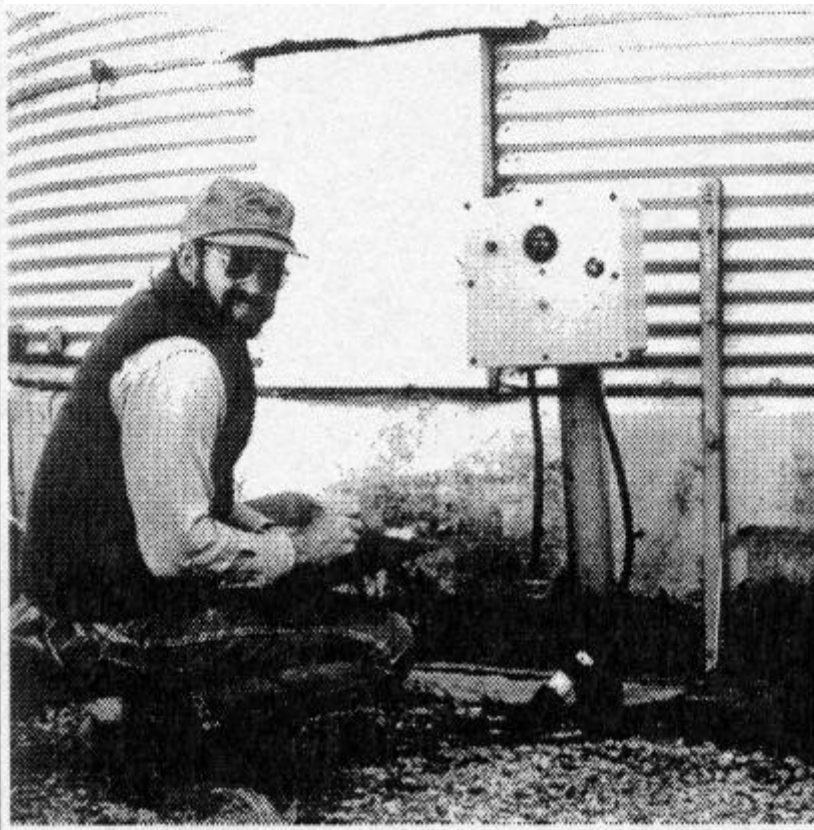


INTEGRATED PEST MANAGEMENT

IN KANSAS FARM-STORED WHEAT

USING AERATION CONTROLLERS



Report of Progress 737

Agricultural Experiment Station, Kansas State University, Manhattan

Marc A. Johnson, Director

INTEGRATED PEST MANAGEMENT IN KANSAS FARM-STORED WHEAT USING AERATION CONTROLLERS¹

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ABSTRACT

For years, Cooperative Extension Service personnel have stressed a chemical-based management system for preserving the quality of farm-stored wheat. However, research performed by Kansas Agricultural Experiment Station scientists has documented that the use of aeration as the basis of an integrated pest management (IPM) strategy for controlling insects in farm-stored wheat is highly effective. Public concern about the presence of pesticide residues in the food supply and a commitment by the Clinton Administration for 75% adoption of IPM by the year 2000 heightens the need for Kansas farmers to adopt this technology. This report summarizes a special project in which Kansas State University personnel and cooperating farmers demonstrated the use of aeration controllers to facilitate cooling of farm-stored wheat at 16 locations across Kansas. Project results include pest populations, grain temperatures in demonstration bins, and grain quality at the end of the demonstration. In addition to maintaining grain quality, the IPM strategy appeared to be a more cost effective method for controlling stored grain insects than either a chemically based management strategy or a no-control strategy.

¹Contribution no. 95-492-S from the Kansas Agricultural Experiment Station

²Contributors are identified in a list starting on pg. 7.

PROJECT DESCRIPTION

A special project, funded by the Cooperative States Research, Education, and Extension Service, U.S.D.A., permitted the demonstration of inexpensive aeration controllers at 16 Kansas farms. This technology enables producers to cool farm-stored wheat following harvest, thereby eliminating the need for stored grain insecticides.

