Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

Nachet: Weed Seed identification using Artificial Intelligence

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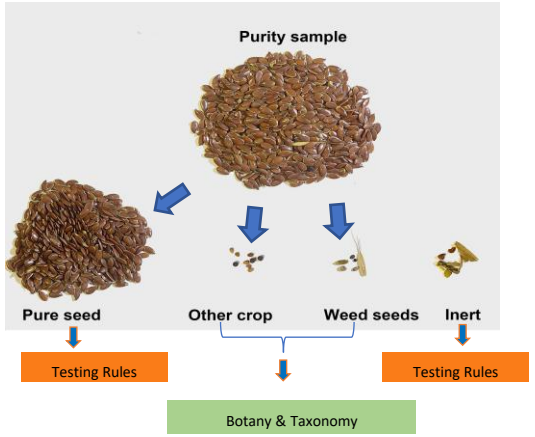
Outline

- Background and introduction
- Materials & methods
- Results and discussion

Weed Seed Identification

Specialists trained to identify seeds in commodities for their taxonomy identity or for quarantine species in trade.



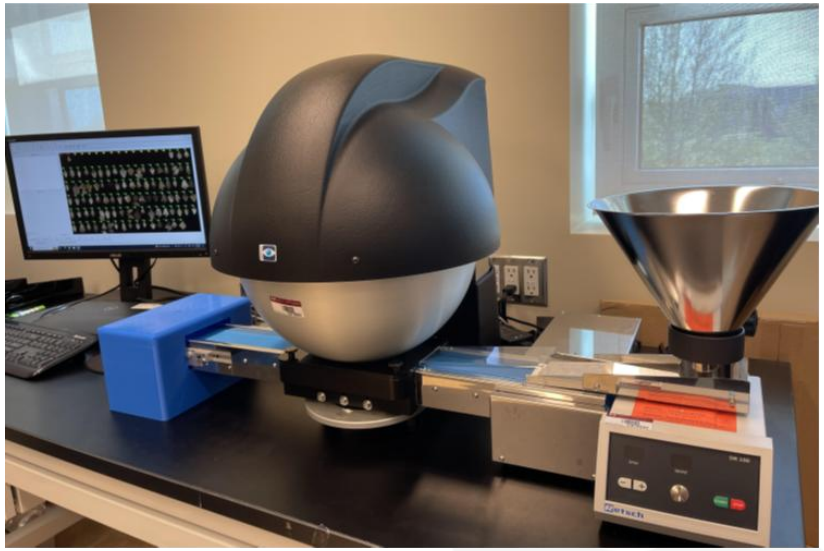
Testing innovation: Computer Vision (AI)

Artificial Intelligence (AI), especially deep learning, emerges as a promising solution for method innovation in seed testing. However, continued study for testing application is required.

Study Objectives

- Develop deep learning computer vision using different imaging systems for seed identification

Tagarno® Trend with visual light, i.e., Red, Green and Blue (RGB)



VideometerLab4® 19 LED channels with light from 970-365nm

Trial Seed Species

Family and species name

Brassicaeae
- *Brassica juncea*
- *Brassica napus* subsp. *napus* (image)

Poaceae
- *Bromus secalinus*
- *Bromus japonicus*
- *Bromus hordeaceus* (image)
- *Lolium temulentum*

Asteraceae
- *Cirsium arvense*
- *Carduus nutans* **(Image)**
- *Cirsium vulgare*
- *Ambrosia psilostachya*
- *Ambrosia trifida* (Image)
- *Ambrosia artemisiifolia*
- *Cychlochaena xanthiifolia*
- *Tripleurospermum inodorum*
- Tripleurospermum maritimum
- *Iva axillaris*

Solanaceae
- *Solanum carolinense* (Image)
- *Solanum rostratum*
- *Solanum nigrum*
- Solanum elaeagnifolium

Centaurea
- *Centaurea calcitrapa*
- *Centaurea calcitrapa*
- *Centaurea melitensis*
- *Centaurea solstitialis*
- *Centaurea solstitialis*

