

PROJECT LEADERS IN CEREAL INVESTIGATIONS

Name	Appointment	Termination
A. D. Colliver	April 1, 1905	December 31, 1908
C. C. Cunningham	January 21, 1909	July 31, 1911
B. E. Rothgeb	April 1, 1910	March 1, 1912
F. A. Kiene	March 1, 1910	April 30, 1919
A. F. Swanson	June 1, 1919	October 3, 1951
Lowell Penny	April 1947	June 1, 1949
A. J. Casady	June 1, 1949	June 30, 1951
Wayne L. Fowler	July 1, 1952	July 31, 1953
W. M. Ross	September 1, 1951	To date
John D. Miller	August 17, 1953	August 28, 1957
James A. Wilson	September 16, 1957	October 1, 1961
Ronald W. Livers	February 1, 1962	To date

PUBLICATIONS RELATING TO CEREAL CROPS

1. Aicher, L. C. 1935. Growing Combine Sorghums. Kans. Agr. Expt. Sta. Circ. 170.
2. Aubel, C. E. and Swanson, A. F. 1951. Testing the Comparative Palatability of Different Sorghums. 38th Annual Livestock Feeders' Day Rpt., Kans. Agr. Expt. Sta. Circ. 273, pp. 6-7.
3. Bieberly, Frank G., Cleavinger, E. A., Walter, Ted L., Miller, John D., Hansing, Earl D., Painter, R. H., and Heyne, E. G. 1957. Barley in Kansas. Kans. Agr. Exten. Circ. C-262.
4. Clapp, A. L., Ross, W. M., Walter, Ted L., Stegmeier, W. D., Gwin, Roy E., Moore, W. A., Axelton, M. C., and Raney, R. J. 1960. Grain Sorghum Performance Tests, 1959. Kans. Agr. Expt. Sta. Bul. 420.
5. Heyne, E. G., Miller, John D., Finney, K. F., and Hansing, E. D. 1957. Bison Winter Wheat (CI 12518). Kans. Agr. Expt. Sta. Cir. 352.
6. Laude, H. H. and Swanson, A. F. 1933. Sorghum Production in Kansas. Kans. Agr. Expt. Sta. Bul. 265.
7. Laude, H. H. and Swanson, A. F. 1942. Natural Selection in Varietal Mixtures in Winter Wheat. Jour. Amer. Soc. Agron. 34:270-274.
8. Pauli, A. W., Wilson, J. A., and Stickler, F. C. 1962. Flowering Response in Winter Wheat as Influenced by Temperature, Light, and Gibberellic Acid. Crop Sci. 2:271-274.
9. Price, Mary E. and Ross, W. M. 1957. Cytological Study of a Triploid x Diploid Cross of *Sorghum vulgare* Pers. Agron. Jour. 49:237-240.
10. Price, Mary E. and Ross, W. M. 1955. The Occurrence of Trisomics and Other Aneuploids in a Cross of Triploid x Diploid *Sorghum vulgare*. Agron. Jour. 47:591-592.
11. Martin, John H., Sieglinger, John B., Swanson, A. F., Burnham, D. R., Clemmer, H. J., Coles, E. H., Keating, F. E., and Osborn, W. M. 1929. USDA Tech. Bul. 131.
12. Miller, John D. and Ross, W. M. 1955. A Four-row V-Belt Nursery Seeder. Agron. Jour. 47:282-283.
13. Miller, John D. and Ross, W. M. 1955. Relative Yields of Varieties of Wheat on Fallow and on Cropland at Hays, Kansas, 1921-52. Agron. Jour. 47:308-311.
14. Ross, W. M. 1956. Bright Future for Sorghum Hybrids. Kans. State Board of Agr. 39th Bien. Rpt., pp. 58-60.
15. Ross, W. M. 1957. Stigma Receptivity in Cytoplasmic Male-Sterile Sorghum. Agron. Jour. 49:219-220.
16. Ross, W. M. 1958. A Comparison of Grain Sorghum Varieties in Plots with and without Border Rows. Agron. Jour. 50:344-345.

