

# **Data on the Genebank**

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icarda.org International Center for Agricultural Research in the Dry Areas

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# **ICARDA's GENEBANK**

#### At the crossroad of the origin of the species...

- Crossroad between Near East and Mediterranean Centers of Origin.
- More than 65% of the global human calories consumption is "originated" from the CWANA Mega Center of crop origin



At the heart that first crop domestication occurred (Fertile Crescent)...



a) Mortar and pestle from Wadi Hammeh in the southern Levant, 14,000 years ago. b) Bases guerns in a room at Jerf el Ahmar, northern Syria and c) Quern from Tell 'Abr, northern Syria, all dated to 11,300 years ago. From Wilcox (Science 341, 39 (2013)).

Actions for complementary actions for effective *in situ* and *ex situ* conservation of genetic resources





Gap analysis Collection Conservation Distribution Documentation FIGS subsetting Identify

useful traits Pre-breeding Transfer useful genes to elite germplasm

### Wide crosses



# **ICARDA's COLLECTION IN NUMBERS**

Сгор	No of	Crop	No of	Crop	Global	% acc.	Total taxa	908
	accs.		accs.	genepool	Ranking	globally	Perennial	> 100
Barley	30,225	<i>Pisum</i> spp.	6,131	Barley	2 <sup>nd</sup>	19.0	Cross-pollinated	> 130
Bread wheat	15,088	<i>Trifolium</i> spp.	5,933	Wheat	4 <sup>th</sup>	14.6		- 150
Durum wheat	20,540	Vicia spp.	6,556	Chickpea	2 <sup>nd</sup>	23.2	% unique accessions	45
Primitive wheat	1,214	Faba bean	10,034	Faba bean	1 <sup>st</sup>	89.1	% landraces and native species	65-85
Aegilops spp.	5,155	Chickpea	15,195	Lentil	1 <sup>st</sup>	43.5	% characterized	78
Wild Triticum	1871	Lentil	13,980	Lathyrus	1 <sup>st</sup>	63.6	% safe duplicated	98
Wild Hordeum	2,563	Wild Cicer	554	Medicago	2 <sup>nd</sup>	15.0	% stored in Svalbard	80
Not mandate cereals	182	Wild Lens	617	Pisum	3 <sup>rd</sup>	12.1	Number of Rhizobium	1380
Lathyrus spp.	4,458	Range & Pasture	7,404	Trifolium	3 <sup>rd</sup>	9.0	strains	
Medicago annual	9,160	Others	50	Vicia	1 <sup>st</sup>	23.7	1	
Total			156,910	Overall	4 <sup>th</sup>	4.0		



### **RELOCATION OF ICARDA's COLLECTION**



# **RECONSTITUTION OF ICARDA's COLLECTION**



147,699 accs. as active collections in Syria

#### Two seed withdrawals from SGSV...

- > September 2015: 38,073 accs.
- > September 2017: 52,451 accs.





Morocco: 53,094 accs ... out of them 18,470 under preparation coming from 2018 season



Lebanon: 39,108 accs (faba bean, forages, CWR)



### **FOCUS OF ICARDA's COLLECTION**

Genebank's accessions need to be accompanied by related data

Data are equally important as the individual genebank's accessions themselves

# **DOCUMENTING THE INFORMATION AT ICARDA's GENEBANK**



A. Offline documentation system (old database structured on Foxpro)

Currently	transitional	period	for	ICARDA's
Genebank I	Documentati	on Syst	em	

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	3	10.18730/5N2CR	Lens cullnane subsp. cullnane	JOR	1972	1972/10	
	4	10.18730/5N2RS	Lens colloaris subsp. culinaris	JOR	1972	1972/10	
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n	7	10 18750/5N21AV	Leas cullaeris subsp. cullaeris	IOR	1972	1972/10	
tive wheat	۵	10.18700/5N2WK	Lens culineria aubapi culineria	JOR	1972	1972/10	
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B. New on-line ICARDA's Genebank Documentation System

