

# 季节性空气过滤系统对非洲猪瘟防控与净化的应用研究

## Application of seasonal air filtration system in prevention and control of African swine fever

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2025-10-18

# 主要内容 Main content

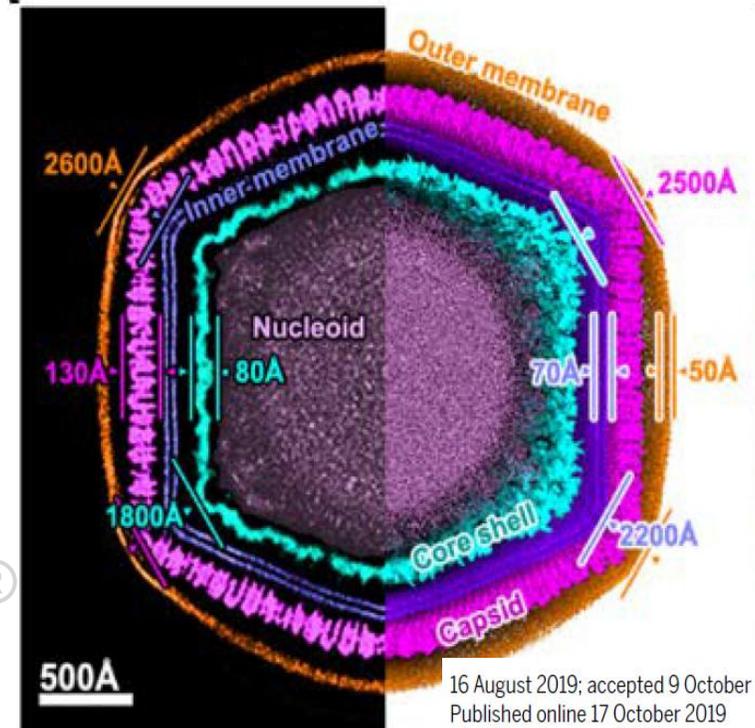
- 2018—2025回归历史走过的ASF七阶段
- 2018-2025: A Review of the Seven Phases of ASF
- ASF空气传播的观察与验证
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# 第一部分 2018—2025回归历史走过的ASF七阶段

## Part 1: The Seven Phases of ASF from 2018 to 2025, Reflecting on Historical Trends

- ASF, 2018年8月首次报道, 从陌生到熟悉, 改变了生猪格局和走势的一个病毒和传染病
- ASF, first reported in August 2018, has changed the pattern and trend of the pig industry from being unfamiliar to familiar, as a virus and infectious disease
- 从2024年10月的视角看“过往的七阶段”
- The Seven Stages of the Past from the Perspective of October 2024



# 2018.8—2025.9过去的七年七阶段

## 2018.8—2025.9 The past seven years and seven stages

- 第一轮，2018.8-2019.8，坚持不立即清群、学会检测-剔除法；
- The first round, from August 2018 to August 2019, adhered to the principle of not immediately clearing the group and learned the detection-elimination method;
- 第二轮，2019.9-2020.8，学会复产方法，不用“活疫苗”；
- The second round, from September 2019 to August 2020, involved learning the method of resuming production without using "live vaccines";
- 第三轮，2020.9-2021.8，知道疫苗毒不能带毒生产，发现空气传播；
- The third round, from September 2020 to August 2021, revealed that vaccine production cannot be conducted with live virus and identified airborne transmission;
- 第四轮，2021.9-2022.8，不盲目坚持精准剔除净化，认识空气传播；
- The fourth round, from September 2021 to August 2022, is to not blindly adhere to precise elimination and eradication, but to recognize airborne transmission;
- 第五轮，2022.9-2023.8，阻断空气传播、运用“流调-清除”或者区域清除控制净化；
- The fifth round, from September 2022 to August 2023, focuses on blocking airborne transmission, using "flow investigation-elimination" or regional elimination to control and purify the environment;
- 第六轮，2023.9-2024.8，践行空气阻断，完胜，反之就是对照组；
- The sixth round, from September 2023 to August 2024, implemented air blocking and achieved a complete victory. Conversely, the control group failed;
- 第七轮，2024.9-2025.8，历史流行率最低、损失最小、产能释放最大。验证空气传播的发现、阻断、践行和见效；
- The seventh round, from September 2024 to August 2025, had the lowest historical prevalence, the smallest loss, and the largest capacity release. It verified the discovery, prevention, implementation, and effectiveness of airborne transmission;
- 第八轮，2025.9-2026.8，尊重历史、研究规律、谨防重复历史
- The eighth round, from September 2025 to August 2026, is about respecting history, studying patterns, and guarding against repeating the past

# 因此： Therefore:

1、过去的七年，是我们来时的路；

**1.The past seven years represent the journey we have traveled;**

2、少犯错、少自得、多敬畏、多学习、多倾听、多践行，因为非洲猪瘟专治各种不服；

**2. Make fewer mistakes, be less complacent, show more respect, learn more, listen more, and practice more, because African swine fever is a disease that will not be defeated by any resistance;**

3、过去七年非洲猪瘟防控领域，重大的技术应用可以总结为两个：早期群体内剔除净化技术和发现田间空气传播及应用，这两项是推动产业革命的“启动子”，是改变ASF防控格局的大事件。

**3.In the past seven years, major technological applications in the field of African swine fever prevention and control can be summarized into two: early elimination and eradication technology within the population and the discovery and application of field airborne transmission. These two items are the "initiators" that drive industrial revolution and are major events that change the pattern of ASF prevention and control.**

## 第二部分：ASF空气传播的观察与验证

# Part 2: Observation and verification of ASF airborne transmission

ASF空气传播观察与验证研究：ASF Airborne Transmission Observation and Verification Study:

时间轴回顾：Timeline review:

- 2020.5月，一个案例反常，挑战了经典剔除净化方法，复盘与思考；
- In May 2020, a case was abnormal, challenging the classic elimination and eradication methods, and requiring review and reflection;
- 2020冬季，猪舍外部环境阳性，特别是严重的沙尘暴或者大风过后更高，进风口频繁阳性，与2021年之前出现不同。怀疑和质疑增多；
- In the winter of 2020, the external environment of the pigsty tested positive, especially after severe sandstorms or strong winds. The air intake frequently tested positive, which was different from before 2021. Suspicions and doubts increased;
- 2021年初，验证经典的剔除净化技术方法在群体内要扩大范围，且净化时间延长；
- In early 2021, it was verified that the classic elimination and eradication technology method should be expanded within the population, and the eradication time should be extended;
- 2021.12.21，定义了“非接触性传播”，并采取多个自发行动和硬件配置验证；
- On December 21, 2021, the term "non-contact transmission" was defined, and multiple spontaneous actions and hardware configurations were adopted for verification;
- 2022年，验证和试验结论；
- In 2022, conclusions from verification and testing were drawn;
- 2023.2，南农“后浪论坛”行业共识；
- In February 2023, the "Houlang Forum" hosted by Nanjing Agricultural University reached an industry consensus;
- 2023.6，第一篇田间传播的研究报告刊出；
- In June 2023, the first research report on field transmission was published;
- 2023年冬季，一次大验证；
- In the winter of 2023, a major verification will be conducted;
- 2024年10月，李曼中国养猪大会，总结报告，也基本代表了行业的共识报告；
- In October 2024, the Li Man China Pig Husbandry Conference released a summary report, which essentially represents the consensus of the industry;
- 2024-2025，第七轮，北方基本控制了“场间传播”，历史性的流行最低，北方产能快速恢复，也为山东放养模式井喷式发展提供了一定的技术支撑。
- In the seventh round from 2024 to 2025, the north basically controlled the "inter-field transmission", achieving a historic low epidemic level. The rapid recovery of production capacity in the north also provided certain technical support for the blowout development of the free-range model in Shandong.

