

Discovering. Delivering. Yielding.



How is drought defined?

In agriculture, drought stress refers to situations where the amount of soil moisture does not meet the needs of a particular crop. The severity of the stress depends upon the degree and duration of moisture deficiency. In the western U.S. plains, such as western Nebraska, dry soils are more typical and frequent, while in the central U.S. Corn Belt, like Illinois, significant soil water deficiencies are less frequent.

The Impact of Drought on U.S. Agriculture

Many farmers' crops are affected by drought stress to some degree every year, but in some cases, agricultural losses due to severe drought can be tremendous. For example, the Dust Bowl days of the 1930s negatively affected 50 million acres of land, rendering farmers helpless.¹ More recently, the drought of 1988 led to severe losses to agriculture and related industries estimated around \$40 (61.6) billion.²

It does not take severe drought to affect crop yields. Even a moderate lack of available water can reduce yields, and threaten the ability of growers to recoup the investment in their crops. Consequently, farmers typically produce crops that are best adapted to the amount of available water.

Effects of Drought on Corn

Corn is adapted to a wide geographic range within the United States, but yield potential is closely related to the amount of available water. Whether it is the higher-producing central Corn Belt or the drier western plains, the supply of water is a major factor affecting the level and consistency of yields where corn is grown. Corn is particularly sensitive to drought stress during tasseling, silking and early grain-filling.

Sporadic drought stress may reduce the profitability of corn farmers even in areas that normally receive adequate rainfall. So for many corn farmers, an improvement in the corn plant's ability to withstand drought stress would lead to more consistent and dependable yields.

Corn cannot be grown profitably without irrigation in much of the western and southern United States due to typically lower rainfall. The crop species that growers can choose to grow is severely restricted in the absence of irrigation. An increase in the level and consistency of yield from dry-land (non-irrigated) corn would provide growers with the option of

growing more corn in rotation with other crops, such as sorghum or wheat, that have lower water requirements.

Role of Irrigation in Agriculture

According to the U.S. Department of Agriculture, irrigated agriculture continues to withdraw and use the most freshwater of any economic sector. With freshwater withdrawals of 150 million acre-feet, irrigated agriculture accounts for almost 40 percent of the U.S. total. Globally, according to the United Nations Environmental Program, agricultural water use accounts for about 70 percent of total consumption, mainly through crop irrigation.

The lowering of the water tables in many western states also means that access to water will be even more restricted in the future. Irrigation costs are heavily dependent upon energy prices and the supply of water, and therefore are steadily increasing. The development and introduction of corn hybrids that require less irrigation could reduce the costs of production and competition for water resources.

Technology Progress on Drought-Tolerant Corn

Over the last several years, Monsanto has focused biotech resources and expertise on the discovery and development of drought-tolerant traits. Monsanto's genomics discovery program has focused on identifying genes that improve a plant's ability to tolerate dry soils, resulting in several candidate genes for introduction and testing in corn. In 2007, the first-generation of corn drought tolerance technology within Monsanto's R&D collaboration with BASF completed its fifth year of field trials. Hybrids that show enhanced yields when water is limited are currently in Monsanto's advanced development phase. This project is the industry's first biotech drought corn project to move into the regulatory phase, which involves demonstrated efficacy of traits in elite germplasm and development of regulatory data.

Monsanto's breeding program also is focusing on ensuring the availability of adapted germplasm that performs well under drought stress to maximize the benefits of drought-tolerant traits. Drought-tolerant traits are expected to be provided in combination with the insect-resistant and herbicide-tolerant traits desired by growers, following extensive performance and quality testing and approval by government regulatory agencies.

1: <http://www.wrh.noaa.gov/fqz/science/drought.php?wfo=fqz>

2: <http://lwf.ncdc.noaa.gov/oa/reports/billionz.html>