ICARDA
Science for Better Livelihoods in Dry Areas

International Center for Agricultural Research in the Dry Areas

Biodiversity and Integrated Gene Management Program

# Mining barley genetic resources and elite germplasm for useful traits

*Summary of acheivements*

*Cropping season 2013-2014*

CGIAR

GRDC
Grains Research & Development Corporation

# Barley FIGS subsets developed

| s.n. | Crop | Trait | No of accessions | Institute/Project | Researcher |
|---|---|---|---|---|---|
| 1. | ICB | PM resistance | 283 | AWCC | |
| 2. | ICB | Boron Tolerance | 50 | UWA | Ed Barret - UWA - screen ICARDA |
| 3. | ICB | BYDV | 200 | ICARDA | Safaa Kumari, ICARDA |
| 4. | ICB | Drought | 270 | ICARDA | Malal Al Faleh, Tunisia |
| 5. | ICB | Frost | 152 | | Rosebur, Australia |
| 6. | ICB | Low input - organic | 50 | SOLIBAM | SOLIBAM project Europe |
| 7. | ICB | Net blotch | 62 | AWCC | Greg Grimes, AWCC |
| 8. | ICB | Net blotch | 307 | ICARDA | ICARDA - Barley program |
| 9. | ICB | Net blotch | 120 | VIR | Olga Koveleva, VIR Barley department |
| 10. | ICB | Non-Host resistance - Leaf rust | 1774 | Wageningen Univ. | Wageningen University |
| 11. | ICB | PM resistance | 200 | AWCC | Greg Grimes, AWCC - Australia |
| 12. | ICB | YR resistance | 297 | ICAR | NBPGR, India |
| 13. | ICB | Salinity | 100 | VIR | Olga Koveleva VIR Barley department |
| 14. | ICB | Stem gall midge | 339 | ICARDA | Mustapha El Bouhssini, ICARDA entomology |

# Barley characterization/evaluation (2014 cropping season)

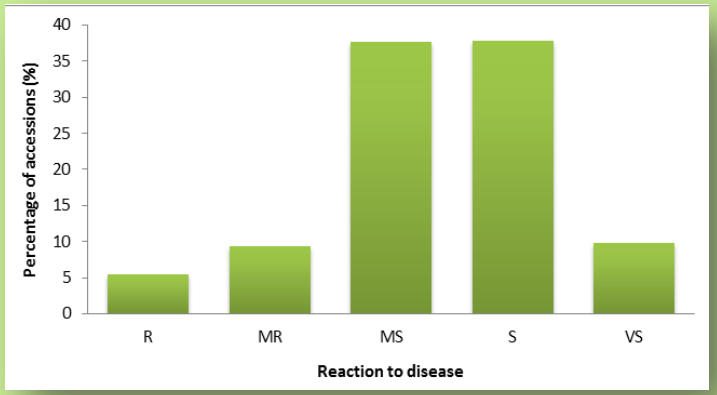
| Country | Location | Type of material | Purpose | No of accs. |
|---|---|---|---|---|
| Lebanon | Terbol | Landraces | Characterization | 198 |
| Lebanon | Terbol | Wild relatives | Characterization | 39 |
| Tunisia | 1. Mornag<br>2. El – Kef | FIGS | Drought tolerance; other agronomic traits | 270 |
| Tunisia | 1. Mornag<br>2. El – Kef | GCP | Drought tolerance; other agronomic traits and diseases resistance | 260 |
| Tunisia | Tunis | FIGS | BYDV resistance | 199 |
| Tunisia | Mornag | Landraces | BYDV resistance | 100 |
| Tunisia | Mornag | Landraces | Characterization; evaluation for agronomic traits | 613 |
| Morocco | Marchouch | GCP | Drought tolerance; other agronomic traits and PM | 200 |
| **Total** | | | | **1879** |

# Landraces evaluation to powdery mildew

- 613 accessions evaluated for resistance to PM, Mornag - Tunisia
  - ✓ 33 accs. resistant (i.e. 5.38%)
  - ✓ 57 accs. moderate resistant (i.e. 9.29%)
  - ✓ 523 accs. moderate susceptible or susceptible (85.33 %)

