

Seed pathway for pest dissemination:

ISTA Reference Pest List

a bibliographic resource
in non-vegetable plant species



Dr. Nicolas Denancé

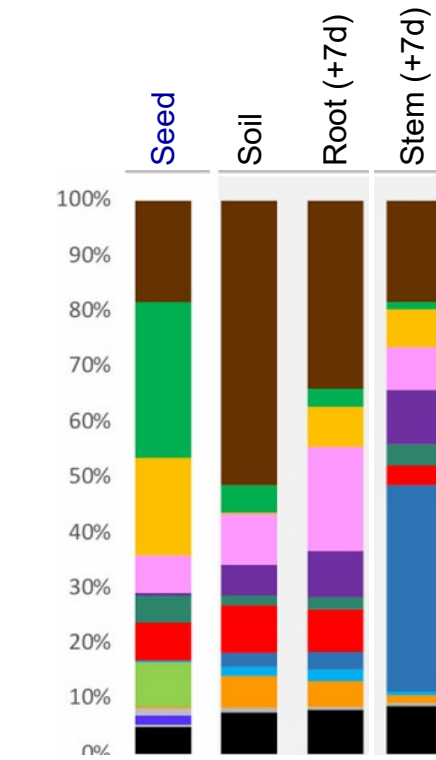
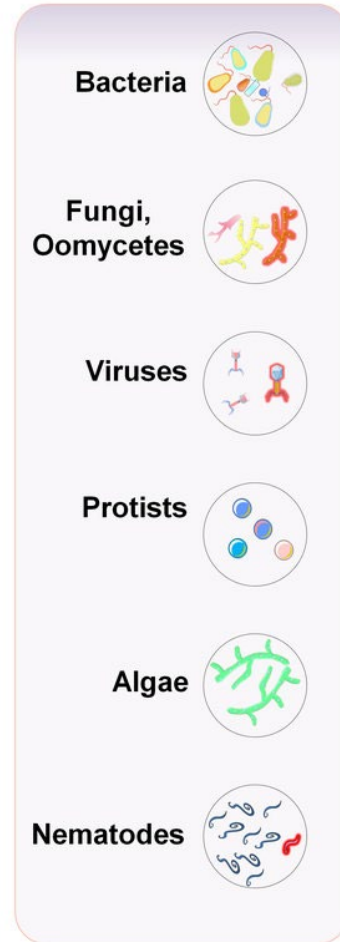
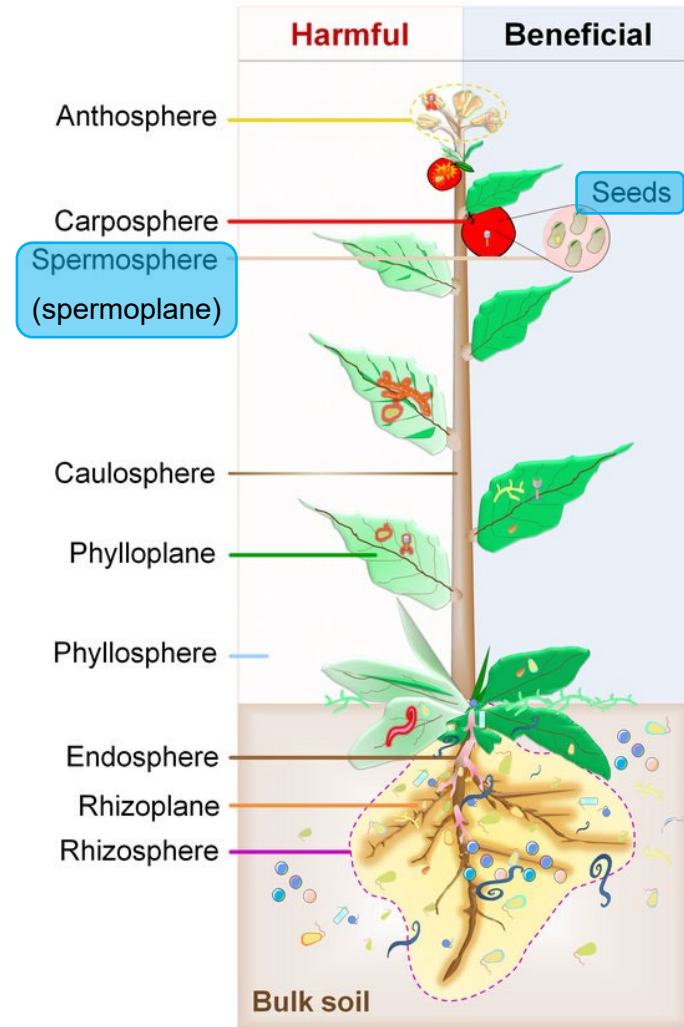
nicolas.denance@geves.fr

 @NicoDNCE

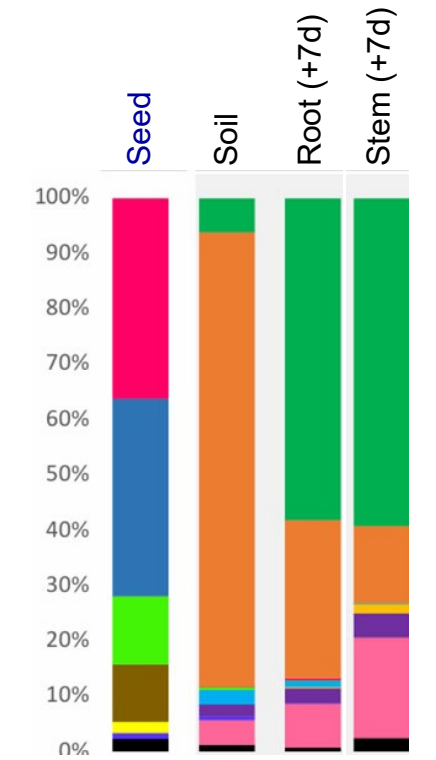


The spermosphere – a paradise for many organisms

(e.g., *B. napus*)



