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Edema.

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Current research concerns edema, which is an abnormal accumulation of fluid in plant cells. The research is being carried out in association with Kimberly A. Williams and Sunghun Park in the Department of Horticulture, Forestry, and Recreational Resources, along with graduate student Qingyu Wu. Nicole Rud, another graduate student who also worked on the project, graduated in December, 2009. Edemata are a physiological disorder, not caused by any pathogen. They occur only under greenhouse conditions, and in the past, they have been thought be due to overwatering. Because wheat is usually grown in the field, edemata on wheat apparently have not been documented. We reported last year that lack of ultraviolet light was a cause for edemata (also called intumescences or enations) in tomato plants. The glass of greenhouses filters out ultraviolet light, which makes the plants susceptible to the intumescences. When we added back UV-B light to the tomato plants grown under greenhouse conditions, they did not develop the intumescences. Kirkham and Keeney (1974) associated the formation of enations on leaves of potato, which they observed under controlled environmental conditions, with the presence of abnormal amounts of ethylene, a gaseous hormone. We are carrying out research to determine the biochemical reason for the formation of the intumescences in tomato.

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News.

Ms. Kalaiyarasi Pidaran is continuing work toward the master's degree. Under greenhouse conditions, she is studying the effect of water deficit on sorghum hybrids varying in maturity.

The book on carbon dioxide, cited last year, will be published by CRC Press in late March, 2011 (see Publications, below). Here is an excerpt from the epilogue:

> "Because elevated carbon dioxide stimulates growth, yield is usually increased under elevated carbon dioxide. In a classic paper, Kimball (1983) analyzed more than 430 observations of the yield of 37 species grown with CO_2 enrichment, which were published in more than 70 reports of experiments carried out in a 64 year period beginning in 1918. His analysis showed that, with a doubling of atmospheric CO_2 concentration, yield probably will increase by 33%. In this book I have not cited papers dealing with models, except in passing. My focus has been on data published in refereed journal articles. However, Ken Caldeira at the

Carnegie Institution for Science in Stanford, California has modeled plant growth under elevated CO_2. He and his colleagues (Govindasamy et al. 2002) have found that "doubling the amount of carbon dioxide while holding steady all other inputs—water, nutrients, and so forth—yields a 70 percent increase in plant growth, an obvious boon to agricultural productivity" (Levitt and Dubner 2009, p. 185). This is an even greater increase than that documented by Kimball (1983). The year to year increases in crop yields that have been observed during the last 50 years, since Charles Keeling first started to record the CO_2 concentration in the atmosphere in 1958, probably are related, in part, to the increased CO_2 concentration in the atmosphere. If other factors controlling plant growth are neglected, we can calculate that yields are 7% more in 2008 than in 1958 due to the increase in atmospheric CO_2. The elevated levels of CO_2 in the air probably are adding to our food security without our recognizing it.

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