CSIBER INTERNATIONAL JOURNAL OF ENVIRONMENT (CIJE)

Vol. 1, Issue No. 2, October 2024

Published By :
CSIBER Press, Central Library Building,
CSIBER Campus, University Road,
Kolhapur, Maharashtra, 416004, INDIA.

Find the Journal online at
https://www.siberindia.edu.in/journals
E-mail :editorcije@siberindia.edu.in

CSIBER International Journal of Environment – CIJE

A Bi-Annual Double-Blind Peer Reviewed (Refereed/Juried)
Open Access International e-Journal - Included in the International Serial Directories

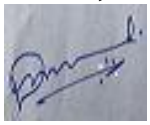
Published By:
CSIBER Press, Central Library Building
Chhatrapati Shahu Institute of Business Education & Research (CSIBER)
University Road, Kolhapur – 416004, Maharashtra, India

Editorial Note

CSIBER International Journal of Environment (CIJE) offers a venue where relevant interdisciplinary research, practice and case studies are recognized and evaluated. Increasingly, environmental sciences and management integrate many different scientific and professional disciplines. Thus the journal seeks to set a rigorous, credible standard for specifically interdisciplinary environmental research. CIJE is a multidisciplinary journal, publishing research on the pollution taking place in the world due to anthropogenic activities. CIJE welcomes submissions that explore environmental changes and their cause across the following disciplines like atmosphere and climate, biogeochemical dynamics, ecosystem restoration, environmental science, environmental economics & management, environmental informatics, remote sensing, environmental policy & governance, environmental systems engineering, freshwater science, interdisciplinary climate studies, land use dynamics, social-ecological urban systems, soil processes, toxicology, pollution and the environment, water and wastewater management, etc.

We invite authors to contribute original high-quality research on recent advancements and practices in Environment Management. We encourage theoretical, experimental (in the field or in the lab), and empirical contributions. The journal will continue to promote knowledge and publish outstanding quality of research so that everyone can benefit from it.

Er. D. S. Mali
Editor, CIJE



CSIBER International Journal of Environment (CIJE)

Contents

A Review on Control Measures for Various Gerbera Diseases

Anagha A. Raut
Krishna Institute of Allied Sciences, Krishna Vishwa Vidyapeeth, Deemed to be university, Karad (Formerly known as Krishna Institute of Medical Sciences, Deemed to be university) Maharashtra, India – 415539

A.G. Pathade
Krishna Institute of Allied Sciences, Krishna Vishwa Vidyapeeth, Deemed to be university, Karad (Formerly known as Krishna Institute of Medical Sciences, Deemed to be university) Maharashtra, India – 415539

G.R. Pathade
Krishna Institute of Allied Sciences, Krishna Vishwa Vidyapeeth, Deemed to be university, Karad (Formerly known as Krishna Institute of Medical Sciences, Deemed to be university) Maharashtra, India - 415539

Abstract
Gerbera Jamesonii is a popular and colourful flowering plant that belongs to the Asteraceae family. Gerbera flowers are prized for their striking, daisy-like appearance and vibrant colours, making them a favourite choice for floral arrangements, bouquets, and gardens. Gerbera flowers hold both aesthetic and ecological importance, making them significant in various contexts like ornamental value, economic importance, gardening and landscaping, cultural and symbolic importance. Gerbera daisies are known to attract pollinators like bees and butterflies, which are essential for maintaining healthy ecosystems and supporting biodiversity. They can be used effectively in garden beds and borders to add bright splashes of colour. Their sturdy stems and long-lasting blooms make them popular in floral arrangements. They are often used in bouquets, centrepieces, and decorative displays. The gerbera plant is susceptible to various microbial diseases. Effective management of gerbera diseases involves a combination of awareness, preventive measures, and timely interventions. In this paper we are dealing with awareness about the diseases that affect gerbera plant, identification of pathogens as well as control measures which will be helpful for hobbyist gardeners as well as commercial growers.

Keywords- Gerbera, pathogen, control measures

Introduction:
Gerbera, scientifically known as *Gerbera jamesonii*, is a popular and widely cultivated flowering plant native to South Africa. It belongs to the Asteraceae family, which includes daisies, sunflowers, and asters. Gerbera is commonly referred to as the "African daisy" or simply "gerbera daisy."