# 图例1:

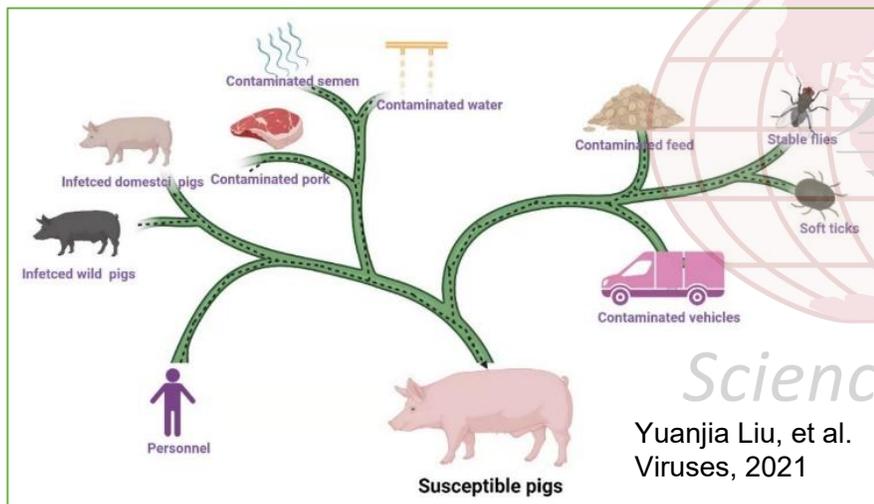
2018-2020年

2021年以后

传播方式是  
否发生变化  
Whether the  
mode of  
transmission  
has changed

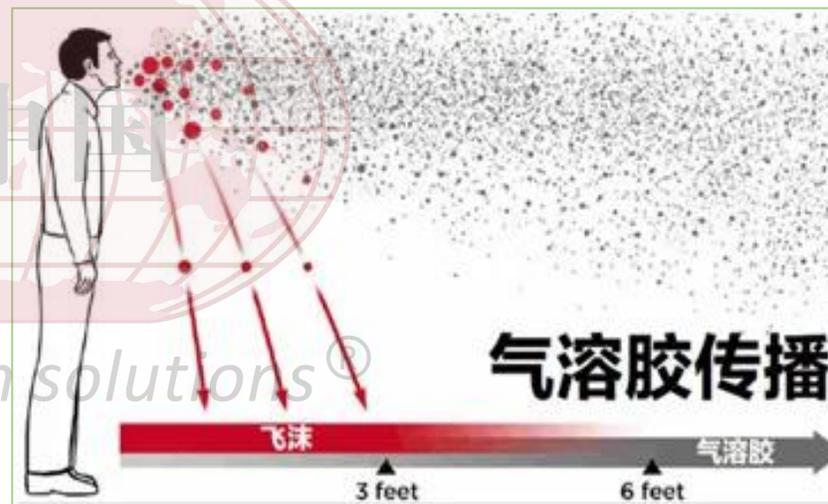
- 高度接触传播 High-contact transmission
- 野毒为主 Mainly wild virus
- 精准剔除 Precisely eliminate
- 3周净化 3 weeks of eradication

- 传统的防控方法逐渐失效
- Traditional prevention and control methods are gradually losing their effectiveness
- 多种毒株共存
- Multiple strains coexist
- 净化时间持续延长
- The eradication process is taking longer



直接接触或间接接触感染

Direct or indirect contact with infection



新观点: 非接触传播?

New perspective: Non contact transmission?

## 图例2： Legend 2:

2020年冬季以来，北方地区阳性场数量增加，而且在多个阳性场区的通风进风口、过滤棉等监测阳性，越来越多人怀疑气溶胶在田间、场内、舍内的传播。

Since the winter of 2020, the number of positive farms in the northern region has increased, and positive detections have been found in ventilation inlets, filter cotton, and other monitoring areas in multiple positive farms. More and more people suspect the spread of aerosols in fields, farms, and barns.



过滤棉  
Filter cotton



风机端  
Fan end



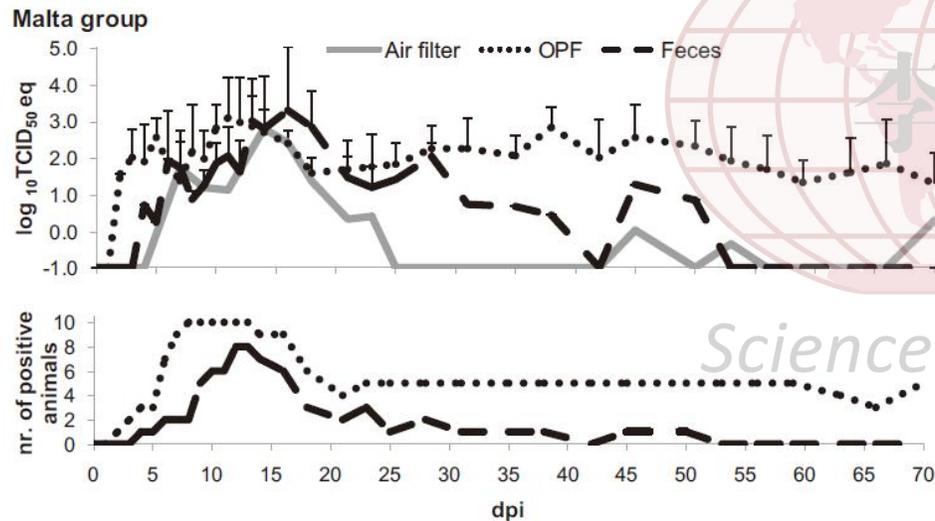
舍内空气阳性  
Positive air in the building

# 参考文献:



## Quantification of airborne African swine fever virus after experimental infection

非洲猪瘟病毒气溶胶的实验条件下的定量检测



目前只有几篇文献报道在实验条件下ASFV能够在一定的湿度和温度条件下进行短距离的传播。Currently, only a few studies have reported that ASFV can spread over short distances under specific humidity and temperature conditions in experimental settings.