Indicative landraces assessed as resistant to PM on 2014 cropping season at Mornag station, Tunisia.

| IG No | Species | Subspecies | Origin |
|---|---|---|---|
| 157481 | *H. vulgare* | L. *pallidum* Ser. (*hybernum* Vib.) | UZB |
| 157541 | *H. vulgare* | L. *pallidum* Ser. (*hybernum* Vib.) | MEX |
| 157564 | *H. vulgare* | L. *pallidum* Ser. (*hybernum* Vib.) | MEX |
| 157579 | *H. vulgare* | distichon, L. nutans Schubl. | MEX |
| 157848 | *H. vulgare* | *nutans* Schubl. | TJK |
| 157849 | *H. vulgare* | *himalayense* Ritt. | TJK |
| 157850 | *H. vulgare* | L. *pallidum* Ser. (*hybernum* Vib.) | TJK |
| 157852 | *H. vulgare* | L. *pallidum* Ser. (*hybernum* Vib.) | UZB |
| 157853 | *H. vulgare* | L. *pallidum* Ser. (*hybernum* Vib.) | UZB |
| 157857 | *H. vulgare* | *nutans* Schubl. | UZB |
| 157882 | *H. vulgare* | L. *pallidum* Ser. (*hybernum* Vib.) | UZB |




Response to powdery mildew of 613 barley accessions planted at Mornag-Tunisia on 2013-14 cropping season.

# FIGS drought subset evaluation (Tunisia)

- 270 accessions and 5 checks as augmented design in two locations, Mornag and Kef, Tunisia

## A. Agronomic performance traits

- ✓ 72 accs. earlier than the best check (from 1 up to 10 days)
- ✓ 11 accs. outperformed the best check in terms of yield
- ✓ 42 accs. with higher CCI values than the best check.

Descriptive statistics on different quantitative traits for the FIGS barley accessions grown at Mornag station in Tunisia during the 2013-2014 growing season.

| Quantitative traits | Count | Minimum | Maximum | Average | Standard deviation |
|---|---|---|---|---|---|
| Days to heading | 275 | 108.0 | 161.0 | 125.82 | 14.374 |
| Plant height (cm) | 275 | 36.0 | 120.0 | 80.14 | 19.223 |
| CCI* | 275 | 20.0 | 63.0 | 48.89 | 6.264 |
| Grain yield ($g/m^2$) | 275 | 22.2 | 1373.3 | 458.96 | 296.748 |