Gerbera daisies are known for their striking and colourful flowers. They typically have large, single blooms with a prominent central disk surrounded by radiating petals. There are numerous cultivars and varieties of gerbera daisies, each with its unique flower colors, sizes, and characteristics. Gerbera daisies are perennial plants in their native habitat but are often grown as annuals or treated as tender perennials in temperate climates. They thrive in well-drained soil and require plenty of sunlight to produce abundant flowers. They are also popular choices for container gardening. Gerbera daisies typically bloom during the spring and summer months, although they can flower intermittently throughout the year under suitable conditions. Gerbera daisies are highly prized in the floral industry for their vibrant colors and long vase life. They are often used in bouquets, floral arrangements, and cut flower displays.

The genus Gerbera consists of about 40 species and amongst them only one species namely *G. jamesonii* is under cultivation (6).

Gerbera has great ornamental value due to the typical capitulum inflorescence that displays a great variety of colors, and to the floral stem, which is highly valued by consumers as individual vase decorations and bouquet compositions (Mata et al., 2009). Gerbera cultivars of commercial importance throughout the world are Zingaro (red), Vista (red), Dustty (red), Fredorella (red), Silvester (white), Delphi (white), Salvadore (yellow), Rosaline (pink), Davaellen, Goliath, Cream Clementine (creamy white), Maroon Clementine (orange), Flamingo (Pale rose), Uranus (yellow), Fredenking (yellow), Terra queen (Pink), Valentine (pink), Fredaisy (pink), Labalga (lilac) etc (6).

They are versatile and adaptable plants that can brighten up gardens, homes, and celebrations with their vibrant and cheerful blooms.

Importance of Gerbera:
The first official description of the South African species Gerbera jamesonii, also known as Transvaal daisy or Barberton daisy, was made by 1.D. Hooker in 1889 in the Curtis Botanical Magazine (Penningsfeld and Forchthammer 1980). It bears a large capitulum with prominent, yellow, orange, white, pink, or various red-colored ray florets (Hansen 1985). The breeding of gerbera started at the end of the 19th century in Cambridge, England, when two South African species. *G. jamesonii* and *G. viridifolia*, were crossed by RI. Lynch. He named the hybrid *Gerbera x cantebrigiensis*, known today also as Gerbera hybrid. Today, gerbera is known as an important article of trade and it belongs to the most important ornamental plant species in the world, together with rose, chrysanthemum, carnation, and tulip. In 1991 gerbera was ranked sixth in sales through Dutch flower auctions and it is sold both as cut flowers and pot plants (3).

The flowers are hardy and stand the rigors of transportation and a long keeping quality fetches a good market price. The species, a perennial herb, is native to South Africa and Asia. It is an important commercial flower grown throughout the world in a wide range of climatic conditions. Gerberas mostly inhabit temperate and mountainous regions. In India they are distributed in the temperate Himalayas from Kashmir to Nepal at altitudes from 1,300 to 3,200 m. Gerbera belongs to the family Asteraceae and can be propagated by both sexual and asexual methods. Most of the commercially grown cultivars are propagated through vegetative means, to maintain uniformity and genetic purity (7).

Gerbera is one of the top cut flowers in Europe in demand and a major portion of it is produced in various countries, including India (3).

Gerbera plays an important environmental role in the removal of chemical fumes and toxic gases according to a study of NASA (7).

Diseases of Gerbera:
Tetranychus urticae Koch, 1836 is considered a key pest of this and other ornamental plants. Several pests are known to be resistant to one or more pesticides used in flower cultivation. (11)

Alternaria leaf spot, bacterial leaf spot, bacterial blight, botrytis blight, fusarium rot, phytopthora crown rot, powdery mildew, pythium root rot, rhizoctonia crown rot and viruses are the diseases that occur in gerbera (Gary, 1995). Crown rot, root rot, bacterial blight, fusarium, powdery mildew, botrytis, are the major diseases of gerbera and root rot, fusarium wilt, powdery mildew are found prominently and are responsible for major yield loss(7).