### 参考观点: Reference viewpoint:

- ASFV的在空气中的半衰期是14-19min (相对湿度61% - 80% , 温度20.6 - 21.0 °C ) ;
- The half-life of ASFV in the air is 14-19 minutes (relative humidity 61% - 80%, temperature 20.6 - 21.0 °C);
- 在猪只接种ASFV后第4天, 空气样本开始检出阳性, 在25-30天, 病毒含量可以高达  $10^{3.2}$ TCID<sub>50</sub>/m<sup>3</sup>;
- On the 4th day after pigs were vaccinated with ASFV, positive results began to be detected in air samples. On the 25th to 30th day, the virus content can reach up to  $10^{3.2}$  TCID<sub>50</sub>/m<sup>3</sup>;
- 病毒在栋舍内的检出顺序: 攻毒猪—同圈猪—相邻圈猪—空气接触猪;
- The detection sequence of the virus within the shed is as follows: pigs that were directly exposed to the virus, pigs in the same enclosure, pigs in adjacent enclosures, and finally, pigs that came into contact with the air;
- 实验室条件下, ASFV空气传播距离为2.3m。
- Under laboratory conditions, the airborne transmission distance of ASFV is 2.3 meters.

# 验证：田间条件下，在两个栋舍之间的气溶胶传播

## Validation: aerosol transmission between two barns under field conditions

 frontiers | Frontiers in Veterinary Science

TYPE Brief Research Report  
PUBLISHED 01 June 2023  
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 Check for updates

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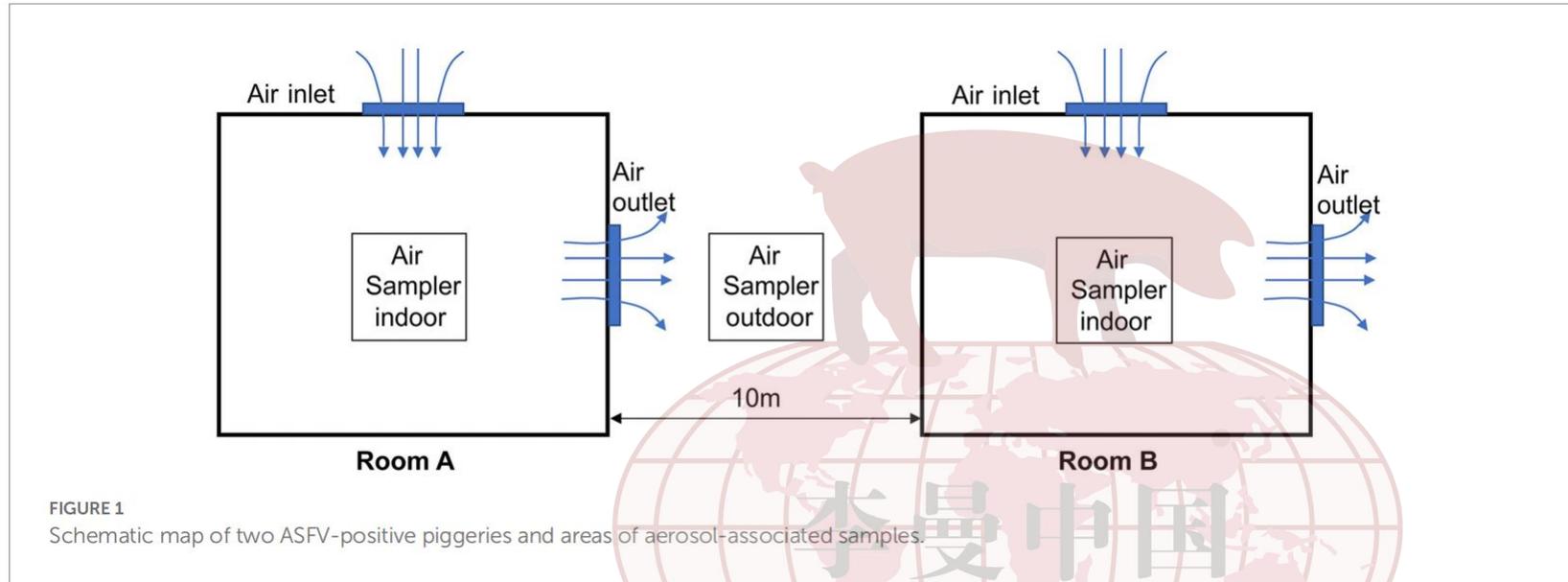
## Evidence of aerosol transmission of African swine fever virus between two piggeries under field conditions: a case study

Xiaowen Li<sup>1,2,3,4,\*†</sup>, Zhiqiang Hu<sup>1,2,3,4†</sup>, Mingyu Fan<sup>1,2,3,4†</sup>,  
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# 1、田间场景1. Field scene



## 猪场满足以下条件: The pig farm meets the following conditions:

- 具有完整的生物安全措施, 且该场配备自动喂料和喂水系统, 不存在人为接触污染的风险;
- The farm has complete biosecurity measures and is equipped with automatic feeding and watering systems, eliminating the risk of human contact contamination;
- 每个栋舍的人员、物资以及废弃物资处理通道都是相对独立的, 不存在物理交叉;
- The personnel, materials, and waste disposal channels for each building are relatively independent, with no physical overlap;
- 所有饲料均经过85°C 3分钟的处理以保证无病毒污染;
- All feed was treated at 85°C for 3 minutes to ensure no viral contamination;
- 整个场区包含多个类似的产房, 目前只有这两个产房发病, 因此排除水源感染的因素。
- The entire site includes multiple similar production rooms, but only these two have been affected, ruling out the possibility of water source infection.

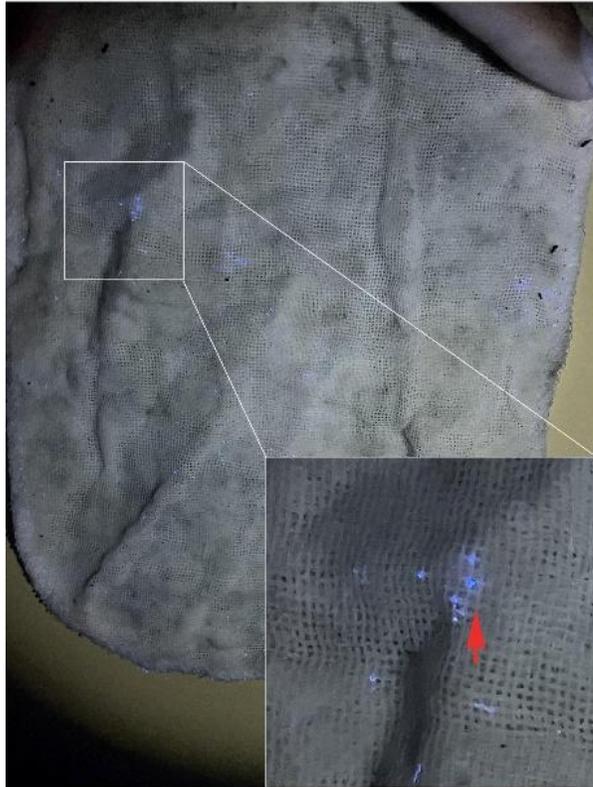
## 2、结果2. Results

Date		Day 0	Day 3	Day 6	Day 9	Day 12	Day 15	Day 18	Day 21	Day 24
Room A	Pig		/		/		/		/	
	Aerosol			35.41±0.74	35.51±1.16			38.72±0.41	37.16±0.95	37.54±1.18
	Air outlet (dust)				35.61±0.94		36.40±1.32		33.75±0.25	33.65±0.87
Aerosol outside					37.47±0.49			36.25±0.98	36.62±0.57	37.73±0.53
Room B	Pig		/		/		/			
	Aerosol								35.71±0.46	35.22±0.36
	Air inlet (dust)						38.82±0.62	38.72±0.43	36.14±0.75	35.32±0.59