- > The new System does not incorporate yet all the information and functions of the old database
- The central object of the system is the accession in the sense of an anchor for all the documented information

#### A. Passport Data

- > Include basic information about the *where*, *when* and *what* of the accessions
- Information documented according to the "FAO/BIOVERSITY MULTI-CROP PASSPORT DESCRIPTORS" (V.2.1)
- "Accession Number" is for ICARDA's Genebank the unique identifier for each one of the accessions conserved in the Collection (IG)
- Currently... DOI has been also applied
- Numerical and nominal data
  - Collecting number, date, institute
  - Genus, species, subtaxon
  - ✓ Country of origin, province, site
  - ✓ Geographical coordinates
  - ✓ Biological status of accession (landrace, wild, etc.)
  - ✓ Number of individuals collected
  - ✓ Habitat and related flora
  - ✓ pH, electric conductivity
  - ✓ MLS status
  - Remarks

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#### Passport Data Completeness Index



#### **B. Experiments and Observations**



#### All types of experiments though... speak a common documentation language

- Crop ID, Experiment code, location, field, season
- ✓ Number of accs., checks, replications, experimental design
- ✓ Date of planting, row number, row length/width, accessions per range

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Fertilization and other treatments, date of first effective rainfall, irrigation intervals

#### **B1. Regeneration and Characterization**

- > Use of crop specific descriptor lists (for ICARDA's Genebank applicable IPGRI descriptors)
- Data recorded as numeric, independently the nature of data, i.e. quantitative (plant height), ordinal (intensity of leaf coloration), nominal (awn color)
- > In cases of "mixtures", previous years characterization data serve as a guide
- Up to now... data recording on hard copies (field books) and transferred to xls files (efforts to move to tablet applications, e.g. KDSmart)
- > Characterization data validated by genebank manager/crop curator and uploaded in the database
- Once in database, automatic update of GENESYS can be done, "by one click"





- Growth class (seasonality)
  - 1. Winter
  - 2. Facultative (intermediate)
  - 3. Spring

ARDA	International Center for Agricultural Pesearch in the Dry Areas	Data of scorios			Barley des	criptors			ICARDA			
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#### Vegetative traits (continue...)

- Plant height (excluding awns, measured on March and during maturity)
  - a. Recorded in cm (quantitative value)
  - b. Recorded in a scale, 1: very short, 3: short, 5: intermediate, 7: tall,
    9: very tall (categorical variable)
- Auricle pigmentation
  - 1. Green
  - 2. Pale purple
  - 3. Purple
  - 4. Dark purple



#### B. Reproductive traits (spike and spikelets)

- Photoperiodical sensitivity
  - 1. Very low or no sensitivity
  - 2. Low sensitivity
  - 3. Intermediate sensitivity
  - 4. High sensitivity
- Days to heading



1. Counted in number of days from showing up to when 50% of the plants in the plot have started heading



#### Reproductive traits (spike and spikelets) continue...

- > Row number/lateral florets
  - 1. Two rowed, large or small sterile lateral florets
  - 2. Two row, deficient
  - 3. Irregular, varietal lateral florets development
  - 4. Six rows, awnless or awnletted lateral florets
  - 5. Six rows, long awns on lateral florets
  - 6. Other (specify)





#### Reproductive traits (spike and spikelets) continue...

- Spike density
  - 1. Very lax
  - 2. Lax
  - 3. Intermediate
  - 4. Dense
  - 5. Very dense



#### Reproductive traits (spike and spikelets) continue...

- Lemma awn/hood
  - 1. Awnless
  - 2. Awnletted
  - 3. Awned
  - 4. Sessile hoods
  - 5. Elevated hoods





- Lemma awn barbs
- 1. Smooth (few barbs at tip)
- 2. Intermediate (small barbs upper part)
- 3. Rough