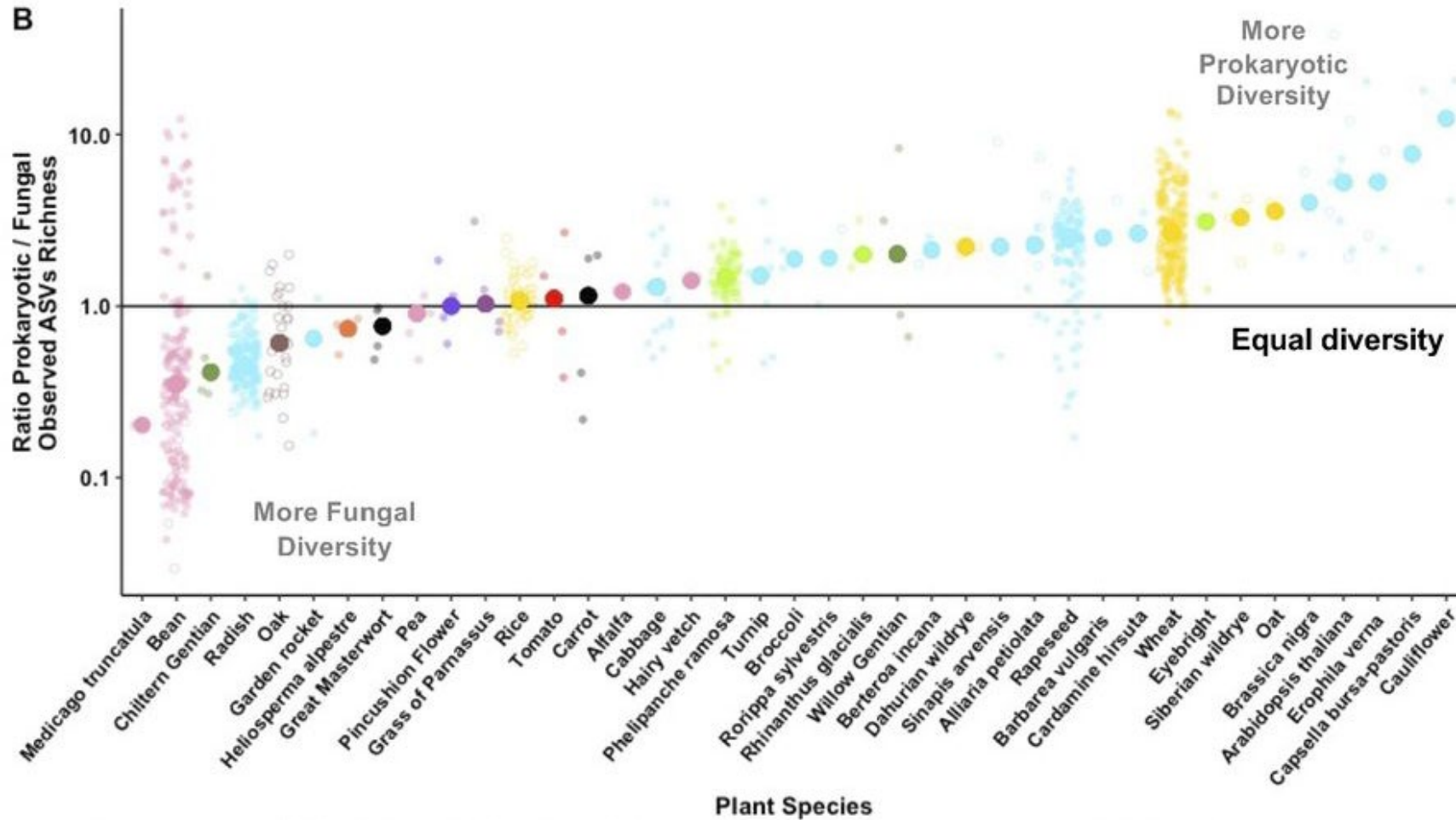
- Bacterial Order**
- Burkholderiales
 - Sphingomonadales
 - Pseudomonadales
 - Propionibacteriales
 - Xanthomonadales
 - Rhizobiales
 - Bacillales
 - Caulobacteriales
 - Micrococcales
 - Enterobacteriales
 - Nitrosomonadales
 - Chitinophagales
 - Rhodospirillales
 - Rubrobacteriales
 - Corynebacteriales
 - Others



- Fungal Order**
- Hypocreales
 - Mortierellales
 - Pezizales
 - Pleosporales
 - Capnodiales
 - Tremellales
 - Helotiales
 - Sordariales
 - Cantharellales
 - Trichosporonales
 - Sporidiobolales
 - Eurotiales
 - Microascales
 - Filobasidiales
 - Saccharomycetales
 - Others

Shelake et al., Microorganisms (2019); Rochefort et al., mSystems (2021)

Seed microbiota diversity is dependent on plant species



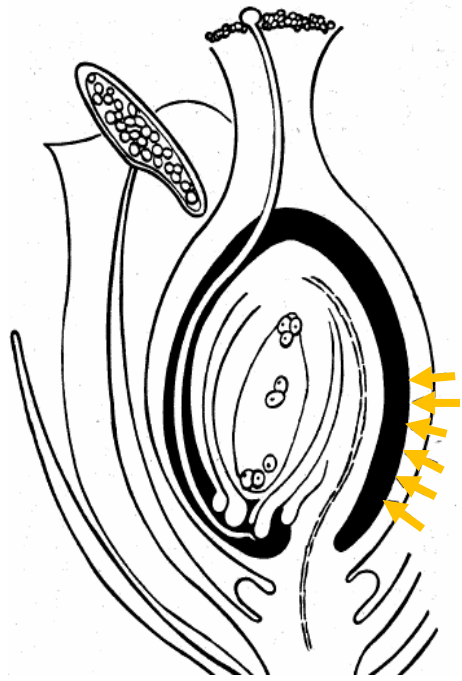
Contribution to:

- seed preservation
- release of seed dormancy
- germination rate
- **emergence of diseases**

