

A Hop Farmer and an Alpha Acid Theory

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As *terrior's* presence and effects on all crops becomes more well known and understood, so too does the need to answer a question I've had for the past few years; why do Colorado hops produce such high alpha acids (AA)?

After three successful harvests at Billy Goat Hop Farm and lots of conversations with other hop farmers in the state who have been growing for much longer than I, a pattern of consistently higher AA from hops grown in Colorado compared to other growing regions or the industry average has emerged. This year's crop in particular contains extra high AA. I began to dig into why this might be. Unsurprisingly, I couldn't find a clear answer, in fact some studies contradict each other. So, what is presented here is my personal opinion along with data and information that was found to be unanimously agreed upon.

What is an alpha acid?

AA's are chemical compounds found in the resin of the lupulin glands (the golden/yellow stuff on the inside of a hop cone). Alpha acids are widely thought of as a general indicator of plant health and quality. AA's are the main contributor to the bitterness in beer, they also contain anti-bacterial and microbial properties, which were more important prior to pasteurization for the longevity of beer not to spoil.

Throughout my research, I found three main environmental factors that could positively or negatively influence AA production; air temperature, precipitation, and sunlight duration. (Humidity was tested in various studies but found to be negligent.)

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So first we'll look at the air temperature in July and rainfall in May through June. Multiple studies found that higher accumulated average daily temperatures during the vegetative period have a negative effect on AA content, while a higher total rainfall during that same period has a positive effect. Montrose Colorado, where Billy Goat Hop Farm is located, has a historically higher average temperature of 1-degree Fahrenheit from May to August than Yakima Valley, Washington, which leads the world in hop production volume. One degree difference is not significant in my opinion.

However, Montrose typically receives just over a half an inch of precipitation more per month than Yakima Valley during the vegetative period. Two more inches of rain over the course of the four vigorous growing months could be significant and could possibly explain the higher AA levels. But as with most things involving hops, nothing is that straight forward or easy. For example, this year was exceptionally hot and dry, with significantly less precipitation and higher average temperatures, and yet produced the highest AA levels that the valley has seen in years. This completely contradicts what studies have shown.

Colorado Climate and Alpha Acids

The Centennial state offers unique environmental factors that contribute to the alpha acid production in hops, mainly altitude— Billy Goat Hop Farm is located at 6,200 feet, which is close to a mile higher than Yakima valley, and also there is a relentless wind that I am unfortunately reminded of every spring after a calm winter.

Both of these factors increase photosynthesis, the process of plants creating sugar/food from carbon dioxide and water. High photosynthetic rates are usually associated with plant vigor and health, happy farmers, and maybe higher AA too! On average Colorado hops are 3 percentage points higher than the industry standards throughout all varieties.

Higher altitude means an increase in shortwave solar radiation(energy), - makes sense; you're closer to the source! Most plants in the world photosynthesize light on a dynamic spectrum from zero to a saturation point. At night there is zero photosynthesis occurring. As the day goes on, photosynthesis increases until the plant reaches its saturation point at solar noon when the sun is perpendicular to the plants. Then as afternoon proceeds on, the plant comes out of photosynthesis saturation and gradually decreases back to zero when night settles in.

The wind here on the Western Slope of Colorado from spring into summer is definitely something to take into consideration. It is strong and consistent. In order for photosynthesis to occur the stomata, which is basically a pore on the skin of a plant, must be open. One of the three conditions that will open the stomata is the presence of CO₂. Windy conditions create a CO₂ rich environment for the plant, and under certain conditions force the plant's stomata to

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remain open, driving photosynthesis (which is good) but also increasing transpiration (which is bad) especially in windy conditions when a plant is vulnerable to becoming desiccate. These windy conditions become a juggling act because the plant is losing a lot of water through transpiration and is physically wilting while the root zone is completely saturated. The plant can not bring the water to it's extremities fast enough. This becomes even more drastic with hops due to their height and the distance the water must travel.

So to conclude, due to elevation and wind, plants in Colorado receive higher solar radiation and a longer full saturation photosynthesis period. Now to be fair, as you go north and up in latitude, the summer days are longer, and thus there's more incident sunlight each day (although a shorter full saturation period). I don't know if either of these theories of mine account for why Colorado hops have higher AA levels than the industry standard, only time and more observations will tell!

Yet another thought to ponder is that maybe high AA levels are affected by the care and speed of harvesting and processing. Stay tuned in for more on this!

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Billy Goat Hop Farm is a family owned and operated farm - Chris, Audrey and Gumbo Ya Ya are putting their lives into every aspect of the farm. They're obsessed with crafting superior quality hops, committed to sustainable practices, and passionate about creating brewer-farmer relationships. Brewers enjoy the bright aroma, freshness, and subtly unique flavor profile imparted from Colorado's terroir and the personal touch in processing. *Know your farmer, Love your beer.* Learn more at billygoathopfarm.com and reach out at billygoathopfarm@gmail.com