#### Reproductive traits (spike and spikelets) continue...

- > Glume and glume awn (outer glume)
  - 1. Length of glume and awn shorter than kernel
  - 2. Length of glume and awn as long as kernel
  - 3. Glume plus awn longer than kernel
  - 4. Glume plus awn nearly twice as long as kernel
  - 5. Lemma like
  - 6. Other (specify)



### Reproductive traits (spike and spikelets) continue...

- > Glume colour
  - 1. White
  - 2. Yellow
  - 3. Brown
  - 4. Black



- Lemma type
  - 1. No lemma teeth
  - 2. Lemma teeth (barbs or lateral nerves)
  - 3. Lemma hair



#### C. Reproductive traits (grains)

- Kernel covering (lemma and palea adhere to the caryopsis)
  - 1. Naked grain
  - 2. Semi-covered grain
  - 3. Covered grain





- Lemma colour
- 1. Amber (=normal)
- 2. Tan/red
- 3. Purple
- 4. Black/grey
- 5. Other (specify)

#### Reproductive traits (grain) continue...

- Grain colour
  - 1. White
  - 2. Tan/red
  - 3. Purple
  - 4. Black
  - 5. Other (specify)



Aleurone colour (difficult to observe, used for market type classification)

1. White

2. Blue

#### Reproductive traits (grain) continue...

- > 1000 kernel weight
- Grain size
  - 1. Very small
  - 3. Small
  - 5. Intermediate
  - 7. Large
  - 9. Very large



Seed vitreousness (glass like appearance when seeds transversely sectioned)

- 1. Non vitreous (bread wheat)
- 2. Partly vitreous
- 3. Vitreous (durum wheat)

#### Validation of Characterization Data

- > Data entered into a statisticall packet and run basic descriptive statistics for each trait
- > Data checked for distribution patterns, variation, outliers, etc.
- > Once outliers identified meaningful explanations are sought, otherwise outlier values are rejected



#### Automatic update of GENESYS portal for characterization data

- > Genesys... A global portal to plant genetic resources with information for 474 Genebanks all over the world
- Last update in GENESYS for characterization data, 17<sup>th</sup> January 2018
- Serving as an on line tool for ICARDA's Genebank for seed requests

Accession profiler 16 12990 × +		- a	×	
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Location	Syria	Characterization & Evaluation data		
Accession number	IG 12990			
Cenus	Vicia	100 Seed weight in grams	181.30 1304	weight of 100 seeds in grams.
Species	Viola faba – View Viola faba at SYR002	Basal node branching	1.00 1104	Branching from basal nodes, mean number of branches /plant, taken
Scientific name	Vicia taba l	Flower pround color		Ground color of standard ostal /flac).
Crop name	Faha bean		WHITE Iso'a	
Provided crop name	tababean	Hilum color	BLACK 1301	color of hilum of mature seed.
Biological status of accession		Leaflet per leaf	5.00 1 904	Number of leaflets per leaf.
Type of Germplasm storage	Seed collection			
Acquisition date	1978/11	Leafiet shape	INTERMEDIATE (SUB-ELLIPTIC) 1104	Leafiet shape observed on middle leafiet of fully expanded leaf at the intermodiate flowering node of the plant.
Availability for distribution	Not available	Leaflet size	MEDIUM 1304	Leaflet size observed on fully expanded leaves at the intermediate flowering node.
		Podicolor	LIGHT / YELLOW 1394	Pod color at maturity
icarda.org		Pod angle	Erect 1304	Pod angle / attitude at maturity on the second or third pod bearing node.
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#### **B2.** Evaluation

- > Field trials or controlled conditions
- > They are structured as experimental designs, with replications or repeated checks
- > Data recorded as numeric or rarely as string values (e.g. disease reaction: R, MR, MS, S, VS)
- > Many of the data recorded **are not introduced** into the database
  - ✓ Need to incorporate functions for introducing new traits under consistent manner
- Data analyzed through statistical packages and results published in scientific papers or reports









