OREGON AGRICULTURAL EXPERIMENT STATION

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Proposed release of ‘Alba’ winter feed barley

Alba is a six-row selection with rough awns and a lax spike. The grain has white aleurone. Alba is an obligate winter type: it requires vernalization for flowering in a timely manner. Alba has a level of winter hardiness comparable to other varieties commercially available in the Pacific Northwest of the US. Alba is resistant to barley stripe rust and scald. The planned end use of Alba grain is as feed. Food use is possible. Alba would not be suitable for the production of malt using current protocols or for current beer styles.

According to pedigree records, Alba was derived from the F1 of the cross “Strider x Orca” made in 1997. Strider is a winter feed six-row with a strong vernalization requirement and winter hardiness comparable to other commercially available winter varieties. Orca is a two-row spring feed variety with no vernalization sensitivity and no winter hardiness. However, genotyping with over 3,000 single nucleotide polymorphisms (BOPA 1 and 2), under the auspices of the USDA-NIFA-Barley Coordinated Agricultural Project ([www.barleycap.org](http://www.barleycap.org)), revealed that this pedigree is not complete. Although Alba shares alleles in common with Strider and Orca, there are also alleles present in Alba that are not present in either parent. The SNP haplotype of Alba is available at the T3 database (<http://triticeaetoolbox.org/>). Conventional generation advance, phenotypic selection, and head row purification were used to develop Alba. Alba was tested as OR77 throughout the Pacific Northwest in breeding and extension trials. On-farm trials were initiated in the fall of 2010. The name Alba was chosen due to the bright and attractive appearance of the crop at maturity. Alba is derived from the Latin for “white” and means “dawn” in Spanish.

**Performance data**

Alba was tested for agronomic, disease resistance, and malting quality traits at multiple locations throughout Oregon, Idaho, and Washington from 2008 - 2011. More limited data are available from other locations and on-farm trials. Trials have been conducted under irrigation, without irrigation under high rainfall, and without irrigation under moderate rainfall. Winter survival was characterized under field and controlled environment conditions.

Overall, Alba is a high yielding selection with excellent test weight and kernel plumpness. Alba has excellent resistance to barley stripe rust (incited by *Puccina striiformis* f.sp. *hordei*) and scald (incited by *Rhynchosporium secalis*). Winter hardiness is comparable, and in some cases superior, to commercially available varieties. When malted under standard conditions, Alba does not have a malting quality profile that would be of interest to mainstream or craft brewers. The principal defect is high wort beta glucan. Alba has only been characterized in a preliminary fashion for food quality traits. The high kernel plumpness yields an attractive pearled product and a high flour: hull ratio. Grain beta glucan is comparable to other commercially available barley varieties and oat products.

Summary data are presented in the following Tables and provided online at <http://barleyworld.org/breeding-genetics/food-feed-forage>. As shown in Table 1, averaged over 28 location/years, Alba had an average yield of 6,611 lbs/acre. This yield was 2% less than that of Strider, 5% greater than that of Maja, 8% greater than Eight-Twelve and 15% greater than that of Charles. Alba has an excellent test weight (52 lbs/bu), which was higher than that of any variety except Maja. In addition to high test weight, Alba has high grain plumpness. It was the plumpest six-row averaged across all trials and it was only 3% less plump than Charles, a two-row. Alba was significantly taller than the other varieties and it was also significantly later (by 3 – 4 days). Although taller and later, Alba is not more prone to lodging than the comparator varieties. Tables 2, 3, and 4 separate the overall data in three types of production conditions: (irrigated; non-irrigated, high rainfall; and non-irrigated, moderate rainfall). In each of the separate environments Alba is among the highest yielding varieties and consistently has high test weight and kernel plumpness. The later maturity and greater plant height for Alba observed in the average data was most obvious in the high rainfall, non-irrigated environment (Corvallis, OR). In this environment, lodging was not a problem. Therefore, Alba has high yield potential in production environments of the Pacific Northwest.

Alba has excellent resistance to scald and barley stripe rust, as shown in Tables 5 and 6. Strider and Orca, who figure in the pedigree of Alba, have remained resistant to the spectrum of barley stripe rust virulence encountered in the Pacific Northwest of the United States since their releases in 1997 and 1998, respectively. Like Strider and Orca, limited stripe rust symptom development is observed on Alba – an average severity of 1% and a high of 2%. This limited symptom development may be indicative of quantitative resistance, which is more likely to be durable than qualitative resistance. Alba has consistently shown the lowest scald ratings of any variety. As in the case of barley stripe rust, some level of scald disease will be observed under intense epidemic conditions. Barley Yellow Dwarf Virus (BYDV) occurrence is episodic and not uniform in trials when it does occur. Therefore, no data on this disease are presented. However, Alba has shown severe localized BYDV symptoms when the disease is present. Therefore, every precaution should be taken to reduce the incidence of BYDV.

