

Story Behind Late Blight of Potato: Origin of Plant Pathology

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SUMMARY

The late blight of potato, a devastating disease caused by the fungus *Phytophthora infestans*, played a pivotal role in shaping the field of Plant Pathology. This notorious disease led to the Irish Potato Famine in the 1845, shakes the fate of Ireland and highlighting the urgent need for scientific understanding of plant diseases. This crisis catalysed the birth of Plant Pathology as a distinct scientific discipline, paving the way for extensive research, disease management strategies, and agricultural innovations to tackle plant diseases worldwide.

INTRODUCTION

Prior to the potato becoming the staple of Ireland, the poor of Ireland consumed mostly rye and dairy products, which was also true of most of the peasant people in Western Europe, but grains were often diseased and unfit for consumption, and the amount of grain available, after harvest, was less when compared to the potato crop. In the early 17th century, the potato was introduced to Ireland, rapidly expanding its cultivation and eventually supplying 80% of the dietary needs due to its rich nutritional profile, high productivity, adaptability to various soil types, and suitability for small-scale farming in Ireland's cool and damp climate, potatoes planted their name forever in Ireland. By the starting 1800, when the potato became the predominant staple crop in Ireland, the country's population doubled, rising from 4.5 million to 8 million people by 1845. For the Irish peasant, potatoes were not just a part of every meal, but often the sole food source for each meal. On average, these peasants consumed 8-14 pounds of potatoes daily.

The silent invader

Everything going smooth, but in the summer of 1845, due to sudden temperature drops to lowest (1.5 to 7°F) and a new disease occurs to the plants with water-soaked lesion, blighted symptoms on the leaves. When dug most of the potatoes decayed and the left few rotted later in storage. The blight affected various regions in Europe, not just Ireland, but its impact was particularly devastating in Ireland due to their heavy reliance on monoculture, resulting in a severe famine and left the people with great hunger. Late Blight affected only the potato. Crop failure of the potato had occurred and people had starved before, but none as serious as in 1845. So, the farmers knew from the beginning that there was something new and evil that was killing their crops. However, 1845 was not the first occurrence of the disease. Local incidents of the disease had been known and documented as early as 1835 in the columns of the "*Gardeners Chronicle and Agricultural Gazette*" but it is not a severe as it is in 1845.



Fight for the right towards blight

There were two prominent scholars, **John Lindley**, a Botany Professor and editor of the *Gardener's Chronicle and Agricultural Gazette*, and Reverend **M.J. Berkeley**, renowned for his expertise in mycology due to his passion for collecting and studying fungi, engaged in a public debate through letters to the editor. Both individuals held significant recognition within the community.

Lindley's explanation for the blight was notably unscientific for a scientist. According to his theory, the potato plants had been growing vigorously under normal weather conditions. However, when heavy rain arrived,

the plants absorbed excessive water through their roots. Unable to dispel the surplus water, the plant tissues swelled and eventually decayed, as per Lindley's argument.

On the other hand, **Berkeley** presented a more plausible explanation, especially by modern standards. Upon inspecting infected leaves and potatoes under the microscope, covered with a mould-like growth, he speculated that this growth might be responsible for killing the potatoes. He carefully documented his microscopic observations on paper. Shortly after, he received a letter from his old friend **Montage**, a physician in Napoleon's army, containing blighted potatoes and drawings that closely resembled Berkeley's earlier observations. Berkeley was immediately convinced that the blight was caused by this new fungus. Montage took it a step further and officially named the pathogen as *Botrytis infestans*.

But unfortunately, none of the readers took his theory seriously because everyone thought Berkeley was merely expressing his opinion solely based on his observation. Even though Lindley's theory might appear far-fetched by contemporary standards, it was Berkeley's explanation that was met with doubtfulness when he presented it in a letter to the editor. Lindley took this opportunity to point it out Berkeley, that the new fungus was an opportunistic invader, thriving in the already deceased tissue of the potato plant due to the wet conditions, as he had previously suggested. These debates persisted even as the blight continued its devastating impact.

Who solved the mystery behind late blight of potato?

Amidst the ruins of the potato fields, **Anton de Bary** emerged as pioneers. Armed with microscopes and unyielding curiosity, de Bary meticulously studied the disease, identifying the microscopic culprit behind the blight. It was **Anton de Bary** in 1861 who proved that it is caused by fungi with a simple experiment using scientific methods. He cultivated two sets of healthy potato plants in pot culture under the same cool and wet environmental conditions favourable to the blight fungus. One group of plants are inoculated with the sporangia collected from blighted plants, while the other free of inoculum served as control, remained free of the fungus. Within a few days, the sporangia inoculated plants displayed clear signs of the disease and eventually decayed. In contrast, the control group remained disease-free, conclusively proving that the fungus was the cause and reason behind the blight and not saturation from too much water. Anton de Bary also re named the pathogen as *Phytophthora infestans* (Phyto – plant; phthora - destroyer) in 1876 from *Botrytis infestans* (Mont.).

Destroying all the theories, he also laid foundation for experimental research. His groundbreaking research marked the beginning of a new era, where diseases were no longer seen as mere acts of nature but phenomena to be studied, understood, and controlled. The breakthrough not only did this mark the inception of plant pathology, in the following year, in 1862, Louis Pasteur's Germ Theory would supplant the idea of spontaneous generation of microorganisms in deceased or dying organisms. Consequently, de Bary's research preceded Pasteur's Germ Theory, deserving recognition for this groundbreaking theory as well.

