AirROS SURFACE AND AIR PURIFICATION

Discover How This Cultivator Overcame Their Odor

An odor sampling study in a late flower grow

Information sourced from Intertox odor study 2023-07-13

Intertox Inc. (Intertox) was contracted by AirROS by SAGE Industrial Corp (AirROS) to design and conduct an initial odor sampling program at an indoor cannabis grow facility, PDX Organics, in Beaverton, Oregon on May 24-25, 2023.

Intertox is a scientific consulting and research firm based in Seattle, Washington. Intertox is comprised of scientists with expertise and extensive experience conducting odor monitoring and evaluations of odor for various facilities including landfills, wastewater treatment, and cannabis grow facilities.

THREE OBJECTIVE TESTS

LEVELS

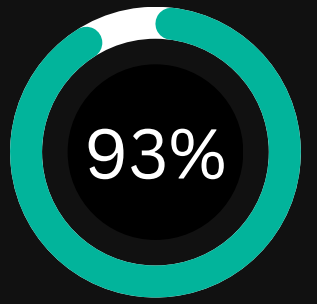
Quantify the odor intensity at the cannabis grow facility before and after activation of an AirROS purifier.

TIME

Quantify the rate of change in odor intensity over time after the AirROS purifier has been turned off and back on.

PERCENT

Quantify the percent odor intensity reduction capability of the AirROS purifier within and around the cannabis grow facility.



AirROS reduced odor 93% from the highest level to the lowest level

RESULTS OF ODOR STUDY

Levels

Before AirROS ranged from 7 to 30 D/T

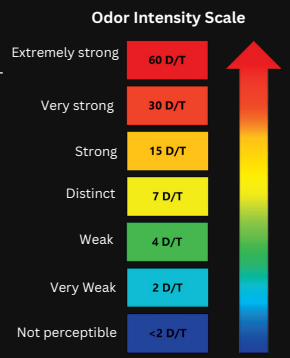
With AirROS ranged from 2 to 4 D/T

Time

Reduction was noticed immediately and at the lowest the next day

Percent

AirROS was effective at reducing the cannabis odor in and around the facility.



For more information on how AirROS can help you visit AirROSshield.com

QUANTIFYING CANNABIS ODORS BEFORE AND AFTER ACTIVATION OF AIRROS BY SAGE INDUSTRIAL COMMERCIAL AIR AND SURFACE PURIFIER AT AN INDOOR CANNABIS GROW FACILITY IN BEAVERTON, OR

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BACKGROUND

Intertox Inc. (Intertox) was contracted by AirROS by SAGE Industrial Corp (AirROS) to design and conduct an initial odor sampling program at an indoor cannabis grow facility, PDX Organics, in Beaverton, Oregon on May 24-25, 2023.

OBJECTIVES

The primary objective of this initial odor sampling program was to understand the effectiveness of the AirROS commercial air & surface purifier (referred to herein as AirROS purifier) for reducing odors in an indoor cannabis grow facility. To meet the primary objective, three sub-objectives were identified and included:

Sub-Objective 1: *Quantify the odor intensity at the cannabis grow facility before and after activation of an AirROS purifier;*

Sub-Objective 2: *Quantify the rate of change in odor intensity over time after the AirROS purifier has been turned off and back on; and*

Sub-Objective 3: *Quantify the percent odor intensity reduction capability of the AirROS purifier within and around the cannabis grow facility.*

COLLECTING ODOR SAMPLES

Odor Sampling Equipment

To meet these objectives, odor samples were obtained using the Nasal Ranger® Field Olfactometer (Figure 1). This device directly measures and quantifies odor strength in the ambient air by mixing odorous ambient air with odor-free, carbon-filtered air in discrete volume ratios. Each discrete volume ratio is defined as a dilution to threshold (D/T) ratio. The D/T ratio is a measure of the number of dilutions needed to make the odorous ambient air non-detectable by a human nose, where:

$$\text{D/T} = \frac{Volume\ of\ Carbon\ Filtered\ Air}{Volume\ of\ Odorous\ Air}$$

The operator uses the Nasal Ranger® to measure odor intensity in D/T by changing the volume of odorous ambient air entering the chamber with the D/T dial (Figure 1). The dial is calibrated at the following discrete D/T ratios, where a smaller value indicates less odorous ambient air: 2 D/T, 4 D/T, 7, D/T, 15 D/T, 30 D/T, and 60 D/T. If an odor is not detected at 2 D/T, it is considered <2 D/T.

