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A Study on Combating COVID-19 Aerosol Transmission by way of Spraying Organic Solution using hybrid Approach of Drones and Mist Blower

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ABSTRACT

A novel Corona Virus, SARS-CoV-2 (Covid-19) was declared a global health pandemic that caused severe respiratory infections in humans and animals. Initial research has found that the spread of this viruses can occur effectively often in the form of micro-droplets (size >5µm) and deposition of such droplets on surfaces. Hence the requirement of "social- distance" is about 1.5m to be kept between individuals. Such droplets were found to persist on various inanimate surfaces ranging from 4 hrs to 72 hrs and days (depending on the inoculum shed). In the same study, it was also found that the virus can remain viable and infectious in aerosols (size<5µm) for hours and that aerosol transmission of SARS-CoV2 is also plausible. Further studies in this line also suggested that converging lines of evidence indicate that SARS-CoV-2, the coronavirus responsible for the COVID-19 pandemic, can pass from person to person in tiny droplets called aerosols that drift through the air beyond 1.5m and accumulate over time. Disinfectant sprays were found to be effective in preventing the transmission of Covid-19 Virus in indoors as they were easily inactivated by biological or chemical disinfectants by spraying in the indoor air and wiping the surfaces. A study in this regard has in fact found them to be effective in indoor hospital environments in arresting the spread. However given the emerging evidence on aerosol transmission spraying disinfectants across large masses of land presents a challenge. Also many of the existing chemical disinfectant are harmful to humans, animals or to the environment. Hence, the present study is to study the effectiveness of aerial spraying of bio disinfectants using a combination of drones and mist blowers fitted with specialty sprinklers capable of spraying the disinfectant in the form of nano-sized mist to bind the aerosol based SARS-CoV 2 able to control the transmission in open spaces and outdoor environments. This method was found to be effective in containing the infection in sprayed areas compared to unsprayed areas at minimal cost, time and human interacts and also avoiding the adverse health effects caused by chemical disinfectants. The efficacy of the study was verified by comparing zone-wise covid-19 data, before and after the disinfectant shower. Further, covid-19 reduction rate due to aerial disinfectant spray has been cross verified with nearby district covid-19 data and the operation was found to be more effective. The study proposes an effective and Safe Aerial Spray Mechanism to disrupt the covid-19 transmission and necessary changes needed in government policies for operating drones to reduce the workload and risks in the overall public health system. Keywords: Covid-19, Transmission, Persistent in Aerosol and Surface, Control Measures, Aerial Disinfectant Spray, Mist Blower, Air Viral Load Test, Efficacy Study, Recommendations for outbreak.

I. INTRODUCTION

Corona virus belongs to a large group of viruses that causes the disease namely COVID-19 affecting humans or animals (Swain et al., 2021) which is presently called SARS-CoV-2. It appeared in Wuhan city, China, in December 2019 and is currently producing a pandemic situation (Mohammed et al., 2020). In India the first COVID-19 case was identified on 30th January 2020 in the state of Kerala (Sharma, 2020). The virus can be transmitted from the infected person to a neighbor (within one feet to six feet distance) through contagious respiratory droplets emitted during coughing or sneezing (Swain et al., 2021). COVID-19 is widely expressed as an airborne illness.

The corona virus can survive on different surfaces from the several hours (paper, aluminum, copper, and cardboard) up to a few days (plastics,stainless steel, plastics, wood, ceramics, glasses and metal) (Nazario, 2020; Van Doremelan, 2020; Swain et al., 2021). Covid viruses persist around five minutes to five days based on different surfaces or objects. India's response against the first wave of COVID-19 has shown reasonably good results in terms of number of deaths and high recovery rates. In second wave of COVID-19, the state and central government have taken various measures to control the impacts by enacting lockdown procedures. However, there is increase in the number of deaths and the recovery cases are also low when compared to the amount of infected cases of COVID-19. Therefore, to significantly disrupt the viral transmission chain, the government should employ the recent advanced scientific spraying technologies along with the present aware- ness programs and restriction protocols. The Unmanned Aerial Vehicles (UAVs), also called as Drones, are a new technology that has extended its operational capabilities to various fields such as the mining,surveying, , agriculture, forestry management and logistics and among others (Saari et al.,2017; Gonzalez- Jorge et al., 2017; Beck et al., 2020; Duarte et al., 2020; Outay et al., 2020). Drones have been used for spraying disinfectants in various countries to control COVID-19 spread. In Dubai, the drones are often used to disinfect the whole city. In America, the company Eagle Hawk is performing a test for disinfecting large open areas, such as football fields.

