

## USE OF ORNAMENTAL PLANT AS PHYTOREMEDIATION IN REDUCING THE RISK OF COVID 19: A REVIEW

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### Abstract

Coronaviruses are minute in size, group of viruses that are positive, single stranded RNA. Coronaviruses group are made up of four subfamily, Alphacoronaviruses, Betacoronaviruses, Gammacoronaviruses and Deltacoronaviruses. These viruses are zoonotic in nature, can be transmitted from animal to man. In December 2019, it was identified in Wuhan and since then it has travelled globally. Coronavirus disease is a pandemic disease that has caused the death of many and has posed great threat to human health. The virus responsible for the disease is called Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV- 2) the disease it caused is Coronavirus disease 2019 (COVID 19). According to WHO Statistics, air pollution kills 7 million people worldwide annually, there is no doubt that it has caused severe health problem in human (respiratory disease, cancer, stroke, cardiovascular illness). It can act as a carrier for the virus thereby weakens the immune system, as a result of this underlining illness, triggers complications in COVID 19 patients leading to death. Although, eradication of air pollution seems almost impossible, but it can be reduced by ornamental plant acting as natural filter. Ornamental plants absorb gases (pollutants) through their stomata, surface area of leaves, intercept Particulate matter on their leaves and they release oxygen as well. According to research, it has been concluded that Ornamental plants function as natural filters.

**Keywords:** Coronavirus, Covid 19, Particulate matter, Ornamental plants.

### Introduction

A novel virus was identified in Wuhan in December 2019, due to high number of Pneumonia cases of unknown source, samples collected from affected patients shows that the Pneumonia symptoms was caused by an infection with a virus. The pathogen was identified and named Severe Acute Respiratory Syndrome Corona Virus 2 (SARS – CoV-2), (Manoj, et. al.,2020; Travaglio et. al.,2020), the disease it caused is called Coronavirus disease 2019 (COVID 19). Coronaviruses are member of the Kingdom Orthornavirae, Class Pisoniviricetes, Order Nidovirales, Family Coronaviridae and Subfamily Coronavirinae. (King et al., 2012).

These viruses are minute in size, the length of the viral genome is between 26-32 kbs, they are made up of positive, single stranded RNA. (King et al., 2012). Coronaviruses family are made up of four sub groups namely, Alphacoronaviruses, Betacoronaviruses, Gammacoronaviruses, Deltacoronviruses. These viruses infect birds and mammals, although Alpha and Betacoronaviruses infect mainly mammals while Gamma and Delta coronaviruses infect birds mainly but some can infect mammals as well (Cui, et al., 2019). Coronaviruses are zoonotic, meaning they can be transmitted from animal to man, they are as well the root cause of some illness in man such as Common cold, Fever, Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV). (WHO, 2020)

Air pollution can be defined as existence of harmful substance in the atmosphere that has negative effect on both human and other living organisms. (Jilian Mackenzie, 2016). Air pollutants are everywhere both indoor and outdoor, they are grouped into three, Gases (Ammonia, Carbon monoxide, Sulfur dioxide, etc), Particulates (Particulates matters forms are, PM<sub>10</sub> and PM<sub>2.5</sub> metals having harmful effect) and Biological molecules.; (Khallaf 2011). There is no doubt that air pollutants are detrimental and pose great threat to human health, studies have revealed that the consequence of being exposed to air pollutants have effect on the respiratory, cardiovascular, ophthalmologic, dermatologic, neuropsychiatric, hematologic and reproductive systems. (Ghorani-Azam et. al., 2016).

