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# An Overview of Diseases in Ornamental Plants

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**ABSTRACT**
Ornamental plants represent a significant component of agriculture, exhibiting considerable versatility in their application and frequently attaining relatively high sale prices for certain species. A number of factors have been identified that act as inhibitors during the process of cultivation. The disturbance of plant diseases is known to have a particularly deleterious effect. The absence of expertise among ornamental plant cultivators results in a protracted response to diseases, leading to adverse disturbances that can be deleterious. In this observation, the author seeks to provide information regarding various diseases that have the potential to affect ornamental plants. The present study was conducted through the observation of ornamental plants on a global scale. The causative agents of the disease are predominantly pathogens derived from fungal, bacterial, viral, and other sources. It is a fact that pathogens are capable of attacking all parts of a plant, including the leaves, trees, roots, and flowers. It is to be hoped that, following the acquisition of knowledge regarding the diseases that can affect ornamental plants, ornamental plant growers will become more vigilant and implement preventive measures to control them. The recommended measures for the management of diseases may encompass various strategies, including physical control, technical cultivation, and the utilization of antagonistic fungi.

**KEYWORDS**
Ornamentals, diseases, control, fungi, agriculture



## INTRODUCTION

Ornamental plants are defined as those that are cultivated with the deliberate intention of achieving optimal results in their development. The cultivation of ornamental plants constitutes a significant component of agriculture on a global scale[1]. In Indonesia, ornamental plants are those that are held in high esteem by the populace. In 2020, amidst the global pandemic of the Coronavirus, it was observed that an increasing number of individuals were cultivating ornamental plants within their domestic environments. This phenomenon was attributed to the potential benefits of these plants in providing a means of alleviating stress, a common occurrence during periods of significant stress, such as that experienced during the aforementioned pandemic. It is important to note that certain species of plants also possess a high commercial value at specific periods. For instance, aglaonema plants and similar species are often highly sought after during certain seasons. The caladium plant is distinguished by its distinctive pattern and leaf shape, which has led to its widespread cultivation[2]. One of the obstacles that can cause problems in the cultivation of ornamental plants is both abiotic and biotic factors. Abiotic factors are known to have a significant impact on the environment, with extreme weather changes and nutrient deficiencies being two notable examples[3].

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The cultivation of ornamental plants can be impacted by biotic factors, which encompass diseases caused by fungi, bacteria, viruses, nematodes, and phytoplasmas. The following diseases are known to affect ornamental plants: *Fusarium wilt*, *Perenospora digitalis*, *Alternaria alternata*, *Rhizoctonia solani*, *Colletotrichum fuscum*, *Golovinomyces orontii*, *Entyloma gaillardianum*, and *Colletotrichum fuscum*[4]. In consequence of the aforementioned plant diseases, a decline has been observed in the sale price of ornamental plants within the marketplace[5].

The development of diseases that utilise spores signifies that the smallest quantity of water can disseminate spores of the *Colletotrichum* fungus to other plants in the vicinity. The following are examples of fungal symptoms caused by the fungi *Phytophthora ramorum* and *Phytophthora kernoviae*: Leaf blight, death on twigs of infected plants, and red cankers on stems. In the case of *P. attrantheridium,* recorded in the British Plantation, symptoms of root rot and leaf blight have been observed in 39 genera of plants[6]. In the context of agricultural cultivation, farmers may encounter various challenges that can impede their efforts. These difficulties can be attributed to both biotic and abiotic factors. Biotic factors are defined as elements comprising living organisms, encompassing fungi, bacteria, viruses, nematodes, and higher plants. Abiotic factors are non-living and non-living organisms, and include weather, pH, temperature, and others. Alternaria, a fungus that has the capacity for rapid dissemination through seed dispersal and climate change, is among the most prevalent pathogens affecting ornamental plants[7]. The Rosa plant is notable for its high sale price, extensive global distribution network, and significant economic value[8].