The OMI Drone disinfection system disperses a mist of EPA approved agents that kills COVID-19 and 99.9% of bacteria within 60 seconds of contact (Shen et al., 2021). Multirotor drones can be utilized in fighting the pandemic by disinfecting the environment using sanitizers, thus, reducing the risk of contamination. In India, the states of Telangana, Tamil Nadu, Chhattisgarh, Karnataka, Uttar Pradesh etc. have solicited the services of drone companies to spray disinfectants in earmarked areas. Drones are uniquely positioned to perform the task of spraying disinfectants several times faster and are able to cover wider geographical areas with less cost and minimal work force. While the effectiveness of drones deployed to spray disinfectants remains a contested factor, it is a use case of drones which has been widely deployed by state authorities in India to fight COVID-19 pandemic (FICCI, 2020). Drones can also be used to reach inaccessible areas. China is the first country to face the rage of COVID-19, has forge great use of drone technology to counter the COVID-19 outbreak. Taking that as inspiration, several countries around the world have joined forces with numerous researchers and innovators in an attempt to find ingenious ways of using drones to fight against COVID-19. In this paper, we explore the numerous benefits that spraying of organic disinfectant solution using a combination of Drones and mist blowers present in terms of managing the COVID-19 pandemic or any other future outbreak. The COVID-19 pandemic caused by a new mutated virus that originated in animals and moved to humans. COVID-19, caused by the neovirus, SARS-CoV-2, represents only one of multiple worldwide illnesses caused by mutated pathogens. People around the globe are facing an alarmingly changing world in which such mutations of viruses are creating human epidemics and pandemics with enormous consequences associated with human morbidity and mortality resulting in huge societal costs. We are now dealing with zoonotic viruses that move from animals to humans, e.g. Ebola and others, and viral mutations such as the corona viruses that include the flu virus, MERS and SARS-CoV-1 and now SARS-CoV-2, the virus causing the current COVID-19 pandemic, which itself appears to be mutating into a more contagious form as this is being written. Humans have little natural defense against these newly introduced pathogens. We are vulnerable.

COVID TRANSMISSION: Droplet vs Aerosol The several modes of transmission of the virus has been the subject of intense discussion since the start of the pandemic. It was initially suggested that the virus spreads predominantly through large droplets that come out when a person is talking, sneezing or coughing. These droplets, because of their large size, were supposed to travel only short distances before falling on the ground. A person 6 feet (2 metres) away was considered safe from infection. Over the months, however, scientists have been discovering compelling evidence of the viruses becoming airborne,i.e. through aerosols. Aerosols are small solid particles suspended in air and relatively light, thereby capable of carrying the virus to much larger distances. Also, they canremain suspended in the air for several minutes, or even hours, thereby greatly increasing the chances of infecting a person who comes into contact with the contaminated air after several hours. In this context, 'aerosols' mean fine droplets that can stay suspended in the air for long periods that are able to be carried over longer distances (greater than 2m), but which can also transmit the virus over shorter distances (over 1m or less). Traditionally, such fine droplets were classified to lie below a 5µm diameter cut-off, but this is now considered to be only a relative threshold and much of the suspension and transport of such fine respiratory droplets (or 'microdroplets') will depend on the ambient airflow in each situation (Tellier et al., 2019). Also given the recent recommendation on keeping the patients in well ventilated rooms and also the advisory on home isolated patients to stay indoors in well ventilated rooms and the evidence on aerosol transmission there is a real threat of aerosol contamination in the surrounding environs of such spaces even at relatively larger distances. In an updated note on Covid-19 transmission, the US Centers for Disease Control and Prevention has said, though the chances of an infection gets reduced significantly at distances greater than six