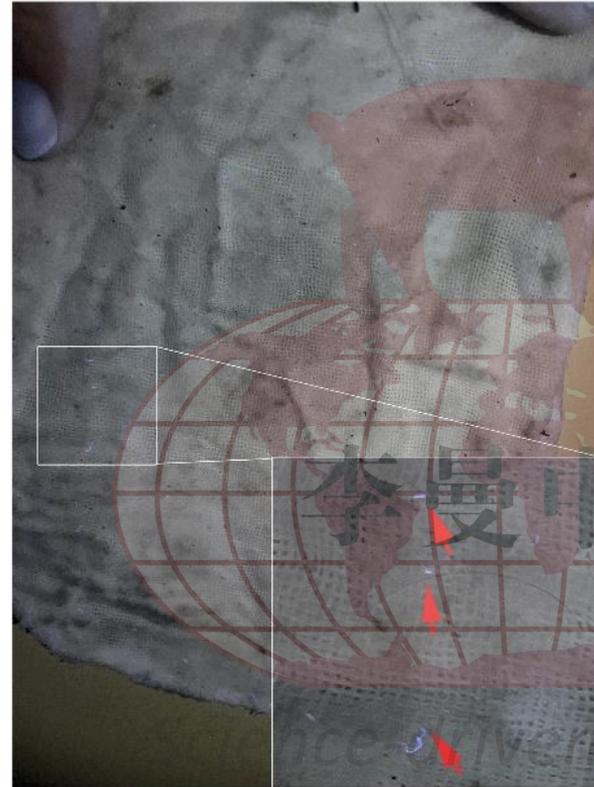
FIGURE 2  
ASFV detection in pigs and aerosol-associated samples in Rooms A and B. Cells in red color: ASFV-positive; cells in green color: ASFV-negative; number in red cells: Cq value of qPCR (Mean±SD); "/": no detection.

- 在A栋舍，气溶胶样本最初在**第6天**检测呈阳性，并持续呈阳性直到第24天，尽管第12天和第15天的样本呈阴性。从出风口采集的粉尘样品在**第9天**最后呈阳性，并一直呈阳性直至第24天。从第15天开始，Cq值从第15天开始呈下降趋势，表明病毒在粉尘中富集。
- In Building A, the aerosol sample initially tested positive on Day 6 and remained positive until Day 24, despite negative samples on Days 12 and 15. The dust sample collected from the air outlet finally tested positive on Day 9 and remained positive until Day 24. From Day 15 onwards, the Cq value showed a downward trend, indicating that the virus was enriched in the dust.
- 在B栋舍，**第15天**首次检测到从进风口收集的阳性粉尘。而且，Cq值在**第21天**显著下降。同一天，猪只也被检出阳性。
- In Building B, positive dust collected from the air intake was first detected on day 15. Moreover, the Cq value significantly decreased on day 21. On the same day, pigs were also tested positive.
- 两个栋舍之间的空气样品是在**第9天**检测到阳性。
- The air sample between the two barns tested positive on Day 9.

### 3、粉尘传播验证3. Verification of dust transmission



Air outlets in Room A



Air inlets in Room B

参考COVID-19的粉尘传播的研究方法，在A栋舍的出风口附近放置荧光粉，3天后，使用上述方法从A栋舍的出风口和B栋舍的进风口表面收集粉尘样本。随后，在黑暗条件下展开纱布并拍照，以可视化荧光粉的存在和分布。

Based on the research method for dust transmission of COVID-19, fluorescent powder was placed near the air outlet of Building A. After 3 days, dust samples were collected from the surfaces of the air outlet of Building A and the air inlet of Building B using the aforementioned method. Subsequently, the gauze was unfolded and photographed under dark conditions to visualize the presence and distribution of the fluorescent powder.

如作图所示，3天后，在A栋舍出风口和B栋舍进风口的纱布上都观察到荧光斑点，说明灰尘可能从A栋舍传播到B栋舍。

As shown in the diagram, after 3 days, fluorescent spots were observed on the gauze at the air outlet of Building A and the air inlet of Building B, indicating that dust may have spread from Building A to Building B.

# 行业数据与共识

## Industry data and consensus

### 33家养猪企业空气过滤系统启用年份



数据截至：2024年7月26日

数据来源：新猪派调研



扫码关注“新猪派”

### TOP52养猪企业空气过滤系统覆盖率

100% 80%-100% 60%-80% 40%-60% 20%-40% 0%-20%



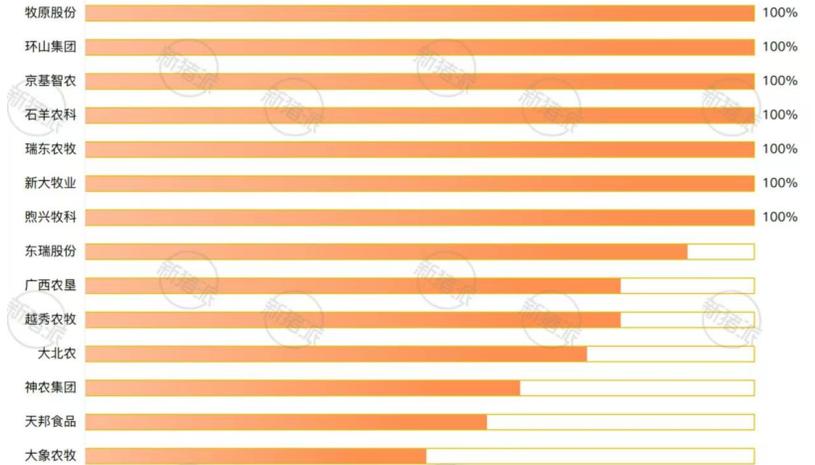
数据截至：2024年7月25日

数据来源：新猪派调研



扫码关注“新猪派”

### 14家猪舍空滤系统覆盖率超过50%的养猪企业



数据截至：2024年7月25日

数据来源：新猪派调研



扫码关注“新猪派”



用数据读懂养猪业



用数据读懂养猪业



用数据读懂养猪业

# 小结：ASFV空气传播

## Summary: ASFV airborne transmission

- 非洲猪瘟传入我国后的第二次产业技术革命;
- The second industrial technological revolution following the introduction of African swine fever into China;
- 守住了北方地区“养猪的倔强”;
- Maintained the "stubbornness of pig farming" in the northern region;
- 第二次崛起，育肥场更加灵活和灵动，享受到这次革命的红利;
- In the second rise, the fattening farm is more flexible and agile, enjoying the dividends of this revolution;
- 全行业共识和行动，事实证明，是推动北方养猪振兴的转折点和“第七轮传播”的分水岭。
- The consensus and action of the whole industry have proved to be the turning point for promoting the revitalization of pig farming in the north and the watershed of the "seventh round of dissemination".

