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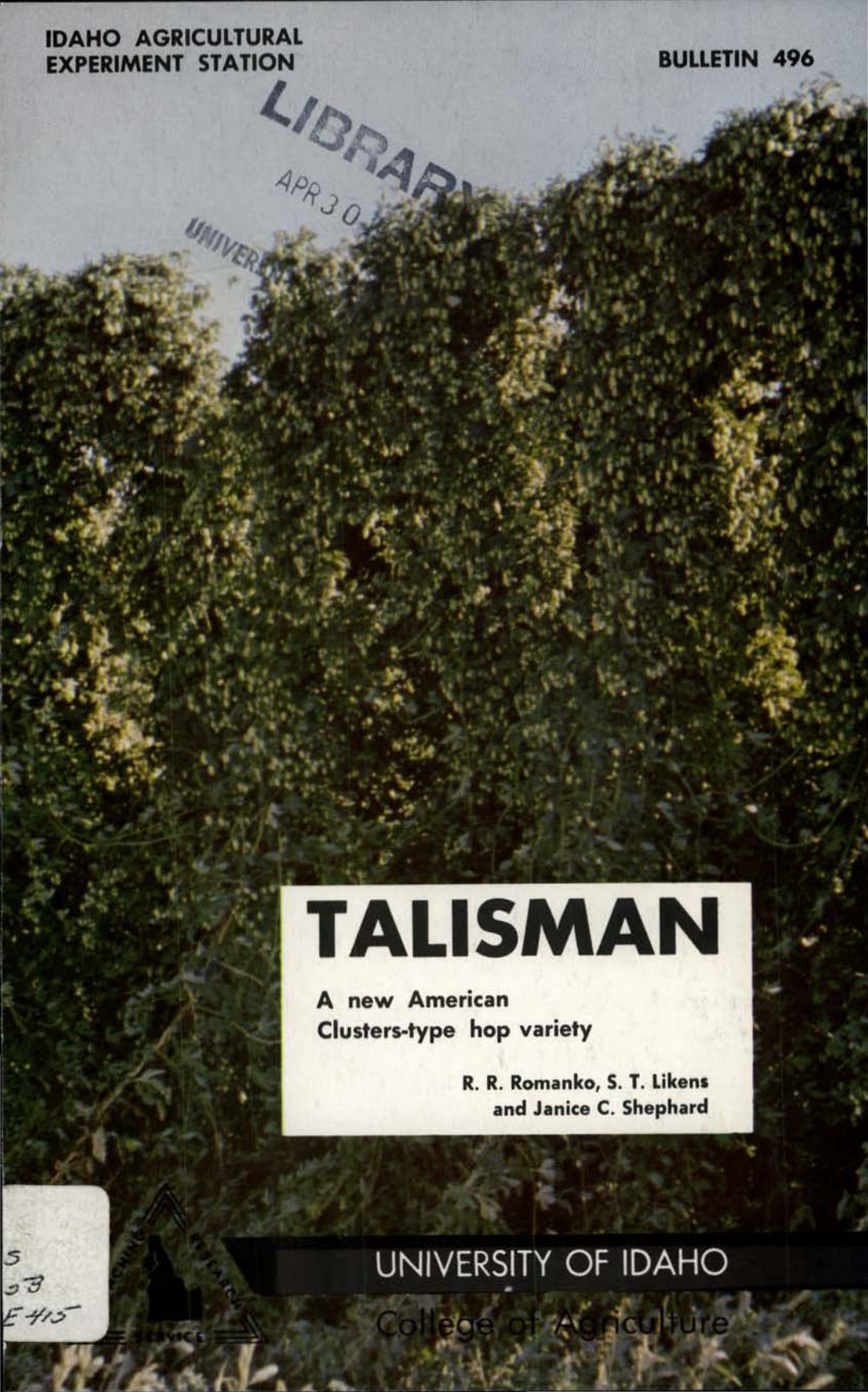

TALISMAN

A new American Clusters-type hop variety

R. R. Romanko, S. T. Likens
and Janice C. Shephard

UNIVERSITY OF IDAHO
College of Agriculture

Cover photo

Mature Talisman grown in commercial hopyard in Notus area as they appeared at harvest Sept. 18, 1965. The strong "head" formation results in a continuous web of bine growth on the wire. The crop shown here averaged 13 bales per acre.

