ful in the handling of this fumigant. Carbon disulfide (sometimes referred to as carbon bisulfide) **is inflammable and explosive** and many insurance companies refuse to pay claims resulting from fires and explosions caused by its use. While carbon disulfide is an effective fumigant, it should be understood that the operator uses it entirely at his own risk. It is as readily ignited as high test gasoline by open flame, sparks, and burning tobacco. Therefore lighted matches and tobacco, sparks and open flame of any kind should be kept away from any place where this gas is being used. Under satisfactory bin and temperature conditions carbon disulfide is applied at the rate of about 1½ gallons per 1,000 bushels of grain. Where temperature and bin conditions are not satisfactory, this dosage may have to be doubled. This fumigant material is usually applied by sprinkling it over the surface of the grain. The fumes being heavy penetrate deeply into the grain.

The most important natural aid in holding these insects in check is a fairly dry climate, characterized by cold winters. Such a situation exists in this northern section of the Great Plains States and is the reason why storage insects are nowheres near the problem they are in warmer and more humid areas of this country.

Cold Weather Helps

Practical application of cold weather in the control of grain storage insects is frequently applied by grain elevator operators and owners of farm bins who have facilities for aerating the infested grain during sub-zero weather. It is accomplished by moving the grain by conveyors from one bin to another during the coldest weather in winter and may coincide with the cleaning of the grain. While exposure of the insects in this manner to low temperatures may not be of sufficient duration to destroy all the insects, it will at least cool the grain sufficiently to maintain the surviving insects in a dormant state until conditions are favorable for bin fumigation. From the data available on the lethal temperatures of several of our stored grain insects, it is highly probable that if grain is subjected to zero temperatures for several hours, all stages of the more important species are killed.

For information on the bin temperatures of grain in storage during the winter months, the reader is referred to the next article in this issue of the Bimonthly by Thomas E. Long.

Temperature of Wheat in Bins of Various Construction*

By Thomas E. Long, Assistant Agricultural Engineer
North Dakota Agricultural Experiment Station

IN the preceding article is pointed out the desirability of moving the grain from one bin to another during the coldest portion of winter to aid in the control of stored grain insects Such a procedure should be particularly useful when combined with cleaning operations of the grain because it would accomplish a two fold purpose—the cleaning of the grain and chilling the contents of the bin in a more uniform manner than would otherwise occur.

* These data are from results on the Farm Grain Storage Project located at Fargo. This work is on a cooperative basis between the North Dakota Agricultural Experiment Station and the Bureau of Agricultural Chemistry and Engineering, Agricultural Marketing Service and Bureau of Plant Industry, U. S. Department of Agriculture.

Frequently questions have been asked concerning the temperatures to which insects would normally be subjected to in bins which remain undisturbed during the winter months.

The temperature of the wheat in winter in different types of bins will depend upon their construction and the weather conditions. The results given here were obtained from bins of 1000-bushel capacity which were divided in half by a partition placed in the N-S direction. The reason for this procedure was to provide a greater variation of experimental work in the different types of bin construction. Hereafter, the word "bin" means 500-bushel capacity or one-half of a 1000-bushel bin.

The data discussed are only for the winter seasons of 1938-39 and 1940-41. Whenever the average temperature of the bin is given in the discussion of the "results", this represents all of the temperatures recorded in sixteen different points within the 500-bushel capacity bin. These points are distributed at various depths in the wheat; near the floor, in the center of the bin and near the surface of the wheat. At each of these depths there were four places where temperature determinations were made. They are (1) near the north wall, (2) near the south wall, (3) half way between the north and south wall, and (4) center of the 500-bushel bin.

Bin No. 1—(Plain Metal Bin)

Type of Construction:

This bin has a plain metal floor and side walls with the common cone-type roof equipped with ventilator.

Results: (See Figure 1)

In October 1938, the wheat temperature averaged about 66°F. and there was a gradual decrease each month thereafter. The average low point of 11.4°F. was reached in February 1939. Similar results were obtained in October and November of the second season in 1940. This season's lowest average temperature was 20.4°F. in February 1941.

Bin No. 5—(Perforated Metal Bin)

Type of Construction:

The sidewalls and the floor of this bin was made of 20 gauge perforated metal. The slits or perforations are 1 inch long and are spaced 3 inches apart horizontally and 1¾ inches vertically. The ordinary metal roof was used on this bin.