Winter hardiness, as measured by percent survival in field and controlled environment tests, is a challenging trait to measure. When differential winter injury has been observed, Alba is similar to other six-row varieties and generally superior to Charles (Tables 7 and 8).

As shown in Table 9, the malting quality profile of Alba does not meet current industry criteria. Although grain plumpness is excellent, when malted using standard protocols the percentage of malt extract is too low, and the percentage of wort beta glucan too high, to interest craft or mainstream brewers. For food purposes, the hull of Alba would need to be removed for most uses – either by pearling or by sieving of stone-ground flour. Alba has normal (non-waxy) starch. Grain Beta glucan was measured in two tests (both at Corvallis, OR in 2011) and the average value for Alba was 4.3%, as compared to 4.2% for Strider. This grain beta glucan level is typical of varieties that have not been specifically bred for higher levels of the trait and is comparable to that observed in commercially available rolled oats. At this level of grain beta glucan, standard serving sizes of whole grain barley foods and breads containing up to 40% barley flour will meet the USDA Health Claim. The only feed quality traits measured were kernel plumpness and test weight, and Alba excels for these traits.

More limited data are available for Alba from Parma, Idaho (irrigated) and on-farm trials in Northwest Washington. At Parma, Idaho in 2011, Alba was compared with Maja, Strider, Sunstar Pride and Charles. Data are available at <http://www.extension.uidaho.edu/swidaho/Newsletters>. Yields were not significantly different, but the average yield of Alba was 8,400 lbs/acre, as compared to 7,344 lbs/acre for Sunstar Pride and 7,584 lbs/acre for Charles. Alba had a test weight of 50 lbs/bu, and significantly better kernel plumpness (87%) than Maja, Sunstar Pride, or Charles. Alba was significantly taller than the other varieties (45 inches) but the lodging percentage was only 2%. Three on-farm trials were conducted in Western Washington (2011 harvest). On ~ 8 acres (Roozen Farm near Mt. Vernon, WA), the yield of Alba was estimated to be 8,000 lbs/acre. Test weight and kernel plumpness were 49 lbs/bu and 96%, respectively. Alba and Strider were grown side by side in ~0.13 acre blocks at the Ebey Road Farm on Whidby Island, WA. The yields of both varieties were estimated at 7,200 lbs/acre. A ~1 acre block of Alba on the Tovelde Farm (near Lynden, WA) yielded 10,300 lbs/acre with a test weight of 49 lbs/bu and a percent plump of 98%. On farm trials of Alba were seeded in the Skagit and Willamette Valleys in fall, 2011.

1,000 F16 head rows of Alba were planted at the Washington State Crop Improvement facilities (Othello, WA) in fall 2011 to produce Breeders’ Seed. Seed for these head rows was obtained from a F15 generation head-row purification block grown at Corvallis, Oregon in 2010-2011. These head rows will be checked for uniformity in the spring of 2012 and rogued as necessary. Assuming purity and uniformity standards are met, the head rows will be harvested in bulk and tagged.

Given the high level of grower interest in Alba, and its success in experiment station and on-farm trials, it is proposed for public release.

Table 1. Agronomic trait data for Alba compared to other commercially available fall-sown varieties (Maja, Strider, Eight-Twelve and Charles) across locations and years (2008 – 2011). Not all traits were measured in all environments. Years and locations are specified in Tables 2, 3, and 4.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variety | Grain Yield (lb/A) | Test Weight (lb/bu) | Grain Plumpness (%) | Plant Height (in) | Heading Date  (Julian days) | Lodging (%) |
| Alba | 6611 | 52 | 89 | 40 | 150 | 11 |
| Maja | 6299 | 52 | 76 | 37 | 146 | 11 |
| Strider | 6758 | 50 | 82 | 37 | 147 | 13 |
| Eight-Twelve | 6087 | 49 | 73 | 37 | 147 | 13 |
| Charles | 5607 | 50 | 92 | 33 | 146 | 19 |
| *No. environments* | *28* | *23* | *23* | *23* | *22* | *19* |
| *LSD ( 0.05)* | *557* | *1.3* | *7.9* | *1.4* | *1.9* | *9.2* |

