Hay Making Weather in Kentucky: How to Get Good Information

UK Ag Weather Meteorologists Matt Dixon and Tom Priddy

Overview

The UK Agricultural Weather Center, housed within the Department of Biosystems and Agricultural Engineering, was developed in 1978. As part of the Cooperative Extension Service, the goal of the Ag Weather Center is to minimize weather and climate related surprise for Kentucky residents and their agricultural needs, ultimately for profitable and sustainable production. In doing so, numerous tools and models have been developed throughout the years to further help farmers and producers in management and production related decisions.

Weather, for the most part and especially in agriculture, is the governor of what we do on a daily basis. Kentucky, situated within the Lower Ohio Valley, experiences a varying and complex weather pattern throughout the year. At times, this results in abrupt changes in weather conditions and complications of agricultural management and production practices, often posing challenges to hay producers in the area. Knowing some basic principles and incorporating those with some tools offered by the Ag Weather Center, can go a long way in mitigating risks and in the case of hay, maximizing quality. No matter the situation, understanding different weather patterns and phenomena is a skill that anyone could benefit and can bring a new meaning to the 6 PM newscast. For a strong foundation, Tom Priddy, director of the Ag Weather Center, developed some simple rules-of-thumb over his career that act as a foundation to forecast the weather worldwide.

Forecasting Rules-of-Thumb

To start, it is important to know the characteristics of areas of high and low pressure. These features prove to be the foundation for understanding the weather here in Kentucky and around the United States. Just by knowing the position of high and low-pressure centers, along with potential movement can provide a great deal of information. This info includes wind direction, cloud cover, precipitation chances, dew point trends, and much more.

Areas of high and low pressure generally move from west to east across the United States, guided by winds aloft. A blue 'H' (Figure 1) on a surface weather map symbolizes high-pressure centers. Most of the time, high pressure provides mostly clear and dry conditions, along with low humidity as air is directed out and away from the center of the high. Air is sinking. This downward moving air actually warms up as it descends, which is the opposite needed to create any clouds and precipitation. At times, these high-pressure centers can become stationary overhead for an

extended period, resulting in excellent drying conditions and an opportunity to cut hay. Other times, their exact position can become detrimental to a hay crop. More to come about this in the paragraphs below.

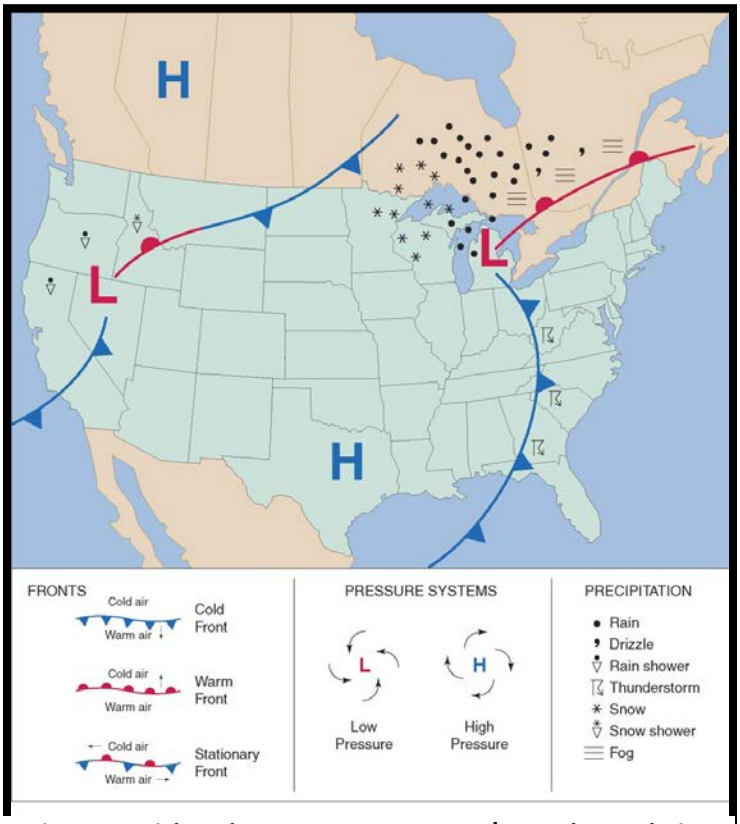

Figure 1 - High and Low Pressure Systems/Frontal Boundaries
Courtesy – American Meteorological Society

Low-pressure centers, on the other hand, symbolized by a red 'L' (Figure 1), usually provide the area with cloudy and wet conditions as air is directed in and up through the center of the low. This upward moving air cools to the point that condensation occurs. We see this as clouds. If the air continues to rise, then precipitation can occur.