Ornamental plants are plants grown mainly for aesthetic purposes, it can be in form of a shrub, broad leaf, evergreen, deciduous, palms, etc, (Encyclopedia, 1979) although they are grown majorly for beautification they perform other functions like removal of air pollution, this is done through the stomata, they help in removing carbon from the air and is being captured in plants, function in the production of oxygen, removal of dust and reduction of glare (Bayewu and Olayiwola, 2005; Kapoor, 2017; Grupta and Dube 2018)

## History of Coronavirus

In 1960, a nasal washing was collected from a young boy having cold, the virus was cultivated and termed B814 by Tyrell and Bynoe in Salisbury. Hamre and Procknow discovered a new virus almost at the same time with Tyrell and Bynoe, from nasal secretion gotten from a group of some medical students in 1962, specimen was collected from five individuals, although four individual were suffering from cold, an isolate of specimen 229E from student was identified as prototype strain, both viruses B814 and 229E were subjected and examined under an electron microscope, the result pointed out that they are identical morphologically. (Myint, 1994).

The discovery of Human Coronaviruses (HCV) came about when the agent of common cold was being researched about, in 1962 (Hierholzer, and Tannock, 1988). International Committee on Taxonomy of Viruses classified these viruses within the *Coronaviridae* family, they were termed coronaviruses because they were all characterised by spikes projecting from the membrane, (Hierholzer, and Tannock, 1988; Tyrell et al., 1968)

## The Disease Covid 19

Over the years, a lot of coronaviruses have been discovered, but seven (7) viruses have been said to cause disease in human. Four out of the seven viruses are responsible for common cold symptoms (229E and OC43), serotypes NL63 and HUK 1 are related with common cold as well, three amidst the seven viruses are responsible for severe respiratory infections in human. (Brenda L., 2020). SARS-CoV-2 (responsible for coronavirus disease), the name was given by the International Committee on Taxonomy of Viruses (ICTV), February 11, 2020, while WHO announced the name of the disease as “COVID 19”. (WHO, 2020). MERS-CoV identified in 2012 is said to be responsible Middle East Respiratory Syndrome disease, SARS-CoV-2, responsible for an outbreak of Severe Acute Respiratory Syndrome in 2003. (Brenda L., 2020).

## Covid 19 in Nigeria

Index case was discovered in Nigeria on 24<sup>th</sup> of February, 2020 (NCDC, 2020) and since then the virus has spread from states to states. As of 14<sup>th</sup> September, 2020 Nigeria has 56,388 confirmed cases with 37 States affected including the Federal Capital Territory, 35,773 male while 20,615 female. Globally 28,918,900 confirmed cases with 922,252 deaths. Although, Nigeria has been grouped as one of the 13 high-risk African countries with weak state of health care system. (Marbot, 2020; Amzat *et. al*, 2020). To curtail the spread of this virus, different measure was put in place by the Federal government which includes, an initial lockdown of non-essential activities, closure of schools, ban on international flight, ban was placed on large gatherings, people being advised to use face mask etc, although the lockdown is being eased in phases. (NCDC, 2020)

## Air Pollution

Air pollution is the presence of harmful substance in the atmosphere that can bring about or pose threat to human health, have negative effect on living organisms and the environment at large. (Admassu, and Wubeshet, 2011). Air pollutants are everywhere can be outdoor or indoor. According to WHO, air pollution is the world largest single environmental health risk, if this menace can be combated, millions of lives will be saved. According to WHO to 2012, both indoor and outdoor air pollution can cause cardiovascular diseases (Ischaemic heart disease), cancer, respiratory diseases (Acute Respiratory Infections and Chronic Obstructive Pulmonary Disease), WHO, 2012.

The Assistant Director-General Family, Women and Children’s Health says, to prevent chronic diseases and minimize disease risk, the air we breathe in should be clean. People died as a result of cardiovascular diseases majorly, due to polluted air.

Outdoor air pollution-caused deaths – breakdown by disease;

40% - ischaemic heart disease;

40% - Stroke;

11% - Chronic Obstructive Pulmonary Disease (OCPD)

6% - lung cancer

3% - acute lower respiratory infections in Children.

Source; WHO, 2012.

Indoor air pollution – caused deaths – breakdown by disease

34% - Stroke;  
 26% - ischaemic heart disease  
 22% - COPD;  
 6%- lung cancer  
 Source; WHO, 2012.