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Contents

Summary

Talisman is a vigorous-growing, late-maturing hop variety obtained from a cross between Late Clusters and a male of unknown origin. It appears to be superior to Late Clusters in yield potential and in resistance to crown rot and hill die-out caused by downy mildew. This resistance is not the near-immune type as in Fuggles, however. Talisman is susceptible to mosaic-like virus diseases but appears to be as tolerant of them as are Early and Late Clusters.

In brewing value, Talisman is closer to the Wye varieties than to Clusters. It has a distinct, clean aroma, sometimes suggestive of European aroma. Storage qualities are similar to those of the Clusters varieties.

Results of brewing trials suggest that seedless Talisman should be accepted as readily as seedless Early or Late Clusters in both domestic and foreign markets. Because of its high brewing value, however, it may become more useful as a bittering hop or as a source of hop extract.

The authors

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Introduction

In the U. S., hop production is concentrated in 3 arid areas and 1 semihumid zone. In the semihumid zone — the Willamette Valley and Western Washington — Fuggles, Bullion Hop and Brewer's Gold are the main varieties, with some acreage of Hallertauer, Late Clusters and possibly some Goldings. Except for Late Clusters, these are introductions from England and Germany. Only hops of the Clusters varieties seem adapted to and are grown in the drier areas. Although they are variously referred to in the trade as Sonomas, Sacramentos, California Clusters, Yakimas or Idahos, only two varieties are actually involved: Early Clusters and Late Clusters (2). Late Clusters, while of uncertain origin, has been a standard variety since before the turn of the century. Early Clusters, which originated about 1908, is believed to have been derived as a mutation of the Late (1, 2). Early Clusters came into general production in Oregon in the early 1930's but proved to be so susceptible to hop downy mildew that it is now grown only in Yakima, Eastern Oregon and in Idaho where it comprises about one-half of the Clusters acreage.

The Clusters and the so-called English or Wye varieties, Bullion Hop and Brewer's Gold, form a group characterized by high alpha acid content, high cohumulone ratio and a distinctive "domestic" or "North American" aroma. These qualities in the Wye varieties are considered an inheritance from their female parent which originated in Manitoba (4). Despite these common traits, the Wye and Clusters varieties differ significantly. The former are not considered to be well adapted to hot, dry climates and their production therefore has been restricted to the Willamette Valley. They are usually higher in brewing value, much richer in essential oils and are probably used as kettle hops or almost exclusively for ale production. They are grown seeded and are stable in storage only at subzero temperatures. The Clusters varieties, on the other hand, are not as rich in brewing value as Bullion Hop or Brewer's Gold, but are significantly richer than Fuggles, Goldings and continental varieties. They are usually

grown seedless, are well adapted to a dry climate, have excellent storage qualities and are therefore equally useful for export or domestic markets. Both Late and Early Clusters are prone to crown die-out following attacks of hop downy mildew.

Hops of the Clusters or American type are sometimes discriminated against because some brewers consider their flavor harsh and aroma pungent. However, the annual production of Clusters (approximately 90 per cent of the U. S. hop crop) is probably greater than that of any other single type and is still increasing. The new variety Talisman is apparently a Clusters type hop.

Pedigree

Talisman is a seedling obtained from a Late Clusters female parent open-pollinated by a male plant of unknown origin. Since male plants are rogued in areas of seedless hop production but continually reappear, presumably through sexual reversion, it is possible that the male parent was a Late Clusters and that the Talisman is, in essence, a genetic F_2. In the spring of 1959, seed from this source was germinated and exposed to zoospore suspensions of *Pseudoperonospora humuli* (Miy. and Tak.) G. W. Wils. After 12 months, only 23 of 1,190 original seedlings remained (3). From one of these, the clone University of Idaho 0-11, now Talisman, was obtained.

Description

In the Boise Valley of Idaho, Talisman has been a thrifty plant with a characteristically strong *head* formation (cover). It is late emerging from the soil in the spring, grows rapidly and is a tenacious climber. Bloom occurs 7-10 days later and harvest maturity about 7 days later than Late Clusters.

The foliage is a brighter green than Late Clusters and the undersides of the leaves are paler with less yellow background color. Leaf size tends to be larger and the blade is flat compared with the cupped blade of Clusters. Lobe clefts are deeper than in Late Clusters. Length of the leaf blade is usually more than one-half the blade width; width of apical lobe is usually between two-thirds and three-fourths the apical lobe length. In these ratios, taken from leaves on the main bine of 3-year-old plants, Talisman is distinct from all established hop varieties known to the authors.

