**The Oregon Naked Barley Blend -**

**A germplasm release for education and collaborative research**

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**Background and germplasm development**

The Oregon Naked Barley Blend (ONBB) is a resource for research and plant breeding. It consists of 753 doubled haploids derived from 33 crosses involving 28 different parental lines and 40 different grandparental lines (Table 1). Grandparents originated from the following breeding programs/germplasm collections: CIMMYT/ICARDA-Mexico (Calicuchima-sib); Crop Development Center, University of Saskatchewan (CDC Alamo); Getreidezuechtungsforschung Darzau (DZ100289, DZ100341); KWS (Fridericus, KW2-8499); Martonvasar Research Institute of the Hungarian Academy of Sciences (Luca); Oregon State University (Alba, BISON1,4,5, Full Pint, Maja, Orca, Oregon Wolfe Barley Dominant, Strider, StabBC42 ((Strider/88Ab536//Strider), Kab51 (Kold/88Ab536//Kold)); Research Institute of Bioresources, Okayama University Germplasm collection (Chame 14 Nepal, Tibet Black 8, Tibet Violet 1); University of California, Davis (Tamalpais); University of Minnesota (Legacy); University of Nebraska, Lincoln (NB3437f, P713); USDA-ARS Idaho (Charles, Transit, 2Ab09-X05W048-378HL, 2Ab11-W06Bg60-18); USDA National Small Grains Germplasm Collection (Karma = PI 60205); Virginia Polytechnic and State University (Doyce); and WestBred/Monsanto/Highland Specialty Seeds (Merlin, Waxbar). The only common denominator of the parental lines is that all are naked (hull-less) and therefore homozygous recessive at the *Nud* locus (Taketa et al., 2008). The grandparental germplasm is genetically diverse and includes known alternative alleles for growth habit (facultative, spring, and winter), inflorescence type (2-row, 6-row), plant height (semi-dwarf, standard), seed color (blue, brown, purple, white), seed starch type (normal, waxy). This diverse germplasm is also likely to have contributed allelic variation for uncharacterized traits including aroma, disease resistance, drought tolerance, flavor, malting quality, nutritional factors, and yield. The doubled haploids were produced at Oregon State University, following the protocol of Cistue et al. (2003). The doubled haploids were increased in the field at the Hyslop Agronomy Farm and harvested *en masse* in 2014 as a blend. The blend has been planted and harvested annually at the same location.

**A resource for education and outreach within the framework of a USDA-NIFA-OREI competitive grant**

As part of a recently funded USDA-NIFA-OREI project “Multi-use naked barley for organic systems”, the ONBB will be grown in school gardens in each of five collaborating states (NY, MN, OR, WA, WI) region in order to teach K-12 students about genetic diversity, plant breeding, how to produce and prepare organic naked barley, and natural vs. artificial selection. Detailed lesson plans that are aligned to the Next Generation Science Standards will be developed based on this germplasm. University collaborators will work with teachers in their respective states. The ONBB education/outreach effort will be coordinated by a lead teacher (Johannah Withrow-Robinson, Springfield, Oregon) in collaboration with project personnel. Lead teachers have been identified in participating states. Student/teacher experiences will be documented and shared via the project website maintained by e-Organic. Oregon Tilth will provide expertise, as needed for schools transitioning to organic or seeking additional expertise for organic production. We have been in contact with the USDA-NIFA National Agriculture in the Classroom Project about this proposal and identified opportunities to work towards developing curricula and sharing resources nationwide.

The ONBB will also provide a mechanism for reaching the broad audience of home gardeners, home bakers, and home brewers. The OSU Barley Project will provide samples of the germplasm to those who request it - a condition for release of a germplasm with an announcement in the Journal of Plant Registrations. The availability of the ONBB germplasm will be announced via electronic and hard copy media. The offering will include a brief description of the ONBB and its role in the national organic naked barley effort, as well as documentation of how to engage in selection and propagation of individual components within the mixture. Recipients will be invited to contribute observations and experiences and these will be posted on the project website – an informal “crowd science” approach to organic grains breeding. This experiment will use an evolutionary-participatory breeding (EPB) model, which emphasizes the contribution of human selection combined with natural selection at site-specific locations (Murphy et al., 2005). An EPB method involves increasing genetic diversity by growing a heterogeneous population that will be better able to deal with pests and disease (*as reviewed by* Murphy et al., 2005). In the case of naked barley, varieties breed true. A key difference between a conventional variety and an EPB-derived variety is that the latter is a mixture of pure lines. Heterogeneity is a positive attribute as it can provide buffering against changes in the environment and changes in both type and strain of crop pests. The only condition is that the crop variety be sufficiently uniform for management and processing purposes. Our project is an excellent candidate for the organic EPB model because it involves breeders and students working together to make selections, and it focuses on a heterogeneous blend of lines that will help bolster the crop against disease and pest pressures.