Symptoms of *Botrytis cinerea* can manifest on various parts of the plant, including the leaves, stems, and flowers. These symptoms can be categorised into several different types, which include spots on the petals, blossom blight, yellowing sepals and bent petioles[9]. In the case of *Radermachera sinica* plants being subject to an attack by pathogens of the genus *Colletotrichum*, symptoms are shown in the form of thinning leaves. The leaves exhibit a greyish colouration with a white, dark brown centre, the presence of dark brown-black stripes and blotches that appear on the leaves[10]. Symptoms indicative of the fungus *Botrytis cinerea*, a pathogen belonging to the Oomycetes class, include a change in leaf colour to yellow, and the presence of a white, powdery mildew-like substance on the upper surface of leaves[6]. A further illustration of these phenomena is furnished by the infestation of *Phytophthora* spp., in nursery phases of ornamental plants within the California Region[11]. The genera *Colletotrichum*, *Fusarium*, *Neocosmospora* and *Rhizoctonia* have also been identified as significant pathogens affecting aromatic and ornamental cultivated plants in Italy[12-15].

In order to mitigate the potential for the propagation of disease in a horticultural setting, there are a number of measures that can be implemented before the onset of widespread disease. These include the utilisation of seeds and the undertaking of regular soil maintenance, in addition to the regulation of humidity and the maintenance of optimal temperature conditions, to minimise the risk of disease[4]. In the contemporary era, a variety of technologies are employed, including the utilisation of the Internet of Things (IoT) system for the detection of foliage that has been impacted by diseases[15]. It is also imperative to implement the prevention stage to minimise the occurrence of disease outbreaks during and following the harvesting process. One efficacious approach to this end is the use of adequate sanitation materials[5].

This research ascertains the pathogens that are capable of attacking different types of ornamental plants. The objective of this study is to furnish readers with the knowledge to identify the diseases and symptoms of attacks that may affect ornamental plants. This article will discuss the various diseases that have been found to affect ornamental plants. Ornamental plants themselves possess a relatively high economic value and are in demand by a wide range of individuals for a variety of purposes. The presence of diseases that affect ornamental plants has the potential to result in a decline in productivity, leading to financial losses for farmers who cultivate them. The purpose of this study is to provide a comprehensive overview of the various diseases that can afflict these plants. By understanding the nature of these diseases, stakeholders in the ornamental plant industry can develop analytical capabilities to identify diseases, implement preventative measures, and develop treatment strategies.

Table 1: Symptoms of biotic pathogen attack that are commonly seen from the attack of various pathogens[17]

| Pathogens are agents that can cause diseases | Following symptoms are observable |
|---|---|
| Fungi | Necrosis, leaf blight, blights, blast, sprout lodging, scabies, root rots, dieback, leaf curling, swelling, clubroot, and gummosis |
| Bacteria | Most common bacterial plant diseases: Bacterial wilting, galls, bacterial leaf spot, bacterial scab, bacterial canker, bacterial soft rot, and bacterial blight |
| Virus | Mottling, mosaic pattern, leaf blistering, leaf streaking, plant stunting, leaf rolling, concentric ringspots, necrosis, tumour formation, shoe-stringing, hypoplasia and hyperplasia, and local lesions |
| Nematode | Yellow patches, root stunts, stubby roots and corky ringspots, galls, root-tip swelling, yellow dwarf, stem rot, and flagging |
| Mycoplasma | Yellowing, abnormal shoot branching and stunted growth, proliferation, stunting, yellowing and witches' broom, and yellow-type disease |

**Diseases, signs, and symptoms:** The manifestation of symptoms in response to pathogens that infect plant material can vary significantly among affected plants. The damage caused by these plants manifests in symptoms that vary in severity, ranging from minor to severe. Damage may be initiated by biological or abiotic factors. The following symptoms may be indicative of a range of pathogens (Table 1). The visible symptoms of diseased plants can be seen through the physiological parts of the leaves of diseased plants[16].

