

# DATA CONSOLIDATION FOR THE INTERNATIONAL SPACE STATION'S ENVIRONMENTAL AND VEGGIE MICROBIAL ISOLATES INCREASES TRENDING CAPABILITIES

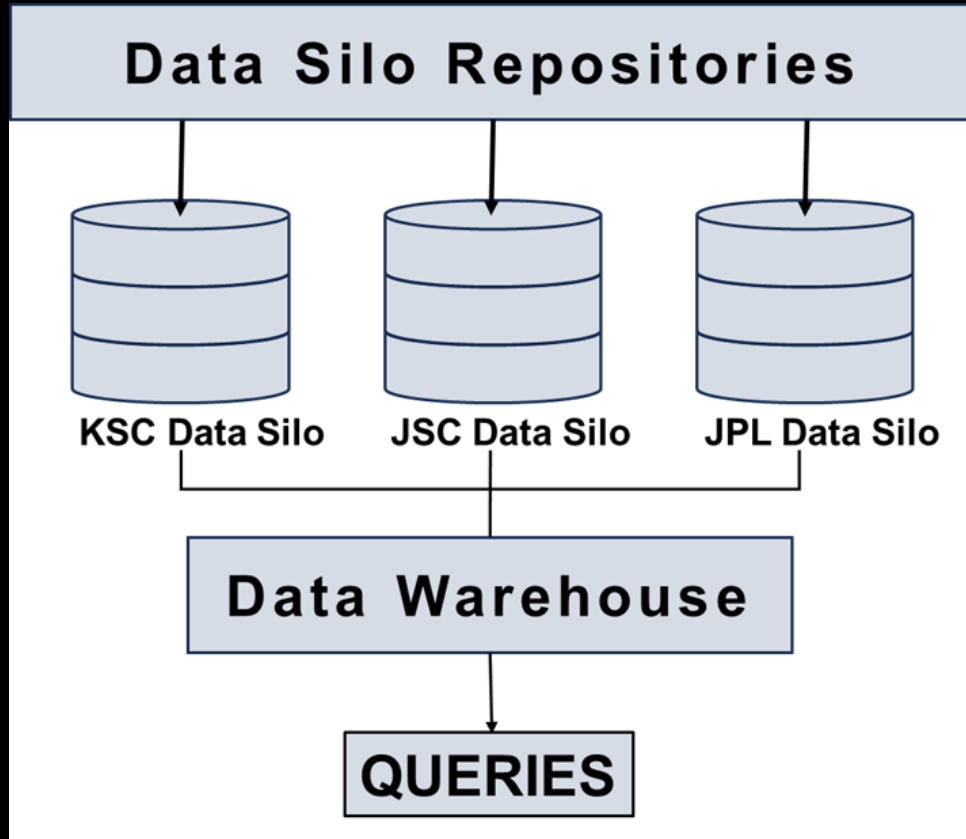


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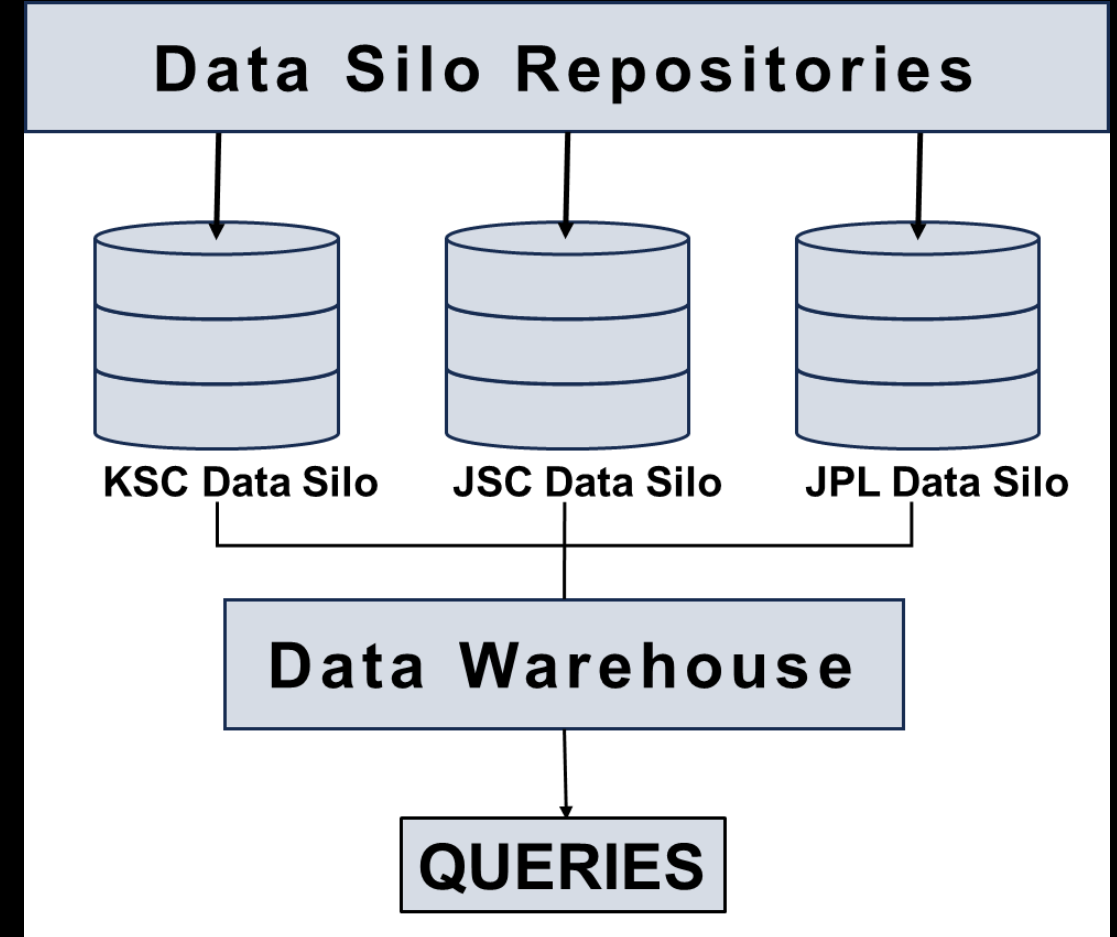
# Why We Need This