# 第三部分：季节性空气过滤及其应用实践

## Part 3: Seasonal Air Filtration and Its Application Practice

■从发现到试验

■From discovery to experimentation

■从试验到实践

■From experiment to practice

■从实践到改善

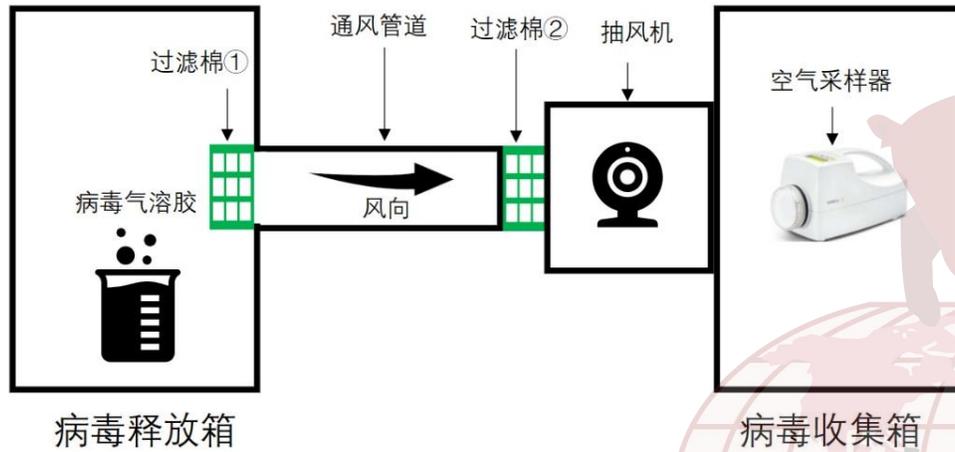
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■From practice to improvement



# 试验1：空气过滤效果模拟

## Experiment 1: Simulation of Air Filtration Effect



模拟气溶胶，收集器及验证

(以核酸阳性判断，试验前ASFV灭活)

Simulated aerosol, collector and verification

(Judged by nucleic acid positivity, with ASFV

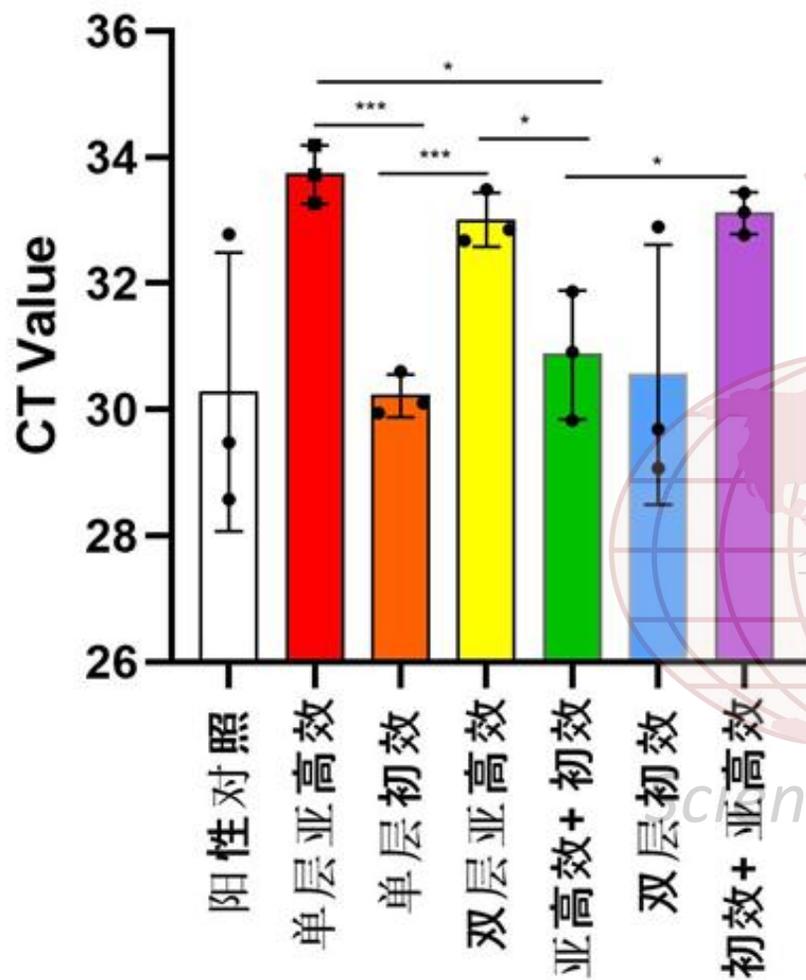
inactivated before the test)



雾化装置



过滤棉



小结: Summary:

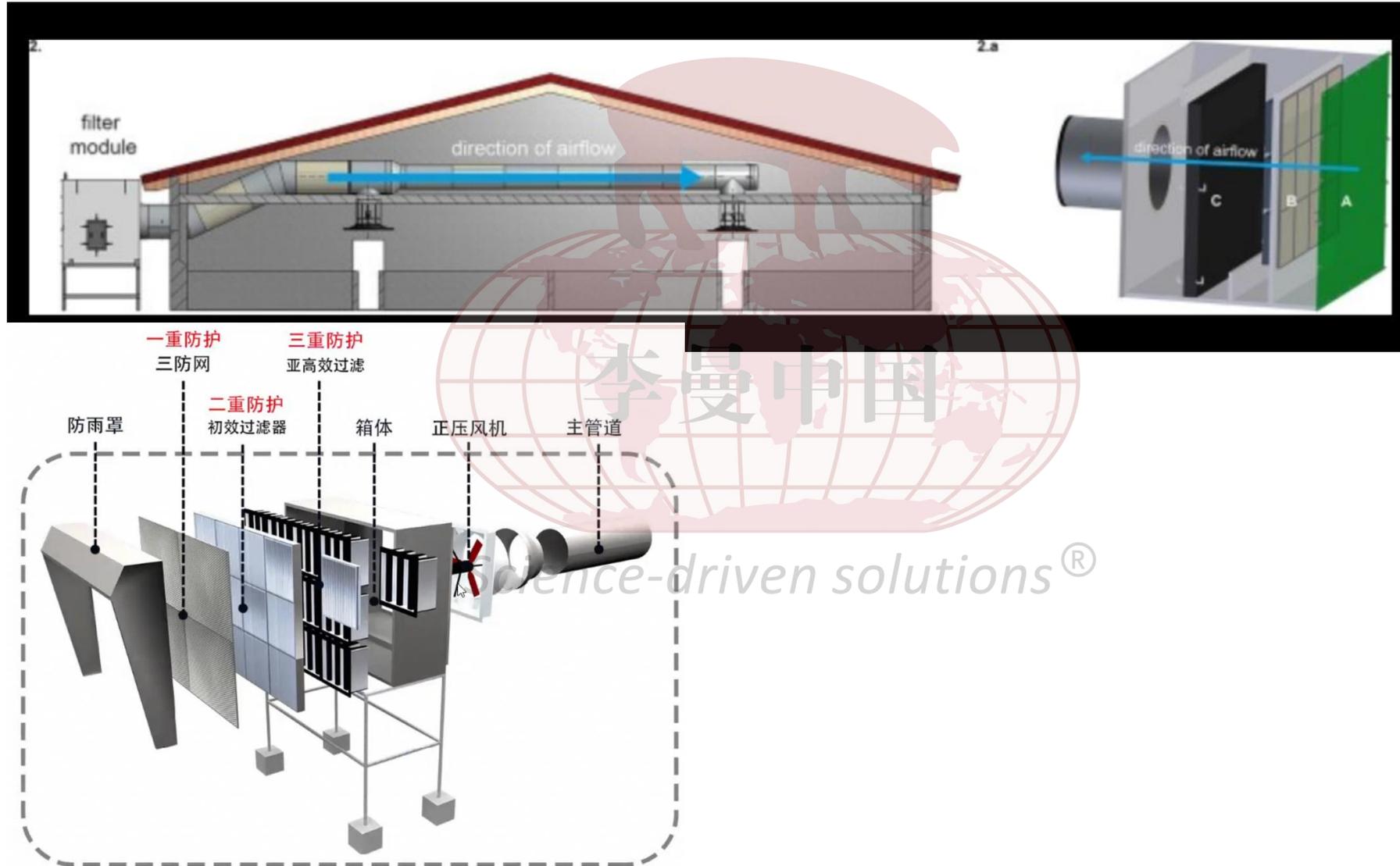
- 1、浓度持续性;
1. Consistency of concentration;
- 2、时间持续性;
2. Time continuity;
- 3、与群体的接触感染呈正相关
3. There is a positive correlation between contact with the group and infection

