains like corn, sorghum, wheat, and rice, as well as dried figs and nuts such as peanuts, pistachios, almonds, walnuts, coconuts, Brazil nuts, and hazelnuts for signs of mold. Throw away any that appear moldy, discolored, or shrunken.To prevent harm to grains before and during the drying process and when storing them, it's important to keep them undamaged. Grain that is damaged is more likely to be invaded by molds, which can lead to contamination by mycotoxins.Purchase grains and nuts that are as fresh as you can find.Make sure to store food correctly by keeping it away from bugs, making sure it stays dry, and not letting it get too hot. Make sure to eat many different kinds of food. This not only helps to lower the amount of harmful substances you consume, but also makes your diet healthier.

These rules help people know that the food they buy is up to a certain standard no matter where it comes from.These experts review all the studies and data available on certain mycotoxins to provide scientific insights. The results of health risk assessments can be either a safe level of exposure or advice on how to prevent and control contamination. The assessments may also include guidance on analytical methods and monitoring activities.Governments and international risk managers,use these acceptable daily amounts to determine the highest levels of harmful substances called mycotoxins that can be present in food. The amount of mycotoxins allowed in food is set at a very low level because they are extremely harmful. We should try to minimize exposure to mycotoxins to keep people safe. Mycotoxins are harmful substances that can make both humans and animals sick. They also make it harder for people to get enough healthy food. The standard helps prevent the presence of dangerous contaminants and toxins, making our food and animal feed safer to consume. Harmful substances that occur naturally in the food we eat.

CONCLUSION

Mycotoxins have probably been around for as long as people have been growing crops. However, it was not until recently that scientists discovered the exact chemical nature of

these poisonous substances that are produced by fungi. It is believed that they have been there for a long time, possibly as far back as the time mentioned in the Dead Sea Scrolls. There is proof that these incidents happened regularly in the past, until scientists discovered aflatoxins in the early 1960s. During that time, people believed that mycotoxins were formed in stored grains that had become moldy.

These mycotoxins are harmful when eaten by humans and animals. Later on, it was discovered that different types of toxins called aflatoxins and mycotoxins are produced when crop plants grow in the field. You can figure out which mycotoxins are important by looking at how often they occur and how severe the diseases they cause are, particularly if they can cause cancer. These are some types of mycotoxins: aflatoxins, deoxynivalenol, fumonisins, zearalenone, T-2 toxin, ochratoxin, and certain ergot alkaloids. The illnesses caused by these toxic substances called mycotoxins are different and affect many different animals, including humans. Most of these illnesses happen after eating grain or products made from grain that has a poison called mycotoxin on them, but there are also other ways to get sick from mycotoxin. It can be hard to diagnose mycotoxicoses because the symptoms of this disease are very similar to symptoms caused by other things. So, finding out if someone has mycotoxicoses depends on doing the right tests to look for mycotoxins. This means taking samples, preparing them, and analyzing them.

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CHAPTER 12
CONTROL OF SEEDBORNE PATHOGENS: A COMPREHENSIVE OVERVIEW

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ABSTRACT:

We control seedborne pathogens and diseases by using different methods together. This chapter talks about ways to stop seeds from getting infected in the field or to control the infection and infestation caused by seeds. Taking care of crops properly can help produce seeds that have fewer disease-causing organisms. Seed treatment is a process that helps protect seeds or soil from harmful microorganisms. This process can be done using various methods like using biological, chemical, mechanical, or physical substances. The goal of seed treatment is to ensure that the seeds grow into healthy plants.

This means checking seeds before planting and after gathering, and examining crops to make sure they meet certain rules, like being grown away from other plants and being free from weed seeds and diseases. We look at diseases carried by seeds to see if they could make crops grow less and produce fewer fruits or vegetables. The levelfactors that increase the risk and make it harder to control the spread of disease through seeds.Where the disease comes from and how quickly it spreads in plants. Control strategies that rely on checking the quality of seed cropsThe process of choosing seeds, treating them and spraying a liquid on the leaves is discussed, including specific examples to help understand it.Basic ideas of control based on a basic understanding of how diseases develop. The need for plant quarantines has grown because more seeds or grains are being traded for eating and transportation methods have improved.