The same process goes for frontal boundaries that are connected to the low-pressure center, whether that is a cold, warm, occluded, or stationary front. As fronts move through an area, they are accompanied by a noticeable change in temperature, humidity, and wind direction. In different ways, air is lifted to a point of condensation, resulting in a period of cloudy and wet conditions with the frontal passage.

These boundaries act to separate large masses of air with different moisture and temperature characteristics. Here in the Lower Ohio Valley, Kentucky is susceptible to a variety of air masses. As the old saying goes, "If you don't like the weather today, just wait for tomorrow." As shown by the map in Figure 2, continental polar (cP) (dry and cold) air masses originate to our north (Canada). Maritime tropical (mT) (Moist and warm) air masses originate to our south or east (Gulf of Mexico, Atlantic Ocean).

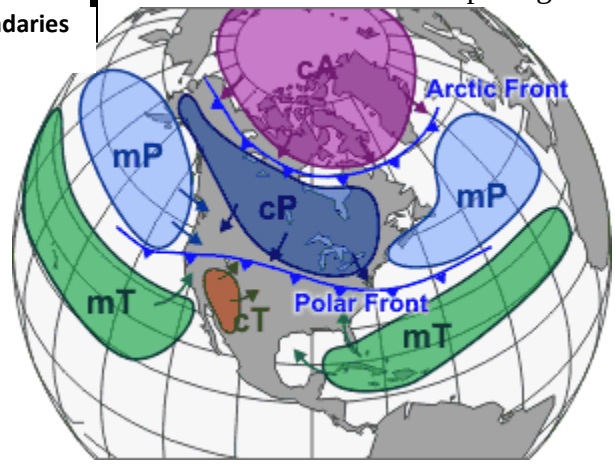

Figure 2 - Air Masses across North America
Courtesy – National Weather Service

As areas of high and low pressure progress across the region, there wind circulation and associative frontal boundaries are key to what type of air mass Kentucky encounters on any given day. Winds rotate clockwise around high-pressure centers and outward away from the center. Low-pressure systems are the exact opposite, rotating counter-clockwise and inward toward the center of the low.

Just as an example, a high-pressure center located just west in Missouri would result in northerly flow into Kentucky, bringing a dry and cool air mass. As the high moves overhead, we should see winds relax, along with dry conditions and mostly clear skies. When the high shifts to the east, winds on the backside of the system will be coming from the south in Kentucky, introducing a warmer and moister air mass from the Gulf of Mexico. During the summer months, with high pressure to the east/southeast, this could lead to isolated to scattered, short-lived convective showers. Figure 3 shows an example in which high pressure is centered over Eastern Kentucky. In this setup, Kentucky tends to experience mostly clear and dry conditions. Winds would be very light or even calm across Eastern Kentucky, while Western Kentucky would be seeing a southerly flow pattern (warmer, moister air) with high pressure to the east.