#### **B3.** Pre-Breeding

- Field trials or greenhouse
- > Data recorded by the form of pedigrees and selection history
- > All data introduced into the database
- > Need to seek a different system for the management of this kind of data



#### C. Stock Data

- Information for all types of Collections, i.e. Base, Active, Safe, Duplication, Svalbard
- Information is recorded in terms of seed quantity (number, weight), position into the genebank, date of last regeneration, percentage of germination and date of germination, availability
- New ICARDA's Genebank System is accommodating information for three Genebank's sites, Syria, Lebanon, Morocco
- > Upon each seed dispatch stock can be automatically or manually adjusted

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nitive wheat		Distribution flag	Germination packs	100 Seeds Weight	
bilum		Extra seeds	Virus test	FAO designation	Y
3					

#### **D. Distribution**

- Recording information for all types of seed dispatches (requests or safe duplications)
- Information documented
  - Request number, requestor, institute, country
  - Physical person as recipient
  - Crop and number of accessions
  - ✓ SMTA number
  - ✓ Details on purpose of the particular seed request
  - Full list of accessions dispatched along with the year of seed production and health test
- All related documents (i.e. SMTA, phytosanitary certificate, etc.) are uploaded into the database
- No possibility for on-line requests (only from GENESYS)
- No functions for day to day monitoring about the status of preparing each particular seed request

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#### E. Seed health

- All newly acquired accessions and the accessions regenerated at the field are subjected to seed health test prior to enter the Genebank
- Information on the accession IG, plot number, date of last regeneration, type of collection, date of the seed health test, pathogens traced



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3	16871	100005 A		BSMV	1991/09/29		
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3	16897	100031 A	1984	BSMV	1991/09/29		
-	16258	100332 4	1004	BOWL/	1001/00/20		-

#### F. Taxonomy

- Information about taxonomy of accessions
- > Full taxon information (Family, Genus, Species, Subspecies, Variety, Author, Sub-author)
- Information about longevity (annual, biennial, perennial, self-pollinated, open-pollinated, selfincompatible, pollination agents)

#### G. Pedigree

- Information about accessions' pedigree
- Cross, selection history, developer, full pedigree, release year

#### **H.** Other identifiers

Information about other identifiers (names) in other Institutes for the same accession

D	WHAT	DEST	PREF	05	DLOCUS	*	Double clic
22786 GAW 151	-11 COL	ETH70	Y	GAW 151-11	0		beader to
22767 PI 383205	ACC	USDA	1	PI 383205	D		Ascer
22767 GAW 152	-1 COL	ETN70	Y.	GAW 152-1	c		C Deso
22788 PI 383206	ACC	USDA		PI 383206	0		
22768 GAW 152	COL	ETH70	Y	GAW 152-2	C		
22789 PL383207	ACC	USDA	-	PI 383287	0		
22789 GAW 152	L3 C01	FTH70	v	GAW 152-3	0		
22770 PI 383209	224	USDA	1	PI 383209	0		C
22770 GAW 152		ETH70	Y	GAW 152-8	e	1	_
22771 PI 383854	ACC	USDA		PI 383854	0		Print
22771 DL 69	CIII		v	01.69	N N N N N N N N N N N N N N N N N N N		-
22771 PAK 3073	4	PARC		PAK 30724	0		Sta
22772 PI 383881	400	USDA	-	PI 383861	0		
22772 HOR 500	SEL ACC	EK	-	HOR SOD, SEL	ŏ		F
22772 A 285 64	00	TUR28/30	-	A 285 SFI	č		
22773 PI 383862	400	USDA	-	PI 383862	0		
22773 HOR 925	224	EK.	-	HOR 925	0	[	
22773 Anatolea	100		v	ANATOLEN	N		C Selec
22773 A 818	000	11028/30	1	A 818	e		
20774 DI 383883	400	USDA		01383863	0		
22774 HOR 925	SEI ACC	EV.	-	HOD 025 SEL	0		
22774 0 818 mm	0	TUR28/50	-	A BIE CE			
22776 01393036	400	lison	-	01383036	0		
22776 6564110		Paum		A C AME 40			
22775 40047	001		1	40017	a .		
22773 00 203037	400	HOD A	_	01959597	0		
22776 P1 303921	ACC	USUA		PI 303827			
22776 TOCHIGI	201.051			A ZURA COLDEN			
22170 ALUNA 0	SOLDEN GOL	INCO A	1	AZUMA GULUEN	n		
22777 FULLADO	ALL	USUA	v	FI 303320			
22777 471 100	COL	-		1711074			
22171 4/LV14	COL	10000	-	4/ LV/ 4		-	
24/70 PI 3839/8	ACC	USUA		H 703878	V.		