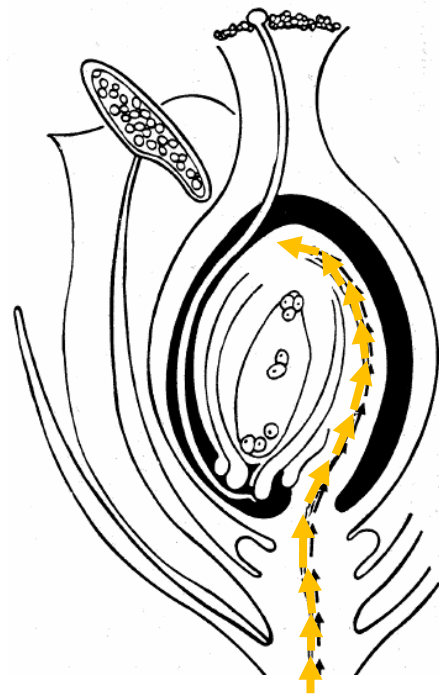
(884 datasets ; 39 crops)

Chee-Sanford et al., Weed Sci. (2006); Goggin et al. Ann. Bot. (2015);
Barret et al., Mol. Plant Pathol. (2016); Nelson, Plant Soil (2018); Simonin et al., New Phytol. (2022)

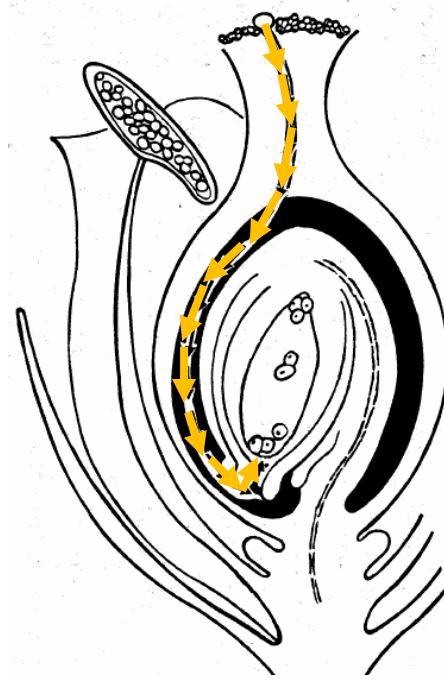
How do beneficial and undesirable microbes meet seeds?



pericarp
(ovary wall)



hilum
(vascular system)



stigma
(floral part)

Alternative sources:
during / after harvest
(environment & human activities)



Baker & Smith, Annu. Rev. Phytopathol. (1966); Maude, in: Seedborne diseases and their control: principles and practice (1996)

International seed trade - *a few statistics*

Import



field crops
flower seed
potato seed
tree seed
vegetable crops

6 841 668 metric tons
13.86 billions USD

Quantity
Values

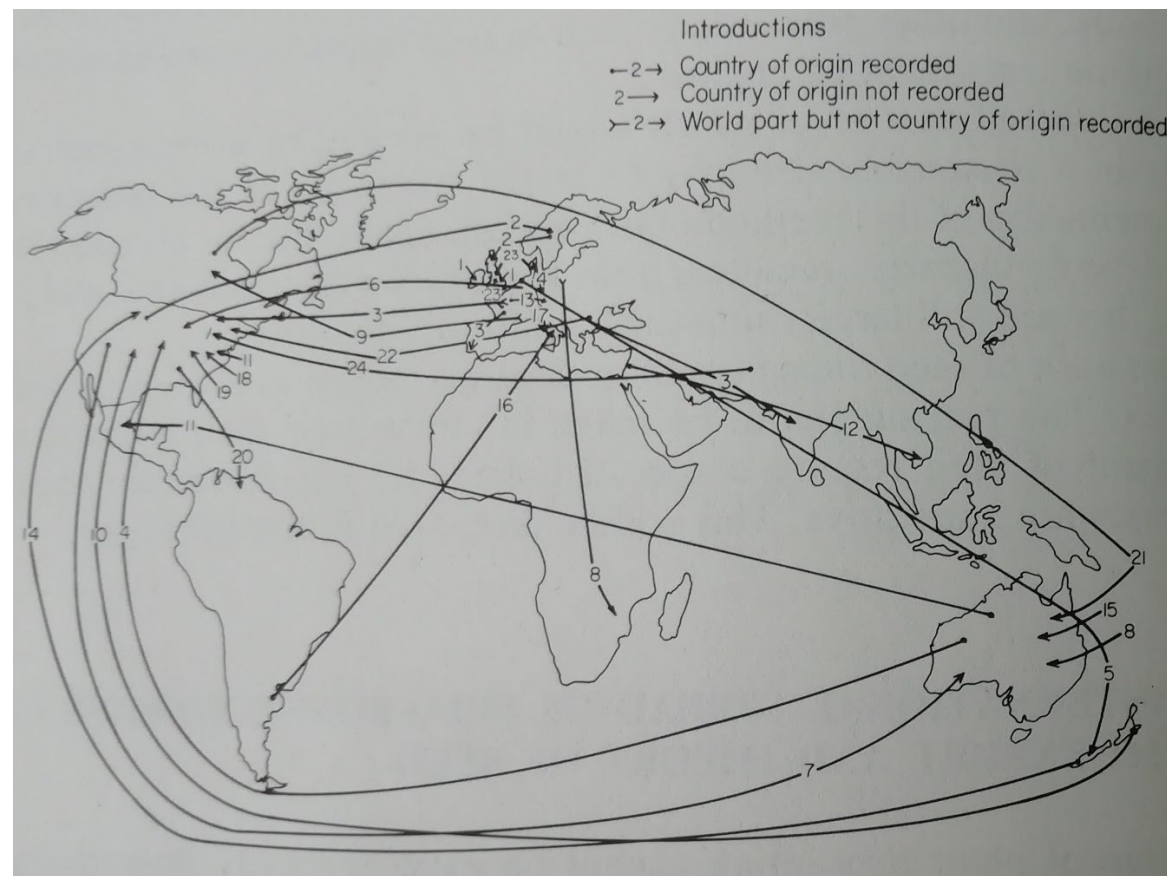
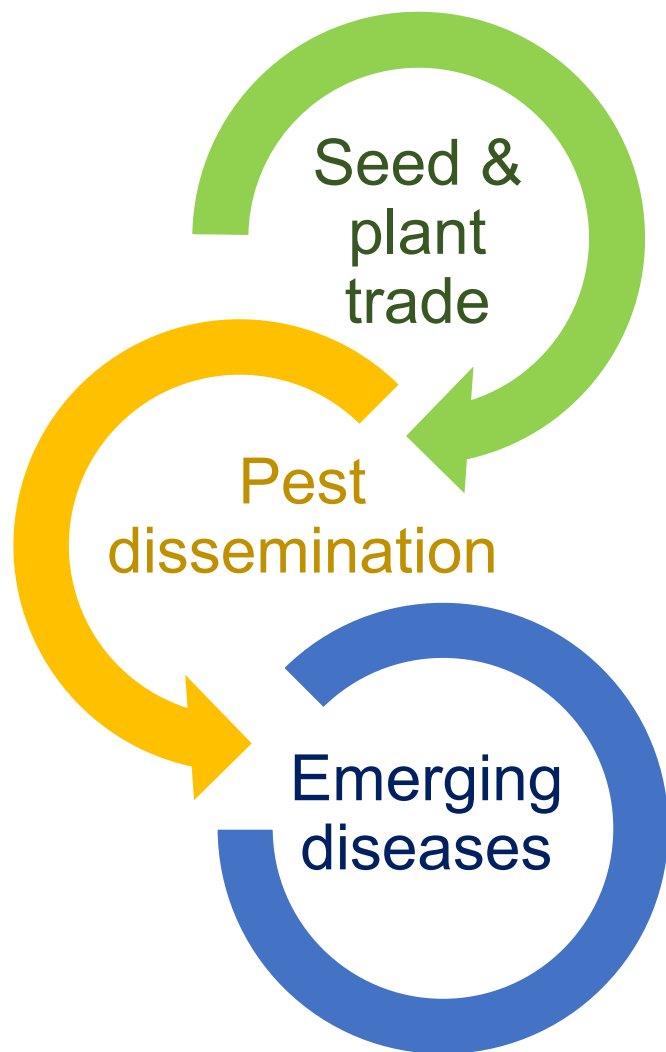
Export