The concept of cooling grain to control stored insects is not new; however, this practice is not used on Kansas farms following wheat harvest. A perception exists that Kansas summers are too hot to permit sufficient grain cooling during July and August.

Five years of research conducted by Kansas Agricultural Experiment Station personnel documented that grain temperatures can be lowered enough during the summer to slow insect development. This strategy relies upon an aeration controller, which runs the fan only when outside air temperature drops below a predetermined set point, and the utilization of three cooling cycles to lower stored grain temperature.

The combination of good **sanitation** in and around the grain bin; **aeration** to cool grain; and **monitoring** grain temperature, fan run-time, and insect population can replace the need for grain protectants and, in most cases, eliminate the use of fumigation. These three practices have been packaged into an integrated pest management (IPM) strategy represented by the acronym SAM³.

This project addresses several critical issues facing Kansans. By replacing a pesticide-based insect control system in farm-stored wheat with an IPM approach, Kansas producers will help achieve a national goal established by the President of the United States for 75% adoption of IPM by the year 2000. Reducing pesticide use in farm-stored wheat increases food safety, reduces grain storage costs, and decreases farm workers' exposure to pesticides.

PROJECT TEAM

This project involves all segments of the grain industry by utilizing a team approach. Agricultural Extension agents in 16 counties formed local teams consisting of a farmer, country elevator manager(s), and a local Consolidated Farm Services Agency (CFSA, formerly ASCS) representative. Country elevator managers and CFSA personnel are encouraging the adoption of this IPM approach by participating in field days highlighting the aeration controller, distributing Extension literature to interested producers, and discussing this technology with customers.

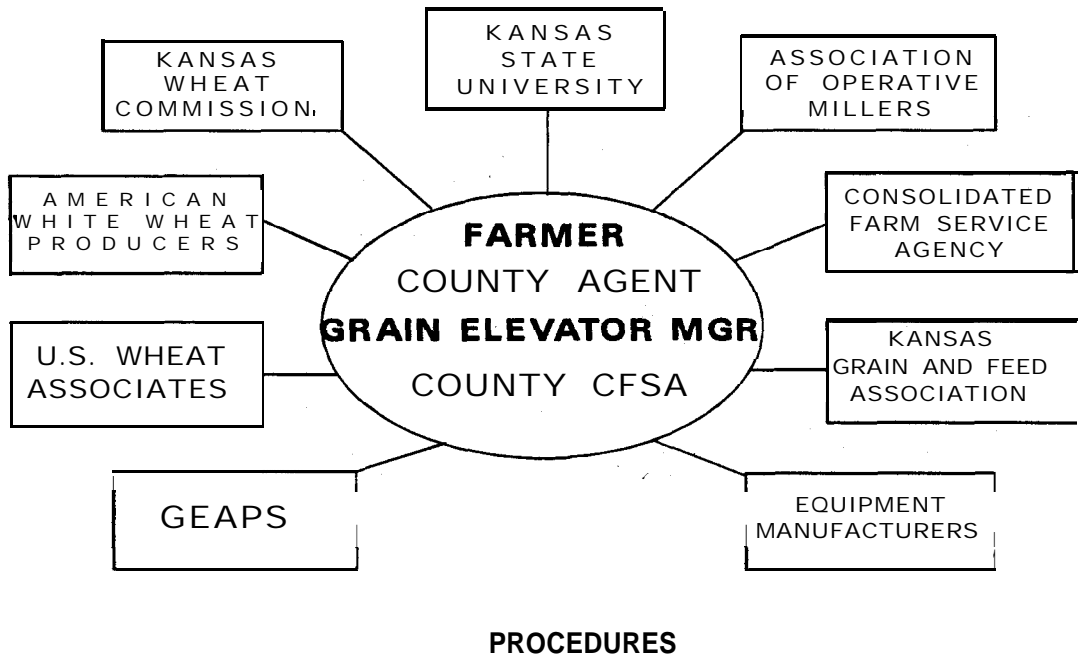
An advisory committee consisting of representatives from the Grain Elevator and Processing Society (GEAPS), U.S. Wheat Associates, American White Wheat Producers Association, Kansas Wheat Commission, Association of Operative Millers, Consolidated Farm Services Agency, Kansas Grain and Feed Association, and aeration controller manufacturers from Kansas was formed to help ensure project relevance and success.