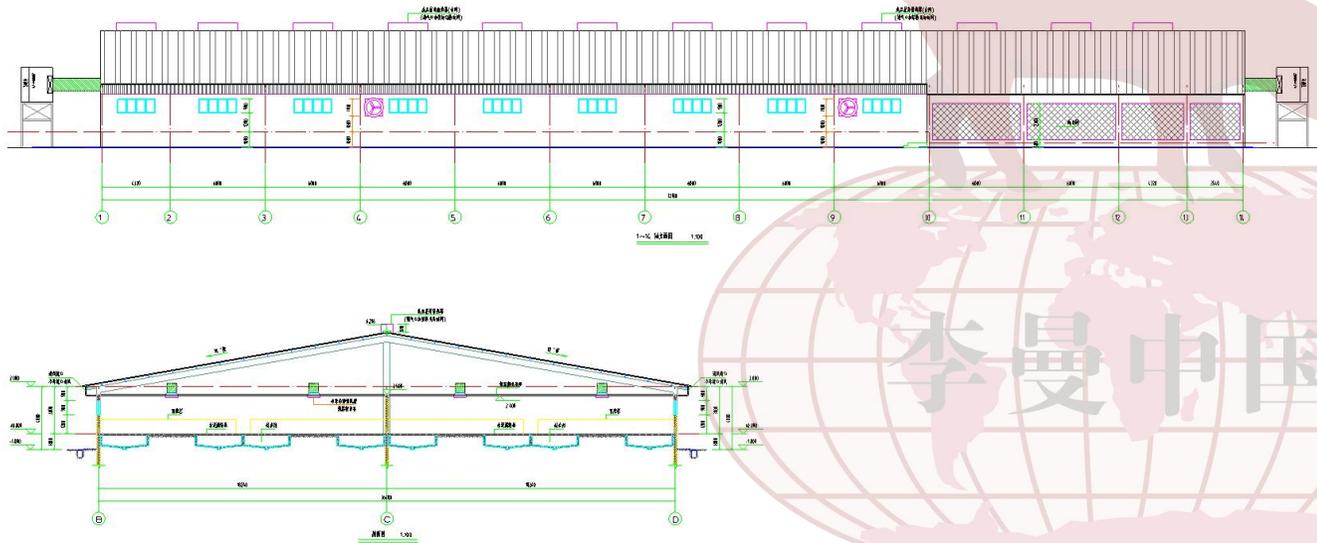
李曼中国

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# 试验及实践2：育肥舍正压空气过滤

## Experiment and Practice 2: Positive Pressure Air Filtration in Fattening Houses





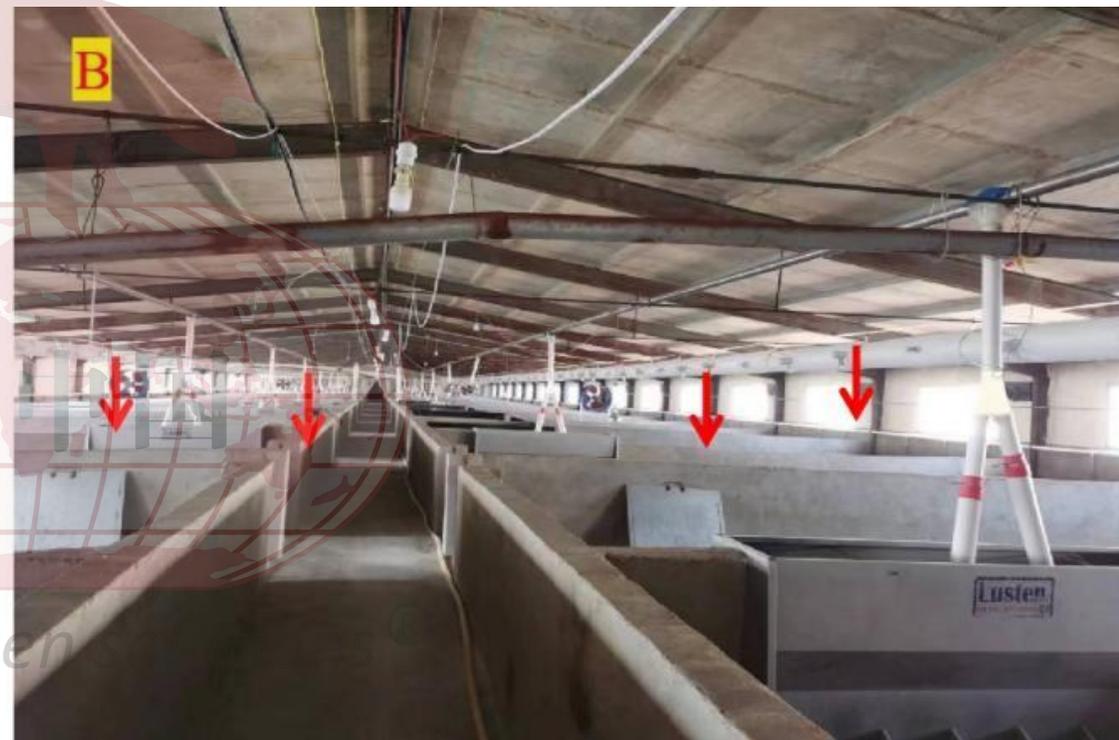
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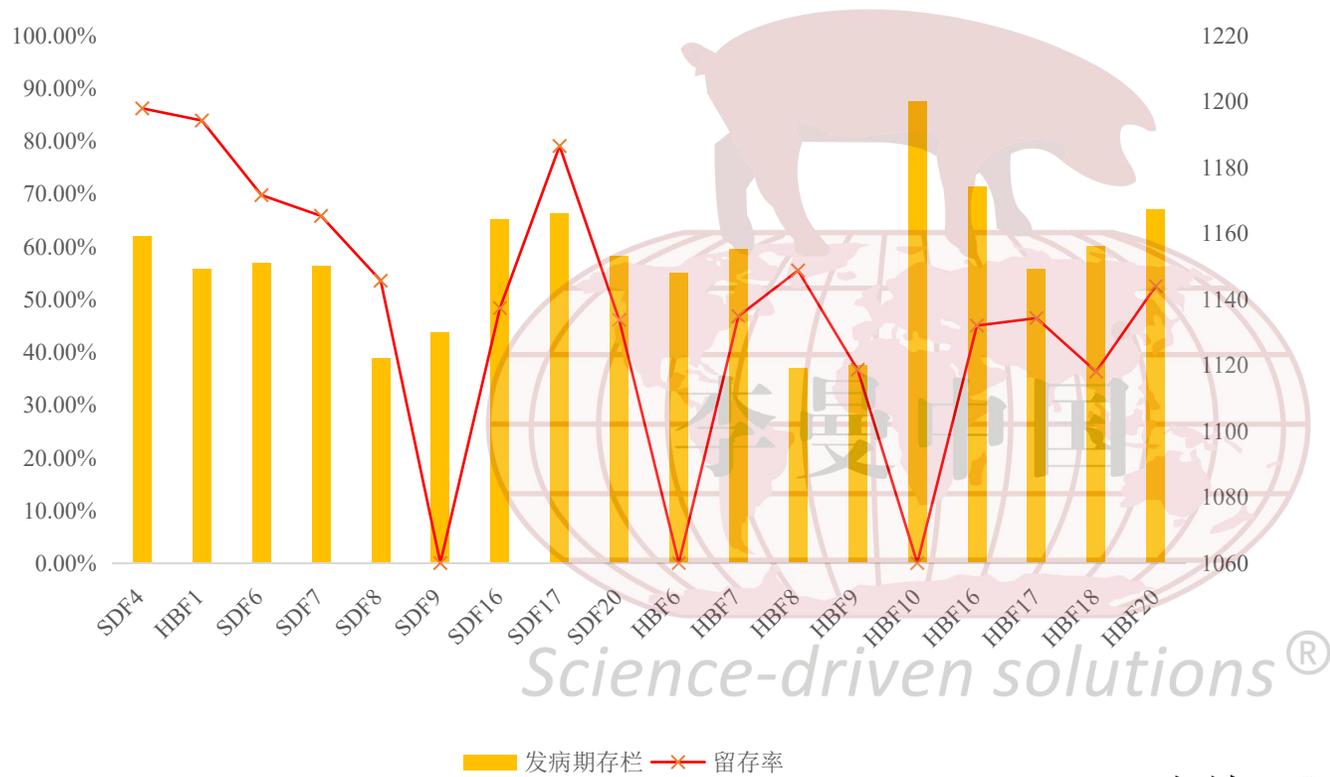
“聊大高效循环农场”  
"Liaocheng University High-efficiency Circular Farm"

# 舍外Outside the room



# 舍内 Inside the barn

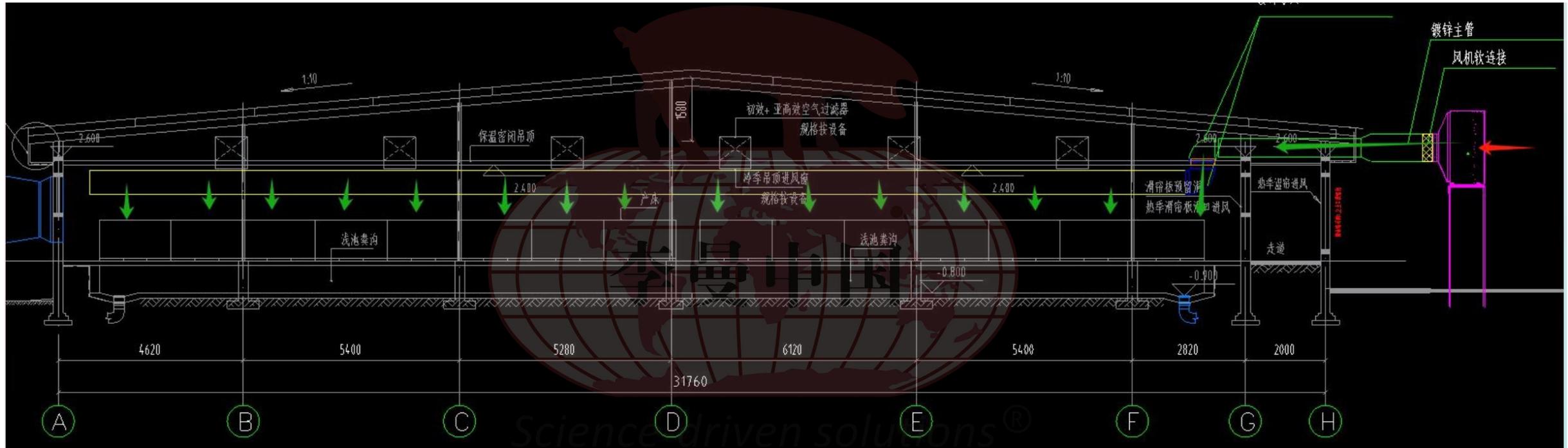




小结：阻断预防效果90%，留存率84.96%  
 Summary: The prevention efficacy of the intervention is 90%, with a retention rate of 84.96%