7 257 898 metric tons
14.37 billions USD

Source: ISF compilation based on official statistics and international seed trade reports data 2019 / release Oct. 2021; <https://www.worldseed.org/resources/seed-statistics/>

Seed pests threaten food security



1. *Corynebacterium michiganense* 1942
2. *Pseudomonas glycinea* 1940s
3. *Xanthomonas campestris* 1961
4. *Corynebacterium rathayi* 1945, 1965
5. *Xanthomonas phaseoli* 1969
- 6-8. *Puccinia sp.* 1885, 1906, 1940, 1952
9. *Uromyces betae* 1943
10. *Tilletia caries* 1854
11. *Urocystis agropyri* 1919, 1946
12. *Ustilago tritici* 1970
13. *Urocystis cepulae* 1924
14. *Gloeotinia temulenta* 1940
- 15-17. *Peronospora sp.* 1881, 1922, 1935
18. *Botrytis riini* 1926
19. *Sclerotium oryzae* 1926
20. *Gloeocercospora sorghi* 1949
21. *Septoria linicola* 1948
22. *Epichloë typhina* 1942
23. Barley stripe mosaic virus 1959, 1972
24. Squash mosaic virus 1964
25. *Ascochyta rabei* 1973

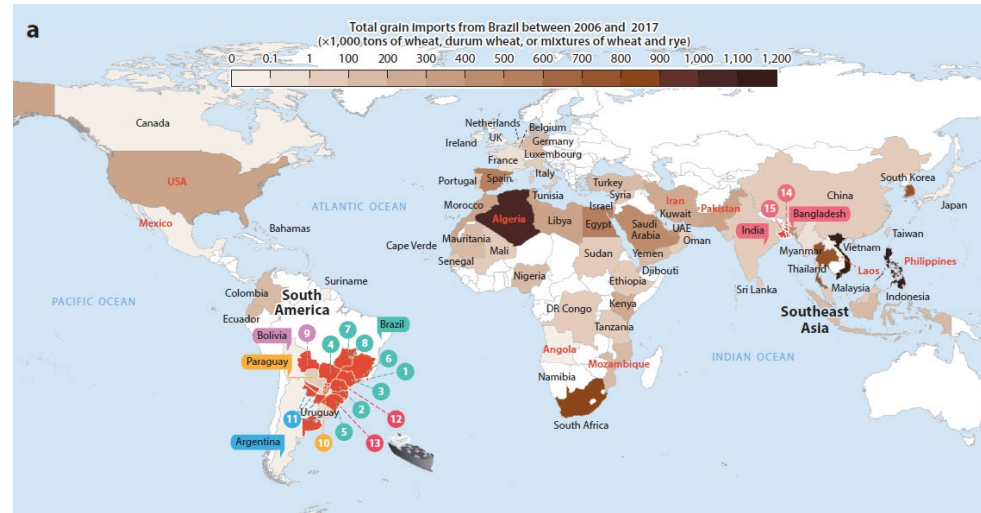
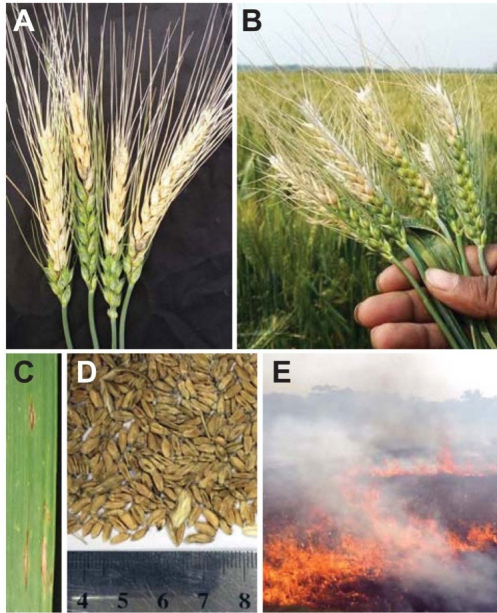
Introduction via infested seeds 1880s – 1970s

Neergaard, In: Seed Pathology 1977; Strange & Scott, Annu. Rev. phytopathol. 2005; Engering et al., Emerg. Microb. infect. 2013

Recent outbreaks of seed-borne pests – *Magnaporthe oryzae* (MoT)

First reported in South America...