feet, such incidences had been "repeatedly documented under certain preventable circumstances". Various research studies predicate the possibility of the aerosol transmission of COVID-19. A COVID airborne infection risk estimator was used toestimate the probability of infection by aerosol transmission in various commuter micro-environments: (a) air conditioned (AC) taxi (b) non-AC taxi (c) bus and (d) auto rickshaw. Hand washing and maintaining social distance are the main measures recommended by the World Health Organization (WHO) to avoid contracting COVID-19. Unfortunately, these measured do not prevent infection by inhalation of small droplets exhaled by an infected person that can travel distance of meters or tens of meters in the air and carry their viral content. An article by Cheng et al. (2020) on the effectiveness of universal masking in Hong Kong to control the spread of COVID-19 (coronavirus disease 2019) highlights the recent, very public change in guidance over the wearing of masks in public places by multiple agencies and countries. This runs in parallel with another, perhaps even larger ongoing debate– whether or not SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2), the cause of COVID-19, is transmitted via aerosols. 1) Airborne Transmission of SARS-CoV-2: Proceedings of a workshop — in brief states that experts from specialties encompassing aerosol studies, ventilation, engineering, physics, virology and clinical medicine have joined together to pro- duce this review to consolidate the evidence for airborne transmission mechanisms, and offer justification for modern strategies for prevention and control of COVID-19 in health care and the community. This review details the airborne transmission of SARS- CoV-2, the aerodynamics, and different modes of transmission (e.g. droplets, droplet nuclei, and aerosol particles). SARS-CoV-2 can be transmitted by an infected person during activities such as expiration, coughing, sneezing, and talking. During such activities and some medical procedures, aerosols and droplets contaminated with SARS-CoV-2 particles are formed. Depending on their sizes and the environmental conditions, such particles stay viable in the air for varying time periods and can cause infection in a susceptible host. Very few studies have been conducted to establish the mechanism or the aerodynamics of virus-loaded particles and droplets in causing infection. The emergent coronavirus, designated severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), is a zoonotic pathogen that has demonstrated remarkable transmissibility in the human population and is the etiological agent of a current global pandemic called COVID-19. We measured the dynamic (short-term) aerosol efficiencies of SARS-CoV-2 and compared the efficiencies with two other emerging corona viruses, SARS-CoV (emerged in 2002) and Middle Eastern respiratory syndrome CoV (MERS-CoV; emerged starting in 2012). We also quantified the long-term persistence of SARS-CoV-2 and its ability to maintain infectivity when suspended in aerosols for up to 16 hours. This is the first evidence that SARS-CoV-2 RNA can be present on PM, thus suggesting a possible use as indicator of epidemic recurrence.

The New Advisory The Indian advisory has adopted a cautious approach, and warned that transmission through aerosols could happen even at a distance of 10 metres. Droplets coming out from an infected person fall within a two-metre distance, while aerosols can be carried in air up to ten metres. It has said that droplets and aerosol remain the main modes of transmission of the disease, although it has also warned of the possibility of "surface transmission" — droplets falling on different surfaces, and getting picked up by people who touch these surfaces. The risk from surface transmission, considered very high in the initial months of the pandemic, is now believed to be greatly reduced. The CDC has said, current evidence "strongly" suggested transmission from contaminated surfaces "does not contribute substantially to new infections".

Existing Methods for Containing COVID-19 Transmission: Apart from the advise on wearing masks, maintain social distance and washing hands etc., the present commonly prevalent methods adopted by various governments for containing the spread of COVID-19 are conducting fever camps, vaccination and lockdown and such measures are only partially successful as the virus appears to be mutating into more contagious forms as it is seen from numerous waves of the spread.

THE PRESENT STUDY: The present study presents a more successful and effective method in containing the spread in any number of waves as soon as the spread keeps rising. 1) Why drones and mist blowers and organic disinfectant The present method adopts a method of spraying natural/organic and bio disinfectant solution even before the lockdown measures are undertaken in open spaces as the organic solutions are safe to the humans, children and the environment. Also the method proposes a hybrid method of using drones and mist blowers equipped with specially designed sprinklers which discharges disinfectant solution in the form of a foam of size just above 5µm thereby the disinfectant solution used in atomized drones and Mist blowers have the capacity to attach itself to the water molecule in air latching itself to the aerosol based COVID virus of less than 5µm sizes and deactivate the aerosolized virus by bursting its cell wall.Agricultural / Spraying Drone (DH-AG-H1) Centre for Aerospace Research (CASR), Madras Institute of Technology Campus (MIT), Anna University, Chromepet, Chennai has an indigenously Designed and Developed drone for Agricultural resolutions. Director General of Civil Aviation (DGCA), Ministry of Civil Aviation, Government of India, DGCA HQ, Opp. Safdarjung Airport,