Results: (See Figure 2)

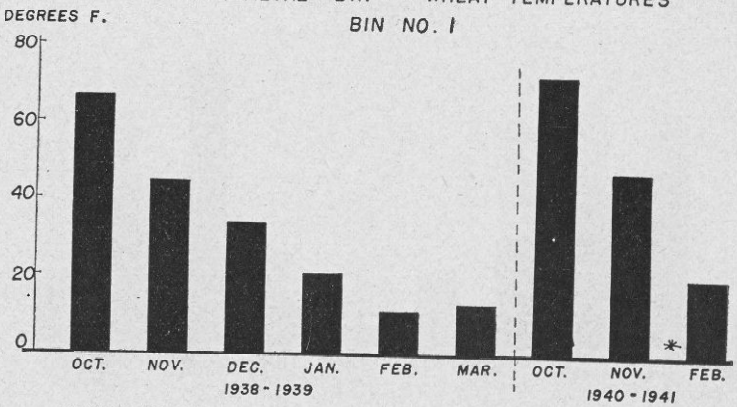
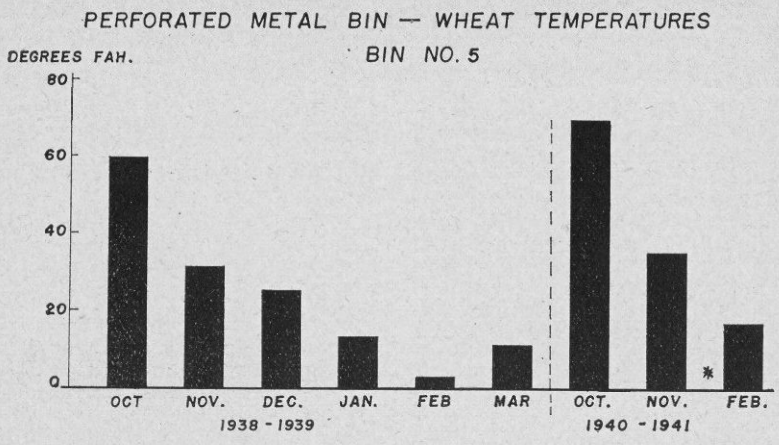


Fig. 1



AVERAGE VALUES OF 15-16 TEMPERATURE READINGS WITHIN 500 BUSHEL BIN.
* RECORDS OMITTED FOR DEC. 1940 AND JAN. 1941 .

Fig. 2

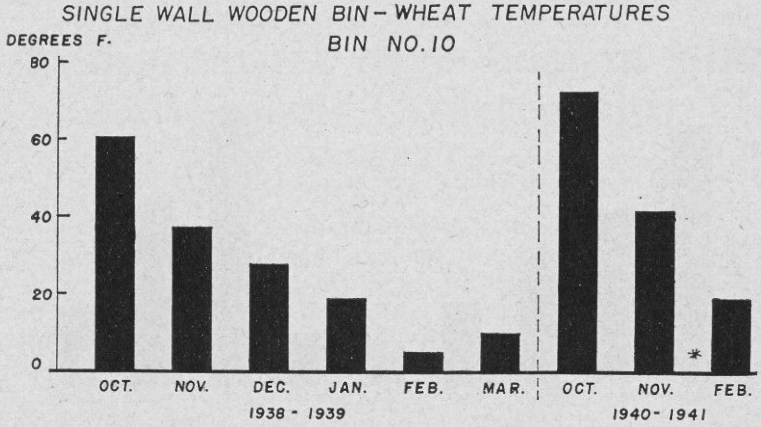
The rate of decrease in the perforated metal bin was more rapid, and a temperature of 2.4°F. was reached in February 1939. This was approximately 9 degrees lower than the plain metal bin for the same date. The average temperature for this perforated bin in February 1941 was 16.9°F. or approximately 14 degrees warmer. The temperature in the first season started to rise in March and during this month averaged approximately 11°F. in the entire bin. Similar increases in temperature occurred in the plain metal bin during March.

Bin No. 10—(Single Wall Wood Bin)

Type of Construction:

The walls of this storage are made of 6-inch drop siding fastened on 2 x 6 inch studs spaced 16 inches on center. The roof is the gable-type covered with ordinary "rubber" roofing material.

Results: (See Figure 3)



AVERAGE VALUE OF 15-16 TEMPERATURE READINGS WITHIN 500 BUSHEL BIN.
* RECORDS OMITTED FOR DEC. 1940 AND JAN. 1941.

Fig. 3

The low point in temperature, 4.8°F., was recorded also during the month of February. Similar to the previous two bins in November and December, the temperature of the entire bin averaged about 30°F. In February of the first season, the single wall and double wall bins had almost identical temperatures, 4.7°F., but in the second season (1941), the single wall bin was about 14 degrees warmer and the double wall 11 degrees warmer than in the previous season.

Bin No. 12—(Double Wall Wood Bin)

Type of Construction:

This double wall wood bin is similar to bin 10 except that it is lined on the inside with 1 x 6 inch tight fitting lumber.