The bine of the Talisman is not unlike the bine of the Late but is larger in diameter, has longer, more uniformly developed laterals and is generally a lighter green color. Direct sunlight on the bine produces a suberized layer which is a light reddish brown compared to the grey-brown bark of the Clusters. "Growing-off" is notably reduced in Talisman yards. Even the laterals exhibit a marked climbing propensity, frequently attaching to and climbing other laterals.

Fig. 1. Arms or laterals of first year Early and Late Clusters (left and center) and first year Talisman (right). Variation of cone type in Late Clusters is common. Cones on all 3 laterals are approximately ripe.

Mature cones are a uniform pale green color with less prominent stripes than produced in seedless Clusters by the dark green tips of bracts (Fig. 1). In mature plants, the strong foliation of the head results in a high proportion of pale, bleached-appearing, fluffy cones. Bracts have everted tips, the strig appears stout and condensed and lupulin is lemon yellow, usually paler than in Clusters. The oil content is such that hand rubbing mature cones results in an oily or buttery feel comparable with Brewer's Gold. Cones are highly aromatic and the aroma, while unique, is distinctly hoppy in character.

Talisman essential oil has unique features which are readily recognizable under conditions of standardized gas chromatography. Talisman oil is similar to Late Clusters in its proportions of methyl decanoate, undecanone-2, methyl dec-4-enoate, and methyl dec-4, 8-dienoate. The low content of humulene is an identifying characteristic of Talisman, especially when considered in conjunction with the distinct methyl geranate peak and the high concentrations of the hydrocarbon peaks 40 and 40a. The chromatogram of Talisman oil should serve as a permanent "finger print" for genetic identity (Fig. 2).

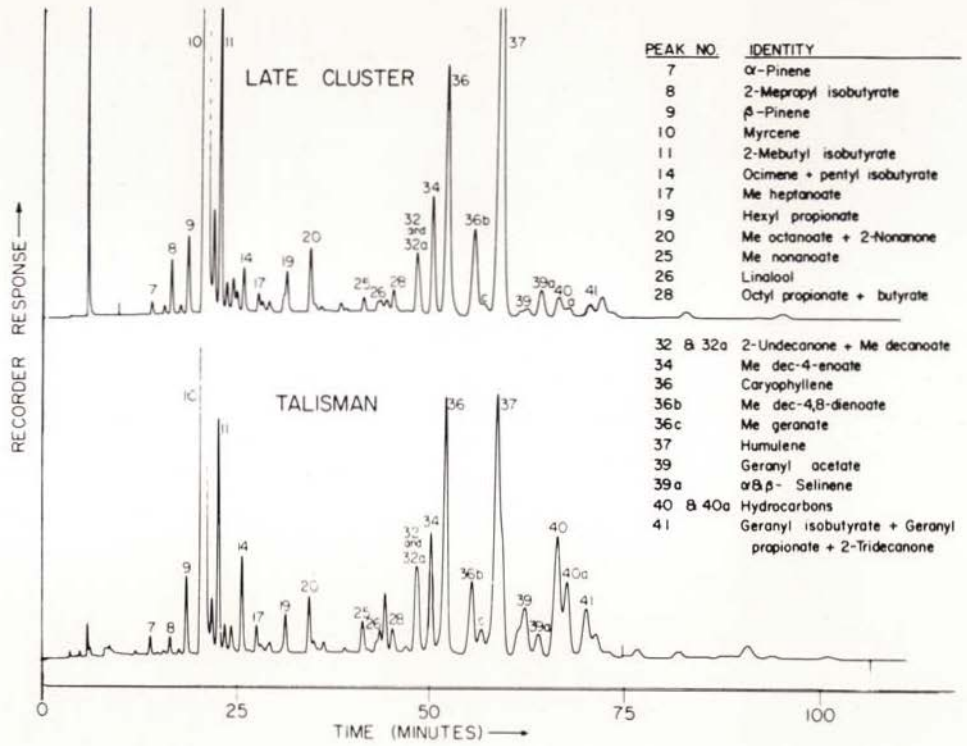

Fig. 2. Comparison of gas chromatograms of essential oils of Late Clusters and Talisman. Characteristics of the chromatogram serve as an identifying feature of the variety. (Chromatographic conditions. Column: ⅛ in. x 25 ft. Packing: 10% Carbowax 20-M on 60-80 mesh Chromasorb P. Temperature: programmed at 2°/min. from 80°C to 180°C. Carrier gas: helium. Sample size: 1 microliter.)