New Delhi, has given the Provisional Acceptance of Agricultural/Spraying Drone in Medium category, Reference No. DGCA-31035/1/2021-Drone-Dte, dated on 9th March 2021. Wireless Planning and Coordination wing, Department of Telecommunication, Ministry of Communication, Government of India has given the Equipment Type Approval of Agricultural/Spraying Drone DH-AG-H1 - Certificate ETA- 1578/2017-RLO(SR) dated on 26th November 2020. Agricultural/Spraying Drone has an inbuilt petrol engine and will act as generator to produce continuous power to the Drone. It has an overall weight of 46.9 Kg. including the payload16 liters of Agricultural matters, Fuel of 3.5 liters, Air- frame, Engine/Generator, Four Propeller, Four Drone driven Brushless Direct Current Motor (BLDC), Two 10,000 mAh Batteries for stabilizing the Agricultural/ Spraying Drone, and Spraying BLDC motor with Nano-Nozzles will helps to spread mist in finest form. Agricultural/Spraying Drone has the capabilities of flying at an altitude of 50 ft. within Visual Line of Sight (VLOS). Spraying operations may depend on the discharge of the liquid. Maximum endurance of 3.5 liters of fuel is around 40 minutes.

Fig. 1. Drone Sprayer

1) Sprinkler System Details: Sprinkler System is a foremost portion of Agricultural/Spraying Drone, a lesser amountof Weighing Sprinkler consumes less voltage of current and the Sprinkler water pump sprayer is placed in between the battery tray which from a central point the water beginning the payload tank to the shower nozzle (Brushless Diaphragm pump) forcibly discharge the sanitizing liquid continuously. Subsequently Agricultural/Spraying has a long endurance of 40 minutes operating altitude of 50 feet and an operating range of 600 meters will widely cover more disinfected areas in a very minimum period of timeline.

2) Atomizer Features: Weight: 53.5g, Operating voltage: 50V825 degrees down spray angle anticyclone vortex and flows in the form of mist.

3) B. Mist Blower Mist Blower taking a virtuous place for COVID-19. Mist Blower might cover a Massive zone of Communal places, Public gathering Markets, Roads, Street shops, Government & Private offices, and other residential zones in any place and in order to refuge huge areas in a minutest duration of time united with optimal usage of disinfecting chemicals. Centre for Aerospace Research (CASR), Madras Institute of Technology Campus (MIT), Anna University, Chromepet, Chennai has put a step forward into the ergonomics Design and Development of the Atomizer Disinfectant Sprayer / Disinfect Mist Blower, especially for COVID-19 for an accomplishment of the involvement in the Communal needs, Mist Blower is an effective Disinfectant Sprayer which can spray sanitizer – sanitizing liquid covering bigger area in a finest form of mist. The Atomizer disinfection sprayer machines liquidate the pressurized water droplets in an identical precise manner with the presence of Sanitizing product. Mixtures of this atomizing Nano-Particles are attached with the environment without difficulty on surfaces using an Aerodynamic Convergent- Divergent Nozzle design will help to ensure the system protection. The Aerodynamic Convergent- Divergent Nozzle design has twenty-four nozzle mouths which helps to pressurize the sanitizing liquid and the shape of Aerodynamic blade has enhanced the flow direction and makes it to refuge huge range at a minute. The Mist Blower has a capability of working autonomously and large surface areas can be disinfected quite efficiently deprived of flooding the environment. The Mist Blower system could be used for sanitizing the Urban and Rural Areas, Public places, hospitals, working places etc.

Design Details: The Aerodynamic Convergent- Divergent Nozzle design has been used to increase the force of the liquid flow aerodynamically so as to spread with less power. The Mist Blower system has a designed weight of 250 kilograms will make it quite compact and reliable for societal applications. It consists of Aerodynamically designed-Blower Fan Blades, Three phase water pump produces 3.0 KW power & 380 Volt and Electrical control circuits. The Mist Blower/Atomizer Sprayer system can be operated through the customized Remote Controller / JoystickControl has 360 degree Pan Control and -10 to 60 degree tilt control.

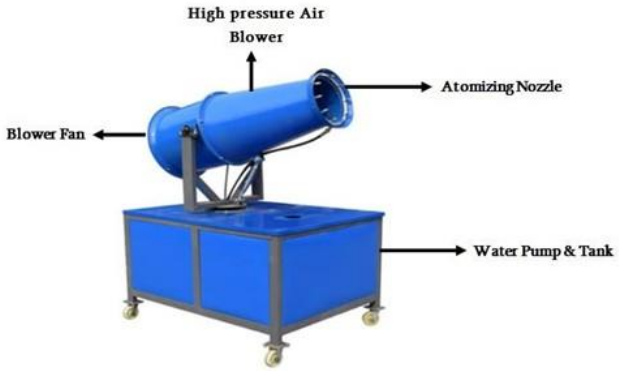

Fig. 2. DH AD Sprayer

Advantages of Mist Blower/Atomizer Sprayer:

1. Strong capabilities, high & far throw range, wide cover- age area, and high efficiency spray speed.
2. Micro fog droplet, form wet mist to spread
3. Flexible power: three-phase 380V and diesel generator power supply optional.
4. Fixed on the concrete platform or moving vehicles optional.
5. Flexible, safe & reliable to use. RC & Joystick control operation.
6. Water consumption saves 70 80 percentage, a wide coverage area.