Figure 1. Diagram of the Nasal Ranger® and componentry. Source: St. Croix Sensory.

Odor Sampling Personnel

Odor sampling was conducted by two Intertox personnel who have successfully completed Nasal Ranger® ODOR SCHOOL® training and odor sensitivity testing provided by St. Croix Sensory, Stillwater, MN[i, ii, iii].

Odor Sampling Locations

Sample locations are shown in Figure 2. Sample locations were classified as either targeted samples (orange; locations 01–04, in the room with the AirROS purifier (the Indoor Mature Canopy Area #2, with an area of approximately 1,650 sq. ft.)), whole facility samples (blue; locations 05–15, located throughout the rest of the facility (approximately 7,020 sq. ft.)), or background samples (purple; location B, located on the roof and upwind of the facility's ventilation exhaust system).

Data Collection

Shortly (approximately 5 minutes) before arrival of Intertox sampling personnel at the facility, the AirROS purifier (located in Indoor Mature Canopy Area #2) was turned off by facility faculty after running for several weeks. Once the AirROS purifier was turned off, Intertox personnel collected samples using the following protocol:

1. Collection of targeted samples sequentially at locations 01–04 was repeated continuously for 30 minutes following the AirROS being turned off.
2. After 30 minutes, targeted samples were taken sequentially at locations 01–04 every 15 minutes.
3. After a total of 60 minutes had elapsed, targeted samples were taken sequentially at locations 01–04 every 20 minutes.

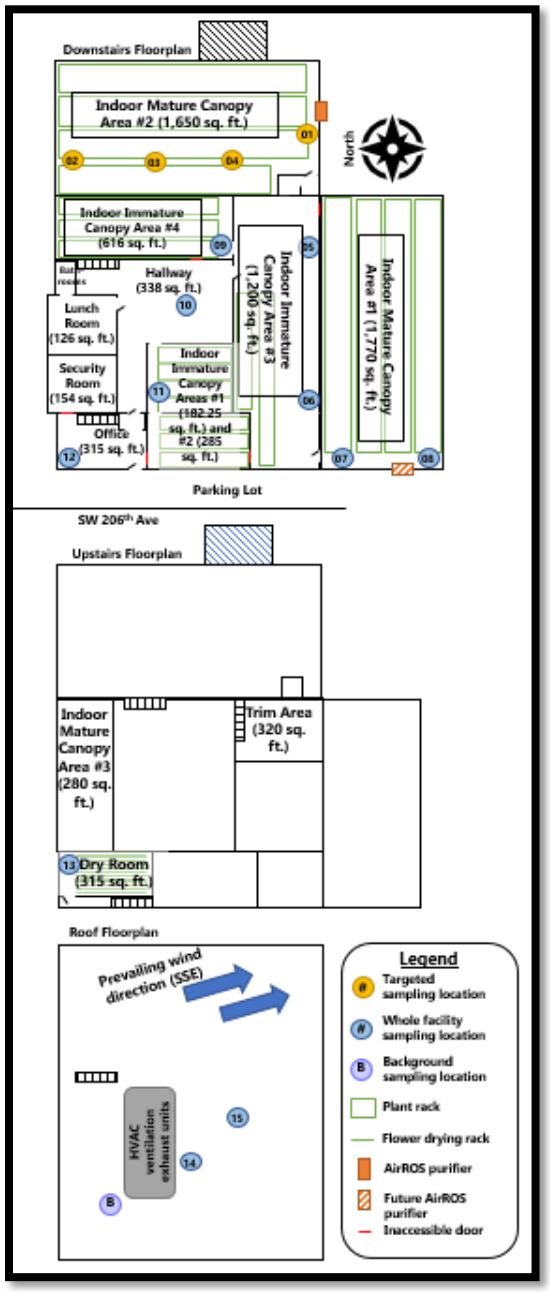


Figure 2. Diagram of sampling locations at PDX Organics, Beaverton, OR.