Disease reaction

Downy mildew

Talisman has displayed varying degrees of resistance to hop downy mildew. Under field conditions, cones and top growth appear to be no more resistant than Late Clusters. Crown infection appears to be governed by a threshold effect. Even with heavy basal shoot infection, crowns may remain free of infection or show only traces of peripheral invasion by the fungus. However, once the crown proper is invaded, destruction may be complete. In one field plot in which all mildew control practices were deliberately withheld during an epiphytotic of mildew, 74 percent of 275 Late Clusters had infected basal shoots, compared to 46 percent of 115 Talismans. In the following spring 55 percent of the crowns were infected or dead in the Late Clusters, compared with 9 percent of the Talisman. In 1963, 1 and 5 percent cone infection developed in Late Clusters and Talisman, respectively, at harvest. At another location in 1964, 1.1 and 0.2 percent cone infection developed in Late Clusters and Talisman, respectively.

Virus diseases

Mosaic and the latent virus in Late Clusters seem readily transmitted to Talisman in the field when the two varieties are grown side by side. The latter produces a leaf mottle pattern in Talisman. Symptoms gradually become masked and there is no apparent reduction in yield except in new plants obtained from diseased clones. Symptoms apparently do not develop until the growing season following transmission.

Verticillium wilt

This disease is not known to occur in hops in Idaho. Limited tests with potato-infecting strains of *Verticillium albo-atrum* have not produced the disease in Talisman, Early Clusters or Fuggles when tested together.

Secondary root rotting soil organisms

Although no formal tests were made, the crowns, roots and rhizomes of Talisman appear to be more resistant to secondary invasion by soil fungi than either Late or Early Clusters. This was observed in hills previously attacked either by downy mildew or by the strawberry root weevil.

Yielding ability

From 1962 through 1965, yield data were taken on Talisman plots in commercial yards, harvested and dried with commercial equipment. First year or baby yard production has ranged from 400 to 2260 pounds per acre and averaged 1390 pounds or nearly 7 bales per acre. Production of mature hops in 5 locations has averaged 2360 pounds per acre (Table 1). Where valid comparisons with Late Clusters were possible, Talisman consistently outyielded Late Clusters by 1 to 2 bales.

Table 1. Net yield of dried hops and leaf and stem content of mature Talisman grown and harvested under commercial conditions at five Idaho locations.

Cooperator	Acreage	Lb. per acre 1963	1964	1965	Avg	% leaf and stem[a] 1963	1964	1965
Obendorf Farms	0.1	2550	2070	2960	2527	1.2	0.7	—
Wilder Farms	0.1	2550	1840	2190	2177	0.5	0.7	—
Top Farms	10	—	1540[b]	3160	2350	—	0.5	0.9
Enrose Farms	18	—	—	2590	2590	—	—	0.5
Sun Valley Farms	22	—	—	2160	2160	—	—	0.9
Averages		2550	1817	2612	2361			

[a]Idaho State-Federal hop inspection.
[b]Trellis downed by storm 6 weeks prior to harvest.

Maturity

Optimum maturity or ripeness of hops may be defined as that stage at which dry weight is maximized, picking loss and drying time are minimized and the resulting cured hops have a bright, silky appearance, bright lupulin and an appropriate aroma. Although date of harvest is based on physical qualities of the ripening cone, it coincides fairly closely with maximum content of alpha acids. Oil content increases throughout harvest and for some time after harvest is normally completed.

The most favorable period for harvesting Late Clusters in Idaho is usually considered to be September 5 to 15. After these dates, cones discolor rapidly and the aroma of green hops becomes harsh and pungent. The most favorable period for Talisman quality begins about September 12 and continues past the normal termination date for harvesting Late Clusters without deterioration of color or aroma.

A maturation study in 1962 (Table 2) shows that content of alpha acid and dry matter accumulated at approximately the same rate during September but oil accrued at a higher rate. These results suggest that Talisman can be picked before it is mature with some sacrifice of production and oil content but no reduction in the ratio of brewing value to weight. If high oil is

Table 2. Maturation characteristics of third production year Talisman in 1962.