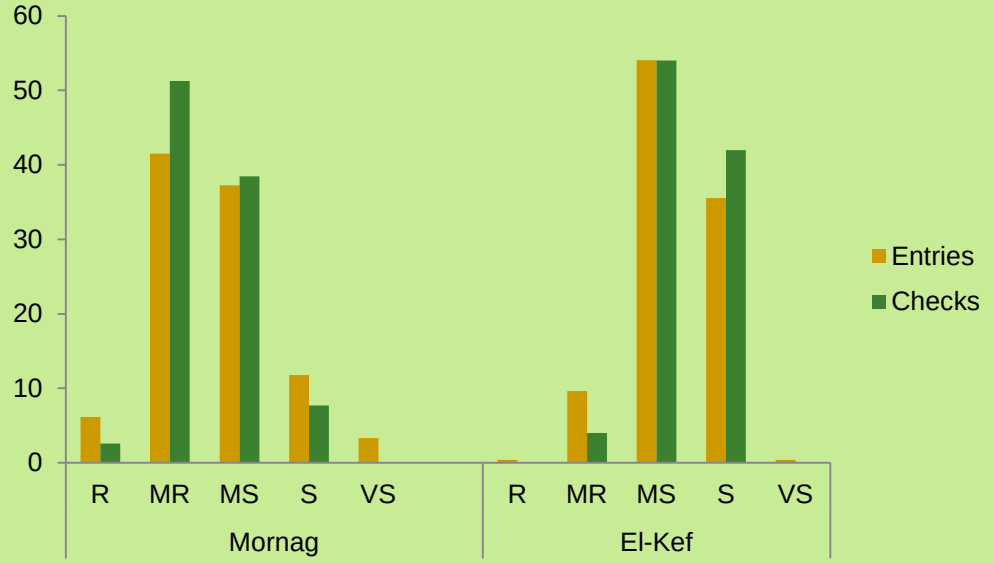
*CCI: chlorophyll concentration index

# FIGS drought subset evaluation (continue…)

## B. Evaluation for Powdery mildew resistance

- ✓ Symptoms at El-Kef more severed than Mornag for the same set of accessions
- ✓ Higher ratio of "R" and "MR" response for FIGS accessions (Mornag and Kef, respectively) compared to checks

**Evaluation for drought is continued**




Response to powdery mildew of FIGS drought subset planted at Mornag and Kef stations in Tunisia on 2013-14 cropping season (y-axis: values %).

## GCP subset evaluation (Tunisia)

- 260 accessions and 5 checks as augmented design in two locations, Mornag and Kef, Tunisia

## A. Agronomic performance traits

- ✓ 32 accs. earlier than the best check (from 1 up to 7 days)
- ✓ 125 accs. outperformed the best check in terms of yield
- ✓ 107 accs. with higher CCI values than the best check.

Descriptive statistics on different quantitative traits for the GCP barley accessions grown at Mornag station in Tunisia during the 2013-2014 growing season.

| Quantitative traits | Count | Minimum | Maximum | Average | Standard deviation |
|---|---|---|---|---|---|
| Days to heading | 265 | 110.0 | 159.0 | 125.11 | 13.981 |
| Plant height (cm) | 265 | 60.0 | 130.0 | 92.33 | 13.903 |
| CCI* | 265 | 21.3 | 65.1 | 49.06 | 5.640 |
| Grain yield ($g/m^2$) | 265 | 44.4 | 1263.3 | 581.13 | 243.024 |

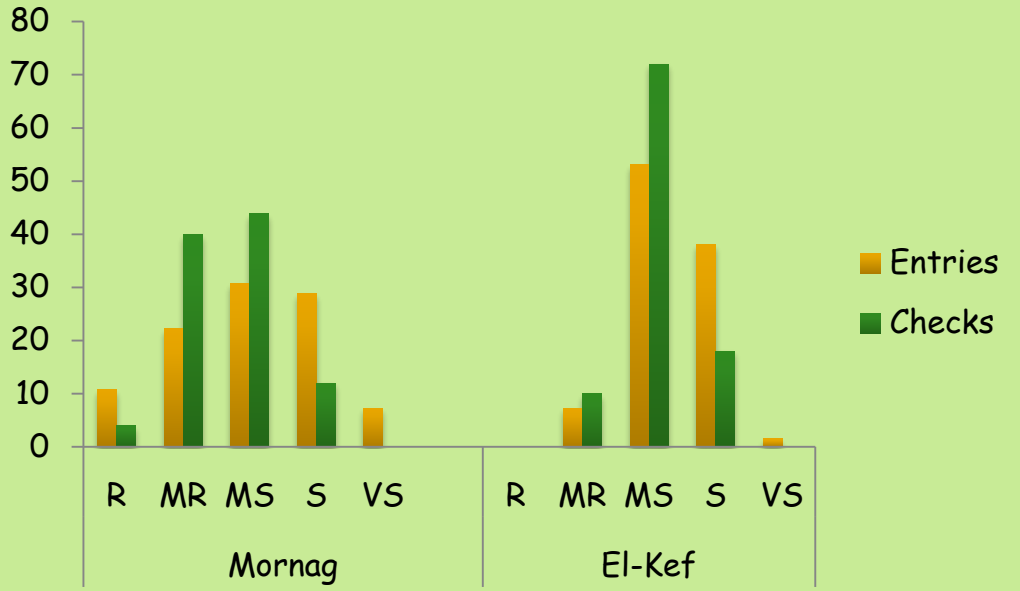
*CCI: chlorophyll concentration index

# GCP subset evaluation (continue…)

## B. Evaluation for Powdery mildew resistance

- ✓ Symptoms at Kef more severed than Mornag for the same set of accessions
- ✓ Higher ratio of "R" response for GCP accessions (Mornag) compared to checks
- ✓ Higer ratio of "S" response for GCP accessions at both locations compared to checks

**Evaluation for drought is continued**




Response to powdery mildew of GCP drought subset planted at Mornag and Kef stations in Tunisia on 2013-14 cropping season (y-axis: values %).