...now reported in Asia and Africa



Islam et al., BMC Biol. (2016); Islam et al. Plant Pathol. J. (2019); Ceresini et al., Mol. Plant Pathol. (2019); <https://gd.eppo.int/taxon/PYRIOR> ; <http://openwheatblast.net/>

How to tackle the spread of seed-borne pests due to the international movement of seeds?

Seed-borne pests – *what's behind the term?*

- Carried externally

i.e., seed surface

- Carried internally

i.e., seed coat, endosperm, perisperm, embryo

- May or may not be transmitted to plants growing from these seeds and cause their infestation

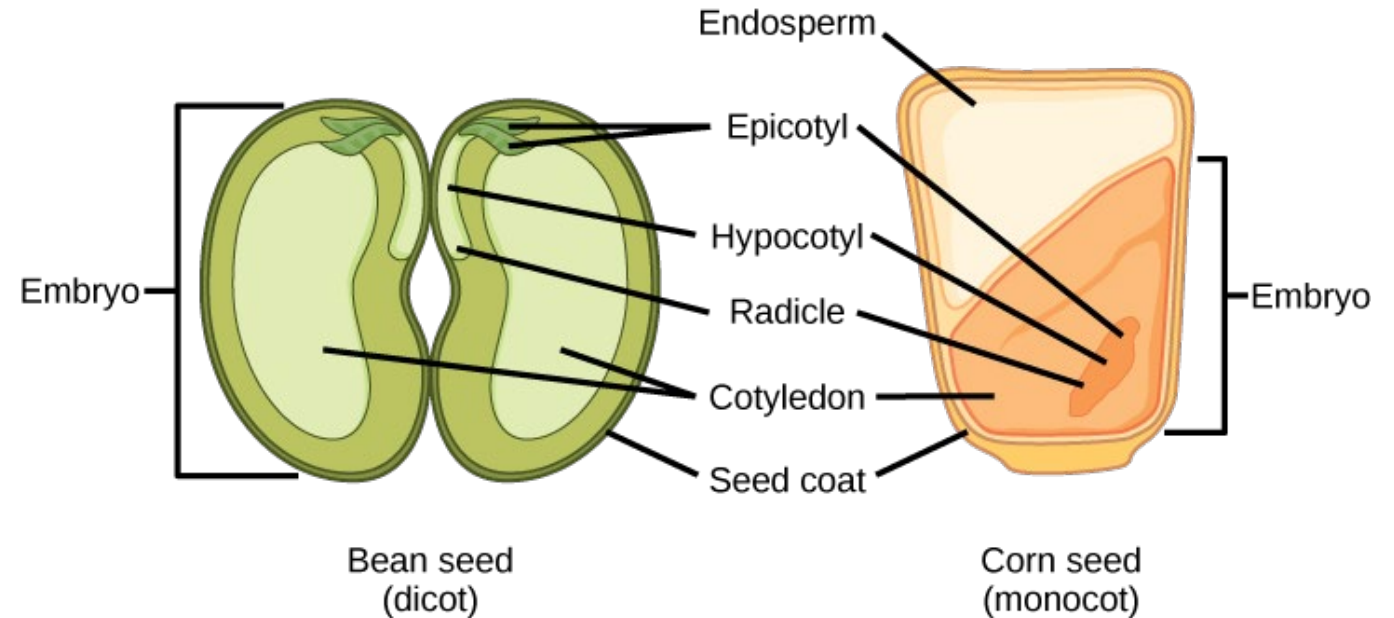
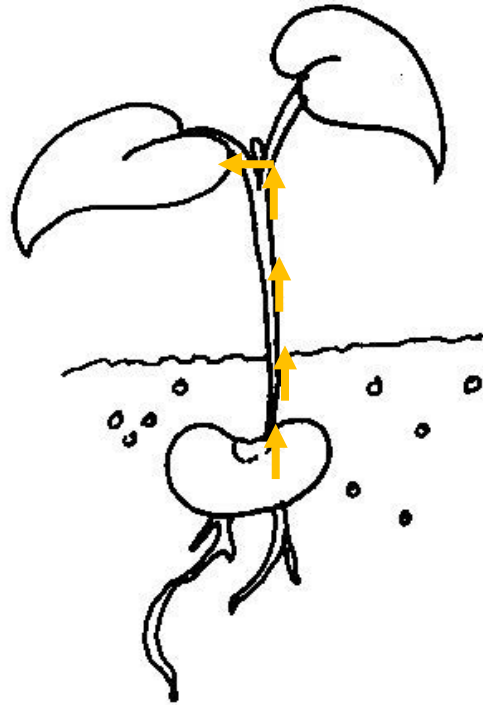


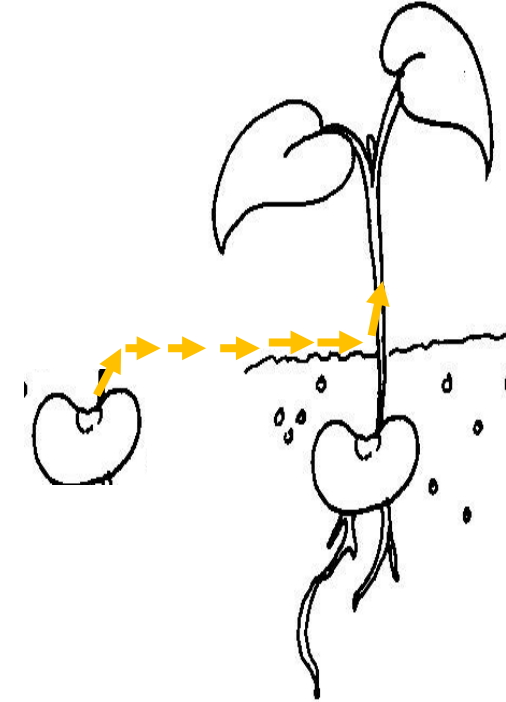
illustration credit: lumenlearning.com

Baker & Smith, Annu. Rev. Phytopathol. 1966; Maude, in: Seedborne diseases and their control: principles and practice 1996; IPPC, in ISPM38 2017

