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**NOTICE OF RELEASE OF AROMA HOP CULTIVAR, USDA 'TRIUMPH'**

The Agricultural Research Service (ARS) announces the release of USDA 'Triumph', a new high-yielding aroma hop (*Humulus lupulus* L.) cultivar. The defining characteristics of USDA Triumph are its high yield potential in Pacific Northwest USA hop producing regions, excellent brewing characteristics, and relative tolerance to common hop plant diseases and insects. It is expected that brewers will utilize this cultivar as an aroma hop in either lager or pilsner-style beers as well as pale ale brews. Current cultivars used in these styles include 'Willamette', 'Saazer', 'Hallertau' and 'Tettnang'.

USDA Triumph was obtained from a cross made in 2000 between USDA 'Nugget' and USDA '21110M'. USDA Nugget originated from a cross made in 1970 between USDA '65009' and USDA '63015M' and was released in 1983. USDA 21110M originated from a cross made in 1970 between 'Bullion' and USDA '64035M'. As such the pedigree for USDA Triumph is Early Green/OP//Brewers Gold///Brewers Gold//East Kent Golding/OP////Bullion//Halletauer Mittelfruh/OP. It is a diploid ( $2n=2X=20$ ) perennial female line developed for production on normal trellis (approximately 6-m).

USDA Triumph was first grown in 2001 at the USDA-ARS hop research facility near Corvallis, OR as experimental line no. 2000009-033. It was evaluated for 4 years as a single-hill experimental line with yield and hop chemistry taken during 2003-2004. USDA Triumph was subsequently expanded to 5-hill plots at the USDA-ARS hop research facility and evaluated for an additional three years (2007-2009). The selection exhibited high yields and favorable sensory and chemistry evaluations in these tests, which warranted further evaluation.

The line was expanded into 45-hill plots near Hubbard, OR during 2011 and yield, disease and insect observations and hop chemistry analyses were conducted from 2012 to 2016. Single-hop pilot-brewing tests were also performed by OSU Fermentation Science Department during 2012 and compared to seven other experimental hop accessions. The resulting single-hopped lager-style beer received extremely favorable scores across multiple audiences and significant interest in future public release was expressed. As a result, additional 30-hill plots were established near Toppenish, WA during 2015 and a third 30+ hill plot established near Wilder, ID in 2016. Finally, a commercial scale 0.73-hectare plot was established in 2016 with the first harvest in 2017.

This cultivar produces medium sized compact cones that mature early: August 24th to September 3rd in Oregon and the first week of September in Washington and Idaho. Observations on large

scale commercial field plots suggest picking during the third week of August in OR for optimum aroma characteristics. USDA Triumph had estimated average yields of 2064 Kg ha<sup>-1</sup> in single hill plots near Corvallis, OR. It yielded slightly less in the 5-hill plot at the same location with an average estimated yield of 2075 kg ha<sup>-1</sup> (+/- 195 kg ha<sup>-1</sup>). USDA Triumph out-performed the industry standard for aroma cultivars, USDA 'Willamette', in both multi-hill and commercial scale plots in Oregon. Estimated yields in 32-hill plots near Hubbard, OR averaged 2988 kg ha<sup>-1</sup> (+/- 586.8 kg ha<sup>-1</sup>) from 2012 to 2016 while Willamette yield estimates averaged 1979 Kg ha<sup>-1</sup> (+/- 186 kg ha<sup>-1</sup>) during the same time-frame. Initial yields in both ID and WA were qualitatively evaluated by growers as being similar to USDA 'Nugget' although actual harvest yields per plot were not obtained during 2016 (WA) and 2017 (WA & ID) and only sufficient quantities for chemistry were picked. Finally, the two years of commercial scale testing of USDA Triumph on the 0.73 ha plot near Keizer, OR produced an average of 2802 kg ha<sup>-1</sup> of pelleted hop.

Chemical analyses of USDA Triumph cones indicate its primary use as an aroma hop with slightly higher than normal bittering capabilities. Alpha acids for most aroma-style cultivars used in pilsners and lagers range from 3.5% (v/v) for Hallertau to 4-6% (v/v) for 'Willamette'. Alpha acids averaged 10.6% (v/v) in single-hill and 11.44%(v/v) in 5-hill plots at the USDA hop research farm (Corvallis, OR), while producing 11.2% (v/v) in 32-hill and larger commercial plots in OR and 10.0% in 30-hill plots in WA. Beta acid content is comparable to other aroma-style cultivars averaging 3.34% (v/v) and 3.95% (v/v) on single-hill and 5-hill plots respectively (Corvallis, OR). USDA Triumph produced on average 3.84% beta-acids (v/v) in 32-hill plots in Oregon (Woodburn, OR), while in Washington it produced 3.8% (v/v). Triumph has moderately good storage capabilities with a hop storage index (HSI) of 0.26 across all locations and years. Cohumulone levels for this cultivar are relatively low, as compared with USDA Willamette, with levels ranging from 22 to 26% (v/v) with an average of 23.6% in 32-hill plots and larger commercial plot.

