Lidar Research on Crop Growth in Wind Farms

Lidar measurements have shown that wind turbines in Midwestern farm fields may be doing more than producing electricity. The turbine blades that generate renewable energy might also help corn and soybean crops stay cooler and drier, help them fend off fungal infestations and improve their ability to extract growth-enhancing carbon dioxide from the air and soil.

The team of Julie Lundquist, assistant professor in the University of Colorado at Boulder's atmospheric and oceanic studies department, has used Lidar to measure winds and turbulence from near the Earth's surface to well above the uppermost tip of a turbine blade. "Our laser instrument could detect a beautiful plume of increased turbulence that persisted even a quarter-mile downwind of a turbine," she said.

The preliminary findings of a months-long study that examines how wind turbines on farmlands interact with surrounding crops were presented in December at the annual fall meeting of the American Geophysical Union in San Francisco. The presentation was made by researcher Gene Takle of the US Department of Energy's Ames Laboratory and Lundquist.

"We've finished the first phase of our research, and we're confident that wind turbines do produce measureable effects on the microclimate near crops," said agricultural meteorology expert Takle, who also is the director of the Climate Science Program at Iowa State University.

According to Takle, turbine blades channel air downward, in effect bathing the crops below with the increased airflow they create.

Both Lundquist and Takle stressed their early findings have yet to definitively establish whether or not wind turbines are beneficial to the health and yield potential of soybeans and corn planted nearby. However, their finding that the turbines increase airflow over surrounding crops suggests this is a realistic possibility.

"Because wind turbines generate turbulence and the mixing of air downwind, they may accelerate the natural exchange processes between crops and the lower part of the atmosphere," said Lundquist.
For example, the sun warms crops and some of that heat is given off to the atmosphere. Extra air turbulence likely speeds up this heat exchange, so crops may stay slightly cooler on hot days, Lundquist said. On cold nights, the turbulence created by the wind turbines stirs the lower atmosphere and keeps nighttime temperatures around the crops warmer.

"In both the spring and in the fall, we suspect that turbines' effects are beneficial by warming and perhaps preventing a frost, thus extending the growing season," said Lundquist.

Wind turbines also may have positive effects on crop moisture levels. Extra turbulence may help dry the dew that settles on plants, minimising the amount of time fungi and toxins can grow on plant leaves. Additionally, drier crops at harvest help farmers reduce the cost of artificially drying corn or soybeans.
Another potential benefit to crops is that increased airflows could enable corn and soybean plants to more readily extract CO_2, a needed fuel for crops, from the atmosphere and the soil, thus helping the crops' ability to perform photosynthesis.

The team's initial measurements consisted of visual observations of wind turbulence upwind and downwind of the turbines. The team also used wind-measuring instruments called anemometers to determine the intensity of the turbulence. The bulk of the wind-turbulence measurements and the crop-moisture, temperature and CO_2 measurements took place in the spring and summer of this year.
The CU-Boulder and ISU teams hope to continue their measurements throughout the next growing season.

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