



Genotyping a Composite Germplasm Set of Lentil

PI's: B.J. Furman¹ and M. Baum¹

Collaborators: A. Hamwieh^{1,2} and C. Jung²

ICARDA¹ and Universität Kiel²

Outline

- Brief introduction to lentil
- ICARDA lentil collection
- Development of a composite collection
- Present status
- What's next

Lentil

- 7th most important pulse worldwide
 - grown on over 3.5 million hectares in over 48 countries
 - a total production of over 3 million metric tons

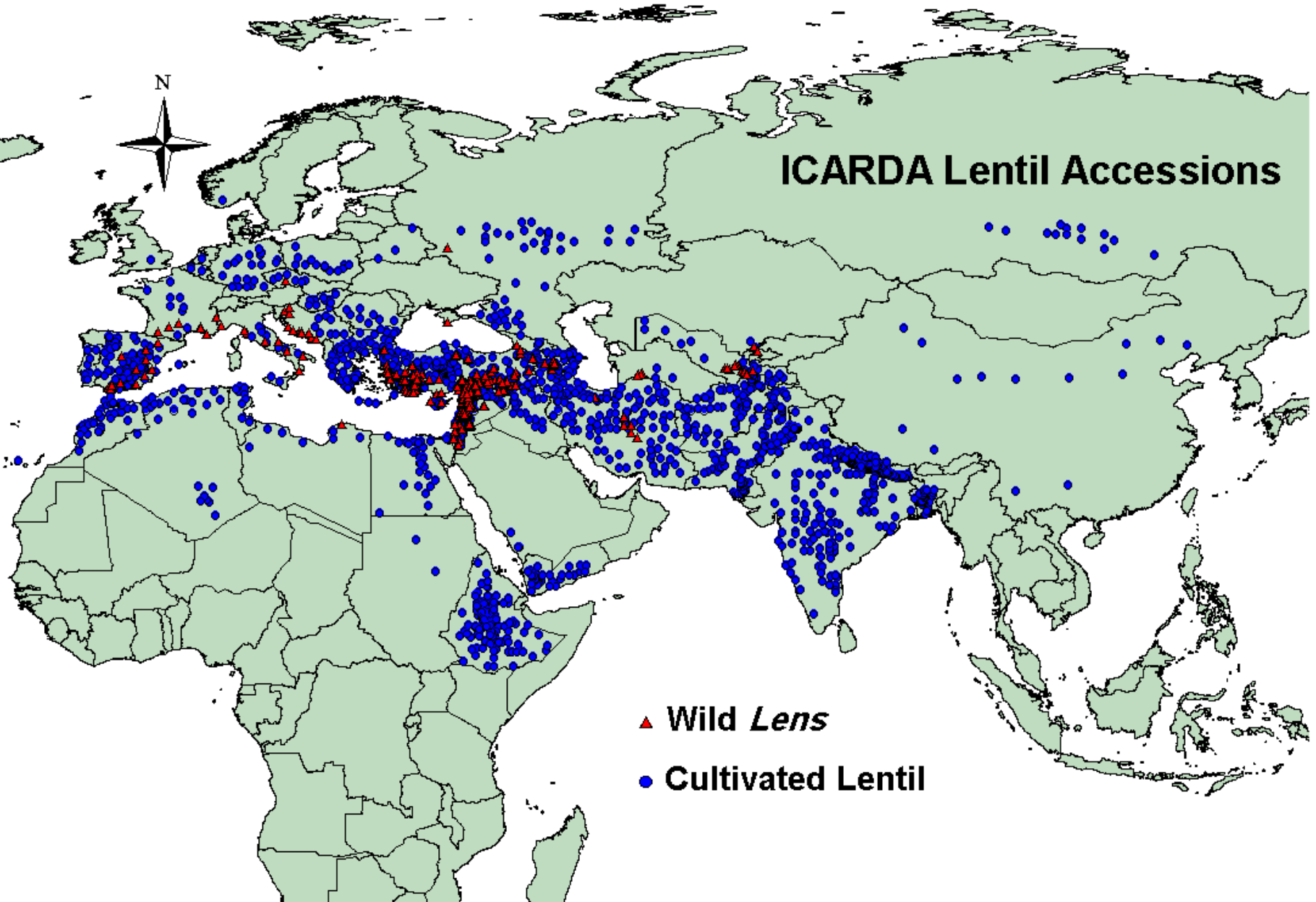
Lentil

- 7 taxa (Ferguson et al., 2000):
 - *Lens culinaris* subsp. *culinaris*
orientalis
tomentosus
odemensis
 - *L. ervoides*
 - *L. nigricans*
 - *L. lamottei*