17. Ross, W. M. and Bieberly, Frank G. 1962. Growing and Utilizing Sorghums in Kansas. Kans. Agr. Exten. Cir. C-301.
18. Ross, W. M. and Laude, H. H. 1955. Growing Sorghums in Kansas. Kans. Agr. Expt. Sta. Cir. 319.
19. Ross, W. M. and Miller, John D. 1955. A Comparison of Hill and Conventional Yield Tests Using Oats and Spring Barley. Agron. Jour. 47:253-255.
20. Ross, W. M. and Webster, O. J. 1959. Additional Notes on Cytoplasmic Male Sterility in Sorghum. Agron. Jour. 51:682.
21. Ross, W. M. and Webster, O. J. 1960. Cultivation and Utilization of Grain Sorghum. USDA Agr. Info. Bul. 218.
22. Sieglinger, J. B., Swanson, A. F., and Martin, J. H. 1934. Inheritance of Awn Development in Sorghums. Jour. Agr. Res. 49:663-668.
23. Swanson, A. F. 1926. Relation of the Seed Coat of Feterita to the Rate of Water Absorption and Germination. Jour. Amer. Soc. Agron. 18:428-432.
24. Swanson, A. F. 1927. Cereal Experiments at the Fort Hays Branch Station, Hays, Kans., 1912-23. USDA Tech. Bul. 14.
25. Swanson, A. F. 1928. Seed-coat Structure and Inheritance of Seed Color in Sorghums. Jour. Agr. Res. 37:577-589.
26. Swanson, A. F. and Getty, R. E. 1930. Chemical Seed Treatments for Sorghum. Jour. Amer. Soc. Agron. 22:272-275.
27. Swanson, A. F. 1930. Variability of Grain Sorghum Yields as Influenced by Size, Shape, and Number of Plots. Jour. Amer. Soc. Agron. 22:833-838.
28. Swanson, A. F. 1934. Sorghum—The Emigrant Crop of Kansas. Arend 5:109-113.
29. Swanson, A. F. 1935. The Development of Sorghum Culture in Kansas. Kans. State Board of Agr. 29th Bien. Rpt., pp. 165-174.
30. Swanson, A. F. 1938. "Weak Neck" in Sorghum. Jour. Amer. Soc. Agron. 30:720-724.
31. Swanson, A. F. 1939. Long-time Storage of Winter Wheat. Jour. Amer. Soc. Agron. 31:896-897.
32. Swanson, A. F. 1941. Relation of Leaf Area to Grain Yield of Sorghum. Jour. Amer. Soc. Agron. 33:908-914.
33. Swanson, A. F. 1949. Recent Developments in Grain Sorghum Production by Plant Breeding Methods. Agron. Jour. 41:179-191.
34. Swanson, A. F. 1950. Starch—A New Outlet for Grain Sorghum. Kans. State Board of Agr. Rpt. Aug. 1949. Vol. 68, No. 292, pp. 49-59.
35. Swanson, A. F. 1950. Sorghum—Its Production and Utilization. Kans. State Board of Agr. Rept. Aug. 1949. Vol. 68, No. 292, pp. 32-38.
36. Swanson, A. F. 1951. Relation of Rainfall and Other Climatic Factors to Crop Production in the Great Plains. Agron. Jour. 43:397-400.
37. Swanson, A. F. Making Pellets of Forage Sorghum. USDA Yearbook 1950-51. pp. 353-356.
38. Swanson, A. F. and Anderson, K. L. 1951. Winter Wheat for Pasture. Kans. Agr. Expt. Sta. Bul. 345.
39. Swanson, A. F. and Hunter, Robert. 1936. Effect of Germination and Seed Size on Sorghum Stands. Jour. Amer. Soc. Agron. 28:997-1004.
40. Swanson, A. F. and Laude, H. H. 1934. Varieties of Sorghums in Kansas. Kans. Agr. Expt. Sta. Bul. 266.
41. Swanson, A. F. and Laude, H. H. 1935. Pasturing Winter Wheat in Kansas. Kans. Agr. Expt. Sta. Bul. 271.
42. Swanson, A. F. and Laude, H. H. 1938. Barley Production in Kansas. Kans. Agr. Expt. Sta. Bul. 280.
43. Swanson, A. F. and Laude, H. H. 1942. Sorghums for Kansas. Kans. Agr. Expt. Sta. Bul. 304.

