

Climate and Agriculture: Challenges for Efficient Production

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Climate has always been and will continue to be an important factor in agricultural production. Evidence of this is apparent when looking at where plants or animals are distributed around the world and the variation among years in terms of grain, forage, vegetable, and fruit production. The recent release of the plant hardiness map that shows the northward movement of the areas where plants can grow in the more moderate environments is an indicator that demonstrates how changes in climate affect what grows and where they grow. In agriculture, the combinations of temperature, precipitation, sunlight, and carbon dioxide form the basis for plant growth and indirectly for animals because of the forage or feed they consume from plant materials. Efficient production of agricultural commodities will require that we utilize the information available on the interactions of climate and agriculture combined with the scenarios of climate variability. The direct and indirect impacts of climate on agriculture will have large impacts on agricultural production unless we are prepared to respond to these changes and provide information that will reduce the risk of climate variation on agricultural production. These interactions are complex because of the seasonal patterns of plant growth and the natural temporal variation in temperature, precipitation, and sunlight and further complicated by the variation that occurs around these seasonal patterns.

One of the most critical factors for agricultural production is precipitation which determines the amount of soil water available for plant development. Not only does the seasonal pattern determine the cropping distribution, the variation within the season directly affects crop productivity. This is further exaggerated by the variation in water holding capacity of the soil which determines the available water for the crop. Variation of crop yields within a production field is an indication of the response to soil water availability which is larger than the variation among years. If we couple an uncertainty in soil water availability with higher than normal temperatures, which increase the demand for crop water use, this will lead to either decreased productivity or increased demand for irrigation water. Either of these scenarios will lead to a decrease in efficiency because a decrease in yield results in decreased nutrient use efficiency and light capture efficiency. The trend of increased temperatures during the growing season on the pollen survivability will decrease fruit or grain yield leading to decreased efficiency in crop production. Increasing temperatures affect the rate of phenological development resulting in smaller plants or decreased length of the grain-filling or fruit growth periods will have negative impacts on plant productivity. Although the increases in carbon dioxide will have positive impacts on plant growth and water use these increases will be offset by the increased temperatures that are occurring. Changes in climate provide opportunities for agriculture to examine our plant and animal production systems to determine how we can increase the efficiency of production with increasing variation in the climatic resources.

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