Seed is a pathway – *what does it mean?*



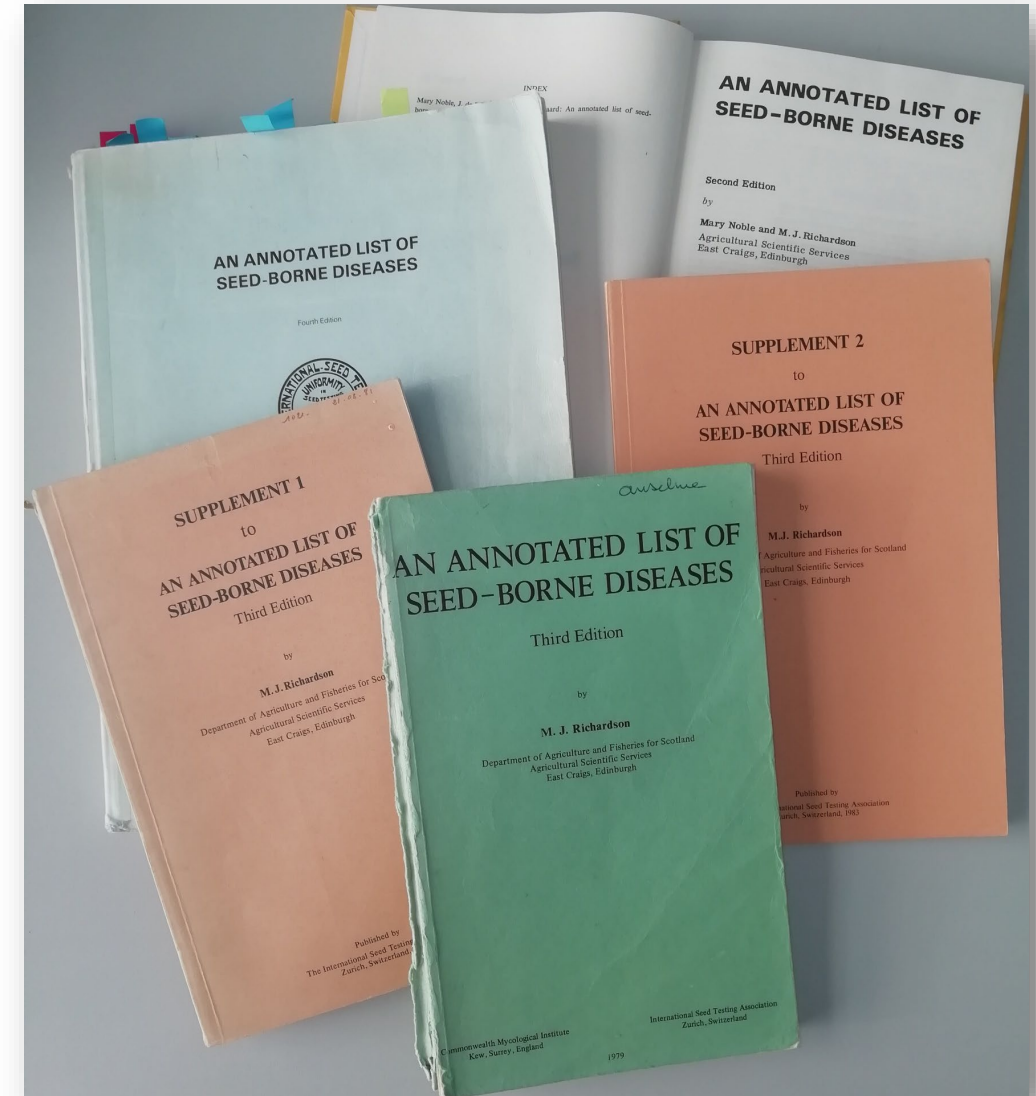
Seed-transmitted
(via seeds directly to plants)



Seed-transferred
(to the environment; then infests plants)

IPPC, in ISPM38 (2017)

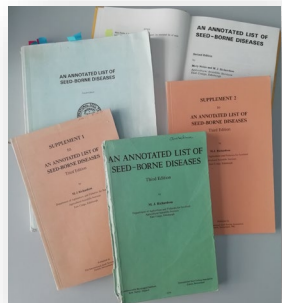
ISTA has published “An annotated list of seed-borne diseases”



- 1958 - 1990: 4 editions, 2 supplements
- Latest revised: +30 years ago

Noble et al., 1st edition 1958; Noble & Richardson, 2nd edition 1968;
Richardson, 3rd edition 1979, Supplement 1 1981, Supplement 2 1983, 4th edition 1990; Yorini et al., In: Seed pathology – Progress and problems 1979

From outdated to updated lists – *process of validation and publication*



Any expertise to offer?
Please, contact me!