Applications of Mist Blower:

1. The Mist Blower/Atomizer Sprayer machine works by nebulizing liquid into Nano-Particles and spraying them to sanitize the COVID-19 Cautioned Areas. This system helps to diminishes the chance of labors
2. This System can also spray the Disinfectant liquid for the locust attack operation to kill the locust.

Organic Disinfectant

Why Organic/Bio Disinfectant: Toxic exposure to humans and the environment is resulting from efforts to address these pathogens with current sanitizers and disinfectants. It turns out that many of the chemicals such as quaternary ammonium compounds ("QUATS"), bleach, hydrogen per- oxide or ethyl alcohol we are currently using in our efforts to sanitize our environment are proving poisonous to people, especially to children, to animals including our pets, and to the environment. Of these three issues, the threat to our society of the toxicity of the chemicals we are exposing our people and children to is likely the greatest threat of all. Ironically, the effort toward cure has become a significant problem in itself. The products we use have, until now, represented the state of the art in cleaning, sanitizing and disinfecting technology but the great majority of these products contain toxic chemicals. Most known disinfectants are only made for hard and soft surfaces and NOT for humans. Generaldisinfectants or sanitizers are based on Chlorine, sodium hypochlorite, Ethanol, QAM, Dodecylbenzenesulfonic acid etc. most of which have known health hazard on long term use as,

1) irritation or injury to eyes and skin (very common)
2) a strong association with development of childhood asthma27
3) a cause of adult onset asthma27.
4) a cause of development of COPD (chronic obstructive pulmonary disease). In fact, one investigator stated that "the effect of occupational cleaning (ed.: use of sprays and other cleaners) was comparable to smoking somewhat less than 20 pack-years" (ed: 1 pack year equals one pack of cigarette a day).
5) a cause of thyroid cancer.
6) a cause of "endocrine disruption" with a reduction in fertility in mice.
7) an increase in defects in neural tube (brain) developments in mice.

Hence the present study proposes an adoption of organic/bio disinfectant for the reasons that the organic/bio disinfectants are non-toxic, skin safe, stable, pH-controlled, concentration-targeted disinfectants, that is fast-acting, comprehensively effective and acts as a safe disinfecting and sanitizing agent. They are commonly made with proprietary blend of essential oils and natural extracts made with ingredients widely available in nature in and around us produced by plants for the purpose of killing invading bacteria, viruses and other pathogens and are powered by Ayurveda. The organic/bio disinfectant used in this study is Sugaradhana's Antimicrobial Concentrate which has addressed the prior limitations by way of its proprietary technology that enables production of effective disinfectant:

1. in a stable solution.
2. Enveloped and non -enveloped viral efficacy.

3. Works by attaching with the spike protein of SARS COV-2. Inhibiting its attachments with ACE receptors thus resisting mutation or spread.
4. Made with completely biodegradable ingredients.
5. Dermatology tested for safety.
6. with a broad range of specifically targeted concentrations designed for disrupting the viral cell membrane, products meet or exceed the major criteria of the "ideal disinfectant".
7. rapidly and effectively kill offending pathogens including bacteria, viruses, fungi and molds.
8. are completely non-toxic to humans and pets.
9. are completely non-toxic to the environment. Sugaradhana's Antimicrobial Concentrate, in a study administered by a certified, independent laboratory (Radiant
10. Research Services Pvt Ltd, quickly and successfully produced a $\log^{-3}$ (that is, a 99.99 percentage) eradication on both Enveloped and Non Enveloped Viruses inspected via Vero cell study at far higher concentrations than one could encounter in real life.
11. In the study, Sugaradhana organic disinfectant is provedto work effectively on enveloped viruses, the bio-active ingredients in the product effectively disburses uniformly in the air through ULV technology readily inactivating "S" protein of SARS COV-2 .Structurally making it inactive for the virus to multiply.
12. SUGARADHANA ANTIMICROBIAL CONCENTRATE EFFICACY OF BIO-ACTIVE COMPONENT OF SUGARADHANA ORGANIC ANTIMICROBIAL SPRAY USING SPIKE PROTEIN OF SARS-COV-2.
13. The docking study below shows how Sugaradhana works against SARS CoV-2 The docking results based on binding site analysis performed using the S309 neutralizing antibody are presented in the sections below.
14. The interactions between the antibody and SPIKE protein are shown in table below.