#### I. WorldClim data

Accession nu	nber: IG	16867	Cro	op: ICB	Cr	rop No.: 1	00001	Taxon:	Hordeur	n vulgare	e subsp. (	vulgare co	onvar. vulg
Passport C	ollection Sit	e Sto	ock	Pedigree	e Envir	onment	Characteriz	ation and E	Evaluatior	Pict	ures		
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Rainfall	53.00	41.00	39.00	40.00	44.00	52.00	49.00	48.00	45.00	38.00	53.00	69.00	571.00
Max. Temp.	2.60	3.78	8.59	16.14	21.95	25.93	28.46	28.46	23.59	17.04	10.50	5.56	16.03
Min. temp.	-3.53	-3.11	0.45	6.67	12.08	16.04	18.39	17.89	13.40	7.71	3.35	-0.45	7.41
Pot. evapor.	10.31	17.18	39.19	74.80	112.97	130.48	139.69	122.28	79.95	44.58	19.21	10.75	801.35
Aridity index	5.141	2.386	0.995	0.535	0.389	0.399	0.351	0.393	0.563	0.852	2.759	6.419	0.713
Annual Mea	ariables n Temperatu	re:		11.7	Mea	n Diurnal R	ange(Mea	n of monthl	y (max te	mp-min t	emp)) 7	7.7	
Isothermality	(P2/P7):			24.7	Temperature Seasonality (standard deviation): 885.6								
Max Temper	ature of Wa	mest Mor	nth:	27.8	Min Temperature of Coldest Month: -3.3								
Temperature	Annual Rar	nge(P5-P6	ð):	31.1	.1 Mean Temperature of Wettest Quarter: 3.2								
Mean Temp	erature of Dr	iest Quart	er:	5.3	5.3 Mean Temperature of Warmest Quarter: 2						22.6		
Mean Tempe	erature of Co	dest Qua	arter:	1.0	1.0 Annual Precipitation: 612						612.0		
Precipitation	of Wettest M	Month:		80.0	Prec	ipitation of	Driest Mon	ith:			4	1.0	
Pre. Season	ality (Coeffic	ient of Va	riation):	21.7	Prec	ipitation of	Wettest Qu	uarter:			1	95.0	
Precipitation	of Driest Qu	larter:		127.0	Prec	ipitation of	Warmest C	Quarter:			1	54.0	
Precipitation	of Coldest (	Quarter:		184.0									

#### **MAJOR BACKLOGS**

- > Data for major activities recorded in hard copies and xls files... prone to errors
- > Parallel use of different software for handling and anylizing genebanks data
- Limited options to incorporate new traits or new data formats (e.g. genotypic data, measurements on physiological traits, etc.)
- > Not truly on-line... no access for external requestors and receiving on-line request

#### **STEPS TO MOVE AHEAD**



- Developing and incorporating high-precision phenotyping techniques
- Incorporating genotypic data
- Incorporate different subsets







# Thank you for your kind attention

# **Time for Discussion** ③