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SCHOOL OF AGRICULTURE, POLICY AND DEVELOPMENT

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ICARDA
Science for resilient livelihoods in dry areas

Optimizing seed harvest and processing of wild lentil genetic resources entering active and base genebank collections

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What is seed viability?

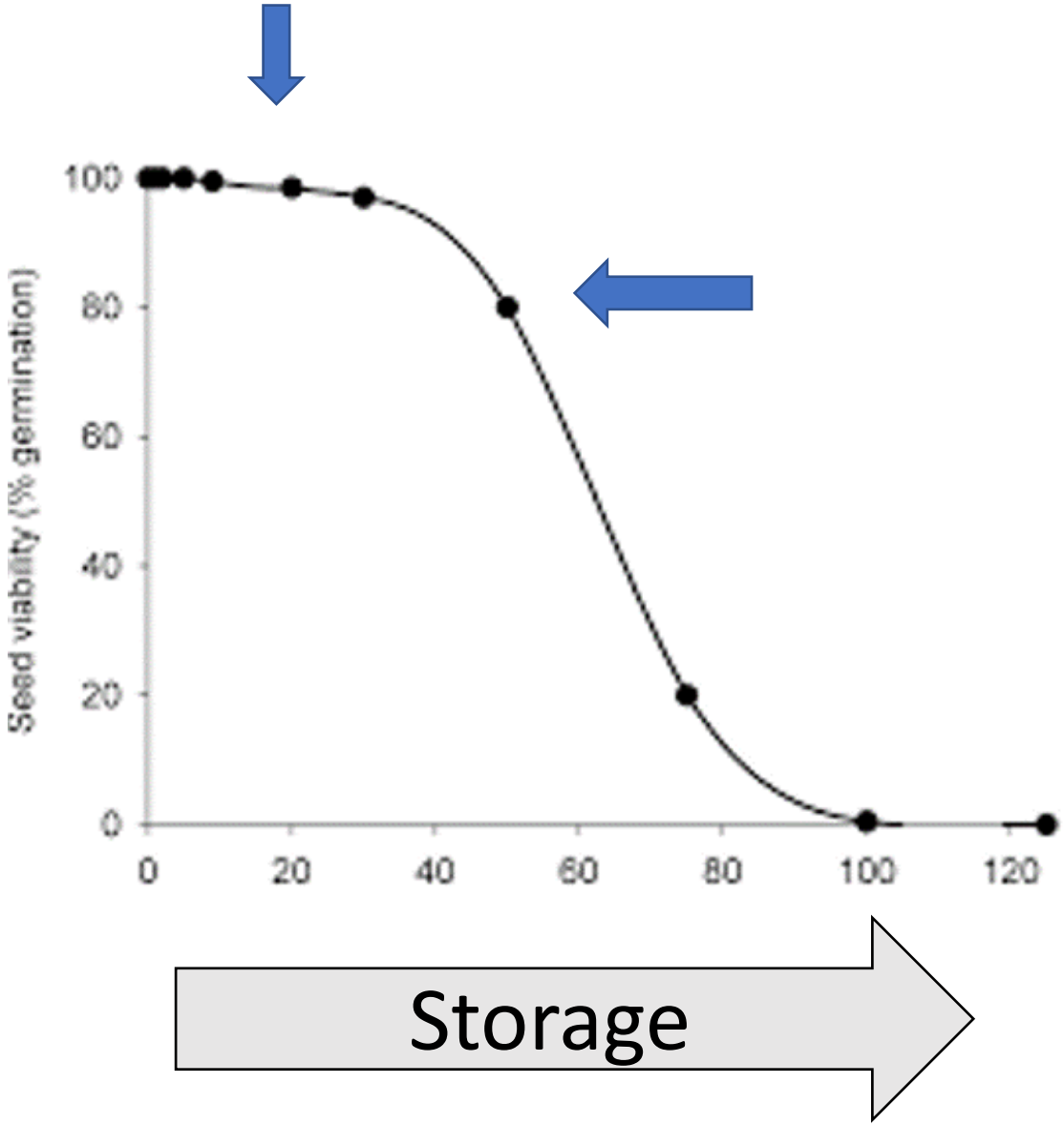
Definition: Seed viability is the measure of how many seeds in a lot are alive and could develop into plants that will reproduce under appropriate field conditions (according to ISTA).