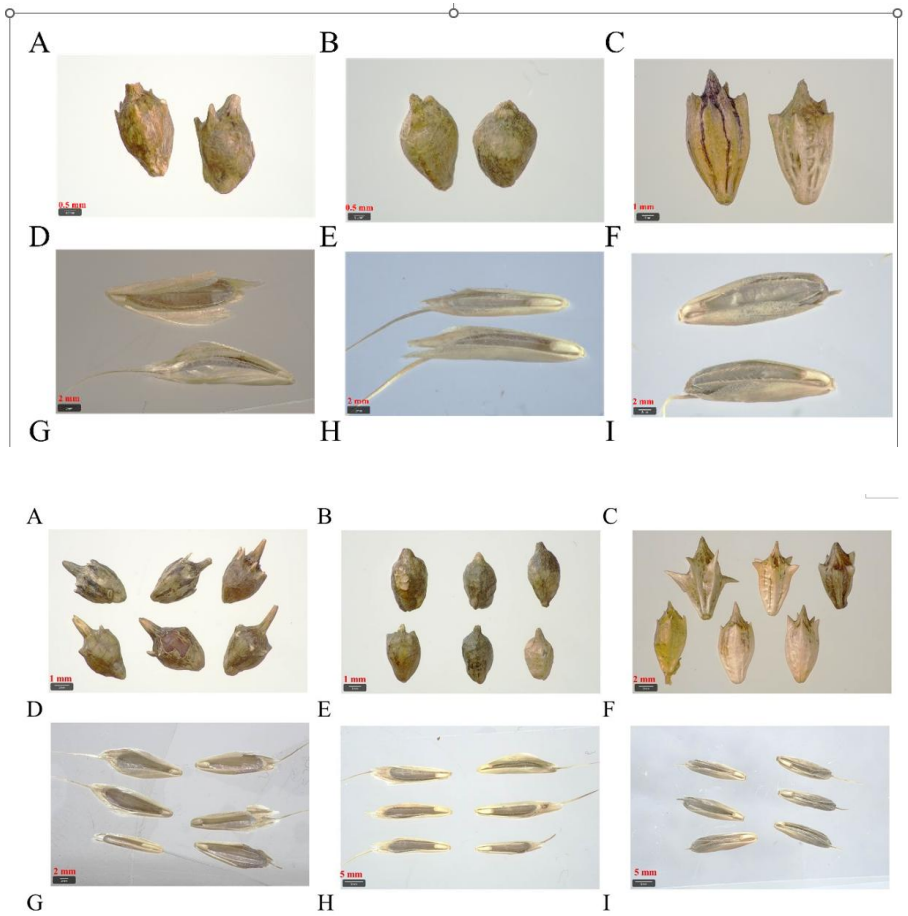
Convolvulaceae
- *Cuscuta gronovii*
- *Cuscuta spp*

AI Model Development

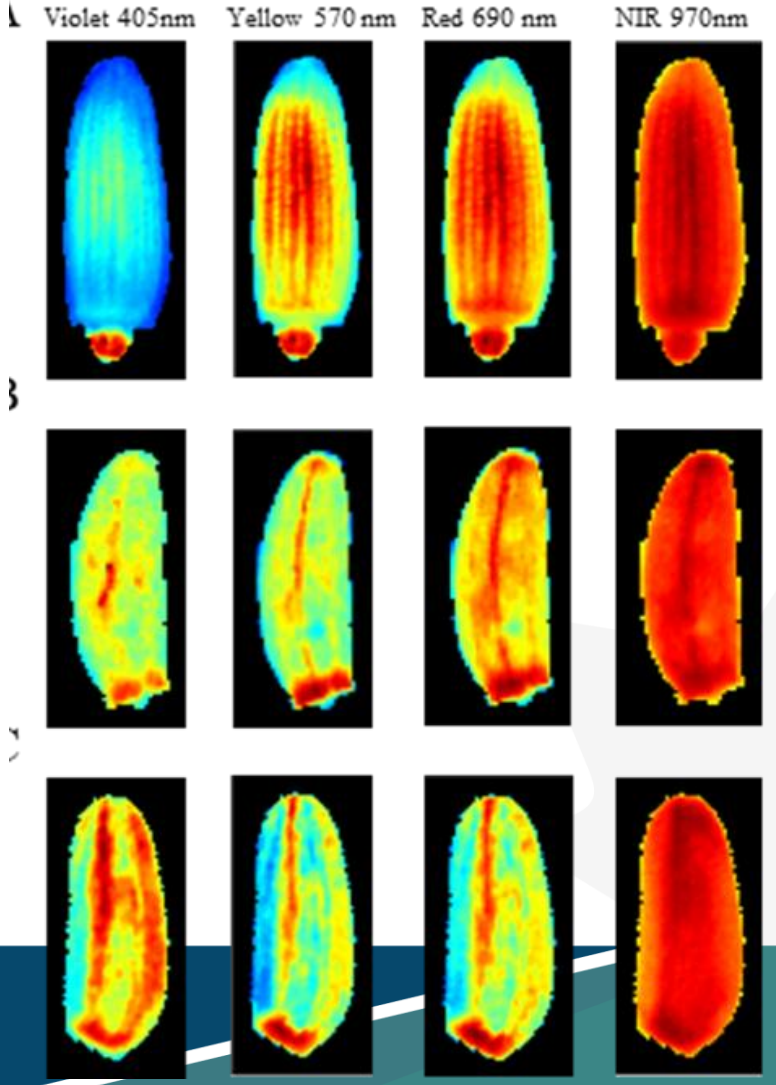
- Each species with 400-100 seeds for model training, another 100-50 seeds for model validation
- RGB Imaging condition:
  - Magnification with the field of imaging of 1, 2, 6, 8 seeds,
  - 2 side images for Poaceae with random position
- Muti-spectral imaging
  - Belt with setting parameters (belt speed and distance) suitable to each species
  - Manual image taking with Petri dish

