BELIEVE IT OR NOT:
A CHANGING CLIMATE CHANGES FORAGE CROP PRODUCTION

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Most of us remember at least one year in the last 10 to 20 where farms suffered severe yield drops or untimely plantings – then we immediately recall the abnormal weather conditions of that year. It is indisputable that weather plays a key role in forage production, impacting yield; forage quality; the growth and spread of insect, disease, and weed pests; and the ability to plant and harvest in a timely manner. The unpredictability of weather is a constant challenge when growing and harvesting crops.

Understanding long-term weather (climate) trends is important to minimize risk and increase the likelihood of successful forage production in any given season.

Earth's climate system is complex and dynamic and has different effects in different regions. Shifts in climate trends associated with rising temperatures have the potential to impact annual and perennial forage crop production. A tendency toward more variable, more intense, and more frequent weather events requires the development of forage production systems with greater resiliency.

Observed and Projected Climate Trends

The 4th National Climate Assessment (NCA4) summary, focusing on the Midwestern U.S., gives us a picture of what climate scientists are measuring and the potential implications for crop farming. The key changes experienced in the Midwest include temperature, precipitation, drought, frost-free season, and polar vortex disruption (Table 1).

Table 1. Climate Trends in the Midwestern United States

Climate Trend	Impact in Midwestern U.S.	Magnitude of Change
Annual temperature changes	• Maximum temps higher in winter months • Minimum nighttime temps higher in all seasons • Moderate change in Midwest due to higher precipitation and evapotranspiration, which suppresses extreme temps	• Max temp +0.77^{o}F • Min temp +1.75^{o}F Comparison data 1901-1960 vs. 1986-2016 (nClimDiv dataset, Vose et al., 2017)
Precipitation changes	• Increased rainfall in April-June due to warmer air which holds more water • Rainfall events more intense and longer lasting	• Des Moines, IA, rainfall in April-June up 50% since 1950 • 37% increase in amount of precipitation in very heavy events from 1958 to 2012
Drought frequency	• Frequency of season-long drought is lower • More frequent pattern of excess spring moisture followed by lack of moisture in the summer months	
Frost-free season length	• Longer frost-free growing season results in growing longer maturity crops	• Frost-free season increased 9 days compared to 1901-1960 time period (Walsh et al., 2014)
Polar vortex disruption	• Potential for more extreme cold snap events due to a warming Arctic region and jet stream changes	• Expect more polar vortex events like January of 2019

Crop Management Implications

Changes in climate necessitate changes in forage crop management to achieve high forage yield and quality. Some management changes have already occurred – almost without thinking – due to the ongoing optimization of crop species, variety genetics, and other agronomic practices to maximize productivity. Actively adapting to climate change effects in the near term will be focused on dealing with excessive and intense rainfall.

One of the greatest risks to forage yield and forage quality will be the inability to conduct field operations in a timely manner. More spring rainfall with intense events will reduce the number of suitable days for planting. Also, first-crop alfalfa will be more difficult to manage for high quality due to harvest delays. Higher spring rainfall may lead to more alfalfa tonnage, but with a greater risk of low forage quality. To compensate for these risks, field drainage will be increasingly important along with the machinery and labor resources to conduct operations in a short time window.

Reduced lignin genetic technologies like BMR corn and HarvXtra alfalfa will help reduce weather-related risk of low forage quality.

More spring precipitation and rainfall intensity will have the potential to cause more soil erosion and greater soil compaction. Planting cover crops after corn silage or planting a perennial crop like alfalfa will reduce the risk of erosion and flooding with heavy rains. Crop management factors which increase soil organic matter and structure will help make the soil more resilient to compaction. Using GPS-guided traffic lanes within fields will help minimize soil compaction due to multiple passes.

Increased rainfall will also impact fertility of soils with an increasing need to manage nitrogen (N) and other nutrient loss through denitrification, leaching, or erosion. Nitrification inhibitors will be a useful tool for helping protect applied N. Targeted manure applications using injection equipment or timely incorporation will be critical to protect against nutrient loss or leakage into sensitive environments.

Warmer winter and summer temperatures will impact weed, disease, and insect pressure. Expect to see pests which are more traditionally active in the southern U.S. As the southern boundary of the seasonal freeze zone moves north, more pests will overwinter and increase in prevalence. Changes in weed species and weed growth habits will require more diligent use of herbicide programs with multiple modes of action and application times. Finally, diseases favored by higher humidity, temperature, or precipitation will become more frequent and challenging to control.

Midwestern dairy and forage farmers will need to adapt and protect their farms from increased precipitation in the winter and spring and more intense storm events. This will have implications for field operations, soil conservation practices, and fertility management. Warmer temperatures and longer frost-free seasons may alter crop rotations or hybrid/variety selections. Weed and insect pressure will worsen overall, requiring more diligent management.

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