44. Swanson, A. F. and Laude, H. H. 1943. Sorghums for Kansas. Kans. Agr. Expt. Sta. Bul. 318.
45. Swanson, A. F. and Laude, H. H. 1951. Grain and Forage Sorghum for Kansas. Kans. Agr. Expt. Sta. Bul. 349.
46. Swanson, A. F. and Parker, John H. 1931. Inheritance of Smut Resistance and Juiciness of Stalk. Jour. Hered. 22:51-56.
47. Tanner, Fred W., Swanson, A. F., and Curtis, J. J. 1949. Breeding for Niacin Content in a Sorghum Cross, Westland x Cody. Cereal Chem. 6:333-338.
48. Walter, Ted L., Clapp, A. L., Ross, W. M., Lawless, John R., Stegmeier, W. D., Gwin, Roy E. Jr., Moore, W. A., Axelton, M. C., and Raney, R. J. 1961. Kansas Grain Sorghum Performance Tests, 1960. Kans. Agr. Expt. Sta. Bul. 435.
49. Walter, Ted L., Gwin, Roy E. Jr., Lawless, John R., Ross, W. M., Stegmeier, W. D., Axelton, M. C., Moore, W. A., Peterson, V. H., and Raney, R. J. 1962. Grain Sorghum Performance Tests, 1961. Kans. Agr. Expt. Sta. Bul. 446.
50. Wilson, J. A. and Ross, W. M. 1961. Haploidy in Twin Seedlings of Winter Wheat. Crop Sci. 1:82.
51. Wilson, J. A. and Ross, W. M. 1961. Cross-breeding in Wheat, *Triticum aestivum*. I. Frequency of the Pollen-restoring Character in Hybrid Wheats Having *Aegilops ovata* cytoplasm. Crop Sci. 1:191-193.
52. Wilson, J. A. and Ross, W. M. 1962. Cross-breeding Wheat, *Triticum aestivum*. II. Hybrid Seed Set on a Cytoplasmic Male-sterile Winter Wheat Subjected to Cross-pollination. Crop Sci. 2:415-417. 1962.
53. Wilson, J. A. and Ross, W. M. 1962. Male Sterility Interaction of the *Triticum aestivum* nucleus and *Triticum timopheevi* cytoplasm. Wheat Info. Service 14:29.
54. Wilson, J. A. and Swanson, A. F. 1962. Effect of Plant Spacing on the Development of Winter Wheat. Agron. Jour. 54:327-328.

GRAIN STORAGE INVESTIGATIONS

Introduction of the combine resulted in much wheat being harvested while too moist for safe storage. It is estimated that high moisture content caused injury to 10 to 25 percent of the total Kansas wheat crop during the latter part of the 1920's and the early 1930's. Work was undertaken at the Hays Station in 1929 to study whether the type of bin in which the wheat was stored immediately after harvest might influence the extent of the damage. Eleven 500-bushel grain bins were erected on the Station grounds. The storage work was under the direction of Prof. F. C. Fenton

of the Department of Agricultural Engineering and the milling and baking studies under the direction of Dr. C. O. Swanson of the Department of Milling Industry of the College.

The 1929 harvest began June 28 when windrowed wheat was picked up and threshed. The weather was hot, dry, and windy, drying the grain rapidly. Grain that contained 18 percent moisture in the morning was down to 14 percent in the afternoon. A second combine was started in another field of standing grain that was still green in low places. This wheat ranged in moisture content from 16.2 to 18.6 percent moisture.

Three bins of the mixture of the green and ripe wheat proved to be the most difficult to store without damage.