Table 1. Interactions between the S309 neutralizing antibody and SPIKE protein

Ligand	Interaction type	Residues
S309 neutralizing antibody	Hydrophobic	ASN334, LEU335, PRO337, GLU340, ASN343, ALA344, THR345, LYS356, LEU441A
	Hydrogen Bonding	GLY339, ASN343

Table 2. Interactions between the bio active component of Sugardhana Concentrate solution and SPIKE protein

Ligand	Interaction type	Residues	Docking Score
S309 neutralizing antibody	Hydrophobic	**GLY339, GLU340, ASN343**	-5.0 kcal/mol

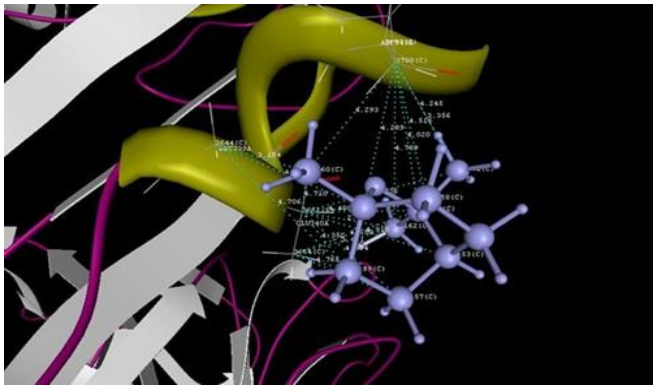

Fig. 3. Demonstrating hydrophobic interactions (Cyan Color) between Bio active components of Sugardhana Concentrate solution (Blue color) and spike protein.

The results suggest that the Bio active components of Sugardhana Concentrate solution can effectively bind to theSPIKE protein based on the interactions and the docking scores. The compound demonstrates potential to bind to the key surface protein of the SARS-CoV-2 hence can restrict the binding between the SPIKE protein and the host cells ACE receptor in humans thus inhibiting contamination and spread of SARS CoV-2. The Sugaradhana organic disinfectant liquid used in the study also showed log reduction of >3 (>99.9%) against all the test organisms. The results indicate the product's significant disinfectant activity against bacteria as per EN 1276 standard.

II. METHODOLOGY

Spider Monkey Optimization algorithm popularly used in recent years as a swarm intelligence based algorithm is being applied for many engineering optimization problems. This algorithm helps to optimize the intense aerial spraying operations in the required zones as well as in plotting an optimal route to reach the destination (Sharma H et al., 2019). The three zones were selected namely Zone A, B and C consist of 2, 3, 6 wards in each. The Covid positive case- detailed data were collected before the commencement of drone based aerial spray and mist spray activities. Further, the drone based aerial disinfection tasks and mist blower based grounds spraying were done in selected wards irrespective of building height and spacing. In the First Stage, three days of spraying the organic disinfectant using four drones and a mist blower was carried out in zone A, B & C. Then a day break was taken to check the efficacy and validate the data. In Second stage, another three days spraying operation was carried out for Zone A, B and C. The data on covid positive cases was taken after the spray to check the efficacy of spray in containing the outbreak by comparing pre spraying data and post spraying data but qualitatively and quantitatively.