Accreditation Membership Technical Committees

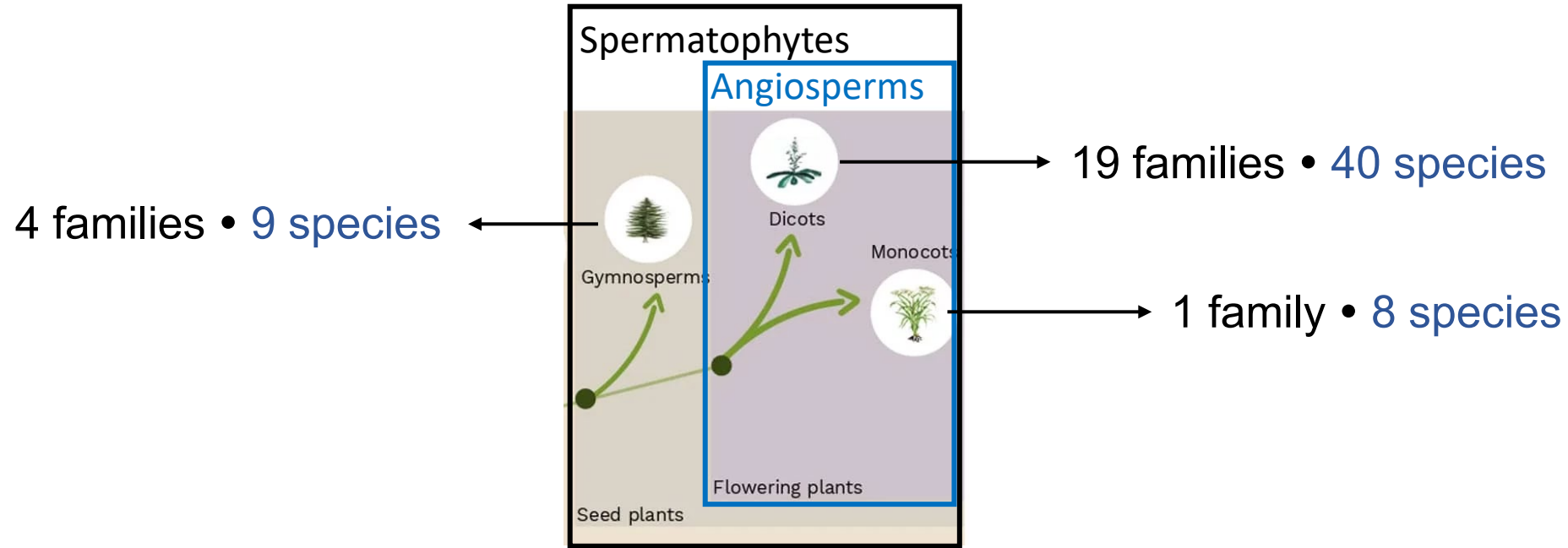
Home / Tools / Seed Health Committee

ISTA Reference Pest List

2022 07 11 ISTA Reference Pest List v9 (XLS, 568.9 kB)



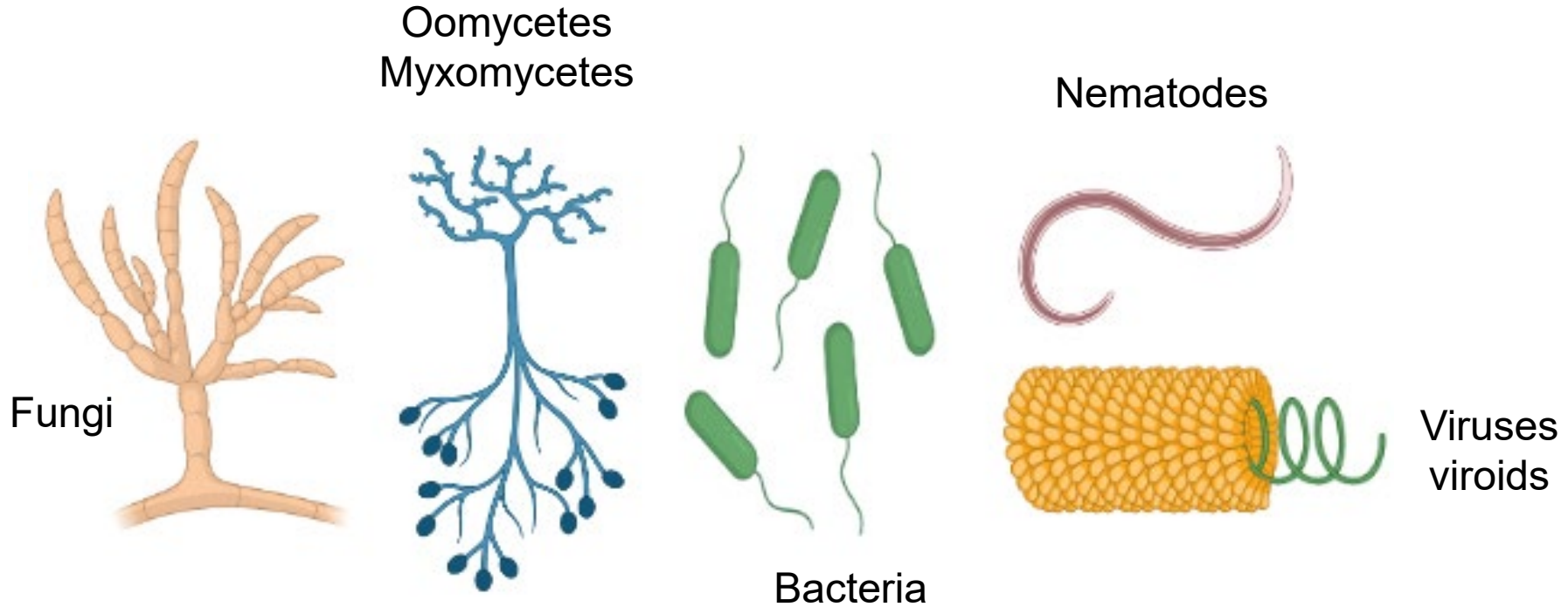
ISTA Reference Pest List – *investigated non-vegetable crops*



- Cereals
- Legumes
- Herbs
- Forest trees (conifers, deciduous)
- Fruit trees
- temperate
- (sub)tropical

ISTA Reference Pest List – *investigated pests*

Illustrations: Biorender.com



- Seed-borne (general)
- Seed-borne and seed-*transmitted*
- Seed-borne and seed-*transferred*

- Other diseases, insects or disorders are excluded (at the moment)

ISTA Reference Pest List - *methodology*

seed-**borne** (transported) + seed-**transmitted** ?
seed-**borne** (transported) + seed-**transferred** ?

no

seed is not
a pathway

uncertainty

seed pathway
not proven

Yes but artificially
or
No research found
No definitive evidence
Contradictory results

yes

seed is a
pathway

(if natural conditions)

Level of information:

- Host & disease
- Pest taxonomy & regulation
- Role of the seed
- Scientific data & references



Denancé & Grimault, EPPO Bull. (2022)