Why should seed viability be determined?

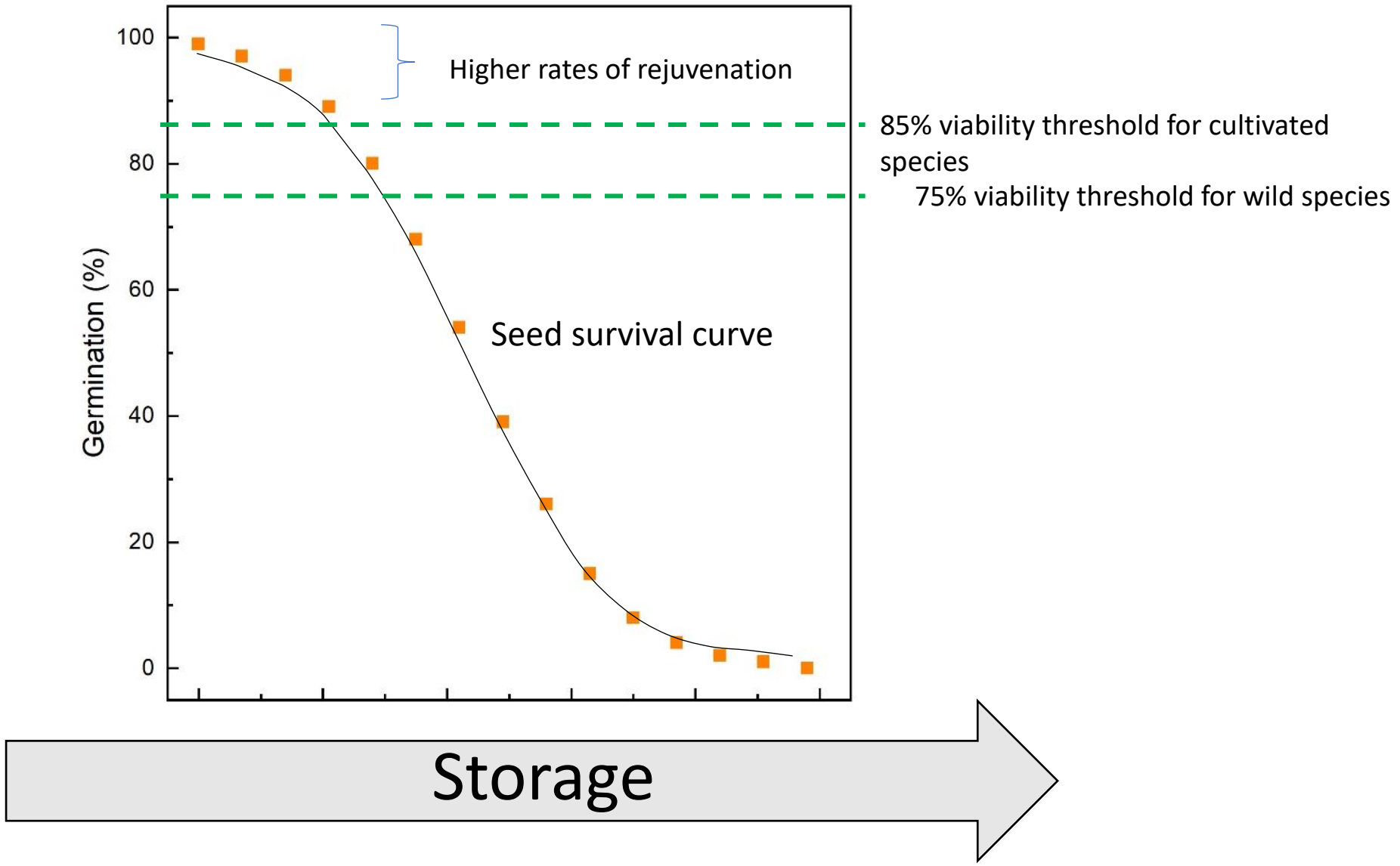
- Seeds should be capable of producing plants when sown in the field.
- Seeds must have high viability at the start of storage and maintain it during storage.
- Seeds with high initial viability will also survive longer in storage.