Lentil Collection at ICARDA

- Global collection at ICARDA
 - 9935 accessions (cultivated)
 - 8789 landrace accessions from 71 countries
 - 1146 ICARDA breeding lines
 - 538 accessions (wild *Lens*)
 - 6 taxa representing 23 countries

ICARDA Lentil Accessions

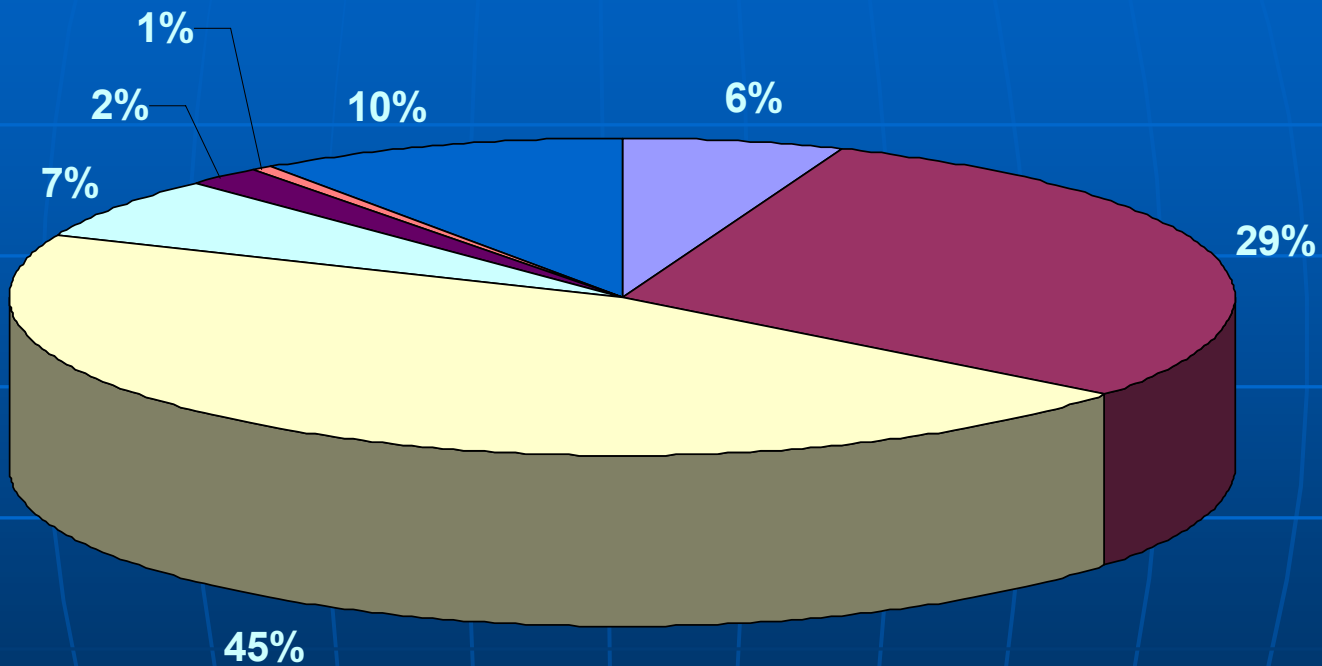




Composite Collection Methodology

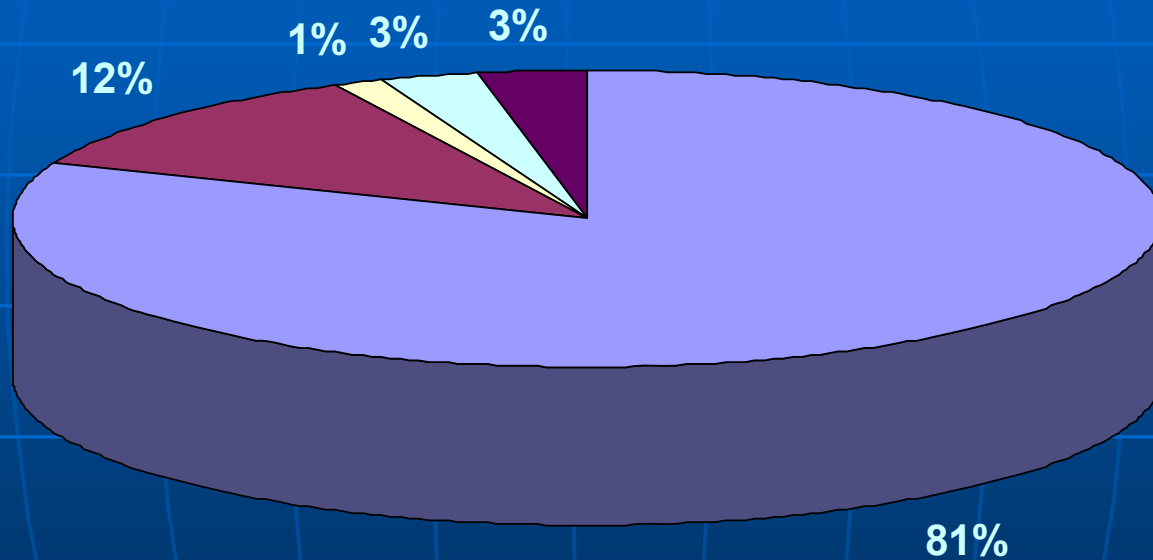
- Accessions chosen as candidates if have following criteria:
 - FAO designated
 - Seed levels sufficient for distribution
- 7345 candidate accessions of cultivated lentil

Lentil candidate collection by region



Americas Asia CWANA Europe Other Unknown ICARDA breeding material

Lentil candidate collection by type



Legend: Landrace (light purple), Breeding Material (maroon), Cultivars (yellow), Unknown (light blue), Wild species (dark purple)

Methodology

- Cluster analyses within geographic origins using agronomic characters
- Cluster analyses by agro-climatological origin
- Inclusion of 64 accessions of breeding materials with known resistances
- Inclusion of 28 wild species
- Verification of representative variation

Cluster analyses within geographic origins

- Followed Upadhyaya *et al* 2001
- 5 major data sets created
 - Evaluation data for different years
- Data separated by geographic location for each major data set
- Hierarchical cluster analysis (squared Euclidean distance) utilizing agronomic characteristics
- Approximately 10% of each cluster within a set was randomly selected, with a minimum of one accession per cluster.

16 agronomic characters utilized

- days to 50% flowering
- days to maturity
- plant height
- canopy width
- 1st pod height#
- pods per plant
- pod length
- # seeds per pod
- # seeds per m²
- biological yield per ha
- seed yield per ha
- straw yield per ha
- harvest index %
- # seeds per plant
- hundred seed weight
- protein content

Cluster analyses by agro-climatological origin

- Data set created of all accessions with complete agro-climatological data
- A 2-step cluster analysis was carried out utilizing 66 agro-climatological data.
 - A fixed total of 200 clusters was created.
- 1 accession per cluster was chosen unless cluster already represented from previous method.
 - Total of 73 accessions included

Cluster analyses by agroclimatological origin: 66 data utilized

- longitude
- latitude
- altitude
- monthly precipitation
- monthly max. temp.
- monthly min. temp.
- monthly potential evapotranspiration
- aridity index
- aridity class
- agro-climatic zone
- soil type

Inclusion of breeding materials

- 64 accessions of landraces, released cultivars, and breeding materials were included in the collection by ICARDA scientists for tolerance or resistance to abiotic and biotic stresses
 - high temperatures
 - drought
 - boron deficiency
 - lodging
 - rust
 - fusarium wilt
 - downy mildew
 - Ascochyta blight