While the grain available was not sufficiently uniform in moisture to permit comparison for the different types of bins, it was possible to arrive at certain conclusions: 1. Any wheat stored with moisture content of 15 percent or higher is likely to be damaged because of heating. 2. Wheat stored in tight-walled bins seems more likely to heat than that stored in ventilated bins. 3. Severe damage in damp wheat may be prevented by moving it as soon as it starts heating; this moving will be effective to the extent that it cools the wheat and removes moisture. 4. Power cost of moving wheat is small, amounting to 8 to 15 cents for 500 bushels. 5. Hot weather influences heating of wheat in steel bins more than in better insulated bins. 6. When the outside temperature is low and the bin is filled with hot wheat, there is a decided condensation of moisture on the wheat near the outside walls, especially in the steel and **concrete** stave bins; this causes the outside 6 or 8 inches of wheat to mold more rapidly. 7. Ventilation appears to be an important factor in preventing heating of wheat in storage. This ventilation, however, must facilitate air movement sufficiently to cool the wheat and remove moisture. Ventilators which do not accomplish this do more harm than good. The

work in 1929 indicated that the material of which a bin was constructed was probably of less importance than the type of ventilation.

In 1930 work was undertaken to determine the best methods of ventilation and the effect of ventilation upon cooling, the removal of moisture, and the prevention of damage. Wheat was stored in five 1,000-bushel bins, each representing a different type of ventilation. The wheat used in the study was combined before it was entirely ripe and contained enough moisture to create a difficult storage problem. Each load of wheat as it came from the field was divided equally among the five bins. No attempt was made to force air through the wheat artificially. This study led to the following conclusions: 1. Wheat with a moisture content of 17.5 percent is too damp for safe storage in any ordinary type of bin in hot weather. 2. Cooling wheat by transferring it from one bin to another is not very effective when the weather is extremely hot. 3. Ventilation is very valuable in lowering the temperature in damp wheat in storage. 4. Ventilated bottom bins proved to be the most effective in lowering the temperature during the summer of 1930. 5. A bin with ventilated side walls, a flue in the center, and suction cupola on top was also effective in cooling the wheat. 6. Ventilation flues of perforated metal were of little value in cooling the grain; in fact, they might have

promoted molding. 7. The blower type of elevator cracked much of the grain if the moisture content was below 15 percent. 8. The wheat in all the bins was damaged from the standpoint of milling.

The studies to this time had demonstrated the value of ventilation in preventing damage to damp wheat in storage. They had shown that when the moisture content was too high and the weather hot, no system of natural ventilation was effective. It was decided, therefore, to try methods of forced ventilation in 1931 and to compare them with those methods of natural ventilation that in previous studies had shown the greatest promise. Four 1,000-bushel steel bins were used having different types of forced and natural ventilation.

Harvest started June 29, 1931. The moisture content of the wheat when stored varied from 10.8 percent to 17.23 percent. The following conclusions were drawn: 1. Forced ventilation was more effective than natural ventilation in cooling the wheat. 2. The evidence comparing suction of air with forcing of air was limited, but indications were that forcing was more effective. 3. The temperature of wheat stored in the ventilated bins approximated outside air temperatures more closely than did that stored in unventilated bins.

Further experiments in the storage of damp wheat were undertaken in coopera-

tion with the Bureau of Agricultural Chemistry and Engineering, United States Department of Agriculture, in 1936 and continued through 1937 and 1938. The experiments embraced work with both natural and forced ventilation and various types of bin construction. The following conclusions were drawn from these studies: "The results seem to indicate that in this area wheat can be stored safely for several years in tight unventilated bins if the moisture content is 13 percent or less. In order to store wheat safely that has a moisture content in the range of 13 to 14.5 percent, it appears necessary to provide ventilation. This may be accomplished in many ways, but the following types of wind-ventilated bins (in order of efficiency) have proved effective in field tests: (1) Bins having a system of horizontal flues with alternate layers connected to suction and pressure cowls and so spaced that the maximum air travel between the flues is 2 feet. (2) Bins having a suction or pressure cowl which is connected to a perforated chamber so proportioned and located in the center of the mass of grain that the maximum distance the air travels through the wheat is 3 1/2 feet. These bins must have perforated floors and, preferably, perforated walls. (3) Bins having a suction cowl connected to the space above the grain in such a fashion that the air is drawn through a perforated floor and

