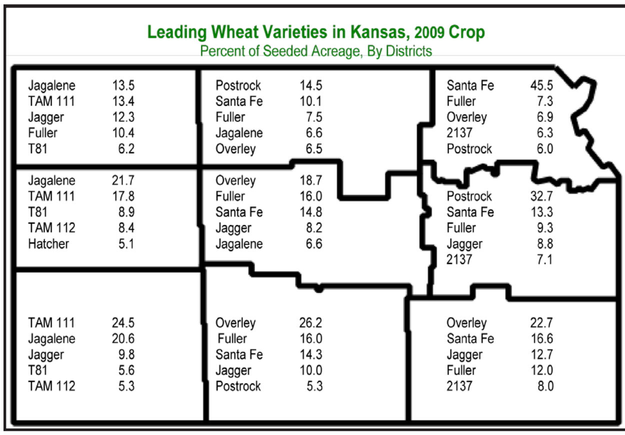

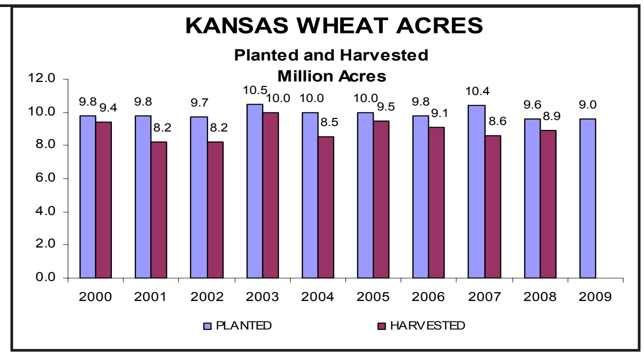

KANSAS STATE UNIVERSITY
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M.B. Kirkham.

Increasing atmospheric carbon dioxide (CO_2) and water use efficiency.

The Environmental Physics Group (formerly the Evapotranspiration Laboratory) at Kansas State University was the first to carry out experiments with winter wheat under elevated levels of carbon dioxide (CO_2) in the field. For three years (1984–87), we grew winter wheat under elevated levels of CO_2 in closed top chambers at the Rhizotron Facility of the Evapotranspiration Laboratory, located at the Ashland Experimental Field Site, about eight miles south of the Kansas State University campus in Manhattan, Kansas. The research was funded by the Department of Energy (DOE), and the detailed data were published in three reports to the DOE (Chaudhuri et al. 1986, 1987, 1989). The results were summarized in two journal articles (Chaudhuri et al. 1990a, 1990b).

When we started the experiments, the concentration of CO_2 in the atmosphere was 330 ppm. Our control (the ambient CO_2 concentration) was 330 ppm. The four atmospheric CO_2 concentrations that we used were 330, 485, 660, and 825 ppm. The CO_2 concentration in the air in 2007, the last year for which data are compiled, was 382.7 ppm (Schnell 2008) or, rounding off, 383 ppm. Because the concentration of CO_2 in the atmosphere has increased 53 ppm since we started our experiments, it is time to revisit the earlier data, in particular the data that dealt with water use efficiency, to determine how much the water use efficiency has increased as a result of increased levels of CO_2 in the atmosphere. Elevated CO_2 increases water-use efficiency because it closes the stomata, and this conserves water.

The closed-top chambers, which we used to control the CO_2 concentration, were placed over underground boxes (rhizotrons) that could be pulled out of the ground and weighed to determine water lost. Water in half of the boxes, which contained a silt loam soil, was maintained at a high water level (field capacity; 0.38 m^3/m^3) and the other half was maintained at a low-water level (half field capacity). The amount of

Table 1. Water requirement (mL/g) for winter wheat grain grown under high and low water levels as affected by CO_2 concentrations during a three-year study (1984–87) (* = estimated).

CO2 concentration (ppm)	Well watered				Drought stressed			
	84–85	85–86	86–87	Average	84–85	85–86	86–87	Average
330	680	530	710	640	860	670	870	800
383 (surrent)				599*				739*
485	510	470	570	517	810	450	590	617
660	490	450	460	467	730	440	530	567
825	500	430	440	457	670	450	520	547

water required to produce a gram of grain was calculated from water used and grain yield for each CO_2 level (Chaudhuri et al. 1990a). The water requirement, which is the reciprocal of water use efficiency, decreased as CO_2 concentration increased (Table 1, p. 201; reproduced from Fig. 3 in Chaudhuri et al. 1990a).

The greatest reduction in water requirement occurred between the control (330 ppm CO_2) and the first increment of CO_2 added to the air (485 ppm CO_2). That increment is 155 ppm CO_2. We already are one-third of the way to reaching that first increment (53 ppm divided by 155 ppm = 0.34 or about one-third). In Table 1, I have estimated what the water requirement of wheat now is, based on the data collected for wheat grown 1984-1987. For the well-watered and dry conditions, wheat is using 41 mL and 61 mL less water, respectively, to produce a gram of grain than it was in the 1984-1987 period. This will benefit farmers. That is, increases in atmospheric CO_2 apparently have allowed production of more wheat grain for the same amount of water applied.