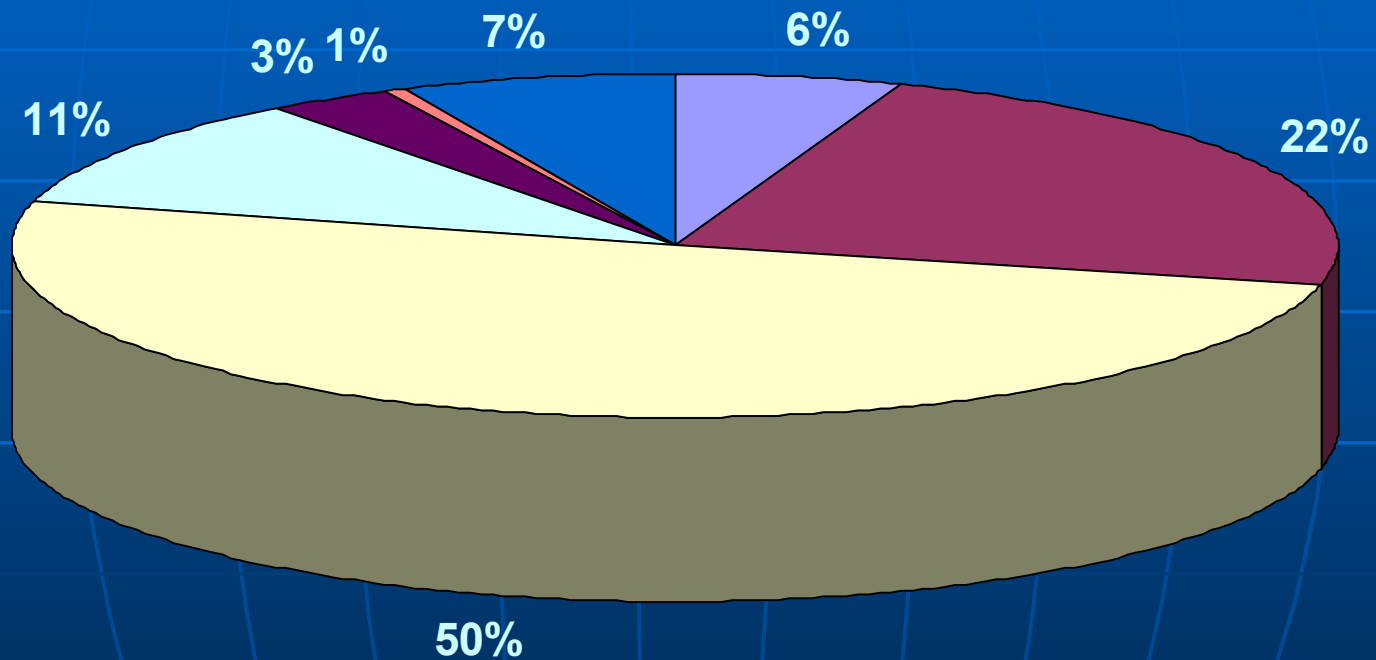
Inclusion of wild relatives

- 10 accessions chosen utilizing cluster methodology based on agronomic data
- 18 accessions chosen for known resistance to abiotic and biotic resistance
 - cold temperatures
 - drought
 - fusarium wilt
 - Ascochyta blight