KEYWORDS:

Crops, Chemical, Disease, Plants, Seeds, Treatments.

INTRODUCTION

We have known for a while that plant diseases are a major problem for crop productivity. This is because diseases prevent crops from achieving their full potential, which is influenced by their genetic makeup and their surroundings. Scientists have spent a long time studying the tiny living things that make us sick, like viruses, bacteria, and fungi. They want to understand how these organisms cause diseases. Lately, there has been more focus on how to actually prevent and control diseases. For a lot of diseases, the time between crops is when the pathogen is most vulnerable and when we have the best chance to stop or control the disease using chemicals or farming methods. Some dangerous germs can spread from plant to plant through seeds. This helps them survive because it takes away their vulnerability in the life cycle. However, seeds can sometimes carry disease-causing agents. These agents can be treated or avoided using chemicals, reducing or completely getting rid of them before they infect a new crop. Because most plants are grown from seeds, they can get sick from various diseases carried by the seeds. To prevent this, we need to use the right methods. This paper discusses the dangers to crop production caused by diseases that come from seeds, the factors

that determine how much of the disease is transferred through seeds, the ways to control these diseases using our understanding of how they spread, and the possibilities for seed production[1], [2].

There are laws from the government that control how crops can be grown and shared between different places. This helps stop harmful germs from entering the country or individual states.These rules are put in place to control the spread of diseases in plants. This is done by separating infected plants and checking them in the field or storage facilities. Sometimes, plants that can carry the disease are removed, either because the owner chooses to or because they are required to.Plant quarantine is a way to deal with diseases in plants. It has two main principles: keeping diseases out and getting rid of them if they do appear. When germplasm is controlled by quarantine, we stop infected organisms and seeds from coming in by checking them and treating them. We may also ban or limit the host from entering.Plants, plant parts, and their products are controlled and limited from entering different countries by laws called Plant Quarantine Acts. Quarantine rules have been increasing since 1870. Since that time, every country has its own organization like that.In India, the government passed a law called the Destructive Insect and Pests Act (DIP Act) in 1914. The laws in different states protect crops from pests and diseases by stopping them from spreading across state lines. The plant quarantine stations are located at important sea and airports[3], [4].

Diseases can get into plants by being on live plants, seeds, tubers, and other planting material. They can also come from imported grain, fruit, vegetables, and other food. Plant material used in industry, like cotton fibers, and plant material used in packing can also carry diseases. Lastly, diseases can come from soil or leftover plant debris.Plants and their products should only be brought in from places where there are no diseases. Even if the material has already been inspected by the quarantine services of the country it is being sent from, it still needs to be checked again when it arrives at the destination country. Extra care is necessary when dealing with dangerous fungi, bacteria, and other harmful organisms. Scientific purposes involve the exchange of items.

In very serious situations, it might be needed to stop bringing in certain plants from places where certain diseases are present. To properly check incoming plants, it's important to have enough trained and experienced inspectors at ports, airports, railway stations, and border crossings. The big increase in people flying has caused issues with keeping plants safe from diseases and pests.There are many systems in place that inspect and certify things like seeds, seedlings, and potato seeds in different areas. Things are made. Farmers who want to sell these materials can choose to have their crops inspected and documented by a regulatory agency while they are growing in the fields and when they are stored.This method can protect crop plants from diseases caused by viruses, mycoplasmas, fungi, bacteria, and nematodes. We need to make sure that the things we use to grow plants (like seeds, bulbs, and stems) don't have any germs.