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News.

Graduate student Nicole A. Rud (nrud@ksu.edu) continues with research on her Master's degree, which she is getting jointly under Professor Kimberly A. Williams (kwilliam@ksu.edu) in the Department of Horticulture, Forestry, and Recreational Resources and M.B. Kirkham (mbk@ksu.edu). Nicole is studying the causes of the physiological disorder, edema, which affects a wide range of greenhouse-grown agronomic and horticultural plant species. The disorder is thought to occur when roots absorb water faster than it is transpired by a plant, which results in small blisters of fluid on a leaf that burst and leave corky lesions. Edema is of great concern to the protected-agricultural industry, because of its economic damage.

Graduate student Prasanna Ayyaru Thevar (prasan@ksu.edu) has finished his research on his master's degree, which he is getting jointly under M.B. Kirkham and Dr. Robert M. Aiken (raiken@ksu.edu) of the Kansas State University Northwest Research-Extension Center, Colby, Kansas. He graduated in May, 2009. The title of his thesis is 'Transpiration Efficiency of Eight Grain Sorghum Lines [*Sorghum bicolor* (L.) Moench].'

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Notice of release of KS09WGGRC51-J and KS09WGGRC51-C Hessian fly-resistant hard red winter wheat and KS09WGGRC51-P Hessian fly-resistant spring wheat germ plasm.

The Agricultural Research Service, U.S. Department of Agriculture and the Kansas Agricultural Experiment Station announce the release of KS09WGGRC51-J and KS09WGGRC51-C hard red winter wheat (*Triticum aestivum* L.) and KS09WGGRC51-P spring wheat germ plasm with resistance to Hessian fly for breeding and experimental purposes. Scientists participating in this development were B.S. Gill, B. Friebe, J.C. Cainong, D.L. Wilson, and W.J. Raupp, Department of Plant Pathology, Kansas State University, Manhattan, KS 66506; A.K. Fritz, Department of Agronomy, Kansas State University, Manhattan, KS 66506; M.S. Chen and M.O. Pumphrey, USDA–ARS Plant Science and Entomology Research Unit, Department of Agronomy, Kansas State University, Manhattan, KS 66506; J. Johnson, Griffin Campus, University of Georgia, Griffin, GA 30223; and L.E. Zavatsky and A.J. Lukaszewski, Department of Botany and Plant Sciences, Batchelor Hall, University of California, Riverside, CA 92507.

KS09WGGRC51-J, KS09WGGRC51-J, and KS09WGGRC51-P are improved derivatives of Hamlet (KS89WGRC08, PI 549276) with the resistance gene *H21* in the form of a wheat-rye (*Secale cereale*) recombinant chromosome T2BS·2BL-2R#2L. The recombinant chromosome consists of the short arm of wheat chromosome 2B, most of the long arm of 2B, and a shortened distal segment derived from the long arm of the *S. cereale* chromosome 2R#2 harboring *H21*. KS09WGGRC51-J is derived from the cross Hamlet (T2BS·2R#2L)/2B(L)+20 (T2BS·2BL-2R#5L)/2*Jagger. KS09WGGRC51-C is derived from the cross Hamlet (T2BS·2R#2L)/2B(L)+20 (T2BS·2BL-2R#5L)/2*Culver. KS09WGGRC51-P is derived from the cross Hamlet (T2BS·2R#2L)/2B(L)+20 (T2BS·2BL-2R#5L)/2*Pavon. The F_4-derived families are homozygous for *H21* but are segregating for other traits.

Small quantities (3 grams) of seed of KS09WGGRC51 are available upon written request. We request that the appropriate source be given when this germ plasm contributes to research or development of new cultivars. Seed stocks are maintained by the Wheat Genetic and Genomic Resources Center, Throckmorton Plant Sciences Center, Kansas State University, Manhattan, KS 66506. Genetic material of this release will be deposited in the National Plant Germplasm System where it will be available for research purposes, including the development of new cultivars.

Development and characterization of wheat–Leymus racemosus translocation lines with resistance to Fusarium head blight.

Lili Qi, Mike Pumphrey, Bernd Freibe, Bikram Gill, and P.D. Chen.

Fusarium head blight can be a significant disease in Kansas in a year with a wet spring. Working with scientists at Nanjing Agricultural University in China, we have identified a new source of resistance from a perennial grass relative *L. racemosis* (Lr). A chromosome segment (called 7Lr#1S) from this grass specifying resistance to FHB has been transferred to a chromosome arm of wheat (called 7AL) in the form of a translocation T7AL·7Lr#1S. Using *ph1*-induced homoeologous method, we identified three putative recombinants. Putative recombinants were confirmed by genomic in situ hybridization (GISH), and we identified one proximal recombinant (rec124) with the proximal 80% derived from 7Lr#1S and the distal 20% derived from 7AL, and two distal recombinants (rec679 and rec989) with the proximal 80% derived from 7AL and the distal 20% of the arm derived from 7Lr#1. We presently are backcrossing these recombinants with adapted Kansas winter wheats and selecting homozygous recombinant stocks. Once these have been obtained, they will be evaluated for their resistance to FHB.