³C. Reed and F. Worman. 1993. Quality maintenance and marketing of wheat stored on farms and in elevators in Kansas: Description, techniques, and innovations. Bull. 660, Kansas Agricultural Experiment Station.

Cooperative Extension Specialists and Experiment Station researchers from Kansas State University provided technical expertise in establishing demonstration sites, evaluating demonstration results, preparing training material, and participating in field days and meetings highlighting this new approach to grain quality maintenance.

Figure 1.

NETWORK OF PROJECT COLLABORATORS



PROCEDURES

In 1994, 16 farm sites were equipped with aeration controllers, which consisted of a thermostatically controlled on-off switch and hour meter. The aeration controller was placed between the power source and the grain bin's aeration system, so that the controller would turn on the bin's fan when the outside air temperatures reached a predetermined set point. Temporary thermocouple lines were installed to permit grain temperature monitoring. Three cooling cycles were used to lower wheat temperature; the first set point was 75°F (except in Sheridan and Sherman Counties, where it was 70°F). After the cooling front had moved through the wheat, the set point on the aeration controller was lowered 15°F. A comparison bin was established at each site to compare the farmer's normal pest control strategy with the aeration controller. Grain temperature data and fan hours were recorded weekly by the cooperating farmer.

Cooperators were requested not to apply grain protectants to wheat in the bin equipped with the aeration controller. Twelve of the 16 sites met this criterion, and insect population numbers are reported for these bins. Grain temperatures and fan hours are reported for all sites.

RESULTS

Initial grain temperatures in farm bins following harvest ranged from 88° to 100°F, with an average of 95° F. Wheat temperatures were lowered by an average of 19°F in 2 weeks following harvest in bins equipped with an aeration controller (Figure 2). The average air flow (cubic feet per minute (cfm) per bushel (bu)) was .27, and the average observed electrical cost to cool grain using three cooling cycles was .71 cents per bu (Table 1).

Samples of the insect populations were taken in mid-July and again in late September by pitfall probe traps (5 traps/bin, 4-day trap time) in bins with the aeration controller and the nearby comparison bins containing wheat harvested at the same time. The average numbers of insects per bin from five traps for the aeration-controlled and comparison bins were 9.7 and 16.1, respectively, in July and 29.9 and 447.5, respectively, in September.

In November, final samples were taken from the aeration-controlled bins using a grain probe. In 67% of these bins, no insects were detected. In the remainder, the number of insects per 1000 g sample ranged from 0.4 to 1.1 with a mean of 0.9/1000g. At each site, grain quality characteristics were maintained in the bins equipped with an aeration controller.

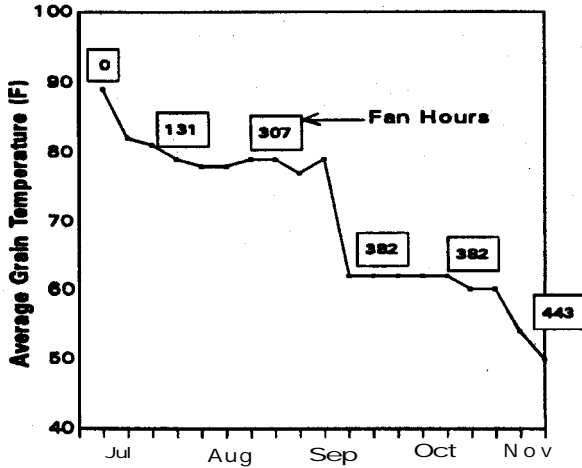
Table 1. 1994 IPM demonstration bin sites, bin capacities, air flows, and electrical costs.