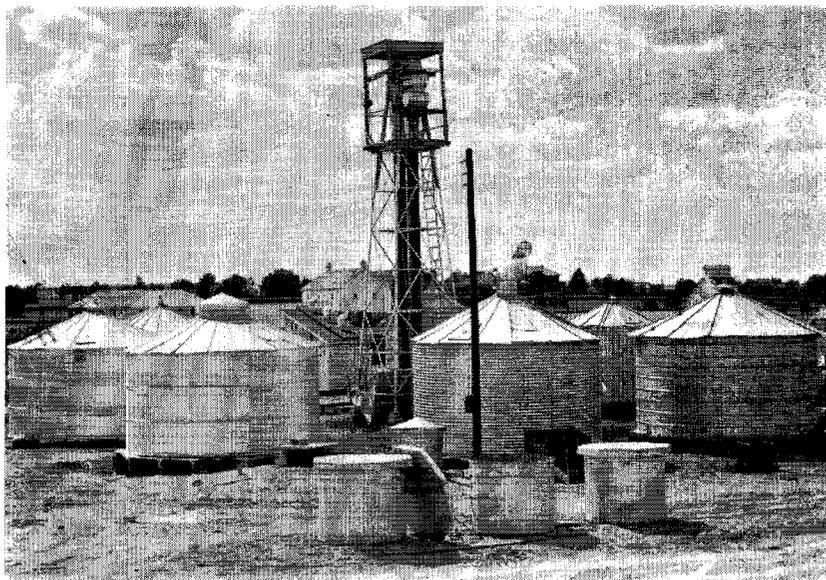


Fig. 47.—Grain storage bins were used to study the effect of ventilation upon the removal of moisture, cooling, and prevention of damage in stored wheat.

not more than 8 feet of grain. (4) Bins having a suction or pressure cowl connected to a perforated central chimney so the air enters through perforated walls and passes through not more than 6 feet of grain. Any of the naturally ventilated types enumerated above can be provided with power ventilation to prevent damage to grain having more than 14.5 percent of moisture. If the weather is favorable for drying, wheat at 18 percent moisture content can be stored in ventilated bins if the air travel is very short and the blowers have high capacity.” (36)

A complete report of the grain storage investigations at Hays is contained in the following publications: 1.

Kansas Agricultural Experiment Station Technical Bulletin No. 33, December, 1932. The Quality of Wheat as Affected by Farm Storage. 2. U.S.D.A. Circular 544, April, 1940. Methods of Ventilating Wheat in Farm Storages.

FORAGE INVESTIGATIONS

Experimental work with forage crops began with the establishment of the Station. Efforts to improve alfalfa, brome grass, and big bluestem were attempted. Observational plantings of sweetclover and various large-seeded annual legumes such as soybeans were made. A selection of pink kafir, made in 1907, led to its subsequent widespread distribution. Not until 1913 when a cooperative agreement was

initiated with the Bureau of Plant Industry of the U.S.D.A. did the work become firmly established. Under this agreement the department paid the salary of a scientific worker stationed at Hays and the Station provided the physical facilities and most of the labor. From 1937 half of the scientific worker's salary was paid by the Station to conduct full-time research on alfalfa, grasses, and sweetclover. Federal support for the project terminated in 1950.

The most extensive work at the beginning was with forage sorghums, relating to the choice of varieties, their improvement, and development of the most effective methods of culture and utilization. Varieties of forage sorghum improved by selection and recommended for distribution were Early Sumac, Red Amber, Western Blackhull, and Atlas. Although major emphasis prior to 1930 was placed on experiments with sweet sorghums, many other forage crops were investigated. Studies with sudangrass involved rate and date of seeding, determination of optimum growth, and stage of harvesting for hay. With newer selections of sudangrass, tests were initiated on palatability and grazing. In 1951 a sudangrass breeding program was initiated, and with the advent of cytoplasmic male sterility in sorghums efforts were directed toward the development of male-sterile lines, useful in hybrid combinations.