Farmers have always adjusted their crop management techniques to protect their crops from diseases and other factors that can cause losses. It is a very important part of farming in poor countries. Cultural practices are now being seen as important backup methods for managing plant varieties that are resistant to pests or diseases, as well as for crops that are protected using chemicals.To get sick, the person needs to come into contact with the germ in a place where the germ and disease can grow easily. Making appropriate changes in cultural practices can alter the environment so that it becomes unfavorable for the pathogen, but favorable for the host.Cultural practices help prevent diseases. Many methods decrease the concentration and movement of the disease-causing organisms. The precautions we take to avoid something are usually based on our culture. Many types of fungi, bacteria and viruses can spread

through seeds or plant parts that are used for growing new plants. To control disease effectively, it is important to manage the main source of bacteria or virus that causes the disease. Even though chemicals or physical methods can remove pathogens from contaminated plants, the initial and crucial step is growing healthy plants in the field. These are the methods used to make and use seed material that is free from harmful germs[5], [6].

Seed-borne diseases that thrive in wet weather can be controlled by growing the crop in dry regions. Here are a few examples of plant diseases. One is anthracnose of bean, another is anthracnose of cucurbits, and a third is Ascochyta blight of pea.To grow seeds for certain plants, it is better to choose dry areas where there is no moisture on the leaves. You can make wet areas have reasonably nice and dry weather by managing how the plants grow so that the air can move around and the sun can shine through.Keeping seed plots separate from sources of infection helps in producing healthy seeds. When making certified seed, there must be a specific amount of space between each plot.Regularly checking the crops being grown for seeds and the orchards producing young fruit trees for distribution is an important task. The infected plants or parts of plants are removed right after they are checked. If the crop is very sick, the area is not used to grow new plants. This is how potato seed tubers are made.

Some harmful microorganisms cannot survive when seeds become dry. Some seeds can last longer than the germs inside them. So, if you store the seed for a long time, it usually gets rid of the germ that can cause diseases. Fusarium solani f. sp is a type of fungus. Cucurbitae is a plant disease that infects different types of cucurbits. It is carried inside the seeds of the plants.When the sick seed is kept for two years before planting, the fungus dies. To make sure the seeds stay safe, it's important to store them correctly.Hardened structures of fungi and eggs of nematodes may be in the plant debris mixed with the seeds. Some common examples include white blisters on plants like crucifers, small worms in sugar beet called cyst nematodes, and swollen areas on wheat known as ear cockles.To clean seeds, we can use a hot air blast and also clean them by hand to remove dust. To clean the seed, it is placed in a solution made with 20% common salt. The waste materials and small creatures that look like worms or shells float on top of the water and can be removed by hand using a tool.

DISCUSSION

We can control many harmful diseases that are carried by seeds by choosing the right seeds and treating them before planting. But, when measures to control diseases are successful and there are no more disease cases, people often forget to continue controlling or following infection prevention guidelines. Therefore, periods of rapid growth and decline over a long time are often a common feature of diseases that spread through seeds in advanced agricultural countries. In areas with less progress, these diseases can cause frequent and significant crop losses because the methods to prevent them are not working well enough. From 951-60, the U. SA only lost 0. 8% of wheat due to loose smut. However, 70% of the total crop production in India can be attributed to the seed certification programs and the cultivation of resistant plant varieties. To help make lots of good seed, many farming programs are in dry areas of advanced countries. This happens because water and high moisture in the air help spread spores, make them grow, and allow them to enter the plant's tissues. The dry states in the western part of the United States. Special areas in Oregon and Idaho, the north of Italy, and the Marlborough and Canterbury provinces in New Zealand have been chosen for growing specialized seeds. New Zealand is known for good seed production because it has the right weather conditions that help seeds grow well and avoid diseases that can harm them. But these favorable conditions are not common in other places. To keep the New Zealand seed industry reputable and productive, it's important to maintain good health standards and stay updated on technology and cultivar development. Some types

of seeds, especially ones for plants, are not as popular from New Zealand anymore. People only buy them because they are cheaper than other places.

Treating seeds with heat or chemicals before storing them is a common practice to ensure healthy seed production. Using chemicals on seeds is necessary when making certified seed. Thermal treatment of seeds is useful when the disease-causing organism is buried deep and regular fungicides cannot effectively reach it.Many types of fungicides can get inside the plants and reach their internal parts. Using vitavax and thiram to treat seeds is a way to remove any harmful germs or pathogens from them. Treating young plants with nematicides before planting them in soil without a container is done to prevent the growth of harmful worms that cause damage to the roots. This method helps control the problem of root knot and other types of nematodes.Common plant diseases like club root of cabbage and root knot of tomato are usually spread by young plants or grafts that come from infected nurseries. You should be careful when choosing the location for the nursery. Avoid areas near fields that have pests or insects. You should also regularly treat the soil with heat or chemicals[7], [8].