**Major Outdoor Air Pollutant Sources and There Effects in Public Health.**

Pollutants	Sources	Effects
Ozone (O <sub>3</sub> )	Formed when Nitrogen Oxide and Volatile Organic compounds mix in sunlight.	Frequent Asthma, Sour throat, breathing difficulty.
Carbon dioxide (CO <sub>2</sub> )	Burning oil, coal and natural gases	Vision defects, reduces respiration and brain function.
Carbon Monoxide (CO)	Fossil fuels, furnaces and heaters	Dizziness, Headaches.
Nitrogen dioxide (NO <sub>2</sub> )		Cough, short breath, respiratory infections, defect in lungs.
Sulphur dioxide (SO <sub>2</sub> )	Industrial processes, coal, oil in power plant	Irritation of the eyes and nose, respiratory inflammations.
Toxic Air Pollutants	Chemical plants.	Cancer
Suspended Particulate Matter (PM <sub>10</sub> PM <sub>2.5</sub> SPM)	Mixture of solid and liquid organic and inorganic materials.	Respiratory illness, Abnormal lungs gas exchange functions.

Source:( Kapoor, 2017; Jonathan Levy, Harvard School of Public Health. Based on information provided by the Environmental Protection Agency).

**How Air Pollution Triggers Covid 19**

A study was conducted at Harvard University( Study awaiting peer review) revealed that an individual exposed to high-particulates pollution has 8% likelihood to die when compared with the individual less exposed (just one small unit less),(Paul Costello, 2020). To corroborate this, another study was conducted in Italy deduced that air pollution can trigger fatality rate due to Covid 19 infection. (Bon Lau, 2020).Particle pollution are particles that can be inhaled, (PM<sub>10</sub> inhalable particles & PM<sub>2.5</sub> fine inhalable particles), Particulate matters with diameter of size 2.5 are fine particles that can be inhaled deeply even to the lungs and can travel all through the body, this can result in chronic disease in human. It is important for us to understand the level of pollutants our body can tolerate, with this we know how vulnerable our body may be to this disease. (Paul Costello, 2020; United States Environmental Protection Agency, 2018).

An individual that has been exposed to pollution, the immune system of that individual is suppressed as a result of the exposure and thereby increasing the risk of death when infected with the disease. (Bon Lau, 2020). A review also identified that people with prior Chronic disease (Diabetes, Hypertension, Respiratory System Disease) and Cardiovascular disease are more susceptible to Covid 19 by triggering proinflammatory responses that can cause weak immune system. (Bon Lau, 2020).

**Ornamental Plant, Phytoremediator**

The removal of air pollution from the atmosphere is part of the important function that plants performs, they also reduce heat build-up and remove dust from the air (Baiyewu et al, 2005; Kapoor, 2017), and beautify the environment. In choosing an ornamental plant, location, purpose, adaptability to soil, weather, all this factors varies widely and they should be considered, the vulnerability of plant species to air pollutants varies as well.

**Features of Ornamental Plants That can be Used to Reduce Pollution**

The important factors to consider in the ornamental plants to be used are evergreen, large leaved, rough bark, native to the environment, ecologically compatible, low water requirement, minimum care, high absorption of pollutants, resistant pollutants, canopy spread, aesthetic features (attractive flower) ability to tolerate pollution and remove dust (Reshma et al, 2017; Kumar et al., 2013).

Ways in which plants and trees reduce air pollution includes, (Brethour et al., 2007; Reshma *et al.*, 2017; McPherson, 2005).

- Absorption of gases through their leaves and stomata
- They intercept Particulate Matter on plant surfaces.
- Oxygen is released through the process of photosynthesis
- Transpiration and shading of building surfaces occurs, which lowers local air temperature.
- Lowering of Parking Lot temperatures and Cars been shaded reduces evaporative emissions of hydrocarbon from fuel tanks and hoses. (McPherson, 2005).