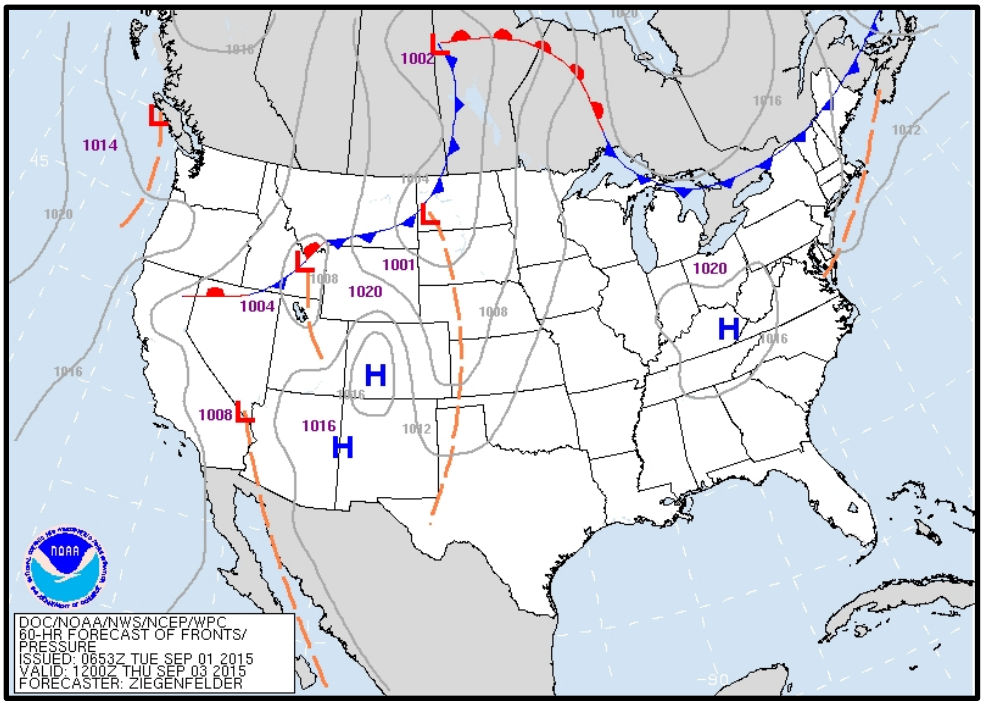

Figure 3 - Surface Analysis
Courtesy – Weather Prediction Center

The exact opposite process can be found with the movement of a low-pressure system across an area. Ahead of a low, winds will be coming from the south, ushering warmer and humid conditions into the Bluegrass State. Behind a passing cold front and the backside of a low-pressure system, winds will be coming from the north/northwest, filtering much cooler and drier air into the Bluegrass State.

A couple other rules of thumb pertain to the jet stream aloft and probability of precipitation (POP). First, the jet stream is typically found near 25,000 to 30,000 feet and can be seen as the fastest winds aloft. This feature divides cold, dry air to the north and warm, moist air across the south. In the summertime, the jet stream is typically located farther north of Kentucky, near the Canadian/United States border. During the winter, the jet stream invades locations near and south of Kentucky, sometimes moving all the way to the southern states. "U"- shaped bends in the jet are called troughs and provide cloudy, wet weather at the surface. Inverted "U" shapes in the jetstream are called ridges and provide clear, dry weather at the surface. The best weather map to forecast the trend in weather at any given location is of the jet stream.

Probability of precipitation or 'POP' is one of the more confusing terms in meteorology. In the past, you may have heard that a 50% POP meant that 5 times out of ten and under these same weather conditions, precipitation occurred. That means very little and that definition really does not lend itself to being very useful. However, if POP is considered the area of expected coverage of precipitation, it is easier to understand what the forecast means. POP decreases as you move away from the center of low pressure. Expected coverage of precipitation near the center of a low-pressure system is 70 to 90 percent. As you move away from the center and down, the "area of expected coverage" reduces to 50 percent. So a 50% chance of rain today can be translated to imply 50 percent of the forecast area WILL receive rain and 50% of the area will be dry. Further, if the POP is for a 20% chance of snow that implies that 20% of the area will get snow and 80% will remain dry.

In summary, trying to forecast the weather here in Kentucky can definitely hold its challenges. A good foundation to forecasting starts with high and low pressure systems, frontal boundaries, and the fact that everything generally moves west to east, but there is always going to be exceptions. Yet, understanding these basic rules can lead to a much better understanding of why weather changes from day-to-day here in the Ohio Valley.

Data

The Ag Weather Center now operates with a cluster of 20 computers, powering several models and digesting a considerable amount of weather station and forecast data. Data is gathered and maintained from over 160 weather stations across the state. This information is provided by the Kentucky Mesonet through Western Kentucky University, National Oceanic and Atmospheric Administration (NOAA), and the Unidata community program through the University Corporation of Atmospheric Research (UCAR). Most of the data is made available on the Ag Weather website (weather.uky.edu) in annual, monthly, daily, and hourly formats.

DAY	TUESDAY				WEDNESDA	
CST 3HR	2P	5P	8P	11P	2A	5A
MAX/MIN	--	49°	--	--	--	36°
TEMP.	48°	48°	43°	40°	38°	37°
Sky Cover	95%	97%	97%	96%	92%	78%
Clouds						
DEW PT	36°	38°	39°	39°	37°	33°
RH	63%	68%	85%	96%	96%	85%
POP 12HR	--	48%	--	--	--	66%
Rain/Snow	--	0.02in	--	0.13in	--	0.02in
Wind Speed	1	1	2	3	6	8
Wind Gust	1	1	3	5	8	12
Wind Dir.	W	SW	NW	N	N	N
DEW	--	--	--	--	--	Patchy Frost
Rain	Chance	Chance	Likely	Likely	Chance	Chance
RainShowers	--	--	--	--	--	--

Figure 4 - Point Ag Forecast

Ag Weather Tools

Collecting forecast and climatological data has allowed the Ag Weather Center to develop a variety of tools in several different agricultural-related operations, all of which can be found on the UK Ag Weather Center website at: **weather.uky.edu**.

One of the more widely used tools is the **'Point Ag Forecast'**. This tool consists of a detailed seven-day forecast of both weather and agricultural-related conditions and impacts for any farm across the nation. In the tool, producers are first presented with a summary of the upcoming 7 days, including max/min temperatures, probability of precipitation, relative humidity (high/low), dew point information, wind speeds and evapotranspiration estimates, among other things. A much more detailed forecast (Figure 4) can then be found below with forecast information given in three-hour increments for the

first three days and 6 hour increments for the next four. Analyzing the table on a daily basis can give quick indications of favorable drying conditions. All forecast information is taken from the local National Weather Service office.