Whitefly, leaf miner, thrips, red mites, cyclamen mites, caterpillar and root knot nematode are the major insects found in gerbera. These insect may attack the plant in any stages; and can cause huge loss in production as well as deteriorate the plant vigour and deform the plant (7).

Gerbera daisies (Gerbera jamesonii) are popular flowering plants known for their bright and colourful blooms. Like any plant, gerbera daisies can be susceptible to various diseases, which can affect their growth and overall health. Here are some common diseases that can affect gerbera daisies:

Powdery Mildew:
Powdery mildew is a fungal disease that appears as a white, powdery substance on the leaves and stems of gerbera daisies. It can lead to reduced photosynthesis and weakened plants.

Powdery mildew is major fungal disease in gerbera and can be caused by two species, Erysiphe *cichoracearum DC.* and *Podosphaera* (*Syn. Sphaerotheca*) *fusca* (Fr.) S. Blumer (8)

For the powdery mildew, the bio fungicide products tested when applied prior to disease infection may reduce powdery mildew significantly as compared to untreated. As a consequence, these products can be used as part of an integrated disease management program as an alternative to reduce the use of standard fungicides for the control of powdery mildew in gerbera daisy (8).

Botrytis Blight (Gray Mold):
Botrytis cinerea is a fungus that causes gray mold on gerbera daisies. It typically appears as brownish-gray spots on the leaves and flowers. *Botrytis* can lead to rotting and wilting of affected plant parts.

The temperature range in which *B. cinerea* could germinate and growin vitro is 5–30 °C. In climate chamber experiments flowers had more lesions of *B. cinerea* at temperatures of 20 and 25 °C than at 10 and 15°C. At 15, 20 and 25°C the infectivity of *B. cinerea* conidia was negatively affected during a storage-period of 7 days (10).

Therefore, if the flowers are maintained at 20 and 25°C gerbera can be protected from the *B. cinerea* conidia during their storage period.

Alternaria Leaf Spot:
Leaf spot diseases, caused by various fungi, can create circular or irregular spots on the leaves. These spots may be brown, black, or tan. In severe cases, the leaves may turn yellow and drop prematurely.

Alternaria leaf blight is one of the most important diseases of gerbera (*Gerbera jamesonii*) worldwide. The disease was prevalent in all the flower growing areas of Kashmir valley.

Symptoms of disease were observed on leaves and peduncles. However, lesions on peduncles were longer rather than round. The periodical observations of disease development revealed that Alternaria leaf blight in the field appeared in early May as small brown scattered spots which gradually enlarged in size and attained maximum diameter of 23 to 26 mm within a period of 55 to 59 days. These spots frequently coalesced to cover maximum leaf area. However, sporulation was observed when spots had obtained more than 4 mm size (3).

The sypmtoms at the initial stage of the infection were brown, small, scattered spots on the leaves that gradually become round or irregular. Spots coalesce to affect large areas of leaves and cause defoliation. Affected plants showed lower vitality, suppressed development and fewer, smaller, distorted shape of flowers. Fungal isolates, obtained from infected leaf tissues were grown in pure culture and on the basis of morphological characteristics of colony and conidia, the pathogen was identified as *Alternaria alternata*. The fungus produced effuse, olivaceous black colonies with dark olive-green margins, and abundant branched septate, golden-brown mycelium. The conidiophores were branched, straight, pale brown to olive brown. The pale brown conidia of the isolates were catenated in long, sometimes branched chains of 5-12 spores. The size of conidia varied from 20-63 µm in length and 9-18 µm in width and usually ovoid to ellipsoid or obclavate with short conical beak at the tip (5).

Gerbera cut flower business is becoming more channelized as many growers came in this business. Leaf folding, pseudo flowers, twins flower, escape pitting or cracking and stalk bending are the major physiological disorders seen during the gerbera production duration (7).

Integrated pest management (IPM) is a decision support system for the selection and use of pest control tactics, singly or harmoniously coordinated into a management strategy, based on cost/benefit analyses that take into account the interests of and impacts on producers, society, and the environment. In an IPM program, pest management is coordinated with production practices to achieve economic protection from pest damage while minimizing hazards to crops, human health, and the environment. The famers are also getting more yields of crops; more annual income and they had developed better leadership than the non-practitioners. IPM has been a widely accepted technology transfer platform for the policy makers, academicians, technicians and farmers in Nepal. The information regarding the occurrence of insect-pests and diseases on gerbera is scanty hence the present studies were undertaken to explore the prevalence of insect pests and diseases of gerbera and its management practices adopted in Kathmandu valley (7).