Table 1: Table summarized the example of root disease control by bacteriaor fungi to seeds [Biology Discussion.Com].

Antagonist	Pathogen	Crop	Location
Bacteria			
Agrobacterium radiobacter	*Agrobacterium tumefaciens,*	Peach	Field
Arthrobacter sp.	*Pythium debaryanum*	Tomato	Greenhouse
Bacillus subtilis	*Colletotrichum corchori*	Jute	Laboratory
	Fusarium oxysporum	Pigeon pea	Greenhouse
	F. roseum, Pythium sp.	Corn	Field
	Rhizoctonia solani	Wheat	Greenhouse
		Wheat, Carrot	Field
Streptomyces griseus	*Sclerotium rolfsii*	Lentil	Greenhouse
	Rhizoctonia solani	Wheat	Greenhouse
		Wheat, Carrot	Field
Fungi			
Aspergillus niger	*Fusariumsolani,*	Egg plant	Greenhouse
	Rhizoctonia solani		
Chateomium globosum	*F. roseum, Pythium* sp.	Corn	Field
	Pythium aphanidermatum,		
	P. ultimum		
	Helminthosprium victoriae	Squash	Laboratory
Coniothyrium minitans	*Sclerotium cepivorum*	Oats	Greenhouse
Laetisaria arvalis	*Rhizoctonia solani*	Onion	Greenhouse
		Sugarbeet	Field
Penicillium frequentans	*Pythium ultimum*	Table beet	Greenhouse
P. oxalicum	Pea root rot fungi	Pea	Field
Phialophora radiciola	*Gaeumannomyces graminis*	Wheat	Greenhouse
			Field
Trichoderma harizanum	*Sclerotium rolfsii*	Lentil	Greenhouse
T. viride	*Pythium ultimum*	Table beet	Greenhouse
	Pythium spp.	White mustard	Greenhouse

Soil solarization is a good way to treat soil in a plant nursery. Another way is to set fire to a pile of unused farm waste on top of the beds. Chemical treatment for soil can include fungicides.The time when the crops are gathered can impact how clean the seeds are. When farmers in areas with moderate climates wait too long to harvest their grain crops, it gives diseases more opportunities to infect the seeds. When grain crops are harvested when it's raining, the seeds they produce may become contaminated.When potatoes are harvested

while their leaves are still green, it allows a disease called late blight to spread to the potatoes. These infected potatoes can then carry the disease to the next growing season. This problem can be prevented by changing the time when we gather the crop.Gardeners in Scotland first used hot water treatment or therapy to help cure ornamental plant bulbs.Hot water is often used to control disease-causing bacteria, viruses, and fungi found in seeds. The temperature and duration of treatment will depend on the type of infection or germ involved. In the hot water treatment, the seeds need to be soaked in water for four hours at a temperature between 20-30°C. This allows the dormant mycelium to become active and more easily affected when we expose them to hot water at a temperature of 50-52°C for a short period of time.

The seeds need to be dried carefully before they can be used for planting. This method is difficult and complicated. You can handle a small amount at once. Also, the temperature needs to be carefully controlled throughout the treatment.Hot air treatment is not as harmful to seeds and is easy to use, but it is not as effective as hot water treatment. This is used to treat a disease called Ratoon-stunting Disease (RSD) in sugarcane stalks on a large scale. In this method, we use hot air at 54°C for 8 hours to kill germs without harming the growth of buds. The disease that affects the grassy part of sugarcane plants has been stopped by using hot air at a temperature of 54 degrees Celsius for a duration of 8 hours. Solar heat treatment is a good way to control diseases that can affect both seeds and soil.Solar heat treatment is a good way to control loose smut in wheat. In this method, the seed is placed in water for four hours starting at 8 a. m On a sunny summer day, I am going to meet with my friends at the park at 12 noon. After being soaked, the seed is left in the sun to dry for four hours, starting from 12 noon till 4 p. m