Results: (See Figure 4)

The temperature in this bin was slightly higher than in the single wall wood bin in November, December and January; but in February the temperatures were almost identical. This bin, like the others mentioned, has not reached as low a temperature this season (1940-41) as in the previous season.

Extreme Temperature Variations Within the Bin

The two temperature extremes are just as important as the average temperature of the bin. It might be possible for some insects to exist in the warmer sections of these bins while in another part it would be cold enough to kill them.

The table on page 16 gives the highest and lowest temperature readings in the two seasons in the four different bin constructions.

The warmest part of the plain metal bin for these seasons was in the center section of the 500-bushel bin, and the coldest section was near the north wall.

In the perforated bin, the warmest portion was in the middle of the bin about 2 feet below the surface of the wheat. The floor of this bin was the coldest.

The single wall wood bin was similar to the plain metal bin for these few months. The north wall was the coldest, and the direct center of the bin was the warmest. Nearly the same locations for the warm and cold spots were recorded for the double wall wood bin.

Weather Conditions

The weather records show the following monthly mean temperatures for these months in 1938-39: October 52.5°F., November 24.5°, December 17.5°, and January 11.5°. There was not more than 1½ degrees variation from these values during 1940-41. In 1938-39 for these same months, there were a few more days in which the temperature was below 32 degrees and also below zero than in 1940-41. This

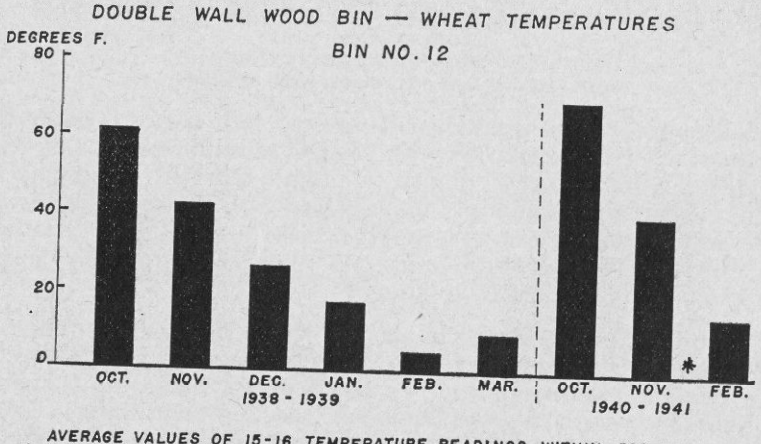


Fig. 4

MAXIMUM AND MINIMUM WINTER TEMPERATURES OF WHEAT IN THE BINS

DATE	Plain Metal Bin High	Plain Metal Bin Low	Perforated Metal Bin High	Perforated Metal Bin Low	Single Wall Wood Bin High	Single Wall Wood Bin Low	Double Wall Wood Bin High	Double Wall Wood Bin Low
First Season								
October 17, 1938	73°F.	54°F.	65°F.	51°F.	67°F.	51°F.	67°F.	53°F.
November 22, 1938	58	18	44	15	49	12	55	36
December 19, 1938	43	21	28	21	36	23	32	23
January 17, 1939	29	5	18	4	26	8	23	10
February 14, 1939 [1]	20	0	11	-5	11	-2	12	4
March 14, 1939	21	9	18	3	18	6	18	4
Second Season								
October 3, 1940	78	65	78	63	80	68	78	66
November 16, 1940	68	29	45	24	57	24	54	26
December								
January								
February 24, 1941	27	11	25	9	24	12	22	7

[1] Lowest temperature during season.

would have an additional cooling effect on all of the bins in the 1938-39 season.

Conclusions:

1. During October and November the rate of decrease in average wheat temperature was approximately 15 degrees per month. In the following two months, January and December, the decrease was at the rate of 10 degrees per month.
2. The lowest temperatures were recorded in February.
3. In the first season's records the temperature in the bins started to rise in March.
4. The temperatures in all of the bins were higher in 1940-41 than in 1938-39 during February which was the coldest month for the wheat in the bin.

Testing Corn Variety and Hybrid Performance in North Dakota

By WILLIAM WIDAKAS, Assistant Agronomist
North Dakota Agricultural Experiment Station

THE popularity of corn hybrids in corn belt states is dependent upon their performance with respect to superior root development which causes plants to stand upright, resistance to disease, good plant type which makes harvesting easier, uniformity in maturity which facilitates timely harvesting, higher quality of grain indicated by adequate maturity and freedom from disease, and higher yield of grain or silage.

The individual grower, however, faces the task of choosing a hybrid or variety which can be expected to produce well on his farm. His interest is mainly with the performance of a specific corn hybrid or variety that is suitable to his conditions. So the most frequent questions in choosing a particular variety or hybrid are: Will it get ripe on my farm? Will it yield higher? Will it be easier to handle at harvest?