4. After 120 minutes had elapsed since the AirROS purifier was turned off, targeted samples were taken every 30 minutes at locations 01–04, in sequence, until the D/T recorded had stabilized for 3 subsequent targeted samples (i.e., the D/T at three (3) subsequent sampling locations was the same).
5. Once the D/T at the targeted sampling locations had stabilized as described in Step 4 above, targeted sampling was stopped and one round of whole facility samples was collected at whole facility and background locations (05–15 and B).

The AirROS purifier was then turned back on and the sampling procedure described above was repeated.

DATA ANALYSIS

Collected data were categorized by whether the AirROS was on or off during sample collection and then further organized by whether the data were collected from Indoor Mature Canopy Area #2 (targeted sample locations 01–04) or from outside Indoor Mature Canopy Area #2 (whole facility sample locations 05–15, and B).

Data collected while the AirROS purifier was off were further categorized based on time since the AirROS purifier was turned off, as follows:

- 0–5 hours after the AirROS purifier was turned off (the total period that the AirROS purifier was off);
- 0–1 hour after the AirROS purifier was turned off;
- 1–2 hours after the AirROS purifier was turned off; and
- 4–5 hours after the AirROS purifier was turned off.

Data collected while the AirROS purifier was on were further categorized based on time since the AirROS purifier was turned on, as follows:

- 0–20 hours after the AirROS purifier was turned on (total period with AirROS purifier on)
- 0–1 hour after the AirROS purifier was turned on;
- 1–2 hours after the AirROS purifier was turned on; and
- 19–20 hours after the AirROS purifier was turned on.

Deviation from the Sampling Plan

After data was categorized as described above, the data was further reviewed to identify data that was inadequately collected—these were excluded from data analysis. Data that was excluded because samples could not be adequately collected were due to the following:

- Approximately 2 hours after the AirROS purifier was turned off, an incident occurred that resulted in interference with odor data collection: an employee at the facility mopped the floor of the Indoor Mature Canopy Area #2 with bleach-water. Because the bleach odor dominated the odors detected at targeted sample locations, and persisted for approximately 2 hours, samples collected during this period were considered

contaminated and were not included in the data analysis.

- Intertox sampling personnel were informed that the facility was to close at 6:00 pm, upon which all personnel are required to vacate the facility. Intertox sampling personnel discontinued sample collection at approximately 5:30 pm (approximately 2 hours after the AirROS purifier was turned back on). Because the odor intensity recorded had not yet stabilized for 3 subsequent samples as specified in the Sampling Plan (and described in above), Intertox personnel returned to the facility the following day, approximately 19 hours after the AirROS purifier was turned on, to complete sampling.

OVERALL RESULTS AND CONCLUSIONS

The following was concluded with regard to the three sub-objectives.

Sub-Objective 1: *Quantify the odor intensity at the cannabis grow facility before and after activation of an AirROS purifier* .

We observed:

- **After the AirROS purifier was turned off in Indoor Mature Canopy Area #2, D/T ranged from 7 to 30 D/T**. For 19 of 21 samples, D/T ranged from 7 to 30 D/T within the first 2 hours, with two samples at 30 D/T. Later, between 4–5 hours after the AirROS purifier was turned off, odor intensity ranged from 15–30 D/T for 11 of 12 samples, with one sample where odor intensity was 7 D/T (Figure 3).
- **With the AirROS purifier turned on in Indoor Mature Canopy Area #2, odor intensity ranged from 15 to 2 D/T.** For 26 out of 28 samples, D/T ranged from 15 to 7 D/T within the first 2 hours, with two samples where odor intensity was 4 D/T. After sampling resumed the next day, odor intensity was 4 D/T for six out of eight samples approximately 20 hours after the AirROS purifier was turned on, with two samples where odor intensity was 2 D/T (Figure 3).