What is seed viability?

- During storage, seed viability declines slowly at first and then rapidly as seeds age.
- It is important to know when this decline occurs in order to take action to regenerate the accession.
- Excessive deterioration will lead to loss of material



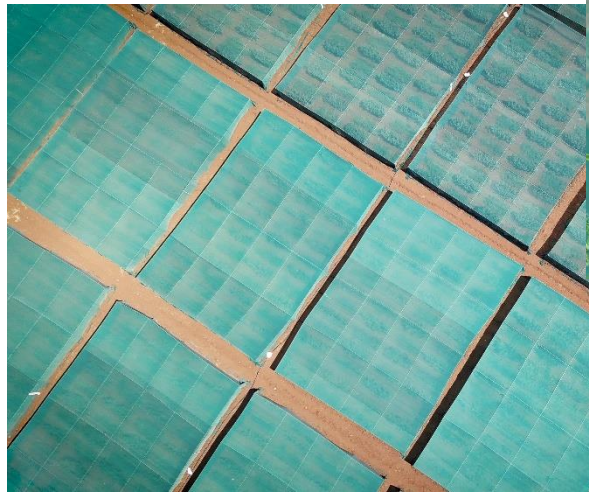
Timing of loss ability to germinate varies



ICARDA genebank

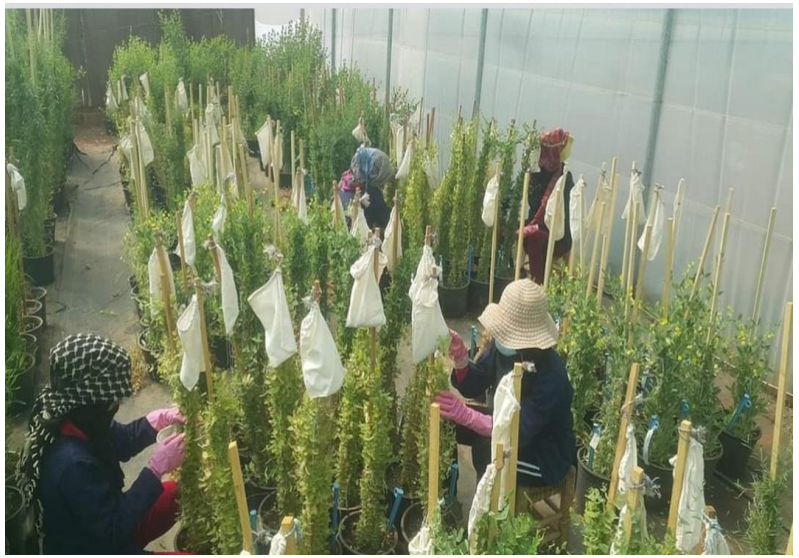
- The collections held in-trust by ICARDA-Lebanon totaling around 63,993 accessions, mainly of wild wheat, forages, and wild legumes.

- Targeted crops at ICARDA: Faba bean, Barley and wild barley, wheat and wild wheat, chickpea and wild chickpea, Lentils and wild lentils, Pisum, Vicia, lathyrus, pastures and range species.
- Seed multiplication differ from one crop to another, in order to maintain the genetic diversity for each accession.



Harvesting method for all crops at ICARDA

- Cloth bags are distributed for each accession.
- At maturity, the spikes/pods/seeds from each accession are harvested and placed in the cloth bag (cumulative harvest).
- Harvesting is done manually.
- Cloth bags are left in PH/field until all of the accessions for each trial are harvested (bags collected) together.
- Harvested material goes to fumigation chamber for 3 days, then threshing and cleaning, then to drying room (15°C; 15% RH), this is the current ICARDA practice.



Potential problem

- Temperature and moisture content are the most important factors that should be controlled to maintain seed viability.
- Seed longevity can be affected by pre- and post-harvest environment and practices.

- Delayed processing of seeds from field/plastic house to drying room (controlled environment):

1. Seeds are subjected to high and/or fluctuating temperature.
2. Seeds are subjected to high and/or fluctuating relative humidity.