Composite Collection: 1000 accessions

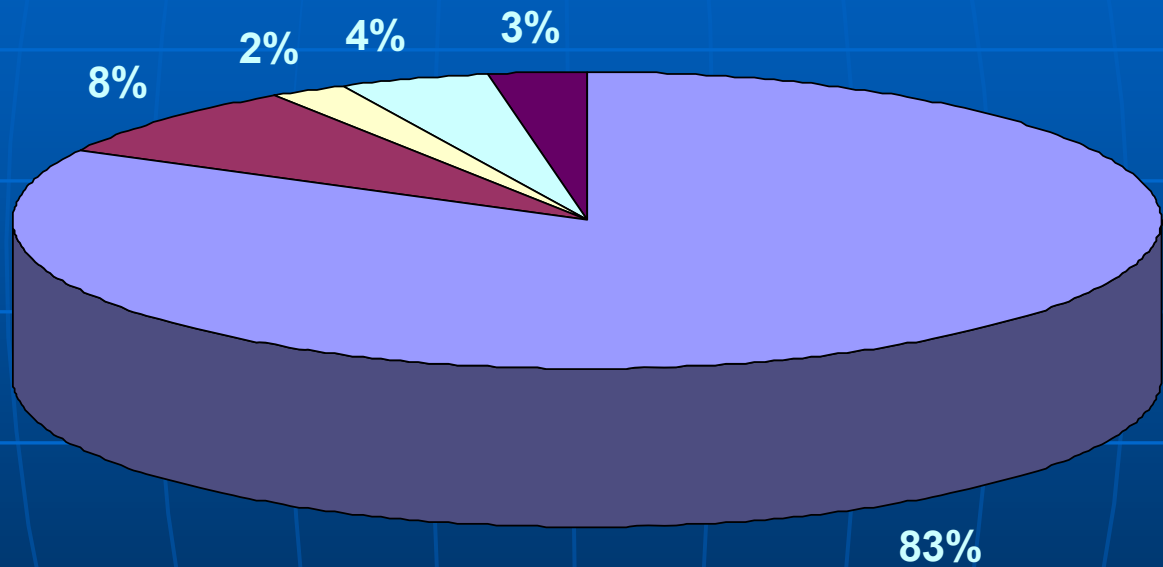
- 835 accessions from hierarchical cluster analyses
- 73 accessions from agro-climatological clustering
- An additional 64 accessions were chosen by ICARDA scientists for valuable traits.
- 28 accessions of wild *Lens*
 - *L. culinaris* ssp. *orientalis*, *odemensis* and *tomentosus*