Image Data

RGB Image Data



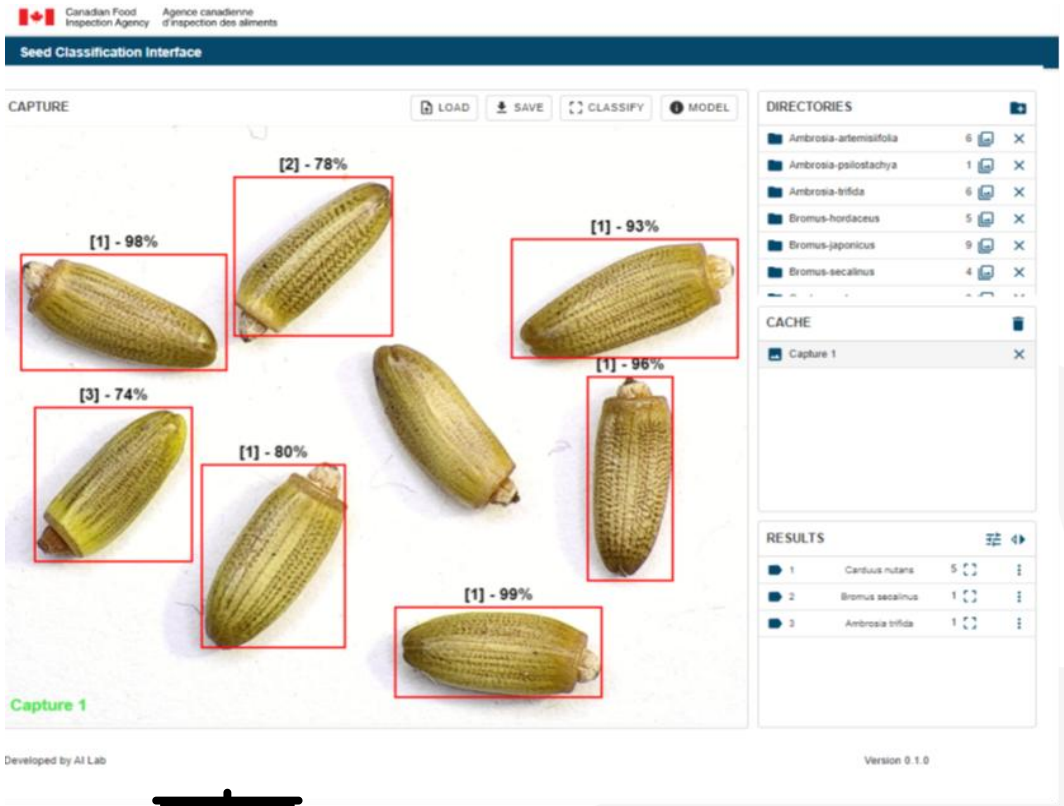
Multispectral Image Data



RGB App – Nachet: AI assisted ID

Micro-imaging with a digital microscope

Interface developed by CFIA Ai-lab



How to use Nachet (Video)

[CFIA Nachet Video Demo]


How to use Nachet?

