**Presenter:** Andrea C. Meyer

# Illuminating Landscapes: Discovering Potential Pharmaceuticals from a Mobile Darkroom

### Introduction:

- Natural products are a major source of drugs used by humans, but random screening of plants is inefficient.
- A mobile darkroom could identify individual plants with the highest potential of chemical diversity and bioactivity, which will save time and resources in the drug discovery process.

### Rationale for Illuminating Sagebrush Chemistry in the Sagebrush Landscape:

- Historically, sagebrush has been used treat various illnesses and ailments [1].
- Vertebrate herbivore (sage-grouse [*Centrocercus urophasianus*, 2, 3], mule deer [*Odocoileus hemionus*, 4]) avoid species of sagebrush that tend to lack UV signals and have higher concentrations and diversity of chemicals:
  - Sage-grouse prefer mountain big sagebrush (*Artemisia tridentata subsp. vaseyana*) over Wyoming big sagebrush (*Artemisia tridentata subsp. wyomingensis*) or Basin big sagebrush (*Artemisia tridentata subsp. tridentata*).[5]
- Mountain sagebrush leaves in water have an intense blue to Creamy-blue color when placed under a UV light and the other two subspecies appear colorless [5].

### Significance of Project:

- Contributes to mission of NIH Idaho INBRE: enhance the science and technology knowledge of Idaho's workforce by expanding skills and equipment that can detect variation in natural products in plants
- Contributes to NSF EPSCoR Genomics Underlining Toxin Tolerance by expanding skills and equipment to identify toxins across landscapes
- Advances in capacity to detect variation in natural products in plants:
  1. Designed and tested prototypes of a mobile darkroom
  2. Custom-built light array for UV fluorescent assays
  3. 3D printed cuvette holder to analyze extracts
  4. Compared conditions for visualizing variation in spectral signals:
     - Whole leaf versus ground plant material
     - Field-accessible solvents (water and ethanol)
     - Microtubes, cuvette material, 96-well plates, TLC plates
     - Use of orange filters in field prototype

## Mobile Darkroom Prototype Development

"Trash bag Method" Printed with permission from Justan Meyer July 2021 (Andrea Meyer)

**Before**

Black bag was used to Visualize UV Fluorescence

**Current Prototype**

This mobile darkroom was laser cut from ⅛" plywood at the Boise State University Maker Lab. The UV light array was custom made and powered by a rechargeable power bank.

## Orange PMMA Filter Results in a Clearer Image

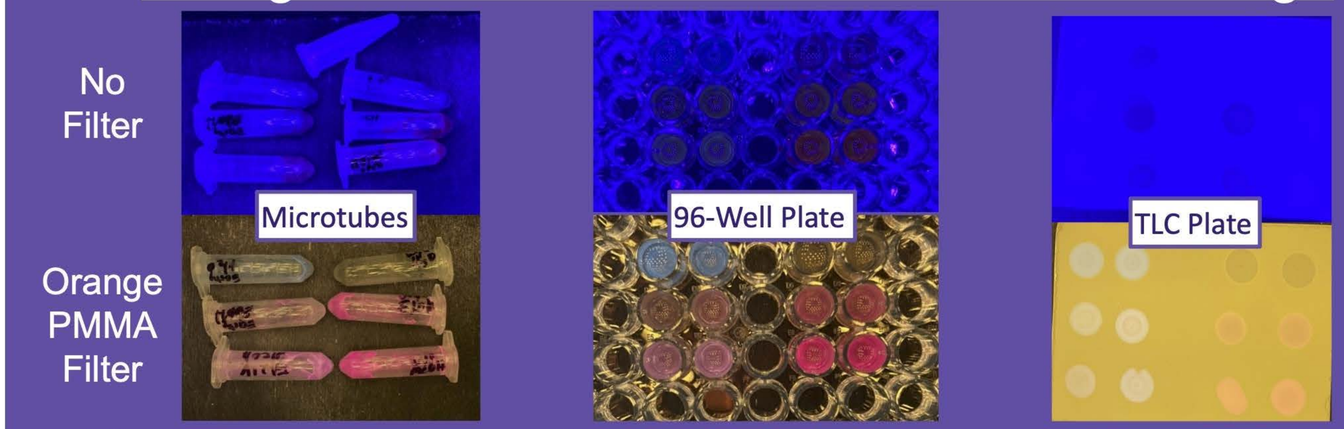


Figure 1: The above images show the comparison of the sagebrush species, early sagebrush and Wyoming big sagebrush. The samples were extracted in three different solvents: water, ethanol and methanol. The samples were then imaged with and without the orange PMMA filter while in: microtubes, 96-well plate and TLC plate. With the use of the orange PMMA filter, new colors were observed than previously documented in literature.

**Sagebrush Species Fluorescence Under UV**

| | Solvent | Sagebrush Species: Early Sagebrush | Sagebrush Species: Wyoming Big Sagebrush |
|---|---|---|---|
| Without Filter | Water | Creamy-blue | Colorless |
| Without Filter | Ethanol | Creamy-blue | Colorless to pale brownish-red |
| With Orange Filter | Water | Vibrant Blue | Colorless |
| With Orange Filter | Ethanol | Pale Lavender | Pale Magenta |
| With Orange Filter | Methanol | Vibrant Lavender | Vibrant Magenta |

Table 1: Previously color observed from UV fluorescence was limited to what could be seen with the eye when the sagebrush was extracted in water and ethanol and exposed to UV light. With the use of an orange PMMA filter and a smartphone, new colors were observed when excited with 395-400 nm UV light , potentially leading to new criteria to identify sagebrush species.

**Co-authors:** Dr. Jennifer Forbey (Senior PI and Mentor at Boise State University), Dr. Lisa Warner ( Boise State University), Aurora Zantman (Undergraduate, Boise State), Debbie Conner (Graduate student, Boise State ), Justan Meyer BSME

### References:

[1] Elmore, Francis H. *Ethnobotany of the Navajo a Monograph of The University of New Mexico and The School of American Research*. The University of New Mexico Press, 1944, http://theplantlady.net/resources/Ethnobotany%20of%20the%20Navaho.pdf

[2] Frye G.G., Connelly J.W., Musil D.D., Forbey J.S. 2013. Phytochemistry predicts habitat selection by an avian herbivore at multiple spatial scales. Ecology. 94(2):308–314. doi:10/f4tpcx.

[3] Welch B., Wagstaff F., Roberson J. 1991. Preference of wintering sage grouse for big sagebrush. Journal of Range Management. 44(5):462–465. doi:10.2307/4002745.

[4] Wambolt C.L. 1996. Mule deer and elk foraging preference for 4 sagebrush taxa. Journal of Range Management. 49(6):499. doi:10.2307/4002289.

[5] Rosentreter R. 2005. Sagebrush identification, ecology, and palatability relative to sage-grouse. In: NL Shaw, M. Pellant, and SB Monsen, compilers. Sage-grouse habitat restoration symposium proceedings. US Department of Agriculture, Forest Service Proceedings, RMRS-P-38, Boise, Idaho, USA. p. 3–16.

### Funding:

EPSCoR RII Track-2 FEC OIA-1826801

RII Track-1 FEC OIA-1757324