Which may:

- Damage the seed and affect seed quality and longevity.
- And so, affect the safe storage period in the ICARDA genebank.

Research

Objective:

- Compare the “Current ICARDA” seed harvesting practices with alternative proposed practice.
- Does the answer vary among the species?
- Should the seeds be removed directly from the harvesting area?

Null hypothesis:

- Seed longevity of wild lentil accessions is not affected by delays to seed processing (storing harvested seeds in bags under plastic house)
- Seed longevity of wild lentil is not affected by bulking
- Harvest date has no effect on subsequent seed longevity.

Experiment

Eight accessions of four wild lentil species,

*Lens ervoides (*IG 72586 and IG 107438),

Lens nigricans (IG 72549, IG 72541),

L. culinaris subsp. *odemensis* (IG 72689, IG 72928)

L. culinaris subsp. *orientalis* (IG 72878, IG 72620)

Three harvesting procedures with sequential harvests:

1. Immediate: harvested material sent immediately (same day) for 3 days fumigation, followed by routine processing (threshing, drying, storage)
2. Delayed: harvested material placed in separate bags (one bag per harvest date) and kept in PH until the whole trial is harvested, then sent for 3 days fumigation, followed by routine processing (threshing, drying, storage).
3. Current ICARDA practice: plant turned yellow, cut it put in bag until the last harvest, then sent for 3 days fumigation, followed by routine processing (threshing, drying, storage)

Wild lentil species

Laboratory work

- Water activity tested using the hygrometer (Rotronic,UK)
- Fresh weight.
- Moisture content using the low constant oven method (ISTA), at harvest and after drying.
- Germination test (4 replicates of 25 seeds each), at harvest and after drying (drying room 15^{o}C;15% RH).
- After drying, samples were transferred into aluminum foil to the cold room at 2-4^{o}C to be tested using the storage experiment.

Storage experiment

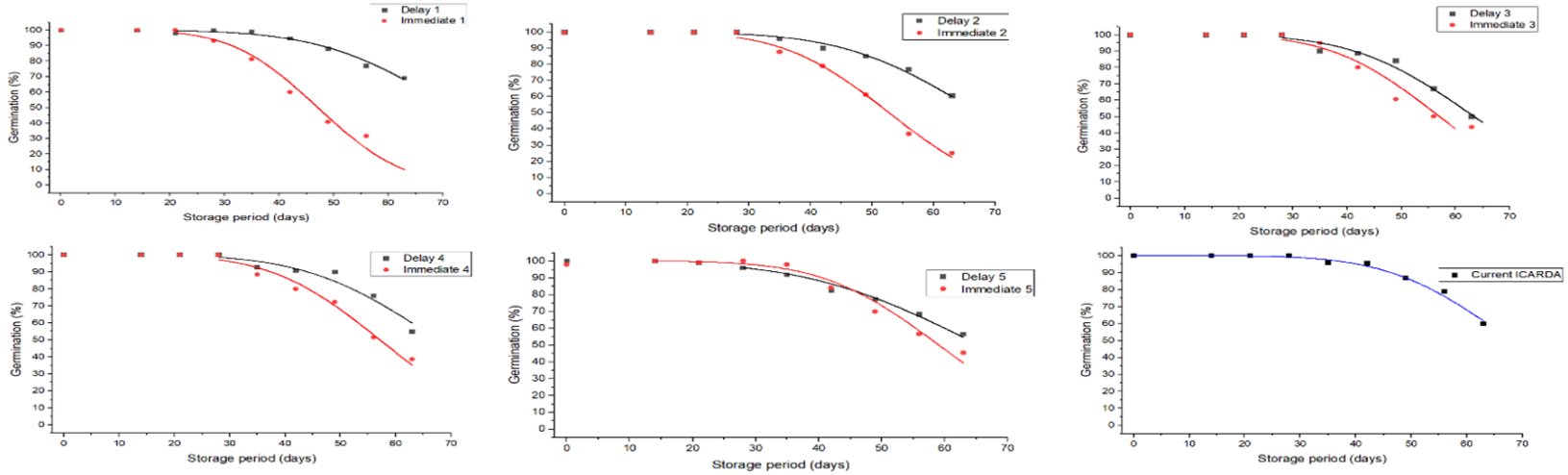
- Up to 14 sub-samples of scarified seeds were prepared of 100 seeds (each treatment)
- Seeds were equilibrated over a non-saturated lithium chloride solution (60%RH)
- Samples sealed in aluminum foil bags - and stored in an incubator (45^{o}C) for different periods and tested for germination.
- Moisture content was determined using the low constant oven method (beginning and mid storage).