Table 2. Agronomic trait data for Alba compared to other commercially available fall-sown varieties (Maja, Strider, Eight-Twelve and Charles) from trials grown under irrigation (Hermiston, Oregon; Fort Collins, Colorado; Aberdeen, Filer, Rupert, Burley, and Kimberly, Idaho) for the years 2008 – 2011. Not all traits were measured in all environments.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variety | Grain Yield (lb/A) | Test Weight (lb/bu) | Grain Plumpness (%) | Plant Height (in) | Heading Date  (Julian days) | Lodging (%) |
| Alba | 6947 | 52 | 92 | 37 | 153 | 11 |
| Maja | 6613 | 52 | 85 | 36 | 151 | 8 |
| Strider | 7110 | 50 | 89 | 35 | 151 | 16 |
| Eight-Twelve | 7081 | 51 | 91 | 35 | 151 | 11 |
| Charles | 5906 | 51 | 94 | 33 | 152 | 18 |
| *No. environments* | *19* | *14* | *14* | *14* | *16* | *13* |
| *LSD ( 0.05)* | *635* | *0.9* | *6.4* | *1.7* | *1.4* | *8.5* |

Table 3. Agronomic trait data for Alba compared to other commercially available fall-sown varieties (Maja, Strider, Eight-Twelve and Charles) at a high rainfall location (Corvallis, Oregon) for the years 2009 – 2011.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variety | Grain Yield (lb/A) | Test Weight (lb/bu) | Grain Plumpness (%) | Plant Height (in) | Heading Date  (Julian days) | Lodging (%) |
| Alba | 5718 | 52 | 86 | 51 | 139 | 0 |
| Maja | 5272 | 50 | 52 | 44 | 127 | 0 |
| Strider | 5656 | 47 | 62 | 44 | 130 | 0 |
| Eight-Twelve | 2420 | 39 | 21 | 45 | 127 | 8 |
| Charles | 4197 | 48 | 86 | 39 | 121 | 28 |
| *No. environments* | *4* | *4* | *4* | *4* | *4* | *1* |
| *LSD ( 0.05)* | *1589* | *4.5* | *20.4* | *3.6* | *2.0* | *-* |

Table 4. Agronomic trait data for Alba compared to other commercially available fall-sown varieties (Maja, Strider, Eight-Twelve and Charles) under dryland conditions (Pendleton, Oregon and Pullman, Washington) for the years 2008 – 2011.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variety | Grain Yield (lb/A) | Test Weight (lb/bu) | Grain Plumpness (%) | Plant Height (in) | Heading Date  (Julian days) | Lodging (%) |
| Alba | 6051 | 53 | 82 | 38 | 152 | 14 |
| Maja | 5928 | 52 | 70 | 35 | 149 | 19 |
| Strider | 6302 | 51 | 77 | 37 | 151 | 8 |
| Eight-Twelve | 5446 | 51 | 71 | 35 | 149 | 20 |
| Charles | 5596 | 50 | 91 | 31 | 151 | 19 |
| *No. environments* | *5* | *5* | *5* | *5* | *2* | *5* |
| *LSD ( 0.05)* | *952* | *1.4* | *13.6* | *2.6* | *7.1* | *31.3* |

Table 5. Scald resistance data (0 – 9 scale) for Alba compared to other commercially available fall-sown varieties (Maja, Strider, Eight-twelve, and Charles) at Corvallis, Oregon for the years 2008 – 2011. 0 = no disease observed; 9 = severe lesions, including flag leaf. When the varieties were included in more than one experiment in the same year, data were averaged.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variety | 2008 | 2009 | 2010 | 2011 | **average** |
| Alba | 3 | 1 | 1 | 1 | **2** |
| Maja | 4 | 1 | 7 | 6 | **5** |
| Strider | 3 | 1 | 1 | 1 | **2** |
| Eight-twelve | 6 | 3 | 7 | 4 | **5** |
| Charles | 8 | 4 | 9 | 8 | **7** |

Table 6. Barley stripe rust resistance data (% disease severity) for Alba compared to other commercially available fall-sown varieties (Maja, Strider, Eight-Twelve, and Charles) at Corvallis, Oregon for the years 2008, 2009 and 2011. 2010 data are from Mt. Vernon, WA because there were no trials in which all varieties were included and where barley stripe rust was observed. 0% = no disease; 100% = spores covering all leaf tissue). When the varieties were included in more than one experiment in the same year, data were averaged.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variety | 2008 | 2009 | 2010 | 2011 | **average** |
| Alba | 2 | 0 | 0 | 0 | **1** |
| Maja | 7 | 3 | 0 | 0 | **3** |
| Strider | 0 | 0 | 0 | 0 | **0** |
| Eight-twelve | 22 | 82 | 97 | 97 | **75** |
| Charles | 3 | 22 | 63 | 0 | **22** |