- Microbes have been introduced on the International Space Station (ISS)
  - Crew members
  - Flight hardware
  - Plants cultivated in Veggie or Advanced Plant Habitat (APH)
- Large amounts of data accumulated and maintained at several NASA centers
  - May create **data sprawl**
- These data were not easily accessible to others
  - May create a **data silo**

## BENEFITS of a REPOSITORY

- Eliminates data silo
- Centralized data makes data more accessible
- Improves decision making
- Enhances models, planning
- Streamline data analyses, queries
- May be useful for data validation



# Microbial Isolate and Veggie Monitoring Microbial Database

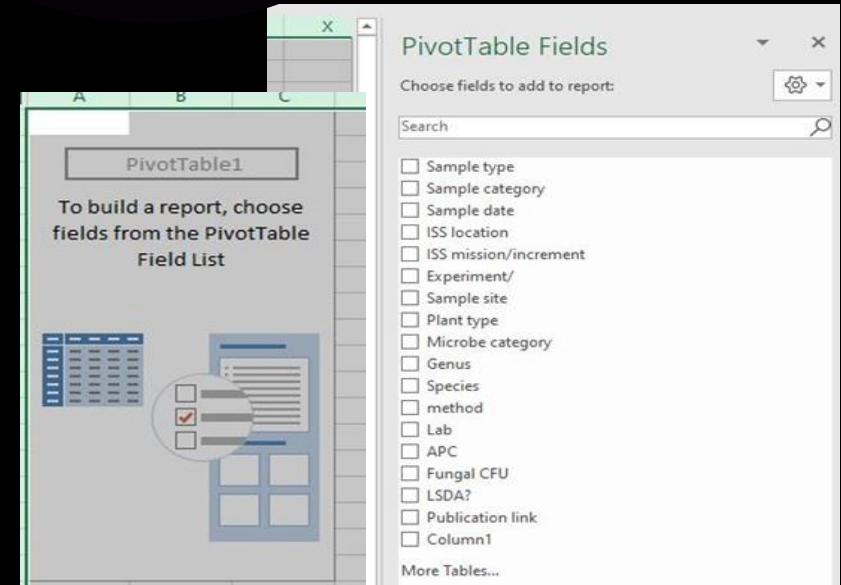
- Microbial Isolate Collections
  - JSC - Microbial monitoring of the air, surfaces and water on the ISS since 2001 by the JSC Microbiology Laboratory.
  - KSC - Microbial analyses of the Veggie, APH and XROOTS hardware and the associated plant material at KSC Life Sciences Labs since 2014.
  - KSC - Space X monitoring since Crew 1 by Environmental Lab.
  - JPL - Microbial Tracking 1 and 2.
- These collections are currently stored in separate locations.



# Microbial Isolate Database



- Acquire and organize ISS microbial isolate data since 2001
    - ISS Air
    - ISS Surface
    - Veggie, APH, XROOTS
    - Ground Surfaces including vehicles and payload hardware to be launched
  - Developed a series of searchable fields
  - Developing a tutorial for use
  - Over 3200 entries of cultured isolates
- Data will allow analysis of microbial community trends of the ISS environment.