Site	Bushels	¹ Airflow cfm/bu	Observed Cost
Barton	20,000	-	1.41
Cloud	3,300	0.27	0.65
Dickinson	2,000	0.67	0.65
Graham	4,000	0.19	0.39
Harper	7,000	0.15	0.68
Lincoln	5,500	-	1.16
Marion	4,400	0.29	0.15
Mitchell	8,700	0.25	0.29
Ness	9,000	-	-
Republic	2,700	0.40	0.86
Rooks	10,000	0.22	0.36
Saline	4,500	0.23	0.68
Sheridan	4,000	0.15	1.32
Sherman	3,200	0.17	1.20
Sumner	5,000	-	0.48
Average	5,590	0.27	0.71

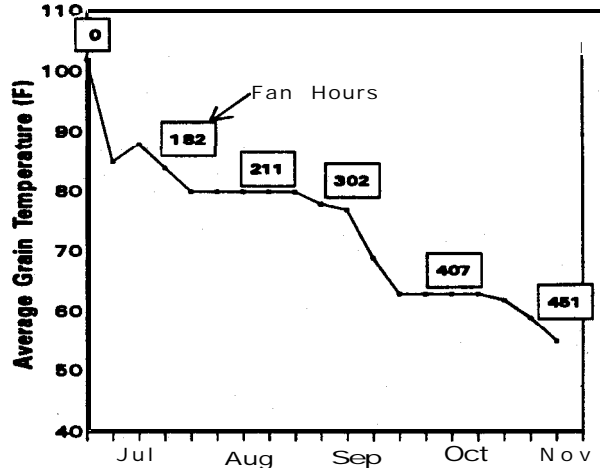
¹Airflow could not be measured at four locations.

Figure 2.

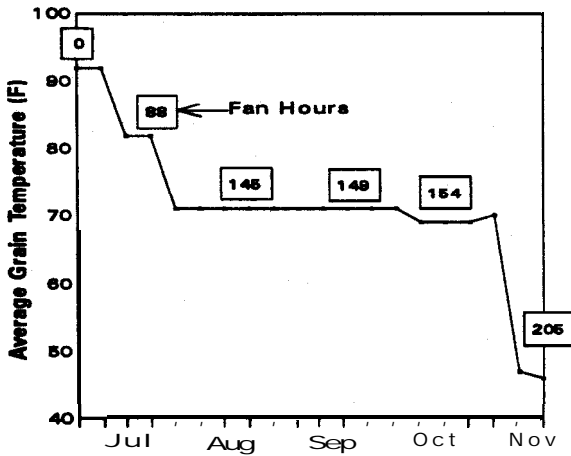
BARTON COUNTY
GRAIN TEMPERATURES 1994



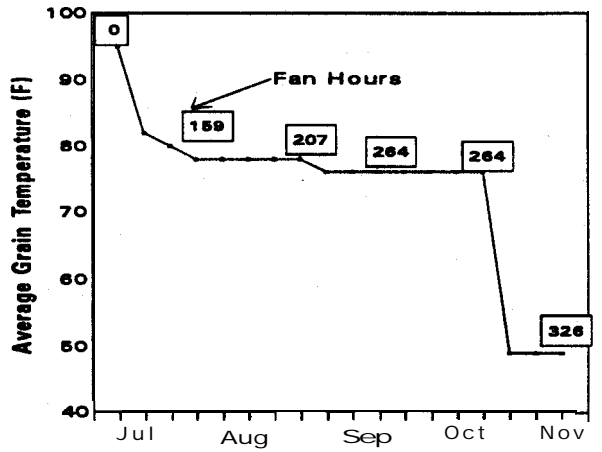
CLOUD COUNTY
GRAIN TEMPERATURES 1994



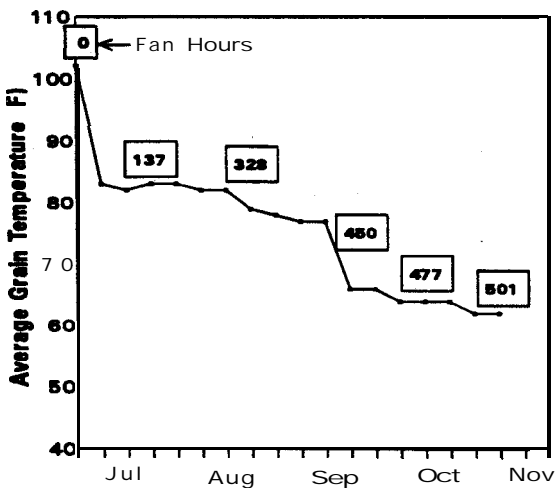
DICKINSON COUNTY
GRAIN TEMPERATURES 1994