Sub-Objective 2: *Quantify the rate of change in odor intensity over time after the AirROS purifier has been turned off and back on*.

We observed:

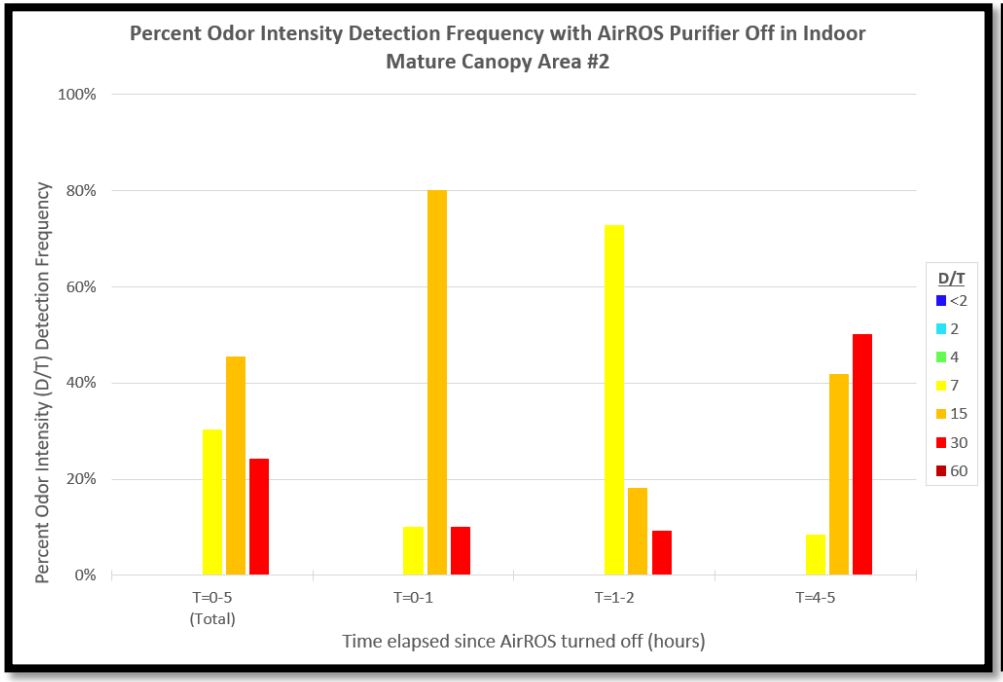
- **After the AirROS purifier was turned off, observed odor intensity in Indoor Mature Canopy Area #2 initially decreased** (the most frequently recorded odor intensity value was 15 D/T during the first hour and 7 D/T during the second hour), **but then increased** (the most frequently recorded odor intensity value was 30 D/T during the fourth hour) (Figure 3). The rate of change in odor intensity over time was not linear. Contamination of odor samples as a result of bleach-water mopping in Indoor Mature Canopy Area #2 approximately 2 hours after the AirROS was turned off resulted in a gap in valid D/T measurements between 2-4 hours after the AirROS purifier was turned off.
- **After the AirROS purifier was turned on, observed odor intensity in Indoor Mature Canopy Area #2 decreased** (the most frequently recorded odor intensity value was 7 D/T during the first and second hours after the AirROS purifier was turned on, and 4 D/T between 19–20 hours after the AirROS purifier was turned on (Figure 3)). A minimum odor intensity of 2 D/T was recorded between 19–20 hours after the AirROS purifier was turned off. The rate at which odor intensity changed over time with the AirROS purifier on did not appear to be linear, and minimum odor intensity may have been reached earlier but limitations in the facility's operating hours (the facility closed at 6:00 pm, upon which all personnel are required to vacate the facility) prevented sampling from occurring between 2 hours and 19 hours after the AirROS purifier was turned on.

