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Missouri Weather Patterns and Their Impact on Agriculture

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The impact of weather and climate on Missouri agriculture and farm planning or decision making is sometimes subtle, other times pronounced and obvious. This publication focuses on the weather patterns that are responsible for the major episodes either highly favorable or unfavorable to agriculture. Special attention is given to patterns that tend to produce extremes in precipitation resulting in unusually wet or droughty conditions and extremes in temperature, either abnormally warm or cold.

Source regions of air over Missouri

The character of air over Missouri on any particular day or series of days is dominated by the source regions from which it comes. Missouri's mid-continental location makes it subject to air flows from a variety of source regions with markedly different properties.

The state is close enough to the Gulf of Mexico that warm air with high humidities can flow into the state from a southerly direction at almost any time of the year. This warm, moist air is the principal source of spring, summer and fall precipitation and, occasionally, in winter as well.

In contrast, air arriving over Missouri from semi-arid to arid regions to the southwest is warm or hot and usually dry.

Air that has moved from west to east over the Rocky Mountains arrives warm and dry, having lost most of its low-level moisture as it climbed the west side of the mountains. Such air may arrive over Missouri with surface winds from southwest through west to northwest.

Abnormally cold air in the winter and cold summer air with only very small moisture content arrives over Missouri from the northwest or north. The air has acquired its coolness in the polar and arctic source regions of Canada, Alaska, and, at times, Siberia. Occasionally, when a low-pressure center passes eastward or northeastward to the south of Missouri while a high-pressure center is passing eastward to the north, air will enter Missouri from a northeasterly direction and will tend to be cool and moist. Steady light precipitation-rain or snow-may accompany this air.

Normally, the flow from one of the principal source regions will last for two or three days before switching to a different direction and source region. These transitions typically are accompanied by a frontal passage during which the change in wind direction, temperature and moisture content, or any combination, is concentrated. These typical and frequent variations give rise to short-term variability in Missouri weather in which natives, such as Mark Twain, take some pride.

In some instances, however, a particular flow pattern may be very persistent or dominant for a period of weeks or even months. These periods can lead to wet, dry, hot or cold spells that place stress on normal agricultural processes or activities. A look aloft where flow patterns are less complex and variable than at the surface provides a better understanding of the atmospheric factors that determine the surface flow patterns present at any one time or persisting for an abnormally long time.

Upper air flow patterns

Several simple yet striking features are apparent from studying the flow in the atmosphere just two to four miles above the earth's surface. The basic flow is from west to east around the hemisphere. Superimposed on this basic west-to-east flow are wave-like meanders. These upper-level waves tend to migrate slowly from west to east but, at times, they can also become essentially stationary.

The location and strength of the upper-level waves dictates the type of flow that will exist at the surface and serves to determine the tracks of migrating lows and highs at the surface. If the upper-flow pattern remains unchanged for an extended period of time, the surface-flow patterns also tend to persist in time and place for longer than normal, producing extended wet, dry, hot or cold spells.

Unfortunately, many of the brief weather presentations made as part of a television newscast do not show or discuss upper air flow patterns. If, however, a display is shown of the "jet stream" location in the upper atmosphere, it can be assumed to be basically parallel to the major flow patterns aloft and along the axis of maximum wind speeds.

Upper air flow patterns and associated surface weather patterns

The precipitation-producing case

A cold front moving toward the southeast extends southward and southeastward from the low center. Ahead of the cold front a strong surge of warm moist air from the Gulf of Mexico is pulled northward into Missouri and surrounding states. In this warm, moist air, numerous showers and thunderstorms will develop, usually reaching peak frequency and intensity by late afternoon and evening.

The dry-drought producing case

The upper air flow pattern shows air flowing in a broad arc over the central plains with higher speeds in southern Canada than over the United States. The southern plains are characterized by a weak clockwise circulation. This upper air pattern tends to steer storm systems coming off the Pacific Ocean across the extreme northwestern states and across southern Canada.

As long as this upper flow pattern persists, the warm-dry associated surface pattern will also persist, giving Missouri day after day of hot, dry, droughty weather. This is frequently the case in summer, especially during July and August.

The cold-dry case

The upper air flow is characterized by an abnormally strong flow out of the north and northwest. This flow pattern favors bringing cool low-level air southward out of Canada across the northern plains and Great Lakes areas. As the leading edge of this air clears the east coast and moves southward into the Gulf of Mexico, a strong cold front is created. The west edge of this cold air frequently nudges into the front range of the Rocky Mountains, where it becomes stationary. A cold high-pressure center develops over Iowa and adjacent states and tends to drift slowly southeastward.

In the winter this high-pressure center would be characterized by bitterly cold early morning temperatures, particularly in areas of clear skies and existing snow cover.

Summary

The extremes in the weather and climate affecting Missouri agriculture are characterized by a few easily recognized and, at times, persistent flow patterns. The more complex flow patterns at the surface, as seen on the daily weather maps presented on television, are controlled by much simpler flow patterns aloft. Monitoring the upper air-flow patterns helps not only to understand the short-term changes in the surface flow, but gives guidance to the potential persistence of the surface flow patterns.

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