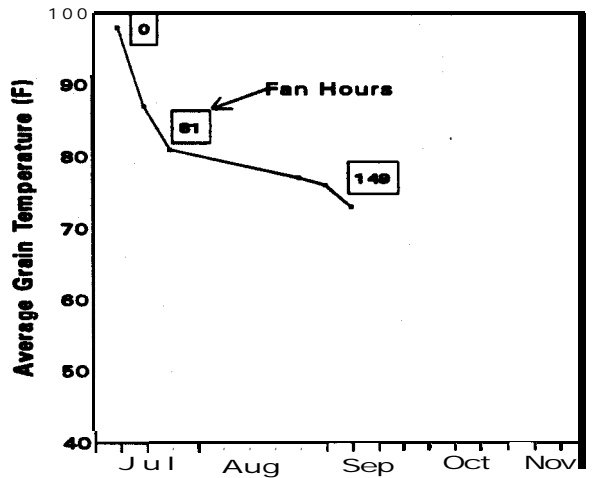
GRAHAM COUNTY
GRAIN TEMPERATURES 1994



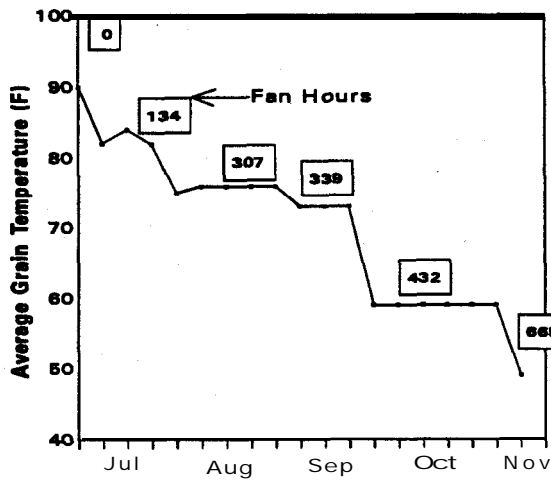
HARPER COUNTY
GRAIN TEMPERATURES 1994



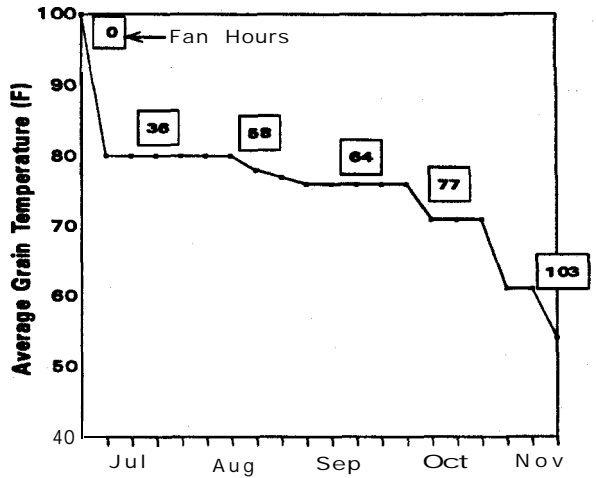
HARVEY COUNTY
GRAIN TEMPERATURES 1994



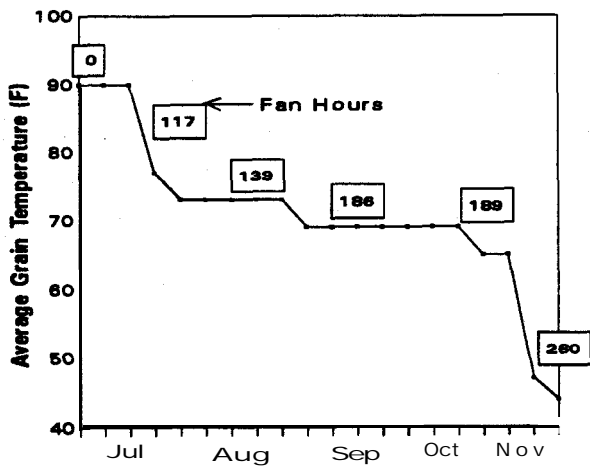
LINCOLN COUNTY GRAIN TEMPERATURES 1994



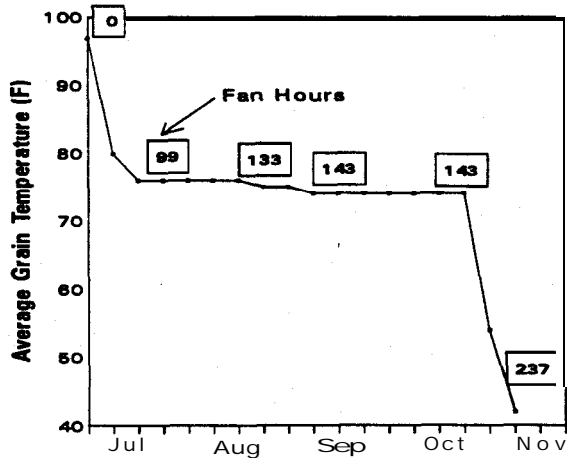
MARION COUNTY GRAIN TEMPERATURES 1994



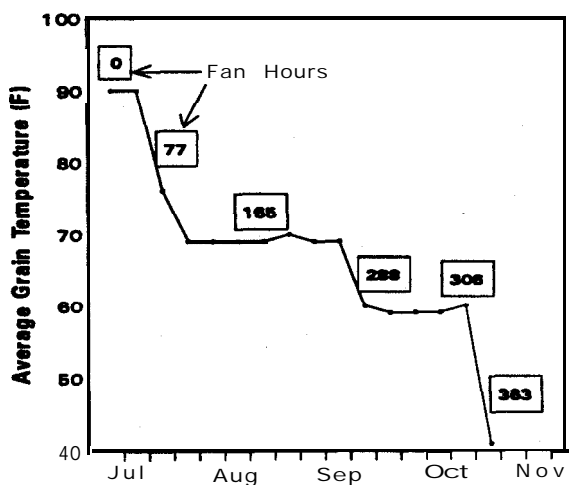
MITCHELL COUNTY GRAIN TEMPERATURES 1994



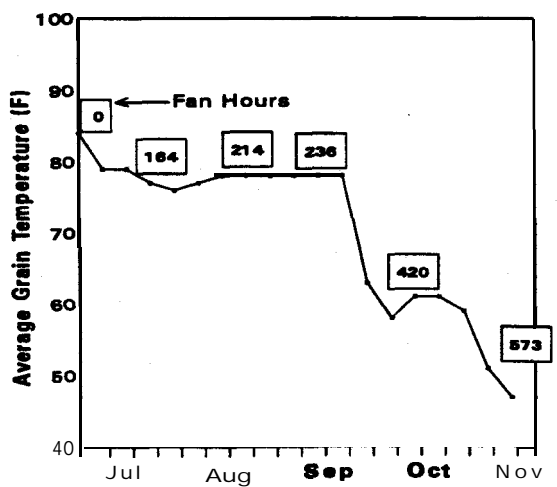
NESS COUNTY GRAIN TEMPERATURES 1994



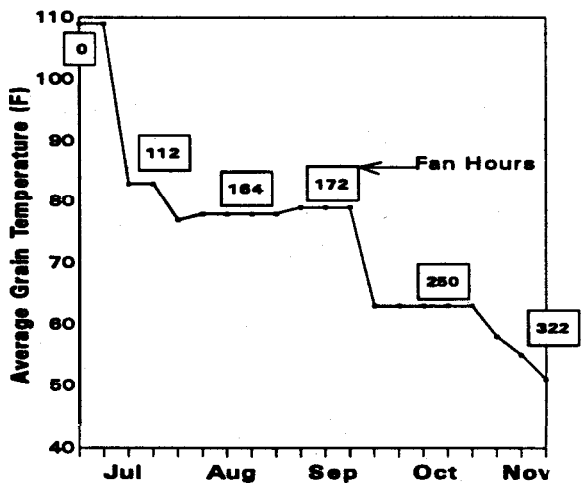
REPUBLIC COUNTY GRAIN TEMPERATURES 1994



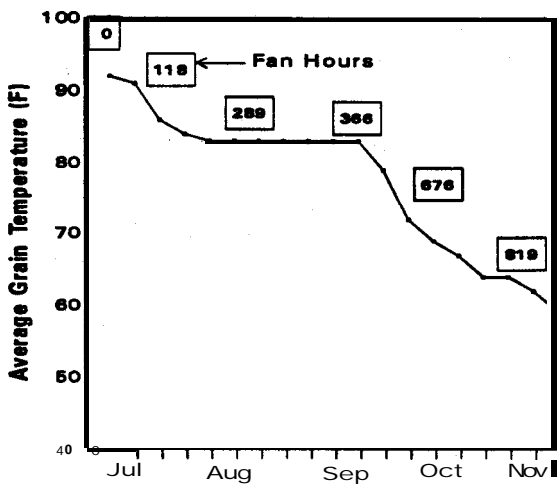
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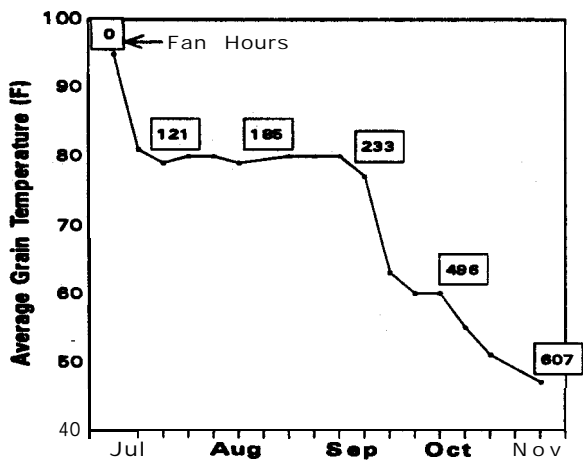