Composite collection by Region

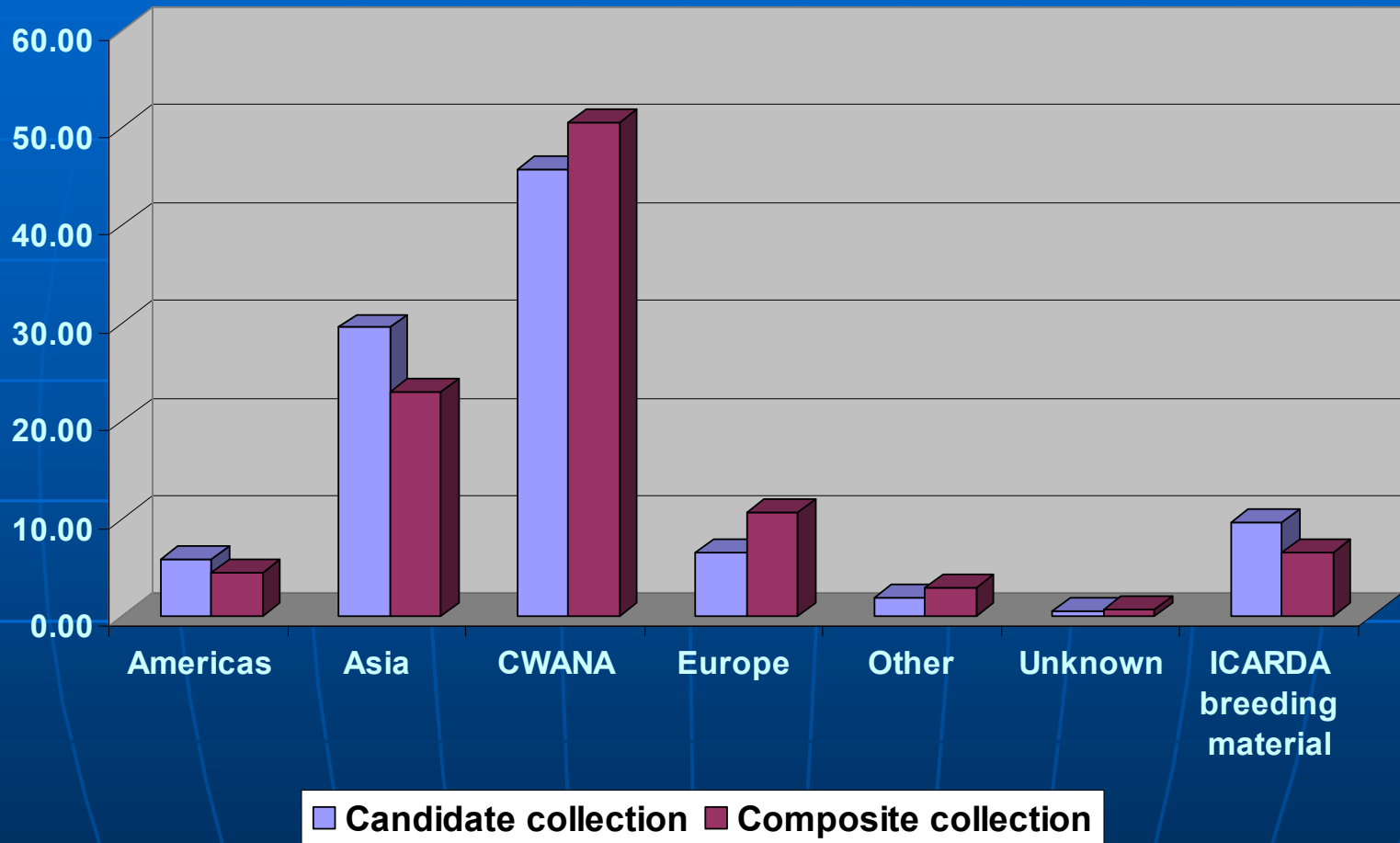