### Scientific Research on Phytoremediation of Ornamental Plants.

Research have shown that, some ornamental plants can remove some toxic gases (Ammonia, Formaldehyde, Toluene, Volatile Organic Compounds) from the environment (Kapoor, 2017). A study was conducted using commonly used ornamental species 28 in number, for interior plantscapes to examine their ability to remove volatile pollutant, Aromatic hydrocarbon (Benzene and Toluene), aliphatic hydrocarbon (octane), halogenated hydrocarbons {(trichloroethylene TCE)}, and terpene (a-pinene). Four ornamental species, *Hemigraphis alternata*, *Hendera helix*, *Hoya carnososa*, and *Asparagus densiflorus* exhibited greater removal efficiency for all pollutants, *Tradescantia pallida* displayed higher removal efficiency for four VOCs out of five (i.e benzene, toluene, TCE and a-pinene ). Their removal efficiency ranged among the five species from 26.08 to 44.4 g/m<sup>3</sup>.m<sup>2</sup>/h of the total VOCs. *Fittonia argyroneura* effectively removed benzene, toluene and TCE, *Ficus benjamina* effectively removed octane and a-pinene, moreso, *Polyscias fuiticosa* effectively removed octane. Due to variation in removal of efficiency among the species, multiple species are require for optimum improvement of indoor air quality.

Enete and Ogbona worked on five species of outdoor ornamental shrubs (Ixora Red, Yellow Bush, Masquerade Pine, Tuja Pine and Yellow ficus) reported that Ixora Red had the highest Air Pollution Tolerance Index while Yellow bush with the lowest, Ixora Red tolerate pollutants more when compared to other ornamental plants. (Enete and Ogbona, 2012; Reshma *et al.* 2017). Gawronska and Bakera, 2014 also conducted a study on removal of Particulate Matter from indoor air using Spider plant, it was revealed that spider plants accumulates Particulate Matter and also contribute to air quality. Moreso, the report of the research conducted by Abass et al., 2017 on indoor plant for passive removal of indoor ozone, also reported that indoor plants removed ozone moderately from indoor air. (Abass et al., 2017; Sharma et al., 2019).

### Clean Air Reduces the Risk Of Covid 19

Wu *et al.*, 2020 reported that part of the factors that increases death rate of Covid 19 is air quality, underlined health issues ( respiratory and cardiovascular) of some people, aggravated the risk of death ratio (Karuppasamy, 2020) when infected with the virus.

WHO reported that dirty air leads to the death of 7 million annually, this occurs as a result of people being exposed to polluted air. e.g Particulate Matters, when inhaled, causes some health challenges e.g Hypertension, Heart disease, Breathing trouble and diabetes, all this aggravates complications in Coronavirus patients which can lead to death, but an individual that is less exposed to polluted air, without underlined health issues, have more chance of survival when infected with the virus. (Beth Gardiner, 2020)

### Conclusion

To combat the menace of respiratory illness as a result of polluted air, which increases death rate of Coronavirus patients, planting of ornamental plants both indoor and outdoor is important, helps in cleaning the air i.e (absorbing the pollutants) and making the environment more conducive which reduces mortality rate. (Business Insider, 2019).

### References

Abbas, O. A., Sailor, D.J., & Gall, E.T. (2017). Effectiveness of indoor plants for passive removal of indoor ozone. *Building and Enviroment*, 119, 62-70.