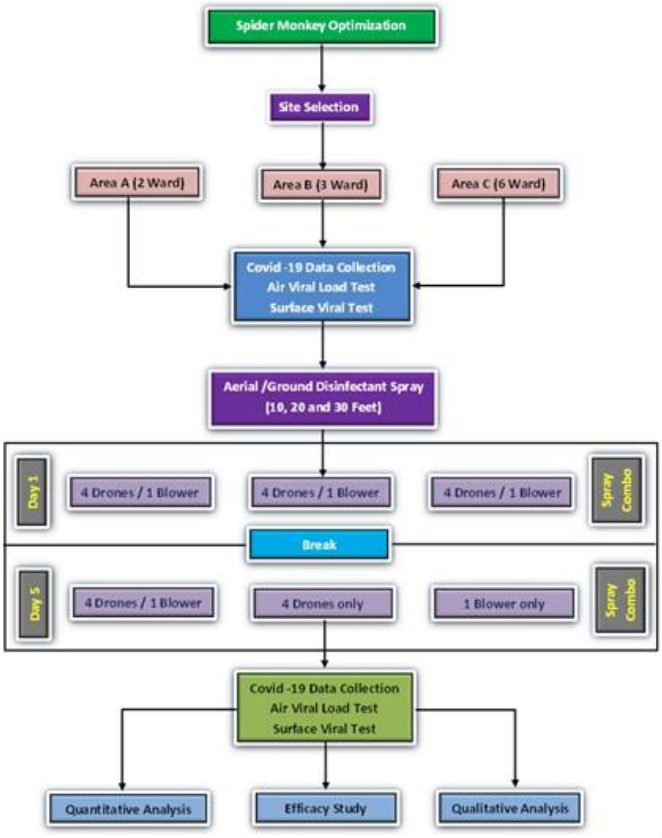

Fig. 4. Adopted Methodology for Sugaradhana Organic Disinfectant Spray using Drone and Mist Blower

III. RESULTS & DISCUSSION

The efficacy of the Organic disinfectant spray using drones and mist blowers was at selected zones in Tirunelveli Corporation. The Covid positive case data collected from the Tirunelveli Corporation Before and After Disinfectant spray was compared and it was plotted as a graph to efficiently visualize the Covid outbreak.

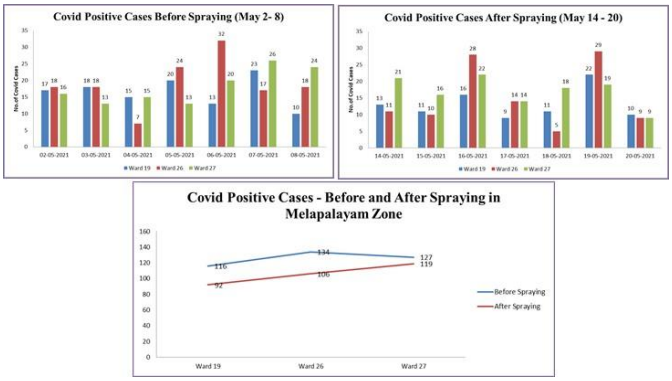

Fig. 5. Ward Wise Comparison of No. of Covid Positive Cases in Melapalayam Zone

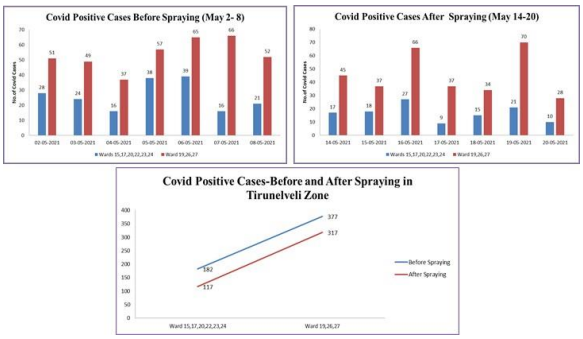

Fig. 6. Ward Wise Comparison of No. of Covid Positive Cases in Tirunelveli Zone

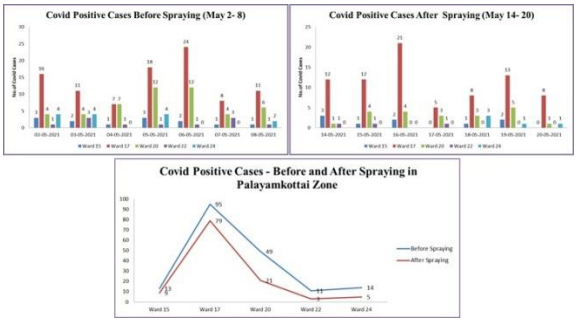

Fig. 7. Ward Wise Comparison of No. of Covid Positive Cases in Palayamkottai Zone