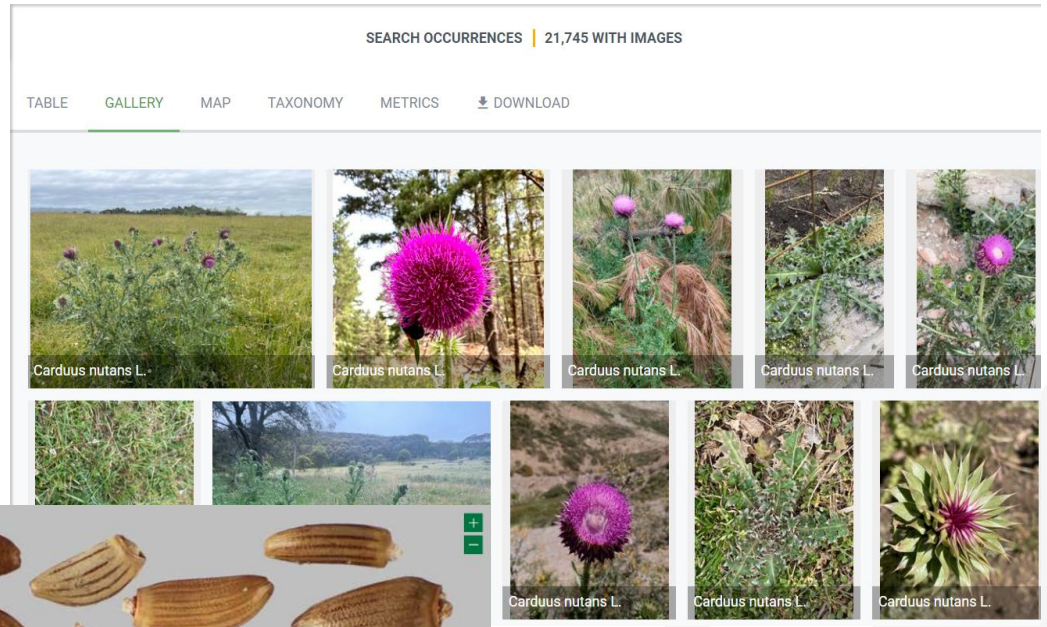
Results & success factors

Accuracy - Results to-date:

- 27 species tested / added to tool algorithm
- Accuracy rates thus far – 80-98%

Application success factors:

- Seed Image data availability for AI modeling
- Training data specification and end use similarity
- Hardware and software coordination



Nodding thistle (*Carduus nutans*) achenes

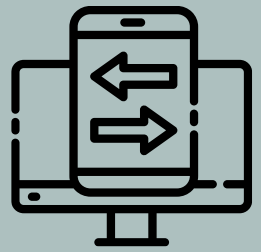
Next steps

Current Priority:

- Increasing the number of weed seed species that the tool can identify
  - To do so, CFIA requires a large volume of high-resolution images as well as diversity of types of images of weed seeds to train the tool
  - Aim is to expand tool's ability to be able to identify all quarantine weed seeds of Canada's major trading partners

Collaborating with accredited labs across Canada:

Collecting species of focus



Sharing images of seeds with CFIA

Testing & providing input on Nachet tool

CFIA's Seed Team leads

- Jennifer Neudorf
- Angela Salzl
- Jo Anne Hornseth
- Liang Zhao
- Taran Meyer
- Dr. Ruojing Wang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🔬 **Nachet** refers to **Camille Sébastien Nachet**, a renowned 19th-century French optician and microscope maker. He played a significant role in the development of scientific instruments during the golden age of microscopy.

Here's a quick breakdown:

🧪 Who Was Nachet?

- **Camille Nachet (1799–1881)** started his career making lenses for Charles Chevalier, another famous microscope maker.
- In **1839**, he founded his own company in Paris and began producing **drum-type microscopes** [1].
- His son, **Albert Nachet**, later joined the business and continued the legacy into the early 20th century [1].

🔍 Why Is Nachet Important?

- Nachet microscopes were known for their **precision and craftsmanship**, often used in scientific and medical research.
- He contributed to innovations like the **inverted microscope** and **binocular designs**, adapting ideas from other inventors [2].
- His instruments, such as the **Grand Modèle**, featured advanced mechanics like rack-and-pinion focusing, rotating stages, and accessories for polarized light [2].

If you're into antique scientific instruments or the history of microscopy, Nachet's work is a fascinating chapter. Want to dive deeper into how his microscopes were used or what made them stand out from others of the time?

[1] stichtinghistorischemicroscopie.nl [2] microscope-antiques.com

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