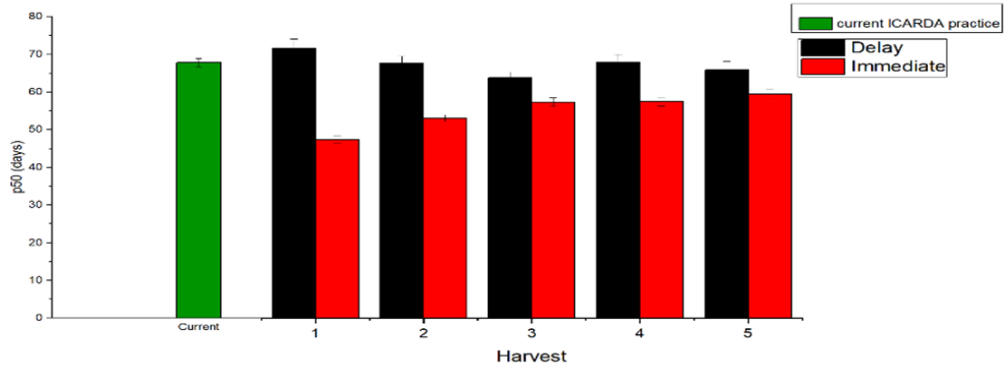
Example of seed survival curves in hermetic storage at 45°C, 60% RH (IG 72549 *L. nigricans*)

The germination data from the seed storage experiments were modelled using the FITNONLINEAR directive in Genstat to fit the viability equation taking into account the binomial error distribution of germination data:

$$v = K_i - {}^{p}/_{\sigma} \qquad [1]$$

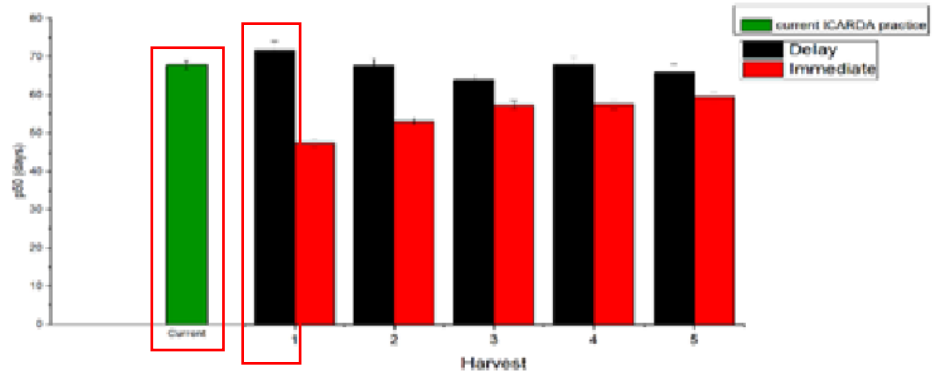
in which, *v* is the viability (germination) in normal equivalent deviates (NED) after *p* days in experimental storage; K_i is the fitted initial viability in NED and σ is the time it takes for viability to fall by 1 NED (Ellis and Roberts, 1980).