The presence of symptoms associated with plant diseases is likely to have a significant impact on the processes of plant growth and development. This impact will be characterised by a disruption to the optimal production potential of the affected plants, which will result in a reduction in the yield of produce[18]. In the case of plant specimens that have been affected by pathogens, an array of external symptoms may become apparent, encompassing the morphology of various parts, including leaves, roots, stems, and other components of the affected plant[19]. The symptoms of a fungal attack generally manifest as spots on the affected plant parts, leaf blight, and other such indications. Furthermore, the presence of hyphae or mycelium is indicative of a fungal attack. One such example is the occurrence of anthracnose, a fungal infection that results in the formation of lesions on the leaves. These lesions are characterised by a greyish hue with a white central region, a blackish brown pigmentation at the periphery, and the presence of black spots on the affected plant[10]. The identification of plant diseases is conventionally facilitated through the observation of characteristic symptoms, including spots, blotches, galls, necrotic areas, leaf blight, and flower blight, accompanied by evidence of spores, hyphae, and fungal exudates.

**Diseases of ornamentals:** Ornamental plants have been observed to demonstrate a heightened degree of vulnerability to infection by fungal pathogens[20]. The majority of the leaves displayed signs of infection with anthracnose disease. A condition brought on by the presence of the fungus *Colletotrichum* sp. This conclusion was reached through the analysis of both symptoms exhibited and the results of microscopic observations of the pathogen. The symptoms manifested as spots, rust, and blotches, attributable to the expression of pathogen-infected plants. This phenomenon results in a deficiency of aesthetic value in the affected plants. In certain instances, the most severe level of attack by plant pathogens can result in death. The dissemination of diseases in ornamental plants can be influenced by abiotic and biotic factors present within the field. This plant pathogen is able to thrive and develop optimally in warm and humid conditions, such as those experienced from August to December, marking the transition from summer to the rainy season. The growth of *Colletotrichum* fungi ranges from 0 to 450°C[21]. The dissemination of diseases within agricultural settings can also be attributed to the dispersion of rainwater splashes, the transportation of spores via wind, and other such factors. A survey of reports about ornamental plant disease data reveals a considerable degree of variability (Table 2). This finding is indicative of the severe consequences that may ensue should these pathogens be undetected on time.

Table 2: List of diseases that have been reported on ornamental plants

| Plant | Disease | Country | Source |
|---|---|---|---|
| *Tulipa* spp. | *Fusarium solani* | India | Nisa *et al.*[22] |
| *Euonymus japonicus* | *Botryosphaeria dothidea* | China | Fan *et al.*[23] |
| *Echinacea purpurea* | Tobacco streak virus | China | Liu *et al.*[24] |
| *Brassica oleracea* | *Tobacco rattle virus* | India | Kesharwani *et al.*[25] |
| *Euonymus japonicus* | *Agrobacterium rosae* | Iran | Mafakheri *et al.*[26] |
| *Abelia x grandiflora* | *Xanthomonas dyei* | Northern California, USA | Noh *et al.*[27] |
| *Camellia chrysantha* | *Colletotrichum siamense, C. fructicola* | China | Zhao *et al.*[28] |
| *Canna indica* | *Puccinia thaliae* | Malaysia | Khoo *et al.*[29] |
| *Clivia miniata* | *Fusarium solani* | China | Sun *et al.*[30] |
| *Allamanda cathartica* | *Colletotrichum siamense* | China | Huang *et al.*[31] |
| *Impatiens hawkeri* | *Alternaria burnsii* | Taiwan | Chang *et al.*[32] |
| *Tilia miqueliana* | *Alternaria alternata* | China | Yue *et al.*[33] |
| *Davidia involucrata* | *Nigrospora oryzae* | China | Yang *et al.*[34] |
| *Dianthus chinensis* | *Fusarium acuminatum* | China | Xu *et al.*[35] |
| *Sesuvium portulacastrum* | *Gibbago trianthemae* | China | Chen *et al.*[36] |
| *Zinnia elegans* | *Tomato leaf curl Karnataka virus* associated with leaf curl disease | India | Snehi *et al.*[37] |
| *Oxalis corymbosa* | *Nigrospora hainanensis* | China | Zheng *et al.*[38] |
| *Hemerocallis* spp. | *Alternaria alternata* | China | Huang *et al.*[39] and Marin *et al.*[40] |
| *Alocasia* spp. | *Agroathelia rolfsii* | Florida | Marin *et al.*[40] |
| *Gossypium hirsutum* | *Brasiliomyces malachrae* | Mexico | Márquez-Licona *et al.*[41] |
| *Aloe vera* | *Uromyces aloes* | United States | Bily *et al.*[42] |
| *Hyophorbe lagenicaulis* | *Diapothoeckeri* | China | Guo *et al.*[43] |
| *Tropaeolum majus* | Tomato Spotted Wilt Virus | China | Yu *et al.*[44] |
| *Chaenomeles sinensis* | *Colletotrichum gloeosporioides* | China | Ni *et al.*[45] |
| *Lavandula stoechas* | *Epicoccum sorghinum* | China | Gu *et al.*[46] |
| *Ligustrum lucidum* | *Neopestalotiopsis chrysea* | China | Xu *et al.*[47] |
| *Canna indica* | *Enterobacter mori* | China | Zhang *et al.*[48] |
| *Livistona chinensis* | *Alternaria alternata* | Pakistan | Zhu *et al.*[49] |
| *Cordyline fruticosa* | Ti Ringspot-Associated virus | Hawai | Olmedo-Velarde *et al.*[50] |
| *Septoria* sp. | *Escallonia* | United Kingdom | Henricot[6] |