The cause of Ascochytosis in chickpeas is a fungus called Ascochyta rabiei, and it can live in the seeds. Chaube and Singh researched how drying chickpea seeds in the sun affects the survival of the pathogen in them (Table 1).The seeds were out in the strong sunshine between the end of May and beginning of June. The seeds were scattered on a hard floor at 8 a. m from 8 in the morning until 4 in the afternoon, every day for 15 days. Putting seeds directly on a cement floor made it harder for the fungus to grow back.The number of A organisms that can survive is decreased when seeds are covered with plastic sheets on a hard surface. Rabiei was very strong. In both ways of letting the seed grow, it didn't make a difference on its ability to sprout.

We know that many diseases and pathogens can be carried or introduced through seeds. Seed treatment is when chemicals are put on seeds to stop diseases and insects from being on them. Seed treatment helps seeds to resist and fight against fungal infections that can happen in the soil when the seedlings are growing.Managing diseases caused by pathogens that are present in seeds or that infect seeds.Protecting a new plant or baby plant from harm caused by diseases in the soil.Treating seeds properly can remove pathogens that harm seeds and prevent diseases from occurring. Additionally, putting a protective chemical on the outside of a seed can lower the chance of infection from harmful organisms in the soil that can cause the seeds to decay, or cause problems with germination or infection in new seedlings.The methods commonly used in India to treat seeds with chemicals are as follows.

Chemicals that dissolve in water are mixed with water in containers that are easy to use. Seeds are then placed in the water for a specific amount of time and then dried before being packed, stored, or planted. If the seed is not dried correctly, it may get harmed when stored. Don't use metal containers when using mercury-based chemicals for seed treatment. This method is usually not chosen because it takes a lot of time.Dry seed treatment is typically done using machines called rotary or gravity-fed seed dressers. Most of the seeds are treated

with a form of dust that does not need difficult equipment. Industry-made drums are used for treating seeds. These drums help to lessen the risks of breathing in harmful substances. They treat the seeds efficiently and evenly.There are round drums that are closed and can rotate. You can buy them in the market or borrow or rent them from the Government agencies.The slurry method helps solve problems with treating seeds when they are wet or dry. This method works best for using wet-table powder. The substances are combined with a small amount of water and then placed on seeds using either hands or machines that can work manually, automatically, or semi-automatically[9], [10].

During treatment, a thin paste called slurry is applied to the seeds, and it dries up on the surface. This method can also be used for large-scale seed treatment. Seeds that have been treated with dry dust or slurry can be stored for a long time. But when seeds are soaked in liquid, they cannot be kept.Seed disinfestation means getting rid of tiny living things on the outside of a seed that can cause contamination, without affecting the inside of the seed. In simpler terms, it means using a chemical before the microorganism infects something.Seed disinfection means getting rid of tiny living things that can cause diseases and that have grown on the outside or inside of a seed or plant. In simpler terms, a chemical is used to treat an infection caused by a microorganism.

Seeds and young plants can protect against tiny living things in the soil that can cause seeds or young plants to rot. This kind of chemical is used to protect seeds.Seed treatment means putting a layer of chemical on the outside of a seed to protect it from pests, diseases, or insects.Wettable powders can be easily mixed with water and spread out evenly. Wet-table powders are often used in sprays. Stirring is usually needed in the spray tanks to make sure everything is mixed evenly.These mixtures usually have 4-10% of the main ingredient and are usually applied in a dry, powdery form. In the formulas for dust, there are only a few active ingredients.A true solution is when the main ingredient or a mix of ingredients and a liquid called a solvent are dissolved in water. Solutions are great because once they are mixed with water, there is no need to stir or shake them. These substances can dissolve easily in water and are commonly used for fast mixing.