Just recently, this information has been incorporated into **'County Ag Weather Summaries'** (Figure 5). While also providing a seven day forecast summary, this product provides a long-range weather outlook and summarizes climatological data for each county across the Commonwealth. The long-range outlooks give a producer a sense to expect above, below, or near normal precipitation in the 6-10 day, 8-14 day, 1 month, and 3 month time spans. The climatological data gives a farmer an idea of precipitation, temperatures, and evapotranspiration estimates for a weather station in their county over different durations. Also included is information on growing and insect degree-days, one of which, alfalfa weevil. More on the alfalfa weevil field-sampling program can be found through the **UK Entomology Department**.

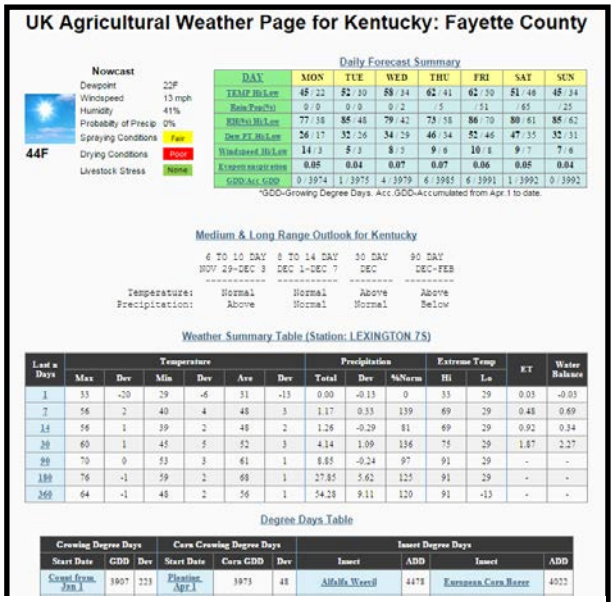

Figure 5 - Ag Weather Summary

Historical precipitation information can also be retrieved through **'Rainfall at Your Farm'**. This product utilizes National Weather Service rainfall data to estimate precipitation for any point across the nation. Producers can zoom right to their farm's location and get a precipitation estimate that otherwise may not be available without a weather station in the vicinity.

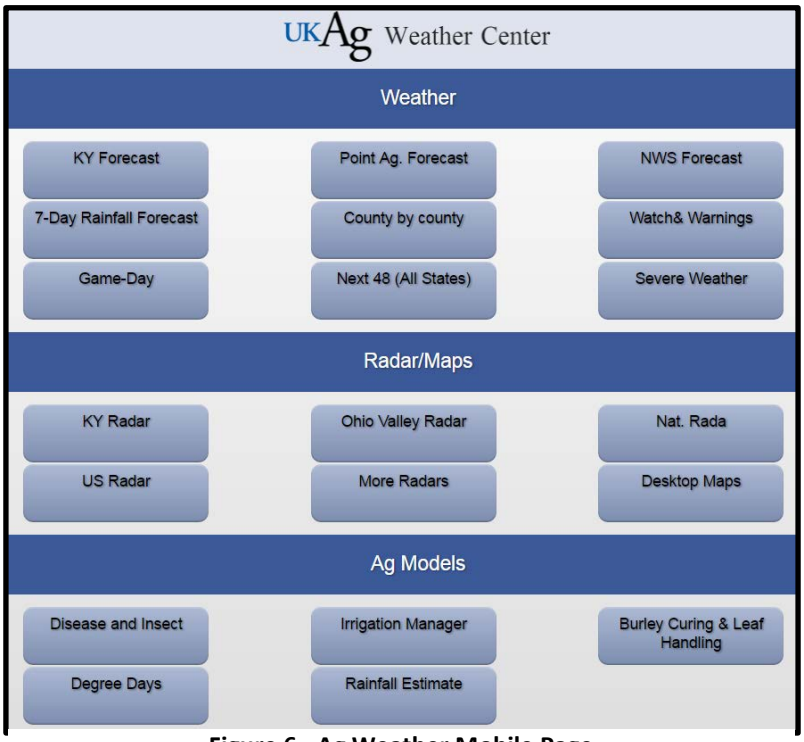

Figure 6 - Ag Weather Mobile Page

Lastly, the **'Irrigation Manager'** was developed to determine moisture surplus or deficits at Kentucky Mesonet stations across the Bluegrass State. This product is available for all Kentucky counties and compares precipitation accumulations at a station within the county to evapotranspiration estimates.

All of these tools can be accessed on a smart phone with the mobile version (Figure 6) of the website, in addition to radar and other models. A mobile version of the website will be automatically loaded by typing in weather.uky.edu.