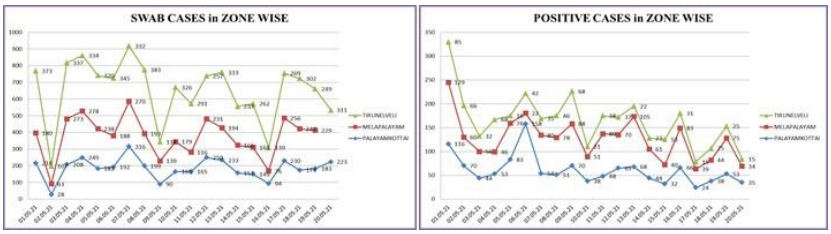

Fig. 8. Covid Positive Case Comparison in Zone Wise

There was a significant reduction in Covid positive cases after disinfectant sprayed using drones in Melapalayam, Palayamkottai and Tirunelveli zones. The Covid reduction rate in Melapalayam - 15 percentage, Tirunelveli – 23 percentage, Palayamkottai – 35 percentage (refer-Fig.5,6,7) and also the swab cases in selected area, the positive cases are only 19.96 percentage from may 1, 2021 to may 20,201 in three zones (refer- Fig.8).

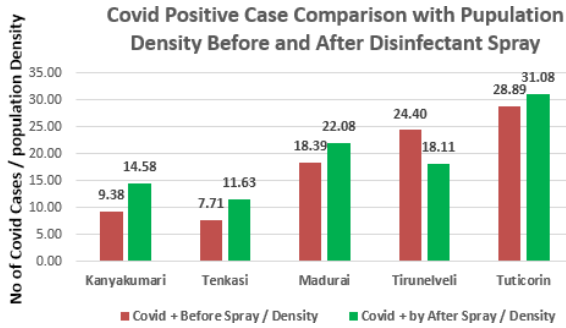

Fig. 9. Covid Positive Case comparison with Population Density

The Covid positive case corresponding to the population density comparison shows that there was a significant reduction in Covid positive cases from 24.40% to 18.11% (reduction up to 6.29%) after disinfectant spray whereas the neighbor district has peak in Covid positive. (Data Source: https://www.indiacensus.net) (refer-Fig.9).

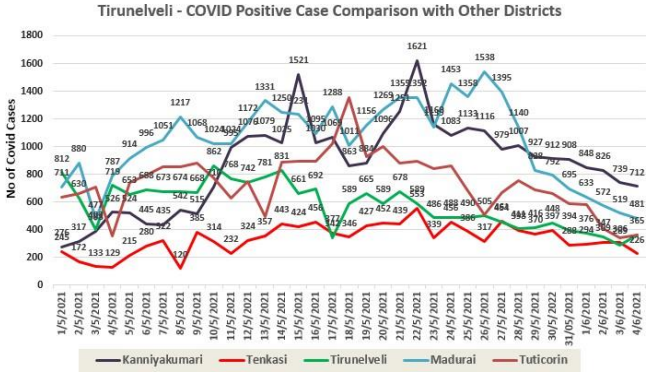

Fig.10. Covid Positive Case Comparison with Other Districts

There was a Covid positive comparison study was done with neighborhood districts of Tirunelveli i.e. Kanyakumari, Tuticorin, Madurai and Tenkasi. It was found that Covid positive cases in Tirunelveli district drastically flat- ten and fell down compare to neighbor district after thedisinfectant sprayed using drones (Date Source: Health & Family Welfare Department Government of Tamil Nadu - https://stopcorona.tn.gov.in (refer-Fig.10))

IV. CONCLUSION

The overall reduction of COVID cases inTirunelveliCorporation in 6 wards of Payalamkottai as per the Field Official data regarding sprayed areas there is 33 percentage reductions in new cases end of first cycle spray. The main market areas in Tirunelveli which is also known to be a super spreader hotspot there has been Very less cases reported after post spraying. In Nainarkulam Market Area – 72 Samples are collected where Zero Cases reported After Spray and in Palayamkottai Market Area totally 196 Samples are collected after spraying of organic disinfectant where 6 Cases are reported. We are Expecting Drastic Reduction of about 50 percentages after Second Cycle Spray continues. The emerging evidence on the growth rate in new COVID cases at -15% at Tirunelveli, the only district where the study operations were carried out compared to other districts where such operations were not carried out presents a strong case of the operation in containing the spread.

V. RECOMMENDATIONS

Drone based Bio Disinfectant spraying option, offers the following distinct benefits:

- Faster than manual spraying and kills the aerosols in Air
- Can reach otherwise unreachable or difficult-to-reach areas
- Very effective on irregular surfaces, garbage dumps, wetlands, etc.
- Can focus on high risk ‘hotspots’for spraying quickly and effectively
- Operator health hazard associated with manual spray process is eliminated
- Best suited in urban settings with high population density instead of Streetwise it is more effective in Area/ Zone wise.

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