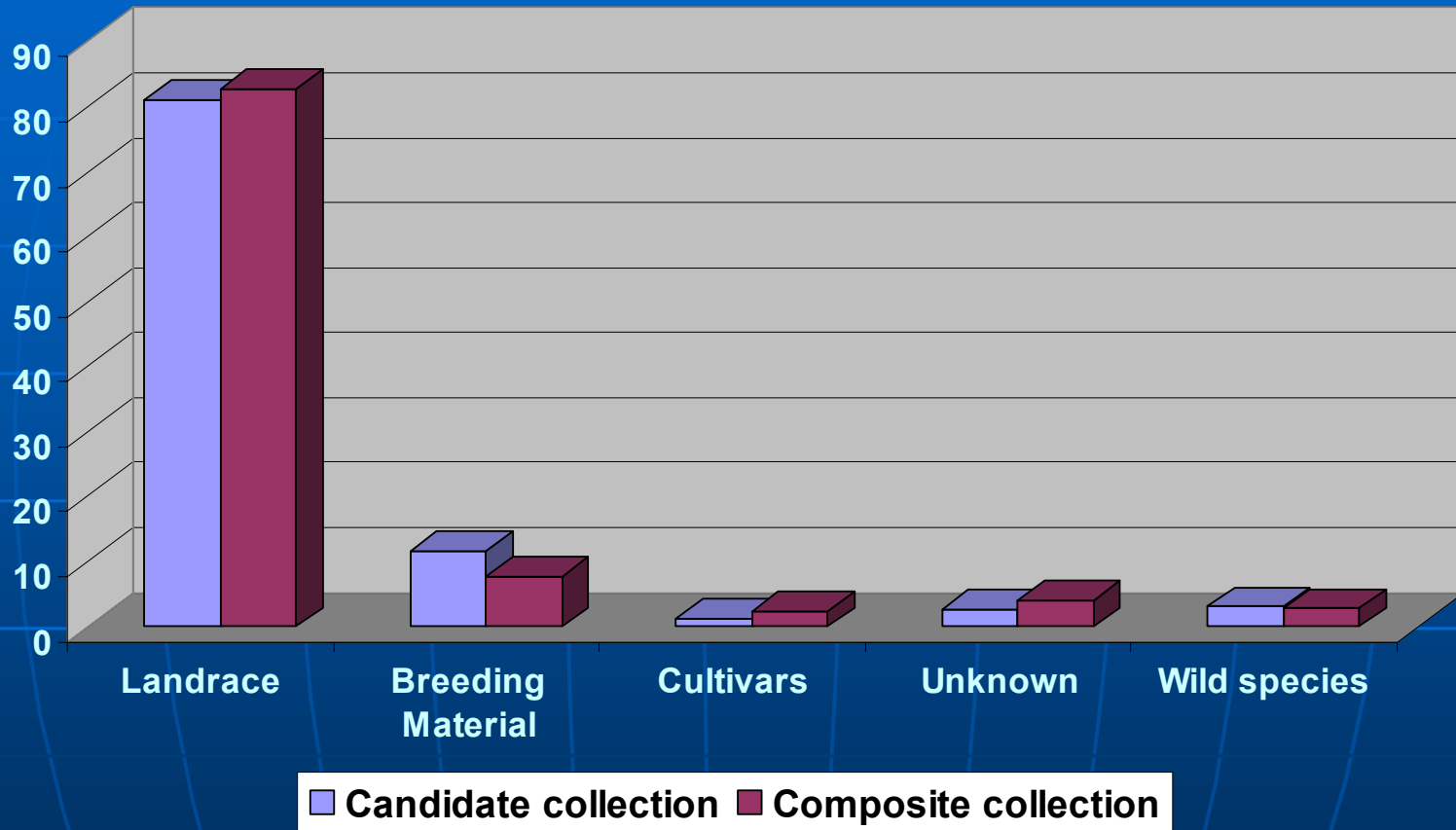
Americas Asia CWANA Europe Other Unknown ICARDA breeding material