Category	Sampling dates[a] 8/27	8/29	9/5	9/10	9/12	9/19	9/24	9/26	10/1
Dry matter (percent)	17.4	18.3	19.3	20.3	20.4	21.7	23.2	23.5	23.3
Oil content (ml/100 g)	0.58	0.83	1.12	1.40	1.61	1.74	1.91	2.07	2.22
Alpha acid (percent)	8.0	8.6	8.2	8.3	8.2	8.2	8.0	8.1	8.5

[a]Data for August 29 through September 26 represent 3 sampling date moving averages.

desired, as for certain ales, harvest should be delayed as late as possible. Maximum dry cone weight, 125 mg per cone, was reached on September 12 in 1962. In 1965, the maximum dry cone weight of 181 mg was reached on September 9 where a 7 x 7 foot spacing was used. In a block with 8 x 8 foot spacing, the dry weight of cones was 203 mg on September 1 and the peak was 219 mg per cone on September 14. From the standpoint of brewing value and total production, the maturity of Talisman does not differ significantly from Late Clusters. However, because of the physical softness of the cones and its relation to probable machine picking efficiency there is probably a 5- to 7-day difference between the optimum harvest dates of Late Clusters and Talisman.

Picking and drying qualities

Table 1 indicates that low leaf and stem in Talisman should be the rule rather than the exception. Talismans are considerably softer and fluffier than Clusters, particularly in the shaded tops of mature bines. But cleaning equipment in the modern picking machines can be adjusted so loss is not excessive if the bines are "fed" slowly. On mature Talismans, the long upper laterals tend to hang below the plucking banks of upright pickers. Cutting the bines higher might compensate for this. However, factory-built pickers seem inadequate to handle mature Talismans at the usual rate of 14-16 bines per minute without considerable waste. Despite the abundant top growth, zero leaf and stem "picks" should be common with mature Talismans. One percent leaf and stem "picks" should prevail with baby crops. There is no indication of abnormal shattering.

Kiln drying time appears to be comparable to Late Clusters harvested on the same date. Due to the plumper strig of Talisman, however, drying may require more time.

Analyses of brewing constituents

Talisman has been evaluated for brewing content since 1962 (Table 3). Alpha acid based on 8 percent moisture has ranged from 7.4 to 10.1 percent, averaging 8.8. Percent beta acid has ranged from 3.9 to 4.7, averaging 4.3. This firmly indicates that Talisman is a rich hop, approaching Bullion Hop and Brewer's Gold in brewing value. The amount of beta acid is somewhat less than in Clusters but this is more than compensated for by the higher content of alpha acid and the slightly higher cohumulone ratio. For 3 crop years, Talisman has averaged 1.15, 1.23 and 1.47 ml of oil per 100 g of dried hops, indicating that in this respect Talisman is intermediate to the Clusters and Wye varieties.

With the current interest in hops of high brewing value and the trend toward increasing use of hop concentrate, a hop with these properties could be of considerable future value to the U. S. hop industry.

Table 3. Alpha acid, computed at 8 percent moisture, and oil fraction in bale samples of newly harvested Talisman hops.

Cooperator	% alpha acid[a]					ml oil/100 g hops[b]			
	1962	1963	1964	1965	Avg	1962	1963	1964	1965
Obendorf Farms	9.3	8.0	9.6	8.8	8.9	1.23	1.37	1.45	—
Wilder Farms	9.7	8.3	8.5	8.0	8.6	1.71	1.19	1.30	—
Top Farms	—	8.1	10.1	9.6	9.3	—	1.14	1.01	2.38
Enrose Farms	—	—	7.4	9.2	8.3	—	—	0.82	—
Sun Valley Farms	—	—	9.4	7.5	8.5	—	—	1.09	1.84
Averages	9.5	8.1	9.0	8.6	8.7				

[a]Range of main alpha acid constituents found through 1965 crop: cohumulone, 68.1 — 43%; adhumulone, 14.0 — 8.3%; humulone, 43 — 21.9%.

[b]Range of main oil constituents found through 1965 crop: myrcene, 73.2 — 63%; undecanone-2, 2.2 — 1.8%; caryophyllene, 3.1 — 2.2%; humulene, 5.0 — 4.4%; others, 29.0 — 12.9%.

Storage qualities

Since over 20 million pounds of hops produced in the U.S. are exported annually, the suitability of a new variety for the export trade may depend on its keeping qualities. Comparisons of Talisman and Late Clusters in cold (36-40°F) and common storage indicate similar keeping qualities. Although brewing value deteriorates at a slightly higher rate in Talisman, the differences in cold storage do not appear to be significant. Table 4 shows the results of a storage test of 1963-crop Talisman and Late Clusters grown in adjacent plots. The bales of Late Clusters by chance were exceptionally rich in brewing value for this variety, so the four samples were very comparable at the beginning of the test.