# FIGS BYDV subset

- 199 accs. with artificial inoculation under greenhouse, Tunis
  - ✓ 3 accs. resistant (infection rate 0-20%)
  - ✓ 13 moderate resistant (infection rate 21-50%)
  - ✓ 183 susceptible (infection >50%)

| IG no | Origin | Range of infection rate |
|---|---|---|
| 23154 | ETH | 0-20 % |
| 23241 | ETH | 0-20 % |
| 17273 | ETH | 0-20 % |
| 17165 | ETH | 21-50% |
| 22319 | ETH | 21-50% |
| 23102 | ETH | 21-50% |
| 21897 | ETH | 21-50% |
| 23016 | ETH | 21-50% |
| 23127 | ETH | 21-50% |
| 17151 | ETH | 21-50% |
| 17153 | ETH | 21-50% |
| 21973 | ETH | 21-50% |
| 21974 | ETH | 21-50% |
| 23181 | ETH | 21-50% |
| 28914 | ETH | 21-50% |
| 36852 | NPL | 21-50% |

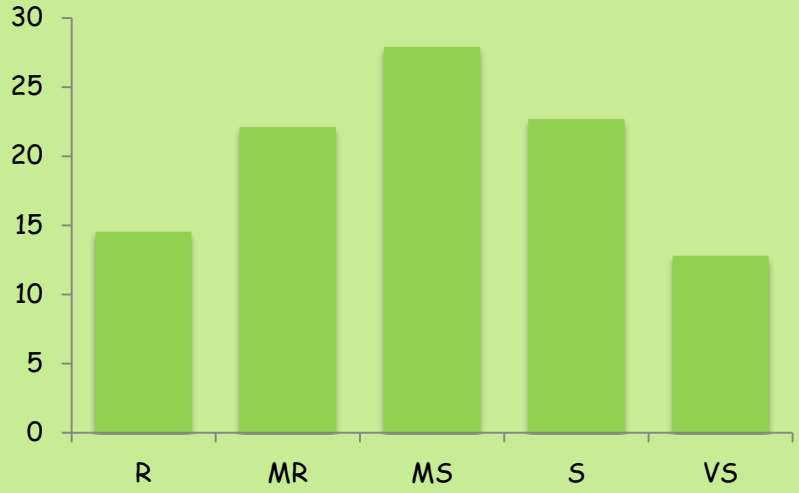
# Barley landraces evaluation to BYDV

- 100 accs. with artificial inoculation under field conditions, Mornag - Tunisia
  - ✓ 2 accs. developed very few symptoms (scored as 2; disease score 0-9)
  - ✓ 2 accs. developed few symptoms (scored as 3; disease score 0-9)
  - ✓ 23 accs. developed symptoms between 4 and 5
  - ✓ 73 accs. developed symptoms >5