Table 7. Low temperature tolerance data (% survival) for Alba compared to other commercially available fall-sown varieties (Maja, Strider, Eight-Twelve, and Charles) in trials conducted under the auspices of the Barley Coordinated Agricultural Trial (Barley CAP). MRIH = Martonvasar Research Institute, Hungary (a controlled environment freeze test). The remaining data are from field trials. Charles was not included in the CAP I trials.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variety | MRIH 2006 | Fort Collins, CO  2005-06 | Pendleton, OR  2006-07 | St. Paul, MN  2010 | **average** |
| Alba | 83 | 93 | 66 | 78 | **80** |
| Maja | 78 | 80 | 66 | 83 | **77** |
| Strider | 58 | 70 | 56 | 81 | **66** |
| Eight-twelve | 82 | 80 | 66 | 76 | **76** |
| Charles | - | - | - | 61 | **61** |

Table 8. Low temperature tolerance data (% survival) for Alba compared to other commercially available fall-sown varieties (Maja, Strider, Eight-Twelve, and Charles) in field trials from Pacific Northwest locations where differential winter survival was observed (2008-2011).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variety | Aberdeen,  ID  2008 | Pullman,  WA  2008 | Pullman,  WA  2009 | Pendleton,  OR  2010 | Hermiston,  OR  2010 | Fort Collins,  CO  2011 | Bozeman,  MT  2011 | **average** |
| Alba | 93 | 93 | 91 | 12 | 89 | 96 | 57 | **79** |
| Maja | 90 | 95 | 93 | 69 | 100 | 63 | 33 | **85** |
| Strider | 80 | 95 | 90 | 16 | 100 | 84 | 34 | **78** |
| Eight-twelve | 97 | 93 | 95 | 30 | 100 | 71 | 23 | **81** |
| Charles | 83 | 90 | 83 | 9 | 93 | 38 | 30 | **66** |

Table 9. Malting quality of Alba compared to Maja and Charles. High rainfall location: Corvallis, Oregon for the years 2009, 2010, and 2011. Irrigated locations: Hermiston, Oregon for the years 2010 and 2011 and Aberdeen, Idaho for the years 2009 and 2010. Dryland location: Pendleton, Oregon for the years 2009 and 2011and Pullman, Washington for the year 2009. Data courtesy of the USDA/ARS Cereal Crops Research Unit.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Line | Year | Region | Malt  Extract  (%) | Barley  Protein  (%) | Wort  Protein  (%) | S/T  (%) | DP  (°ASBC) | Alpha-  amylase  (20°DU) | Beta- glucan (ppm) |
|  |  |  |  |  |  |  |  |  |  |
| Alba | 2009-11  2010-11  2009, 2011 | High rainfall  Irrigated  Dryland  **Overall** | 78.9  79.0  76.8  **78.3** | 9.8  10.2  11.7  **10.5** | 3.8  3.4  3.5  **3.6** | 42.4  35.5  31.6  **36.4** | 86.8  86.4  102.8  **91.4** | 53.5  38.7  39.4  **43.3** | 485 476 435  **466** |
|  |  |  |  |  |  |  |  |  |  |
| Maja | 2009-11  2010-11  2009, 2011 | High rainfall  Irrigated  Dryland  **Overall** | 79.3  80.4  78.6  **79.6** | 10.2  10.4  12.0  **10.7** | 4.2  3.9  4.2  **4.0** | 43.7  39.4  37.9  **40.4** | 126.5  117.5  144.3  **127.2** | 56.0  45.3  49.5  **49.9** | 119 105 97 **108** |
|  |  |  |  |  |  |  |  |  |  |
| Charles | 2009-11  2010-11  2009, 2011 | High rainfall  Irrigated  Dryland  **Overall** | 81.1  82.7  81.6  **81.9** | 11.1  10.7  11.9  **11.1** | 5.0  4.8  4.8  **4.9** | 50.2  47.4  43.6  **47.4** | 125.2  117.3  134.0  **124.1** | 81.3  80.3  85.6  **81.9** | 273 100 114  **161** |