ISTA Reference Pest List – *current version (July 2022)*

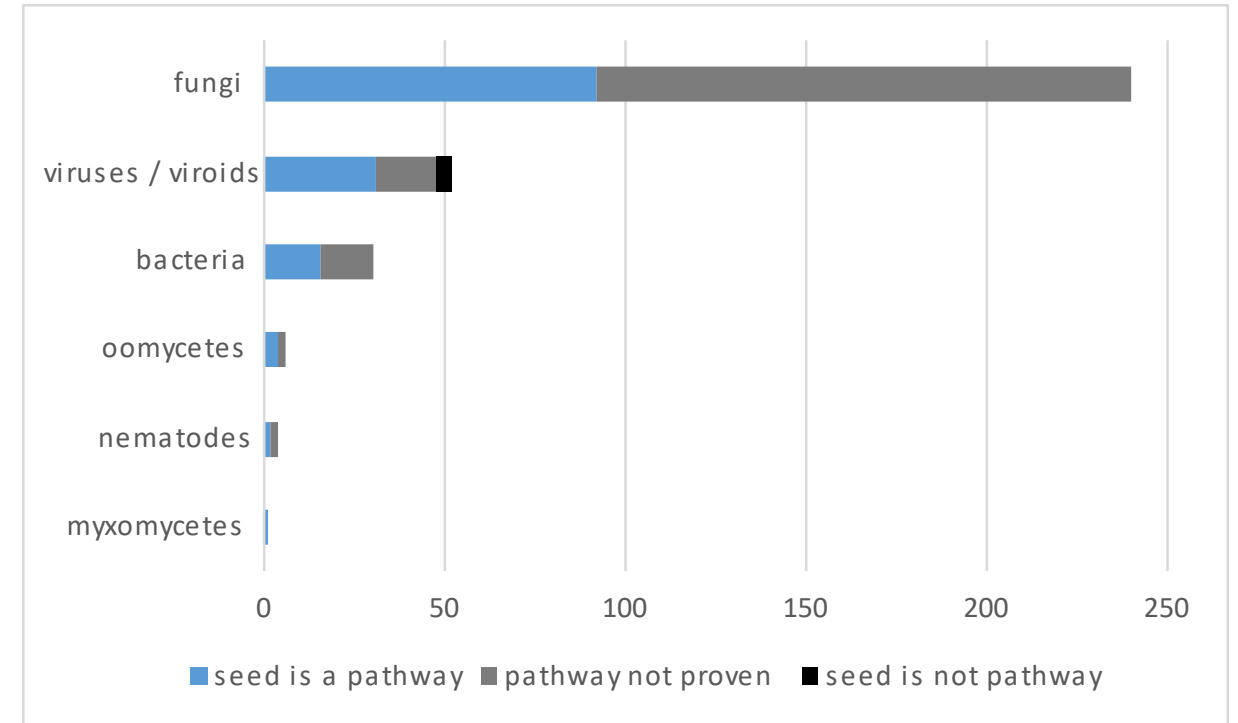
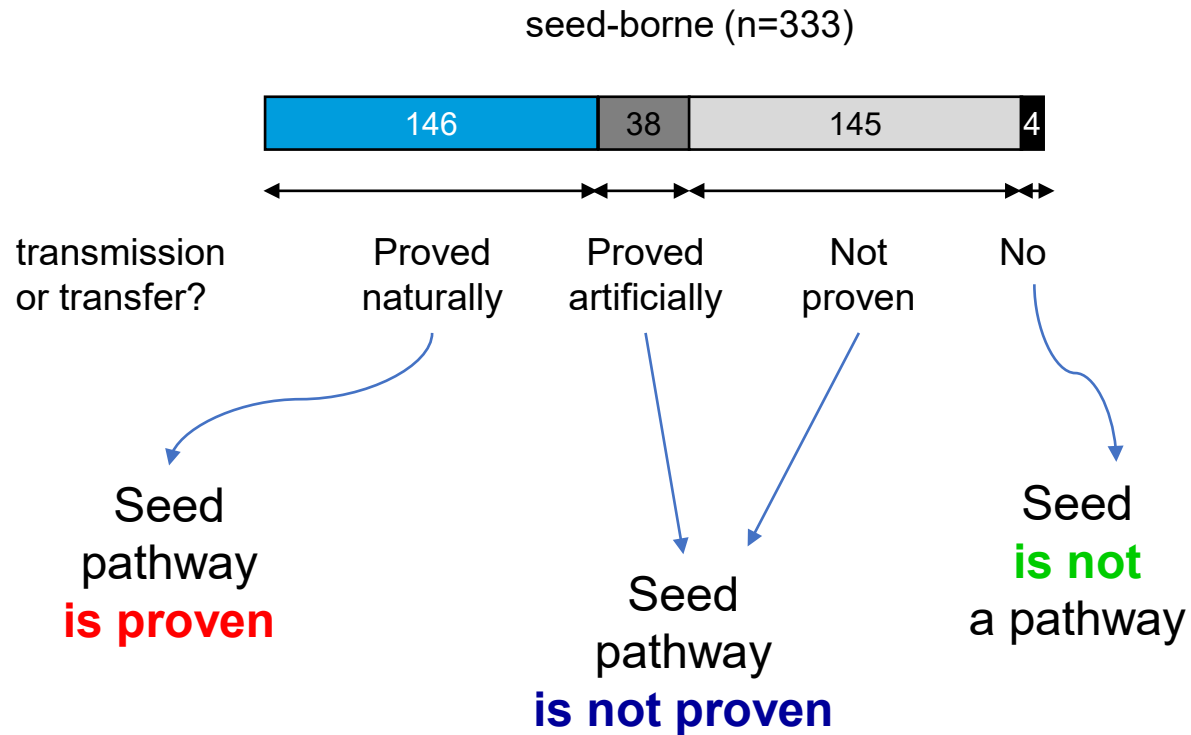


Free tool online
(ISTA website)



23 hosts ■ 333 seed-borne pests ■ 146 “seed pathway” ■ 558 scientific references

ISTA Reference Pest List – *the knowns & the unknowns*



More to come – *stay tuned!*



chickpea

Pests: 15
Seed pathway: 8
Literature: 14



lupin

Pests: 7
Seed pathway: 4
Literature: 6



lentil

Pests: 11
Seed pathway: 5
Literature: 10



potato

(TPS + tubers, to be distinguished)

Pests: 11
Seed pathway: 4
Literature: 15

(preliminary data – international experts to identify)

(expected publication: Q1-2023)



... and others!

Take home messages & future challenges – *From science to ...*

... R&D (public & private)

- Diagnostics
- Detection or treatment methods
- Breeding
- Investigation of seed transmission

... NPPOs and policymakers

- Primary bibliographic resource
- Part of future PRAs, complementary to others

Seed
pathway
is proven

Seed
pathway
is not proven

Seed
is not
a pathway

Thank you!



Executive Committee
Seed Health Committee
Andreas WAIS & Secretariat



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