Count of Genus	Achromobacter	Aspergillus	Bacillus	Enterobacter	Fusarium
Columbia module	2	1	2	1	
FGB			1		
Node 1			2		3
Node 2					2
Node 3					1
PMM			1		
Service module			1		
US lab				2	
(blank)					1
<b>Grand Total</b>	<b>2</b>	<b>1</b>	<b>7</b>	<b>9</b>	<b>1</b>

# Searchable Fields

- Location (Flight or Ground)
- Sample category (i.e. Surface, Air, Plant)
- Sample date
- ISS location
- ISS mission/increment
- Experiment/Tech Demo
- Sample site (i.e. Bellows, Fans, Pillow#)
- Sample type (i.e. Root, Leaves, Substrate)
- Plant type (if applicable)
- Microbial category
- Genus
- Species
- Method (of identification)
- Lab (source)
- APC
- Fungal CFU
- LSDA submission
- Publication Link

PivotTable Fields

Choose fields to add to report: 

Search 

- Location
- Sample category
- Sample date
- ISS location
- ISS mission/increment
- Experiment/Tech Demo
- Sample Site
- Sample Type
- Plant type
- Microbe category
- Genus
- Species
- method
- Lab
- APC
- Fungal CFU
- LSDA?
- Publication link

# CASE STUDY – *Fusarium oxysporum* tracking

## Genomic Characterization and Virulence Potential of Two *Fusarium oxysporum* Isolates Cultured from the International Space Station

Camilla Urbaniak,<sup>a</sup> Peter van Dam,<sup>b</sup> Alexander Zaborin,<sup>c</sup> Olga Zaborina,<sup>c</sup> Jack A. Gilbert,<sup>c</sup> Tamas Torok,<sup>d</sup> Clay C. C. Wang,<sup>e</sup> Kasthuri Venkateswaran<sup>a</sup>



## *Fusarium oxysporum* as an Opportunistic Fungal Pathogen on *Zinnia hybrida* Plants Grown on board the International Space Station

Andrew C. Schuerger, Bimal S. Amaradasa, Nicholas S. Dufault, Mary E. Hummerick, Jeffrey T. Richards, Christina L. Khodadad, Trent M. Smith, and Gioia D. Massa

# Case Study: *Fusarium oxysporum* – First Occurrence

- Select species of interest.
  - The Species field is filtered to *oxysporum*
- Select additional criteria:
  - ISS location
  - Experiment/Tech demo
  - Sample Type (where it was found in each experiment)
  - Add Species to Values to acquire a total number of detected isolates

PivotTable Fields

Choose fields to add to report:

Drag fields between areas below:

Search

Sample category

Sample date

ISS location

ISS mission/increme...

Experiment/Te...

Sample Site

Sample Type

Plant type

Microbe category

Genus

Species

method

Lab

APC

Filters

Species

Columns

ISS location

Rows

Experiment/Tech D...

Sample Type

Values

Count of Species

Defer Layo...



# Case Study: Results

- *Fusarium oxysporum* isolate first detected in VEG-01C
- Detected in multiple Sample Types including leaves, roots, pillow and media (substrate)
- Number of times detected in Sample Type by ISS location
- Grand Total indicating total number of detected isolates in query

Species	oxysporum		
Count of Species		ISS location	
Experiment/Tech Demo	Sample Type	Columbus	Grand Total
VEG-01C	leaves	3	3
	leaves pillow F	1	1
	media	1	1
	root	1	1
	wick	1	1
	wicking pillow A	1	1
VEG-01C Total		8	8
VEG-03D	leaf	1	1
	root	1	1
	Substrate	1	1
	wick	1	1
VEG-03D Total		4	4
VEG-03E	fan inside	1	1
	leaves	1	1
	pillow	1	1
VEG-03E Total		3	3
VEG-03F	pillow	1	1
VEG-03F Total		1	1
VEG-03I	media	1	1
	pillow	1	1
	wick	1	1
VEG-03I Total		3	3
VEG-03K	leaves	1	1
	media	1	1
	pillow	1	1
	root	1	1
	wick	1	1
VEG-03K Total		5	5
VEG-03L	media	1	1
	root	1	1
	wick	1	1
VEG-03L Total		3	3
VEG-04A	pillow	1	1
VEG-04A Total		1	1
VEG-04B	leaves	1	1
	media	1	1
	pillow	1	1
	root	1	1
	wick	1	1
VEG-04B Total		5	5
Grand Total		33	33

# Future Plans

- Work in Progress
  - Include Sequencing Data
    - Plant pathogens
    - Obligate biotrophic pathogens
    - Anaerobes
    - Thermophiles
    - Other extremophiles
  - Update database as information becomes available
- Clarify validation rules and terminology

# ACKNOWLEDGEMENTS

- The authors would like to thank all the contributors of these data, and those that tracked, identified, and entered these microbial data.
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QUESTIONS?