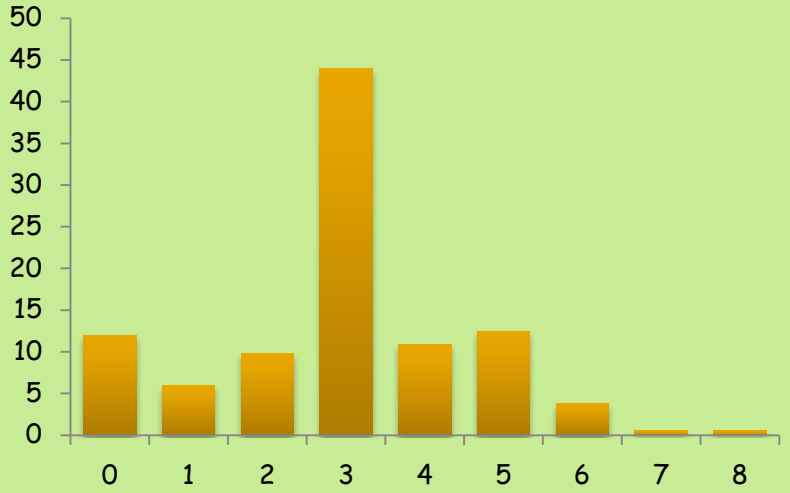
| IG no | Origin | Disease score (0-9) | Remarks |
|---|---|---|---|
| 154327 | Belarus | 2 | |
| 154279 | Belarus | 2 | |
| 154340 | Belarus | 3 | |
| 154364 | Belarus | 3 | |
| ICB01-1108 | ICARDA | 1 | Resistant check |
| Alanda | Tunisia | 9 | Susceptible check |
| Rihane | Tunisia | 9 | Susceptible check |
| Manal | Tunisia | 7 | Susceptible check |

# GCP subset evaluation, Morocco

- 200 accs. evaluated for resistance to PM and NB, Marchouch - Morocco
  - ✓ 25 accs. resistant and 35 accs. moderate resistant to PM
  - ✓ 22 accs. no symptoms (disease score 0) and 29 acc.s few symptoms (disease score 1-2)




Response to powdery mildew of the GCP barley subset planted at Marchouch-Morocco on 2013-14 cropping season (y-axis: values %).




Response to net blotch of the GCP barley subset planted at Marchouch-Morocco on 2013-14 cropping season (diesease score 0-9; y-axis: values %).

# Lines selected from barley breeding program

- 90 lines selected from the barley breeding program and sent to Australia
  - ✓ 36 lines from the Low Input Barley
  - ✓ 38 lines from the High Input Barley
  - ✓ 16 line from the yield trials

Quote table with some of the lines selected from ICARDA's barley breeding program and sent to Australia

| Country | Pedigree | Nursery |
|---|---|---|
| 1:ZBS15 | Weeah11//WI2291/Bgs/3/ER/Apm//AC253 | LIB |
| 2:ZBS15 | Pamir-147/Sonata/3/Pamir-154//ICB-100709/WB156 | LIB |
| 7:ZBS15 | WI2198/Hml-02//INRA55-86-2/Rt1703/3/Hml | LIB |
| 19:ZBS15 | Arupo'S'12/3/PI002325/Maf102//Cossack/4/Viringa'S'/5/Mundah | LIB |
| 37:ZBS15 | J04079060 09/3T0038 | YT |
| 38:ZBS15 | H97054003 09/6T0007 | YT |
| 53:ZBS15 | PFC9202//LM 844/QUILMES PAMPA/3/CANELA | HIB |
| 54:ZBS15 | ESMERALDA/PALTON | HIB |
| 55:ZBS15 | CANELA//E.ACACIA/DEFRA | HIB |

# Visit to Morocco – Major outcomes

- Joint visit of ICARDA-CAIGE-INRA to Morocco stations and selection of accessions from GCP for PM and NB and of breeding germplasm
- Agreement on implemented activities for the stations used in Morocco, Tunisia and Lebanon
- Agreement on sharing the information of the entries tested (genebank's accessions accompanied by passport data and breeding lines with pedigree and all data collected during the evaluation).
- Data gathered from Australian partners will be sent back to ICARDA.
- All seeds will be provided with SMTA and will be exchanged with others under the same SMTA terms
- Genetic resources cannot be included in the base and active collections but can be used as working collections

## Plans for future

- Testing for malting quality using NIRS and micro-malting tests on selected best lines; information to be returned to ICARDA
- Bringing into Australia barley IN for HI and LI trials every year;
- Genotyping of FIGS subsets and breeding lines using SNPs platform
- Checks to share and to include in trials: obsolete varieties and varieties in the public domain and checks (Hindmarsh, Buloke, Commander, Bass, Keel, Gairdner, Baudin, Barque, Vlamingh, Schooner) to be included in ICARDA trials