SALINE COUNTY GRAIN TEMPERATURES 1994



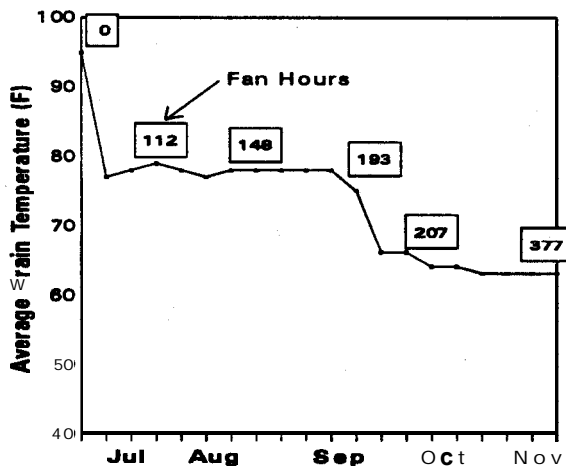
SHERIDAN COUNTY GRAIN TEMPERATURES 1994



SHERMAN COUNTY GRAIN TEMPERATURES 1994



SUMNER COUNTY GRAIN TEMPERATURES 1994



COSTS AND BENEFITS

Comparisons among the costs of three management strategies (aeration controller, chemical protectant, and no insect control) were made for a scenario involving 10,000 bushels of farm-stored wheat. In this case study, the average cost of an aeration controller was \$325, the cost of Reldan grain protectant was 2.3 cents per bushel, and the discount for delivering insect-infested wheat to a grain elevator was 5 cents per bushel.

The first comparison involved an aeration controller versus Reldan. In this example, the cost per bushel for an aeration controller amortized over 10 years at an 11% interest rate was 0.55 cents per bushel. The electrical cost of utilizing three aeration cycles was .71 cents per bushel based on the 16 demonstration sites in this project. No moisture shrink was observed in the grain stored in bins equipped with the aeration controllers, so no additional cost was incurred for this technology. Individuals who utilize a strategy involving a chemical protectant often cool their grain in late September, which would result in an electrical charge. However, this cost was not calculated into the comparison. The net benefit of the aeration controller in this example was about 1.04 cents per bushel.