Composite collection by type



■ Landrace ■ Breeding Material ■ Cultivars ■ Unknown ■ Wild species





Variation maintained: agronomic characters

Candidate 1987

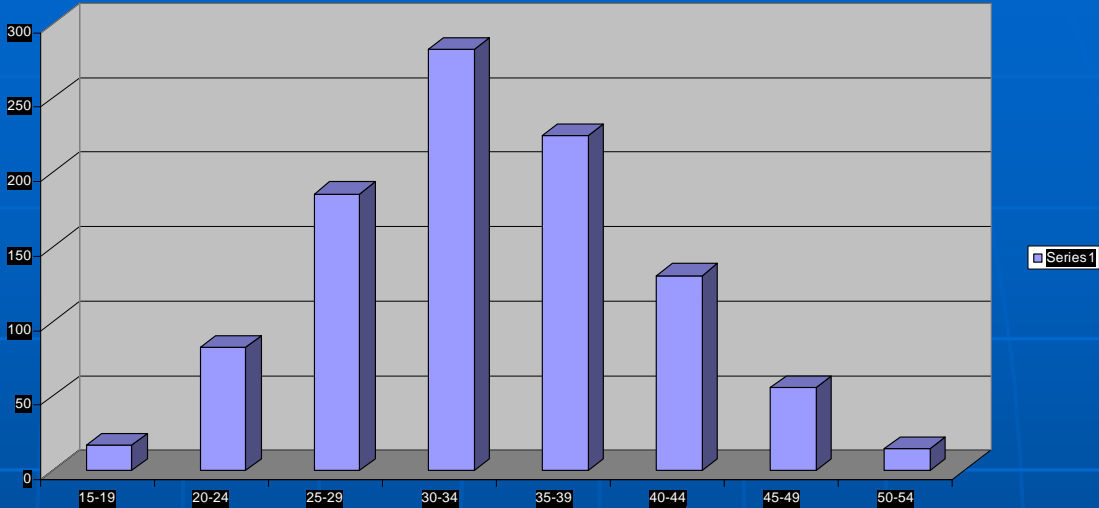
Trait	dflr	dmat	ptht	hlp	spd	byld	syld	styld	hi	hsw
Obs.	996	996	996	996	992	953	996	953	953	994
Mean	116.81	162.30	33.34	17.43	1.34	3151.60	1090.83	2060.78	34.69	3.86
Variance	72.56	71.46	52.29	32.82	0.07	1305507.1	316908.91	651739.16	162.59	1.58
Range	44	34	47	31	1.4	6787	3647	5409	76.9	6.26
GCV	0.07	0.05	0.20	0.31	0.17	0.32	0.48	0.35	0.35	0.32