Root and crown rot Disease:
Root and crown rot diseases in gerbera are often caused by soil-borne pathogens, including various fungi and water molds. These diseases can lead to the decay of roots and the crown (the area where the stems meet the roots), ultimately resulting in wilting, yellowing, and death of the plant.

Farmers were using biological agents like *Trichoderma viridae* and *Pseudomonas* for the management of root rot, fusarium wilt and crown rot (7).

This is a fungal disease that affects the base of the plant, often near the soil line. It can cause dark, sunken lesions and eventually lead to the plant's collapse causes crown and stem rot.

Root rot is another fungal disease caused by overly wet soil conditions and is characterized by rotting of the plant's root system. It can lead to wilting, yellowing leaves, and eventual plant death.

Gerbera daisies are susceptible to root rot in waterlogged or poorly drained soils. Therefore should avoid soils with organic matter to improve drainage. Plant gerbera daisies should have provided with good air circulation. Crowded plants are more prone to fungal diseases. Garden must be kept free of debries and fallen leaves, as these can harbour pathogens must be removed and destroyed.

Bacterial Diseases:

Bacterial leaf spot disease on gerbera caused by Pseudomonas cichorii also is reported. The symptoms of this disease were: small to large spots, circular at first and then became irregular and dark brown to black spots. (6)

Viral Diseases:
Gerbera daisies can be susceptible to various virus diseases, including Gerbera mosaic virus and Tomato spotted wilt virus. Symptoms can include mottled or distorted leaves, stunted growth, and reduced flower production.

Plant viruses are infectious particle composed of a protein coat and a nucleic acid core. Viruses are classified by the type of nucleic acid they contain, and the shape of their protein capsule. Till date only RNA viruses are reported on gerbera, which may be of two types: single or double stranded. The single stranded RNA viruses are further divided into two, positive sense and negative sense. In gerbera mostly single stranded positive sense RNA [ss (+) RNA] viruses such as Tobacco mosaic virus (TMV), Tomato black ring virus (TBRV), Cucumber mosaic virus (CMV), Tobacco rattle virus (TRV) are reported. Contrary to that, a very few reports of single stranded negative sense RNA [ss(-)RNA] viruses are also reported in literature. The Tomato spotted wilt virus (TSWV) and Impatiens necrotic spot virus (INSV) are the tospovirus, and their genome consists of single stranded one negative and two ambisense single-stranded RNAs (6).

It was noticed that greenhouse-grown *G. jamesonii* plants were showing severe malformations of flowers and necrotic spots on the leaves.

Diseases caused by CMV in Gerbera
Cucumber Mosaic Virus is a plant pathogenic virus that affects a wide range of host plants, including gerbera daisies. This virus is known for causing mosaic-like symptoms on the leaves of infected plants.

CMV is the member of genus Cucumovirus in the family Bromoviridae. CMV infection is characterized by severe chlorotic mosaic, greening of veins on leaves, color breaking in florets accomplished with flower deformations, and poor growth of the bloom. It causes yellowing and mottling in gerbera leaves.

Diseases caused by TRV in gerbera
TRV typically refers to "Tobacco Rattle Virus." Tobacco Rattle Virus is a plant virus that affects a variety of crops, including ornamental plants like gerbera daisies. It is transmitted by soil-inhabiting nematodes, particularly the species Trichodorus and Paratrichodorus.

TRV is an important plant pathogenic virus of family Virgaviridae of genus Tobravirus. The leaves showed ring spots and light green line patterns, which in older leaves often became necrotic.

TRV is transmitted by nematodes. Managing nematode populations in the soil is crucial. Crop rotation, use of nematode-resistant plant varieties, and soil treatments are the methods to control nematode populations.

While TRV is transmitted by nematodes, other pests, can also vector the virus. Integrated pest management strategies are implemented to control vectoring insects.