These formulations are made by combining a form of the medicine that is dry with a liquid. Slurry treatment involves using a thick soup made of chemicals dissolved in a little bit of water or a safe liquid. This mixture is applied to seeds, creating a thin paste that dries on their surface.These mixtures typically contain a large amount of substances that can effectively do their job, just like wet-table powder. They are combined with water before use and need to be stirred.These are liquids where the main ingredient is mixed with a liquid. These liquids cannot be mixed with water, so a material that helps them mix together is already included. When you add these emulsifiable concentrates to water, it creates a milky mixture. This mixture contains active ingredients and a solvent that is emulsified, or evenly distributed, in the water. However, fungicides are usually not made as emulsifiable concentrates.These particles are made into small pieces like coarse sugar. The amount of active ingredients in dusts is usually not very high. Fungicides that come in the form of solid particles are not commonly used.

Using chemicals to clean seeds was popular for a long time. Copper sulphate is used to treat cereal seeds that have spores of a harmful fungus called bunt. Sulphur dust is used to treat seeds that have smuts causing fungi.Scientists found that mercuric chloride can remove infections in seeds caused by a fungus called fusarium. Later, they developed a new compound containing mercury that can also disinfect seeds. This opened up a new way to treat fungal infections in seeds.Organic mercury chemicals have been found to be effective in treating various diseases in different types of crops. These chemicals can be referred to as

broad spectrum seed treating fungicides. Using organomercurial as a coating for seeds has been effective in preventing many diseases in grains and crops that are sold commercially. Afterwards, other types of organic chemicals without mercury started being sold and were effectively used to treat seeds.These treatments can help prevent pests and infections and also protect seeds and young plants from fungi in the soil as they grow.Seeds that have been treated with chemicals need to be kept dry when stored. The treatment should be done at least one week before planting. If you want to treat seeds with liquids, you must do it right before planting them because they can't be stored after treatment. You should follow the recommended time for the purpose without fail[11], [12].

Liquid treatment is typically used to treat plants like cuttings, tubers, bulbs, etc, that cannot be treated with dry or slurry methods. Storing seeds in damp conditions after treatment can harm their ability to grow. Therefore, it is important to make sure that treated seeds are stored correctly.Some of the chemicals used to treat seeds can be harmful to people and animals, so we need to be careful when using them.Seeds that have been treated with chemicals should not be eaten by people or animals as food or feed.Seed treatment should be done in an area with good air circulation.Avoid inhaling chemicals and keep them away from contact with your skin and eyes.Bacteria and fungi that fight against harmful organisms may work better when applied directly to seeds instead of the soil. This is because they are closer to where the infection happens, and there are more of them. Seeds can easily get sick from diseases in the seeds or the soil, and the protection they have doesn't last for a long time.

Bacteria are tiny living things that can be easily damaged or killed by heat. They are made up of one cell and are very simple in structure. They can only live in a bug or in a plant. If bugs are in the seed, heating it up can easily kill them. Fungi have tough walls and are not affected by heat, so it's tough to get rid of them using natural treatments for seeds. Viruses are basically genetic materials (DNA or RNA) that produce proteins. These different proteins can be found using strip tests and used before planting. If there are viruses in the seed, organic treatments for the seed will not work well.If plants have germs on them when they start growing, they are more likely to get really sick. Plants that get infected at a young age are more likely to die. Basil downy mildew, which is caused by a type of fungus, is an example. The sickness quickly spread through contaminated seeds, causing a lot of damage to farmers' finances. Planting seeds or transplants that are infected with a disease can lead to serious issues. This is because the disease can spread to the soil or plant remains, and continue to harm crops for a long time, sometimes even for years.Some harmful organisms live on the surface of seeds. Some plant diseases, like basil downy mildew, can get inside the seed and are hard to get rid of. Cucumber mosaic virus, lettuce mosaic virus, and Botrytis spp. are types of plant diseases. Onions can have certain diseases that can easily infect the seed.