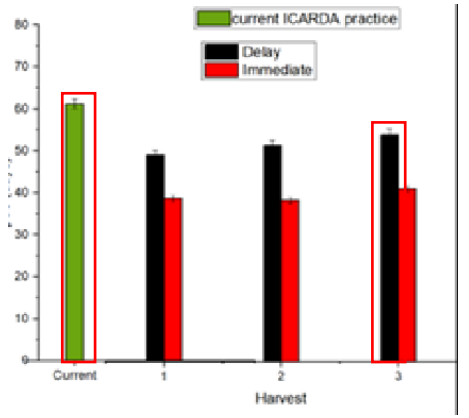


Longevity (*p50*) of all treatments in hermetic storage at 45°C, 60% eRH

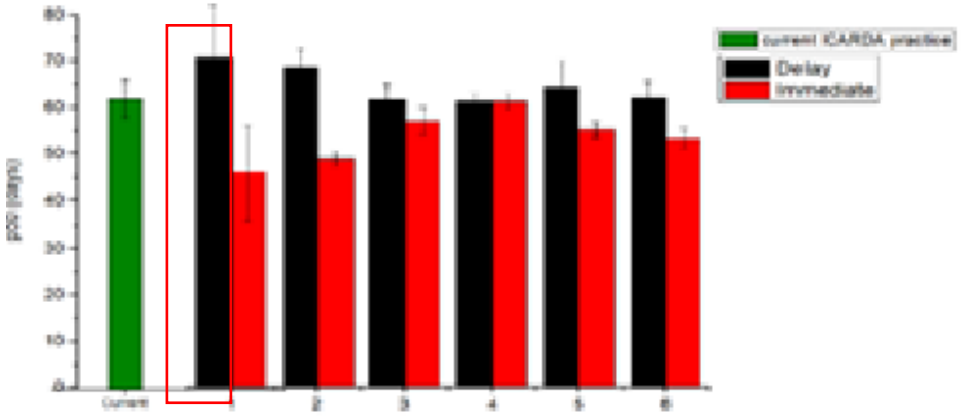
IG 72549



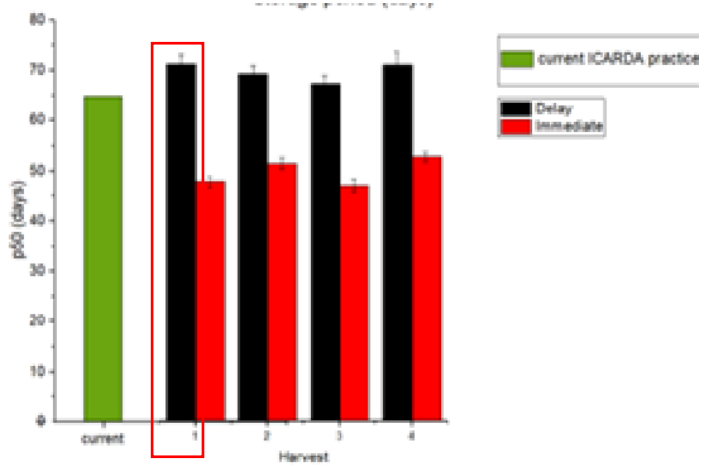
IG 72541



Lens nigricans



IG 72586

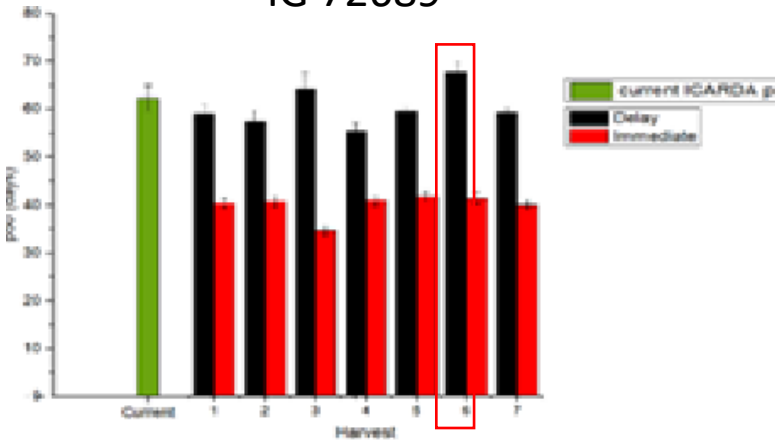


IG 107438

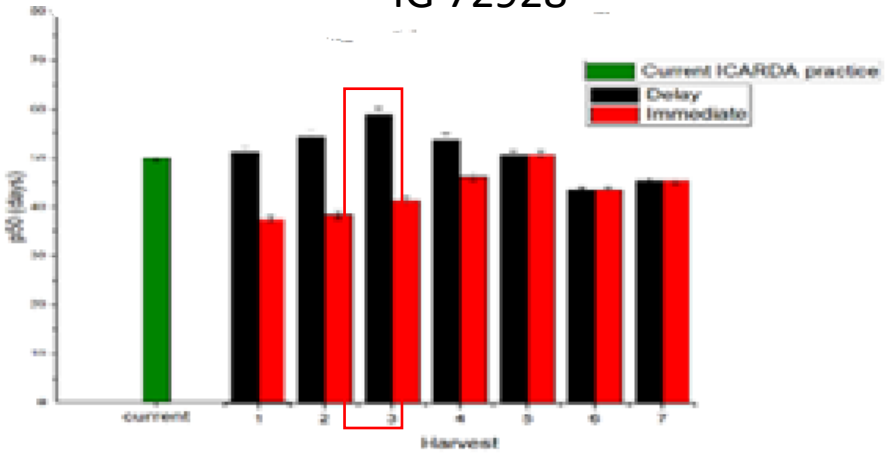
Lens ervoides

Longevity (*p50*) of all treatments in hermetic storage at 45°C, 60% eRH

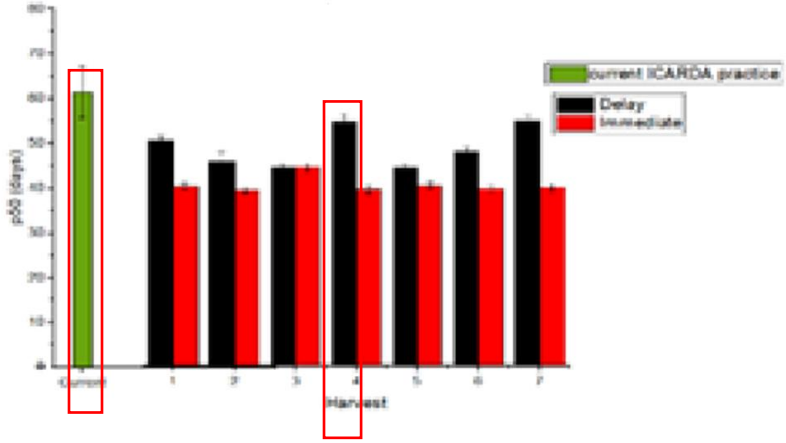
IG 72689



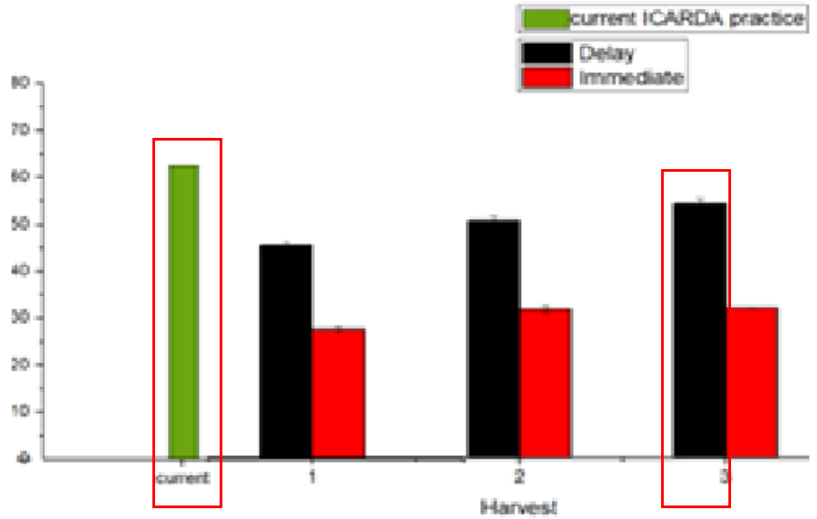
IG 72928



Lens culinaris subsp. *odemensis*



IG 72878



IG 72620

Lens culinaris subsp. *orientalis*

Conclusions

a. Delayed harvest was not a problem

b. Delayed processing provided better seed longevity than immediate processing.

c. “current ICARDA” practice does not negatively affect the subsequent longevity of seeds; in fact, for some accessions, it even enhanced their longevity.

Acknowledgments

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Thank you for your attention.
Any question?