Table 4. Deterioration of alpha and beta acids in 1963-crop Talisman and Late Clusters in common and cold storage.[a]

Months post harvest	Talisman				Late Clusters			
	Common storage		Cold storage		Common storage		Cold storage	
	alpha	beta	alpha	beta	alpha	beta	alpha	beta
1	8.9	4.7	8.9	4.7	9.1	5.9	8.8	5.9
3	9.5	4.3	9.2	4.8	9.0	6.1	9.2	6.3
6	8.9	4.5	9.4	4.8	8.2	5.6	9.0	6.4
9	7.6	3.9	8.6	4.4	8.5	5.6	8.3	5.7
12	5.8	2.5	8.6	4.4	6.5	4.1	8.5	6.0
17	4.4	1.7	7.9	3.9	5.7	3.6	8.1	5.1
25	—	—	4.5	1.6	—	—	5.7	3.6
Percent loss after								
17 months	51	63	11	13	37	39	10	14
25 months[b]	—	—	49	66	—	—	35	39

[a]Chemical analysis by method of Alderton et al., using benzene as the extracting solvent. Alderton, G., et al. 1954. Anal. Chem. 26:983.

[b]Losses between 17 and 25 months were accelerated by a breakdown in refrigeration during summer months.

Fig. 3. Sample plugs of Talisman, left, and Late Clusters, right. Although similar, the cut reveals a thicker cone with a heavier concentration of lupulin centered around the core in the Talisman sample.

From the standpoint of physical condition — color, silkiness and aroma — the Talisman may age more slowly than the Late Clusters in cold storage.

Brewing trials

The factor of overriding importance in establishing a new hop variety is acceptance by the brewing trade.

Since 1962, bale samples of Talisman have been given extensive trials by domestic and foreign brewers. Cooperating brewers ranged from those who use only domestic hops to those who import the bulk of their hops. Foreign brewers were included because of the importance of the export trade.

The results of these trials indicate that Talisman is commercially suitable. More than half of the cooperating brewers either gave favorable reports or indicated that no undesirable or adverse traits were found.

Of 10 domestic brewers who participated in the trials, 6 indicated favorable results. Three of these repeated their trials a second year with continued favorable results. In one case, a flavor difference but no flavor preference was found. Since some trials compared Talisman hops alone with the brewer's usual blend of hops from 2 or 3 sources, the favorable results were particularly meaningful. One domestic brewer indicated that Talisman was unacceptable for brewing and three did not report results. Of the 7 foreign brewers who conducted trials, 4 reported favorable results, 1 indicated indifferent results and 2 failed to respond.

Some of the cooperating brewers indicated favorable aroma characteristics with Talisman. Several indicated that a lower hopping ratio was used, or was needed. Only 1 of the 17 cooperating brewers reported that Talisman was unacceptable, possibly because of undesirable flavor imparted by excessive isocohumulone.

Representatives of two large hop-buying firms have indicated privately that, on the basis of common price and acceptable quality, there should be no market preference for Idaho-grown Clusters over Talisman.

Acknowledgments

Evaluation of an experimental hop variety is a complex task requiring resources far exceeding those available to the authors and the Idaho Agricultural Experiment Station.

We thank all the brewers and their representatives who made their skills, facilities and judgments available.

Thanks also to S. S. Stiener, Inc., and to John I. Haas, Inc., for their role in evaluation and liaison in preparing brewing trials.

Last but not least, special thanks to the members of the Idaho Hop Growers Commission and the Idaho Hop Growers Association for supplying time, resources and encouragement to this program.

The following brewers participated in the brewing trials with Talisman hops from 1962 to 1964:

Domestic Brewers: Adolph Coors Co.; Anheuser-Busch, Inc.; Erie Brewing Co.; Falstaff Brewing Corp.; Jos Schlitz Brewing Co.; Lone Star Brewing Co.; Sick's Ranier Brewing Co.; Sterling Brewers, Inc.; Stroh Brewery Co.; Theo. Hamm Brewing Co.

Foreign Brewers: Anonymous, Europe; Castle Brewery, Union of South Africa; Cerveceria Cuauhtemoc, Mexico; Henniger-Brau, West Germany; John Labatt Ltd., Canada; Molson's Breweries Ltd., Canada; Molson's Capilano Brewery, Canada.

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