The value of foxtail millets

was explored. They were shown to be less valuable for forage than were sorghums or sudangrass. Varietal and cultural studies with various large-seeded annual legumes, root crops, and miscellaneous crops continued through the mid-1930's.

Drouth that prevailed from 1932 to 1936 permitted extensive studies on survival of native grasses. Studies were made of time, depth, rate of seeding, and methods of preparatory cropping for seeding native grasses. It was found that protective stubble such as sudangrass or close-drilled sorghums provided best conditions for spring seeding of warm-season grasses.

The breeding program for improvement of buffalograss was begun in 1936. A selection that was superior in seed production was increased vegetatively in 1942. Pollination of this plant with selected male plants resulted in a strain with superior seeding vigor. Seed produced from this planting was named Hays buffalograss. The use of Hays buffalograss and its importance in revegetating western Kansas is discussed fully in another section of this report (page 83).

With the establishment of the Station in 1902 alfalfa at once assumed an important role on the bottomland of the farm. Problems associated with establishment and production were studied. Lines developed by the breeding program at the College were evaluated, including the bac-

terial wilt-resistant variety Buffalo. Foundation plantings of Buffalo alfalfa were made. With the appearance of spotted alfalfa aphids in 1954, an alfalfa breeding project was initiated as a part of the U.S.D.A. interdepartmental cooperative breeding program. A spotted alfalfa aphid-resistant variety, Cody, was released in 1959. The program has increased in scope and is now centered on insect resistance and breeding of types of alfalfa better suited to upland conditions and capable of per-

sisting under grazing in association with grasses.

No consistently satisfactory and reliable method has been found for establishment of sweetclover. Attention is being given to the possible exploitation of large-seeded types which appear to be more readily established. Madrid sweetclover, a selection from introductions of sweetclover seed from the Madrid Botanical Garden in Spain, was tested extensively both at the College and the Station and released for increase and distribution in 1937.

PROJECT LEADERS IN FORAGE CROPS

Name	Appointment	Termination
R. E. Getty	April 1, 1913	March 31, 1929
D. A. Savage	April 1, 1929	January 23, 1937
L. E. Wenger	March 1, 1937	August 6, 1943
R. E. Wagner	October 20, 1943	May 1, 1945
F. E. Meenen	March 5, 1945	June 16, 1951
A. J. Casady	July 1, 1951	August 28, 1954
H. L. Hackerott	November 1, 1954	To date

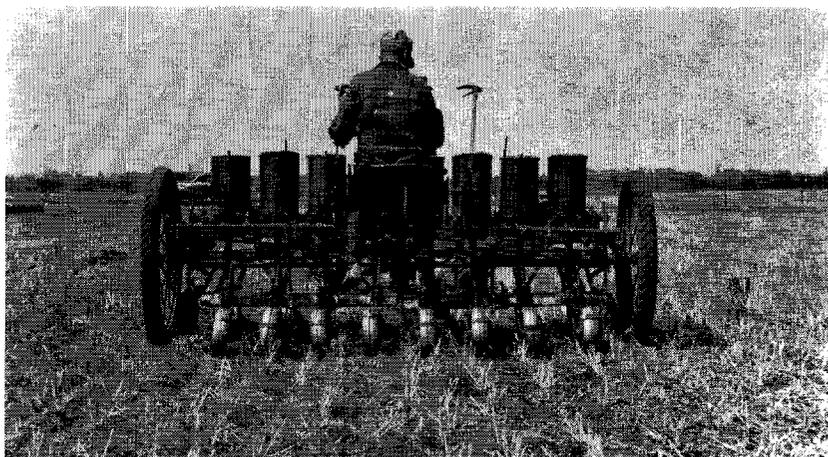


Fig. 48.—Planting grass seed in Sudan stubble with the new improved grass drill built in the Station shop. It was found that protective stubble such as Sudan grass or close-drilled sorghum provided best conditions for spring seeding of warm-season grasses.