Due to his groundbreaking contributions, he is recognized as the "Father of Plant Pathology", "Father of Modern Plant Pathology", "Founder of Modern Mycology" and "Father and Founder of Modern Experimental Plant Pathology".

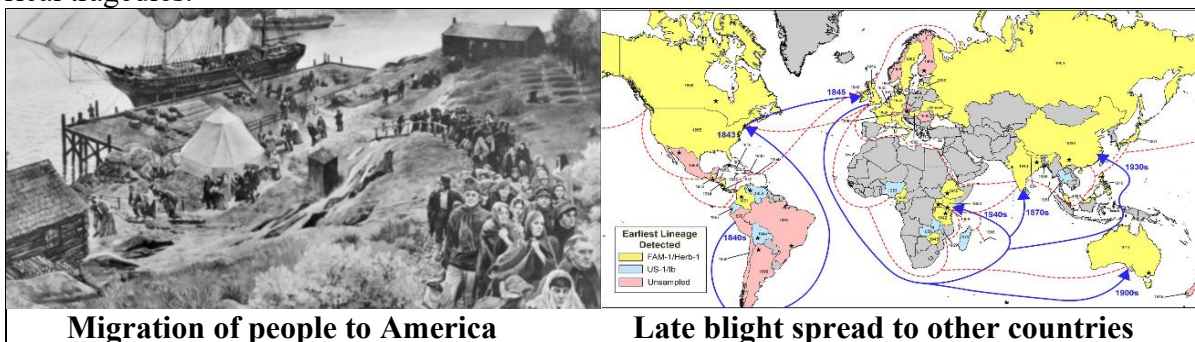
The Irish famine – The great hunger and the greatest migration

The Irish Famine, often referred to as the "**Great Hunger**", stands as one of the most devastating events in Ireland's history. The disease starts to appear year after years and destroying all the crops left the Irish hopeless with great hunger. The late blight epidemics led to widespread hunger and forced many people to migrate or caused their death. Aside from hunger, diseases manifested predominantly in the forms of cholera, dysentery, scurvy, and typhus, leading to the killing of at least 1-1.5 million people. In later years the disease spread to other parts of the world.

The dire circumstances forced a massive wave of emigration from Ireland, families, desperate for a chance at survival, fled their homeland in search of a better life abroad. The magnitude of this migration is unparalleled in Irish history and ranks among the largest forced migrations ever witnessed. Countless Irish families at least 2-3 million people are trajected towards United States, Europe, North America and many other parts of the nations. The potato famine left a lasting mark on Ireland's history, even today, people from Ireland are haunted by the memories of those days.

The 35th president of the USA, **John F. Kennedy**, was a descendent of the Fitzgeralds, who migrated to the USA between 1846-1855 to escape the famine caused by late light of potato. The legacy of the Irish Famine endures in the collective memory of the Irish people and their descendants. It left a profound impact on Ireland, shaping its demographics, culture, and societal structures. Today, the Great Hunger remains a poignant reminder

of the resilience and strength of the Irish people, as well as a symbol of the importance of remembering and learning from historical tragedies.



Migration of people to America

Late blight spread to other countries

Plant Pathology's Genesis: Birth of a New Branch of Science

De Bary's work laid the foundation for Plant Pathology, a discipline dedicated to unravelling the mysteries of plant diseases. The study of late blight became a cornerstone, guiding scientists towards a deeper understanding of pathogens, host-pathogen interactions, and disease management strategies. Plant Pathology emerged as a distinct scientific field, essential for safeguarding global food security.

W.G. Farlow was America's outstanding early plant pathologist thought the first plant pathology course focusing on plant diseases as a special subject in the United States. **Roland Thaxter** (1858–1932) was the first plant pathologist hired under the Hatch Act and became the first plant pathologist stationed at the Connecticut Agricultural Experiment Station. In India, the teaching of plant pathology as a course commenced at the University of Calcutta, Bombay, and Madras in 1857, with a primary focus on fungal taxonomy. However, plant pathology as a distinct university science began in 1930 at the University of Allahabad, Lucknow, and Madras. Among these, the University of Madras might have been the first to introduce plant pathology as a formal course. Agra University initiated a post-graduate program in plant pathology at the Government Agricultural College, Kanpur, in 1945. The systematic teaching of Mycology and Plant Pathology became an integral part of agricultural science under the umbrella of the Indian Agricultural Research Institute. The subject gained prominence, and the teaching of supporting courses such as mycology, bacteriology, virology, and nematology in both undergraduate and postgraduate programs of Agriculture became regular after the establishment of Agricultural Universities in different states of India in 1960.

CONCLUSION

The late blight of potato and the subsequent Irish Potato Famine were pivotal moments in the history of agriculture and science. This devastating disease, caused by *Phytophthora infestans*, not only led to unparalleled hunger and migration but also spurred scientific inquiry and the birth of Plant Pathology as a distinct field. The relentless pursuit of understanding by scholars like Anton de Bary challenged existing theories and laid the foundation for modern plant pathology. The Great Hunger, with its profound impact on Ireland, stands as a testament to the resilience of its people and serves as a solemn reminder of the importance of scientific vigilance in safeguarding global food security and preventing future agricultural catastrophes.

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