Composite 1987

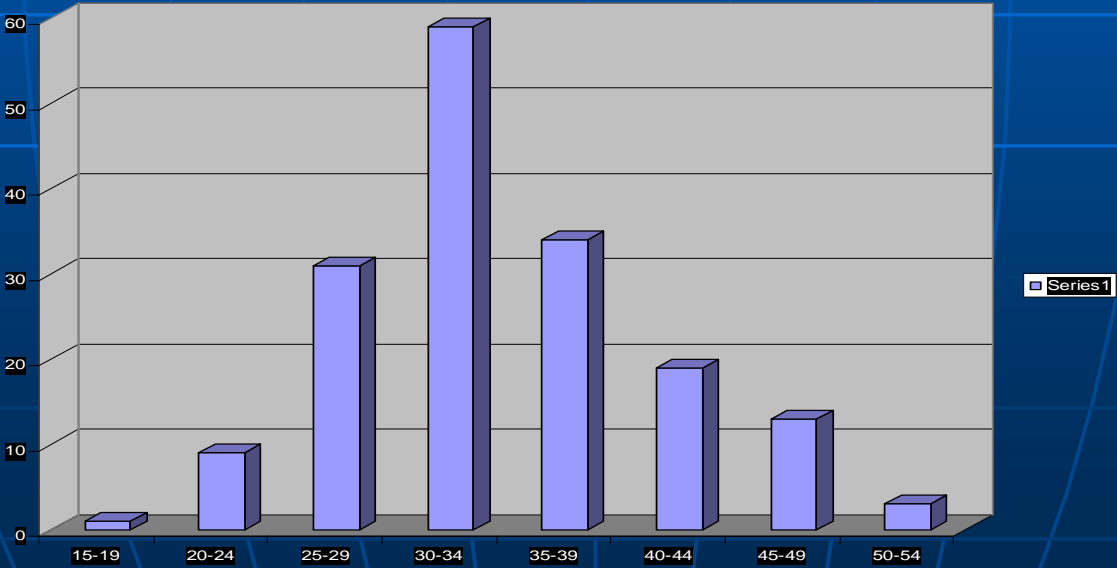
Trait	dflr	dmat	ptht	hlp	spd	byld	syld	styld	hi	hsw
Obs.	163	163	163	163	163	163	163	163	163	163
Mean	118.15	163.19	34.00	18.23	1.36	3239.10	1067.43	2173.18	33.15	3.71
Variance	72.42	70.56	50.56	30.79	0.71	1549374.8	318061.99	851715.56	167.80	1.59
Range	35	34	42	24	1	6650	2520	5303	67	6
GCV	0.13	0.12	0.21	0.30	0.19	0.36	0.49	0.40	0.38	0.35

Plant height

1987 Eval



87 Eval Selected



Variation maintained: morphological characters

87 Eval	lfs	lfp	tl	lod	pdh	pss	fgc	fpi	\hat{H}
n	1992	1992	1992	1992	1992	1992	1992	1992	1992
H'	1.02	0.76	0.07	1.27	1.25	1.26	1.08	0.81	0.94
87 Eval sel	lfs	lfp	tl	lod	pdh	pss	fgc	fpi	\hat{H}
n	338	338	338	338	338	338	338	338	338
H'	1.05	0.77	0.08	1.29	1.29	1.27	1.10	0.85	0.95

Summary

- Composite collection of lentil was completed
- A combination of hierarchical cluster analyses using agronomic data and 2-step clustering utilizing agro-climatological data ensured comprehensive inclusion
- Genetic variation maintained

Current status

- Plants grown in plastic house for DNA extraction
- Molecular characterization will be carried out utilizing 30 SSR markers

What's next

- Phenotypic analysis at Tel Hadya
- Establishment of a mini-core collection for multi-locational evaluation

Thank you!