**References**

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**Table 1 – Numbers of doubled haploids, doubled haploid pedigrees and parents of the Oregon Naked Barley Blend**

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| **Number of DH** | **Pedigree** | **Female** | **Male** |
| 1 | 09OR-55/Color-F4-SSD-034 | Strider/Merlin, F1//Strider | Tibet Violet 1///Luca/Merlin//Luca |
| 4  229 | 09OR-55/DZ100341 | Strider/Merlin, F1//Strider | Astrid///BGRC5110/BGRC5126//Billa |
| 28 | 09OR-56/Color-F4-SSD-092 | Strider/Merlin, F1//Strider | Tibet Black 8/// Luca/Merlin//Luca |
| 16 | 09OR-59/2Ab09-X05W048-378HL | Strider/Merlin, F1//Strider | 93Ab428/Orca//CDC Alamo |
| 39 | 09OR-59/Color-F4-SSD-148 | Strider/Merlin, F1//Strider | Oregon Wolfe Barley Dominant/Calicuchima sib//Luca/Merlin//Luca |
| 31 | 2Ab09-X05W048-378HL/DZ100289 | 93Ab428/Orca//CDC Alamo | BGRC5110/BGRC5126//Tiffany///Carrero |
| 18 | 2Ab09-X05W048-378HL/OR101 | 93Ab428/Orca//CDC Alamo | StabBC 42///Kab 51/Legacy//Kab 51 |
| 20 | 2Ab09-X05W048-378HL/Tamalpais | 93Ab428/Orca//CDC Alamo | Tamalpais |
| 6 | 2Ab11-W06Bg60-18/09OR-56 | 93Ab428/Orca//Azhul/Thuringia | Strider/Merlin, F1//Strider |
| 5 | Alba/Color-F4-SSD-151 | Alba | Oregon Wolfe Barley Dominant/Calicuchima sib///Luca/Merlin//Luca |
| 45 | Alba/DZ100341 | Alba | Astrid///BGRC5110/BGRC5126//Billa |
| 16 | Chame 14 Nepal///Luca/Merlin//Luca | Chame 14 Nepal | Luca/Merlin//Luca |
| 12 | Charles/Color-F4-SSD-092 | Charles | Tibet Black 8/// Luca/Merlin//Luca |
| 25 | Color-F4-SSD-002/10.0655 | Chame 14///Luca/Merlin//Luca | KW2-849/Luca/Waxbar//Luca |
| 5 | Color-F4-SSD-092/Full Pint | Tibet Black 8/// Luca/Merlin//Luca | FullPint |
| 5 | Color-F4-SSD-092/Bison 1,4,5 | Tibet Black 8/// Luca/Merlin//Luca | Bison1,4,5 |
| 50 | Color-F4-SSD-092/PO71DH-87 | Tibet Black 8/// Luca/Merlin//Luca | P713/OR71 |
| 17 | Color-F4-SSD-148/OBADV10-13 | Oregon Wolfe Barley Dominant/Calicuchima sib//Luca/Merlin//Luca | Strider/Doyce |
| 10 | DH 10.0655/09OR-55 | KW2-849/Luca/Waxbar//Luca | Strider/Merlin, F1//Strider |
| 37 | DH 10.0655/Color-F4-SSD-034 | KW2-849/Luca/Waxbar//Luca | Tibet Violet 1///Luca/Merlin//Luca |
| 29 | DH 10.0655/Color-F4-SSD-043 | KW2-849/Luca/Waxbar//Luca | TibetViolet 1///Luca/Waxbar//Luca |
| 3 | DH 10.0655/Karma | KW2-849/Luca/Waxbar//Luca | Karma |
| 12 | DH 10.0655/Tamalpais | KW2-849/Luca/Waxbar//Luca | Tamalpais |
| 14 | DH 10.0969/Color-F4-SSD-138 | KW2-849/Luca/Waxbar//Luca | Tibet Black 8///Luca/Merlin//Luca |
| 11 | NO71DH-86/Color-F4-SSD-092 | NB3437f/OR71 | Tibet Black 8/// Luca/Merlin//Luca |
| 18 | OBADV10-13/Color-F4-SSD-092 | Strider/Doyce | Tibet Black 8/// Luca/Merlin//Luca |
| 3 | OBADV10-13/Tamalpais | Strider/Doyce | Tamalpais |
| 1 | OR101/Color-F4-SSD-017 | StabBC 42///Kab 51/Legacy//Kab 51 | Chame 14///Luca/Merlin//Luca |
| 14 | OR101/Color-F4-SSD-138 | StabBC 42///Kab 51/Legacy//Kab 51 | Tibet Black 8/// Luca/Merlin//Luca |
| 13 | OR101/DZ100341 | StabBC 42///Kab 51/Legacy//Kab 51 | Astrid///BGRC5110/BGRC5126//Billa |
| 17 | Tetonia/Karma | Tetonia | Karma (PI 60205) |
| 292 | Tibet Black 8///Luca/Merlin//Luca | Tibet Black 8 | Luca/Merlin//Luca |
| 25 | Tibet Violet 1///Luca/Merlin//Luca | Tibet Violet 1 | Luca/Merlin//Luca |
| 3 | Tibet Violet 1///Luca/Waxbar//Luca | Tibet Violet 1 | Luca/Waxbar//Luca |
| 5 | Transit/DH 10.1126 | Transit | Fridericus/Maja/Legacy//Maja///Doyce |