Seeds can be treated with hot water, steam, chlorine, or hot and dry air. This treatment has to kill the harmful germ, but not harm the seed itself. You can use biological, organic or regular fungicides to treat seeds. Biological products attack and live off the harmful germ. Fermentation helps good bacteria grow and is commonly used with tomato seeds. The type of seed and the germ that causes the disease determine which treatment is most effective.Deadly plant illnesses that are transmitted through seeds.The most serious diseases that are transmitted through seeds in Brassica crops are called black leg and black rot, according to Lew-Smith. Black rot is a sickness caused by a type of bacteria called *Xanthomonas campestris*. It quickly spreads when the weather is warm and humid, and it causes the plant to melt. Its unique triangular shape is always visible at the edge of the leaf.Black leg is a type of disease caused by fungus. It can spread when the weather is warm and humid. The spores of the fungus can stay alive in the field for a long time. You can tell if a plant has a problem if

you see black spots on its stem or upper roots. These spots are groups of fungus, and will release a lot of tiny particles that spread the disease.

There is a test that can detect this virus. Like most viruses, the plant shows signs of mottled appearance when it's infected. Certain types of lettuce can carry diseases without showing any symptoms. This is why it is important to test the seeds for diseases before planting them.Alternaria leaf blight in carrots is a disease that spreads through the seeds to some extent, but it can greatly reduce the amount of carrots that are produced. It is also worrying in beets.Lew-Smith explained that the damage mostly occurs when you lose a large amount of leaves, which leads to reduced crops.The tomato mosaic virus can easily spread from seeds and is difficult to get rid of. There is a test that is like a strip. Fruit that is infected cannot be sold. There are three other diseases that can easily spread in tomato seeds bacterial speck, bacterial canker, and bacterial spot. These can be eliminated by using steam or by letting the seeds ferment.

White rot is a type of fungus that is often found together with onion seeds. However, it does not live inside or on the seed, and it is not a disease that specifically comes from the seed. The issue happens because the fungus's sclerotia, which are small black dots, cannot be easily told apart from the onion seed, which also look like small black dots. Sclerotia are special parts of fungus that help them reproduce. These parts can survive in soil for more than ten years. That's why it's very important to stop white rot from entering a field.Preparing seeds before planting is just the beginning of stopping diseases from spreading. Because diseases that can be transmitted through seeds can also be spread through other methods and can still survive in the soil and leftover plant materials, it is still crucial to properly clean and maintain the fields. Disease-causing germs can often enter through water or wind, or through bugs. Seed that comes from fields with a harmful germ can spread the germ and cause more problems.

Plants like vegetables often get sick from fungi, even from fungi that are in their seeds. In cases like this, the harmful germ is already on the seed or its surface, and can cause the seed to rot and the seedling to die. Scientists have found that treating vegetable seeds can stop the spread of plant diseases caused by fungi that live on the seeds. Also, using seed treatments can help reduce the amount of pesticides needed to control a disease. This is because if the seed treatments are effective, there won't be a need to apply fungicides on the leaves later in the season. Although fungicides usually work well, their unintended effects on the environment and the rise of resistant pathogens have made people look for different ways to control fungal diseases, especially recently. In the past, certain physical methods and natural substances have been successful in controlling harmful pathogens that affect seeds. These methods include using plant extracts, natural compounds, and agents that help control pests.

CONCLUSION

We can make farming more productive and sustainable by either growing more crops using special kinds of plants that produce a lot of food, or by preventing crop failures caused by bugs and illnesses. Many crops that produce a lot of food are often easily affected by diseases. The most important thing is having access to good, healthy seeds or plants to use for planting. Seeds can carry many tiny living things. Around 90% of crops are grown from seeds. This means that seeds can spread diseases and allow harmful organisms to survive from one season to another. Getting healthy seeds can be done by using the right certification programs or by treating the seeds properly. However, it is challenging to prevent diseases that are transmitted through seeds and also exist in the soil or on plants after they have died. Farmers use specific times to spray chemicals on their crops to prevent diseases from causing

too much damage. However, this approach can leave chemical traces on the crops and make the disease-causing organisms resistant to the chemicals. It can also disrupt the natural animals that live on the farm. Plant diseases causing losses will have a bigger impact on humans in the future than they have had in the past. We need a combined approach to effectively control diseases and produce and keep seeds free from pathogens in the field and while storing them.

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