- Abd El Aziz, N.G., Mahgoub, M.H., Azza, .M.M., Farahat, M. M. & Abouziena, H.F. (2015). Potentiality of ornamental plants and woody trees as phytoremediators of pollutants in the air: a review. *International Journal of Chem Tech Research*, 8 (6), 468-482.
- Admassu, M., & Wubeshet, M. (2011). For Environmental Health Science Students. *E. Miaskiewicz-Peska and M. Lebkowska*, "Effect of antimicrobial air filter treatment on bacterial survival," *Fibres & Textiles in Eastern Europe*, 19, 1.
- Amzat, J., Aminu, K., Kolo, V. I., Akinyele, A. A., Ogundairo, J. A., & Danjibo, M. C. (2020). Coronavirus outbreak in Nigeria: Burden and socio-medical response during the first 100 days. *International Journal of Infectious Diseases*, 98, 218-224.
- Beth, Gardiner (2020) National Geographic Pollution made COVID-19 worse. Now lockdowns are clearing the air. [http://www.google.com/amp/s/api.nationalgeographic.com/distribution/public/\\_amp/science/2020/04/pollution-made-the-pandemic-worse-but-lockdowns-clean-the-sky](http://www.google.com/amp/s/api.nationalgeographic.com/distribution/public/_amp/science/2020/04/pollution-made-the-pandemic-worse-but-lockdowns-clean-the-sky).
- Baiyewu, R.A., Amusa, N.A., & Olayiwola, O. (2005). Survey on the use of ornamental plants for environmental management in Southwestern Nigeria. *Research Journal of Agriculture and Biological Sciences*, 1(3), 237-240.
- Brenda L. Tesini, M.D University of Rochester School of Medicine and Dentistry, Coronaviruses and Acute Respiratory Syndromes (Covid-19, MERS and SARS), 2020.
- Brethour, C., Watson, G., Sparling, B., Bucknell, D. & Moore, T. (2007). literature review of documented health and environmental benefits derived from ornamental horticulture products. final reports. George Morris Centre, [http://www.deenelandscaping.com/UsersFiles/file/Morris\\_Report.pdf](http://www.deenelandscaping.com/UsersFiles/file/Morris_Report.pdf)
- Business Insider, India (2019).  
[http://www.google.com/amp/s/www.businessinsider.in/india/news/these-10-outdoor-plants-can-save-you-from-air-pollution/amp\\_article/show/71917238.cms](http://www.google.com/amp/s/www.businessinsider.in/india/news/these-10-outdoor-plants-can-save-you-from-air-pollution/amp_article/show/71917238.cms)
- Cui, J., Li, F., & Shi, Z. L. (2019). Origin and evolution of pathogenic coronaviruses. *Nature Reviews Microbiology*, 17(3), 181 – 192.
- Dubbey, S., Shri, M., Gupta, A., Rani, V., & Chakrabarty, D. (2018). Toxicity and detoxification of heavy metals during plant growth and metabolism, *Environmental Chemistry Letters*, 16(4), 1169-1192.
- Enete, I. C., & Ogbonna, C. E. (2012). Evaluation of Air Pollution Tolerance Index (APTI) of Some Selected Ornamental Shrubs in Enugu City, Nigeria. *IOSR Journal of Environmental Science, Toxicology and Food Technology* (IOSR-JESTFT. Volume 1 (2): 22, 25.
- EARTH.ORG; Bon Lau, (2020), How Air Pollution Contributes To the Spread of COVID-19. <https://earth.org/air-pollution-exacerbating-the-spread-of-covid-19/>
- Ghorani-Azam, A., Riahi-Zanjani, B., & Balali-Mood, M. (2016). Effects of air pollution on human health and practical measures for prevention in Iran. *Journal of research in medical sciences : the official journal of Isfahan University of Medical Sciences*, 21, 65. <https://doi.org/10.4103/1735-1995.189646>.
- Hierholzer, J. C., & Tannock, G. A. (1988). Coronaviridae: the coronaviruses. In *Laboratory Diagnosis of Infectious Diseases Principles and Practice* (pp. 451-483). Springer, New York, NY.
- How Air Pollution Contributes To The Spread of Covid 19, Bon Lau, 2020)  
<https://earth.org/air-pollution-exacerbating-the-spread-of-covid-19/>
- Iuliana Florentina Gheorghie and Barbu Ion (September 26th 2011). The Effects of Air Pollutants on Vegetation and the Role of Vegetation in Reducing Atmospheric Pollution, The Impact of Air Pollution on Health, Economy, Environment and Agricultural Sources, Mohamed K. Khallaf, IntechOpen, DOI: 10.5772/17660. Available from: <https://www.intechopen.com/books/the-impact-of-air-pollution-on-health-economy-environment-and-agricultural-sources/the-effects-of-air-pollutants-on-vegetation-and-the-role-of-vegetation-in-reducing-atmospheric-pollu>