# 实践3：繁殖场空气过滤改造

## Practice 3: Air filtration transformation of breeding farm



适用于初效、中效、高中效、亚高效空气过滤器

规格	平均粒径范围的综合计数效率 (%)			计重效率 %	最小终阻力 Pa
	范围1 0.30~1.0μm	范围2 1.0~3.0μm	范围3 3.0~10.0μm		
MERV 1	N/A	N/A	E <sub>3</sub> <20	E<65	75
MERV 2	N/A	N/A	E <sub>3</sub> <20	65≤E<70	75
MERV 3	N/A	N/A	E <sub>3</sub> <20	70≤E<75	75
MERV 4	N/A	N/A	E <sub>3</sub> <20	75≤E	75
MERV 5	N/A	N/A	20≤E <sub>3</sub> <35		150
MERV 6	N/A	N/A	35≤E <sub>3</sub> <50		150
MERV 7	N/A	N/A	50≤E <sub>3</sub> <70		150
MERV 8	N/A	N/A	70≤E <sub>3</sub> <80		150
MERV 9	N/A	E <sub>2</sub> <50	85≤E <sub>3</sub>		250
MERV 10	N/A	50≤E <sub>2</sub> <65	85≤E <sub>3</sub>		250
MERV 11	N/A	65≤E <sub>2</sub> <80	85≤E <sub>3</sub>		250
MERV 12	N/A	80≤E <sub>2</sub> <90	90≤E <sub>3</sub>		250
MERV 13	E <sub>1</sub> <75	90≤E <sub>2</sub>	90≤E <sub>3</sub>		350
MERV 14	75≤E <sub>1</sub> <85	90≤E <sub>2</sub>	90≤E <sub>3</sub>		350
MERV 15	85≤E <sub>1</sub> <95	90≤E <sub>2</sub>	90≤E <sub>3</sub>		350
MERV 16	95≤E <sub>1</sub>	90≤E <sub>2</sub>	90≤E <sub>3</sub>		350

### 亚高效密褶式空气过滤器

#### 玻璃纤维滤材

产品型号	尺寸 (mm)	过滤效率	
		EN779:2012 标准	ANSI/ASHRAE 52.2-1999 标准
MZ/GE66-F9	592*592*292	F9	MERV15
MZ/GE66-E10	592*592*292	E10	MERV16



产品材质：耐老化 ABS 边框，超细玻璃纤维滤纸  
性能特点：高效、低阻、过滤面积大、通用性强

产品型号	初阻力 (Pa)	额定 风量 (m³/h)	初阻力 (Pa)	猪场常 用风量 (m³/h)	建议		建议	
					终阻力 (Pa)	风量 (m³/h)	终阻力 (Pa)	风量 (m³/h)
MZ/GE66-F9	≤100	3400	≤25	1000	≤200	3400	≤50	1000
MZ/GE66-E10	≤120	3400	≤30	1000	≤250	3400	≤60	1000

MZ/GE66 系列过滤器风量与初阻力对照表

风量 m³/h	产品型号	500	1000	1250
初阻力 Pa (±5%)	MZ/GE66-F9	11	25	32
初阻力 Pa (±5%)	MZ/GE66-E10	15	30	39

### 亚高效密褶式空气过滤器

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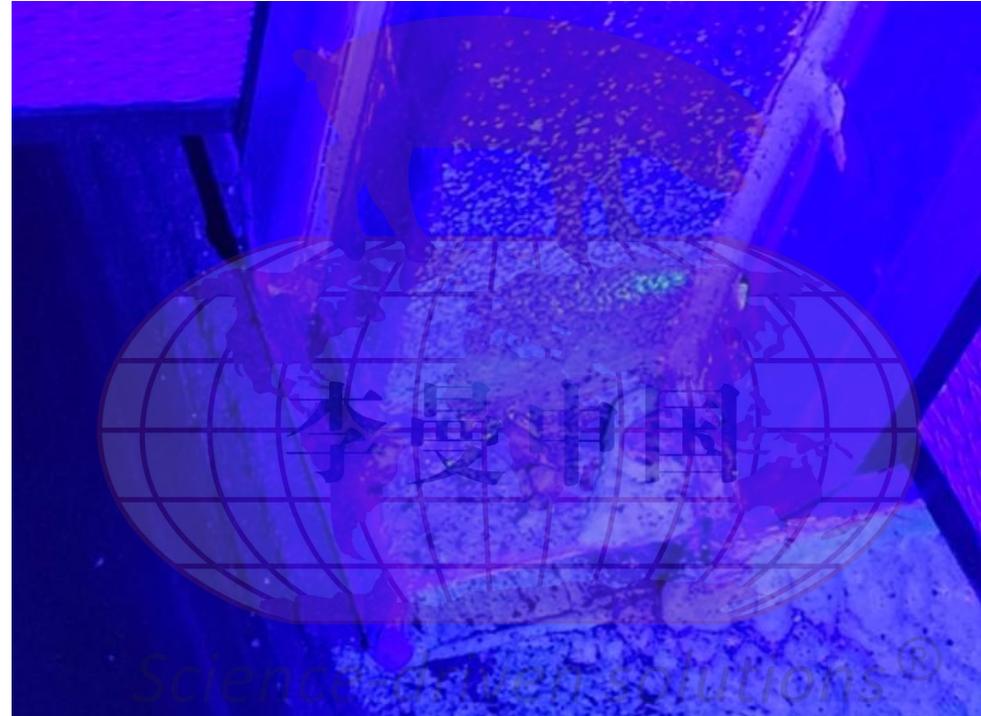
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# 外部及内部 External and Internal



# 运维、检查及更换 Operation and maintenance, inspection and replacement



# 第四部分： 全篇总结

## Part 4: Summary of the whole article

- 非洲猪瘟的预防、控制、净化和复产依然依靠生物安全体系；
- The prevention, control, eradication, and resumption of production for African swine fever still rely on the biosecurity system;
- 灰尘携带/气溶胶/二次污染性的传播的发现、试验与实践是第七轮低流行率的主要贡献，应该给予正面的、行业及其他渠道的合理评价；
- The discovery, testing, and implementation of dust-borne/aerosol/secondary pollutant transmission are major contributions to the seventh round of low prevalence, and should be given positive, industry, and other reasonable evaluations;
- 季节性空气过滤目前实践是符合北方生产的实际，抓住了流行病的规律；
- Seasonal air filtration is currently a practice that is in line with the reality of production in the north and captures the patterns of epidemics;
- 空气过滤的维护和可持续使用是第八轮的挑战。
- The maintenance and sustainable use of air filtration is the challenge for the eighth round.

谢谢大家!

Thank you all!

聊城大学农业与生物学院

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山东禾邦（聊大共建）养猪研究院

Shandong Hebang (Liaocheng University Co-construction) Pig Research Institute

聊城大学“猪传染病防控与高效生产”创新团队

Innovative team of "Swine Infectious Disease Prevention and Control and High-efficiency Production" of Liaocheng University

Science-driven solutions