To compare the no-control strategy (e.g., no aeration, no protectant, no fumigation) with the aeration-controller strategy, information from previous research was used⁴. No control implies no treatment costs; therefore, this comparison relied on discounts associated with the numbers of live insects in samples of farm-stored wheat through the fall and winter. Reed et al. documented that, during this time, 75.6% of the wheat held on a farm using a no-control strategy was infested (average density = 5 insects per 1000g). The average discount for the no-control strategy was 3.78 cents per bushel (0.756×5 cents), resulting in a net benefit of the aeration controller strategy of 2.48 cents per bushel. Although 36% of the wheat under aeration control in this project contained insects in November, the low population density (0.9 insects per 1000 g) resulted in a detection probability of about 5%.

LOCAL DEMONSTRATION TEAMS

Barton County:
Agent: Richard C. Snell
Farmer: Kent Standy
Grain Elevator: Great Bend Coop

Dickinson County:
Agent: John W. Gattshall
Farmer: Steve Hoover
Grain Elevator: Farmers Coop Assn.

Cloud County:
Agent: Darrel D. Hosie
Farmer: Ron Johnson
Grain Elevator: Cloud Co. Coop Assn.

Graham County:
Agent: Randy V. Hein
Farmer: Cleon Davis

⁴C. Reed, K. Anderson, J. Brodeschmidt, V. Wright, J. Pedersen. 1990. Cost and effectiveness of chemical insect measures in farm-stored Kansas wheat. *J. Kansas Entom. Soc.* 63:351-360.

Harper County:
Agent: Neal D. Schatz
Farmer: Mark Fisher
Grain Elevator: Farmers Coop

Harvey County:
Agent: Ronald W. Graber
Farmer: Nelson Drier
Grain Elevator: Farmers Grain Coop Assn.

Lincoln County:
Agent: Milton J. Krainbill
Farmer: Merrill Neilson
Grain Elevator: Farmway Coop, Inc.

Marion County:
Agent: Steven R. Tonn
Farmer: Don Fruechting
Grain Elevator: Coop Grain & Supply

Mitchell County:
Agent: Gary D. Fike
Farmer: Jerry and Mary Kay Eilert
Grain Elevator: Farmway Coop, Inc.

Ness County:
Agent: R. Scott Barrows
Farmer: Lance Stum
Grain Elevator: Bondurant Grain Co., Inc.

EQUIPMENT SUPPLIERS

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7-M Inc.
HC 01 Box 56
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Janice O'Hare
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Dick Shephard
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925 West Maple
Arkansas City, KS 67005

Glenn Wells
MCI, Inc.
P.O. Box 563
Newton, KS 67114

Republic County:
Agent: Michael Musselman
Farmer: Brad Habelmann
Grain Elevator: Coop. Business Assn.

Rooks County:
Agent: John J. Forshee
Farmer: John Greibel
Grain Elevator: Farmers Union Mercantile

Saline County:
Agent: Thomas M. Maxwell
Farmer: Mark Bacon
Grain Elevator: Bunge Grain

Sheridan County:
Agent: Douglas C. Musick
Farmer: Bill Patmon
Grain Elevator: Hoxie Grain, Inc.

Sherman County:
Agent: Dana J. Belshe
Farmer: Ken Palmgren
Grain Elevator: Mueller Grain Co.

Sumner County:
Agent: Gerald E. LeValley
Farmer: Arless Day
Grain Elevator: Wolcott & Lincoln, Inc.

EXTENSION SPECIALISTS/RESEARCHERS

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Joe Harner, Biol. & Ag. Engineering
Tim Herrman, Grain Science & Industry
Randy Higgins, Entomology
John Pedersen, Grain Science & Industry
Carl Reed, Grain Science & Industry

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John Drach, Consolidated Farm Service Agency
Jim Frahm, U.S. Wheat Associates
Steven Graham, Kansas Wheat Commission
Dave Krejci, GEAPS
Max Streit, Association of Operative Millers
Kent Symns, American White Wheat Producers Association

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