The genus *Colletotrichum* encompasses a range of pathogens that demonstrate a broad spectrum of virulence and can be encountered in diverse plant taxa, including those employed for aesthetic enhancement, within the field of agriculture. the *Colletotrichum* fungus comprises 340 species, which are further subdivided into 20 distinct complexes. In addition, a total of 3,400 different plant species have been identified as suitable hosts for the *Colletotrichum* fungus[51]. Furthermore, the fungus is able to infect all plant parts, including flowers, leaves, and stems. *Colletotrichum* species is a genus of fungi that plays a significant role as a causal agent of plant diseases[4]. It is a saprophyte and can act as an endophyte, thereby establishing itself within a wide range of plant hosts, including ornamentals, fruit, and vegetable crops. The ease and speed with which *Colletotrichum* fungi spread is further facilitated by the substantial number of host plants and the diversity of fungal species. The genus *Colletotrichum* comprises significant pathogens that can infect a wide range of plant species, including those employed for ornamental, fruit, and vegetable crops[52].

It is evident that, based on the symptoms exhibited, several species of *Colletotrichum* fungus have been identified, including *Colletotrichum diversisporum*, *Colletotrichum dematium*, *Colletotrichum* sp., *Colletotrichum subacidae*, and *Colletotrichum acutatum*. It is evident that the various *Colletotrichum* species possess a range of distinct characteristics, sizes, and morphologies[53]. The manifestation of symptoms occurs in the form of blackish-brown necrotic lesions. The initial symptoms are characterised by minute necrotic lesions that gradually enlarge and deepen over seven to eight months, resulting in the complete decomposition and desiccation of all tissues[52]. The utilisation of chemical fungicides and environmental management are amongst the controls that are recommended for implementation[54]. Notably, certain species of *Colletotrichum* are pathogens that are endemic to a limited number of regions. In such cases, the implementation of plant quarantine measures can be an effective strategy for the suppression of the spread of *Colletotrichum* pathogens[55].

Another affliction that has been observed to impact the health of plants is known as *Alternaria* sp., leaf spot. This fungal infection has been documented to affect leaves belonging to various ornamental plants, particularly those commonly cultivated in the supplier and the paper flower industries. *Alternaria* sp., represents a significant global threat to plant health, particularly in the context of climate change. This fungal pathogen poses a considerable risk to a wide range of flowering plants[56]. A comprehensive study was conducted to ascertain the prevalence of *Alternaria* sp., disease in Biella Province, Northern Italy. A total of 22 isolates of the *Alternaria* sp., fungus were identified on 13 ornamental plants, thereby providing a quantitative basis for further analyses[7]. Disturbance from other pathogens, including those caused by nematodes of the species *Meloidogyne* spp., *Aphelenchoides* spp., *Paratylenchus* spp., *Pratylenchus* spp., *Helicotylenchus* spp., *Radopholus* spp., *Xiphinema* spp., *Trichodorus* spp., *Paratrichodorus* spp., *Rotylenchus* spp., and *Longidorus* spp., has been observed[57].