Sub-Objective 3: *Quantify the percent odor intensity reduction capability of the AirROS purifier within and around the cannabis grow facility.*

We observed:

- **Odor intensity was reduced up to 93%** between the lowest odor intensity measured with the AirROS purifier turned on (2 D/T) and the highest odor intensity measured with the AirROS purifier turned off (30 D/T).

These conclusions are based on a limited set of data collected over one cycle of AirROS purifier use at an indoor cannabis grow facility. Because of the small sample size, statistical significance of observed trends could not be determined.



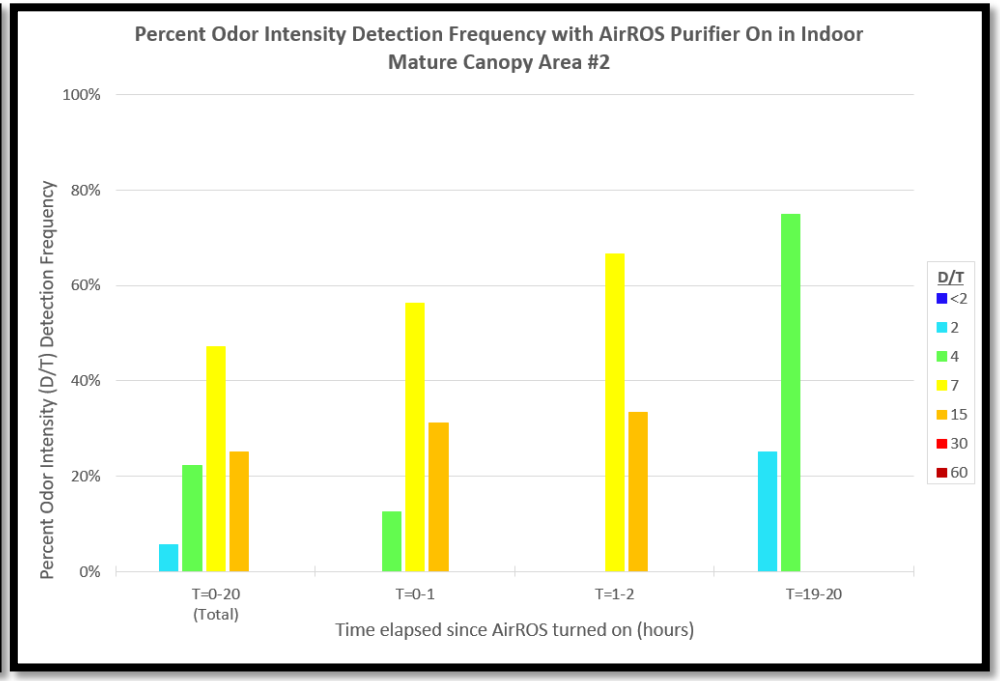


Figure 3. Percent odor intensity (D/T) detection frequency in Indoor Mature Canopy Area #2 with the AirROS purifier off (left) and on (right), as measured using the Nasal Ranger olfactometer on May 24-25, 2023. The frequency of distinct odor intensity (D/T) values during each sampling period is shown by the colored bars. A higher D/T value (corresponding to orange/red bars) indicates greater observed odor intensity. Total time elapsed since the AirROS purifier is turned off (left) or on (right) is indicated by the bottom (horizontal) axis.