The essential oil levels present in USDA Triumph are comparable with other noble-style hops ('Willamette' and 'Hallertau') with an average concentration for both Oregon and Washington of 1.07 to 1.15 mL 100g<sup>-1</sup>. Myrcene makes up the majority of the essential oils in USDA Triumph with an average of 25 to 40% (v/v) across both OR and WA with lower levels observed in OR. In OR, levels of humulene are equivalent to levels of myrcene with average values ranging from 28 to 33.6% (v/v). In comparison to USDA Willamette, levels of the less desirable flavoring compound, beta-caryophyllene are lower at 8.6 – 9.5% (v/v) as compared to 11.6%. This results in a higher ratio of humulene to beta-caryophyllene in USDA Triumph that ranges from 3.2 to 3.57 as compared to USDA Willamette at 2.76. USDA Triumph also has high levels of the floral-like terpenoid, linalool, with levels regularly exceeding 1% (v/v) of the total essential oils. The floral, rose, citrus flavor of citronellol is present at levels that regularly exceed 1.5%. Minimal levels of the spice-like terpenoid, farnesene, were observed with levels less than 0.2% (v/v), while slightly higher than normal levels of the citrus-like terpenoid, limonene, were detected [0.34 – 0.9% (v/v)]. Additional aroma descriptors for USDA Triumph include apricot-stone fruit coupled with bubblegum aromas creating a definitively unique combination for brewing.

Infections of downy mildew [caused by *Pseudoperonospora humuli* (Miyabe. & Takah.) G.W.

Wilson] have been observed in Triumph in multi-hill nursery trials in Oregon. The resistance level to this disease is similar to its maternal parent, USDA Nugget, and is classified as moderately susceptible (scoring an average of 3 on a scale of 1 – 5 with 1 = resistant and 5 = susceptible). Under normal growing conditions in the Pacific Northwest USA, early downy mildew infections are easily controlled with fungicides registered in the United States for use on hop. In regions with warm, moist or rainy summer weather, growers are advised to continue control measures as needed.

Field-based observations show Triumph as “resistant” to non-v6 strains of powdery mildew [caused by *Podosphaera macularis* Braun & Tak. formerly *Sphaerotheca macularis* Braun & Tak.] but moderately susceptible to v6 races found in the Pacific Northwest USA. Field-based observations in plots with limited prophylactic control measures taken showed some signs of cone infection. Field-based observations of commercial nurseries practicing normal fungicidal applications indicated no serious infections of this disease and no yield loss due to infection. As a result, regular prophylactic spraying for this disease is recommended. No cases of Verticillium wilt (caused by *Verticillium albo-atrum*) were observed in nursery plots. Growers are cautioned against growing Triumph in known verticillium-infested fields due to the potential susceptibility of this cultivar based upon its parentage. No information is available on Triumph's susceptibility to hop aphids (*Phorodon humuli* Schank) although growers are cautioned to perform prophylactic sprays for this pest. Finally, field observations of spider mites (*Tetranychus urticae* Koch) in 2017 on untreated 45-hill plots in OR suggests a possible preference of this pest for this line. Again, growers are cautioned to utilize prophylactic sprays for this pest.

The release of Triumph provides a new aroma hop exhibiting high yields, good picking tendencies and excellent brewing quality coupled with adequate disease and pest resistance under normal production practices. Genetic material of this release has been deposited in the National Clean Plant Network and is available for purchase ([http://nationalcleanplantnetwork.org/HOPS\\_CPN/](http://nationalcleanplantnetwork.org/HOPS_CPN/)). In addition, this line has been deposited with the National Germplasm System at the USDA ARS National Clonal Germplasm Repository in Corvallis, OR as PI689549. This material will be available for research purposes including use as a parent to develop and commercialize new cultivars. It is requested that appropriate recognition be given if this germplasm contributes to the development of a new breeding line or cultivar.

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Signature:



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