Diseases caused by INSV in gerbera
INSV Impatiens Necrotic Spot Virus or Indian Peanut Clump Virus, is a plant virus that primarily affects eanut plants. It belongs to the genus Tospovirus. However, in the context of gerbera daisies, another virus with a similar acronym, INSV, refers to Impatiens Necrotic Spot Virus. Impatiens Necrotic Spot Virus is a member of the Tospovirus genus and is known to infect a wide range of plants, including gerbera daisies. INSV is easily mechanically transmissible, often causes severe damage on infected plants, and spread rapidly through insect vector (Thysanopthera).

Impatiens Necrotic Spot Virus (INSV) can cause several symptoms in gerbera plants. Some common symptoms associated with INSV infection include:

Ring Spots: Circular or ring-like patterns of discoloration on leaves.

Necrosis: Necrotic (dead) areas on leaves, often appearing as brown or black lesions.

Leaf Curling: Infected leaves may exhibit curling or distortion.

Stunting: Reduced growth and stunted plant development.

Yellowing: Yellowing of leaves, which may resemble nutrient deficiencies.

Mosaic Patterns: Mottled or mosaic patterns on leaves.

Management of viral diseases in gerbera

Management of viral diseases is much more difficult than that of diseases caused by other pathogens because the viral diseases have a complex disease cycle, efficient vector transmission and no effective virucides available. Integration of various approaches like the avoidance of sources of infection, control of vectors, cultural practices (conventional) and use of resistant host plants (non-conventional) have been used for the management of diseases caused by plant viruses (6).

By Cultural Practices:

Prevention is the key for managing the viral diseases because virus-infected plants cannot be cured. If viral infection is suspected in gerbera plants, samples should be sent to testing facilities to confirm the presence of the virus. Once the disease has been identified, the only management option is to discard infected plants (Whipker, 2014). However, managing the vector of the virus, the spread of western flower thrips can be minimized. This can be done using strategies to physically exclude the pests such as installing fine mesh screens (mesh size < 135 nm) on external openings to prevent entry of thrips vectors into the greenhouse. Monitoring using indicator plants, such as petunia, or sticky cards can be helpful to provide early warnings of the presence of *F. occidentalis* (Allen and Matteoni, 1991). It is worthwhile to mention that western flower thrips can acquire virus at larval stage and it can transmit the TSWV and if we prevent adults from developing, transmission of the virus may be prevented (6).

By Sanitation:

It is well known fact that sanitation of the cultivation fields reduces infection and enhances crop production by many folds.

All plant debris as well as weeds and flowering plants growing nearby production areas must be removed as these can be sources of new infections and infestations. It was suggested that soil sterilization can also eliminate the developmental stages of vector species (6).

By Biological Controls:

Thrips are tiny, slender insects belonging to the order Thysanoptera. They are pests in agriculture and horticulture, as they can damage crops by feeding on plant tissues and transmitting plant viruses. There are many species of thrips, and they can be difficult to control once they infest a plant.

Biological controls can be effective for controlling of insect species when their populations are low. Some predator species have been identified for control of western flower thrips. These are *Euseius stipulatus*, *Metaseiulus occidentalis* (Nesbitt), *Amblyseius andersoni* (Chant), *Amblyseius scutalis* (Athias-Henriot), and *Amblyseius* (Euseius) *tularensis* (Congdon).

Lady beetles (Coleoptera: Coccinellidae), ladybugs, or ladybird beetles are among the most visible and best known beneficial predatory insects (6).

By Use of Virus-Free Gerbera Planting Material

Viruses spread from mother plant to their progenies through planting of infected cuttings, tubers and other vegetative plant materials that have great possibility of virus transmission. Consequently, population of plants may become infected by the virus if not protected timely and hence reliable early diagnosis of viruses is essential for designing their efficient disease management. Use of virus-free planting material and their transplantation in greenhouses has been suggested for better crop production (6).

General Precautions

The problem of Leaf folding can be prevented by ensuring consistent and adequate humidity levels in the greenhouse or growing area to prevent excessive transpiration, which can lead to leaf folding.

Appropriate support must be provided to the gerbera stems to prevent bending. Stake plants as needed to ensure upright growth. Also, during the storage should be kept in good condition.