- Jonathan Levy, Harvard School of Public Health. Based on information provided by the Environmental Protection Agency).
- Khallaf, M. (Ed). (2011). The impact of air pollution on health, economy, environment and agricultural sources. BoD- Book on Demand.
- Kapoor, M. (2017). Managing ambient air quality using ornamental plants-an alternative approach. *Universal Journal of Plant Science*, 5(1), 1-9.
- Karuppasamy, M.B., Seshachalam, S., Natesan, U. et al. Air pollution improvement and mortality rate during COVID-19 pandemic in India; global intersectional study. *Air Qual Atmos Helath* (2020). <https://doi.org/10.1007/s11869-020-00892-w>
- King, A. M.Q., Adams, M.J., Carstens, E.B., & Lefkowitz, E. J. (2012). Order-tymovirales, virus taxonomy. <https://en.wikipedia.org/wiki/Coronaviridae>.
- Kurmar, R.S., Arumugam, T., Anandakumar, C.R., Balakrishnan, S. and Rajavel, D.S. 2013. Use of Plant Species in Controlling Environmental Pollution-A Review. *Bull. Env. Pharmacol. Life Sci.*, 2 (2): 52-63.
- Marbot O. Coronavirus Africa Map; Which countries are most at risk?. 2020 <http://www.theafricareport.com/23948/coronavirus-africa-which-countries-are-most-at-risk/>
- Marco Travaglio, Yizhou Yuks between air pollution and COVID-19 in England Marco Travaglio 1, Yizhou Yu 1 4, Rebeka Popovic, Liza Selley, Nuno Santos Leal, and Luis Miguel Martins MRC Toxicology Unit, University of Cambridge Correspondence to: L. Miguel Martins, e-mail: martins.lmiguel@gmail.com 1 Equal contributions.
- Manoj, M. G., Kumar, M. S., Valsaraj, K. T., Sivan, C., & Vijayan, S. K. (2020). Potential link between compromised air quality and transmission of the novel corona virus (SARS-CoV-2) in affected areas. *Environmental Research*, 110001.
- McPherson, E. G. (2005). Trees with Benefits. *American Nurseryman* April: 34-40 Myint, S. H. (1994). Human coronaviruses: a brief review. *Reviews in Medical Virology*, 4(1), 35.
- Reshma, V.S., Kumar, P., & Chaitra, G.S. (2017). Significant Role of Ornamental Plants as Air Purifiers – A Review *Int. J. Curr Microbiol App Sci*, 6, 2591-2606.
- Sawidis, T., Marnasidis, A., Zachariadis, G., & Stratis, . (1995). A Study of air pollution with heavy metals in Thessaloniki city (Greece) using trees as biological indicator. *Archives of Environmental Contamination and Toxicology*, 28 (1), 118-124.
- Sharma, P., Toma, P.C., & Chapadgaonkar, S.S. (2019). Phytoremediation of indoor pollution-a mini review. *World J. Pharma Res*, 8, 2136-2143
- Stanford University, Why Air Pollution Linked To Severe Case of Covid 19 (Paul Costello, 2020). <https://scopeblog.stanford.edu/2020/07/17/why-air-pollution-is-linked-to-severe-cases-of-covid-19/>. United States Environmental Protection Agency, 2018
- World Health Organization, (2020), Coronavirus disease: What you need to know <https://www.afro.who.int/news/coronavirus-disease-what-you-need-know>).