## DISEASES CONTROL

The implementation of measures aimed at the control of diseases affecting ornamental plant species. In the context of the investigation, it was observed that of the several plants identified, those most frequently subject to attack by disease were the ornamental varieties. This finding serves to highlight the perpetual threat of plant diseases and underscores the necessity for future research and management strategies to address this issue. The management of ornamental plant diseases can be approached in a variety of ways, including land management, the selection of superior seeds, and environmental management, among others. In the contemporary era, a plethora of insects have the potential to act as natural enemies of pests. These include parasitoids and predators. The utilisation of natural controls, encompassing microbes, bacteria, and beneficial or antagonistic herbs, constitutes a component of environmentally friendly control measures[58].

The presence of beneficial microbes in the soil has the potential to be highly advantageous for plant health, as these microorganisms can serve as a nutrient source that may enhance the resilience of plants against diseases and disorders[59]. The utilisation of endophytic fungi as microorganisms is predicated on the premise that they possess innate defensive mechanisms that encompass a range of strategies, including but not limited to: (i) Competition, (ii) Induction of resistance, (iii) Mycoparasitism, and (iv) antibiosis[60]. The application of technological advancements in the field of plant disease detection has also been explored. This research area encompasses studies such as[61,62] the process of detection involves the identification of symptomatic and healthy leaves from plants.

The utilisation of genome editing and genome sequencing for diagnostic purposes has become a prevalent medical practice[63]. Some controls that can be used to control virus vector insects such as entomopathogenic fungi, parasitoids, predators, and hyperparasitoids[64]. Integrated pest management can be conducted through crop rotation, land sanitation, variety selection, balanced fertilization, and technical culture. Changing physical factors, such as the use of various mulch types, can also affect the ability of vectors to attack plants and the intensity of plant disease attack. The utilisation of biological agents and microorganisms has been demonstrated to possess the capacity to impede the proliferation of the *Fusarium oxysporum* fungi that are known to cause harm to ornamental plants[65]. Further research is required to identify genetic information from pathogens. This will assist in determining effective control measures for pathogens that attack ornamental plants, as well as identifying other plants that may act as hosts for the disease. The following steps have been completed by Febryani and Takikawa[66], this study obtain information regarding the genetic diversity of Dickeya bacteria, which have been observed to cause damage to a range of ornamental plants, including carnation, chrysanthemum, and kalanchoe. In the domain of virus control, the implementation of preventive and curative measures is of paramount importance. The curative measures encompass a range of approaches, including the exclusion, eradication and control of virus vectors[67]. Furthermore, the mapping of diseases that commonly affect specific crops can also facilitate the management of crop diseases[68]. The Internet of Things (IoT) has been demonstrated to be a valuable asset in the agricultural sector. It can function as a preventative measure for further planting, with the capacity to draw upon the findings of disease observations conducted in the field[69]. It is submitted that technologies that adopt machine learning (ML) and deep learning (DL) may also function as a tool for the detection of plant diseases[70]. Planting *Ocimum sanctum* can affect insect vectors on chili plants[71].

## CONCLUSION

The inevitable presence of pathogens in ornamental plants remains a significant challenge that demands serious attention. The potential transmission of these pathogens poses a threat to the health and quality of cultivated ornamental species. The lack of early disease detection among growers can lead to severe losses and compromised plant aesthetics. Therefore, it is essential to adopt comprehensive management strategies, encompassing both preventive and curative measures. Understanding and applying these approaches is crucial for sustaining healthy ornamental plant production and minimizing the risk of disease-related damage.

## SIGNIFICANCE STATEMENT

This study discovered the major diseases that commonly affect ornamental plants, which can be beneficial for home gardeners, horticulturists, and commercial ornamental plant growers. By identifying symptoms, sources of infection, and disease progression, the study provides valuable insights into early diagnosis and effective control measures. The findings are particularly important for minimizing economic losses and maintaining the aesthetic value of ornamental species. In addition, the study emphasizes the importance of disease prevention strategies and environmental factors influencing disease outbreaks. This study will help researchers to uncover the critical areas of ornamental plant pathology that many researchers were not able to explore. Thus, a new theory on integrated disease management in ornamental horticulture may be arrived at.

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