There's a need to keep detailed records of growing practices, environmental conditions, and any observed disorders.

Conclusion:

There are many pathogens that can affect the growth of the gerbera plant such as Insect-pest, fungi, bacteria and viruses. Control of these insects and viruses can help good growth of the plant.

The various diseases that can harm the gerbera plant are reviewed with the possible identification and solutions to it. This can help the growers to identify the diseases and know more about the cause of the disease. It can make more awareness about the disease and its prevention.

The general precautions, sanitation and hygiene are important to the plant, with well-maintained conditions in the polyhouse to protect the plant.

The information compiled will be helpful for gerbera hobbyist gardeners as well as commercial growers, which will ultimately improve the financial and social standing of farmers who are involved in the gerbera industry. Additionally, a strategy for managing diseases has been proposed, such as biological control of virus-transmitting vectors in nature, regular monitoring and prompt action can help keep gerbera daisies healthy and free from diseases.

Acknowledgement-
I take this opportunity to express my profound gratitude and indebtedness to Head and Dean, Krishna institute of Allied sciences, (KVVDU) Karad for availing to carry out the work and his guidance. We are also grateful to teaching, non-teaching staff of the institute for their co-operation during this course of my work.

Conflict of Interest- There are no conflict of interest amongst authors.

References

Bhat, H. A., Ahmad, K., Ahanger, R. A., Qazi, N. A., Dar, N. A., & Ganie, S. A. (2013). Status and symptomatology of Alternaria leaf blight (*Alternaria alternata*) of Gerbera (*Gerbera jamisonii*) in Kashmir valley. African journal of agricultural research, 8(9), 819-823.

Chudali, B., Shrestha, S., Rajbhandari, B. P., & Sah, L. P. (2020). Status of insect pests and diseases associated with gerbera in Kathmandu valley. Nepalese Journal of Agricultural Sciences 2020, volume 19, 82.

Elomaa, P., Teeri, T.H. (2001). Transgenic Gerbera. In: Bajaj, Y.P.S. (eds) Transgenic Crops III. Biotechnology in Agriculture and Forestry, vol 48. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-10603-7_11

Faraje, F. M. H., Mustafa, H. A., & Latif, S. A. A. (2020). Effect of biofertilizers and carbolizer on population density of green peach aphid Myzus persicae on Gerbera jamesonii (bolus) in greenhouse. Kufa Journal for Agricultural Sciences, 12(1), 11-17.

Farhood, S., & Hadian, S. (2012). First report of Alternaria leaf spot on Gerbera (*Gerbera Jamesonii* L.) in North of Iran. Adv. Environ. Biol, 6(2), 621-624.

Gautam, K. K., Kumar, S., & Raj, S. K. (2021). Current status of viral and phytoplasma diseases affecting gerbera cultivation and their management. Acta Phytopathologica et Entomologica Hungarica, 55(2), 133-150.

Kanwar, J. K., & Kumar, S. (2008). In vitro propagation of Gerbera-A review. Hort. Sci. (Prague), 35(1), 35-44.

Moyer, C., & Peres, N. A. (2008). December). Evaluation of biofungicides for control of powdery mildew of gerbera daisy. In Proceedings of the Florida State Horticultural Society (Vol. 121, pp. 389-394).

Paladugu, Y. (2020). Incidence and management of sucking pests on gerbera under protected cultivation (Doctoral dissertation, Department of Agricultural Entomology, College of Agriculture, Vellayani).

Shoemaker PB and Lorbeer JW (1970). the role of dew and temperature in the epidemiology of Botrytis leaf blight of onion. Phytopathology 61: 910

Silva, E. A., Reis, P. R., Carvalho, T. M. B., & Altoé, B. F. (2009). *Tetranychus urticae* (Acari: Tetranychidae) on *Gerbera jamesonii* Bolus and Hook (Asteraceae). Brazilian Journal of Biology, 69, 1121-1125.

Singh, H., & Kaur, T. (2020). Pathogenicity of entomopathogenic fungi against the aphid and the whitefly species on crops grown under greenhouse conditions in India. Egyptian Journal of Biological Pest Control, 30(1), 1-9.