Uncertainties and Limitations

The following uncertainties or limitations regarding collected samples are noted:

- Unanticipated circumstances required deviations from the sampling plan (described above). As a result, some gaps in the collection of samples or in the availability of valid measurements occurred.
- Because the current data set is limited, statistical significance of observed trends could not be determined. To establish the statistical significance of findings, a larger more robust data set would be required.
- The AirROS purifier generates low levels of gas-phase hydrogen peroxide and ozone during operation to kill viruses, bacteria, mold and other biological contaminants. Some studies suggest that acute (2-hour) exposure to low concentrations (200 ppb or 0.2 ppm) of ozone can impair olfactory functioning[iv]. When the AirROS system was running it was set not-to-exceed 20 ppb (0.020 ppm) ozone in Indoor Mature Canopy Area #2, well below the concentration studies suggest would impair olfactory functioning. Therefore, it is unlikely the concentration of ozone present impaired or reduced the sampling personnel's olfactory function.

Overall, **based on the data collected, the AirROS purifier appears to be effective at reducing cannabis-related odors in and around an indoor cannabis grow facility** where sampling was conducted.

About Intertox

Intertox is a scientific consulting and research firm based in Seattle, Washington. Intertox is comprised of scientists with expertise in assessing the risk to humans from exposure to chemical and biological agents. Intertox's team of scientists also has extensive experience conducting odor monitoring and evaluations of odor for various facilities including landfills, wastewater treatment, and cannabis grow facilities.

Intertox's team of scientists have expertise in developing odor monitoring and sampling plans, conducting monitoring, evaluating monitoring data, and providing technical reports to summarize odor monitoring results. Our team of samplers is trained to use the most sophisticated odor sampling equipment available to measure odor intensity in real-time in the field using unbiased and scientifically accepted methods.

Intertox works with local, national, and international clients, including large private and public organizations, governments, and legal firms to provide objective, third-party scientific monitoring, and evaluations for health- and odor-related issues. We help our clients effectively communicate with regulatory agencies, stakeholders, and the public about health- and odor-related issues. Our overall goal is to provide long-term solutions that ensure the safety of the public and environment.

http://www.intertox.com/

http://www.intertox.com/our-staff/

Dr. Richard C. Pleus, Ph.D., M.S., Founder, CEO, Chief Toxicologist

Kelli R. Hackney, Scientist

About AirROS by SAGE Industrial

Our commercial air and surface purifiers use ROS (Reactive Oxygen Species) to reduce pathogens, bacteria, molds (BOTRYTIS, POWDERY MILDEW, ASPERGILLUS), cross-contamination, and odor control. The ROS is organic, which means it doesn't use chemicals.

AirROS by SAGE commercial air & surface purifiers clean surfaces and air in cannabis facilities such as grow rooms, greenhouses, mothering rooms, cloning rooms, growing areas, drying/trim processing areas. We also make portable options for transport or as the job requires.

Our commercial air and surface purifiers are compact, ultra-low energy efficient and will effectively treat/sanitize facilities of all sizes ranging from small indoor grow/processing rooms to large multi-acre greenhouses.

Our customers main concerns revolve around keeping their products bacteria free and reducing odor. AirROS purification systems address these issues.

We are a Clovis, CA. (Fresno) based company that manufactures Surface & Air Purification Equipment. MADE in the USA! For over 18 years we have applied our technology to Destroy, Purify, & Defend perishables including Meats, Poultry, Seafood, Fresh Fruit & Vegetables, Nuts, Wine, Flowers, and Cannabis!

https://airrosshield.com/

sales@airros.com

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[i] St. Croix Sensory, Inc. (N.d.) *St. Croix Sensory, Inc. Institute "ODOR SCHOOL"®* Training. From: https://sensoryinstitute.com/

[ii] ISO (International Organization for Standardization). (2005). *General requirements for the competence of testing and calibration laboratories* (ISO/ISE 17025-2005). From: https://www.iso.org/standard/39883.html

[iii] ASTM (American Society for Testing and Materials). (2019). *Standard Practice for Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series Method of Limits* (ASTM E679). From: https://www.astm.org/e0679-19.html

[iv] Muttray, A., Gosepath, J., Schmall, F., Brieger, J., Mayer-Popken, O., Melia, M., & Letzel, S. (2018). *An acute exposure to ozone impairs human olfactory functioning.* Environmental Research, https://doi.org/10.1016/j.envres.2018.07.006